EPA United States
Environmental Protection
Agency

2003 Urban Air Toxics Monitoring Program (UATMP)

July 2004
Final Report

EPA-454/R-04-003
July 2004

2003 Urban Air Toxics Monitoring Program(UATMP)

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

Prepared for:
Sharon Nizich, Program Manager
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

Contract No. 68-D-03-049
Delivery Orders 23 and 29

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

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-99-007 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

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Page

List of Appendices

LIST OF FIGURES

Page

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF ABBREVIATIONS

AIRS	Aerometric Information and Retrieval System
AQS	Air Quality Subsystem (of the Aerometric Information and Retrieval System)
BTEX	benzene, toluene, ethylbenzene, and xylenes (*o*-, *m*-, and *p*-xylene)
CAA	Clean Air Act
CFR	code of federal regulation
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 *tert*-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 ABBREVIATIONS (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
WBAN	Weather Bureau/Army/Navy ID

LIST OF ABBREVIATIONS (Continued)

Monitoring Stations

APMI	Allen Park in Detroit, Michigan
AZFL	Azalea Park in St. Petersburg, Florida
BAPR	Barceloneta, Puerto Rico
BGFL	Belle Glade, Florida
BOMA	Boston, Massachusetts
BOUT	Bountiful, Utah
BTMO	Bonne Terre, Missouri
BTUT	Bountiful, Utah
BUND	Beulah, North Dakota
CANC	Candor, North Carolina
CANJ	Camden, New Jersey
CHNJ	Chester, New Jersey
CUSD	Custer, South Dakota
CWFL	Clearwater, Florida
DBFL	Delray Beach, Florida
DECO	Denver, Colorado (Site #1)
DEMI	Dearborn in Detroit, Michigan
DITN	Dickson, Tennessee
E7MI	E7 Mile in Detroit, Michigan
EATN	Nashville, Tennessee (Site #1)
ELNJ	Elizabeth, New Jersey
FLFL	Pompano Beach, Florida
GAFL	Gandy in Tampa, Florida
GPMS	Gulfport, Mississippi
GRMS	Grenada, Mississippi
HACT	Hartford, Connecticut
HOMI	Houghton Lake, Michigan
ITCMI	Sault Sainte Marie, Michigan
JAMS	Jackson, Mississippi
KITN	Kingsport, Tennessee
LDTN	Loudon, Tennessee
LEFL	Lewis in Tampa, Florida
LONE	Lincoln, Nebraska (Site #2)
LOTN	Nashville, Tennessee (Site #2)
MCAZ	Phoenix, Arizona

LIST OF ABBREVIATIONS (Continued)

MDFL	Miami, Florida
NBIL	Northbrook in Chicago, Illinois
NBNJ	New Brunswick, New Jersey
ORFL	Orlando, Florida
PGMS	Pascagoula, Mississippi
PLOR	Portland, Oregon (Site #1)
PNW	Portland, Oregon (Site #2)
POOK	Ponca City, Oklahoma
PSAZ	Supersite in Phoenix, Arizona
QVAZ	Queen Valley in Phoenix, Arizona
S4MO	St. Louis, Missour (Site #4)
SFSD	Sioux Falls, South Dakota
SJPR	San Juan, Puerto Rico
SLMO	St. Louis, Missouri (Site #1)
SPAZ	South Phoenix, Arizona
SPIL	Schiller Park in Chicago, Illinois
TUMS	Tupelo, Mississippi
WECO	Denver, Colorado (Site #2)

Executive Summary

This report presents the results and conclusions from the ambient air monitoring conducted as part of the 2003 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 2003 UATMP included 53 monitoring stations that collected 24-hour air samples, typically on a 6- or 12-day schedule. Forty-eight sites analyzed ambient air samples for concentrations of 59 volatile organic compounds (VOC) and 16 carbonyl compounds. Nine sites also analyzed for 80 speciated nonmethane organic compounds (SNMOC). One site analyzed for 19 semivolatile compounds (SVOC). Nine sites analyzed metal compounds, while two sites analyzed hexavalent chromium. Overall, nearly 118,600 ambient air concentrations were measured during the 2003 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 2003 UATMP serve a wide range of purposes. Not only do these data characterize the nature and extent of urban air pollution close to the 59 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 2003 UATMP monitoring effort, which included 12 months of six- and twelve-day measurements of ambient air quality at 53 monitoring sites in or near 32 urban/rural locations including 23 metropolitan statistical areas (MSAs). Much of the analysis and data interpretation in this report focuses on compound-specific data trends.

Note: 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 and 2003 "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 53 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.

Ultimately, the contents of this report should 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 strongly to air pollution, or to forecast whether proposed pollution control initiatives might significantly improve air quality. Recently, EPA has been actively participating in 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. Though they are extensive, the analyses in this report should not be viewed as a comprehensive account of urban air pollution at every UATMP monitoring station. State and local environmental agencies are encouraged to perform additional analyses of the monitoring data so that the many factors that affect ambient air quality can be appreciated fully.

To facilitate examination of the 2003 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 twenty-five text sections and 14 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 2003 UATMP Report

Report Section	Section Title	Overview of Contents
2	The 2003 UATMP	This section provides background information on the scope of the 2003 UATMP and includes information about the: • Monitoring locations • Compounds selected for monitoring • Sampling and analytical methods • Sampling schedules • Completeness of the air monitoring program.
3	Summary of the 2003 UATMP	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.
4	Sites in Arizona	Monitoring results for Phoenix-Mesa-Scottsdale, AZ (MCAZ, PSAZ, QVAZ, and SPAZ) MSA
5	Sites in Colorado	Monitoring results for Denver-Aurora, CO (DECO and WECO) MSA
6	Site in Connecticut	Monitoring results for Hartford-East Hartford, CT (HACT) MSA
7	Sites in Florida	Monitoring results for Miami-Ft. Lauderdale-Miami Beach, FL (BGFL, DBFL, FLFL, MDFL) MSA, Orlando, FL (ORFL) MSA, and Tampa-St. Petersburg-Clearwater, FL (AZFL, CWFL, GAFL, and LEFL) MSA
8	Sites in Illinois	Monitoring results for Chicago-Naperville-Joliet, IL-IN-WI (SPIL and NBIL) MSA
9	Site in Massachusetts	Monitoring results for Boston-Cambridge-Quincy, MA-NH (BOMA) MSA
10	Sites in Michigan	Monitoring results for Detroit-Warren-Livonia, MI (APMI, DEMI, and E7MI) MSA, Houghton Lake, MI (HOMI) and Sault Sainte Marie, MI (ITCMI)
11	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)
12	Sites in Missouri	Monitoring results for St. Louis, MO-IL (S4MO and SLMO) MSA, and Bonne Terre, MO (BTMO)
13	Site in Nebraska	Monitoring results for Lincoln, NE (LONE) MSA
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

Table 1-1. (Continued)

Report Section	Section Title	Overview of Contents
15	Site in North Carolina	Monitoring results for Candor, NC (CANC)
16	Site in North Dakota	Monitoring results for Beulah, ND (BUND)
17	Site in Oklahoma	Monitoring results for Ponca City, OK (POOK)
18	Sites in Oregon	Monitoring results for Portland-Vancouver-Beaverton, OR-WA (PLOR and PNW) MSA
19	Sites in Puerto Rico	Monitoring results for San Juan-Caguas-Guayabo, PR (BAPR and SJPR) MSA
20	Sites in South Dakota	Monitoring results for Custer, SD (CUSD) and Sioux Falls, SD (SFSD) MSA
21	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
22	Site in Utah	Monitoring results for Ogden-Clearfield, UT (BOUT, BTUT) MSA
23	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 2003 UATMP ambient air monitoring data.
24	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.
25	References	This section lists the references cited throughout the report.

2.0 The 2003 UATMP

The 2003 UATMP included 53 monitoring stations that collected 24-hour integrated canister and cartridge samples of ambient air for up to 12 months at six and twelve day sampling intervals. One site in Ponca City, OK (POOK) opted to sample every three days. 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, hexavalent chromium from pre-treated filters, and metal compounds from filters. The following discussion reviews the monitoring locations, the compounds selected for monitoring, the sampling schedules, the completeness of the 2003 UATMP, and the 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. Some monitors were placed near the centers of heavily populated cities (e.g., Denver, CO and Phoenix, AZ), while others were placed in moderately populated areas (e.g., Beulah, ND and Custer, SD). The monitoring stations participating in previous UATMP programs are listed in Table 2-1.

Figure 2-1 shows the 32 urban and rural areas participating in the 2003 program. The site descriptions in Table 2-2 and in Appendix A provide detailed information on the surroundings at the 2003 UATMP monitoring locations. Monitors that are designated as EPA National Air Toxic Trend System (NATTS) sites are indicated by bold type in Table 2-2. Sections 4 through 22 contain topographic maps for each of the sites. Industrial facilities within 10 miles of the monitoring sites were plotted in these sections as well. The location and category descriptions of these industrial emissions sources were report in the 1999 National Emission Inventory (NEI) (EPA, 2003a).

As Figure 2-1 shows, the 2003 UATMP monitoring sites were 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 urban environments.

Chemical concentrations measured during the 2003 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 respective contributions of motor vehicle emissions and industrial emissions on ambient air quality at each site, Table 2-3 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 1999 NEI.

At every UATMP monitoring location, the air sampling equipment was installed in a small temperature-controlled enclosure (usually a trailer or a shed) with the sampling inlet probe protruding through the roof. 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 (VOC), 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 59 VOCs (13 hydrocarbons, 37 halogenated hydrocarbons, and 9 polar compounds), 13 carbonyl compounds, 80 Speciated Nonmethane Organic Compounds (SNMOC), 19 Semivolatile Organic Compounds (SVOC), 11 metals, and hexavalent chromium. Tables 2-4, 2-5, 2-6, 2-7, and 2-8 identify the specific compounds of interest.

2.3 Sampling Schedules

Tables 2-9a and 2-9b present the dates on which sampling began and ended for each monitoring location. With the following exceptions, the UATMP monitoring locations started sampling in January 2003 and stopped sampling in December 2003. The following seventeen sites did not start at the beginning of the sampling period:

- Allen Park in Detroit, MI (APMI) site started in August 2003;
- Boston, MA (BOMA) site started in November 2003;
- Bountiful, Utah site #2 (BTUT) started in July 2003;
- Candor, NC (CANC) site started in May 2003;
- E7MI in Detroit, MI site started in June 2003;
- Elizabeth, NJ (ELNJ) site started in February 2003;
- Grenada, MS (GRMS) site started in April 2003;
- Inter-Tribal Council site in Sault Sainte Marie, MI (ITCMI) started in June 2003;
- Dickson, TN sites (DITN) started in December 2003;
- Phoenix, AZ site (MCAZ) started in April, respectively;

- Chicago, IL sites (NBIL and SPIL) started in April 2003;
- Orlando, FL (ORFL) site started in April 2003;
- Ponca City, OK (POOK) site started November 2003; and
- Portland, OR site #2 (PNW) started May 2003.

Ten sites ended sampling before December 2003: Allen Park, MI site (APMI) ended November 2003; the Puerto Rico sites (BAPR and SJPR) ended in August 2003; the Denver, CO, sites (DECO and WECO) ended in May 2003; E7MI in Detroit, MI ended in August 2003; Lincoln, NE (LONE) ended in April 2003; Bountiful, UT (BOUT) site 1 ended in June 2003; and the Portland sites (PLOR and PNW) ended in October 2003.

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 test site, VOC and carbonyl samples were collected concurrently, except for: all Florida sites (AZFL, BGFL, CWFL, DBFL, FLFL, GAFL, LEFL, MDFL, and ORFL) - carbonyls only; Allen Park, MI (APMI) and Houghton Lake, MI (HOMI) - VOCs 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; and all Phoenix, AZ, sites (MCAZ, PSAZ, QVAZ, and SPAZ) - VOCs only.

Of the 53 sites, only five did not sample for VOCs and/or carbonyls. They were: E7MI in Detroit, MI; both Portland sites (PLOR and PNW); BOMA in Boston, MA; and Ponca City, OK (POOK). Only ITCMI collected SVOC samples. The following nine sites also collected SNMOC samples:

- Bountiful, Utah sites 1 and 2;
- Custer, South Dakota;
- Ponca City, Oklahoma;

- Detroit (East 7 Mile only), Michigan;
- Sioux Falls, South Dakota; and
- St. Louis (Bonne Terre, site 1, and site 4 only), Missouri.

Nine sites collected Metals samples:

- Boston, MA site (BOMA);
- Bountiful, UT sites 1 and 2;
- All Colorado sites;
- Nashville, TN sites EATN and LOTN;
- Houghton Lake, MI; and
- St. Louis, MO site #4.

Two sites collected Hexavalent Chromium samples:

- Portland, OR sites 1 and 2 (PLOR and PNW).

As part of the sampling schedule, site operators were instructed to collect duplicate samples on roughly 10 percent 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 7 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. Tables 2-9a and 2-9b summarize the completeness of the monitoring data sets collected during the 2003 UATMP:

- For VOC sampling, the completeness ranged from 70 to 100 percent, with an overall completeness of 91 percent;
- For carbonyl sampling, the completeness ranged from 69 to 100 percent with an overall completeness of 95 percent;
- For SNMOC sampling, the completeness ranged from 87 to 100 percent with an overall completeness of 95 percent for all sites;
- For SVOC sampling, the completeness was 97 percent at one site;
- For Metals sampling, the completeness ranged from 85 to 100 percent with an overall completeness of 98 percent; and
- For Hexavalent Chromium, the completeness was 100 percent at both sites.

The UATMP data quality objectives are based on the 2003 Quality Assurance Plan, 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 Tables 2-9a and 2-9b show that 8 data sets (from a total of 96 data sets) from the 2003 UATMP monitoring stations did not meet this data quality objective. Twleve sites which measured carbonyls (out of 37 sites), 4 VOC sites (out of 35), 2 SNMOC sites (out of 9), 0 SVOC sites (out of 1), 6 Metals sites (out of 9), and 2 Hexavalent Chromium sites (out of 2) achieved 100% completeness.

2.5 Sampling and Analytical Methods

During the 2003 UATMP, five EPA-approved methods were used to characterize urban air pollution:

- *Compendium Method TO-15* was used to measure ambient air concentrations of 59 VOC and 80 SNMOC;
- *Compendium Method TO-11A* was used to measure ambient air concentrations of 13 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; and,
- *Modified CARB Method 039* and ERG's revised method was used to analyze ambient air concentrations of hexavalent chromium.

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 (i.e., cleaned and evacuated) canisters 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 59 VOC (13 hydrocarbons, 37 halogenated hydrocarbons, and 9 polar compounds) and 80 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 method detection limits for the laboratory analysis of the VOC samples and Table 2-5 lists the method detection limits for the SNMOC samples. Although the sensitivity of the analytical method varies from compound to compound, the detection limit for VOC reported for every compound is lower than 0.35 parts per billion by volume (ppbv); most of the detection limits were below 0.20 ppbv. Speciated Nonmethane Organic Compound (SNMOC) detection limits are expressed in parts per billion carbon (ppbC). All of the detection limits were less than 0.49 ppbC.

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. Unlike previous UATMP seasons, nondetects will not be replaced with one-half of the compound’s corresponding method detection limit. The nondetect is treated as a valid data point which can be used, in conjunction with back trajectories, for validation of nearby emission sources.

Similar to last year, 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.

Appreciating Detection Limits

The detection limit of an analytical method 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.*

Method detection limits are determined at the analytical laboratory by analyzing at least 7 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.

Table 2-6 lists the method detection limits reported by the analytical laboratory for measuring concentrations of 13 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 0.023 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. Table 2-10 summarizes the semivolatiles sampled for in 2003. ERG supplies prepared sampling media and receives the samples from the sites for analysis only. Semivolatile sampling modules containing PUF (polyurethane foam) 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 method detection limits for the laboratory analysis of the SVOC samples. Method detection limits for semivolatile organic compounds ranged from 0.15 to 0.04 pg/m^3, with most falling below 0.10 pg/m^3 in an average sample volume of 200 m^3.

2.5.4 Metals and Hexavalent Chromium 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 analyses based on Compendium Method IO-3.5.

Sodium bicarbonate-impregnated filters were used to collect hexavalent chromium. The prepared filters were connected to the hexavalent chromium sampler as shown in Figure 2-2. Ambient air was drawn through the filters through a glass sampling probe using Teflon sampling lines at a point as close to the ambient air monitoring point as possible. Duplicate samples and field blanks were collected and analyzed at a rate of 10% of the number of samples.

ERG shipped bicarbonate-impregnated sodium filters to each site in coolers. The samples were collected for a 24-hour period. After sampling, the filters were removed from the sampling apparatus, sealed, and returned to the ERG laboratory in the coolers in which they were received. Disposable polyethylene gloves were used by the field operators when handling the filters to reduce background contamination levels. Additional details of the hexavalent chromium sampling and analysis procedures are presented in the California Air Resources Board Method 039 (CARB, 1993) and in ERG's SOP (ERG-MOR-063).

Table 2-8 lists the method detection limits for the laboratory analysis of the metal and hexavalent chromium samples. Because the sample volumes for the collection of metals ranged from approximately 20 to 2100 m^3, the method detection limits are only presented in total ng/filter. The method detection limits ranged from 100 to 10 total ng/filter. Hexavalent chromium method detection limit was 0.034 ng/m^3 in an average sample volume of 12 m^3.

Figure 2-1. Cities Participating in the 2003 Program

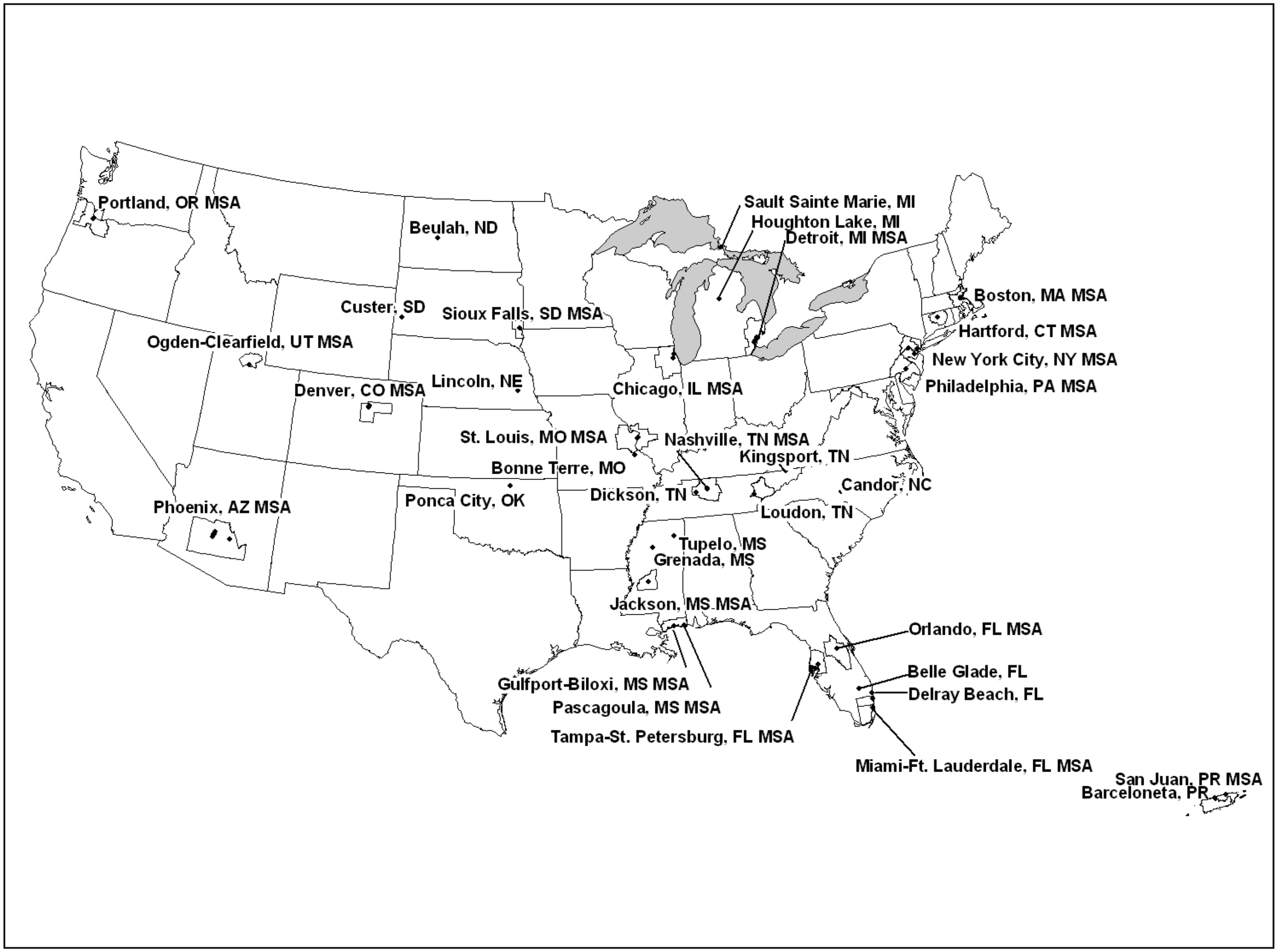


Figure 2-2. Hexavalent Chromium Sampling System

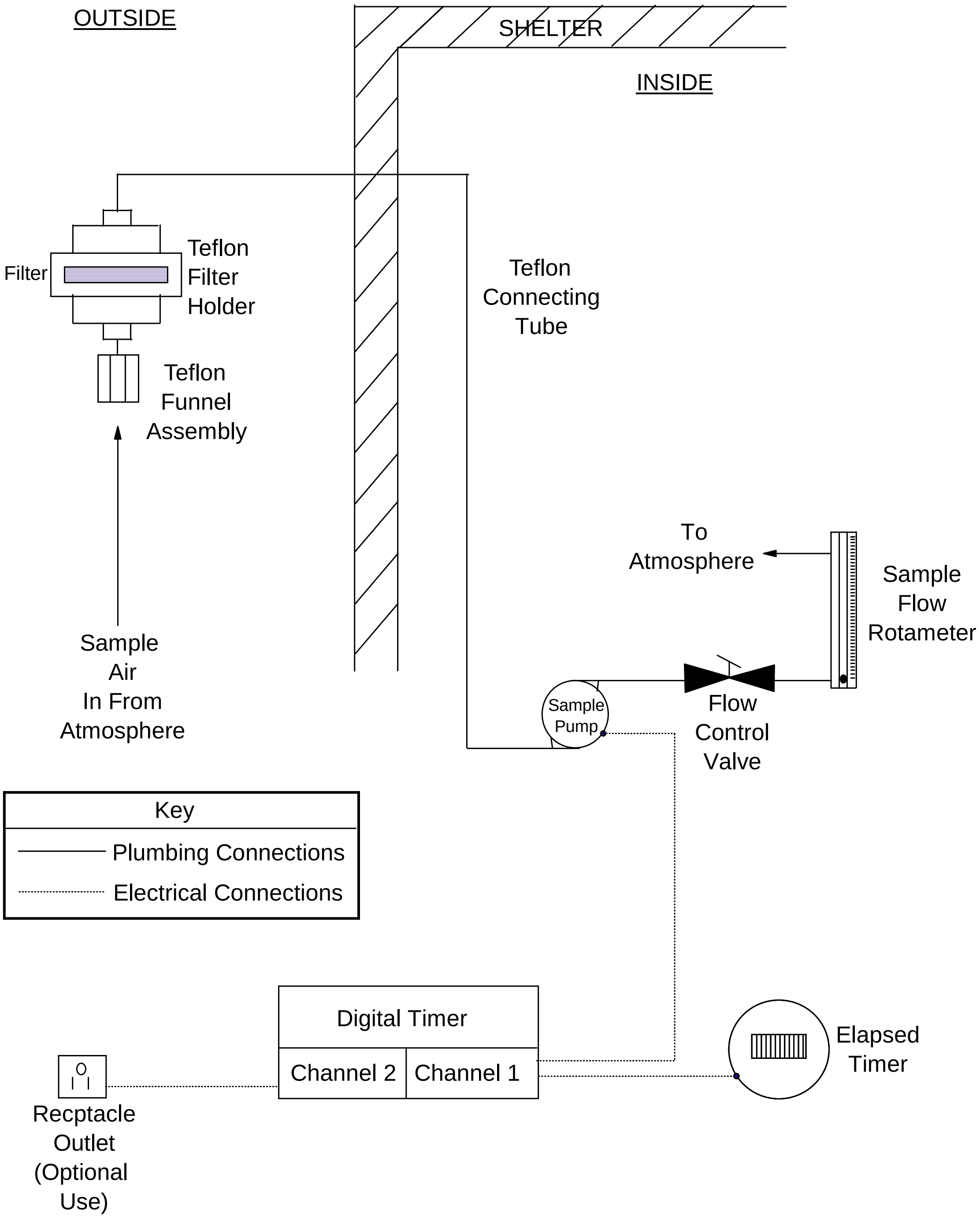


Table 2-1. Monitoring Stations with Past Participation in the UATMP

	Program Years During Which Station Past Participated in the UATMP							
Monitoring Station	1994	1995	1996	1997	1998	1999 2000	2001	2002
Allen Park, Detroit, MI (APMI)							✓	✓
Azalea Park, St. Petersburg, FL (AZFL)							✓	✓
Barceloneta, Puerto Rico (BAPR)							✓	✓
Belle Glade, Florida (BGFL)								✓
Beulah, ND (BUND)					✓	✓	✓	✓
Bonne Terre, MO (BTMO)								✓
Camden, NJ (CANJ)	✓	✓	✓	✓	✓	✓	✓	✓
Chester, NJ (CHNJ)							✓	✓
Clearwater, FL (CWFL)								✓
Custer, SD (CUSD)								✓
Delray Beach, FL (DBFL)								✓
Dearborn, Detroit, MI (DEMI)							✓	✓
Denver, CO Site 1 (DECO)						✓	✓	✓
Denver, CO Site 2 (WECO)								✓
E7 Mile, Detroit, MI (E7MI)							✓	✓
Elizabeth, NJ (ELNJ)						✓	✓	✓
Ft. Lauderdale, FL (FLFL)								✓
Gandy, Tampa, FL (GAFL)							✓	✓
Gulfport, MS (GPMS)							✓	✓
Houghton Lake, MI (HOMI)								✓
Jackson, MS (JAMS)							✓	✓
Lewis, Tampa, FL (LEFL)							✓	✓
Lincoln, NE (LONE)								✓
Nashville, TN Site #1 (EATN)								✓

Table 2-1. (Continued)

Monitoring Station	Program Years During Which Station Past Participated in the UATMP							
	1994	1995	1996	1997	1998	1999 2000	2001	2002
Nashville, TN Site #2 (LOTN)								✓
Miami, FL (MDFL)								✓
New Brunswick, NJ (NBNJ)							✓	✓
Pascagoula, MS (PGMS)							✓	✓
Portland, OR (PLOR)						✓		✓
Queen Valley, Phoenix, AZ (QVAZ)							✓	✓
San Juan, Puerto Rico (SJPR)							✓	✓
Sioux Falls, SD (SFSD)						✓	✓	✓
South Phoenix, AZ (SPAZ)							✓	✓
St. Louis, MO Site 1 (SLMO)							✓	✓
St. Louis, MO Site 4 (S4MO)								✓
Supersite, Phoenix, AZ (PSAZ)							✓	✓
Tupelo, MS (TUMS)							✓	✓

Note: 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 2002).

Table 2-2. Text Descriptions of the 2003 UATMP Monitoring Locations

UATMP Code	Monitoring Location	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 near 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 8 to 15 kilometers 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.
BAPR	Barceloneta, PR	Residential	Rural	10	1994	The Barceloneta site is a residential area surrounded by 5 pharmaceutical plants. The greater area outside the city is rural in character and the city itself is within 2 miles of the Atlantic Ocean.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
BGFL	Belle Glade, FL	Industrial	Rural	12,200	Unknown	Belle Glade is a city located in Broward County, FL. This is a rural location with possible pollution coming from mobile and hospital sources as well as sugar cane burning areas (major source). Broward and Miami-Dade Counties are ranked high in the range of the air toxics monitoring criteria ranking document draft. The Southeast Florida Regional Air Toxics Program is interested in conducting ambient carbonyl sampling in the Southeast Florida area to assess the potential health threat and cancer risk.
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.
BOUT	Bountiful, UT	Commercial	Suburban	11,120	Unknown	The Bountiful site is located in a suburban area of the Salt Lake City/Ogden MSA, at 65 West 300 South in Bountiful, Utah. The site is located in front of a fire station, adjacent to a city park, the fire station, a store, and a street. The surrounding neighborhood is made up of residential and commercial properties. BOUT 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 station. Several petroleum refineries are located one to five miles away from the site, as are several sand and gravel mining operations.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	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. It's 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 nearby sources, 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 Salt Lake City/Ogden MSA, at 1390 North 200 West 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.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
BUND	Beulah, ND	Agricultural	Rural	1,350	1998	Beulah, North Dakota, located in Mercer County, is a rural, agricultural area with primarily wheat, small grains, and cattle farms. There are six lignite coal-fired power plants within thirty miles of Beulah, one to the east-southeast; one to the northeast; two to the east; one to the northwest; and one to the southwest. A petroleum refinery and a lignite coal-fired power plant are fifty miles southeast of Beulah. Lignite coal mines are located north of the town, south-southwest of town and southeast of town. The monitoring station is located in the approximate area of two coal-fired power plants and a coal gasification plant (the only functioning coal gasification plant in the nation). A power plant is located seven miles to the southwest of the monitoring station; another is six miles to the northwest; and the gasification plant is five miles to the northwest.
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 in the vicinity. EPA also monitors next to this site.
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 ten 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.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
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.
CWFL	Clearwater, FL	Commercial	Suburban	1,000	Unknown	This site was a replacement for our Dunedin site, at St. Petersburg, FL. In addition to carbonyls, we also monitor VOCs, toxic metals, and ozone at the Clearwater site. Our objective is to measure HAPs (and ozone) in an area of high population density. Therefore we are monitoring population exposure, not any specific sources. Clearwater is a "Neighborhood" spatial scale.
DBFL	Delray Beach, FL	Commercial	Urban	201,032	1995	Delray Beach is located in Broward County, FL, a rural location with possible pollution coming from a major highway (mobile) and hospital sources. Broward and Miami-Dade Counties are ranked high in the range of the air toxics monitoring criteria ranking document draft. The Southeast Florida Regional Air Toxics Program is interested in conducting ambient carbonyl sampling in the Southeast Florida area to assess the potential health threat and cancer risk.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
DECO	Denver, CO (Site #1)	Commercial	Urban	44,200	1995	The Denver site, designated as the Denver-CAMP site by the State of Colorado, is on the northern edge of downtown Denver on a small triangle of land bounded by Broadway, Champa St. and 21st St. The site was originally established in 1965 as a maximum concentration site for the Denver downtown area and provides a measure of the air pollution levels to which a large working population is exposed. The site is next to a major road in the downtown Denver area, where the primary influences are motor vehicles. Some industrial facilities are located to the north of the site, but no large facilities lie within a one or two mile radius. Residential areas are located a quarter- to a half- mile to the northeast and east.
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 station. 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.
DITN	Dickson, TN			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.
E7MI	E7 Mile in Detroit, MI	Residential	Suburban	6,999	Unknown	The East 7 Mile site represents a location downwind from the Detroit urban center city area and is located in a residential neighborhood near Interstate 94. Criteria pollutants that include NO_2, O_3, SO_2, $PM_{2.5}$, and PAMS are also measured at East 7 Mile.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
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 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.
FLFL	Pompano Beach, FL	Commercial	Suburban	1,000	1989	The City of Pompano Beach is located in Broward County, FL, an urban, residential location in a neighborhood with pollution sources coming from a major traffic artery (source) as well as other minor area sources. Broward and Miami-Dade Counties are ranked high in the range of the air toxics monitoring criteria ranking document draft. The Southeast Florida Regional Air Toxics Program is interested in conducting ambient carbonyl sampling in the Southeast Florida area to assess the potential health threat and cancer risk.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
GAFL	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 approximately 8 to 15 kilometers 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.
GPMS	Gulfport, MS	Commercial	Rural	17,000	1995	The Gulf Port 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 wood products industry. The area is moderately populated but the area itself would be considered rural.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
HACT	Hartford, CT	Commercial	Urban	10,000	Unknown	The Morgan St. CO 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.
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).

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
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	Louden, 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.
LEFL	Lewis in Tampa, FL	Residential	Urban	1,055	1999	This monitor is located in an area of moderate population density with fewer commercial and industrial influences at the neighborhood scale. Major point sources are located approximately 8 to 15 kilometers and at least 150 meters from major roadways. Given the proximity of motor vehicle traffic, mobile sources are expected to contribute appreciably to the measured samples.
LONE	Lincoln, NE	Residential	Suburban	6,200	2000	The monitoring network for Lancaster County focuses on a large transportation corridor which includes the Lincoln Municipal Airport, a large railroad switching yard, and various high volume roadways. This site was set up at a different fire station (from LINE) from October through March. The monitor was placed at a south location (Fire Station 13) in order to sample the effects of northerly wind flows.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
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.
MCAZ	Phoenix, AZ	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).
MDFL	Miami, FL	Commercial	Urban	15,200	2002	Miami is a city located in Dade County, FL. The monitoring station is located in a urban, commercial and residential section of town. Pollution can come from mobile, area and hospital sources. Broward and Miami-Dade Counties are ranked high in the range of the air toxics monitoring criteria ranking document draft. The Southeast Florida Regional Air Toxics Program is interested in conducting ambient carbonyl sampling in the Southeast Florida area to assess the potential health threat and cancer risk.
NBIL	Northbrook in Chicago, IL	Residential	Suburban	34,900	1993	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 (I94) 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.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
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.
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.
PLOR	Portland, OR (Site #1)	Residential	Urban	1,000	1989	The Northeast Portland site is a neighborhood scale site located in a primarily residential area. Surrounding housing is mostly single-family with some nearby apartment buildings. Within a mile of the site are three elementary schools, a middle school, a high school, and a major hospital. The site is located between an arterial street couplet, and within a quarter mile of major arterials having significant commercial activity, as well as bus and truck traffic. No major point sources are located in close proximity to the site, although it is a only a few miles downwind (summertime) of several Title V sources in the North and Northwest parts of Portland.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
PNW	Portland, OR (Site #2)	Commercial	Urban	500	1989	This site in the Northwest quadrant of the city is on a residential street and is on the boundary between the highest density residential area in the city and Portland's primary industrial area. Located in a parking lot for the neighborhood post office, the site is within a half kilometer of a small commercial area, a foundry, and numerous metal finishing operations. Railroad yards, port operations, including fuel handling facilities, wood products and other manufacturing businesses, and a major traffic bridgehead are within a kilometer. The West Hills, less than a half kilometer from this site, create a barrier to air movement to the west and restrict dispersion of pollution. Neighborhood concerns have driven a variety of suspended and deposited metals studies at this site since the 1999 project.
POOK	Ponca City, OK	Residential	Urban	1,496	2002	This site was established in 1995 at Ponca City. This source oriented site also operates SO_2, $PM_{2.5}$, and $PM_{10,}$ monitors. This site, in North Central Oklahoma, is used to monitor nearby refineries.
PSAZ	Supersite in Phoenix, AZ	Residential	Urban	250	1993	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 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
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 location and a PAMS Type 3 monitoring location. 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.
S4MO	St. Louis, MO (Site #4)	Residential	Urban	22,840	1995	Blair 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.
SJPR	San Juan, PR	Commercial	Suburban	51,000	Unknown	The Site at the Bayamon Regional Jail, in San Juan, conducts monitoring for VOC and carbonyls. The prevailing sources within a 3 mile radius of the site include the San Juan power plant, highways with a nearby toll gate, an asphalt plant, a sewage authority facility, and industry. Additionally, the San Juan area has a large number of automobiles.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	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 2001.
SPAZ	South Phoenix, AZ	Residential	Urban	50,000	1995	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.
SPIL	Schiller Park in Chicago, IL	Mobile	Suburban	214,900	1994	This monitoring site is located on a trailer at 4743 Mannheim Road just south or 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.
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.

Table 2-2. (Continued)

UATMP Code	Monitoring Location	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
WECO	Denver, CO (Site #2)	Agricultural	Rural	1,500	Unknown	Located 7 miles north-northeast of downtown Denver on the bank of the South Platte River, this site is ideally located to measure nighttime drainage of the air mass from the Denver metropolitan area and the thermally driven, daytime upvalley flows. This site is located next to agricultural and open space areas, with residential areas located within one mile. In addition, major industrial sources are located about one mile upvalley, including a power plant, sewage treatment plant and refineries.

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

Table 2-3. Site Descriptions for the 2003 UATMP Monitoring Stations

2003 UATMP Code	AQS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Station [a]	County-level Stationary Source HAP Emissions in the 1999 NEI[b] (tpy)	Closest National Weather Service Station
APMI	26-163-0001	Allen Park in Detroit, MI	965,005	12,627	Detroit/Metropolitan Airport
AZFL	12-103-0018	Azalea Park in St. Petersburg, FL	575,371	5,116	St. Petersburg/Whitted Airport
BAPR	72-017-0003	Barceloneta, PR	4,253[c]	3,497	San Juan, PR/Isla Verde Intl. AIR
BGFL	12-099-0008	Belle Glade, FL	34,023	5,741	Hollywood Int’l. Airport
BOMA	25-025-0042	Boston, MA	1,585,559	1,979	Logan Int’l. Airport
BOUT	49-011-0001	Bountiful, UT	245,409	2,344	Salt Lake City International
BTMO	29-187-0005	Bonne Terre, MO	33,587	199	Cahokia/St. Louis, IL
BTUT	49-011-0004	Bountiful, UT	245,409	2,344	Salt Lake City International
BUND	38-057-0004	Beulah, ND	7,451	2,332	Bismarck Municipal Airport
CANC	37-123-0001	Candor, NC	10,025	113	Monroe Airport
CANJ	34-007-0003	Camden, NJ	2,023,903	1,627	NE Philadelphia Airport
CHNJ	34-027-3001	Chester, NJ	231,275	1,686	Somerville, NJ/Somerset Airport
CUSD	46-033-0003	Custer, SD	5,094	229	Custer County Airport

Table 2-3. (Continued)

2003 UATMP Code	AQS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Station [a]	County-level Stationary Source HAP Emissions in the 1999 NEI[b] (tpy)	Closest National Weather Service Station
CWFL	12-103-0004	Clearwater, FL	562,482	5,116	St.Petersburg/ Clearwater International Airport
DBFL	12-099-2005	Delray Beach, FL	493,006	5,741	Palm Beach International
DECO	08-031-0002	Denver, CO	1,283,560	1,901	Denver/Centennial Airport
DEMI	26-163-0033	Dearborn in Detroit, MI	1,208,975	12,627	Detroit City Airport
DITN	47-043-0010	Dickson, TN	29,329	1,741	Outlaw Field Airport
E7MI	26-163-0019	E7 Mile in Detroit, MI	1,167,824	12,627	Detroit City Airport
EATN	47-037-0011	Nashville, TN (Site #2)	513,967	5,299	Nashville/Metro Airport
ELNJ	34-039-0004	Elizabeth, NJ	2,160,143	2,724	Newark International
FLFL	12-011-2004	Pompano Beach, FL	1,050,037	5,352	Hollywood International Airport
GAFL	12-057-1065	Gandy in Tampa, FL	455,039	9,859	Tampa, FL International
GPMS	28-047-0008	Gulfport, MS	172,557	4,617	Gulf Port/Biloxi Regional Airport
GRMS	28-043-0001	Grenada, MS	19,933	1,023	Greenwood - Leflore Airport

Table 2-3. (Continued)

2003 UATMP Code	AQS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Station [a]	County-level Stationary Source HAP Emissions in the 1999 NEI[b] (tpy)	Closest National Weather Service Station
HACT	09-003-0017	Hartford, CT	575,327	2,967	Hartford-Brainard Airport
HOMI	26-113-0001	Houghton Lake, MI	10,386	123	Houghton Lake/Roscommon County Airport
ITCMI	26-033-0901	Sault Sainte Marie, MI	21,881	361	Sault Ste. Marie Municipal Airport
JAMS	28-049-0010	Jackson, MS	264,058	1,630	Jackson/Allen C. Thompson Field
KITN	47-163-1007	Kingsport, TN	131,461	3,695	Tri City Airport
LDTN	47-105-0108	Loudon, TN	46,361	1,857	McGhee Tyson Airport
LEFL	12-057-1075	Lewis in Tampa, FL	587,295	9,859	Tampa International
LONE	31-109-0024	Lincoln, NE (Site #1)	239,504	10,525	Lincoln Municipal Airport
LOTN	47-037-0023	Nashville, TN (Site #2)	464,054	5,299	Nashville Metro Airport
MCAZ	04-013-4009	Phoenix, AZ	835,936	9,589	Phoenix-Deer Valley Municipal Airport
MDFL	12-086-4002	Miami, FL	1,209,024	8,468	Miami International Airport

Table 2-3. (Continued)

2003 UATMP Code	AQS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Station [a]	County-level Stationary Source HAP Emissions in the 1999 NEI[b] (tpy)	Closest National Weather Service Station
NBIL	17-031-4201	Northbrook in Chicago, IL	884,133	20,665	Palwaukee Municipal Airport
NBNJ	34-023-0006	New Brunswick, NJ	768,506	4,111	Somerville, NJ/Somerset Airport
ORFL	12-095-2002	Winter Park, FL	949,497	5,607	Orlando Executive Airport
PGMS	28-059-0006	Pascagoula, MS	58,083	4,196	Pascagoula, MS/Lott International Airport
PLOR	41-051-0246	Portland, OR	989,953	17,918	Portland International Airport
PNW	41-051-0244	Portland, OR	1,021,272	17,918	Portland International Airport
POOK	40-071-0602	Ponca City, OK	32,920	637	Ponca City Municipal Airport
PSAZ	04-013-9997	Supersite in Phoenix, AZ	1,385,905	9,589	Phoenix/Deer Valley Municipal Airport
QVAZ	04-021-8001	Queen Valley in Phoenix, AZ	62,714	1,293	Phoenix/Sky Harbor Airport
S4MO	29-510-0085	St. Louis, MO (Site #4)	824,653	4,193	Cahokia/St. Louis
SFSD	46-099-0007	Sioux Falls, SD	151,161	688	Joe Foss Field Airport

Table 2-3. (Continued)

2003 UATMP Code	AQS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Station [a]	County-level Stationary Source HAP Emissions in the 1999 NEI[b] (tpy)	Closest National Weather Service Station
SJPR	72-127-0006	San Juan, PR	421,958[c]	1,196	San Juan, PR/Isla Verde International Airport
SLMO	29-510-0089	St. Louis, MO (Site # 1)	754,882	4,193	Cahokia/St Louis
SPAZ	04-013-4003	South Phoenix, AZ	835,936	9,589	Phoenix - Deer Valley Municipal Airport
SPIL	17-031-3103	Schiller Park in Chicago, IL	2,094,530	20,665	O'Hare International Airport
TUMS	28-081-0005	Tupelo, MS	69,738	2,804	Tupelo Municipal Airport
WECO	08-031-3001	Denver, CO (Site #2)	874,731	1,935	Denver/Centennial Airport

[a] Reference: http://zipnet.htm

[b] Reference: EPA, 2003a.

[c] For the two Puerto Rico sites, population data reflect county-level, or zona urbana, population from the 2002 Census.

Table 2-4. VOC Method Detection Limits

Compound	Method Detection Limit (ppbv)
Hydrocarbons	
Acetylene	0.05
Benzene	0.05
1,3-Butadiene	0.10
Ethylbenzene	0.07
n-Octane	0.10
Propylene	0.06
Styrene	0.10
Toluene	0.09
1,2,4-Trimethylbenzene	0.10
1,3,5-Trimethylbenzene	0.09
m-,*p*-Xylene	0.08
o-Xylene	0.07
Halogenated Hydrocarbons	
Bromochloromethane	0.15
Bromodichloromethane	0.10
Bromoform	0.14
Bromomethane	0.08
Carbon Tetrachloride	0.11
Chlorobenzene	0.11
Chloroethane	0.09
Chloroform	0.06
Chloromethane	0.07
Chloromethylbenzene	0.19
Chloroprene	0.05
Dibromochloromethane	0.14
1,2-Dibromoethane	0.08
m-Dichlorobenzene	0.08
o-Dichlorobenzene	0.11
p-Dichlorobenzene	0.12
1,1-Dichloroethane	0.04
1,2-Dichloroethane	0.07
1,1-Dichloroethene	0.05
cis-1,2-Dichloroethylene	0.11
trans-1,2-Dichloroethylene	0.07
1,2-Dichloropropane	0.05
cis-1,3-Dichloropropene	0.10

Table 2-4. (Continued)

Compound	Method Detection Limit (ppbv)
Halogenated Hydrocarbons (Continued)	
trans-1,3-Dichloropropene	0.08
Dichlorodifluoromethane	0.08
Dichlorotetrafluoroethane	0.07
Hexachloro-1,3-butadiene	0.23
Methylene Chloride	0.05
1,1,2,2-Tetrachloroethane	0.09
Tetrachloroethylene	0.09
1,2,4-Trichlorobenzene	0.17
1,1,1-Trichloroethane	0.07
1,1,2-Trichloroethane	0.06
Trichloroethylene	0.06
Trichlorofluoromethane	0.05
Trichlorotrifluoroethane	0.06
Vinyl Chloride	0.06
Polar Compounds	
Acetonitrile	0.35
Acrylonitrile	0.21
Ethyl Acrylate	0.16
Ethyl *tert*-Butyl Ether	0.10
Methyl Ethyl Ketone (MEK)	0.20
Methyl Isobutyl Ketone	0.18
Methyl Methacrylate	0.10
Methyl *tert*-Butyl Ether (MTBE)	0.10
tert-Amyl Methyl Ether	0.12

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

Table 2-5. SNMOC Method Detection Limits

Compound	Method Detection Limit	Compound	Method Detection Limit
	ppbC		ppbC
Acetylene	0.11	3-Methyl-1-butene	0.22
Benzene	0.18	Methylcyclohexane	0.25
1,3-Butadiene	0.17	Methylcyclopentane	0.21
n-Butane	0.17	2-Methylheptane	0.25
cis-2-Butene	0.16	3-Methylheptane	0.20
trans-2-Butene	0.17	2-Methylhexane	0.21
Cyclohexane	0.16	3-Methylhexane	0.17
Cyclopentane	0.20	2-Methylpentane	0.13
Cyclopentene	0.22	3-Methylpentane	0.22
n-Decane	0.25	2-Methyl-1-pentene	0.32
1-Decene	0.25	4-Methyl-1-pentene	0.32
m-Diethylbenzene	0.20	*n*-Nonane	0.11
p-Diethylbenzene	0.22	1-Nonene	0.21
2,2-Dimethylbutane	0.20	*n*-Octane	0.21
2,3-Dimethylbutane	0.20	1-Octene	0.21
2,3-Dimethylpentane	0.28	*n*-Pentane	0.19
2,4-Dimethylpentane	0.22	1-Pentene	0.20
n-Dodecane	0.49	*cis*-2-Pentene	0.22
1-Dodecene	0.49	*trans*-2-Pentene	0.21
Ethane	0.17	α-Pinene	0.25
2-Ethyl-1-butene	0.32	β-Pinene	0.25
Ethylbenzene	0.21	Propane	0.19
Ethylene	0.15	*n*-Propylbenzene	0.21

Table 2-5. (Continued)

Compound	Method Detection Limit	Compound	Method Detection Limit
	ppbC		ppbC
m-Ethyltoluene	0.15	Propylene	0.11
o-Ethyltoluene	0.22	Propyne	0.19
p-Ethyltoluene	0.19	Styrene	0.20
n-Heptane	0.23	Toluene	0.20
1-Heptene	0.28	*n*-Tridecane	0.49
n-Hexane	0.21	1-Tridecene	0.49
1-Hexene	0.32	1,2,3-Trimethylbenzene	0.19
cis-2-Hexene	0.32	1,2,4-Trimethylbenzene	0.21
trans-2-Hexene	0.32	1,3,5-Trimethylbenzene	0.18
Isobutane	0.14	2,2,3-Trimethylpentane	0.21
Isobutene/1-Butene	0.17	2,2,4-Trimethylpentane	0.19
Isopentane	0.19	2,3,4-Trimethylpentane	0.20
Isoprene	0.20	*n*-Undecane	0.24
Isopropylbenzene	0.18	1-Undecene	0.24
2-Methyl-1-Butene	0.22	*m*-,*p*-Xylene	0.16
2-Methyl-2-Butene	0.22	*o*-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 only report 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 together as a sum.

Table 2-6. Carbonyl Method Detection Limits

Compound	Method Detection Limit (ppbv)
Acetaldehyde	0.014
Acetone	0.014
Benzaldehyde	0.001
Butyr/Isobutyraldehyde	0.007
Crotonaldehyde	0.005
2,5-Dimethylbenzaldehyde	0.002
Formaldehyde	0.023
Hexaldehyde	0.002
Isovaleraldehyde	0.002
Propionaldehyde	0.003
Tolualdehydes	0.004
Valeraldehyde	0.001

Notes: The carbonyl detection limits vary from site to site. Therefore, the above MDLs are averages.

Because butyraldehyde and isobutyraldehyde elute from the HPLC column at the same time, the carbonyl analytical method can only report 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 Method Detection Limits

Compound	Method Detection Limit Total pg/m^3
Acenaphthene	0.04
Acenaphthylene	0.10
Anthracene	0.06
Benzo(a)anthracene	0.09
Benzo(a)pyrene	0.12
Benzo(b)fluoranthene	0.15
Benzo(e) pyrene	0.09
Benzo(g,h,i)perylene	0.08
Benzo(k)fluoranthene	0.05
Chrysene	0.04
Coronene	0.10
Dibenz(a,h)anthracene	0.10
Fluoranthene	0.04
Fluorene	0.05
Indeno(1,2,3-cd)pyrene	0.10
Naphthalene	0.04
Perylene	0.08
Phenanthrene	0.06
Pyrene	0.09

Table 2-8. Metals and Hexavalent Chromium Method Detection Limits

Compound	DL
Antimony[a]	50 ng/filter
Arsenic[b]	75 ng/filter
Beryllium[c]	10 ng/filter
Cadmium[d]	50 ng/filter
Chromium (total Chromium)[e]	100 ng/filter
Cobalt[f]	100 ng/filter
Lead[g]	50 ng/filter
Manganese[h]	100 ng/filter
Mercury[i]	15 ng/filter
Nickel[j]	100 ng/filter
Selenium[k]	50 ng/filter
Cr^{+6}	0.034 ng/m^3

[a] BOMA and BTUT: 10 ng/filter
[b] BOMA: 85 ng/filter; BTUT: 100 ng/filter
[c] BOMA: 50 ng/filter; BTUT: 25 ng/filter; S4MO: 15 ng/filter
[d] BOMA: 20 ng/filter
[e] BOMA: 600 ng/filter
[f] BOMA: 50 ng/filter
[g] BOMA: 90 ng/filter; BTUT: 100 ng/filter; BOUTand WECO: 125 ng/filter
[h] BOMA: 125 ng/filter
[i] BOMA and S4MO: 25 ng/filter
[j] BOMA: 500 ng/filter
[k] BOMA: 30 ng/filter

Table 2-9a. Sampling Schedules and Completeness for Carbonyl Compounds, VOC, SNMOC, and SVOC

Site	Monitoring Location	Sampling Period[a]		Carbonyl Data			VOC Data			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C
APMI	Allen Park in Detroit, MI	8/13/03	11/29/03	---	---	---	53	53	100	---	---	---	---	---	---
AZFL	Azalea Park in St. Petersburg, FL	1/3/03	12/29/03	59	60	98	---	---	---	---	---	---	---	---	---
BAPR	Barceloneta, PR	1/3/03	8/7/03	22	24	92	21	26	81	---	---	---	---	---	---
BGFL	Belle Glade, FL	1/3/03	12/17/03	35	35	100	---	---	---	---	---	---	---	---	---
BOUT	Bountiful, UT	1/09/03	6/26/03	39	40	98	35	36	97	35	36	97	---	---	---
BTMO	Bonne Terre, MD	1/3/03	12/29/03	69	71	97	---	---	---	65	69	94	---	---	---
BTUT	Bountiful, UT	7/14/03	12/29/03	30	35	86	28	33	85	28	31	90	---	---	---
BUND	Beulah, ND	1/3/03	7/8/03	2	2	100	39	41	95	---	---	---	---	---	---
CANC	Candor, NC	5/27/03	12/29/03	8	9	89	---	---	---	---	---	---	---	---	---
CANJ	Camden, NJ	1/3/03	9/24/03	52	57	91	55	62	89	---	---	---	---	---	---
CHNJ	Chester, NJ	1/3/03	12/29/03	88	92	96	85	93	91	---	---	---	---	---	---
CUSD	Custer Park, SD	1/3/03	12/29/03	79	80	99	75	79	95	78	80	98	---	---	---
CWFL	Clearwater, FL	1/3/03	12/29/03	147	148	99	---	---	---	---	---	---	---	---	---
DBFL	Delray Beach, FL	1/3/03	12/17/03	36	36	100	---	---	---	---	---	---	---	---	---
DECO	Denver, CO	1/3/03	5/3/03	18	18	100	25	26	96	---	---	---	---	---	---

Table 2-9a. Sampling Schedules and Completeness for Carbonyl Compounds, VOC, SNMOC, and SVOC (Continued)

Site	Monitoring Location	Sampling Period[a]		Carbonyl Data			VOC Data			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C
DEMI	Dearborn in Detroit, MI	1/3/03	12/29/03	94	94	100	77	92	84	---	---	---	---	---	---
DITN	Dickson, TN	12/18/03	12/23/03	4	4	100	5	5	100						
E7MI	E7 Mile in Detroit, MI	6/8/03	8/31/03	---	---	---	---	---	---	13	15	87	---	---	---
EATN	Nashville, TN	1/3/03	12/29/03	35	44	80	36	44	82	---	---	---	---	---	---
ELNJ	Elizabeth, NJ	2/14/03	12/29/03	75	82	91	74	80	93	---	---	---	---	---	---
FLFL	Ft. Lauderdale, FL	1/15/03	12/5/03	39	40	98	---	---	---	---	---	---	---	---	---
GAFL	Gandy in Tampa, FL	1/3/03	12/29/03	75	76	99	---	---	---	---	---	---	---	---	---
GPMS	Gulfport, MS	1/3/03	12/29/03	39	41	95	36	39	92	---	---	---	---	---	---
GRMS	Grenada, MS	4/30/03	12/29/03	28	28	100	24	28	86	---	---	---	---	---	---
HACT	Hartford, CT	6/3/03	12/29/03	56	56	100	---	---	---	---	---	---	---	---	---
HOMI	Houghton Lake, MI	1/3/03	12/29/03	---	---	---	27	35	77	---	---	---	---	---	---
ITCMI	Sault Sainte Marie, MI	6/8/03	12/23/03	---	---	---	32	35	91	---	---	---	29	30	97
JAMS	Jackson, MS	1/3/03	12/29/03	38	41	93	37	41	90	---	---	---	---	---	---
KITN	Kingsport, TN	1/9/03	12/22/03	41	45	91	41	44	93	---	---	---	---	---	---

Table 2-9a. Sampling Schedules and Completeness for Carbonyl Compounds, VOC, SNMOC, and SVOC (Continued)

Site	Monitoring Location	Sampling Period[a]		Carbonyl Data			VOC Data			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C
LDTN	Loudon, TN	11/5/03	12/23/03	7	7	100	4	4	100	---	---	---	---	---	---
LEFL	Lewis in Tampa, FL	1/3/03	12/29/03	82	84	98	---	---	---	---	---	---	---	---	---
LONE	Lincoln, NE Fire Station #14	1/3/03	4/15/03	21	22	95	20	21	95	---	---	---	---	---	---
LOTN	Nashville, TN	1/3/03	12/29/03	29	42	69	30	43	70	---	---	---	---	---	---
MCAZ	Phoenix, AZ	4/3/03	12/29/03	---	---	---	78	79	99	---	---	---	---	---	---
MDFL	Miami-Dade, FL	1/3/03	12/5/03	36	38	95	---	---	---	---	---	---	---	---	---
NBIL	Northbrook in Chicago, IL	4/21/03	12/29/03	---	---	---	47	53	89	---	---	---	---	---	---
NBNJ	New Brunswick, NJ	1/3/03	12/31/03	75	86	87	73	82	89	---	---	---	---	---	---
ORFL	Orlando, FL	4/9/03	12/29/03	57	59	97	---	---	---	---	---	---	---	---	---
PGMS	Pascagoula, MS	1/3/03	12/29/03	43	43	100	37	41	90	---	---	---	---	---	---
POOK	Ponca City, OK	11/11/03	12/29/03	---	---	---	---	---	---	21	21	100	---	---	---
PSAZ	Supersite in Phoenix, AZ	1/3/03	12/29/03	---	---	---	73	74	99	---	---	---	---	---	---
QVAZ	Queen Valley in Phoenix, AZ	1/9/03	12/29/03	---	---	---	30	31	97	---	---	---	---	---	---
S4MO	St. Louis, MO Site #4	1/3/03	12/29/03	91	91	100	88	88	100	88	88	100	---	---	---

Table 2-9a. Sampling Schedules and Completeness for Carbonyl Compounds, VOC, SNMOC, and SVOC (Continued)

Site	Monitoring Location	Sampling Period[a]		Carbonyl Data			VOC Data			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C
SFSD	Sioux Falls, SD	1/3/03	12/29/03	59	76	78	67	78	86	67	77	87	---	---	---
SJPR	San Juan, PR	1/3/03	8/7/03	25	26	96	24	28	86	---	---	---	---	---	---
SLMO	St. Louis, MO (Site #1)	1/3/03	12/29/03	76	78	97	---	---	---	75	78	96	---	---	---
SPAZ	South Phoenix, AZ	1/3/03	12/29/03	---	---	---	72	76	95	---	---	---	---	---	---
SPIL	Schiller Park in Chicago, IL	4/15/03	12/29/03	---	---	---	40	44	91	---	---	---	---	---	---
TUMS	Tupelo, MS	1/3/03	12/29/03	40	40	100	36	38	95	---	---	---	---	---	---
WECO	Denver, CO Site #2	1/3/03	5/3/03	26	28	93	26	28	93	---	---	---	---	---	---
---	**Overall**	**---**	**—**	**1875**	**1978**	**95**	**1550**	**1700**	**91**	**470**	**495**	**95**	**29**	**30**	**97**

[a] Begins with 1st valid sample and includes all six types.
A = Valid Samples
B = Total Number of Samples
C = Completeness (%)

Table 2-9b. Sampling Schedules and Completeness for Metals and Hexavalent Chromium

Code	Monitoring Location	Sampling Period		Metals			Hexavalent Chromium		
		Starting Date	Ending Date	A	B	C	A	B	C
BOMA	Boston, MA	10/18/03	11/29/03	16	16	100	---	---	---
BOUT	Bountiful, UT (Site #1)	1/9/03	6/26/03	27	27	100	---	---	---
BTUT	Bountiful, UT (Site #2)	7/14/03	9/30/03	17	17	100	---	---	---
DECO	Denver, CO	1/3/03	4/27/03	17	20	85	---	---	---
EATN	Nashville, TN (Site #1)	1/15/03	12/29/03	25	26	96	---	---	---
HOMI	Houghton Lake, MI	4/9/03	8/7/03	2	2	100	---	---	---
LOTN	Nashville, TN (Site #2)	1/15/03	12/29/03	31	31	100	---	---	---
PLOR	Portland, OR (Site #1)	1/3/03	10/30/03	---	---	---	57	57	100
PNW	Portland, OR	5/9/03	10/30/03	---	---	---	28	28	100
S4MO	St. Louis, MO	7/8/03	12/29/03	37	37	100	—	---	---
WECO	Denver, CO Site #2	1/3/03	4/27/03	29	30	97	---	---	---
---	**Overall**	**---**	**—**	**201**	**206**	**98**	**85**	**85**	**100**

A = Days With Valid Samples
B = Days When Samples Were Collected
C = Completeness (%)
Note: The completeness data only indicate the number of days when samples were collected.

Table 2-10. Semivolatile and Inorganics (Metals) Which Are HAPs

HAP	Analytical Method	HAP	Analytical Method
Category IV		**Category V**	
Acenaphthene	TO-13A	Antimony & Compounds	IO-3.5(29)
Acenaphthylene	TO-13A	Arsenic & Compounds	IO-3.5(29)
Anthracene	TO-13A	Beryllium & Compounds	IO-3.5(29)
Benzo(ghi)perylene	TO-13A	Cadmium & Compounds	IO-3.5(29)
Fluoranthene	TO-13A	Chromium & Compounds*	IO-3.5(29)
Fluorene	TO-13A	Lead & Compounds	IO-3.5(29)
Naphthalene	TO-13A	Manganese & Compounds	IO-3.5(29)
Phenanthrene	TO-13A	Mercury & Compounds	IO-3.5(29)
Pyrene	TO-13A	Nickel & Compounds	IO-3.5(29)
Benz(a)anthracene	TO-13A	Antimony & Compounds	IO-3.5(29)
Benzo(a)pyrene	TO-13A	Selenium & Compounds	IO-3.5(29)
Benzo(b)fluoranthene	TO-13A	Cobalt & Compounds	IO-3.5(29)
Benzo(k)fluoranthene	TO-13A	Hexavalent Chromium	CARB 039(30)
Chrysene	TO-13A		
Dibenz(a,h)anthracene	TO-13A		
Indeno(1,2,3-cd)pyrene	TO-13A		
Phenol	TO-13A		
p-Cresol	TO-13A		
o-Cresol	TO-13A		
Quinoline	TO-13A		

* Total Chromium only.

3.0 Summary of the 2003 UATMP Data

This section summarizes the data gathered during the 2003 UATMP reporting year. A total of 72 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: 1) hydrocarbons; 2) halogenated hydrocarbons; and 3) polar compounds. All four of the these compound groups (including 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 N. Specifically:

- Appendix C: 2003 Summary Tables for VOC Monitoring;
- Appendix D: 2003 Summary Tables for SNMOC Monitoring;
- Appendix E: 2003 Summary Tables for Carbonyl Monitoring;
- Appendix F: 2003 Summary Tables for SVOC Monitoring;
- Appendix G: 2003 Summary Tables for Metals Monitoring;
- Appendix H: 2003 Summary Tables for Hexavalent Chromium Monitoring;
- Appendix I: 2003 VOC Raw Monitoring Data;
- Appendix J: 2003 SNMOC Raw Monitoring Data;
- Appendix K: 2003 Carbonyl Raw Monitoring Data;
- Appendix L: 2003 SVOC Raw Monitoring Data;
- Appendix M: 2003 Metal Raw Monitoring Data; and
- Appendix N: 2003 Hexavalent Chromium Raw Monitoring Data.

Nearly 118,600 urban air toxics VOC and carbonyl data concentrations (including duplicate and replicate samples) were collected at the forty-eight sites for the 2003 UATMP reporting year. Additionally, nine sites chose to sample for speciated nonmethane organic compounds (SNMOC) accounting for another 36,894 data concentrations. Semivolatile data were collected at one site totaling 551 data concentrations (data listed in Appendix F). Metals data were collected at nine sites totaling nearly 2,255 data concentrations (listed in Appendix G). Finally, Hexavalent Chromium data were collected at two sites totaling 85 data concentrations (listed in Appendix H). These data will be analyzed on a site-specific basis in sections four through twenty-two of this document. Although there are fifty-three stations listed in Section 2 of this document, the Portland, OR sites (PLOR and PNW), E7MI in Detroit, MI, Boston, MA (BOMA), and Ponca City, OK (POOK) did not sample for either VOCs or carbonyls.

3.1 Data Summary Parameters

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

3.1.1 Number of Sampling Detects

Tables 3-1 and 3-2 are sampling detect summaries of the seventy-two VOC and carbonyl concentrations. Less than 41% of the pollutants sampled were found to be above the method detection limit (MDL). Of those that were detected:

- 30.8% were hydrocarbons;
- 23.3% were halogenated hydrocarbons;
- 5.5% were polar compounds; and
- 40.4% were carbonyl compounds.

These numbers resemble those from the 2001 and 2002 UATMP reports. Acetaldehyde, acetone, butyr/isobutyraldehyde, and formaldehyde had the greatest number of detectable values reported in samples (1,314), while ten compounds had zero detects (see Tables 3-1 and 3-2).

3.1.2 Concentration Range

Nearly 86% of the detects had concentration values less than 1 ppbv, consistent with the trends from the 2001 and 2002 report. Less than 2% had concentrations greater than 5 ppbv. Polar compounds were observed in the highest number of samples with concentrations greater than 5 ppbv (187); halogenated hydrocarbons had the lowest (25). There was at least one compound sampled at a concentration greater than 5 ppbv on 68 of 91 total sampling days. An interesting note is that 34 of the seventy compounds never exceeded 1 ppbv.

The range of detectable values for each site is listed in Table 3-3. The APMI, CUSD, HOMI, KITN, LDTN, LOTN, NBIL, SFSD, SPAZ, TUMS, and WECO sites had maximum concentration values of over 100 ppbv, unusually high when compared to the other sites. S4MO had the greatest number of detects (1,695), ELNJ and also had the greatest number of samples with concentrations greater than 5 ppbv (43).

3.1.3 Geometric Means

The geometric mean is the central tendency of lognormally distributed data, and can be calculated by taking the "n^{th}" 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 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 (39.61 ppbv) while the SPAZ site had the highest geometric mean for total hydrocarbons (11.45 ppbv). The highest total halogenated hydrocarbon geometric mean was at APMI (11.18 ppbv). The LDTN site also has the highest total carbonyl geometric mean (37.96 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. For the 2003 UATMP, prevalence refers only to compounds which are identified by EPA as cancer or noncancer. 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 cancer and noncancer.

UATMP concentrations are normalized based on the toxicity of the compound. Thus, multiple compounds can be compared based on toxicity. 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 which have high measured concentrations (e.g., acetylene) will not be considered prevalent. Of the 261 total UATMP compounds, less than 100 compounds have either a URE for cancer or RfC for noncancer (Table 3-5). Only the VOC and carbonyl compounds (which are measured at 48 of the 53 total sites) will be used to determine nationwide prevalence.

Another change for the 2003 UATMP is that each site will have a ranking of compounds by toxicity. Inter- and intra-site comparisons of the toxic compounds can now be performed because of the normalization, and can provide useful insight in and among the urban and rural areas.

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 not to confuse the most prevalent compounds program-wide identified by the 2003 UATMP with the most prevalent compounds in urban air pollution.

A compound was considered prevalent if its average cancer and/or noncancer toxicity across the network of sites contributed to the top 95% of the total toxicity weighting for the network. Of the 15 VOC and carbonyl compounds with URE factors, the top seven contributed to 95% of the total cancer toxicity weight. Of the 32 VOC and carbonyl compounds with RfC factors, the top nine pollutants contributed to 95% of the total noncancer toxicity weight. Tables 3-5a-b summarize the toxicity analysis. Cancer risk out of a 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 2003 UATMP, the program-wide prevalent compounds are:

- **HYDROCARBONS**
  - 1,3-Butadiene
  - Benzene
  - Xylene Compounds (*o*-, *m*-, *p*-)
- **HALOGENATED HYDROCARBONS**
  - Bromomethane
  - Carbon Tetrachloride
  - *p*-Dichlorobenzene
  - Tetrachloroethylene
- **POLAR COMPOUNDS**
  - Acetonitrile
  - Acrylonitrile
- **CARBONYL COMPOUNDS**
  - Acetaldehyde
  - Formaldehyde

"Xylene Compounds (*o*-, *m*-, *p*-)" are also referred to as "Total Xylenes" or "Xylenes (total)" throughout this report. Of the prevalent compounds, five have both cancer and noncancer weightings: 1,3-butadiene; acetaldehyde; acrylonitrile; benzene; and tetrachloroethylene. The other cancer compounds are carbon tetrachloride and *p*-dichlorobenzene; acetonitrile, formaldehyde, bromomethane, and xylenes (total) are the remaining noncancer compounds.

Readers interested in closer examination of data trends for the less program-wide prevalent compounds should refer to the summary tables in Appendices F through I, and the raw monitoring data in Appendices J through M. However, the reader 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 zero.

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 zero.
- 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 23), 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.

3.2 UATMP Compound Groups

The seventy-two 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 2003 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, for the monitors identified as a NATTS site (Table 2-2), 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. The temperature will help 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. Bromomethane had the strongest correlation with maximum temperature (-0.29), as well as the strongest correlation with average temperature (-0.27). It should be noted that, although the correlations are low, they are negative, which indicates that an increase in temperature is associated with a proportionate decrease in bromomethane concentration.

The poor correlation across the majority of the sites is not surprising due to the complex and diverse local meteorology associated with the monitoring locations. In the previous UATMP report, 56 sites are spread across sixteen states and one U.S. territory. For this report, 53 sites are spread across seventeen states and one U.S. territory. As discussed in Sections 4 through 22, the temperature parameters correlate much better at certain individual sites.

3.3.2 Moisture Parameters

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.

As can be seen in Table 3-6, the three moisture parameters had mostly weak correlations with the prevalent compounds. The strongest correlation was the relative humidity and the 1,3-butadiene concentration (-0.32), again a negative correlation. The sites used for sampling in this program year were located in different climatic zones ranging from a desert climate (Arizona) to a very moist climate (Puerto Rico). Bromomethane and 1,3-butadiene concentrations had the strongest negative correlation with wet bulb and dew point temperatures (-0.26 with wet bulb temperature and -0.27 with dew point temperature, respectively). As discussed in Sections 4 through 21, 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 speed is the vector value traveling toward the x-axis in a Cartesian grid coordinate system. The u-component is calculated as follows:

u-component = -1* (wind speed) * sin(wind direction, degrees)

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

v-component = -1* (wind speed) * cos(wind direction, degrees)

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

As shown in Table 3-6, the u- and v- components of the wind speed 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 2003 program year were located in different geographic zones ranging from a mountainous region (Colorado) to a plains region (Nebraska). Additionally, sites located downwind may correlate better with the measured concentrations than sites upwind. Bromomethane concentrations had the strongest correlation with the u-component of the wind speed (0.15, a positive correlation), while 1,3-butadiene had the strongest correlation with the v-component of the wind speed (-0.15, a negative correlation). As discussed in Sections 4 through 22, 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 bromomethane (0.16), while the strongest negative correlation occurred with chloromethane and acrylonitrile (-0.28).

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 four parameters to evaluate the impact of motor vehicle emissions on ambient air quality:

- Estimated motor vehicle ownership data;
- Motor vehicle emissions profiles;
- Estimated daily traffic estimates; and
- Reformulated gasoline (RFG) analysis.

3.4.1 Motor Vehicle Ownership Data

As an indicator of motor vehicle emissions near the UATMP monitoring locations, Table 3-7 presents estimates of the number of cars owned by residents in the county which the monitor is located. Car registration data are available at the state-level (EIA, 2003). 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. The data in the table indicate a positive linear correlation between motor vehicle ownership and ambient air concentrations of hydrocarbons. 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 monitor do not necessarily imply increased motor vehicle use in the immediate vicinity of a monitoring location. 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 Motor Vehicle Emissions 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 2003 UATMP monitoring sites, Figure 3-1 compares concentration ratios for the BTEX compounds measured during the 2003 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 locations: the more similar the concentration ratios at a particular monitoring location are to those of the roadside study, the more likely that motor vehicle emissions impact ambient levels of hydrocarbons at that location.

As Figure 3-1 shows, the concentration ratios for BTEX compounds measured at nearly every UATMP monitoring station bear some resemblance to the ratios reported in the roadside study. The BTEX ratios at the ELNJ and PGMS monitoring site appear to be the most similar to the roadside study profile. For all monitoring locations the toluene:ethylbenzene ratio is clearly the largest value of the four ratios, with the exceptions of BUND, DITN, GRMS, and QVAZ; the benzene:ethylbenzene ratio is clearly the smallest value of the ratios, with the exceptions of BUND, HOMI, ITCMI, and LONE. 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 which daily pass the monitor. For forty-eight of the 53 UATMP monitors, traffic data were available; for the unknown traffic data count, local agencies were contacted to provide an estimation. 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 occurs at the SPIL site, with over 215,000 vehicles passing by this monitor. However, the average hydrocarbon (total) value was only 4.38 ppbv, which is ranked 20th among sites that measured hydrocarbons. The highest average hydrocarbon values were at SPAZ, PSAZ, and DECO, yet the traffic count is ranked 12th, 49th, and 13th, respectively. Specific characterizations for these sites appear in the separate state sections. Estimated on-road county emissions were highest in Cook County, IL, which is the location of two UATMP sites (NBIL and SPIL). The hydrocarbon averages in Cook County, IL were similar to one another (4.38 ppbv for SPIL and 3.13 ppbv for NBIL). Estimated non-road county emissions were also highest in Cook County, IL. Non-road emission sources include, but are not limited to, activities from airplanes, construction vehicles, and lawn and garden equipment. There does not appear to be any direct correlation between traffic counts and average hydrocarbon concentrations.

3.4.4 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 that gasoline that had 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 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 following questions were analyzed:

- Have VOC concentrations decreased during the RFG season?
- Have the BTEX compound concentrations decreased during the RFG season? (Recall: BTEX refers to benzene, toluene, ethylbenzene, and xylene)
- Is there 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 VOC compounds. 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-Butudiene;
- 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 which participated in a 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 were 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 3-2 to 3-12 are graphical displays of site standard deviation versus average concentration. Most of the prevalent compounds are either in a cluster (such as carbon tetrachloride), exhibit a positive linear correlation (such as *p*-dichlorobenzene), or are spread randomly (such as xylene). The coefficient of variation provides a relative measure of variability by expressing variations to the magnitude of the arithmetic mean. This analysis is better suited for comparing variability across data distributions for different sites and compounds.

Seasonal variability was 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 3-13 to 3-23 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 winter, although high concentrations were also sampled in other seasons. Spring is the season where the lowest concentrations were measured. Some compound-specific trends were also noted, such as high concentration of: 1) 1,3-butadiene, xylene, and benzene were sampled in winter; 2) formaldehyde in summer; and 3) acetaldehyde and tetrachloroethylene in autumn. However, a quick review of the profiles reveals most compounds experienced noticeable "spikes" across all sites, while few exhibited a relatively uniform profile (carbon tetrachloride, for example). This observation validates the variabilities for each of the sites.

3.6 UATMP NATTS Sites

Additional analyses were provided on the EPA-designated National Air Toxics Trends System (NATTS) sites (NATTS sites are designated in bold in Table 2-2). The monitors will be used to evaluate air quality, similar to the National Ambient Air Quality Standard (NAAQS) monitors that measure criteria pollutants. The three additional analyses are: 1) composite back trajectory analysis; 2) federal/state regulation analysis; and 3) emission tracer analysis.

3.6.1 Back Trajectory Analysis

A back trajectory analysis traces the origin of an air parcel in relation to the location where it is currently being examined. 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 is what 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 2003 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 (which include a NATTS site) discuss these results in full detail.

3.6.2 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 stations are already subject to emission limitations. Consequently, the ambient concentrations of UATMP compounds recorded at the monitoring stations reflect, to some degree, the emission limitations achieved 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 stations should decrease as facilities and mobile sources achieve compliance with the new regulations.

3.6.2.1 Regulations for Stationary Sources

The national regulations that have the potential to reduce emissions of UATMP pollutants from stationary sources are grouped into two categories: standards for VOC developed under section 183(e) of the Clean Air Act (CAA) (Federal Ozone Measures, Control of Emissions From Certain Sources), and standards for air toxics developed under section 112(d) of the CAA (Hazardous Air Pollutants, Emission Standards).

As required by section 183 of the CAA, EPA conducted a study of VOC emissions from consumer and commercial products and developed categories of products that account for at least 80 percent of the total VOC emissions (on a reactivity-adjusted basis) in areas that violate the national ambient air quality standards (NAAQS) for ground-level ozone. The EPA divided the list into four groups for developing regulations based on the best available controls (as defined by the CAA). In March 1995, EPA included architectural coatings, automobile refinishing, consumer products, and commercial products among the highest priority consumer and commercial product categories listed for regulation. Table 3-9 provides a brief summary of the national VOC regulations. However, since the VOC rules affect products and coatings manufactured after 1999, these rules are not expected to achieve future reductions of UATMP pollutants.

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 (listed in the 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) standards 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. Currently, the EPA has promulgated 92 national emission standards for hazardous air pollutants (NESHAP) and proposed 1 NESHAP to regulate air toxic emissions from the listed source categories. Table 3-10 provides an overview of the NESHAP that were identified during this analysis. Please refer to Section 3.6.2.3 for further details.

3.6.2.2 Mobile Sources

For mobile sources, there are two applicable programs that have the potential to reduce ambient concentrations of UATMP pollutants: National Low Emissions Vehicles (NLEV) and Phase II Reformulated Gasoline (RFG), which was discussed in Section 3.4.4 of this report.

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 also 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. The standards are enforceable in the same manner that other federal motor vehicle emissions control requirements are enforceable.

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).

3.6.2.3 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 pilot monitoring stations. For this analysis, a list of stationary facilities that emit UATMP compounds within a 10-mile radius of each monitoring station was obtained from the National Emissions Inventory for HAPs database. The list of facilities from the NEI database was restricted to those facilities that account for approximately the top 90 percent of the UATMP pollutant emissions in the 10-mile areas.

For these facilities, the various air regulations were reviewed to determine if they could potentially be applicable. The regulations reviewed were limited to those with publication dates of 1999 or later. This date was selected to coincide with the year of the emissions data in the NTI database. Regulations with earlier compliance dates would already be in place and no future emission reduction would be achieved. For this analysis, Standards of Performance for New Sources (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 stations are not available, projections of the emission trends associated with the mobile source regulations were also not included in this analysis.

To determine the applicability of the various regulations to the facilities in the 10-mile areas, the type of process or operation in use at each facility was obtained from the standard industrial classification (SIC) codes in the NEI database (EPA, 2003a). Additionally, searches of facility names were conducted on the World Wide Web to obtain additional information regarding a facility's activities. For the NESHAP, the preambles that accompany the promulgated regulations typically identify the SIC codes for the industrial categories and entities that are potentially subject to the NESHAP. Consequently, the SIC codes were used directly to assign NESHAP to specific facilities.

To determine the potential emission reductions attributable to the regulations, the average emission reductions that are expected to be achieved by the regulations were obtained from the rule preambles. These average emission reductions were applied to the urban air toxic compounds covered by the particular regulation. 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.

For each of the individual monitoring stations, the major contributors to emissions of UATMP HAP pollutants and the expected trend in emissions are discussed fully in the individual state sections. Table 3-11 provides a summary of the pollutants and sources regulated for the NATTS sites.

3.6.3 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. Additionally, the RfC Noncancer Benchmark value is plotted to reflect the noncancer exceedance concentrations. This analysis only reviewed NATTS sites in which a pollutant exceeded the Noncancer Benchmark. Results are discussed in the individual state sections.

3.7 Metals Analysis

Figure 3-24 is a profile of the average metals concentrations that were sampled during the 2003 UATMP. Nine sites opted to sample for metals. BOUT (147.91 ng/m^3) had the highest metal concentrations of all eight sites. BOUT had a significantly higher average metal concentration than BTUT, nearly three times as much, which is interesting because these two sites are close to each other. The Denver sites (DECO and WECO) and the Nashville sites (LOTN and EATN) had comparable average concentrations.

3.8 Trends Analysis

Table 2-1 represents past UATMP participation for sites also participating in this year’s program. For sites that participated prior to 2002 and are still participants through the 2003 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 Trends in Annual Averages

Figures 3-25a thru 3-25v show a comparison of the yearly average concentrations of 1,3-butadiene, benzene, and formaldehyde for each of the twenty-two sites. At sites where all three compounds were sampled, formaldehyde consistently had the highest average annual concentrations while 1,3-butadiene, with few exceptions, consistently had the lowest.

Of the 19 sites that 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 2001 for twelve of the eighteen sites (SFSD did not sample for carbonyls until 2002). For CANJ, the site with the most years of participation, the highest average annual formaldehyde concentration was sampled in 1997.

Average annual concentrations of 1,3-butadiene were highest at SFSD in 2002 and PGMS in 2001. These sites had average annual concentrations 4-5 times higher than any 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 SPAZ, DECO, and PSAZ. Average benzene concentrations were greater than 1.00 ppbv from 2000 to 2002 at DECO, both 2001 and 2002 for SPAZ, and in 2002 at PSAZ. The distribution of the highest average benzene concentrations for the sites was spread fairly evenly across the years. CANJ sampled its highest average benzene concentration in 1998.

3.8.2 Trends in Seasonal Averages

Figures 3-26a thru 3-26v show a comparison of the seasonal average concentrations for each year of participation for each of the eight sites. Again, average formaldehyde concentrations were the highest of the three compounds for each site, year, and season, while 1,3-butadiene had the lowest. For 1,3-butadiene and benzene, the seasons with the highest average concentrations tended to be autumn and winter. For formaldehyde, the seasons with the highest average concentrations tended to be summer and autumn.

Figure 3-1. Comparison of Concentration Ratios for BTEX Compounds vs. Roadside Study

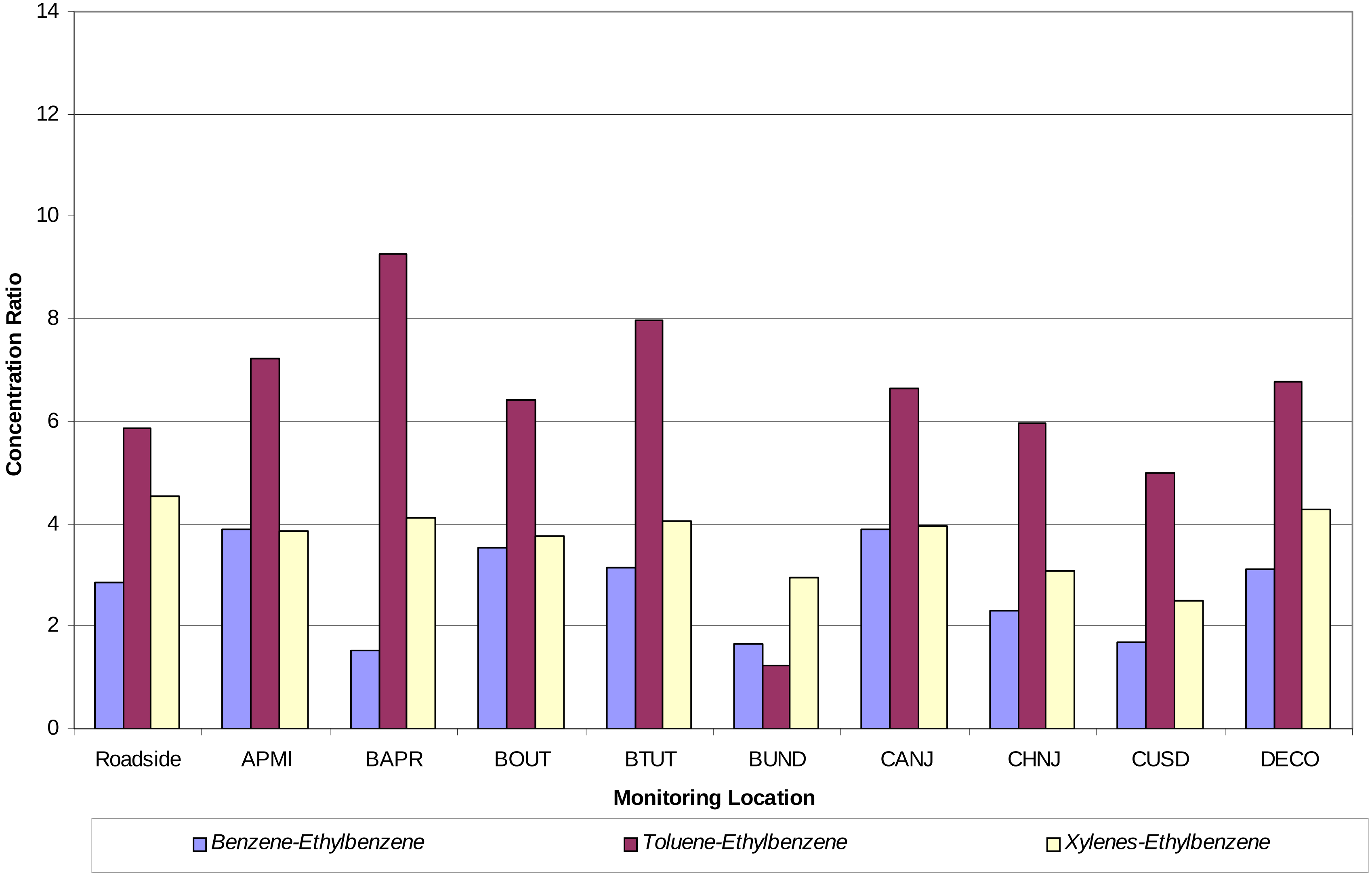


Figure 3-1 (Continued)

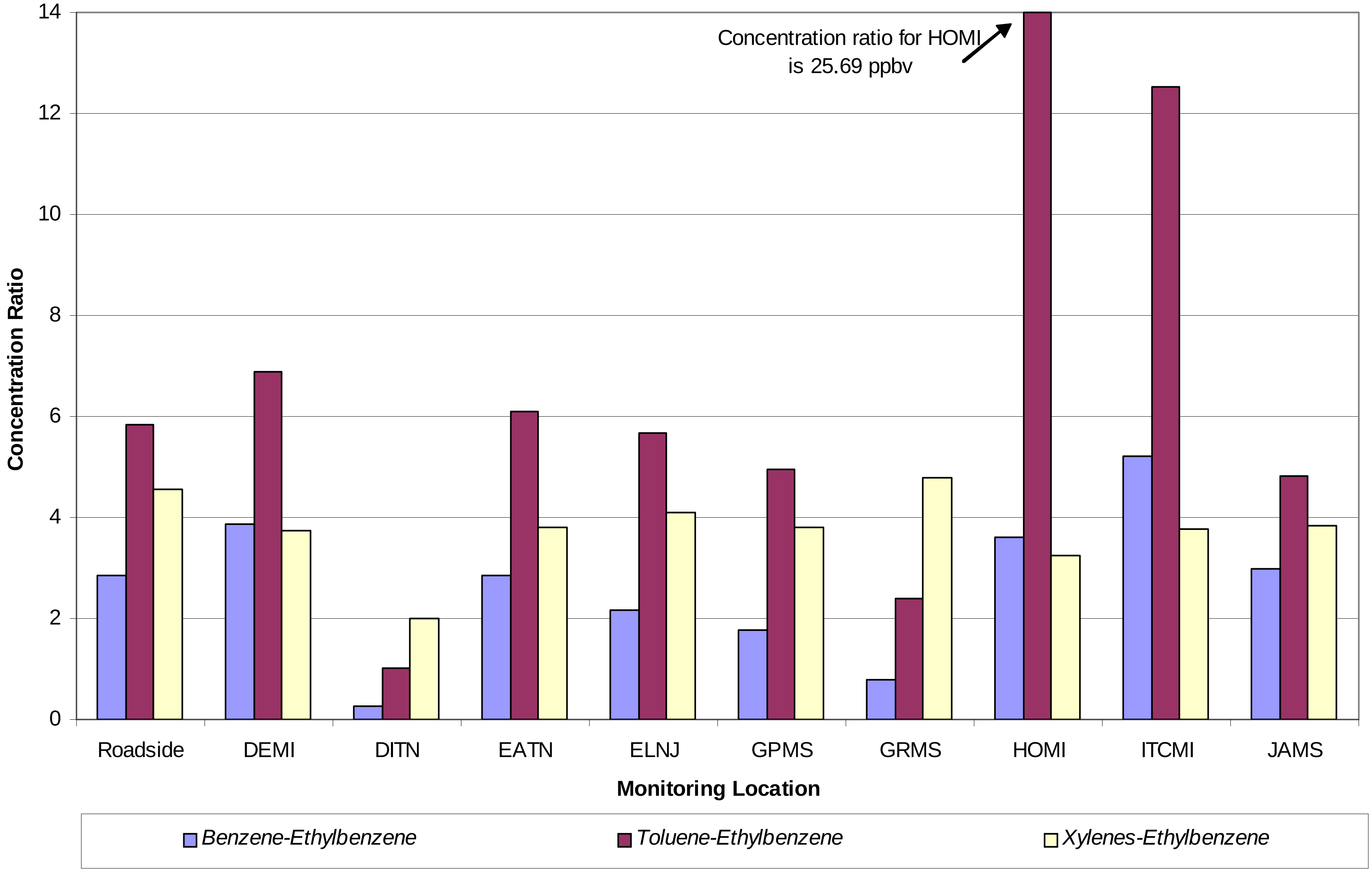

Concentration ratio for HOMI is 25.69 ppbv

Figure 3-1 (Continued)

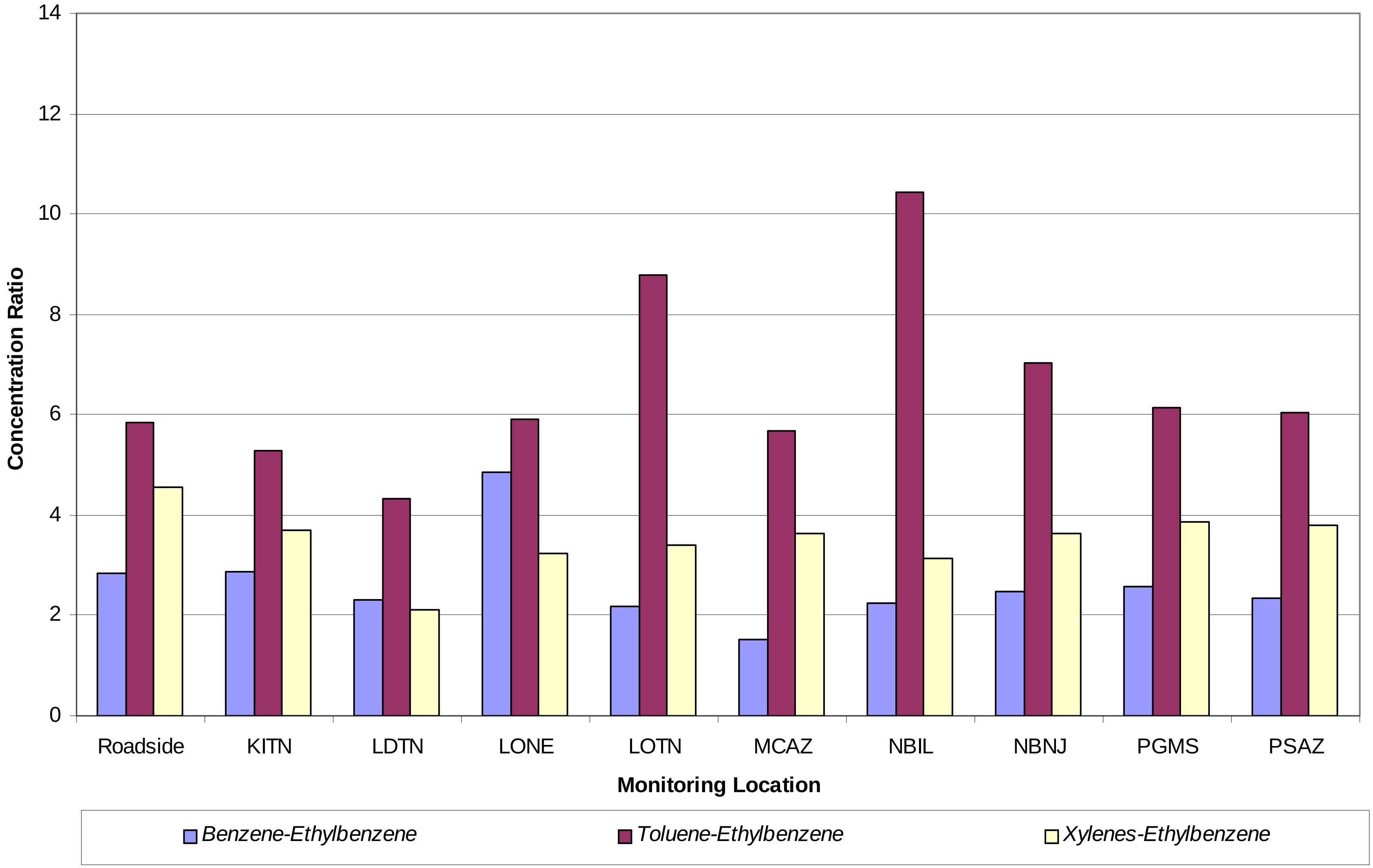


Figure 3-1 (Continued)

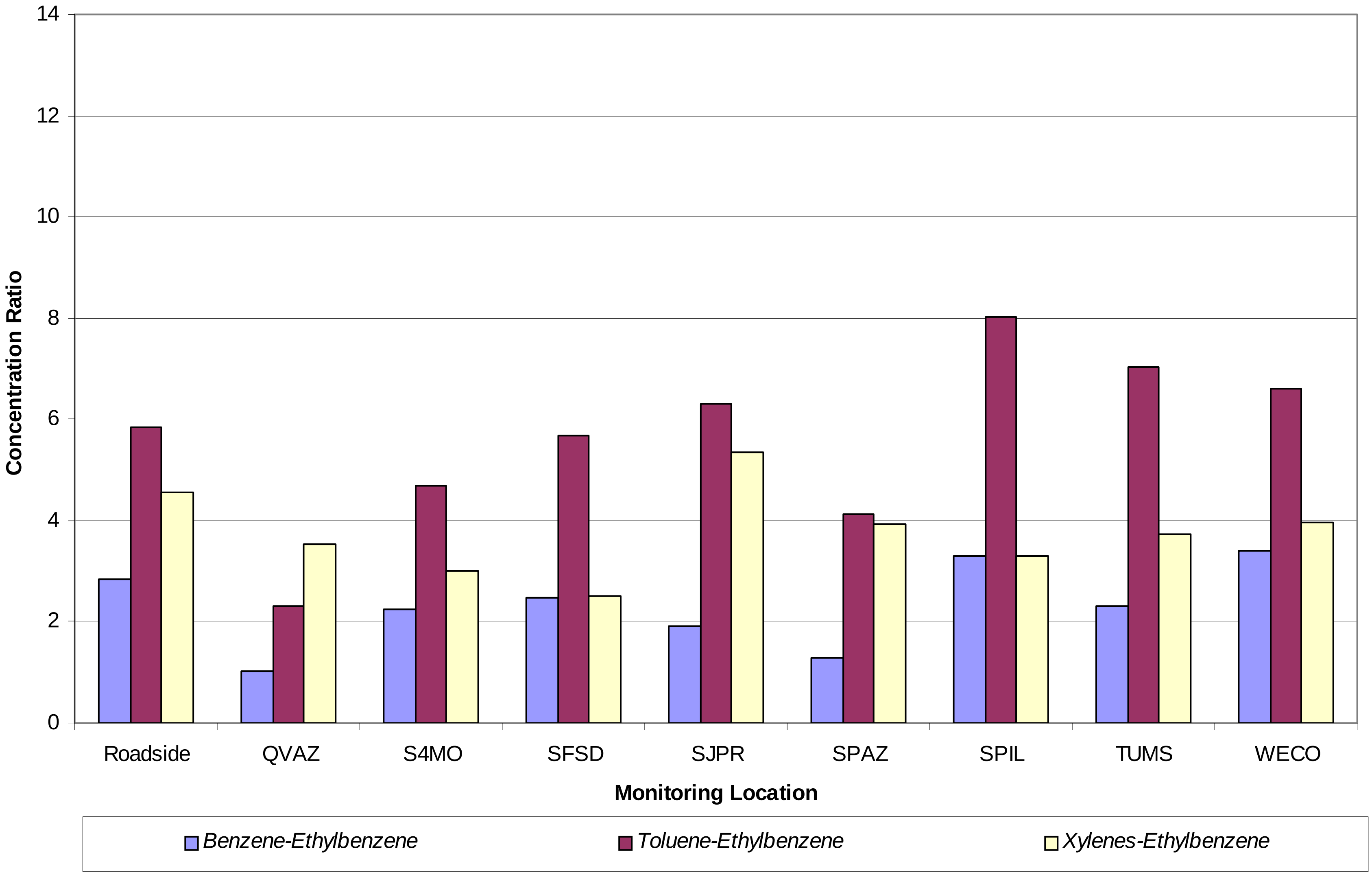


Figure 3-2. Coefficient of Variation Analysis of 1,3-Butadiene Across 30 Sites

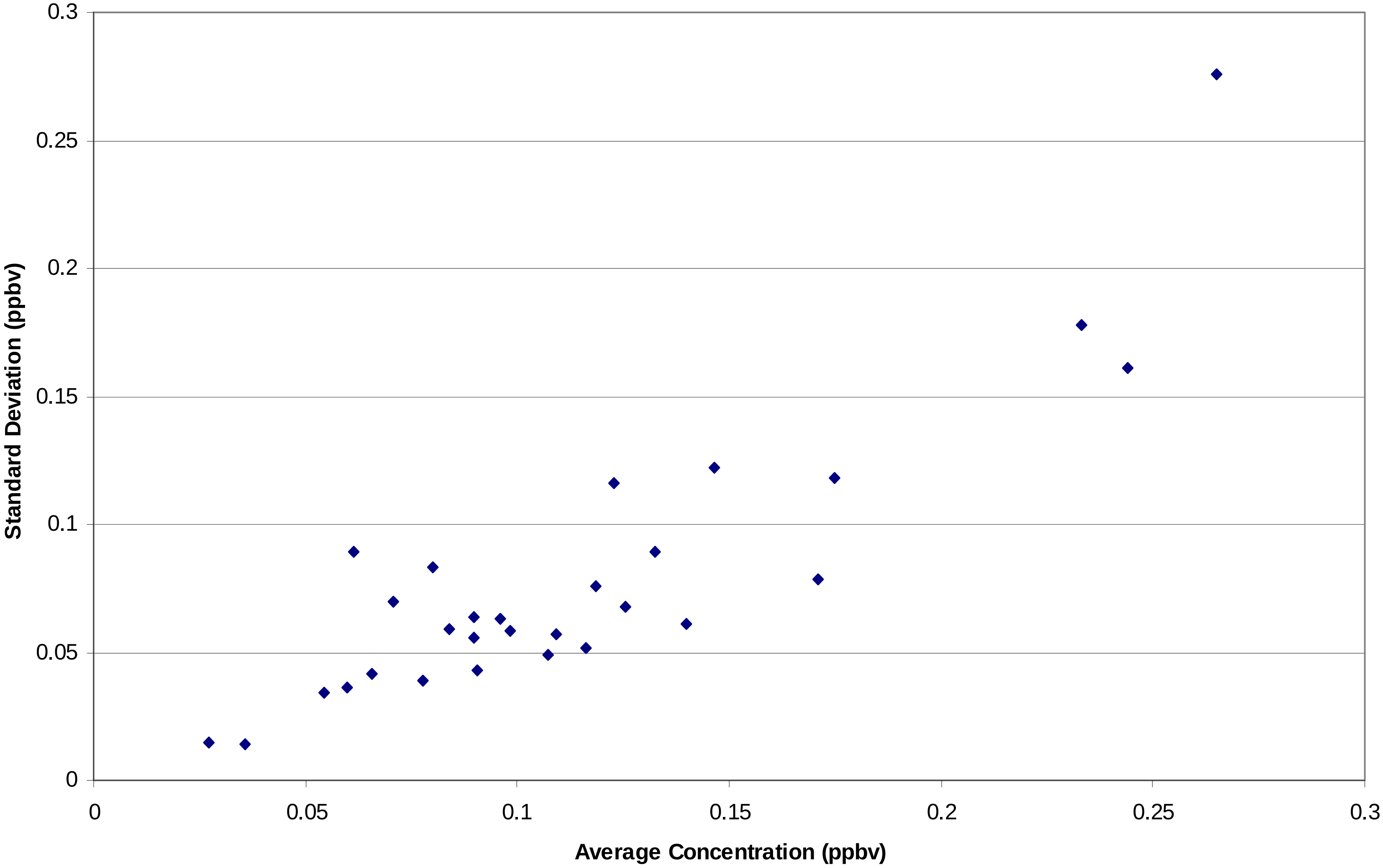


Figure 3-3. Coefficient of Variation Analysis of Acetaldehyde Across 39 Sites

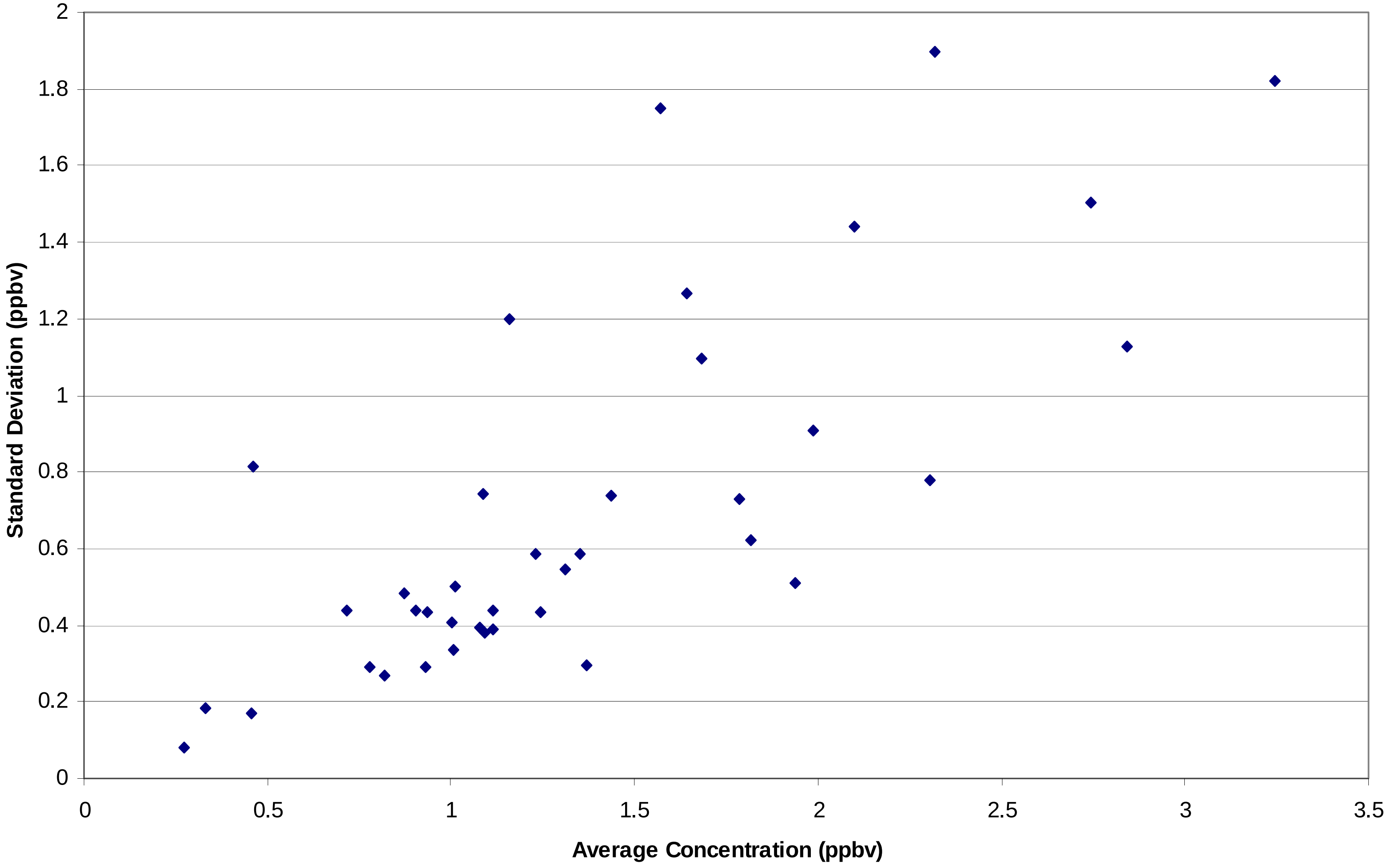


Figure 3-4. Coefficient of Variation Analysis of Acetonitrile Across 32 Sites

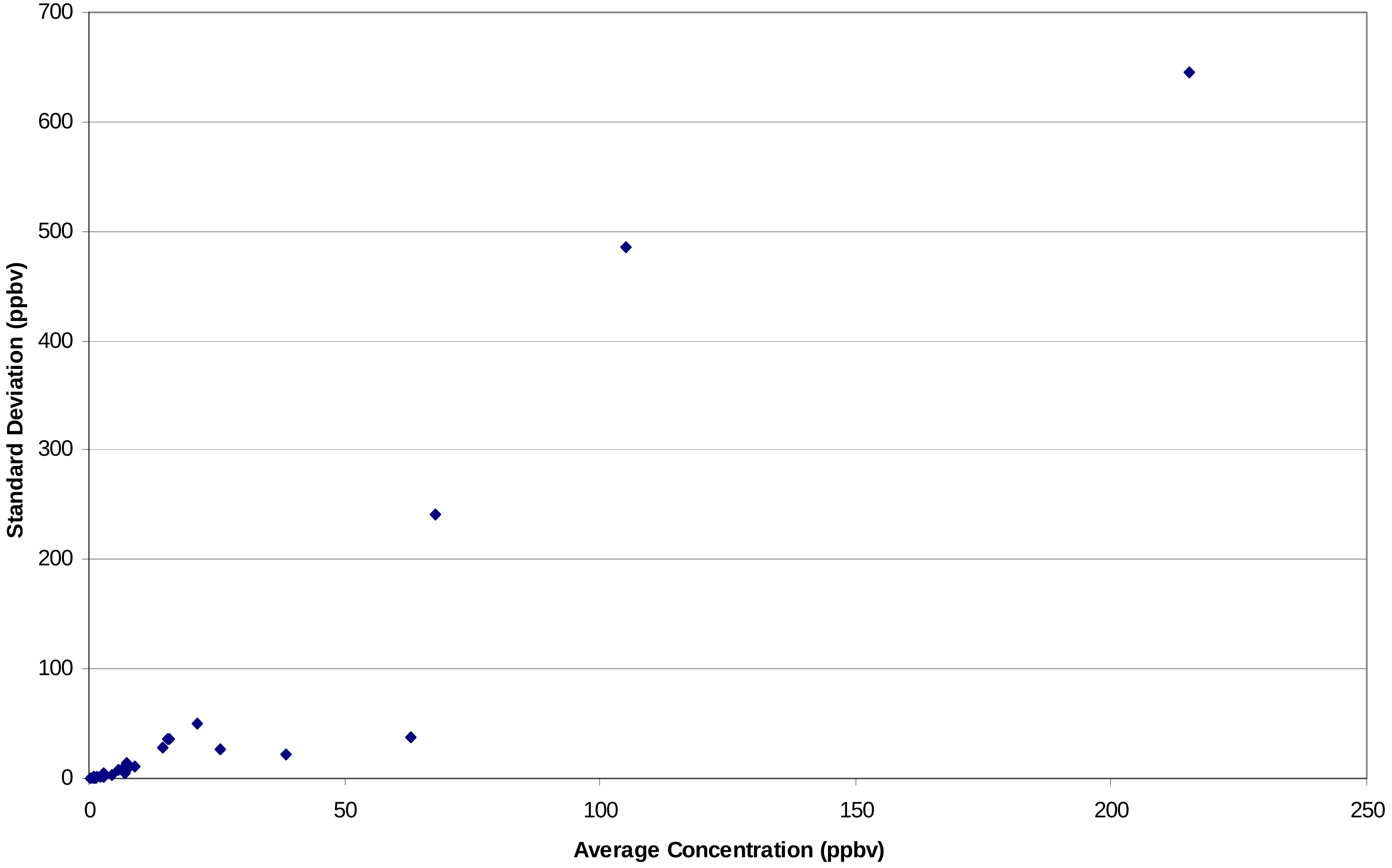


Figure 3-5. Coefficient of Variation Analysis of Acrylonitrile Across 15 Sites

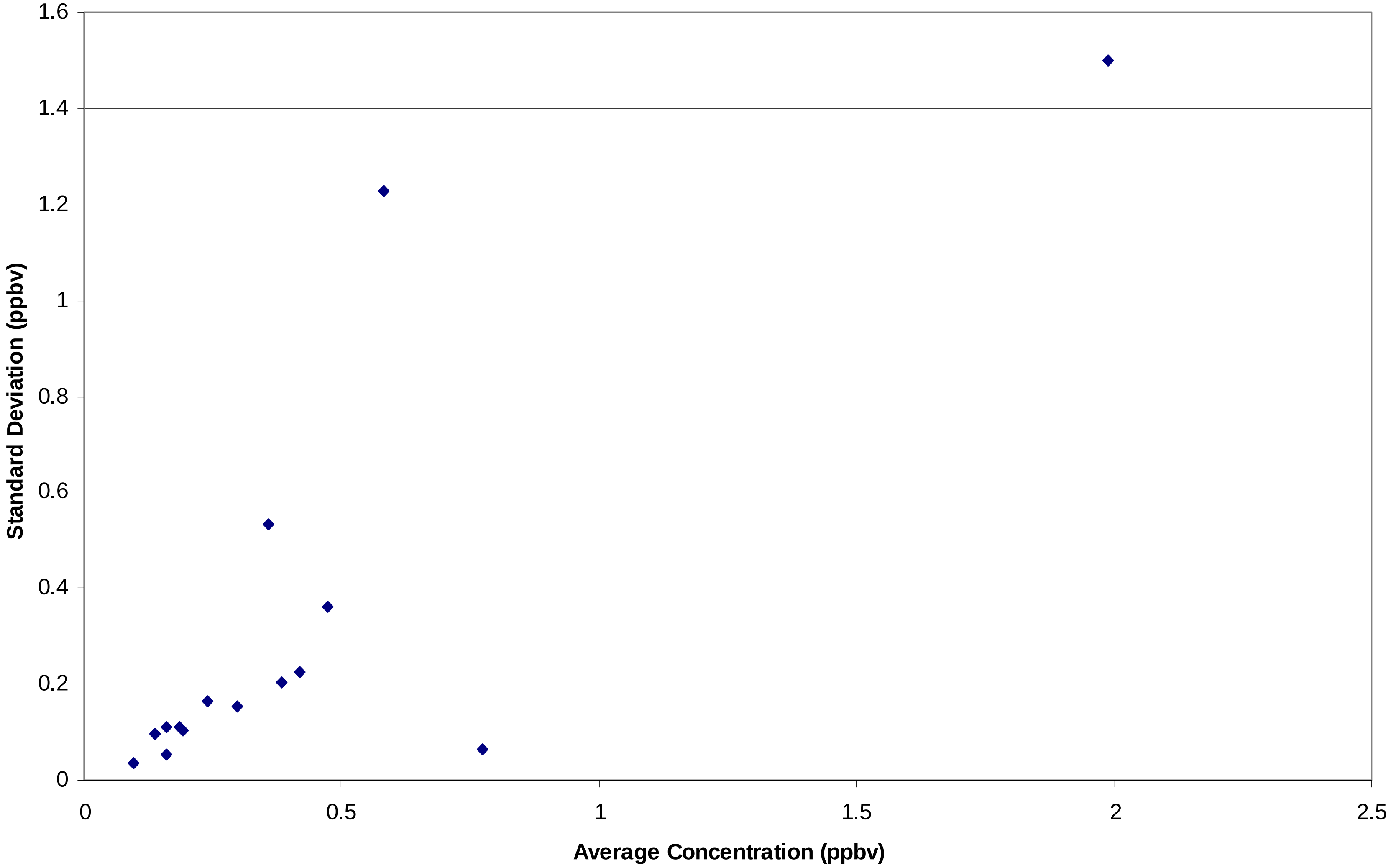


Figure 3-6. Coefficient of Variation Analysis of Benzene Across 36 Sites

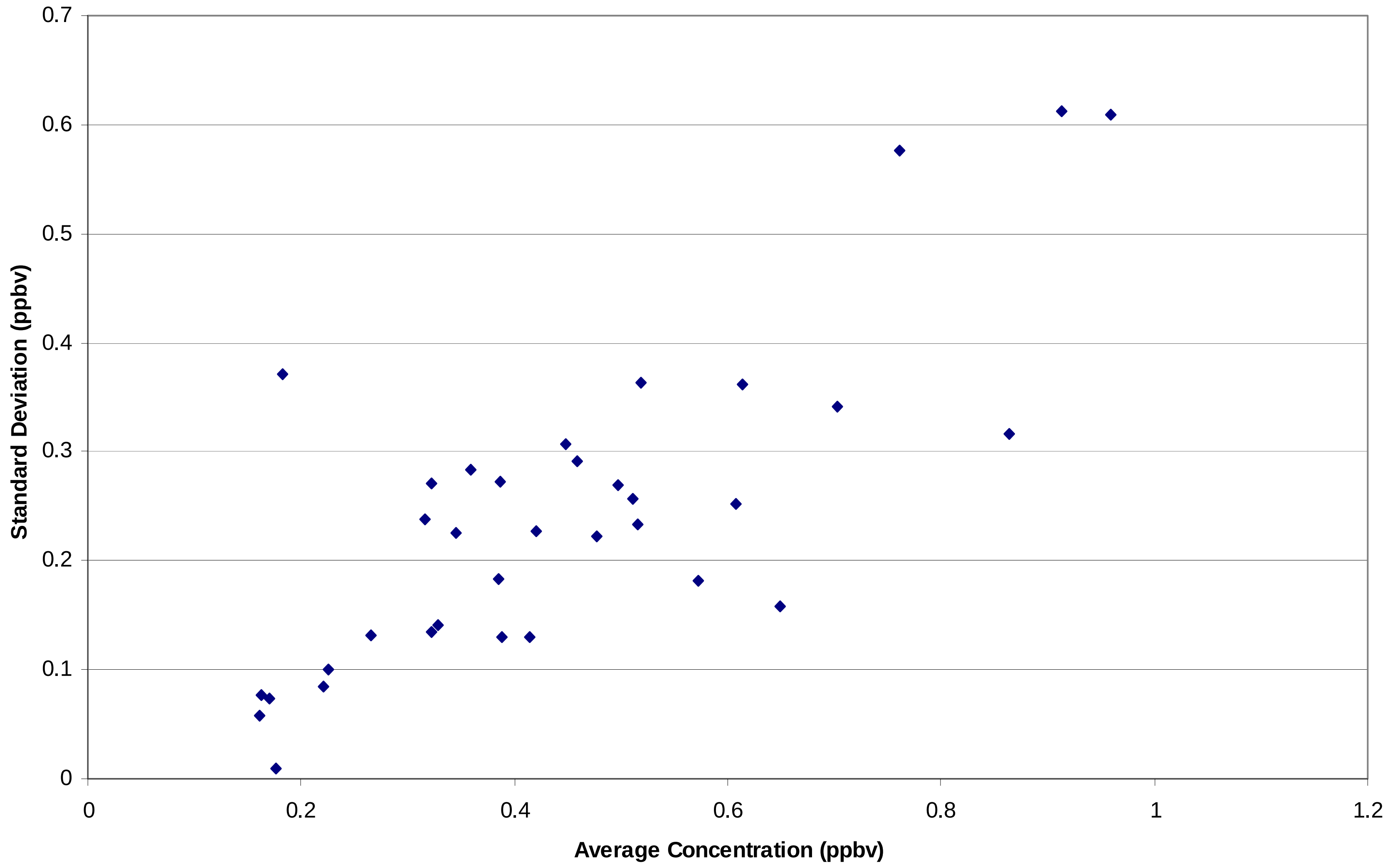


Figure 3-7. Coefficient of Variation Analysis of Bromomethane Across 11 Sites

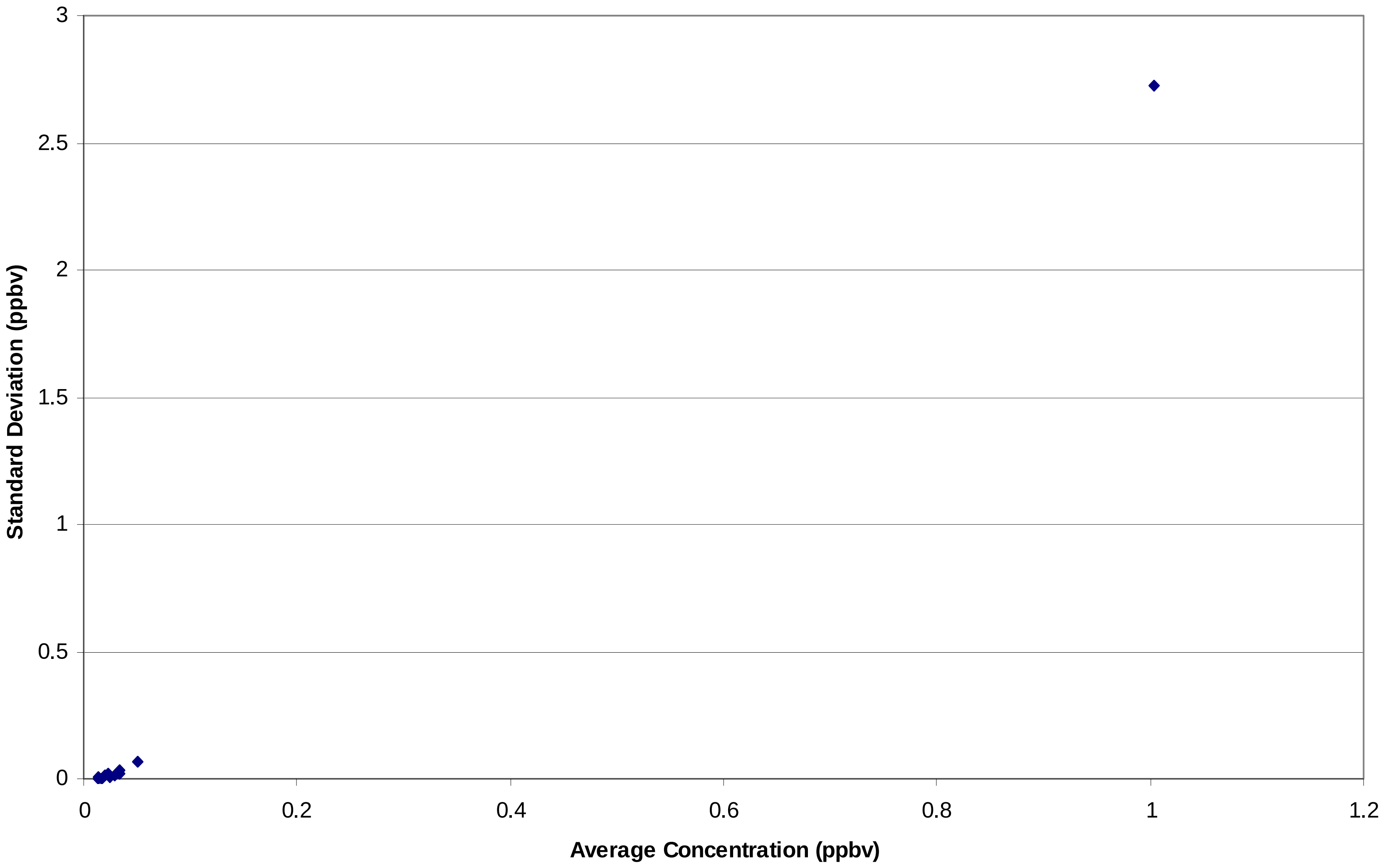


Figure 3-8. Coefficient of Variation Analysis of Carbon Tetrachloride Across 35 Sites

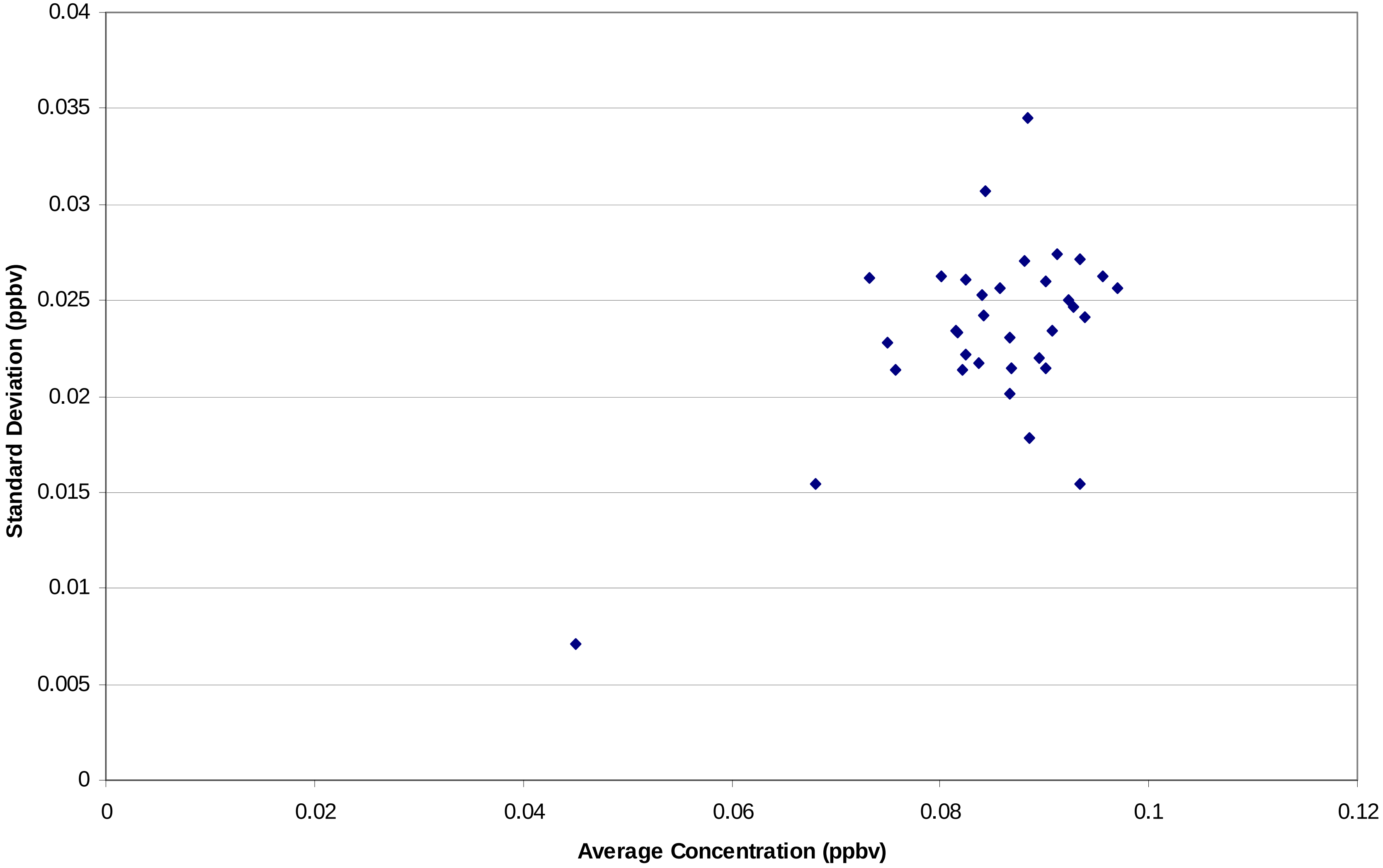


Figure 3-9. Coefficient of Variation Analysis of Formaldehyde Across 39 Sites

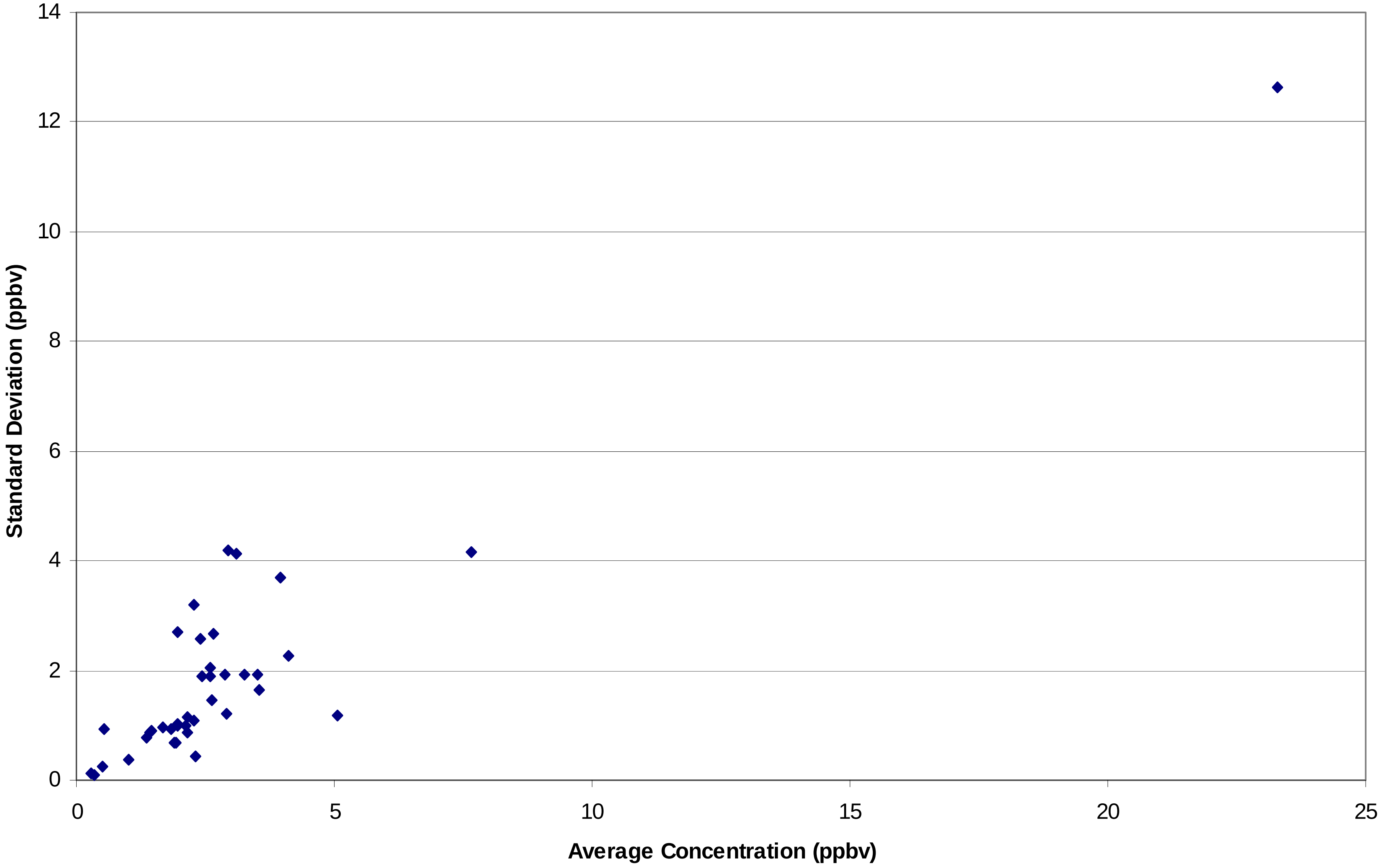


Figure 3-10. Coefficient of Variation Analysis of *p*-Dichlorobenzene Across 21 Sites

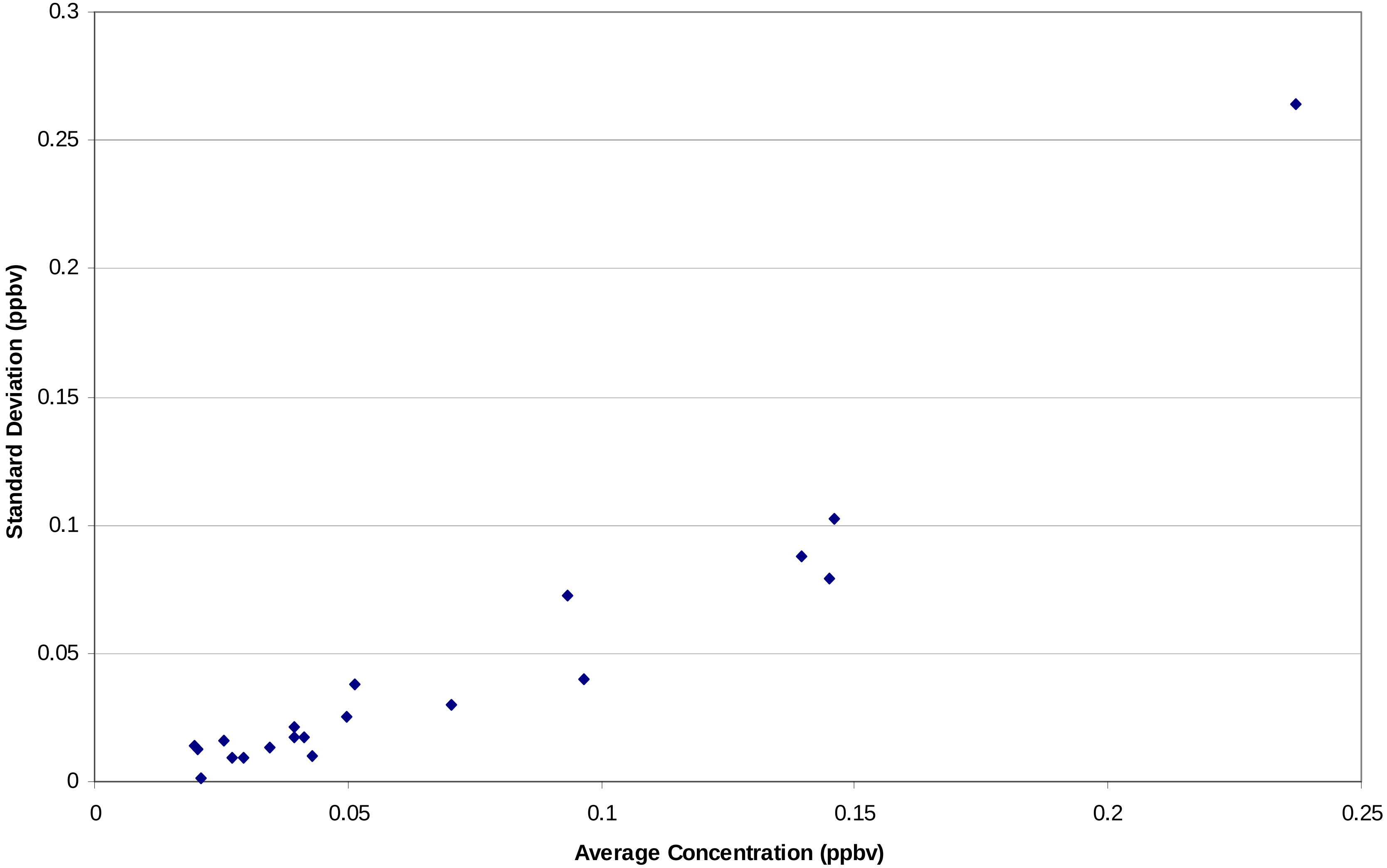


Figure 3-11. Coefficient of Variation Analysis of Tetrachloroethylene Across 29 Sites

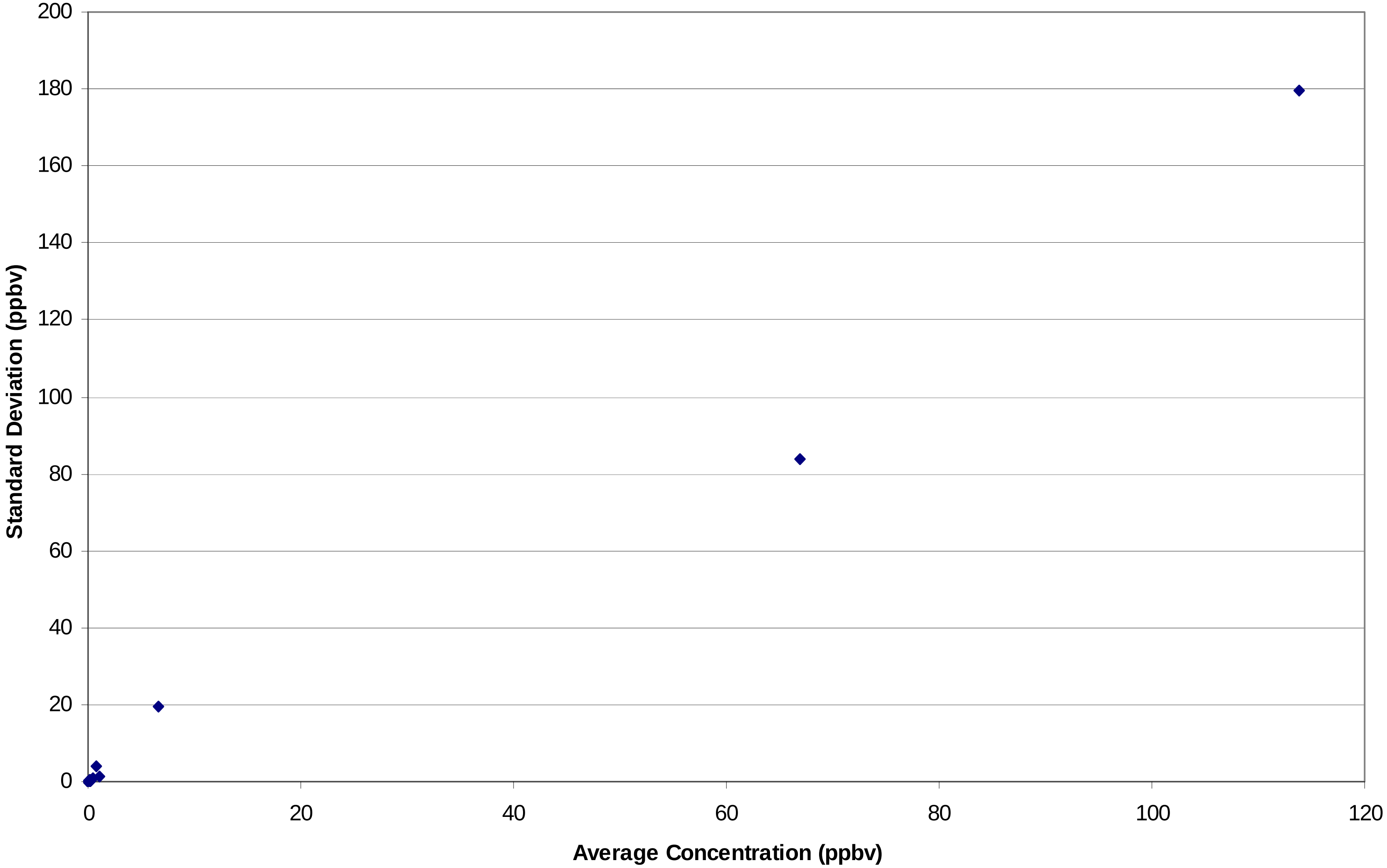


Figure 3-12. Coefficient of Variation Analysis of Xylenes (*o-*,*m-*,*p-*) Across 36 Sites

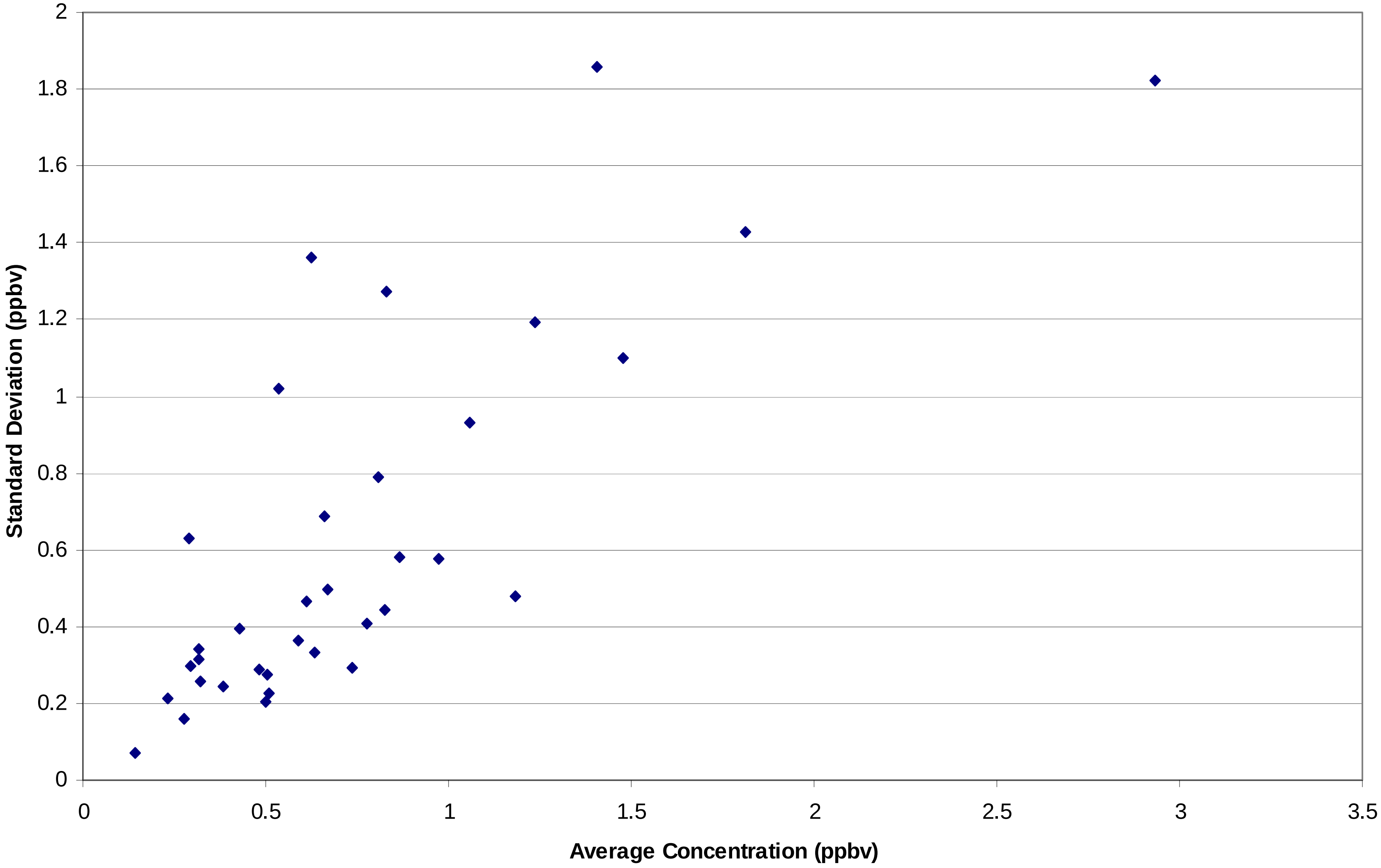


Figure 3-13a. Average 1,3-Butadiene Concentration by Season (APMI-LONE)

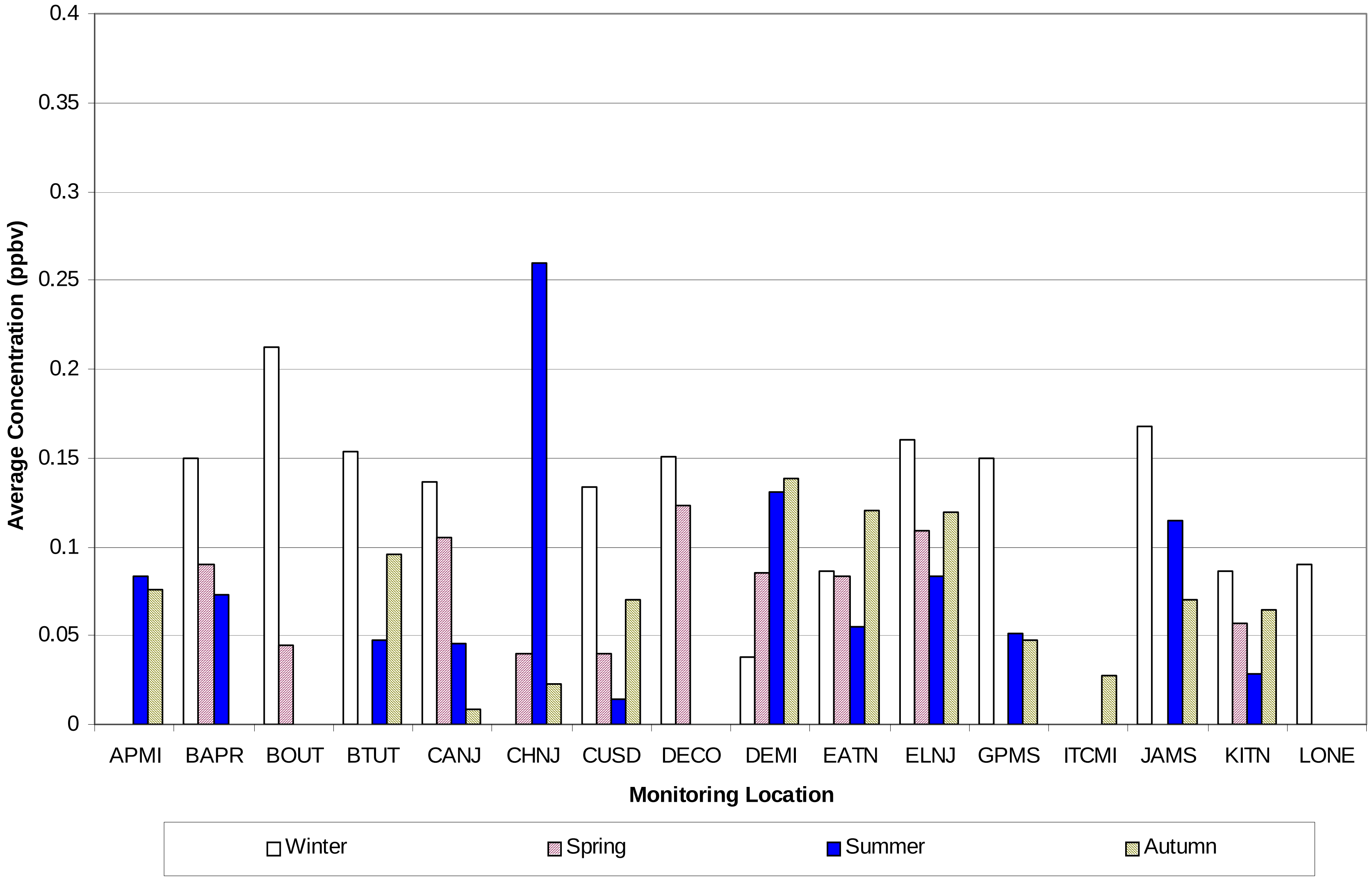


Figure 3-13b. Average 1,3-Butadiene Concentration by Season (LOTN-WECO)

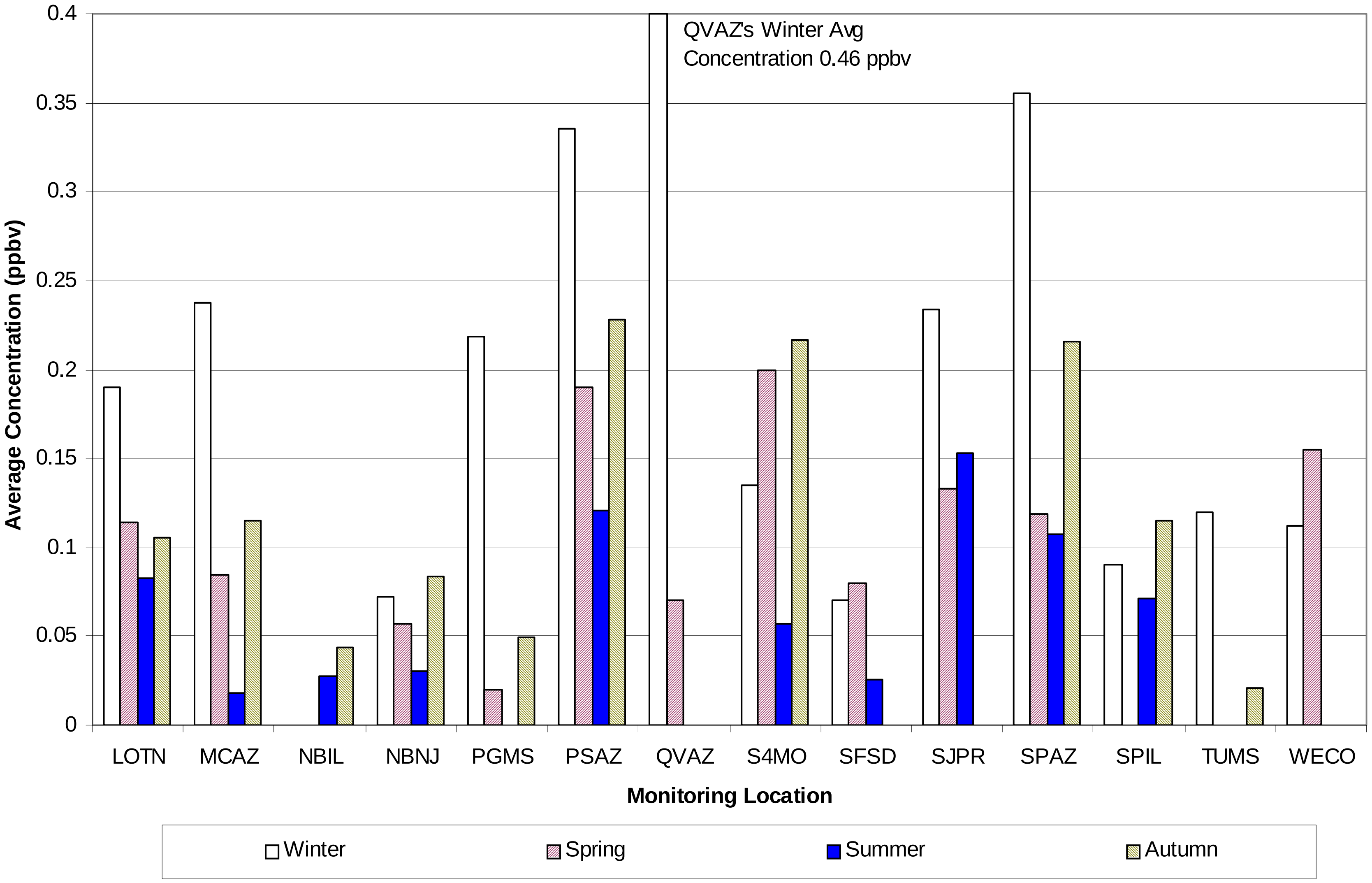


Figure 3-14a. Average Acetaldehyde Concentration by Season (AZFL-GAFL)

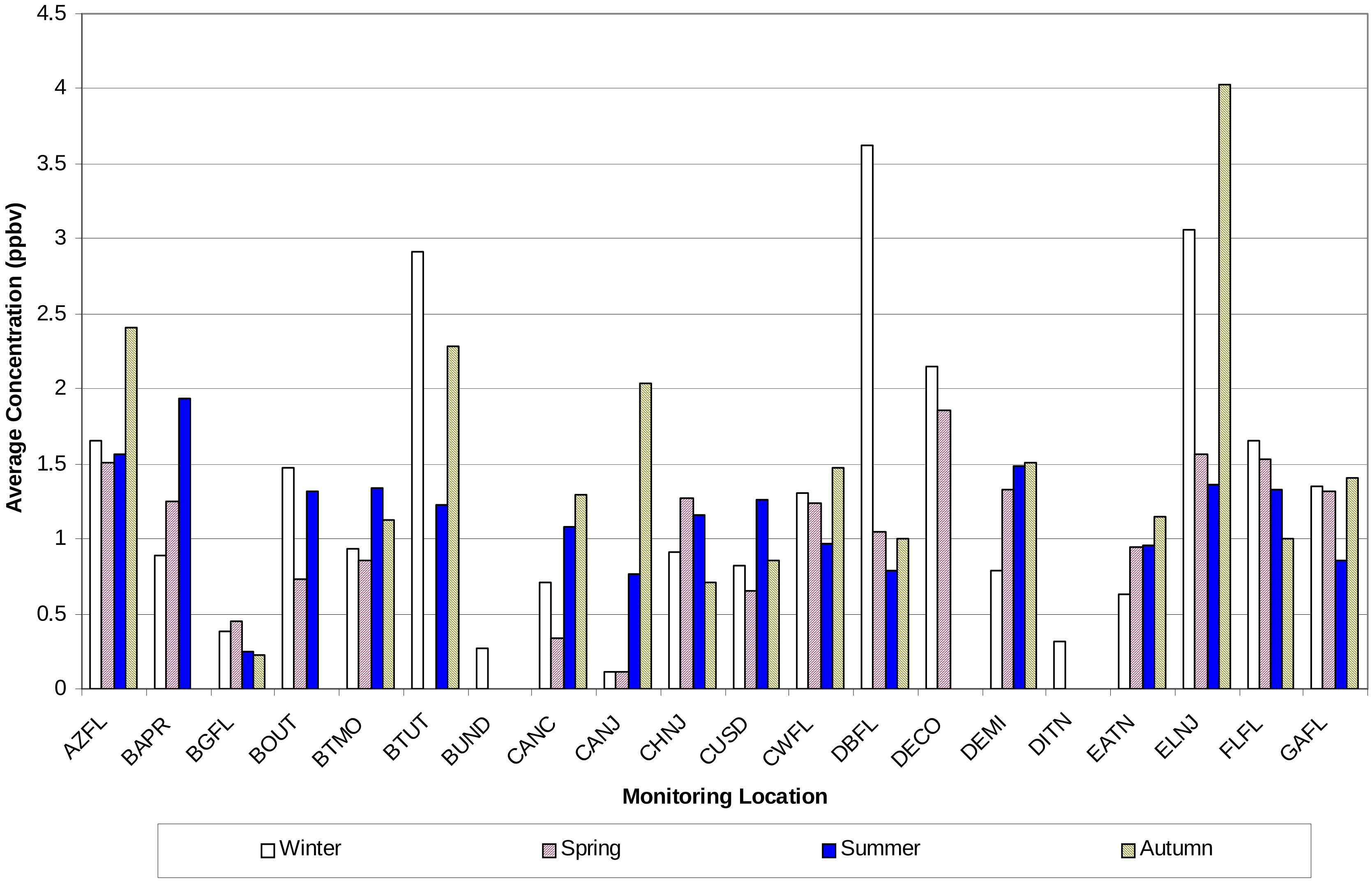


Figure 3-14b. Average Acetaldehyde Concentration by Season (GPMS-WECO)

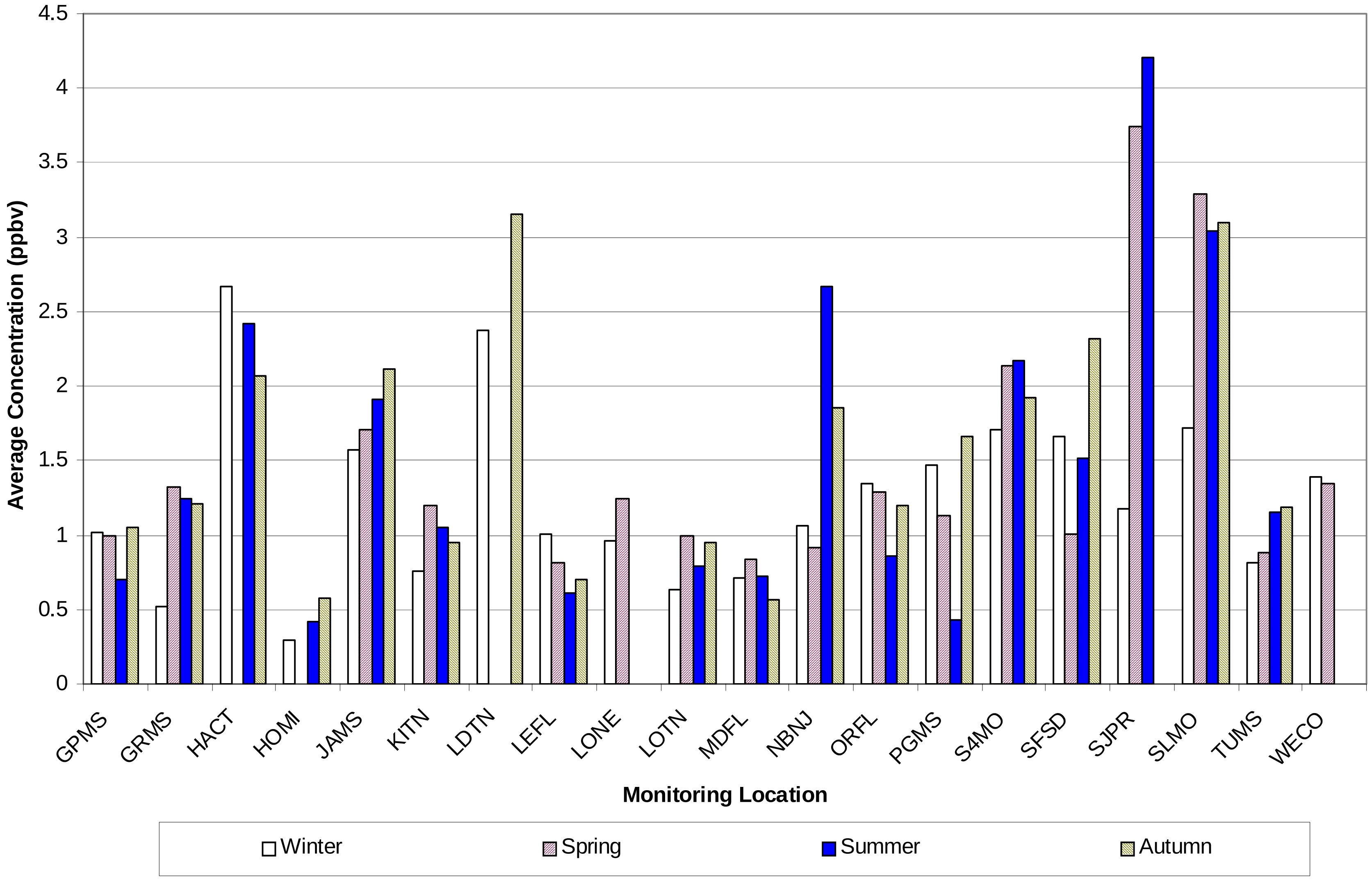


Figure 3-15a. Average Acetonitrile Concentration by Season (APMI-KITN)

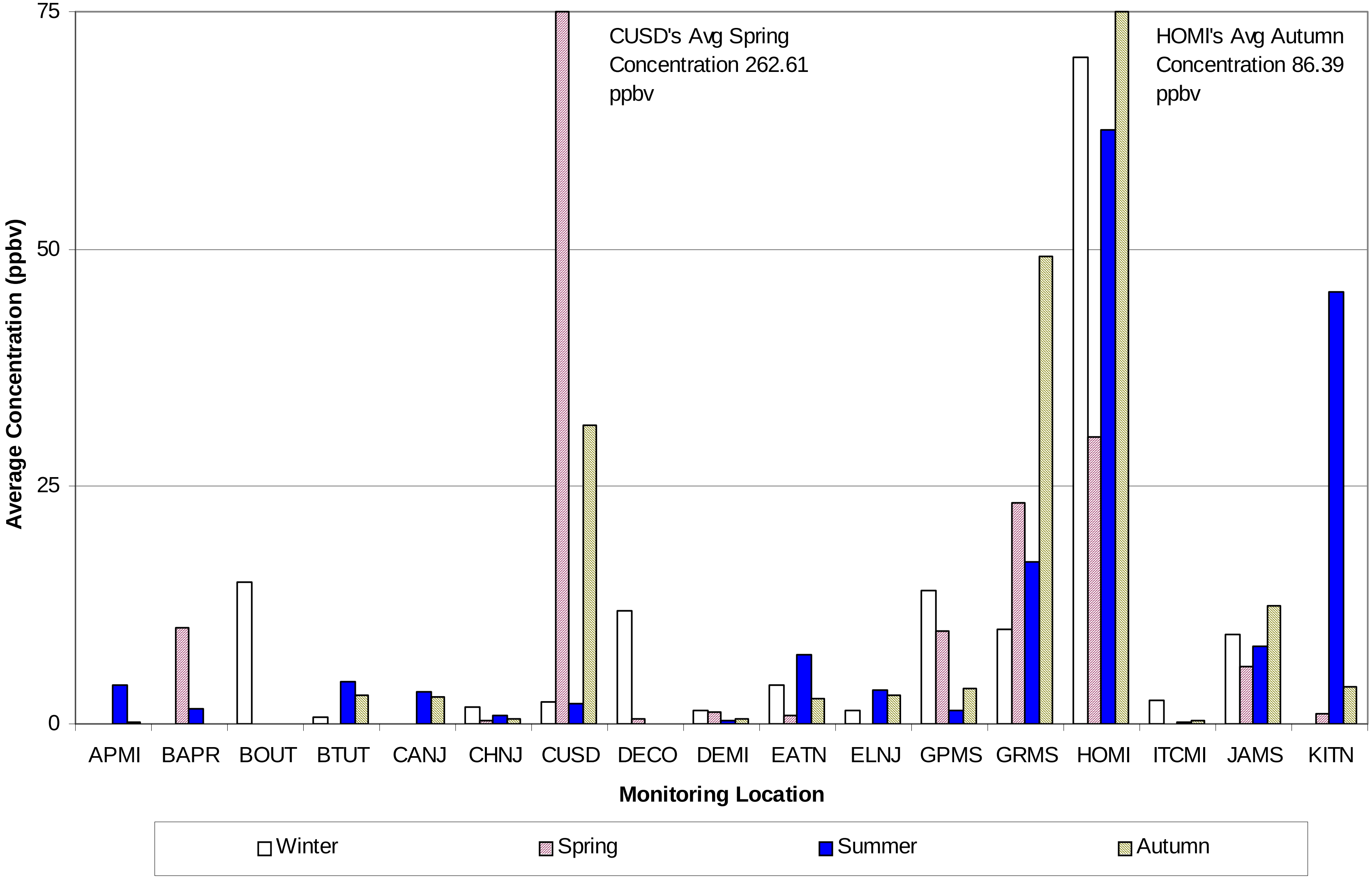


Figure 3-15b. Average Acetonitrile Concentration by Season (LOTN-WECO)

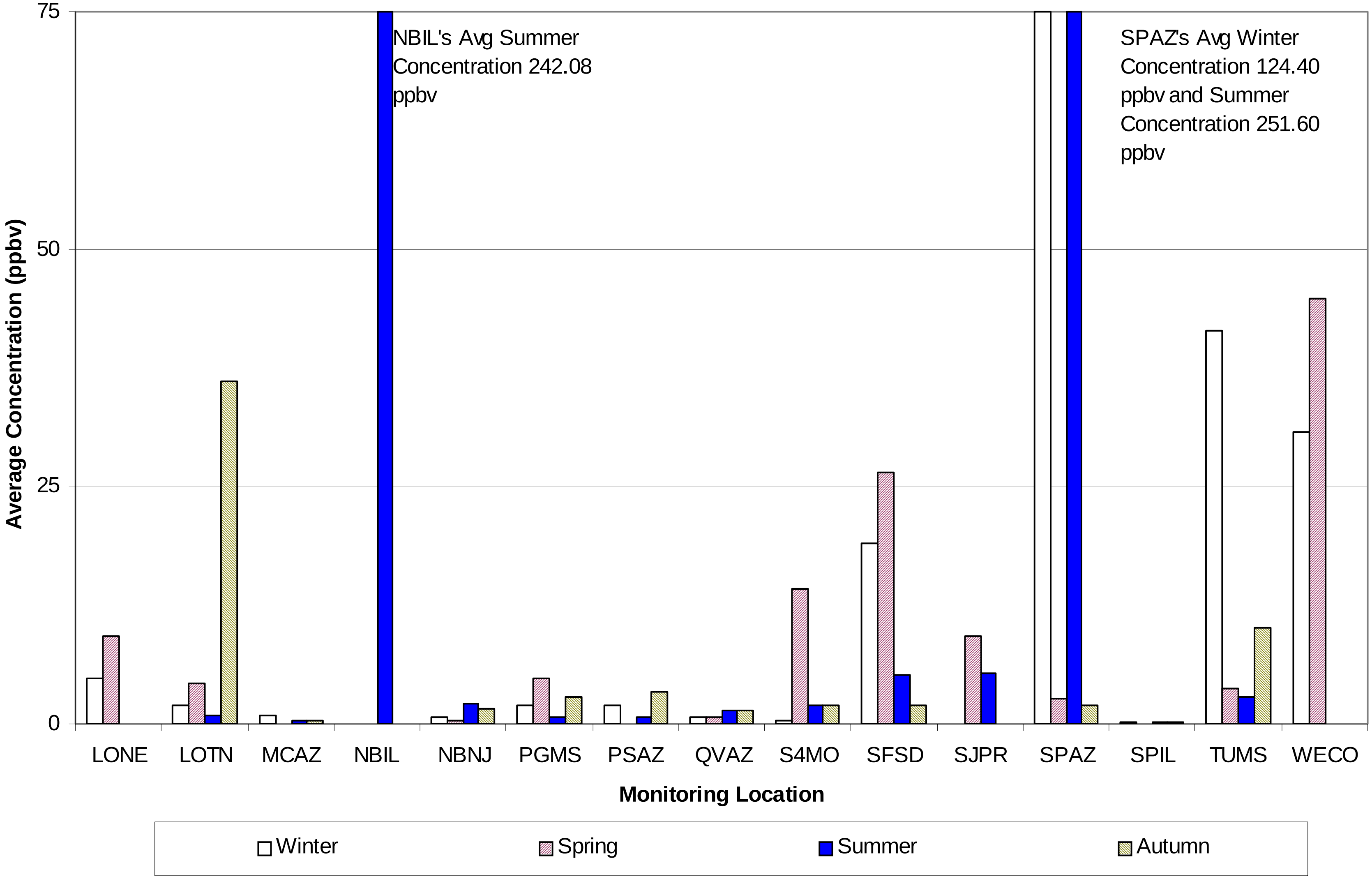


Figure 3-16. Average Acrylonitrile Concentration by Season

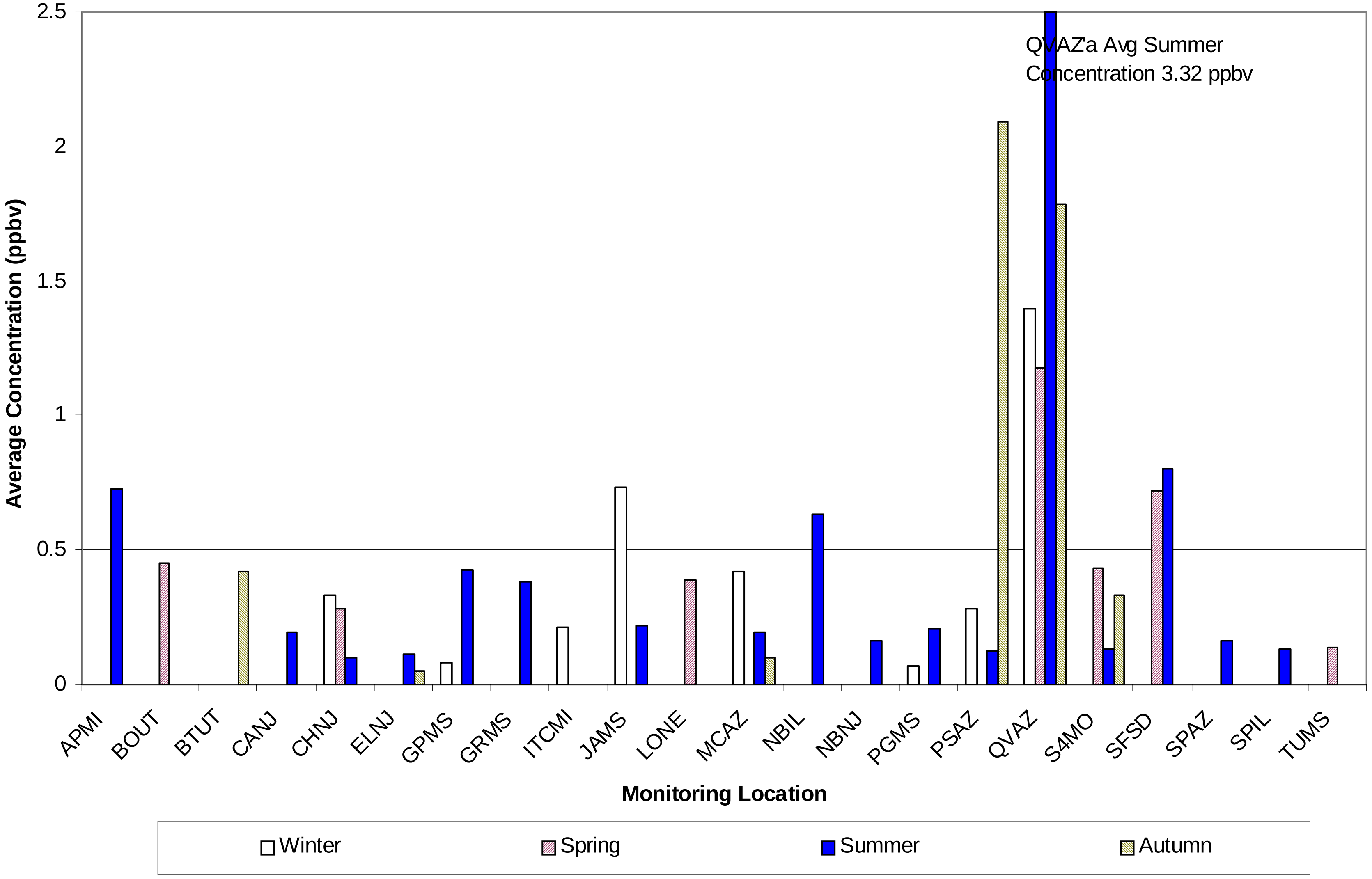


Figure 3-17a. Average Benzene Concentration by Season (APMI-JAMS)

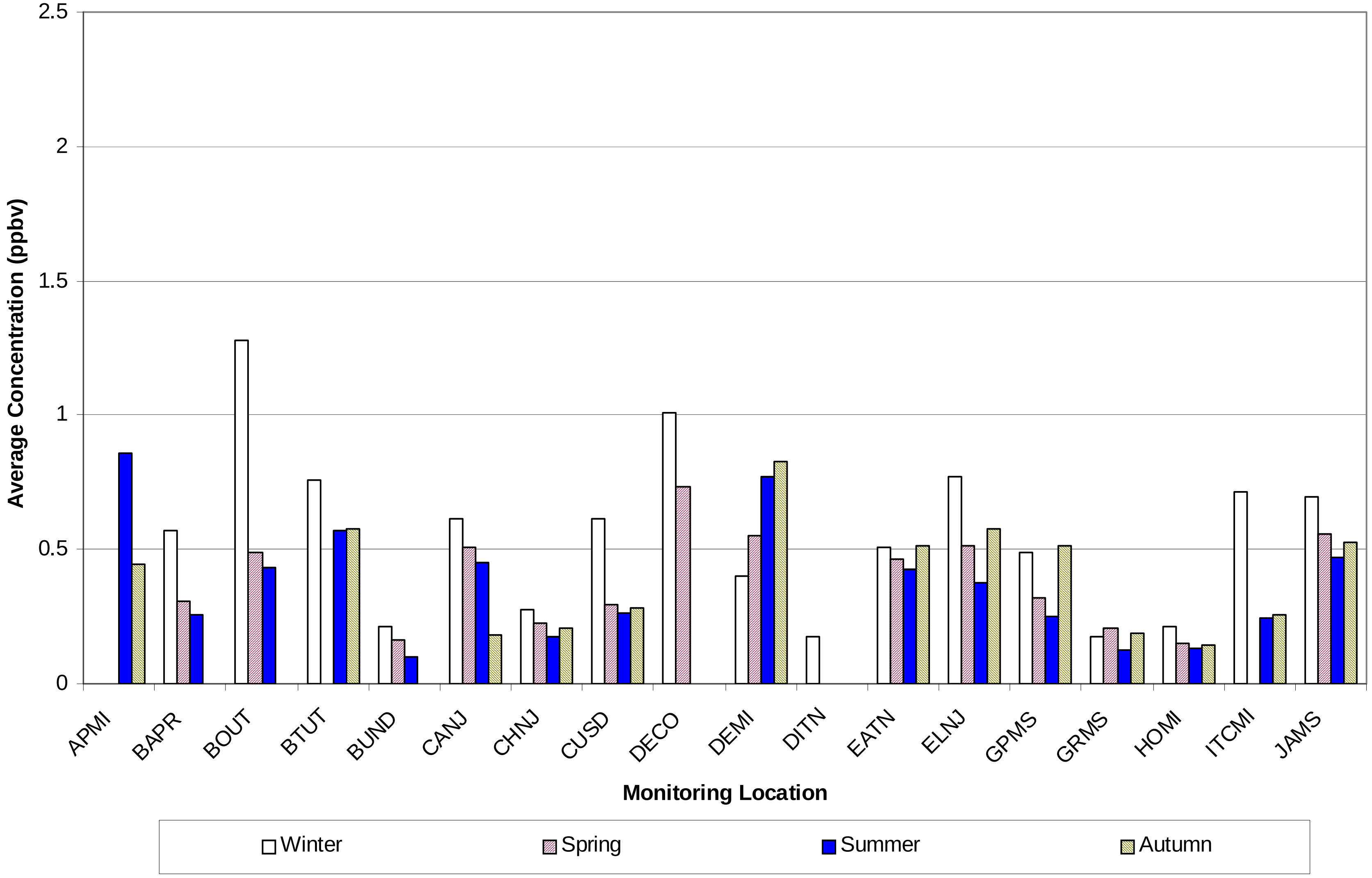


Figure 3-17b. Average Benzene Concentration by Season (KITN-WECO)

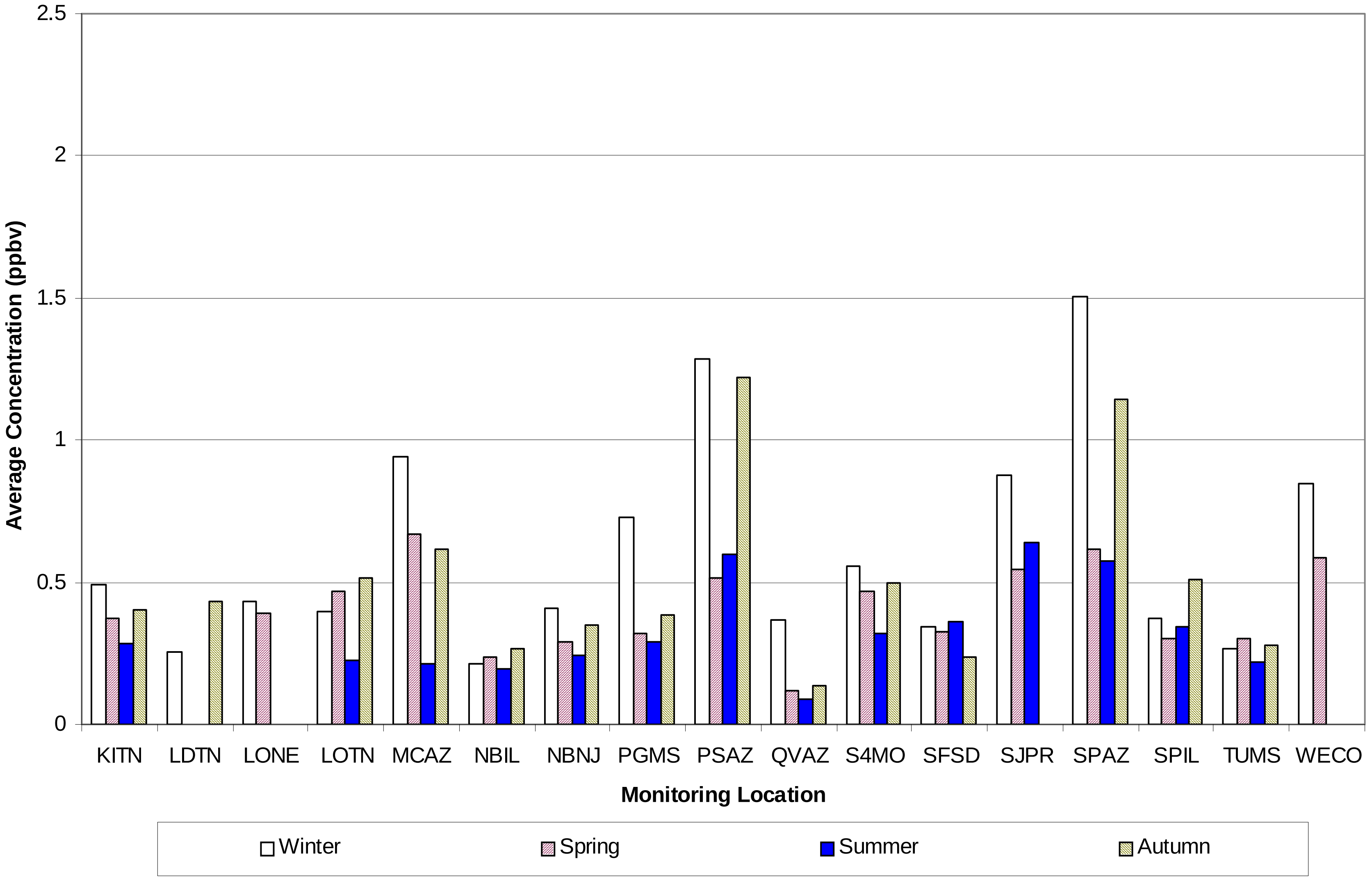


Figure 3-18. Average Bromomethane Concentration by Season (APMI-TUMS)

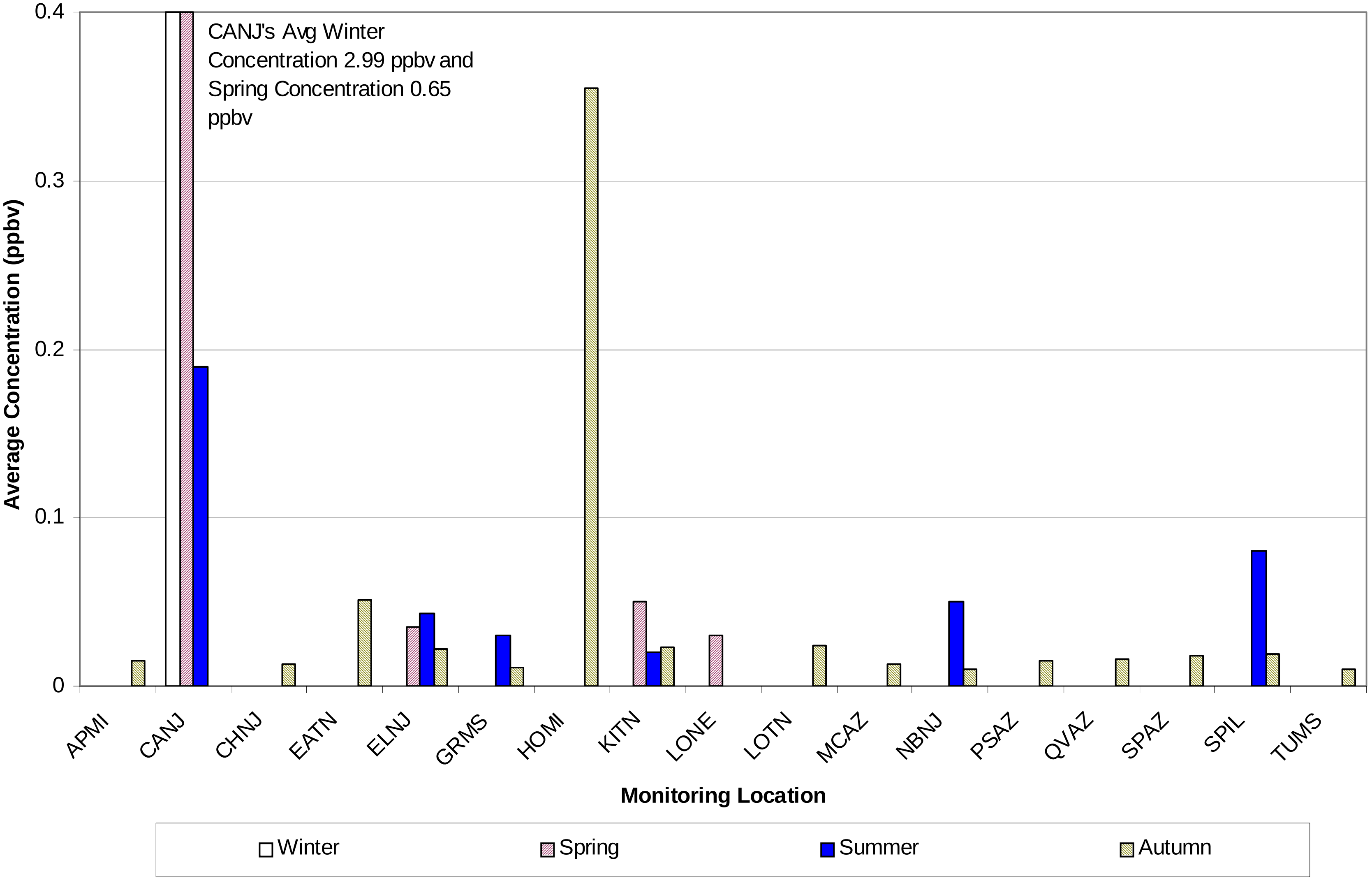


Figure 3-19a. Average Carbon Tetrachloride Concentration by Season (APMI-KITN)

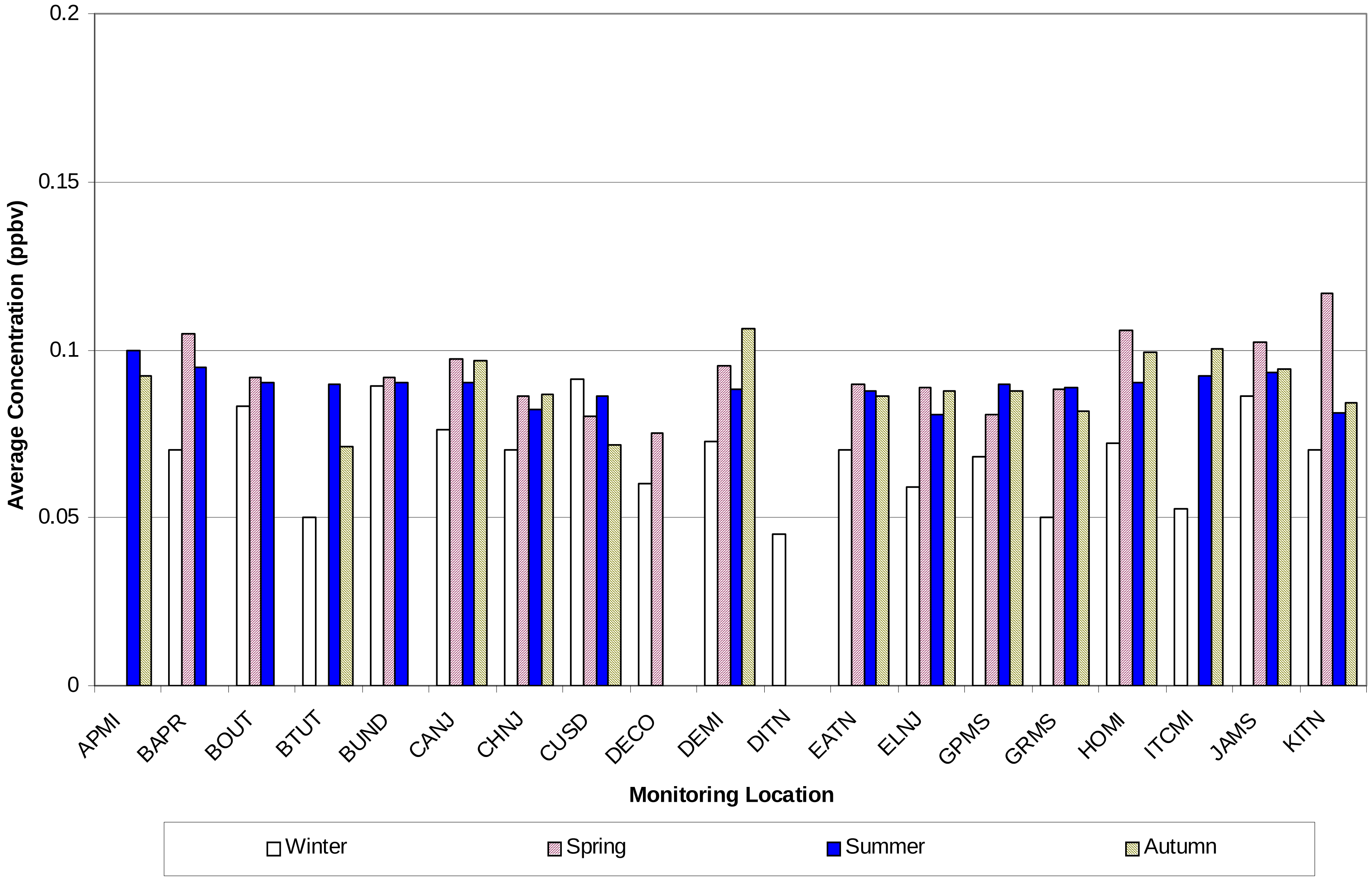


Figure 3-19b. Average Carbon Tetrachloride Concentration by Season (LDTN-WECO)

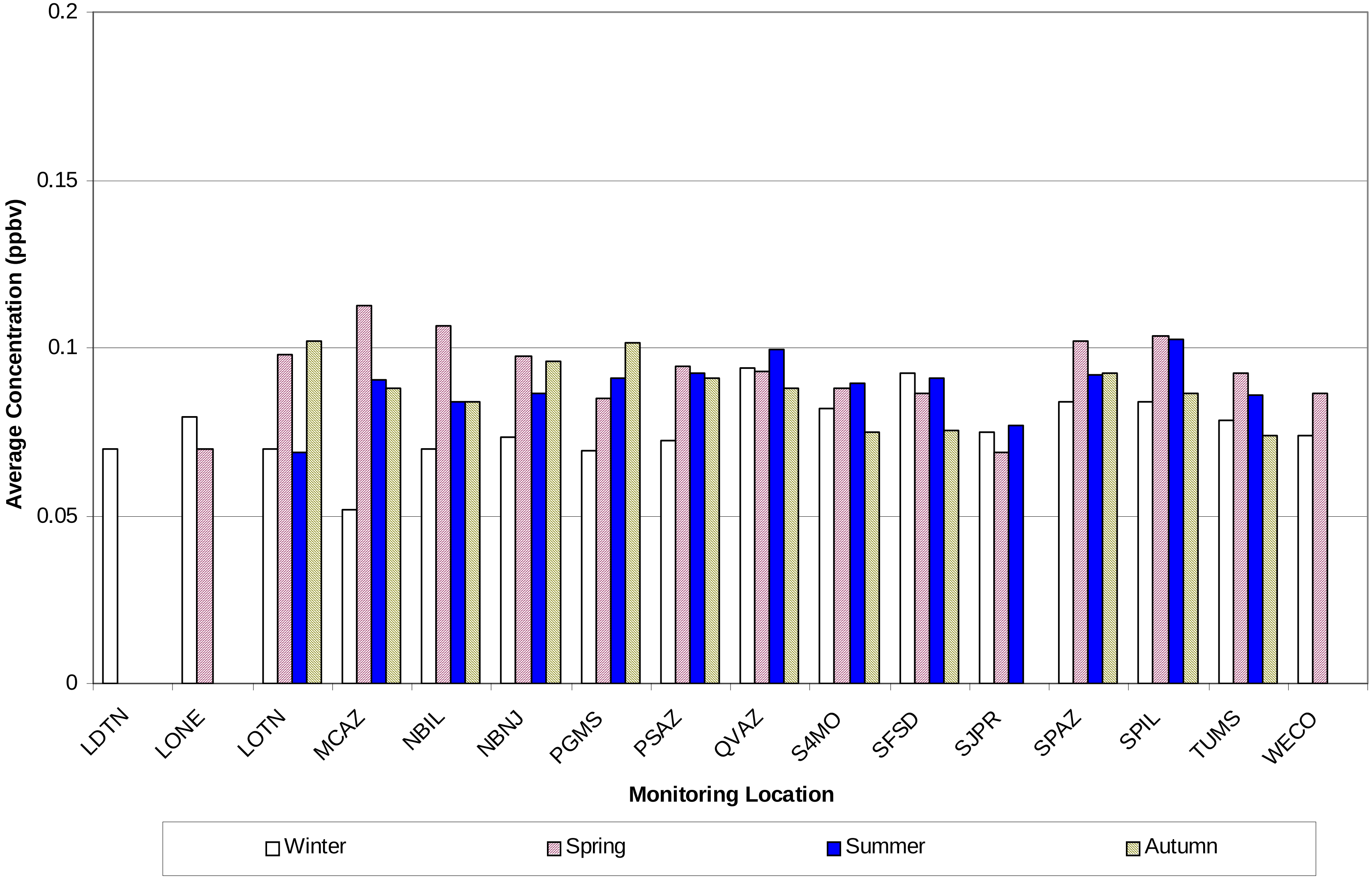


Figure 3-20a. Average Formaldehyde Concentration by Season (AZFL-GAFL)

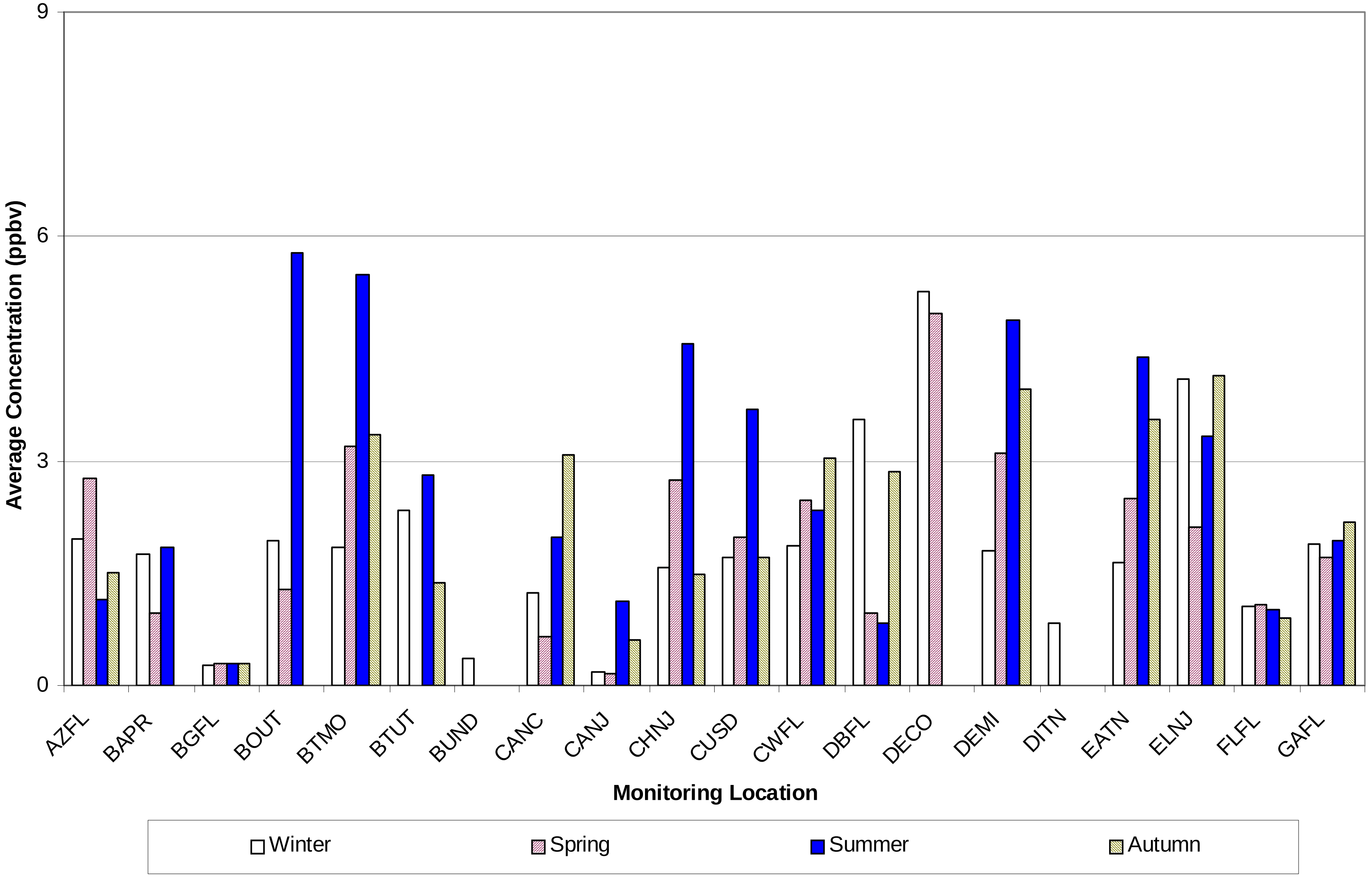


Figure 3-20b. Average Formaldehyde Concentration by Season (GPMS-WECO)

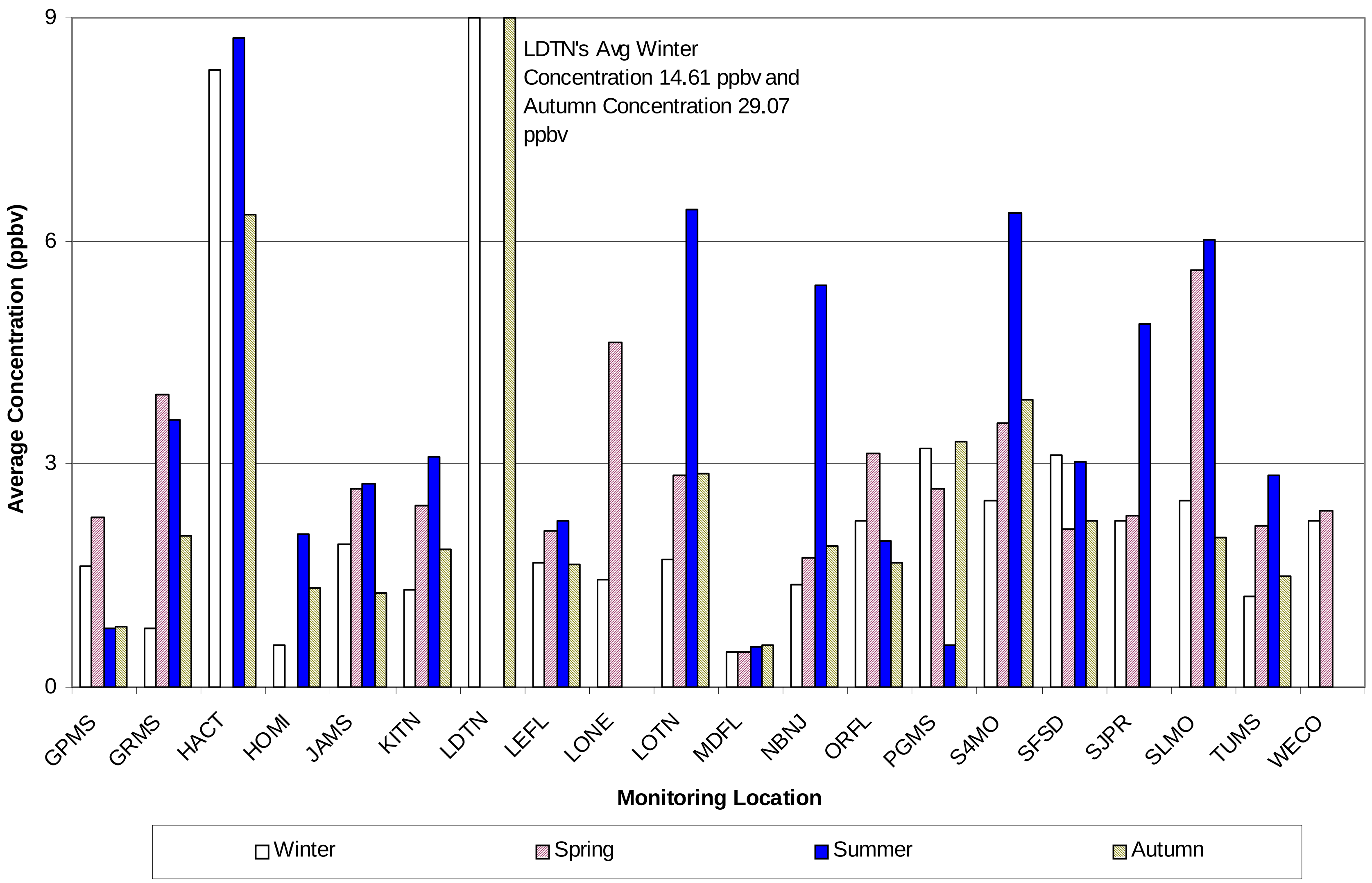


Figure 3-21a. Average *p*- Dichlorobenzene Concentration by Season (APMI-KITN)

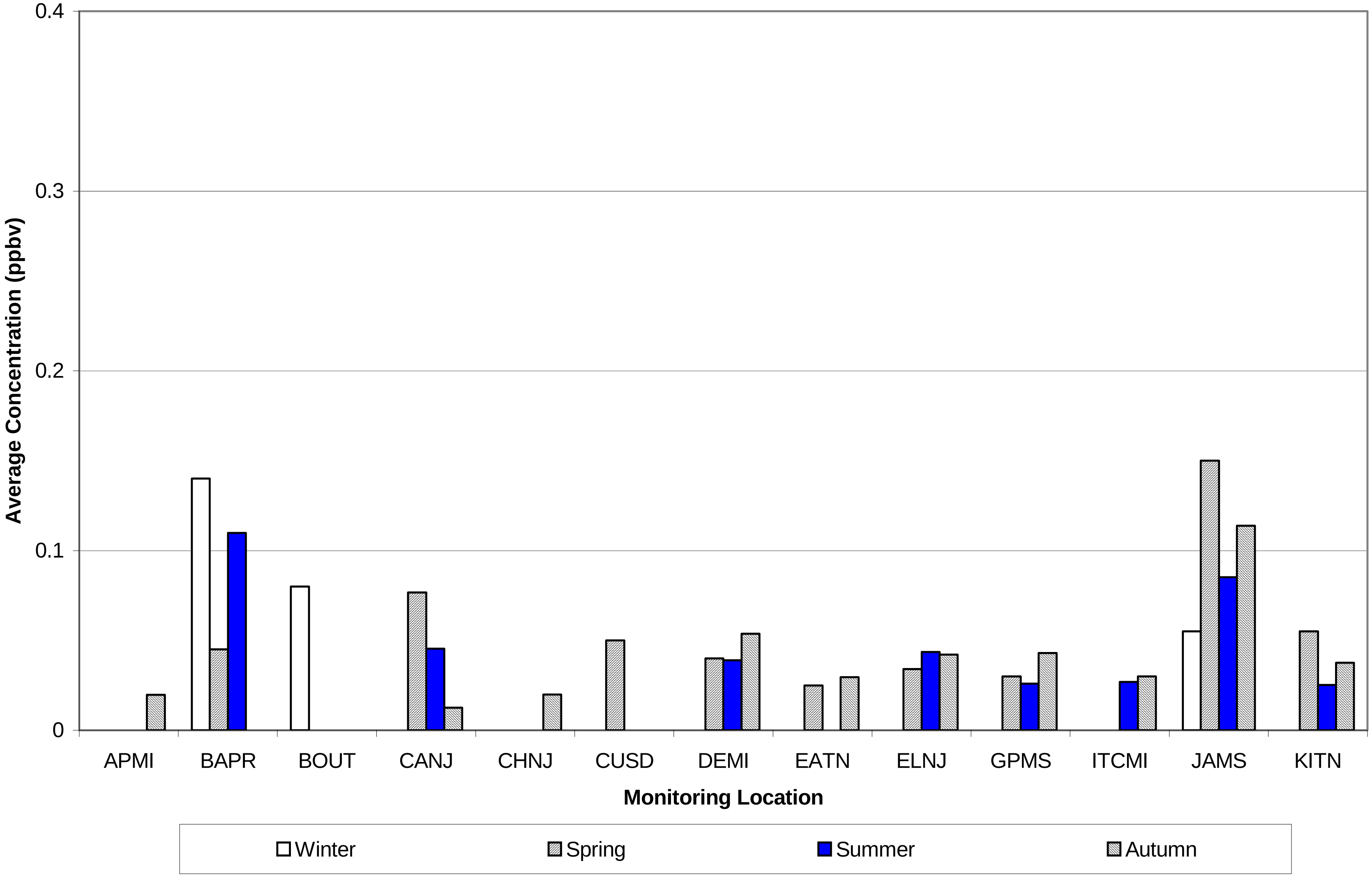


Figure 3-21b. Average *p*- Dichlorobenzene Concentration by Season (LOTN-WECO)

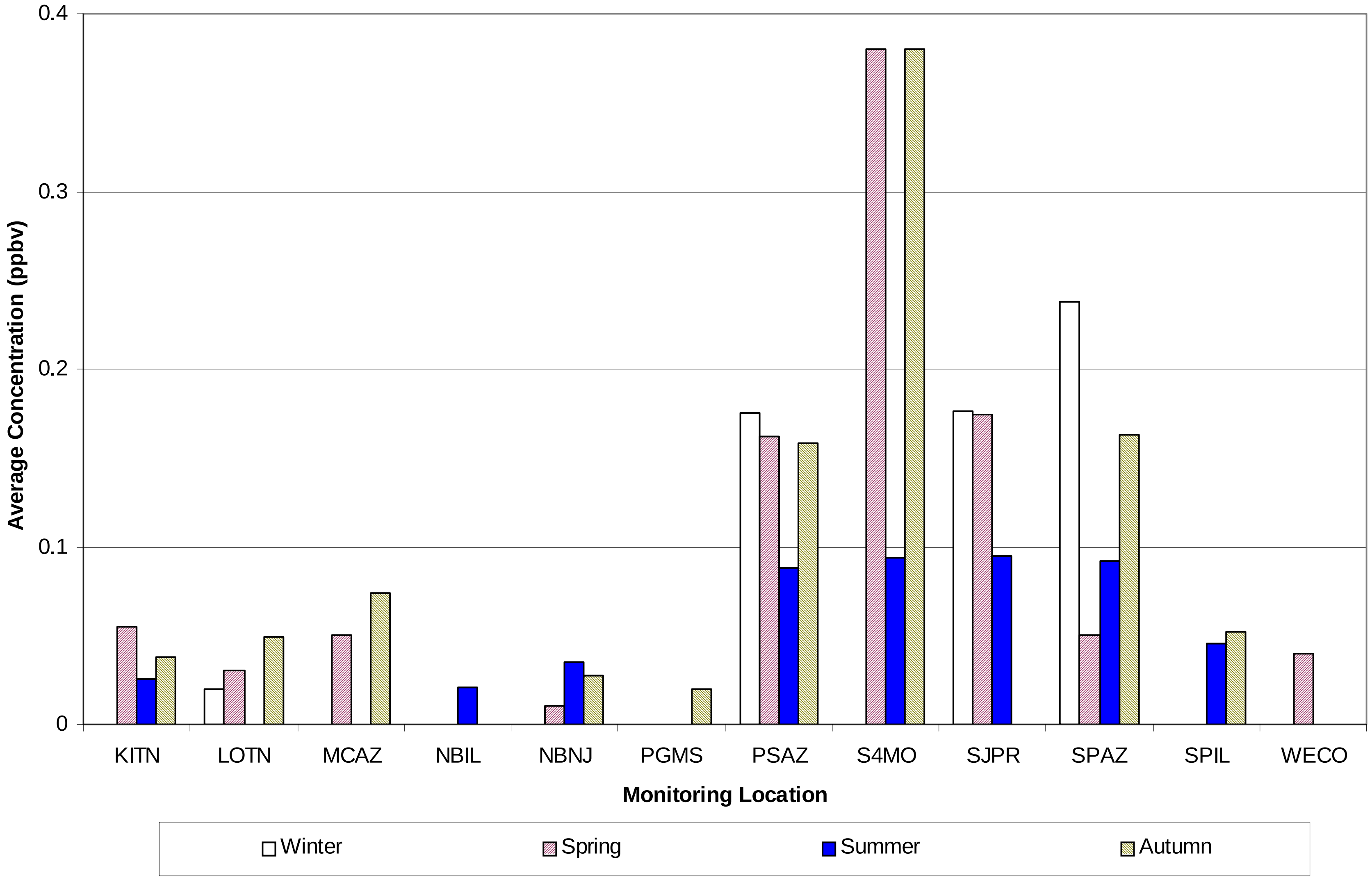


Figure 3-22a. Average Tetrachloroethylene Concentration by Season (APMI-JAMS)

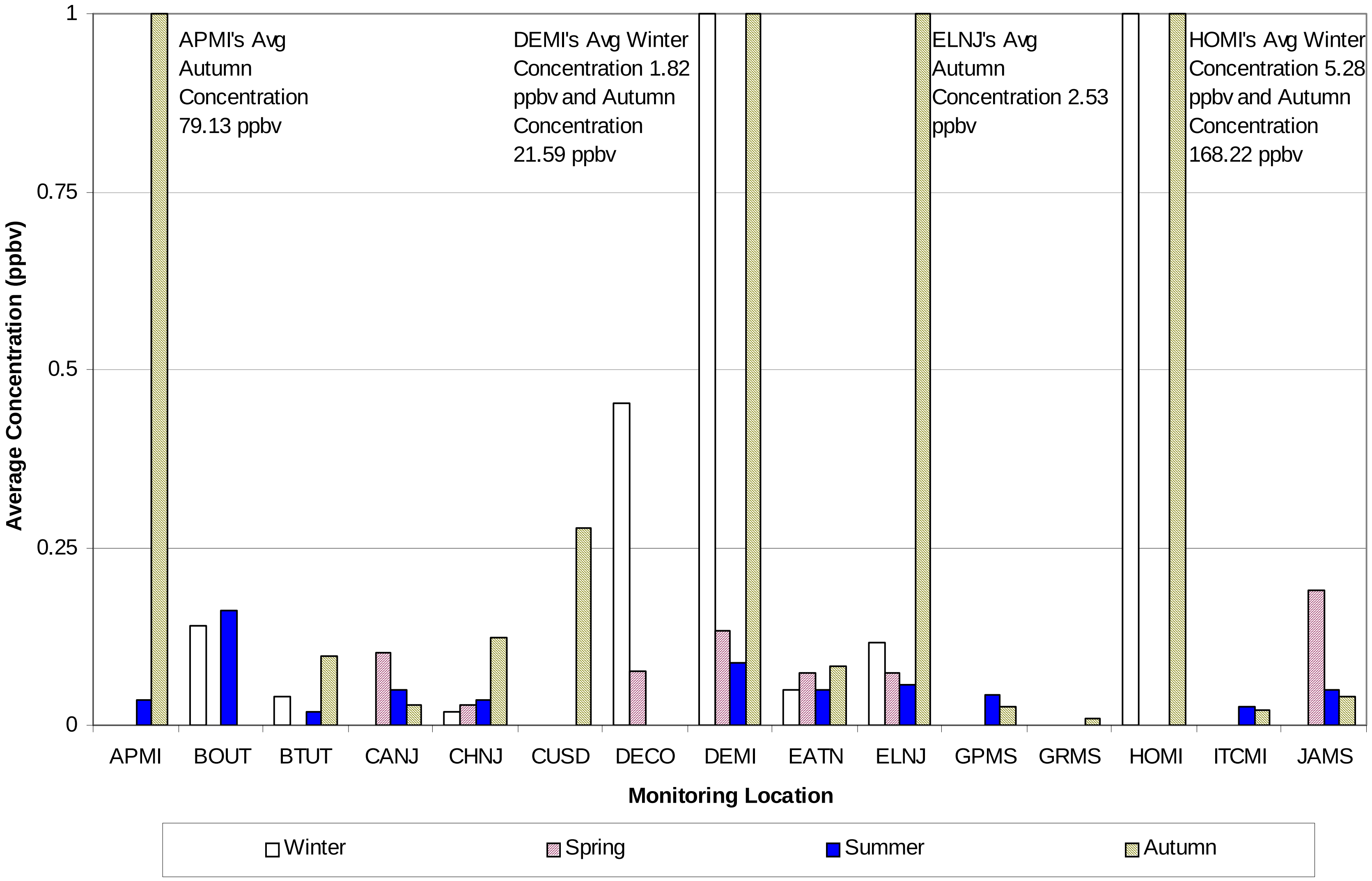


Figure 3-22b. Average Tetrachloroethylene Concentration by Season (KITN-WECO)

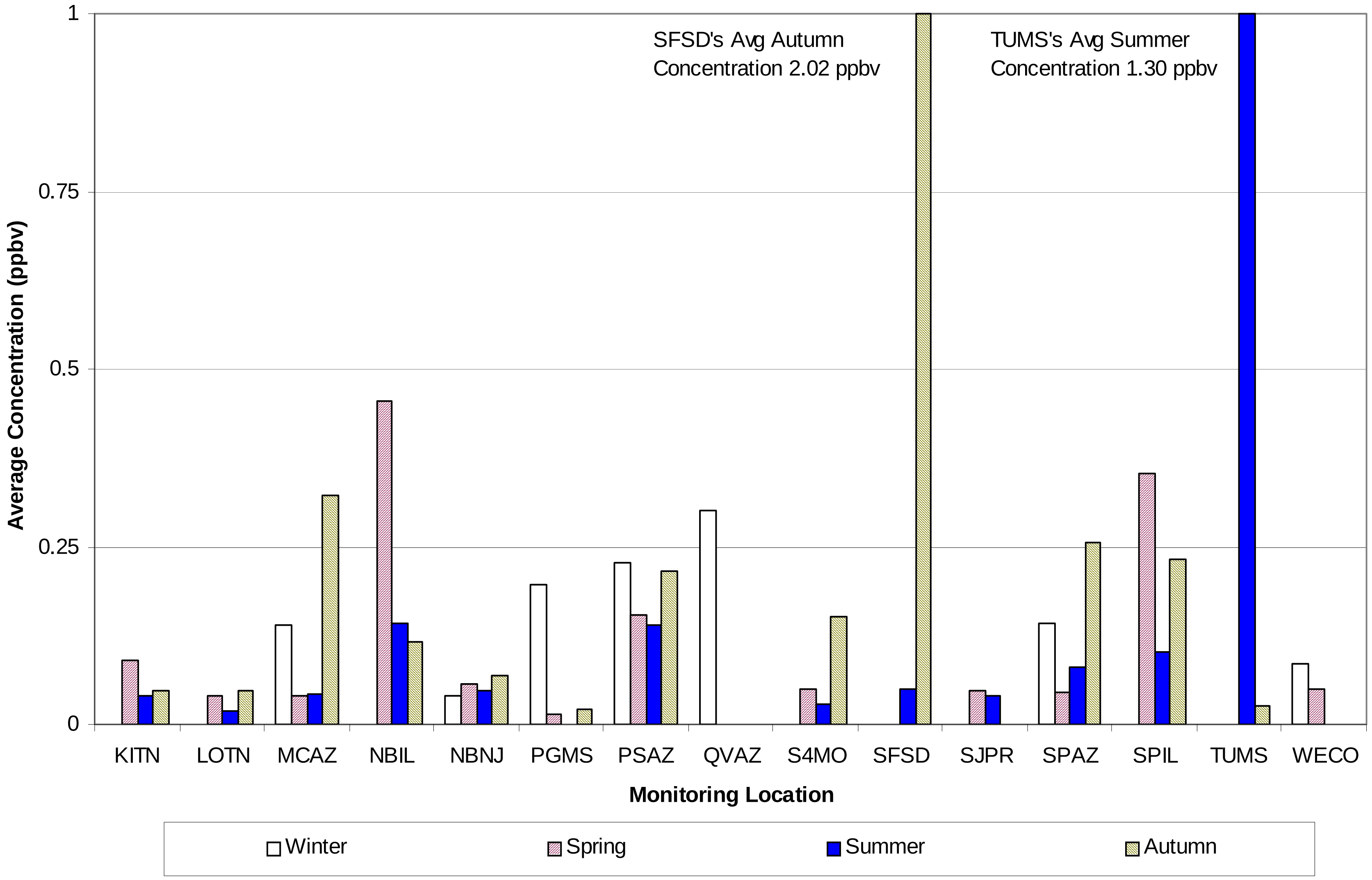


Figure 3-23a. Average Xylenes(*o-*,*m-*,*p-*) Concentration by Season (APMI-ITCMI)

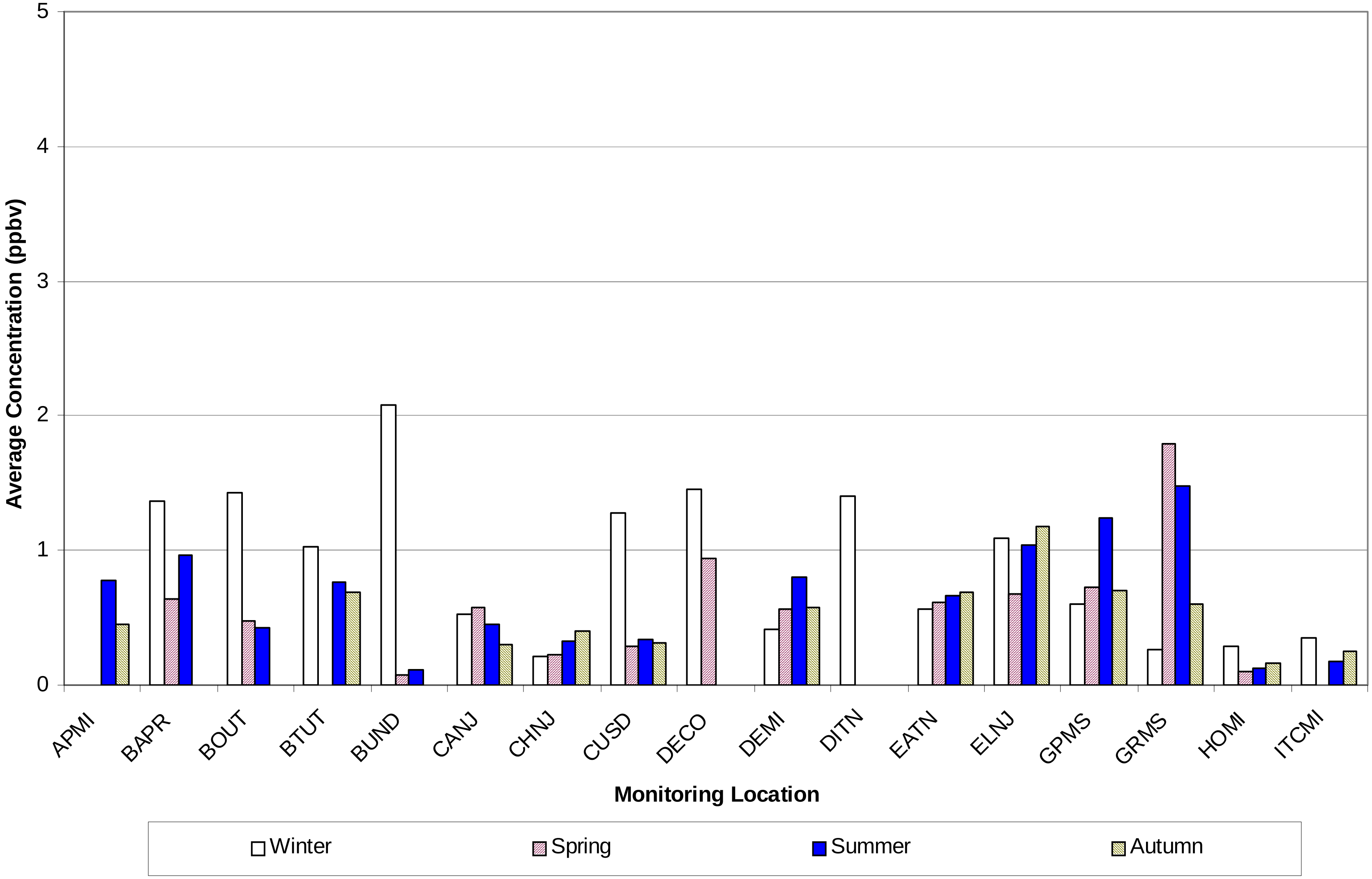


Figure 3-23b. Average Xylenes (*o*-,*m*-,*p*-) Concentration by Season (JAMS-WECO)

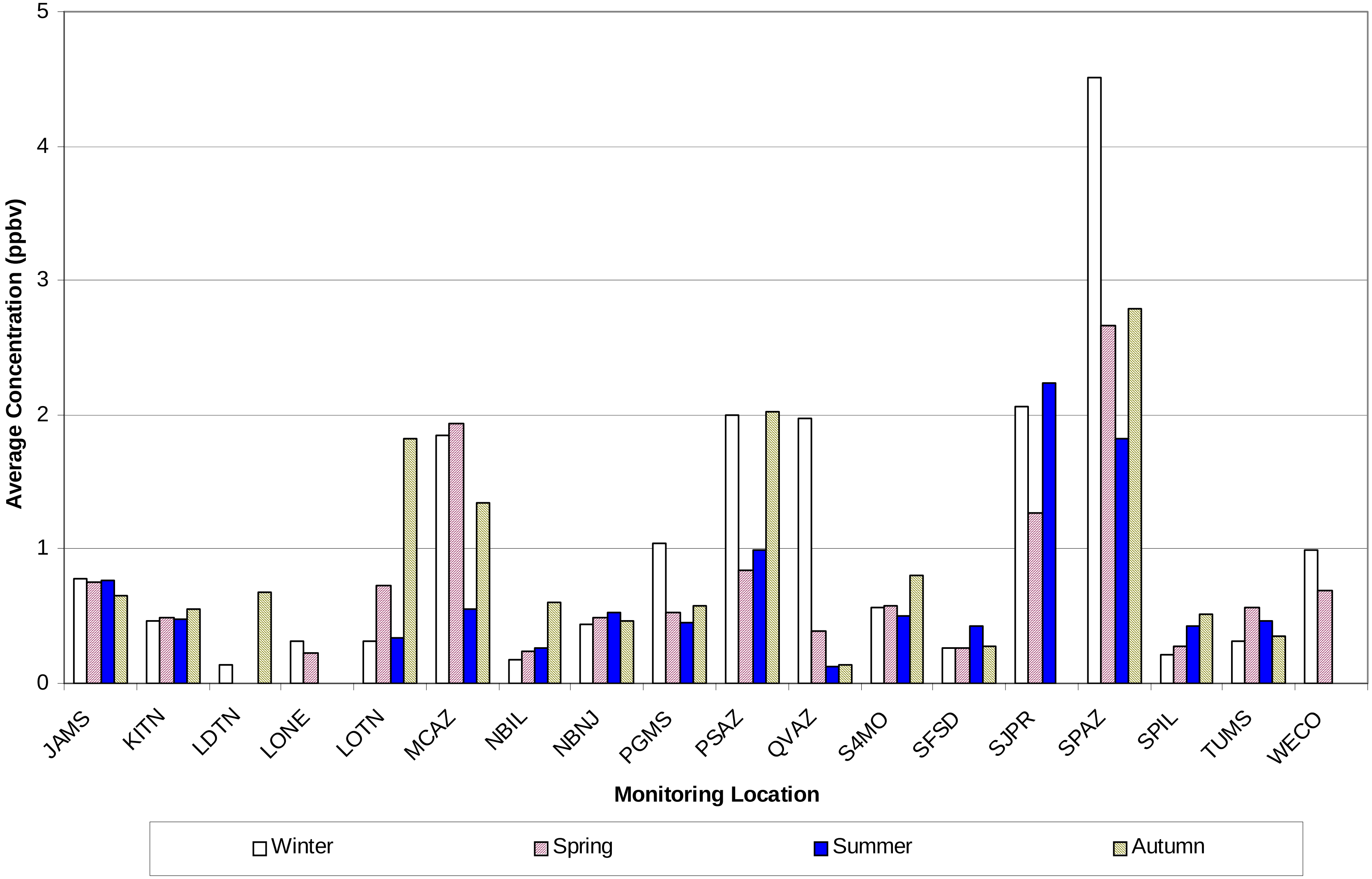


Figure 3-24. Average Sum of Metal Concentrations

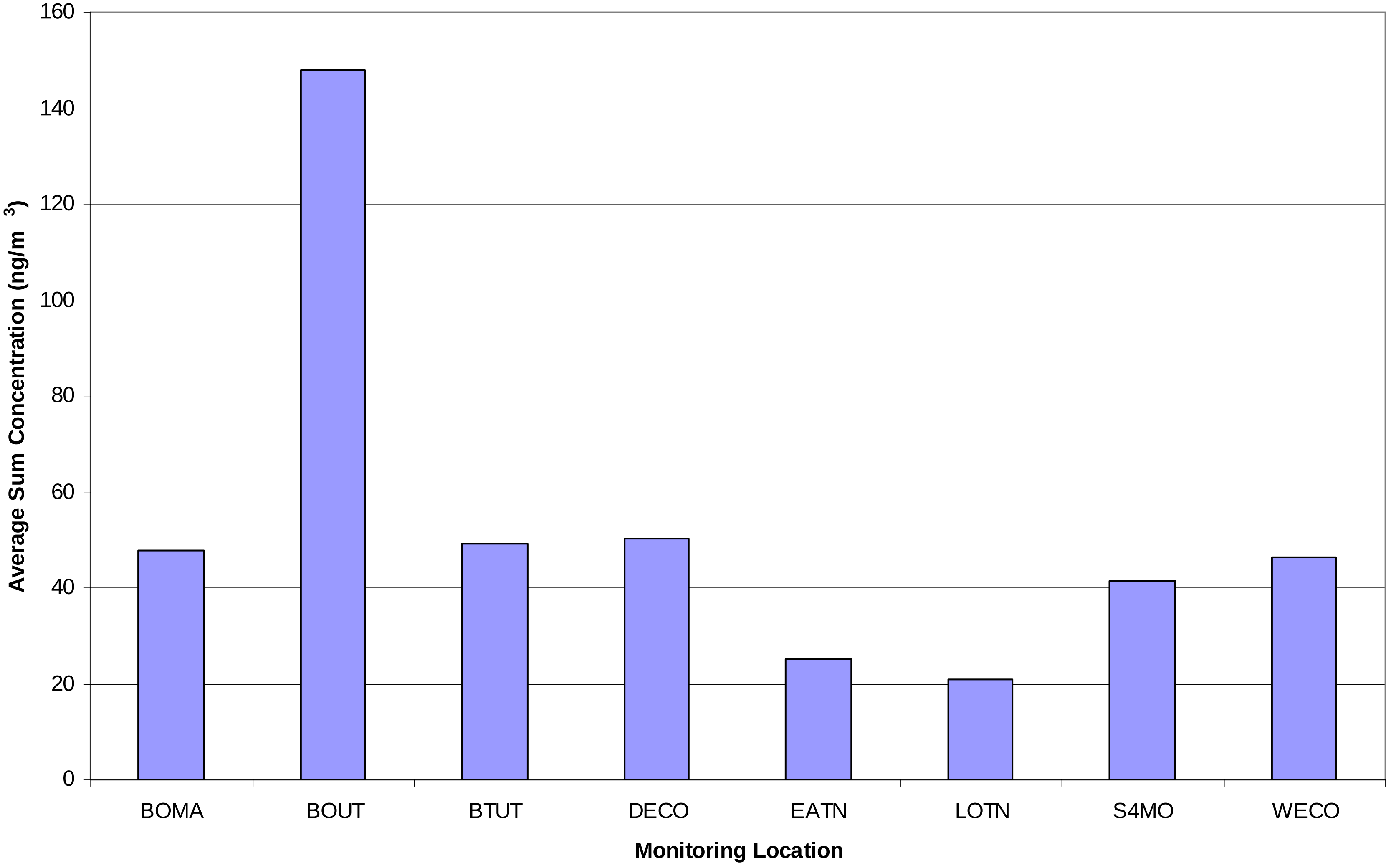


Figure 3-25a. Comparison of Yearly Averages for the APMI Monitoring Station

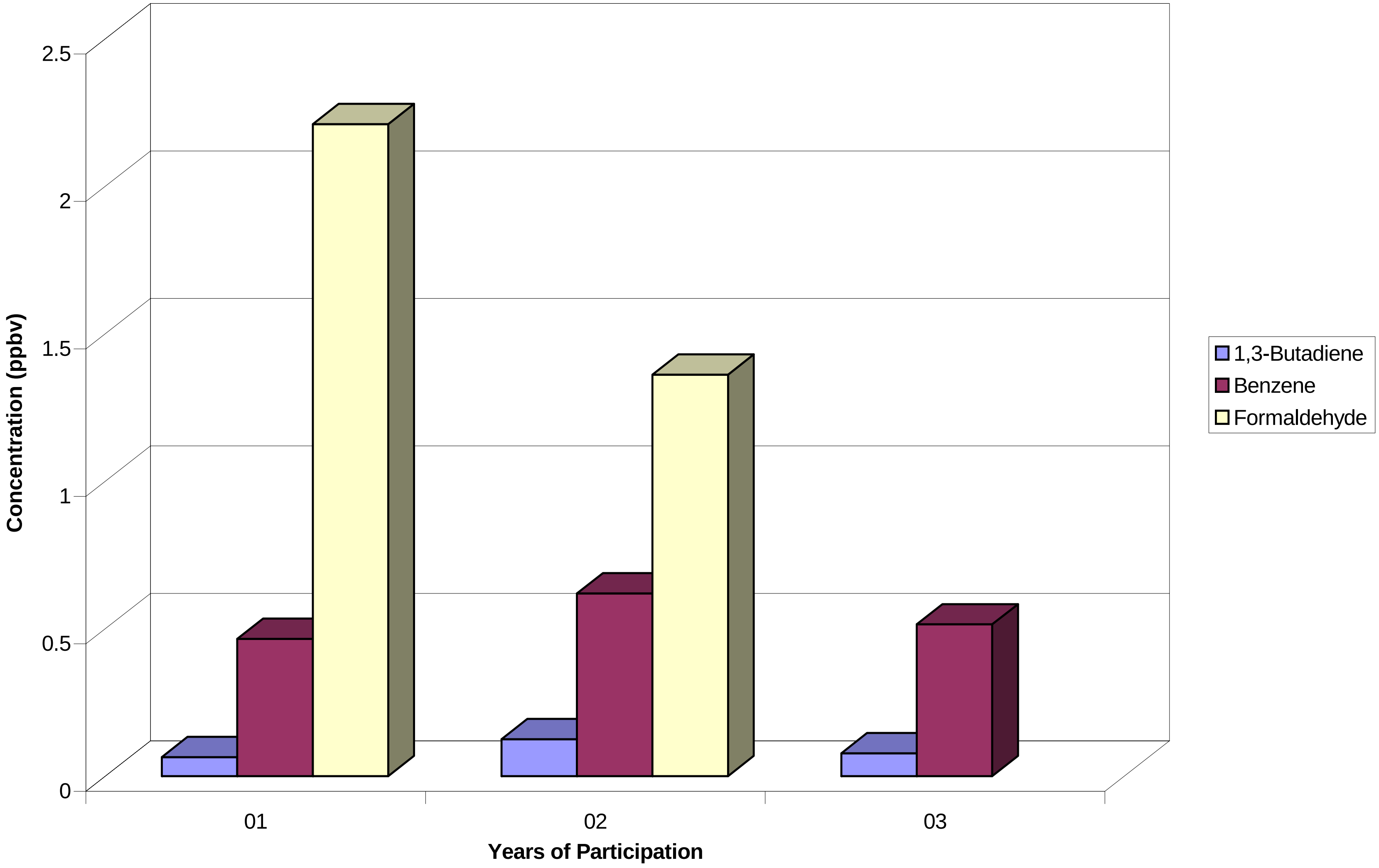


Figure 3-25b. Comparison of Yearly Averages for the AZFL Monitoring Station

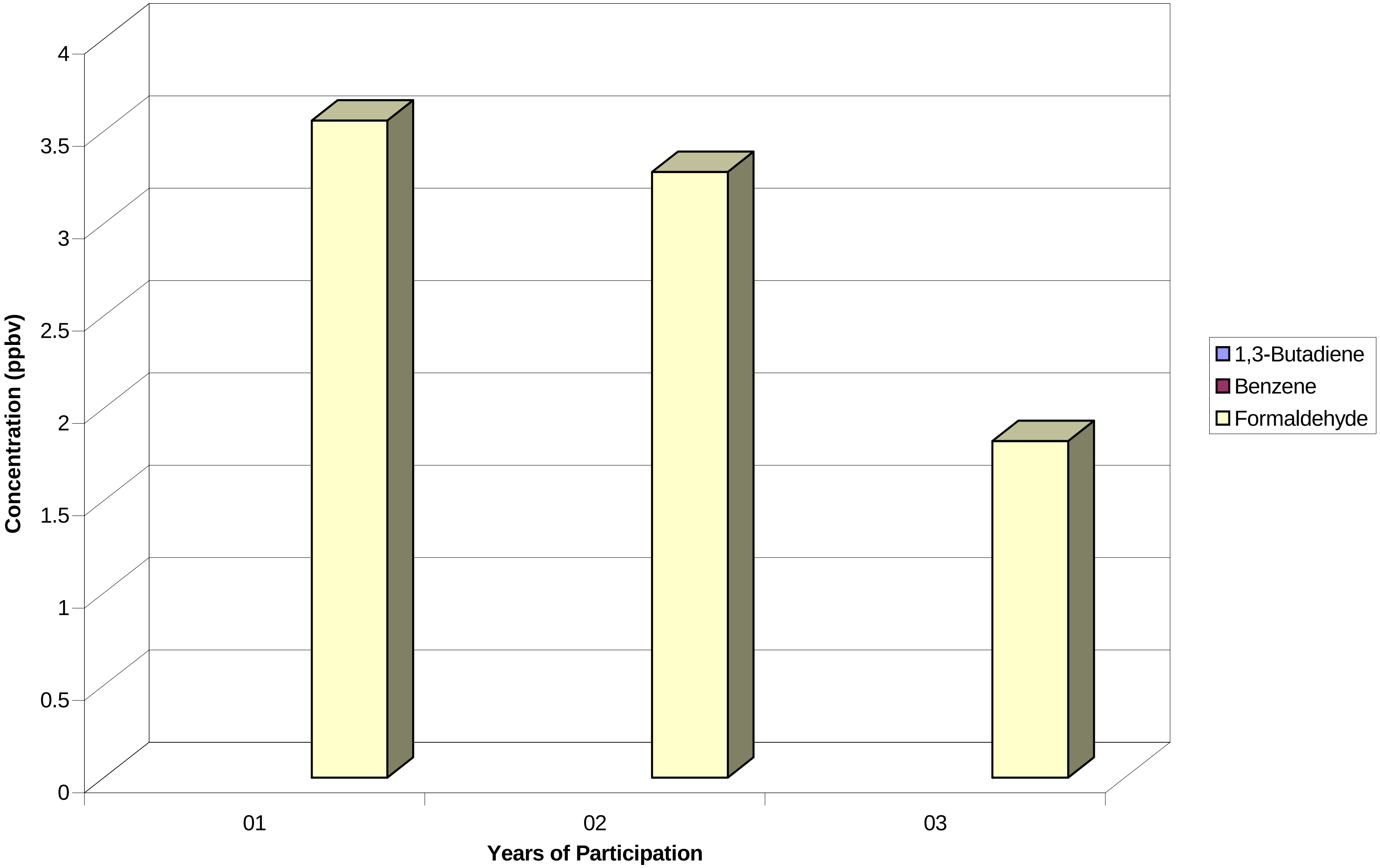


Figure 3-25c. Comparison of Yearly Averages for the BAPR Monitoring Station

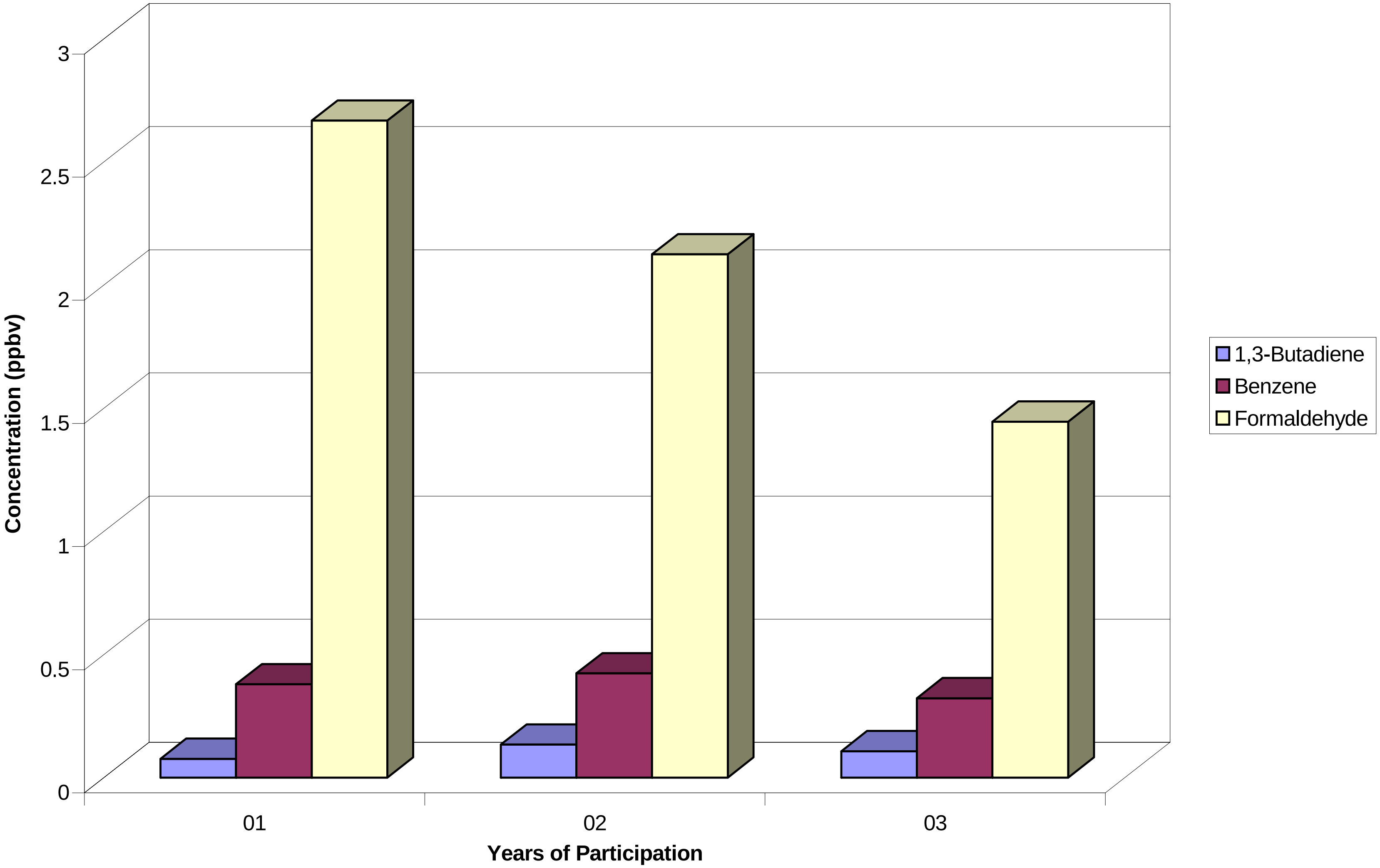


Figure 3-25d. Comparison of Yearly Averages for the BUND Monitoring Station

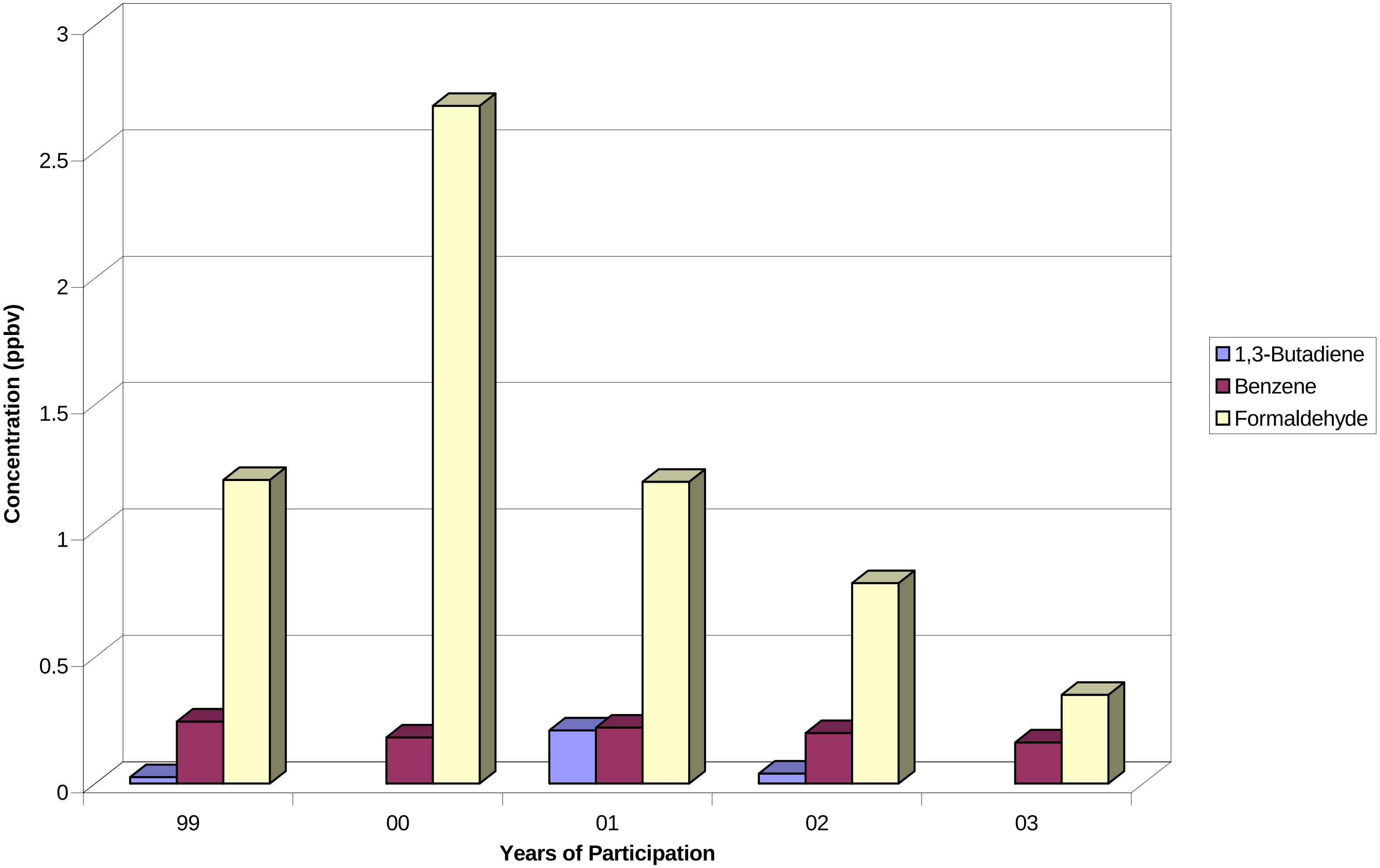


Figure 3-25e. Comparison of Yearly Averages for the CANJ Monitoring Station

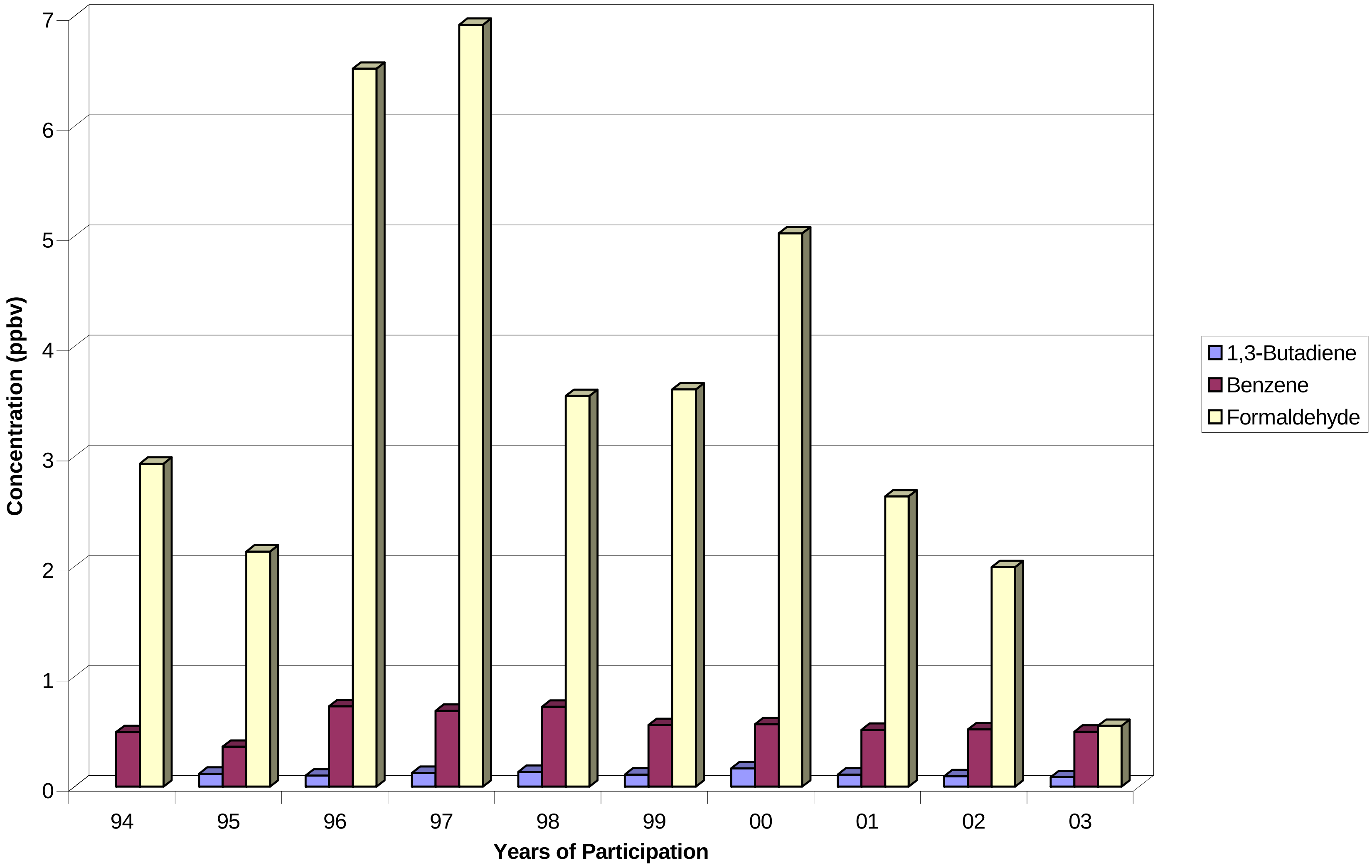


Figure 3-25f. Comparison of Yearly Averages for the CHNJ Monitoring Station

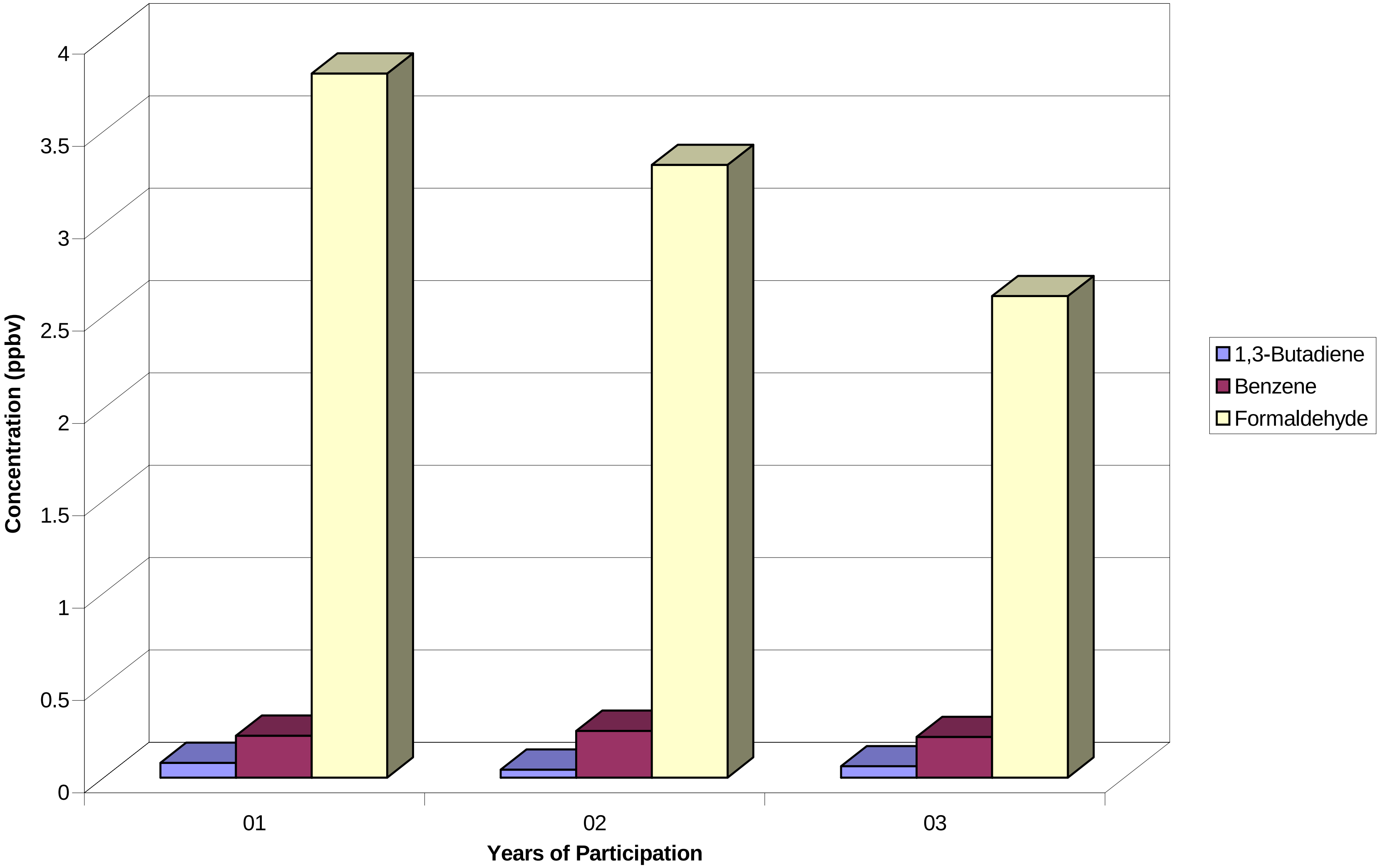


Figure 3-25g. Comparison of Yearly Averages for the DECO Monitoring Station

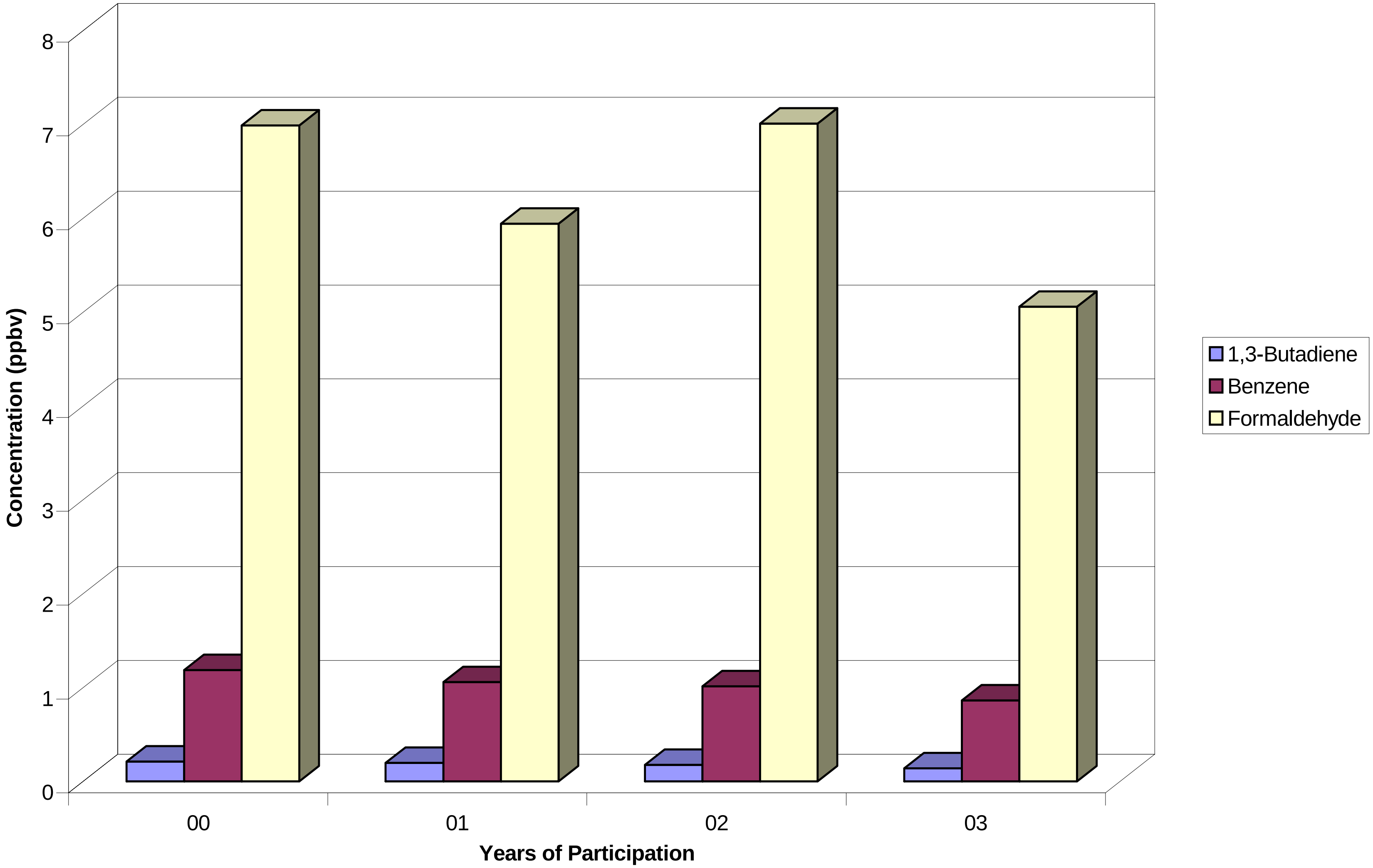


Figure 3-25h. Comparison of Yearly Averages for the DEMI Monitoring Station

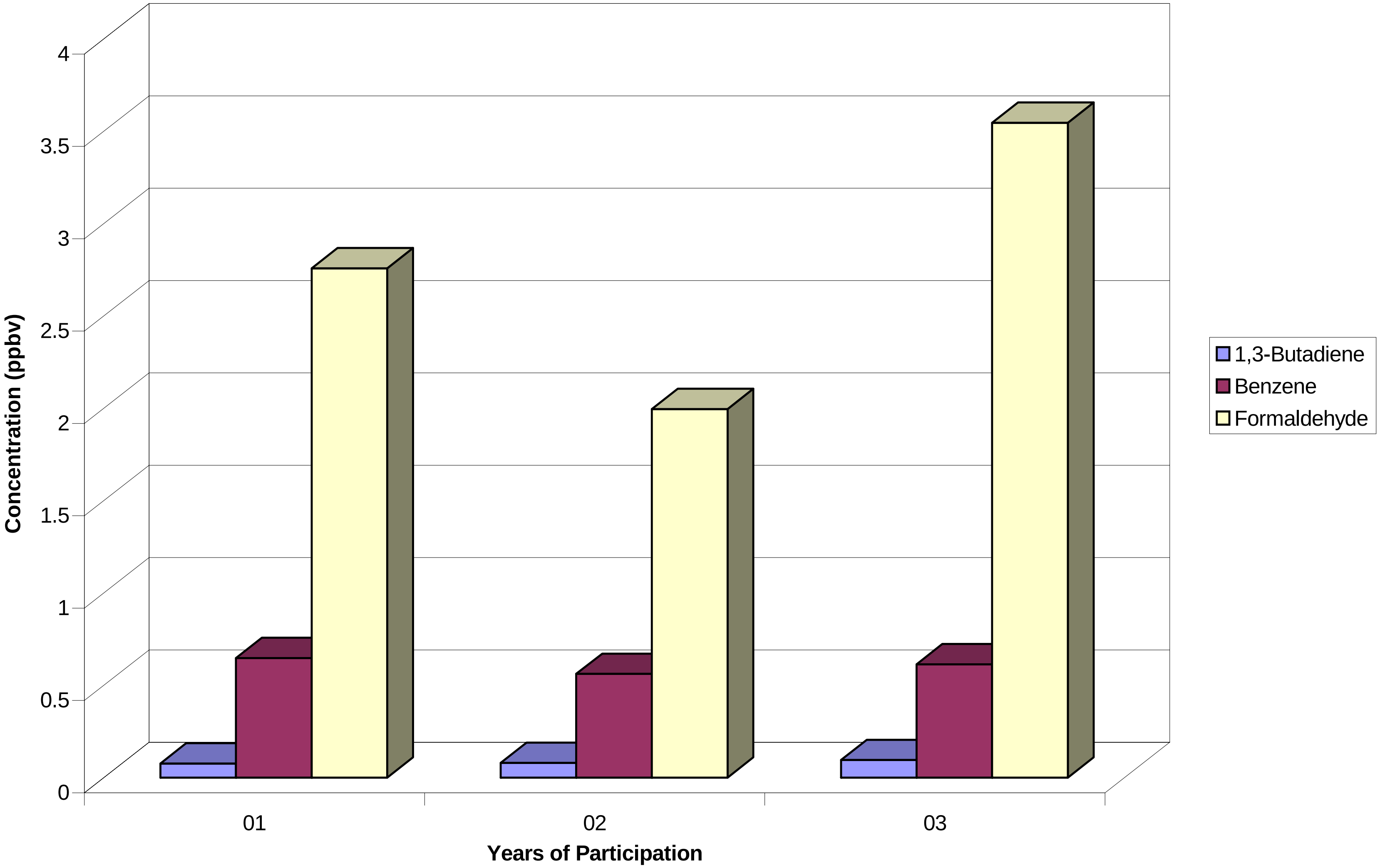


Figure 3-25i. Comparison of Yearly Averages for the ELNJ Monitoring Station

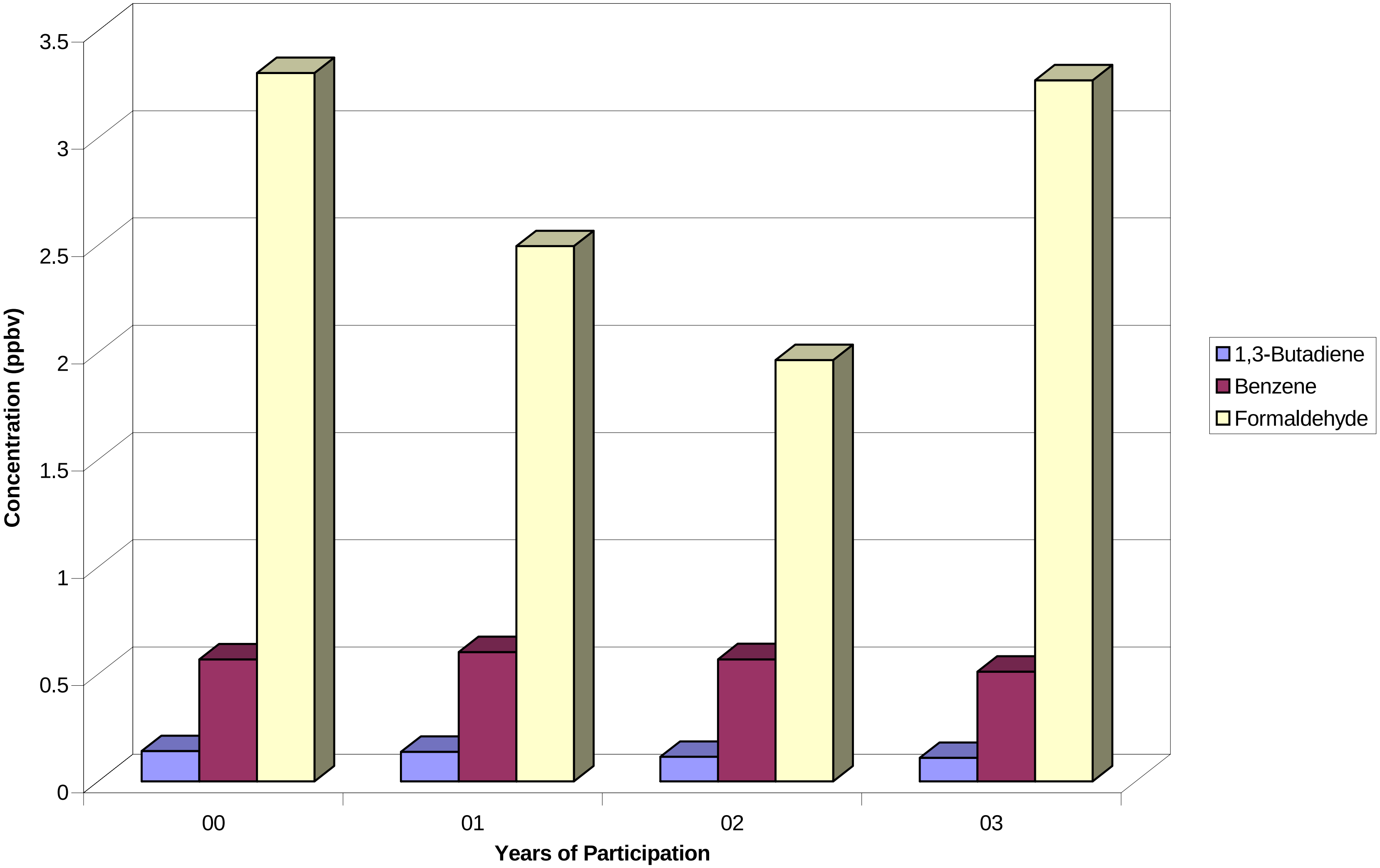


Figure 3-25j. Comparison of Yearly Averages for the GAFL Monitoring Station

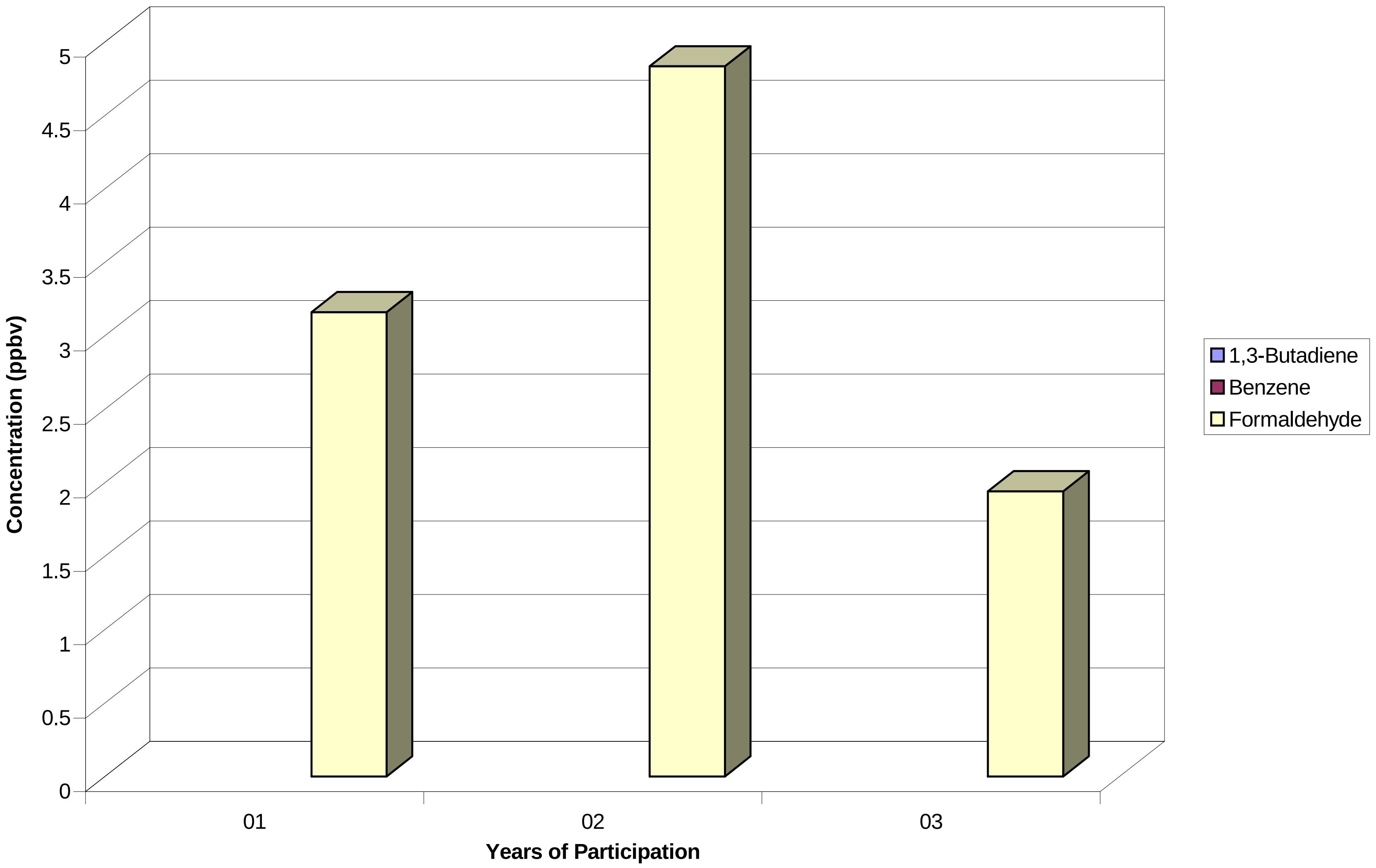


Figure 3-25k. Comparison of Yearly Averages for the GPMS Monitoring Station

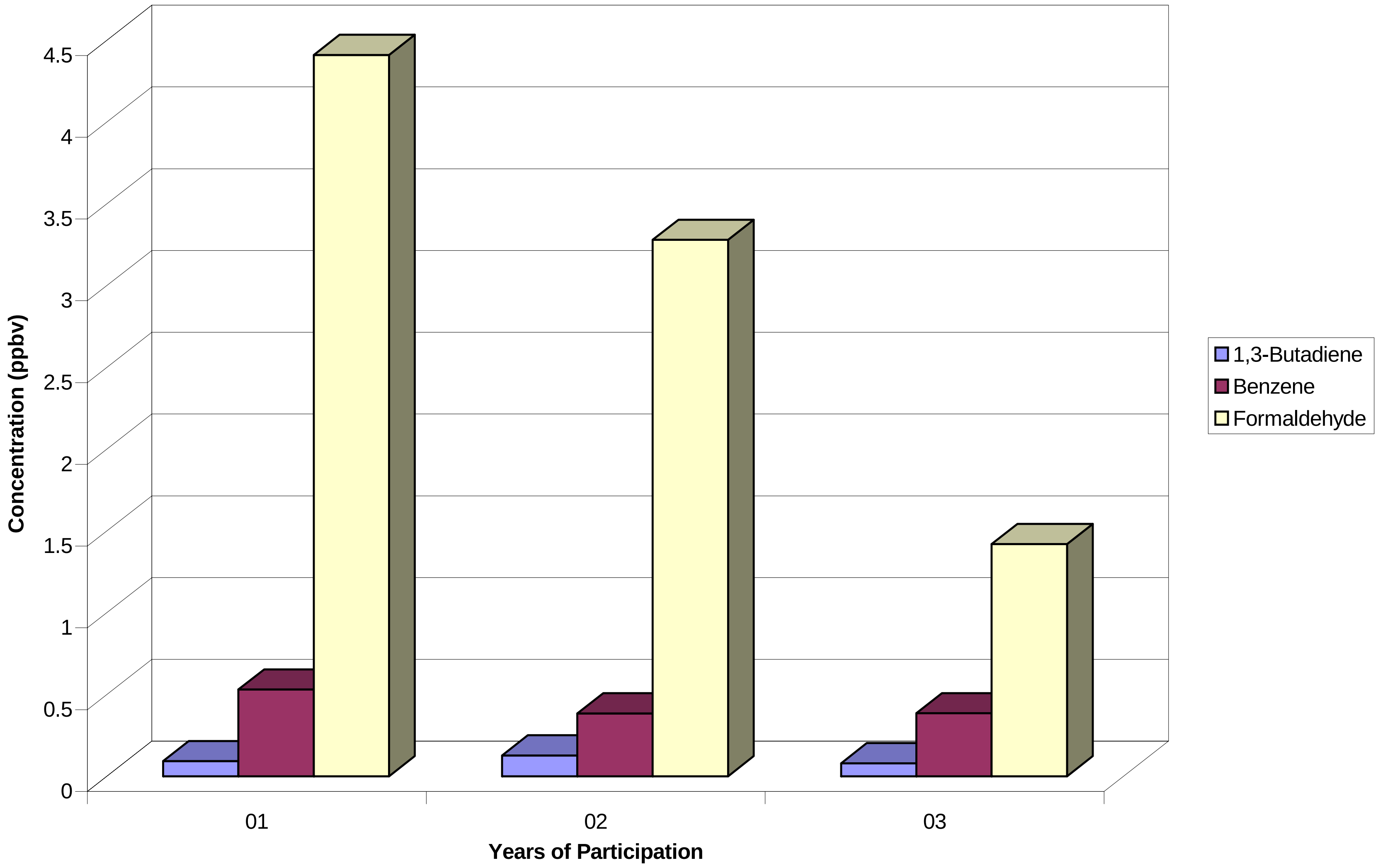


Figure 3-25l. Comparison of Yearly Averages for the JAMS Monitoring Station

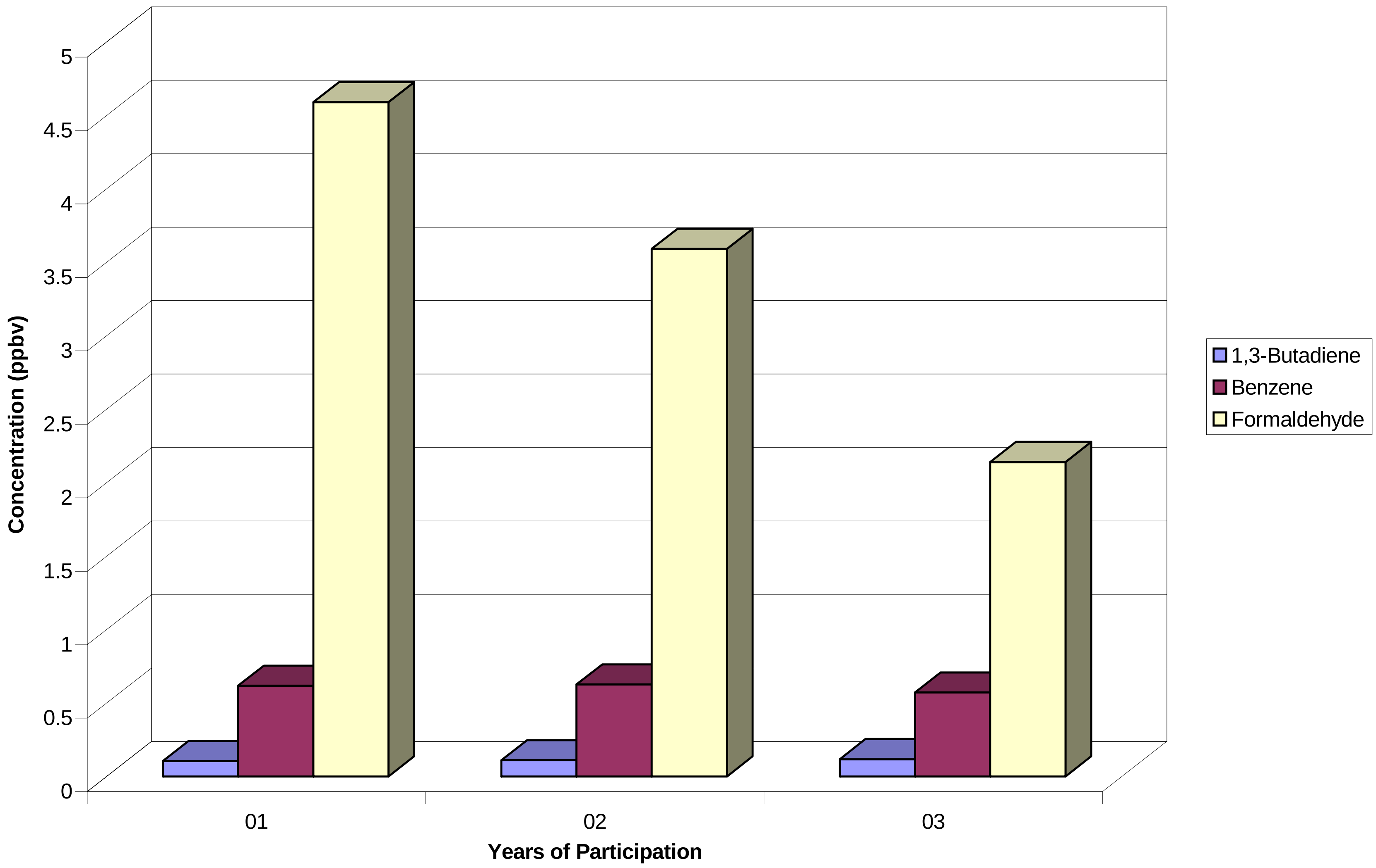


Figure 3-25m. Comparison of Yearly Averages for the LEFL Monitoring Station

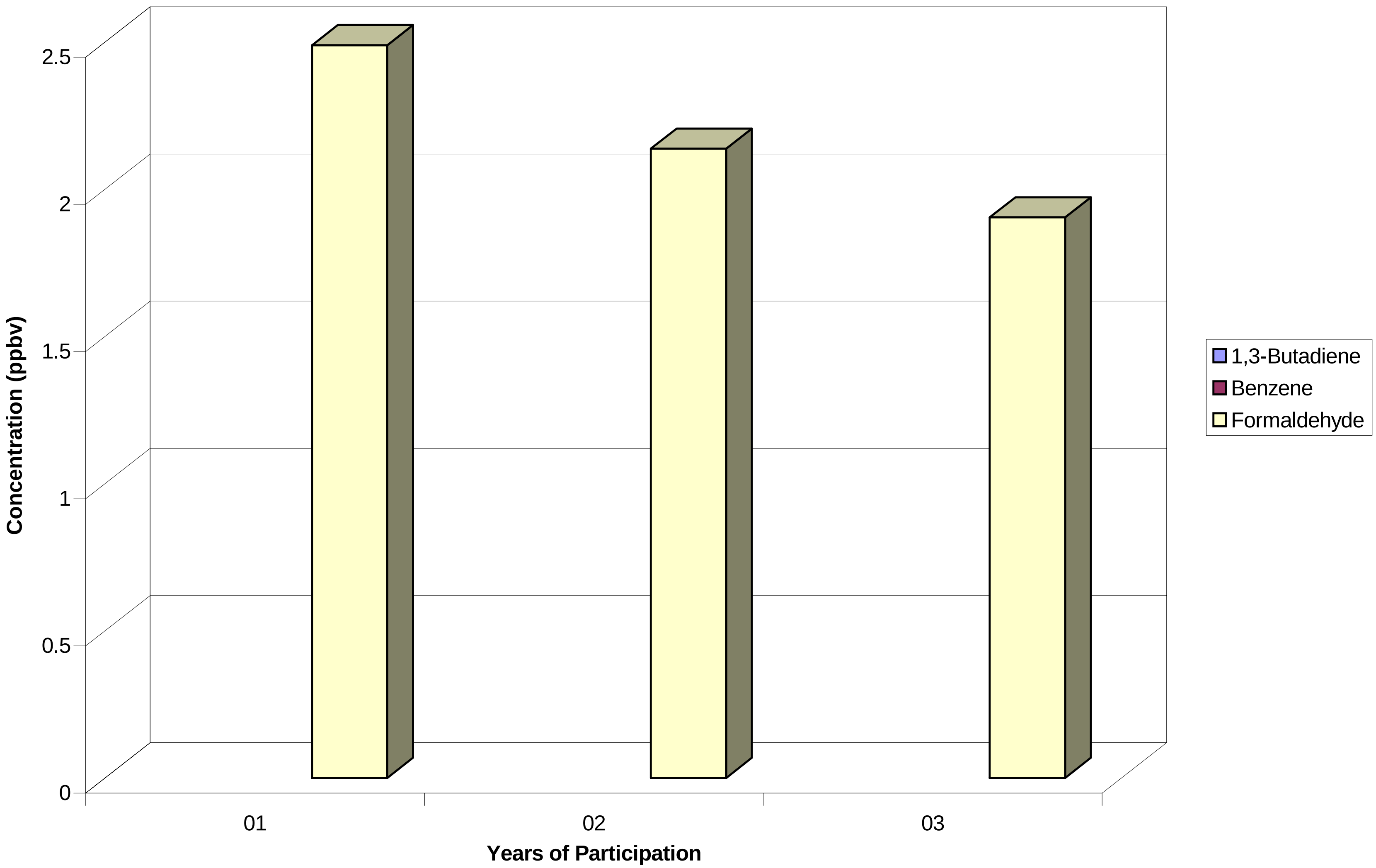


Figure 3-25n. Comparison of Yearly Averages for the NBNJ Monitoring Station

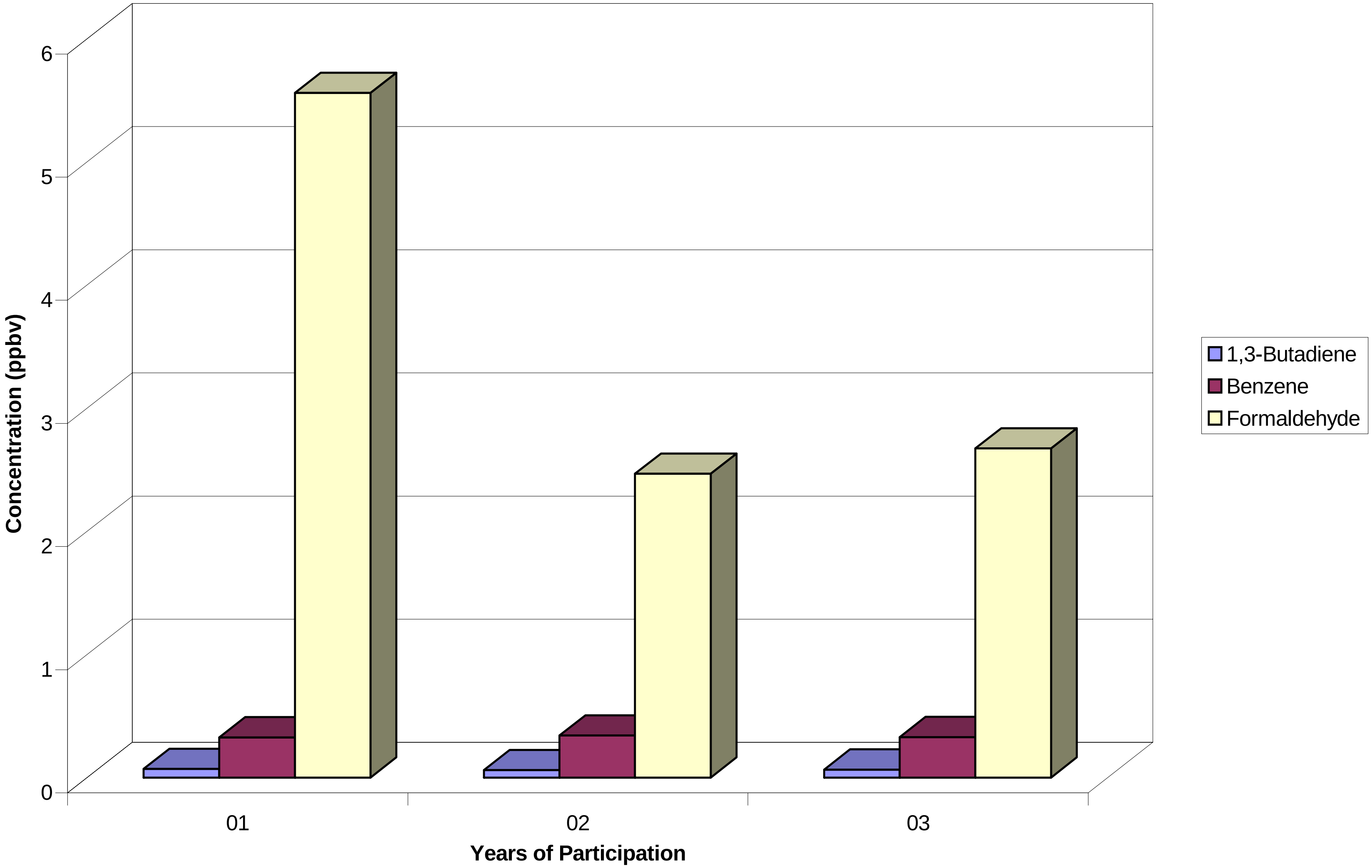


Figure 3-25o. Comparison of Yearly Averages for the PGMS Monitoring Station

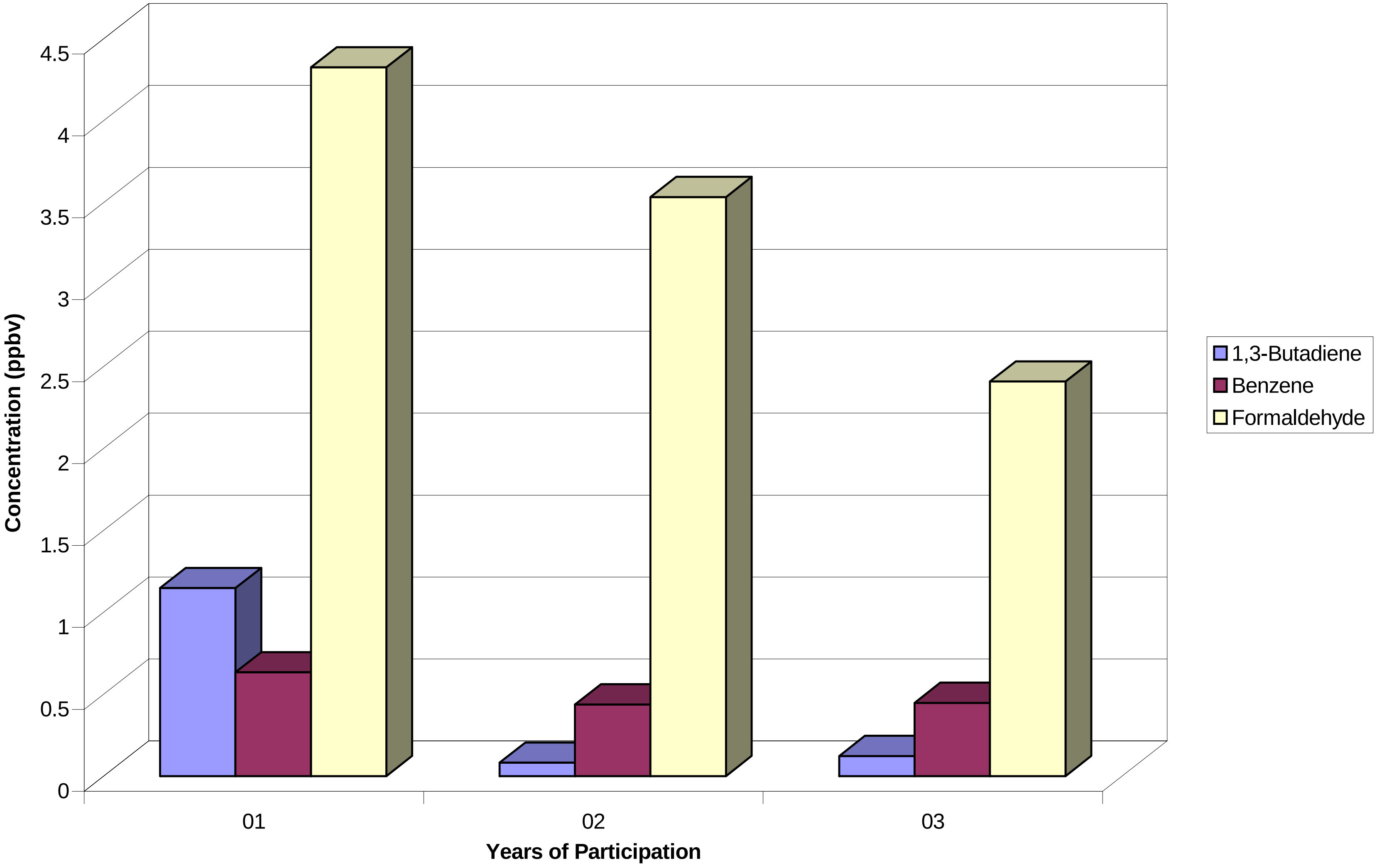


Figure 3-25p. Comparison of Yearly Averages for the PSAZ Monitoring Station

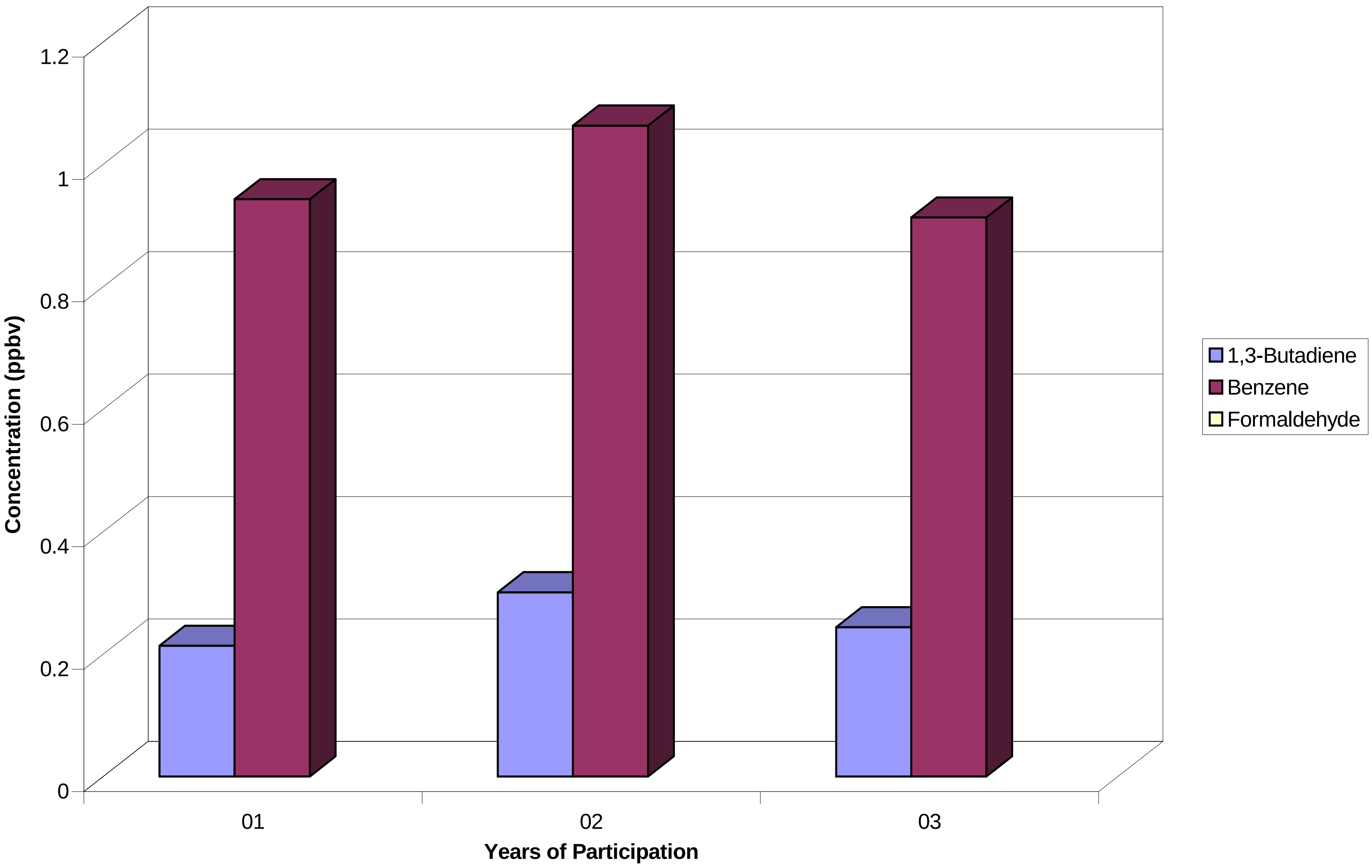


Figure 3-25q. Comparison of Yearly Averages for the QVAZ Monitoring Station

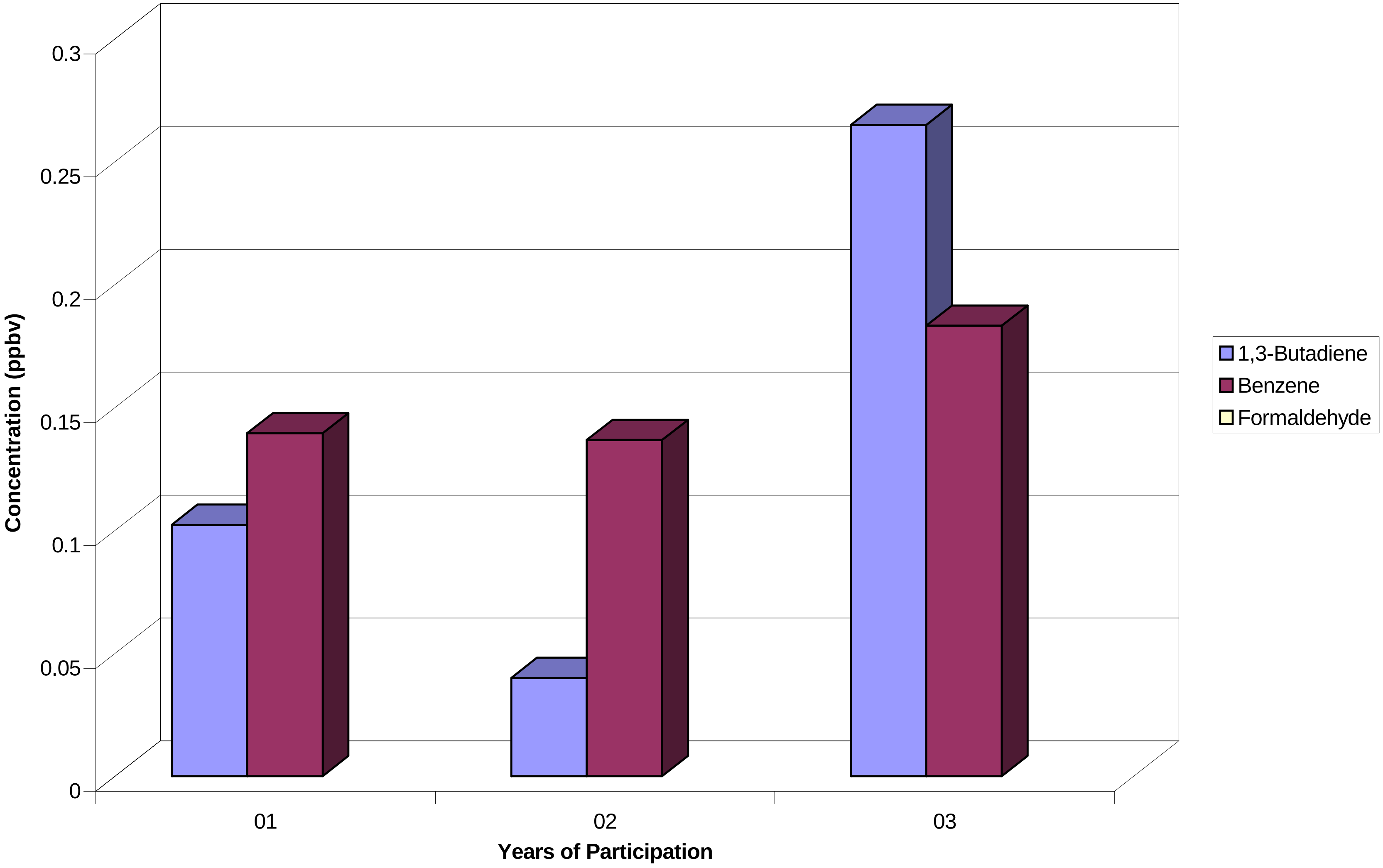


Figure 3-25r. Comparison of Yearly Averages for the SFSD Monitoring Station

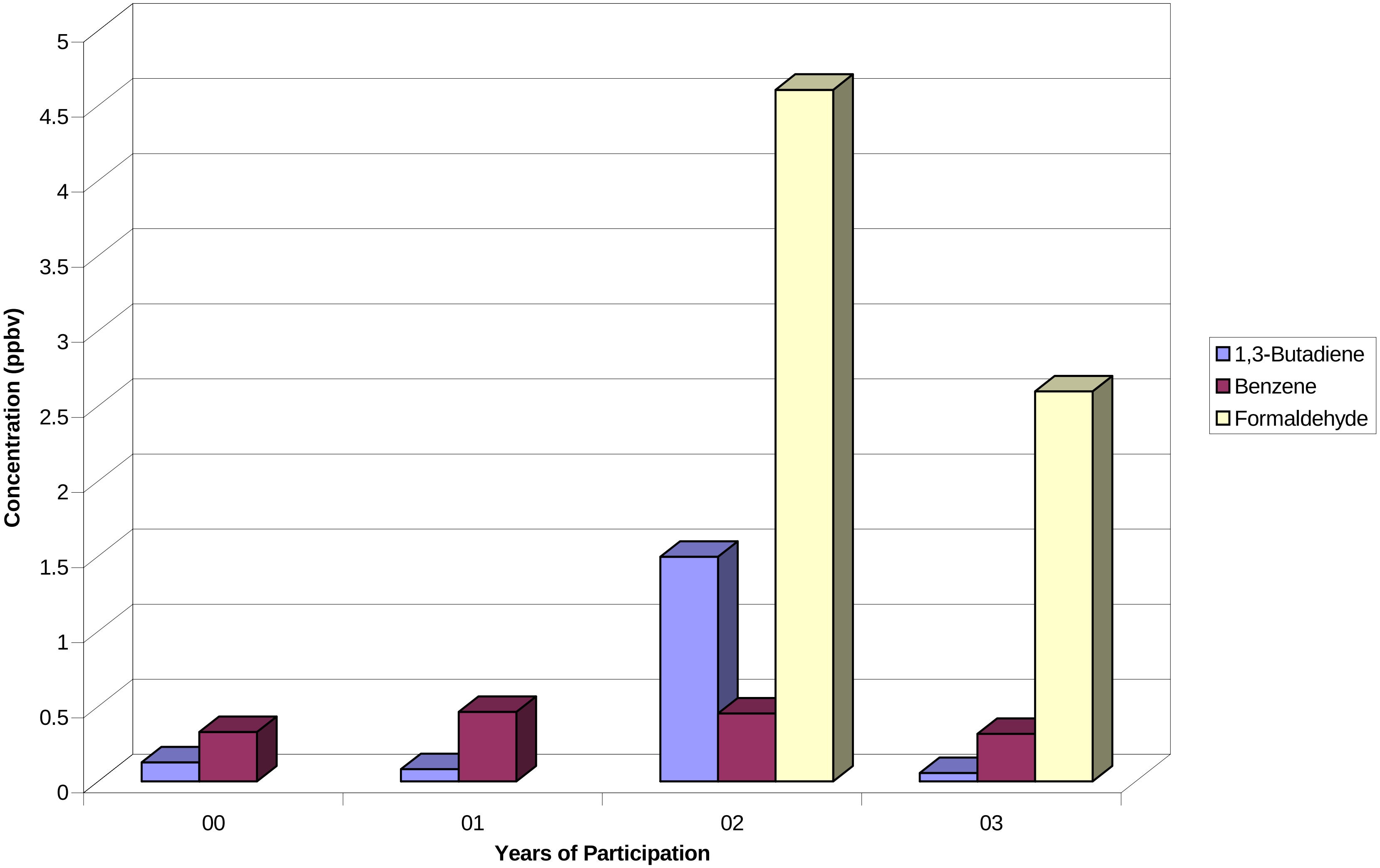


Figure 3-25s. Comparison of Yearly Averages for the SJPR Monitoring Station

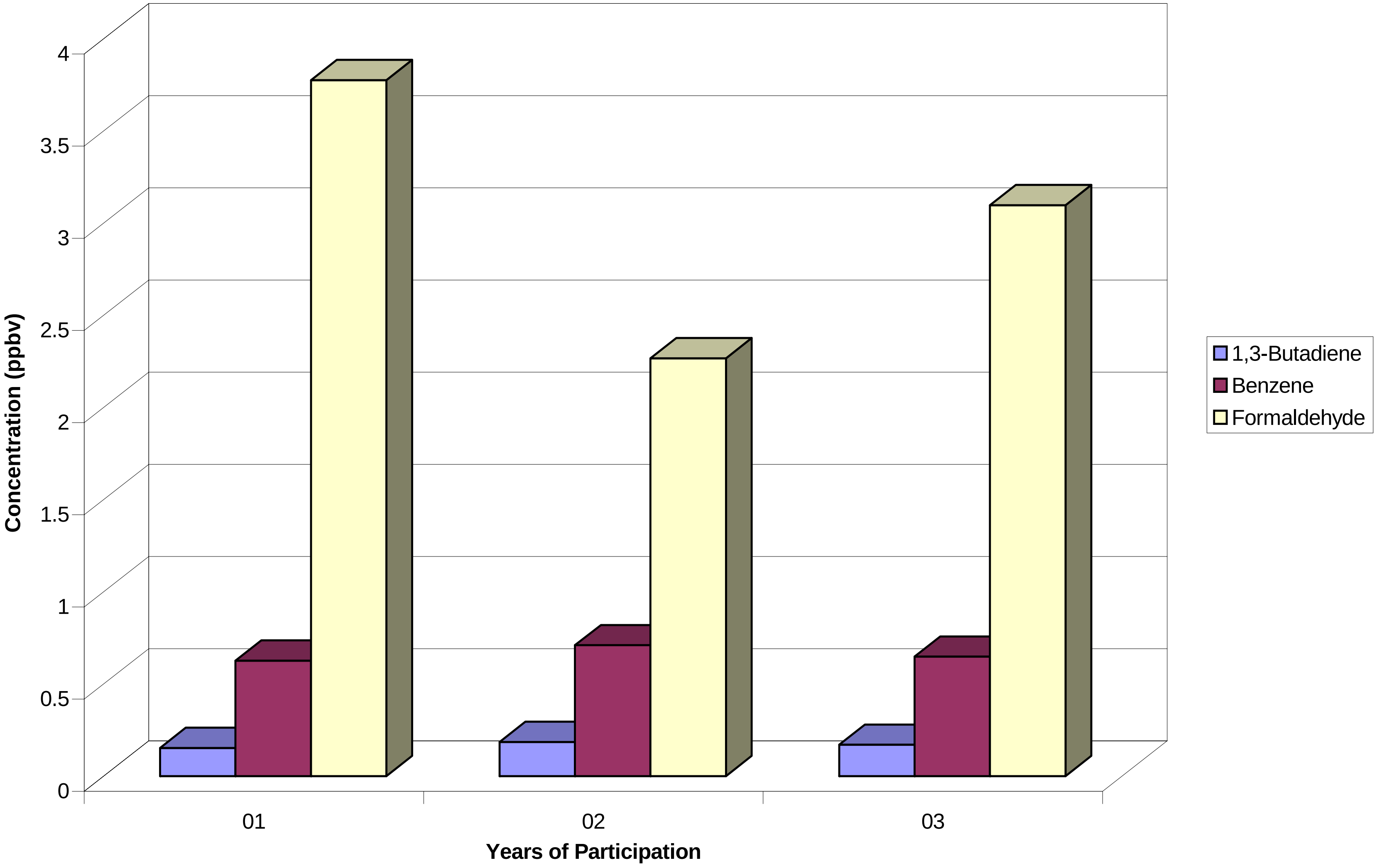


Figure 3-25t. Comparison of Yearly Averages for the SLMO Monitoring Station

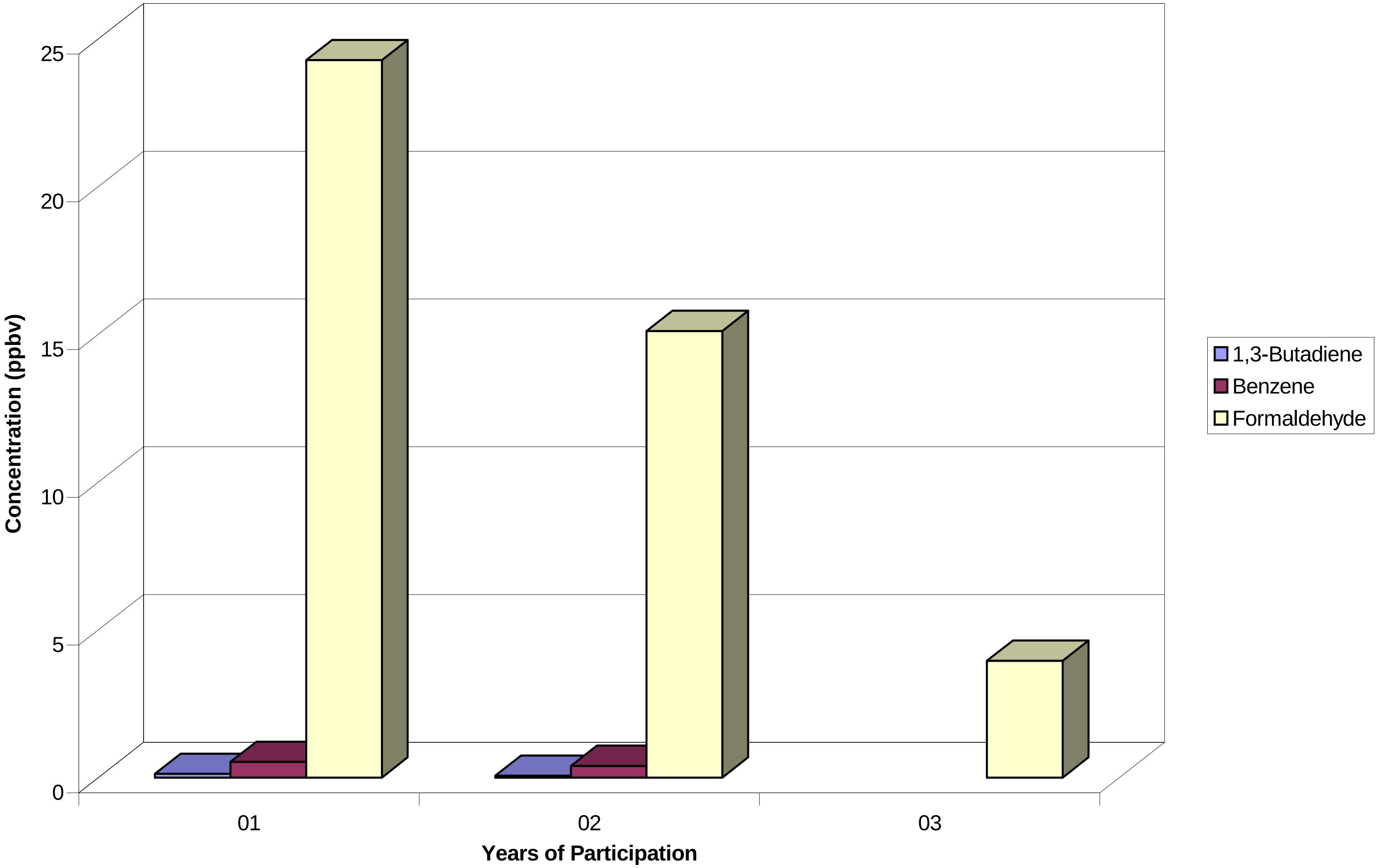


Figure 3-25u. Comparison of Yearly Averages for the SPAZ Monitoring Station

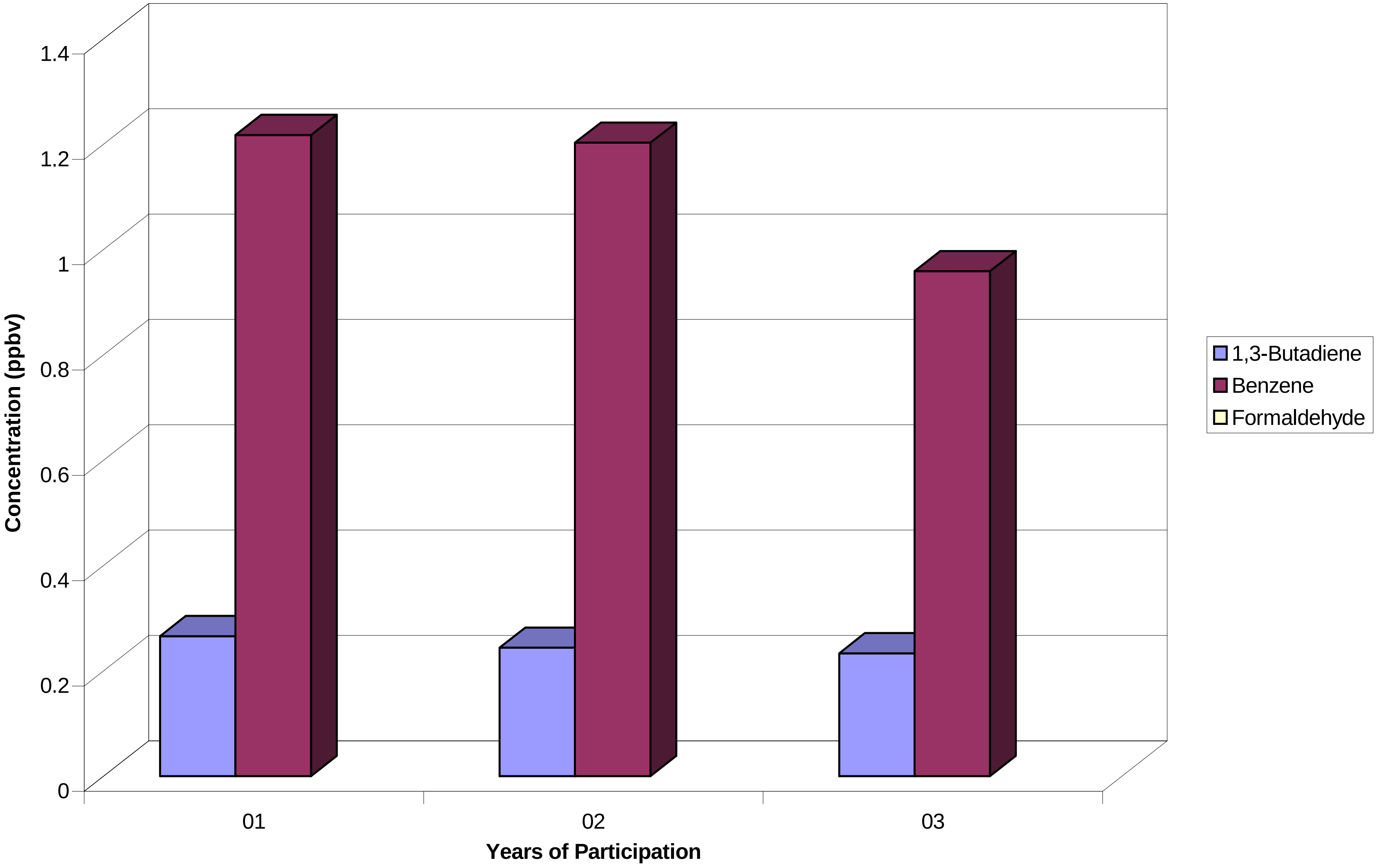


Figure 3-25v. Comparison of Yearly Averages for the TUMS Monitoring Station

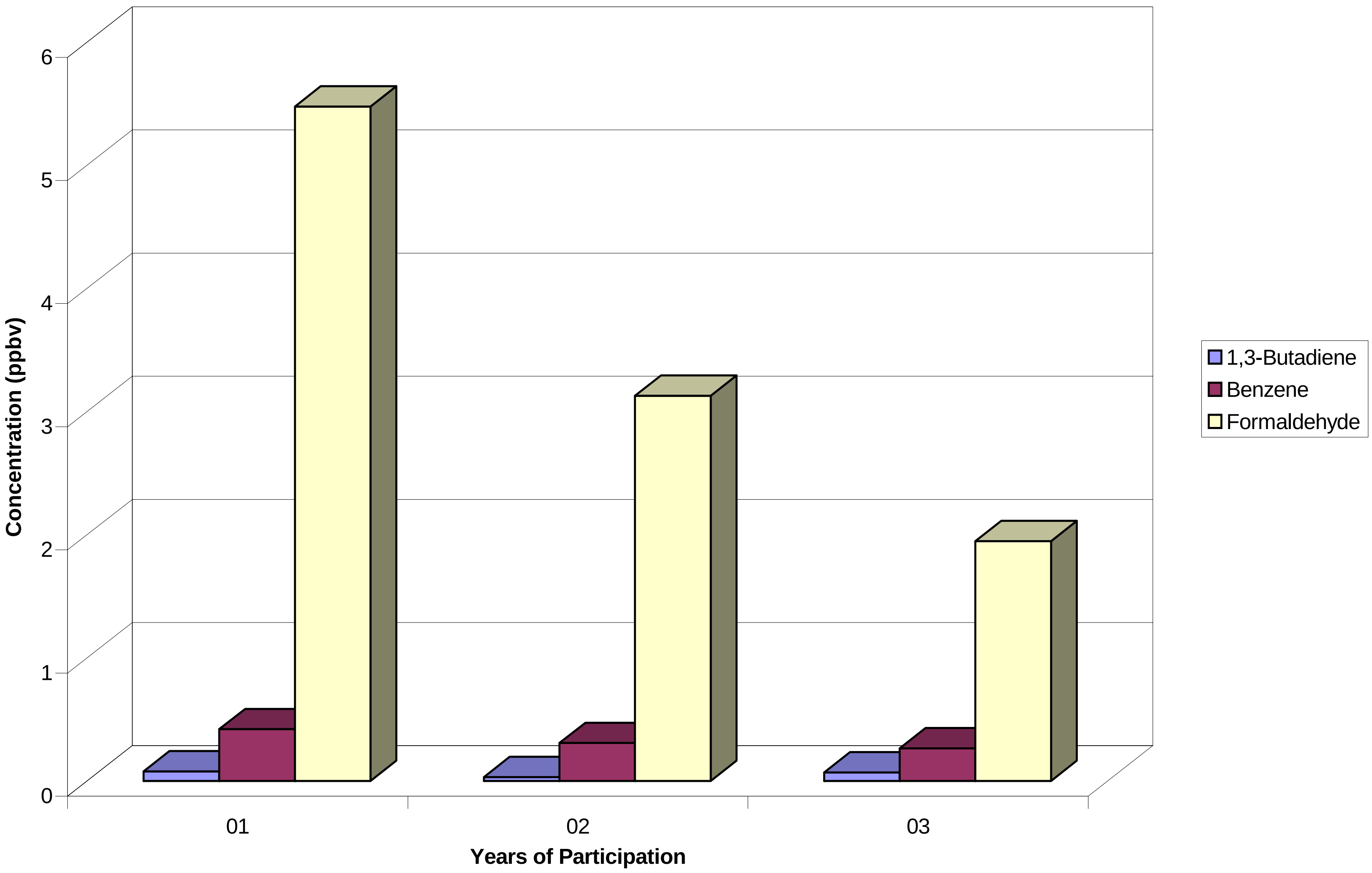


Figure 3-26a. Comparison of Seasonal Averages for the APMI Monitoring Station

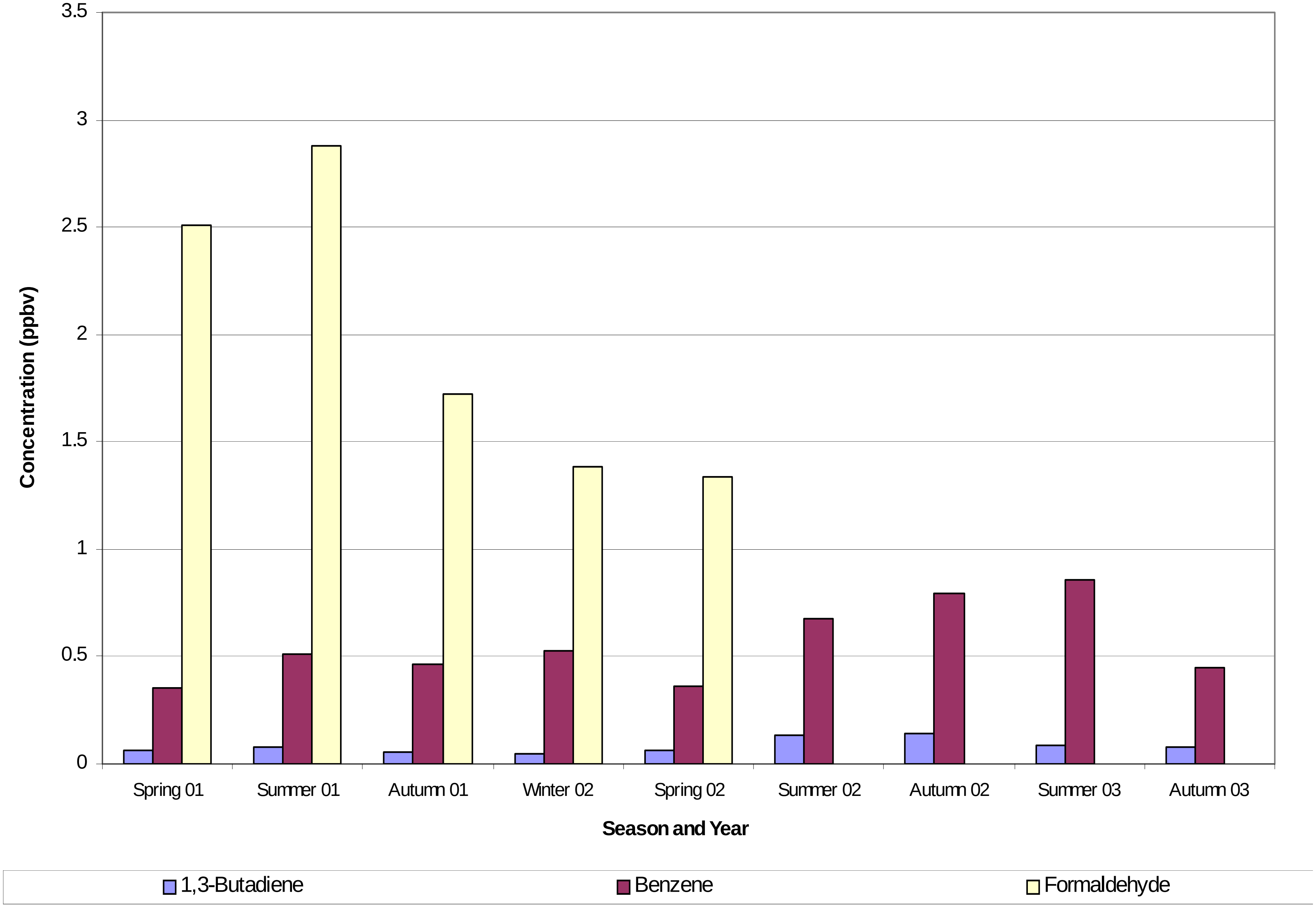


Figure 3-26b. Comparison of Seasonal Averages for the AZFL Monitoring Station

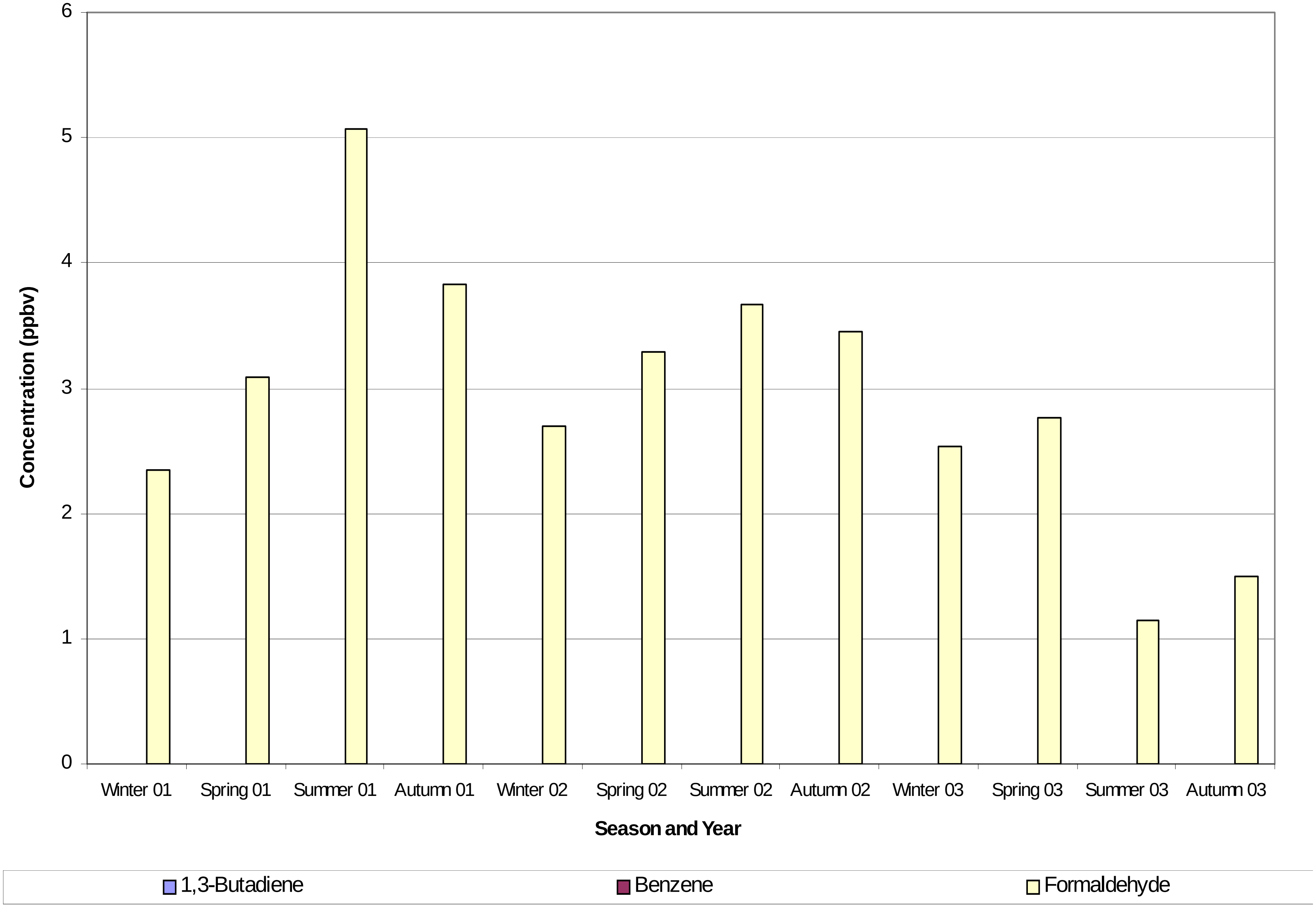


Figure 3-26c. Comparison of Seasonal Averages for the BAPR Monitoring Station

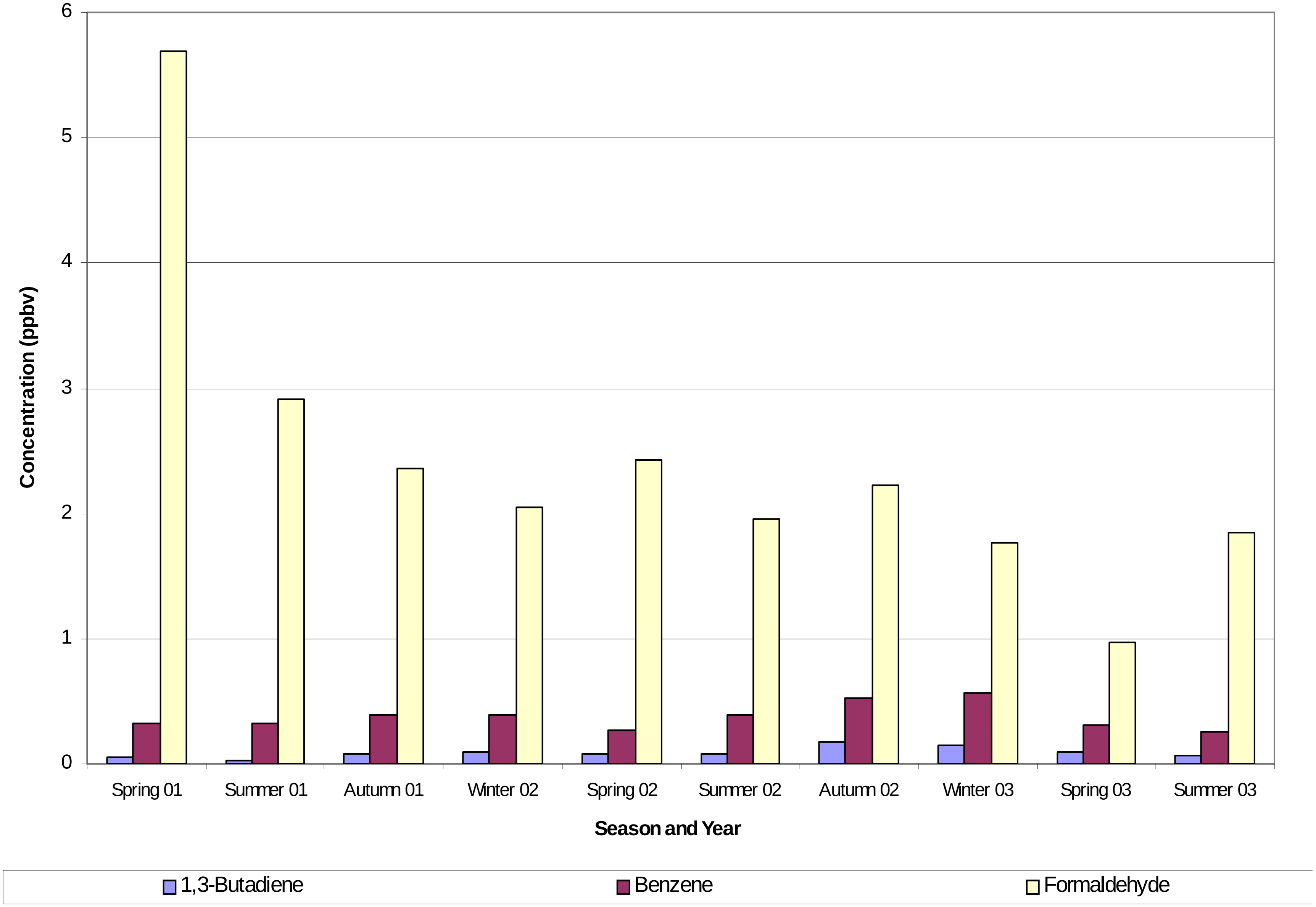


Figure 3-26d. Comparison of Seasonal Averages for the BUND Monitoring Station

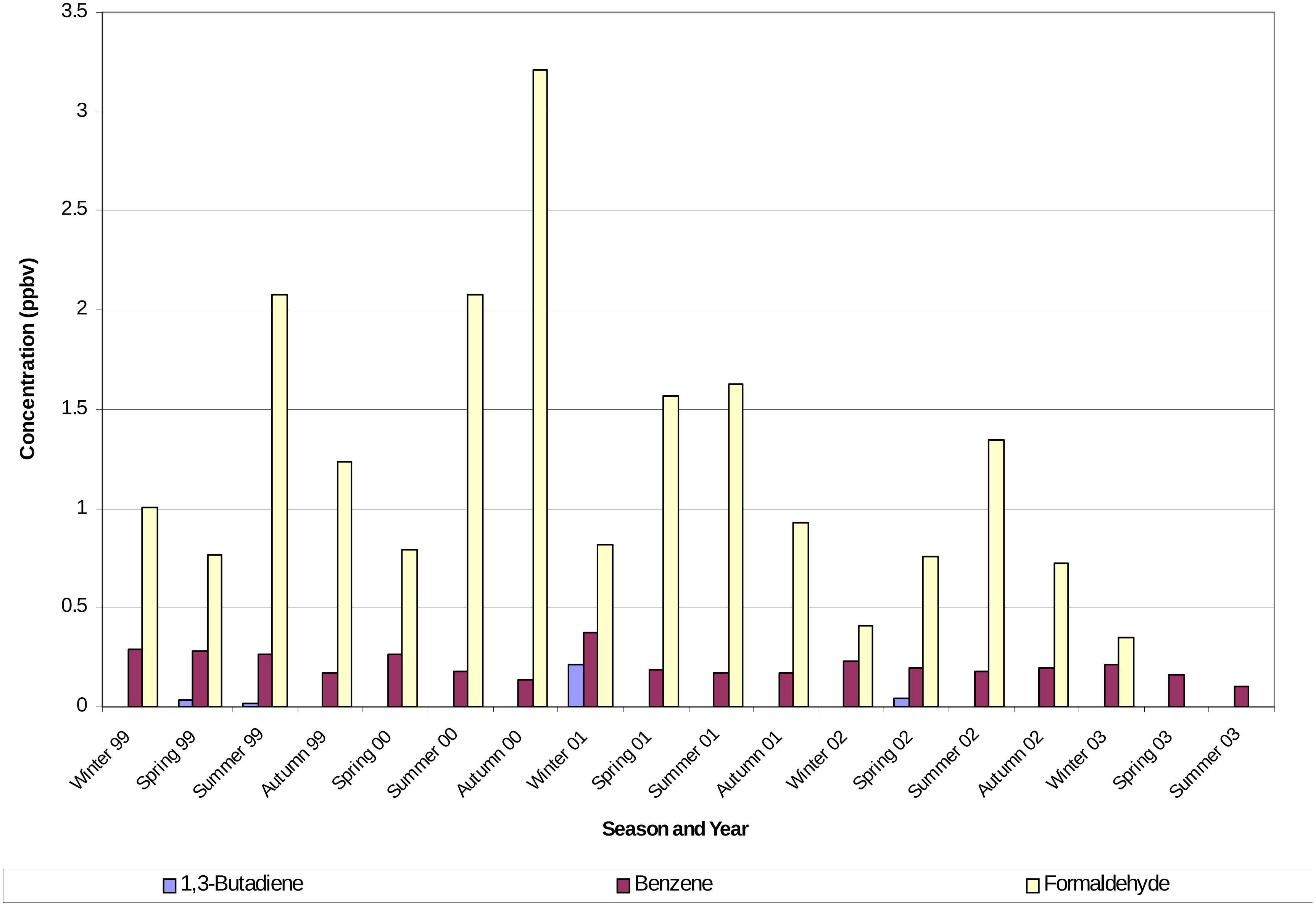


Figure 3-26e. Comparison of Seasonal Averages for the CANJ Monitoring Station (1994-1998)

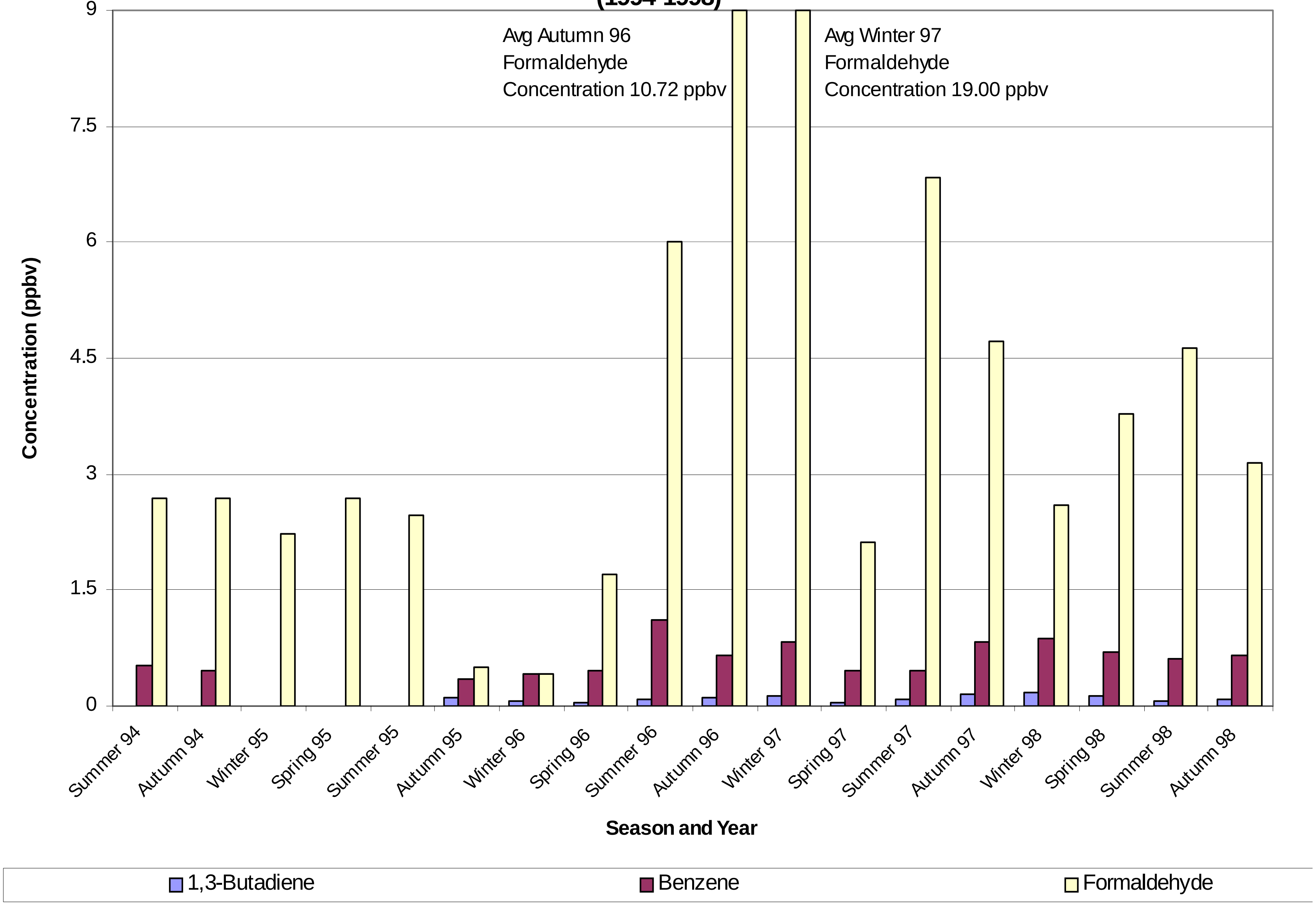


Figure 3-26e. Comparison of Seasonal Averages for the CANJ Monitoring Station (1999-2003)

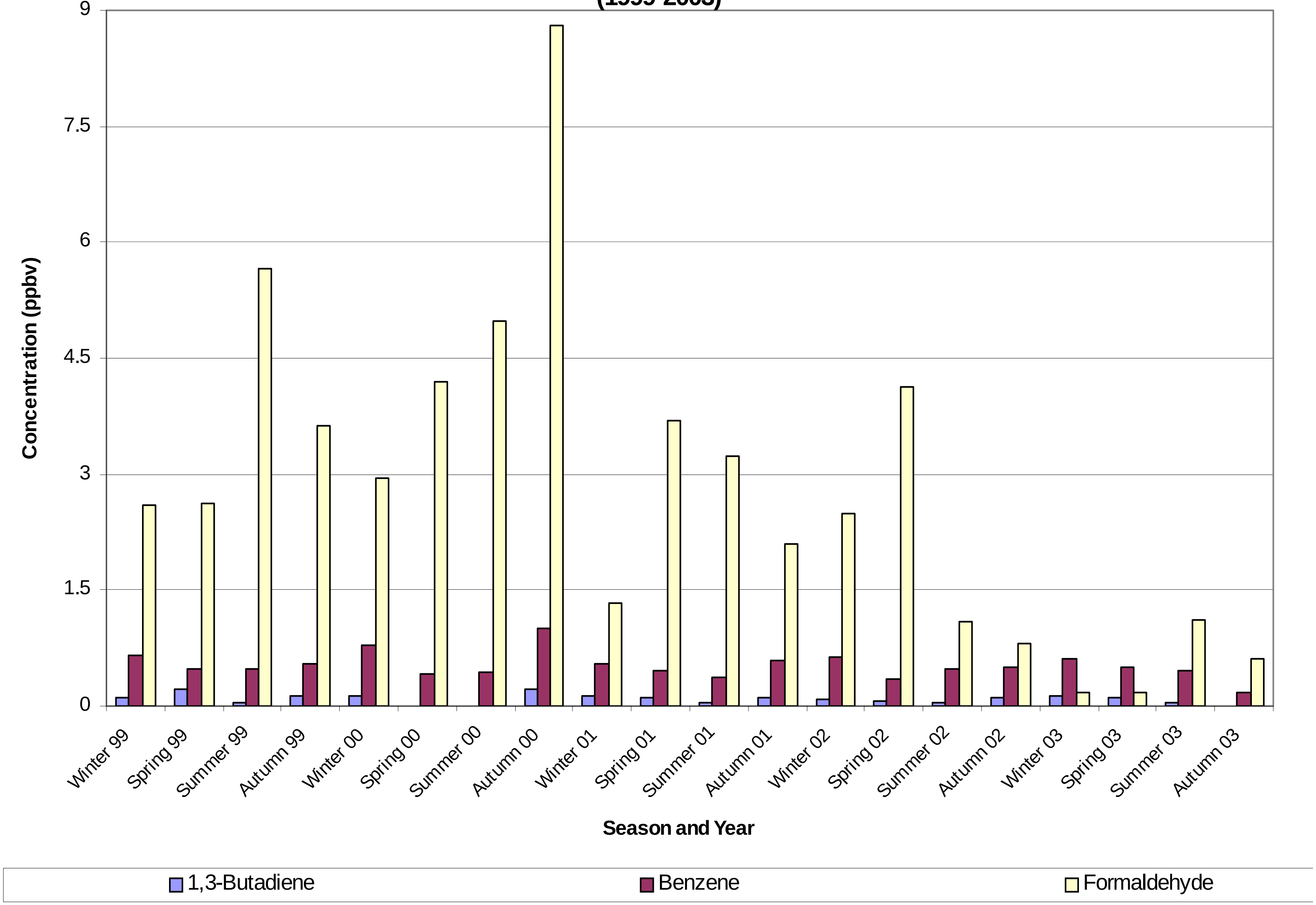


Figure 3-26f. Comparison of Seasonal Averages for the CHNJ Monitoring Station

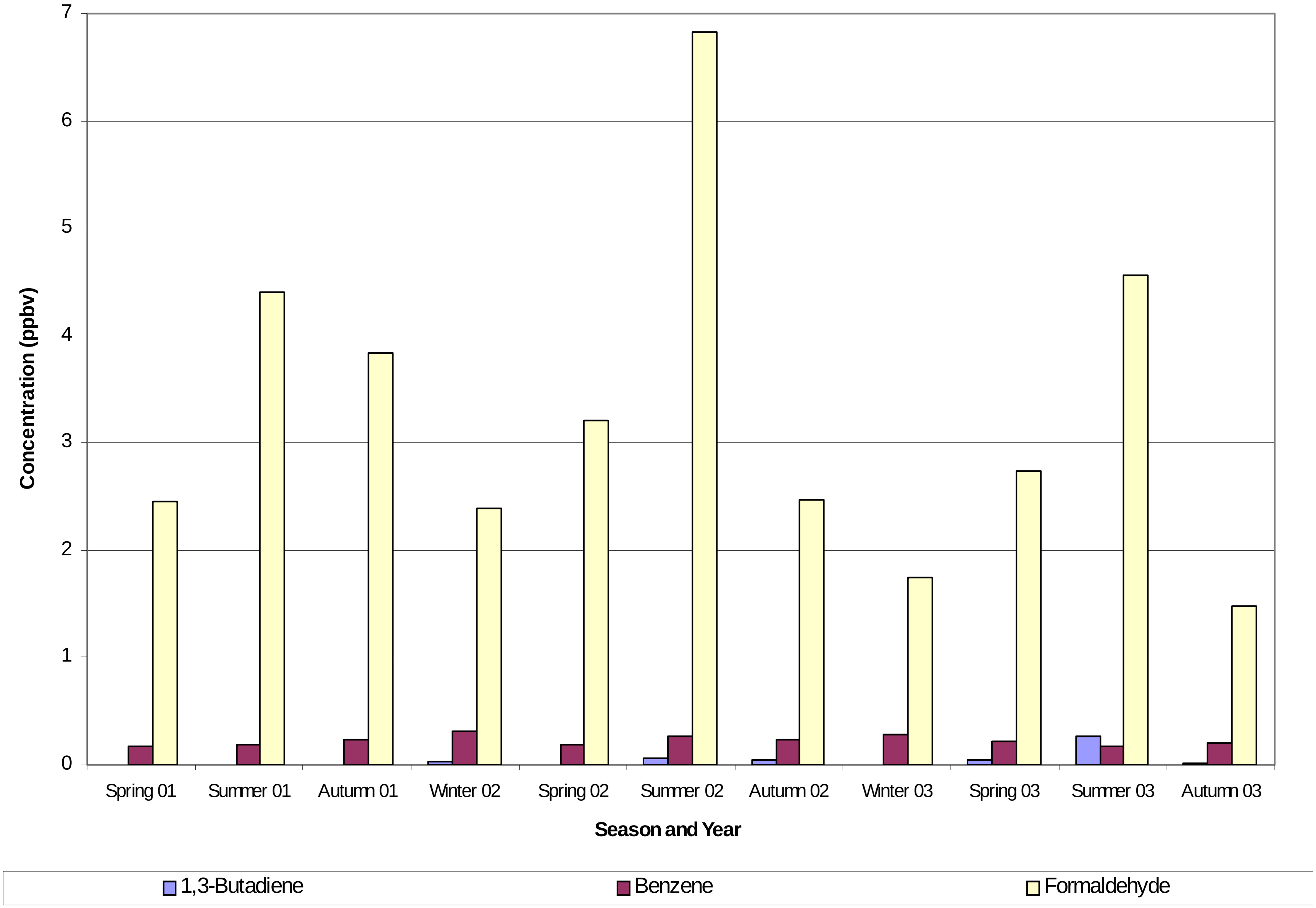


Figure 3-26g. Comparison of Seasonal Averages for the DECO Monitoring Station

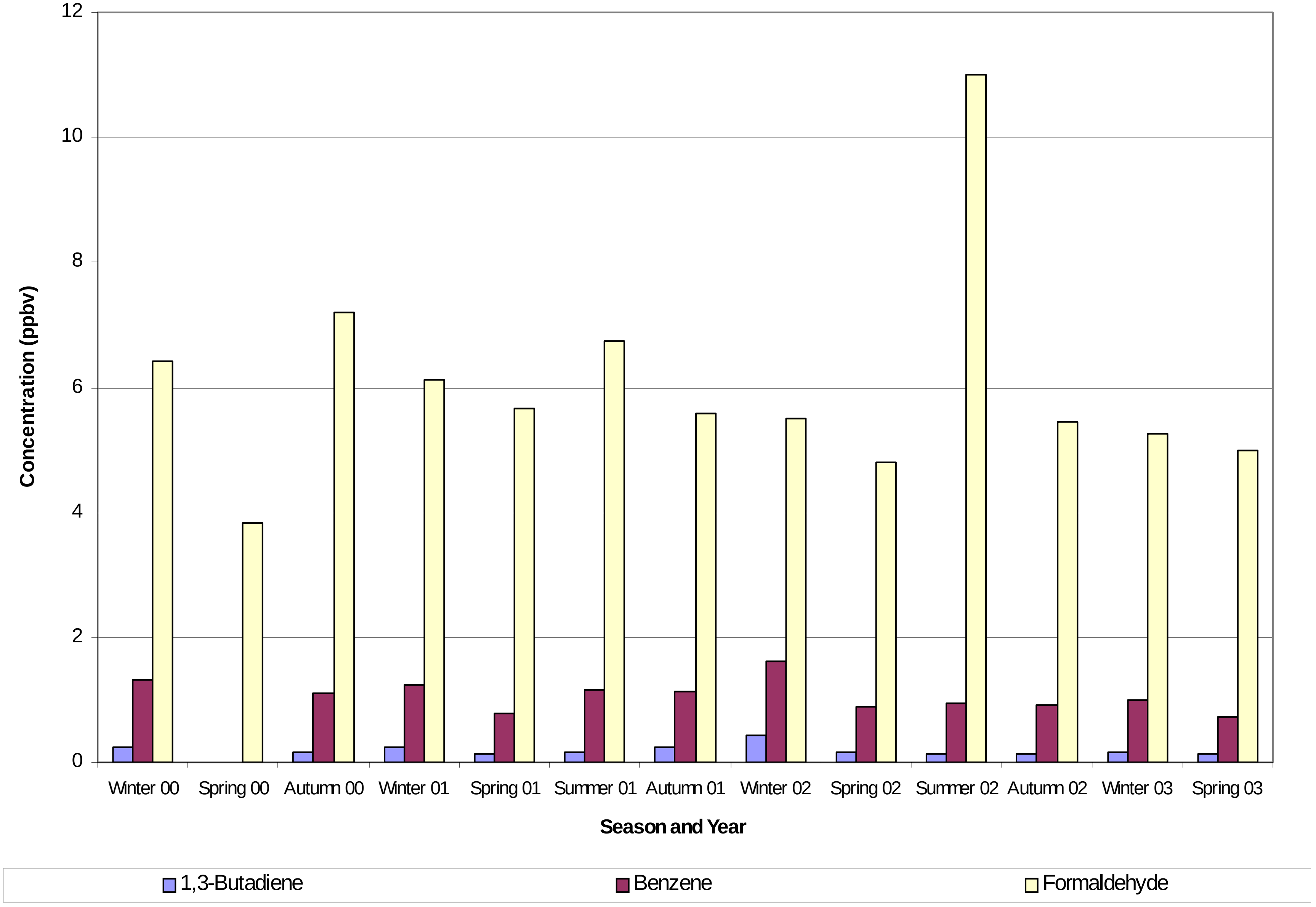


Figure 3-26h. Comparison of Seasonal Averages for the DEMI Monitoring Station

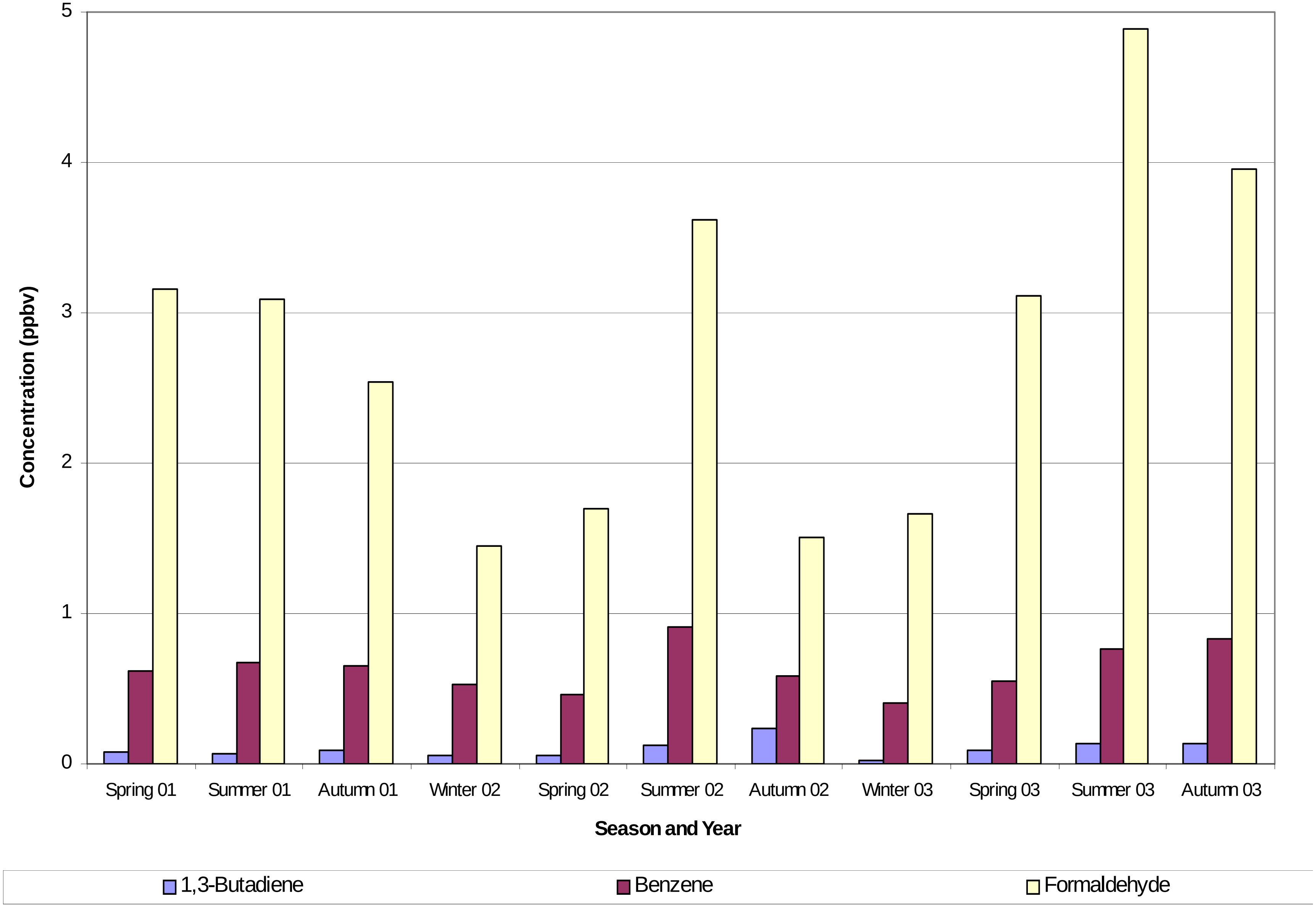


Figure 3-26i. Comparison of Seasonal Averages for the ELNJ Monitoring Station

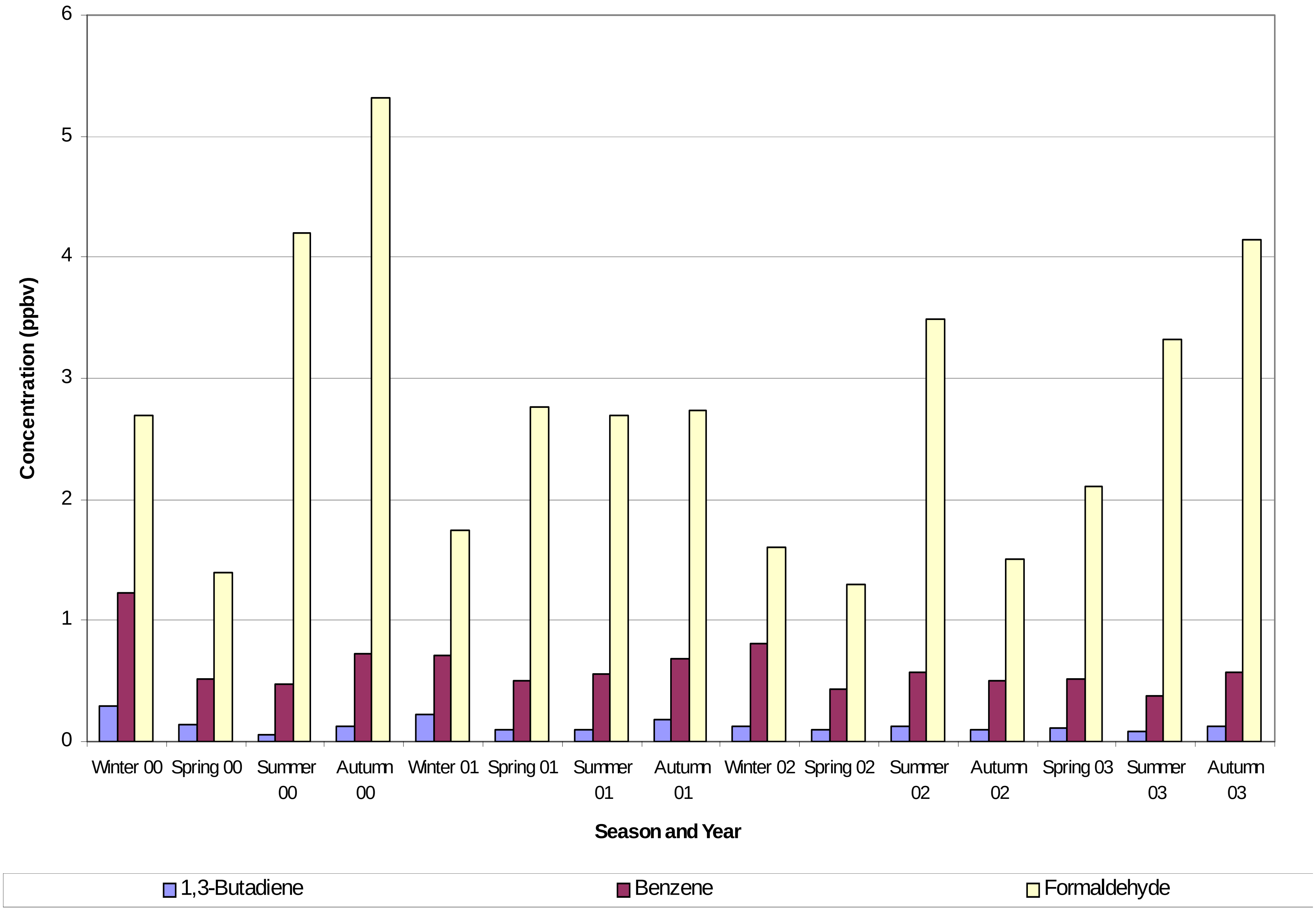


Figure 3-26j. Comparison of Seasonal Averages for the GAFL Monitoring Station

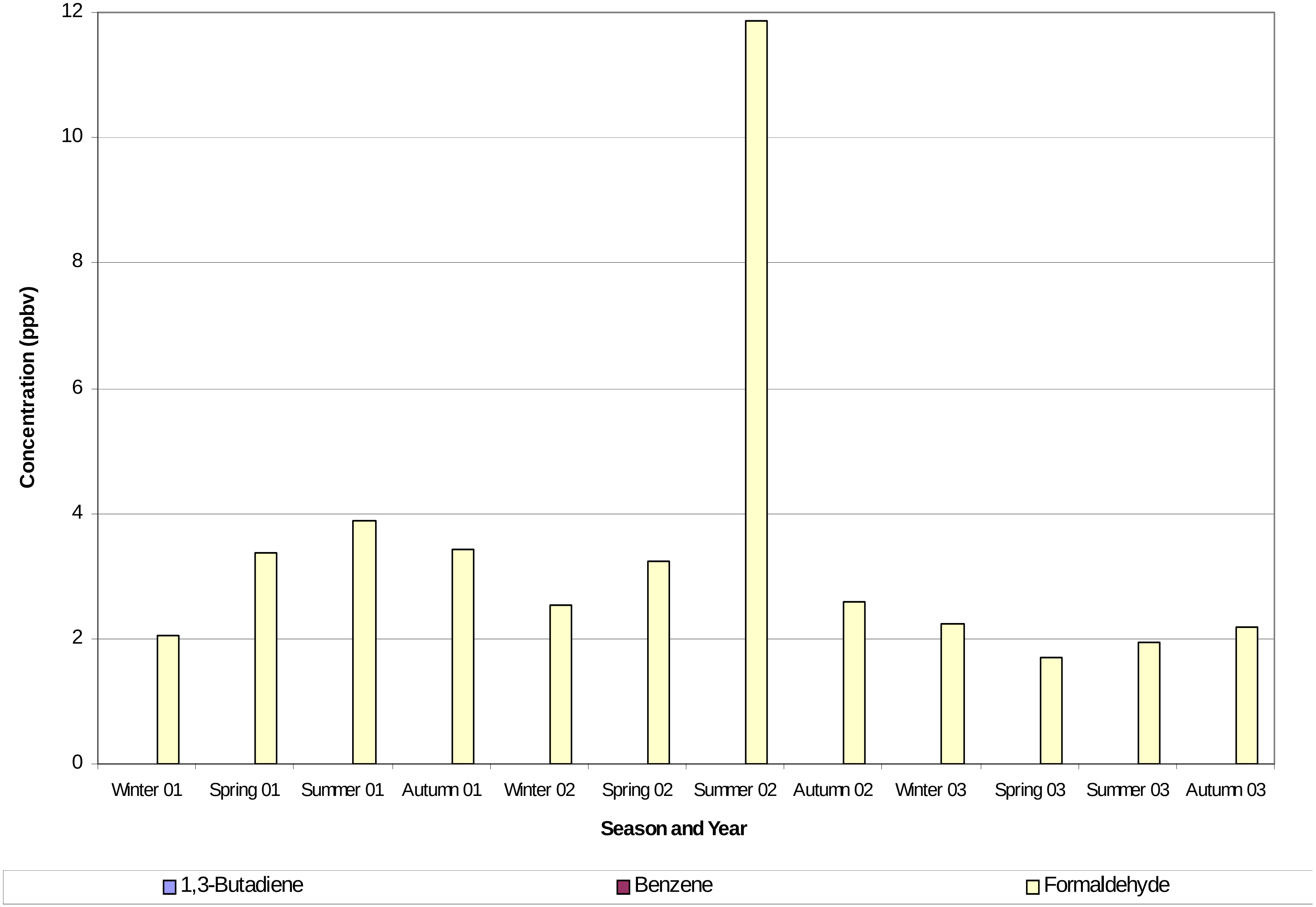


Figure 3-26k. Comparison of Seasonal Averages for the GPMS Monitoring Station

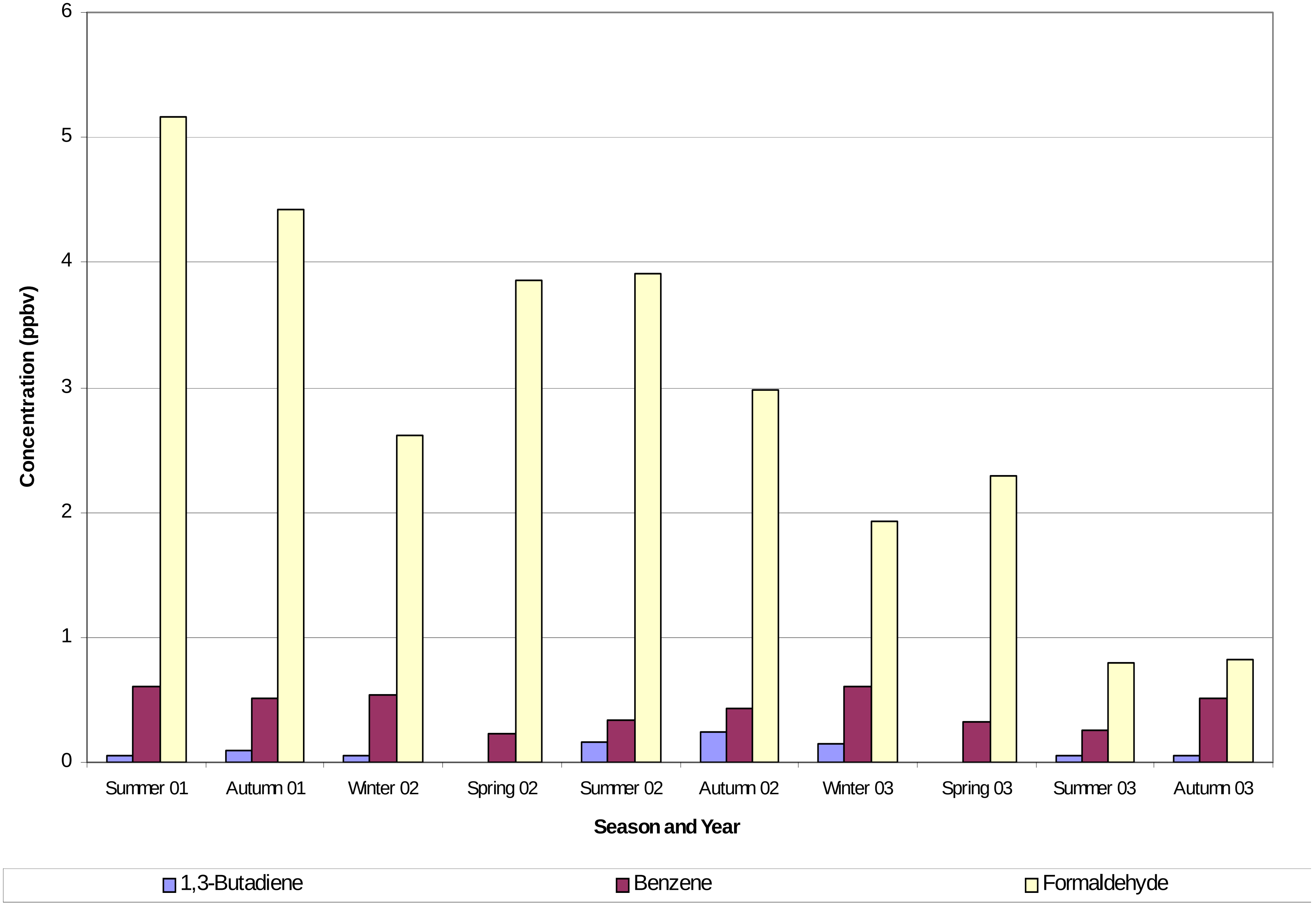


Figure 3-26l. Comparison of Seasonal Averages for the JAMS Monitoring Station

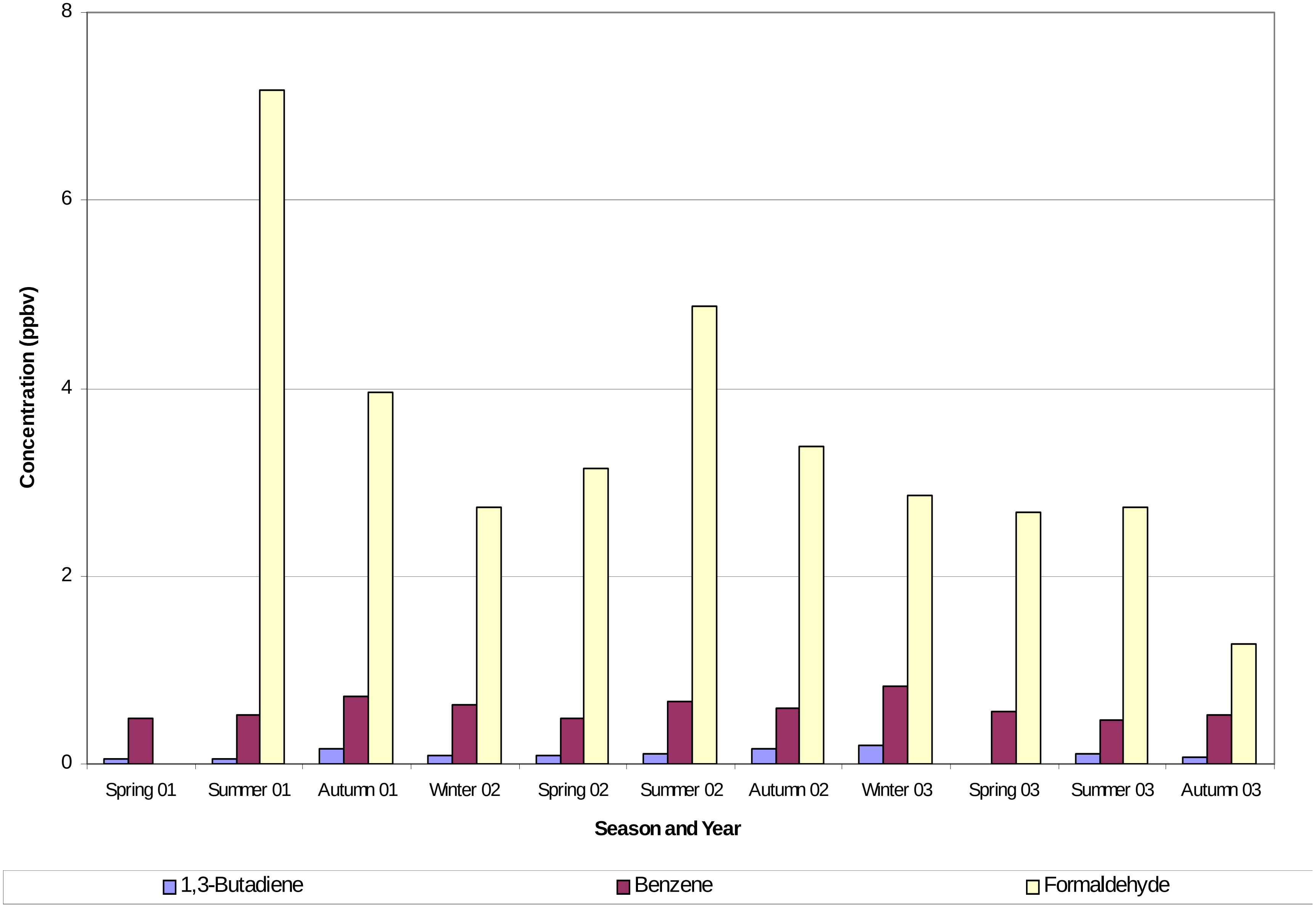


Figure 3-26m. Comparison of Seasonal Averages for the LEFL Monitoring Station

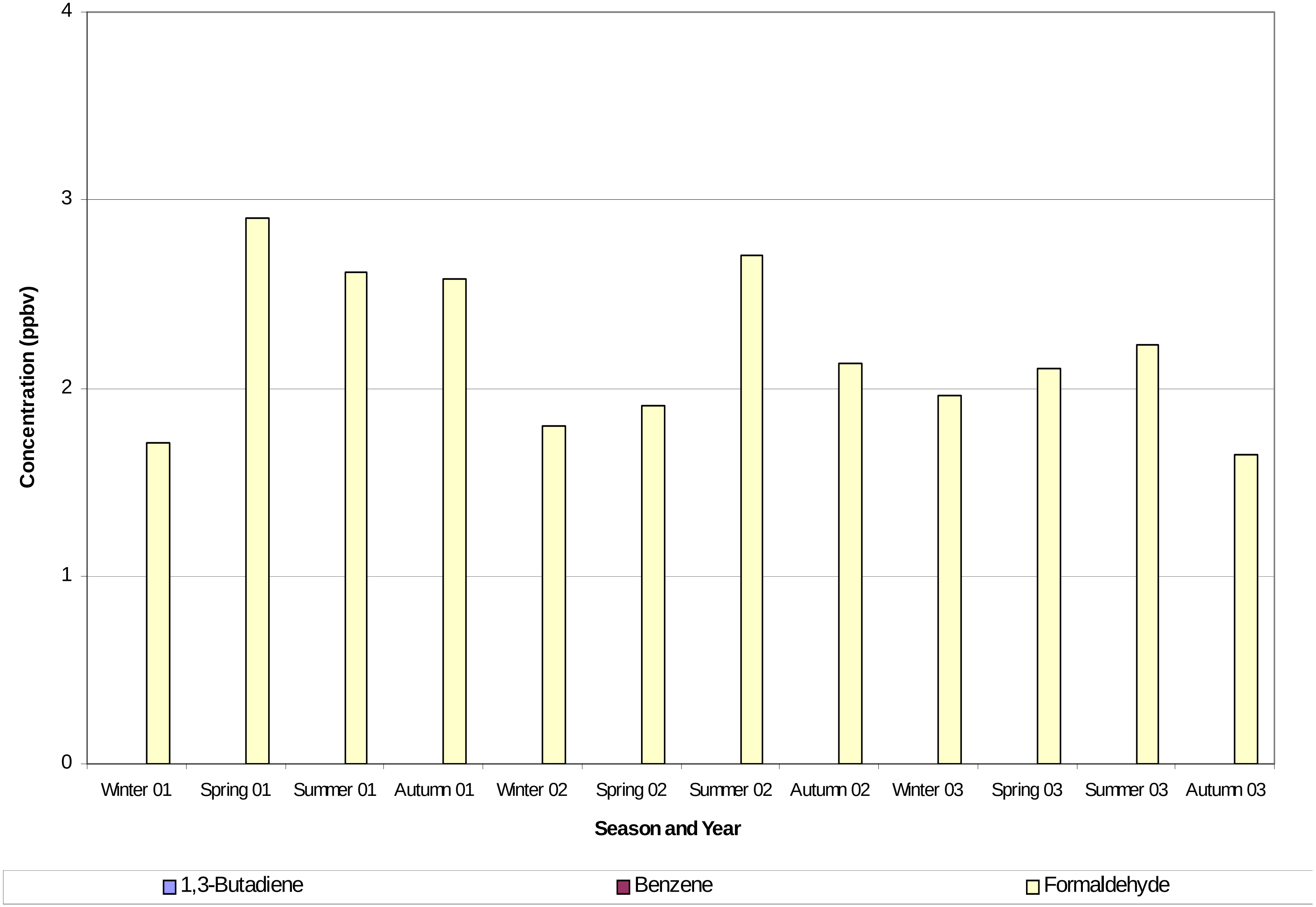


Figure 3-26n. Comparison of Seasonal Averages for the NBNJ Monitoring Station

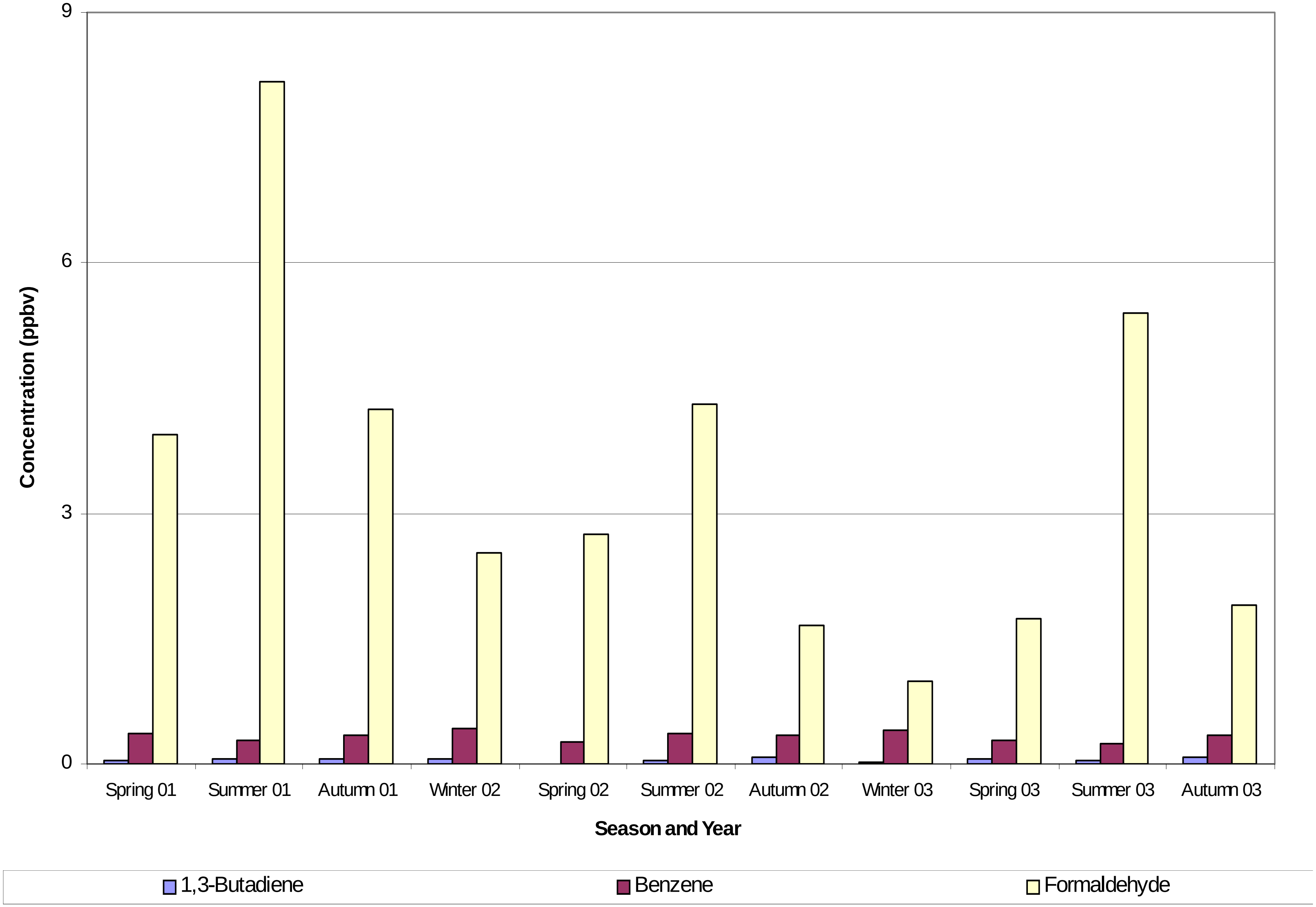


Figure 3-26o. Comparison of Seasonal Averages for the PGMS Monitoring Station

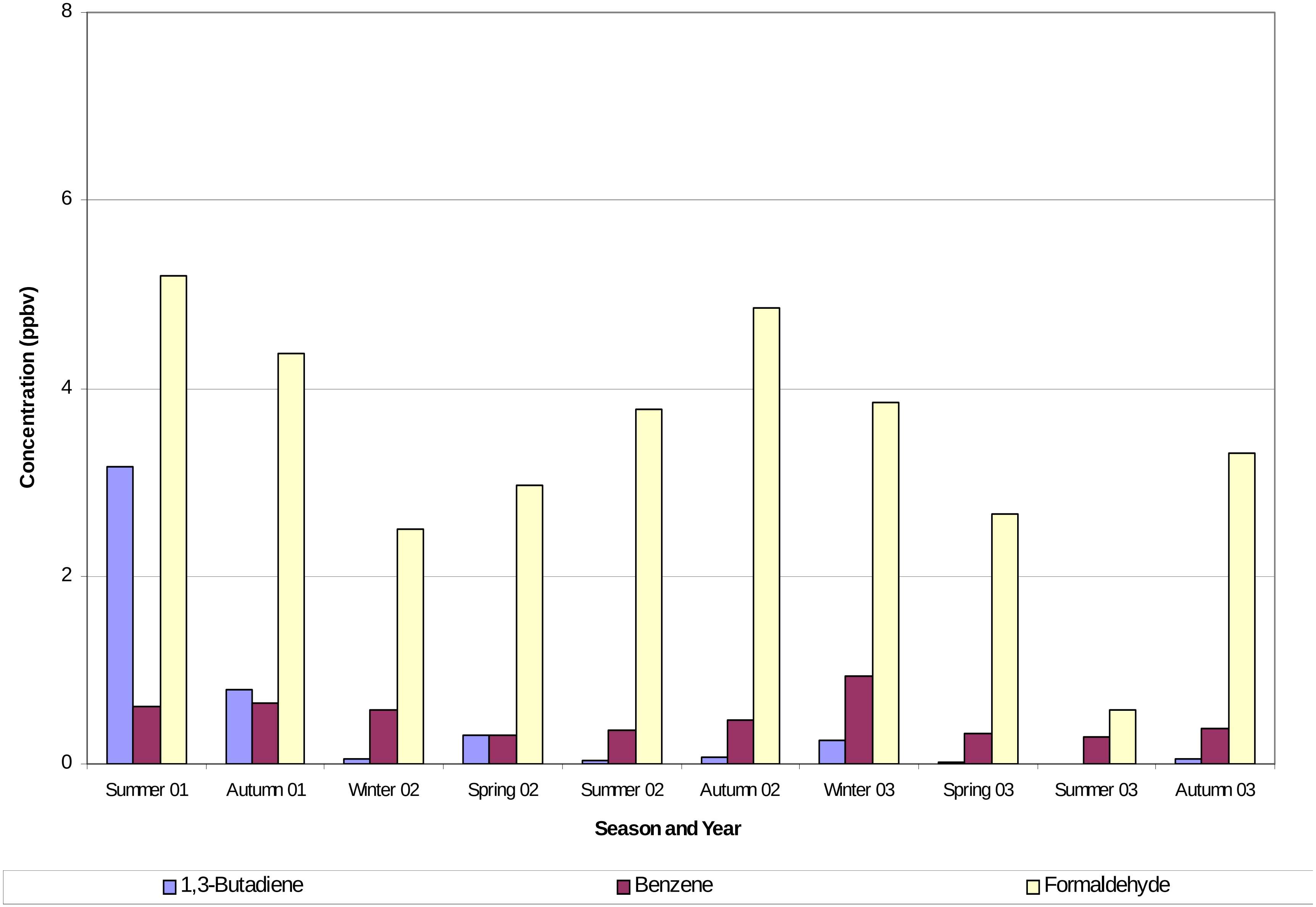


Figure 3-26p. Comparison of Seasonal Averages for the PSAZ Monitoring Station

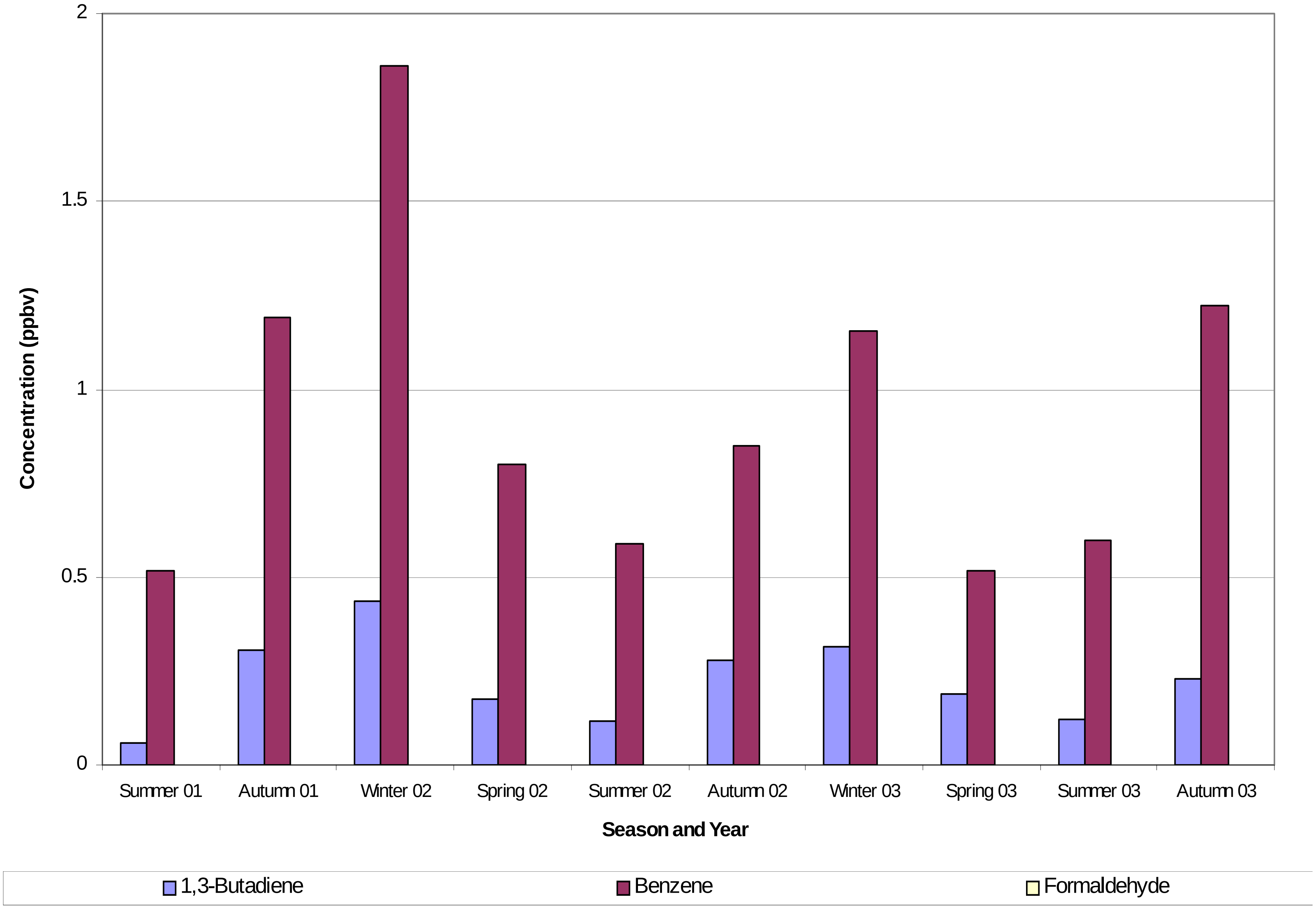


Figure 3-26q. Comparison of Seasonal Averages for the QVAZ Monitoring Station

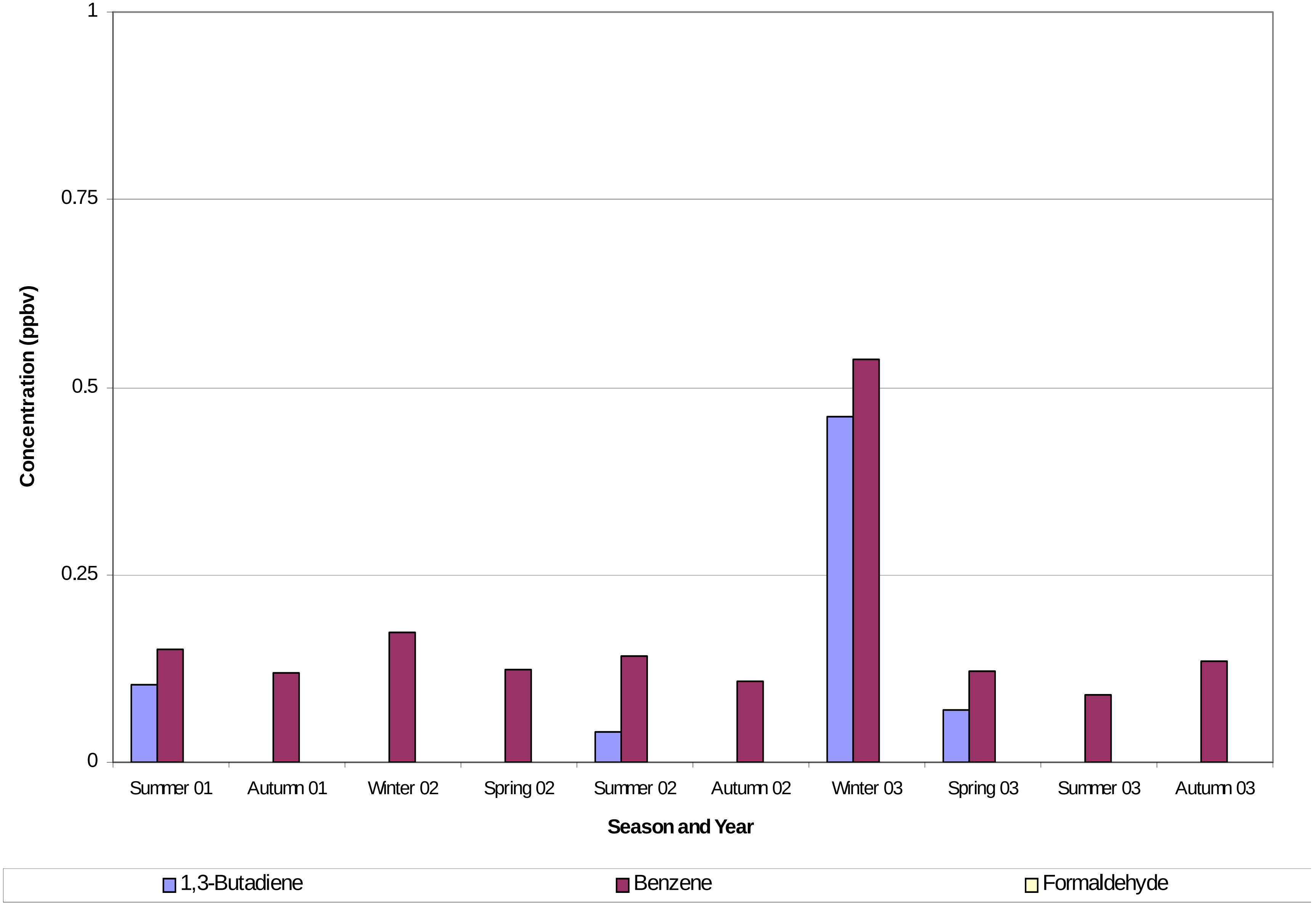


Figure 3-26r. Comparison of Seasonal Averages for the SFSD Monitoring Station

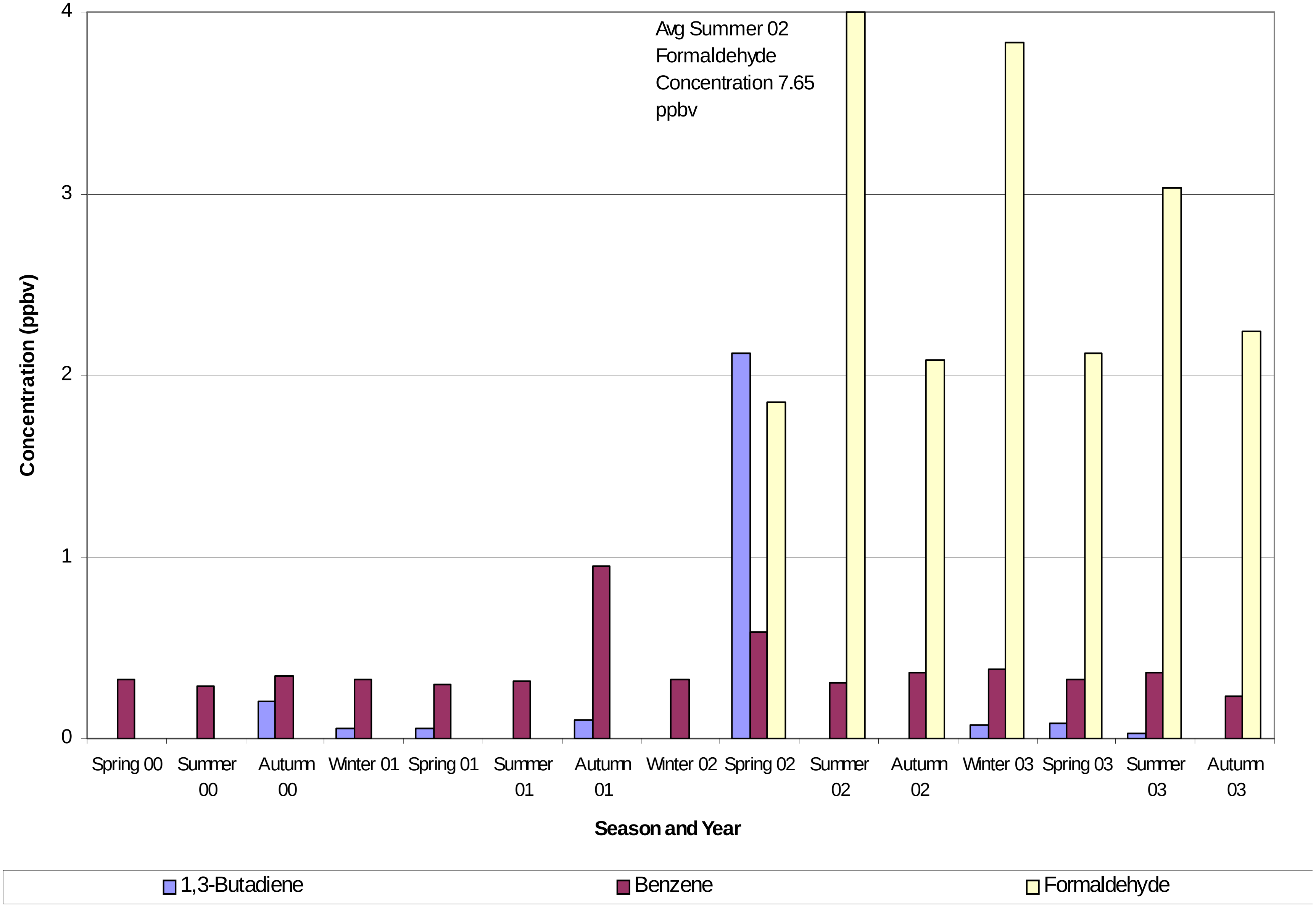


Figure 3-26s. Comparison of Seasonal Averages for the SJPR Monitoring Station

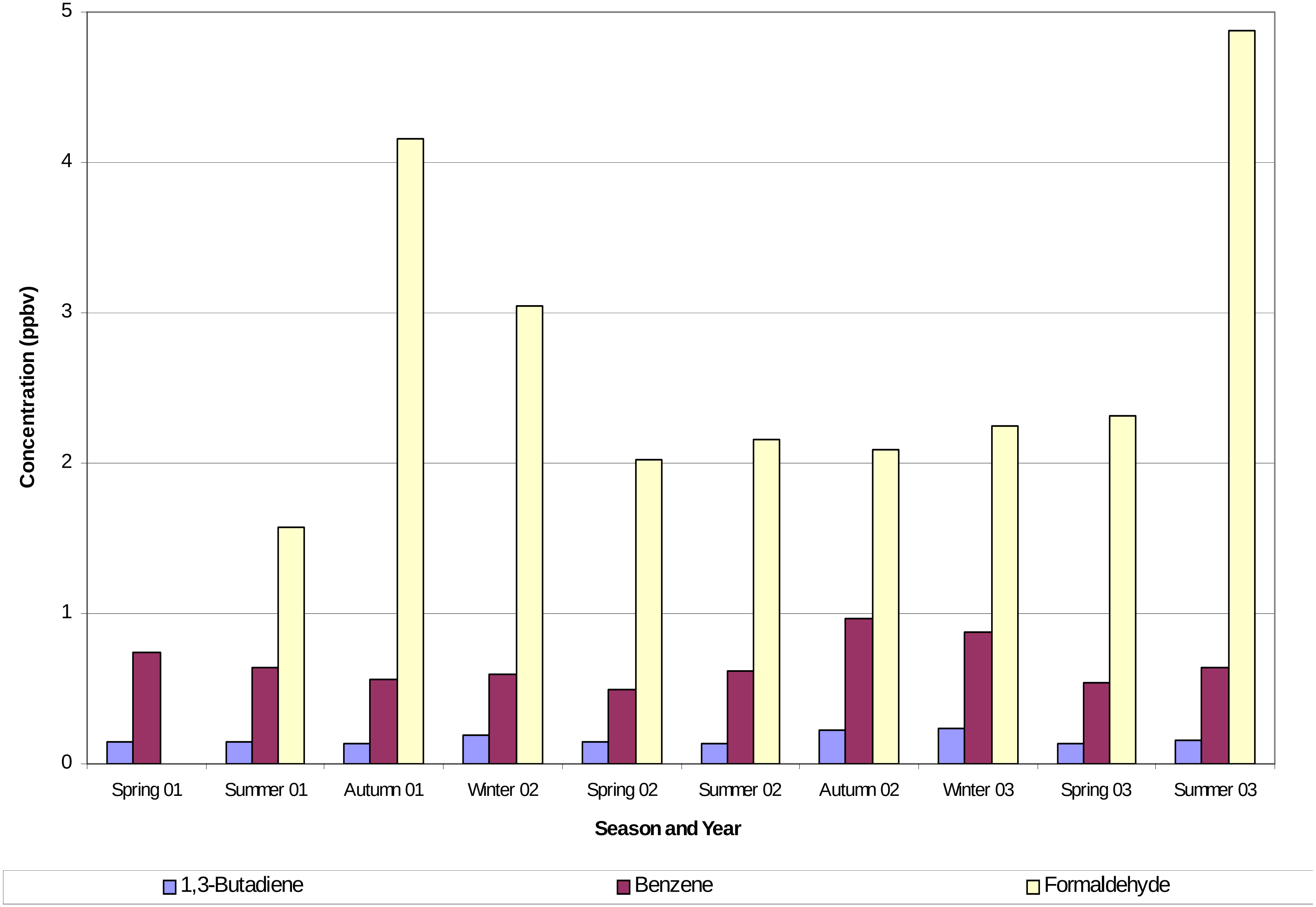


Figure 3-26t. Comparison of Seasonal Averages for the SLMO Monitoring Station

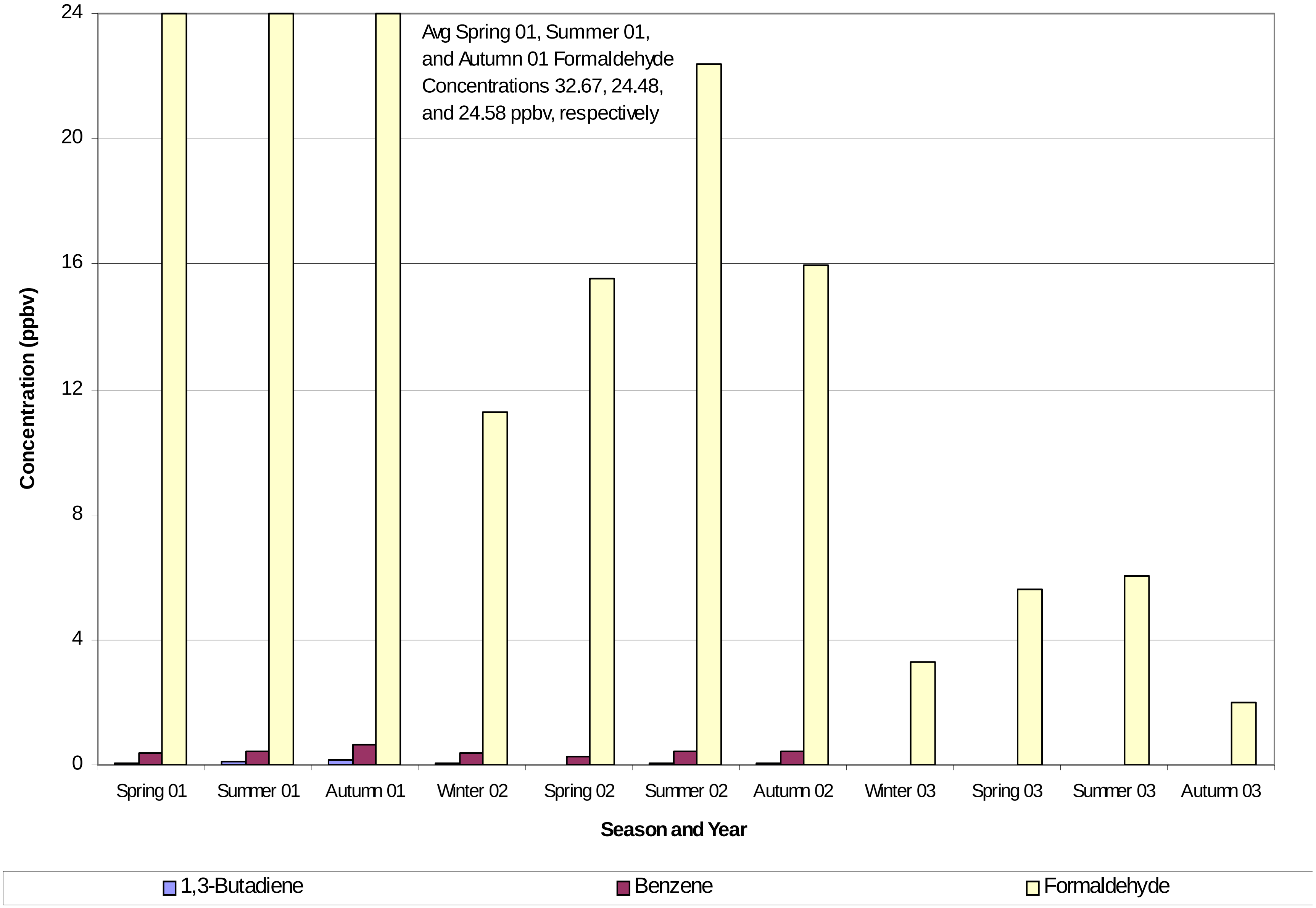


Figure 3-26u. Comparison of Seasonal Averages for the SPAZ Monitoring Station

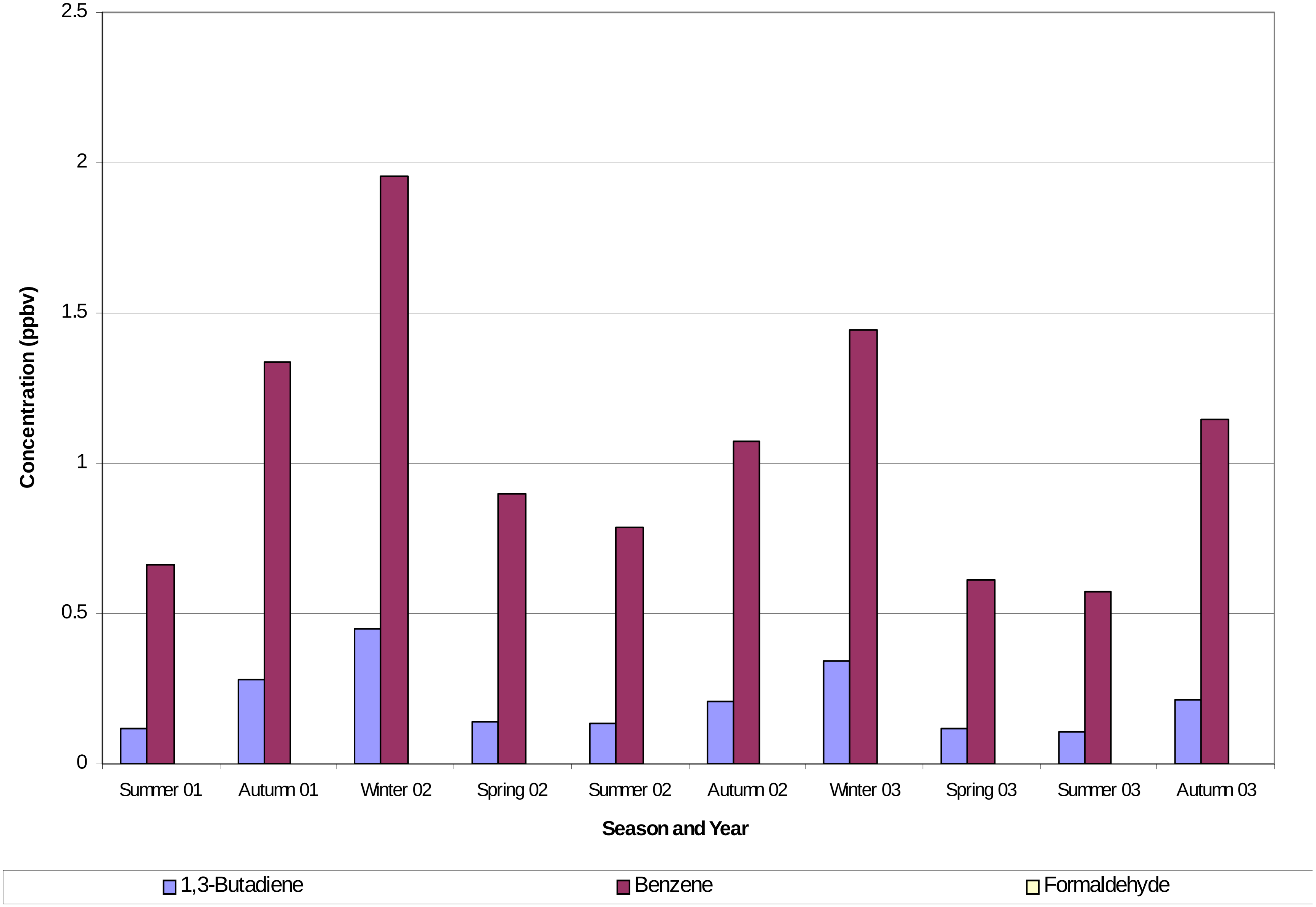


Figure 3-26v. Comparison of Seasonal Averages for the TUMS Monitoring Station

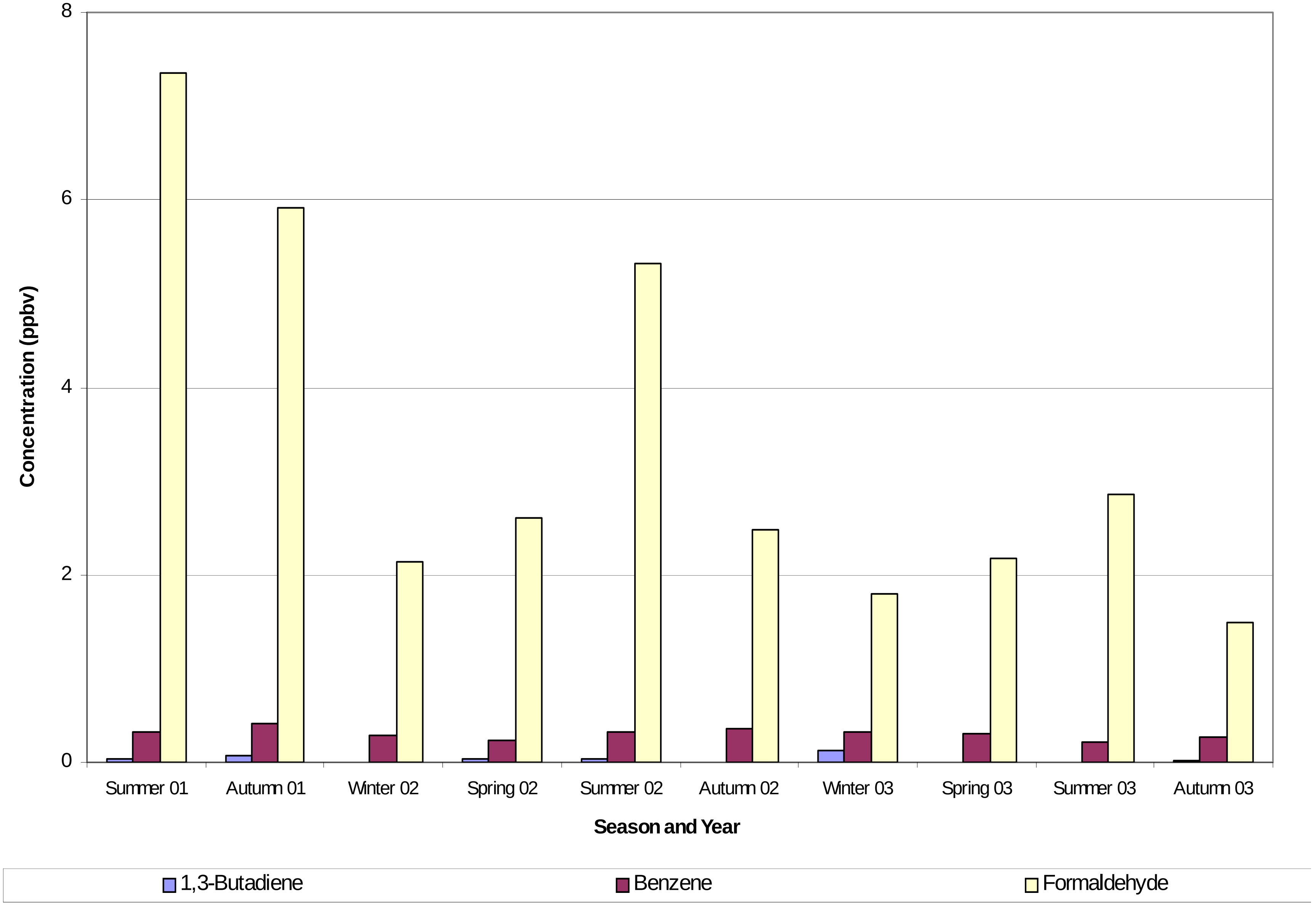


Table 3-1. Sampling Detect Summaries of the VOC Concentrations

Chemical[1]	# 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	1160	0.14	18.13	1.56	0.94	1.03	0.64	1.84	1.68	0.93
Benzene	1160	0.04	2.69	0.45	0.24	0.34	0.22	0.54	0.38	1.20
1,3-Butadiene	401	<0.01	0.65	0.13	0.08	0.09	0.05	0.17	0.11	1.14
Ethylbenzene	943	<0.01	2.87	0.23	0.09	0.15	0.09	0.27	0.28	0.84
n-Octane	339	0.01	2.25	0.14	0.05	0.09	0.05	0.15	0.19	0.71
Propylene	1161	0.03	47.5	0.86	0.25	0.51	0.30	0.93	1.75	0.49
Styrene	458	0.01	4.26	0.15	0.04	0.08	0.04	0.13	0.35	0.43
Toluene	1161	0.02	20.96	1.18	0.35	0.69	0.38	1.33	1.63	0.73
1,2,4-Trimethylbenzene	899	0.01	3.72	0.21	0.09	0.13	0.08	0.23	0.27	0.77
1,3,5-Trimethylbenzene	557	<0.01	2.07	0.10	0.06	0.07	0.04	0.12	0.13	0.74
***m-,p*-Xylene**	1096	0.02	7.82	0.56	0.16	0.32	0.19	0.64	0.72	0.79
***o*-Xylene**	980	0.02	3.22	0.25	0.09	0.16	0.09	0.29	0.29	0.88
Halogenated Hydrocarbons										
Bromochloromethane	1	NA								
Bromodichloromethane	8	0.02	0.16	0.06	NA	0.04	0.03	0.06	0.04	1.32
Bromoform	1	NA								
Bromomethane	55	0.01	11.09	0.32	0.01	0.02	0.02	0.14	1.49	0.21
Carbon Tetrachloride	1040	0.02	0.19	0.09	0.09	0.09	0.07	0.10	0.02	3.50
Chlorobenzene	12	0.01	0.36	0.13	NA	0.04	0.03	0.24	0.13	1.02
Chloroethane	26	0.01	0.89	0.11	0.05	0.07	0.04	0.10	0.17	0.66

Table 3-1. Sampling Detect Summaries of the VOC Concentrations (Continued)

Chemical[1]	# 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
Chloroform	258	0.01	0.56	0.08	0.02	0.05	0.03	0.12	0.09	0.93
Chloromethane	1158	0.02	1.24	0.62	0.59	0.61	0.54	0.69	0.13	4.95
Chloromethylbenzene	NA									
Chloroprene	6	0.05	0.13	0.08	0.06	0.07	0.06	0.08	0.03	2.92
Dibromochloromethane	3	<0.01	0.03	0.02	NA	0.01	0.01	0.02	0.01	2.08
1,2-Dibromoethane	NA									
m-Dichlorobenzene	NA									
o-Dichlorobenzene	3	<0.01	0.02	0.01	NA	0.01	0.01	0.01	<0.01	2.25
***p*-Dichlorobenzene**	180	0.01	0.71	0.09	0.05	0.06	0.03	0.12	0.09	1.01
1,1-Dichloroethane	NA									
1,2-Dichloroethane	7	<0.01	0.18	0.05	0.03	0.03	0.02	0.04	0.06	0.82
1,1-Dichloroethene	1	NA								
cis-1,2-Dichloroethylene	5	0.04	0.42	0.24	NA	0.30	0.09	0.34	0.15	1.62
trans-1,2-Dichloroethylene	1	NA								
1,2-Dichloropropane	NA									
cis-1,3-Dichloropropene	3	0.05	0.13	0.08	NA	0.06	0.06	0.10	0.03	2.58
trans-1,3-Dichloropropene	4	0.04	0.10	0.06	NA	0.06	0.05	0.07	0.02	2.64
Dichlorodifluoromethane	1161	0.09	2.00	0.61	0.58	0.60	0.55	0.66	0.13	4.82
Dichlorotetrafluoroethane	12	0.01	0.02	0.02	0.02	0.02	0.01	0.02	<0.01	4.23
Hexachloro-1,3-butadiene	NA									
Methylene Chloride	738	0.02	18.52	0.32	0.07	0.13	0.07	0.22	1.25	0.26

Table 3-1. Sampling Detect Summaries of the VOC Concentrations (Continued)

Chemical[1]	# 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
1,1,2,2-Tetrachloroethane	NA									
Tetrachloroethylene	308	<0.01	436.30	5.54	0.04	0.06	0.04	0.15	35.04	0.16
1,2,4-Trichlorobenzene	NA									
1,1,1-Trichloroethane	405	<0.01	1.18	0.04	0.03	0.03	0.02	0.04	0.07	0.65
1,1,2-Trichloroethane	1	NA								
Trichloroethylene	140	<0.01	20.38	0.38	0.04	0.05	0.02	0.11	2.21	0.17
Trichlorofluoromethane	1159	0.09	6.08	0.35	0.27	0.29	0.27	0.35	0.29	1.19
Trichlorotrifluoroethane	1081	0.01	1.25	0.10	0.09	0.10	0.08	0.12	0.06	1.73
Vinyl Chloride	3	0.02	0.06	0.05	0.06	0.06	0.04	0.06	0.02	2.47
Polar Compounds										
Acetonitrile	487	<0.01	2,913.53	24.57	0.46	2.36	0.81	6.39	173.73	0.14
Acrylonitrile	76	0.05	5.69	0.68	0.09	0.26	0.13	0.72	1.05	0.65
tert-Amyl Methyl Ether	42	0.01	0.34	0.13	0.03	0.11	0.06	0.17	0.08	1.56
Ethyl Acrylate	NA									
Ethyl *tert*-Butyl Ether	NA									
Methyl Ethyl Ketone	699	0.12	19.99	1.60	0.63	0.92	0.55	2.05	1.76	0.91
Methyl Isobutyl Ketone	131	0.02	15.06	0.32	0.05	0.13	0.07	0.22	1.32	0.24
Methyl Methacrylate	12	0.02	2.25	0.38	NA	0.17	0.11	0.33	0.58	0.65
Methyl *tert*-Butyl Ether	394	0.02	10.37	0.89	0.06	0.50	0.23	1.14	1.22	0.73

[1] = **BOLD** indicates the compound is prevalent for 2003 Program Year.
Italics indicates the chemical is an urban air toxics strategy HAP.

Table 3-2. Sampling Detect Summaries of the Carbonyl Concentrations

Chemical[1]	# 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
Carbonyl Compounds										
Acetaldehyde	1314	0.04	9.44	1.38	1.87	1.12	0.72	1.72	1.05	1.32
Acetone	1314	0.01	14.83	1.00	0.05	0.73	0.35	1.20	1.22	0.82
Benzaldehyde	1313	<0.01	1.37	0.06	0.04	0.03	0.02	0.05	0.15	0.41
Butyr/Isobutyraldehyde	1314	0.01	7.48	0.15	NA	0.10	0.07	0.16	0.32	0.48
Crotonaldehyde	1296	<0.01	1.44	0.09	<0.01	0.05	0.02	0.12	0.13	0.72
2,5-Dimethylbenzaldehyde	93	<0.01	0.08	0.01	NA	0.01	<0.01	0.02	0.01	0.91
Formaldehyde	1314	0.08	40.00	2.62	4.38	1.99	1.22	3.07	2.73	0.96
Hexaldehyde	1313	<0.01	4.45	0.05	0.01	0.02	0.02	0.04	0.22	0.25
Isovaleraldehyde	417	<0.01	0.35	0.02	NA	0.01	0.01	0.02	0.02	0.63
Propionaldehyde	1236	<0.01	1.72	0.10	0.25	0.08	0.04	0.13	0.11	0.88
Tolualdehydes	1312	<0.01	1.04	0.04	0.01	0.02	0.02	0.04	0.06	0.63
Valeraldehyde	1305	<0.01	1.49	0.04	<0.01	0.02	0.01	0.03	0.09	0.38

[1] = **BOLD** indicates the compound is prevalent for 2003 Program Year.
Italics indicates the chemical is an urban air toxics strategy HAP.

Table 3-3. Range of Detectable Values by Site

UATMP Site	Range of Detectable Values (ppbv)	Number of Valid Sampling Days		Number of Detects	Number of Concentrations > 5ppbv
		Carbonyl	VOC		
APMI	0.01-303.44	N/A	18	348	8
AZFL	0.002-4.43	59	N/A	604	0
BAPR	0.002-24.13	16	15	415	6
BGFL	0.0007-0.71	29	N/A	280	0
BOUT	0.004-18.14	29	28	691	7
BTMO	0.0008-8.61	54	N/A	558	12
BTUT	0.009-8.72	21	21	555	3
BUND	0.006-5.29	2	30	350	1
CANC	0.003-3.07	8	N/A	82	0
CANJ	0.0007-11.09	37	37	1040	4
CHNJ	0.0003-11.87	58	57	1503	9
CUSD	0.001-1,044.38	61	59	1427	9
CWFL	0.00009-15.87	60	N/A	641	1
DBFL	0.002-12.12	30	N/A	297	6
DECO	0.01-33.00	15	19	484	10
DEMI	0.005-74.06	27	24	729	8
DITN	0.02-1.89	1	2	37	0
EATN	0.002-8.78	23	24	687	5
ELNJ	0.003-47.50	51	53	1654	43
FLFL	0.001-2.51	27	N/A	273	0
GAFL	0.001-4.00	57	N/A	594	0
GPMS	0.0007-40.68	30	30	813	9
GRMS	0.003-97.05	22	21	556	15
HACT	0.002-16.54	36	N/A	373	33
HOMI	0.003-436.30	16	24	535	22
ITCMI	0.01-6.78	N/A	32	488	3
JAMS	0.003-57.65	29	28	801	14
KITN	0.002-136.07	26	26	710	8
LDTN	0.03-40	5	4	103	8
LEFL	0.004-3.25	58	N/A	609	0
LONE	0.003-20.40	17	17	404	7
LOTN	0.002-116.85	23	24	643	12
MCAZ	0.003-14.70	N/A	45	901	9
MDFL	0.0005-1.96	27	N/A	261	0
NBIL	0.007-1,934.33	N/A	35	587	5
NBNJ	0.002-15.28	51	51	1496	12
ORFL	0.001-5.10	45	N/A	488	1
PGMS	0.004-13.72	31	281	771	9
PSAZ	0.01-18.43	N/A	59	1259	28
QVAZ	0.01-10.21	N/A	30	423	4

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

UATMP Site	Range of Detectable Values (ppbv)	Number of Valid Sampling Days		Number of Detects	Number of Concentrations > 5ppbv
		Carbonyl	VOC		
S4MO	0.0002-30.74	61	61	1695	33
SFSD	0.002-147.13	50	55	1317	15
SJPR	0.003-20.16	16	15	456	0
SLMO	0.003-25.17	55	N/A	567	16
SPAZ	0.02-2,913.53	N/A	60	1248	42
TUMS	0.002-131.95	31	30	787	10
WECO	0.009-114.60	20	20	545	22

Table 3-4. Geometric Means by Site

UATMP Site	Geometric Mean (ppbv)			
	Carbonyls	Halogenated Hydrocarbons	Hydrocarbons	Polar
APMI	NA	11.18	4.41	0.82
AZFL	4.51	NA	NA	NA
BAPR	3.78	4.51	4.43	2.49
BGFL	0.74	NA	NA	NA
BOUT	4.49	1.76	4.92	2.87
BTMO	4.91	NA	NA	NA
BTUT	5.72	1.87	5.94	1.20
BUND	1.81	1.66	0.97	0.90
CANC	3.52	NA	NA	NA
CANJ	0.94	2.06	4.46	1.73
CHNJ	4.50	1.75	2.03	1.05
CUSD	4.39	1.76	2.56	2.87
CWFL	4.41	NA	NA	NA
DBFL	2.74	NA	NA	NA
DECO	10.38	2.30	9.01	1.85
DEMI	6.19	2.54	5.12	0.87
DITN	2.00	2.28	3.90	1.09
EATN	5.05	1.75	4.57	1.54
ELNJ	6.06	2.18	7.39	3.36
FLFL	2.68	NA	NA	NA
GAFL	3.76	NA	NA	NA
GPMS	2.81	1.88	3.46	3.90
GRMS	4.29	1.74	2.56	12.61
HACT	15.52	NA	NA	NA
HOMI	2.67	3.80	1.39	39.61
ITCMI	NA	1.68	2.10	1.19
JAMS	5.40	1.95	4.95	6.23
KITN	5.76	1.76	3.77	1.28
LDTN	37.96	1.60	2.54	0.93
LEFL	3.63	NA	NA	NA
LONE	4.32	1.63	2.97	6.54
LOTN	4.72	1.75	4.27	3.50
MCAZ	NA	2.09	5.47	3.68
MDFL	1.39	NA	NA	NA
NBIL	NA	2.11	2.29	1.02
NBNJ	5.21	1.82	3.82	1.43
ORFL	3.68	NA	NA	NA
PGMS	3.08	1.87	3.79	2.39
PSAZ	NA	2.72	7.75	3.67
QVAZ	NA	1.70	1.14	1.77

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

UATMP Site	Geometric Mean (ppbv) Carbonyls	Halogenated Hydrocarbons	Hydrocarbons	Polar
S4MO	7.09	1.91	4.35	2.58
SFSD	5.21	1.79	2.52	2.87
SJPR	6.40	2.33	8.28	3.36
SLMO	7.27	NA	NA	NA
SPAZ	NA	2.20	11.45	6.35
SPIL	NA	2.29	3.69	0.67
TUMS	3.78	2.01	2.40	6.00
WECO	5.63	1.78	5.91	34.76

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

Compound	Formula Weight	# Detects	Average Concentration (μg/m^3)	Cancer URE[1] (1/(μg/m^3))	Cancer Weighted Toxicity	Cancer Risk (Out of 1 million)	% Contribution Weighted Toxicity	Cumulative % Contribution Weighted Toxicity
Tetrachloroethylene	165.85	308	37.56	5.90 E-06	2.22 E-04	222	58.84	58.84
Acrylonitrile	53.06	76	1.48	6.80E-05	1.01 E-04	101	26.77	85.61
Benzene	78.11	1160	1.45	7.80 E-06	1.13 E-05	11.3	3.00	88.61
1,3-Butadiene	54.09	401	0.29	3.00 E-05	8.64 E-06	8.64	2.29	90.90
Carbon Tetrachloride	153.82	1040	0.54	1.50 E-05	8.16 E-06	8.16	2.17	93.07
p-Dichlorobenzene	147.00	180	0.55	1.10 E-05	6.05 E-06	6.05	1.61	94.68
Acetaldehyde	44.05	1314	2.49	2.20 E-06	5.48 E-06	5.48	1.46	96.13
Elthylene Dichloride	98.96	7	0.19	2.60 E-05	4.91 E-06	4.91	1.30	97.44
Trichloroethylene	131.40	140	2.02	2.00 E-06	4.05 E-06	4.05	1.07	98.51
1,3-Dichloropropene	110.97	4	0.56	4.00 E-06	2.24 E-06	2.24	0.59	99.11
1,1,2-Trichloroethane	133.41	1	0.11	1.60 E-05	1.75 E-06	1.75	0.46	99.57
Vinyl Chloride	62.50	3	0.12	8.80 E-06	1.05 E-06	1.05	0.28	99.85
Methylene Chloride	84.94	738	1.10	4.70 E-07	5.20 E-07	<1	0.14	99.99
Bromoform	253.75	1	0.03	1.10 E-06	2.97 E-08	<1	0.01	100.00
Formaldehyde	30.03	1314	3.22	5.50 E-09	1.77 E-08	<1	<0.01	100.00
			Total Cancer Toxicity		3.77 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/m^3 in air.

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

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

Compound	Formula Weight	# Detects	Average Concentration ($\mu g/m^3$)	Noncancer RfC[1] (mg/m^3)	Noncancer Weighted Toxicity	Adverse Health Concentrations	% Contribution Weighted Toxicity	Cumulative % Contribution Weighted Toxicity
Acetonitrile	45.07	487	45.29	0.06	7.54 E-01	49	27.43	27.43
Acrylonitrile	53.06	76	1.48	0.002	7.42 E-01	15	25.47	52.90
Formaldehyde	30.03	1314	3.22	0.0098	3.29 E-01	47	11.29	64.19
Acetaldehyde	44.05	1314	2.49	0.009	2.77 E-01	21	9.51	73.70
Methyl Bromide	94.94	55	1.23	0.005	2.46 E-01	2	8.45	82.15
1,3-Butadiene	54.09	401	0.29	0.002	1.44 E-01	0	4.95	87.09
Tetrachloroethylene	165.85	308	37.56	0.27	1.39 E-01	10	4.78	91.87
Xylenes (*o*-,*m*,-*p*-)	318.48	1096	5.87	0.1	5.87 E-02	0	2.02	93.89
Benzene	78.11	1160	1.45	0.03	4.83 E-02	0	1.66	95.55
Chloroprene	88.50	6	0.28	0.007	3.96 E-02	0	1.36	96.91
1,3-Dichloropropene	110.97	4	0.56	0.02	2.80 E-02	0	0.96	97.87
Methyl Chloride	50.49	1158	1.28	0.09	1.43 E-02	0	0.49	98.36
Carbon Tetrachloride	153.82	1040	0.54	0.04	1.36 E-02	0	0.47	98.83
Toluene	92.13	1161	4.46	0.4	1.12 E-02	0	0.38	99.21
Chloroform	120.39	258	0.41	0.098	4.23 E-03	0	0.15	99.36
Trichloroethylene	131.40	140	2.02	0.6	3.37 E-03	0	0.12	99.47
1,1-Dichloroethene	96.95	1	0.66	0.2	3.28 E-03	0	0.11	99.58
Methyl Methacrylate	100.12	12	1.55	0.7	2.21 E-03	0	0.08	99.66

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
1,2,4-Trichlorobenzene	181.46	5	0.32	0.2	1.60 E-03	0	0.05	99.72
Vinyl Chloride	62.50	3	0.12	0.1	1.19 E-03	0	0.04	99.76
Methylene Chloride	84.94	738	1.11	1	1.11 E-03	0	0.04	99.79
Methyl *tert*-Butyl Ether	88.15	394	3.21	3	1.07 E-03	0	0.04	99.83
Ethylbenzene	106.16	943	1.01	1	1.01 E-03	0	0.03	99.87
Methyl Ethyl Ketone	72.11	699	4.71	5	9.43 E-04	0	0.03	99.90
p-Dichlorobenzene	147.00	180	0.55	0.8	6.88 E-04	0	0.02	99.92
Styrene	104.14	458	0.65	1	6.49 E-04	0	0.02	99.94
Chlorobenzene	112.56	12	0.59	1	5.92 E-04	0	0.02	99.96
Methyl Isobutyl Ketone	100.16	131	1.30	3	4.33 E-04	0	0.01	99.98
1,1,2-Trichloroethane	133.41	1	0.11	0.4	2.73 E-04	0	0.01	99.99
Methyl Chloroform	133.42	405	0.23	1	2.32 E-04	0	0.01	100.00
Ethylenedichloride	98.96	7	0.19	2.4	7.87 E-05	0	<0.01	100.00
Ethyl Chloride	64.52	26	0.30	10	2.96 E-05	0	<0.01	100.00
			Total Noncancer Toxicity		2.91 E+00			

[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	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
1,3-Butadiene	-0.02	-0.05	-0.27	-0.16	-0.32	0.04	-0.10	-0.15
Acetaldehyde	0.08	0.04	0.03	0.03	-0.02	0.08	-0.06	0.03
Acetonitrile	0.01	0.02	-0.05	-0.02	-0.09	-0.10	0.11	0.04
Acrylonitrile	0.18	0.20	-0.04	0.06	-0.28	-0.28	0.07	0.01
Benzene	-0.05	-0.07	-0.19	-0.13	-0.20	0.08	-0.09	-0.03
Bromomethane	-0.29	-0.26	-0.22	-0.26	0.01	0.16	0.15	-0.14
Carbon Tetrachloride	0.20	0.20	0.16	0.19	-0.04	-0.10	-0.02	0.03
Formaldehyde	0.10	0.07	0.04	0.05	-0.04	0.01	<0.01	-0.08
Tetrachloroethylene	-0.17	-0.19	-0.11	-0.17	0.09	0.05	0.07	0.11
Xylenes (*o*-,*m*-,*p*-)	0.13	0.12	-0.02	0.06	-0.20	<0.01	-0.10	-0.06

Table 3-7. Summary of Mobile Information by Site

UATMP Site	Estimated No. of County Motor Vehicles Owned	2002 County Population	Estimated Traffic Near Site	County-Level On-Road Emissions (tpy)	County-Level Non-Road Emissions (tpy)	Hydrocarbon Arithmetic Mean (ppbv)
APMI	1,734,417	2,045,540	60,000	12,013	2,003	4.80
AZFL	1,139,738	926,716	51,000	4,690	2,176	N/A
BAPR	12,362	22,556	10	96	127	5.42
BGFL	889,710	1,190,390	12,200	5,089	3,871	N/A
BOMA	562,969	689,925	27,287	1,432	2,123	N/A
BOUT	177,652	249,224	11,120	1,163	449	5.24
BTMO	41,871	56,775	4,360	336	62	N/A
BTUT	177,652	249,224	33,310	1,163	449	6.64
BUND	13,203	8,542	1,350	34	59	1.09
CANC	25,854	27,288	100	136	38	N/A
CANJ	393,869	511,957	62,000	2,126	670	5.02
CHNJ	366,433	478,730	12,623	1,740	1,296	2.38
CUSD	8,820	7,467	1,940	48	34	3.50
CWFL	1,139,738	926,716	1,000	4,690	2,176	N/A
DBFL	889,710	1,190,390	201,032	5,089	3,871	N/A
DECO	415,535	560,415	44,200	2,610	1,011	9.66
DEMI	1,734,417	2,045,540	12,791	12,013	2,003	5.90
DITN	39,083	44,231	4,420	284	64	4.89
E7MI	1,734,417	2,045,540	6,999	12,013	2,003	N/A
EATN	590,410	570,785	38,540	4,012	1,078	5.07
ELNJ	407,799	530,763	170,000	1,889	631	9.18
FLFL	1,195,203	1,709,118	1,000	7,605	2,810	N/A
GAFL	763,989	1,053,864	81,460	4,956	2,265	N/A
GPMS	155,303	190,936	17,000	1,080	1,457	4.26
GRMS	15,714	22,915	1,100	154	135	2.86

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

UATMP Site	Estimated No. of County Motor Vehicles Owned	2002 County Population	Estimated Traffic Near Site	County-Level On-Road Emissions (tpy)	County-Level Non-Road Emissions (tpy)	Hydrocarbon Arithmetic Mean (ppbv)
HACT	686,895	867,332	10,000	3,615	1,424	N/A
HOMI	12,454	14,950	7,000	55	291	2.21
ITCMI	32,552	38,898	100,000	292	615	2.73
JAMS	176,453	249,579	12,500	1,487	258	5.29
KITN	160,005	153,051	300	1084	248	3.96
LDTN	35,698	40,631	13,360	353	185	3.16
LEFL	763,989	1,053,864	1,055	4,956	2,265	N/A
LONE	197,341	257,513	6,200	1,172	353	3.23
LOTN	590,410	570,785	3,000	4,012	1,078	5.46
MCAZ	2,742,367	3,303,876	10,108	10,106	5,584	7.35
MDFL	1,699,557	2,332,599	15,200	8,661	3,879	N/A
NBIL	2,087,197	5,377,507	34,900	21,526	6,715	3.13
NBNJ	591,406	775,549	63,000	2,658	1,259	4.22
ORFL	750,761	946,484	59,000	5,700	2,475	N/A
PGMS	112,820	133,259	8,600	802	1,167	4.61
PLOR	721,796	677,626	1,000	3,119	1,141	N/A
PNW	721,796	677,626	500	3,119	1,141	N/A
POOK	41,888	47,680	1,496	341	176	N/A
PSAZ	2,742,367	3,303,876	250	10,107	5,584	10.65
QVAZ	165,676	196,275	200	1,010	206	2.51
S4MO	252,556	338,353	22,840	2,024	463	5.11
SFSD	148,759	152,545	4,320	641	213	2.87
SJPR	238,799	433,412	51,000	1,656	2,183	8.71
SLMO	252,556	338,353	15,016	2,024	463	N/A
SPAZ	2,742,367	3,303,876	50,000	10,107	5,584	13.97
SPIL	2,087,197	5,377,507	214,900	21,526	6,715	4.38
TUMS	65,844	77,220	4,900	540	170	2.90

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

UATMP Site	Estimated No. of County Motor Vehicles Owned	2002 County Population	Estimated Traffic Near Site	County-Level On-Road Emissions (tpy)	County-Level Non-Road Emissions (tpy)	Hydrocarbon Arithmetic Mean (ppbv)
WECO	415,535	374,099	1,500	1,692	420	6.97

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

Site	MSA	Fuel Program	Fuel Additive	
			Summer[1]	Winter[2]
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
DECO	Denver-Aurora, CO	Winter-oxygenated	n/a[3]	Ethanol
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
MCAZ	Phoenix-Mesa-Scottsdale, AZ	Winter-oxygenated	n/a	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	Ethanol
QVAZ	Phoenix-Mesa-Scottsdale, AZ	Winter-oxygenated	n/a	Ethanol
S4MO	St. Louis, MO-IL	RFG Opt-in	MTBE Ethanol	MTBE Ethanol TAME

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

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

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

[2] 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.

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

Table 3-9. Summary of the National Emission Standards for Volatile Organic Compounds

Rule Title	Applicability	Affected Equipment	Overall Percent Reduction	Compliance Date
National Volatile Organic Compound Emission Standards for Architectural Coatings (40 CFR part 59, subpart D)	Manufacturers and importers of architectural coatings (e.g., interior and exterior paints, traffic markings, sign paints, industrial maintenance coatings) that are recommended for field application to stationary structures and their appurtenances.	The rule establishes VOC content limits in coatings rather than VOC emission limits for process equipment.	20	Coatings that are manufactured after September 13, 1999, and for any architectural coating registered under the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. Section 136, et seq.), the rule applies to any such coating manufactured on or after March 13, 2000, for sale or distribution in the United States.)
National Volatile Organic Compound Emission Standards for Consumer Products (40 CFR part 59, subpart C)	The rule applies to manufacturers, importers, and distributors of subject consumer products[a] manufactured or imported on or after December 10, 1998, for sale or distribution in the United States, including the District of Columbia and all United States territories.	The rule establishes VOC content limits in products rather than VOC emission limits for process equipment.	20	Consumer products manufactured or imported on or after December 10, 1998
National Volatile Organic Compound Emission Standards for Automobile Refinish Coatings (40 CFR part 59, subpart B)	The provisions of the rule apply to automobile refinish coatings and coating components that are manufactured on or after January 11, 1999 for sale or distribution in the United States, including the District of Columbia and all U.S. territories.	The rule establishes VOC content limits in refinish coatings and coating components rather than VOC emission limits for process equipment.	33	Refinish coatings and coating components that are manufactured on or after January 11, 1999

[a] Consumer product means any household or institutional product (including paints, coatings, and solvents), or substance, or article (including any container or packaging) held by any person, the use, consumption, storage, disposal, destruction, or decomposition of which may result in the release of VOC.

Table 3-10. Summary of Potentially Applicable National Emission Standards for Hazardous Air Pollutants

SIC Description	Regulation Citation	Regulation Title	UATMP Pollutants Covered by Regulation	Overall Percent Reduction	Compliance Date
Motor Vehicles and Passenger Car Bodies (SIC Code 3711)	40 CFR part 63, subpart IIII	Auto and Light Duty Trucks (Surface Coating) NESHAP	Methyl ethyl ketone, methyl isobutyl ketone, ethylbenzene, toluene, and xylene	60	2007
Plastic Foam Products (SIC Code 3086)	40 CFR part 63, subpart MMMMM	Flexible Polyurethane Foam Fabrication Operation NESHAP	Methylene chloride	100	2004
Plastic Foam Products (SIC Code 3086)	40 CFR part 63, subpart III	Flexible Polyurethane Foam Production NESHAP	Methylene Chloride	70	2001
Steel works, Blast Furnaces (Including Coke Ovens), and Rolling Mills (SIC Code 3312)	40 CFR part 63, subpart FFFFF	Integrated Iron and Steel NESHAP	Manganese, lead, and benzene	20	2006
Metal Cans (SIC Code 3411)	40 CFR part 63, subpart KKKK	Metal Can (Surface Coating) NESHAP	Hexane, methyl ethyl ketone, methyl isobutyl ketone, and xylene	70	2006
Coating, Engraving, and Allied Services, NEC (SIC Code 3479)	40 CFR part 63, subpart SSSS	Metal Coil (Surface Coating) NESHAP	Methyl ethyl ketone, toluene, and xylene	53	2005
Paints, Varnishes, Lacquers, Enamels, and Allied Products (SIC Code 2851) Adhesives and Sealants (SIC Code 2891)	40 CFR part 63, subpart HHHHH	Miscellaneous Coating Manufacturing NESHAP	Toluene, xylene, methyl ethyl ketone, and methyl isobutyl ketone	64	2006

Table 3-10. Summary of Potentially Applicable National Emission Standards for Hazardous Air Pollutants (Continued)

SIC Description	Regulation Citation	Regulation Title	UATMP Pollutants Covered by Regulation	Overall Percent Reduction	Compliance Date
Electroplating, Plating, Polishing, Anodizing, and Coloring (SIC Code 3471) Pumps and Pumping Equipment, NEC (SIC Code 3561) Railroad Equipment (SIC Code 3743) Automatic Controls for Regulating Residential and Commercial Environments and Appliances (SIC Code 3822)	40 CFR part 63, subpart MMMM	Miscellaneous Metal Parts and Products (Surface Coating) NESHAP	Ethylbenzene, methyl ethyl ketone, methyl isobutyl ketone, styrene, toluene, and xylene	48	2007
Industrial Inorganic Chemicals, NEC (SIC Code 2819) Pharmaceutical Preparations (SIC Code 2834) Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments (SIC Code 2865) Industrial Organic Chemicals, NEC (SIC Code 2869)	40 CFR part 63, subpart FFFF	Miscellaneous Organic Chemical Production and Processes (MON) NESHAP	Methylene chloride, toluene, and xylene	69	2006
Petroleum Bulk Stations and Terminals (SIC Code 5171)	40 CFR part 63, subpart EEEE	Organic Liquids Distribution (non-Gasoline) NESHAP	Benzene, ethylbenzene, toluene, vinyl chloride, and xylene	28	2002
Commercial Printing, Gravure (SIC Code 2754) Unsupported Plastics Film and Sheet (SIC Code 3081)	40 CFR part 63, subpart JJJJ	Paper and Other Web (Surface Coating) NESHAP	Toluene, methyl ethyl ketone, xylenes, hexane, methyl isobutyl ketone, formaldehyde, methylene chloride, ethylbenzene	80	2005

Table 3-10. Summary of Potentially Applicable National Emission Standards for Hazardous Air Pollutants (Continued)

SIC Description	Regulation Citation	Regulation Title	UATMP Pollutants Covered by Regulation	Overall Percent Reduction	Compliance Date
Plastics Foam Products (SIC Code 3086)	40 CFR part 63, subpart PPPP	Plastic Parts (Surface Coating) NESHAP	Methyl ethyl ketone, methyl isobutyl ketone, toluene, and xylene	80	2004
Petroleum Refining (SIC Code 2911)	40 CFR part 63, subpart UUU	Petroleum Refineries-Catalytic Cracking, Catalytic Reforming, and Sulfur Plant Units NESHAP	Acetaldehyde, benzene, formaldehyde, hexane, toluene, xylene, manganese, nickel, antimony, arsenic, beryllium, cadmium, chromium, cobalt, and lead	87	2005
Medicinal Chemical and Botanical Products (SIC Code 2833) Pharmaceutical Preparations (SIC Code 2834) Cyclic Organic Crudes, and Intermediates, and Organic Dyes and Pigments (SIC Code 2865)	40 CFR part 63, subpart GGG	Pharmaceutical Production NESHAP	Hexane, Methylene, Chloride, and Toluene	65	2001
Medicinal Chemicals and Botanical Products (SIC Code 2833) Petroleum Refining (SIC Code 2911) Photographic Equipment and Supplies (SIC Code 3861) Electric Services (SIC Code 4911)	40 CFR part 63, subpart ZZZZ	Reciprocating Internal Combustion Engines NESHAP	Acetaldehyde and formaldehyde	65	2007

Table 3-11. Summary of Pollutants and Sources Regulated

Monitoring Station	Ten Mile Point UATMP Emissions (tpy)[1]	Number of Point Source Facilities Within Ten Miles[1]	Number of Point Source Facilities Subject to Future Regulations	UATMP Pollutants Covered in New Regulations	Expected Reduction (%)
Arizona: PSAZ	228.2	20	2	Methylene Chloride	66
				Methyl Ethyl Ketone	8
				Toluene	0.2
Florida: LEFL	144.22	16	1	Acetaldehyde	0.5
				Formaldehyde	0.8
Illinois: NBIL	383.55	51	2	Methyl Ethyl Ketone	25
				Methyl Isobutyl Ketone	19
				Toluene	4
Massachusetts: BOMA	291.00	17	5	Acetaldehyde	0.3
				Benzene	18
				Ethylbenzene	10
				Formaldehyde	0.01
				Toluene	6
Michigan: DEMI	421.35	12	7	Ethylbenzene	41
				Formaldehyde	0.1
				Methyl Ethyl Ketone	45

Table 3-11. Summary of Pollutants and Sources Regulated (Continued)

Monitoring Station	Ten Mile Point UATMP Emissions (tpy)[1]	Number of Point Source Facilities Within Ten Miles[1]	Number of Point Source Facilities Subject to Future Regulations	UATMP Pollutants Covered in New Regulations	Expected Reduction (%)
Michigan DEMI:				Methyl Isobutyl Ketone	44
				Toluene	12
Missouri: SLMO	3771.99	38	16	Acetaldehyde	0.6
				Benzene	4
				Ethylbenzene	11
				Formaldehyde	9
				Lead Compounds	10
				Manganese Compounds	13
				Methyl Ethyl Ketone	25
				Methyl Isobutyl Ketone	26
				Methylene Chloride	59
				Toluene	28

Table 3-11. Summary of Pollutants and Sources Regulated (Continued)

Monitoring Station	Ten Mile Point UATMP Emissions (tpy)[1]	Number of Point Source Facilities Within Ten Miles[1]	Number of Point Source Facilities Subject to Future Regulations	UATMP Pollutants Covered in New Regulations	Expected Reduction (%)
Utah: BOUT	464.58	4	4	Acetaldehyde	47
				Antimony Compounds	81
				Arsenic Compounds	44
				Benzene	0.3
				Beryllium Compounds	17
				Cadmium Compounds	47
				Cobalt Compounds	87
				Formaldehyde	62
				Lead Compounds	49
				Manganese Compounds	59
				Nickel Compounds	78
				Toluene	0.05

[1] Ten mile point UATMP pollutant emissions and facilities that contributed to 90% of the area's emissions.

4.0 Sites in Arizona

This section focuses on meteorological, concentration, and spatial trends for the four UATMP sites in Arizona (MCAZ, PSAZ, QVAZ, and SPAZ). 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 stations in their urban locations. Figures 4-5 and 4-6 are maps identifying facilities within ten miles of the sites that reported to the 1999 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 only two nearby industrial sources. MCAZ, PSAZ and SPAZ are located near mainly two types of industries: surface coating and fuel combustion. QVAZ is nearest to a surface coating facility.

Hourly meteorological data were retrieved for all of 2003 at two weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The two weather stations are Phoenix-Sky Harbor and Phoenix-Deer Valley (WBAN 23183 and 3184, respectively).

Table 4-1 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), 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. 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). Table 4-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

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. Tables 4-2a-d summarize the cancer weighting scores and Tables 4-3a-d summarize 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.

Tables 4-2a-d show that most of the prevalent cancer compounds reflect the nationwide prevalent cancer list, which is in Section 3 of this report. Only 1,3-dichloropropene (detected at MCAZ and PSAZ) are not listed among the nationwide prevalent compounds. Of the prevalent noncancer compounds summarized in Tables 4-3a-d, the compounds 1,3-dichloropropene (detected at MCAZ and PSAZ), chloroprene (detected at MCAZ), chloromethane (detected at MCAZ), and toluene (detected at MCAZ and PSAZ) are not listed among the nationwide noncancer prevalent list.

The following toxic compounds were not detected at any of the Phoenix MSA sites: vinyl chloride, chloroprene, and 1,1-dichloroethene. Note, carbonyls were not sampled at the Arizona sites; therefore, acetaldehyde and formaldehyde would not be detected.

4.2 Toxicity Analysis

Acrylonitrile and 1,3-butadiene were the only prevalent cancer compounds across all four sites, and were among the top four in toxicity weighting at each site. Although acrylonitrile's toxicity is consistently the highest of all cancer compounds across the Phoenix MSA sites, the number of detects is low (range 1-16). This observation would suggest that the prevailing wind on certain high days passed over localized sources of acrylonitrile. Benzene detections were the highest among all the sites (30-60). Acrylonitrile, 1,3-butadiene, and xylenes (total) were the only noncancer compounds to be considered prevalent across all four sites, and were the top three in that order by toxicity weighting at three of the four sites.

The acrylonitrile cancer risk at QVAZ was the highest among the four sites at 293 in a million, while at PSAZ, MCAZ, and SPAZ, the acrylonitrile cancer risk was 85.9, 35.2, and 23.8 in a million, respectively. Cancer risk from exposure to benzene was also high at MCAZ, PSAZ, and SPAZ (12.9, 22.8, and 23.8 in a million, respectively), while at QVAZ, 1,3-butadiene had the second highest risk at 17.6 in a million.

For the compounds which may lead to adverse noncancer health effects, the average acrylonitrile toxicity at QVAZ was 2.16 (over 1 indicates a significant chance of a noncancer health effect). Of the sixteen measured acrylonitrile concentrations, 13 were above the acrylonitrile noncancer RfC weighting factor at QVAZ. At SPAZ, the average acetonitrile toxicity was 32.2 for forty-one measurements. One acetonitrile measurement on June 20, 2003 is driving this high average.

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 are listed in Table 4-1. By far, the SPAZ site has the highest average UATMP concentrations. Tables 4-4a-d summarize the 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 MCAZ, *p*-dichlorobenzene had the strongest correlations (-0.55 to -0.69, and 0.23 to 0.51) with almost all of the meteorological parameters, while chloromethane had consistently weak correlations (-0.08 to 0.10). Most of the compound correlations with the meteorological parameters were negative. Pearson correlations could not be computed for 1,3-dichloropropene, acrylonitrile, or chloroprene due to the low number of detects (fewer than 4).

At PSAZ, acetonitrile and 1,3-butadiene had the strongest correlations among the prevalent compounds, while carbon tetrachloride generally had the lowest correlations. Most of the compound correlations with the meteorological parameters were negative. Pearson correlations could not be computed for 1,3-dichloropropene due to the low number of detects (fewer than 4).

At QVAZ, acrylonitrile correlations were mostly positive, while xylenes (total) were mostly negative. The dew point and wet bulb temperature correlations for acrylonitrile were the strongest (0.74 and 0.72, respectively). Pearson correlations could not be computed for 1,3-butadiene and tetrachloroethylene due to the low number of detects (fewer than 4).

At SPAZ, tetrachloroethylene had the strongest correlations among the prevalent compounds, while carbon tetrachloride generally had the lowest correlations. Most of the compound correlations were negative with the meteorological parameters. Pearson correlations could not be computed for acrylonitrile due to the low number of detects (fewer than 4).

4.4 Spatial Analysis

County-level car registration and population in Maricopa County, AZ, 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. Also included in Table 4-5 is the population within 10-miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10-mile car registrations was computed using the 10 mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds 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 ten miles.

These two sites also have the highest average daily 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 3-1 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; SPAZ only partly resembles the ratios, and the QVAZ site does not resemble these ratios at all.

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 an RFG additive in the Phoenix MSA is ethanol. Figures 4-7 through 4-10 are the VOC profiles at the Arizona sites.

At MCAZ (Figure 4-7), the total VOC concentrations were varied, with the highest concentration occurring on April 15, 2003. On that day, the BTEX contribution was much higher than on other sampling days. The non-HAP concentrations were typically low or non-existent. The sampling at MCAZ ran from April 3 - December 29, thus missing most of the winter season. However, there does not appear to any reduction in total VOCs or the BTEX compounds during the winter season. It appears that the summer VOC and BTEX concentrations were generally lower than the winter VOC and BTEX concentrations.

At PSAZ (Figure 4-8), the total VOC concentrations were also varied, with the highest concentration occurring on December 5, 2003. On that day, the Mobile HAP contribution (BTEX and non-BTEX) was much higher than on other sampling days. The stationary source HAP concentrations were typically low. The sampling at PSAZ ran from January 3 - December 29, thus encompassing the winter season. There does not appear to be any reduction in total VOCs or the BTEX compounds during the winter season. Similar to MCAZ, it appears that the summer VOC and BTEX concentrations were generally lower than the winter VOC and BTEX concentrations. The non-HAP VOCs also appear to be more prevalent outside the winter period.

At QVAZ (Figure 4-9), the total VOC concentrations were low, with the highest concentration occurring on January 21, 2003. On that day, the Mobile HAP contribution (BTEX and non-BTEX) was much higher than on other sampling days. The stationary source HAP concentrations are typically low. The sampling at QVAZ ran from January 9 - December 29, thus encompassing the winter season. There does not appear to any reduction in total VOCs or the BTEX compounds during the winter season. The non-HAP concentrations were virtually non-existent, only being detected on three sample days.

At SPAZ (Figure 4-10), the total VOC concentrations were also varied, with two very high concentrations occurring on February 2, 2003, and June 20, 2003. On those days (both Noncancer Benchmark exceedance days), the stationary source HAP contribution were much higher than other sampling days. Typically, the mobile source HAP concentrations were typically low. The sampling at SPAZ ran from January 3 - December 29, thus encompassing the winter season. There does not appear to any reduction in total VOCs or the BTEX compounds during the winter season. Similar to MCAZ and PSAZ, it appears that the summer VOC and BTEX concentrations were generally lower than the winter VOC and BTEX concentrations. The non-HAP VOCs also appear to be more prevalent outside the winter period.

4.6 NATTS Site Analysis

One of the Phoenix sites, PSAZ, is an EPA-designated NATTS site. A description of the NATTS program is given in Section 3.6 of this report. For PSAZ, each of the following analyses were conducted: a composite back trajectory analysis, a regulation analysis, and an emission tracer analysis. Details on each type of analysis are also provided in Section 3.6.

4.6.1 Composite Back Trajectory Analysis

Figure 4-11 is the composite back trajectory map for the PSAZ site. 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 4-11, the majority of the back trajectories originated from the west and southwest of PSAZ, or from southern California, southwest Arizona or portions of northwest Mexico. A second cluster of trajectories originated from the east or southeast of PSAZ, or from eastern and southeastern Arizona and western New Mexico. The 24-hour airshed domain for PSAZ is large, as the farthest away a back trajectory originated was central Idaho, over 600 miles away. As each circle around the site represents 100 miles, 71% of the trajectories originated within 200 miles, and 87% within 300 miles from the PSAZ site.

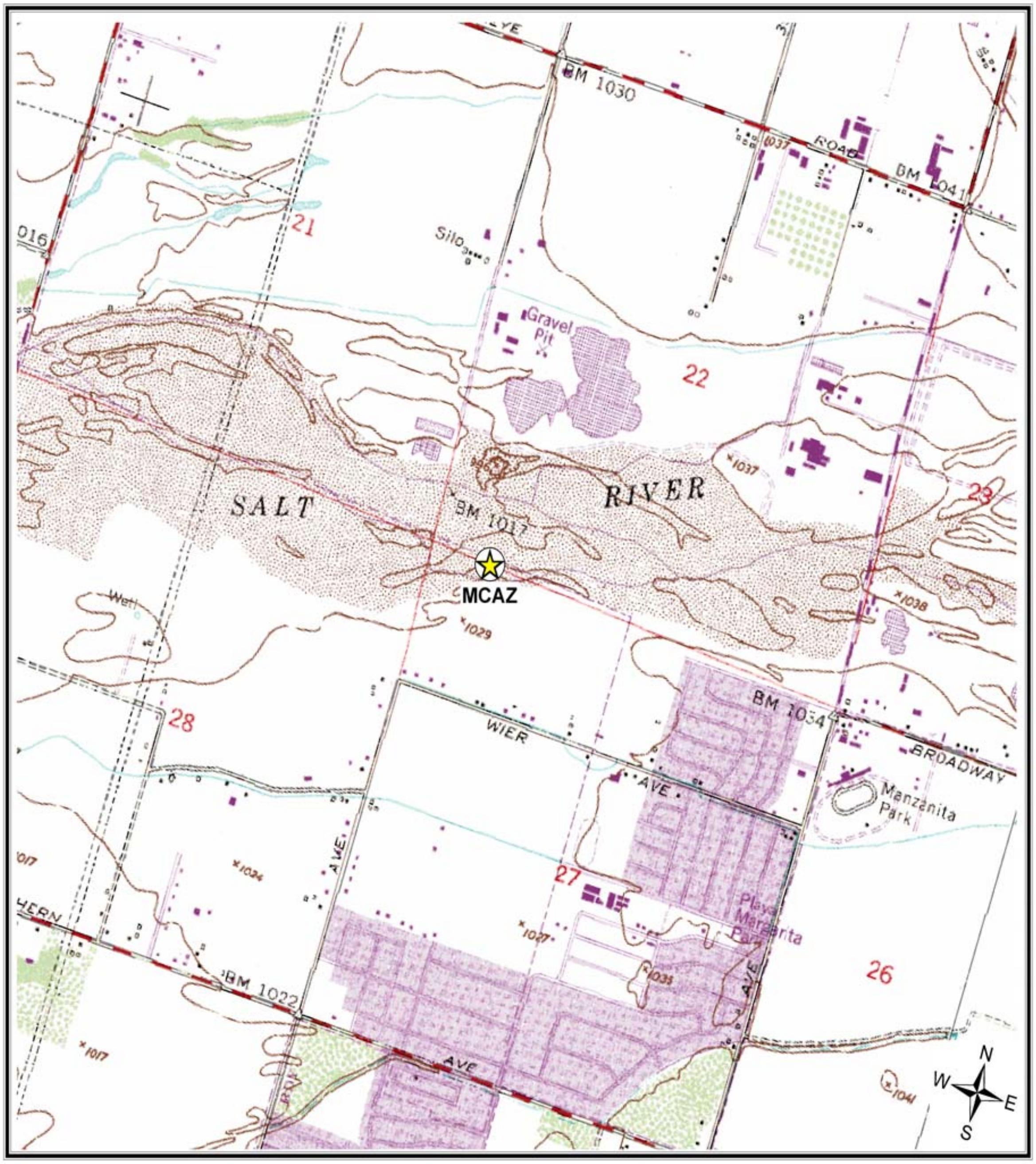
4.6.2 Regulation Analysis

Table 3-10 summarizes the number of facilities that account for approximately 90% of the total UATMP pollutant emissions in the 10-mile area around the PSAZ monitoring station. At PSAZ, of the 20 facilities listed in Table 3-11, two are potentially subject to future regulations. Table 4-6 identifies the regulations that are potentially applicable. Based on this analysis, the regulations shown are expected to achieve reductions in ambient concentrations of the following UATMP pollutants: methylene chloride, methyl ethyl ketone, and toluene. Reductions are projected for methylene chloride (100%), methyl ethyl ketone (8%), and toluene (0.2%) as the regulations are implemented (the latest compliance date is 2007). The emission reductions are primarily attributed to regulation of surface coating of metal parts and flexible polyurethane foam manufacturing.

4.6.3 Emission Tracer Analysis

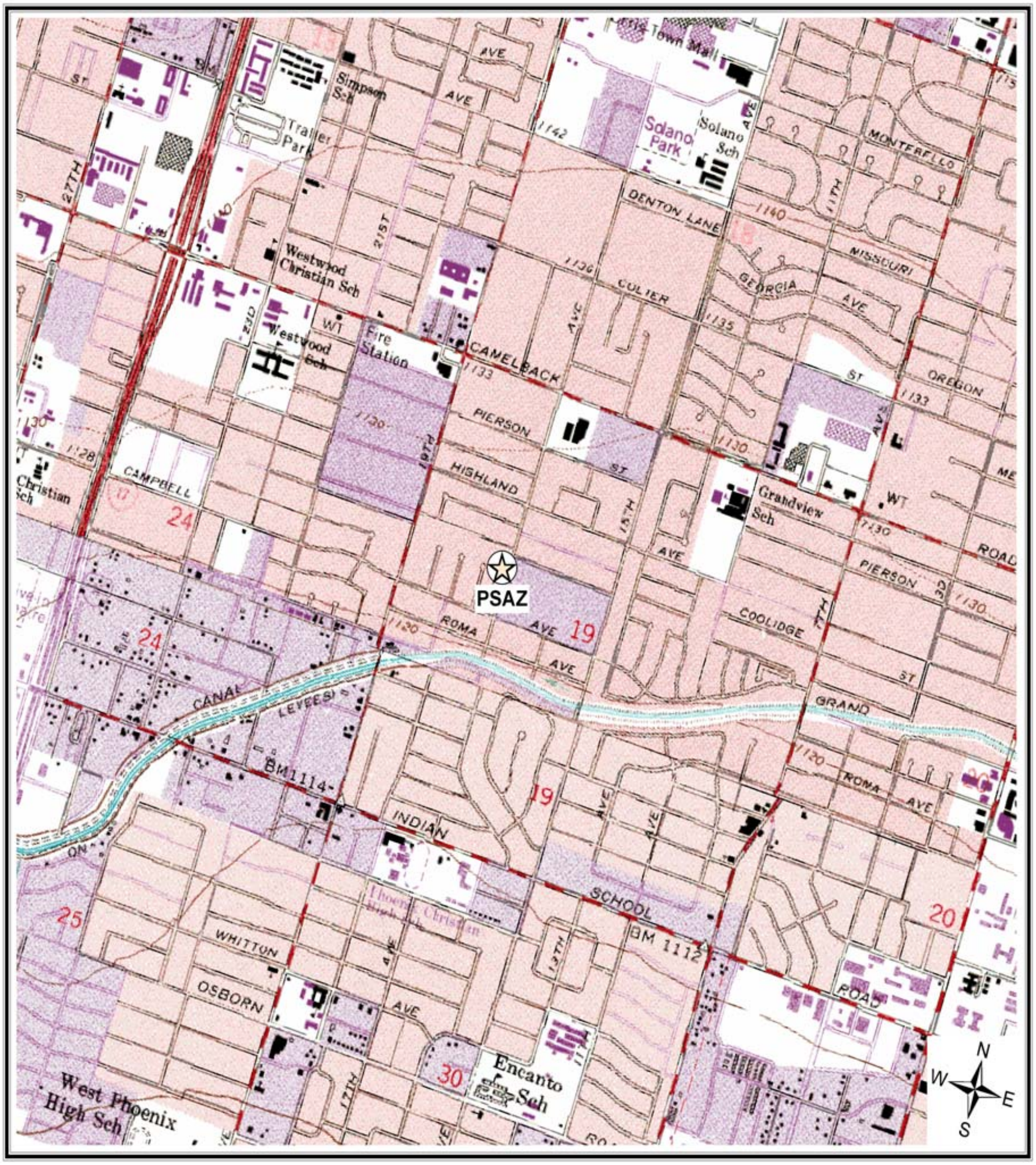
The highest noncancer toxicity measurement occurring at PSAZ was acrylonitrile on October 12, 2003. Figure 4-12 is the pollution rose for all acrylonitrile samples at PSAZ. As can be shown, the lone exceedance points to possible acrylonitrile emission sources east of the monitor. Figure 4-13 is a map of acrylonitrile stationary emission sources east of the PSAZ monitor. According to the 1999 NEI, the Salt River-Pima-Maricopa Indian Community Landfill and the Apache Junction Municipal Solid Waste Landfills are directly east of the monitoring site. It is likely that air sampled at PSAZ on this date passed over these landfills earlier in the day. Figure 4-14 is a back trajectory map for this date, which shows the air originating east of the monitor. It is interesting to note that in Figure 4-8, the VOC profile plotted for October 12 doesn’t highlight anything unusual in the magnitude of the stationary source VOC HAPs in comparison to other sampling days. However, the average 24-hour wind flow for this exceedance day was from the east; for the other sampling days when acrylonitrile was measured, the wind flow originated from other wind directions.

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



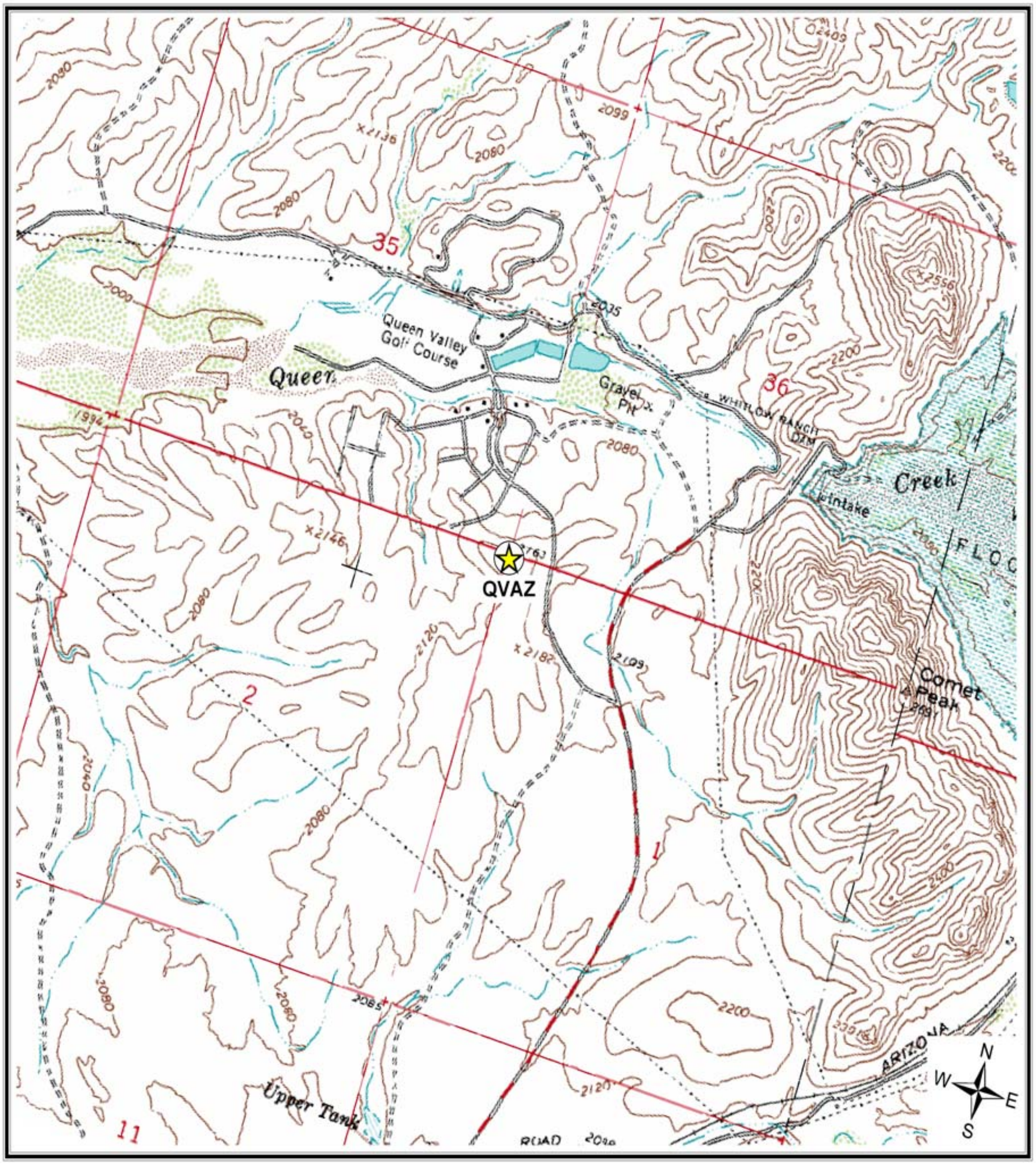
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

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



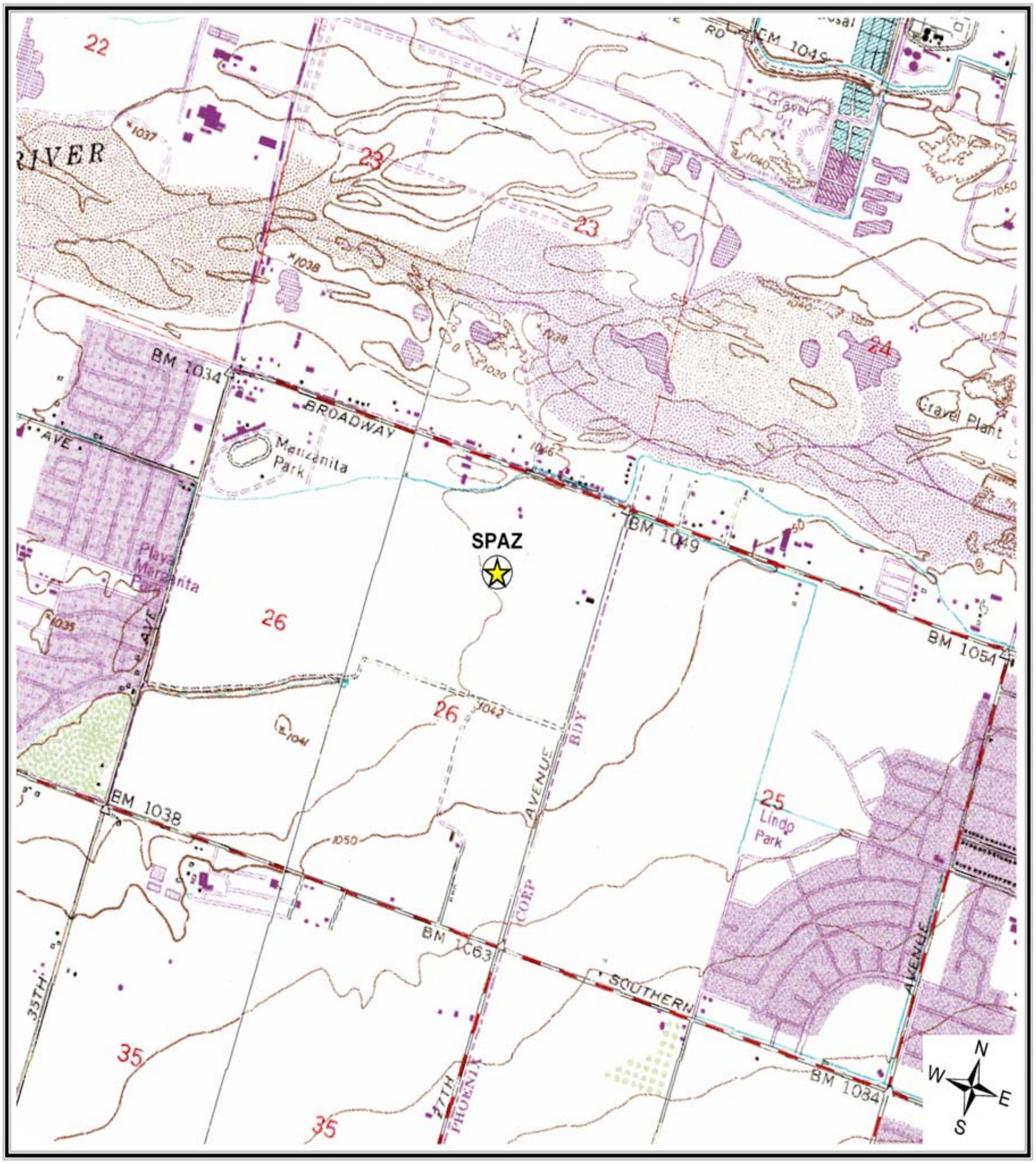
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

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



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

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



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

Figure 4-5. Facilities Located Within 10 Miles of QVAZ

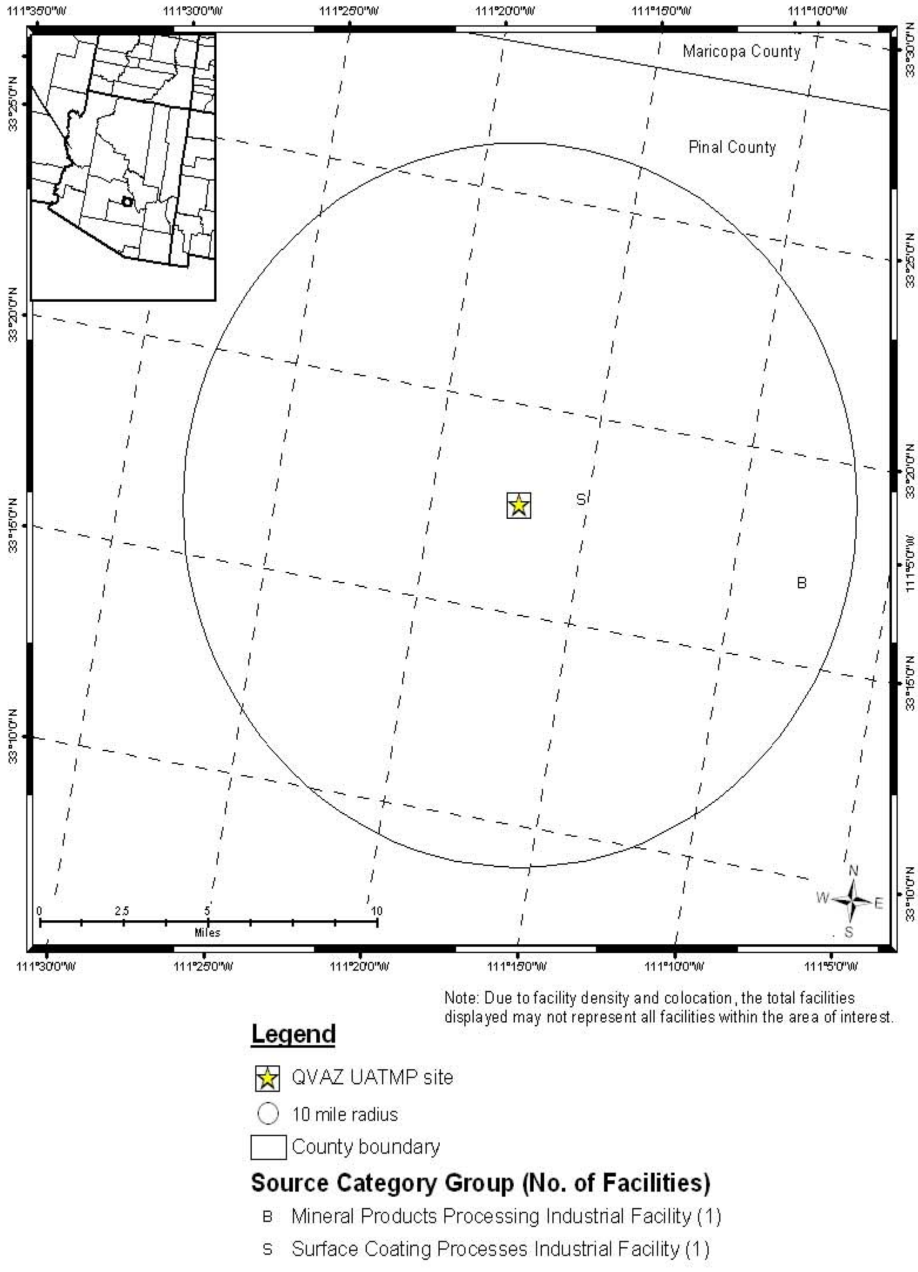
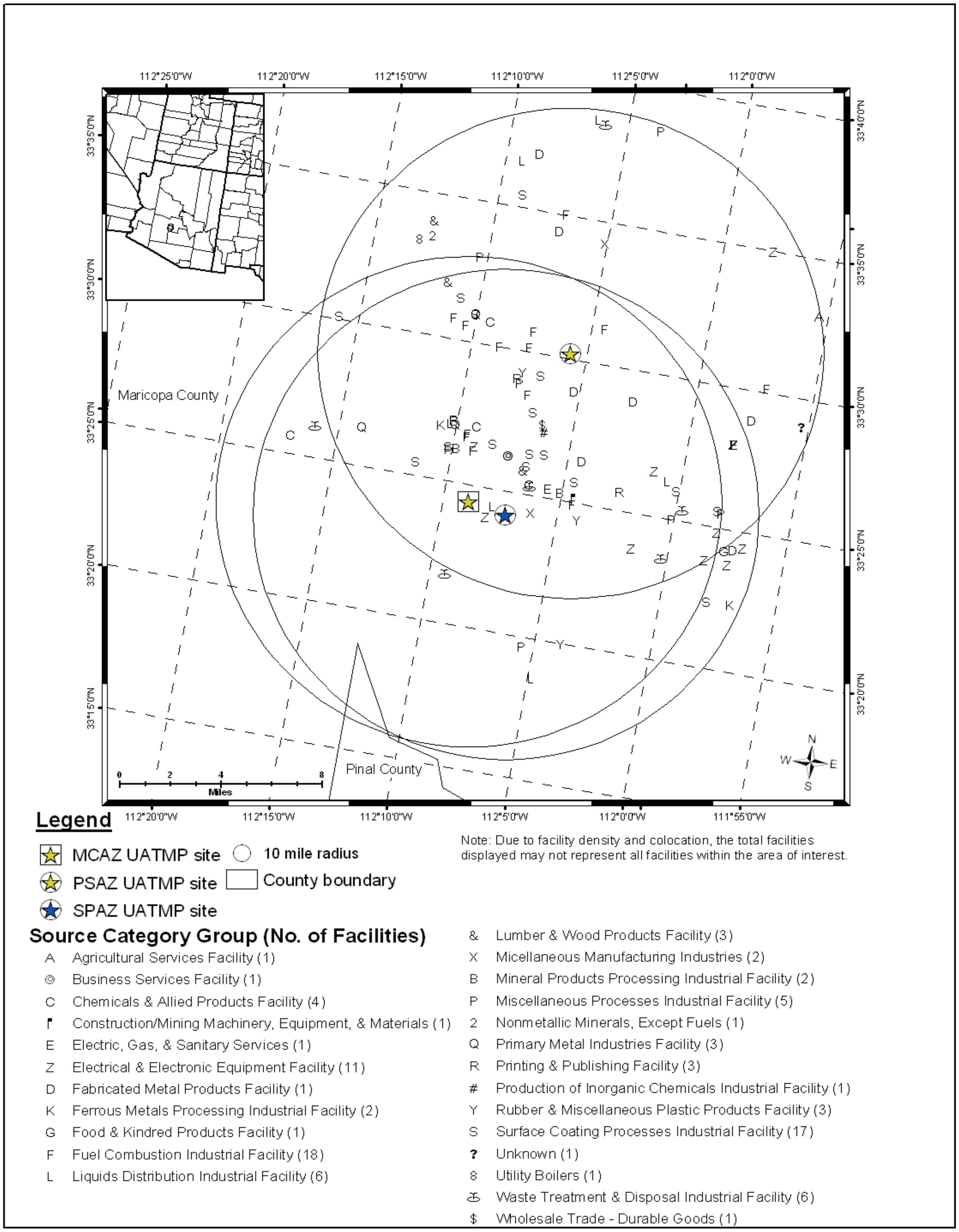


Figure 4-6. Facilities Located Within 10 Miles of MCAZ, PSAZ, and SPAZ



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

Figure 4-7. 2003 Total VOC Profile at MCAZ

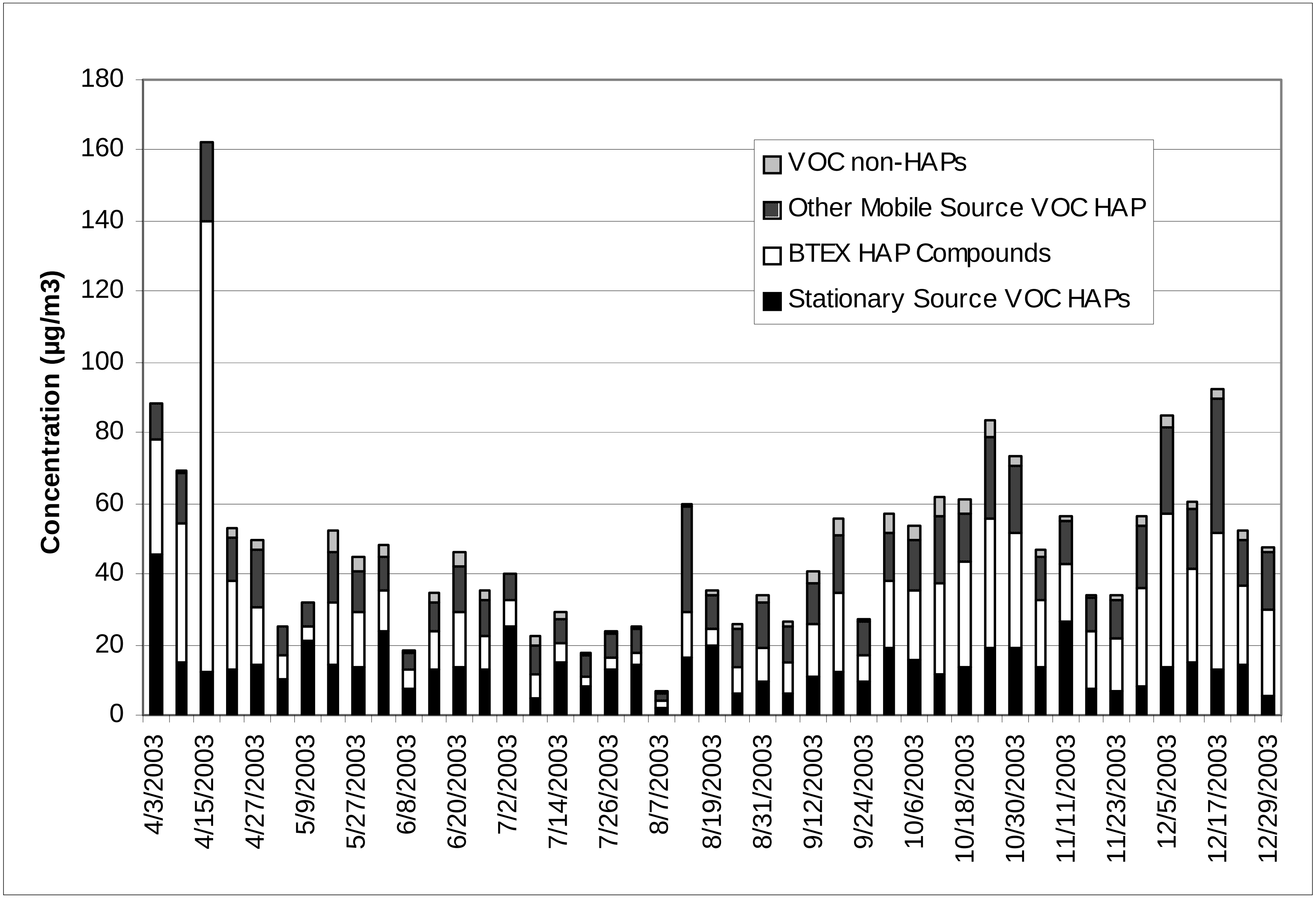


Figure 4-8. 2003 Total VOC Profile at PSAZ

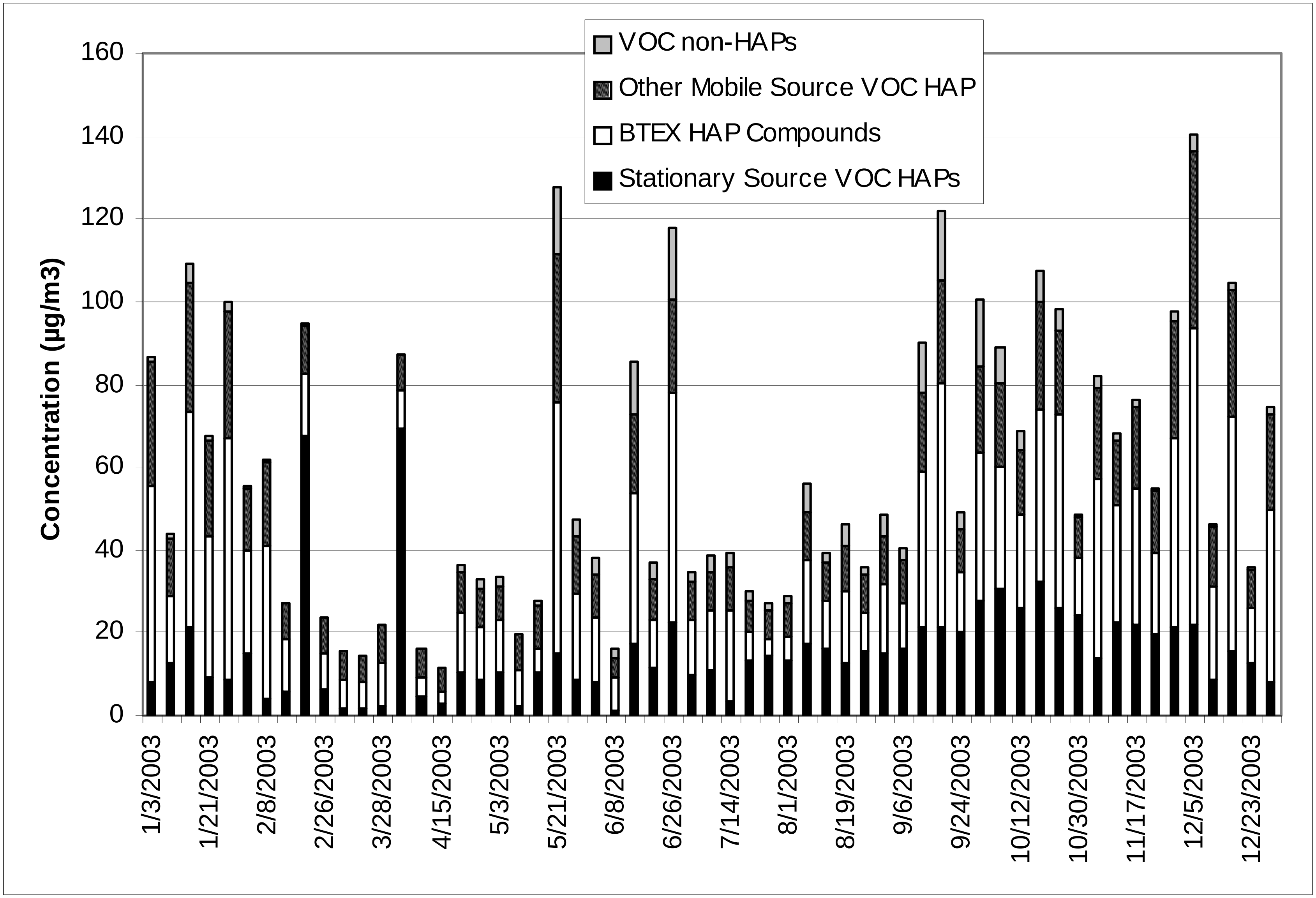


Figure 4-9. 2003 Total VOC Profile at QVAZ

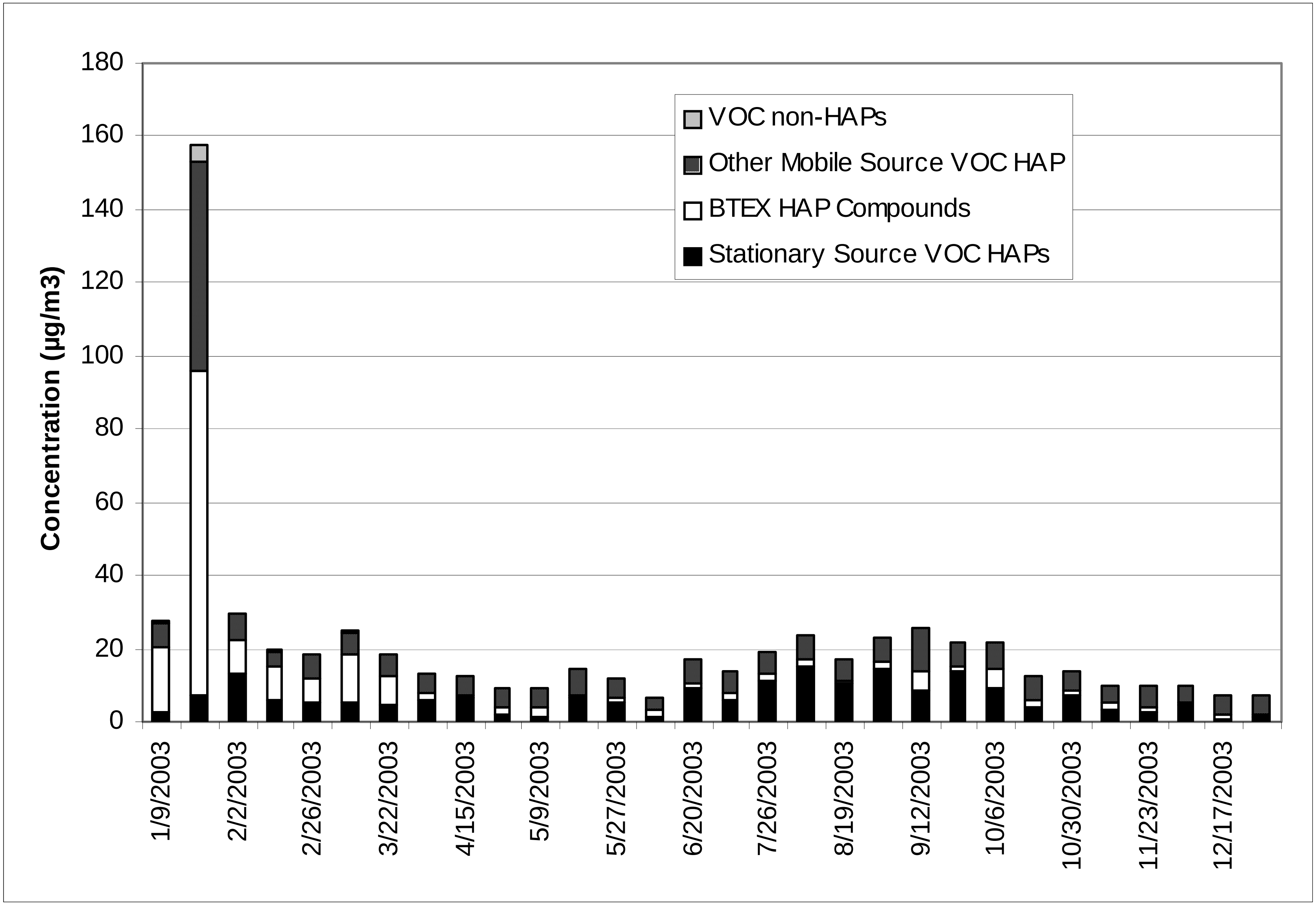


Figure 4-10. 2003 Total VOC Profile at SPAZ

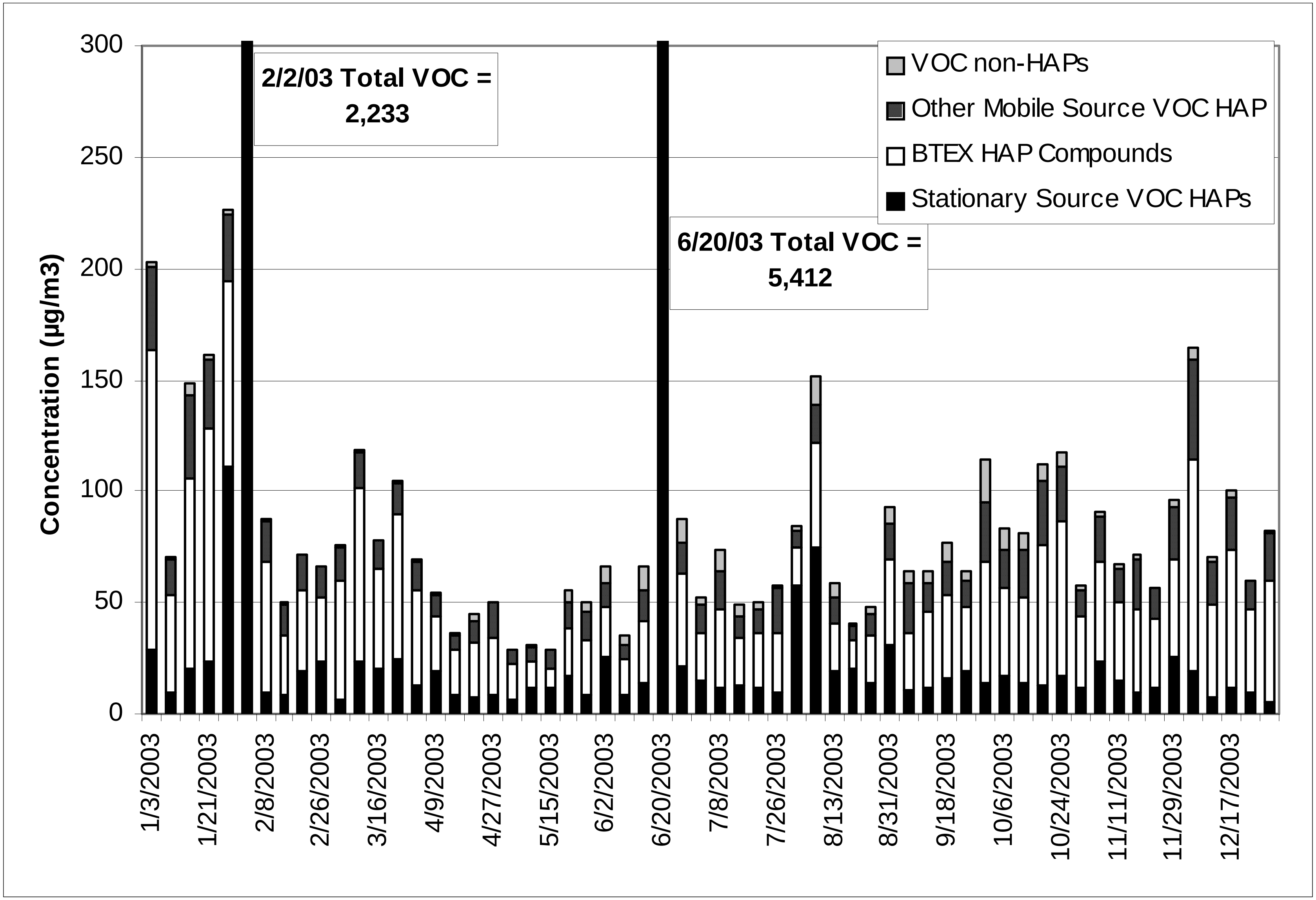


Figure 4-11. Composite Back Trajectory for PSAZ

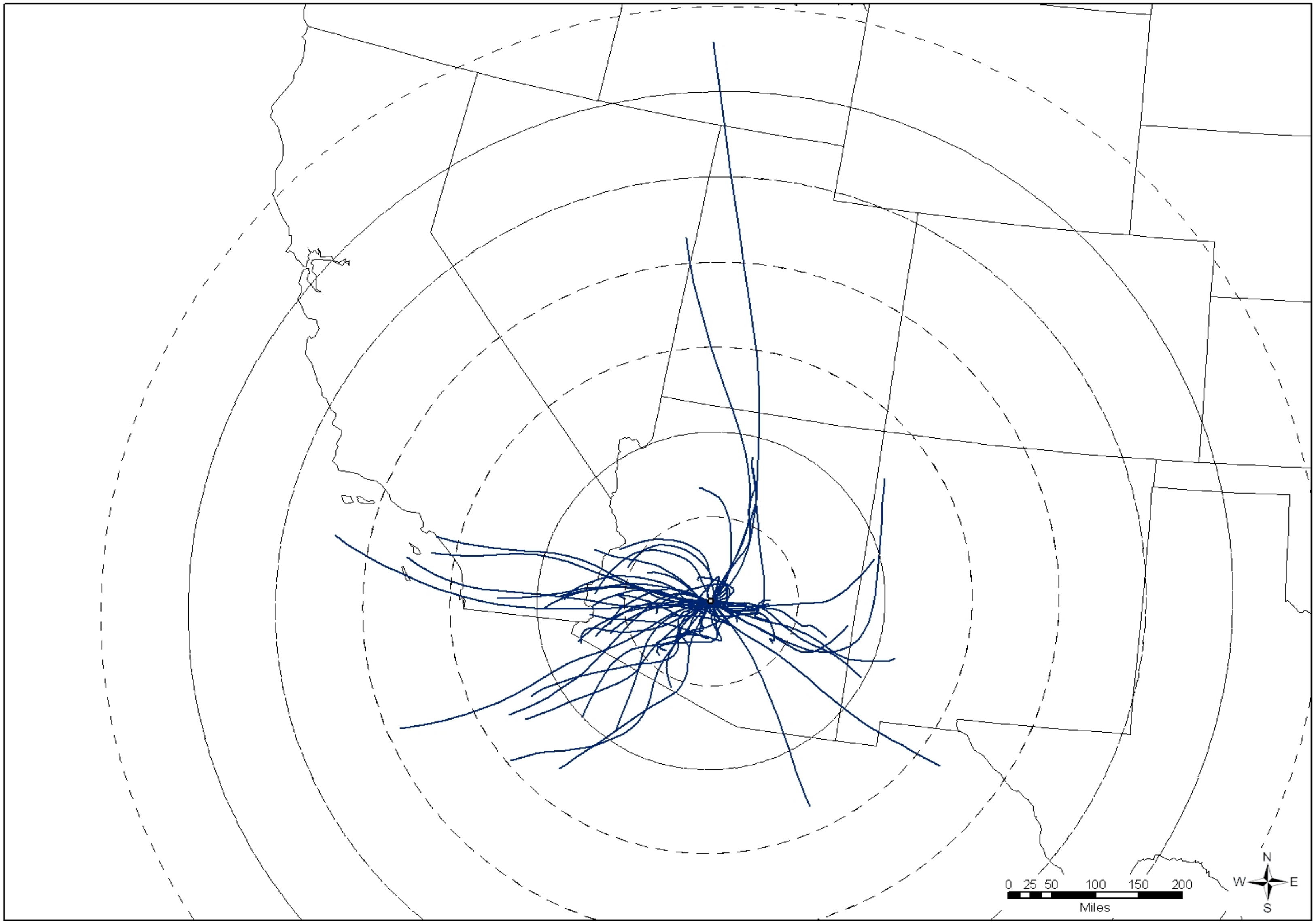


Figure 4-12. Acrylonitrile Pollution Rose for PSAZ

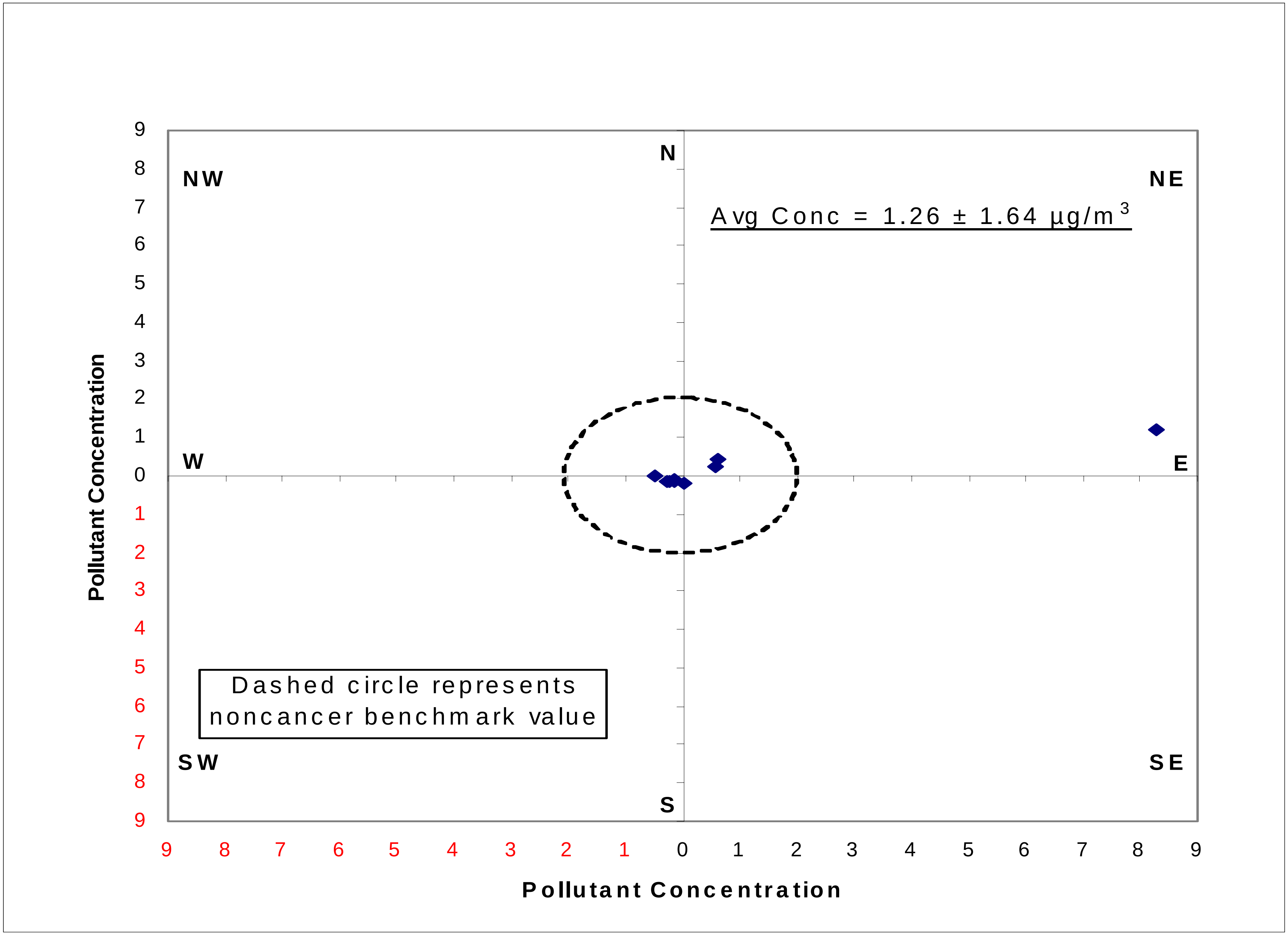


Figure 4-13. Acrylonitrile Sources East of the PSAZ Monitoring Site

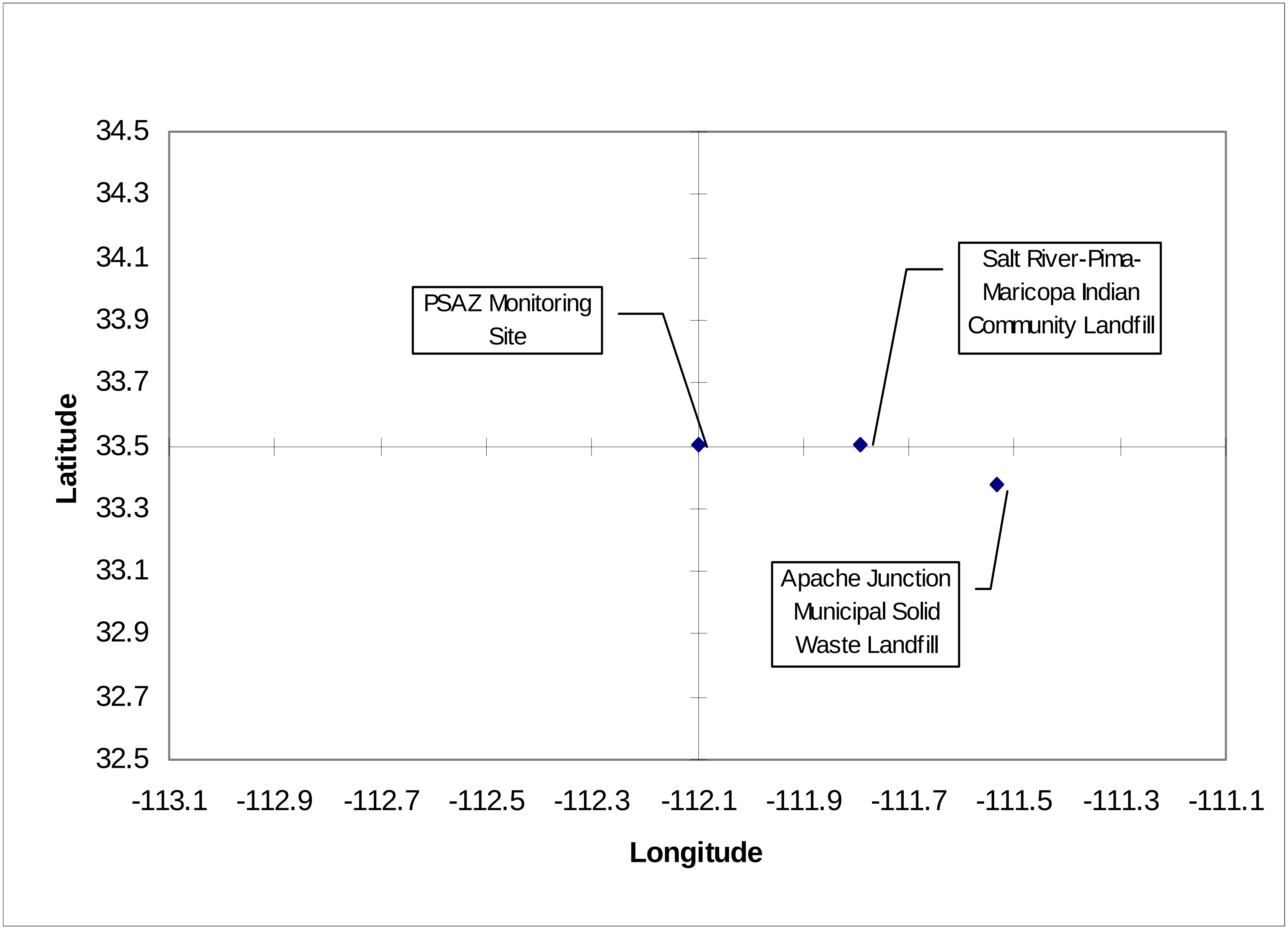


Figure 4-14. 24-Hour Back Trajectory (50, 250, and 500 Meters Aboveground) at PSAZ on October 12, 2003

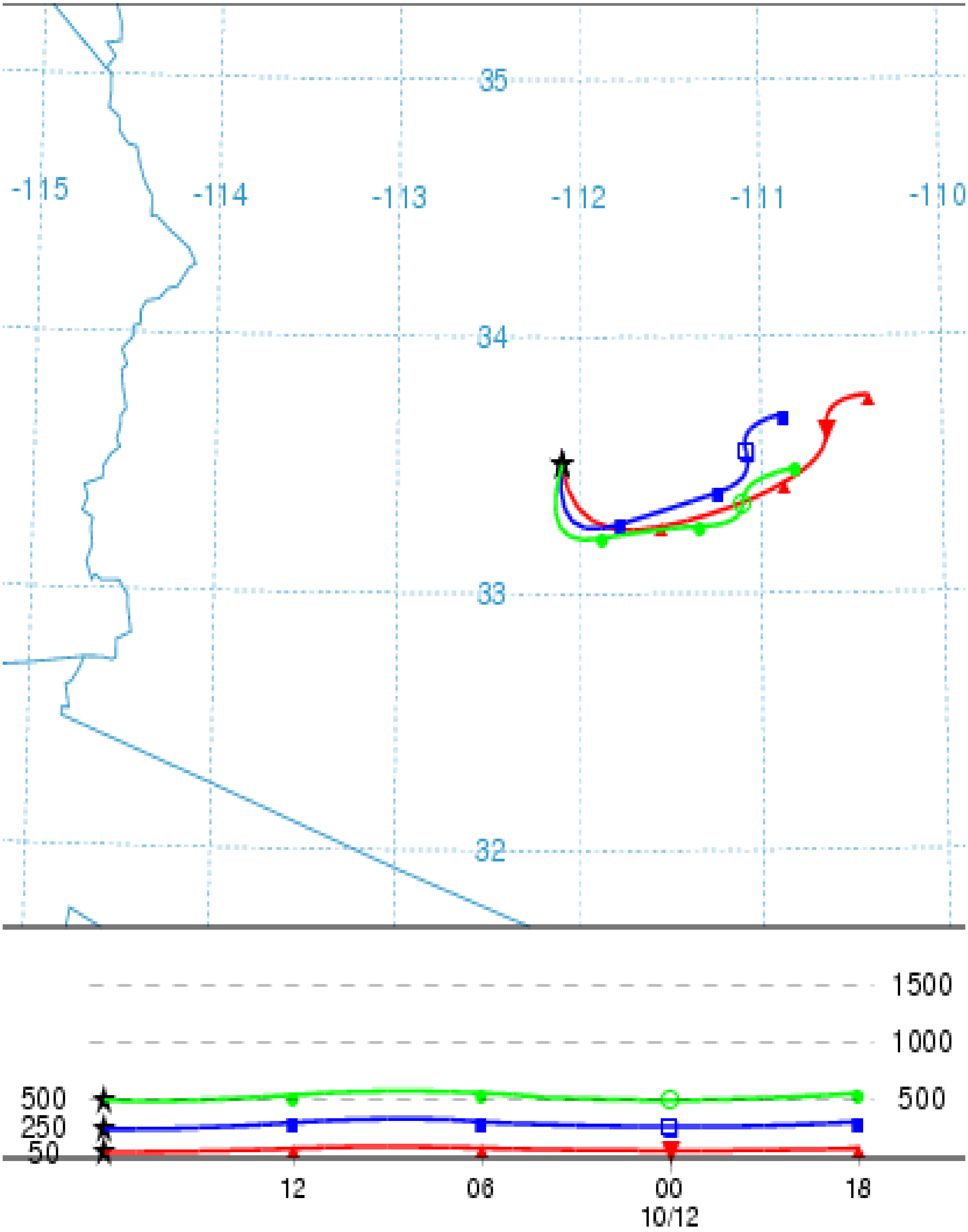


Table 4-1. Average Concentration and Meteorological Parameters for Sites in Arizona

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)
MCAZ	All 2003	▨	84.01 (± 1.66)	73.20 (± 1.60)	41.50 (± 1.37)	56.11 (± 1.07)	36.76 (± 1.79)	1011.50 (± 0.50)	0.43 (± 0.25)	0.54 (± 0.22)
	sample day	48.54 (± 7.61)	88.69 (± 4.87)	77.73 (± 4.57)	42.61 (± 4.40)	58.43 (± 3.28)	32.48 (± 4.42)	1010.65 (± 1.35)	0.84 (± 0.84)	0.70 (± 0.57)
PSAZ	All 2003	▨	84.01 (± 1.66)	73.20 (± 1.60)	41.50 (± 1.37)	56.11 (± 1.07)	36.76 (± 1.79)	1011.50 (± 0.50)	0.43 (± 0.25)	0.54 (± 0.22)
	sample day	58.94 (± 8.44)	83.58 (± 4.49)	73.15 (± 4.12)	41.43 (± 3.69)	56.15 (± 2.76)	37.47 (± 5.12)	1011.17 (± 1.22)	0.65 (± 0.70)	0.42 (± 0.56)
QVAZ	All 2003	▨	86.85 (± 1.68)	75.90 (± 1.63)	38.87 (± 1.39)	56.38 (± 1.02)	32.16 (± 1.73)	1011.74 (± 0.51)	0.41 (± 0.32)	0.65 (± 0.17)
	sample day	20.89 (± 9.38)	84.37 (± 5.90)	74.12 (± 5.63)	39.58 (± 5.32)	56.11 (± 3.63)	35.81 (± 7.87)	1011.98 (± 1.89)	1.20 (± 1.16)	1.22 (± 0.61)
SPAZ	All 2003	▨	84.01 (± 1.66)	73.20 (± 1.60)	41.50 (± 1.37)	56.11 (± 1.07)	36.76 (± 1.79)	1011.50 (± 0.50)	0.43 (± 0.25)	0.54 (± 0.22)
	sample day	204.42 (± 185.46)	83.65 (± 4.39)	73.07 (± 4.05)	41.66 (± 3.60)	56.20 (± 2.69)	37.86 (± 5.06)	1011.24 (± 1.21)	0.56 (± 0.68)	0.35 (± 0.55)

Table 4-2a. Summary of the Toxic Cancer Compounds at the Arizona Monitoring Site 1 - MCAZ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	3.52 E-05	41.65	41.65	0.517	3	35.2
Benzene	1.29 E-05	15.30	56.95	1.657	45	12.9
Tetrachloroethylene	9.17 E-06	10.86	67.81	1.554	14	9.17
1,3-Butadiene	8.78 E-06	10.40	78.21	0.293	19	8.78
Carbon Tetrachloride	8.61 E-06	10.20	88.41	0.574	39	8.61
p-Dichlorobenzene	4.65 E-06	5.51	93.91	0.423	7	4.65
1,3-Dichloropropene	1.99 E-06	2.35	96.27	0.497	2	1.99
1,1,2-Trichloroethane	1.75 E-06	2.07	98.33	0.109	1	1.75
1,2-Dichloroethane	8.34 E-07	0.99	99.32	0.032	1	<1
Methylene Chloride	2.83 E-07	0.34	99.66	0.602	34	<1
Trichloroethylene	2.60 E-07	0.31	99.96	0.130	5	<1
Bromoform	2.97 E-08	0.04	100.00	0.027	1	<1

Table 4-2b. Summary of the Toxic Cancer Compounds at the Arizona Monitoring Site 2 - PSAZ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	8.59 E-05	54.72	54.72	1.263	9	85.9
Benzene	2.28 E-05	14.50	69.22	2.917	59	22.8
1,3-Butadiene	1.62 E-05	10.31	79.53	0.540	36	16.2
p-Dichlorobenzene	9.59 E-06	6.11	85.64	0.872	31	9.59
Carbon Tetrachloride	8.32 E-06	5.30	90.94	0.554	52	8.32
Tetrachloroethylene	7.90 E-06	5.03	95.97	1.338	39	7.90
1,3-Dichloropropene	4.08 E-06	2.60	98.57	1.019	1	4.08
Methylene Chloride	1.56 E-06	0.99	99.56	3.313	50	1.56
Trichloroethylene	6.93 E-07	0.44	100.00	0.347	15	<1

Table 4-2c. Summary of the Toxic Cancer Compounds at the Arizona Monitoring Site 3 - QVAZ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	2.93 E-04	86.95	86.95	4.312	16	293
1,3-Butadiene	1.76 E-05	5.21	92.16	0.586	2	17.6
Tetrachloroethylene	1.20 E-05	3.56	95.72	2.035	1	12.0
Carbon Tetrachloride	8.85 E-06	2.63	98.35	0.590	25	8.85
Benzene	4.57 E-06	1.35	99.70	0.586	30	4.57
Trichloroethylene	8.19 E-07	0.24	99.94	0.410	2	<1
Methylene Chloride	1.87 E-07	0.06	100.00	0.398	12	<1

Table 4-2d. Summary of the Toxic Cancer Compounds at the Arizona Monitoring Site 4 - SPAZ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	2.38 E-05	25.63	25.63	3.055	60	23.8
Acrylonitrile	2.38 E-05	25.55	51.18	0.349	3	23.8
1,3-Butadiene	1.58 E-05	16.95	68.13	0.525	40	15.8
p-Dichlorobenzene	9.23 E-06	9.93	78.06	0.839	25	9.23
Carbon Tetrachloride	8.76 E-06	9.42	87.48	0.584	54	8.76
Tetrachloroethylene	7.64 E-06	8.22	95.69	1.294	19	7.64
1,2-Dichloroethane	3.16 E-06	3.40	99.09	0.121	1	3.16
Methylene Chloride	4.33 E-07	0.47	99.55	0.921	47	<1
Trichloroethylene	4.15 E-07	0.45	100.00	0.207	5	<1

Table 4-3a. Summary of the Toxic Noncancer Compounds at the Arizona Monitoring Site 1 - MCAZ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acrylonitrile	2.59 E-01	36.83	36.83	0.517	3	0
1,3-Butadiene	1.46 E-01	20.85	57.67	0.293	19	0
Xylenes (*o*-, *m*-, *p*-)	9.12 E-02	12.98	70.66	9.118	45	0
Benzene	5.52 E-02	7.86	78.52	1.657	45	0
Chloroprene	4.14 E-02	5.89	84.41	0.290	1	0
1,3-Dichloropropene	2.49 E-02	3.54	87.95	0497	2	0
Toluene	1.82 E-02	2.59	90.54	7.270	45	0
Chloromethane	1.48 E-02	2.11	92.65	1.333	45	0
Carbon Tetrachloride	1.44 E-02	2.04	94.69	0.574	39	0
Acetonitrile	1.18 E-02	1.68	96.37	0.706	13	0
Bromomethane	1.04 E-02	1.48	97.85	0.052	3	0
Tetrachloroethylene	5.75 E-03	0.82	98.67	1.554	14	0
Chloroform	2.72 E-03	0.37	99.06	0.267	17	0
Methyl Ethyl Ketone	2.07 E-03	0.30	99.35	10.359	45	0
Ethylbenzene	1.48 E-03	0.21	99.56	1.477	43	0
Methyl *tert*-Butyl Ether	6.65 E-04	0.09	99.66	1.995	39	0
Methylene Chloride	6.02 E-04	0.09	99.74	0.602	34	0
p-Dichlorobenzene	5.28 E-04	0.08	99.82	0.423	7	0
Styrene	4.35 E-04	0.06	99.88	0.435	29	0
1,1,2-Trichloroethane	2.72 E-04	0.04	99.92	0.109	1	0
Trichloroethylene	2.17 E-04	0.03	99.95	0.130	5	0
Methyl Isobutyl Ketone	1.87 E-04	0.03	99.98	0.560	14	0
Methyl Chloroform	1.38 E-04	0.02	100.00	0.138	16	0
1,2-Dichloroethane	1.34 E-05	<0.01	100.00	0.032	1	0
Chloromethane	8.27 E-06	<0.01	100.00	0.083	3	0

Table 4-3b. Summary of the Toxic Noncancer Compounds at the Arizona Monitoring Site 2 - PSAZ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acrylonitrile	6.31 E-01	47.82	47.82	1.263	9	1
1,3-Butadiene	2.70 E-01	20.43	68.26	0.540	36	0
Xylenes (*o*-, *m*-, *p*-)	1.09 E-01	8.29	76.55	10.945	59	0
Benzene	9.72 E-02	7.37	83.91	2.917	59	0
Acetonitrile	7.36 E-02	5.57	89.49	4.415	22	0
1,3-Dichloropropene	5.10 E-02	3.86	93.35	1.019	1	0
Toluene	2.22 E-02	1.68	95.03	8.879	59	0
Chloromethane	1.65 E-02	1.25	96.28	1.486	59	0
Carbon Tetrachloride	1.39 E-02	1.05	97.33	0.554	52	0
Bromomethane	1.13 E-02	0.86	98.18	0.057	1	0
Chloroform	7.59 E-03	0.57	98.76	0.743	34	0
Tetrachloroethylene	4.96 E-03	0.38	99.13	1.338	39	0
Methylene Chloride	3.31 E-03	0.25	99.38	3.313	50	0
Ethylbenzene	1.69 E-03	0.13	99.51	1.693	56	0
Methyl Ethyl Ketone	1.54 E-03	0.12	99.63	7.709	50	0
Methyl *tert*-Butyl Ether	1.44 E-03	0.11	99.74	4.308	41	0
p-Dichlorobenzene	1.09 E-03	0.08	99.82	0.872	31	0
Trichloroethylene	5.78 E-04	0.04	99.86	0.347	15	0
Methyl Chloroform	5.58 E-04	0.04	99.91	0.558	37	0
Styrene	4.69 E-04	0.04	99.94	0.469	39	0
Methyl Methacrylate	4.61 E-04	0.03	99.98	0.323	2	0
Methyl Isobutyl Ketone	2.76 E-04	0.02	100.00	0.829	17	0
Chloroethane	2.21 E-05	<0.01	100.00	0.221	7	0

Table 4-3c. Summary of the Toxic Noncancer Compounds at the Arizona Monitoring Site 3 - QVAZ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acrylonitrile	2.16 E+00	82.60	82.60	4.312	16	13
1,3-Butadiene	2.93 E-01	11.23	93.83	0.586	2	0
Xylenes (*o*-, *m*-, *p*-)	4.49 E-02	1.72	95.55	4.494	26	0
Acetonitrile	3.69 E-02	1.41	96.96	2.213	11	0
Benzene	1.95 E-02	0.75	97.71	0.586	30	0
Carbon Tetrachloride	1.48 E-02	0.57	98.28	0.590	25	0
Chloromethane	1.39 E-02	0.53	98.81	1.255	30	0
Bromomethane	1.27 E-02	0.49	99.30	0.063	1	0
Tetrachloroethylene	754 E-03	0.29	99.58	2.035	1	0
Toluene	3.86 E-03	0.15	99.73	1.545	30	0
1,2,4-Trichlorobenzene	1.48 E-03	0.06	99.79	0.297	1	0
Chloroform	1.28 E-03	0.05	99.84	0.125	2	0
Styrene	937 E-04	0.04	99.87	0.937	4	0
Ethylbenzene	7.70 E-04	0.03	99.90	0.770	20	0
Trichloroethylene	6.83 E-04	0.03	99.93	0.410	2	0
Methyl *tert*-Butyl Ether	5.41 E-04	0.02	99.95	1.622	1	0
Methyl Ethyl Ketone	4.58 E-04	0.02	99.97	2.289	16	0
Methylene Chloride	3.98 E-04	0.02	99.98	0.398	12	0
Methyl Isobutyl Ketone	2.72 E-04	0.01	99.99	0.817	2	0
1,1,1-Trichloroethane	1.59 E-04	0.01	100.00	0.159	9	0

Table 4-3d. Summary of the Toxic Noncancer Compounds at the Arizona Monitoring Site 4 - SPAZ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetonitrile	3.22 E+01	78.12	78.12	193.407	41	4
1,3-Butadiene	2.63 E-01	6.37	84.48	0.525	40	0
Xylenes (*o*-, *m*-, *p*-)	2.23 E-01	5.42	89.90	22.345	60	0
Acrylonitrile	1.75 E-01	4.23	94.13	0.349	3	0
Benzene	1.02 E-01	2.47	96.60	3.055	60	0
Chloroprene	4.91 E-02	1.19	97.79	0.344	2	0
Toluene	2.89 E-02	0.70	98.49	11.547	60	0
Chloromethane	1.49 E-02	0.36	98.85	1.343	60	0
Carbon Tetrachloride	1.46 E-02	0.35	99.20	0.584	54	0
Bromomethane	1.37 E-02	0.33	99.54	0.068	2	0
Tetrachloroethylene	4.80 E-03	0.12	99.65	1.295	19	0
Chloroform	3.34 E-03	0.08	99.73	0.328	18	0
Ethylbenzene	3.24 E-03	0.08	99.81	3.242	60	0
Methyl Ethyl Ketone	1.60 E-03	0.04	99.85	8.012	58	0
Methyl *tert*-Butyl Ether	1.36 E-03	0.03	99.88	4.071	43	0
1,2,4-Trichlorobenzene	1.11 E-03	0.03	99.91	0.223	1	0
p-Dichlorobenzene	1.05 E-03	0.03	99.94	0.839	25	0
Methylene Chloride	9.21 E-04	0.02	99.96	0.921	47	0
Styrene	7.00 E-04	0.02	99.98	0.700	41	0
Trichloroethylene	3.46 E-04	0.01	99.98	0.207	5	0
Methyl Isobutyl Ketone	2.78 E-04	0.01	99.99	0.833	18	0
1,1,1-Trichloroethane	1.86 E-04	<0.01	99.99	0.186	16	0
Chlorobenzene	1.64 E-04	<0.01	100.00	0.164	1	0
1,2-Dichloroethane	5.06 E-05	<0.01	100.00	0121	1	0
Chloroethane	4.69 E-06	<0.01	100.00	0.047	1	0

Table 4-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at West Broadway in Phoenix, Arizona (MCAZ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.33	-0.37	-0.25	-0.33	0.10	0.36	-0.34	-0.02
1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	-0.36	-0.36	-0.25	-0.33	-0.08	0.10	-0.58	0.05
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.55	-0.61	-0.56	-0.64	-0.01	0.50	-0.34	-0.24
Carbon Tetrachloride	0.18	0.19	0.09	0.15	-0.03	-0.29	0.06	0.21
Chloroprene	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethane	0.10	0.08	0.04	0.07	-0.02	-0.05	-0.05	-0.08
p-Dichlorobenzene	0.51	0.23	-0.68	-0.63	-0.69	-0.06	-0.55	-0.57
Tetrachloroethylene	-0.34	-0.33	0.02	-0.15	-0.22	0.35	-0.11	-0.03
Toluene	-0.45	-0.47	-0.35	-0.45	0.12	0.35	-0.03	-0.03
Xylenes (*o*-, *m*-, *p*-)	-0.39	-0.42	-0.33	-0.41	0.08	0.32	-0.02	-0.06

Table 4-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Supersite in Phoenix, Arizona (PSAZ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.30	-0.41	-0.63	-0.58	-0.26	0.55	-0.34	-0.48
1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	-0.51	-0.55	-0.46	-0.55	<0.01	0.46	-0.25	-0.43
Acrylonitrile	-0.21	-0.25	0.05	-0.07	0.28	-0.05	-0.33	-0.22
Benzene	-0.12	-0.21	-0.45	-0.37	-0.25	0.49	-0.40	-0.42
Carbon Tetrachloride	0.30	0.32	-0.09	0.16	-0.44	-0.23	0.20	0.04
p-Dichlorobenzene	-0.05	-0.15	-0.33	-0.28	-0.19	0.11	-0.32	-0.30
Tetrachloroethylene	0.10	0.02	-0.22	-0.14	-0.26	0.17	-0.19	-0.34
Toluene	-0.02	-0.11	-0.39	-0.28	-0.28	0.40	-0.35	-0.37
Xylenes (*o*-, *m*-, *p*-)	-0.01	-0.10	-0.41	-0.28	-0.31	0.38	-0.37	-0.41

Table 4-4c. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Queen Valley in Phoenix, Arizona (QVAZ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	NA	NA	NA	NA	NA	NA	NA	NA
Acrylonitrile	0.34	0.46	0.74	0.72	0.16	0.01	0.17	-0.36
Tetrachloroethylene	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes (*o*-, *m*-, *p*-)	-0.38	-0.40	0.12	-0.19	0.47	0.46	-0.16	-0.15

Table 4-4d. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at South Phoenix, Arizona (SPAZ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.26	-0.34	-0.41	-0.43	-0.13	0.51	-0.19	-0.10
Acetonitrile	0.03	0.05	-0.15	-0.05	-0.19	-0.29	0.33	0.24
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.30	-0.39	-0.43	-0.47	-0.06	0.58	-0.42	-0.42
Carbon Tetrachloride	-0.02	0.02	-0.01	<0.01	<0.01	-0.22	0.36	0.15
p-Dichlorobenzene	-0.17	-0.29	-0.36	-0.42	-0.15	0.45	-0.34	-0.46
Tetrachloroethylene	-0.51	-0.57	-0.45	-0.60	0.04	0.47	-0.05	-0.29
Xylenes (*o*-, *m*-, *p*-)	-0.36	-0.43	-0.32	-0.43	0.11	0.53	-0.35	-0.42

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

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu g/m^3$)
MCAZ	3,303,876	2,742,367	0.83	835,936	693,827	10,108	48.54 (± 7.61)
PSAZ	3,303,876	2,742,367	0.83	1,385,905	1,150,301	250	58.94 (± 8.44)
QVAZ	196,275	165,676	0.84	62,714	52,680	200	20.89 (± 9.38)
SPAZ	3,303,876	2,742,367	0.83	835,936	693,827	50,000	204.42 (± 185.46)

Table 4-6. Summary of Future Regulations That May be Applicable for Nearby Facilities Surrounding PSAZ

Facility Name	Primary SIC Code	SIC Code Description	Regulation Citation	Regulation Name
Chem Research Co.	3471	Electroplating, Plating, Polishing, Anodizing, and Coloring	40 CFR part 63, subpart MMMM	Miscellaneous Metal Parts and Products (Surface Coating) NESHAP
Western Bonded Prods. Inc. Flex Foam	3086	Plastics Foam Products	40 CFR part 63, subpart III	Flexible Polyurethane Foam Production NESHAP

5.0 Sites in Colorado

This section focuses on meteorological, concentration, and spatial trends for the two UATMP sites in Colorado (DECO and WECO), both located in Denver. Figures 5-1 and 5-2 are topographical maps showing the monitoring stations in their urban locations. Figure 5-3 is a map identifying facilities within ten miles of the sites that reported to the 1999 NEI. The Denver sites are surrounded by numerous sources. A large number of sources near DECO fall into four categories: liquid distribution, surface coating, personal services and fuel combustion. WECO is located near a large number of fuel combustion industrial facilities, liquids distribution facilities, surface coating processes, and personal service sites.

Hourly meteorological data were retrieved for all of 2003 at a weather station near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The weather station is Denver-Centennial Airport (WBAN 93067). Both DECO and WECO sites sampled for VOCs, carbonyl compounds, and metals.

Table 5-1 highlights the average UATMP concentration (VOC and 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), 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. Climatologically, the Denver area is rather dry, as the relative humidity in Table 5-1 indicates, and the daily temperatures can fluctuate drastically between the seasons, providing the area with rather cold winters and warm summers. Wind speeds can vary for the site, but the wind flows from the south-southeast on average. 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). Tables 5-2a-b summarize the cancer weighting scores, and Tables 5-3a-b summarize 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.

Tables 5-2a-b shows most of the prevalent cancer compounds reflect the nationwide prevalent cancer compound list, which is in Section 3 of this report. Of the VOCs and carbonyl compounds, 1,2-dichloroethane (detected at DECO) and trichloroethylene (dectected at DECO) were not listed among the nationwide prevalent cancer compounds. Additionally, arsenic compounds (detected at DECO and WECO) were considered prevalent, based on the site-specific risk analysis. For the prevalent noncancer compounds summarized in Tables 5-3a-b, arsenic and manganese compounds (detected at DECO and WECO) were listed among the site-specific noncancer prevalent list.

The following toxic compounds were not detected at either of the Denver sites were: acrylonitrile; 1,3-dichlorpropene; 1,1,2-trichloroethane; vinyl chloride; bromoform; chloroprene; 1,1-dichloroethene; methyl methacrylate; 1,2,4-trichlorobenzene; methyl *tert*-butyl ether; chlorobenzene; and chloroethane.

5.2 Toxicity Analysis

Benzene, 1,3-butadiene, carbon tetrachloride, acetaldehyde, and tetrachloroethylene were the only nationwide cancer prevalent compounds that were also prevalent at both Denver sites. Benzene’s toxicity score was the highest at both Denver sites, and this compound had the largest number of detects at both sites. The number of detects for most of the prevalent compounds was greater than ten at both sites.

Formaldehyde, acetaldehyde, acetonitrile, 1,3-butadiene, benzene, and xylenes (total) were the only nationwide prevalent noncancer compounds to be considered prevalent at both Denver sites. Both DECO and WECO had the same prevalent compounds, although differing in average toxicity.

The benzene cancer risk at DECO was the highest among the two sites at 21.5 in a million, while at WECO, the benzene cancer risk was 17.5 in a million. For the compounds which may lead to adverse noncancer health effects, the average acetonitrile toxicity at WECO was 1.18 (over 1 indicates a significant chance of a noncancer health effect). Of the twenty measured acetonitrile concentrations, 10 were above the acrylonitrile noncancer RfC weighting factor at WECO.

5.3 Meteorological and Concentration Averages at the Colorado Sites

Carbonyl compounds,VOC, and metal compounds were sampled at each of the sites. Table 5-1 shows that the average UATMP concentration at WECO was nearly twice that of DECO. Tables 5-4a-b present 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. At DECO, the majority of correlations are positive and moderately strong to relatively weak. The strongest correlations at DECO were computed between acetonitrile and tetrachlorothylene and relative humidity (-0.55 and -0.62, respectively). Five compounds exhibited moderately strong correlations with the temperature parameters. Pearson correlations could not be computed for 1,2-dichloroethane and trichloroethylene due to the low number of detects (fewer than 3).

At WECO, correlations between the meteorological parameters and the prevalent compounds tended to be somewhat stronger than at DECO. Both acetonitrile and tetrachloroethylene exhibited moderately strong to strong correlations with nearly all of the meteorological parameters, although they varied between negative and positive correlations. With the exception of formaldehyde, which had moderately strong to strong positive correlations with the temperature parameters and the wet bulb temperature and strong negative correlations with relative humidity, the remaining correlations at WECO were relatively weak. Pearson correlations could not be computed for *p*-dichlorobenzene due to the low number of detects (fewer than 3).

The Colorado sites opted to sample metal compounds in addition to carbonyls and VOC. Average metal concentrations are listed in Table 5-5. Average metal concentrations are similar at both Denver sites. Note: metal compounds are not included in the average UATMP concentrations.

5.4 Spatial Analysis

County-level car registration and population in Adams County, CO, and Denver County, CO, were obtained from the Colorado Department of Revenue and the U.S. Census Bureau, and are summarized in Table 5-6. Also included in Table 5-6 is the population within 10-miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10 mile car registrations was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at each Arizona site in Table 5-6. DECO has both the largest daily traffic volume and the largest vehicle ownership within a ten mile radius, although WECO has nearly twice the average daily UATMP concentration.

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 3-1 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 Denver sites generally resemble those of the roadside study. Both sites had higher toluene-ethylbenzene ratios, had slightly higher benzene-ethylbenzene ratios, and slightly lower xylene-ethylbenzene ratios than the roadside study.

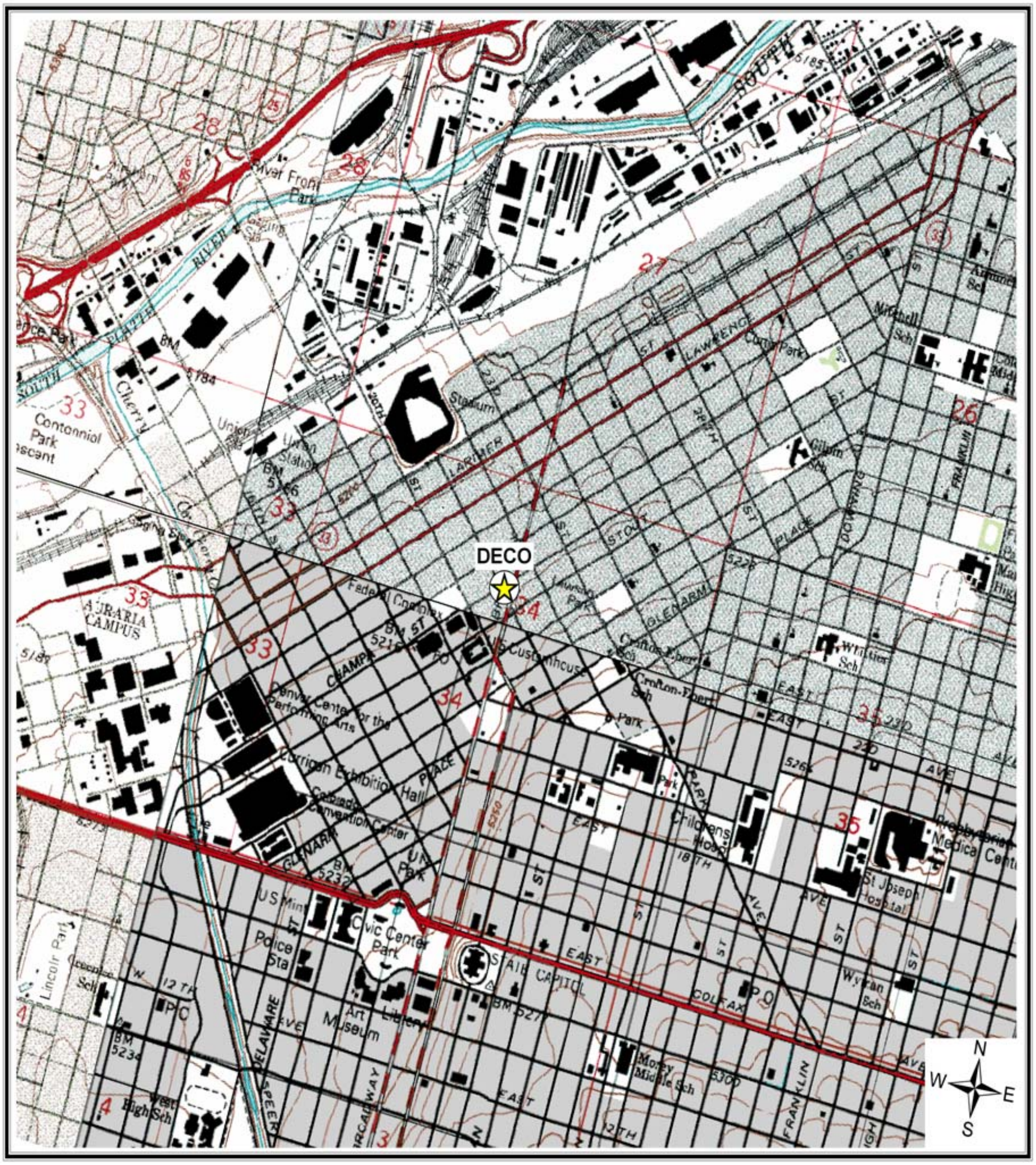
5.5 RFG Analysis

The Denver-Aurora, CO, MSA participates in a winter oxygenated reformulated fuel program (EPA, 2001), as part of their State Implementation Plan (SIP). During the winter season in the Denver MSA (November 1 - February 7), the oxygen content in gasoline must be at least 3.1%, boosting the octane quality, increasing combustion, and reducing exhaust emissions. The oxygenate used as an RFG additive in the Phoenix MSA is ethanol. Figures 5-4 through 5-5 are the VOC profiles at the Denver sites.

At DECO (Figure 5-4), the total VOC concentrations were varied, with the highest concentration occurring on January 27, 2003. On that day, the stationary source HAP contribution was much higher than other sampling days. The non-HAP concentrations were typically low or non-existent. The sampling at DECO ran from January 3 - May 3, thus missing most of the winter season and all of the summer periods. There does not appear to be any reduction in total VOCs or the BTEX compounds during the winter season. However, it appears that the non-winter VOC and BTEX concentrations were generally lower than the winter VOC and BTEX concentrations.

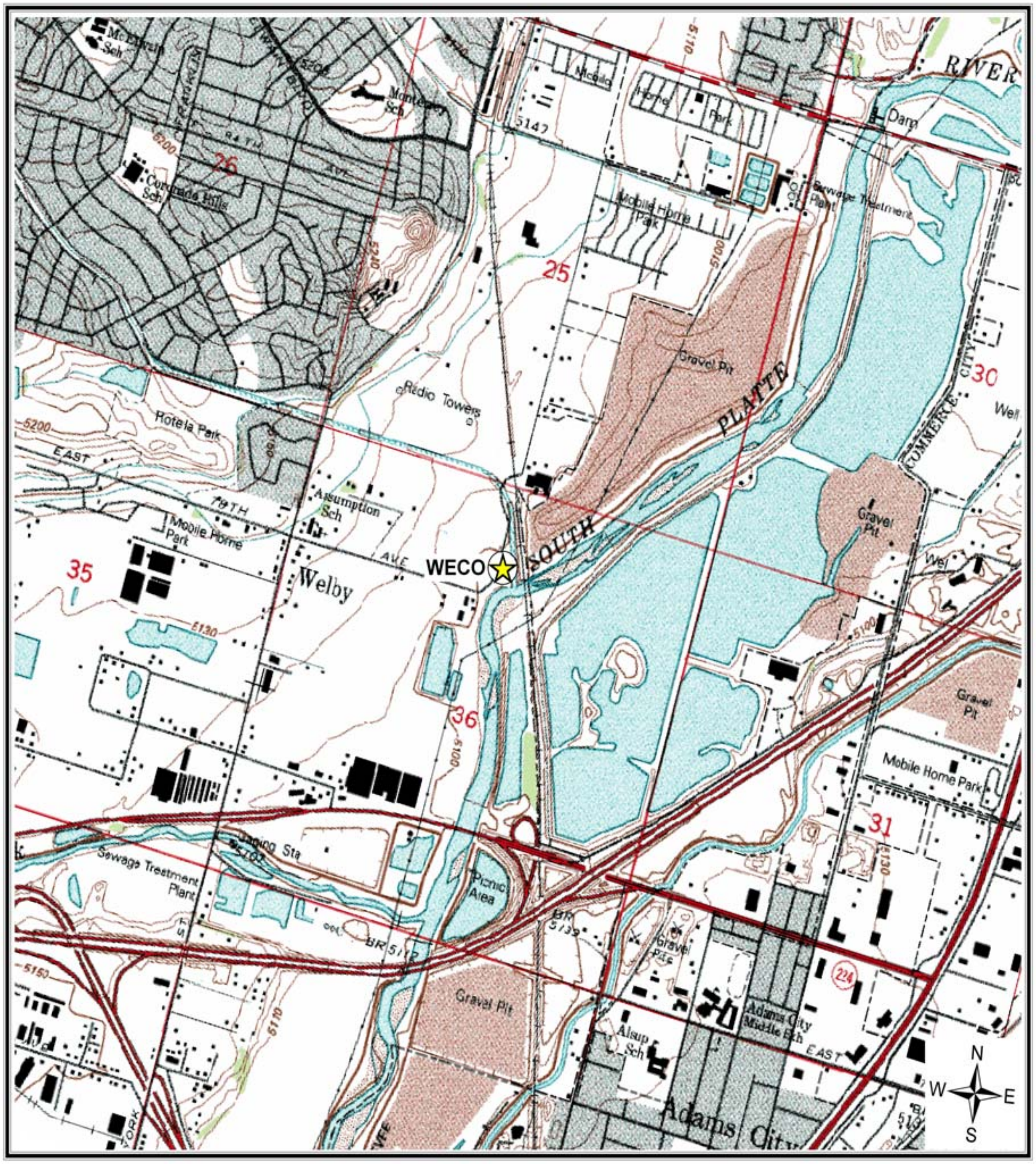
At WECO (Figure 5-5), the total VOC concentrations were also varied, with the highest concentration occurring on April 15, 2003. On that day, the stationary source HAP contribution was much higher than on other sampling days. The mobile source HAP concentrations (BTEX and non-BTEX) were typically low. The sampling at WECO also ran from January 3 - May 3, thus missing most of the winter season and all of the summer periods. There does not appear to be any reduction in total VOCs or the BTEX compounds during the winter season. Similarly to DECO, it appears that the non-winter VOC and BTEX concentrations were generally lower than the winter VOC and BTEX concentrations. The non-HAP VOCs were detected only on five sampling days.

Figure 5-1. Denver, Colorado (DECO) Monitoring Station



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

Figure 5-2. Denver, Colorado (WECO) Monitoring Station



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

Figure 5-3. Facilities Located Within 10 Miles of DECO and WECO

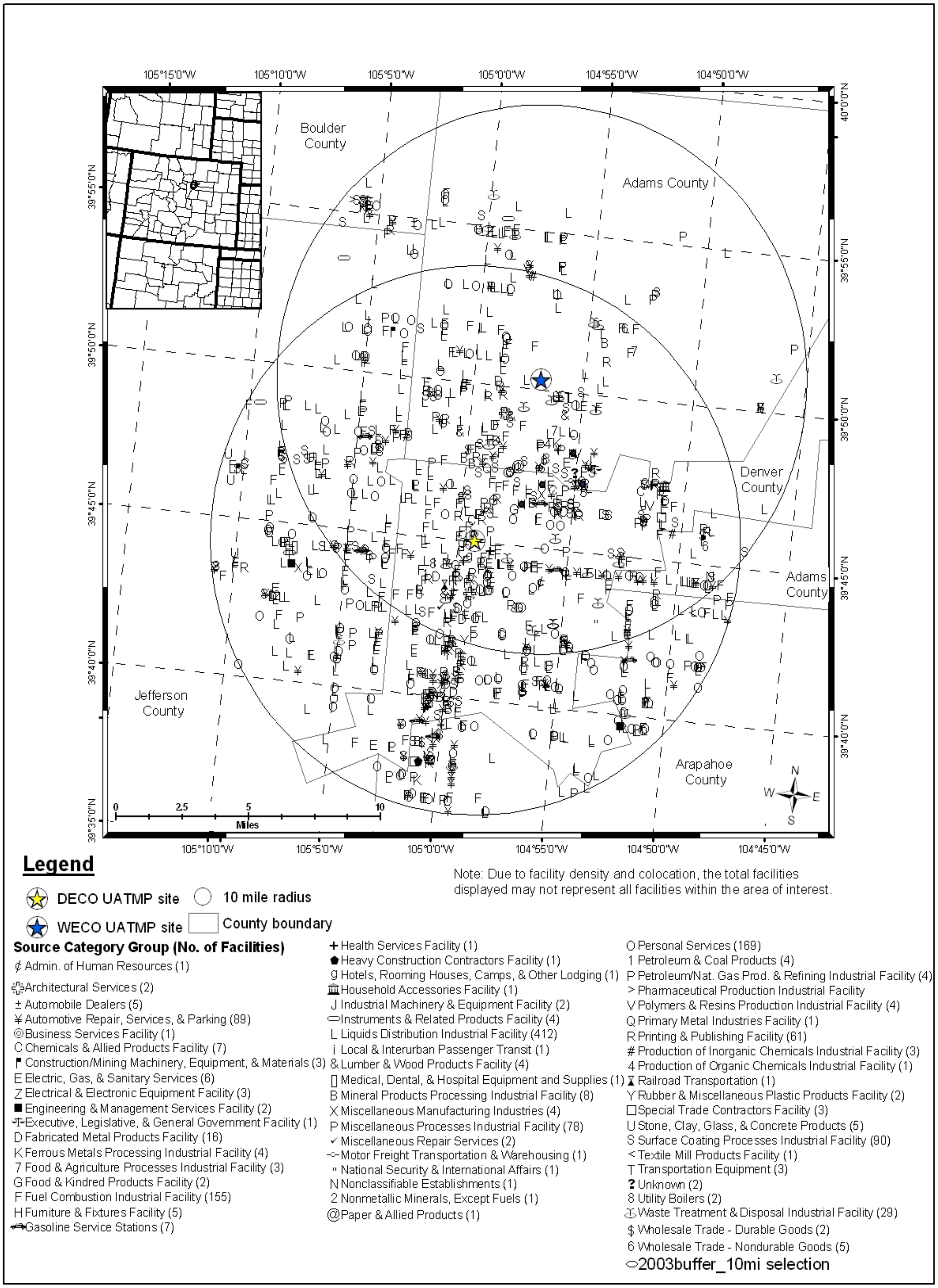


Figure 5-4. 2003 Total VOC Profile at DECO

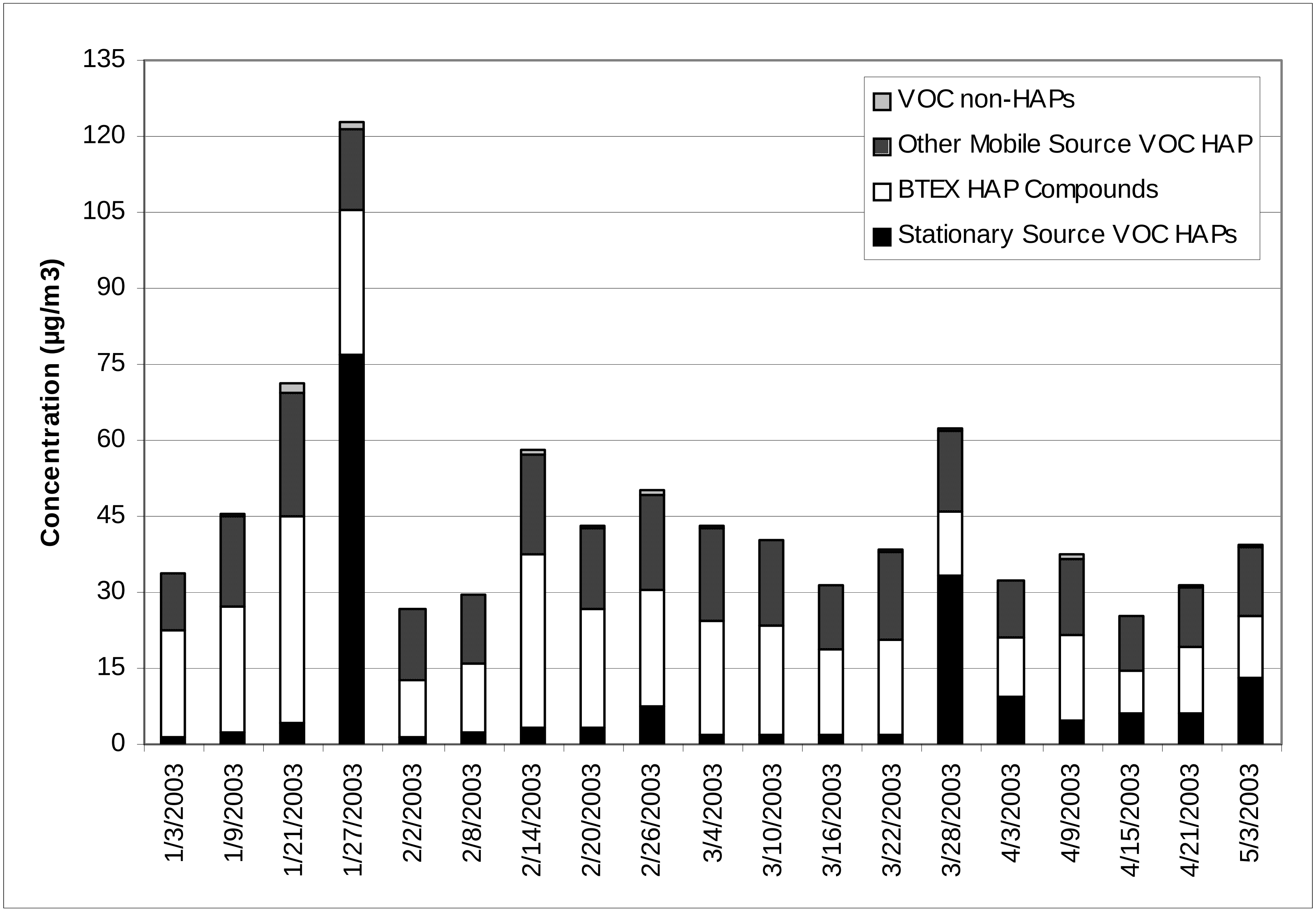


Figure 5-5. 2003 Total VOC Profile at WECO

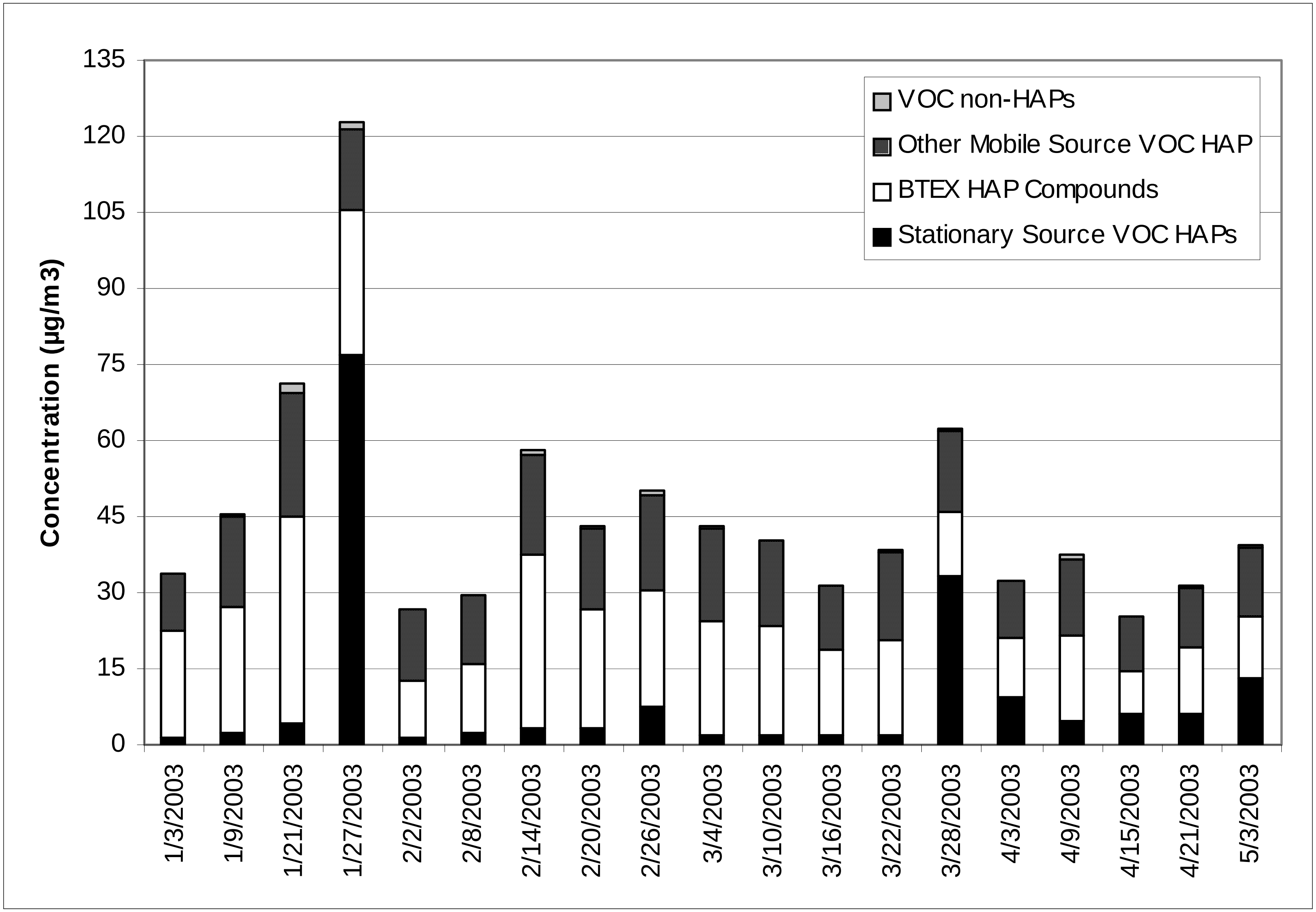


Table 5-1. Average Concentration and Meteorological Parameters for Sites in Colorado

Site Name	Type	Average UATMP Concentration (ppbv)	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)
DECO	All 2003	▨	63.28 (±1.94)	50.46 (±1.75)	29.36 (±1.50)	40.53 (±1.35)	50.92 (±1.92)	1014.84 (±0.72)	0.15 (±0.28)	1.63 (±0.39)
	sample day	57.62 (±11.62)	52.60 (±6.14)	40.50 (±5.48)	19.80 (±3.38)	31.99 (±3.88)	50.11 (±7.58)	1011.60 (±3.57)	0.38 (±1.39)	1.91 (±2.02)
WECO	All 2003	▨	63.28 (±1.94)	50.46 (±1.75)	29.36 (±1.50)	40.53 (±1.35)	50.92 (±1.92)	1014.84 (±0.72)	0.15 (0.28)	1.63 (±0.39)
	sample day	106.96 (±19.90)	52.48 (±5.85)	40.22 (±5.25)	19.61 (±3.24)	31.78 (±3.71)	50.08 (±7.22)	1011.92 (±3.45)	0.55 (±1.36)	1.59 (±2.02)

Table 5-2a. Summary of the Toxic Cancer Compounds at the Colorado Monitoring Site 1 - DECO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	2.15E-05	27.21	27.21	2.758	19	21.5
Tetrachloroethylene	1.31E-05	16.56	43.77	2.219	6	13.1
Arsenic Compounds	1.18E-05	14.88	58.65	0.003	17	11.8
1,3-Butadiene	9.28E-06	11.74	70.39	0.309	15	9.28
Acetaldehyde	7.68E-06	9.71	80.10	3.490	15	7.68
Carbon Tetrachloride	6.42E-06	8.12	88.21	0.428	15	6.42
1,2-Dichloroethane	4.21E-06	5.32	93.54	0.162	1	4.21
Trichloroethylene	2.87E-06	3.63	97.16	1.433	2	2.37
Methylene Chloride	1.47E-06	1.86	99.02	3.126	17	1.47
Cadmium compounds	6.61E-07	0.84	99.86	<0.0001	17	<1
Beryllium Compounds	7.68E-08	0.10	99.96	<0.0001	17	<1
Formaldehyde	3.42E-08	0.04	100.00	6.210	15	<1

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

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	1.75E-05	33.37	33.37	2.247	20	17.5
1,3-Butadiene	8.32E-06	15.84	49.21	0.277	13	8.32
Carbon Tetrachloride	7.56E-06	14.40	63.61	0.504	16	7.56
Arsenic Compounds	7.49E-06	14.26	77.87	0.002	19	7.49
Acetaldehyde	5.42E-06	10.32	88.19	2.466	20	5.42
p-Dichlorobenzene	2.65E-06	5.04	93.23	0.240	1	2.65
Tetrachloroethylene	2.56E-06	4.88	98.10	0.434	5	2.56
Cadmium compounds	5.81E-07	1.11	99.21	<0.0001	19	<1
Methylene Chloride	3.22E-07	0.61	99.82	0.685	16	<1
Beryllium Compounds	7.85E-08	0.15	99.97	<0.0001	19	<1
Formaldehyde	1.56E-08	0.03	100.00	2.838	20	<1

Table 5-3a. Summary of the Toxic Noncancer Compounds at the Colorado Monitoring Site 1 - DECO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	6.34E-01	26.42	26.42	6.210	15	1
Manganese Compounds	6.12E-01	25.52	51.95	0.031	17	1
Acetaldehyde	3.88E-01	16.17	68.11	3.490	15	0
Acetonitrile	2.27E-01	9.45	77.57	13.601	5	1
1,3-Butadiene	1.55E-01	6.45	84.02	0.309	15	0
Benzene	9.19E-02	3.83	87.85	2.758	19	0
Arsenic Compounds	9.12E-02	3.80	91.65	0.003	17	0
Xylenes (*o*-, *m*-, *p*-)	8.71E-02	3.63	95.28	8.708	19	0
Cadmium compounds	1.84E-02	0.77	96.05	<0.0001	17	0
Toluene	1.77E-02	0.74	96.79	7.095	19	0
Choromethane	1.41E-02	0.59	97.38	1.273	19	0
Nickel Compounds	1.09E-02	0.45	97.83	0.002	17	0
Carbon Tetrachloride	1.07E-02	0.45	98.28	0.428	15	0
Lead Compounds	8.58E-03	0.36	98.64	0.013	17	0
Tetrachloroethylene	8.22E-03	0.34	98.98	2.219	6	0
Cobalt Compounds	7.38E-03	0.31	99.29	0.001	17	0
Chloroform	6.91E-03	0.29	99.58	0.677	1	0
Methylene Chloride	3.13E-03	0.13	99.71	3.126	17	0
Trichloroethylene	2.39E-03	0.10	99.80	1.433	2	0
Beryllium Compounds	1.60E-03	0.07	99.87	<0.0001	17	0
Ethylbenzene	1.21E-03	0.05	99.92	1.207	19	0
Methyl Ethyl Ketone	8.99E-04	0.04	99.96	4.493	3	0
Styrene	4.60E-04	0.02	99.98	0.4601	1	0
1,1,1-Trichloroethane	2.18E-04	0.01	99.99	0.218	1	0
Mercury	1.85E-04	0.01	100.00	<0.0001	17	0
1,2-Dichloroethane	6.75E-05	<0.0001	100.00	0.162	1	0
Selenium Compounds	4.05E-05	<0.0001	100.00	0.001	17	0

Table 5-3b. Summary of the Toxic Noncancer Compounds at the Colorado Monitoring Site 2 - WECO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetonitrile	1.18E+00	42.78	42.78	70.812	20	10
Manganese Compounds	5.93E-01	21.48	64.26	0.030	19	2
Formaldehyde	2.90E-01	10.50	74.76	2.838	20	0
Acetaldehyde	2.74E-01	9.93	84.69	2.466	20	0
1,3-Butadiene	1.39E-01	5.03	89.72	0.277	13	0
Benzene	7.49E-02	2.72	92.43	2.247	20	0
Xylenes (*o*-, *m*-, *p*-)	6.13E-02	2.22	94.66	6.128	20	0
Arsenic Compounds	5.81E-02	2.11	96.76	0.002	19	0
Cadmium compounds	1.61E-02	0.59	97.35	0.000	19	0
Chloromethane	1.39E-02	0.50	97.85	1.249	20	0
Toluene	1.29E-02	0.47	98.32	5.167	20	0
Carbon Tetrachloride	1.26E-02	0.46	98.77	0.504	16	0
Nickel Compounds	1.08E-02	0.39	99.17	0.002	19	0
Lead Compounds	7.67E-03	0.28	99.44	0.012	19	0
Cobalt Compounds	5.43E-03	0.20	99.64	0.001	19	0
Methyl Ethyl Ketone	1.92E-03	0.07	99.71	9.620	6	0
Chloroform	1.76E-03	0.06	99.78	0.172	1	0
Beryllium Compounds	1.64E-03	0.06	99.83	<0.0001	19	0
Tetrachloroethylene	1.61E-03	0.06	99.89	0.434	5	0
Ethylbenzene	9.00E-04	0.03	99.93	0.900	18	0
Methylene Chloride	6.85E-04	0.02	99.95	0.685	16	0
Methyl Isobutyl Ketone	4.98E-04	0.02	99.97	1.495	2	0
p-Dichlorobenzene	3.01E-04	0.01	99.98	0.240	1	0
Styrene	2.07E-04	0.01	99.99	0.207	7	0
1,1,1-Trichloroethane	2.05E-04	0.01	99.99	0.205	4	0
Mercury	1.35E-04	<0.0001	100.00	<0.0001	19	0
Selenium Compounds	2.64E-05	<0.0001	100.00	0.001	19	0

Table 5-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Site #1 in Denver, Colorado (DECO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.33	-0.38	-0.18	-0.35	0.33	0.35	-0.50	-0.27
Acetaldehyde	0.02	0.01	0.04	0.03	-0.07	0.14	-0.15	0.31
Acetonitrile	0.34	0.37	-0.17	0.21	-0.55	0.22	0.39	0.12
Arsenic Compounds	0.38	0.41	0.36	0.44	-0.20	-0.39	0.41	0.02
Benzene	-0.23	-0.26	-0.14	-0.25	0.17	0.17	-0.35	-0.22
Carbon Tetrachloride	0.23	0.22	0.23	0.25	0.04	-0.37	0.09	0.45
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
Formaldehyde	0.11	0.16	0.31	0.22	-0.03	0.17	-0.09	0.49
Manganese Compounds	0.32	0.33	0.04	0.29	-0.37	-0.21	0.16	0.13
Tetrachloroethene	0.38	0.41	-0.31	0.21	-0.62	0.19	0.42	0.25
Trichloroethylene	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes (total)	-0.27	-0.28	-0.21	-0.28	0.12	0.26	-0.23	-0.32

Table 5-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Site #2 in Denver, CO (WECO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	0.19	0.24	0.15	0.23	-0.06	-0.28	-0.09	0.04
Acetaldehyde	0.09	0.10	0.09	0.12	-0.06	0.07	-0.24	0.09
Acetonitrile	0.58	0.59	0.44	0.59	-0.41	-0.28	0.52	0.46
Arsenic Compounds	0.21	0.16	-0.10	0.10	-0.30	-0.05	0.43	-0.22
Benzene	-0.17	-0.21	-0.13	-0.19	0.11	0.37	-0.12	-0.16
Carbon Tetrachloride	-0.22	-0.18	0.18	-0.09	0.47	0.10	-0.03	-0.03
Formaldehyde	0.49	0.51	0.14	0.45	-0.54	-0.27	0.00	0.39
Manganese Compounds	0.32	0.26	-0.04	0.20	-0.37	-0.12	0.45	-0.15
p-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	-0.60	-0.65	-0.48	-0.68	0.58	0.33	-0.68	-0.19
Xylenes (total)	-0.12	-0.14	-0.08	-0.12	0.06	0.34	-0.08	-0.13

Table 5-5. Average Metal Concentrations Measured by the Colorado Monitoring Stations

Monitoring Station	Average Metals Concentration (ng/m^3)
DECO	50.39
WECO	46.52

Table 5-6. Motor Vehicle Information vs. Daily Concentration for Colorado Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu g/m^3$)
DECO	560,415	415,535	0.74	1,283,560	949,834	44,200	57.62 (±11.62)
WECO	374,099	300,457	0.80	874,731	699,785	1,500	106.96 (±19.90)

6.0 Site in Connecticut

This section focuses on 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 station in its urban location. Figure 6-2 is a map identifying facilities within ten miles of this site that reported to the 1999 NEI. The Hartford site is surrounded by numerous sources. Many sources near HACT fall into four categories: fabricated metal, surface coating, waste treatment and disposal, and fuel combustion.

Hourly meteorological data were retrieved for all of 2003 at the weather station nearest this site with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The weather station is Hartford-Brainard Airport (WBAN 14752).

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), 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. Hartford’s New England location is one that sees 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. All 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 toxicity was over 67% of the total noncancer toxicity. The acetaldehyde cancer risk was the highest among the toxic carbonyl compounds at 9.14 in a million. For the compounds which may lead to adverse noncancer health effects, the average formaldehyde toxicity was 0.962 (over 1 indicates a significant chance of a noncancer health effect). Of the thirty-six measured formaldehyde concentrations, 15 were above the formaldehyde 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 concentrations. The average UATMP concentration was 33.42 (± 4.29) ug/m^3.

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 very poor correlations with acetaldehyde and formaldehyde, with the exception of the v-component of the wind (0.40 and 0.49, respectively).

6.4 Spatial Analysis

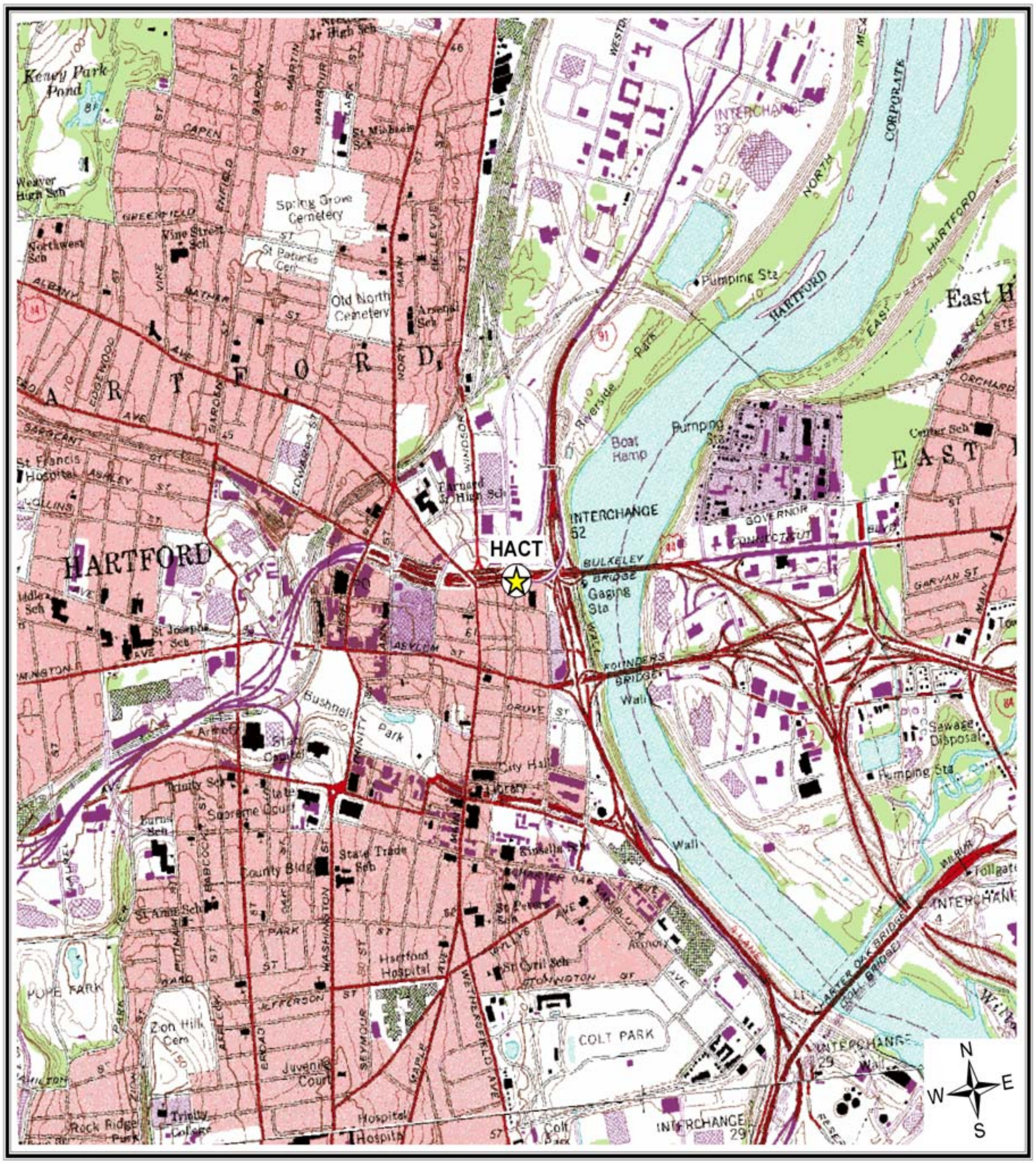
County-level car registration and population in Hartford County, CT, were obtained from the Connecticut Department of Motor Vehicles and the U.S. Census Bureau, and are summarized in Table 6-5. Also included in Table 6-5 is the population within 10 miles of each site and the average daily traffic information, which reflects the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. Using these parameters, a county-level car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the computed car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the HACT site in Table 6-5.

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.) Since only carbonyl compounds were sampled, a BTEX analysis could not be performed.

6.5 RFG Analysis

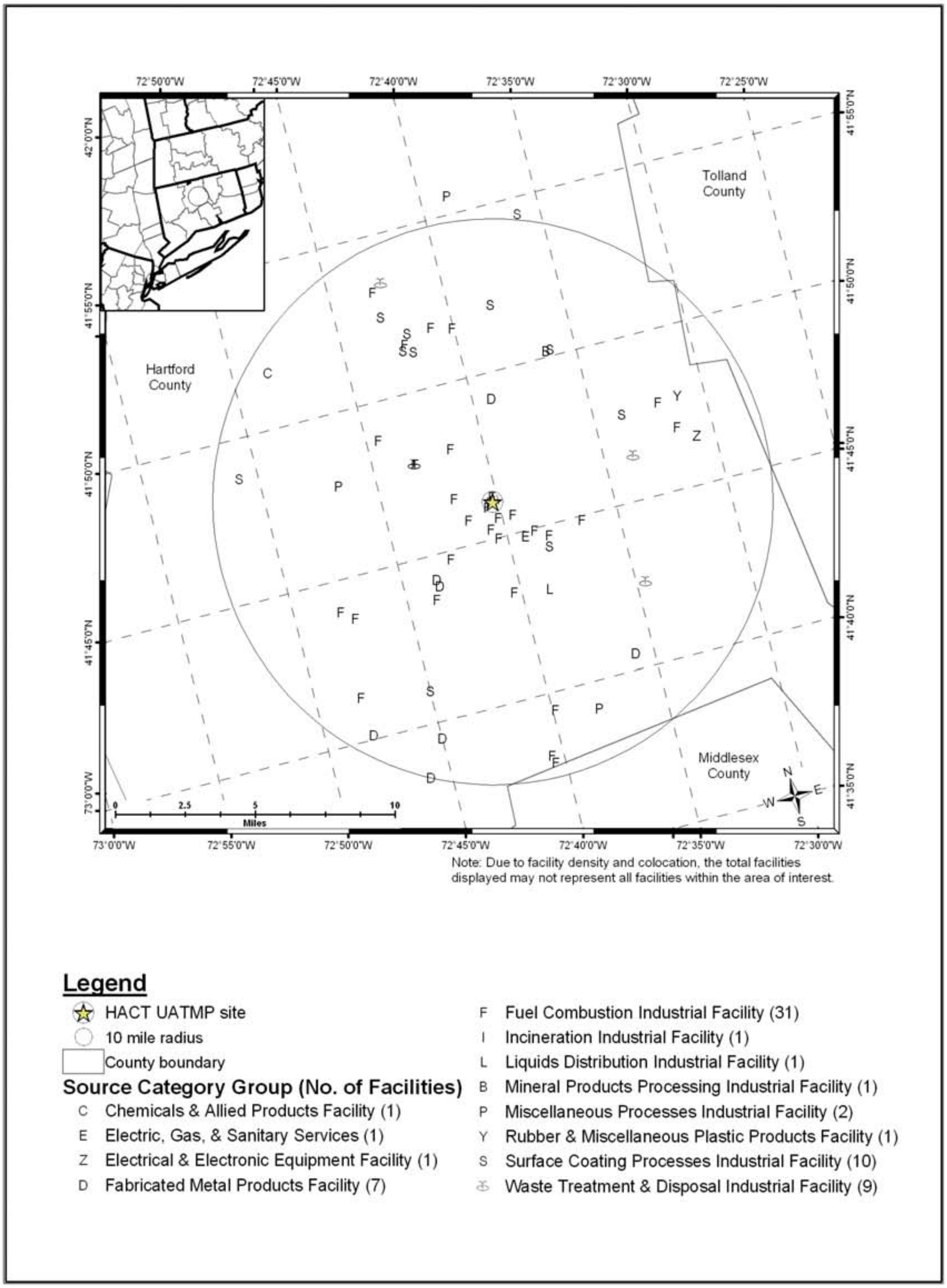
The Hartford MSA is in a federal RFG mandated area (EPA, 1994), and must use gasoline additives to reduce VOC emissions. During the summer period, MTBE and TAME are used; in the winter, MTBE, TAME, ETBE, and ethanol are used. A summer 2002 survey of 6 service stations showed an oxygen content of 2.12% 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). Because VOCs were not sampled at HACT, an RFG analysis was not performed.

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



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

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



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

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

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)
HACT	All 2003	▨	58.61 (±2.01)	50.04 (±1.88)	40.69 (±2.12)	45.93 (±1.82)	73.35 (±1.55)	1015.96 (±0.80)	1.18 (±0.31)	-0.59 (±0.45)
	sample day	33.42 (±4.29)	66.94 (±4.99)	57.82 (±4.81)	50.02 (±4.75)	53.63 (±4.45)	78.14 (±3.34)	1016.91 (±2.41)	0.50 (±0.89)	-0.18 (±1.10)

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

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	9.14E-06	99.44	99.44	4.156	36	9.14
Formaldehyde	5.18E-08	0.56	100.00	9.425	36	<1

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

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	9.62E-01	67.56	67.56	9.425	36	15
Acetaldehyde	4.62E-01	32.44	100.00	4.156	36	0

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	u-component of wind	v-component of wind
Acetaldehyde	0.08	0.10	0.09	0.09	-0.06	-0.11	0.01	0.40
Formaldehyde	0.32	0.31	0.27	0.29	-0.14	0.00	0.05	0.49

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

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu g/m^3$)
HACT	867,332	686,895	0.79	575,327	454,508	10,000	33.42 (±4.29)

7.0 Sites in Florida

This section focuses on meteorological, concentration, and spatial trends for the four UATMP sites in and near the Tampa/St. Petersburg, FL area (AZFL, CWFL, GAFL, LEFL), one site in the Orlando, FL, area (ORFL), and four South Florida sites (BGFL, DBFL, FLFL, MDFL). In the Tampa/St. Petersburg area, one of these sites is located in St. Petersburg, two in Tampa, and one in Clearwater, while the south Florida sites are scattered among Belle Glade, Delray Beach, Pompano Beach and Miami. Figures 7-1 through 7-9 are topographical maps showing the monitoring stations in their urban locations. Figures 7-10 through 7-14 are maps identifying facilities within ten miles of the sites and that reported to the 1999 NEI. The Tampa-St. Petersburg sites are clustered around each other, with a majority of the facilities between CWFL, AZFL, and GAFL, and between GAFL and LEFL. A large number of fuel combustion and surface coating sources are located in this region. BGFL is located south of Lake Okeechobee, with only seven facilities within ten miles of the monitoring station. Five of these facilities are fuel combustion facilities, one is an electric, gas, and sanitary service facility, and one is a liquid distribution facility. DBFL and FLFL are both located on the east coast of Florida, with DBFL to the north of FLFL. There are more facilities near FLFL, most of which are fuel combustion or surface coating facilities. Due to MDFL's coastal location, most of the facilities are located to the west of the monitoring station. Most of the facilities located within ten miles of MDFL are surface coating or fuel combustion sources. Emission sources are fairly evenly distributed around the ORFL site, with a majority of the facilities involved in waste treatment and disposal.

Hourly meteorological data were retrieved for all of 2003 at seven weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The seven weather stations are Tampa International Airport, St. Petersburg/Whitted Airport, St. Petersburg/Clearwater International Airport, Hollywood International, Orlando Executive Airport, Palm Beach International Airport, and Miami International Airport (WBAN 12842, 92806, 12873, 12849, 12841, 12844, and 12839, respectively).

Table 7-1 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 Tampa/St. Petersburg area is located on Florida's Gulf Coast, Belle Glade is in south central Florida, and the remaining sites are located along the east coast of southern Florida. Florida's climate is subtropical, with very mild winters and warm, muggy summers, as Table 7-1 confirms. The annual average maximum temperature is in the 80s for all of the locations and relative humidity is in the 70 to 80 percent range. 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. The only carbonyl compounds with toxicity weighting factors are acetaldehyde and formaldehyde. Tables 7-2a-i summarize the cancer weighting scores, while Tables 7-3a-i summarize 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 can be shown in Tables 7-2a-i and 7-3a-i, acetaldehyde was the only prevalent cancer compound at each of the Florida sites, while both acetaldehyde and formaldehyde were prevalent for noncancer compounds. All of the toxic carbonyl compounds were detected at the Florida sites, similarly 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 each of the sites. Acetaldehyde's cancer toxicity contribution was greater than 99% at all of the sites. The acetaldehyde cancer risk at AZFL was the highest among the nine sites at 7.08 in a million, while the remaining sites ranged from 1.32 (at BGFL) to 6.22 (at DBFL). For the compounds which may lead to adverse noncancer health effects, the associated toxicities of acetaldehyde and formaldehyde were low. The highest noncancer risk was acetaldehyde at AZFL (0.358). Of the six adverse health effect exceedances, five occurred at DBFL.

7.3 Meteorological and Concentration Averages at the Florida Sites

Only carbonyl compounds were measured at the nine sites, as indicated in Tables 3-3 and 3-4. Table 7-1 lists the averages for selected meteorological parameters from January 2003 to December 2003, as well as the average UATMP concentration at each of the sites.

Tables 7-4a-i are the summaries of 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 of this report. The strongest correlations (all negative) were computed at DBFL, between acetaldehyde and the temperature parameters, the dewpoint, and the wet bulb temperature (-0.76, -0.79, -0.74, and -0.78, respectively). FLFL, the closest Florida site to DBFL, did not exhibit the same strength in correlations, although there were strong correlations between the u-component of the wind and acetaldehyde and formaldehyde at this site. However, BGFL, which is located roughly fifty miles west of DBFL, did exhibit similar correlations between acetaldehyde and the aforementioned weather parameters, although somewhat weaker (-0.43, -0.42, -0.48, and -0.47, respectively) but still negative. MDFL generally exhibited weak correlations, with the exception of a moderately strong positive correlation between acetaldehyde and the u-component of the wind. Moderately strong to strong negative correlations between acetaldehyde and the moisture variables exist at ORFL. Formaldehyde also had a moderately strong negative correlation with relative humidity. LEFL had the strongest correlations of the

Tampa/St. Petersburg sites. Acetaldehyde exhibited moderately strong to strong negative correlations with both the temperature and moisture variables while formaldehyde had moderately strong positive correlations with the temperature variables. With few exceptions, the remainder of the correlations at the remaining sites were relatively weak.

7.4 Spatial Analysis

County-level car registration and population information for the Florida counties were obtained from the Florida Department of Highway Safety and Motor Vehicles and the U.S. Census Bureau, and are summarized in Table 7-6. Also included in Table 7-6 is the population within 10 miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10 mile car registration was computed using the 10 mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the Florida sites in Table 7-6. The DBFL site has the largest amount of traffic passing by on a daily basis, while the CWFL and FLFL sites have the lowest. The MDFL site has the highest estimated ten mile vehicle ownership while the BGFL site has the lowest.

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.). Since only carbonyl compounds were sampled at the Florida sites, a BTEX analysis could not be performed.

7.5 NATTS Site Analysis

One of the Tampa sites, LEFL, is an EPA designated NATTS site. A description of the NATTS program is given in Section 3.6. For LEFL, the following two analyses were conducted: a composite back trajectory analysis and a regulation analysis. Details on each type of analysis is also provided in Section 3.6. Since there were no Noncancer Benchmark exceedances, an emission tracer analysis was not performed.

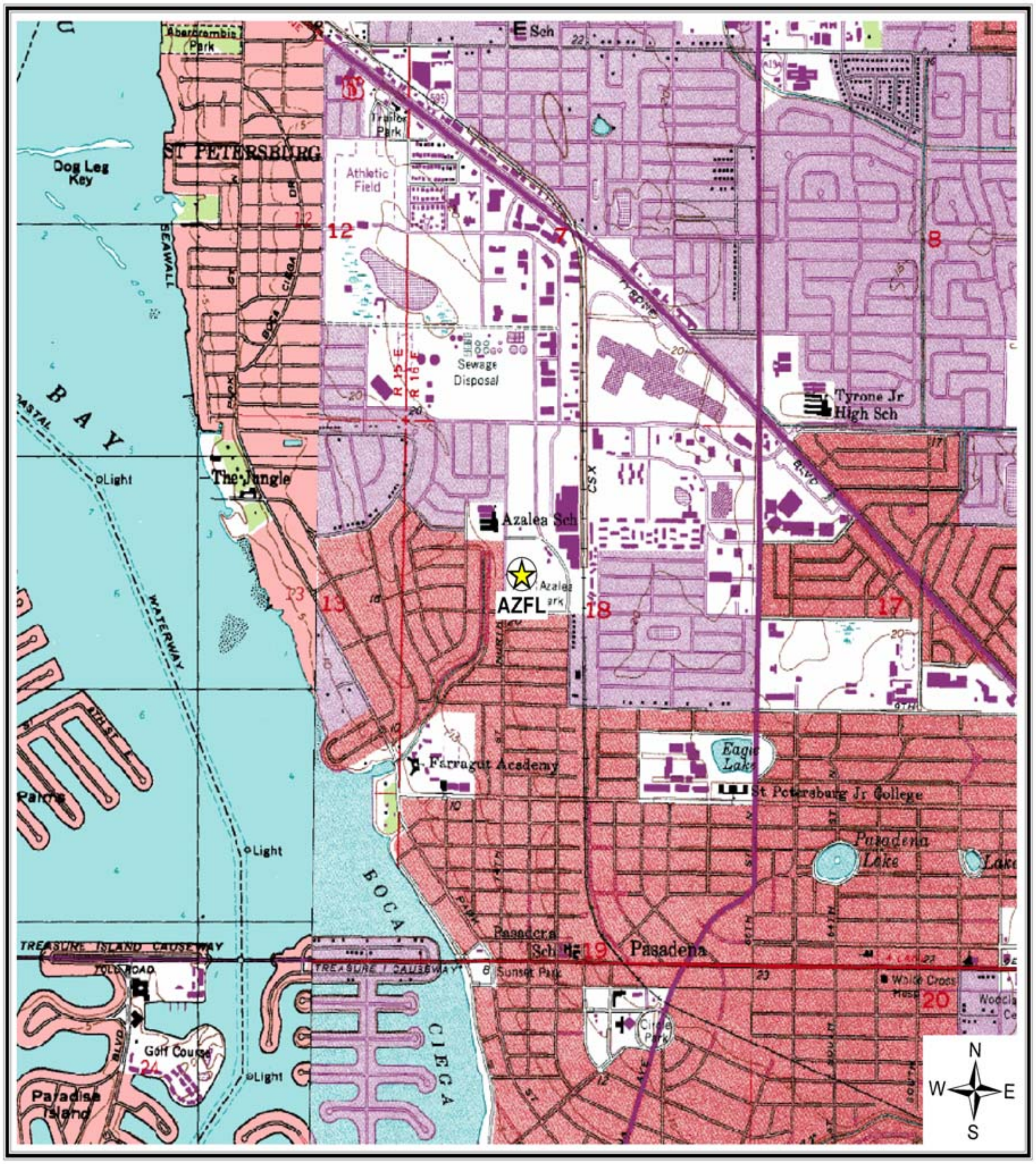
7.5.1 Composite Back Trajectory Analysis

Figure 7-15 is the composite back trajectory map for the LEFL site. Each line represents the 24-hour trajectory along which a parcel of air traveled towards the monitoring location on a sampling day. As shown in Figure 7-15, the back trajectories originated from an array of different directions. Most of the trajectories' paths pass over the Gulf of Mexico or the Atlantic. The 24-hour airshed domain is large, as the furthest away a back trajectory originated was southeast Missouri. As each circle around the site represents 100 miles, 63% of the trajectories originated within 300 miles, and 84% within 400 miles from the LEFL site.

7.5.2 Regulation Analysis

Table 3-10 summarizes the number of facilities that account for approximately 90% of the total UATMP pollutant emissions in the 10 mile area around the monitoring station. One of the 16 facilities at LEFL listed in Table 3-11 is potentially subject to future regulations. Table 7-6 identifies the regulations that are potentially applicable. Based on this analysis, the regulations shown are expected to achieve reductions in ambient concentrations of the following UATMP pollutants: acetaldehyde and formaldehyde. Reductions are projected to be less than 1% for both compounds (0.5% for acetaldehyde and 0.8% for formaldehyde) as the regulations are implemented (the latest compliance date is 2007). The emission reductions are primarily attributed to regulation of reciprocating internal combustion engines.

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

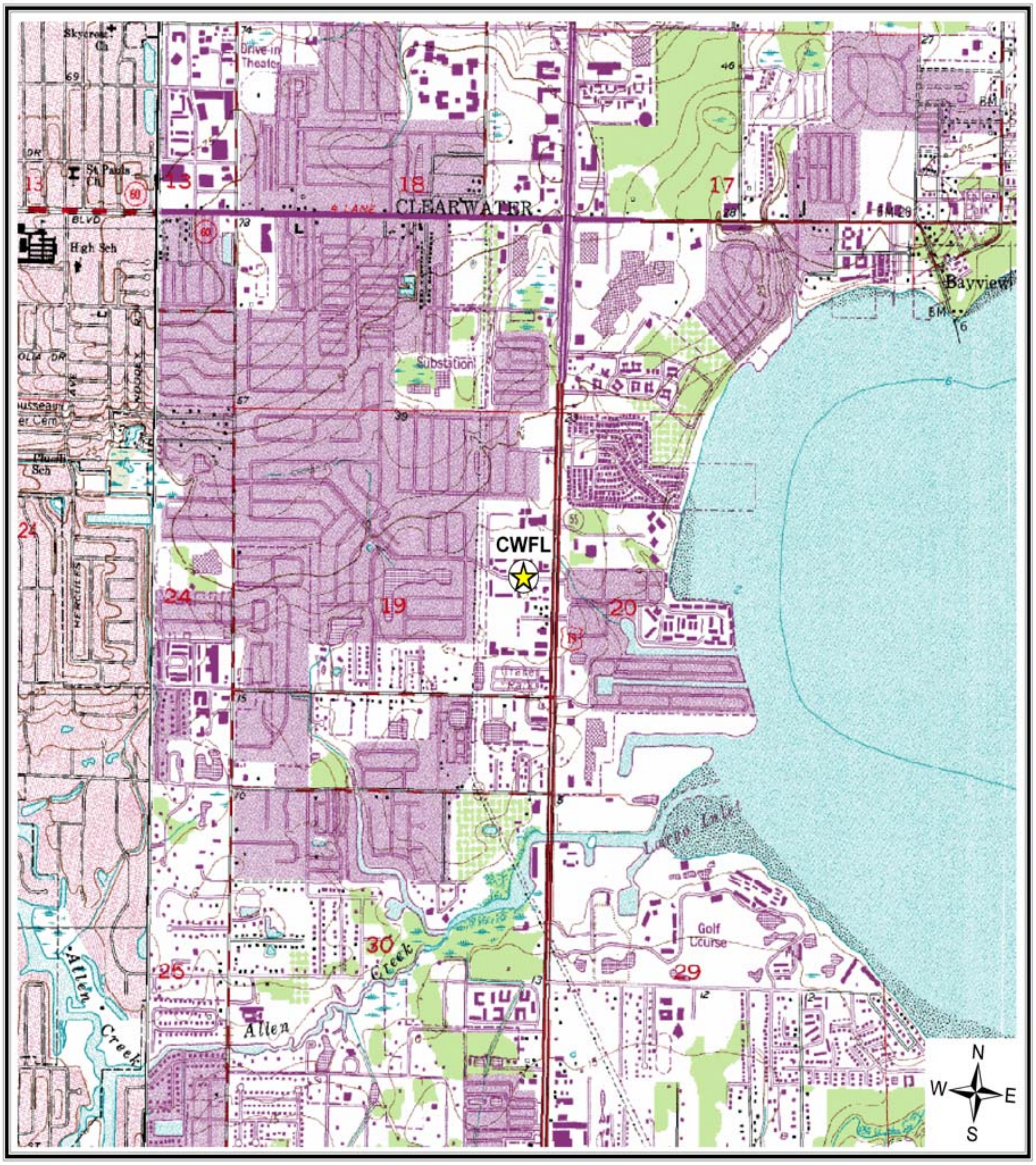


Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-2. Belle Glade, Florida (BGFL) Monitoring Station

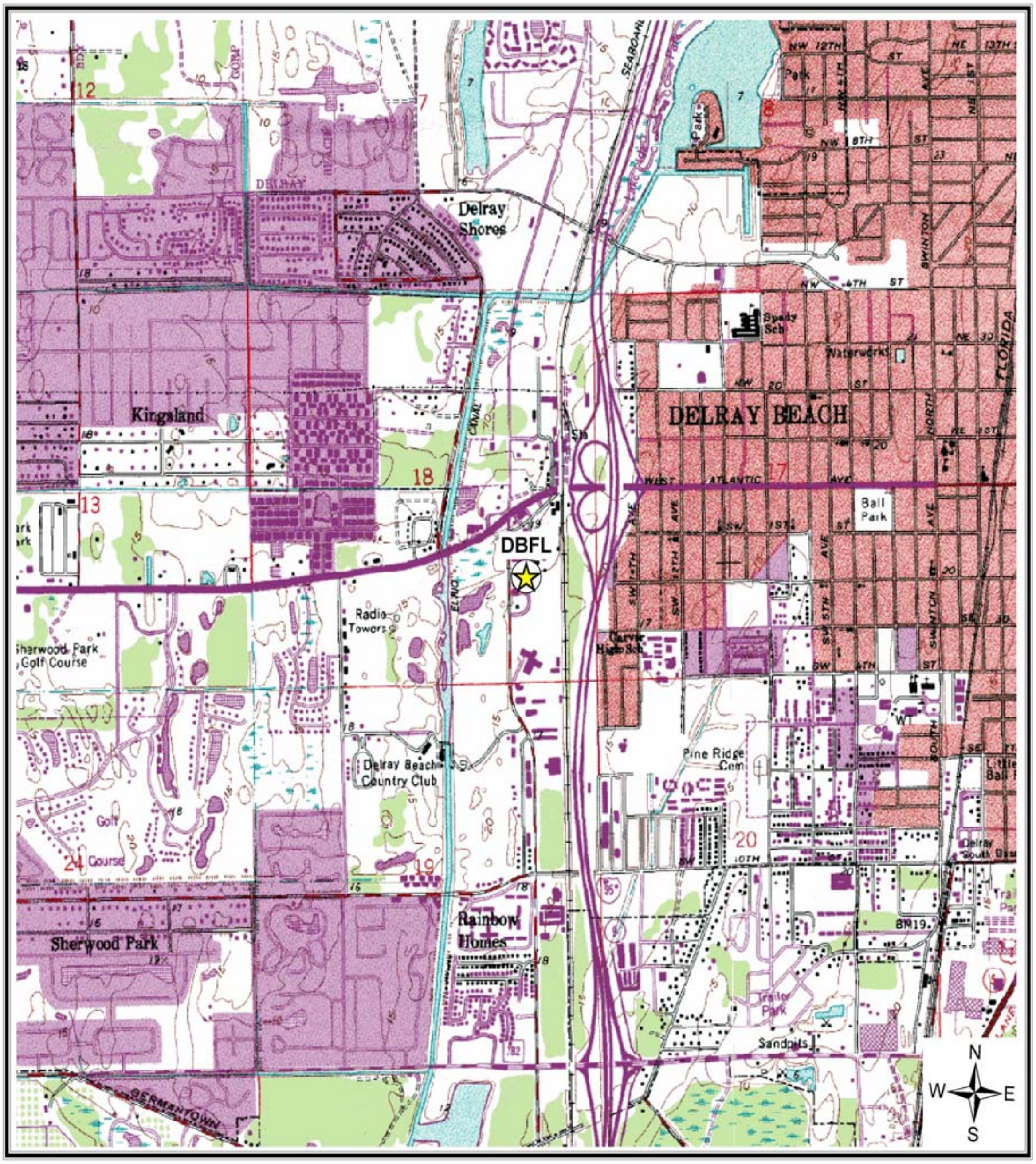
Source: USGS 7.5 Minute Series. Map Scale: 1:100,000.

Figure 7-3. Clearwater, Florida (CWFL) Monitoring Station



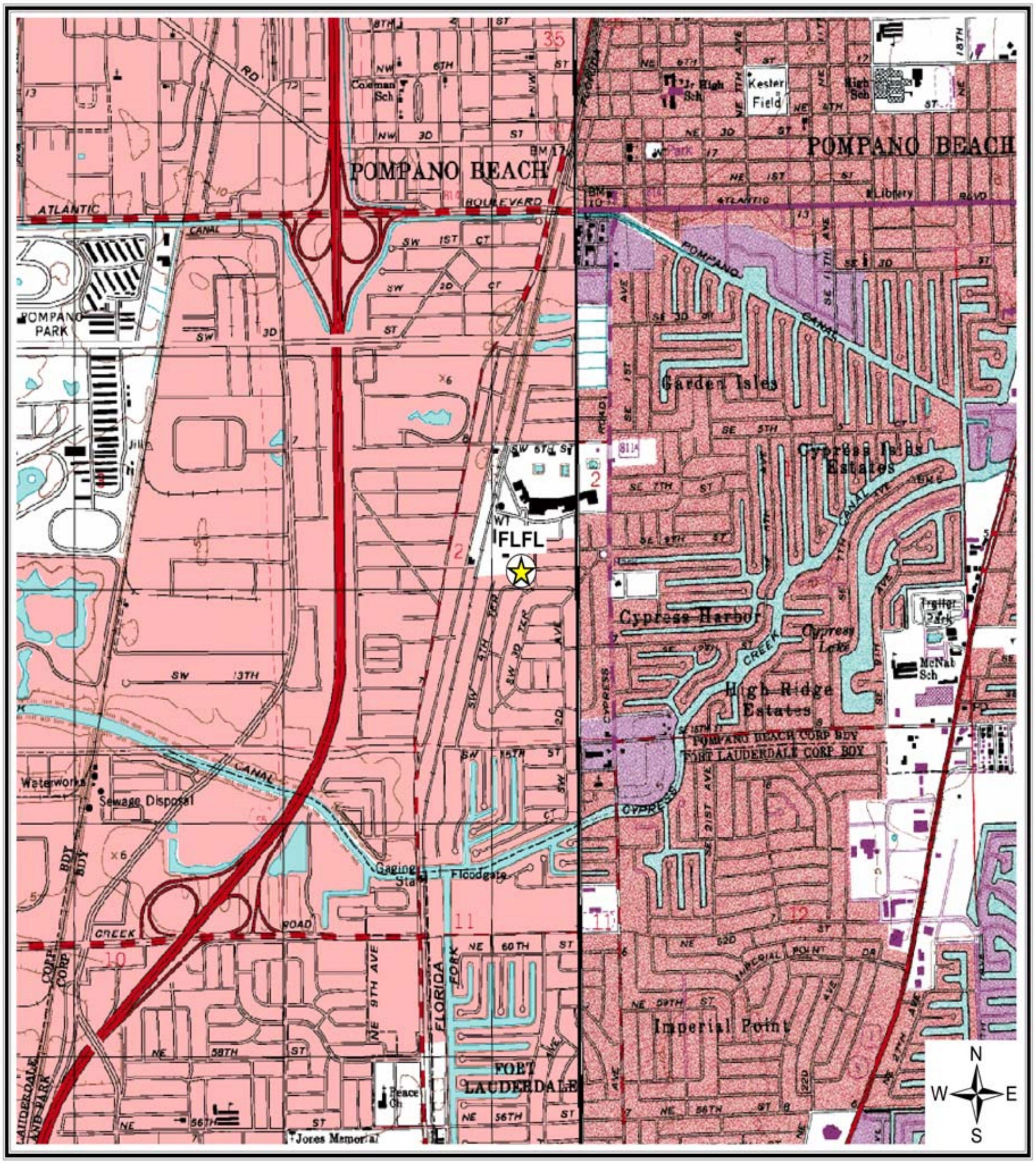
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 7-4. Delray Beach, Florida (DBFL) Monitoring Station



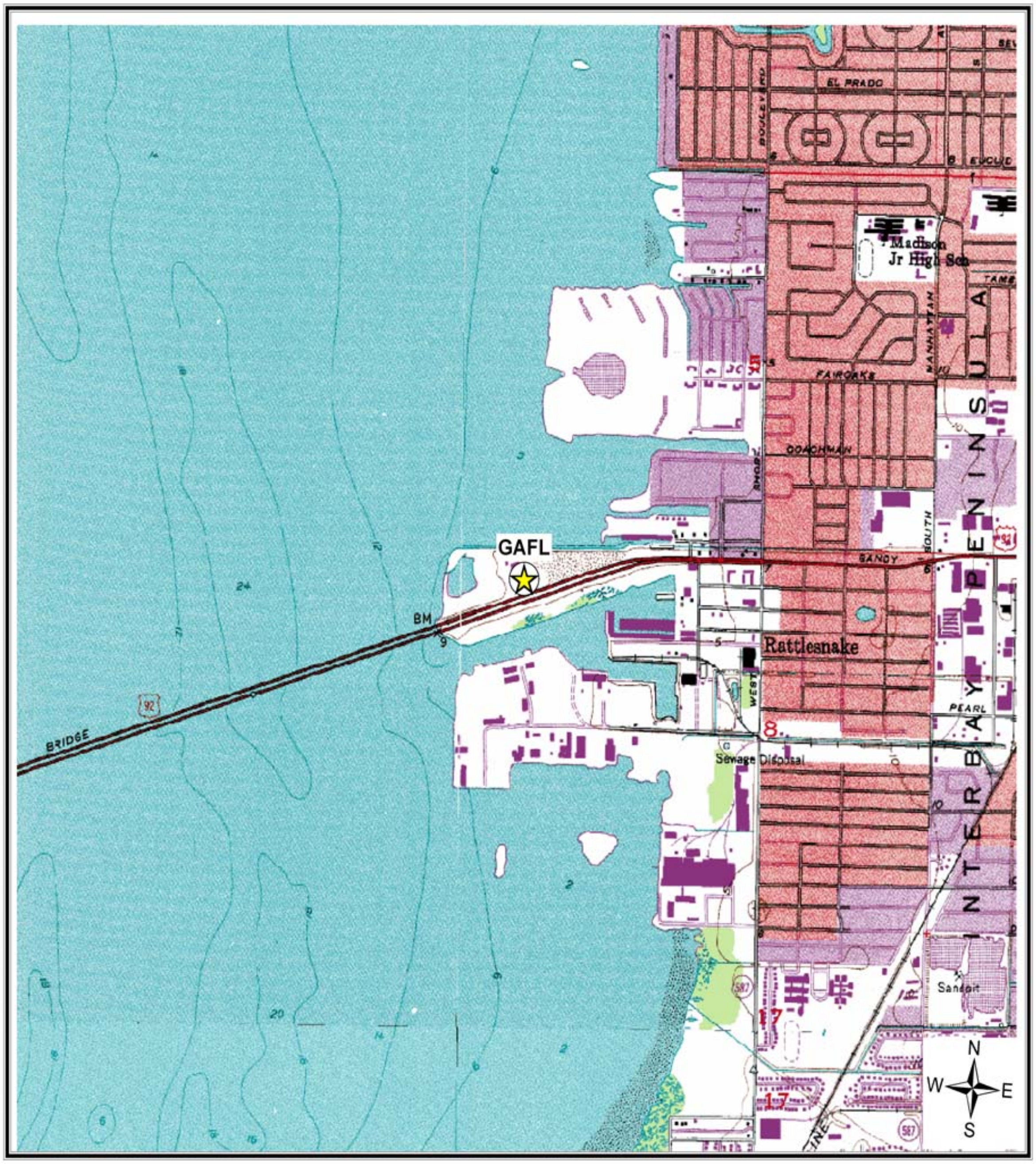
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 7-5. Pompano Beach, Florida Site (FLFL) Monitoring Station



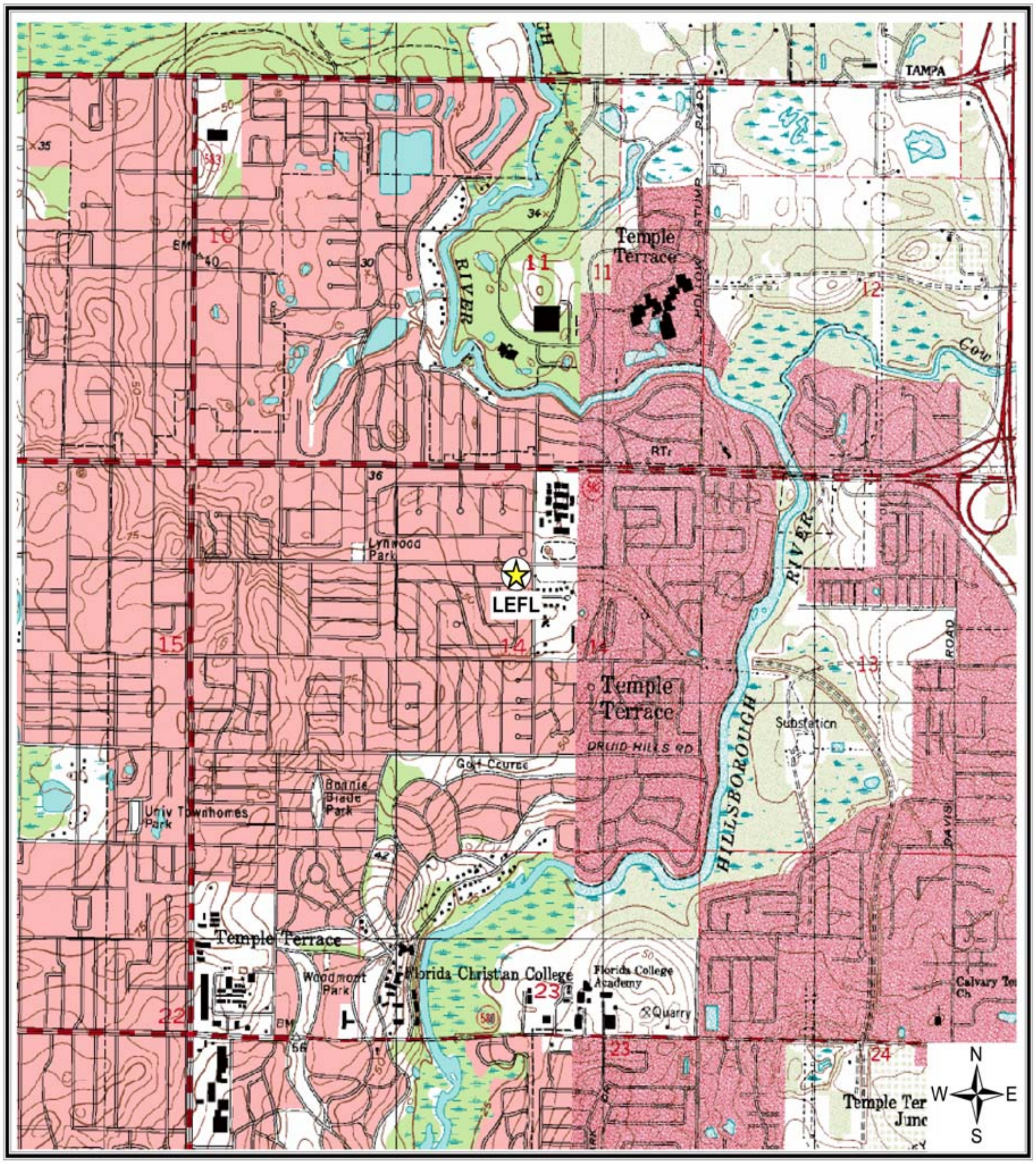
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-6. Tampa, Florida Site 1 (GAFL) Monitoring Station



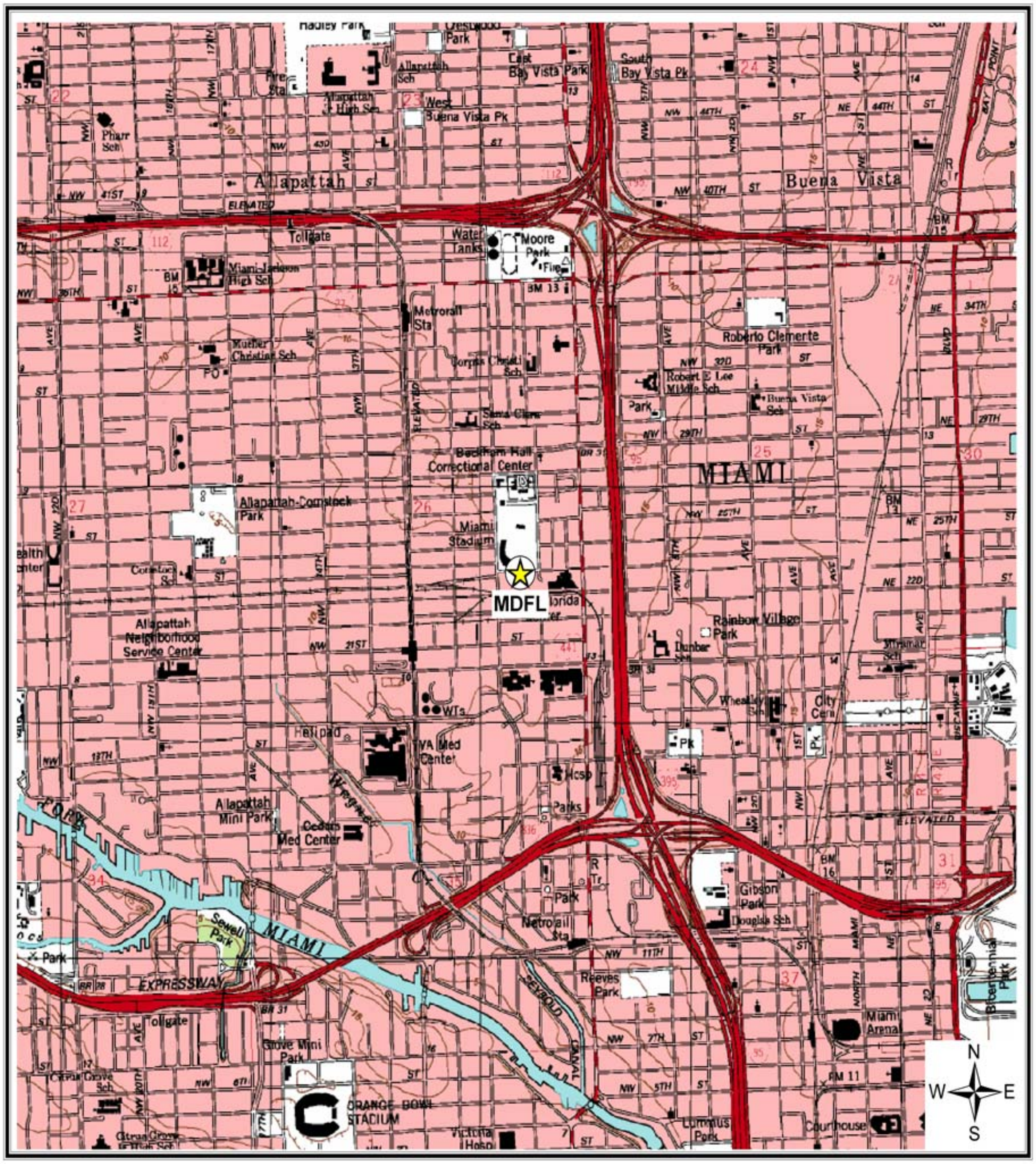
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

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



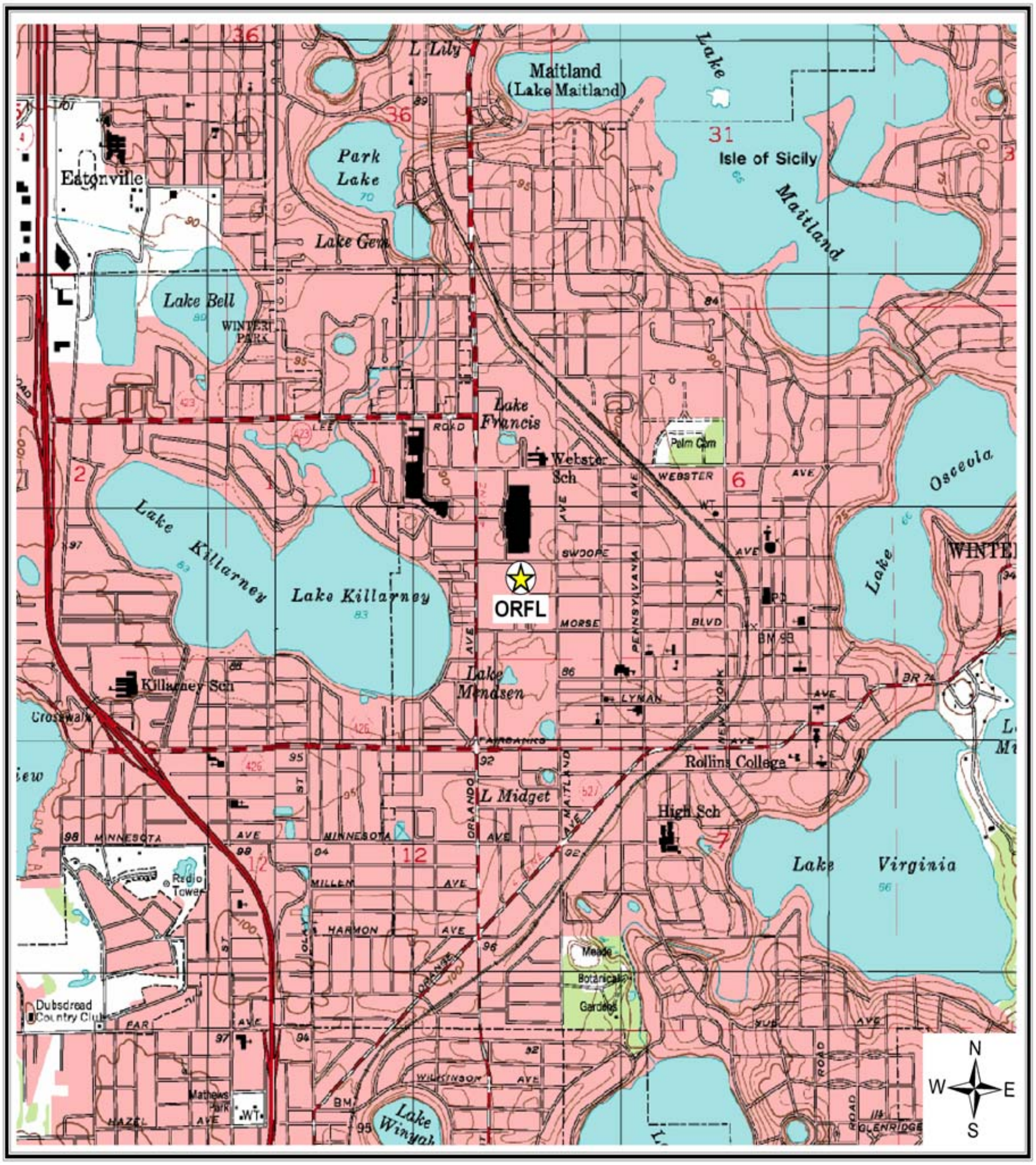
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-8. Miami, Florida (MDFL) Monitoring Station



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

Figure 7-9. Orlando, Florida (ORFL) Monitoring Station



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

Figure 7-10. Facilities Located Within 10 Miles of AZFL, CWFL, GAFL, and LEFL

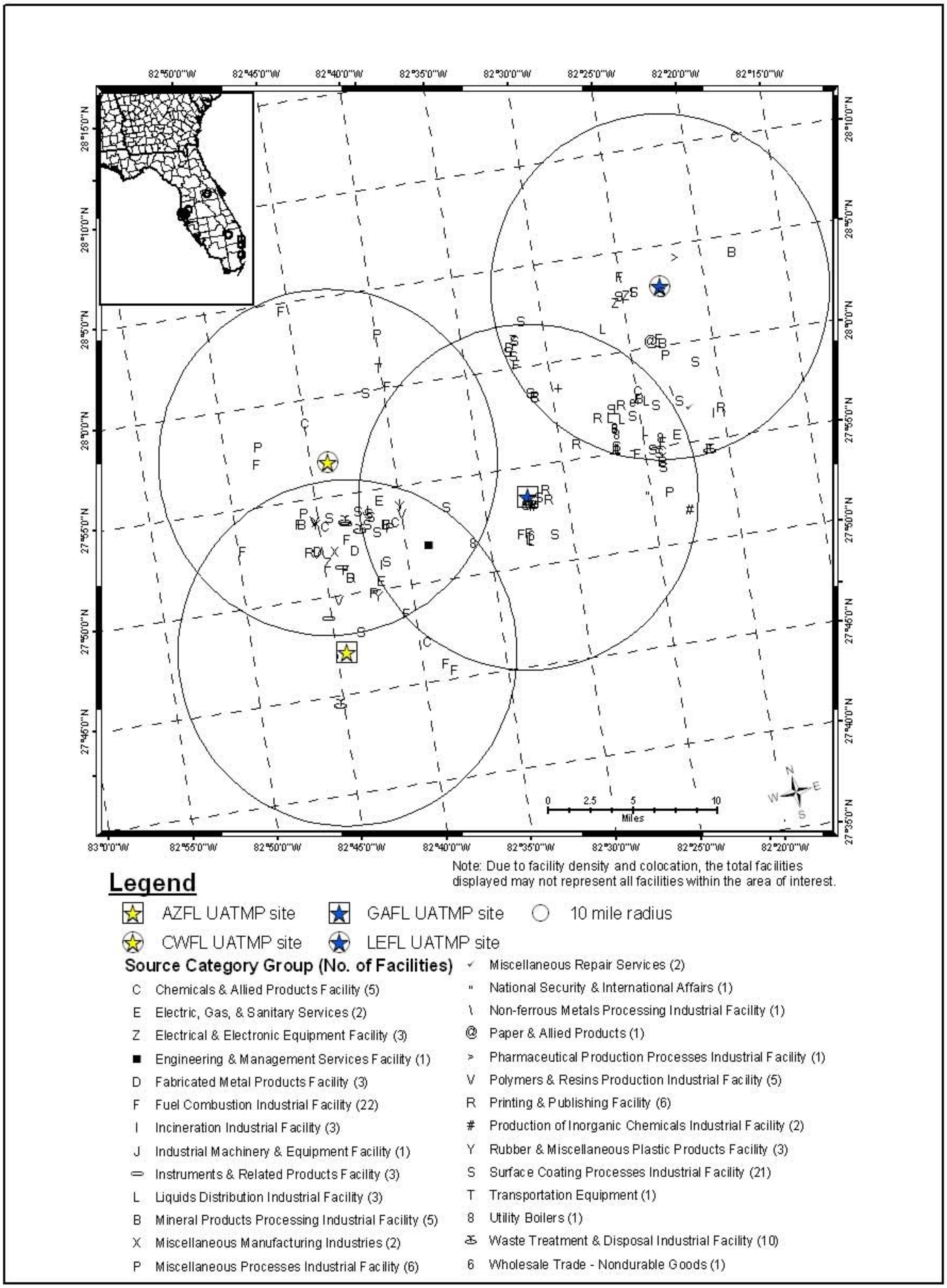
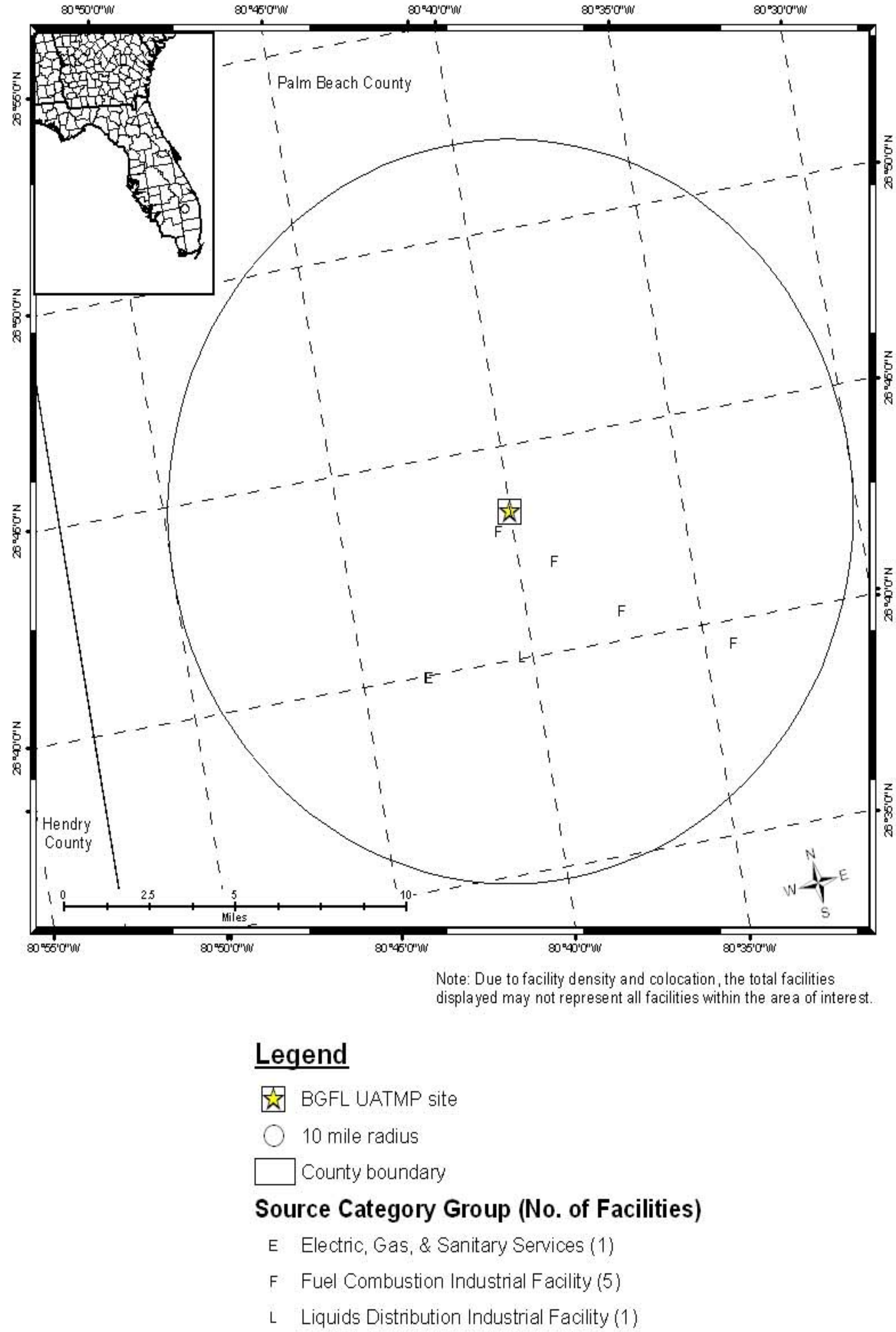
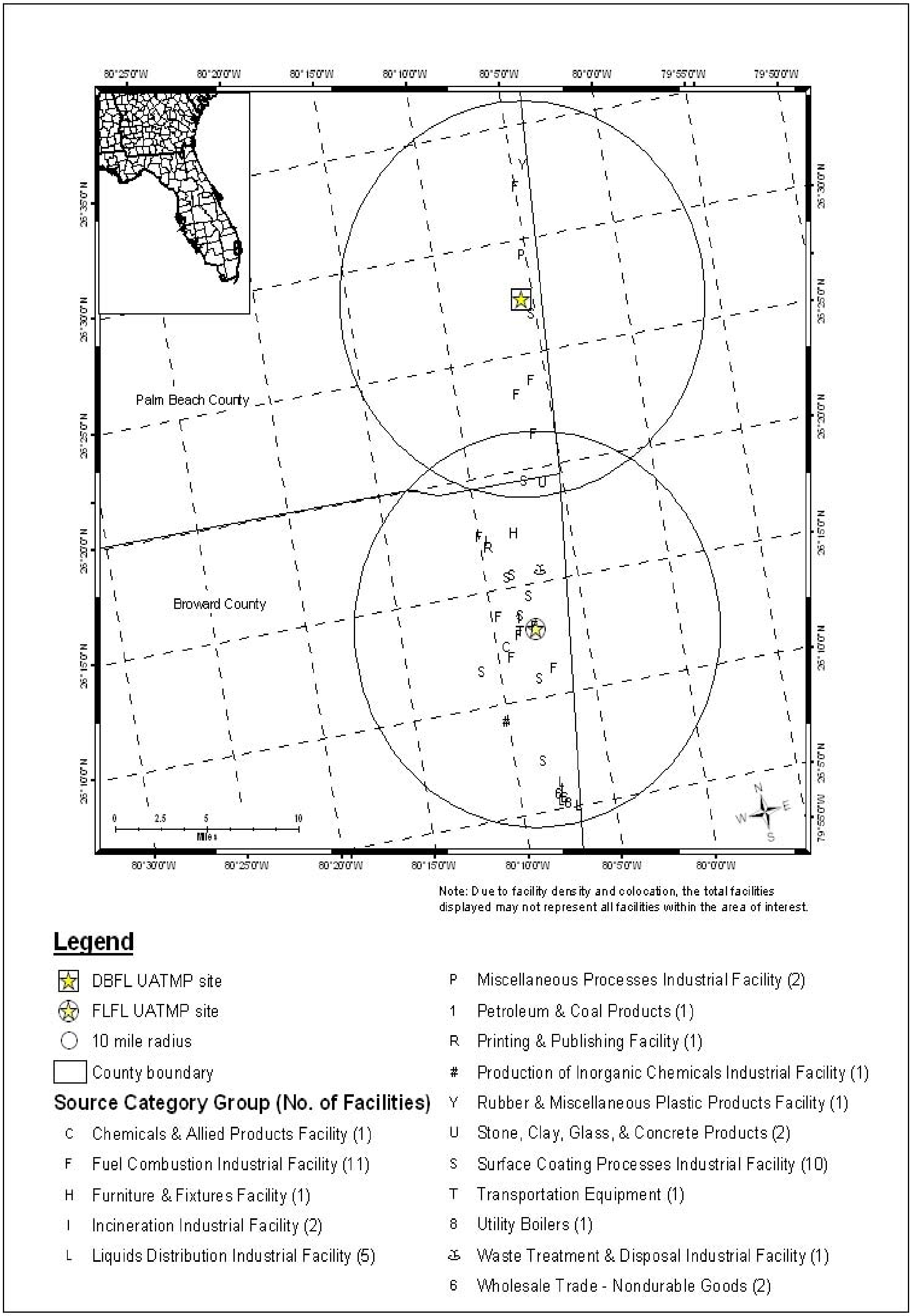


Figure 7-11. Facilities Located Within 10 Miles of BGFL



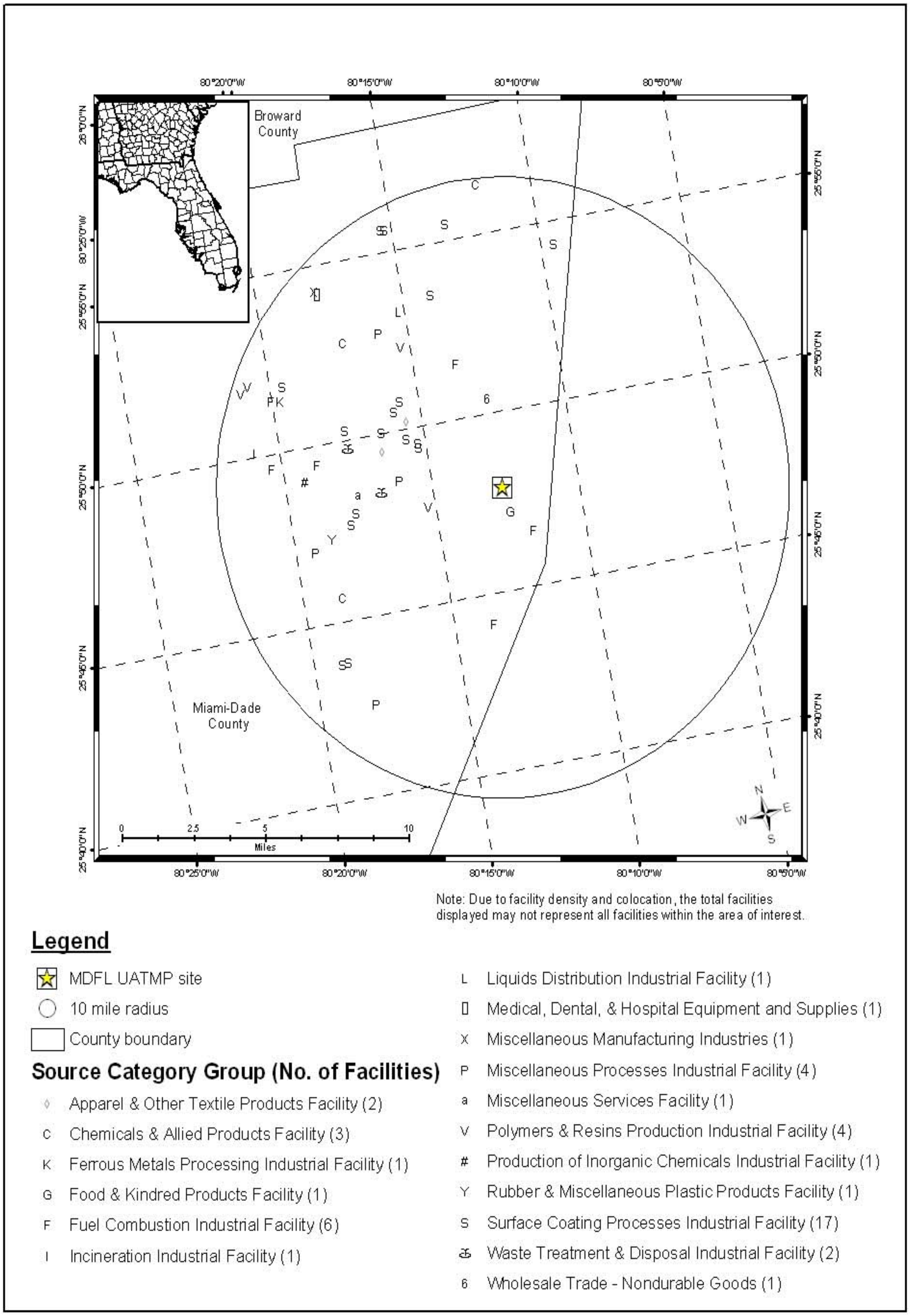
Note: Due to facility density and colocation, the total facilities displayed may not represent all facilities within the area of interest.

Figure 7-12. Facilities Located Within 10 Miles of DBFL and FLFL



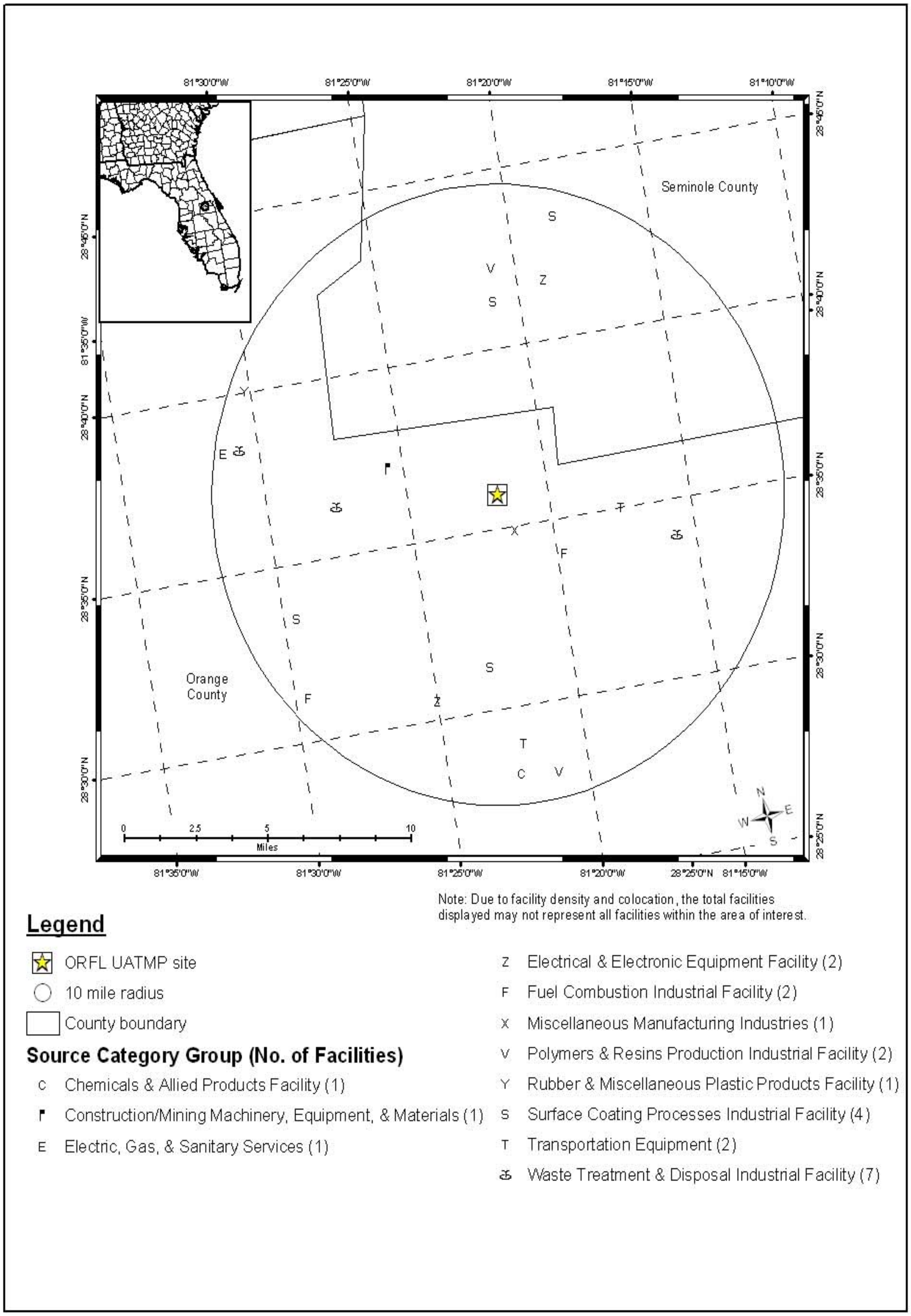
Note: Due to facility density and colocation, the total facilities displayed may not represent all facilities within the area of interest.

Figure 7-13. Facilities Located Within 10 Miles of MDFL



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

Figure 7-14. Facilities Located Within 10 Miles of ORFL



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

Figure 7-15. Composite Back Trajectory for LEFL

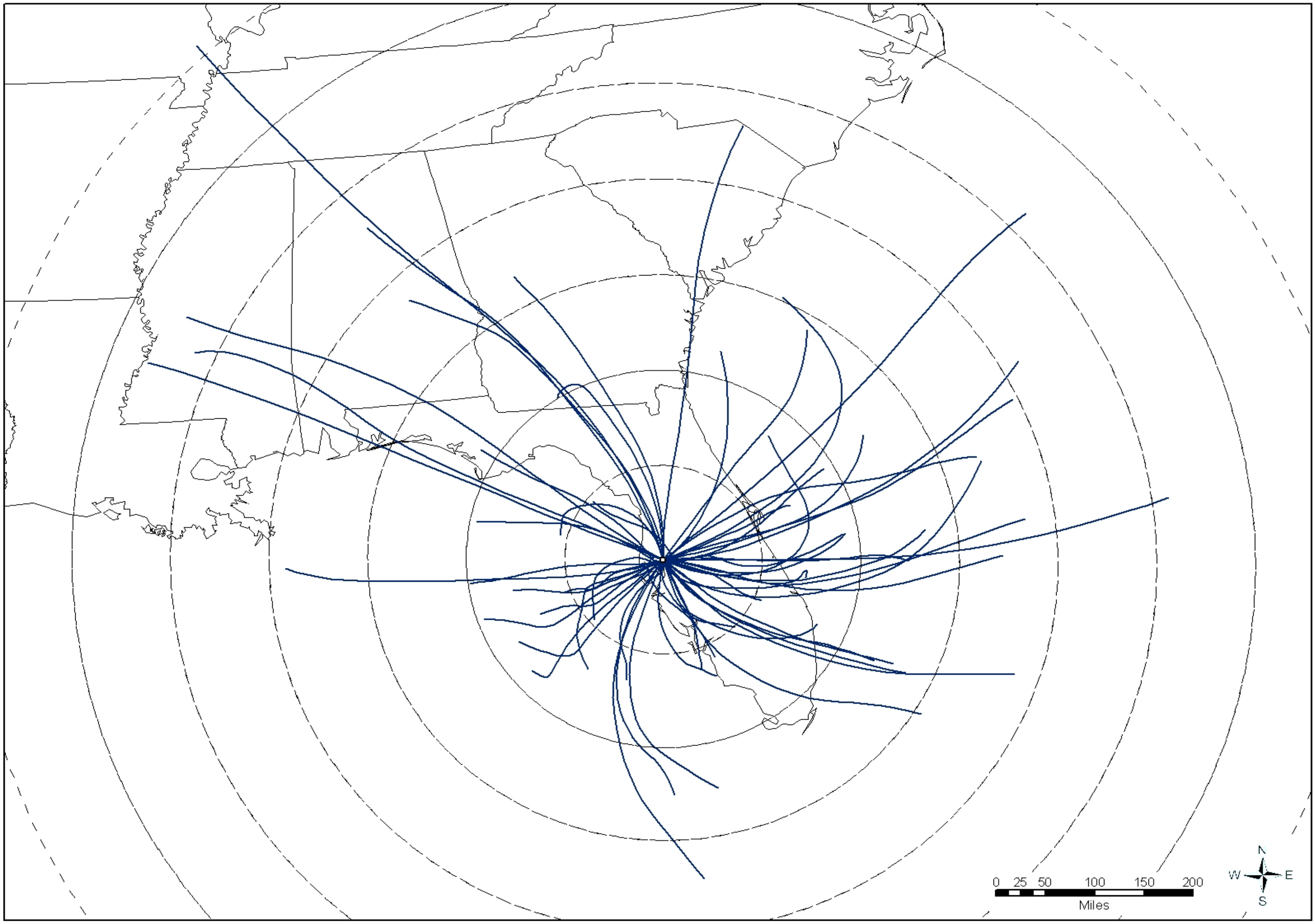


Table 7-1. Average Concentration and Meteorological Parameters for Sites in Florida

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)
AZFL	All 2003	▨	79.66 (±0.95)	73.22 (±0.99)	64.86 (±1.10)	68.03 (±0.96)	76.61 (±0.99)	1016.77 (±0.41)	-1.40 (±0.41)	-0.23 (±0.50)
	sample day	8.63 (±0.77)	80.14 (±2.28)	73.31 (±2.38)	64.25 (±2.73)	67.73 (±2.34)	75.16 (±2.51)	1017.00 (±0.90)	-1.57 (±1.06)	-0.96 (±1.01)
BGFL	All 2003	▨	82.73 (±0.67)	76.55 (±0.77)	67.93 (±0.95)	70.98 (±0.81)	75.87 (±0.83)	1016.50 (±0.35)	-2.84 (±0.48)	0.38 (±0.46)
	sample day	1.45 (±0.19)	82.83 (±2.15)	76.90 (±2.38)	68.87 (±2.95)	71.68 (±2.48)	77.41 (±2.98)	1016.07 (±1.16)	-2.83 (±1.82)	-0.19 (±1.65)
CWFL	All 2003	▨	80.30 (±0.95)	72.26 (±1.00)	63.86 (±1.19)	67.12 (±1.02)	76.61 (±0.96)	1017.15 (±0.41)	-0.61 (±0.4)	-0.41 (±0.47)
	sample day	8.14 (±0.78)	80.5 (±2.3)	72.31 (±2.33)	63.59 (±2.79)	66.95 (±2.38)	75.72 (±2.24)	1017.42 (±0.89)	-0.75 (±1.09)	-1.03 (±0.97)
DBFL	All 2003	▨	82.79 (±0.74)	75.61 (±0.84)	67.54 (±0.96)	70.39 (±0.84)	77.43 (±0.84)	1016.97 (±0.36)	-2.24 (±0.5)	0.52 (±0.45)
	sample day	7.51 (±2.96)	83.47 (±2.45)	76.24 (±2.63)	68.52 (±2.71)	71.16 (±2.46)	78.35 (±2.98)	1016.67 (±1.19)	-1.89 (±1.86)	0.05 (±1.61)
FLFL	All 2003	▨	82.73 (±0.67)	76.55 (±0.77)	67.93 (±0.95)	70.98 (±0.81)	75.87 (±0.83)	1016.50 (±0.35)	-2.84 (±0.48)	0.38 (±0.46)
	sample day	5.29 (±0.83)	84.11 (±1.87)	78.47 (±1.90)	70.57 (±2.45)	73.22 (±2.02)	77.77 (±2.89)	1015.94 (±1.16)	-3.66 (±1.62)	0.28 (±1.65)
GAFL	All 2003	▨	80.45 (±0.95)	72.25 (±1.02)	63.02 (±1.19)	66.61 (±1.02)	74.53 (±0.94)	1017.20 (±0.41)	0.19 (±0.32)	-0.24 (±0.34)
	sample day	6.80 (±0.60)	81.11 (±2.31)	72.64 (±2.45)	62.73 (±2.86)	66.57 (±2.43)	72.99 (±2.49)	1017.44 (±0.93)	0.13 (±0.86)	-0.75 (±0.75)
LEFL	All 2003	▨	80.45 (±0.95)	72.25 (±1.02)	63.02 (±1.19)	66.61 (±1.02)	74.53 (±0.94)	1017.20 (±0.41)	0.19 (±0.32)	-0.24 (±0.34)
	sample day	6.88 (±0.49)	80.95 (±2.34)	72.43 (±2.49)	62.50 (±2.87)	66.37 (±2.45)	72.99 (±2.45)	1017.48 (±0.92)	0.09 (±0.84)	-0.74 (±0.74)
MDFL	All 2003	▨	83.41 (±0.68)	76.67 (±0.76)	67.74 (±0.89)	70.88 (±0.76)	75.16 (±0.78)	1016.77 (±0.34)	-2.51 (±0.43)	0.53 (±0.38)
	sample day	2.76 (±0.43)	84.30 (±2.06)	77.50 (±2.4)	68.82 (±3.08)	71.82 (±2.52)	76.01 (±3.22)	1016.57 (±1.21)	-2.66 (±1.54)	0.11 (±1.43)

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

Site Name	Type	Average UATMP Concentration ($\mu g/m^3$)	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)
ORFL	All 2003	▨	81.24 (±0.97)	71.97 (±1.00)	63.49 (±1.27)	66.84 (±1.06)	76.96 (±1.07)	1016.77 (±0.41)	-1.40 (±0.41)	-0.13 (±0.39)
	sample day	6.87 (±0.70)	83.53 (±2.28)	74.78 (±2.21)	67.05 (±2.94)	69.88 (±2.39)	78.98 (±3.09)	1017.52 (±0.96)	-0.39 (±1.25)	-0.27 (±0.93)

Table 7-2a. Summary of the Toxic Cancer Compounds at the St. Petersburg, Florida Monitoring Site - AZFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	7.08E-06	99.83	99.83	3.220	59	7.08
Formaldehyde	1.23E-08	0.17	100.00	2.239	59	<1

Table 7-2b. Summary of the Toxic Cancer Compounds at the Belle Glade, Florida Monitoring Site - BGFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	1.32E-06	99.85	99.85	0.599	29	1.32
Formaldehyde	1.96E-09	0.15	100.00	0.356	29	<1

Table 7-2c. Summary of the Toxic Cancer Compounds at the Clearwater, Florida Monitoring Site - CWFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	4.92E-06	99.67	99.67	2.238	60	4.92
Formaldehyde	1.64E-08	0.33	100.00	2.974	60	<1

Table 7-2d. Summary of the Toxic Cancer Compounds at the Delray Beach, Florida Monitoring Site - DBFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	6.22E-06	99.79	99.79	2.828	30	6.22
Formaldehyde	1.33E-08	0.21	100.00	2.425	30	<1

Table 7-2e. Summary of the Toxic Cancer Compounds at the Pompano Beach, Florida Monitoring Site - FLFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	5.35E-06	99.87	99.87	2.433	27	5.35
Formaldehyde	6.80E-09	0.13	100.00	1.236	27	<1

Table 7-2f. Summary of the Toxic Cancer Compounds at the Gandy Monitoring Site in Tampa, Florida - GAFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	4.87E-06	99.73	99.73	2.214	57	4.87
Formaldehyde	1.31E-08	0.27	100.00	2.384	57	<1

Table 7-2g. Summary of the Toxic Cancer Compounds at the Lewis in Tampa, Florida Monitoring Site - LEFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	3.09E-06	99.58	99.58	1.402	58	3.09
Formaldehyde	1.29E-08	0.42	100.00	2.339	58	<1

Table 7-2h. Summary of the Toxic Cancer Compounds at the Miami, Florida Monitoring Site - MDFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	2.84E-06	99.88	99.88	1.290	27	2.84
Formaldehyde	3.51E-09	0.12	100.00	0.637	27	<1

Table 7-2i. Summary of the Toxic Cancer Compounds at the Winter Park, Florida Monitoring Site - ORFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	4.41E-06	99.67	99.67	2.620	45	4.41
Formaldehyde	1.44E-08	0.33	100.00	2.006	45	<1

Table 7-3a. Summary of the Toxic Noncancer Compounds at the St. Petersburg, Florida Monitoring Site - AZFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	3.58E-01	61.02	61.02	3.220	59	0
Formaldehyde	2.29E-01	38.98	100.00	2.239	59	0

Table 7-3b. Summary of the Toxic Noncancer Compounds at the Belle Glade, Florida Monitoring Site - BGFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	6.65E-02	64.70	64.70	0.599	29	0
Formaldehyde	3.63E-02	35.30	100.00	0.356	29	0

Table 7-3c. Summary of the Toxic Noncancer Compounds at the Clearwater, Florida Monitoring Site - CWFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	3.04E-01	54.96	54.96	2.974	60	1
Acetaldehyde	2.49E-01	45.04	100.00	2.238	60	0

Table 7-3d. Summary of the Toxic Noncancer Compounds at the Delray Beach, Florida Monitoring Site - DBFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	3.14E-01	55.95	55.95	2.828	30	3
Formaldehyde	2.47E-01	44.05	100.00	2.425	30	2

Table 7-3e. Summary of the Toxic Noncancer Compounds at the Pompano Beach, Florida Monitoring Site - FLFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	2.70E-01	68.20	68.20	2.433	27	0
Formaldehyde	1.26E-01	31.80	100.00	1.236	27	0

Table 7-3f. Summary of the Toxic Noncancer Compounds at the Gandy Monitoring Site in Tampa, Florida - GAFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	2.46E-01	50.28	50.28	2.214	57	0
Formaldehyde	2.43E-01	49.72	100.00	2.384	57	0

Table 7-3g. Summary of the Toxic Noncancer Compounds at the Lewis Monitoring Site in Tampa, Florida - LEFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	2.39E-01	60.51	60.51	2.339	58	0
Acetaldehyde	1.56E-01	39.49	100.00	1.402	58	0

Table 7-3h. Summary of the Toxic Noncancer Compounds at the Miami, Florida Monitoring Site - MDFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	1.43E-01	68.79	68.79	1.290	27	0
Formaldehyde	6.50E-02	31.21	100.00	0.637	27	0

Table 7-3i. Summary of the Toxic Noncancer Compounds at the Winter Park, Florida Monitoring Site - ORFL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	2.67E-01	54.53	54.53	2.620	45	0
Acetaldehyde	2.23E-01	45.47	100.00	2.006	45	0

Table 7-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the St. Petersburg, Florida Site (AZFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	0.15	0.12	0.04	0.07	-0.15	0.13	-0.43	-0.18
Formaldehyde	-0.10	-0.16	-0.31	-0.26	-0.42	0.09	-0.08	-0.08

Table 7-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Belle Glade, Florida Site (BGFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	-0.43	-0.42	-0.48	-0.47	-0.35	0.12	0.14	-0.16
Formaldehyde	-0.08	-0.06	-0.26	-0.20	-0.50	0.19	-0.27	-0.16

Table 7-4c. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Clearwater, Florida Site (CWFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	-0.04	-0.16	-0.28	-0.24	-0.43	0.20	-0.22	-0.05
Formaldehyde	0.26	0.22	0.20	0.21	0.09	0.00	-0.19	0.22

Table 7-4d. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Delray Beach, Florida Site (DBFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	-0.76	-0.79	-0.74	-0.78	0.03	0.45	0.34	-0.45
Formaldehyde	-0.23	-0.20	-0.19	-0.20	0.01	0.24	-0.20	-0.18

Table 7-4e. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Pompano Beach, Florida Site (FLFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	-0.29	-0.39	-0.14	-0.21	0.36	-0.31	0.69	0.03
Formaldehyde	-0.15	-0.29	-0.17	-0.20	0.14	-0.30	0.58	0.00

Table 7-4f. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Gandy Site in Tampa, Florida (GAFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	-0.11	-0.20	-0.34	-0.30	-0.43	0.27	-0.35	0.03
Formaldehyde	0.22	0.12	0.03	0.07	-0.17	0.11	-0.34	0.17

Table 7-4g. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Lewis Site in Tampa, Florida (LEFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	-0.36	-0.43	-0.56	-0.52	-0.54	0.35	-0.03	-0.09
Formaldehyde	0.45	0.43	0.27	0.34	-0.26	-0.05	0.09	0.23

Table 7-4h. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Miami, Florida Site (MDFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	0.19	0.07	0.21	0.17	0.37	-0.27	0.43	0.27
Formaldehyde	0.15	0.09	0.15	0.14	0.20	-0.25	0.19	0.00

Table 7-4i. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Winter Park, Florida Site (ORFL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	-0.23	-0.31	-0.48	-0.45	-0.60	-0.13	0.35	-0.29
Formaldehyde	0.17	0.14	-0.09	-0.03	-0.43	-0.21	0.33	0.11

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

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
AZFL	926,716	1,139,738	1.23	575,371	707,706	51,000	8.63 (± 0.77)
BGFL	1,190,390	889,710	0.75	34,023	25,517	12,200	1.45 (± 0.19)
CWFL	926,716	1,139,738	1.23	562,482	691,853	1000	8.14 (± 0.78)
DBFL	1,190,390	889,710	0.75	493,006	369,755	201,032	7.51 (± 2.96)
FLFL	1,709,118	1,195,203	0.70	1,050,037	735,026	1,000	5.29 (± 0.83)
GAFL	1,053,864	763,989	0.72	455,039	327,628	81,400	6.80 (± 0.60)
LEFL	1,053,864	763,989	0.72	587,295	422,852	1,055	6.88 (± 0.49)
MDFL	2,332,599	1,699,557	0.73	1,209,024	882,588	15,200	2.76 (± 0.43)
ORFL	946,484	750,761	0.79	949,497	750,103	59,00	6.87 (± 0.70)

Table 7-6. Summary of Future Regulations That May be Applicable for Nearby Facilities Surrounding LEFL

Facility Name	Primary SIC Code	SIC Code Description	Regulation Citation	Regulation Name
Tampa Bay Shipbuilding and Repair Company	4911	Electric Services	40 CFR part 63, subpart ZZZZ	Reciprocating Internal Combustion Engines NESHAP

8.0 Sites in Illinois

This section focuses on 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 stations in their urban locations. Figure 8-3 is a map identifying facilities within ten miles of these sites that reported to the 1999 NEI. The NBIL and SPIL sites are within a few miles of each other, with numerous sources between them. Sources near these sites are predominantly fuel combustion facilities.

Hourly meteorological data were retrieved for all of 2003 at two weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The two weather stations are Palwaukee Municipal Airport and O'Hare International Airport (WBAN 04838 and 94846, respectively).

The Chicago sites sampled for VOC only. Table 8-1 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), 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. 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). Table 8-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

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. Tables 8-2a-b summarize the cancer weighting scores, while Tables 8-3a-b summarize 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 8-2a-b, most of the prevalent cancer compounds reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. Only 1,2-dochloroethane (detected at SPIL), and trichloroethylene (detected at SPIL and NBIL) were not listed among the nationwide prevalent compounds. For the noncancer compounds summarized in Tables 8-3a-b, most of the prevalent non-cancer compounds were listed among the nationwide noncancer prevalent list. However, at the NBIL site, only two compounds were considered prevalent. Of the nine prevalent compounds at the SPIL site, six are also on the nationwide prevalent list.

Toxic compounds not detected at either of the Chicago sites were: 1,2-dichloroethane; 1,3-dichloropropene; 1,1,2-trichloroethane; vinyl chloride; bromoform; chloroprene; 1,1-dichloroethene; methyl methacrylate; and chlorobenzene. Note, carbonyl compounds were not sampled at the IL sites. Acetaldehyde and formaldehyde would therefore not be detected.

8.2 Toxicity Analysis

Acrylonitrile, trichloroethylene, carbon tetrachloride, tetrachloroethylene, and benzene were considered prevalent cancer compounds at both sites. At the NBIL site, acrylonitrile made up nearly 70% of the cancer toxicity score, while only making up 23% of the toxicity at the SPIL site. However, acrylonitrile was detected once at each site. Benzene had the largest number of detects at both sites.

At NBIL, acetonitrile made up 89% of the total noncancer toxicity. Acrylonitrile was the only compound to be considered prevalent at both sites, and was near or at the top of the average toxicity lists. As previously mentioned, only one concentration for acrylonitrile was reported at a detectable level. Benzene, methylene chloride, and toluene had the greatest number of detects of the noncancer compounds at both sites.

The acrylonitrile cancer risk at NBIL was the highest among the two sites at 93.0 in a million, while at SPIL, the 1,2-dichloroethane cancer risk was 19.3 in a million. For the compounds which may lead to adverse noncancer health effects, the average acetonitrile toxicity at NBIL was 6.61 (over 1 indicates a significant chance of a noncancer health effect). Of the nine measured acetonitrile concentrations at NBIL, one was above the acrylonitrile noncancer RfC weighting factor. This one concentration on June 26, 2003 is driving the high acetonitrile average.

8.3 Meteorological and Concentration Averages at the Illinois Sites

As previously mentioned, the Chicago sites sampled only for VOC. As indicated in Table 8-1, the average UATMP concentration at NBIL was nearly five times higher than the average UATMP concentration at SPIL.

Tables 8-4a-b present 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 NBIL, most of the correlations between the weather parameters and the prevalent compounds were weak. The strongest correlation was between acetonitrile and the u-component of the wind (0.60). Pearson correlations could not be computed for acrylonitrile due to the low number of detects (fewer than 3).

The SPIL site had somewhat stronger correlations. The strongest correlation was between bromomethane and sea level pressure (0.96). Bromomethane also had strong positive correlations with moisture variables, and very strong negative correlations with the wind components. Tetrachloroethylene had moderately strong to strong negative correlations with the temperature variables, dewpoint and wet bulb temperatures, and the v-component of the wind. Nearly all of the compounds exhibited negative correlations with the u-component of the wind. Pearson correlations could not be computed for acrylonitrile and 1,2-dichloroethane due to the low number of detects (fewer than 3).

8.4 Spatial Analysis

County-level car 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 8-5. Also included in Table 8-5 is the population within 10 miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10 mile car registrations was computed using the 10 mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at each Illinois site in Table 8-5. The SPIL site has both the largest amount of traffic passing by on a daily basis and the largest number of vehicles owned within a ten mile radius.

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 3-1 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. NBIL most closely resembles the ratios of the roadside study of the two Chicago sites, although its toluene-ethylbenzene ratio is much higher and its xylenes-ethylbenzene and benzene-ethylbenzene ratios are somewhat lower than those of the roadside study. Like NBIL, SPIL has a higher toluene-ethylbenzene ratio, but the SPIL site's xylenes-ethylbenzene and benzene-ethylbenzene ratios are roughly equal to each other.

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 8-4 and 8-5 are the VOC profiles at the Illinois sites.

At NBIL (Figure 8-4), the total VOC concentrations varied throughout the year, with the highest concentration occurring on June 26, 2003. On that day (a Noncancer Benchmark exceedance day), the stationary source HAP contribution was much higher than other sampling days. The mobile source (BTEX and non-BTEX) HAP concentrations were low and fairly consistent. The sampling at NBIL ran from April 21 - December 29, thus missing most of the winter season. Only one non-HAP VOC concentration was detected throughout the entire sampling season. 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 a third less than BTUT (7.03 μg/m^3 vs. 25.63 μg/m^3, respectively). It appears that the RFG requirements may be effective at NBIL.

At SPIL (Figure 8-5), the total VOC concentrations were consistently low throughout the year, with the highest concentration occurring on April 27, 2003. On that day, the stationary source HAP contribution was much higher than other sampling days. The mobile source (BTEX and non-BTEX) HAP concentrations varied through the sampling period. The sampling at SPIL ran from April 15 - December 29, thus missing most of the winter season. The non-HAP VOC concentrations were low or nonexistent. 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 in SPIL than ELNJ (7.90 μg/m^3 vs. 14.80 μg/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 given in Section 3.6. For NBIL, each of the following analyses were conducted: a back trajectory analysis, a regulation analysis, and an emission tracer analysis. Details on each type of analysis are also provided in Section 3.6.

8.6.1 Back Trajectory Analysis

Figure 8-6 is the composite back trajectory map for the NBIL site. 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 8-6, the back trajectories originated predominantly from the south, southwest, west, and northwest of the site. The 24-hour airshed domain is large, as the farthest away a back trajectory originated was north-central North Dakota. The trajectories that originated the farthest away from the site generally appeared to originate toward the northwest of NBIL. As each circle around the site in Figure 8-6 represents 100 miles, 60% of the trajectories originated within 300 miles, and 66% within 400 miles from the NBIL site.

8.6.2 Regulation Analysis

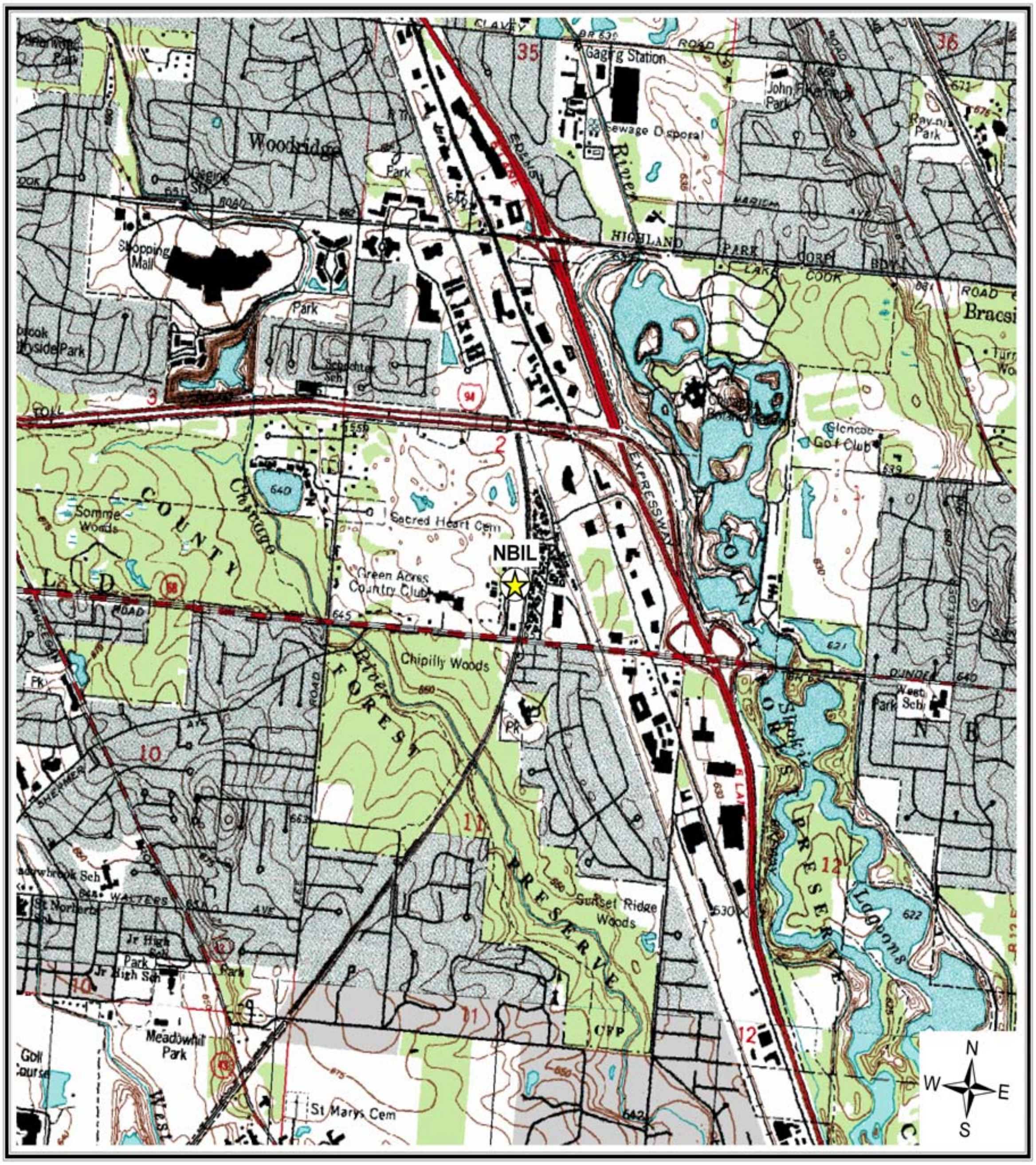
Table 3-10 summarizes the number of facilities that account for approximately 90% of the total UATMP pollutant emissions in the 10 mile area around the monitoring station. Two of the 51 facilities at NBIL listed in Table 3-11 are potentially subject to future regulations. Table

8-6 identifies the regulations that are potentially applicable. Based on this analysis, the regulations shown are expected to achieve reductions in ambient concentrations of the following UATMP pollutants: methyl ethyl ketone, methyl isobutyl ketone, and toluene. Reductions are projected for methyl isobutyl ketone (19%), methyl ethyl ketone (25%), and toluene (4%) as the regulations are implemented (the latest compliance date is 2007). The emission reductions are primarily attributed to regulation of surface coating of metal parts and paper and other web coating.

8.6.3 Emission Tracer Analysis

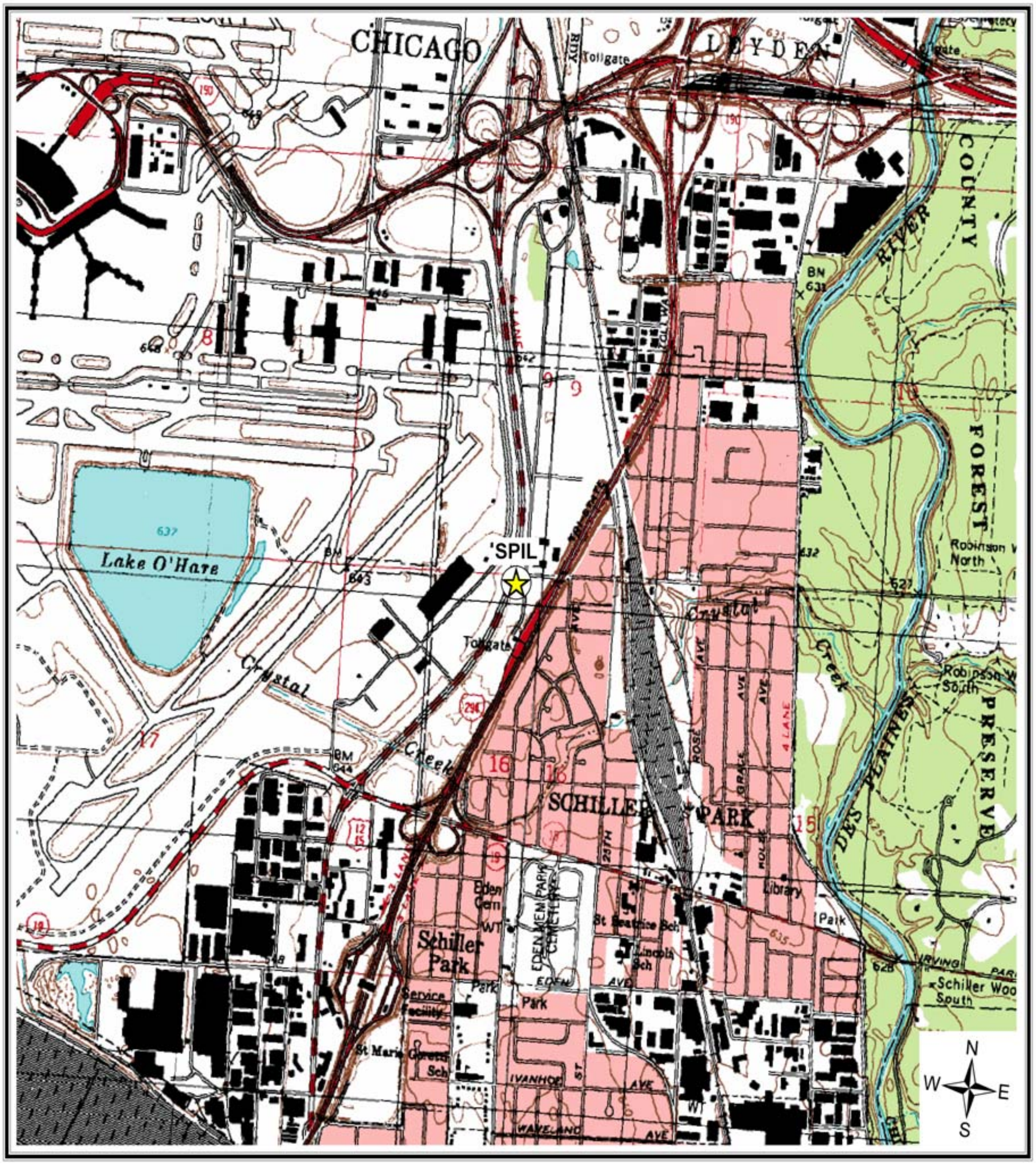
The high acetonitrile noncancer toxicity score was further examined. Figure 8-7 is the pollution rose for all acetonitrile samples at NBIL. The lone high concentration (June 26, 2003) points to possible acetonitrile emission sources west of the monitor. Figure 8-8 is a map of acrylonitrile stationary emission sources west of the NBIL monitor. According to the 1999 NEI, the Chrysler Corporation - Belvedere Assembly Plant is to the west of the monitoring site. Air sampled at NBIL on this date probably passed over this assembly plant earlier in the day. Figure 8-9 is a back trajectory map for this date, which shows the air originating west of the monitor. It is interesting to note that, in Figure 8-4, the VOC profile plotted for June 26 reveals that the magnitude of the stationary source VOC HAPs in comparison to other sampling days was extremely high. For only this acetonitrile sampling day, the 24-hour wind direction was from the west.

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



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

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



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

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

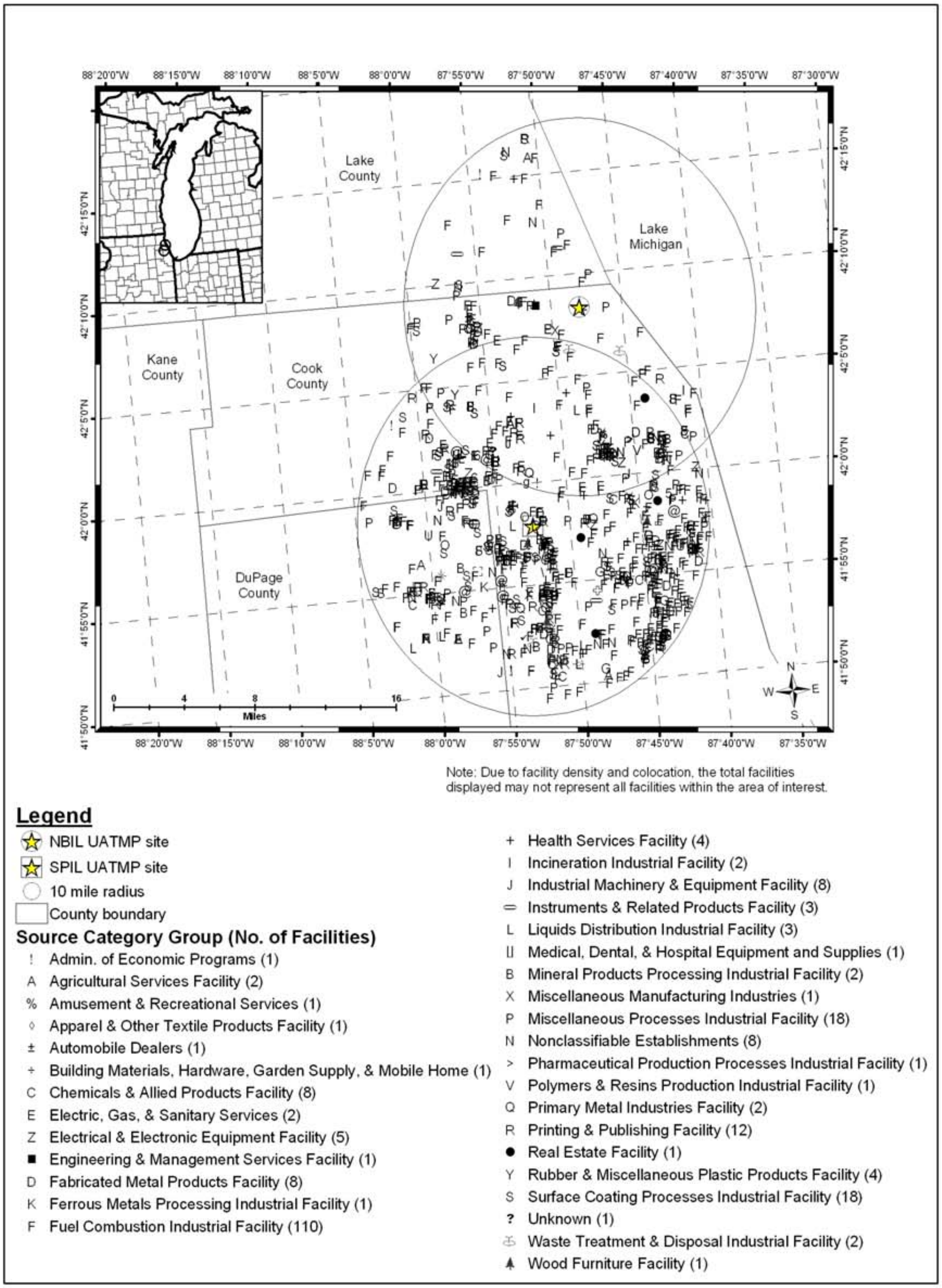


Figure 8-4. 2003 Total VOC Profile at NBIL

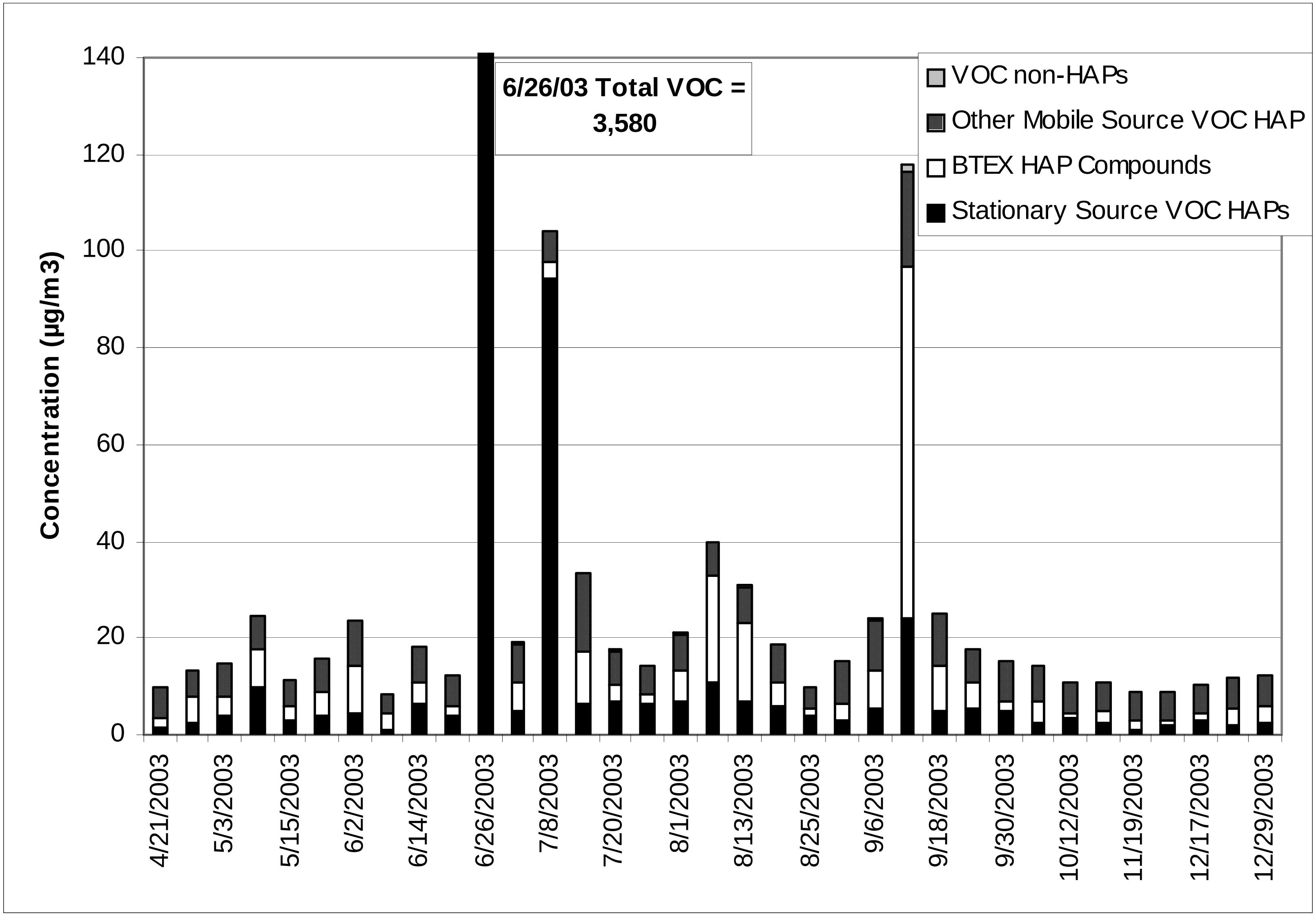


Figure 8-5. 2003 Total VOC Profile at SPIL

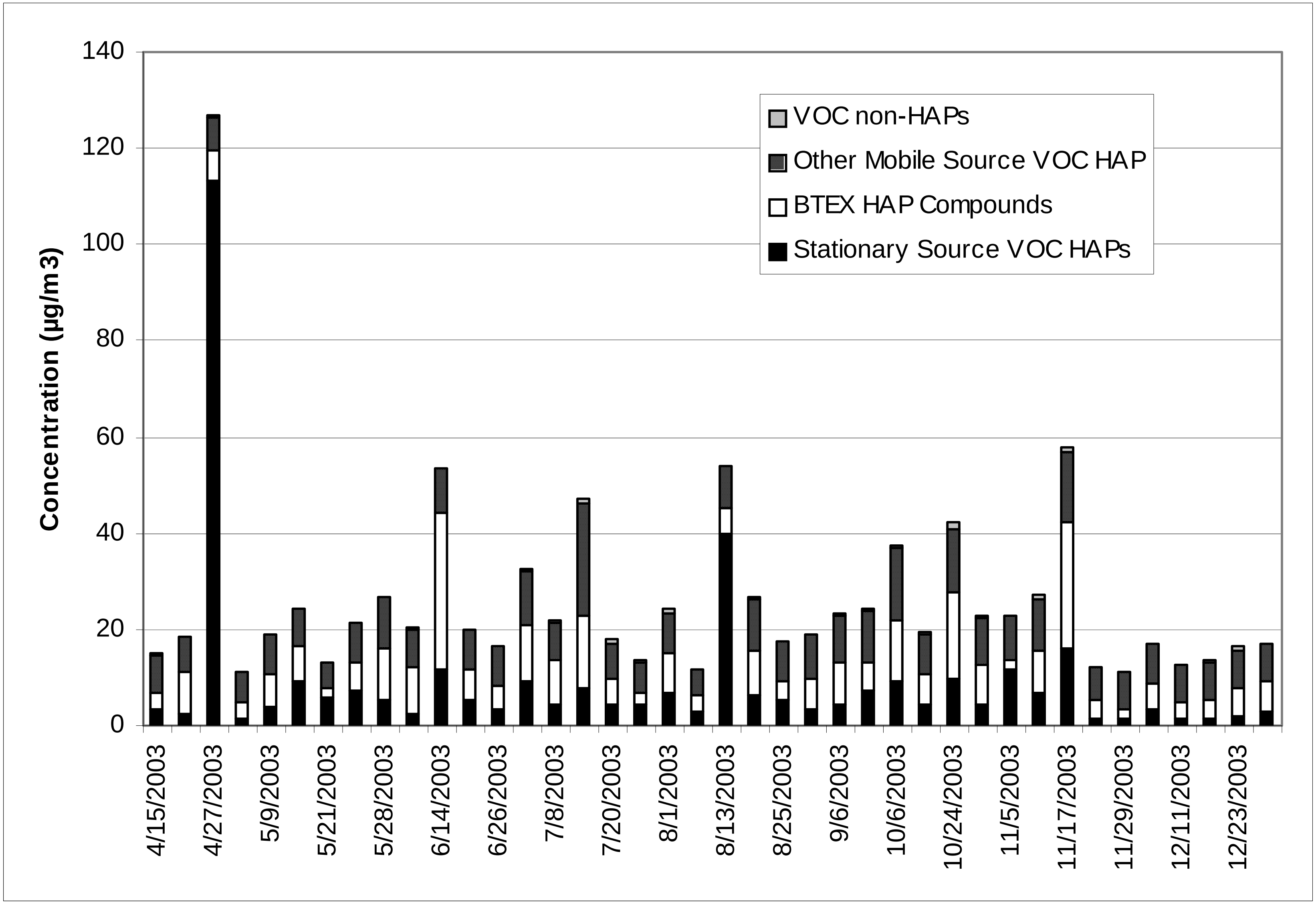


Figure 8-6. Composite Back Trajectory for NBIL

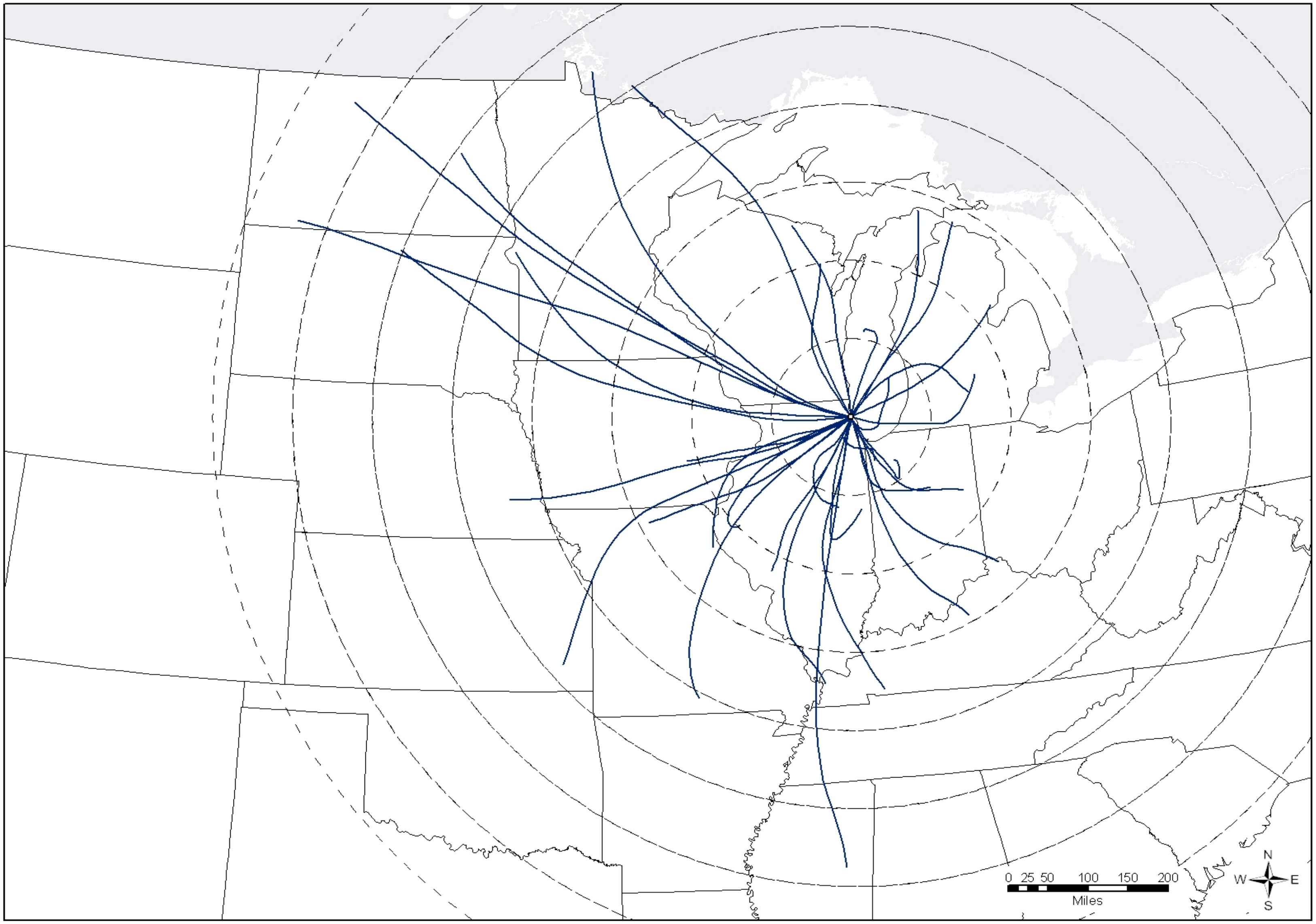
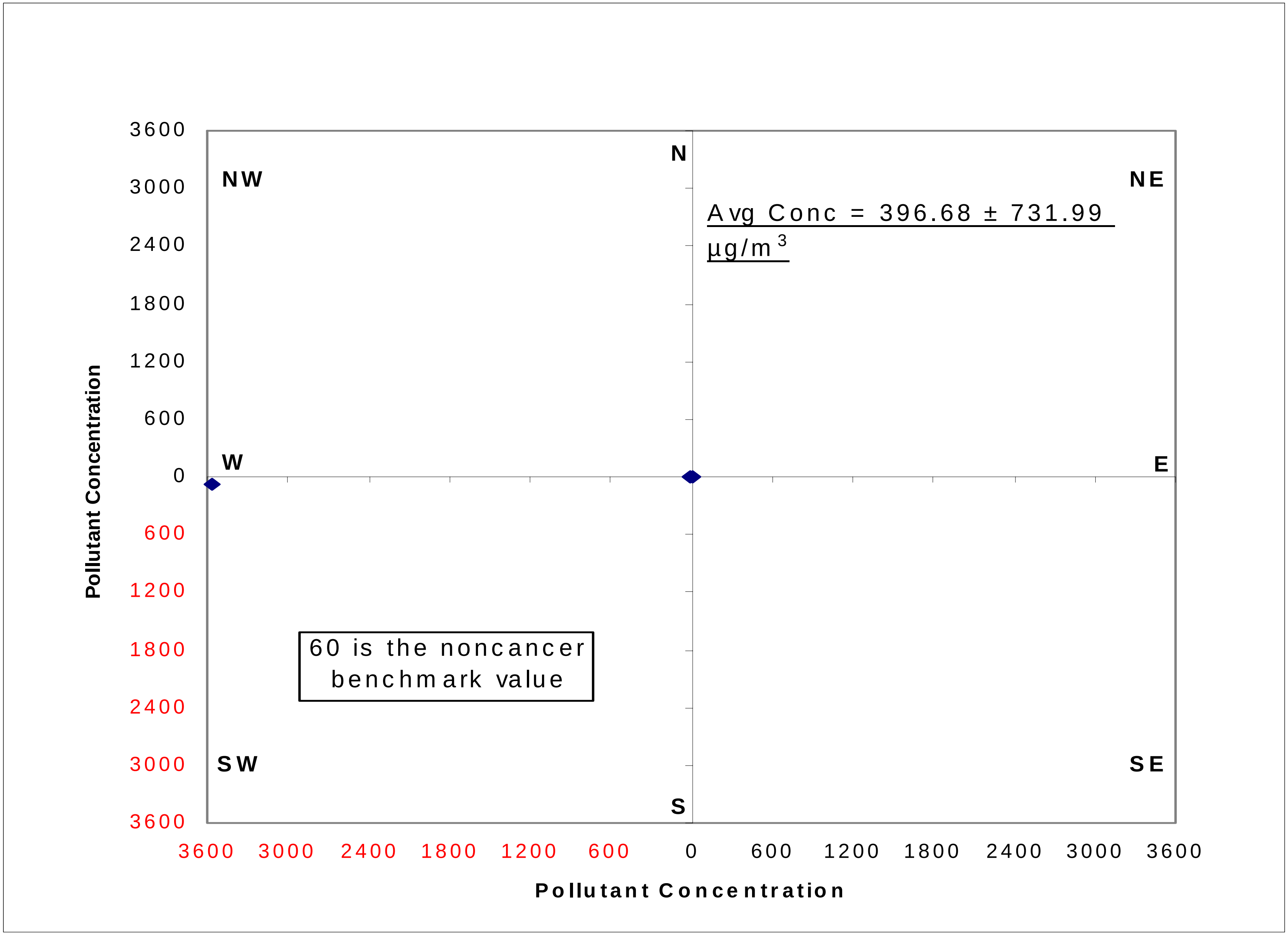


Figure 8-7. Acetonitrile Pollution Rose for NBIL



Avg Conc = 396.68 ± 731.99 µg/m3

60 is the noncancer benchmark value

Figure 8-8. Acrylonitrile Source West of the NBIL Monitoring Site

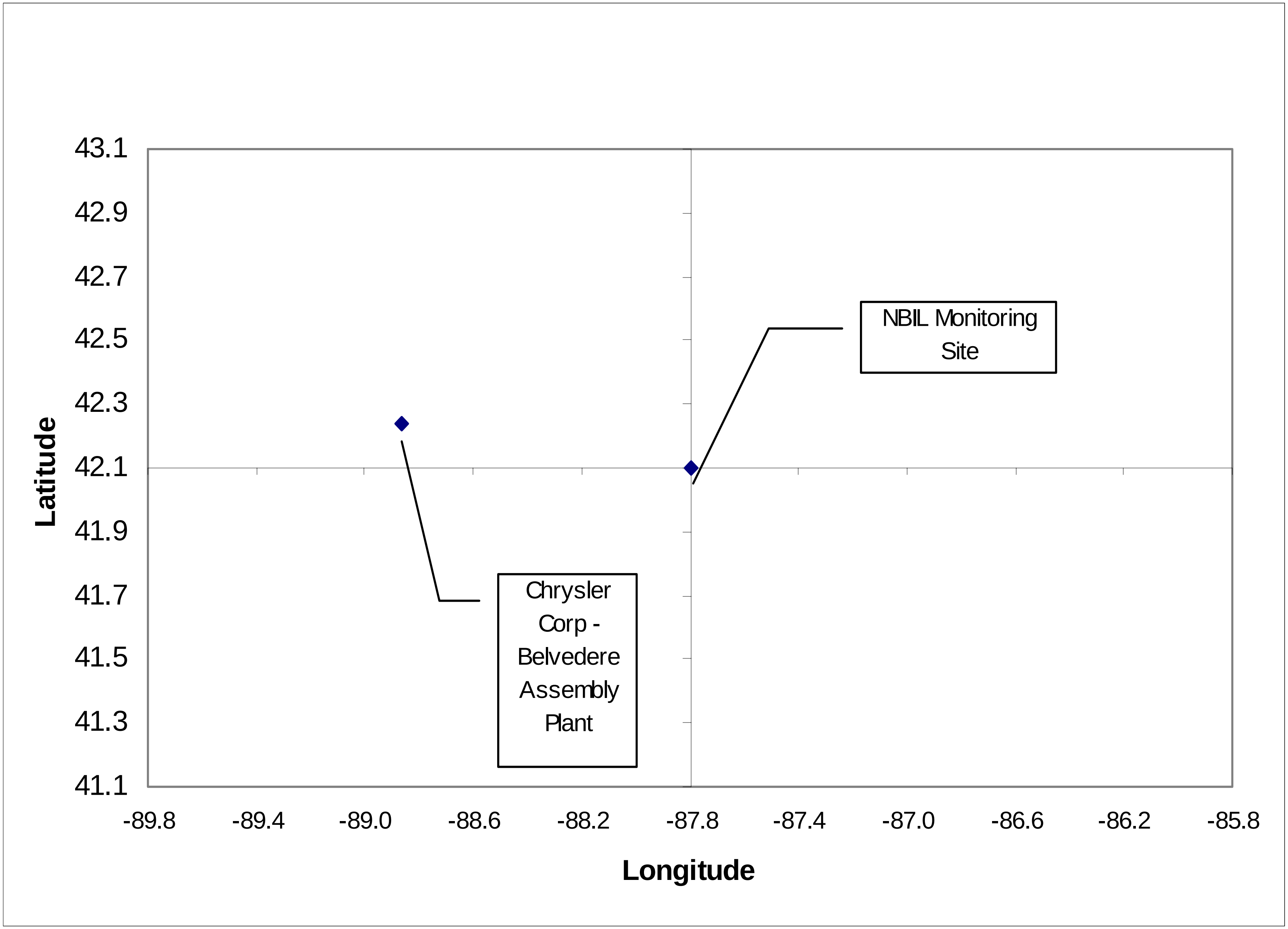


Figure 8-9. 24-Hour Back Trajectory (50, 250, and 500 Meters Aboveground) at NBIL on June 26, 2003

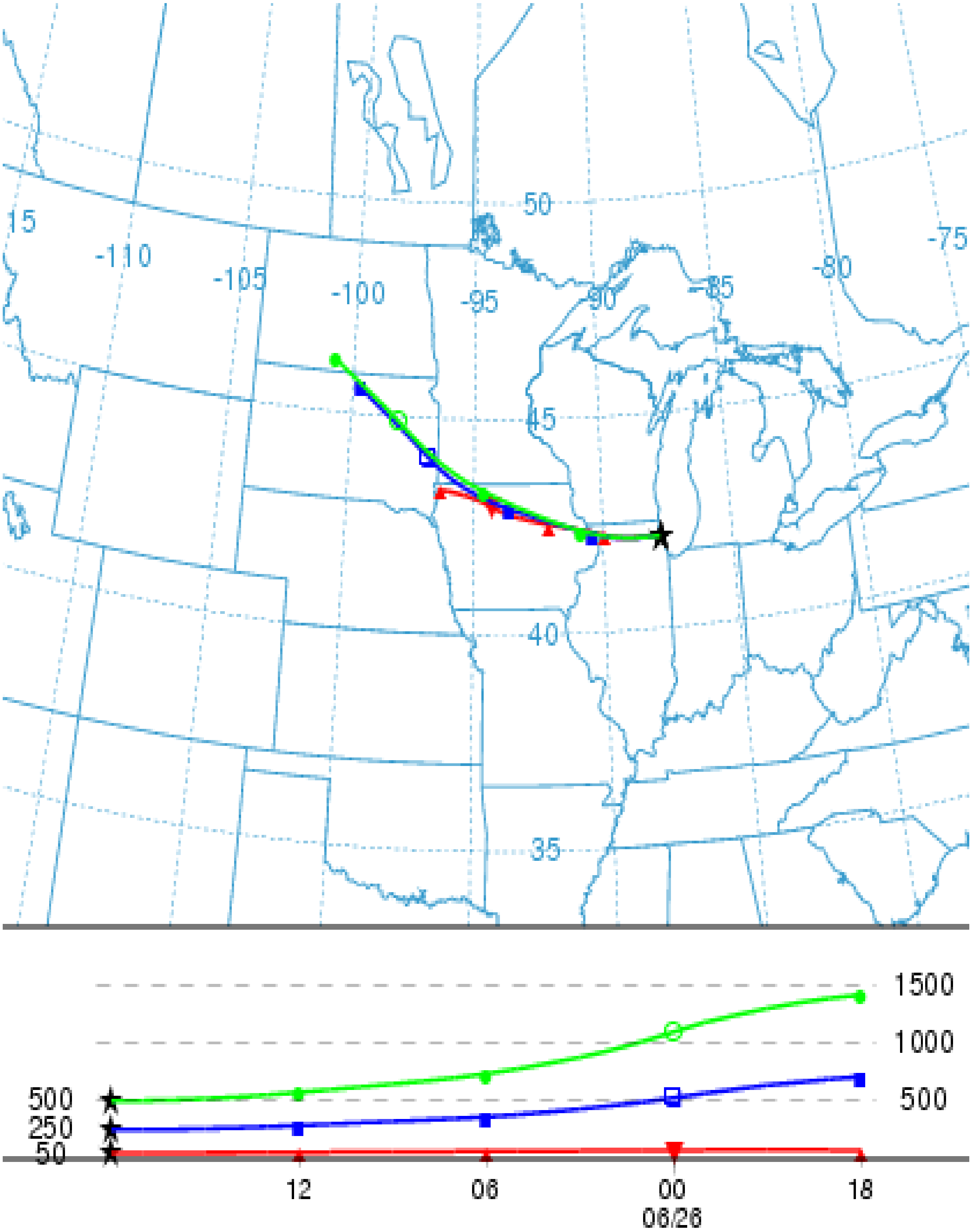


Table 8-1. Average Concentration and Meteorological Parameters for Sites in Illinois

Site Name	Type	Average UATMP Concentration ($\mu g/m^3$)	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)
IL-NBIL	All 2003		56.90 (±2.12)	48.64 (±1.95)	37.91 (±1.96)	43.70 (±1.78)	69.15 (±1.26)	1016.71 (±0.68)	1.42 (±0.47)	-0.32 (±0.51)
	sample day	124.11 (±196.51)	69.34 (±4.98)	60.34 (±4.48)	49.05 (±4.38)	54.23 (±4.04)	69.60 (±3.62)	1015.22 (±1.8)	1.72 (±1.38)	0.98 (±1.43)
IL-SPIL	All 2003		57.64 (±2.13)	49.21 (±1.96)	38.21 (±1.93)	44.06 (±1.78)	68.76 (±1.31)	1016.10 (±0.67)	1.34 (±0.56)	-0.54 (±0.52)
	sample day	26.22 (±6.21)	66.30 (±5.44)	57.41 (±4.87)	45.74 (±4.63)	51.29 (±4.32)	68.51 (±4.16)	1015.17 (±1.66)	1.71 (±1.58)	0.83 (±1.68)

Table 8-2a. Summary of the Toxic Cancer Compounds at the Northbrook, Illinois Monitoring Site - NBIL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	9.30E-05	69.91	69.91	1.367	1	93.0
Trichloroethylene	1.48E-05	11.12	81.03	7.394	13	14.8
Carbon Tetrachloride	8.18E-06	6.15	87.18	0.545	33	8.18
Tetrachloroethylene	7.34E-06	5.52	92.70	1.244	14	7.34
Benzene	5.63E-06	4.23	96.93	0.721	35	5.63
1,3-Butadiene	2.38E-06	1.79	98.72	0.079	6	2.38
p-Dichlorobenzene	1.40E-06	1.05	99.77	0.127	2	1.40
Methylene Chloride	3.03E-07	0.23	100.00	0.645	26	<1

Table 8-2b. Summary of the Toxic Cancer Compounds at the Schiller Park, Illinois Monitoring Site - SPIL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
1,2-Dichloroethane	1.93E-05	23.16	23.16	0.743	1	19.3
Acrylonitrile	1.92E-05	23.00	46.16	0.282	1	19.2
Benzene	9.58E-06	11.49	57.65	1.229	40	9.58
Trichloroethylene	9.38E-06	11.25	68.90	4.692	31	9.38
Carbon Tetrachloride	9.15E-06	10.97	79.87	0.610	36	9.15
Tetrachloroethylene	7.12E-06	8.53	88.40	1.206	22	7.12
1,3-Butadiene	5.95E-06	7.13	95.53	0.198	22	5.95
p-Dichlorobenzene	3.28E-06	3.94	99.47	0.299	5	3.28
Methylene Chloride	4.44E-07	0.53	100.00	0.945	34	<1

Table 8-3a. Summary of the Toxic Noncancer Compounds at the Northbrook, Illinois Monitoring Site - NBIL

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetonitrile	6.61E+00	88.77	88.77	396.682	9	1
Acrylonitrile	6.84E-01	9.18	97.95	1.367	1	0
1,3-Butadiene	3.97E-02	0.53	98.48	0.079	6	0
Benzene	2.40E-02	0.32	98.80	0.721	35	0
Xylenes (*o*-, *m*-, *p*-)	2.35E-02	0.32	99.12	2.349	30	0
Carbon Tetrachloride	1.36E-02	0.18	99.30	0.545	33	0
Chloromethane	1.34E-02	0.18	99.48	1.209	35	0
Trichloroethylene	1.23E-02	0.17	99.65	7.394	13	0
Toluene	9.92E-03	0.13	99.78	3.969	35	0
Chloroform	8.62E-03	0.12	99.90	0.845	27	0
Tetrachloroethylene	4.61E-03	0.06	99.96	1.244	14	0
Methyl Isobutyl Ketone	9.15E-04	0.01	99.97	2.746	2	0
Methylene Chloride	6.45E-04	0.01	99.98	0.645	26	0
Ethylbenzene	4.38E-04	0.01	99.99	0.438	26	0
Methyl Ethyl Ketone	3.95E-04	0.01	99.99	1.977	18	0
Styrene	2.75E-04	<0.0001	99.99	0.275	7	0
1,1,1-Trichloroethane	1.75E-04	<0.0001	100.00	0.175	17	0
p-Dichlorobenzene	1.59E-04	<0.0001	100.00	0.127	2	0
Methyl *tert*-Butyl Ether	7.84E-05	<0.0001	100.00	0.235	1	0

Table 8-3b. Summary of the Toxic Noncancer Compounds at the Schiller Park, Illinois Monitoring Site - SPIL

Compound	**Average Toxicity**	**% Contribution**	**Cumulative % Contribution**	**Average Concentration (μg/m^3)**	**# Detects**	**Adverse Noncancer Concentrations**
Acrylonitrile	1.41E-01	35.38	35.38	0.282	1	0
1,3-Butadiene	9.91E-02	24.86	60.24	0.198	22	0
Benzene	4.10E-02	10.27	70.51	1.229	40	0
Xylenes (*o*-, *m*-, *p*-)	2.87E-02	7.19	77.70	2.867	38	0
Bromomethane	2.64E-02	6.63	84.33	0.132	4	0
Carbon Tetrachloride	1.53E-02	3.83	88.15	0.610	36	0
Chloromethane	1.34E-02	3.35	91.50	1.203	40	0
Toluene	8.79E-03	2.21	93.71	3.517	40	0
Trichloroethylene	7.82E-03	1.96	95.67	4.692	31	0
Acetonitrile	6.45E-03	1.62	97.29	0.387	11	0
Tetrachloroethylene	4.47E-03	1.12	98.41	1.206	22	0
Chloroform	2.14E-03	0.54	98.95	0.210	9	0
Methylene Chloride	9.45E-04	0.24	99.18	0.945	34	0
Methyl Ethyl Ketone	7.00E-04	0.18	99.36	3.499	18	0
1,1,1-Trichloroethane	6.26E-04	0.16	99.52	0.626	15	0
Ethylbenzene	5.06E-04	0.13	99.64	0.506	34	0
Styrene	4.02E-04	0.10	99.74	0.402	21	0
p-Dichlorobenzene	3.73E-04	0.09	99.84	0.299	5	0
1,2-Dichloroethane	3.10E-04	0.08	99.91	0.743	1	0
1,2,4-Trichlorobenzene	1.96E-04	0.05	99.96	0.039	1	0
Chloroethane	7.79E-05	0.02	99.98	0.779	1	0
Methyl Isobutyl Ketone	6.56E-05	0.02	100.00	0.197	5	0

Table 8-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters in Northbrook, Illinois (NBIL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetonitrile	-0.06	0.01	-0.09	-0.03	-0.29	-0.29	0.60	-0.04
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	0.09	0.01	-0.05	-0.02	-0.15	-0.09	-0.22	0.36
Carbon Tetrachloride	0.14	0.09	-0.01	0.05	-0.26	-0.04	-0.18	-0.05
Tetrachloroethylene	-0.22	-0.37	-0.06	-0.20	0.40	-0.44	-0.27	-0.31
Trichloroethylene	-0.11	0.05	0.19	0.15	0.45	-0.07	-0.07	-0.27

Table 8-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters in Schiller Park, Illinois (SPIL)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.19	-0.24	-0.28	-0.27	-0.02	-0.06	-0.19	0.12
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.08	-0.12	-0.08	-0.11	0.15	0.08	-0.15	0.27
Carbon Tetrachloride	0.24	0.24	0.22	0.24	-0.07	0.01	-0.15	-0.07
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA
Bromoethane	-0.02	0.30	0.51	0.43	0.61	0.96	-0.78	-0.79
Chloromethane	0.22	0.19	0.12	0.15	-0.16	0.09	-0.16	0.24
Tetrachloroethylene	-0.54	-0.50	-0.35	-0.45	0.26	0.14	-0.15	-0.49
Toluene	0.08	0.08	0.14	0.10	0.17	-0.02	-0.26	0.02
Trichloroethylene	0.05	-0.03	-0.30	-0.16	-0.45	-0.01	0.09	0.15
Xylenes (total)	0.18	.17	0.26	0.22	0.25	-0.10	-0.23	0.21

Table 8-5. Motor Vehicle Information vs. Daily Concentration for Illinois Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
NBIL	5,377,507	2,087,197	0.39	884,133	344,812	34,900	124.11 (±196.51)
SPIL	5,377,507	2,087,197	0.39	2,094,530	816,867	214,900	26.22 (±6.21)

9.0 Site in Massachusetts

This section focuses on 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 9-1 is a topographical map showing the monitoring station in its urban location. Figure 9-2 is a map identifying facilities within ten miles of this site that reported to the 1999 NEI. BOMA is located near three main types of industries: fuel combustion, waste treatment and disposal, and liquids distribution.

Hourly meteorological data were retrieved for all of 2003 at a weather station near this site with the purpose of 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 9-1 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), 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. 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). Table 9-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

9.1 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 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 the BOMA site only sampled for metals, only metals and metal compounds are listed in the tables of toxic cancer and noncancer compounds, which is reflected in Tables 9-2 and 9-3. 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 all 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.

9.2 Toxicity Analysis

Arsenic and cadmium are prevalent cancer compounds at the BOMA site. Arsenic compounds contribute to nearly 80% of the average cancer toxicity, although both arsenic and cadmium had the same number of detects. Manganese compounds contribute to nearly 55% of the average toxicity, while the other three prevalent metals, nickel, arsenic, and cadmium, contribute almost equally to the toxicity scores.

The arsenic and compound cancer risk was the highest among the toxic metal compounds at 8.60 in a million. For the compounds which may lead to adverse noncancer health effects, the average manganese toxicity was 0.259 (over 1 indicates a significant chance of a noncancer health effect). None of the metal compound concentrations were above their noncancer RfC weighting factors.

9.3 Meteorological and Concentration Averages at the Massachusetts Site

Only metals and metal compounds were sampled at BOMA, and the average metal concentration is listed in Table 9-1. Table 9-4 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 in the moderately strong to very strong range (-0.25 to -1.00 or 0.25 to 1.00) and most were negative. All of the compounds exhibited moderately strong to strong negative correlations with average and maximum temperature, dewpoint, and wet bulb temperature, ranging from -0.34 to -0.81. Three of the four compounds exhibited a strong positive correlation with sea level pressure. Nearly all of the compounds had negative correlations with both wind components. Generally, as temperature, moisture, and wind speeds decrease, and as sea level pressure increases, concentrations of the metals and metal compounds also increase. The average metal concentration for BOMA is listed in Table 9-5.

9.4 Spatial Analysis

County-level car registration was not available in Suffolk County, MA. Thus, state-level car 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 9-6. Also included in Table 9-6 is the population within 10 miles of each site and 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. Using these parameters, a county-specific car registration ratio was computed. An estimate of 10 mile car registration was computed using the 10 mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the BOMA site in Table 9-6.

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.) Since only metals and metal compounds were sampled, a BTEX and RFG analysis could not be performed.

9.5 RFG Analysis

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). Since VOCs were not sampled at BOMA, an RFG analysis could not be performed.

9.6 NATTS Site Analysis

The Boston site is an EPA-designated NATTS site. A description of the NATTS program is found in Section 3.6. For BOMA, the following two analyses were conducted: a back trajectory analysis and a regulation analysis. Details on each type of analysis are also provided in Section 3.6.

9.6.1 Composite Back Trajectory Analysis

Figure 9-3 is the composite back trajectory map for the BOMA site. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring location on a sampling day. BOMA sampled for only two months at the end of 2003 and therefore has very few back trajectories on its composite map. As shown in Figure 9-3, the back trajectories originated from an array of different directions. However, half of the back trajectories originate from the west or northwest of the site. The other half of the trajectories' paths pass over the

Atlantic Ocean. The 24-hour airshed domain is large, as the farthest away a back trajectory originated was central Michigan. As each circle around the site in Figure 9-3 represents 100 miles, 50% of the trajectories originated within 300 miles, and 63% within 400 miles of the BOMA site.

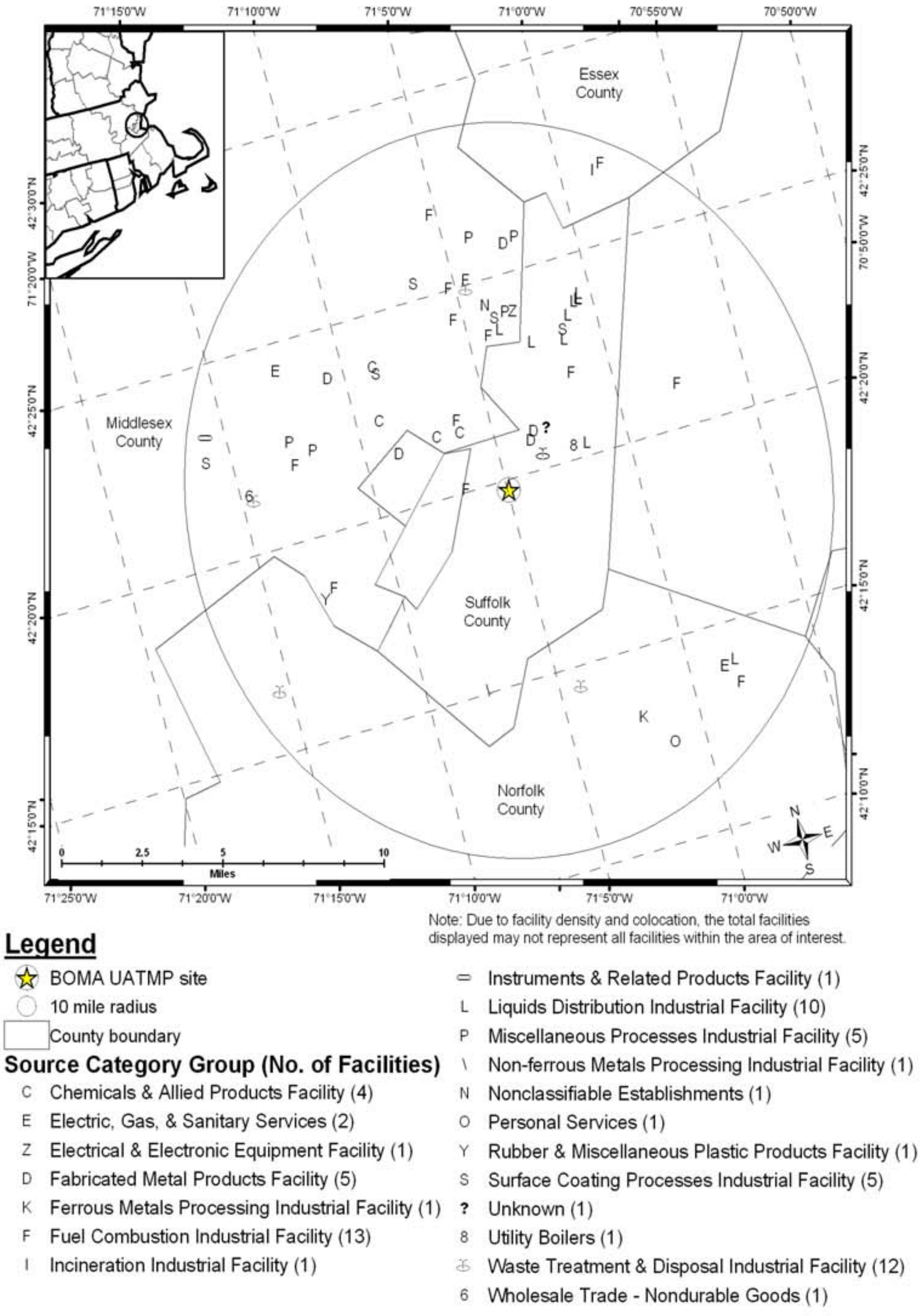
9.6.2 Regulation Analysis

Table 3-10 summarizes the number of facilities that account for approximately 90% of the total UATMP pollutant emissions in the 10-mile area around the monitoring station. Five of the 17 facilities near BOMA listed in Table 3-11, are potentially subject to future regulations. Table 9-7 identifies the regulations that are potentially applicable. Based on this analysis, the regulations shown are expected to achieve reductions in ambient concentrations of the following UATMP pollutants: acetaldehyde, benzene, ethylbenzene, formaldehyde, and toluene. Reductions are projected for acetaldehyde (0.3%), benzene (18%), ethylbenzene (10%), formaldehyde (0.01%), and toluene (6%) as the regulations are implemented (the latest compliance date is 2007). The emission reductions are primarily attributed to regulation of organic liquids distribution and reciprocating internal combustion engines.

Figure 9-1. Boston, Massachusetts (BOMA) Monitoring Station

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

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



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

Figure 9-3. Composite Back Trajectory for BOMA

Table 9-1. Average Concentration and Meteorological Parameters for the BOMA Site in Massachusetts

Site Name	Type	Average UATMP Concentration ($\mu g/m^3$)	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)
BOMA	All 2003		56.74 (±1.94)	50.00 (±1.85)	39.93 (±2.11)	45.67 (±1.78)	71.05 (±1.75)	1015.72 (±0.85)	2.43 (±0.67)	-0.11 (±0.52)
	sample day	0.06 (±0.02)	52.38 (±3.48)	44.58 (±2.69)	32.51 (±3.64)	39.65 (±2.61)	64.48 (±6.93)	1017.80 (±6.81)	4.73 (±3.66)	0.65 (±3.13)

Table 9-2. Summary of the Toxic Cancer Compounds at the Boston, Massachusetts Monitoring Site - BOMA

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Arsenic Metal and Compounds	8.60E-06	79.45	79.45	0.002	8	8.60
Cadmium Metal and Compounds	2.17E-06	20.04	99.49	0.001	8	2.17
Beryllium Metal and Compounds	5.50E-08	0.51	100.00	<0.0001	3	<1

Table 9-3. Summary of the Toxic Noncancer Compounds at the Boston, Massachusetts Monitoring Site - BOMA

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Manganese Metal and Compounds	2.59E-01	54.62	54.62	0.013	8	0
Nickel Metal and Compounds	6.81E-02	14.36	68.98	0.014	8	0
Arsenic Metal and Compounds	6.67E-02	14.07	83.05	0.002	8	0
Cadmium Metal and Compounds	6.03E-02	12.71	95.76	0.001	8	0
Cobalt Metal and Compounds	9.54E-03	2.01	97.78	0.001	8	0
Lead Metal and Compounds	9.03E-03	1.91	99.68	0.014	8	0
Beryllium Metal and Compounds	1.15E-03	0.24	99.92	<0.0001	3	0
Mercury Metal and Compounds	1.94E-04	0.04	99.96	<0.0001	8	0
Selenium Metal and Compounds	1.76E-04	0.04	100.00	0.004	8	0

Table 9-4a. 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	u-component of wind	v-component of wind
Arsenic Metal and Compounds	-0.72	-0.55	-0.46	-0.54	-0.11	0.61	-0.59	-0.24
Cadmium Metal and Compounds	-0.34	-0.40	-0.42	-0.44	-0.19	0.29	-0.22	0.20
Manganese Metal and Compounds	-0.64	-0.36	-0.50	-0.48	-0.34	0.62	-0.35	-0.26
Nickel Metal and Compounds	-0.81	-0.68	-0.42	-0.59	0.08	0.64	-0.67	-0.38

Table 9-5. Average Metals Concentrations Measured by the Massachusetts Monitoring Station

Monitoring Station	Average Metals Concentration (ng/m^3)
BOMA	47.85

Table 9-6. Motor Vehicle Information vs. Daily Concentration for Massachusetts Monitoring Site

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
BOMA	689,925	562,696	0.82	1,585,559	1,293,166	34,900	0.06 (±0.02)

Table 9-7. Summary of Future Regulations That May be Applicable for Nearby Facilities Surrounding BOMA

Facility Name	Primary SIC Code	SIC Code Description	Regulation Citation	Regulation Name
Citgo Petroleum Corporation	5171	Petroleum Bulk Stations and Terminals	40 CFR part 63, subpart EEEE	Organic Liquids Distribution (non-Gasoline) NESHAP
Exxon Everett Terminal	5171	Petroleum Bulk Stations and Terminals	40 CFR part 63, subpart EEEE	Organic Liquids Distribution (non-Gasoline) NESHAP
Gulf Oil, LP Chelsea	5171	Petroleum Bulk Stations and Terminals	40 CFR part 63, subpart EEEE	Organic Liquids Distribution (non-Gasoline) NESHAP
Mobil Oil East, Boston Terminal	5171	Petroleum Bulk Stations and Terminals	40 CFR part 63, subpart EEEE	Organic Liquids Distribution (non-Gasoline) NESHAP
Polaroid Corporation	3861	Photographic Equipment and Supplies	40 CFR part 63, subpart ZZZZ	Reciprocating Internal Combustion Engines NESHAP

10.0 Sites in Michigan

This section focuses on meteorological, concentration, and spatial trends for the five UATMP sites in Michigan. The Detroit, Michigan (APMI, DEMI, and E7MI), sites are located in an urban area, while the Houghton Lake, Michigan (HOMI) site and the Sault Ste. Marie, Michigan (ITCMI) site are in more rural locations. Figures 10-1 through 10-5 are topographical maps showing the monitoring stations in their urban and rural locations. Figures 10-6 through 10-8 are maps identifying facilities within ten miles of the sites that reported to the 1999 NEI. The Detroit sites are oriented relatively north-south, all within a few miles of each other. Numerous facilities surround these sites, mostly fuel combustion or surface coating facilities. HOMI is located in north-central Michigan, with few industrial facilities nearby, most of which are involved in waste treatment and disposal. ITCMI is located on the Upper Pennisula near the U.S-Canadian border and the majority of facilities within ten miles of the site are also involved in waste treatment and disposal.

Hourly meteorological data were retrieved for all of 2003 at four weather stations near the sites with the purpose of 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 10-1 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, as can be confirmed by Table 10-1. 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 Ste. Marie is located on the northeast edge of Michigan's Upper Pennisula. While this area also experiances 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.

10.1 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. Tables 10-2a-e summarize the cancer weighting scores, while Tables 10-3a-e summarize 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 each of the Michigan sites sampled for different types of compounds. APMI sampled for VOC only; DEMI sampled carbonyl compounds and VOC; E7MI sampled for SNMOC; HOMI sampled carbonyl compounds, VOC, and metal compounds; and ITCMI sampled for VOC and SVOC. Therefore the site-specific prevalent compounds are going to vary from site to site.

As can be shown in Tables 10-2a-e, most of the detected cancer compounds reflect the nationwide prevalent cancer compounds list, as listed in Section 3 of this report. However, all of the prevalent compounds at these five sites are also nationwide prevalent compounds, with the exception of trichloroethylene at ITCMI. For the noncancer compounds summarized in Tables 10-3a-e, toluene, bromomethane and chloromethane were the only site-specific prevalent compounds not included on the list of nationwide prevalent compounds. There were no compounds considered prevalent at all five sites.

Toxic compounds not detected at any of the Michigan sites were: 1,2-dichloroethane; vinyl chloride; 1,1-dichloroethene; bromoform; chloroprene; and methyl methacrylate.

10.2 Toxicity Analysis

Tetrachloroethylene was the only prevalent cancer compound at both APMI and HOMI, contributing to 95% and 99%, respectively, of the cancer toxicity score. Tetrachloroethylene was also a prevalent compound at DEMI, contributing to 87% of the total cancer toxicity. Benzene and 1,3-butadiene were prevalent at three of the five sites (DEMI, E7MI, and ITCMI). The number of detects varies across the sites and compounds, and benzene had the highest number of detections at four of the five sites, ranging from 13 to 32. The tetrochloroethylene cancer risk at HOMI was the highest among the five sites at 4,650 in a million, while at APMI and DEMI, the tetrachloroethylene cancer risk was 2,680 and 265 in a million, respectively. Cancer risk at E7MI and ITCMI were not high. It is interesting to note that HOMI is in a rural location with few industrial sources nearby.

For the compounds which may lead to adverse noncancer health effects, the average tetrachloroethylene toxicity at HOMI and APMI was 2.86 and 1.68, respectively (over 1 indicates a significant chance of a noncancer health effect). Of the twenty-five adverse health concentrations measured in the Michigan sites, ten were for tetrachloroethylene and fifteen were for acetonitrile. All of the high acetonitrile concentrations were at HOMI.

10.3 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. SVOC concentrations were sampled at the ITCMI site only. The average SVOC concentration at ITCMI was 7.39 ng. E7MI also opted to have total NMOC and SNMOC measured during its 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 E7MI was 303.78 ppbC, of which 64% could be identified through speciation. Of the speciated compounds, toluene measured the highest concentration at the E7MI site (37.30 ppbC). The HOMI site opted to sample metals and metal compounds in addition to carbonyls and VOC. However, samples were taken on only 2 days. Analysis was therefore not performed. Information on SNMOC and SVOC is given in Table 10-6.

Tables 10-4a-e are the summaries 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. At APMI, both 1,3-butadiene and tetrachloroethylene exhibited negative correlations with both the temperature and moisture variables, although tetrachloroethylene's correlations were stronger. Benzene had a moderately strong positive correlation with the same variables. The strongest correlation at APMI was between benzene and sea level pressure (0.65). Pearson correlations could not be computed for acrylonitrile due to the low number of detects (fewer than 3).

At DEMI, very strong negative correlations were computed between acetonitrile and the temperature variables, the moisture variables (except relative humidity), and the v-component of the wind (ranging from -0.77 to -0.79). Moderately strong to strong positive correlations were found between 1,3-butadiene, acetaldehyde, benzene, carbon tetrachloride, and formaldehyde and the temperature and moisture variables (except relative humidity). The remaining correlations tended to be weak.

While correlations between the compounds and temperature (maximum and average) and moisture (dewpoint and wet bulb) variables tended to be weak at E7MI, they were also all negative. Correlations between the compounds and relative humidity and sea level pressure were all positive. The wind components had the strongest correlations with prevalent compound concentrations. The u-component exhibited a moderately strong negative correlation with the compounds while the v-component exhibited a moderately strong positive correlation with the compounds.

With the exception of formaldehyde, only weak correlations with the meteorological parameters were found at HOMI. Formaldehyde had very strong positive correlations with temperature (maximum and average) and moisture (dewpoint and wet bulb) and a strong negative correlation with relative humidity (0.83, 0.83, 0.75, 0.79, -0.64, respectively). Tetrachloroethylene had one strong correlation with sea level pressure (0.71), while the rest were mainly weak. Pearson correlations could not be computed for bromomethane due to the low number of detects (fewer than 3).

Over half of the computed correlations at ITCMI fall into the moderately strong to very strong categories. Moderately strong negative correlations were computed between 1,3-butadiene, acetonitrile, benzene, and xylenes and temperature (maximum and average) and moisture (dewpoint and wet bulb) variables, while carbon tetrachloride and *p*-dichlorobenzene exhibited moderately strong to strong positive correlations with the same parameters. 1,3-Butadiene had a strong positive correlation with sea level pressure and a very strong negative correlation with the u-component of the wind. Acetonitrile had a strong negative correlation with the v-component of the wind while *p*-dichlorobenzene had a very strong positive correlation with the v-component. Pearson correlations could not be computed for acrylonitrile or trichloroethylene due to the low number of detects (fewer than 3).

10.4 Spatial Analysis

County-level car registration information was not available for the three Michigan counties. Thus, state-level car registration, from the Energy Information Administration (EIA), was allocated to the county level using the county-level population proportion. County-level population data in Chippewa County, Missaukee County, and Wayne County, Michigan, were obtained from the U.S. Census Bureau, and are summarized in Table 10-7. Also included in Table 10-7 is the population within 10 miles of each site and 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. Using these parameters, a county-specific car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the sites listed in Table 10-7. The Dearborn site (DEMI) has the highest estimated vehicle ownership within a ten mile radius; the other Detroit sites were much lower. However, the ITCMI site has the highest daily traffic volume passing a Michigan monitor.

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 3-1 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. None of the four sites that sampled VOC look much like the roadside study. All of these sites had larger toluene ethylbenzene ratios, with HOMI having the largest concentration ratio of all the UATMP sites, more than four times that of the roadside study. The roadside study’s xylene-ethylbenzene ratio is higher than its benzene-ethylbenzene ratio. APMI’s benzene-ethylbenzene and xylenes-ethylbenzene ratios were nearly equal while DEMI, HOMI, and ITCMI all had larger benzene-ethylbenzene ratios than xylene-ethylbenzene ratios. Since E7MI did not sample for VOC, a BTEX analysis could not be performed for this site.

10.5 NATTS Site Analysis

One of the Detroit, MI, sites, DEMI, is an EPA-designated NATTS site. A description of the NATTS program is given in Section 3.6. For DEMI, each of the following analyses were conducted: a back trajectory analysis, a regulation analysis, and an emission tracer analysis. Details on each type of analysis are also provided in Section 3.6.

10.5.1 Back Trajectory Analysis

Figure 10-9 is the composite back trajectory map for the DEMI site. 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 10-9, the back trajectories originated from many different directions, although more than half of them originated from an area west of the monitoring location. The 24-hour airshed domain is large, as the farthest away a back trajectory originated was northern Minnesota, over six hundred miles away. As each circle around the site represents 100 miles, 56% of the trajectories originated within 300 miles, and 76% within 400 miles from the DEMI site.

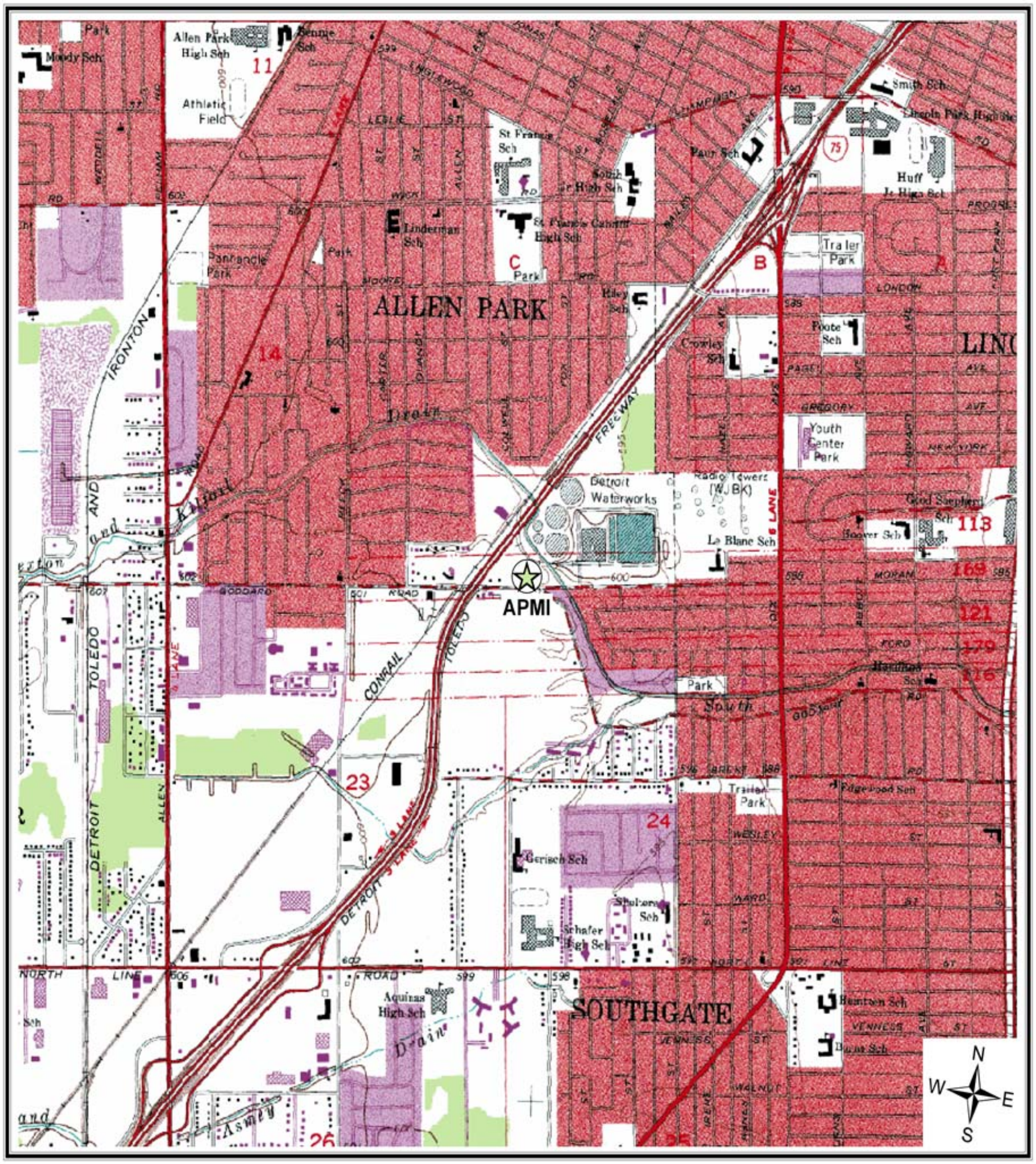
10.5.2 Regulation Analysis

Table 3-10 summarizes the number of facilities that account for approximately 90% of the total UATMP pollutant emissions in the 10-mile area around the monitoring station. Seven of the 12 facilities listed near DEMI in Table 3-11 are potentially subject to future regulations. Table 10-7 identifies the regulations that are potentially applicable. Based on this analysis, the regulations shown are expected to achieve reductions in ambient concentrations of the following UATMP pollutants: ethylbenzene, formaldehyde, methyl ethyl ketone, methyl isobutyl ketone, and toluene. Reductions are projected for ethylbenzene (41%), formaldehyde (0.1%), methyl ethyl ketone (45%), methyl isobutyl ketone (44%), and toluene (12%) as the regulations are implemented (the latest compliance date is 2007). The emission reductions are primarily attributed to regulation of surface coating operations and petroleum refineries.

10.5.3 Emission Tracer Analysis

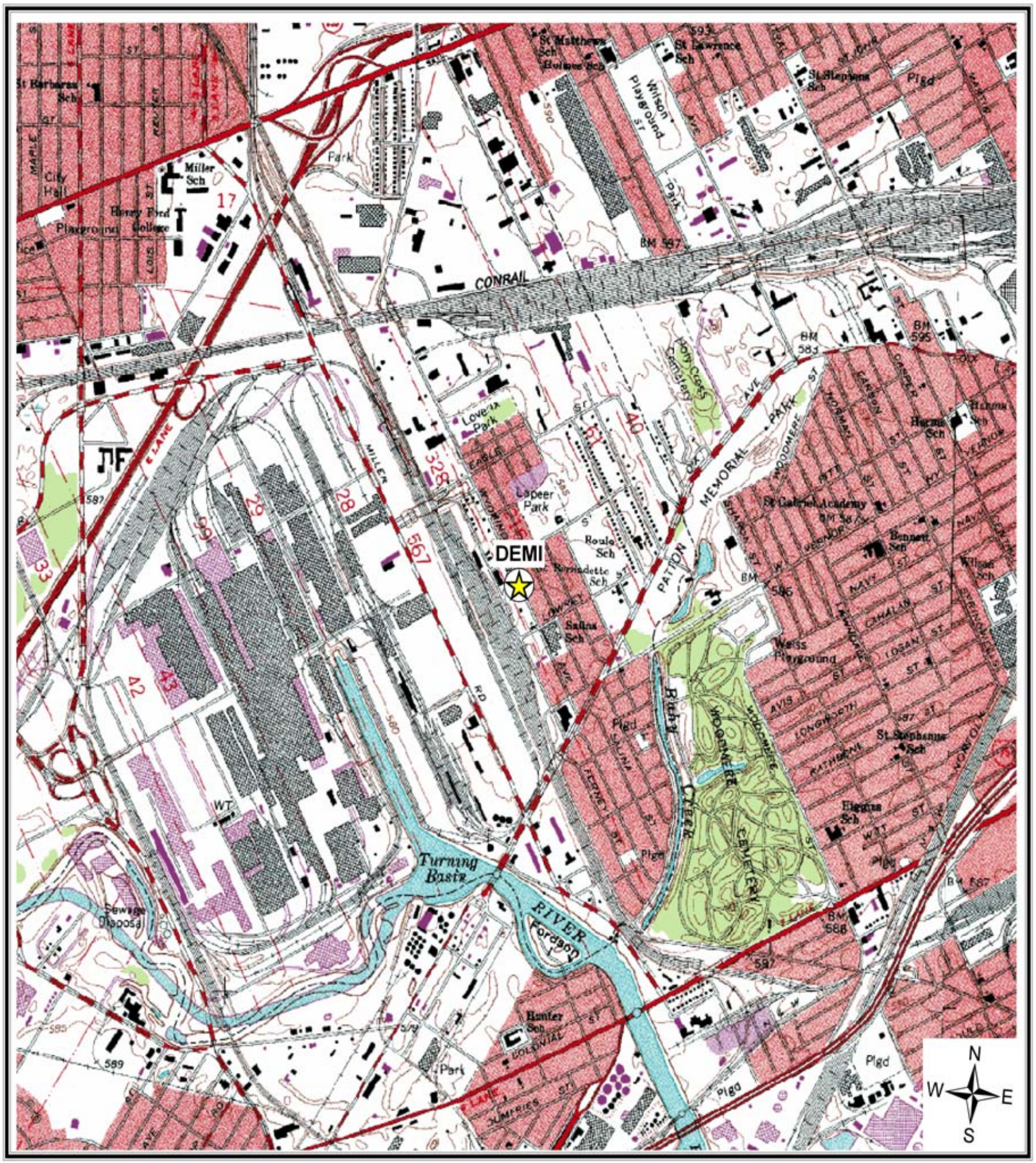
At DEMI, the highest tetrachloroethylene concentration occurred on October 6, 2003. Figure 10-10 is the pollution rose for all tetrachloroethylene samples at DEMI. The lone high concentration points to possible tetrachloroethylene emission sources east of the monitor. Figure 10-11 is a map of acrylonitrile stationary emission sources east of the DEMI monitor. According to the 1999 NEI, Rouge Power & Utility Operations Facility, Detroit Edison - River Rouge Plant, Honeywell, Detroit Coke Plant, and Petro-Chem Processing are all to the east of the monitoring site. However, Figure 10-12 is a back trajectory map for this date, which shows the air originating north and northwest of the monitor. It is possible that air sampled at DEMI on this date passed over the above listed facilities earlier in the day. However, an analysis of the hourly meteorological data shows that winds were primarily calm or light and out of the north for the morning hours, turned southerly during the afternoon, and became calm again overnight. Surface map analysis shows high pressure moved across the area on that day, thus leading to possible stagnation at the surface level.

Figure 10-1. Detroit, Michigan Site 1 (APMI) Monitoring Station



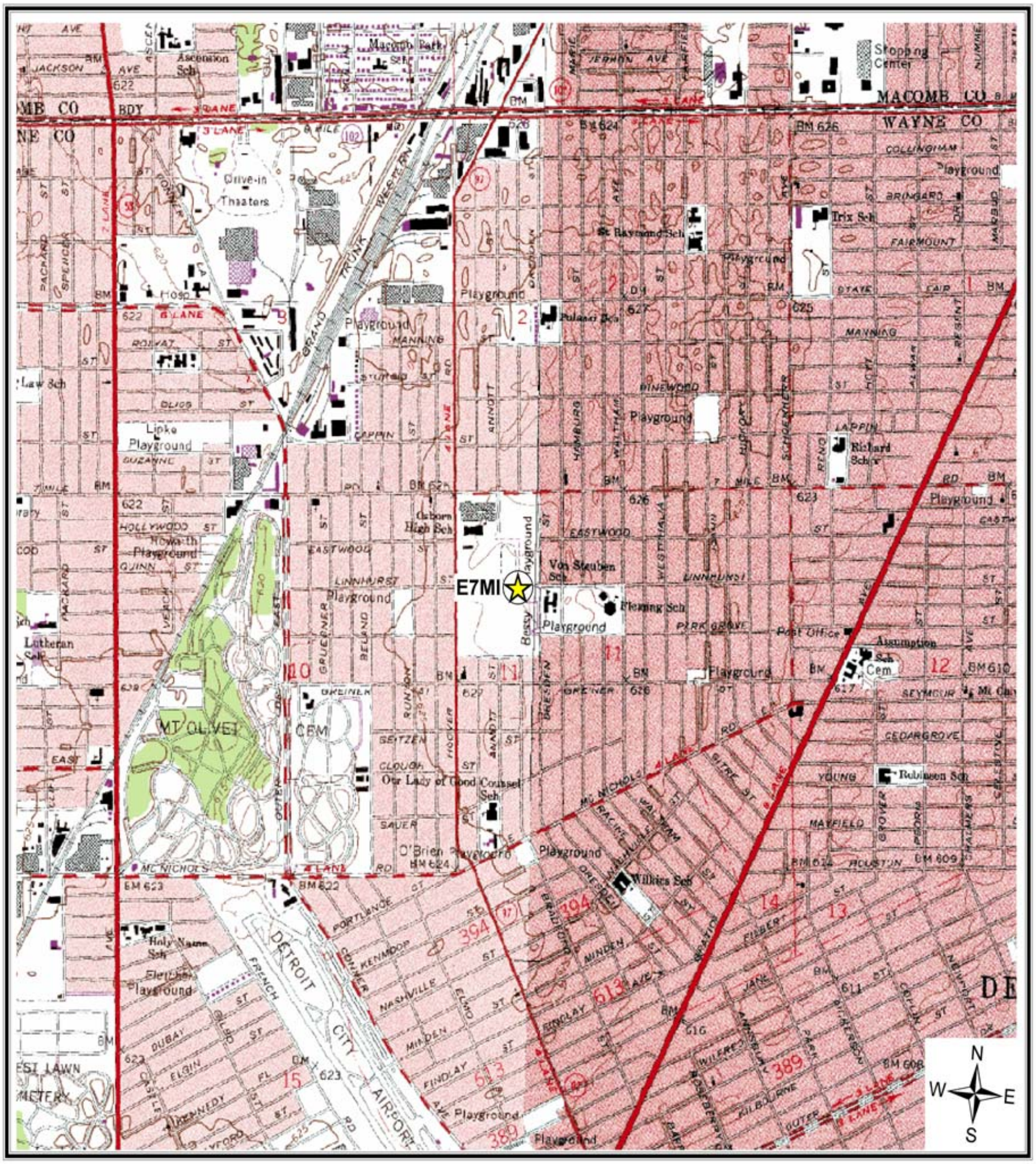
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 10-2. Detroit, Michigan Site 2 (DEMI) Monitoring Station



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

Figure 10-3. Detroit, Michigan Site 3 (E7MI) Monitoring Station

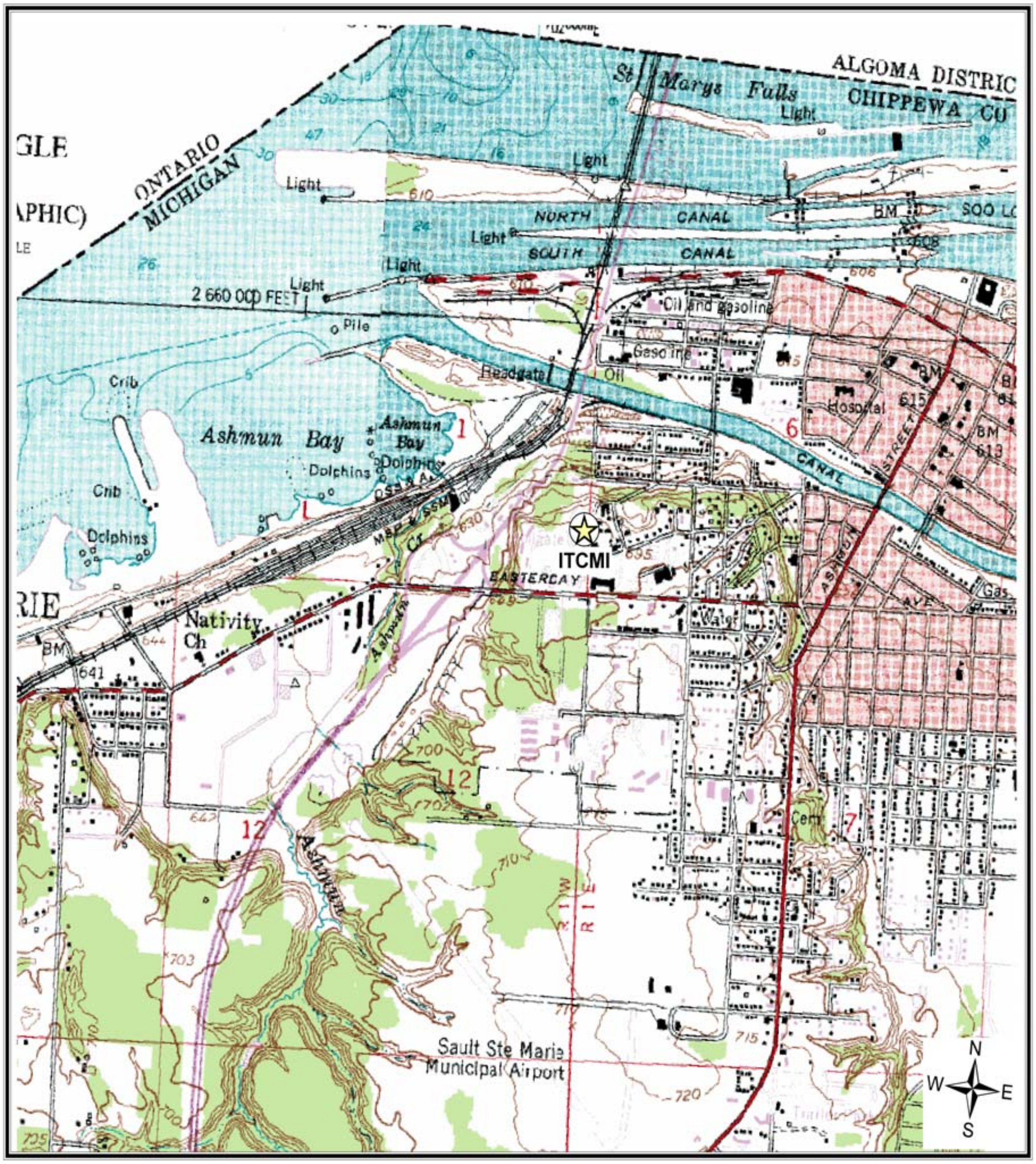


Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 10-4. Houghton Lake, Michigan (HOMI) Monitoring Station

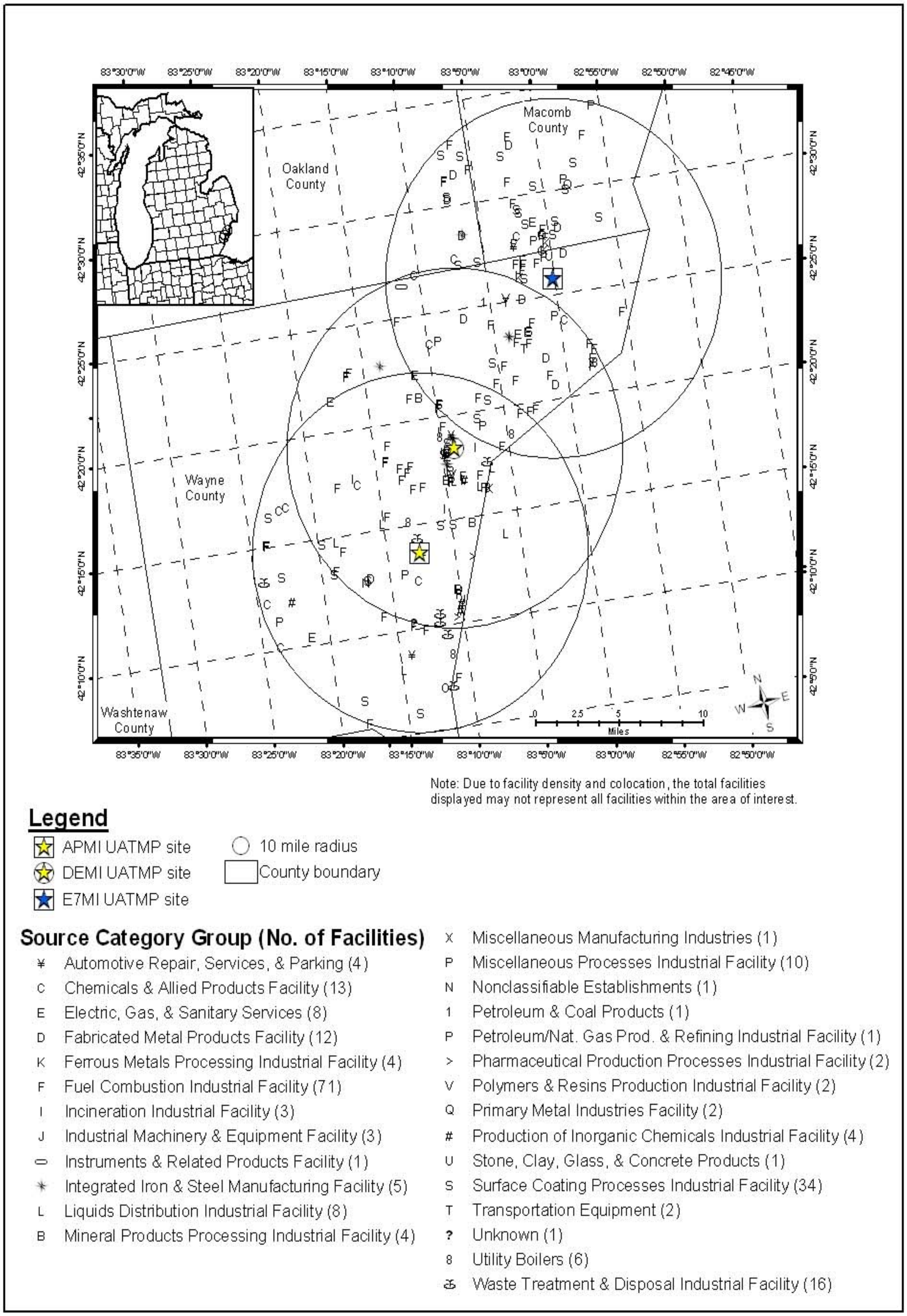
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 10-5. Sault Ste. Marie, Michigan (ITCMI) Monitoring Station



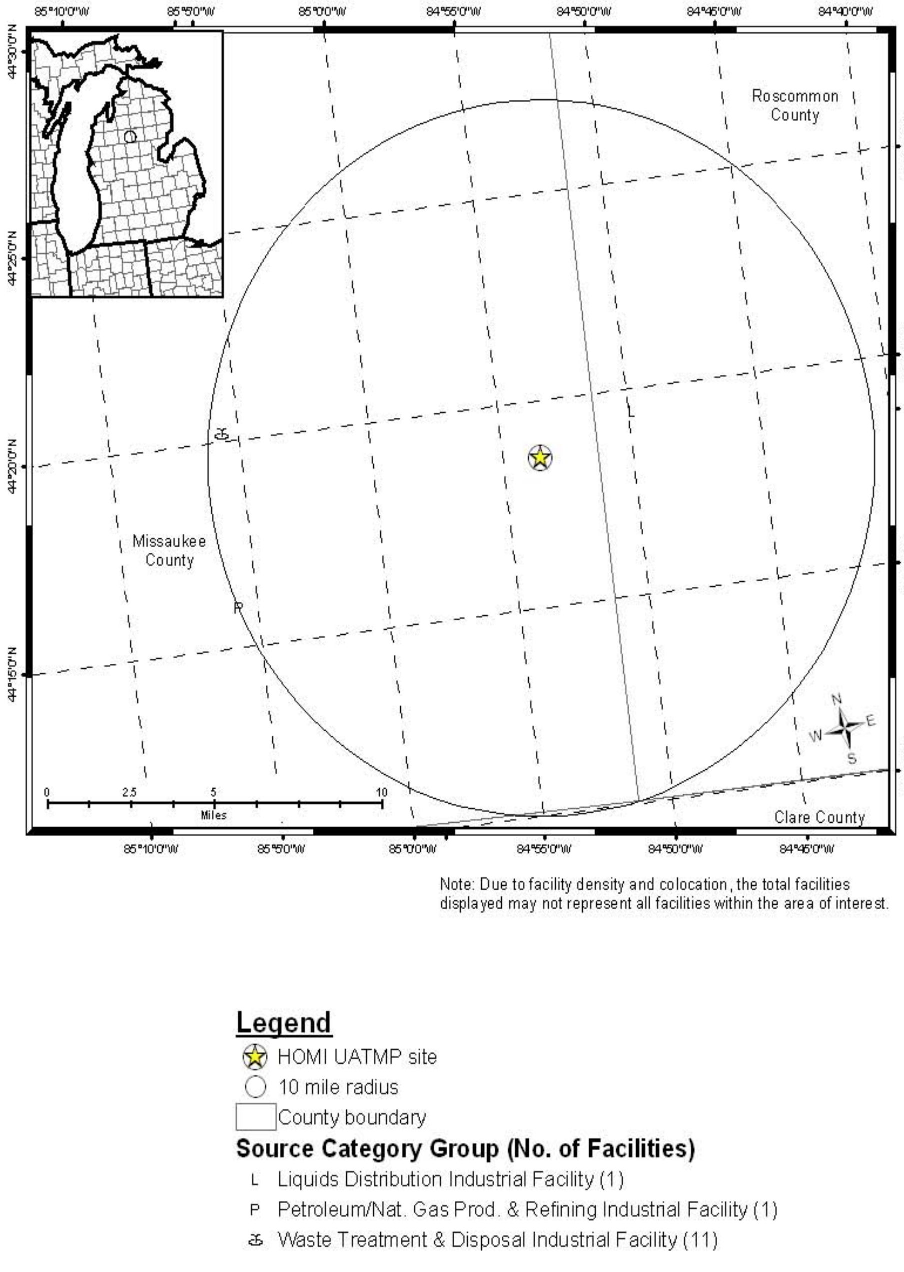
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 10-6. Facilities Located Within 10 Miles of APMI, DEMI, E7MI



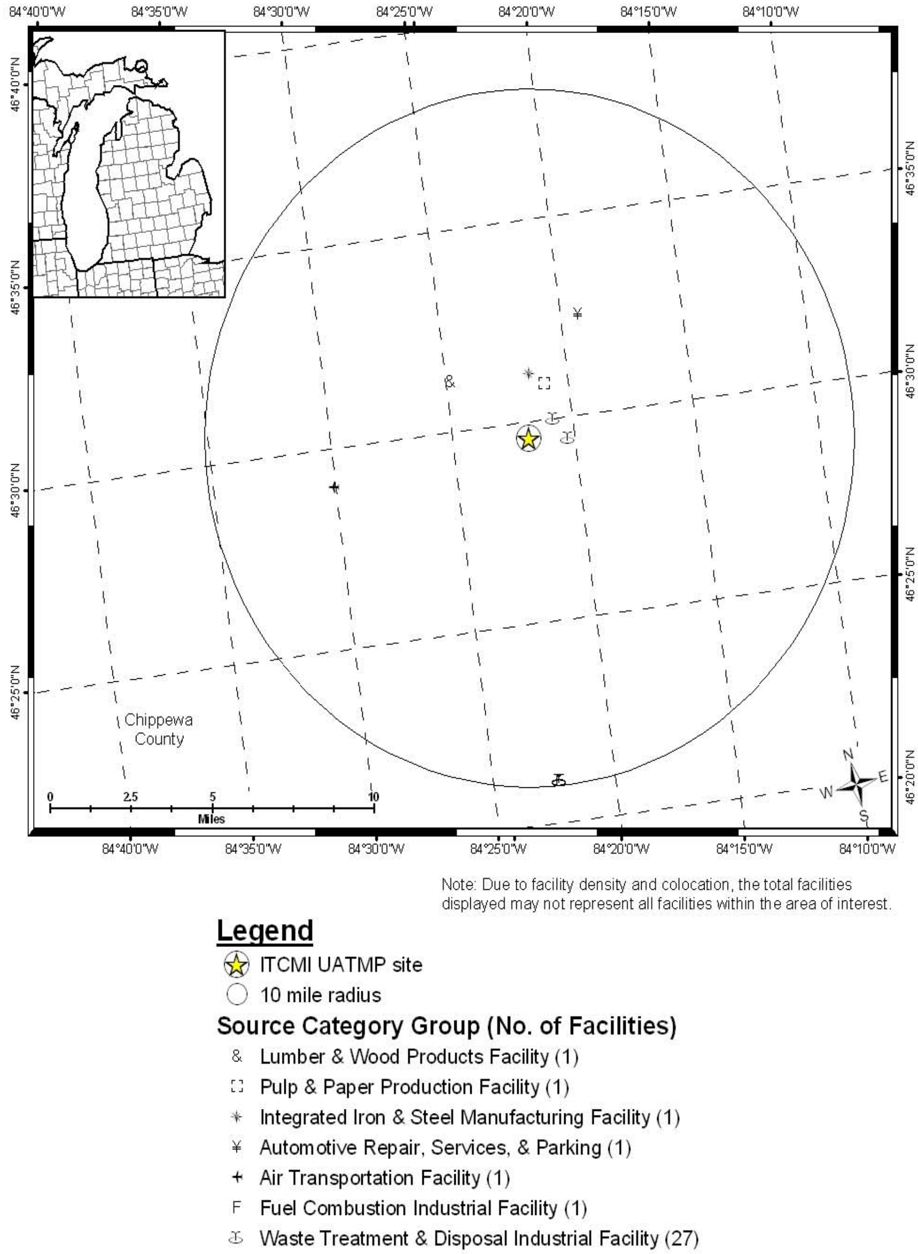
Note: Due to facility density and colocation, the total facilities displayed may not represent all facilities within the area of interest.

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



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

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



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

Figure 10-9. Composite Back Trajectory for DEMI

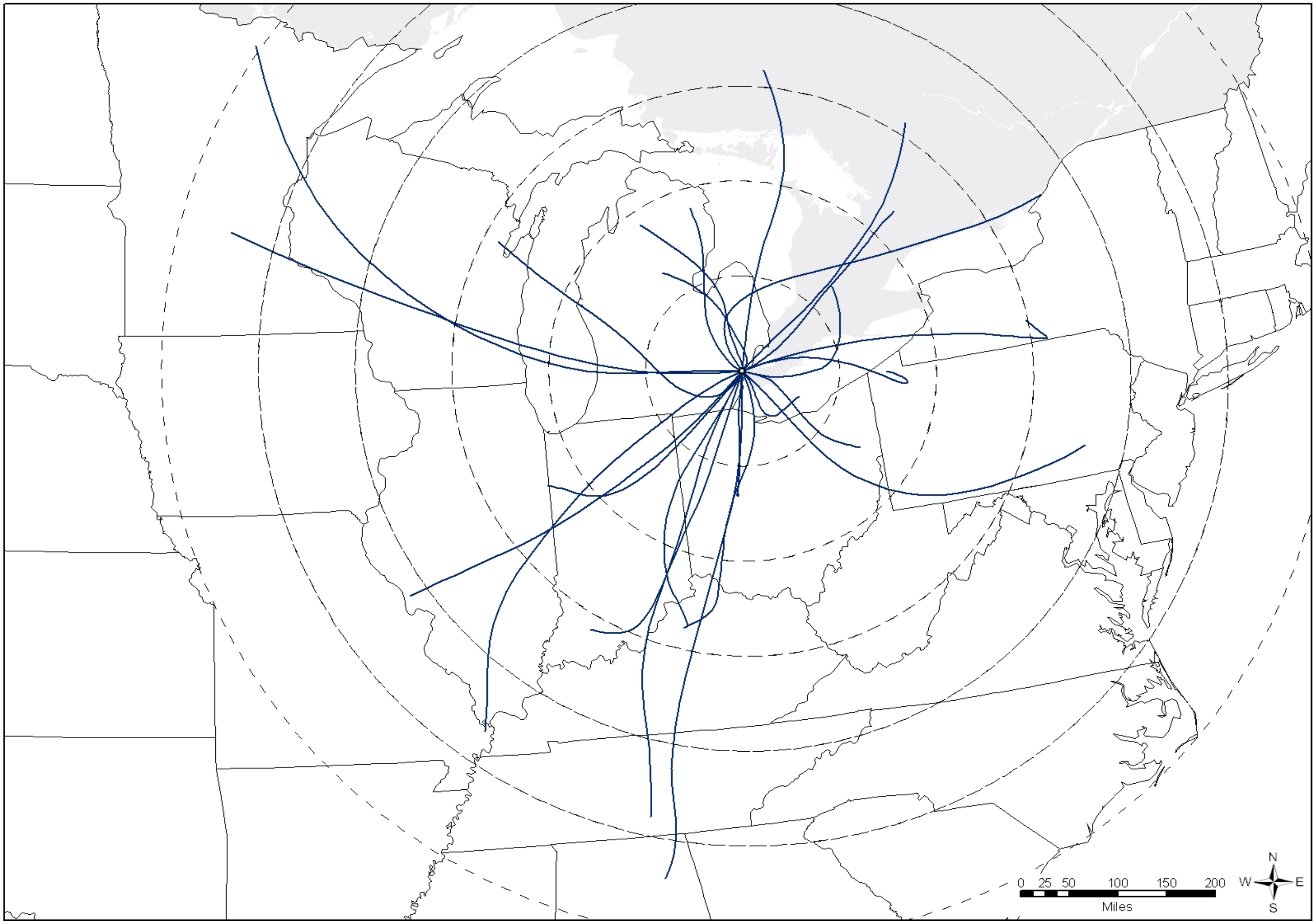


Figure 10-10. Tetrachloroethylene Pollution Rose for DEMI

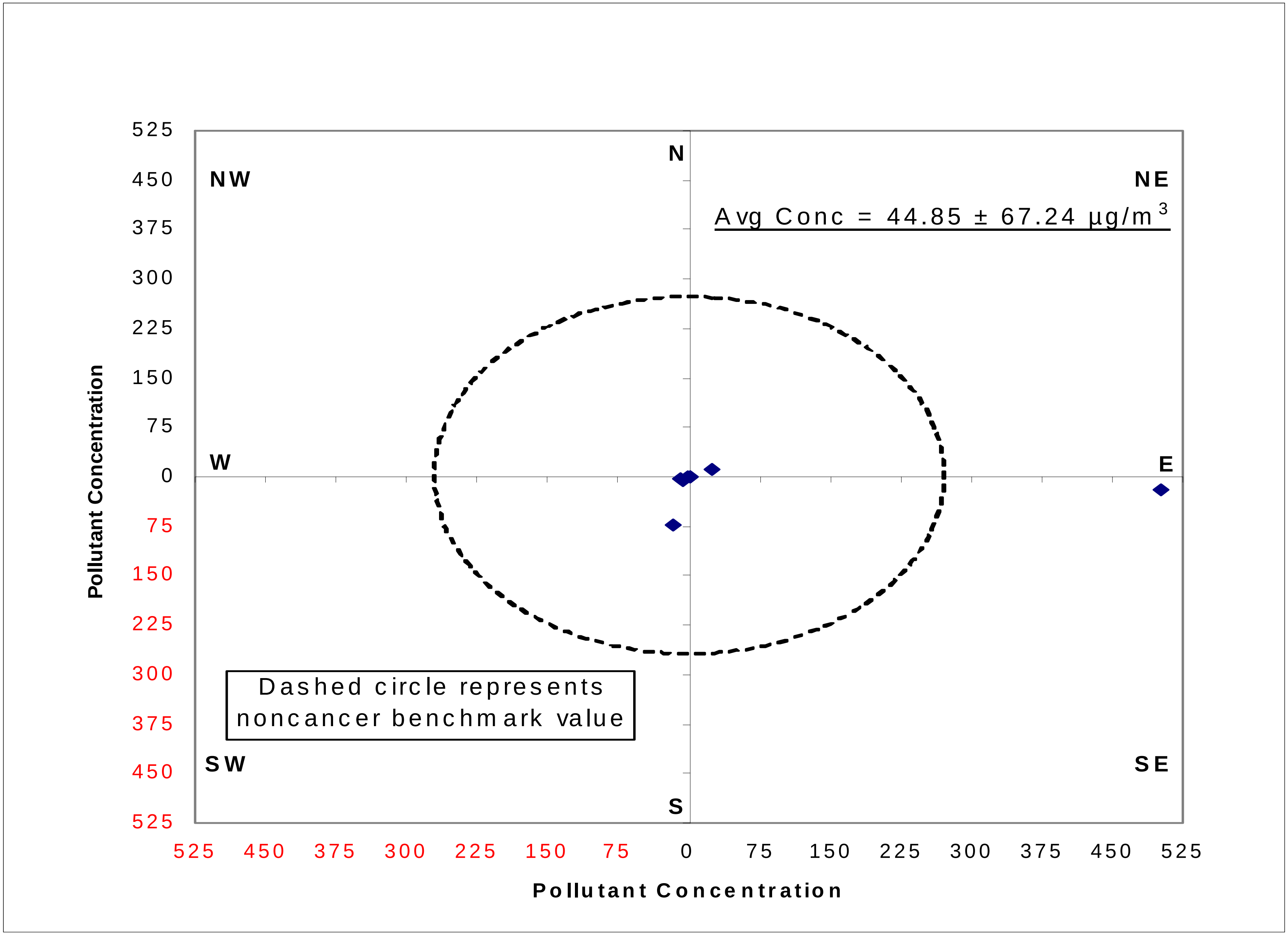


Figure 10-11. Tetrachloroethylene Sources East of the DEMI Monitoring Site

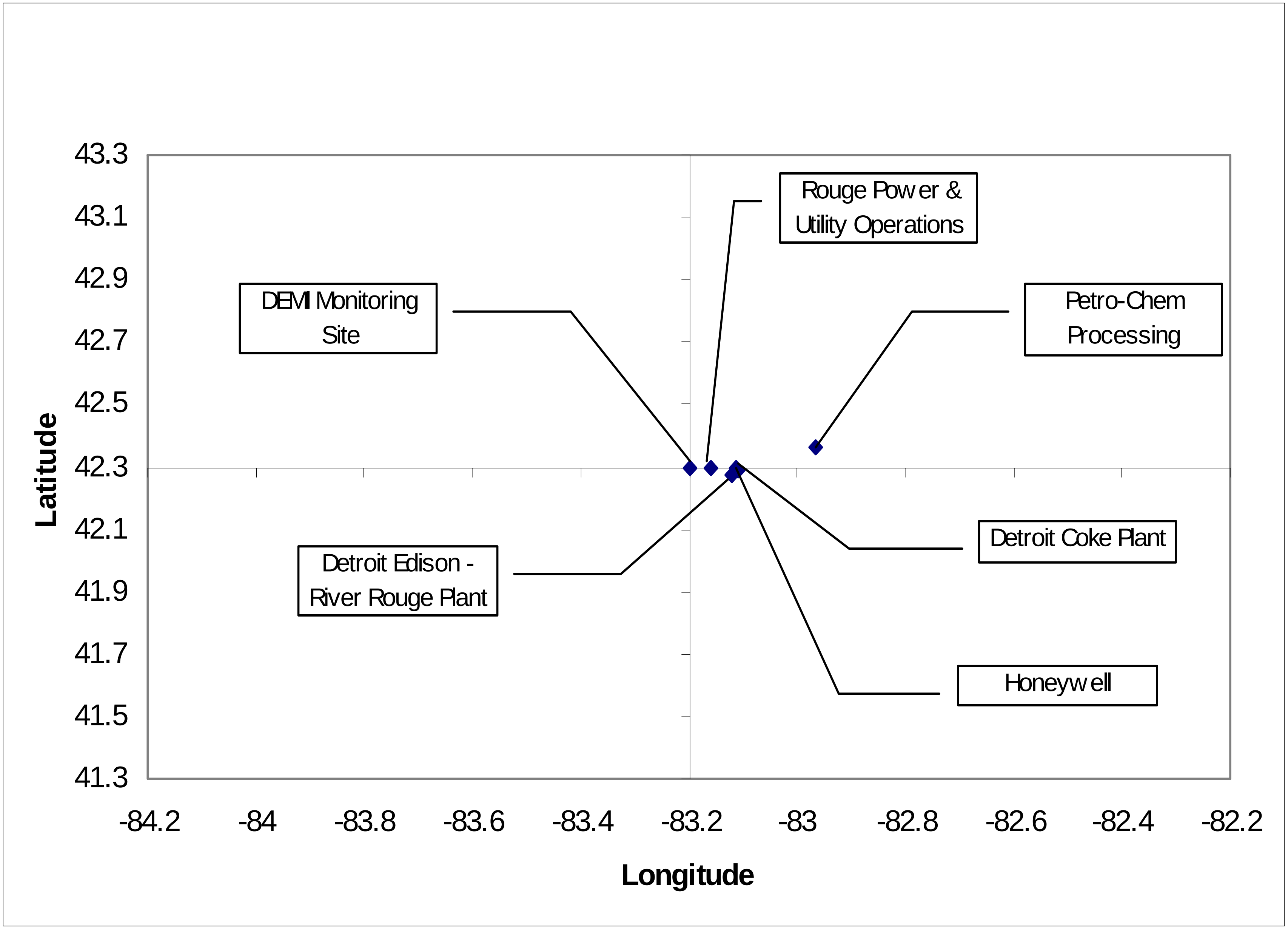


Figure 10-12. 24-Hour Back Trajectory (50, 250, and 500 Meters Aboveground) at DEMI on October 6, 2003

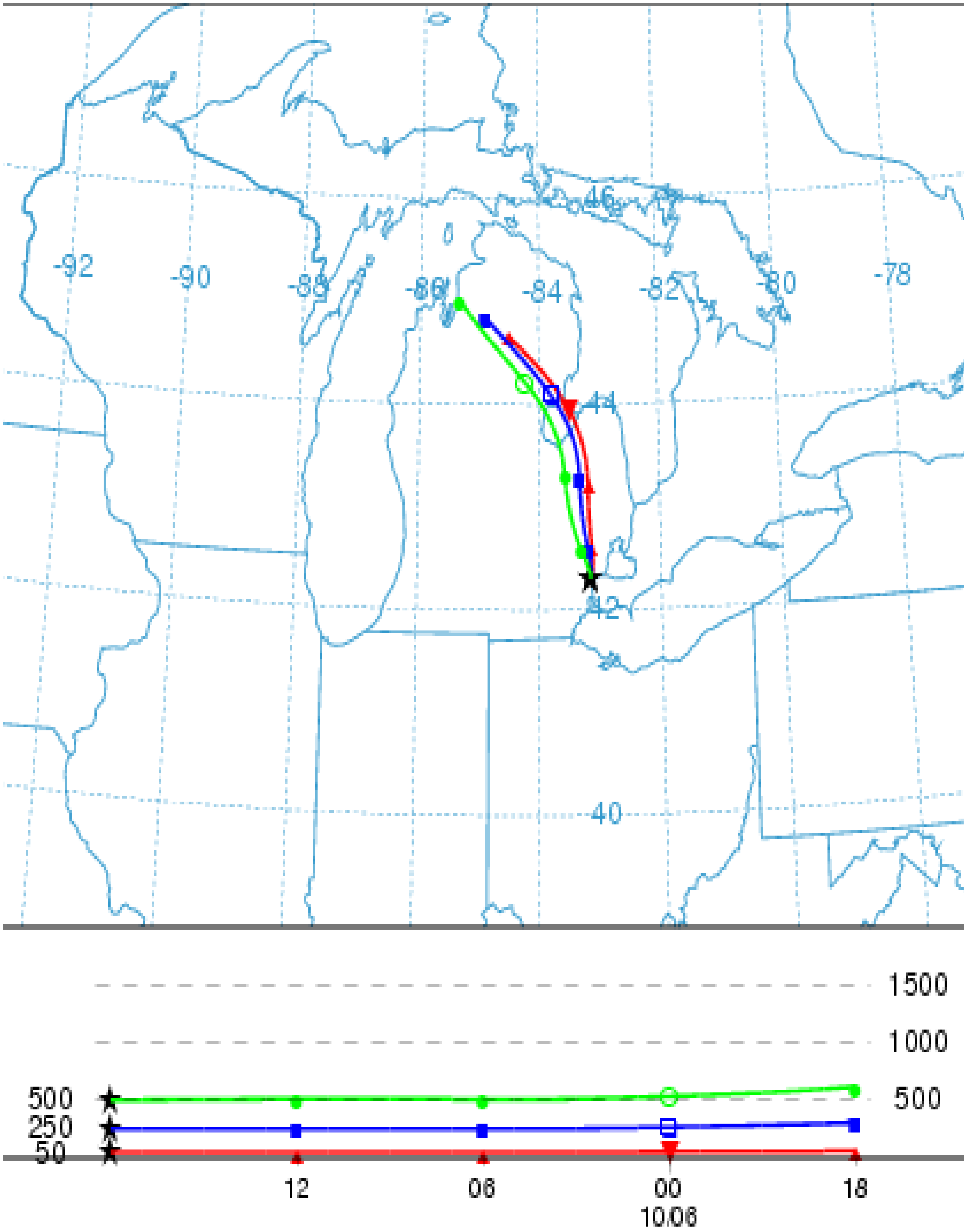


Table 10-1. Average Concentration and Meteorological Parameters for Sites in Michigan

Site Name	Type	Average UATMP Concentration ($\mu g/m^3$)	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)
MI-APMI	All 2003	▨	57.07 (±2.08)	49.01 (±1.93)	40.08 (±1.89)	44.73 (±1.78)	73.56 (±1.11)	1016.14 (±0.67)	2.12 (±0.54)	0.58 (±0.49)
	sample day	352.80 (±232.95)	65.33 (±5.60)	56.82 (±5.03)	48.21 (±5.13)	52.30 (±4.75)	74.71 (±3.36)	1017.74 (±2.22)	1.53 (±2.22)	3.14 (±1.66)
MI-DEMI	All 2003	▨	56.78 (±2.09)	49.45 (±1.96)	38.74 (±1.89)	44.38 (±1.77)	68.95 (±1.17)	1016.18 (±0.68)	1.51 (±0.54)	-0.32 (±0.40)
	sample day	55.77 (±37.93)	58.36 (±6.9)	51.23 (±6.37)	40.64 (±6.05)	46.03 (±5.72)	69.33 (±3.35)	1016.17 (±2.33)	1.45 (±1.88)	1.59 (±1.61)
MI-E7MI	All 2003	▨	56.78 (±2.09)	49.45 (±1.96)	38.74 (±1.89)	44.38 (±1.77)	68.95 (±1.17)	1016.18 (±0.68)	1.51 (±0.54)	-0.32 (±0.40)
	sample day	115.81 (±33.45)	82.31 (±2.62)	73.32 (±2.63)	61.33 (±3.21)	65.87 (±2.62)	68.01 (±3.86)	1017.14 (±2.72)	1.49 (±2.42)	0.73 (±1.49)
MI-HOMI	All 2003	▨	52.93 (±2.24)	43.11 (±1.99)	34.66 (±1.92)	39.25 (±1.83)	75.30 (±1.16)	1015.82 (±0.71)	1.70 (±0.54)	-0.04 (±0.40)
	sample day	240.77 (±225.00)	56.50 (±7.44)	46.19 (±6.90)	38.06 (±6.64)	42.26 (±6.37)	76.61 (±3.71)	1015.32 (±2.50)	2.02 (±1.60)	1.94 (±1.28)
MI-ITCMI	All 2003	▨	49.32 (±2.18)	40.85 (±2.04)	32.02 (±2.08)	37.20 (±1.91)	73.39 (±1.38)	1014.77 (±0.76)	0.92 (±0.49)	-0.62 (±0.34)
	sample day	17.57 (±5.04)	59.53 (±5.73)	51.16 (±5.12)	45.38 (±4.61)	48.04 (±4.62)	82.59 (±2.84)	1013.48 (±2.03)	0.73 (±1.43)	0.27 (±1.16)

Table 10-2a. Summary of the Toxic Cancer Compounds at the Allen Park Monitoring Site in Detroit, Michigan - APMI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Tetrachloroethylene	2.68E-03	95.17	95.17	454.215	13	2,680
Acrylonitrile	1.07E-04	3.82	98.99	1.581	1	107
Benzene	1.28E-05	0.46	99.44	1.646	18	12.8
Carbon Tetrachloride	8.82E-06	0.31	99.76	0.588	17	8.82
1,3-Butadiene	5.17E-06	0.18	99.94	0.172	12	5.17
p-Dichlorobenzene	1.31E-06	0.05	99.99	0.119	2	1.31
Methylene Chloride (Dichloromethane)	2.34E-07	0.01	99.99	0.498	13	<1
Trichloroethylene	1.60E-07	0.01	100.00	0.080	1	<1

Table 10-2b. Summary of the Toxic Cancer Compounds at the Dearborn Monitoring Site in Detroit, Michigan - DEMI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Tetrachloroethylene	2.65E-04	87.05	87.05	44.849	14	265
Benzene	1.53E-05	5.03	92.09	1.962	24	15.3
Carbon Tetrachloride	8.36E-06	2.75	94.84	0.557	22	8.36
1,3-Butadiene	6.37E-06	2.10	96.93	0.212	14	6.37
Acetaldehyde	5.20E-06	1.71	98.65	2.365	27	5.20
p-Dichlorobenzene	2.84E-06	0.93	99.58	0.258	4	2.84
1,3-Dichloropropene	9.08E-07	0.30	99.88	0.227	1	<1
Methylene Chloride (Dichloromethane)	1.84E-07	0.06	99.94	0.392	16	<1
Trichloroethylene	1.60E-07	0.05	99.99	0.080	4	<1
Formaldehyde	2.40E-08	0.01	100.00	4.355	27	<1

Table 10-2c. Summary of the Toxic Cancer Compounds at the E7 Mile Monitoring Site in Detroit, Michigan - E7MI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	2.15E-05	72.80	72.80	2.754	13	21.5
1,3-Butadiene	8.03E-06	27.20	100.00	0.268	12	8.03

Table 10-2d. Summary of the Toxic Cancer Compounds at the Houghton Lake, Michigan Monitoring Site - HOMI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Tetrachloroethylene	4.56E-03	99.67	99.67	772.652	6	4,560
Carbon Tetrachloride	8.71E-06	0.19	99.87	0.581	23	8.71
Benzene	4.01E-06	0.09	99.95	0.515	23	4.01
Acetaldehyde	1.81E-06	0.04	99.99	0.824	16	1.81
Trichloroethylene	2.06E-07	0.00	100.00	0.103	1	<1
Methylene Chloride (Dichloromethane)	1.20E-07	0.00	100.00	0.256	15	<1
Formaldehyde	9.23E-09	0.00	100.00	1.678	16	<1

Table 10-2e. Summary of the Toxic Cancer Compounds at the Sault Ste. Marie, Michigan Monitoring Site - ITCMI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	3.10E-05	57.37	57.37	0.456	1	31.0
Carbon Tetrachloride	8.51E-06	15.75	73.12	0.567	29	8.51
Benzene	8.04E-06	14.88	88.01	1.031	32	8.04
p-Dichlorobenzene	1.95E-06	3.60	91.61	0.177	5	1.95
1,3-Butadiene	1.81E-06	3.36	94.96	0.060	3	1.81
Trichloroethylene	1.56E-06	2.89	97.85	0.779	2	1.56
Tetrachloroethylene	9.39E-07	1.74	99.59	0.159	4	<1
Methylene Chloride (Dichloromethane)	2.23E-07	0.41	100.00	0.474	14	<1
Benzo[a]pyrene	2.21E-10	<0.0001	100.00	<0.0001	25	<1
Dibenz[a,h]anthracene	1.24E-10	<0.0001	100.00	<0.0001	21	<1
Benzo[b]fluoranthene	3.93E-11	<0.0001	100.00	<0.0001	29	<1
Indeno[1,2,3-cd]pyrene	3.80E-11	<0.0001	100.00	<0.0001	27	<1
Benzo[k]fluoranthene	2.76E-11	<0.0001	100.00	<0.0001	29	<1
Benz[a]anthracene	2.55E-11	<0.0001	100.00	<0.0001	28	<1
Chrysene	4.97E-12	<0.0001	100.00	<0.0001	29	<1

Table 10-3a. Summary of the Toxic Noncancer Compounds at the Allen Park Monitoring Site in Detroit, Michigan - APMI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Tetrachloroethylene	1.68E+00	61.52	61.52	454.215	13	7
Acrylonitrile	7.90E-01	28.90	90.42	1.581	1	0
1,3-Butadiene	8.62E-02	3.15	93.57	0.172	12	0
Benzene	5.49E-02	2.01	95.58	1.646	18	0
Xylenes (*o*-, *m*-, *p*-)	3.73E-02	1.36	96.94	3.731	18	0
Acetonitrile	3.01E-02	1.10	98.04	1.806	5	0
Carbon Tetrachloride	1.47E-02	0.54	98.58	0.588	17	0
Chloromethane (Methyl Chloride)	1.36E-02	0.50	99.07	1.221	18	0
Bromomethane (Methyl Bromide)	1.16E-02	0.43	99.50	0.058	1	0
Toluene	8.98E-03	0.33	99.83	3.592	18	0
Chloroform	2.09E-03	0.08	99.90	0.205	8	0
Ethylbenzene	5.74E-04	0.02	99.93	0.574	17	0
Methylene Chloride (Dichloromethane)	4.98E-04	0.02	99.94	0.498	13	0
Methyl Ethyl Ketone (2-Butanone)	4.00E-04	0.01	99.96	2.000	17	0
Chloroethane (Ethyl Chloride)	2.35E-04	0.01	99.97	2.349	1	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.66E-04	0.01	99.97	0.166	8	0
Chlorobenzene	1.65E-04	0.01	99.98	0.165	4	0
Styrene	1.54E-04	0.01	99.98	0.154	8	0
p-Dichlorobenzene	1.48E-04	0.01	99.99	0.119	2	0
Trichloroethylene	1.34E-04	<0.0001	99.99	0.080	1	0
Methyl *tert*-Butyl Ether	7.21E-05	<0.0001	100.00	0.216	1	0
Methyl Isobutyl Ketone (Hexone)	6.83E-05	<0.0001	100.00	0.205	1	0

Table 10-3b. Summary of the Toxic Noncancer Compounds at the Dearborn Monitoring SIte in Detroit, Michigan - DEMI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	4.44E-01	38.07	38.07	4.355	27	0
Acetaldehyde	2.63E-01	22.51	60.58	2.365	27	0
Tetrachloroethylene	1.66E-01	14.23	74.81	44.849	14	1
1,3-Butadiene	1.06E-01	9.10	83.91	0.212	14	0
Benzene	6.54E-02	5.60	89.51	1.962	24	0
Xylenes (*o*-, *m*-, *p*-)	4.41E-02	3.78	93.29	4.412	24	0
Acetonitrile	2.52E-02	2.16	95.45	1.514	10	0
Carbon Tetrachloride	1.39E-02	1.19	96.64	0.557	22	0
Chloromethane (Methyl Chloride)	1.34E-02	1.15	97.79	1.206	24	0
1,3-Dichloropropene	1.13E-02	0.97	98.76	0.227	1	0
Toluene	1.03E-02	0.88	99.64	4.111	24	0
Chloroform	1.70E-03	0.15	99.79	0.167	7	0
Ethylbenzene	6.87E-04	0.06	99.85	0.687	23	0
Methylene Chloride (Dichloromethane)	3.92E-04	0.03	99.88	0.392	16	0
Methyl Ethyl Ketone (2-Butanone)	3.59E-04	0.03	99.91	1.793	14	0
p-Dichlorobenzene	3.23E-04	0.03	99.94	0.258	4	0
Styrene	2.88E-04	0.02	99.96	0.288	10	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.73E-04	0.01	99.98	0.173	11	0
Trichloroethylene	1.33E-04	0.01	99.99	0.080	4	0
Methyl Isobutyl Ketone (Hexone)	1.27E-04	0.01	100.00	0.382	4	0

Table 10-3c. Summary of the Toxic Noncancer Compounds at the E7 Mile Monitoring Site in Detroit, Michigan - E7MI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
1,3-Butadiene	1.34E-01	44.58	44.58	0.268	12	0
Benzene	9.18E-02	30.59	75.16	2.754	13	0
Xylenes (*o*-, *m*-, *p*-)	4.14E-02	13.78	88.95	4.138	13	0
Toluene	1.86E-02	6.21	95.16	7.458	13	0
Hexane	1.32E-02	4.39	99.55	2.635	13	0
Ethylbenzene	1.08E-03	0.36	99.91	1.080	13	0
Styrene	2.77E-04	0.09	100.00	0.277	12	0

Table 10-3d. Summary of the Toxic Noncancer Compounds at the Houghton Lake, Michigan Monitoring Site - HOMI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Tetrachloroethylene	2.86E+00	52.89	52.89	772.652	6	2
Acetonitrile	1.93E+00	35.68	88.56	115.824	18	15
Bromomethane (Methyl Bromide)	2.76E-01	5.09	93.65	1.378	1	0
Formaldehyde	1.71E-01	3.17	96.82	1.678	16	0
Acetaldehyde	9.15E-02	1.69	98.51	0.824	16	0
Benzene	1.72E-02	0.32	98.83	0.515	23	0
Chloromethane (Methyl Chloride)	1.47E-02	0.27	99.10	1.321	24	0
Carbon Tetrachloride	1.45E-02	0.27	99.37	0.581	23	0
Xylenes (*o*-, *m*-, *p*-)	1.10E-02	0.20	99.57	1.104	15	0
Toluene	1.09E-02	0.20	99.77	4.340	24	0
Chloroform	9.15E-03	0.17	99.94	0.897	24	0
1,2,4-Trichlorobenzene	1.48E-03	0.03	99.97	0.297	1	0
Methyl Ethyl Ketone (2-Butanone)	4.98E-04	0.01	99.98	2.488	13	0
Styrene	3.54E-04	0.01	99.98	0.354	13	0
Methylene Chloride (Dichloromethane)	2.56E-04	<0.0001	99.99	0.256	15	0
Ethylbenzene	1.95E-04	<0.0001	99.99	0.195	12	0
Trichloroethylene	1.71E-04	<0.0001	99.99	0.103	1	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.56E-04	<0.0001	100.00	0.156	10	0
Methyl Isobutyl Ketone (Hexone)	1.22E-04	<0.0001	100.00	0.367	1	0

Table 10-3e. Summary of the Toxic Noncancer Compounds at the Sault Ste. Marie, Michigan Monitoring Site - ITCMI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acrylonitrile	2.28E-01	60.70	60.70	0.456	1	0
Benzene	3.44E-02	9.15	69.85	1.031	32	0
1,3-Butadiene	3.02E-02	8.05	77.90	0.060	3	0
Acetonitrile	2.60E-02	6.93	84.83	1.561	11	0
Xylenes (*o*-, *m*-, *p*-)	1.72E-02	4.57	89.40	1.716	29	0
Carbon Tetrachloride	1.42E-02	3.78	93.18	0.567	29	0
Chloromethane (Methyl Chloride)	1.24E-02	3.30	96.47	1.113	32	0
Toluene	7.30E-03	1.94	98.42	2.921	32	0
Trichloroethylene	1.30E-03	0.35	98.76	0.779	2	0
Chloroform	1.19E-03	0.32	99.08	0.116	8	0
Methyl Ethyl Ketone (2-Butanone)	8.36E-04	0.22	99.30	4.181	26	0
Styrene	6.83E-04	0.18	99.48	0.683	2	0
Tetrachloroethylene	5.90E-04	0.16	99.64	0.159	4	0
Methylene Chloride (Dichloromethane)	4.74E-04	0.13	99.77	0.474	14	0
Ethylbenzene	2.68E-04	0.07	99.84	0.268	21	0
p-Dichlorobenzene	2.21E-04	0.06	99.90	0.177	5	0
Methyl Isobutyl Ketone (Hexone)	1.81E-04	0.05	99.95	0.544	5	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.49E-04	0.04	99.99	0.149	14	0
Chlorobenzene	4.77E-05	0.01	100.00	0.048	1	0
Naphthalene	1.85E-06	<0.0001	100.00	<0.0001	29	0

Table 10-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Allen Park Site in Detroit, Michigan (APMI)

Compound	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
1,3-Butadiene	-0.22	-0.32	-0.32	-0.32	-0.15	0.07	0.23	-0.33
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	0.33	0.29	0.32	0.31	0.22	0.65	-0.25	-0.35
Tetrachloroethylene	-0.50	-0.45	-0.47	-0.46	-0.24	-0.21	0.19	0.27

Table 10-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Dearborn Site in Detroit, Michigan (DEMI)

Compound	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
1,3-Butadiene	0.42	0.36	0.34	0.35	-0.07	0.02	0.09	-0.12
Acetaldehyde	0.44	0.40	0.33	0.38	-0.30	-0.09	-0.15	0.29
Acetonitrile	-0.79	-0.79	-0.77	-0.79	0.39	-0.01	0.00	-0.78
Benzene	0.39	0.35	0.26	0.31	-0.33	0.30	-0.22	0.18
Carbon Tetrachloride	0.43	0.38	0.30	0.34	-0.40	0.10	-0.30	0.27
Formaldehyde	0.64	0.63	0.56	0.60	-0.34	0.04	-0.21	0.19
Tetrachloroethylene	-0.16	-0.24	-0.30	-0.27	-0.15	0.24	-0.08	-0.07
Xylenes (*o*-,*m*-,*p*-)	0.35	0.30	0.22	0.26	-0.30	0.28	-0.29	-0.08

Table 10-4c. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the E7 Mile Site in Detroit, Michigan (E7MI)

Compound	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
1,3-Butadiene	-0.12	-0.19	-0.06	-0.12	0.17	0.03	-0.31	0.24
Benzene	-0.12	-0.18	-0.11	-0.15	0.09	0.14	-0.28	0.30
Toluene	-0.10	-0.17	-0.15	-0.17	0.01	0.19	-0.28	0.35
Xylenes (*o*-,*m*-,*p*-)	-0.17	-0.24	-0.20	-0.23	0.02	0.09	-0.30	0.26

Table 10-4d. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Houghton Lake, Michigan Site (HOMI)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetonitrile	-0.11	-0.10	0.00	-0.06	0.26	0.11	-0.05	0.21
Formaldehyde	0.83	0.83	0.75	0.79	-0.64	0.10	-0.26	0.34
Bromomethane (Methyl Bromide)	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	0.05	-0.24	-0.30	-0.27	-0.11	0.71	0.01	-0.21

Table 10-4e. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Sault Ste. Marie, Michigan Site (ITCMI)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.41	-0.66	-0.56	-0.62	0.37	0.70	-0.77	0.33
Acetonitrile	-0.73	-0.68	-0.68	-0.69	0.23	-0.13	0.18	-0.50
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.48	-0.49	-0.50	-0.50	0.06	0.20	0.03	-0.28
Carbon Tetrachloride	0.46	0.44	0.40	0.42	-0.28	0.21	0.20	0.37
Chloromethane (Methyl Chloride)	-0.04	-0.05	-0.07	-0.06	-0.07	0.17	-0.04	0.07
p-Dichlorobenzene	0.73	0.71	0.69	0.70	-0.79	0.38	-0.08	0.88
Trichloroethylene	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes (*o*-,*m*-,*p*-)	-0.35	-0.38	-0.39	-0.39	0.08	0.26	0.20	-0.23

Table 10-5. Motor Vehicle Information vs. Daily Concentration for Michigan Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
APMI	2,045,540	1,734,417	0.85	965,005	820,254	60,000	352.80 (±232.95)
DEMI	2,045,540	1,734,417	0.85	1,208,975	1,027,629	12,791	55.77 (±37.93)
E7MI	2,045,540	1,734,417	0.85	1,167,824	992,650	6,999	115.81 (±33.45)
HOMI	14,950	12,454	0.83	10,386	8,620	7,000	240.77 (±225.00)
ITCMI	38,898	32,552	0.84	21,881	18,380	100,000	17.57 (±5.04)

Table 10-6. SVOC and TNMOC Concentrations for Michigan Monitoring Sites

Monitoring Station	Average SVOC Concentration (ng)	TNMOC Speciated (ppbC)	TNMOC w/ unknowns (ppbC)	% of TNMOC identified	SNMOC Compound with the Highest Concentration (ppbC)
E7MI	NA	198.35	303.78	64%	Toluene 37.30
ITCMI	7.39	NA	NA	NA	NA

NA = Not Applicable.

Table 10-7. Summary of Future Regulations That May be Applicable for Nearby Facilities Surrounding DEMI

Facility Name	Primary SIC Code	SIC Code Description	Regulation Citation	Regulation Name
BASF Corp.	2851	Paints, Varnishes, Lacquers, Enamels, and Allied Products	40 CFR part 63, subpart HHHHH	Miscellaneous Coating Manufacturing NESHAP
Cadillac Div. Det. Hamtramck Assembly	3711	Motor Vehicles and Passenger Car Bodies	40 CFR part 63, subpart IIII	Auto and Light Duty Trucks (Surface Coating) NESHAP
Crown Group Ecourse MI Plant	3479	Coating, Engraving, and Allied Services, NEC	40 CFR part 63, subpart SSSS	Metal Coil (Surface Coating)
Daimlerchrysler Jefferson North Assembly Plant	3711	Motor Vehicles and Passenger Car Bodies	40 CFR part 63, subpart IIII	Auto and Light Duty Trucks (Surface Coating) NESHAP
Exterior Sys. Inc. Owens Corning Metal Sys. (DBA)	3479	Coating, Engraving, and Allied Services, NEC	40 CFR part 63, subpart SSSS	Metal Coil (Surface Coating)
Ford Motor Co. Dearborn Assembly Plant	3711	Motor Vehicles and Passenger Car Bodies	40 CFR part 63, subpart IIII	Auto and Light Duty Trucks (Surface Coating) NESHAP
Marathon Ashland Petroleum LLC	2911	Petroleum Refining	40 CFR part 63, subpart UUU	Petroleum Refineries-Catalytic Cracking, Catalytic Reforming, and Sulfur Plant Units NESHAP

11.0 Sites in Mississippi

This section focuses on 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 11-1 through 11-5 are topographical maps showing the monitoring stations in their urban and rural locations. Figures 11-6 through 11-10 are maps identifying facilities within ten miles of the sites that reported to the 1999 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 of the monitoring station, given its coastal proximity and are mostly surface coating facilities. GPMS is farther west along the Mississippi shoreline, and the few nearby sources, which are mainly involved in fuel combustion and surface coating, are also mainly to the north. Very few facilities are located near the GRMS site. Most of the facilities are located to the south of the monitor and the majority are involved in surface coating processes. JAMS is somewhat centrally located, 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 west of the site. A large number of the sources near the TUMS site are involved in polymer and resin production and inorganic chemical production.

Hourly meteorological data were retrieved for all of 2003 at five weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The weather observations were reported from each of the five cities' reporting stations (WBAN 93874, 13978, 3940, 53858, and 93862, respectively).

Table 11-1 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), 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. Climatologically, all five of the Mississippi cities can be considered warm and humid, especially Gulfport and Pascagoula, the two sites nearest the coast. Table 11-1 reflects this coastal location, as GPMS and PGMS have the highest maximum, average, dew point, and wet bulb temperatures and relative humidity. 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).

11.1 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. Tables 11-2a-e summarize the cancer weighting scores, while Tables 11-3a-e summarize 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.

Tables 11-2a-e show that most of the detected cancer compounds reflect the nationwide prevalent cancer compound list, discussed in Section 3 of this report. Trichloroethylene (detected at GPMS, GRMS, and TUMS), methylene chloride (detected at all of the Mississippi sites), 1,2-dichloroethane (detected at JAMS), and vinyl chloride (detected at TUMS) were not listed among the nationwide prevalent compounds. Acrylonitrile, benzene, carbon tetrachloride, and acetaldehyde were the only prevalent compounds across all five sites. Acrylonitrile contributed the most in toxicity weighting at each MS site. For the noncancer compounds summarized in Tables 11-3a-e, 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 methylene chloride (TUMS). Acrylonitrile, acetonitrile, acetaldehyde, formaldehyde, and xylenes were the only compounds to be considered prevalent across all five sites.

Toxic compounds not detected at the Mississippi sites were: 1,1,2,2-tetrachloroethane; ethyl acrylate; 1,2-dibromoethane; 1,1-dichloroethane; hexachlorobutadiene; 1,2-dichloropropane; vinyl chloride; and 1,1-dichloroethene.

11.2 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 any of the other prevalent compounds. Benzene and acetaldehyde 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 JAMS was the highest among the five sites at 69.9 in a million, while the GRMS, GPMS, TUMS, and PGMS risk was lower at 56.6, 52.7, 20.7, and 20.4 in a million, respectively. For the compounds which may lead to adverse noncancer health effects, the average acetonitrile toxicity at GRMS was 0.793 (over 1 indicates a significant chance of a noncancer health effect). Of the eighteen acetonitrile detects at GRMS, six concentrations were of adverse health concentrations.

11.3 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 11-1 lists the average UATMP concentrations for each of the sites that sampled in Mississippi. The GRMS sites had the highest average UATMP concentration while PGMS had the lowest. Table 11-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

Tables 11-4a-e present 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. A perfect positive correlation (1.00) was computed between acrylonitrile and relative humidity at GRMS, indicating that acrylonitrile concentrations increase as humidity increases. Several other parameters exhibited strong correlations with acrylonitrile at this site as well. It is important to note that acrylonitrile was only detected three times, and this low sample number could make the correlations appear stronger than they would with a more representative sample. 1,3-Butadiene had strong to very strong negative correlations with the temperature and moisture variables at all of the sites at which it was a prevalent compound and was detected more than three times (GPMS, JAMS, and PGMS). Acetaldehyde, carbon tetrachloride, formaldehyde, and xylenes all had moderately strong positive correlations with maximum and average temperature, dewpoint and wet bulb temperature at GRMS. Pearson correlations for acrylonitrile at JAMS, PGMS, and TUMS and 1,3-butadiene, tetrachloroethylene, and trichloroethylene at TUMS could not be computed due to the low number of detects (fewer than 4).

11.4 Spatial Analysis

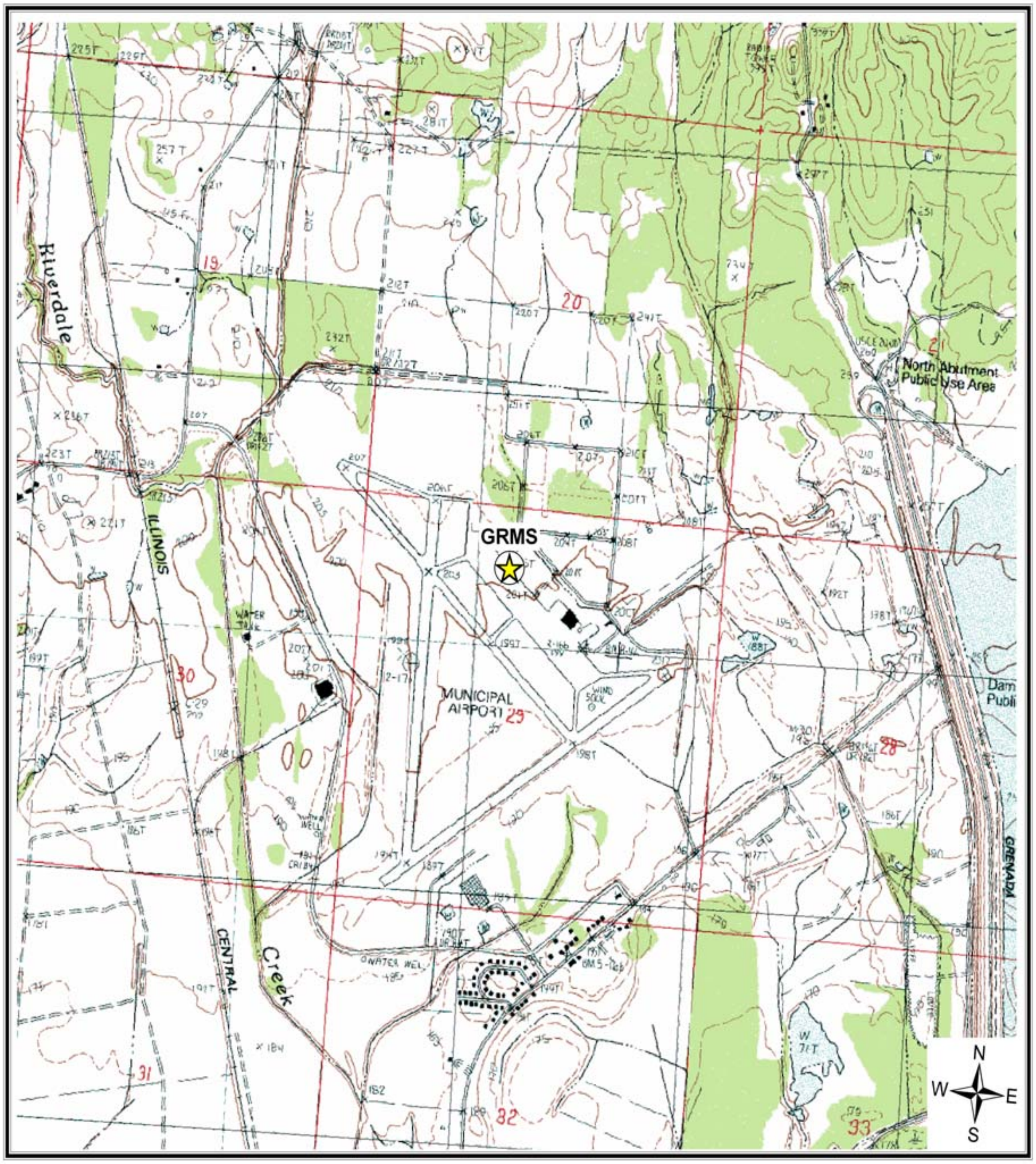
County-level car registration and population information for Grenada County, Harrison County, Hinds County, Jackson County, and Lee County, MS, was obtained from the Mississippi State Tax Commission and the U.S. Census Bureau, and is summarized in Table 11-5. Also included in Table 11-5 is the population within 10 miles of each site and 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. Using these parameters, a county-specific car registration ratio was computed. An estimation of 10-mile car registrations was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the Mississippi sites in Table 11-5. The JAMS site has the largest vehicle ownership within a ten mile radius, while GPMS has the highest traffic volume passing by the site on a daily basis.

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 areas (for more information on this study, refer to section 3.4.2.). Figure 3-1 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. Four of the five site ratios looked relatively similar to those of the roadside study (GPMS, JAMS, PGMS, and TUMS). Only GRMS looked much different. At GRMS, the benzene-ethylbenzene ratio was still the lowest, but the xylenes-ethylbenzene ratio was the largest, and the toluene-ethylbenzene ratio resided in between.

Figure 11-1. Gulfport, Mississippi (GPMS) Monitoring Station

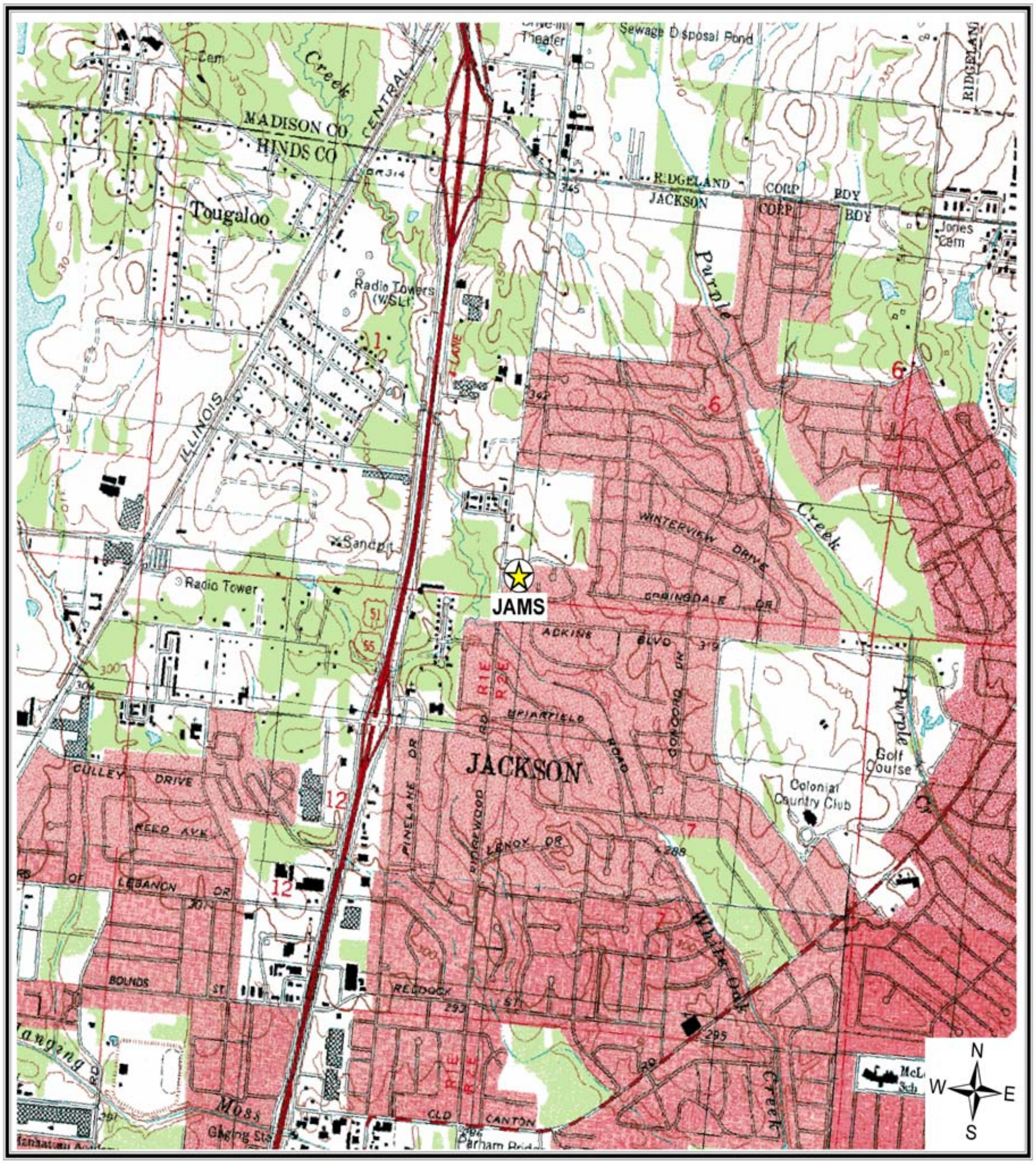
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 11-2. Grenada, Mississippi (GRMS) Monitoring Station



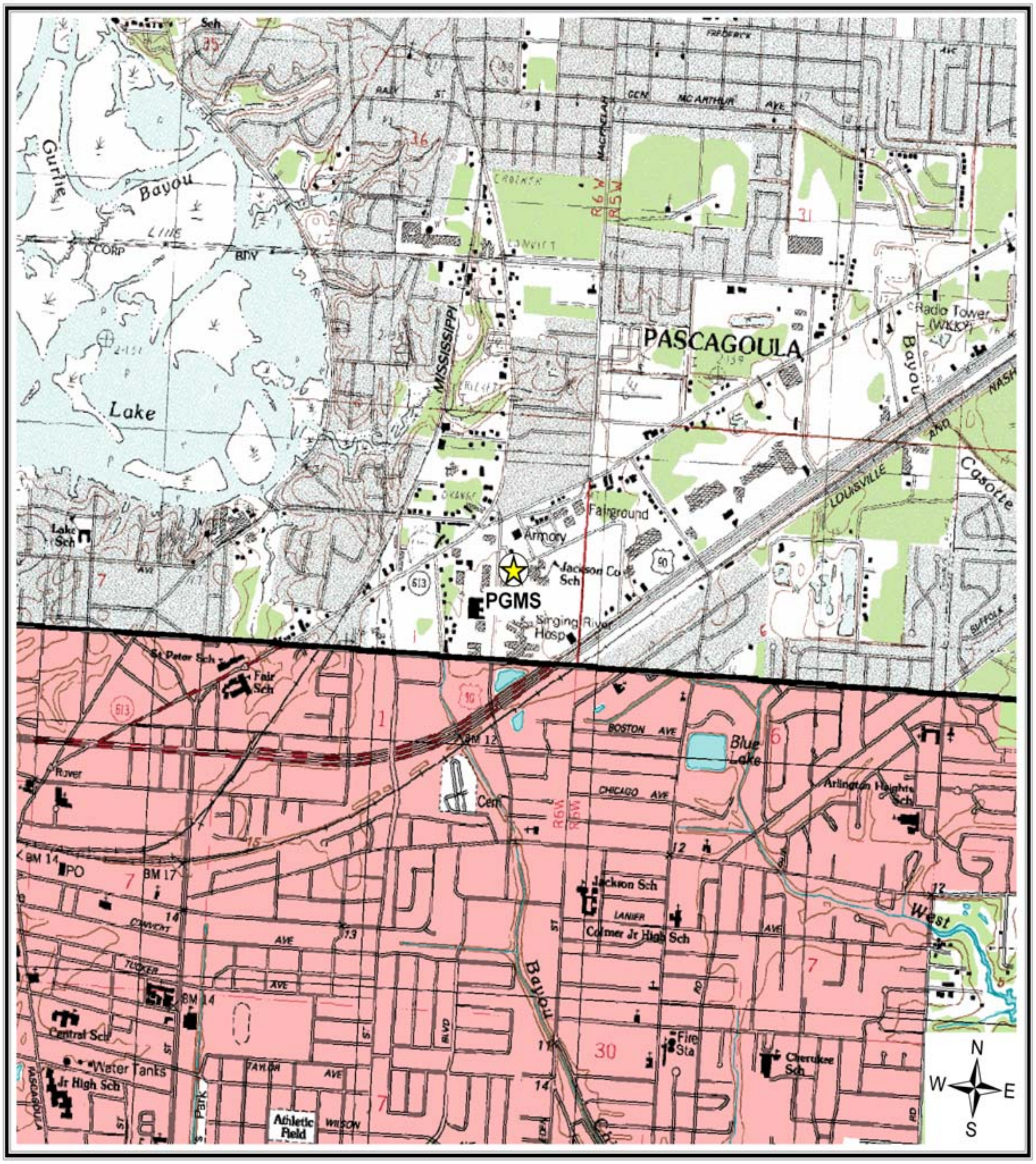
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 11-3. Jackson, Mississippi (JAMS) Monitoring Station



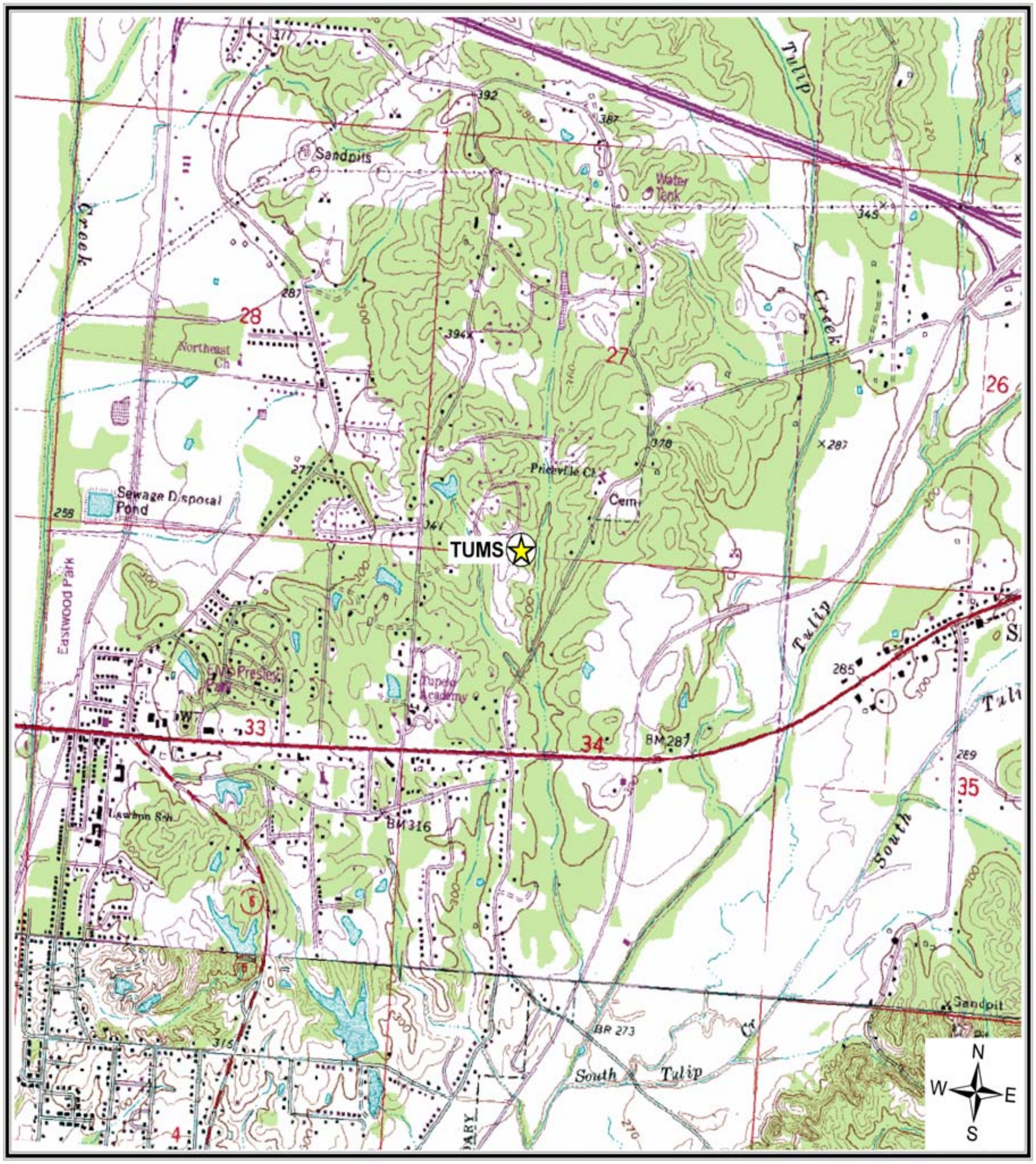
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 11-4. Pascagoula, Mississippi (PGMS) Monitoring Station



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

Figure 11-5. Tupelo, Mississippi (TUMS) Monitoring Station



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

Figure 11-6. Facilities Located Within 10 Miles of GPMS

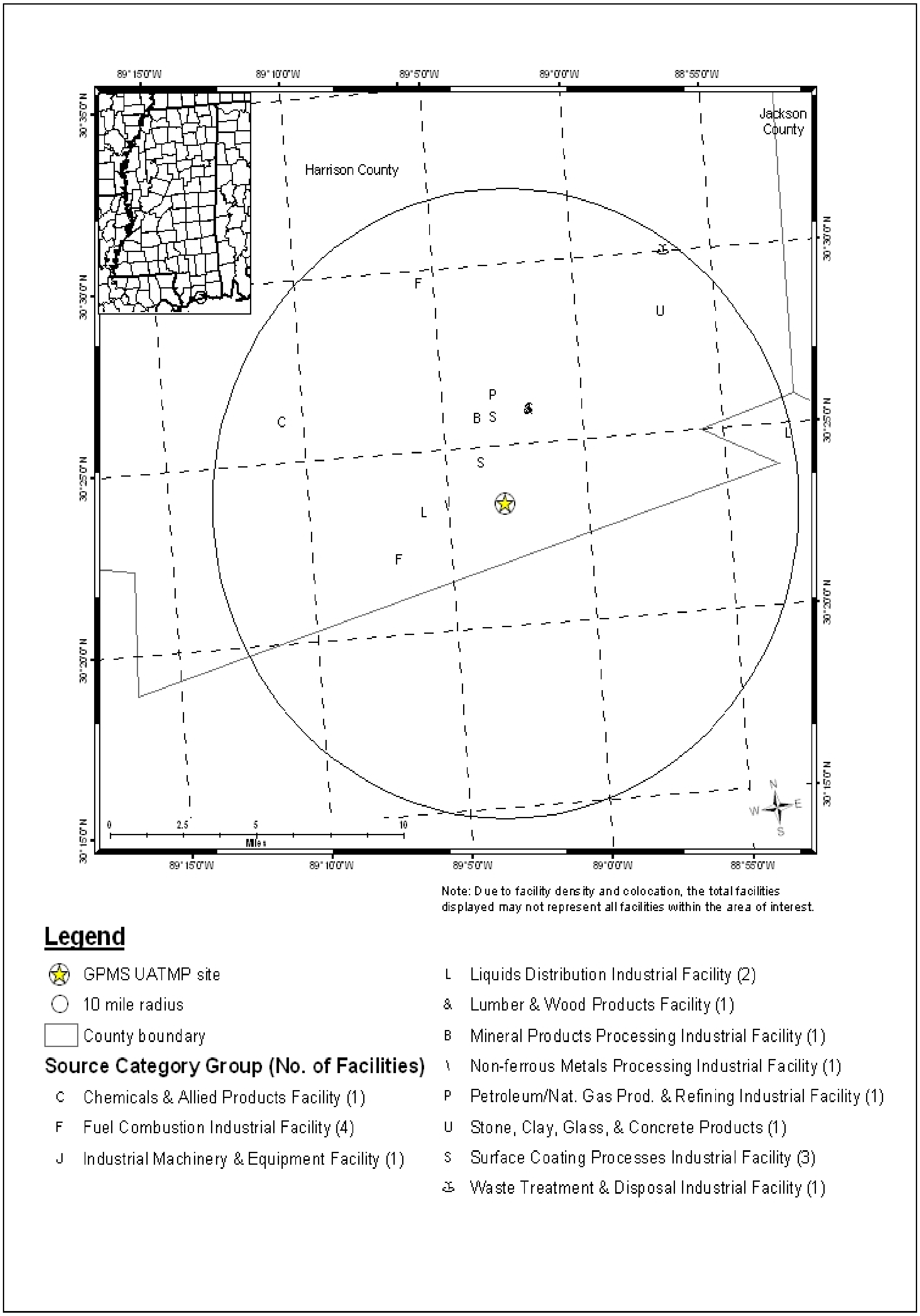
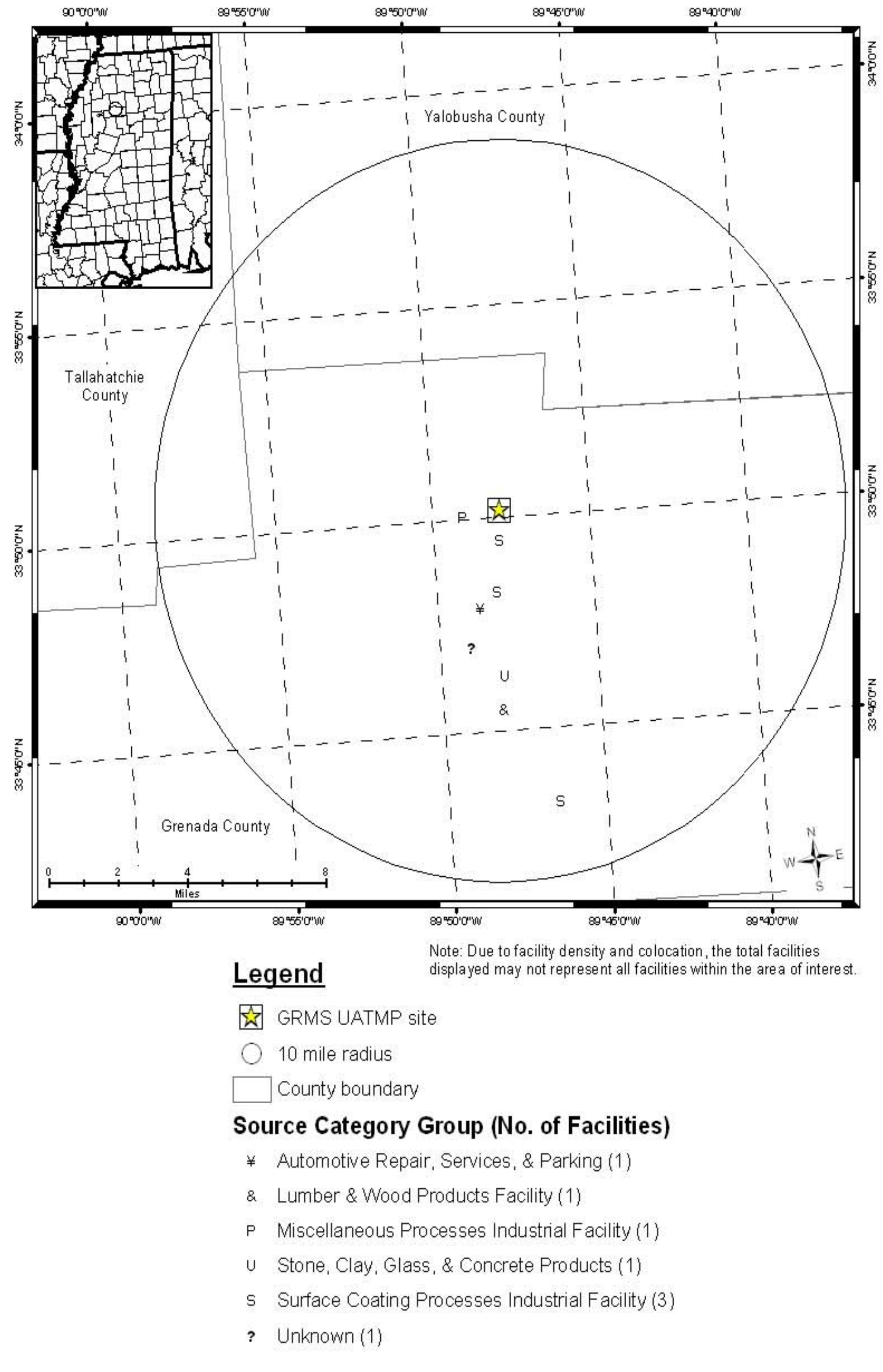
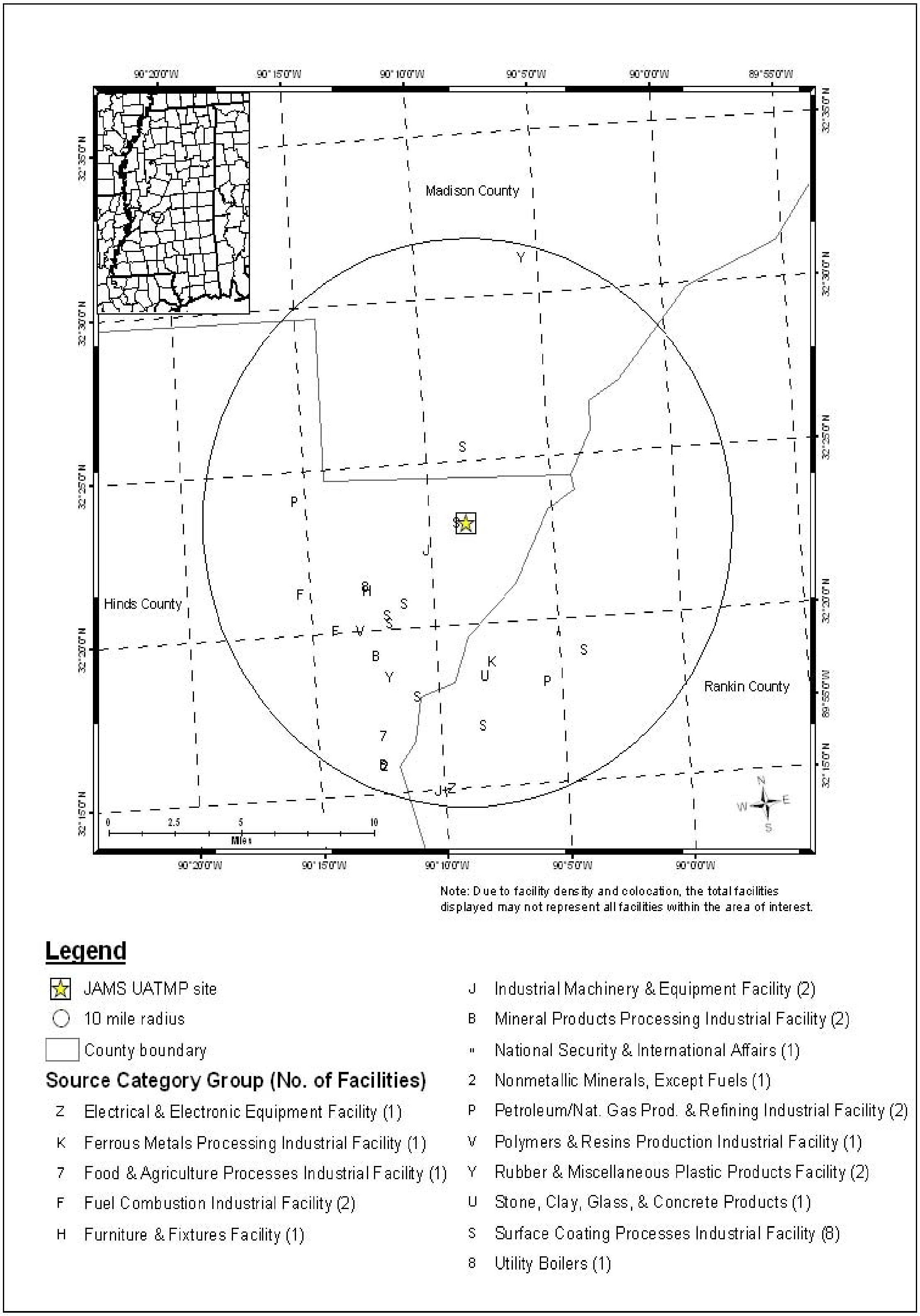


Figure 11-7. Facilities Located Within 10 Miles of GRMS



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

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



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

Figure 11-9. Facilities Located Within 10 Miles of PGMS

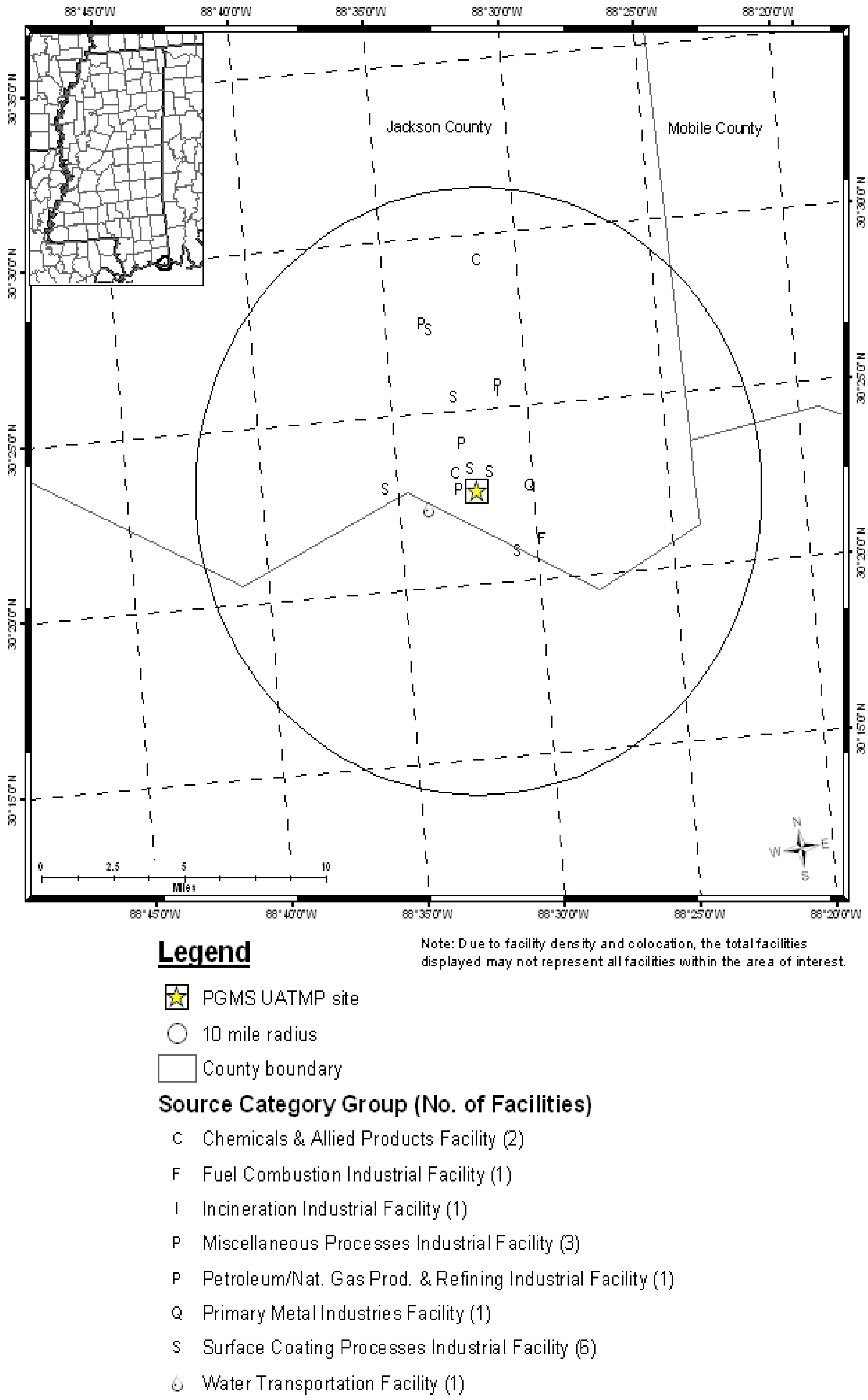
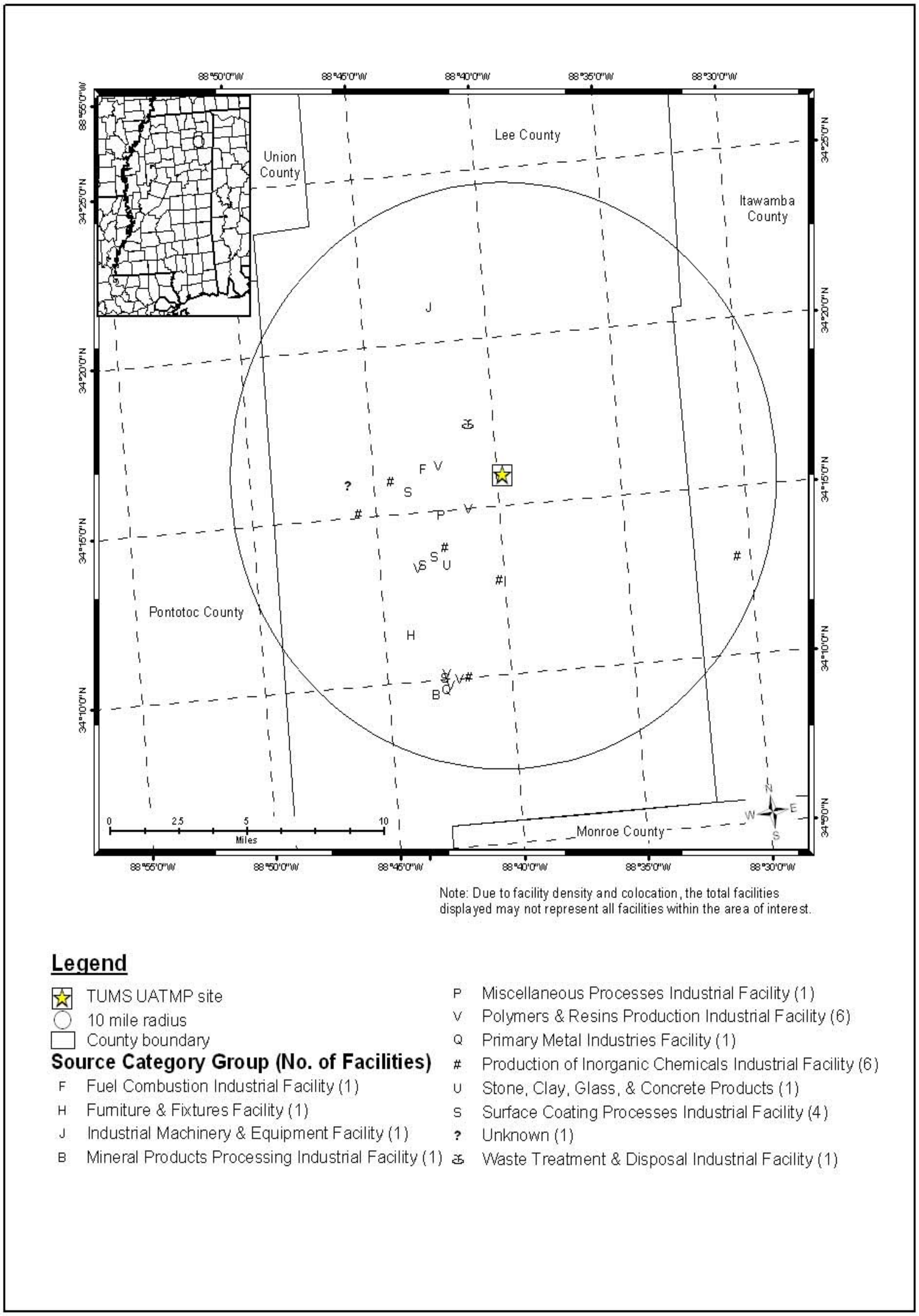


Figure 11-10. Facilities Located Within 10 Miles of TUMS



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

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

Site Name	Type	Average UATMP Concentration ($\mu g/m^3$)	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)
MS-GPMS	All 2003		76.03 (±1.26)	67.11 (±1.35)	59.69 (±1.53)	62.84 (±1.35)	79.54 (±1.13)	1017.07 (±0.52)	-0.48 (±0.29)	0.23 (±0.43)
	sample day	39.84 (±8.25)	75.07 (±4.80)	66.57 (±5.10)	59.96 (±5.69)	62.74 (±5.09)	81.00 (±3.42)	1017.13 (±1.87)	-0.56 (±1.24)	-0.49 (±1.48)
MS-GRMS	All 2003		72.96 (±1.63)	62.49 (±1.56)	54.41 (±1.69)	58.01 (±1.52)	77.61 (±1.09)	1017.24 (±0.58)	-0.13 (±0.27)	0.63 (±0.46)
	sample day	64.98 (±19.46)	78.83 (±5.65)	67.33 (±5.51)	59.83 (±5.55)	62.74 (±5.21)	79.16 (±2.49)	1016.69 (±1.53)	-0.47 (±1.00)	1.08 (±1.70)
MS-JAMS	All 2003		74.12 (±1.52)	63.05 (±1.49)	54.76 (±1.67)	58.45 (±1.47)	77.23 (±1.17)	1017.27 (±0.56)	-0.03 (±0.25)	0.38 (±0.39)
	sample day	51.20 (±7.14)	73.45 (±5.55)	62.24 (±5.53)	54.51 (±6.19)	58.02 (±5.45)	78.20 (±3.75)	1017.64 (±1.99)	-0.45 (±0.81)	0.57 (±1.27)
MS-PGMS	All 2003		76.63 (±1.22)	64.60 (±1.34)	58.49 (±1.56)	61.13 (±1.37)	82.80 (±1.00)	1017.51 (±0.52)	-0.65 (±0.20)	-0.35 (±0.34)
	sample day	32.09 (±6.54)	75.25 (±4.44)	64.29 (±4.49)	58.26 (±5.44)	60.96 (±4.72)	82.62 (±3.36)	1017.67 (±1.75)	-1.08 (±0.84)	-0.76 (±1.02)
MS-TUMS	All 2003		70.70 (±1.60)	60.58 (±1.55)	52.36 (±1.71)	56.16 (±1.52)	77.04 (±1.14)	1017.38 (±0.57)	0.11 (±0.24)	0.17 (±0.45)
	sample day	49.06 (±17.69)	69.35 (±6.00)	59.96 (±5.61)	51.62 (±6.10)	55.49 (±5.40)	76.25 (±3.43)	1017.89 (±1.84)	0.10 (±0.89)	-0.02 (±1.56)

Table 11-2a. Summary of the Toxic Cancer Compounds at the Gulfport, Mississippi Monitoring Site - GPMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	5.27E-05	63.52	63.52	0.775	5	52.7
Benzene	9.62E-06	11.60	75.12	1.234	30	9.62
Carbon Tetrachloride	7.71E-06	9.29	84.40	0.514	29	7.71
1,3-Butadiene	5.30E-06	6.39	90.79	0.177	10	5.30
Acetaldehyde	3.71E-06	4.47	95.26	1.685	30	3.71
p-Dichlorobenzene	2.28E-06	2.74	98.00	0.207	7	2.28
Tetrachloroethylene	1.23E-06	1.49	99.49	0.209	3	1.23
Trichloroethylene	2.15E-07	0.26	99.75	0.107	1	<1
Methylene Chloride (Dichloromethane)	1.98E-07	0.24	99.99	0.420	11	<1
Formaldehyde	9.60E-09	0.01	100.00	1.745	30	<1

Table 11-2b. Summary of the Toxic Cancer Compounds at the Grenada, Mississippi Monitoring Site - GRMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	5.66E-05	76.63	76.63	0.832	3	56.6
Carbon Tetrachloride	7.78E-06	10.53	87.16	0.518	18	7.78
Acetaldehyde	4.41E-06	5.97	93.12	2.004	22	4.41
Benzene	4.24E-06	5.74	98.86	0.544	21	4.24
Tetrachloroethylene	3.56E-07	0.48	99.35	0.060	1	<1
Trichloroethylene	3.22E-07	0.44	99.78	0.161	1	<1
Methylene Chloride (Dichloromethane)	1.43E-07	0.19	99.98	0.304	12	<1
Formaldehyde	1.78E-08	0.02	100.00	3.238	22	<1

Table 11-2c. Summary of the Toxic Cancer Compounds at the Jackson, Mississippi Monitoring Site - JAMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	6.99E-05	58.84	58.84	1.028	2	69.9
Benzene	1.43E-05	12.00	70.84	1.829	28	14.3
Carbon Tetrachloride	8.82E-06	7.42	78.26	0.588	24	8.82
1,3-Butadiene	7.87E-06	6.62	84.88	0.262	12	7.87
Acetaldehyde	7.20E-06	6.05	90.93	3.271	29	7.20
p-Dichlorobenzene	6.38E-06	5.37	96.30	0.580	13	6.38
Tetrachloroethylene	2.47E-06	2.08	98.38	0.419	8	2.47
1,2-Dichloroethane (Ethylene Dichloride)	1.59E-06	1.34	99.72	0.061	1	1.59
Methylene Chloride (Dichloromethane)	3.16E-07	0.27	99.99	0.672	13	<1
Formaldehyde	1.45E-08	0.01	100.00	2.630	29	<1

Table 11-2d. Summary of the Toxic Cancer Compounds at the Pascagoula, Mississippi Monitoring Site - PGMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	2.04E-05	36.38	36.38	0.300	2	20.4
Benzene	1.12E-05	19.89	56.27	1.430	28	11.2
1,3-Butadiene	8.15E-06	14.53	70.81	0.272	8	8.15
Carbon Tetrachloride	8.10E-06	14.44	85.25	0.540	26	8.10
Acetaldehyde	4.59E-06	8.19	93.44	2.087	31	4.59
Tetrachloroethylene	2.22E-06	3.96	97.39	0.376	5	2.22
p-Dichlorobenzene	1.34E-06	2.39	99.79	0.122	2	1.34
Methylene Chloride (Dichloromethane)	1.03E-07	0.18	99.97	0.219	10	<1
Formaldehyde	1.63E-08	0.03	100.00	2.959	31	<1

Table 11-2e. Summary of the Toxic Cancer Compounds at the Tupelo, Mississippi Monitoring Site - TUMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	2.07E-05	30.72	30.72	0.304	1	20.7
Tetrachloroethylene	1.80E-05	26.81	57.53	3.056	3	18.0
Carbon Tetrachloride	7.75E-06	11.52	69.06	0.517	27	7.75
Benzene	6.61E-06	9.83	78.89	0.848	30	6.61
1,3-Butadiene	4.68E-06	6.96	85.85	0.156	2	4.68
Acetaldehyde	3.98E-06	5.91	91.77	1.808	31	3.98
Methylene Chloride (Dichloromethane)	2.10E-06	3.12	94.88	4.462	18	2.10
Trichloroethylene	2.08E-06	3.09	97.97	1.039	3	2.08
Vinyl Chloride	1.35E-06	2.01	99.98	0.153	1	1.35
Formaldehyde	1.32E-08	0.02	100.00	2.393	31	<1

Table 11-3a. Summary of the Toxic Noncancer Compounds at the Gulfport, Mississippi Monitoring Site - GPMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acrylonitrile	3.88E-01	32.27	32.27	0.775	5	1
Acetonitrile	2.10E-01	17.53	49.81	12.629	23	1
Acetaldehyde	1.87E-01	15.59	65.40	1.685	30	0
Formaldehyde	1.78E-01	14.83	80.22	1.745	30	0
1,3-Butadiene	8.84E-02	7.36	87.58	0.177	10	0
Xylenes (*o*-, *m*-, *p*-)	6.20E-02	5.16	92.74	6.196	29	0
Benzene	4.11E-02	3.42	96.17	1.234	30	0
Chloromethane (Methyl Chloride)	1.66E-02	1.38	97.55	1.495	30	0
Carbon Tetrachloride	1.28E-02	1.07	98.62	0.514	29	0
Toluene	1.02E-02	0.85	99.47	4.065	30	0
Chloroform	2.74E-03	0.23	99.69	0.268	6	0
Ethylbenzene	9.48E-04	0.08	99.77	0.948	23	0
Tetrachloroethylene	7.74E-04	0.06	99.84	0.209	3	0
Methyl Ethyl Ketone (2-Butanone)	4.51E-04	0.04	99.88	2.257	20	0
Methylene Chloride (Dichloromethane)	4.20E-04	0.04	99.91	0.420	11	0
Styrene	2.95E-04	0.02	99.93	0.295	13	0
p-Dichlorobenzene	2.59E-04	0.02	99.96	0.207	7	0
Trichloroethylene	1.79E-04	0.01	99.97	0.107	1	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.78E-04	0.01	99.99	0.178	11	0
Methyl *tert*-Butyl Ether	9.09E-05	0.01	99.99	0.273	8	0
Methyl Isobutyl Ketone (Hexone)	5.38E-05	<0.0001	100.00	0.161	1	0
Chloroethane (Ethyl Chloride)	2.27E-05	<0.0001	100.00	0.227	2	0

Table 11-3b. Summary of the Toxic Noncancer Compounds at the Grenada, Mississippi Monitoring Site - GRMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acetonitrile	7.93E-01	41.50	41.50	47.581	18	6
Acrylonitrile	4.16E-01	21.78	63.28	0.832	3	0
Formaldehyde	3.30E-01	17.29	80.57	3.238	22	0
Acetaldehyde	2.23E-01	11.65	92.22	2.004	22	0
Xylenes (*o*-, *m*-, *p*-)	7.82E-02	4.09	96.31	7.821	21	0
Benzene	1.81E-02	0.95	97.26	0.544	21	0
Bromomethane (Methyl Bromide)	1.59E-02	0.83	98.10	0.080	2	0
Chloromethane (Methyl Chloride)	1.47E-02	0.77	98.86	1.319	21	0
Carbon Tetrachloride	1.30E-02	0.68	99.54	0.518	18	0
Toluene	4.95E-03	0.26	99.80	1.978	21	0
Chloroform	9.61E-04	0.05	99.85	0.094	1	0
Ethylbenzene	9.56E-04	0.05	99.90	0.956	18	0
Methyl Ethyl Ketone (2-Butanone)	6.94E-04	0.04	99.94	3.468	13	0
Methylene Chloride (Dichloromethane)	3.04E-04	0.02	99.95	0.304	12	0
Trichloroethylene	2.69E-04	0.01	99.97	0.161	1	0
Tetrachloroethylene	2.23E-04	0.01	99.98	0.060	1	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.68E-04	0.01	99.99	0.168	7	0
Styrene	1.68E-04	0.01	100.00	0.168	8	0
Methyl Isobutyl Ketone (Hexone)	8.19E-05	<0.0001	100.00	0.246	1	0

Table 11-3c. Summary of the Toxic Noncancer Compounds at the Jackson, Mississippi Monitoring Site - JAMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acrylonitrile	5.14E-01	29.30	29.30	1.028	2	0
Acetaldehyde	3.63E-01	20.71	50.01	3.271	29	0
Acetonitrile	2.81E-01	16.02	66.04	16.871	27	1
Formaldehyde	2.68E-01	15.30	81.33	2.630	29	0
1,3-Butadiene	1.31E-01	7.47	88.81	0.262	12	0
Benzene	6.10E-02	3.47	92.28	1.829	28	0
Xylenes (*o*-, *m*-, *p*-)	5.44E-02	3.10	95.38	5.445	28	0
Chloroprene	3.10E-02	1.77	97.15	0.217	1	0
Chloromethane (Methyl Chloride)	1.51E-02	0.86	98.01	1.357	28	0
Carbon Tetrachloride	1.47E-02	0.84	98.85	0.588	24	0
Toluene	8.77E-03	0.50	99.35	3.506	28	0
1,2,4-Trichlorobenzene	3.71E-03	0.21	99.56	0.742	1	0
Chloroform	2.71E-03	0.15	99.71	0.266	6	0
Tetrachloroethylene	1.55E-03	0.09	99.80	0.419	8	0
Ethylbenzene	8.36E-04	0.05	99.85	0.836	25	0
p-Dichlorobenzene	7.25E-04	0.04	99.89	0.580	13	0
Methylene Chloride (Dichloromethane)	6.72E-04	0.04	99.93	0.672	13	0
Methyl Ethyl Ketone (2-Butanone)	5.00E-04	0.03	99.96	2.501	9	0
Methyl *tert*-Butyl Ether	3.05E-04	0.02	99.97	0.916	12	0
Styrene	1.70E-04	0.01	99.98	0.170	9	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.63E-04	0.01	99.99	0.163	10	0
Methyl Isobutyl Ketone (Hexone)	1.06E-04	0.01	100.00	0.317	1	0
1,2-Dichloroethane (Ethylene Dichloride)	2.55E-05	<0.0001	100.00	0.061	1	0

Table 11-3d. Summary of the Toxic Noncancer Compounds at the Pascagoula, Mississippi Monitoring Site - PGMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	3.02E-01	28.82	28.82	2.959	31	2
Acetaldehyde	2.32E-01	22.13	50.95	2.087	31	1
Acrylonitrile	1.50E-01	14.32	65.27	0.300	2	0
1,3-Butadiene	1.36E-01	12.97	78.23	0.272	8	0
Acetonitrile	8.52E-02	8.13	86.37	5.112	14	0
Xylenes (*o*-, *m*-, *p*-)	4.94E-02	4.72	91.09	4.943	28	0
Benzene	4.77E-02	4.55	95.64	1.430	28	0
Chloromethane (Methyl Chloride)	1.59E-02	1.52	97.16	1.433	28	0
Carbon Tetrachloride	1.35E-02	1.29	98.44	0.540	26	0
Toluene	1.00E-02	0.96	99.40	4.009	28	0
Tetrachloroethylene	1.39E-03	0.13	99.53	0.376	5	0
Chloroform	1.14E-03	0.11	99.64	0.112	2	0
Methyl Ethyl Ketone (2-Butanone)	9.74E-04	0.09	99.73	4.871	17	0
Methyl Methacrylate	8.19E-04	0.08	99.81	0.573	1	0
Ethylbenzene	7.51E-04	0.07	99.88	0.751	24	0
1,1,1-Trichloroethane (Methyl Chloroform)	2.95E-04	0.03	99.91	0.295	10	0
Methyl Isobutyl Ketone (Hexone)	2.32E-04	0.02	99.93	0.697	3	0
Methylene Chloride (Dichloromethane)	2.19E-04	0.02	99.96	0.219	10	0
Styrene	2.03E-04	0.02	99.98	0.203	14	0
p-Dichlorobenzene	1.53E-04	0.01	99.99	0.122	2	0
Methyl *tert*-Butyl Ether	1.08E-04	0.01	100.00	0.324	1	0

Table 11-3e. Summary of the Toxic Noncancer Compounds at the Tupelo, Mississippi Monitoring Site - TUMS

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetonitrile	4.45E-01	35.76	35.76	26.702	24	4
Formaldehyde	2.44E-01	19.62	55.38	2.393	31	0
Acetaldehyde	2.01E-01	16.14	71.52	1.808	31	0
Acrylonitrile	1.52E-01	12.21	83.73	0.304	1	0
1,3-Butadiene	7.80E-02	6.27	90.00	0.156	2	0
Xylenes (*o*-, *m*-, *p*-)	3.15E-02	2.53	92.54	3.154	26	0
Benzene	2.83E-02	2.27	94.81	0.848	30	0
Chloromethane (Methyl Chloride)	1.43E-02	1.15	95.96	1.288	30	0
Carbon Tetrachloride	1.29E-02	1.04	96.99	0.517	27	0
Tetrachloroethylene	1.13E-02	0.91	97.90	3.056	3	0
Bromomethane (Methyl Bromide)	7.77E-03	0.62	98.53	0.039	1	0
Toluene	7.57E-03	0.61	99.14	3.027	30	0
Methylene Chloride (Dichloromethane)	4.46E-03	0.36	99.50	4.462	18	0
Trichloroethylene	1.73E-03	0.14	99.63	1.039	3	0
Vinyl Chloride	1.53E-03	0.12	99.76	0.153	1	0
Chloroform	1.19E-03	0.10	99.85	0.117	4	0
Methyl Ethyl Ketone (2-Butanone)	6.25E-04	0.05	99.90	3.125	16	0
Ethylbenzene	4.97E-04	0.04	99.94	0.497	22	0
Styrene	2.74E-04	0.02	99.97	0.274	6	0
Methyl *tert*-Butyl Ether	2.35E-04	0.02	99.98	0.704	10	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.94E-04	0.02	100.00	0.194	10	0

Table 11-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Gulfport, Mississippi Site (GPMS)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.62	-0.56	-0.59	-0.57	-0.73	0.25	0.62	-0.70
Acetaldehyde	-0.15	-0.19	-0.24	-0.23	-0.29	0.20	0.27	-0.53
Acetonitrile	-0.45	-0.48	-0.44	-0.46	0.11	0.29	-0.21	-0.09
Acrylonitrile	0.22	0.23	0.29	0.27	0.36	-0.46	0.12	0.10
Benzene	-0.33	-0.38	-0.36	-0.37	-0.08	0.28	-0.07	-0.08
Carbon Tetrachloride	0.30	0.28	0.30	0.29	0.22	-0.10	-0.10	0.20
Formaldehyde	-0.27	-0.26	-0.23	-0.25	0.00	0.06	0.15	-0.19
Xylenes (o-, m-, p-)	0.18	0.13	0.14	0.14	0.09	0.04	0.05	0.01

Table 11-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Grenada, Mississippi Site (GRMS)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	0.66	0.68	0.61	0.64	-0.28	-0.15	-0.57	0.14
Acetonitrile	0.11	0.09	0.13	0.12	0.28	-0.01	-0.40	0.23
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.19	-0.16	-0.19	-0.18	-0.19	-0.04	0.09	0.13
Carbon Tetrachloride	0.56	0.62	0.60	0.61	0.16	-0.53	-0.21	0.05
Formaldehyde	0.70	0.76	0.70	0.73	-0.19	-0.34	-0.54	-0.13
Xylenes (*o*-, *m*-, *p*-)	0.43	0.44	0.41	0.42	-0.04	-0.56	-0.13	-0.14

Table 11-4c. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Jackson, Mississippi Site (JAMS)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.59	-0.56	-0.50	-0.54	-0.07	0.40	0.23	-0.53
Acetaldehyde	0.31	0.32	0.34	0.33	0.27	-0.10	0.04	-0.29
Acetonitrile	-0.03	-0.07	-0.03	-0.06	0.12	0.00	-0.01	0.35
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.50	-0.53	-0.49	-0.51	-0.14	0.51	-0.03	-0.26
Carbon Tetrachloride	0.20	0.25	0.19	0.22	-0.14	-0.13	-0.20	0.04
Formaldehyde	0.22	0.19	0.13	0.16	-0.16	-0.02	-0.19	-0.14
p-Dichlorobenzene	0.13	0.12	0.07	0.09	-0.18	0.04	-0.23	-0.18
Xylenes (*o*-, *m*-, *p*-)	-0.06	-0.06	-0.07	-0.07	-0.04	0.34	-0.03	-0.40

Table 11-4d. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Pascagoula, Mississippi Site (PGMS)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.69	-0.80	-0.82	-0.81	-0.82	0.81	-0.09	-0.19
Acetaldehyde	-0.15	-0.23	-0.22	-0.23	-0.13	0.07	-0.16	0.31
Acetonitrile	0.06	0.07	0.07	0.07	0.04	-0.26	0.05	0.34
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.52	-0.64	-0.61	-0.63	-0.36	0.62	0.12	-0.22
Carbon Tetrachloride	0.55	0.49	0.44	0.46	0.14	-0.15	-0.03	0.43
Formaldehyde	-0.25	-0.33	-0.29	-0.32	-0.09	0.10	-0.16	0.25
Tetrachloroethylene	-0.96	-0.96	-0.97	-0.96	-0.86	0.94	0.22	-0.88
Xylenes (*o*-, *m*-, *p*-)	-0.37	-0.48	-0.46	-0.47	-0.27	0.52	0.05	-0.13

Table 11-4e. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Tupelo, Mississippi Site (TUMS)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	NA	NA	NA	NA	NA	NA	NA	NA
Acetaldehyde	0.31	0.27	0.20	0.23	-0.19	0.14	-0.48	0.04
Acetonitrile	-0.54	-0.56	-0.55	-0.56	-0.30	0.44	-0.06	0.18
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.08	-0.09	-0.12	-0.11	-0.13	0.18	-0.39	0.12
Carbon Tetrachloride	0.07	0.07	0.05	0.07	-0.02	0.18	-0.18	-0.37
Formaldehyde	0.53	0.52	0.44	0.49	-0.06	-0.16	-0.37	-0.06
Chloromethane (Methyl Chloride)	0.59	0.62	0.62	0.62	0.33	-0.58	-0.26	0.34
Methylene Chloride (Dichloromethane)	0.24	0.23	0.23	0.23	0.13	-0.01	0.19	0.15
Tetrachloroethylene	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes (*o*-, *m*-, *p*-)	-0.02	0.00	-0.01	-0.01	-0.04	0.05	0.04	-0.17

Table 11-5. Motor Vehicle Information vs. Daily Concentration for Mississippi Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu g/m^3$)
GPMS	190,936	155,303	0.82	172,557	141,497	17,000	39.84 (±8.25)
GRMS	22,915	15,714	0.69	19,933	13,754	1,100	64.98 (±19.46)
JAMS	249,579	176,453	0.71	264,058	186,690	12,500	51.20 (±7.14)
PGMS	133,259	112,820	0.85	58,083	49,174	8,600	32.09 (±6.54)
TUMS	77,220	65,844	0.85	69,738	59,464	4,900	49.06 (±17.69)

12.0 Sites in Missouri

This section focuses on 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 12-1 through 12-3 are topographical maps showing the monitoring stations in their urban locations. Figure 12-4 and 12-5 are maps identifying facilities within ten miles of the sites that reported to the 1999 NEI. Many sources are located near the St. Louis sites, most of which are fuel combustion, surface coating, and miscellaneous industries, while BTMO has very few nearby sources. Hourly meteorological data were retrieved for all of 2003 at a weather station near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The weather station is Cahokia-St. Louis (WBAN 03960).

Table 12-1 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), 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. 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 12-1. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

12.1 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. Tables 12-2a-c summarize the cancer weighting scores, and Tables 12-3a-c summarize 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 and hexavalent chromium.

As can be shown in Tables 12-2a through 12-2c, three of the four 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, while the S4MO site has six additional prevalent compounds: acrylonitrile, arsenic and compounds, cadmium and compounds, carbon tetrachloride, trichloroethylene, and tetrachloroethylene. A similar pattern is exhibited for the noncancer compounds summarized in Tables 12-3a-c. At BTMO and SLMO, only four compounds were detected that were not on the nationwide list, while at S4MO, twenty-two additional compounds were detected that are not included in the list of nationwide prevalent compounds. Only formaldehyde, acetaldehyde, 1,3-butadiene and benzene are prevalent across all three sites.

Toxic compounds not detected at the Missouri sites were: 1,2-dichloroethane; 1,3-dichloropropene; 1,1,2-trichloroethane; vinyl chloride; bromoform; chloroprene; 1,1-dichloroethene; methyl methacrylate; 1,2,4-trichlorobenzene; chloroethane.

12.2 Toxicity Analysis

Benzene, acetaldehyde, and 1,3-butadiene were the only prevalent cancer compounds at both BTMO and SLMO, while six additional compounds were prevalent at S4MO. The number of detects was relatively high at SLMO, and the four cancer compounds detected all had similar numbers of detects. However, acetaldehyde contributed to over 40% of the average cancer toxicity. With the exception of 1,3-butadiene, the compounds detected at BTMO also had a relatively high number of detects. However, benzene contributed to over 42% of the average cancer toxicity at BTMO. Benzene was detected in 122 samples at S4MO, the greatest of all the Missouri UATMP sites. Despite this fact, benzene contributed to less than 10% of the average cancer toxicity, while acrylonitrile, only detected three times, contributed to nearly 48% of the average cancer toxicity at S4MO.

Formaldehyde, acetaldehyde, 1,3-butadiene, and benzene were the only noncancer compounds to be considered prevalent across all three sites, and were the top four by toxicity weighting at two of the three sites. Six additional compounds were considered prevalent at S4MO. Only two of the prevalent compounds were detected fewer than 30 times during sampling at any of the Missouri sites, and only eight non-prevalent compounds were detected fewer than 30 times at S4MO.

The acrylonitrile cancer risk at S4MO was the highest among the three sites at 44 in a million, while at SLMO, the acetaldehyde cancer risk was 10.9 in a million. Cancer risk at BTMO was not high. For the compounds which may lead to adverse noncancer health effects, the average acetaldehyde toxicity at SLMO was 0.549 (over 1 indicates a significant chance of a noncancer health effect). Of the nineteen adverse health concentrations measured in the Missouri sites, twelve were for formaldehyde.

12.3 Meteorological and Concentration Averages at the Missouri Sites

Carbonyl compounds and SNMOC were measured at all three Missouri sites, and VOC and metals and 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 12-1. Table 12-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

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 232.88 (± 25.80) ppbC, of which nearly 53% could be identified through speciation. Of the speciated compounds, toluene measured the highest concentration at the SLMO site (16.44 ppbC). The average total NMOC value for S4MO was 245.05 (± 189.39) ppbC, of which nearly 60% could be identified through speciation. Of the speciated compounds, toluene measured the highest concentration at the S4MO site (20.31 ppbC). The average total NMOC value for BTMO was 136.15 (± 41.24) ppbC, of which nearly

50% could be identified through speciation. Of the speciated compounds at BTMO, toluene measured the highest concentration (56.93 ppbC). This information is given in Table 12-5.

Tables 12-4a-c are the summaries 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. At BTMO, acetaldehyde had moderately strong positive correlations with temperature (maximum and average) and moisture (dewpoint and wet bulb temperature) variables, formaldehyde had very strong positive correlations with these variables, and benzene had strong negative correlations with these variables. Correlations with 1,3-butadiene could not be computed due to the low number of detects. At S4MO, several compounds had strong correlations, although some correlated negatively while others correlated positively. Both *p*-dichlorobenzene and tetrachloroethylene strongly or moderately strongly correlated with all of the meteorological parameters. As indicated in Table 12-3c, nearly all of the correlations at SLMO were weak or were on the weaker end of being moderately strong.

12.4 Spatial Analysis

County-level car registration was not available for either St. Francois or St. Louis Counties. Thus, state-level car 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 summarized in Table 12-5. Also included in Table 12-5 is the population within 10 miles of each site and 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. Using these parameters, a county-specific car registration ratio was computed. An estimation of 10 mile car registration was computed using the 10 mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the sites listed in the Table 12-5. The St. Louis sites had higher traffic volume and vehicle ownership that BTMO, and S4MO had the highest traffic volume and vehicle ownership.

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 3-1 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 ratios are somewhat lower than those of the roadside study.

12.5 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 12-6 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 two highest concentrations occurring on April 27 and October 18, 2003. On April 27, the stationary source HAP and BTEX concentrations were higher than other sampling days; on October 18, the mobile source HAP contributions (BTEX and non-BTEX) were much higher than other sampling days. With the exception of a sampling day on May 9, 2003, the non-HAP VOC concentrations were typically low or nonexistent. The sampling at S4MO ran from January 3 - December 29. Total VOC concentrations appear to be lower in the winter months compared to the summer months. 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 (18.96 μg/m^3 vs.12.01 μg/m^3, respectively), suggesting that the RFG requirements may not be effective.

12.6 NATTS Site Analysis

One of the St. Louis sites, SLMO, is an EPA-designated NATTS site. A description of the NATTS program is given in Section 3.6. For SLMO, each of the following analyses was conducted: a back trajectory analysis, a regulation analysis, and an emission tracer analysis. Details on each type of analysis are also provided in Section 3.6.

12.6.1 Composite Back Trajectory Analysis

Figure 12-7 is the composite back trajectory map for the SLMO site. 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 12-7, the back trajectories originated from an array of different directions. The 24-hour airshed domain is large, as the furthest away a back trajectory originated was southeast Saskatchewan, Canada. As each circle around the site represents 100 miles, 52% of the trajectories originated within 300 miles, and 66% within 400 miles from the SLMO site.

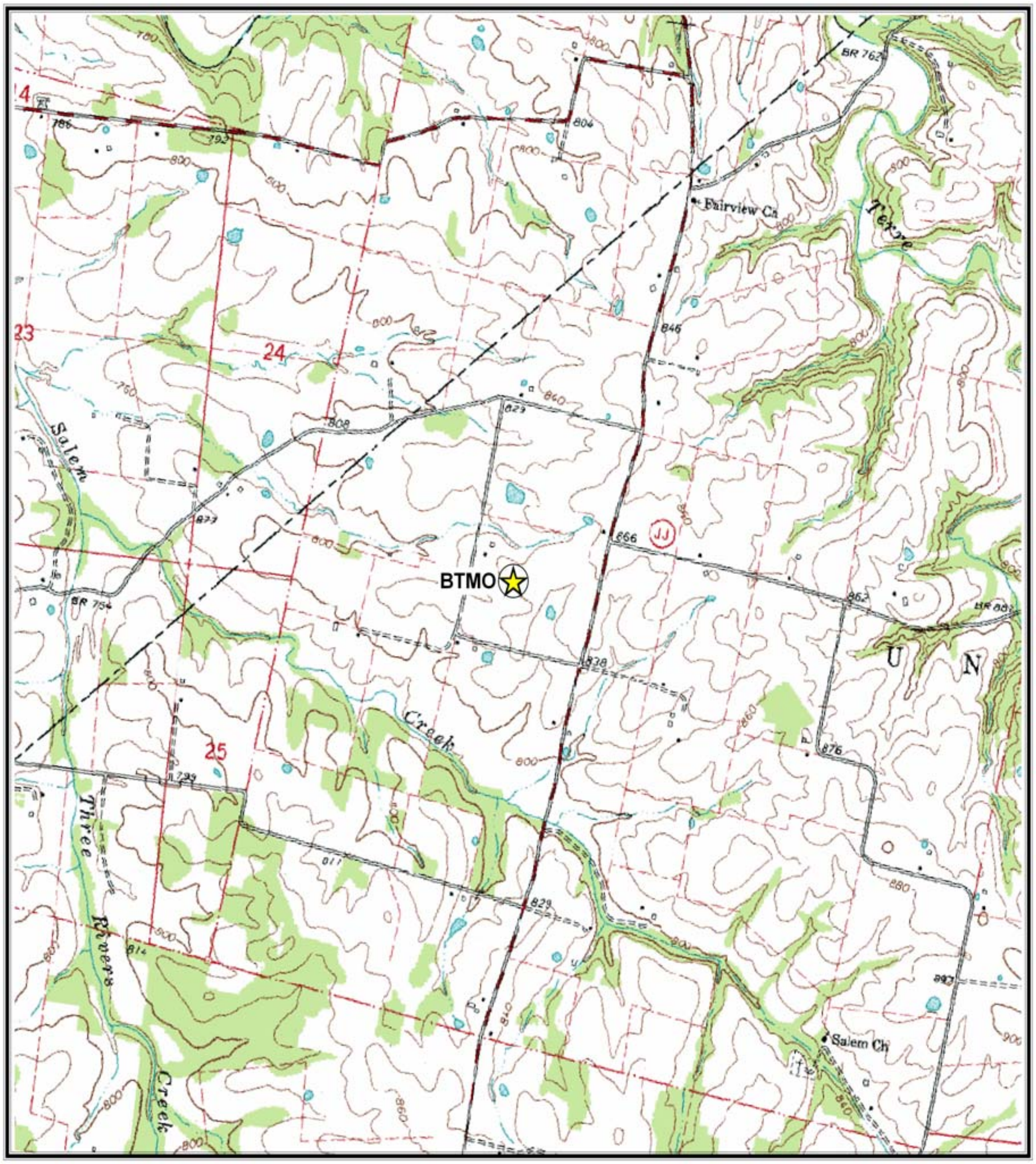
12.6.2 Regulation Analysis

Table 3-10 summarizes the number of facilities that account for approximately 90% of the total UATMP pollutant emissions in the 10-mile area around the monitoring station. Sixteen of the 38 facilities listed near SLMO in Table 3-11 are potentially subject to future regulations. Table 12-7 identifies the regulations that are potentially applicable. Based on this analysis, the regulations shown are expected to achieve reductions in ambient concentrations of the following UATMP pollutants: acetaldehyde, benzene, ethylbenzene, formaldehyde, lead and compounds, manganese and compounds, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, and toluene. Reductions are projected for acetaldehyde (0.6%), benzene (4%), ethylbenzene (11%), formaldehyde (9%), lead and compounds (10%), manganese and compounds (13%), methyl ethyl ketone (27%), methyl isobutyl ketone (31%), methylene chloride (23%), and toluene (32%) as the regulations are implemented (the latest compliance date is 2007). The emission reductions are primarily attributed to regulation of surface coating operations, organic chemical production, integrated iron and steel manufacturing, flexible polyurethane foam manufacturing, and reciprocating internal combustion engines.

12.6.3 Emission Tracer Analysis

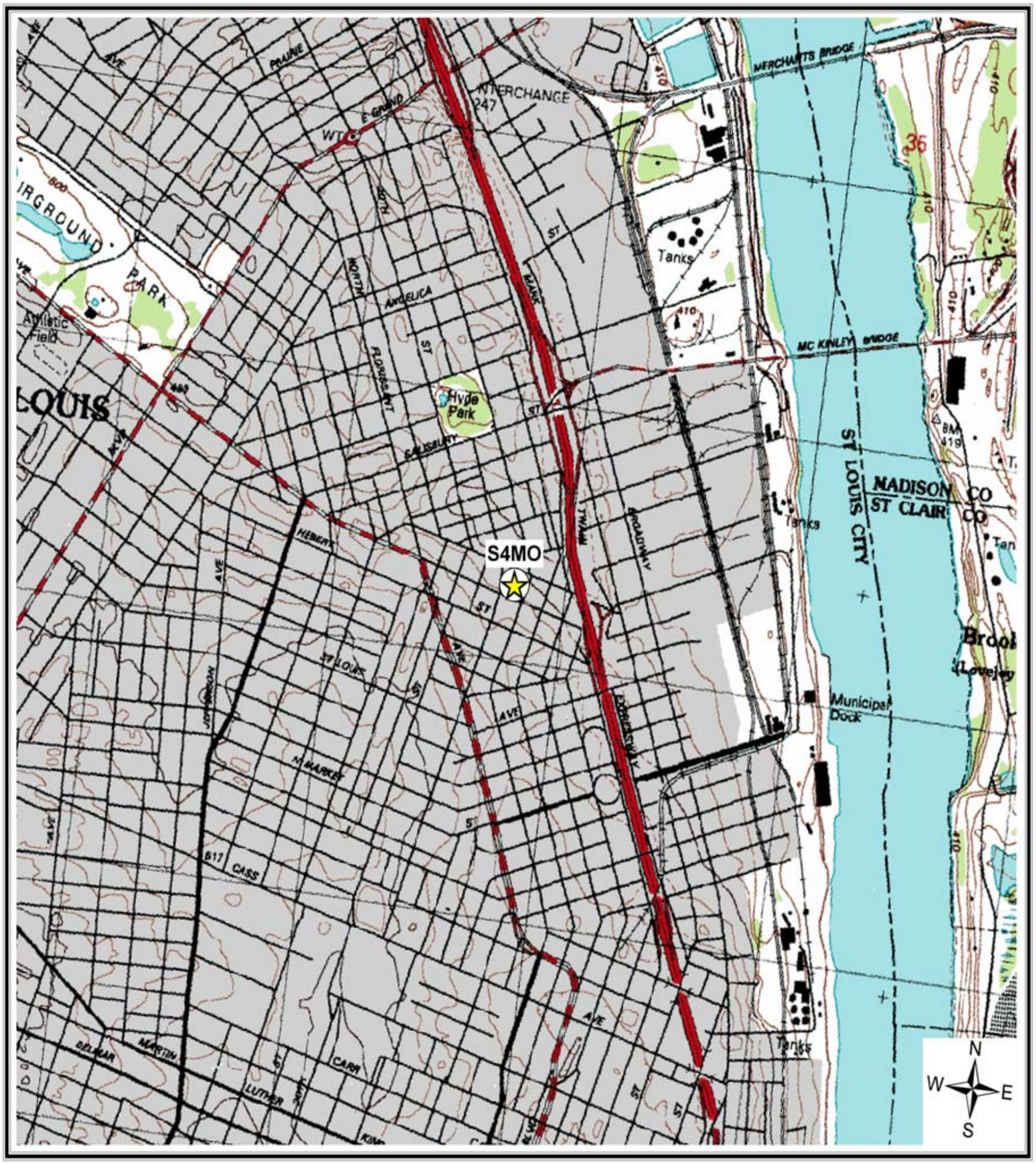
The highest concentrations of acetaldehyde and formaldehyde occurred on April 9, 2003. Figures 12-8 and 12-9 are the pollution roses for all acetaldehyde and formaldehyde samples at SLMO. The highest exceedance values point to possible acetaldehyde and formaldehyde emission sources north of the monitor. Figures 12-10 and 12-11 are maps of acetaldehyde and formaldehyde stationary emission sources north of the SLMO monitor. According to the 1999 NEI, acetaldehyde sources north of the SLMO monitor include: Lewis & Clark Sawmill, ConAgra, Inc., and Lewis & Clark Community College. Formaldehyde sources include the above three, as well as P.D. George Company, Owens-Brockway Glass Container, Elias-Smith Funeral Home and Godfrey Crematory, and the City of Alton Department of Public Works. Figure 12-12 is the back trajectory map for this date, which shows the air originating north of the monitor. An analysis of the hourly meteorological data show that winds were primarily out of the north for most of the day, as well. It is likely that air sampled at SLMO on this date passed over the above listed facilities earlier in the day.

Figure 12-1. Bonne Terre, Missouri (BTMO) Monitoring Station



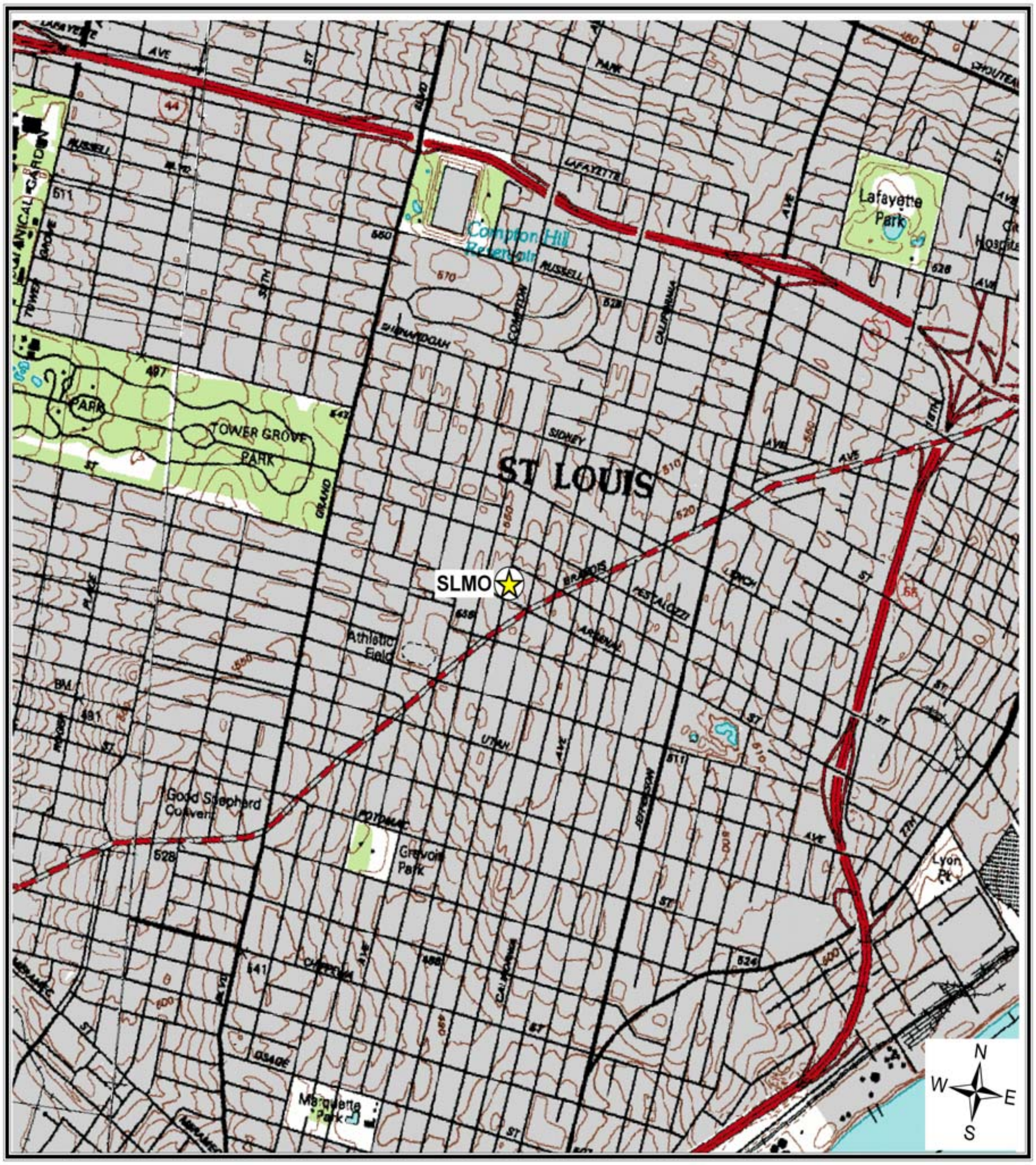
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 12-2. St. Louis, Missouri Site 1 (S4MO) Monitoring Station



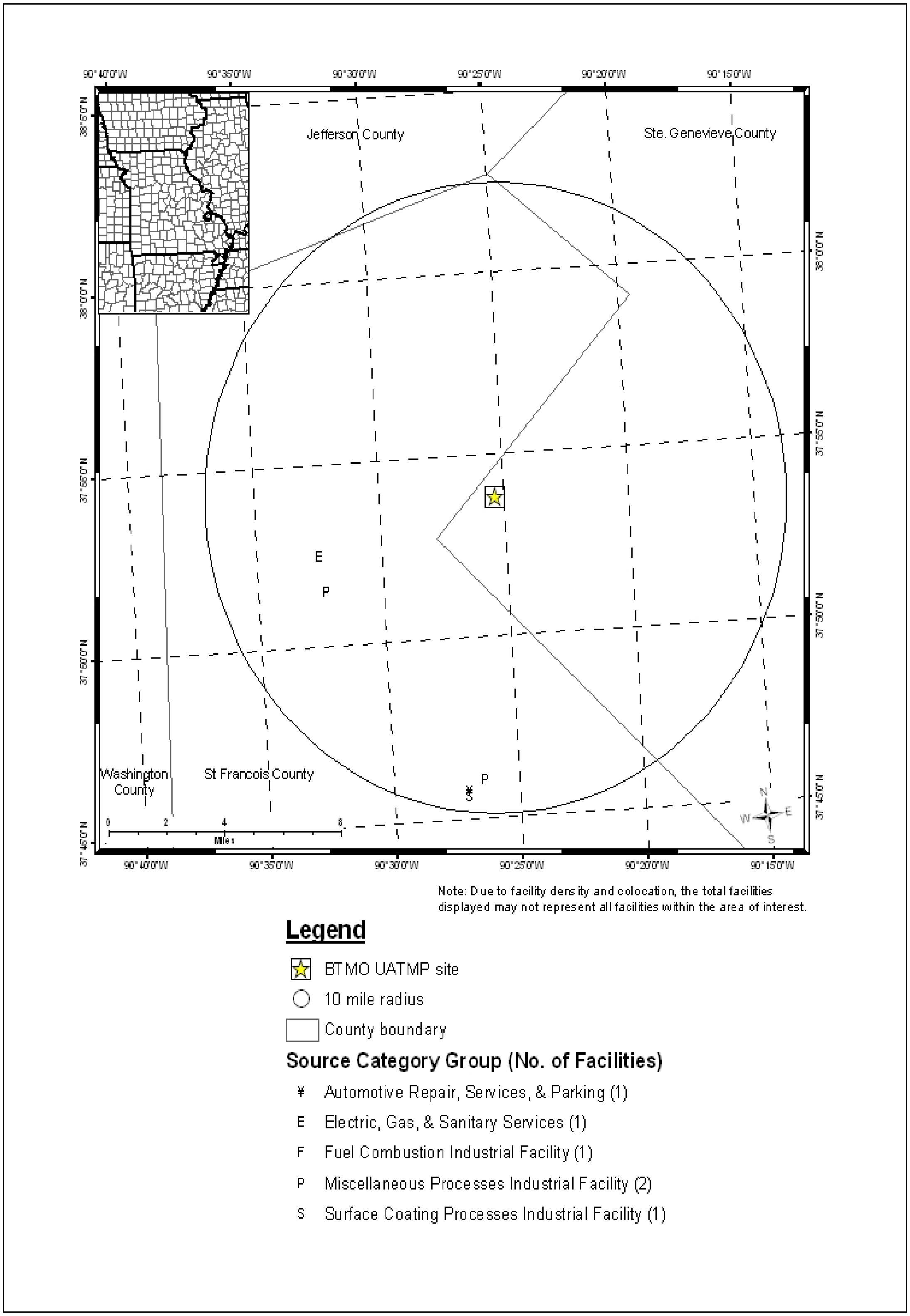
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 12-3. St. Louis, Missouri Site 2 (SLMO) Monitoring Station



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

Figure 12-4. Facilities Located Within 10 Miles of BTMO



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

Figure 12-5. Facilities Located Within 10 Miles of S4MO and SLMO

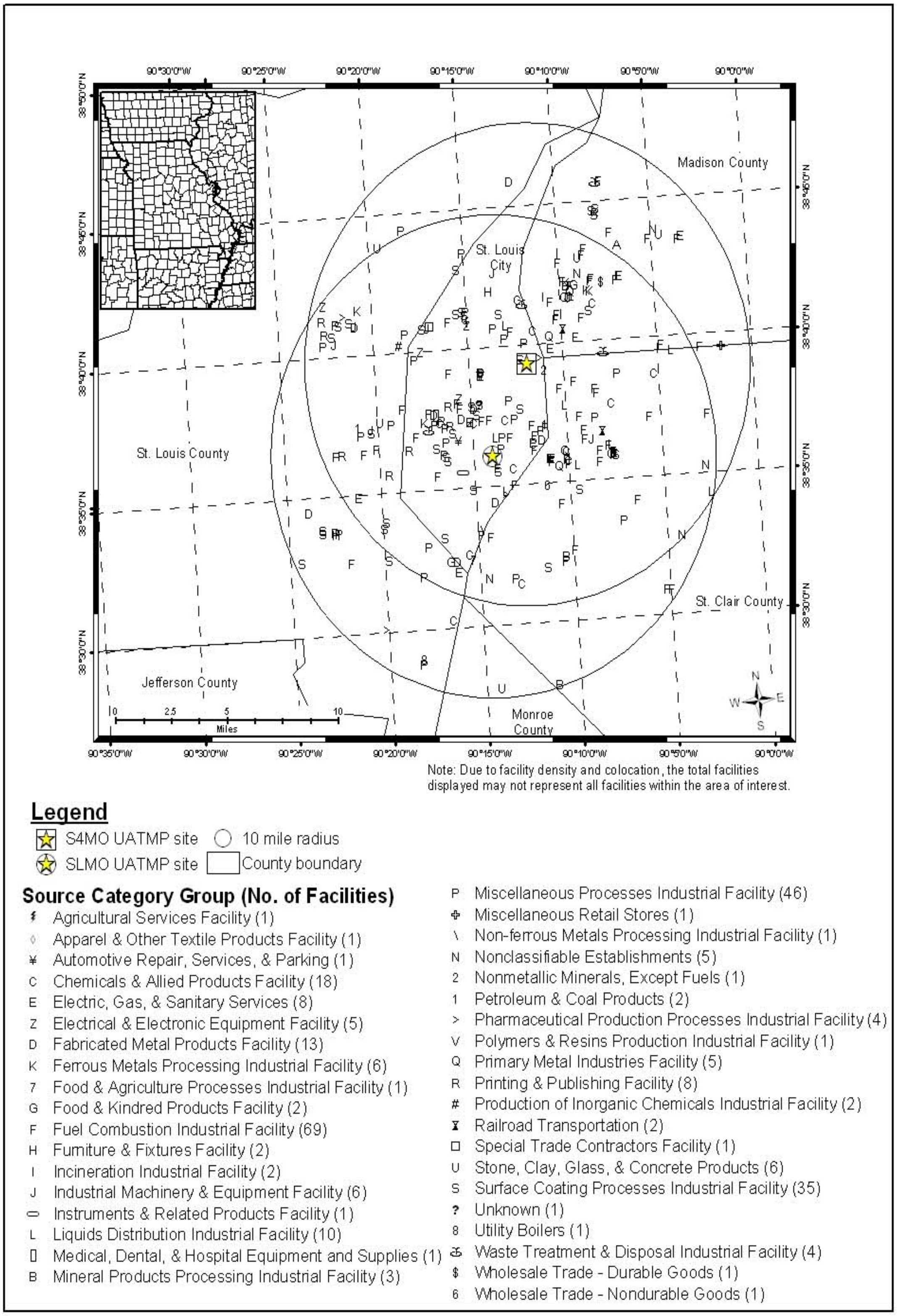


Figure 12-6. 2003 Total VOC Profile at S4MO

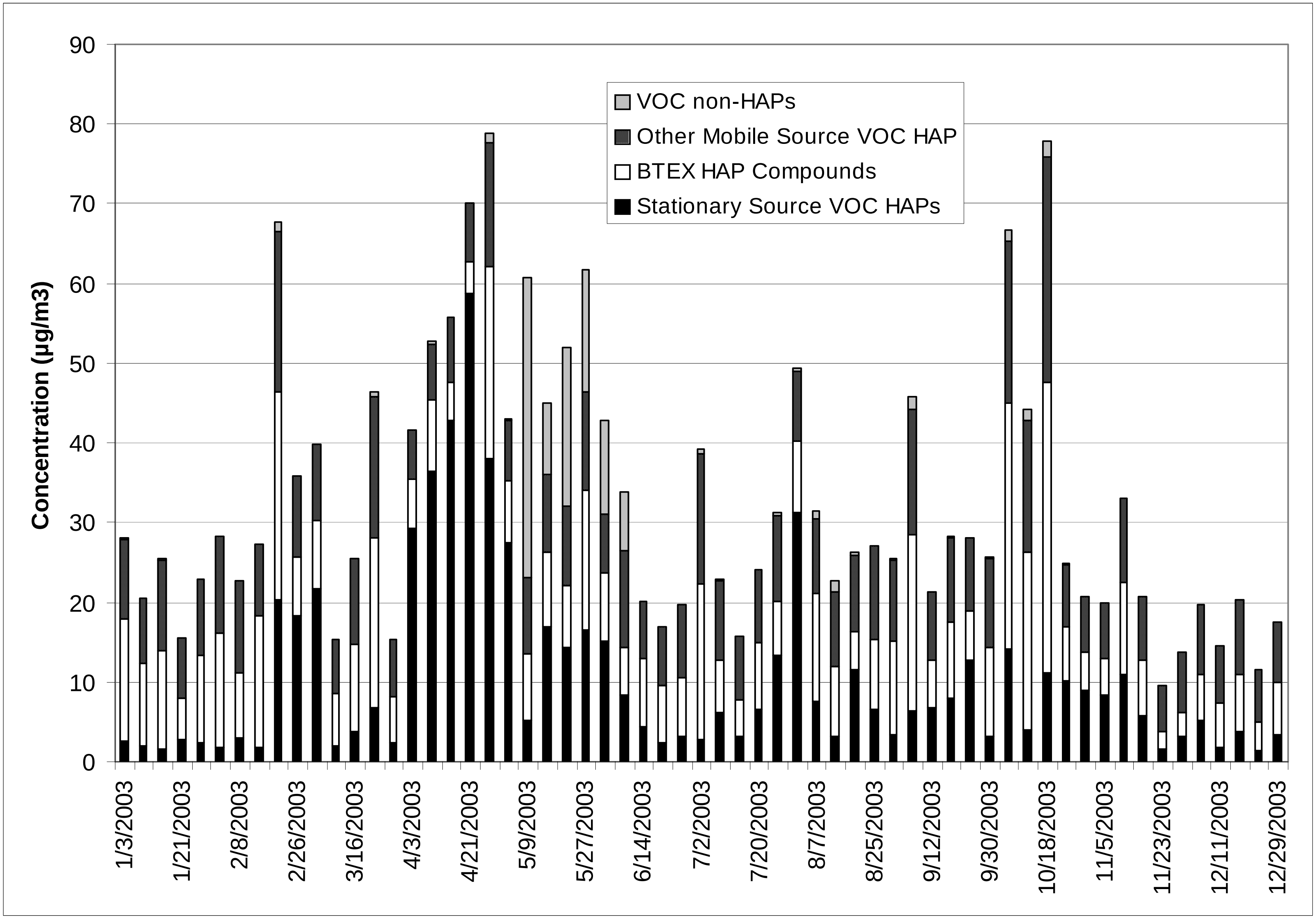


Figure 12-7. Composite Back Trajectory for SLMO

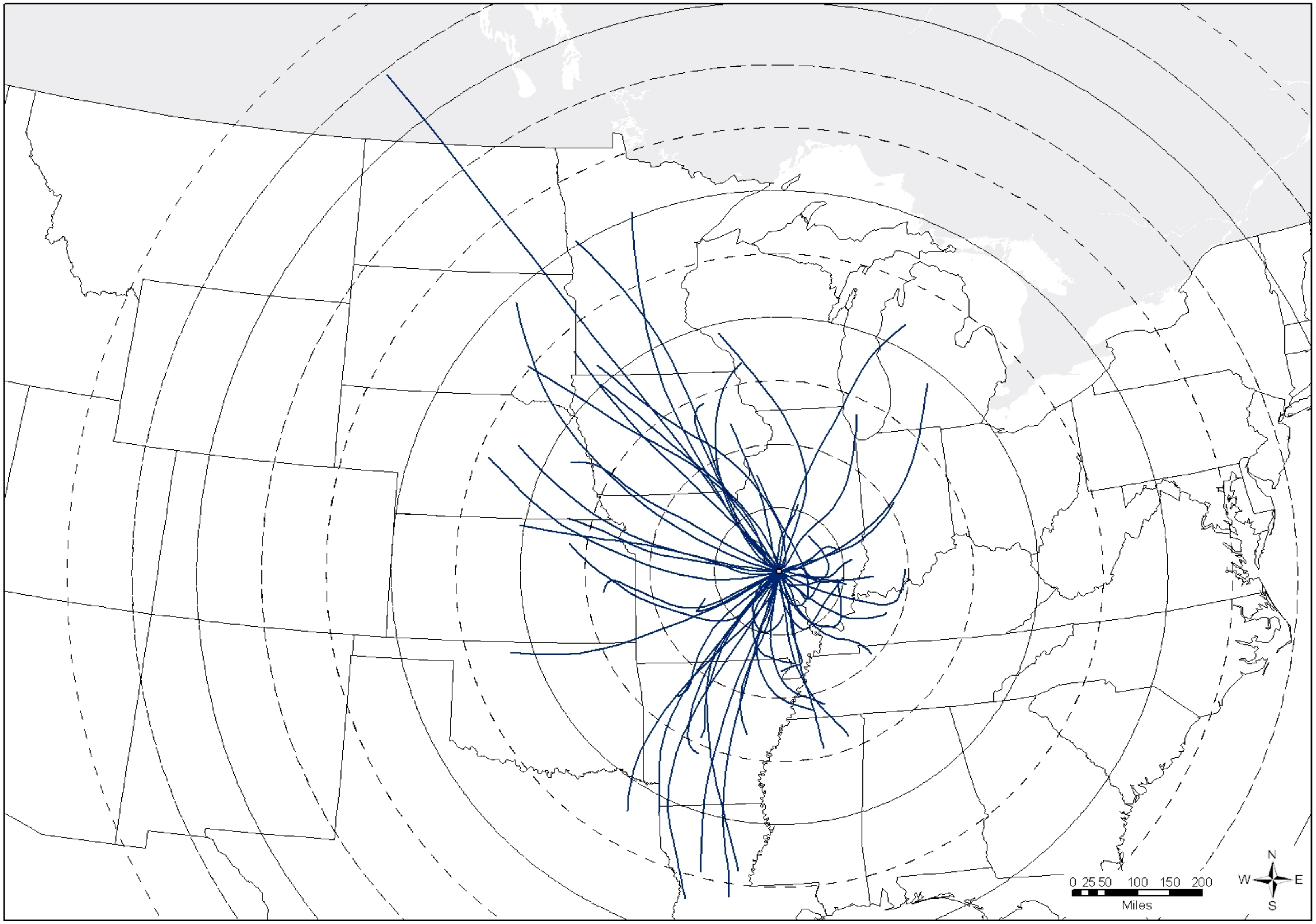


Figure 12-8. Acetaldehyde Pollution Rose for SLMO

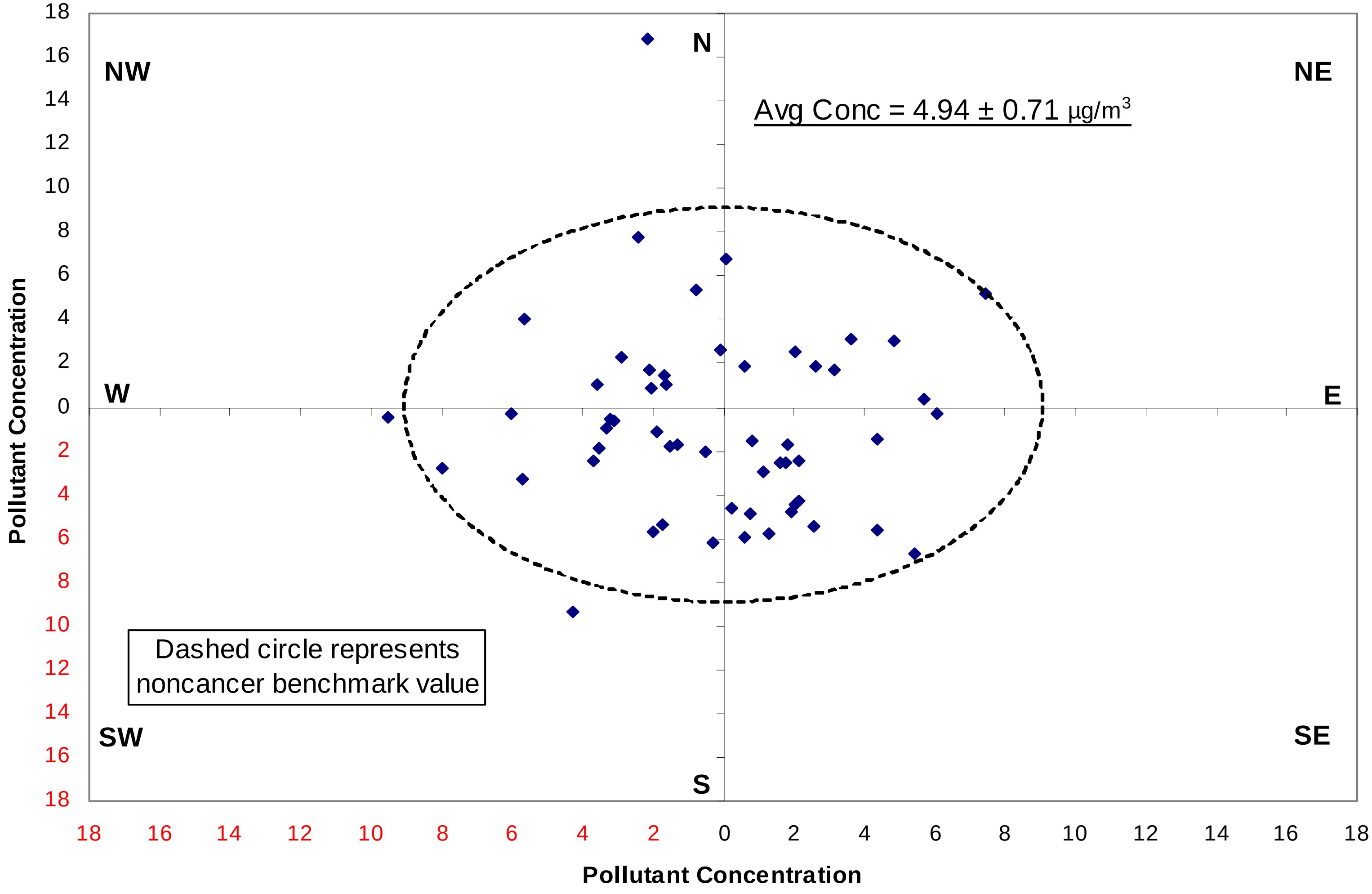


Figure 12-9. Formaldehyde Pollution Rose for SLMO

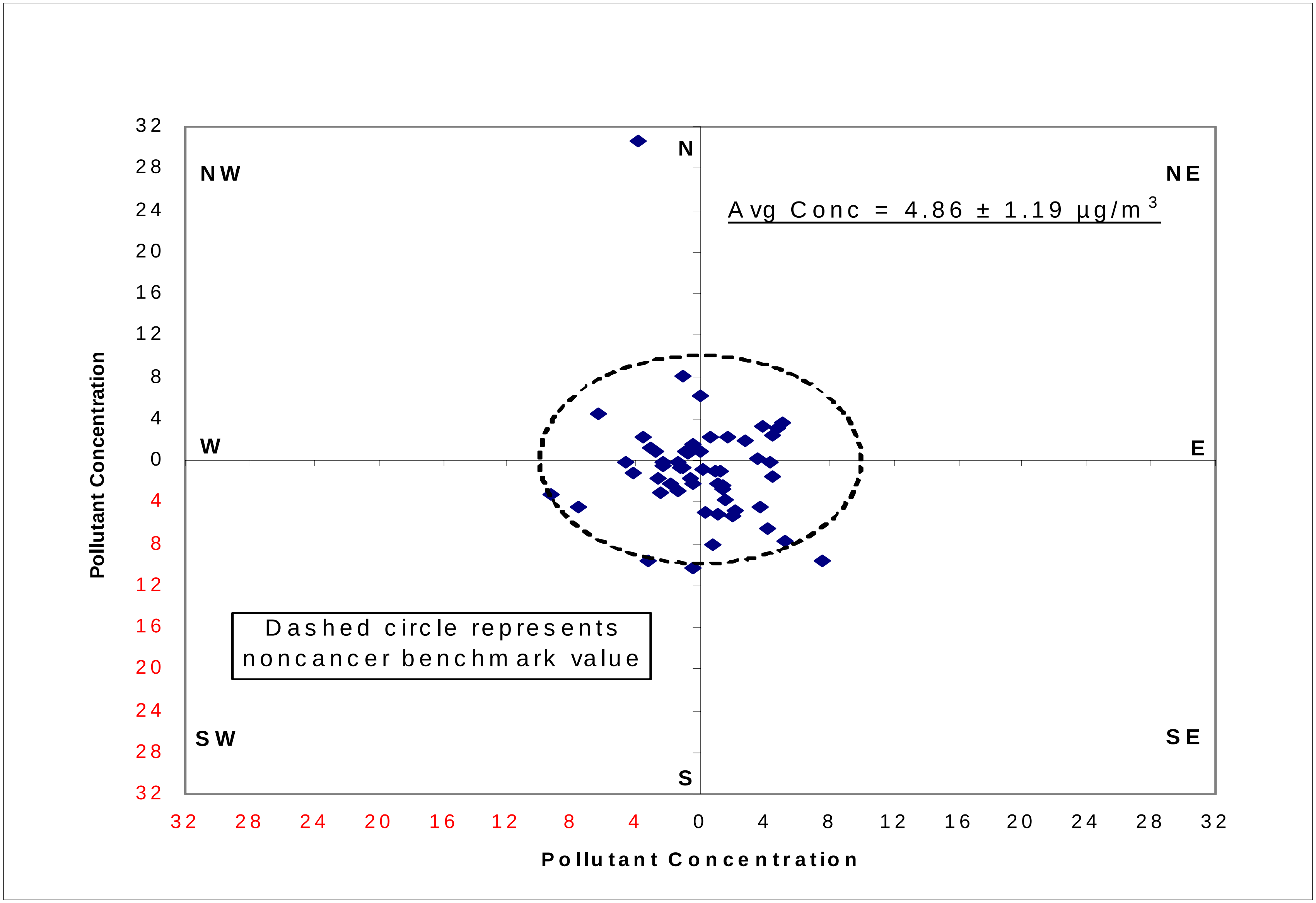


Figure 12-10. Acetaldehyde Sources North of the SLMO Monitoring Site

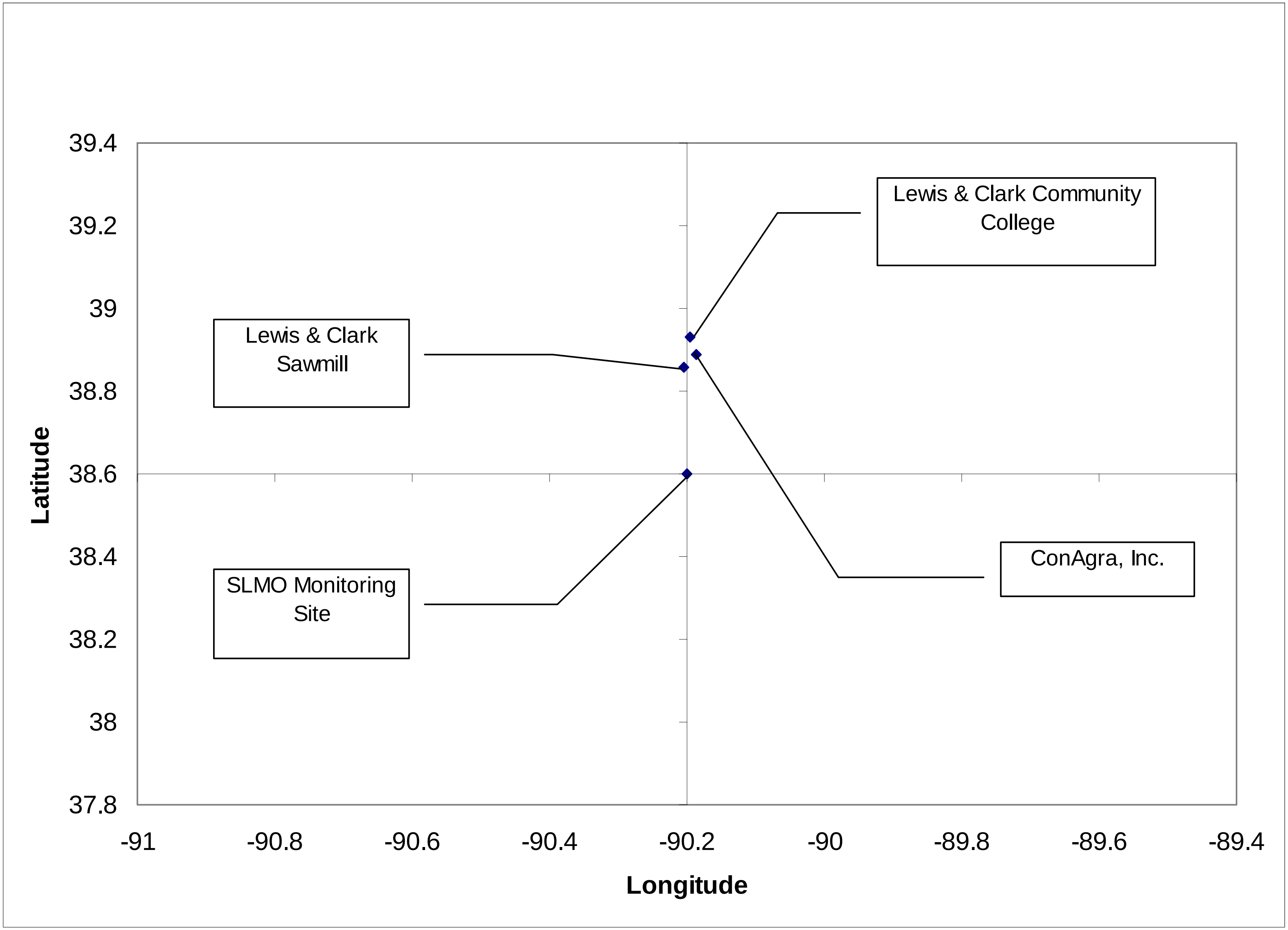


Figure 12-11. Formaldehyde Sources North of the SLMO Monitoring Site

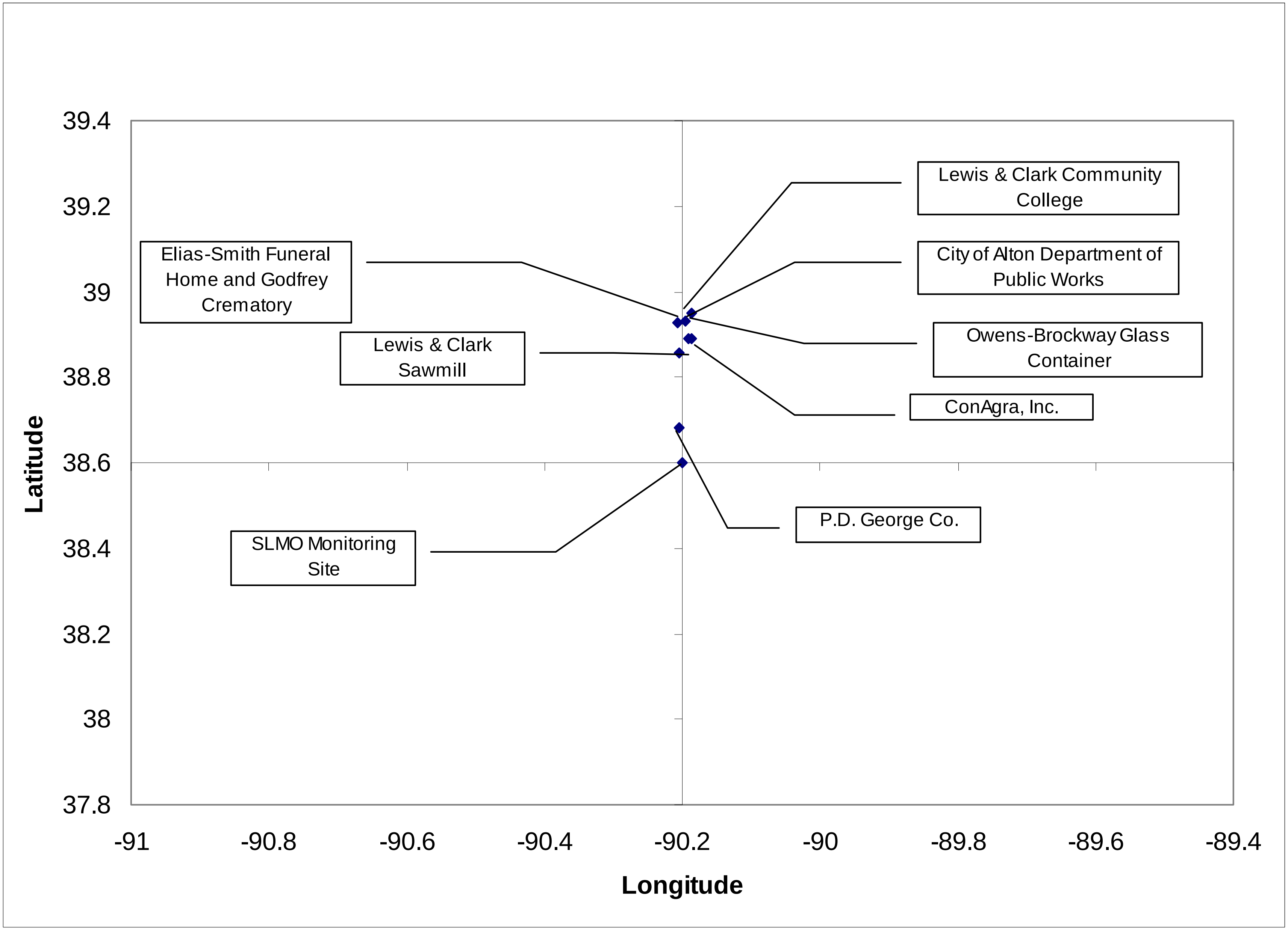


Figure 12-12. 24- Hour Back Trajectory (50, 250, and 500 Meters Aboveground) at SLMO on April 9, 2003

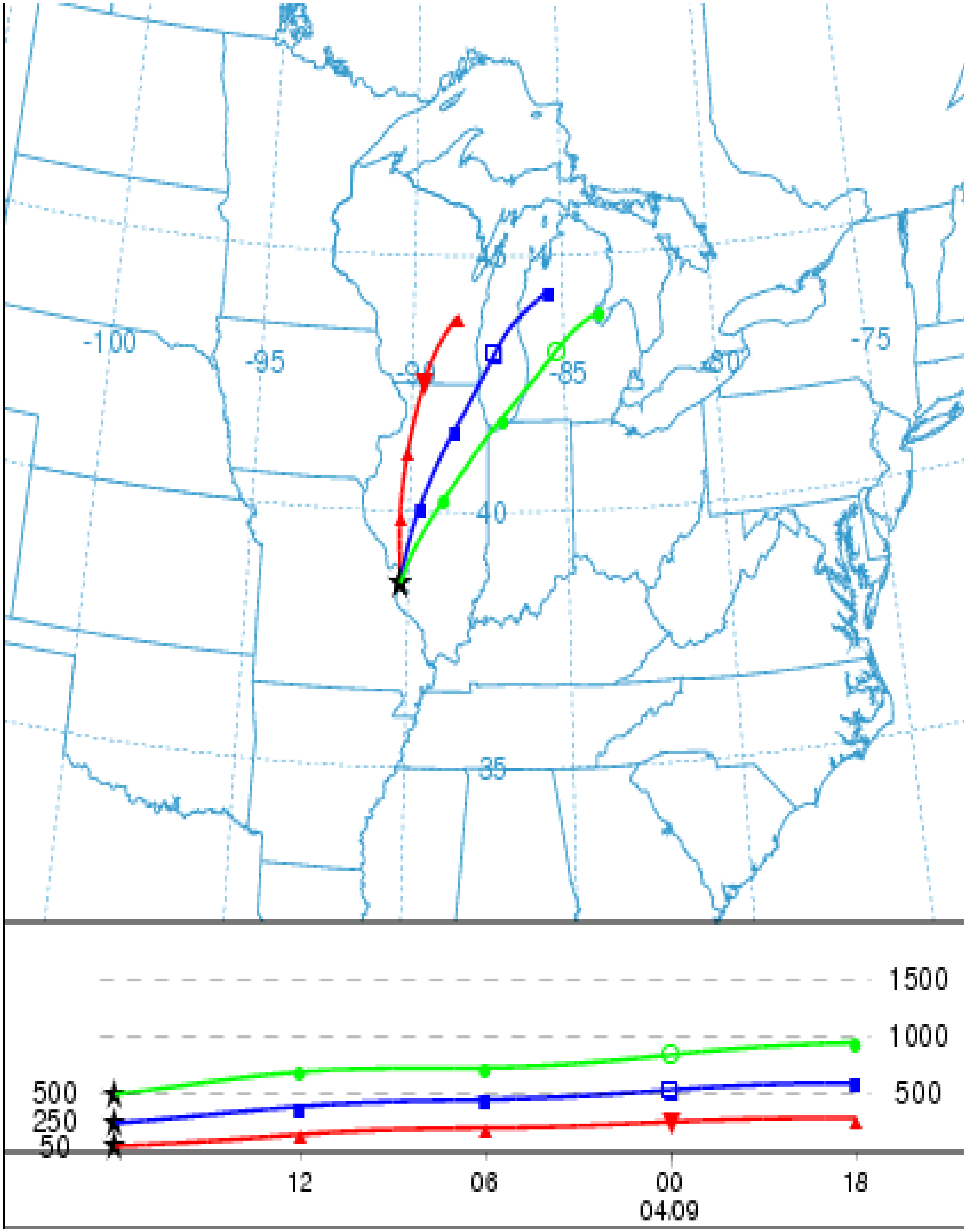


Table 12-1. Average Concentration and Meteorological Parameters for Sites in Missouri

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)
MO-BTMO	All 2003		65.58 (±2.04)	55.6 (±1.86)	46.43 (±1.91)	50.89 (±1.74)	74.28 (±1.24)	1017.03 (±0.67)	0.59 (±0.4)	-0.15 (±0.45)
	sample day	42.1 (±4.14)	65.91 (±5.53)	55.73 (±5.08)	45.98 (±5.25)	50.76 (±4.73)	72.83 (±3.45)	1016.95 (±1.49)	0.54 (±1.04)	0.95 (±1.19)
MO-S4MO	All 2003		65.58 (±2.04)	55.6 (±1.86)	46.43 (±1.91)	50.89 (±1.74)	74.28 (±1.24)	1017.03 (±0.67)	0.59 (±0.4)	-0.15 (±0.45)
	sample day	122.21 (±14.18)	66.36 (±4.99)	56.12 (±4.59)	46.54 (±4.76)	51.2 (±4.29)	73.21 (±3.13)	1016.75 (±1.45)	0.46 (±0.97)	0.68 (±1.15)
MO-SLMO	All 2003		65.58 (±2.04)	55.6 (±1.86)	46.43 (±1.91)	50.89 (±1.74)	74.28 (±1.24)	1017.03 (±0.67)	0.59 (±0.4)	-0.15 (±0.45)
	sample day	81.84 (±8.12)	65.75 (±5.32)	55.38 (±4.91)	45.64 (±5.07)	50.43 (±4.58)	72.8 (±3.32)	1016.59 (±1.45)	0.53 (±1.04)	0.82 (±1.21)

Table 12-2a. Summary of the Toxic Cancer Compounds at the Bonne Terre, Missouri Monitoring Site - BTMO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	5.41E-06	42.30	42.30	0.693	53	5.41
Acetaldehyde	4.27E-06	33.42	75.72	1.942	54	4.27
1,3-Butadiene	3.08E-06	24.09	99.81	0.103	2	3.08
Formaldehyde	2.36E-08	0.19	100.00	4.300	54	<1

Table 12-2b. Summary of the Toxic Cancer Compounds at the St. Louis Site 4, Missouri Monitoring Site - S4MO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	4.40E-05	37.72	37.72	0.647	3	44.0
p-Dichlorobenzene	1.57E-05	13.44	51.16	1.425	6	15.7
Benzene	1.16E-05	9.90	61.06	1.481	122	11.6
Arsenic and Compounds	1.09E-05	9.33	70.39	0.003	30	10.9
Carbon Tetrachloride	7.96E-06	6.82	77.21	0.530	56	7.96
Acetaldehyde	7.88E-06	6.76	83.97	3.582	61	7.88
1,3-Butadiene	6.66E-06	5.71	89.68	0.222	76	6.66
Trichloroethylene	5.40E-06	4.63	94.31	2.701	5	5.40
Tetrachloroethylene	4.06E-06	3.48	97.79	0.688	7	4.06
Cadmium and Compounds	2.22E-06	1.90	99.70	0.001	30	2.22
Methylene Chloride (Dichloromethane)	3.01E-07	0.26	99.95	0.641	41	<1
Formaldehyde	2.78E-08	0.02	99.98	5.052	61	<1
Beryllium and Compounds	2.65E-08	0.02	100.00	0.000	30	<1

Table 12-2c. Summary of the Toxic Cancer Compounds at the St. Louis Site 1, Missouri Monitoring Site - SLMO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	1.09E-05	40.50	40.50	4.944	55	10.9
Benzene	1.07E-05	39.70	80.20	1.367	54	10.7
1,3-Butadiene	5.29E-06	19.70	99.90	0.176	53	5.29
Formaldehyde	2.67E-08	0.10	100.00	4.861	55	<1

Table 12-3a. Summary of the Toxic Noncancer Compounds at the Bonne Terre, Missouri Monitoring Site - BTMO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	4.39E-01	58.92	58.92	4.300	54	1
Acetaldehyde	2.16E-01	28.97	87.89	1.942	54	0
1,3-Butadiene	5.13E-02	6.89	94.78	0.103	2	0
Benzene	2.31E-02	3.10	97.89	0.693	53	0
Xylenes (*o*-, *m*-, *p*-)	8.24E-03	1.11	98.99	0.824	53	0
Toluene	4.13E-03	0.56	99.55	1.653	53	0
Hexane	2.79E-03	0.37	99.92	0.558	53	0
Styrene	3.09E-04	0.04	99.96	0.309	43	0
Ethylbenzene	2.63E-04	0.04	100.00	0.263	53	0

Table 12-3b. Summary of the Toxic Noncancer Compounds at the St. Louis Site 4, Missouri Monitoring Site - S4MO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	5.16E-01	23.01	23.01	5.052	61	6
Manganese and Compounds	3.99E-01	17.79	40.80	0.020	30	2
Acetaldehyde	3.98E-01	17.76	58.56	3.582	61	1
Acrylonitrile	3.24E-01	14.44	73.00	0.647	3	0
Acetonitrile	1.78E-01	7.96	80.96	10.706	27	0
1,3-Butadiene	1.11E-01	4.96	85.92	0.222	76	0
Arsenic and Compounds	8.44E-02	3.77	89.69	0.003	30	0
Cadmium and Compounds	6.17E-02	2.75	92.44	0.001	30	0
Benzene	4.94E-02	2.20	94.64	1.481	122	0
Xylenes (*o*-, *m*-, *p*-)	3.52E-02	1.57	96.21	3.520	122	0
Chloromethane (Methyl Chloride)	1.35E-02	0.60	96.81	1.211	60	0
Carbon Tetrachloride	1.33E-02	0.59	97.41	0.530	56	0
Lead and Compounds	9.42E-03	0.42	97.83	0.014	30	0
Toluene	9.27E-03	0.41	98.24	3.706	122	0
Nickel Compounds	8.58E-03	0.38	98.62	0.002	30	0
Hexane	8.52E-03	0.38	99.00	1.704	61	0
Trichloroethylene	4.50E-03	0.20	99.20	2.701	5	0
Chloroform	3.44E-03	0.15	99.36	0.337	7	0
Methyl *tert*-Butyl Ether	2.62E-03	0.12	99.47	7.873	13	0
Tetrachloroethylene	2.55E-03	0.11	99.59	0.688	7	0
Cobalt and Compounds	2.12E-03	0.09	99.68	<0.0001	30	0
p-Dichlorobenzene	1.78E-03	0.08	99.76	1.425	6	0
Chlorobenzene	1.04E-03	0.05	99.81	1.038	6	0
Methyl Ethyl Ketone (2-Butanone)	9.18E-04	0.04	99.85	4.589	36	0
Ethylbenzene	8.14E-04	0.04	99.89	0.814	116	0
Methylene Chloride (Dichloromethane)	6.41E-04	0.03	99.91	0.641	41	0
Methyl Isobutyl Ketone (Hexone)	5.58E-04	0.02	99.94	1.673	9	0
Beryllium and Compounds	5.52E-04	0.02	99.96	<0.0001	30	0
Styrene	3.58E-04	0.02	99.98	0.358	79	0
1,1,1-Trichloroethane (Methyl Chloroform)	2.39E-04	0.01	99.99	0.239	13	0
Mercury and Compounds	1.51E-04	0.01	100.00	<0.0001	30	0
Selenium and Compounds	7.27E-05	<0.0001	100.00	0.001	30	0

Table 12-3c. Summary of the Toxic Noncancer Compounds at the St. Louis Site 1, Missouri Monitoring Site - SLMO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	5.49E-01	44.49	44.49	4.944	55	4
Formaldehyde	4.96E-01	40.17	84.67	4.861	55	5
1,3-Butadiene	8.82E-02	7.14	91.81	0.176	53	0
Benzene	4.56E-02	3.69	95.50	1.367	54	0
Xylenes (*o*-, *m*-, *p*-)	3.86E-02	3.12	98.62	3.858	54	0
Hexane	8.03E-03	0.65	99.27	1.605	54	0
Toluene	7.79E-03	0.63	99.90	3.116	54	0
Ethylbenzene	6.87E-04	0.06	99.96	0.687	54	0
Styrene	5.02E-04	0.04	100.00	0.502	52	0

Table 12-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Bonne Terre, Missouri Site (BTMO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	NA	NA	NA	NA	NA	NA	NA	NA
Acetaldehyde	0.44	0.44	0.41	0.43	0.01	-0.20	-0.35	0.20
Benzene	-0.55	-0.58	-0.57	-0.58	-0.15	-0.03	-0.18	0.12
Formaldehyde	0.82	0.81	0.72	0.77	-0.13	-0.30	-0.29	0.42

Table 12-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the St. Louis Site 4, Missouri Site (S4MO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	0.05	-0.05	-0.02	-0.04	0.15	0.16	0.04	-0.04
Acetaldehyde	0.37	0.28	0.23	0.25	-0.10	-0.05	-0.17	0.19
Acetonitrile	-0.10	-0.09	-0.19	-0.15	-0.27	-0.03	0.08	-0.15
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic and Compounds	0.31	0.27	0.25	0.26	-0.03	-0.02	-0.32	0.10
Benzene	-0.14	-0.20	-0.14	-0.18	0.24	0.05	-0.28	0.01
Cadmium and Compounds	0.55	0.54	0.51	0.54	-0.08	-0.13	-0.54	0.25
Carbon Tetrachloride	0.09	0.07	0.08	0.08	0.02	-0.05	-0.21	-0.09
Formaldehyde	0.76	0.74	0.67	0.70	-0.02	-0.23	-0.16	0.34
Manganese and Compounds	0.09	0.10	0.07	0.08	-0.16	0.11	-0.13	-0.09
p-Dichlorobenzene	-0.56	-0.67	-0.65	-0.67	0.68	0.65	0.35	-0.40
Tetrachloroethylene	-0.78	-0.67	-0.53	-0.60	0.64	0.71	0.41	-0.75
Trichloroethylene	0.28	0.28	0.23	0.25	-0.45	0.45	-0.21	0.74
Xylenes (*o*-, *m*-, *p*-)	0.07	-0.01	0.03	0.01	0.24	0.13	-0.09	-0.06

Table 12-4c - Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the St. Louis Site 1, Missouri Site (SLMO)

Compound	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
1,3-Butadiene	0.07	-0.01	0.02	0.00	0.18	0.04	-0.01	0.10
Acetaldehyde	0.36	0.32	0.34	0.33	0.21	0.00	-0.13	-0.11
Benzene	-0.05	-0.13	-0.09	-0.11	0.13	0.16	-0.18	0.07
Formaldehyde	0.28	0.28	0.25	0.26	-0.05	0.00	-0.12	-0.12

Table 12-5. Metals and Compounds, and SNMOC Measured by the Missouri Monitoring Stations

Site	Average Metals Concentration (ng/m^3)	TNMOC Speciated (ppbC)	TNMOC with Unknowns (ppbC)	% of TNMOC Identified	SNMOC Compound with the Highest Concentration (ppbC)
BTMO	NA	57.98	136.15	50%	Toluene 56.93
S4MO	41.26	126.43	245.05	60%	Toluene 20.31
SLMO	NA	120.87	232.88	53%	Toluene 16.44

Table 12-6. Motor Vehicle Information vs. Daily Concentration for Missouri Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
BTMO	56,775	41,871	0.74	33,587	24,354	4,360	42.10 (±4.14)
S4MO	338,353	252,556	0.75	824,653	618,490	22,840	122.21 (±14.18)
SLMO	338,353	252,556	0.75	754,882	566,162	15,016	81.84 (±8.12)

Table 12-7. Summary of Future Regulations That May be Applicable for Nearby Facilities Surrounding SLMO

Facility Name	Primary SIC Code	SIC Code Description	Regulation Citation	Regulation Name
Borden Decorative Products	2754	Commercial Printing, Gravure	40 CFR part 63, subpart JJJJ	Paper and Other Web (Surface Coating) NESHAP
Chrysler Assembly South Plant	--	NESHAP application based on MACT Code from NEI	40 CFR part 63, subpart MMMM	Miscellaneous Metal Parts and Products (Surface Coating) NESHAP
Decorative Services Intl	2754	Commercial Printing, Gravure	40 CFR part 63, subpart JJJJ	Paper and Other Web (Surface Coating) NESHAP
Ethyl Petroleum Additives, Inc.	2869	Industrial Organic Chemicals, NEC	40 CFR part 63, subpart FFFF	Miscellaneous Organic Chemical Production and Processes (MON) NESHAP
Granite City Steel	3312	Steel works, Blast Furnaces (Including Coke Ovens), and Rolling Mills	40 CFR part 63, subpart FFFFF	Integrated Iron and Steel NESHAP
KV Pharmaceutical Company	2834	Pharmaceutical Preparations	40 CFR part 63, subpart GGG	Pharmaceuticals Production NESHAP
King Adhesives	2891	Adhesives and Sealants	40 CFR part 63, subpart HHHHH	Miscellaneous Coating Manufacturing NESHAP
Mallinckrodt Specialty Chemicals Co.	2833	Medicinal Chemicals and Botanical Products	40 CFR part 63, subpart GGG	Pharmaceuticals Production NESHAP
	2834	Pharmaceutical Products	40 CFR part 63, subpart GGG	Pharmaceuticals Production NESHAP
Metro East Industries, Inc.	3743	Railroad Equipment	40 CFR part 63, subpart MMMM	Miscellaneous Metal Parts and Products (Surface Coating) NESHAP

Table 12-7. Summary of Future Regulations That May be Applicable for Nearby Facilities Surrounding SLMO (Continued)

Facility Name	Primary SIC Code	SIC Code Description	Regulation Citation	Regulation Name
National Steel Corp./Granite City Div.	3312	Steel works, Blast Furnaces (Including Coke Ovens), and Rolling Mills	40 CFR part 63, subpart FFFFF	Integrated Iron and Steel NESHAP
P.D. George Co.	2851	Paints, Varnishes, Lacquers, Enamels, and Allied Products	40 CFR part 63, subpart HHHHH	Miscellaneous Coating Manufacturing NESHAP
Pro-Tech MFG., Inc.	3086	Plastic Foam Products	40 CFR part 63, subpart III	Flexible Polyurethane Foam Production NESHAP
Silgan Containers, Inc.	3411	Metal Cans	40 CFR part 63, subpart KKKK	Metal Can (Surface Coating) NESHAP
Solutia Inc.,- W. G. Krummrich Plant	2819	Industrial Inorganic Chemicals, NEC	40 CFR part 63, subpart FFFF	Miscellaneous Organic Chemical Production and Processes (MON) NESHAP
	2865	Cyclic Organic Crudes and Intermediates, and Organic Dyes and Pigments	40 CFR part 63, subpart GGG	Pharmaceuticals Production NESHAP
White Rodgers Div.	3822	Automatic Controls for Regulating Residential and Commercial Environments and Appliances	40 CFR part 63, subpart MMMM	Miscellaneous Metal Parts and Products (Surface Coating) NESHAP

13.0 Site in Nebraska

This section focuses on meteorological, concentration, and spatial trends for the UATMP site in Nebraska (LONE). This site is located in Lincoln, situated in southeastern Nebraska. Figure 13-1 is a topographical map showing the monitoring station in its urban location. Figure 13-2 is a map identifying facilities within ten miles of the sites that reported to the 1999 NEI. The map shows that most of the industrial facilities are to the east and northeast of this site. Fuel combustion and miscellaneous industrial sites make up the majority of the nearby sources. Hourly meteorological data were retrieved for all of 2003 at the Lincoln Municipal Airport weather station (WBAN 14939) with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 13-1 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), 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 Lincoln area has a continental climate, with cold winters and warm summers. Lincoln is affected by most storm systems that track across the country, allowing day to day weather fluctuations. Precipitation varies throughout the year, but is typically concentrated in the springtime. On average, wind blows from a southerly direction, as indicated in Table 13-1. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

13.1 Prevalent Compounds at the Nebraska Site

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.

Table 13-2 shows that most of the cancer compounds reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. Only methylene chloride and formaldehyde were not listed among the nationwide prevalent cancer compounds. For the noncancer compounds summarized in Table 13-3, carbon tetrachloride, chloromethane, methylene chloride, toluene, chloroform, methyl ethyl ketone, ethylbenzene, styrene, and 1,1,1-trichloroethane were not listed among the nationwide noncancer prevalent list. The prevalent compounds at LONE are also nationwide cancer and noncancer prevalent compounds.

Toxic compounds not detected at the Nebraska sites were: tetrachloroethylene; *p*-dichlorobenzene; 1,2-dichloroethylene; trichloroethylene; 1,3-dichloropropene; 1,1,2-trichloroethylene; vinyl chloride; bromoform; chloroprene; 1,1-dichloroethene; methyl methacrylate; 1,2,4-trichlorobenzene; methyl *tert*-butyl ether; chlorobenzene; methl isobutyl ketone; chloroethane.

13.2 Toxicity Analysis

Although acrylonitrile's toxicity is the highest of the cancer compounds, it had only one detect. Of the prevalent cancer compounds, benzene and acetaldehyde detections were the highest (17). Formaldehyde accounts for over 25% of LONE's total noncancer toxicity.

The acrylonitrile cancer risk was the highest among the toxic compounds at 57.6 in a million. For the compounds which may lead to adverse noncancer health effects, the average acrylonitrile toxicity was the highest at 0.423 (over 1 indicates a significant chance of a noncancer health effect). The lone compound to measure an adverse health concentration was formaldehyde (one time).

13.3 Meteorological and Concentration Averages at the Nebraska Site

Carbonyl compounds and VOC were measured at this site, as indicated in Tables 3-3 and 3-4. Table 13-1 lists the average UATMP concentration at LONE and the averages for selected meteorological parameters from January 2003 to December 2003.

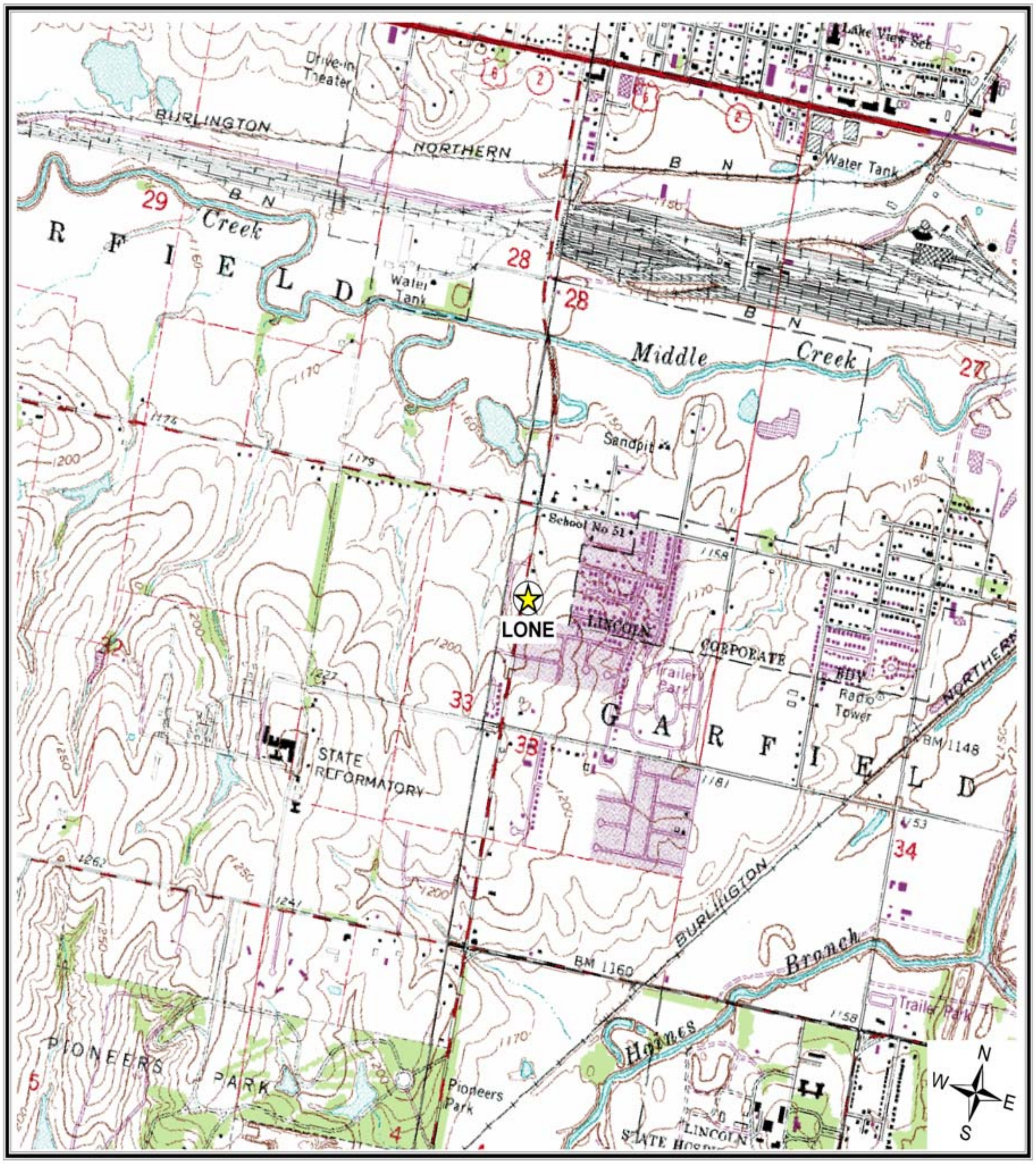
Table 13-4 presents the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. Acetonitrile had moderately strong to strong correlations with all the weather parameters except relative humidity and the u-component of the wind. A moderately strong positive correlation between benzene and relative humidity was computed, as was a moderately strong negative correlation between formaldehyde and relative humidity. The remainder of the correlations tended to be weak. Correlations for 1,3-butadiene, acrylonitrile, and bromomethane could not be computed due to the low number of detects (fewer than 3).

13.4 Spatial Analysis

County-level car registration and population in Lancaster County were obtained from the Nebraska Department of Motor Vehicles and the U.S. Census Bureau, and are summarized in Table 13-5. Also included in Table 13-5 is the population within 10 miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the Lincoln site in Table 13-5.

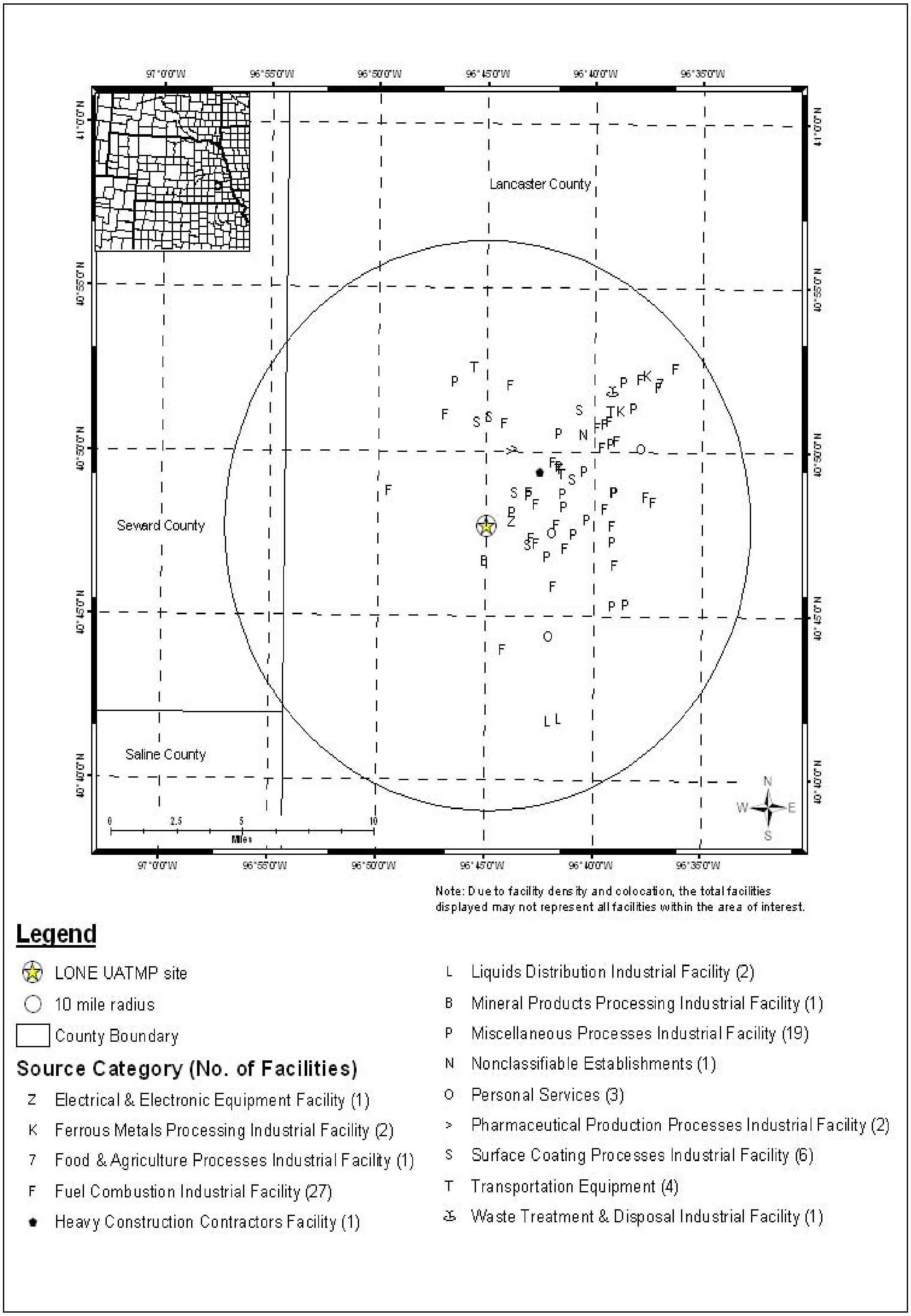
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area. (For more information on this study, refer to section 3.4.2.) Figure 3-1 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The toluene-ethylbenzene concentrations ratio at LONE resembles that of the roadside study. However, the benzene-ethylbenzene and xylenes-ethylbenzene ratios do not. For the roadside study, the xylenes-ethylbenzene ratio is greater than the benzene-ethylbenzene ratio. At LONE, the reverse is true: the benzene-ethylbenzene ratio is larger than the xylenes-ethylbenzene ratio.

Figure 13-1. Lincoln, Nebraska (LONE) Monitoring Station



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

Figure 13-2. Facilities Located Within 10 Miles of LONE



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

Table 13-1. Average Concentration and Meteorological Parameters for the Site in Nebraska

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)
LONE	All 2003	▨	62.79 (±2.31)	51.35 (±2.12)	39.36 (±1.93)	45.31 (±1.85)	67.44 (±1.19)	1016.43 (±0.77)	0.03 (±0.38)	-0.45 (±0.73)
	sample day	35.13 (±5.97)	47.65 (±8.73)	36.09 (±7.69)	24.72 (±6.91)	31.54 (±6.72)	66.52 (±5.18)	1015.55 (±4.56)	-0.01 (±1.78)	-0.09 (±4.24)

Table 13-2. Summary of the Toxic Cancer Compounds at the Lincoln, Nebraska Monitoring Site - LONE

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 million)
Acrylonitrile	5.76E-05	67.36	67.36	0.846	1	57.6
Benzene	1.03E-05	12.10	79.46	1.326	17	10.3
Carbon Tetrachloride	7.08E-06	8.28	87.75	0.472	15	7.08
1,3-Butadiene	5.97E-06	6.99	94.74	0.199	2	5.97
Acetaldehyde	4.33E-06	5.07	99.81	1.970	17	4.33
Methylene Chloride (Dichloromethane)	1.40E-07	0.16	99.98	0.297	8	<1
Formaldehyde	1.98E-08	0.02	100.00	3.608	17	<1

Table 13-3. Summary of the Toxic Noncancer Compounds at the Lincoln, Nebraska Monitoring Site - LONE

Compound	**Average Toxicity**	**% Contribution**	**Cumulative % Contribution**	**Average Concentration (μg/m^3)**	**# Detects**	**Adverse Noncancer Concentrations**
Acrylonitrile	4.23E-01	29.27	29.27	0.846	1	0
Formaldehyde	3.68E-01	25.47	54.74	3.608	17	1
Acetaldehyde	2.19E-01	15.14	69.88	1.970	17	0
Acetonitrile	2.14E-01	14.82	84.70	12.852	12	0
1,3-Butadiene	9.96E-02	6.89	91.59	0.199	2	0
Benzene	4.42E-02	3.06	94.65	1.326	17	0
Bromomethane (Methyl Bromide)	2.33E-02	1.61	96.26	0.116	1	0
Xylenes (*o*-, *p*-, *m*-)	2.08E-02	1.44	97.70	2.081	15	0
Chloromethane (Methyl Chloride)	1.39E-02	0.96	98.66	1.255	17	0
Carbon Tetrachloride	1.18E-02	0.82	99.48	0.472	15	0
Toluene	4.77E-03	0.33	99.81	1.906	17	0
Chloroform	1.00E-03	0.07	99.88	0.098	1	0
Methyl Ethyl Ketone (2-Butanone)	7.72E-04	0.05	99.93	3.858	5	0
Ethylbenzene	3.71E-04	0.03	99.96	0.371	11	0
Methylene Chloride (Dichloromethane)	2.97E-04	0.02	99.98	0.297	8	0
Styrene	1.70E-04	0.01	99.99	0.170	1	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.64E-04	0.01	100.00	0.164	2	0

Table 13-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Lincoln, Nebraska Site (LONE)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	NA	NA	NA	NA	NA	NA	NA	NA
Acetaldehyde	0.23	0.19	0.16	0.17	-0.12	-0.25	-0.29	0.20
Acetonitrile	0.59	0.64	0.63	0.64	-0.22	-0.55	-0.02	0.47
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.07	-0.20	-0.09	-0.16	0.49	-0.12	-0.14	-0.06
Carbon Tetrachloride	-0.12	-0.10	-0.07	-0.09	0.16	0.14	0.30	-0.05
Formaldehyde	-0.02	-0.07	-0.18	-0.10	-0.41	0.15	-0.07	0.20
Bromomethane (Methyl Bromide)	NA	NA	NA	NA	NA	NA	NA	NA

Table 13-5. Motor Vehicle Information vs. Daily Concentration for the Nebraska Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
LONE	257,513	197,341	0.77	239,504	184,418	6,200	35.13 (±5.97)

14.0 Sites in New Jersey

This section focuses on 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 stations in their urban locations. Figures 14-5 through 14-7 are maps identifying facilities within ten miles of the sites that reported to the 1999 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 twelve industrial sites nearby, most of which lie just within the ten mile radius from the site and are also involved in fuel combustion. 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 fuel combustion facilities, miscellaneous industries, and chemicals and allied product facilities.

Hourly meteorological data were retrieved for all of 2003 at three weather stations near these sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The weather stations are Philadelphia, Newark International Airport, and Somerville-Somerset, NJ (WBAN 94732, 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), 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. 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. Annual average wind speed and direction tend to vary among the sites, as indicated in Table 14-1. 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. Tables 14-2a-d summarize the cancer weighting scores and Tables 14-3a-d 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.

Tables 14-2a-d show that most of the prevalent cancer compounds reflect the nationwide prevalent cancer compounds, as listed in Section 3 of this report. Only vinyl chloride (detected at CANJ and ELNJ), trichloroethylene (detected at all four sites), methylene chloride (detected at all four sites), and formaldehyde (detected at all four sites) are listed in Tables 14-2a-d and are not listed among the nationwide prevalent compounds. For the noncancer compounds summarized in Tables 14-3a-d, many of the detected compounds are not listed on the nationwide prevalent noncancer compound list. However, only one site had a prevalent compound (chloromethane) not on the nationwide list.

Toxic compounds not detected at the New Jersey sites were: 1,2-dichloroethane; 1,3-dichloropropene; 1,1,2-trichloroethane; bromoform; 1,2,4-trichlorobenzene; chlorobenzene and chloroethane.

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 three of the four sites, although it consistently had the lowest number of detects. Benzene and acetaldehyde had the highest number of detects of the prevalent cancer compounds at all four sites. At all of the sites except CANJ, formaldehyde and acetaldehyde together contributed to over 57% of the total noncancer toxicity.

The tetrachloroethylene cancer risk at ELNJ was the highest among the four sites at 33.3 in a million, while the acrylonitrile cancer risk at CANJ, CHNJ, and NBNJ was 28.3, 27.3, and 23.7 in a million, respectively. For the compounds which may lead to adverse noncancer health effects, the average bromomethane toxicity at CANJ was 0.780 (over 1 indicates a significant chance of a noncancer health effect). Of the fifty-one acetaldehyde detects at ELNJ, six concentrations were of adverse health concentrations.

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 ELNJ was nearly double the average concentration of the other sites, as indicated in Table 14-1. Table 14-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

Tables 14-4a-d present 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 correlations at CANJ were computed between acrylonitrile and all but two of the meteorological parameters (relative humidity and the v-component of the wind). All of these correlations were negative and strong or very strong (ranging from -0.57 to -0.83). 1,3-Butadiene and tetrachloroethylene exhibited similar correlations with the temperature and moisture variables, although not as strong. Acetaldehyde, carbon tetrachloride, and formaldehyde had moderately strong or strong positive correlations with these same parameters.

At CHNJ, very strong negative correlations were computed between acrylonitrile and average, dewpoint, and wet bulb temperatures (ranging from -0.92–0.98). Very strong positive correlations were exhibited between 1,3-butadiene and maximum temperature, average temperature, and wet bulb temperature; and a very strong negative correlation was calculated between this compound and sea level pressure. However, it is important to note that fewer than eight concentrations were detected for both of these compounds. Benzene, formaldehyde, chloromethane, and tetrachloroethylene all have moderately strong to strong positive or negative correlations with maximum, average, dewpoint, and wet bulb temperatures.

At ELNJ, acrylonitrile had the strongest correlations with the meteorological parameters. However, this compound was only detected four times at this site, which can skew the correlations. Aside from acrylonitrile, the strongest correlation at ELNJ was between 1,3-butadiene and maximum temperature (-0.45). A majority of the correlations at ELNJ were rather weak.

At NBNJ, acrylonitrile exhibited very strong correlations with several weather variables (-0.78 to -0.83). Both formaldehyde and acetaldehyde had strong positive correlations with the temperature and moisture (dewpoint and wet bulb) parameters, while both 1,3-butadiene and benzene had moderately strong to strong negative correlations with these same parameters.

14.4 Spatial Analysis

County level car registration information was not available for Camden, Middlesex, Morris, and Union Counties. Thus, state-level car 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. Also included in Table 14-5 is the population within 10 miles of each site and 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. Using these parameters, a county-specific car registration ratio was computed. An estimation of the 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds 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.

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 3-1 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. Of the New Jersey sites, ELNJ most resembles the roadside study. The benzene-ethylbenzene and xylenes-ethylbenzene concentration ratios are lower than those of the roadside study at CHNJ. NBNJ’s toluene-ethylbenzene ratio is higher than the roadside study’s and its benzene-ethylbenzene and xylenes-ethylbenzene ratios are lower than the roadside study’s. The ratios for the CANJ site resemble the roadside study’s the least, with nearly equal benzene-ethylbenzene and xylenes-ethylbenzene ratios.

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 Phildelphia 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 14-8 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). 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 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 14-9 through 14-11 are the VOC profiles at the New York MSA sites (CHNJ, ELNJ, and NBNJ).

At CANJ (Figure 14-8), the total VOC concentrations varied throughout the year, with the highest concentration occurring on February 20, 2003. 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 fairly consistent. The sampling at CANJ ran from January 3 - September 24, thus missing a portion of the winter season. The non-HAP VOCs varied throughout the season, but were generally higher during the summer season. 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 similar to APMI (8.93 μg/m^3 vs. 9.51 μg/m^3, respectively), suggesting that the RFG requirement may be effective.

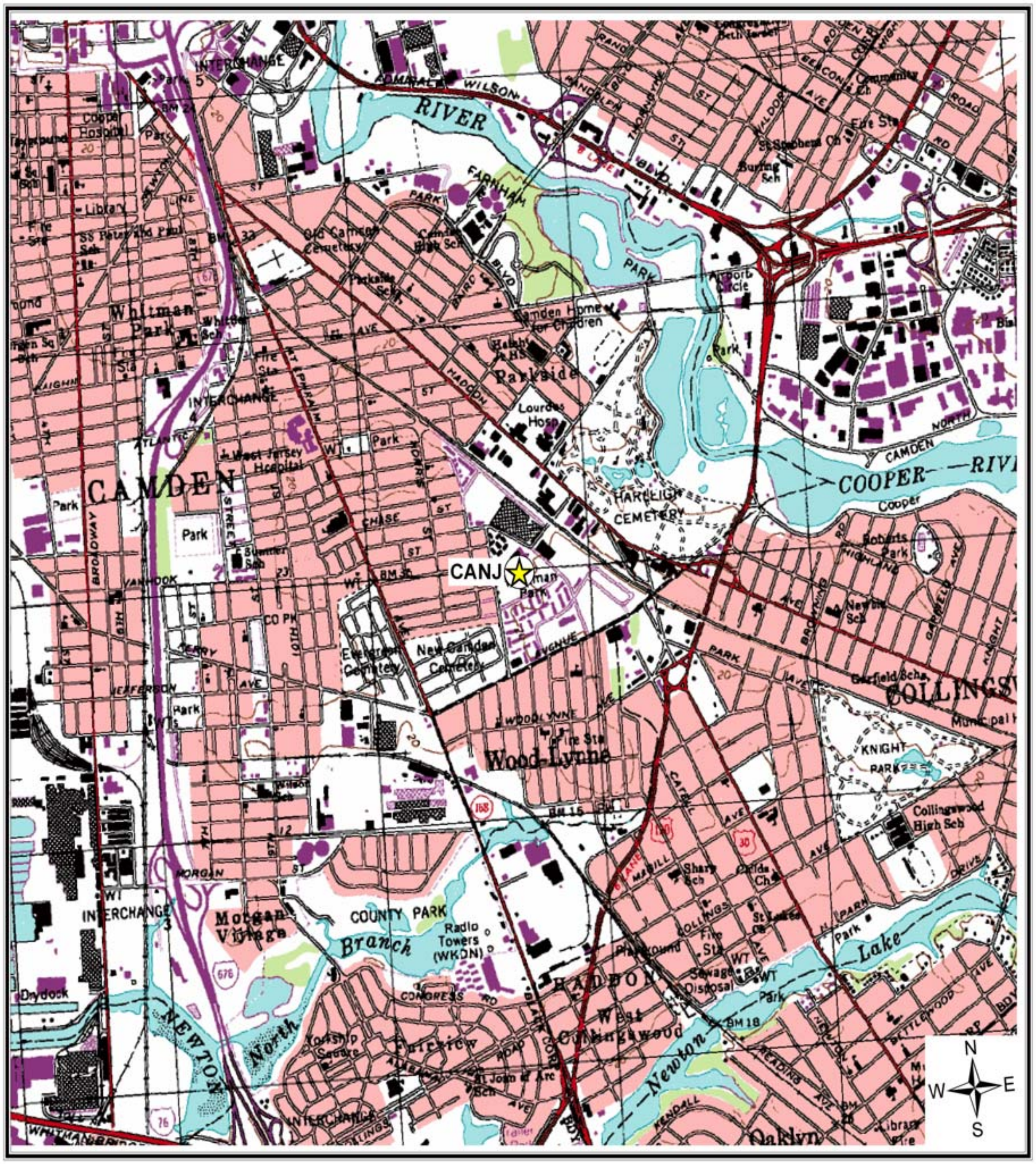
At CHNJ (Figure 14-9), the total VOC concentrations were consistently low throughout the year, with the highest concentration occurring on September 12, 2003. On that day, the BTEX HAP contribution was much higher than other sampling days. The stationary source HAP concentrations were consistently low throughout the year. The sampling at CHNJ ran from January 9 - December 29. The BTEX concentrations appeared lower in the winter season than the summer season. The non-HAP 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 (5.28 $\mu g/m^3$ vs. 11.53 $\mu g/m^3$, respectively), suggesting that the RFG requirement may be effective.

At ELNJ (Figure 14-10), the total VOC concentrations varied throughout the year, with the highest concentration occurring on October 24, 2003. On that day, the stationary source HAP contribution was much higher than other sampling days. The mobile source (BTEX and non-BTEX) HAP and non-HAP VOC concentrations also varied. The sampling at ELNJ ran from March 4 - December 29, thus missing most of the winter season. The ELNJ BTEX concentration was compared to the SPIL BTEX concentration. SPIL is also located in a RFG requirement area and has a similar traffic volumes to ELNJ (ELNJ = 170,000; SPIL = 214,900). The BTEX concentration at ELNJ is nearly double the SPIL concentration (14.80 $\mu g/m^3$ vs. 7.90 $\mu g/m^3$, respectively). It appears as if the RFG requirement may not be effective but there are a high number of stationary sources emitting BTEX compounds near ELNJ.

At NBNJ (Figure 14-11), the total VOC concentrations varied throughout the year, with the highest concentration occurring on July 20, 2003. On that day, the BTEX HAP contribution was much higher than other sampling days. The stationary source HAP and non-HAP VOC concentrations also varied. The sampling at ELNJ ran from January 3 - December 31. Total VOC concentrations appeared to be lower during the winter season.

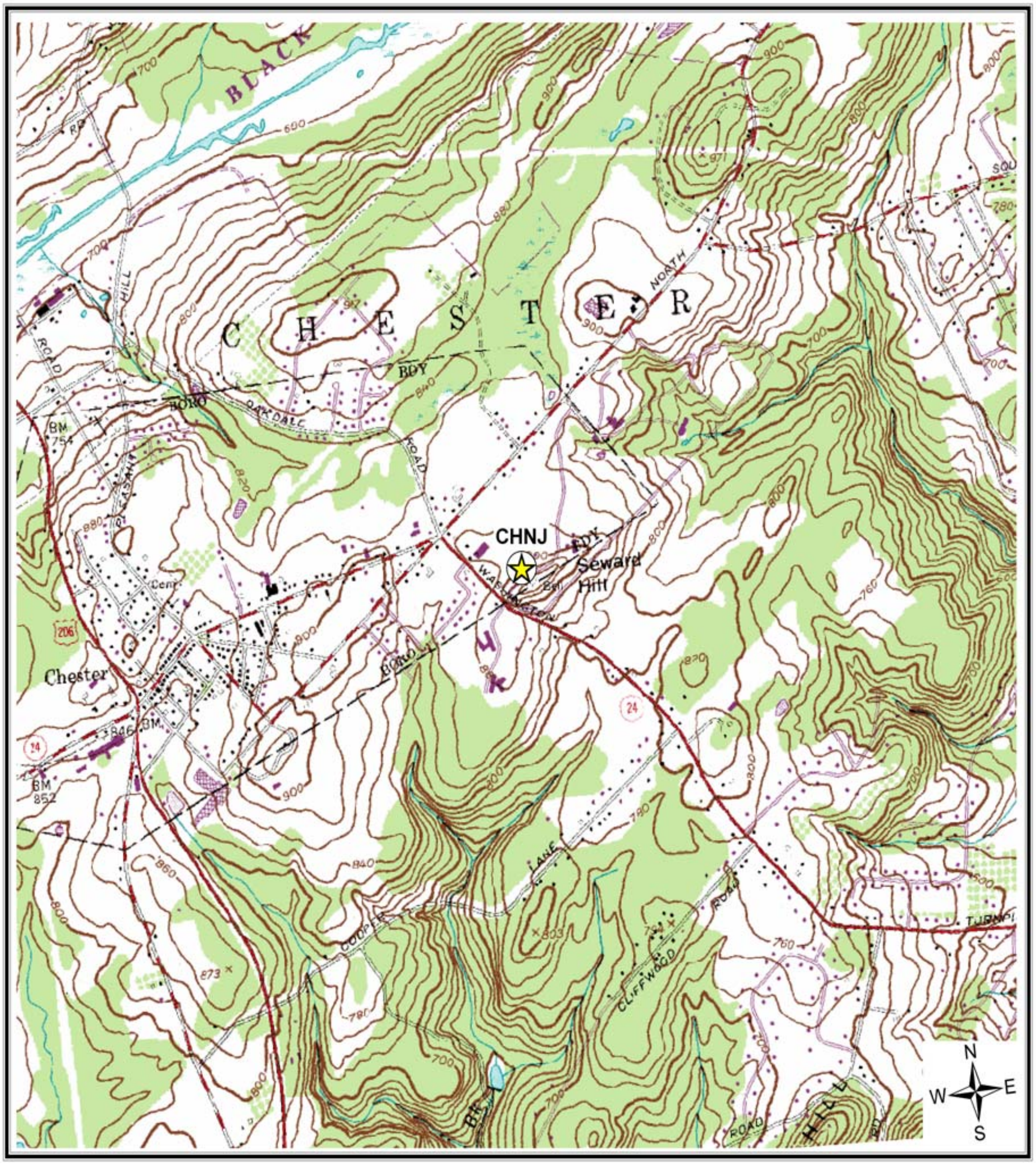
The NBNJ BTEX concentration was compared to the APMI BTEX concentration. APMI is located in non-RFG requirement area, but the two sites have similar traffic volumes (NBNJ = 63,000; APMI = 60,000). The BTEX concentration at NBNJ is similar to APMI (8.59 μg/m^3 vs. 9.51 μg/m^3, respectively). The RFG requirements may be effective at NBNJ.

Figure 14-1. Camden, New Jersey (CANJ) Monitoring Station



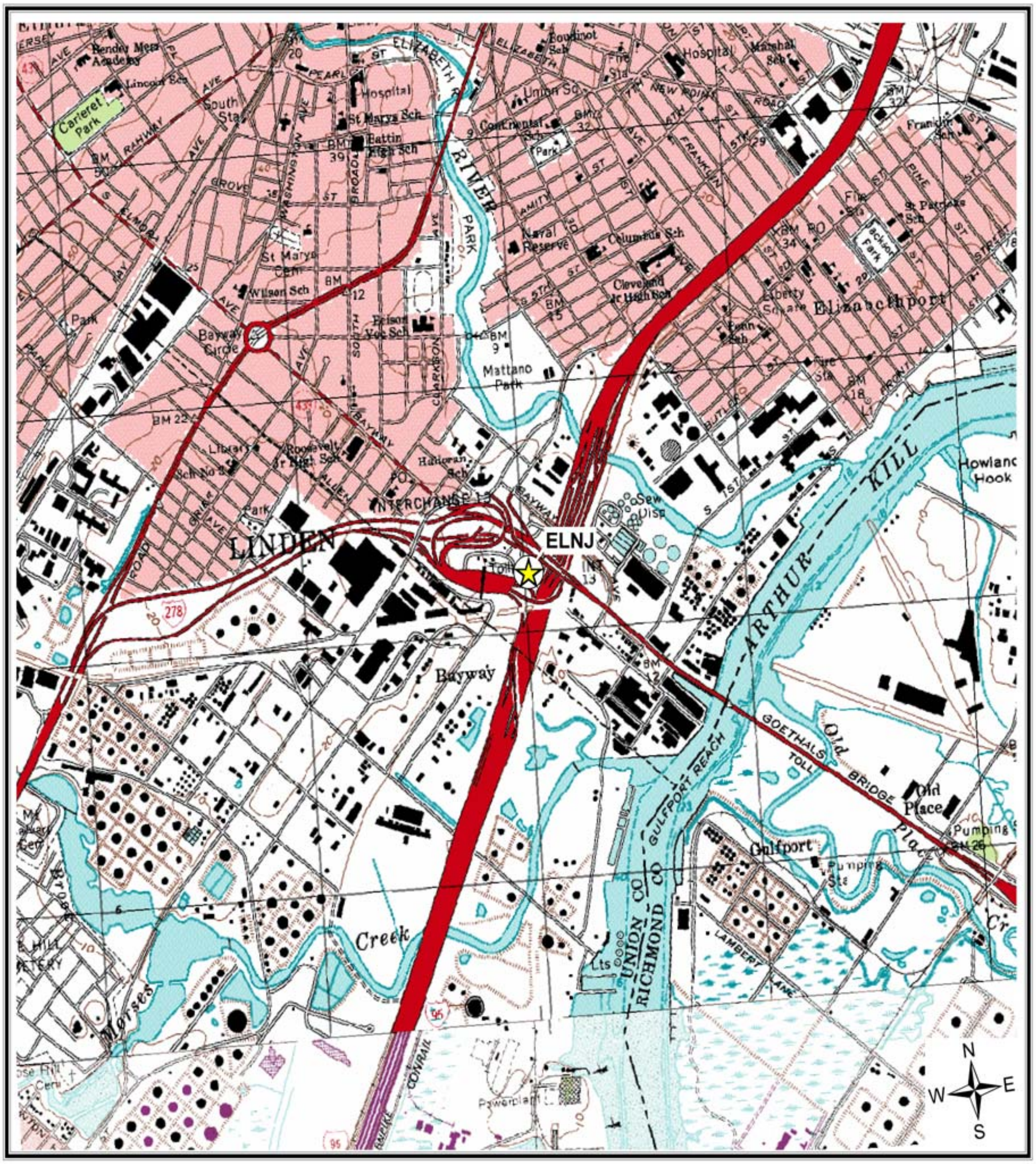
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 14-2. Chester, New Jersey (CHNJ) Monitoring Station



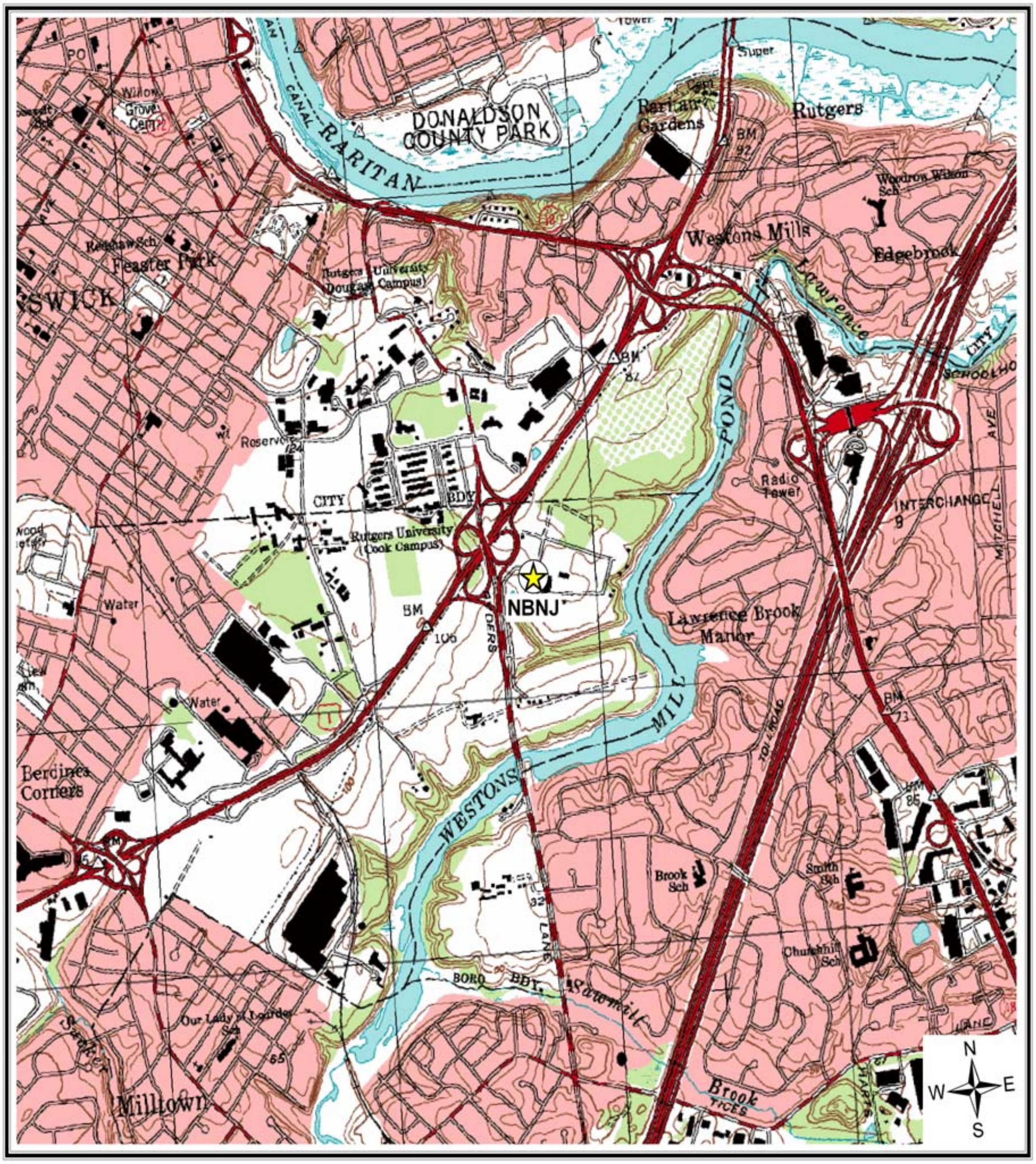
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 14-3. Elizabeth, New Jersey (ELNJ) Monitoring Station



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

Figure 14-4. New Brunswick, New Jersey (NBNJ) Monitoring Station



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

Figure 14-5. Facilities Located Within 10 Miles of CANJ

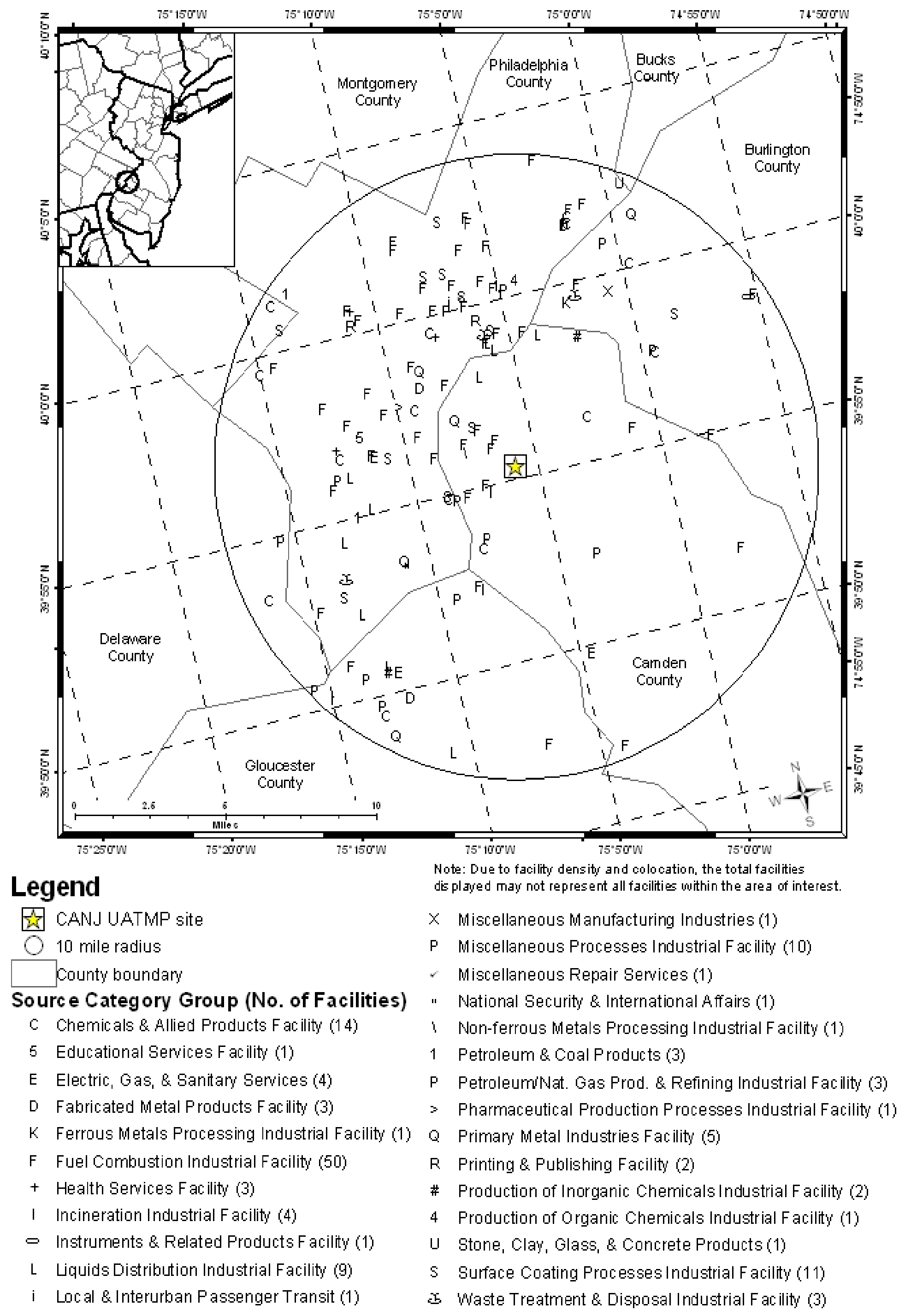
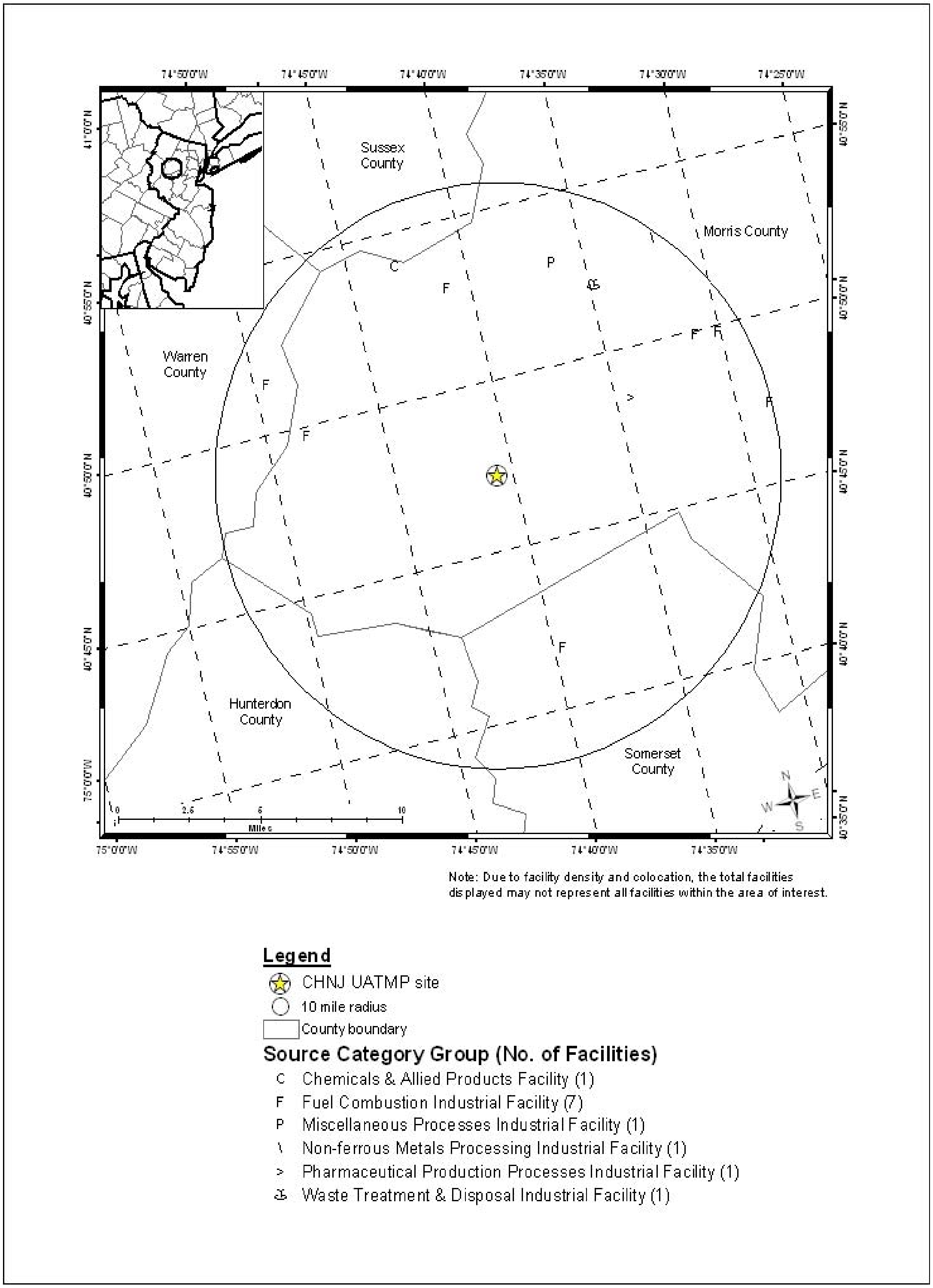


Figure 14-6. Facilities Located Within 10 Miles of CHNJ



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

Figure 14-7. Facilities Located Within 10 Miles of ELNJ and NBNJ

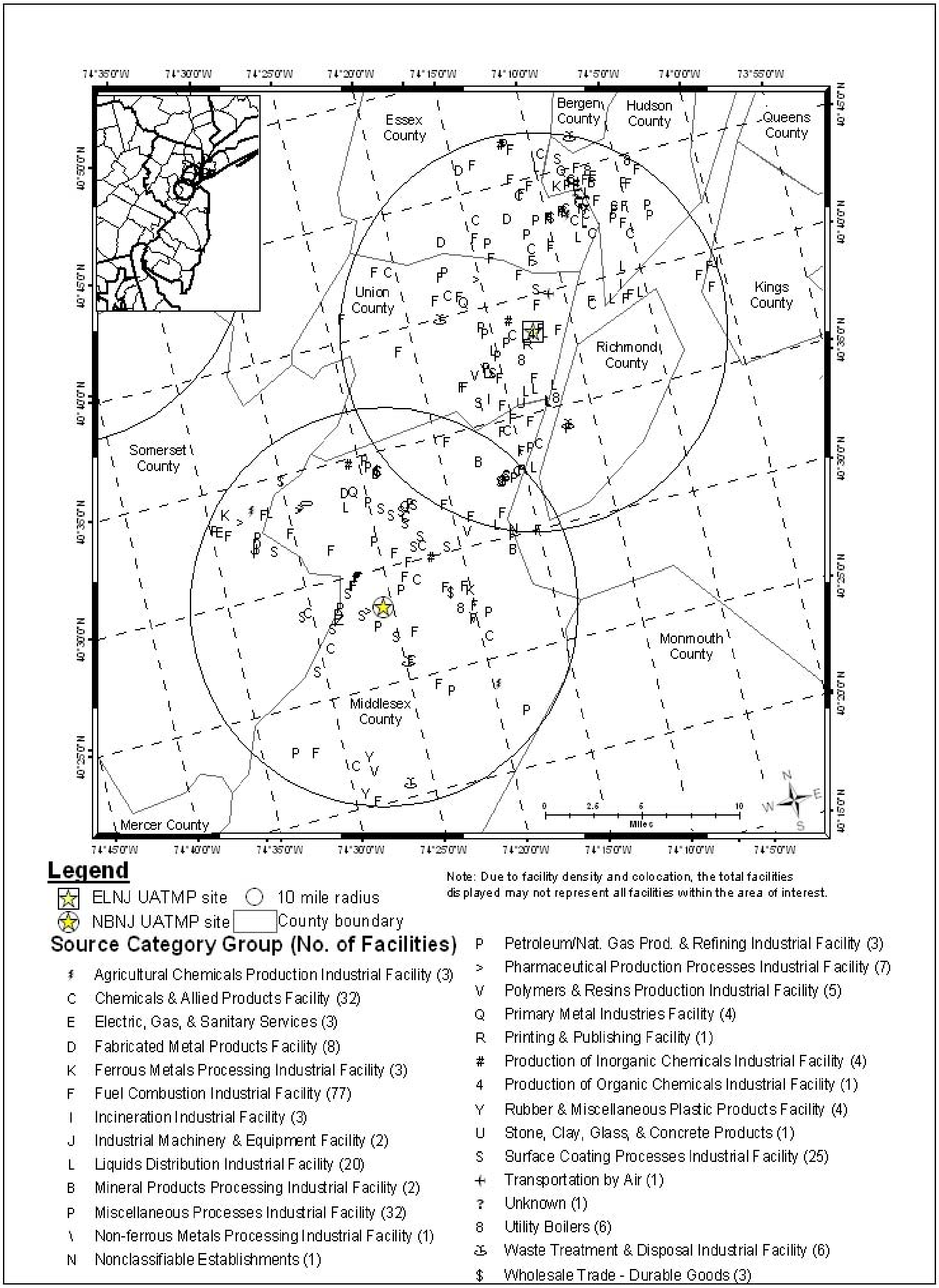


Figure 14-8. 2003 Total VOC Profile at CANJ

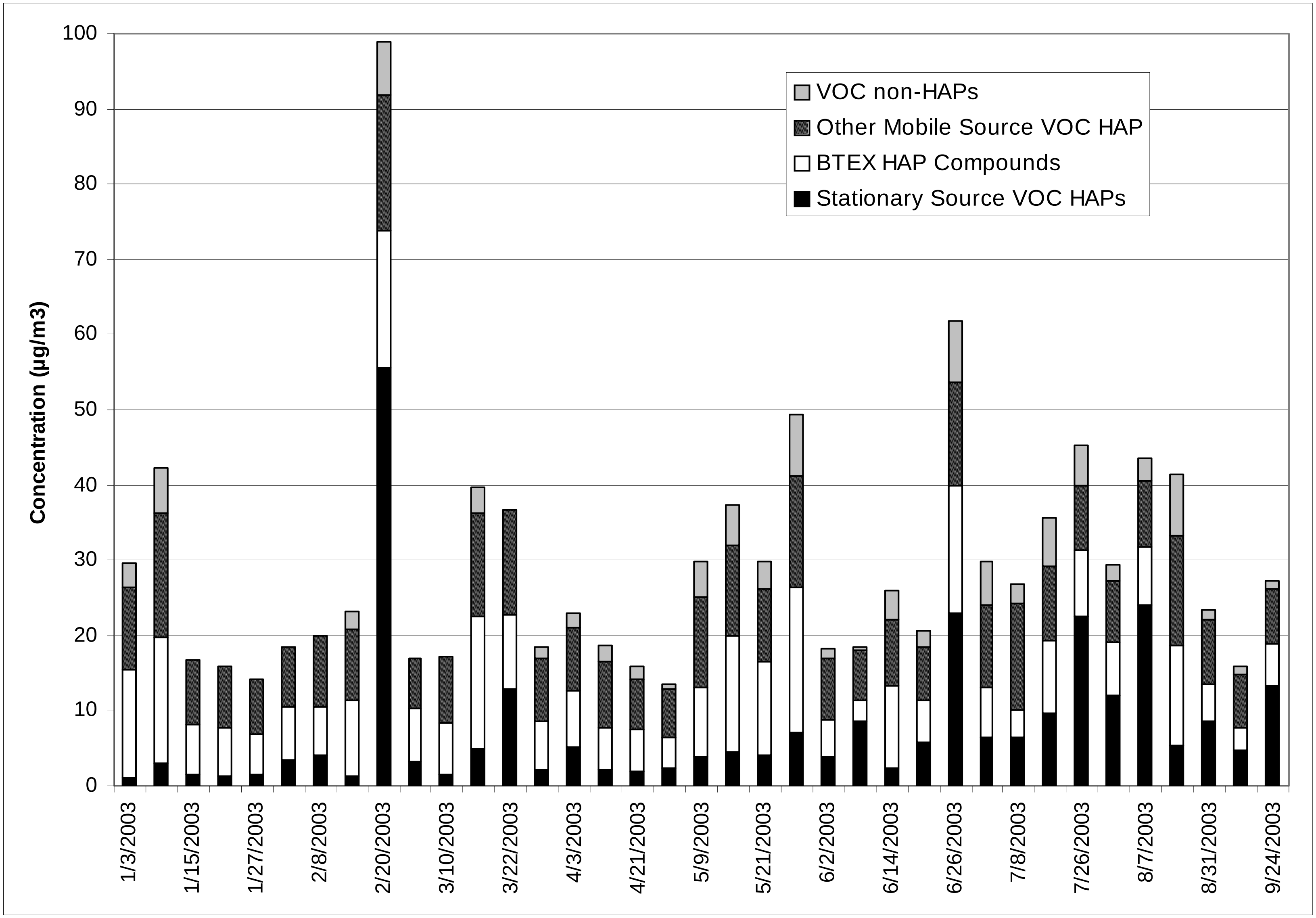


Figure 14-9. 2003 Total VOC Profile at CHNJ

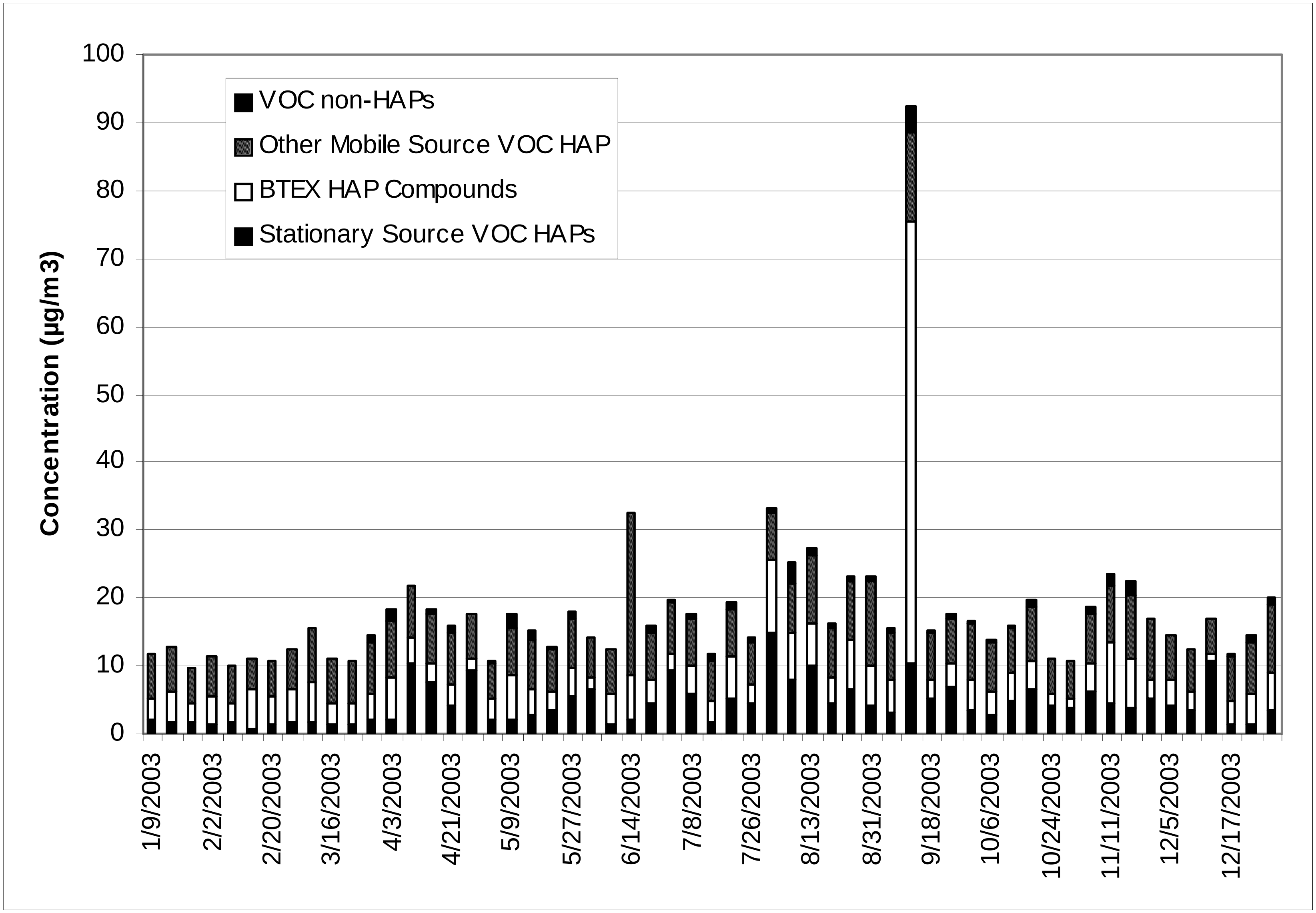


Figure 14-10. 2003 Total VOC Profile at ELNJ

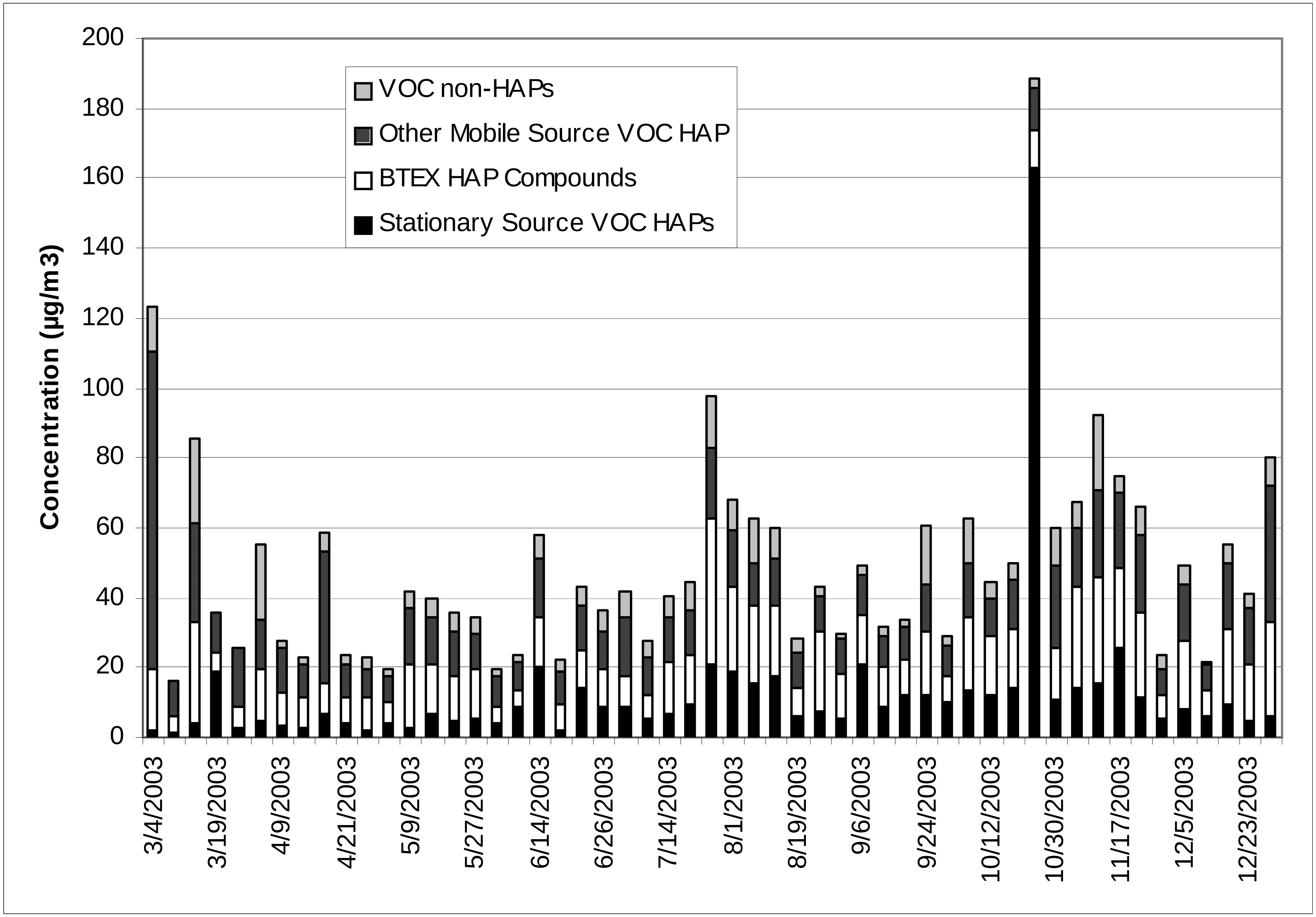


Figure 14-11. 2003 Total VOC Profile at NBNJ

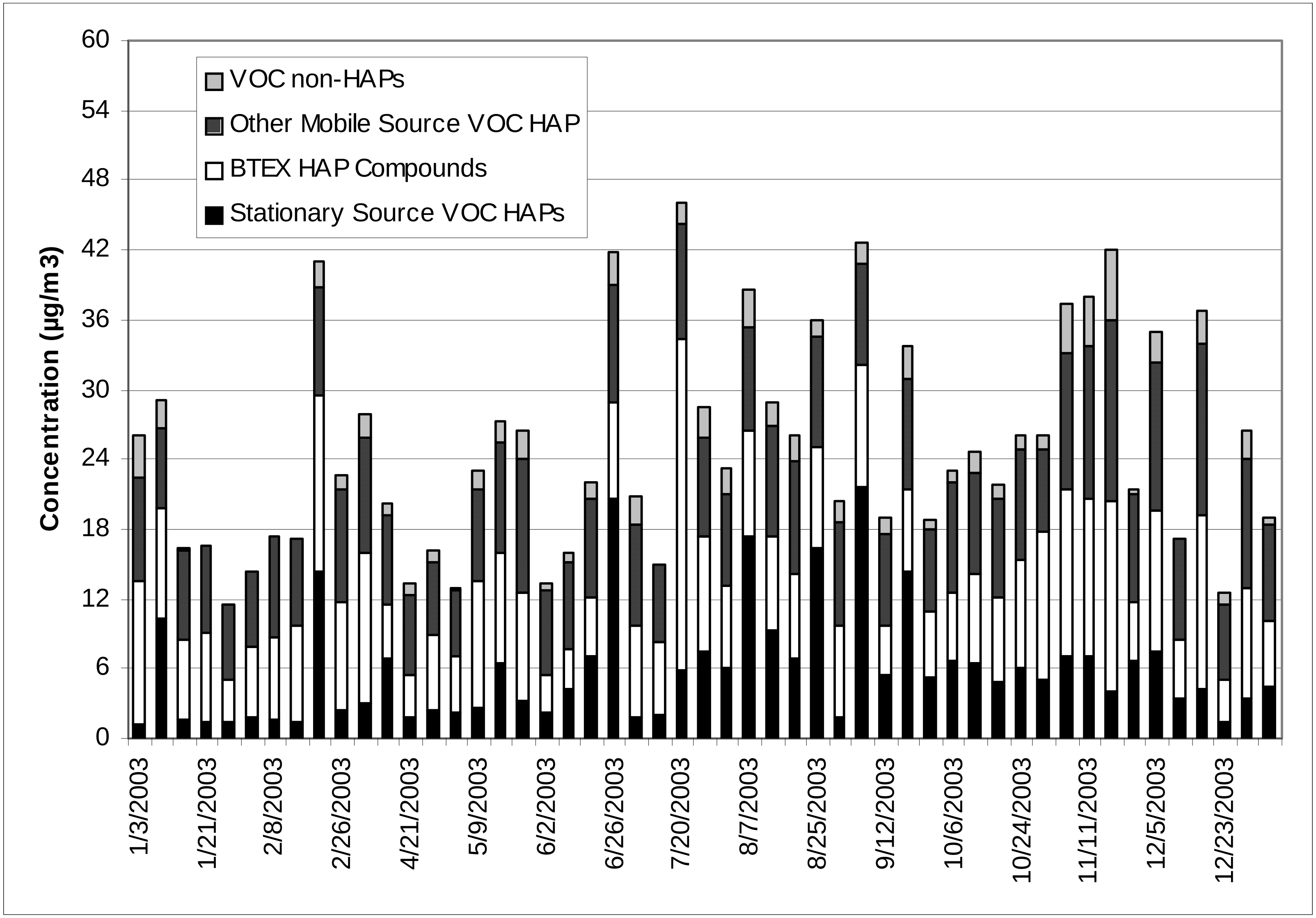


Table 14-1. Average Concentration and Meteorological Parameters for Sites in New Jersey

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)
NJ-CANJ	All 2003	▨	61.56 (±1.95)	53.51 (±1.82)	42.91 (±1.99)	48.53 (±1.73)	70.18 (±1.51)	1016.76 (±0.72)	1.40 (±0.57)	-1.24 (±0.38)
	sample day	30.45 (±5.71)	62.72 (±6.24)	54.77 (±6.00)	43.66 (±6.65)	49.51 (±5.67)	68.82 (±4.77)	1017.10 (±2.01)	0.97 (±1.77)	-0.88 (±1.11)
NJ-CHNJ	All 2003	▨	60.36 (±1.93)	50.46 (±1.77)	41.80 (±2.03)	46.58 (±1.75)	75.05 (±1.42)	1015.97 (±0.74)	-0.06 (±0.27)	-0.89 (±0.29)
	sample day	26.07 (±3.04)	61.19 (±4.50)	50.40 (±4.26)	42.11 (±4.76)	46.60 (±4.20)	75.96 (±3.01)	1016.40 (±1.78)	-0.32 (±0.75)	-0.76 (±0.55)
NJ-ELNJ	All 2003	▨	60.64 (±1.94)	53.51 (±1.85)	42.07 (±2.02)	48.21 (±1.73)	68.17 (±1.62)	1016.25 (±0.75)	1.89 (±0.59)	-1.41 (±0.50)
	sample day	62.78 (±9.66)	66.17 (±3.97)	58.56 (±3.81)	46.61 (±4.12)	52.55 (±3.51)	67.72 (±4.01)	1017.4 (±1.7)	1.10 (±1.55)	-0.71 (±1.19)
NJ-NBNJ	All 2003	▨	60.36 (±1.93)	50.46 (±1.77)	41.8 (±2.03)	46.58 (±1.75)	75.05 (±1.42)	1015.97 (±0.74)	-0.06 (±0.27)	-0.89 (±0.29)
	sample day	35.39 (±3.83)	60.50 (±5.05)	50.01 (±4.77)	41.60 (±5.36)	46.23 (±4.69)	75.54 (±3.40)	1016.49 (±1.96)	-0.25 (±0.79)	-1.07 (±0.69)

Table 14-2a. Summary of the Toxic Cancer Compounds at the Camden, New Jersey Monitoring Site - CANJ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	2.83E-05	43.85	43.85	0.416	4	28.3
Benzene	1.24E-05	19.24	63.09	1.591	37	12.4
Carbon Tetrachloride	8.44E-06	13.09	76.18	0.563	33	8.44
1,3-Butadiene	5.56E-06	8.62	84.80	0.185	14	5.56
p-Dichlorobenzene	3.41E-06	5.28	90.08	0.310	10	3.41
Tetrachloroethene	2.49E-06	3.87	93.94	0.423	11	2.49
Acetaldehyde	1.83E-06	2.84	96.78	0.832	37	1.83
Vinyl Chloride	1.35E-06	2.09	98.88	0.153	1	1.35
Trichloroethylene	4.49E-07	0.70	99.57	0.224	4	<1
Methylene Chloride (Dichloromethane)	2.71E-07	0.42	99.99	0.578	24	<1
Formaldehyde	3.73E-09	0.01	100.00	0.678	37	<1

Table 14-2b. Summary of the Toxic Cancer Compounds at the Chester, New Jersey Monitoring Site - CHNJ

Compound	**Average Toxicity**	**% Contribution**	**Cumulative % Contribution**	**Average Concentration ($\mu g/m^3$)**	**# Detects**	**Cancer Risk (Out of 1 Million)**
Acrylonitrile	2.71E-05	50.70	50.70	0.399	5	27.1
Carbon Tetrachloride	7.70E-06	14.38	65.07	0.513	51	7.70
Benzene	5.49E-06	10.25	75.32	0.704	57	5.49
1,3-Butadiene	4.08E-06	7.63	82.95	0.136	7	4.08
Acetaldehyde	4.01E-06	7.49	90.44	1.824	58	4.01
Tetrachloroethylene	2.97E-06	5.54	95.98	0.503	15	2.97
p-Dichlorobenzene	1.32E-06	2.47	98.45	0.120	1	1.32
Trichloroethylene	6.01E-07	1.12	99.58	0.301	2	<1
Methylene Chloride (Dichloromethane)	2.08E-07	0.39	99.97	0.443	38	<1
Formaldehyde	1.76E-08	0.03	100.00	3.202	58	<1

Table 14-2c. Summary of the Toxic Cancer Compounds at the Elizabeth, New Jersey Monitoring Site - ELNJ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Tetrachloroethylene	3.33E-05	37.39	37.39	5.637	29	33.3
Acrylonitrile	1.44E-05	16.16	53.55	0.211	4	14.4
Benzene	1.27E-05	14.31	67.86	1.632	53	12.7
Acetaldehyde	9.19E-06	10.33	78.19	4.177	51	9.19
Carbon Tetrachloride	7.90E-06	8.88	87.07	0.527	47	7.90
1,3-Butadiene	7.25E-06	8.15	95.21	0.242	39	7.25
p-Dichlorobenzene	2.72E-06	3.06	98.28	0.248	15	2.72
Trichloroethylene	5.45E-07	0.61	98.89	0.273	20	<1
Methylene Chloride (Dichloromethane)	5.16E-07	0.58	99.47	1.099	50	<1
Vinyl Chloride	4.50E-07	0.51	99.98	0.051	1	<1
Formaldehyde	2.21E-08	0.02	100.00	4.014	51	<1

Table 14-2d. Summary of the Toxic Cancer Compounds at the New Brunswick, New Jersey Monitoring Site - NBNJ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	2.37E-05	42.56	42.56	0.348	4	23.7
Benzene	8.20E-06	14.72	57.28	1.051	51	8.20
Carbon Tetrachloride	8.18E-06	14.69	71.97	0.545	47	8.18
Acetaldehyde	6.67E-06	11.97	83.95	3.031	51	6.67
1,3-Butadiene	4.37E-06	7.84	91.79	0.146	16	4.37
Tetrachloroethylene	2.27E-06	4.07	95.86	0.384	23	2.27
p-Dichlorobenzene	1.69E-06	3.03	98.90	0.154	6	1.69
Trichloroethylene	3.57E-07	0.64	99.54	0.178	6	<1
Methylene Chloride (Dichloromethane)	2.40E-07	0.43	99.97	0.510	44	<1
Formaldehyde	1.81E-08	0.03	100.00	3.284	51	<1

Table 14-3a. Summary of the Toxic Noncancer Compounds at the Camden, New Jersey Monitoring Site - CANJ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Bromomethane (Methyl Bromide)	7.80E-01	51.72	51.72	3.899	16	2
Acrylonitrile	2.08E-01	13.79	65.52	0.416	4	0
Acetonitrile	1.03E-01	6.81	72.33	6.164	10	0
1,3-Butadiene	9.27E-02	6.15	78.48	0.185	14	0
Acetaldehyde	9.25E-02	6.14	84.61	0.832	37	0
Formaldehyde	6.92E-02	4.59	89.20	0.678	37	0
Benzene	5.30E-02	3.52	92.72	1.591	37	0
Xylenes (*o*-, *m*-, *p*-)	3.74E-02	2.48	95.20	3.745	36	0
Chloroprene	2.59E-02	1.71	96.92	0.181	1	0
Chloromethane (Methyl Chloride)	1.54E-02	1.02	97.94	1.390	37	0
Carbon Tetrachloride	1.41E-02	0.93	98.88	0.563	33	0
Toluene	7.98E-03	0.53	99.41	3.191	37	0
Tetrachloroethylene	1.57E-03	0.10	99.51	0.423	11	0
Vinyl Chloride	1.53E-03	0.10	99.61	0.153	1	0
Chloroform	1.53E-03	0.10	99.71	0.150	6	0
Methyl *tert*-Butyl Ether	1.13E-03	0.08	99.79	3.405	29	0
Methyl Ethyl Ketone (2-Butanone)	7.10E-04	0.05	99.83	3.552	17	0
Methylene Chloride (Dichloromethane)	5.78E-04	0.04	99.87	0.578	24	0
Ethylbenzene	5.54E-04	0.04	99.91	0.554	34	0
p-Dichlorobenzene	3.87E-04	0.03	99.94	0.310	10	0
Trichloroethylene	3.74E-04	0.02	99.96	0.224	4	0
Styrene	2.40E-04	0.02	99.98	0.240	13	0
1,1,1-Trichloroethane (Methyl Chloroform)	2.26E-04	0.01	99.99	0.226	13	0
Methyl Isobutyl Ketone (Hexone)	1.30E-04	0.01	100.00	0.390	5	0

Table 14-3b. Summary of the Toxic Noncancer Compounds at the Chester, New Jersey Monitoring Site - CHNJ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	3.27E-01	35.48	35.48	3.202	58	1
Acetaldehyde	2.03E-01	22.01	57.48	1.824	58	0
Acrylonitrile	2.00E-01	21.67	79.16	0.399	5	0
1,3-Butadiene	6.81E-02	7.39	86.55	0.136	7	0
Acetonitrile	2.90E-02	3.15	89.70	1.742	18	0
Benzene	2.35E-02	2.55	92.25	0.704	57	0
Xylenes (*o*-, *m*-, *p*-)	2.18E-02	2.36	94.61	2.177	56	0
Chloromethane (Methyl Chloride)	1.29E-02	1.40	96.01	1.163	57	0
Carbon Tetrachloride	1.28E-02	1.39	97.41	0.513	51	0
Bromomethane (Methyl Bromide)	1.02E-02	1.11	98.52	0.051	2	0
Toluene	5.39E-03	0.59	99.10	2.157	57	0
Methyl Methacrylate	2.12E-03	0.23	99.33	1.487	1	0
Tetrachloroethylene	1.86E-03	0.20	99.54	0.503	15	0
Chloroform	1.16E-03	0.13	99.66	0.114	9	0
Methyl Ethyl Ketone (2-Butanone)	5.72E-04	0.06	99.72	2.861	33	0
Trichloroethylene	5.01E-04	0.05	99.78	0.301	2	0
Methylene Chloride (Dichloromethane)	4.43E-04	0.05	99.83	0.443	38	0
Ethylbenzene	4.17E-04	0.05	99.87	0.417	38	0
Styrene	4.07E-04	0.04	99.92	0.407	11	0
Methyl *tert*-Butyl Ether	2.95E-04	0.03	99.95	0.885	36	0
Methyl Isobutyl Ketone (Hexone)	1.66E-04	0.02	99.97	0.497	3	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.54E-04	0.02	99.98	0.154	23	0
p-Dichlorobenzene	1.50E-04	0.02	100.00	0.120	1	0
Chloroethane (Ethyl Chloride)	4.41E-06	0.00	100.00	0.044	2	0

Table 14-3c. Summary of the Toxic Noncancer Compounds at the Elizabeth, New Jersey Monitoring Site - ELNJ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	4.64E-01	32.71	32.71	4.177	51	6
Formaldehyde	4.10E-01	28.87	61.58	4.014	51	0
1,3-Butadiene	1.21E-01	8.51	70.09	0.242	39	0
Acrylonitrile	1.06E-01	7.45	77.54	0.211	4	0
Acetonitrile	9.20E-02	6.49	84.03	5.521	26	0
Xylenes (*o*-, *m*-, *p*-)	7.18E-02	5.06	89.09	7.181	53	0
Benzene	5.44E-02	3.83	92.92	1.632	53	0
Bromomethane (Methyl Bromide)	2.58E-02	1.82	94.74	0.129	6	0
Tetrachloroethylene	2.09E-02	1.47	96.22	5.637	29	0
Chloromethane (Methyl Chloride)	1.36E-02	0.96	97.18	1.227	53	0
Carbon Tetrachloride	1.32E-02	0.93	98.10	0.527	47	0
Toluene	1.26E-02	0.89	99.00	5.057	53	0
1,1-Dichloroethylene (Vinylidene Chloride)	3.28E-03	0.23	99.23	0.655	1	0
Methyl *tert*-Butyl Ether	2.08E-03	0.15	99.37	6.247	50	0
Methyl Methacrylate	2.00E-03	0.14	99.51	1.398	4	0
Chloroform	1.93E-03	0.14	99.65	0.189	14	0
Methylene Chloride (Dichloromethane)	1.10E-03	0.08	99.73	1.099	50	0
Ethylbenzene	1.03E-03	0.07	99.80	1.029	48	0
Methyl Ethyl Ketone (2-Butanone)	7.47E-04	0.05	99.85	3.737	43	0
Styrene	5.24E-04	0.04	99.89	0.524	26	0
Vinyl Chloride	5.11E-04	0.04	99.93	0.051	1	0
Trichloroethylene	4.54E-04	0.03	99.96	0.273	20	0
p-Dichlorobenzene	3.10E-04	0.02	99.98	0.248	15	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.83E-04	0.01	99.99	0.183	26	0
Methyl Isobutyl Ketone (Hexone)	1.04E-04	0.01	100.00	0.313	9	0
Ethyl Chloride	1.26E-05	0.00	100.00	0.126	1	0

Table 14-3d. Summary of the Toxic Noncancer Compounds at the New Brunswick, New Jersey Monitoring Site - NBNJ

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	3.37E-01	30.67	30.67	3.031	51	0
Formaldehyde	3.35E-01	30.52	61.19	3.284	51	3
Acrylonitrile	1.74E-01	15.87	77.06	0.348	4	0
1,3-Butadiene	7.28E-02	6.63	83.68	0.146	16	0
Acetonitrile	4.87E-02	4.43	88.12	2.920	24	0
Xylenes (*o*-, *m*-, *p*-)	3.52E-02	3.21	91.32	3.521	51	0
Benzene	3.50E-02	3.19	94.51	1.051	51	0
Bromomethane (Methyl Bromide)	1.81E-02	1.65	96.16	0.091	3	0
Carbon Tetrachloride	1.36E-02	1.24	97.40	0.545	47	0
Chloromethane (Methyl Chloride)	1.31E-02	1.19	98.60	1.180	51	0
Toluene	8.76E-03	0.80	99.40	3.503	51	0
Chloroform	1.81E-03	0.16	99.56	0.177	17	0
Tetrachloroethylene	1.42E-03	0.13	99.69	0.384	23	0
Methyl Ethyl Ketone (2-Butanone)	6.63E-04	0.06	99.75	3.315	30	0
Methyl *tert*-Butyl Ether	6.19E-04	0.06	99.81	1.858	42	0
Ethylbenzene	5.74E-04	0.05	99.86	0.574	46	0
Methylene Chloride (Dichloromethane)	5.10E-04	0.05	99.91	0.510	44	0
Trichloroethylene	2.97E-04	0.03	99.93	0.178	6	0
p-Dichlorobenzene	1.92E-04	0.02	99.95	0.154	6	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.88E-04	0.02	99.97	0.188	23	0
Methyl Isobutyl Ketone (Hexone)	1.68E-04	0.02	99.98	0.505	6	0
Styrene	1.63E-04	0.01	100.00	0.163	23	0
Chloroethane (Ethyl Chloride)	1.91E-05	0.00	100.00	0.191	2	0

Table 14-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Camden, New Jersey Site (CANJ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.46	-0.47	-0.43	-0.46	-0.04	-0.21	0.31	-0.02
Acetaldehyde	0.39	0.40	0.40	0.41	0.19	0.05	-0.06	0.21
Acetonitrile	0.16	0.23	0.43	0.39	0.36	0.12	0.12	0.49
Acrylonitrile	-0.77	-0.83	-0.61	-0.83	0.21	-0.57	-0.33	-0.79
Benzene	-0.03	-0.07	-0.09	-0.09	-0.08	-0.26	0.33	0.08
Carbon Tetrachloride	0.42	0.43	0.44	0.43	0.23	-0.33	-0.02	0.20
Formaldehyde	0.48	0.49	0.42	0.46	-0.01	0.01	0.08	0.26
Bromomethane (Methyl Bromide)	-0.34	-0.36	-0.35	-0.36	-0.07	0.34	-0.01	-0.12
p-Dichlorobenzene	0.02	-0.09	-0.14	-0.15	-0.07	-0.41	0.32	0.06
Tetrachloroethene	-0.45	-0.44	-0.28	-0.38	0.19	-0.18	-0.11	-0.31
Xylenes (*o*-, *m*-, *p*-)	0.11	0.08	0.11	0.08	0.13	-0.18	0.10	0.15

Table 14-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Chester, New Jersey Site (CHNJ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	0.82	0.80	0.71	0.77	0.25	-0.75	-0.14	0.17
Acetaldehyde	0.14	0.05	0.03	0.04	-0.08	0.09	0.01	0.40
Acetonitrile	-0.26	-0.22	-0.18	-0.19	0.02	0.09	-0.25	-0.36
Acrylonitrile	-0.69	-0.92	-0.98	-0.96	-0.55	0.02	0.53	0.38
Benzene	-0.48	-0.52	-0.49	-0.51	-0.21	0.09	0.09	-0.01
Carbon Tetrachloride	0.24	0.25	0.23	0.24	0.07	-0.07	-0.08	-0.07
Formaldehyde	0.58	0.52	0.48	0.50	0.11	0.00	0.02	0.29
Chloromethane (Methyl Chloride)	0.49	0.45	0.43	0.44	0.18	-0.05	-0.16	0.24
Tetrachloroethene	-0.40	-0.32	-0.30	-0.30	-0.06	-0.06	0.13	-0.22
Xylenes (*o*-, *m*-, *p*-)	0.20	0.23	0.24	0.24	0.14	0.19	-0.27	0.06

Table 14-4c. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Elizabeth, New Jersey Site (ELNJ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.45	-0.41	-0.30	-0.37	0.18	0.17	-0.22	-0.21
Acetaldehyde	-0.28	-0.28	-0.19	-0.25	0.14	0.30	-0.03	-0.04
Acetonitrile	0.40	0.39	0.40	0.42	0.03	0.24	-0.02	0.01
Acrylonitrile	0.91	0.89	0.84	0.87	0.43	-0.12	-0.07	0.92
Benzene	-0.36	-0.41	-0.29	-0.37	0.16	0.16	-0.04	0.11
Carbon Tetrachloride	0.17	0.18	0.13	0.16	-0.05	0.11	-0.28	-0.20
Formaldehyde	0.08	0.09	0.16	0.12	0.16	0.31	0.05	0.18
Bromomethane (Methyl Bromide)	0.28	0.26	0.03	0.12	-0.36	-0.07	0.19	0.27
Tetrachloroethene	-0.24	-0.27	-0.33	-0.30	-0.16	0.13	0.11	-0.23
Xylenes (*o*-, *m*-, *p*-)	0.17	0.16	0.27	0.22	0.29	0.21	-0.03	0.13

Table 14-4d. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the New Brunswick, New Jersey Site (NBNJ)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.52	-0.52	-0.46	-0.49	0.15	0.41	-0.29	0.09
Acetaldehyde	0.56	0.57	0.58	0.58	0.37	0.23	-0.12	0.32
Acetonitrile	0.31	0.22	0.19	0.20	-0.01	-0.32	0.17	0.00
Acrylonitrile	0.34	-0.78	-0.80	-0.83	-0.42	0.08	0.30	-0.07
Benzene	-0.48	-0.49	-0.41	-0.46	0.03	0.18	-0.05	-0.10
Carbon Tetrachloride	0.25	0.28	0.28	0.28	0.18	0.12	-0.12	0.17
Formaldehyde	0.62	0.57	0.55	0.57	0.22	-0.03	0.00	0.33
Bromomethane (Methyl Bromide)	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	-0.10	-0.12	-0.07	-0.09	0.25	0.06	-0.04	0.13
Xylenes (*o*-, *m*-, *p*-)	0.09	0.10	0.17	0.13	0.35	0.07	-0.18	0.09

Table 14-5. Motor Vehicle Information vs. Daily Concentration for New Jersey Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
CANJ	511,957	393,869	0.77	2,023,903	1,558,405	62,000	30.45 (±5.71)
CHNJ	478,730	366,433	0.77	231,275	178,082	12,623	26.07 (±3.04)
ELNJ	530,763	407,799	0.77	2,160,143	1,663,310	170,000	62.78 (±9.66)
NBNJ	775,549	591,406	0.76	768,506	584,065	63,000	35.39 (±3.83)

15.0 Site in North Carolina

This section focuses on meteorological, concentration, and spatial trends for the UATMP site in North Carolina (CANC). This site is located in Candor near the Uwharrie National Forest. Figure 15-1 is a topographical map showing the monitoring station in its urban location. Figure 15-2 is a map identifying facilities within ten miles of the site that reported to the 1999 NEI. The CANC site has very few sources nearby, mostly located to the north of the site, and most are involved in fuel combustion industries. Hourly meteorological data were retrieved for all of 2003 at the Monroe Airport (WBAN 53872) with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 15-1 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), wind information (average u- and v-components of the wind), and pressure (average sea level pressure) 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

15.1 Prevalent Compounds at the North Carolina Site

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 CANC site sampled only carbonyls. As can be shown in Tables 15-2 and 15-3, acetaldehyde was the only prevalent cancer compound at the CANC site, while both acetaldehyde and formaldehyde were prevalent for noncancer compounds. All toxic carbonyl compounds were detected at CANC.

15.2 Toxicity Analysis

For cancer compounds, acetaldehyde contributed to over 99% of the total toxicity while the contribution to total noncancer toxicity was more evenly distributed. The number of detections of acetaldehyde equaled the number of detections of formaldehyde at the CANC site.

The acetaldehyde cancer risk was the highest among the toxic carbonyl compounds at 3.46 in a million. For the compounds which may lead to adverse noncancer health effects, the average acetaldehyde toxicity was 0.209 (over 1 indicates a significant chance of a noncancer health effect). None of the carbonyl compound concentrations were above their noncancer RfC weighting factors.

15.3 Meteorological and Concentration Averages at the North Carolina Site

Carbonyl compounds were measured at the site, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentration at CANC was 35.13 (± 5.97) μg/m^3. Table 15-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

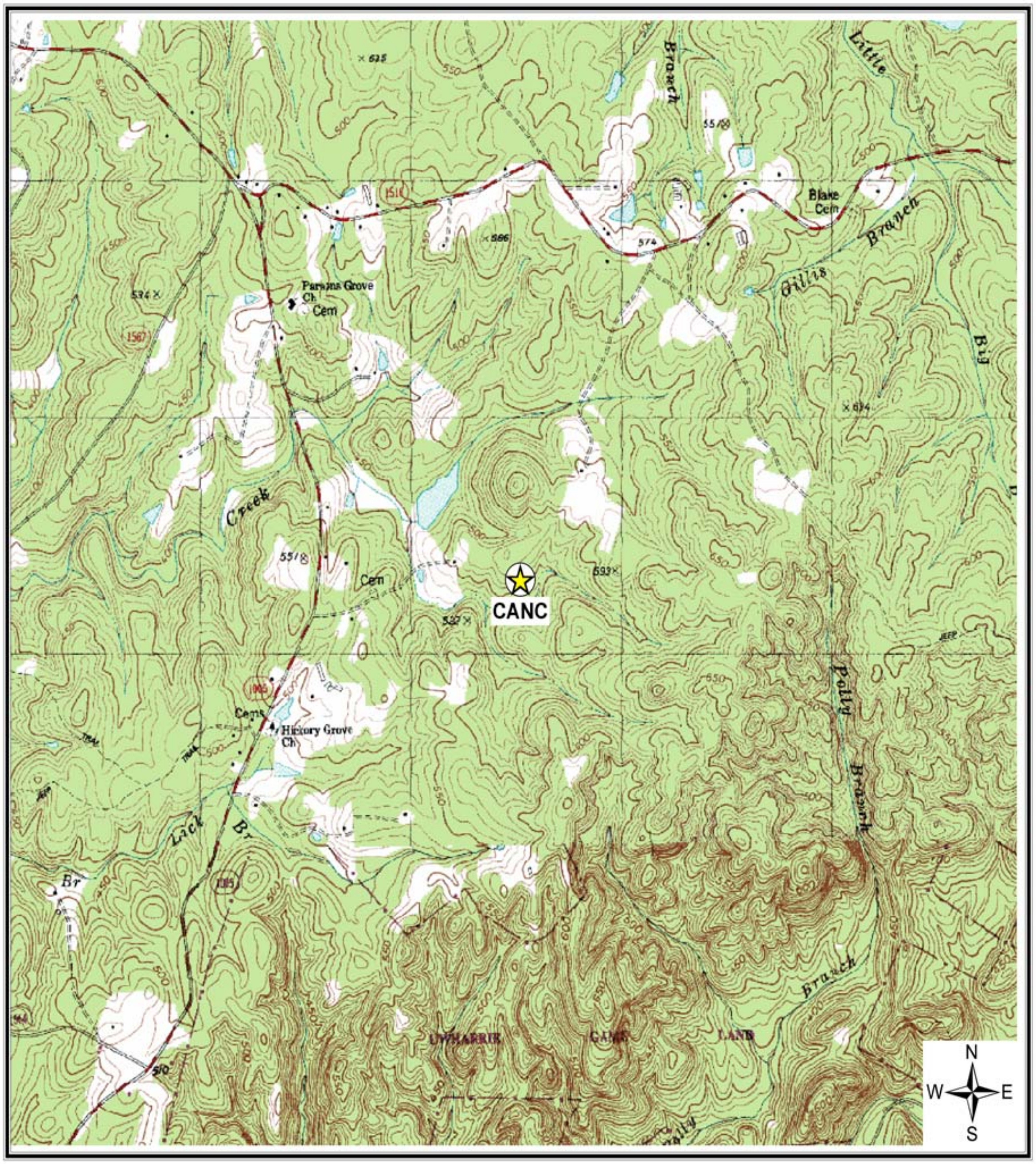
Table 15-4 presents the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. The highest correlation at CANC was computed between acetaldehyde and the v-component of the wind (0.67). Formaldehyde had a moderately strong positive correlation with the v-component as well. Both compounds also had moderately strong to strong positive correlations with the temperature parameters. The strongest negative correlation was computed between formaldehyde and relative humidity.

15.4 Spatial Analysis

County-level car registration and population in Montgomery County, NC, were obtained from the North Carolina Department of Transportation and the U.S. Census Bureau, and are summarized in Table 15-5. Also included in Table 15-5 is the population within 10 miles of the site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the CANC site in Table 15-5.

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). Since only carbonyl compounds were sampled at the CANC site, a BTEX analysis could not be performed.

Figure 15-1. Candor, North Carolina (CANC) Monitoring Station



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

Figure 15-2. Facilities Located Within 10 Miles of CANC

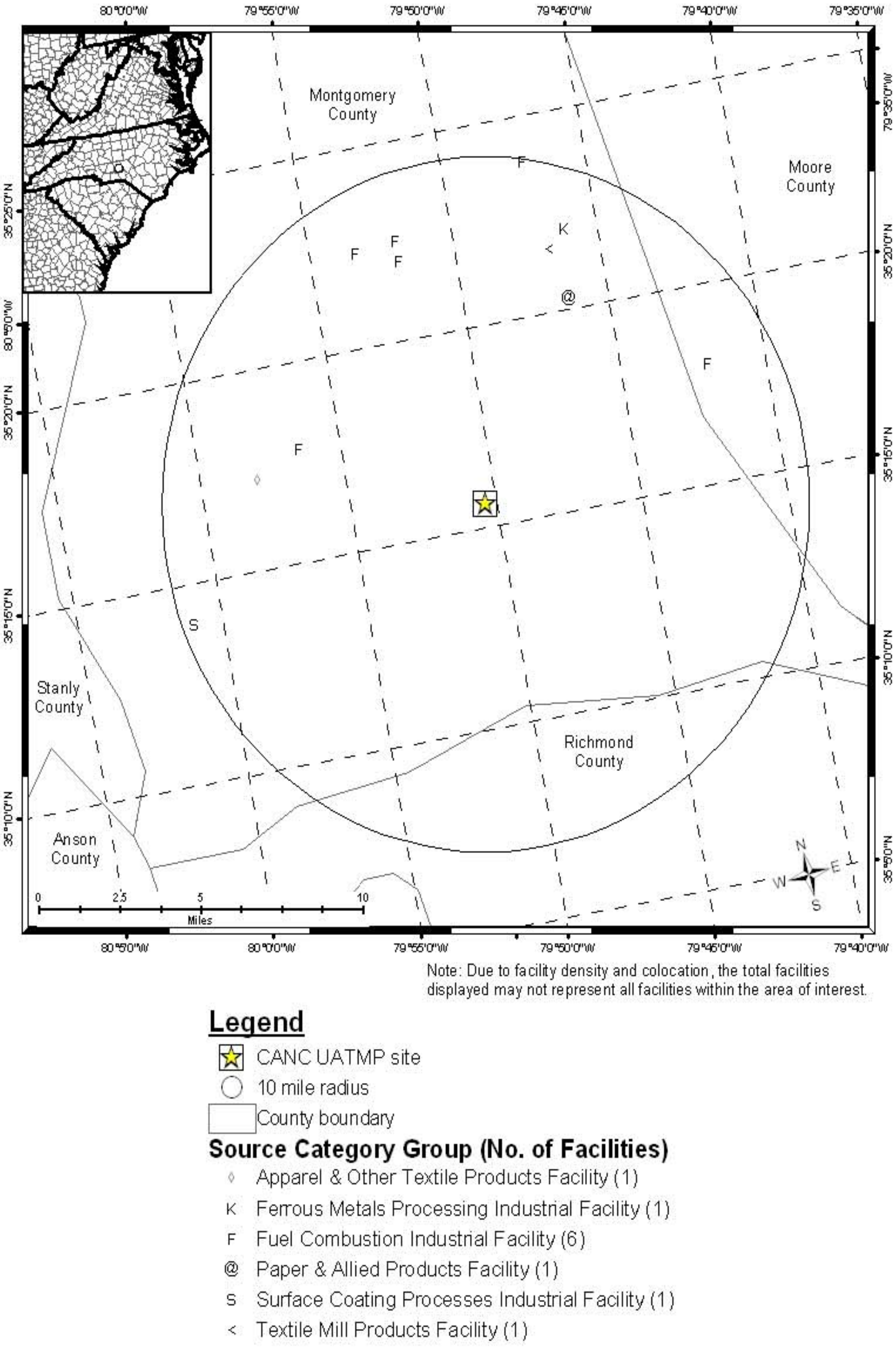


Table 15-1. Average Concentration and Meteorological Parameters for the Site in North Carolina

Site Name	Type	Average UATMP Concentration ($\mu g/m^3$)	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)
CANC	All 2003	▨	69.21 (±1.53)	58.94 (±1.46)	49.90 (±1.82)	54.42 (±1.49)	75.23 (±1.59)	1018.10 (±0.57)	1.05 (±0.37)	-0.09 (±0.38)
	sample day	7.05 (±1.69)	69.25 (±10.33)	58.67 (±9.75)	51.50 (±10.73)	54.92 (±9.69)	79.36 (±7.04)	1016.84 (±3.87)	1.24 (±1.42)	-0.07 (±2.23)

Table 15-2. Summary of the Toxic Cancer Compounds at the Candor, North Carolina Monitoring Site - CANC

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	3.46E-06	99.68	99.68	1.574	8	3.46
Formaldehyde	1.13E-08	0.32	100.00	2.052	8	<1

Table 15-3. Summary of the Toxic Noncancer Compounds at the Candor, North Carolina Monitoring Site - CANC

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	2.09E-01	54.48	54.48	2.052	8	0
Acetaldehyde	1.75E-01	45.52	100.00	1.574	8	0

Table 15-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Candor, North Carolina Site (CANC)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	0.39	0.32	0.22	0.27	-0.27	-0.26	0.28	0.67
Formaldehyde	0.50	0.30	0.15	0.21	-0.51	0.12	-0.08	0.40

Table 15-5. Motor Vehicle Information vs. Daily Concentration for the North Carolina Monitoring Site

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu g/m^3$)
CANC	27,288	25,854	0.95	10,025	9,524	100	7.05 (±1.69)

16.0 Site in North Dakota

This section focuses on meteorological, concentration, and spatial trends for the UATMP site in North Dakota (BUND). This site is located in Beulah, and Figure 16-1 is a topographical map showing the monitoring station in its urban location. Figure 16-2 is a map identifying facilities within ten miles of the site that reported to the 1999 NEI. The BUND site has six sources located within a ten mile radius: two waste treatment and disposal sites, two utility boilers, one fuel combustion site, and one petroleum and natural gas production and refining site. Hourly meteorological data were retrieved for all of 2003 at the Bismarck Municipal Airport (WBAN 24011) with the purpose of 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), wind information (average u- and v-components of the wind), and pressure (average sea level pressure) for the entire year and on sampling days. Beulah is located to the northwest of Bismarck, and Beulah's climate is continental in nature. Cold, dry winters and generally mild summers are normally expected. Climatologically, moderate northerly winds are expected in the winter, with southerly winds in the summer. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

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 three out of five of the detected cancer compounds reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. Only methylene chloride and formaldehyde were not listed among the nationwide prevalent cancer compounds. For the noncancer compounds summarized in Table 16-3, all but one of the prevalent noncancer compounds (chloromethane) were listed among the nationwide noncancer prevalent list.

Toxic compounds not detected at the North Dakota site were: tetrachloroethylene; acrylonitrile; 1,3-butadiene; *p*-dichlorobenzene; 1,2-dichloroethane; trichloroethylene; 1,3-dichloropropene; 1,1,2-trichloroethane; vinyl chloride; bromoform; acetonitrile; bromomethane; chloroprene; chloroform; 1,1-dichloroethene; methyl methacrylate; 1,2,4-trichlorobenzene; methyl-*tert*-butyl ether; styrene; chlorobenzene; and chloroethane.

16.2 Toxicity Analysis

Carbon tetrachloride and benzene contributed most to the site's cancer toxicity and also had the highest number of detects, while acetaldehyde and formaldehyde make up over 50% of the site's noncancer toxicity value. The carbon tetrachloride cancer risk was the highest among the toxic compounds at 8.56 in a million. For the compounds which may lead to adverse noncancer health effects, the average acetaldehyde toxicity was 0.0549 (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

Carbonyl compounds and VOC were measured at the site, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentration at BUND was 11.73 (± 2.26) $\mu g/m^3$. Table 16-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

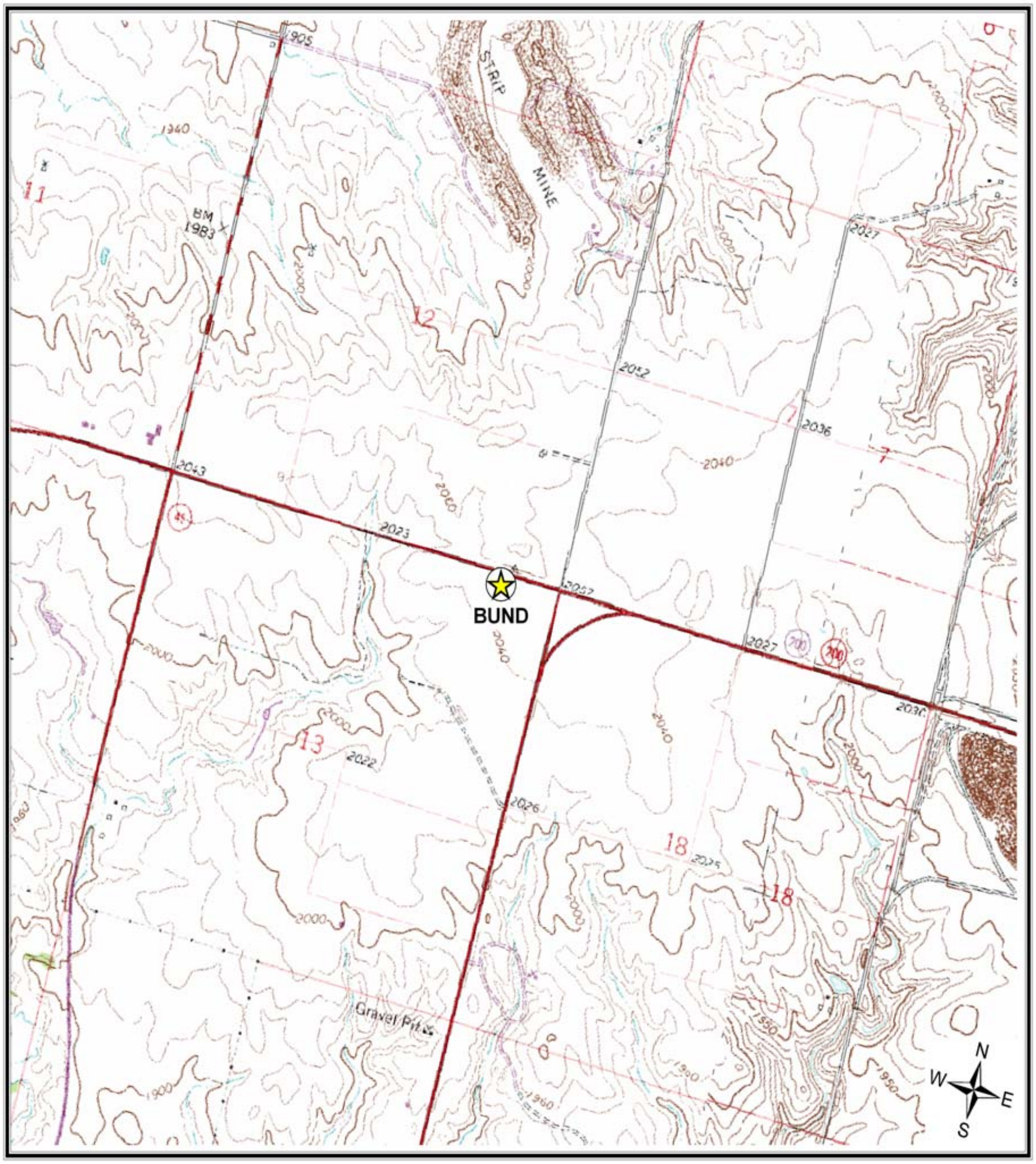
Table 16-4 presents the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. Very strong negative correlations between benzene and the temperature parameters, dewpoint, and wet bulb temperature were computed at BUND. Moderately strong to strong negative correlations were computed for xylenes (total) and the aforementioned meteorological parameters as well. Moderately strong correlations were also found between these two compounds and both relative humidity and sea level pressure. Correlations for acetaldehyde and formaldehyde could not be computed due to the low number of detects (fewer than 3).

16.2 Spatial Analysis

County-level car registration and population in Mercer County, ND, were obtained from the North Dakota Department of Transportation and the U.S. Census Bureau, and are summarized in Table 16-5. Also included in Table 16-5 is the population within 10 miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the Beulah site in Table 16-5.

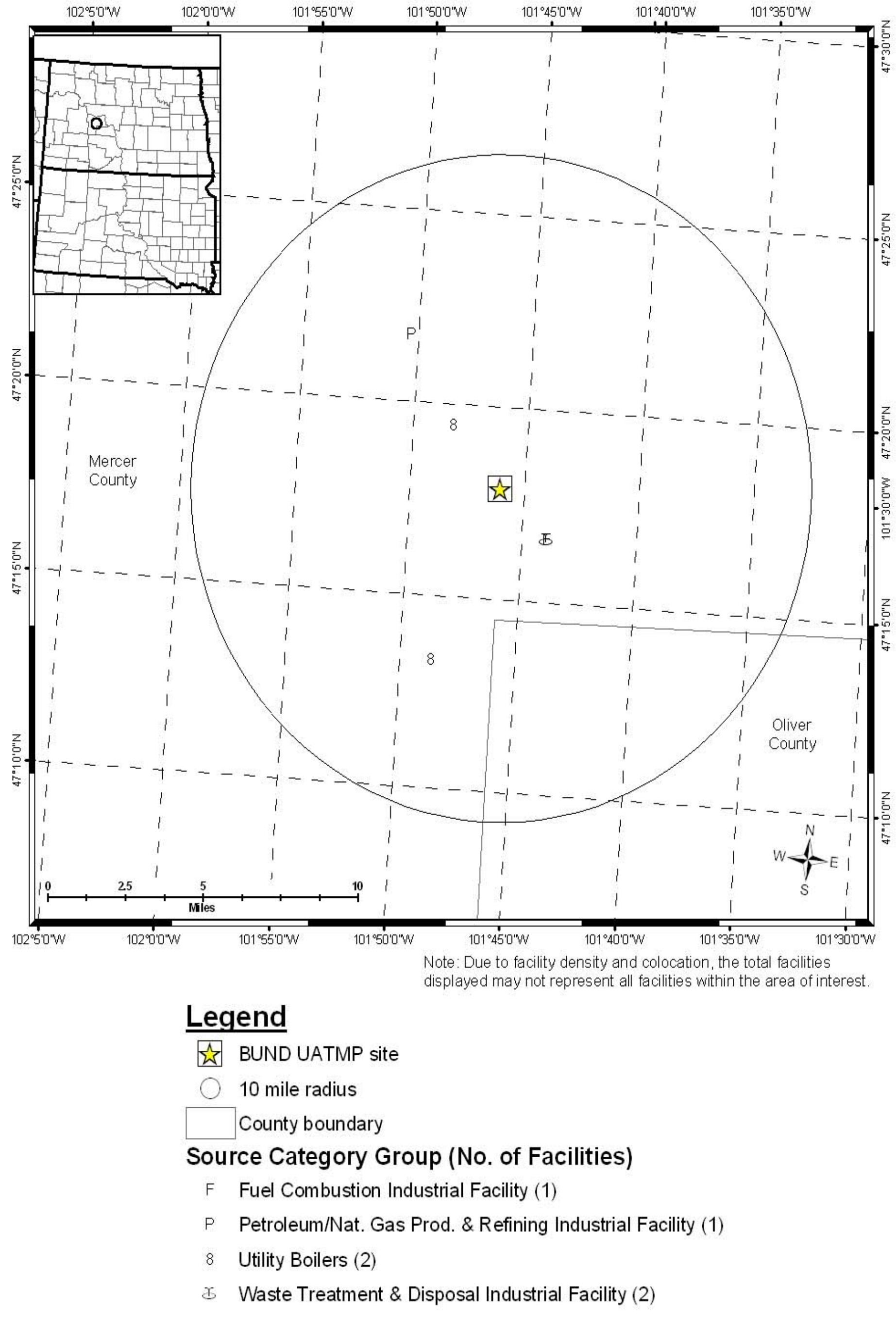
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area (for more information on this study, refer to section 3.4.2.). Figure 3-1 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at the monitoring site. The BUND site’s concentration ratios look significantly different from those of the roadside study. The xylenes-ethylbenzene ratio is the highest concentration ratio of the three, while the toluene-ethylbenzene ratio is the lowest, and the benzene-ethylbenzene ratio resides in the middle. All three values are significantly lower than those of the roadside study.

Figure 16-1. Beulah, North Dakota (BUND) Monitoring Station



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

Figure 16-2. Facilities Located Within 10 Miles of BUND



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

Table 16-1. Average Concentration and Meteorological Parameters for the Site in North Dakota

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)
BUND	All 2003	▨	55.33 (±2.72)	43.63 (±2.46)	30.78 (±2.02)	37.50 (±2.07)	65.40 (±1.36)	1015.48 (±0.80)	0.29 (±0.52)	-0.97 (±0.57)
	sample day	11.73 (±2.26)	52.83 (±9.07)	41.89 (±8.19)	30.20 (±7.12)	36.49 (±7.14)	67.26 (±4.36)	1014.14 (±2.36)	-0.81 (±2.35)	-0.91 (±2.42)

Table 16-2. Summary of the Toxic Cancer Compounds at the Beulah, North Dakota Monitoring Site - BUND

Compound	**Average Toxicity**	**% Contribution**	**Cumulative % Contribution**	**Average Concentration ($\mu g/m^3$)**	**# Detects**	**Cancer Risk (Out of 1 Million)**
Carbon Tetrachloride	8.56E-06	61.84	61.84	0.571	28	8.56
Benzene	4.05E-06	29.28	91.13	0.520	30	4.05
Acetaldehyde	1.09E-06	7.86	98.98	0.494	2	1.09
Methylene Chloride (Dichloromethane)	1.38E-07	1.00	99.98	0.294	13	<1
Formaldehyde	2.37E-09	0.02	100.00	0.431	2	<1

Table 16-3. Summary of the Toxic Noncancer Compounds at the Beulah, North Dakota Monitoring Site - BUND

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	5.49E-02	32.57	32.57	0.494	2	0
Formaldehyde	4.39E-02	26.06	58.63	0.431	2	0
Xylenes (*o*-,*m*-, *p*-)	2.19E-02	13.00	71.63	2.192	10	0
Benzene	1.73E-02	10.27	81.90	0.520	30	0
Carbon Tetrachloride	1.43E-02	8.46	90.36	0.571	28	0
Chloromethane (Methyl Chloride)	1.34E-02	7.97	98.33	1.210	30	0
Toluene	1.13E-03	0.67	99.00	0.450	30	0
Methyl Ethyl Ketone (2-Butanone)	7.73E-04	0.46	99.45	3.867	12	0
Ethylbenzene	4.27E-04	0.25	99.71	0.427	6	0
Methylene Chloride (Dichloromethane)	2.94E-04	0.17	99.88	0.294	13	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.60E-04	0.09	99.98	0.160	10	0
Methyl Isobutyl Ketone (Hexone)	4.10E-05	0.02	100.00	0.123	1	0

Table 16-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Beulah, North Dakota Site (BUND)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.83	-0.83	-0.79	-0.82	0.42	0.46	0.15	-0.36
Carbon Tetrachloride	0.32	0.33	0.29	0.32	-0.21	-0.01	0.29	0.11
Formaldehyde	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethane (Methyl Chloride)	-0.03	-0.12	-0.21	-0.16	-0.22	0.01	0.11	0.22
Xylenes (mixed)	-0.46	-0.58	-0.46	-0.56	0.40	-0.41	0.16	-0.05

Table 16-5. Motor Vehicle Information vs. Daily Concentration for the North Dakota Monitoring Site

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu g/m^3$)
BUND	8,542	13,203	1.55	7,451	11,59	1,350	11.73 (±2.26)

17.0 Site in Oklahoma

This section focuses on meteorological, concentration, and spatial trends for the UATMP site in Oklahoma (POOK). This site is located in Ponca City, and Figure 17-1 is a topographical map showing the monitoring station in its urban location. Figure 17-2 is a map identifying facilities within ten miles of the site that reported to the 1999 NEI. The POOK site has very few sources nearby. Hourly meteorological data were retrieved for all of 2003 at the Ponca City Municipal Airport (WBAN 13969) with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 17-1 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), wind information (average u- and v-components of the wind), and pressure (average sea level pressure) for the entire year and on sampling days. Ponca City is located in north-central Oklahoma, just west of the Osage Indian Reservation and Kaw Lake. The area is characterized by a continental climate, with warm and often humid summers and cool winters. The region experiences ample rainfall, with spring as its wettest season. A southerly wind prevails, bringing warm, moist air northward from the Gulf of Mexico. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

17.1 Prevalent Compounds at the Oklahoma Site

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.

The POOK site sampled for SNMOC only. As can be shown in Table 17-2, the cancer compounds reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. For the noncancer compounds summarized in Table 17-3, hexane, toluene, ethylbenzene, and styrene were not listed among the nationwide noncancer prevalent list. However, hexane and toluene are considered prevalent at POOK.

Toxic compounds detected at the Oklahoma site were: 1,3-butadiene; benzene; xylenes (total); toluene; hexane; ethylbenzene; and styrene. It is important to note that VOC and carbonyl compounds were not sampled at POOK. Therefore, it is important to determine if those compounds would have been detected or not.

17.2 Toxicity Analysis

Benzene and 1,3-butadiene were the only prevalent cancer compounds at the POOK site, and benzene contributed over 74% to the total toxicity. Benzene and 1,3-butadiene contributed to over 72% of the total toxicity for the noncancer compounds. The benzene cancer risk was the highest among the toxic compounds at 12.2 in a million. For the compounds which may lead to adverse noncancer health effects, the average 1,3-butadiene toxicity was 0.0701 (over 1 indicates a significant chance of a noncancer health effect). None of the compound concentrations were above their noncancer RfC weighting factors.

17.3 Meteorological and Concentration Averages at the Oklahoma Site

Only SNMOC were measured at the POOK site, as indicated in Tables 3-3 and 3-4. Table 17-1 lists the averages for selected meteorological parameters from January 2003 to December 2003 in addition to the average SNMOC concentration. 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 POOK was 295.97 ppbC, of which nearly 85% could be identified through speciation. Of the speciated compounds, hexane measured the highest concentration at the POOK site (20.50 ppbC).

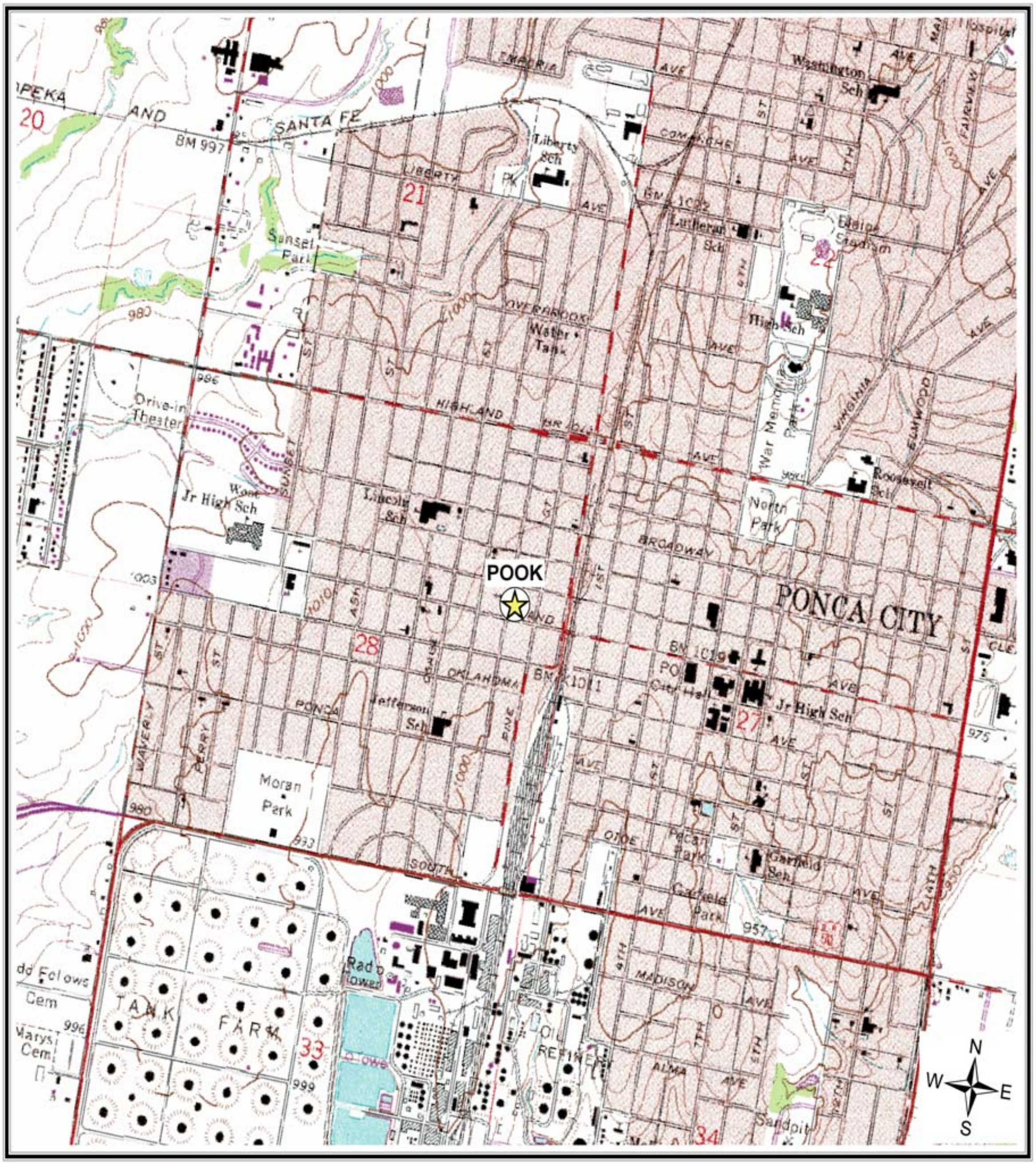
Table 17-2 is the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. All five of the prevalent compounds at POOK exhibited moderately strong to strong positive correlations with the temperature (average and maximum) and moisture (dewpoint and wet bulb) variables. The strongest correlation of this kind was between hexane and maximum temperature (0.62). Hence, as temperature, dewpoint, and wet bulb temperature increase, concentrations of the prevalent compounds at POOK also increase. The remainder of the correlations at POOK were generally weak.

17.4 Spatial Analysis

County-level car registration and population in Kay County, OK, were obtained from the Oklahoma Tax Commission's Motor Vehicle Division and the U.S. Census Bureau, and are summarized in Table 17-5. Also included in Table 17-5 is the population within 10 miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at the POOK site in Table 17-5.

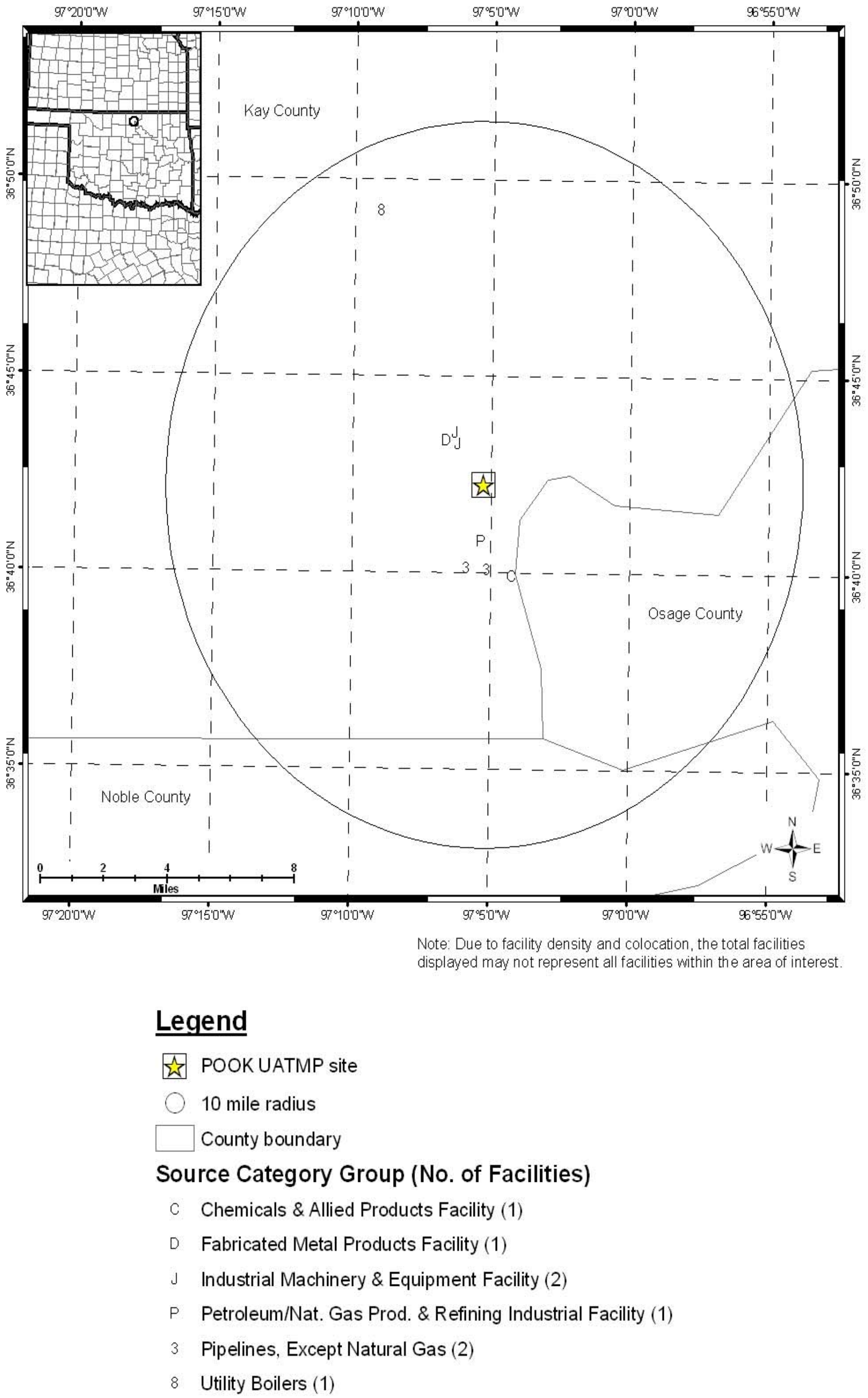
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area (for more information on this study, refer to section 3.4.2.).

Figure 17-1. Ponca City, Oklahoma (POOK) Monitoring Station



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

Figure 17-2. Facilities Located Within 10 Miles of POOK



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

Table 17-1. Average Concentration and Meteorological Parameters for the Site in Oklahoma

Site Name	Type	Average SNMOC Concentration ($\mu g/m^3$)	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)
POOK	All 2003	▨	69.01 (±2.00)	58.45 (±1.92)	46.27 (±1.85)	51.90 (±1.70)	67.79 (±1.34)	1015.73 (±0.76)	-1.77 (±0.38)	0.77 (±0.61)
	sample day	134.70 (±29.51)	53.47 (±5.63)	43.83 (±5.24)	31.41 (±6.19)	38.54 (±5.02)	65.96 (±7.93)	1016.42 (±3.42)	-1.22 (±2.54)	4.02 (±3.24)

Table 17-2. Summary of the Toxic Cancer Compounds at the Ponca City, Oklahoma Monitoring Site - POOK

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	1.22E-05	74.36	74.36	1.564	17	12.2
1,3-Butadiene	4.21E-06	25.64	100.00	0.140	15	4.21

Table 17-3. Summary of the Toxic Noncancer Compounds at the Ponca City, Oklahoma Monitoring Site - POOK

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
1,3-Butadiene	7.01E-02	41.36	41.36	0.140	15	0
Benzene	5.21E-02	30.75	72.12	1.564	17	0
Xylenes (*o*-, *m*-, *p*-)	2.03E-02	11.95	84.07	2.026	17	0
Hexane	1.82E-02	10.73	94.80	3.638	17	0
Toluene	7.90E-03	4.66	99.47	3.161	17	0
Ethylbenzene	5.52E-04	0.33	99.79	0.552	17	0
Styrene	3.54E-04	0.21	100.00	0.354	17	0

Table 17-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Ponca City, Oklahoma Site (POOK)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	0.42	0.32	0.22	0.24	-0.02	-0.07	0.04	0.07
Benzene	0.47	0.41	0.48	0.44	0.32	-0.22	0.16	0.06
Hexane	0.62	0.47	0.20	0.33	-0.23	-0.16	-0.16	0.41
Toluene	0.49	0.39	0.40	0.39	0.20	-0.18	0.15	0.00
Xylenes (*o*-,*m*-, *p*-)	0.36	0.28	0.36	0.33	0.27	-0.09	0.23	-0.08

Table 17-5. TNMOC Measured by the Ponca City, OK (POOK) Monitoring Station

Site	Average TNMOC speciated (ppbC)	Average TNMOC w/ unknowns (ppbC)	% TNMOC Identified	SNMOC Compound with the Highest Concentration (ppbC)
POOK	253.93	295.97	85%	hexane (20.50)

Table 17-6. Motor Vehicle Information vs. Daily Concentration for the Oklahoma Monitoring Site

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu g/m^3$)
POOK	47,680	41,888	0.88	32,920	28,970	1,496	134.70 (±29.51)

18.0 Site in Oregon

This section focuses on a few specific meteorological, concentration, and spatial trends for the UATMP sites in Oregon (PLOR and PNW), located in Portland. Figures 18-1 and 18-2 are topographical maps showing the monitoring stations in their urban locations. Figure 18-3 is a map identifying facilities within ten miles of the sites that reported to the 1999 NEI. Numerous industrial facilities are located within ten miles of the sites. The majority of the facilities are involved in miscellaneous processes. Hourly meteorological data were retrieved for all of 2003 at the Portand International Airport weather station (WBAN 24229) with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

The Portland sites sampled only hexavalent chromium and therefore do not have an average UATMP concentration to report in Table 18-1. However, Table 18-1 does list the average hexavalent chromium concentration in place of the average UATMP concentration. Table 18-1 also lists 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. Portland is nestled between the Cascades mountain range to the east and the coast to the west. The proximity to the Pacific Ocean has a moderating effect on Portland's temperatures, while the mountains act as both a barrier and an enhancer for temperatures and precipitation. The rainy season occurs during the winter months, while the summer is rather dry. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

18.1 Prevalent Compounds at the Oregon Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for hexavalent chromium at each site. Tables 18-2a-b summarize the cancer weighting scores, while Tables 18-3a-b summarize 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 Portland sites sampled only for hexavalent chromium. Tables 18-2a-b and 18-3a-b show that chromium VI compounds have both a cancer and noncancer toxicity weighting. However, chromium VI weighting is not listed in Tables 18-5a and b, because only VOC and carbonyl compounds are listed in these tables.

18.2 Toxicity Analysis

Even though hexavalent chromium was detected in nearly all of the samples taken at both PLOR and PNW, the average concentration at each site was still less than 0.0001 μg/m^3. The average cancer and noncancer toxicity tended to be higher at PLOR than at PNW. The hexavalent chromium cancer risk at PLOR was the highest among the two sites at 2.93 in a million, while at PNW, the cancer risk was 2.14 in a million. For the noncancer toxicity, the average hexavalent chromium toxicity at PLOR was 0.00245 (over 1 indicates a significant chance of a noncancer health effect). None of the compound concentrations were above their noncancer RfC weighting factors.

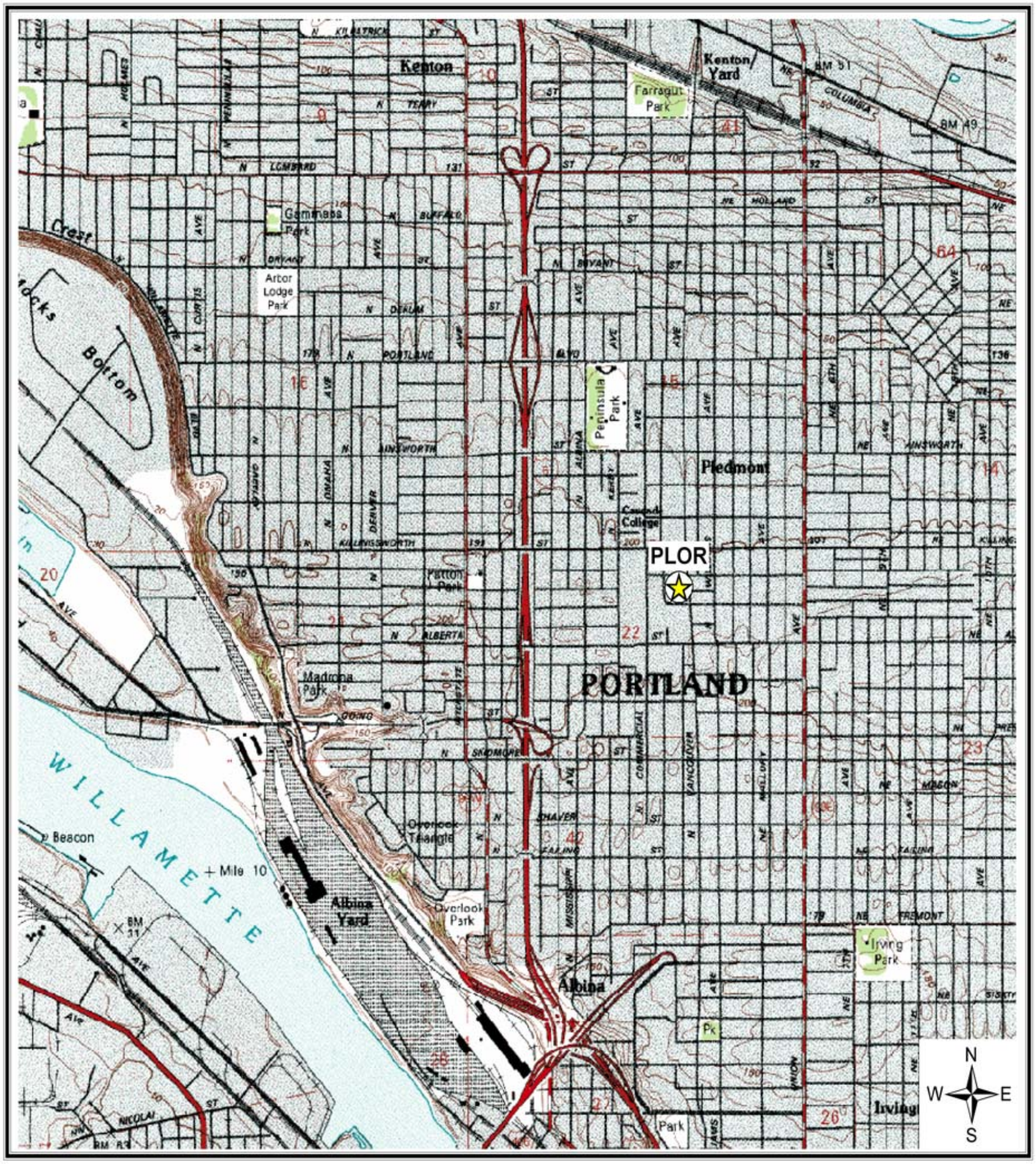
18.3 Meteorological and Concentration Averages at the Oregon Sites

The average hexavalent chromium concentration at PLOR was 0.260 (± 0.049) ng/m^3, and is summarized in Table 18-5. Pearson Correlation coefficients were calculated for these sites for hexavalent chromium and are listed in Tables 18-4a-b. Somewhat stronger correlations were computed at PLOR than at PNW. The strongest correlation was between hexavalent chromium and relative humidity (0.30). However, correlations at both sites tended to be rather weak.

18.4 Spatial Analysis

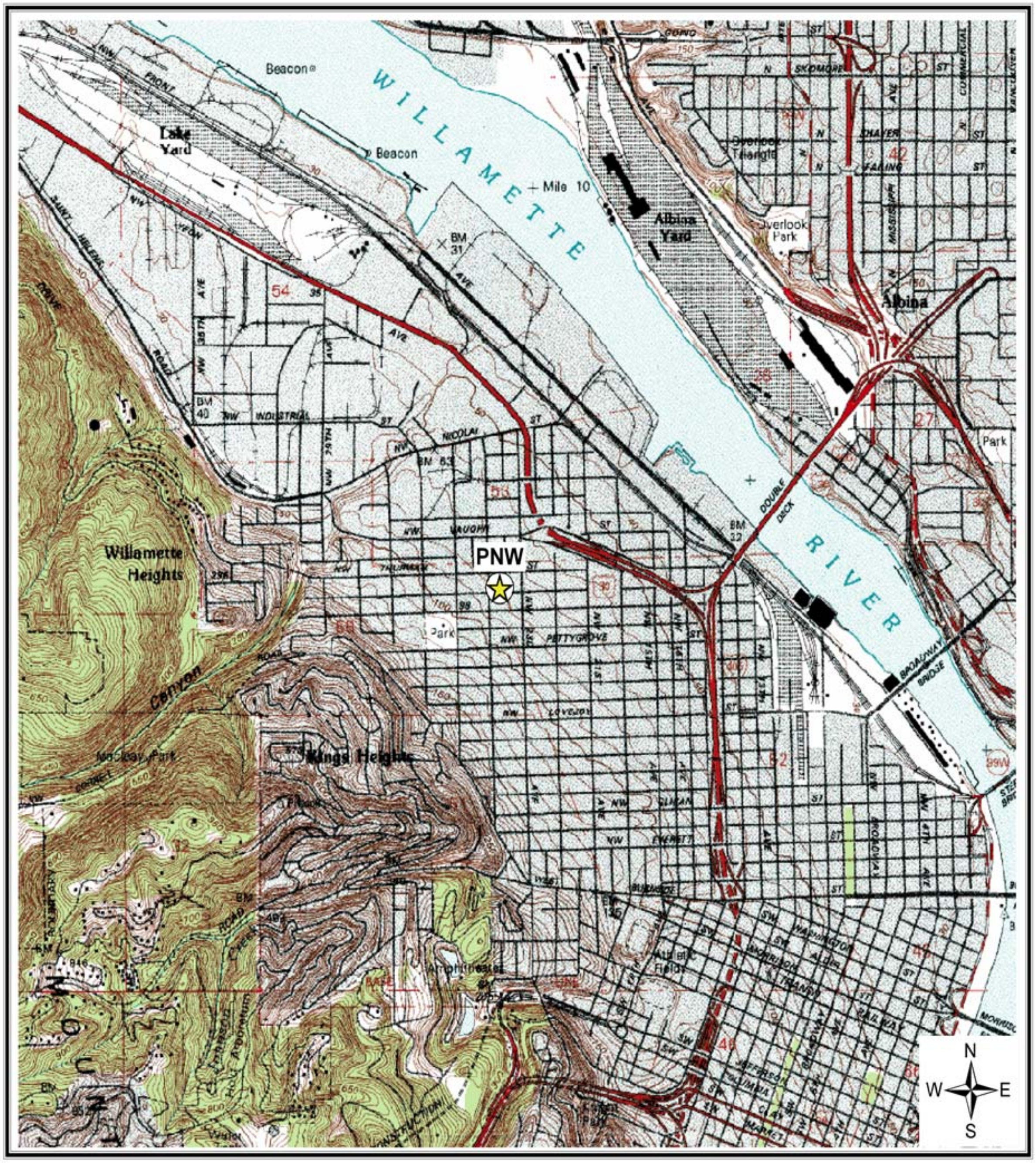
County-level car registration and population in Multnomah County, OR, were obtained from the Oregon Department of Motor Vehicles and the U.S. Census Bureau, and are summarized in Table 18-5. Also included in Table 18-5 is the population within 10 miles of each site and the average daily traffic information, which reflects the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. Using these parameters, a car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at each Portland site in Table 18-5.

Figure 18-1. Portland, Oregon (PLOR) Monitoring Station



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

Figure 18-2. Portland, Oregon (PNW) Monitoring Station



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

Figure 18-3. Portland, Oregon (PLOR and PNW) Monitoring Stations

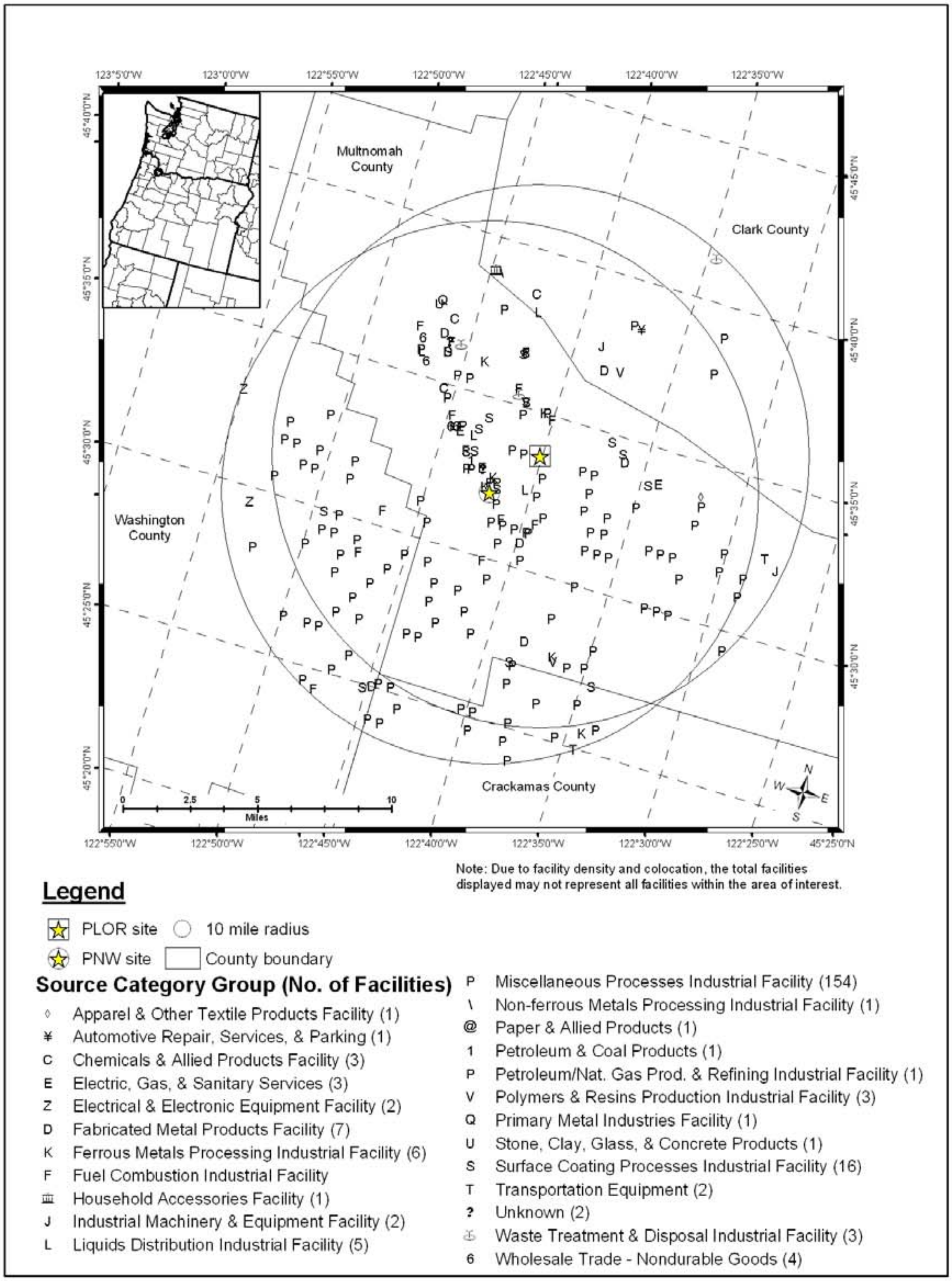


Table 18-1. Average Concentration and Meteorological Parameters for the Sites in Oregon

Site Name	Type	Average Concentration (ppbv)	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)
PLOR	All 2003	▨	63.59 (±1.51)	55.10 (±1.16)	45.26 (±0.88)	49.95 (±0.89)	73.05 (±1.37)	1017.24 (±0.58)	0.17 (±0.47)	0.46 (±0.44)
	sample day	0.00 (±0.00)	66.24 (±3.93)	57.06 (±2.93)	46.27 (±2.23)	51.34 (±2.26)	70.57 (±3.38)	1017.73 (±1.37)	0.95 (±1.28)	-0.17 (±1.20)
PNW	All 2003	▨	63.59 (±1.51)	55.10 (±1.16)	45.26 (±0.88)	49.95 (±0.89)	73.05 (±1.37)	1017.24 (±0.58)	0.17 (±0.47)	0.46 (±0.44)
	sample day	0.00 (±0.00)	75.14 (±3.76)	64.10 (±2.60)	50.60 (±2.52)	56.60 (±2.11)	64.57 (±3.59)	1018.03 (±1.29)	1.9 (±1.44)	-2.04 (±1.37)

Table 18-2a. Summary of the Toxic Cancer Compounds at the Portland, Oregon Monitoring Site 1 - PLOR

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Chromium VI and compounds	2.93E-06	100.00	100.00	<0.0001	48	2.93

Table 18-2b. Summary of the Toxic Cancer Compounds at the Portland, Oregon Monitoring Site 2 - PNW

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Chromium VI and compounds	2.14E-06	100.00	100.00	<0.0001	28	2.14

Table 18-3a. Summary of the Toxic Noncancer Compounds at the Portland, Oregon Monitoring Site 1 - PLOR

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Chromium VI and compounds	2.45E-03	100.00	100.00	<0.0001	48	0

Table 18-3b. Summary of the Toxic Noncancer Compounds at the Portland, Oregon Monitoring Site 2 - PNW

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Chromium VI and compounds	1.78E-03	100.00	100.00	<0.0001	28	0

Table 18-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Portland, Oregon Site 1 (PLOR)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Chromium VI and compounds	-0.25	-0.28	-0.16	-0.24	0.30	-0.27	0.01	0.20

Table 18-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Portland, Oregon Site 2 (PNW)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Chromium VI and compounds	0.00	-0.08	-0.12	-0.12	-0.04	0.05	-0.01	-0.24

Table 18-5. Motor Vehicle Information vs. Daily Concentration for the Oregon Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
PLOR	677,626	721,796	1.07	989,953	1,059,250	1,000	<0.01
PNW	677,626	721,796	1.07	1,021,272	1,092,761	500	<0.01

19.0 Sites in Puerto Rico

This section focuses on meteorological, concentration, and spatial trends for the two UATMP sites in Puerto Rico (BAPR and SJPR). These sites reside along Puerto Rico's northern coastline, with SJPR in San Juan and BAPR farther west in Barceloneta. Figures 19-1 and 19-2 are topographical maps showing the monitoring stations in their urban locations. Figures 19-3 and 19-4 are maps identifying facilities within ten miles of the sites that reported to the 1999 NEI. There are a number of pharmaceutical production and fuel combustion industrial facilities mainly to the east of BAPR. SJPR has nearly as many facilities nearby but they are more evenly scattered around the monitoring site, and are mostly involved in fuel combustion. Hourly meteorological data were retrieved for all of 2003 at the San Juan International Airport weather station (WBAN 11641) with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 19-1 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), 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. Puerto Rico is located in the northern Caribbean and experiences a tropical climate, where the air is warm and humid year-round (as Table 19-1 confirms). Breezy winds flow from the northeast to the east on average with the aid of the sub-tropical high pressure that resides over the tropical Atlantic Ocean.

19.1 Prevalent Compounds at the Puerto Rico Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Tables 19-2a-b summarize the cancer weighting scores and Tables 19-3a-b summarize 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.

Tables 19-2a-b show that most of the detected cancer compounds reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. Only methylene chloride and formaldehyde (detected at BAPR and SJPR) were not listed among the nationwide prevalent cancer compounds. Methylene chloride was the only cancer compound not prevalent at both sites. For the noncancer compounds summarized in Tables 19-3a-b, several of the detected compounds were not listed among the nationwide noncancer prevalent list. However, methylene chloride at BAPR and chloroprene at SJPR were considered prevalent and not listed as a nationwide prevalent noncancer compound.

Toxic compounds not detected at the Puerto Rico sites were: acrylonitrile, 1,2-dichloroethane; trichloroethylene; 1,3-dichloroprene; 1,1,2-trichloroethane; vinyl chloride; bromoform; bromomethane; 1,1-dichloroethene; 1,2,4-trichlorobenzene; chlorobenzene and chloroethane.

19.2 Toxicity Analysis

The prevalent cancer compounds tended to contribute somewhat evenly to each site's toxicity, although benzene contributed to at least 20% of the cancer toxicity at both sites. Acetaldehyde and formaldehyde had the most detects for cancer compounds at both sites, although only acetaldehyde was considered prevalent at both sites. Acetaldehyde contributes to at least 30% of the total noncancer toxicity for both of the sites, and, again, acetaldehyde and formaldehyde have the largest number of detects of the noncancer compounds.

The benzene cancer risk at SJPR was the highest among the two sites at 16.2 in a million, while at BAPR, the carbon tetrachloride cancer risk was 9.03 in a million. For the compounds which may lead to adverse noncancer health effects, the average acetaldehyde toxicity at SJPR was 0.650 (over 1 indicates a significant chance of a noncancer health effect). Of the sixteen measured acetaldehyde concentrations at SJPR, two were above the acetaldehyde noncancer RfC weighting factor.

19.3 Meteorological and Concentration Averages at the Puerto Rico Sites

Carbonyl compounds and VOC were measured at the two Puerto Rican sites, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentration at the two sites was relatively similar, with SJPR's average of 56.62 ±14.64 ppbv, and BAPR's average of 52.24 ±15.18 ppbv. Table 19-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

Tables 19-4a-b present 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. BAPR's strongest correlation was between 1,3-butadiene and relative humidity (-0.97). 1,3-Butadiene, benzene, and acetonitrile tended to have negative correlations with the temperature and moisture parameters, while acetaldehyde and formaldehyde tended to have positive correlations with the same parameters. Both positive and negative strong correlations were computed between the compounds and the weather parameters, making it difficult to make general statements about concentration changes under different weather conditions.

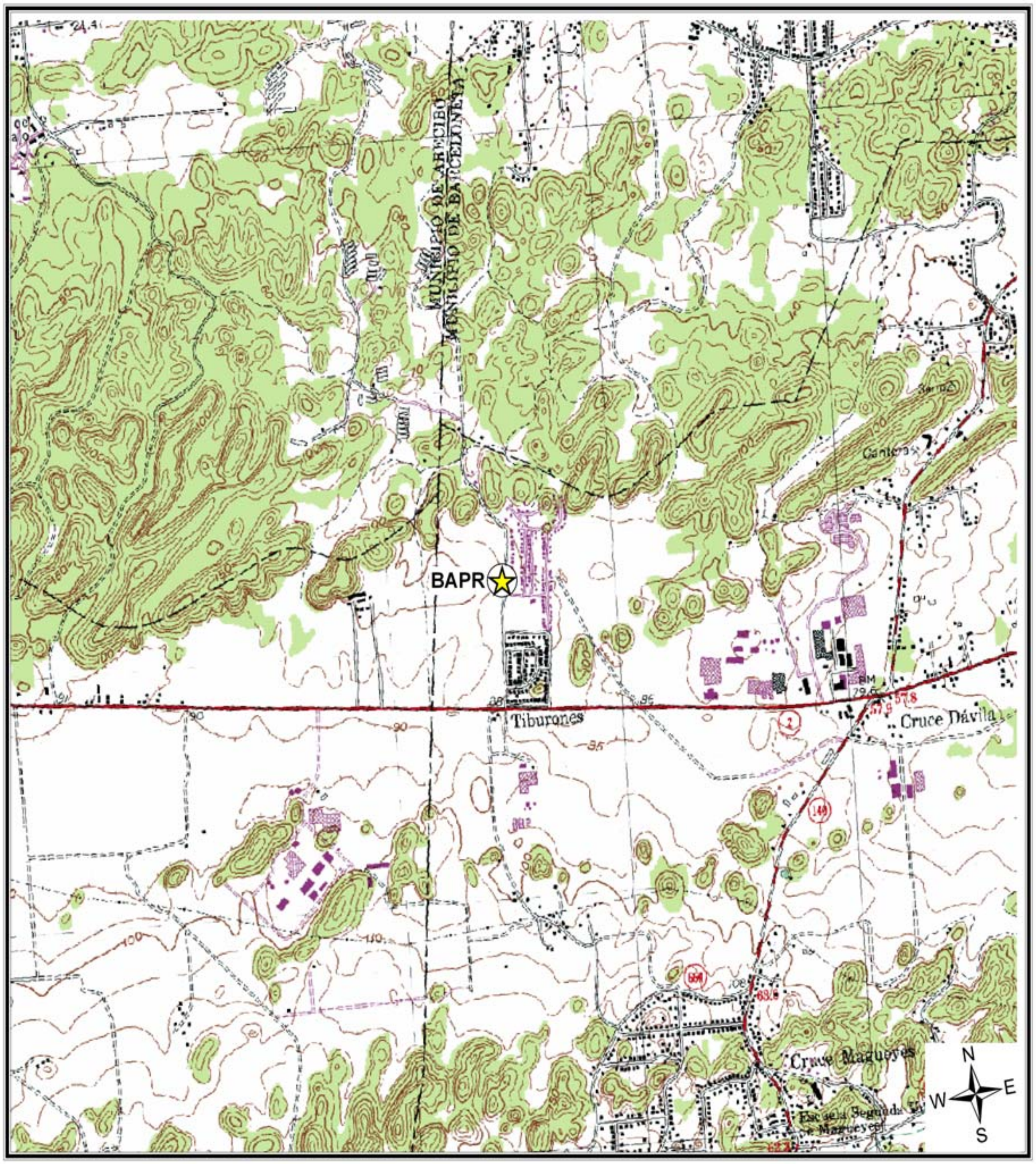
Fewer strong correlations were computed at SJPR than at BAPR. SJPR's strongest correlation was between *p*-dichlorobenzene and average temperature (-0.69). In fact, *p*-dichlorobenzene had moderately strong to strong negative correlations with maximum and average temperature, dewpoint, wet bulb temperature, and strong positive correlations with both components of the wind speed. With one exception, all of the compounds had negative correlations with the v-component of the wind. Pearson correlations could not be computed for chloroprene due to the low number of detects (fewer than 3).

19.4 Spatial Analysis

Data used to estimate the number of motor vehicles operating in proximity to the monitoring stations were not available for the Puerto Rico sites. However, the average daily traffic information, or, more specifically, the average number of motor vehicles passing the monitoring sites on the nearest roadway to each site on a daily basis was available. This information is compared to the average daily concentration of the prevalent compounds at the Puerto Rico sites in Table 19-5. As is evident in Table 19-5, the San Juan site has significantly more nearby traffic than the Barceloneta site.

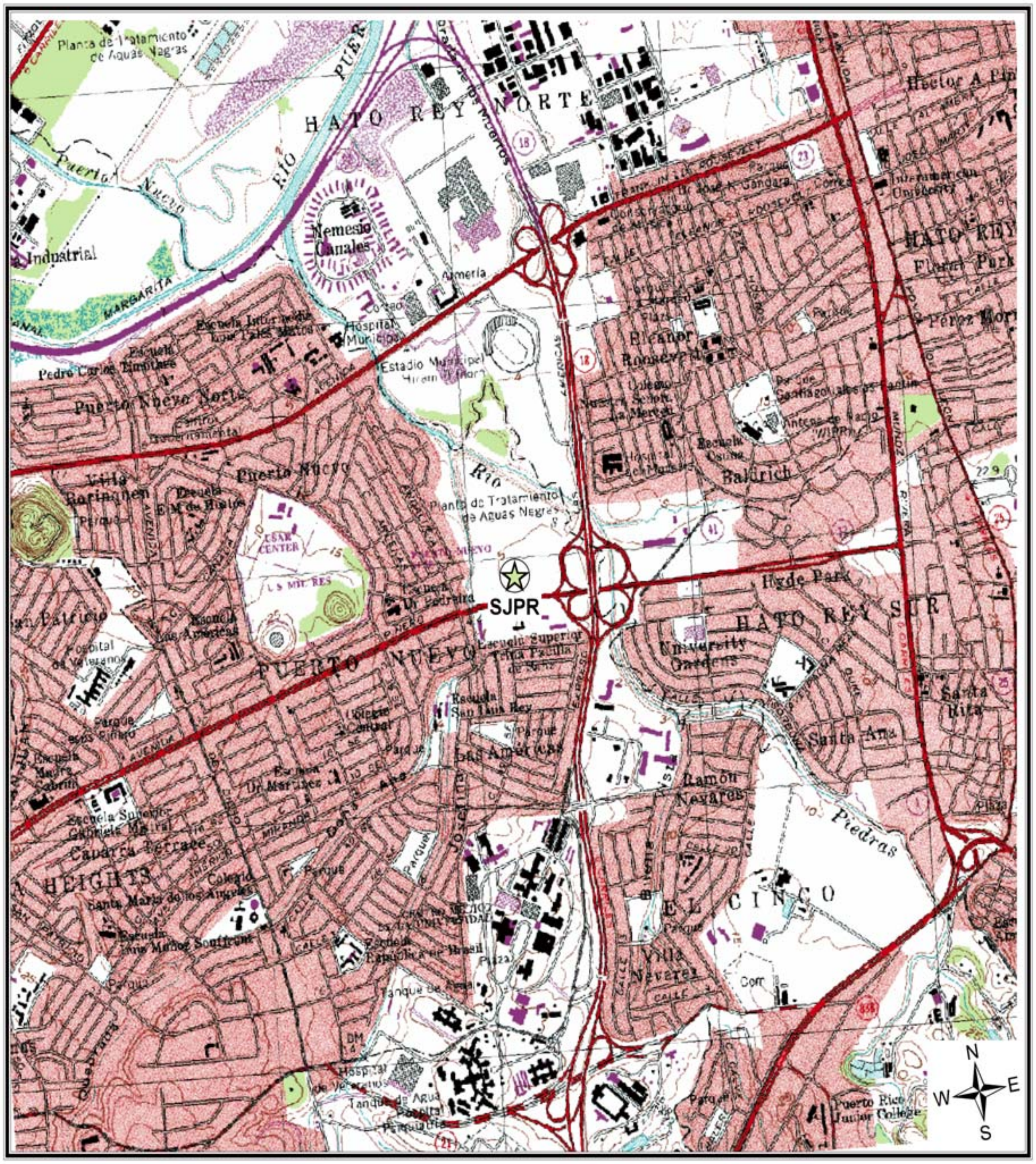
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area (for more information on this study, refer to section 3.4.2.). Figure 3-1 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at the monitoring sites. The Puerto Rico concentration ratios somewhat resemble the roadside study's ratios, although the toluene-ethylbenzene ratios tended to be higher at the Puerto Rico sites than at the roadside study, while the benzene-ethylbenzene ratios tended to be lower at the sites than the roadside study.

Figure 19-1. Barceloneta, Puerto Rico (BAPR) Monitoring Station



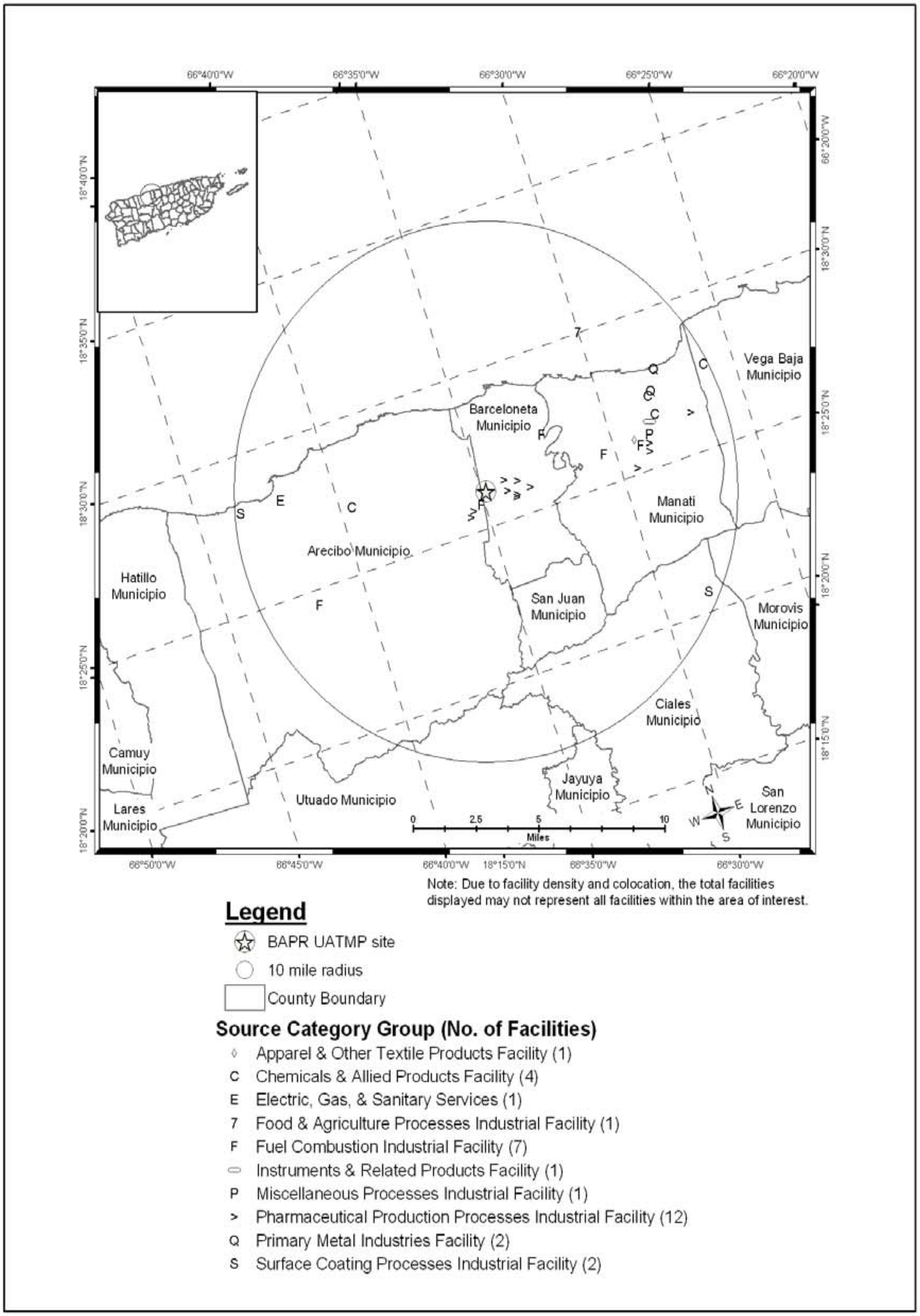
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 19-2. San Juan, Puerto Rico (SJPR) Monitoring Station



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

Figure 19-3. Facilities Located Within 10 Miles of BAPR



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

Figure 19-4. Facilities Located Within 10 Miles of SJPR

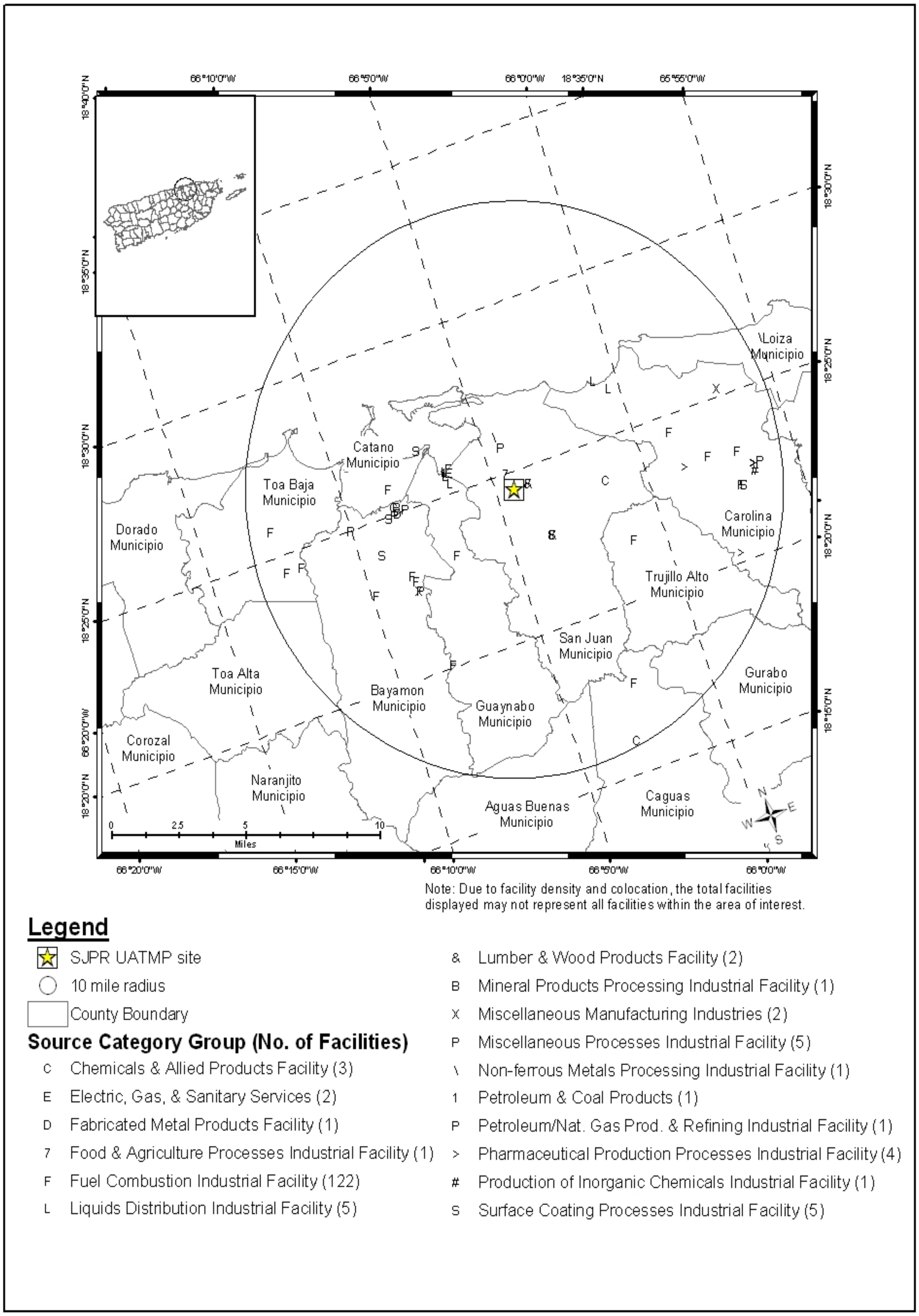


Table 19-1. Average Concentration and Meteorological Parameters for Sites in Puerto Rico

Site Name	Type	Average UATMP Concentration (ppbv)	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)
BAPR	All 2003	▨	85.72 (±0.27)	79.81 (±0.23)	72.71 (±0.29)	74.94 (±0.24)	79.79 (±0.59)	1015.27 (±0.22)	-5.04 (±0.30)	-0.88 (±0.23)
	sample day	52.24 (±15.18)	86.06 (±0.82)	79.76 (±0.84)	72.81 (±1.34)	74.97 (±1.06)	80.16 (±2.45)	1016.29 (±0.84)	-5.80 (±1.32)	-0.80 (±0.72)
SJPR	All 2003	▨	85.72 (±0.27)	79.81 (±0.23)	72.71 (±0.29)	74.94 (±0.24)	79.79 (±0.59)	1015.27 (±0.22)	-5.04 (±0.30)	-0.88 (±0.23)
	sample day	56.62 (±14.64)	85.88 (±0.85)	79.58 (±0.86)	72.60 (±1.32)	74.78 (±1.06)	80.08 (±2.31)	1016.26 (±0.79)	-5.69 (±1.26)	-0.74 (±0.69)

Table 19-2a. Summary of the Toxic Cancer Compounds at the Barceloneta, Puerto Rico Monitoring Site - BAPR

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Carbon Tetrachloride	9.03E-06	22.45	22.45	0.602	14	9.03
Benzene	8.04E-06	20.00	42.46	1.031	15	8.04
1,3-Butadiene	7.12E-06	17.72	60.17	0.237	5	7.12
p-Dichlorobenzene	6.17E-06	15.34	75.52	0.561	6	6.17
Acetaldehyde	5.70E-06	14.18	89.70	2.592	16	5.70
Methylene Chloride (Dichloromethane)	4.13E-06	10.27	99.98	8.788	15	4.13
Formaldehyde	9.77E-09	0.02	100.00	1.776	16	<1

Table 19-2b. Summary of the Toxic Cancer Compounds at the San Juan, Puerto Rico Monitoring Site - SJPR

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	1.62E-05	27.40	27.40	2.072	15	16.2
Acetaldehyde	1.29E-05	21.81	49.22	5.848	16	12.9
1,3-Butadiene	1.13E-05	19.24	68.46	0.378	10	11.3
p-Dichlorobenzene	9.66E-06	16.39	84.84	0.879	11	9.66
Carbon Tetrachloride	6.90E-06	11.71	96.55	0.460	15	6.90
Tetrachloroethylene	1.75E-06	2.97	99.52	0.297	2	1.75
Methylene Chloride (Dichloromethane)	2.63E-07	0.45	99.96	0.559	14	<1
Formaldehyde	2.09E-08	0.04	100.00	3.804	16	<1

Table 19-3a. Summary of the Toxic Noncancer Compounds at the Barceloneta, Puerto Rico Monitoring Site - BAPR

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acetaldehyde	2.88E-01	30.00	30.00	2.592	16	0
Acetonitrile	2.06E-01	21.43	51.43	12.345	5	0
Formaldehyde	1.81E-01	18.88	70.31	1.776	16	0
1,3-Butadiene	1.19E-01	12.37	82.68	0.237	5	0
Xylenes (*o*-, *m*-, *p*-)	6.45E-02	6.72	89.40	6.446	15	0
Benzene	3.44E-02	3.58	92.98	1.031	15	0
Chloromethane (Methyl Chloride)	2.07E-02	2.16	95.14	1.866	15	0
Toluene	1.85E-02	1.92	97.06	7.381	15	0
Carbon Tetrachloride	1.50E-02	1.57	98.63	0.602	14	0
Methylene Chloride (Dichloromethane)	8.79E-03	0.92	99.54	8.788	15	0
Methyl Ethyl Ketone (2-Butanone)	1.51E-03	0.16	99.70	7.570	6	0
Ethylbenzene	9.19E-04	0.10	99.79	0.919	14	0
p-Dichlorobenzene	7.01E-04	0.07	99.87	0.561	6	0
Methyl Isobutyl Ketone (Hexone)	3.69E-04	0.04	99.91	1.106	2	0
Methyl Methacrylate	3.51E-04	0.04	99.94	0.246	1	0
1,1,1-Trichloroethane (Methyl Chloroform)	2.00E-04	0.02	99.96	0.200	3	0
Methyl *tert*-Butyl Ether	1.92E-04	0.02	99.98	0.577	1	0
Styrene	1.56E-04	0.02	100.00	0.156	3	0

Table 19-3b. Summary of the Toxic Noncancer Compounds at the San Juan, Puerto Rico Monitoring Site - SJPR

Compound	**Average Toxicity**	**% Contribution**	**Cumulative % Contribution**	**Average Concentration (μg/m^3)**	**# Detects**	**Adverse Noncancer Concentrations**
Acetaldehyde	6.50E-01	36.99	36.99	5.848	16	2
Formaldehyde	3.88E-01	22.10	59.09	3.804	16	1
Acetonitrile	2.24E-01	12.77	71.86	13.460	6	0
1,3-Butadiene	1.89E-01	10.77	82.63	0.378	10	0
Xylenes (*o*-, *m*-, *p*-)	1.31E-01	7.43	90.06	13.059	15	0
Benzene	6.91E-02	3.93	94.00	2.072	15	0
Chloroprene	4.14E-02	2.36	96.35	0.290	1	0
Chloromethane (Methyl Chloride)	2.21E-02	1.26	97.61	1.991	15	0
Toluene	2.02E-02	1.15	98.76	8.073	15	0
Carbon Tetrachloride	1.15E-02	0.66	99.42	0.460	15	0
Chloroform	3.01E-03	0.17	99.59	0.295	6	0
Ethylbenzene	1.47E-03	0.08	99.67	1.472	15	0
Methyl Ethyl Ketone (2-Butanone)	1.11E-03	0.06	99.73	5.526	5	0
Tetrachloroethylene	1.10E-03	0.06	99.80	0.297	2	0
p-Dichlorobenzene	1.10E-03	0.06	99.86	0.879	11	0
Methyl Isobutyl Ketone (Hexone)	8.59E-04	0.05	99.91	2.577	3	0
Methylene Chloride (Dichloromethane)	5.59E-04	0.03	99.94	0.559	14	0
Styrene	3.90E-04	0.02	99.96	0.390	10	0
Methyl *tert*-Butyl Ether	3.85E-04	0.02	99.98	1.154	2	0
1,1,1-Trichloroethane (Methyl Chloroform)	2.67E-04	0.02	100.00	0.267	7	0
Chloroethane (Ethyl Chloride)	2.11E-05	<0.0001	100.00	0.211	1	0

Table 19-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Barceloneta, Puerto Rico Site (BAPR)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.06	-0.48	-0.81	-0.74	-0.97	0.61	0.37	0.23
Acetaldehyde	0.49	0.59	0.69	0.70	0.42	0.27	-0.55	-0.73
Acetonitrile	-0.54	-0.04	-0.39	-0.37	-0.52	0.61	0.19	-0.14
Benzene	-0.44	-0.63	-0.51	-0.58	-0.17	-0.19	0.48	0.42
Carbon Tetrachloride	-0.12	-0.16	0.00	-0.05	0.17	-0.59	0.25	0.10
Formaldehyde	0.34	0.42	0.38	0.41	0.15	0.49	-0.47	-0.61
Chloromethane (Methyl Chloride)	-0.51	-0.59	-0.24	-0.35	0.15	-0.52	0.54	0.30
Methylene Chloride (Dichloromethane)	0.00	0.09	-0.33	-0.24	-0.52	0.10	-0.27	0.20
p-Dichlorobenzene	0.16	-0.12	-0.19	-0.19	-0.16	0.10	0.06	0.34
Xylenes (*o*-, *m*-, *p*-)	-0.06	0.06	0.07	0.06	0.04	0.30	-0.07	-0.16

Table 19-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the San Juan, Puerto Rico Site (SJPR)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.09	-0.30	-0.30	-0.28	-0.17	0.26	-0.07	-0.16
Acetaldehyde	0.28	0.46	0.25	0.32	-0.05	-0.02	-0.27	-0.12
Acetonitrile	-0.47	-0.30	-0.12	-0.17	0.08	-0.14	0.34	-0.51
Benzene	-0.05	-0.17	-0.02	-0.06	0.12	0.36	-0.08	-0.33
Carbon Tetrachloride	0.12	0.13	0.20	0.20	0.17	0.10	-0.18	-0.45
Chloroprene	NA	NA	NA	NA	NA	NA	NA	NA
Formaldehyde	0.15	0.37	0.30	0.35	0.09	0.37	-0.26	-0.31
p-Dichlorobenzene	-0.65	-0.69	-0.31	-0.43	0.27	-0.30	0.51	0.51
Xylenes (*o*-, *m*-, *p*-)	0.13	0.23	0.28	0.29	0.19	0.41	-0.23	-0.34

Table 19-5. Motor Vehicle Information vs. Daily Concentration for Puerto Rico Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu g/m^3$)
BAPR	22,556	12,362	0.55	NA	NA	10	52.24 (±15.18)
SJPR	433,412	238,799	0.55	NA	NA	51,000	56.62 (±14.64)

20.0 Sites in South Dakota

This section focuses on 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 in Custer, in western South Dakota, south of Rapid City. Figures 20-1 and 20-2 are topographical maps showing the monitoring stations in their urban locations. Figures 20-3 and 20-4 are maps identifying facilities within ten miles of the sites that reported to the 1999 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 site shows no facilities nearby. Hourly meteorological data were retrieved for all of 2003 at the Sioux Falls Foss Field weather station (WBAN 14944) and the Custer County Airport weather station (WBAN 94032) near the sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 20-1 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), 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 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 <u>The Weather Almanac</u>, fifth edition (Ruffner and Bair, 1987).

20.1 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. Tables 20-2a-b summarize the cancer weighting scores and Tables 20-3a-b summarize 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.

Tables 20-2a-b show that most of the detected cancer compounds reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. Only trichloroethylene (detected at CUSD), methylene chloride (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. For the noncancer compounds summarized in Tables 20-3a-b, several compounds not listed on the nationwide prevalent noncancer compound list were detected at CUSD and SFSD. However, all of the site-specific prevalent noncancer compounds are also on the nationwide list.

Toxic compounds not detected at the South Dakota sites were: 1,2-dichloroethane; 1,3-dichloroprene; 1,1,2-trichloroethane; vinyl chloride; bromoform; chloroprene; 1,1-dichloroethene; 1,2,4-trichlorobenzene; chlorobenzene and chloroethane.

20.2 Toxicity Analysis

Tetrachloroethylene, benzene, carbon tetrachloride, and acetaldehyde were the only prevalent cancer compounds across both sites. At both sites, tetrachloroethylene made up nearly a quarter of the total cancer toxicity, although the number of detects was low. Conversely, benzene was detected over 100 times at each site, but contributed to 20% of the total cancer toxicity or less.

Acetonitrile, formaldehyde, acetaldehyde, 1,3-butadiene, 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 two percent of the total noncancer toxicity.

The acrylonitrile cancer risk at SFSD was the highest among the two sites at 114 in a million, while at CUSD, the tetrachloroethylene cancer risk was 11.1 in a million. For the compounds which may lead to adverse noncancer health effects, the average acetonitrile toxicity at CUSD was 2.08 (over 1 indicates a significant chance of a noncancer health effect). Of the eight adverse health concentrations measured at the South Dakota sites, four were for acetonitrile.

20.3 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 140.3 (± 66.33) $\mu g/m^3$, while at SFSD it was considerably lower, 88.97 (± 14.89) $\mu g/m^3$. Table 20-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003.

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 322.09 ppbC, of which nearly 36% could be identified through speciation. Of the speciated compounds, hexane measured the highest concentration at the SFSD site (52.93 ppbC). The average total NMOC value for CUSD was 311.30 ppbC, of which nearly 55% could be identified through speciation. Of the speciated compounds, toluene measured the highest concentration at the CUSD site (69.42 ppbC). This information is presented in Table 20-4.

Tables 20-5a and 20-5b are the summaries 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, formaldehyde had several very strong correlations with the meteorological parameters (0.68 to 0.70). Both acetaldehyde and formaldehyde had moderately strong to strong positive correlations with maximum, average, dewpoint, and wet bulb temperatures. Interestingly, these are the only two prevalent carbonyl compounds. 1,3-Butadiene and benzene both had moderately strong to strong negative correlations with these same parameters. 1,3-Butadiene also had a strong positive correlation with relative humidity. With few exceptions, the remaining correlations were rather weak. Pearson correlations could not be computed for *p*-dichlorobenzene and tetrachloroethylene due to the low number of detects (fewer than 4).

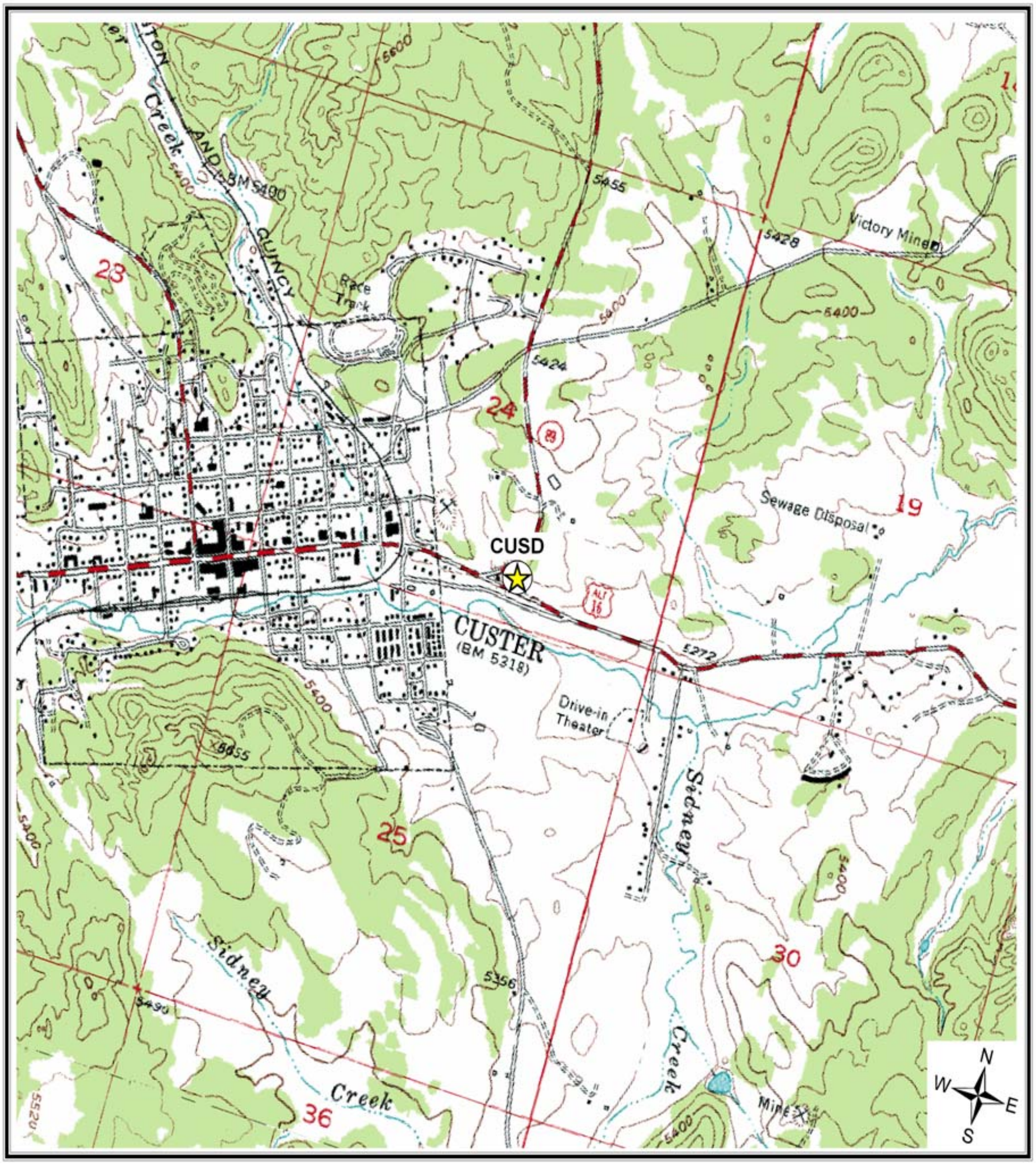
Most of the correlations between the prevalent compounds and weather variables were rather weak at the SFSD site. However, a strong negative correlation was computed between acetonitrile and the u-component of the wind. Pearson correlations could not be computed for tetrachloroethylene and acrylonitrile due to the low number of detects (fewer than 4).

20.4 Spatial Analysis

County-level car registration and population in Custer County, SD, 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 20-6. Also included in Table 20-6 is the population within 10 miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at each South Dakota site in Table 20-6. SFSD has both the largest daily traffic volume and the largest vehicle ownership within a ten mile radius, compared to CUSD.

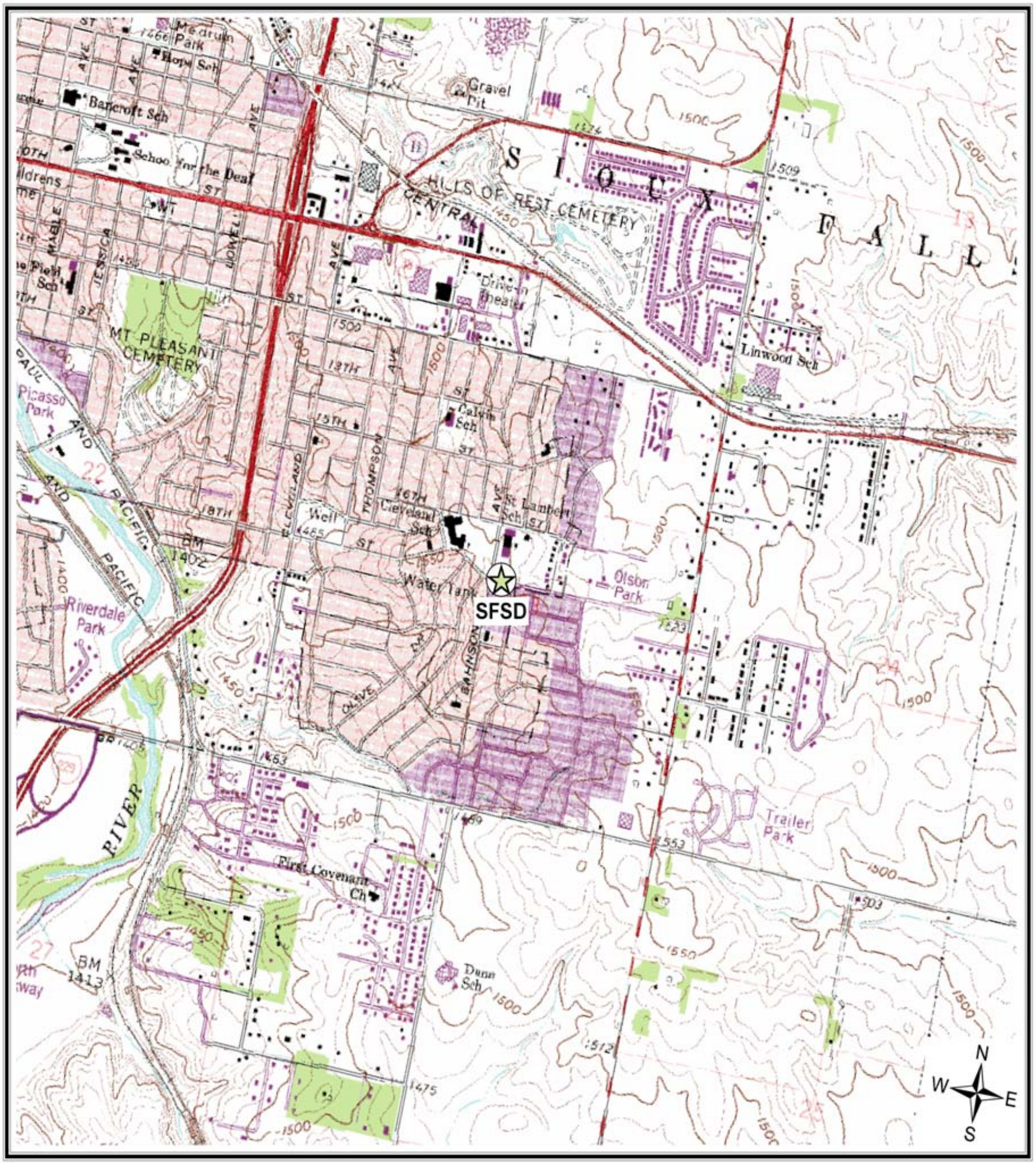
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area (for more information on this study, refer to section 3.4.2.). Figure 3-1 depicts the average concentration ratios 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 roadside study, although each of CUSD's ratios are somewhat lower than the roadside study's. SFSD's toluene-ethylbenzene ratio is comparable to the roadside study's, but SFSD's benzene-ethylbenzene and xylenes-ethylbenzene ratio are lower and roughly equal in value.

Figure 20-1. Custer, South Dakota (CUSD) Monitoring Station



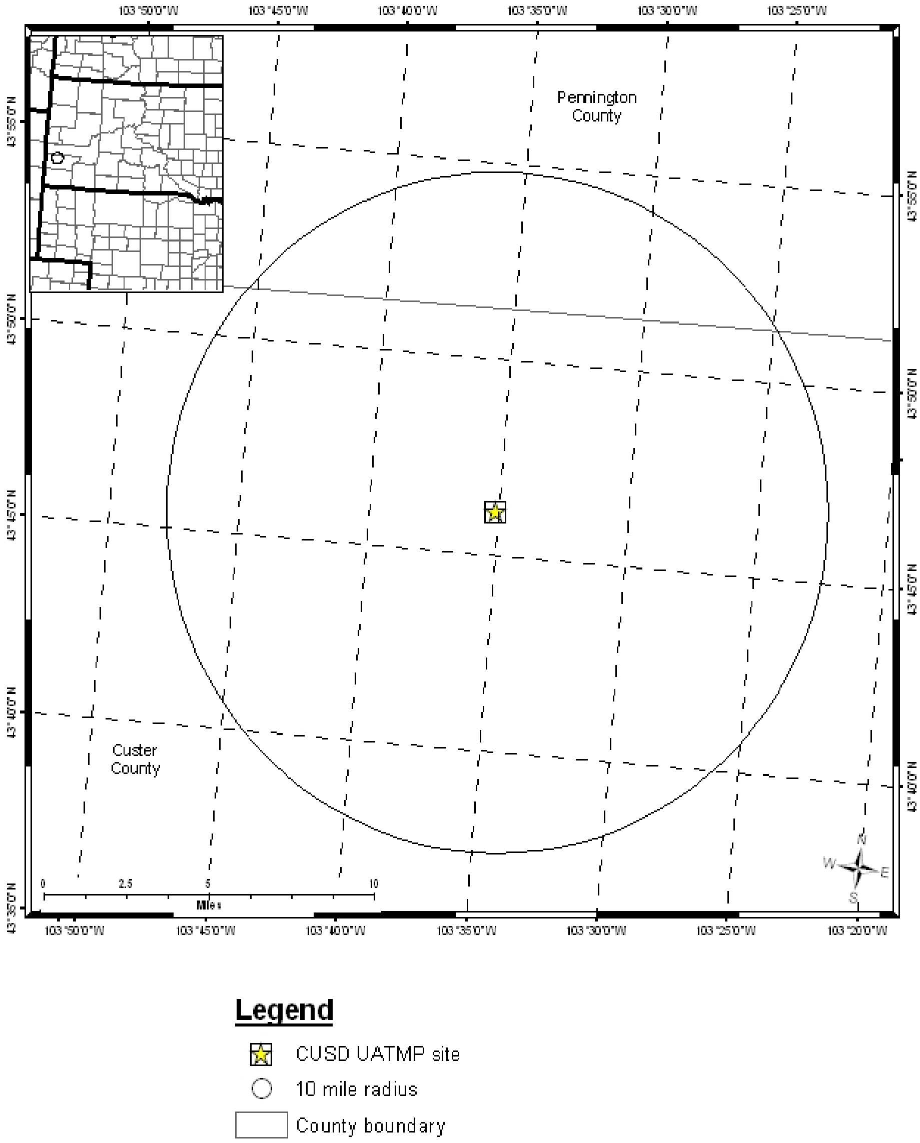
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 20-2. Sioux Falls, South Dakota (SFSD) Monitoring Station



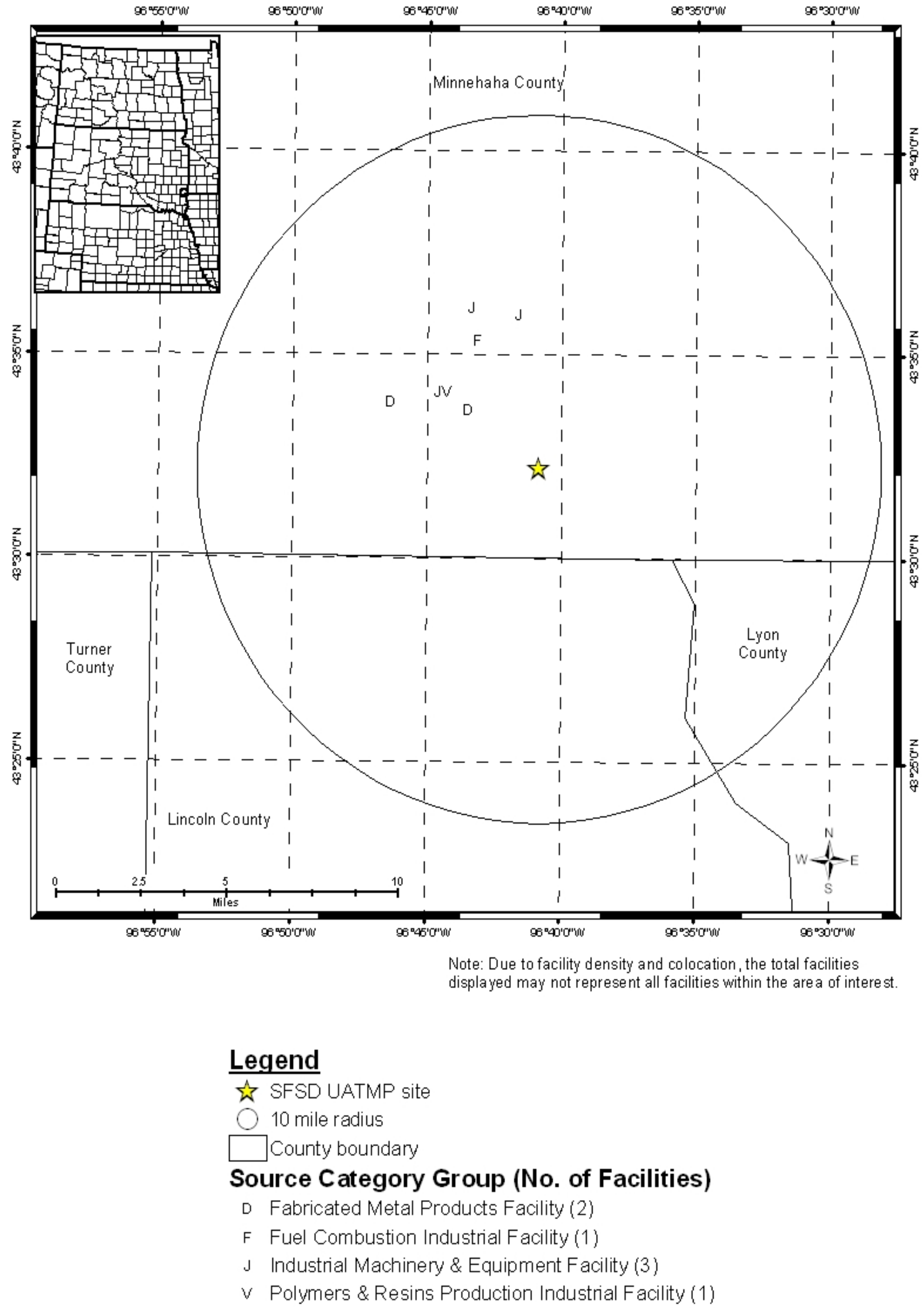
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 20-3. Facilities Located Within 10 Miles of CUSD



*There were no point facilities from the 1999 NEI within 10 miles of CUSD.

Figure 20-4. Facilities Located Within 10 Miles of SFSD



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

Table 20-1. Average Concentration and Meteorological Parameters for Sites in South Dakota

Site Name	Type	Average UATMP Concentration (ppbv)	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)
CUSD	All 2003	▨	53.76 (±2.07)	43.12 (±1.85)	28.10 (±1.55)	36.23 (±1.51)	60.66 (±1.70)	1014.41 (±0.70)	2.34 (±0.42)	-0.73 (±0.27)
	sample day	140.30 (±66.33)	53.27 (±4.99)	42.26 (±4.57)	27.22 (±4.07)	35.54 (±3.85)	60.08 (±4.10)	1014.18 (±1.62)	1.97 (±0.91)	-1.02 (±0.70)
SFSD	All 2003	▨	56.77 (±2.40)	46.64 (±2.23)	36.32 (±2.05)	41.64 (±1.99)	70.48 (±1.16)	1015.77 (±0.76)	0.40 (±0.54)	0.17 (±0.68)
	sample day	88.97 (±14.89)	58.58 (±6.17)	48.42 (±5.62)	37.79 (±5.10)	43.12 (±4.99)	70.03 (±2.93)	1014.71 (±1.89)	0.62 (±1.38)	0.26 (±1.86)

Table 20-2a. Summary of the Toxic Cancer Compounds at the Custer, South Dakota Monitoring Site - CUSD

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Tetrachloroethene	1.11E-05	25.53	25.53	1.877	3	11.1
Benzene	8.98E-06	20.71	46.23	1.151	120	8.98
Carbon Tetrachloride	7.79E-06	17.95	64.19	0.519	51	7.79
1,3-Butadiene	6.55E-06	15.09	79.28	0.218	34	6.55
Acetaldehyde	3.57E-06	8.24	87.52	1.625	61	3.57
p-Dichlorobenzene	3.31E-06	7.62	95.15	0.301	1	3.31
Trichloroethylene	1.88E-06	4.34	99.48	0.940	2	1.88
Methylene Chloride (Dichloromethane)	2.08E-07	0.48	99.96	0.443	15	<1
Formaldehyde	1.55E-08	0.04	100.00	2.816	61	<1

Table 20-2b. Summary of the Toxic Cancer Compounds at the Sioux Falls, South Dakota Monitoring Site - SFSD

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	1.14E-04	62.96	62.96	1.682	3	114
Tetrachloroethene	4.14E-05	22.80	85.76	7.021	2	41.4
Carbon Tetrachloride	8.19E-06	4.51	90.26	0.546	46	8.19
Benzene	7.86E-06	4.33	94.59	1.007	110	7.86
Acetaldehyde	6.51E-06	3.59	98.17	2.961	50	6.51
1,3-Butadiene	3.09E-06	1.70	99.88	0.103	28	3.09
Methylene Chloride (Dichloromethane)	2.06E-07	0.11	99.99	0.438	25	<1
Formaldehyde	1.75E-08	0.01	100.00	3.188	50	<1

Table 20-3a. Summary of the Toxic Noncancer Compounds at the Custer, South Dakota Monitoring Site - CUSD

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acetonitrile	2.08E+00	74.37	74.37	124.991	19	2
Formaldehyde	2.87E-01	10.26	84.63	2.816	61	0
Acetaldehyde	1.81E-01	6.45	91.08	1.625	61	0
1,3-Butadiene	1.09E-01	3.90	94.97	0.218	34	0
Benzene	3.84E-02	1.37	96.34	1.151	120	0
Xylenes (*o*-, *m*-, *p*-)	2.96E-02	1.06	97.40	2.957	113	0
Chloromethane (Methyl Chloride)	1.33E-02	0.47	97.87	1.196	58	0
Methyl Methacrylate	1.32E-02	0.47	98.34	9.224	1	0
Carbon Tetrachloride	1.30E-02	0.46	98.80	0.519	51	0
Toluene	9.61E-03	0.34	99.15	3.843	120	0
Tetrachloroethene	6.95E-03	0.25	99.40	1.877	3	0
Hexane	6.85E-03	0.24	99.64	1.370	61	0
Chloroform	3.52E-03	0.13	99.77	0.345	1	0
Methyl *tert*-Butyl Ether	1.59E-03	0.06	99.82	4.758	14	0
Trichloroethylene	1.57E-03	0.06	99.88	0.940	2	0
Styrene	8.86E-04	0.03	99.91	0.886	73	0
Methyl Ethyl Ketone (2-Butanone)	7.55E-04	0.03	99.94	3.775	18	0
Ethylbenzene	7.50E-04	0.03	99.96	0.750	99	0
Methylene Chloride (Dichloromethane)	4.43E-04	0.02	99.98	0.443	15	0
p-Dichlorobenzene	3.76E-04	0.01	99.99	0.301	1	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.96E-04	0.01	100.00	0.196	11	0

Table 20-3b. Summary of the Toxic Noncancer Compounds at the Sioux Falls, South Dakota Monitoring Site - SFSD

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acrylonitrile	8.41E-01	39.13	39.13	1.682	3	0
Acetonitrile	4.78E-01	22.25	61.38	28.701	18	2
Acetaldehyde	3.29E-01	15.30	76.68	2.961	50	3
Formaldehyde	3.25E-01	15.13	91.82	3.188	50	1
1,3-Butadiene	5.15E-02	2.40	94.22	0.103	28	0
Benzene	3.36E-02	1.56	95.78	1.007	110	0
Tetrachloroethene	2.60E-02	1.21	96.99	7.021	2	0
Xylenes (*o*-, *m*-, *p*-)	1.89E-02	0.88	97.87	1.895	107	0
Carbon Tetrachloride	1.36E-02	0.63	98.50	0.546	46	0
Chloromethane (Methyl Chloride)	1.35E-02	0.63	99.13	1.215	55	0
Toluene	6.80E-03	0.32	99.45	2.720	110	0
Hexane	6.26E-03	0.29	99.74	1.252	55	0
Methyl *tert*-Butyl Ether	1.75E-03	0.08	99.82	5.256	20	0
Chloroform	9.29E-04	0.04	99.86	0.091	1	0
Methyl Ethyl Ketone (2-Butanone)	9.01E-04	0.04	99.91	4.507	27	0
Styrene	5.21E-04	0.02	99.93	0.521	71	0
Ethylbenzene	4.98E-04	0.02	99.95	0.498	95	0
Methylene Chloride (Dichloromethane)	4.38E-04	0.02	99.97	0.438	25	0
Methyl Isobutyl Ketone (Hexone)	4.04E-04	0.02	99.99	1.211	3	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.45E-04	0.01	100.00	0.145	8	0

Table 20-4. TNMOC Measured by the Custer and Sioux Falls, South Dakota (CUSD and SFSD) Monitoring Station

Monitoring Station	Average TNMOC Speciated (ppbC)	Average TNMOC w/ Unknowns (ppbC)	% TNMOC Identified	SNMOC Compound with the Highest Concentration (ppbC)
CUSD	118.60	311.30	55%	Toluene (69.42)
SFSD	99.01	322.09	36%	Hexane (52.93)

Table 20-5a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Custer, South Dakota Site (CUSD)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.48	-0.51	-0.30	-0.47	0.51	-0.01	-0.22	-0.41
Acetaldehyde	0.52	0.51	0.36	0.44	-0.31	-0.01	-0.33	0.08
Acetonitrile	0.17	0.15	0.18	0.16	0.09	-0.23	-0.13	0.36
Benzene	-0.38	-0.40	-0.38	-0.41	0.10	0.11	0.00	-0.18
Carbon Tetrachloride	0.06	0.07	0.17	0.12	0.23	-0.12	-0.07	-0.04
Formaldehyde	0.69	0.70	0.68	0.70	-0.10	0.11	-0.46	0.20
p-Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	NA	NA	NA	NA	NA	NA	NA	NA

Table 20-5b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Sioux Falls, South Dakota Site (SFSD)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.16	-0.21	-0.21	-0.21	-0.01	0.08	0.08	0.43
Acetaldehyde	0.15	0.06	0.00	0.03	-0.19	0.14	-0.03	0.01
Acetonitrile	-0.36	-0.27	-0.19	-0.24	0.43	-0.18	-0.59	-0.53
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	-0.06	-0.08	-0.11	-0.10	-0.11	0.08	0.16	0.01
Carbon Tetrachloride	0.17	0.21	0.29	0.25	0.29	-0.41	-0.11	-0.05
Formaldehyde	0.07	0.02	-0.04	0.00	-0.25	0.23	-0.13	0.04
Tetrachloroethylene	NA	NA	NA	NA	NA	NA	NA	NA

Table 20-6. Motor Vehicle Information vs. Daily Concentration for the South Dakota Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
CUSD	7,467	8,820	1.18	5,094	6,011	1,940	140.33 (±66.33)
SFSD	152,545	148,759	0.98	151,161	148,138	4,320	88.97 (±14.89)

21.0 Sites in Tennessee

This section focuses on 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 21-1 through 21-5 are topographical maps showing the monitoring stations in their urban locations. Figures 21-6 through 21-9 are maps identifying facilities within ten miles of the sites that reported to the 1999 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 ten miles of the monitors, with a majority of the industrial sites located to the southeast, south, and southwest of the UATMP sites. Most of these industrial sites are surface coating, printing and publishing, and fuel combustion facilities. The Dickson site is surrounded by the fewest industrial sources. The Kingsport site has a few more industrial sites nearby, the majority of which are involved in fuel combustion. The Loudon site has the same number of sources nearby as KITN, but most of these are involved in waste treatment and polymer and resin production. Hourly meteorological data were retrieved for all of 2003 at four weather stations near the sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements. The four weather stations are the Nashville International Airport, Knoxville McGhee-Tyson Airport, Clarksville Outlaw Airport, and Bristol Tri-City Airport (WBAN 13897, 13891, 03894, and 13877, respectively).

Table 21-1 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), 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. 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. As indicated in Table 21-1, though, humidity can make the air uncomfortable. 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.

21.1 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. Tables 21-2a-e summarize the cancer weighting scores and Tables 21-3a-e 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.

Tables 21-2a-e show that most of the cancer compounds detected reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. However, as the Nashville sites also sampled metals and compounds, several metals and compounds are considered prevalent at these two sites. Aside from metals and compounds, only methylene chloride (detected at DITN, EATN, KITN, and LOTN), formaldehyde (detected at all TN sites), and trichloroethylene (detected at EATN and LOTN) were not listed among the nationwide prevalent cancer compounds. Only acetaldehyde, benzene, and carbon tetrachloride were prevalent across all five sites. For the noncancer compounds summarized in Tables 21-3a-e, several compounds detected were not listed among the nationwide noncancer prevalent list, especially at the more urbanized locations (EATN, LOTN, and KITN). Formaldehyde and acetaldehyde were the only prevalent noncancer compounds across all five sites.

Toxic compounds not detected at the Tennessee sites were: acrylonitrile; 1,2-dichloroethane; 1,3-dichloroprene; 1,1,2-trichloroethane; vinyl chloride; bromoform; chloroprene; 1,1-dichloroethene; methyl methacrylate; 1,2,4-trichlorobenzene; chlorobenzene and chloroethane.

21.2 Toxicity Analysis

Only acetaldehyde, benzene, and carbon tetrachloride were prevalent across all five sites, and for the sites that did not sample metals and compounds (DITN, KITN, and LDTN), these three compounds contributed to 71% or more of the total cancer toxicity. Of these three sites, only KITN detected the prevalent cancer compounds more than five times. It is important to note that LDTN and DITN sampled in the final months of 2003 only. For the sites that sampled metals and compounds (EATN and LOTN), both arsenic and cadmium and compounds were considered prevalent cancer compounds, and contributed to roughly 25% of the total cancer toxicity. At four of the five sites, benzene contributed most to the total cancer toxicity (ranging in contribution from 24% to 43%). Formaldehyde and acetaldehyde were the only prevalent noncancer compounds across all five sites, and these compounds contributed to over half of the total noncancer toxicity at all of the sites.

The benzene cancer risk at EATN was the highest among the five sites at 11.9 in a million, while the LOTN, KITN, and DITN benzene risk was 10.5, 9.66, and 4.39 in a million, respectively. For the compounds which may lead to adverse noncancer health effects, the average formaldehyde noncancer toxicity at LDTN was 2.92 (over 1 indicates a significant chance of a noncancer health effect). Of the eight adverse health concentrations measured at the Tennessee sites, five were for formaldehyde.

21.3 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 metals and compounds in addition to carbonyls and VOC. Table 21-1 lists the average UATMP concentration for each of the sites as well as the averages for selected meteorological parameters from January 2003 to December 2003. Average metals and compound concentrations are listed in Table 21-5. Average metals concentrations are relatively similar at both Nashville sites.

Tables 21-4a-e are the summaries 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. Because the Dickson site did not detect any of the prevalent compounds more than two times, a Pearson Correlation analysis cannot be conducted. Nearly all of the correlations at LDTN were very strong. However, it is important to keep in mind that this site sampled only carbonyls on eight days, and VOC on four days. This small number of samples can skew the correlations. For the KITN site, nearly all of the compounds exhibited at least moderately strong correlations with maximum, average, dewpoint, and wet bulb temperatures, although some were positive and some were negative. Formaldehyde had the positive strongest correlation at KITN with maximum temperature (0.72), while *p*-dichlorobenzene had the strongest negative correlation with relative humidity (-0.76).

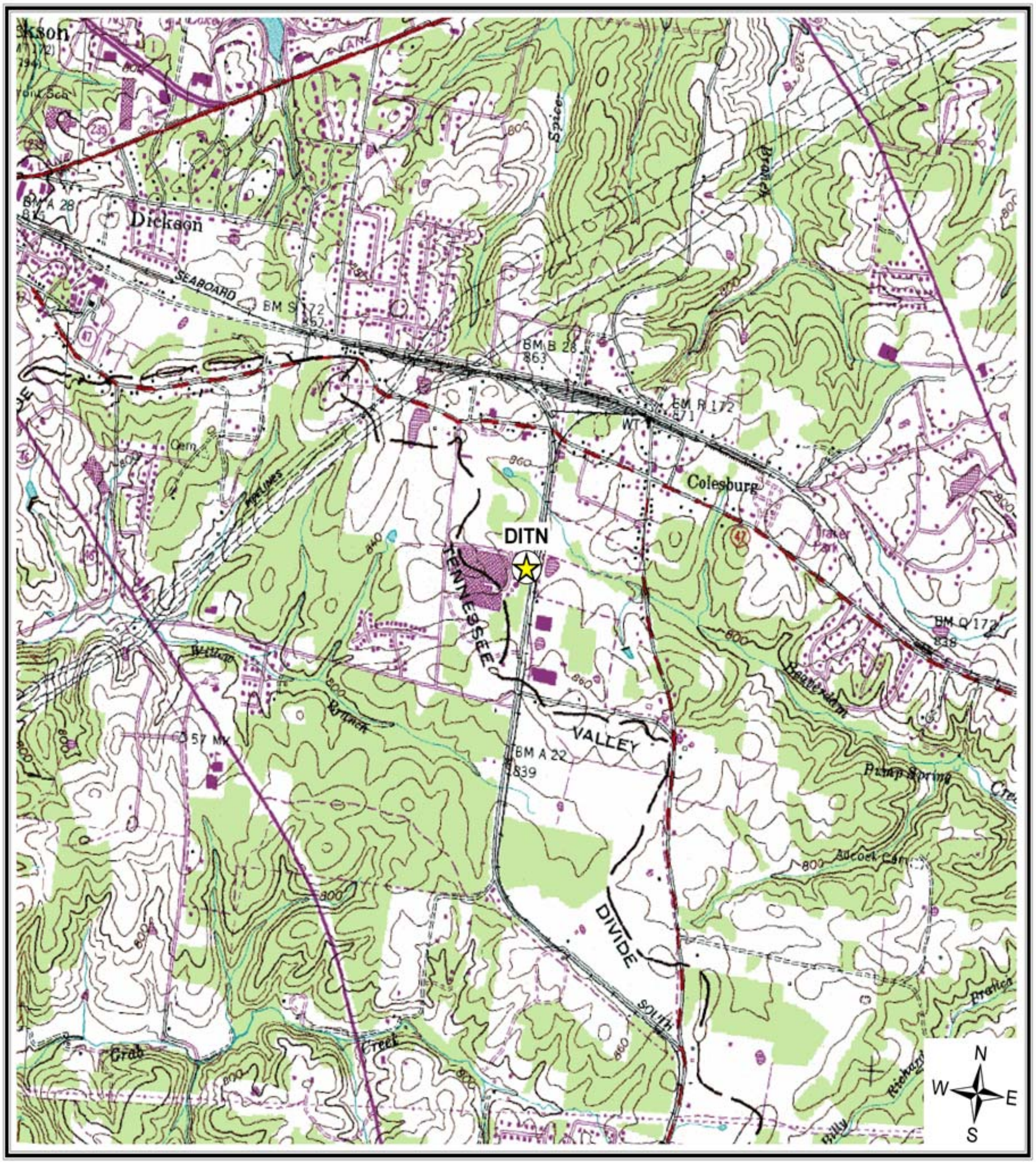
For the Nashville sites, some of the correlation patterns were similar between EATN and LOTN. For example, nearly all of the correlations with the u-component of the wind were negative. Acetaldehyde, arsenic and compounds, benzene, cadmium and compounds, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, and tetrachloroethylene tended to exhibit similar correlations with a majority of the meteorological parameters at both sites. Tetrachloroethylene had strong positive correlations with sea level pressure at both sites. Other correlations were not consistent between EATN and LOTN. 1,3-Butadiene exhibited strong correlations with all of the parameters at LOTN, but exhibited all weak correlations at EATN. All but one correlation with the v-component of the wind was positive at the LOTN site, while this trend is not consistent at EATN. Pearson correlations could not be computed for bromomethane at LOTN due to the low number of detects (fewer than 3).

21.4 Spatial Analysis

County-level car 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 21-6. Also included in Table 21-6 is the population within 10 miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at each Arizona site in Table 21-6. EATN has both the highest traffic volume passing the site and the largest estimate registered vehicles within 10 miles, yet has the lowest average UATMP concentration of the Tennessee sites.

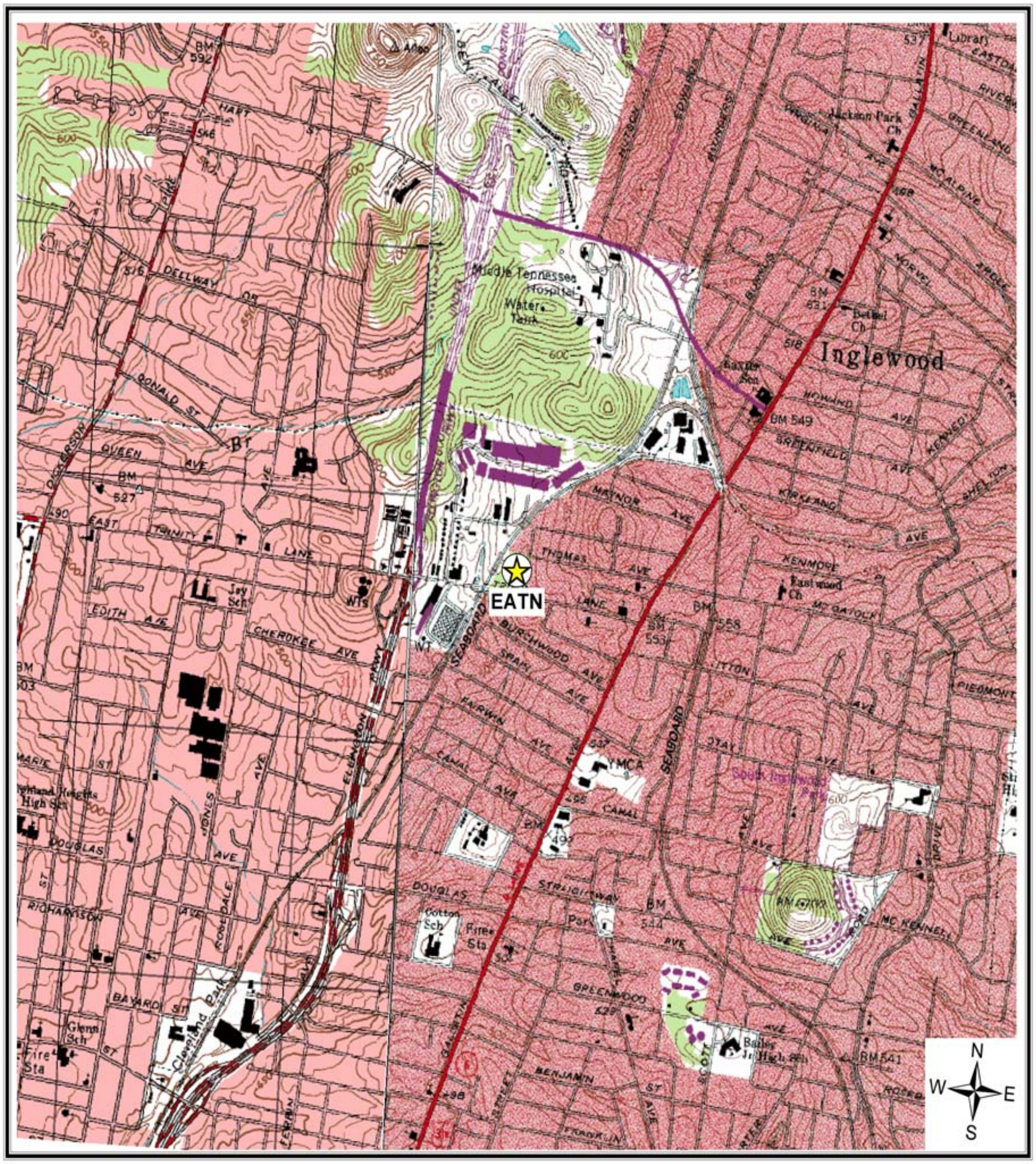
A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area (for more information on this study, refer to section 3.4.2.). Figure 3-1 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The concentration ratios for both EATN and KITN generally resemble those of the roadside study. LOTN somewhat resembles the roadside study, but its toluene-ethylbenzene concentration ratio is significantly higher that the roadside study's. LDTN's ratios are lower than the roadside study's and 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 looks the least like the roadside study, as its xylenes-ethylbenzene ratio is the higher than the toluene-ethylbenzene ratio, and all three ratios are significantly lower than those of the roadside study.

Figure 21-1. Dickson, Tennessee (DITN) Monitoring Station



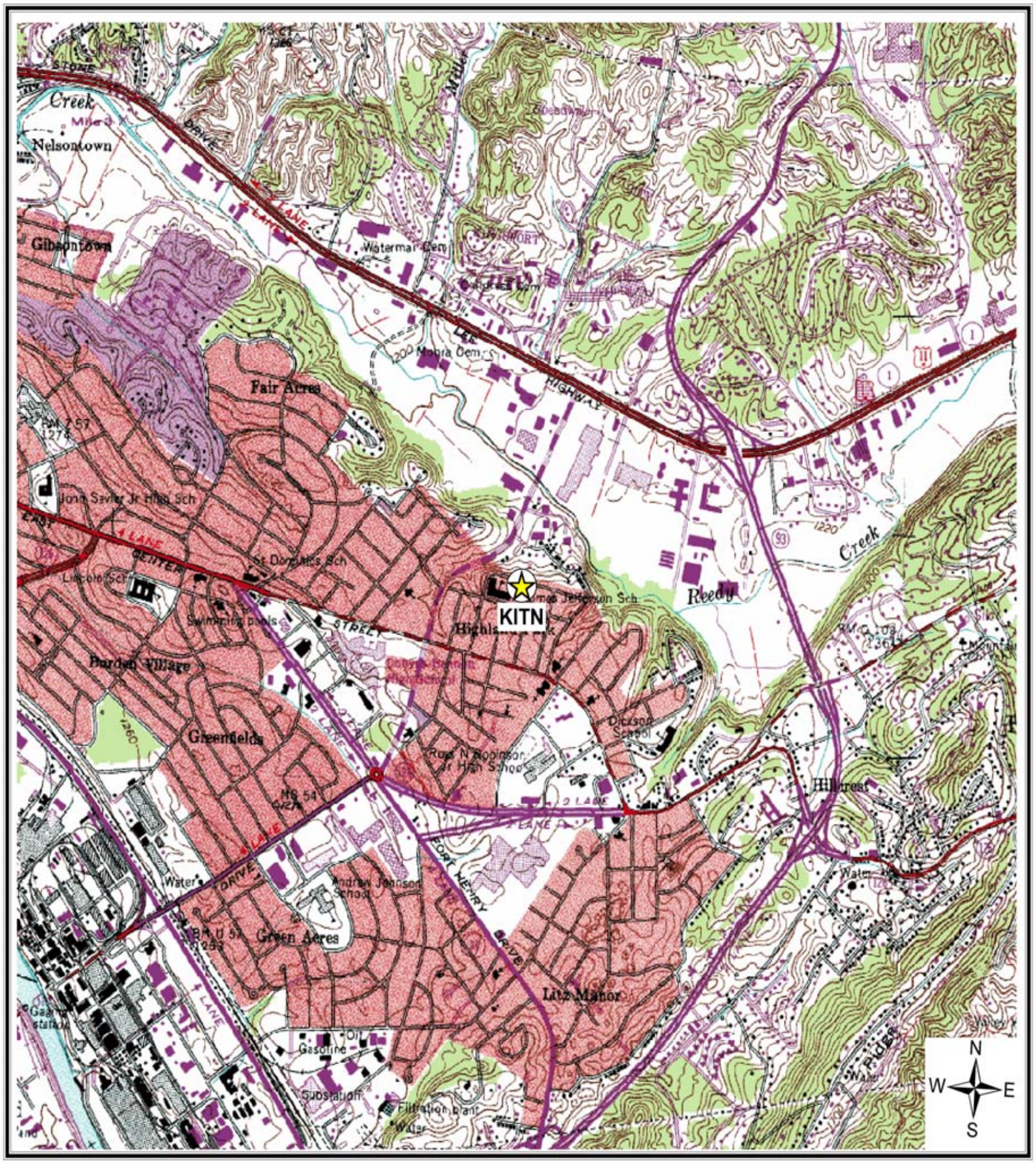
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 21-2. Nashville Site 1, Tennessee (EATN) Monitoring Station



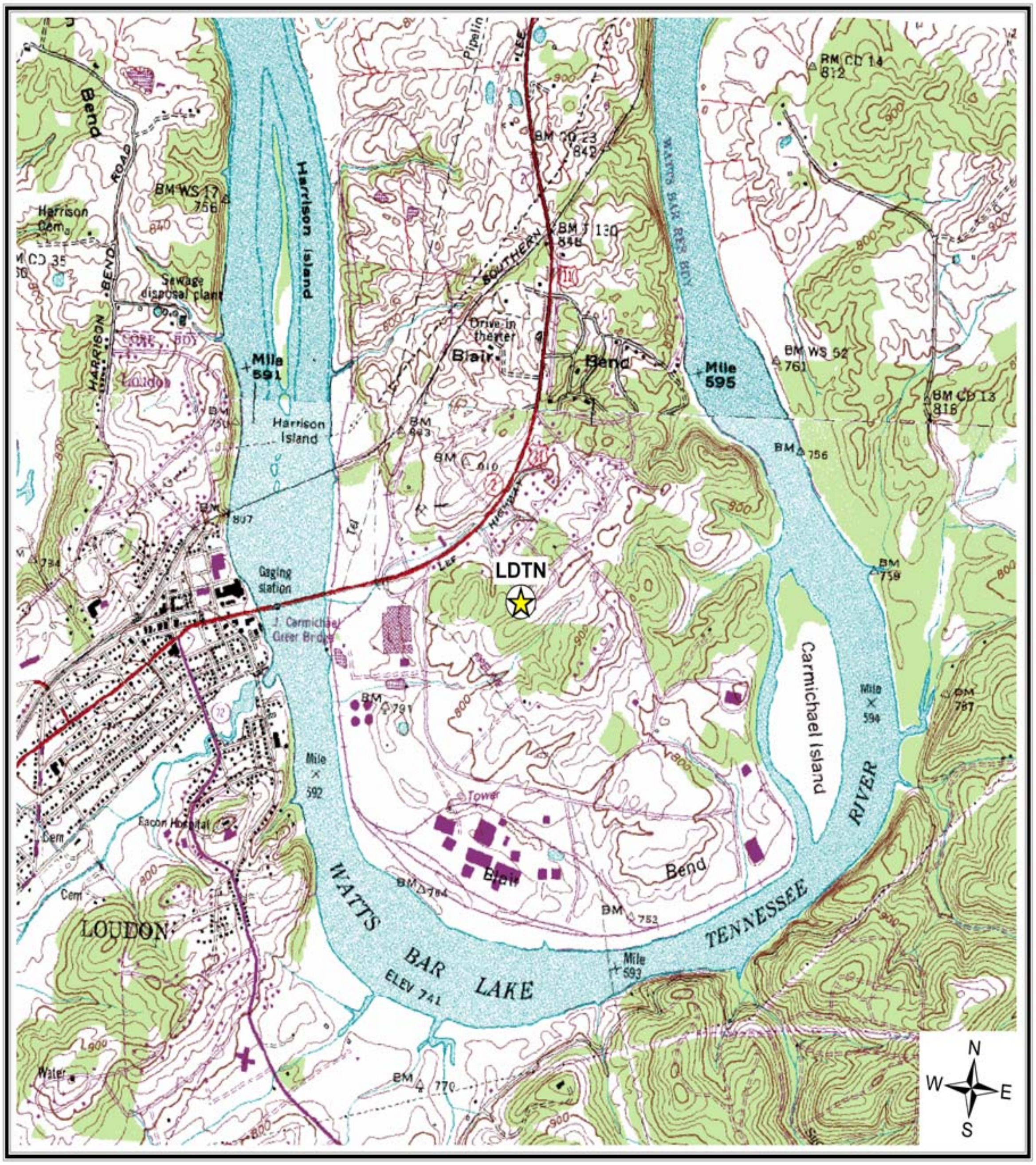
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 21-3. Kingsport, Tennessee (KITN) Monitoring Station



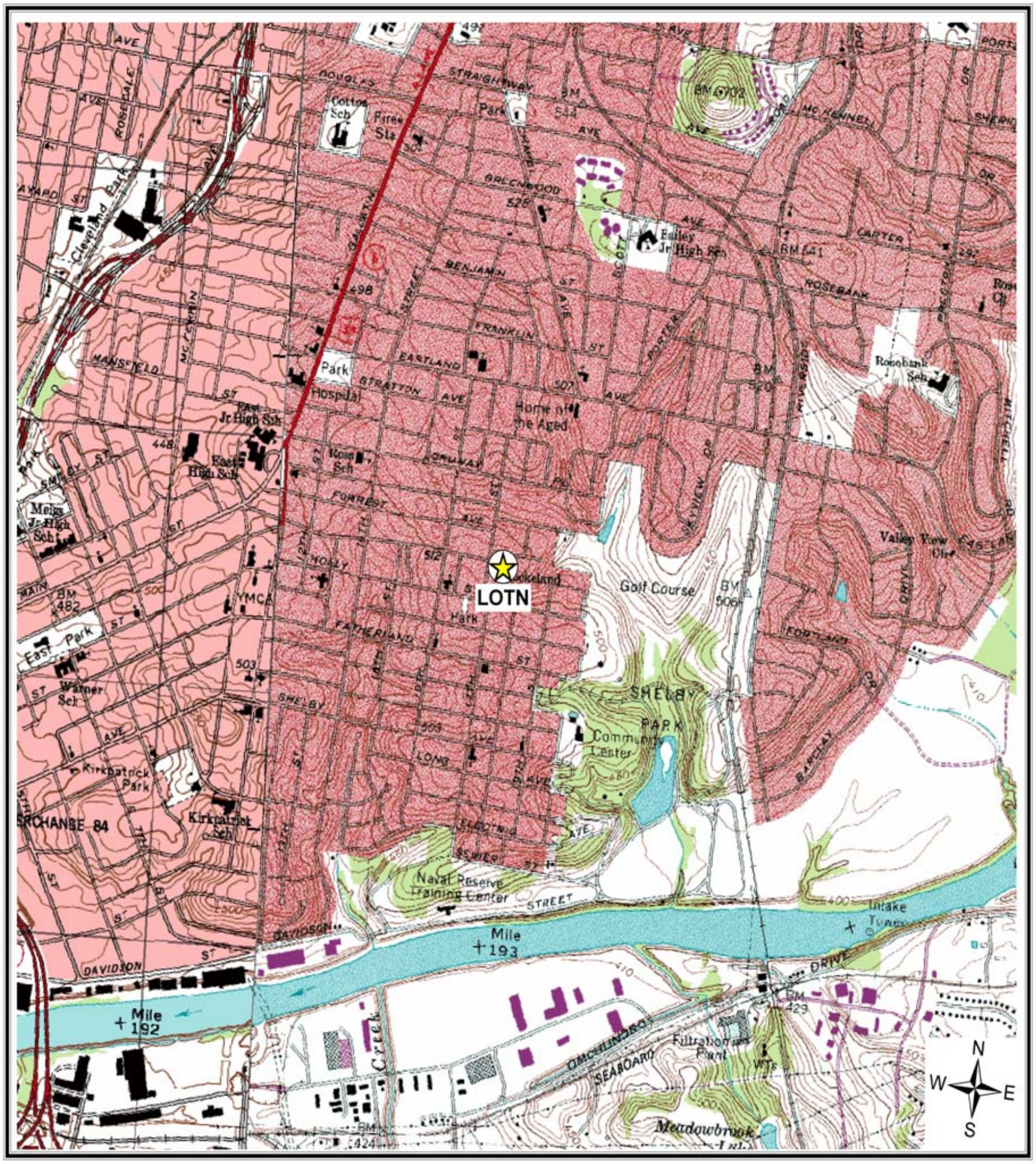
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 21-4. Loudon, Tennessee (LDTN) Monitoring Station



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

Figure 21-5. Nashville Site 2 (LOTN) Monitoring Station



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

Figure 21-6. Facilities Located Within 10 Miles of DITN

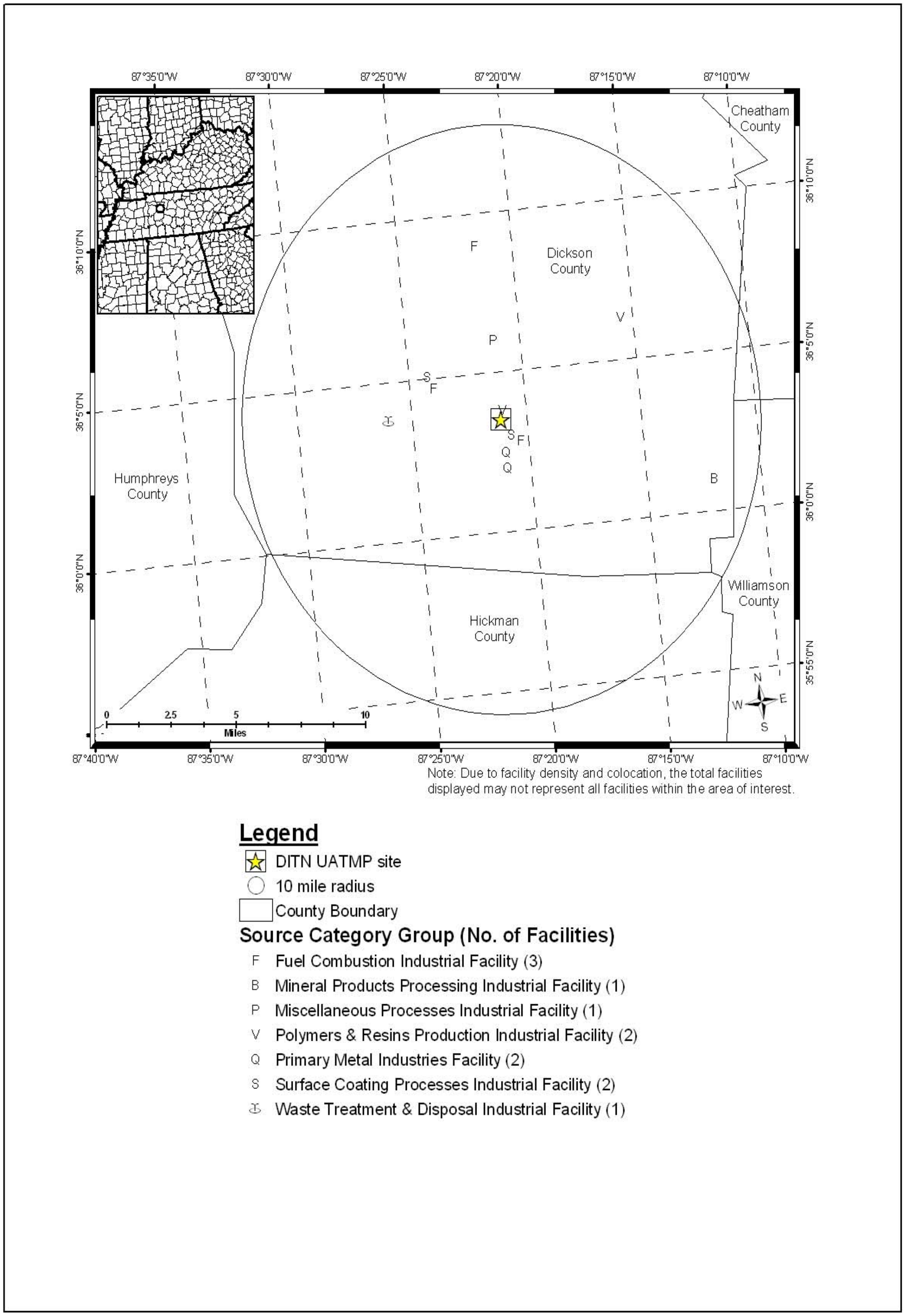
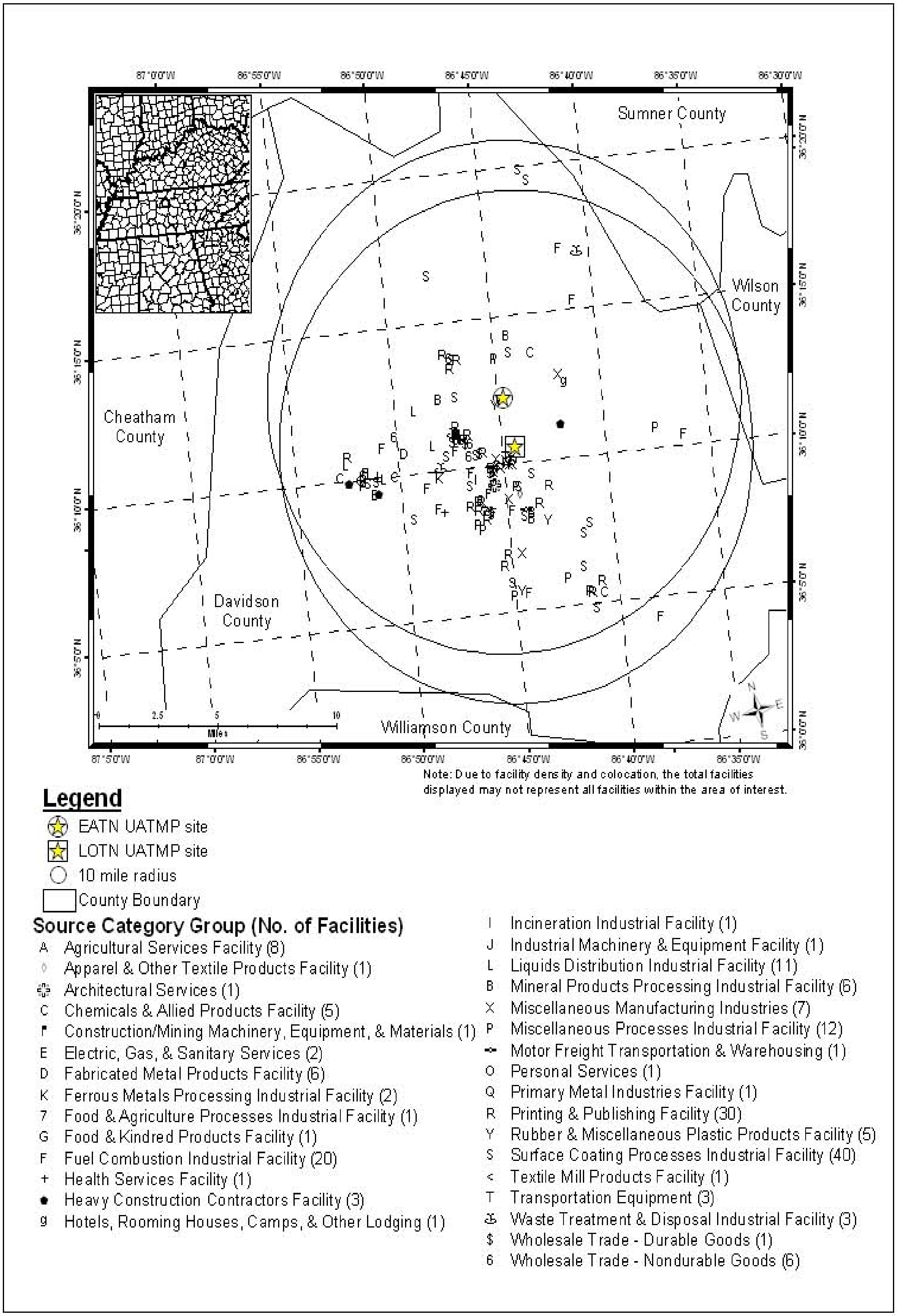
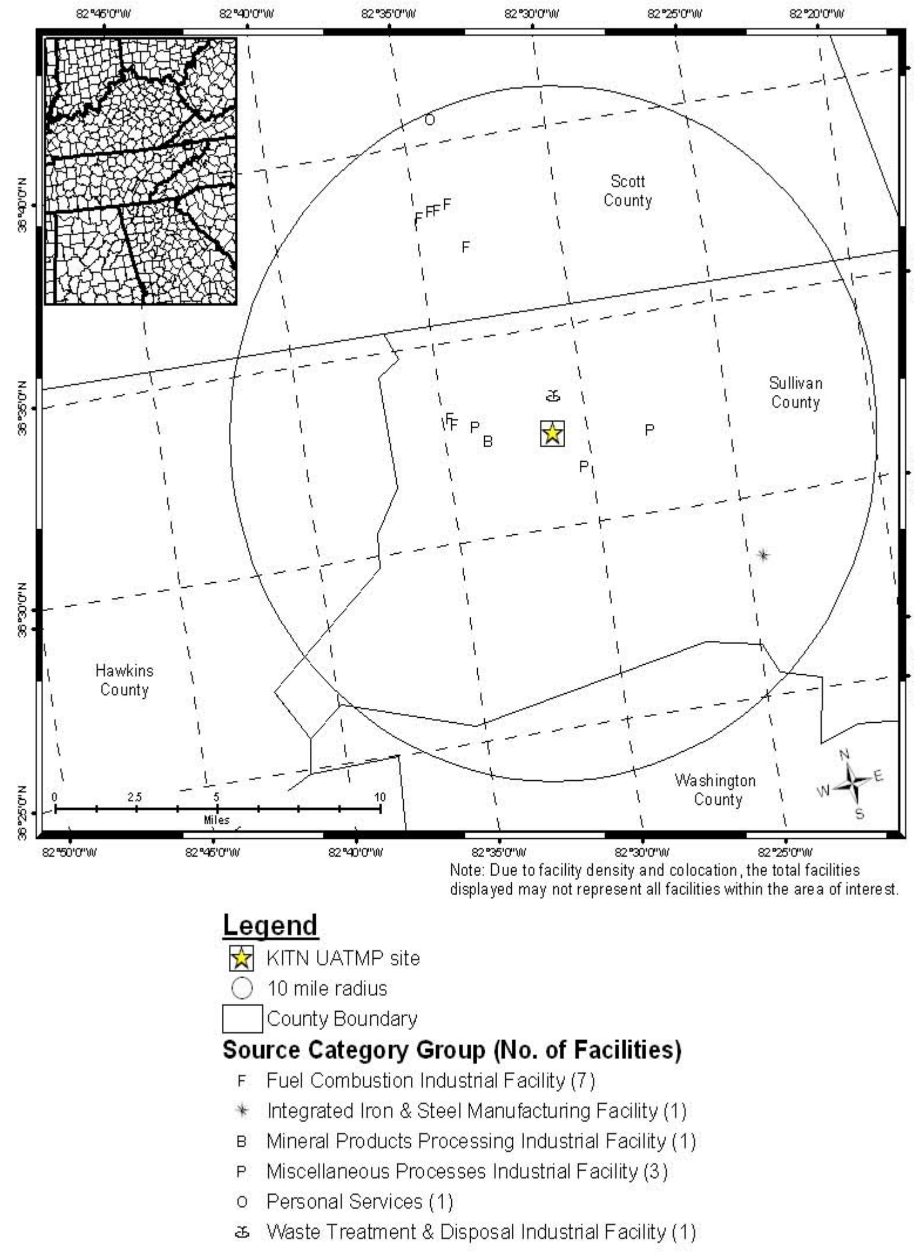


Figure 21-7. Facilities Located Within 10 Miles of EATN and LOTN



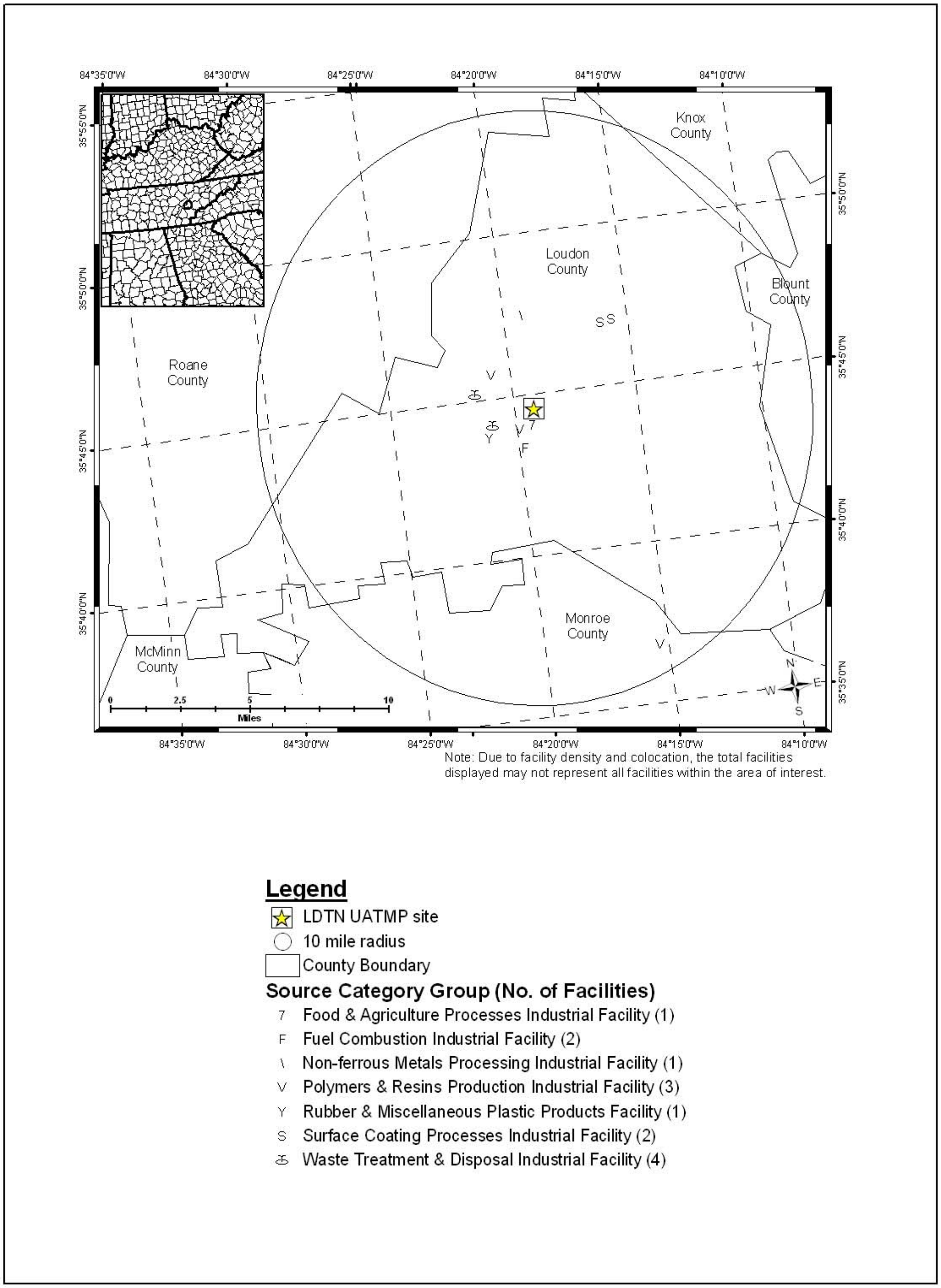
Note: Due to facility density and colocation, the total facilities displayed may not represent all facilities within the area of interest.

Figure 21-8. Facilities Located Within 10 Miles of KITN



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

Figure 21-9. Facilities Located Within 10 Miles of LDTN



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

Table 21-1. Average Concentration and Meteorological Parameters for the Sites in Tennessee

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)
DITN	All 2003	▨	66.71 (±1.85)	56.86 (±1.70)	48.64 (±1.82)	52.59 (±1.65)	76.74 (±1.21)	1016.99 (±0.59)	0.91 (±0.32)	0.38 (±0.42)
	sample day	39.17 (±28.56)	47.50 (±7.62)	39.38 (±1.79)	34.04 (±2.54)	37.23 (±2.17)	81.72 (±2.33)	1014.52 (±0.34)	5.86 (±4.09)	-2.07 (±1.67)
EATN	All 2003	▨	67.68 (±1.78)	58.6 (±1.67)	48.61 (±1.77)	53.39 (±1.58)	72.39 (±1.28)	1017.38 (±0.58)	0.80 (±0.29)	0.59 (±0.44)
	sample day	31.94 (±6.22)	69.46 (±6.42)	60.27 (±5.91)	50.26 (±5.89)	54.79 (±5.41)	72.27 (±3.97)	1017.06 (±1.71)	1.05 (±1.10)	0.84 (±1.77)
KITN	All 2003	▨	65.41 (±1.70)	54.41 (±1.56)	46.21 (±1.70)	50.24 (±1.52)	76.51 (±1.10)	1017.29 (±0.55)	1.71 (±0.33)	0.30 (±0.17)
	sample day	40.79 (±17.95)	67.57 (±5.49)	55.80 (±5.03)	46.94 (±5.54)	51.20 (±4.93)	75.38 (±3.99)	1018.05 (±1.81)	1.71 (±1.07)	0.68 (±0.63)
LDTN	All 2003	▨	67.45 (±1.66)	57.90 (±1.58)	49.64 (±1.74)	53.58 (±1.54)	76.20 (±1.18)	1017.03 (±0.55)	1.91 (±0.36)	-0.01 (±0.31)
	sample day	89.31 (±17.46)	55.60 (±11.97)	48.19 (±11.63)	42.28 (±14.54)	45.62 (±12.57)	81.03 (±10.16)	1018.58 (±3.21)	3.39 (±3.26)	0.72 (±1.80)
LOTN	All 2003	▨	67.68 (±1.78)	58.6 (±1.67)	48.61 (±1.77)	53.39 (±1.58)	72.39 (±1.28)	1017.38 (±0.58)	0.80 (±0.29)	0.59 (±0.44)
	sample day	37.98 (±21.25)	64.00 (±6.45)	55.00 (±6.03)	45.44 (±6.10)	50.12 (±5.59)	72.77 (±3.53)	1018.40 (±1.84)	0.93 (±0.97)	0.19 (±1.44)

Table 21-2a. Summary of the Toxic Cancer Compounds at the Dickson, Tennessee Monitoring Site - DITN

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	4.39E-06	43.33	43.33	0.563	2	4.39
Carbon Tetrachloride	4.25E-06	41.90	85.23	0.283	2	4.25
Acetaldehyde	1.25E-06	12.30	97.53	0.566	1	1.25
Methylene Chloride (Dichloromethane)	2.45E-07	2.42	99.94	0.521	1	<1
Formaldehyde	5.63E-09	0.06	100.00	1.023	1	<1

Table 21-2b. Summary of the Toxic Cancer Compounds at the Nashville Site 1, Tennessee Monitoring Site - EATN

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	1.19E-05	26.67	26.67	1.527	24	11.9
Carbon Tetrachloride	7.94E-06	17.79	44.46	0.529	23	7.94
Arsenic and Compounds	6.76E-06	15.14	59.60	0.002	23	6.76
1,3-Butadiene	6.00E-06	13.44	73.04	0.200	14	6.00
Acetaldehyde	3.69E-06	8.27	81.31	1.678	23	3.69
Cadmium and Compounds	3.17E-06	7.10	88.41	0.002	23	3.17
Tetrachloroethylene	2.86E-06	6.41	94.81	0.485	8	2.86
p-Dichlorobenzene	1.80E-06	4.04	98.85	0.164	4	1.80
Methylene Chloride (Dichloromethane)	1.87E-07	0.42	99.27	0.397	17	<1
Trichloroethylene	1.85E-07	0.41	99.69	0.093	2	<1
Beryllium and Compounds	1.21E-07	0.27	99.96	<0.0001	10	<1
Formaldehyde	1.97E-08	0.04	100.00	3.586	23	<1

Table 21-2c. Summary of the Toxic Cancer Compounds at the Kingsport, Tennessee Monitoring Site - KITN

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	9.66E-06	30.90	30.90	1.238	26	9.66
Carbon Tetrachloride	8.50E-06	27.21	58.10	0.567	24	8.50
Acetaldehyde	4.00E-06	12.79	70.89	1.817	26	4.00
1,3-Butadiene	3.98E-06	12.72	83.61	0.133	14	3.98
p-Dichlorobenzene	2.60E-06	8.31	91.92	0.236	6	2.60
Tetrachloroethylene	2.34E-06	7.48	99.41	0.396	10	2.34
Methylene Chloride (Dichloromethane)	1.71E-07	0.55	99.95	0.363	13	<1
Formaldehyde	1.46E-08	0.05	100.00	2.659	26	<1

Table 21-2d. Summary of the Toxic Cancer Compounds at the Loudon, Tennessee Monitoring Site - LDTN

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	1.13E-05	42.30	42.30	5.119	5	11.3
Benzene	8.60E-06	32.29	74.60	1.102	4	8.60
Carbon Tetrachloride	6.61E-06	24.81	99.41	0.440	1	6.61
Formaldehyde	1.57E-07	0.59	100.00	28.604	5	<1

Table 21-2e. Summary of the Toxic Cancer Compounds at the Nashville Site 2, Tennessee Monitoring Site - LOTN

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Cancer Risk (Out of 1 Million)
Benzene	1.05E-05	24.45	24.45	1.342	24	10.5
Carbon Tetrachloride	7.93E-06	18.54	42.99	0.529	23	7.93
1,3-Butadiene	7.70E-06	18.00	60.99	0.257	9	7.70
Arsenic and Compounds	6.07E-06	14.19	75.18	0.001	28	6.07
Acetaldehyde	3.25E-06	7.59	82.77	1.477	23	3.25
p-Dichlorobenzene	2.62E-06	6.11	88.88	0.238	5	2.50
Cadmium and Compounds	2.50E-06	5.84	94.73	0.001	28	1.61
Tetrachloroethylene	1.61E-06	3.77	98.50	0.273	7	<1
Trichloroethylene	2.69E-07	0.63	99.13	0.134	2	<1
Methylene Chloride (Dichloromethane)	2.50E-07	0.58	99.71	0.531	14	<1
Beryllium and Compounds	1.05E-07	0.25	99.95	<0.0001	10	<1
Formaldehyde	1.94E-08	0.05	100.00	3.531	23	<1

Table 21-3a. Summary of the Toxic Noncancer Compounds at the Dickson, Tennessee Monitoring Site - DITN

Compound	**Average Toxicity**	**% Contribution**	**Cumulative % Contribution**	**Average Concentration (μg/m^3)**	**# Detects**	**Adverse Noncancer Concentrations**
Formaldehyde	1.04E-01	37.06	37.06	1.023	1	0
Xylenes (*o*-, *m*-, *p*-)	6.50E-02	23.06	60.12	6.50	2	0
Acetaldehyde	6.29E-02	22.34	82.46	0.566	1	0
Benzene	1.88E-02	6.66	89.12	0.563	2	0
Chloromethane (Methyl Chloride)	1.25E-02	4.45	93.57	1.128	2	0
Toluene	6.74E-03	2.39	98.47	2.694	2	0
Carbon Tetrachloride	7.08E-03	2.51	96.08	0.283	2	0
Ethylbenzene	3.04E-03	1.08	99.55	3.039	1	0
Methyl Ethyl Ketone (2-Butanone)	7.42E-04	0.26	99.82	3.709	2	0
Methylene Chloride (Dichloromethane)	5.21E-04	0.18	100.00	0.521	1	0

Table 21-3b. Summary of the Toxic Noncancer Compounds at the Nashville Site 1, Tennessee Monitoring Site - EATN

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	3.66E-01	27.37	27.37	3.586	23	0
Manganese and Compounds	1.98E-01	14.79	42.16	0.010	23	0
Acetaldehyde	1.86E-01	13.94	56.11	1.678	23	0
Acetonitrile	1.37E-01	10.21	66.32	8.192	10	0
1,3-Butadiene	1.00E-01	7.48	73.80	0.200	14	0
Cadmium and Compounds	8.81E-02	6.59	80.39	0.002	23	0
Arsenic and Compounds	5.24E-02	3.92	84.31	0.002	23	0
Benzene	5.09E-02	3.81	88.12	1.527	24	0
Xylenes (*o*-, *m*-, *p*-)	4.62E-02	3.46	91.57	4.623	24	0
Bromomethane (Methyl Bromide)	3.96E-02	2.96	94.54	0.198	4	0
Carbon Tetrachloride	1.32E-02	0.99	95.53	0.529	23	0
Chloromethane (Methyl Chloride)	1.32E-02	0.99	96.51	1.186	24	0
Nickel and Compounds	1.24E-02	0.93	97.44	0.002	23	0
Toluene	9.61E-03	0.72	98.16	3.845	24	0
Mercury and Compounds	9.23E-03	0.69	98.85	0.003	20	0
Lead and Compounds	3.78E-03	0.28	99.13	0.006	23	0
Beryllium and Compounds	2.52E-03	0.19	99.32	<0.0001	10	0
Cobalt and Compounds	2.41E-03	0.18	99.50	<0.0001	23	0
Tetrachloroethylene	1.80E-03	0.13	99.64	0.485	8	0
Chloroform	1.44E-03	0.11	99.74	0.142	5	0
Styrene	8.75E-04	0.07	99.81	0.875	16	0
Ethylbenzene	7.26E-04	0.05	99.86	0.726	21	0
Methyl Ethyl Ketone (2-Butanone)	5.48E-04	0.04	99.90	2.739	15	0
Methylene Chloride (Dichloromethane)	3.97E-04	0.03	99.93	0.397	17	0
p-Dichlorobenzene	2.05E-04	0.02	99.95	0.164	4	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.67E-04	0.01	99.96	0.167	12	0
Trichloroethylene	1.54E-04	0.01	99.97	0.093	2	0
Methyl *tert*-Butyl Ether	1.54E-04	0.01	99.98	0.462	6	0
Methyl Isobutyl Ketone (Hexone)	1.51E-04	0.01	100.00	0.454	4	0
Selenium and Compounds	5.92E-05	<0.0001	100.00	0.001	23	0

Table 21-3c. Summary of the Toxic Noncancer Compounds at the Kingsport, Tennessee Monitoring Site - KITN

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acetonitrile	6.54E-01	49.04	49.04	39.255	7	1
Formaldehyde	2.71E-01	20.34	69.38	2.659	26	0
Acetaldehyde	2.02E-01	15.13	84.51	1.817	26	0
1,3-Butadiene	6.63E-02	4.97	89.47	0.133	14	0
Benzene	4.13E-02	3.09	92.57	1.238	26	0
Xylenes (*o*-, *m*-, *p*-)	3.80E-02	2.85	95.41	3.797	26	0
Bromomethane (Methyl Bromide)	2.21E-02	1.66	97.07	0.110	4	0
Carbon Tetrachloride	1.42E-02	1.06	98.13	0.567	24	0
Chloromethane (Methyl Chloride)	1.31E-02	0.98	99.12	1.182	26	0
Toluene	6.73E-03	0.50	99.62	2.693	26	0
Tetrachloroethylene	1.47E-03	0.11	99.73	0.396	10	0
Chloroform	1.24E-03	0.09	99.82	0.122	3	0
Ethylbenzene	5.89E-04	0.04	99.87	0.589	23	0
Methyl Ethyl Ketone (2-Butanone)	3.91E-04	0.03	99.90	1.953	17	0
Methylene Chloride (Dichloromethane)	3.63E-04	0.03	99.92	0.363	13	0
Styrene	3.02E-04	0.02	99.95	0.302	5	0
p-Dichlorobenzene	2.95E-04	0.02	99.97	0.236	6	0
1,1,1-Trichloroethane (Methyl Chloroform)	2.17E-04	0.02	99.99	0.217	12	0
Methyl Isobutyl Ketone (Hexone)	1.29E-04	0.01	100.00	0.387	2	0
Methyl *tert*-Butyl Ether	6.60E-05	<0.0001	100.00	0.198	4	0

Table 21-3d. Summary of the Toxic Noncancer Compounds at the Loudon, Tennessee Monitoring Site - LDTN

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Formaldehyde	2.92E+00	81.66	81.66	28.604	5	5
Acetaldehyde	5.69E-01	15.91	97.57	5.119	5	0
Benzene	3.67E-02	1.03	98.60	1.102	4	0
Xylenes (*o*-, *m*-, *p*-)	2.43E-02	0.51	99.11	2.431	3	0
Chloromethane (Methyl Chloride)	1.16E-02	0.32	99.43	1.043	4	0
Carbon Tetrachloride	1.10E-02	0.31	99.74	0.440	1	0
Toluene	6.10E-03	0.17	99.91	2.440	4	0
Styrene	2.04E-03	0.06	99.97	2.044	1	0
Ethylbenzene	6.51E-04	0.02	99.99	0.651	1	0
Methyl Ethyl Ketone (2-Butanone)	5.68E-04	0.01	100.00	2.839	4	0

Table 21-3e. Summary of the Toxic Noncancer Compounds at the Nashville Site 2, Tennessee Monitoring Site - LOTN

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Acetonitrile	4.87E-01	29.66	29.66	29.235	10	1
Formaldehyde	3.60E-01	21.93	51.59	3.531	23	1
Manganese and Compounds	1.93E-01	11.75	63.34	0.010	28	0
Acetaldehyde	1.64E-01	9.99	73.32	1.477	23	0
1,3-Butadiene	1.28E-01	7.81	81.14	0.257	9	0
Cadmium and Compounds	6.95E-02	4.23	85.37	0.001	28	0
Xylenes (*o*-, *m*-, *p*-)	4.89E-02	2.97	88.34	4.887	23	0
Arsenic and Compounds	4.71E-02	2.87	91.21	0.001	28	0
Benzene	4.47E-02	2.72	93.93	1.342	24	0
Bromomethane (Methyl Bromide)	1.88E-02	1.14	95.07	0.094	2	0
Toluene	1.60E-02	0.98	96.05	6.410	24	0
Carbon Tetrachloride	1.32E-02	0.80	96.85	0.529	23	0
Chloromethane (Methyl Chloride)	1.30E-02	0.79	97.64	1.166	24	0
Nickel Compounds	1.08E-02	0.66	98.30	0.002	28	0
Methyl Isobutyl Ketone (Hexone)	1.03E-02	0.63	98.93	30.929	2	0
Cobalt and Compounds	3.50E-03	0.21	99.14	<0.0001	28	0
Lead and Compounds	3.21E-03	0.20	99.33	0.005	28	0
Chloroform	2.99E-03	0.18	99.52	0.293	6	0
Beryllium and Compounds	2.19E-03	0.13	99.65	<0.0001	10	0
Methyl Ethyl Ketone (2-Butanone)	1.91E-03	0.12	99.77	9.526	13	0
Tetrachloroethene	1.01E-03	0.06	99.83	0.273	7	0
Ethylbenzene	8.40E-04	0.05	99.88	0.840	15	0
Methylene Chloride (Dichloromethane)	5.31E-04	0.03	99.91	0.531	14	0
Styrene	3.86E-04	0.02	99.93	0.386	9	0
p-Dichlorobenzene	2.97E-04	0.02	99.95	0.238	5	0
Trichloroethylene	2.24E-04	0.01	99.97	0.134	2	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.86E-04	0.01	99.98	0.186	9	0
Methyl *tert*-Butyl Ether	1.52E-04	0.01	99.99	0.457	6	0
Mercury and Compounds	8.23E-05	0.01	99.99	<0.0001	25	0
Chloroethane (Ethyl Chloride)	7.92E-05	<0.0001	100.00	0.792	1	0
Selenium and Compounds	5.60E-05	<0.0001	100.00	<0.0001	28	0

Table 21-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Dickson, Tennessee Site (DITN)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	NA	NA	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethane	NA	NA	NA	NA	NA	NA	NA	NA
Formaldehyde	NA	NA	NA	NA	NA	NA	NA	NA
Xylenes (*o*-, *m*-, *p*-)	NA	NA	NA	NA	NA	NA	NA	NA

Table 21-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Nashville Site 1, Tennessee Site (EATN)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	0.03	-0.06	-0.12	-0.09	-0.24	0.23	-0.20	0.13
Acetaldehyde	0.51	0.43	0.30	0.37	-0.39	-0.10	-0.24	0.26
Acetonitrile	0.50	0.55	0.66	0.62	0.03	0.33	-0.59	-0.33
Arsenic and Compounds	0.58	0.58	0.60	0.60	0.07	-0.23	0.04	-0.07
Benzene	-0.10	-0.20	-0.18	-0.19	0.03	0.29	-0.26	0.17
Cadmium and Compounds	-0.63	-0.66	-0.61	-0.64	0.14	0.22	-0.14	-0.10
Carbon Tetrachloride	0.29	0.26	0.17	0.22	-0.29	-0.08	-0.14	0.18
Formaldehyde	0.73	0.69	0.56	0.63	-0.41	-0.04	-0.19	0.20
Manganese and Compounds	-0.20	-0.21	-0.31	-0.26	-0.47	-0.03	0.04	0.04
Bromomethane (Methyl Bromide)	-0.80	-0.68	0.20	-0.19	0.83	0.64	-0.75	-0.84
p-Dichlorobenzene	0.51	0.46	0.26	0.29	0.09	0.33	-0.34	-0.21
Tetrachloroethylene	-0.48	-0.55	-0.34	-0.46	0.61	0.57	-0.44	-0.60
Xylenes (*o*-, *m*-, *p*-)	0.18	0.07	0.08	0.08	0.06	0.10	-0.27	0.13

Table 21-4c. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Kingsport, Tennessee Site (KITN)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.45	-0.46	-0.43	-0.45	-0.04	0.33	-0.05	0.05
Acetaldehyde	0.63	0.55	0.40	0.47	-0.20	-0.08	-0.19	0.10
Acetonitrile	0.26	0.30	0.29	0.29	0.13	-0.05	0.00	0.15
Benzene	-0.24	-0.35	-0.30	-0.34	0.06	0.11	-0.14	0.03
Carbon Tetrachloride	0.28	0.27	0.14	0.21	-0.35	-0.23	0.16	0.02
Formaldehyde	0.72	0.66	0.49	0.57	-0.25	0.05	-0.23	-0.20
p-Dichlorobenzene	-0.02	-0.26	-0.54	-0.44	-0.76	0.15	0.61	-0.20
Tetrachloroethene	-0.36	-0.39	-0.43	-0.40	-0.38	-0.25	-0.39	0.28
Xylenes (*o*-, *m*-, *p*-)	0.34	0.30	0.37	0.33	0.41	0.28	-0.37	-0.12

Table 21-4d. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Loudon, Tennessee Site (LDTN)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Acetaldehyde	0.86	0.74	0.75	0.75	0.79	-0.03	-0.91	-0.38
Benzene	0.71	0.93	0.94	0.94	0.92	0.13	-0.90	-0.88
Carbon Tetrachloride	NA	NA	NA	NA	NA	NA	NA	NA
Formaldehyde	0.81	0.89	0.91	0.90	0.91	0.13	-0.93	-0.79

Table 21-4e. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Nashville Site 2, Tennessee Site (LOTN)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.68	-0.82	-0.89	-0.87	-0.61	0.47	-0.50	0.42
Acetaldehyde	0.48	0.40	0.30	0.36	-0.35	-0.22	-0.27	0.24
Acetonitrile	0.04	0.17	0.25	0.22	0.47	-0.12	0.09	0.02
Arsenic and Compounds	0.54	0.53	0.50	0.52	-0.03	-0.09	-0.14	-0.18
Benzene	-0.02	-0.14	-0.15	-0.15	-0.02	0.15	-0.34	0.13
Cadmium and Compounds	-0.45	-0.46	-0.44	-0.45	-0.02	0.24	-0.26	0.02
Carbon Tetrachloride	0.36	0.32	0.33	0.33	0.17	-0.24	-0.08	0.09
Formaldehyde	0.66	0.64	0.58	0.62	-0.21	-0.33	-0.16	0.02
Manganese and Compounds	0.46	0.43	0.30	0.37	-0.50	-0.19	-0.15	0.25
Bromomethane (Methyl Bromide)	NA	NA	NA	NA	NA	NA	NA	NA
p-Dichlorobenzene	0.75	0.61	0.59	0.60	0.19	-0.70	-0.02	0.77
Tetrachloroethylene	-0.16	-0.34	-0.56	-0.45	-0.28	0.82	-0.03	0.02
Xylenes (*o*-, *m*-, *p*-)	0.35	0.34	0.35	0.35	0.12	-0.11	-0.20	0.11

Table 21-5. Average Metal Concentrations Measured by the Nashville Monitoring Stations

Monitoring Station	Average Metals Concentration (ng/m^3)
EATN	25.23
LOTN	20.93

Table 21-6. Motor Vehicle Information vs. Daily Concentration for the Tennessee Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
DITN	44,231	39,083	0.88	29,329	25,810	4,420	39.17 (±28.56)
EATN	570,785	590,410	1.03	513,967	529,386	38,450	31.94 (±6.22)
KITN	153,051	160,005	1.05	131,461	138,034	300	40.79 (±17.95)
LDTN	40,631	35,698	0.88	46,361	40,798	13,360	89.31 (±17.46)
LOTN	570,785	590,410	1.03	464,054	477,976	3,000	37.98 (±21.25)

22.0 Sites in Utah

This section focuses on meteorological, concentration, and spatial trends for the UATMP sites in Utah (BOUT and BTUT), located in Bountiful, just north of Salt Lake City. The BOUT site was moved in July, 2003, to a new location just north of the original location. This new location was designated as BTUT, and for purposes of this report, will be treated as a different site. Figures 22-1 and 22-2 are topographical maps showing the monitoring stations in their urban locations. Figure 22-3 is a map identifying facilities within ten miles of the sites that reported to the 1999 NEI. The map shows the nearby industrial facilities, which are mostly fuel combustion facilities. The facilities are located mostly to the south and southwest. Hourly meteorological data were retrieved for all of 2003 at Salt Lake City International Airport's weather station (WBAN 24127) near the sites with the purpose of calculating correlations of meteorological data with ambient air concentration measurements.

Table 22-1 highlights the average UATMP concentration at the sites, along with the 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 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).

22.1 Prevalent Compounds at the Utah Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Tables 22-2a-b summarize the cancer weighting scores and Tables 22-3a-b summarize 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.

Tables 22-2a-b show that many of the detected cancer compounds reflect the nationwide prevalent cancer compound list, which is listed in Section 3 of this report. However, both sites sampled metals and compounds and SNMOC in addition to carbonyls and VOC. As a result, arsenic, beryllium, and cadmium and compounds also appear in Tables 22-2a-b. Arsenic and compounds, acrylonitrile, benzene, carbon tetrachloride, 1,3-butadiene, and tetrachloroethylene are all considered prevalent cancer compounds at both sites. For the noncancer compounds summarized in Tables 22-3a-b, many compounds detected were not listed among the nationwide noncancer prevalent list. Manganese and compounds, acrylonitrile, acetonitrile, formaldehyde, arsenic and compounds, acetaldehyde, nickel and compounds, and cobalt and compounds were prevalent at both sites.

Toxic compounds not detected at the Bountiful sites were: 1,3-dichloropropene; 1,1,2-trichloroethane; trichloroethylene; vinyl chloride; bromoform; chloroprene; chloroform; 1,1-dichloroethene; methyl methacrylate; 1,2,4-trichlorobenzene; methyl *tert*-butyl ether; chlorobenzene and chloroethane.

22.2 Toxicity Analysis

Arsenic compounds, acrylonitrile, benzene, carbon tetrachloride, 1,3-butadiene, and tetrachloroethylene are the only prevalent cancer compounds at both sites. Of these compounds, acrylonitrile contributed most to each site's total cancer toxicity, even though it was detected only once at BOUT and twice at BTUT. Benzene contributed less than 15% to the sites' total cancer toxicity, even though it was detected the most times. Metals and compounds account for nearly 73% of the noncancer toxicity at BOUT and 30% of the noncancer toxicity at BTUT.

The cadmium compounds cancer risk at BOUT was the highest among the two sites at 123 in a million, while at BTUT, the acrylonitrile cancer risk was 61.9 in a million. For the compounds which may lead to adverse noncancer health effects, the average cadmium compounds toxicity at BOUT was 3.41 (over 1 indicates a significant chance of a noncancer health effect). Of the twenty-six adverse health concentrations measured at the Utah sites, 21 were at the BOUT site. Manganese had the most adverse health concentrations at 14, while cadmium had 10.

22.3 Meteorological and Concentration Averages at the Utah Sites

Carbonyl compounds and VOC were measured at this site, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentrations at both sites is presented in Table 22-1. Table 22-1 also lists the averages for selected meteorological parameters from January 2003 to December 2003. These sites 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 BOUT was 323.73 ppbC, of which nearly 64% could be identified through speciation. Of the speciated compounds, toluene measured the highest concentration (37.74 ppbC). The average total NMOC value for BTUT was 317.98 ppbC, of which nearly 65% could be identified through speciation. Of the speciated compounds, toluene measured the highest concentration (28.71 ppbC). The Utah sites opted to sample metals and compounds in addition to carbonyls, VOC, and SNMOC. Average metals concentrations are listed in Table 22-5. The average metals concentration at BOUT was nearly three times that of BTUT.

Tables 22-4a-b summarize the 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 the BOUT site, most of the prevalent compounds that are not metals and compounds had relatively weak correlations, with the exception of formaldehyde. The metals and compounds all had weak, moderately strong, strong, or very strong negative correlations with maximum, average, dew point, and wet bulb temperatures, and positive correlations with relative humidity and sea level pressure. The strongest correlations were exhibited between cadmium and compounds and average temperature (-0.68), although several others were very strong. Pearson correlations could not be computed for acetonitrile, acrylonitrile, cobalt and compounds, and tetrachloroethylene due to the low number of detects (fewer than 3).

Similar correlations were not generally seen at BTUT, although formaldehyde did have similar correlations at BOUT and BTUT. The strongest correlations were computed between acetonitrile and several meteorological parameters, but it is important to note that this compound was only detected five times during the sampling period. Several compounds had positive correlations with the temperature parameters and negative correlations with relative humidity. Pearson correlations could not be computed for acrylonitrile due to the low number of detects (fewer than 3).

22.4 Spatial Analysis

County-level car 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 22-6. Also included in Table 22-6 is the population within 10 miles of each site and 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. Using these parameters, a car registration ratio was computed. An estimation of 10-mile car registration was computed using the 10-mile populations surrounding the monitors and the car registration ratio. This information is compared to the average daily concentration of the prevalent compounds at each Utah site in Table 22-6. Because the site locations are close to each other, their car registration data are the same. However, BTUT has nearly triple the daily traffic volume of BOUT.

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 3-1 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. BTUT most resembles the roadside study, although its toluene-ethylbenzene ratio is somewhat higher. Unlike the roadside study, BOUT's benzene-ethylbenzene and xylenes-ethylbenzene ratio are roughly equivalent. Its toluene-ethylbenzene ratio is also somewhat higher than the roadside study's toluene-ethylbenzene ratio.

22.5 NATTS Site Analysis

One of the Utah sites, BOUT, is an EPA-designated NATTS site. A description of the NATTS program is given in Section 3.6. For BOUT, each of the following analyses were conducted: a back trajectory analysis, a regulation analysis, and an emission tracer analysis. Details on each type of analysis are also provided in Section 3.6.

22.5.1 Composite Back Trajectory Analysis

Figure 22-4 is the composite back trajectory map for the BOUT site. 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 22-4, the back trajectories originated primarily from the northwest or south of the monitoring location. The 24-hour airshed domain is large, as the farthest away a back trajectory originated was southeast California. As each circle around the site represents 100 miles, 70% of the trajectories originated within 200 miles and 93% within 300 miles from the BOUT site.

22.5.2 Regulation Analysis

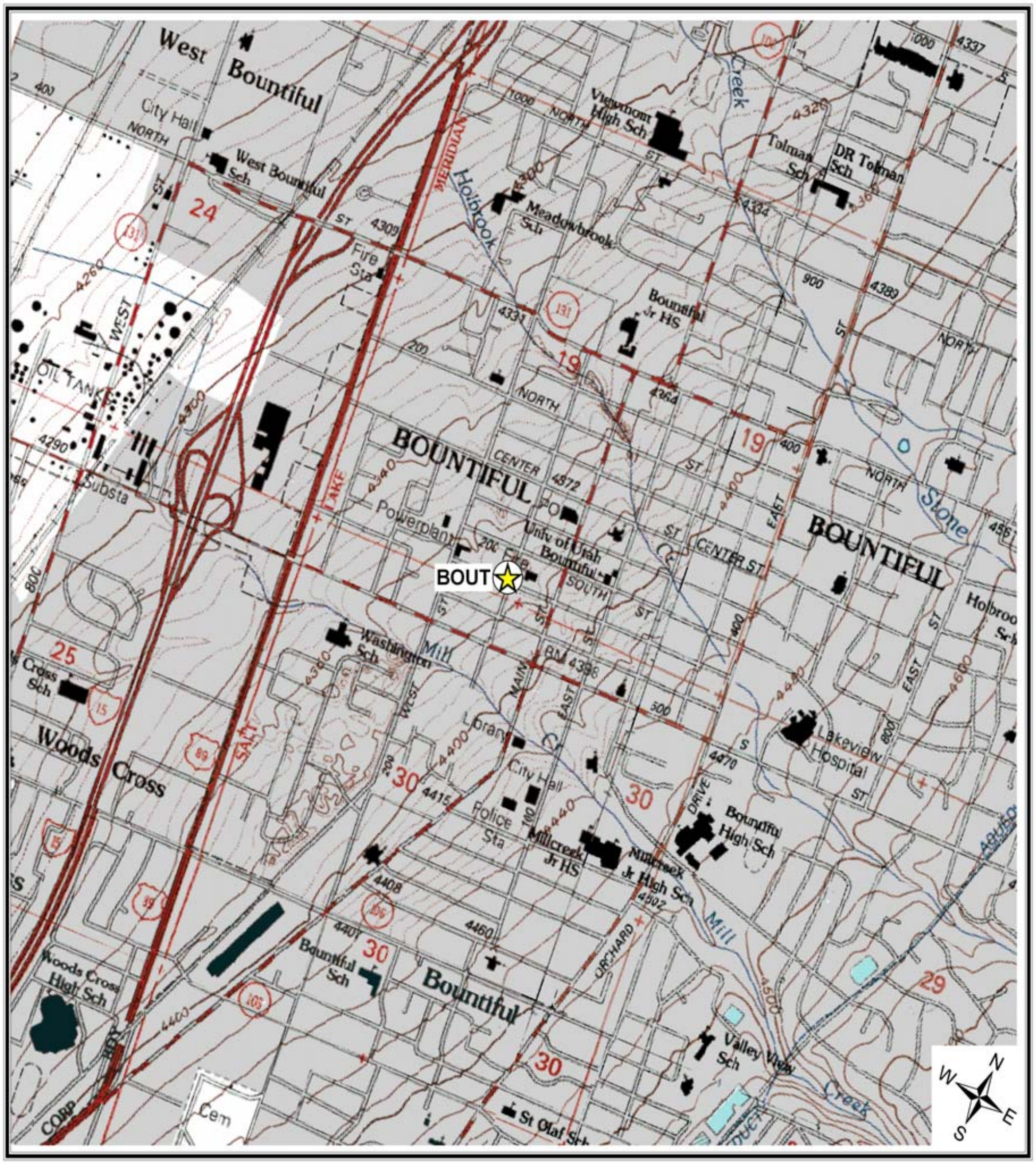
Table 3-10 summarizes the number of facilities that account for approximately 90% of the total UATMP pollutant emissions in the 10-mile area around the monitoring station. At BOUT, of the four facilities listed in Table 3-11, all four are potentially subject to future regulations. Table 22-7 identifies the regulations that are potentially applicable. Based on this analysis, the regulations shown are expected to achieve reductions in ambient concentrations of the following UATMP pollutants: acetaldehyde, antimony and compounds, arsenic and compounds, benzene, beryllium and compounds, cadmium and compounds, cobalt and compounds, formaldehyde, lead and compounds, manganese and compounds, nickel and compounds, and toluene. Reductions are projected for acetaldehyde (47%), antimony and compounds (81%), arsenic and compounds (44%), benzene (0.3%), beryllium and compounds (17%), cadmium and compounds (47%), cobalt and compounds (87%), formaldehyde (62%), lead and compounds (49%), manganese and compounds (59%), nickel and compounds (78%), and toluene (0.05%) as the regulations are implemented (the latest compliance date is 2005). The emission reductions are primarily attributed to regulation of petroleum refineries.

22.5.3 Emission Tracer Analysis

The highest concentrations of cadmium and manganese compounds occurred on January 21, 2003, while for formaldehyde, the highest occurred on June 14, 2003. Figures 22-5 through 22-7 are the pollution roses for all cadmium and compounds, manganese and compounds, and formaldehyde samples at BOUT. As can be shown, the highest cadmium and compounds, manganese and compounds, and formaldehyde exceedance values point to possible emission sources southeast of the monitor. Figures 22-8 and 22-9 are maps of cadmium and compounds and manganese and compounds stationary emission sources southeast of the BOUT monitor. According to the 1999 NEI, cadmium and compounds sources southeast of the BOUT monitor include: Primary Children's Medical Center, Walker Pit, Geneva Steel, Heckett Engineering, Brigham Young University, Pipe Casting Plant, Whitehead Power Plant, A.P. Green Refractories - Lehi Plant, and Explosives Manufacturing. Manganese and compounds sources include eight of the above nine (not Heckett Engineering), as well as Mark Steel Corp - Jordan River Plant, Hobusch Plant, Eidson-Brown Minneapolis Tank Division, and Pitt-Des Moines, Inc. Figure 22-10 is the back trajectory map for January 21, 2003, which shows the air originating south to southeast of the monitor. An analysis of the hourly meteorological data shows that winds were primarily out of the southeast for most of the day, as well. It is likely that air sampled at BOUT on this date passed over the above-listed facilities earlier in the day.

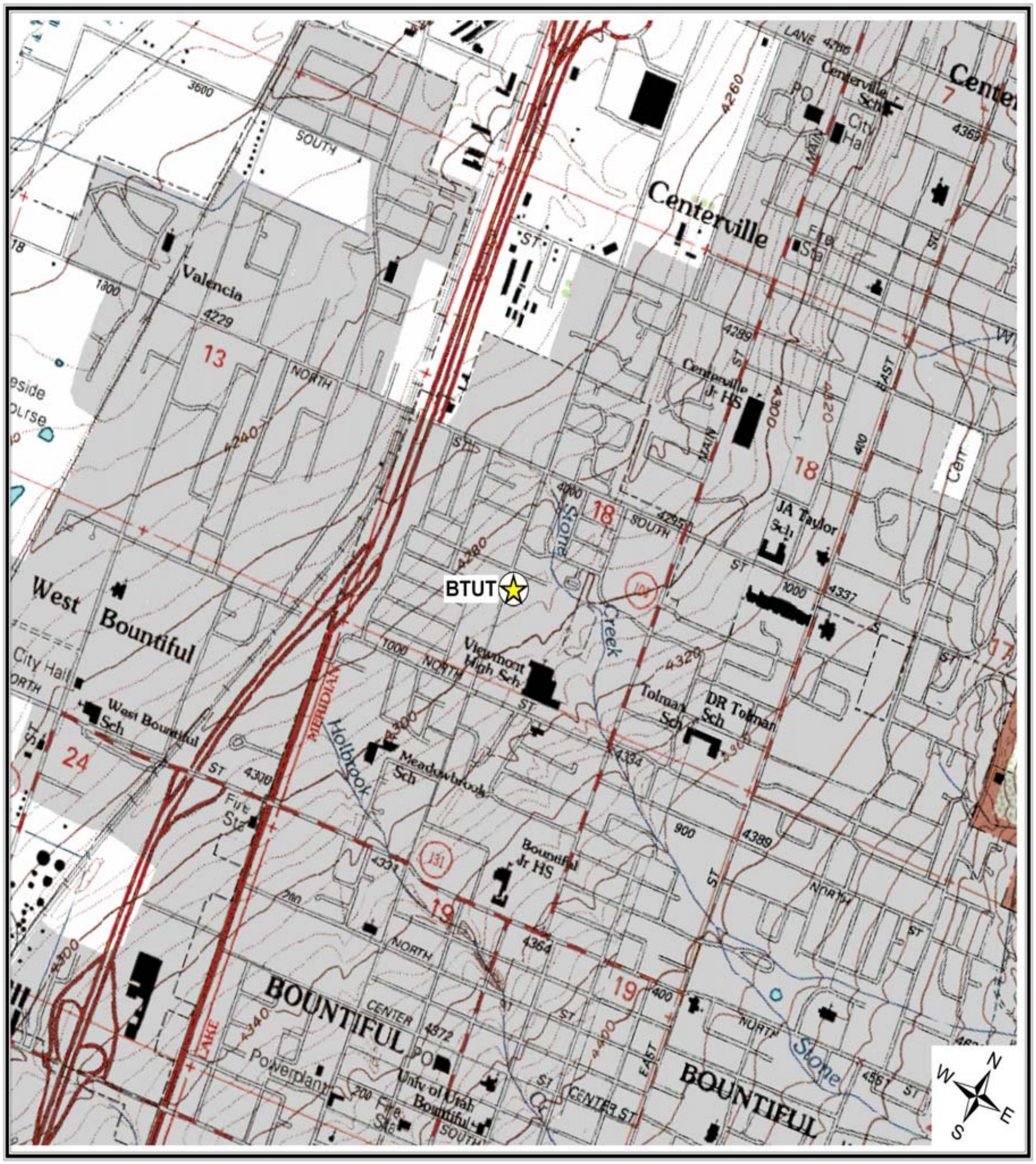
Figure 22-11 is a map of formaldehyde stationary emission sources southeast of the BOUT monitor. According to the 1999 NEI, formaldehyde sources southeast of the BOUT monitor include: Primary Children's Medical Center, Utah Metal Works, and Gravel Pit Concrete Plant. Figure 22-12 is the back trajectory map for June 14, 2003, which shows the air originating south to southeast of the monitor. An analysis of the hourly meteorological data shows that winds were primarily out of the southeast for most of the day, as well. It is likely that air sampled at BOUT on this day passed over the above listed formaldehyde-emitting facilities earlier in the day.

Figure 22-1. Bountiful Site 1, Utah (BOUT) Monitoring Station



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

Figure 22-2. Bountiful Site 2, Utah (BTUT) Monitoring Station



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

Figure 22-3. Facilities Located Within 10 Miles of BOUT and BTUT

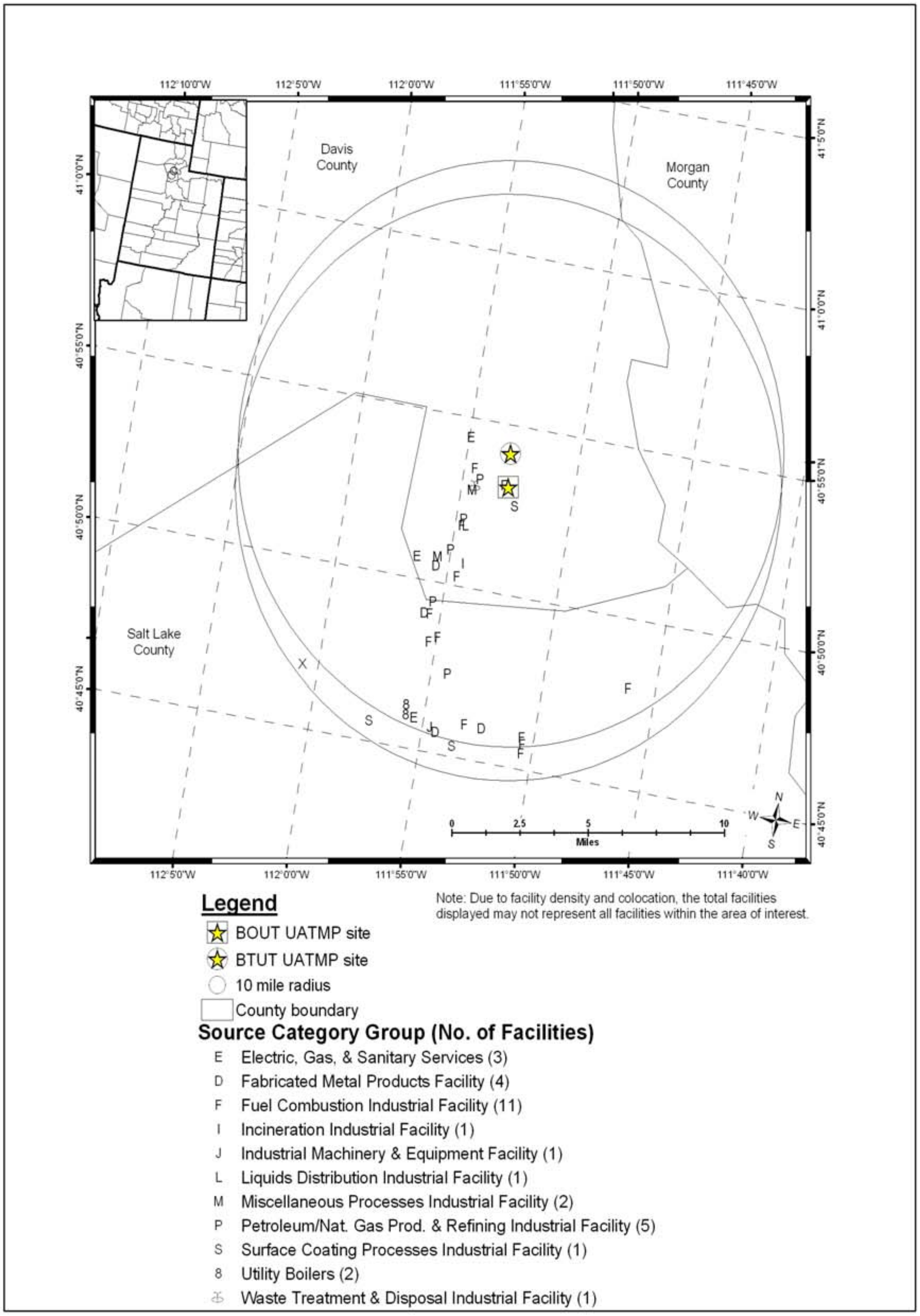


Figure 22-4. Composite Back Trajectory for BOUT

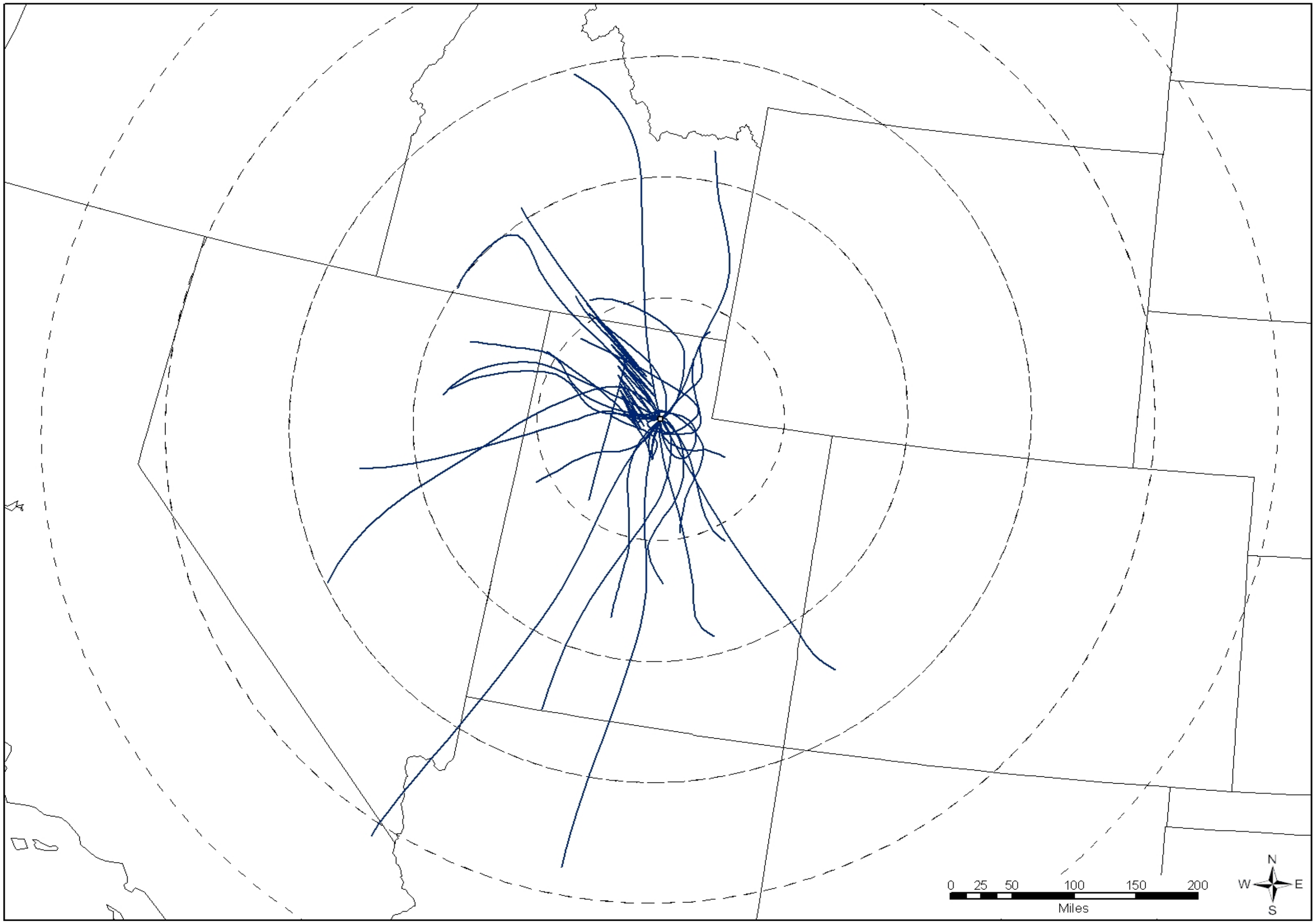


Figure 22-5. Cadmium Pollution Rose for BOUT

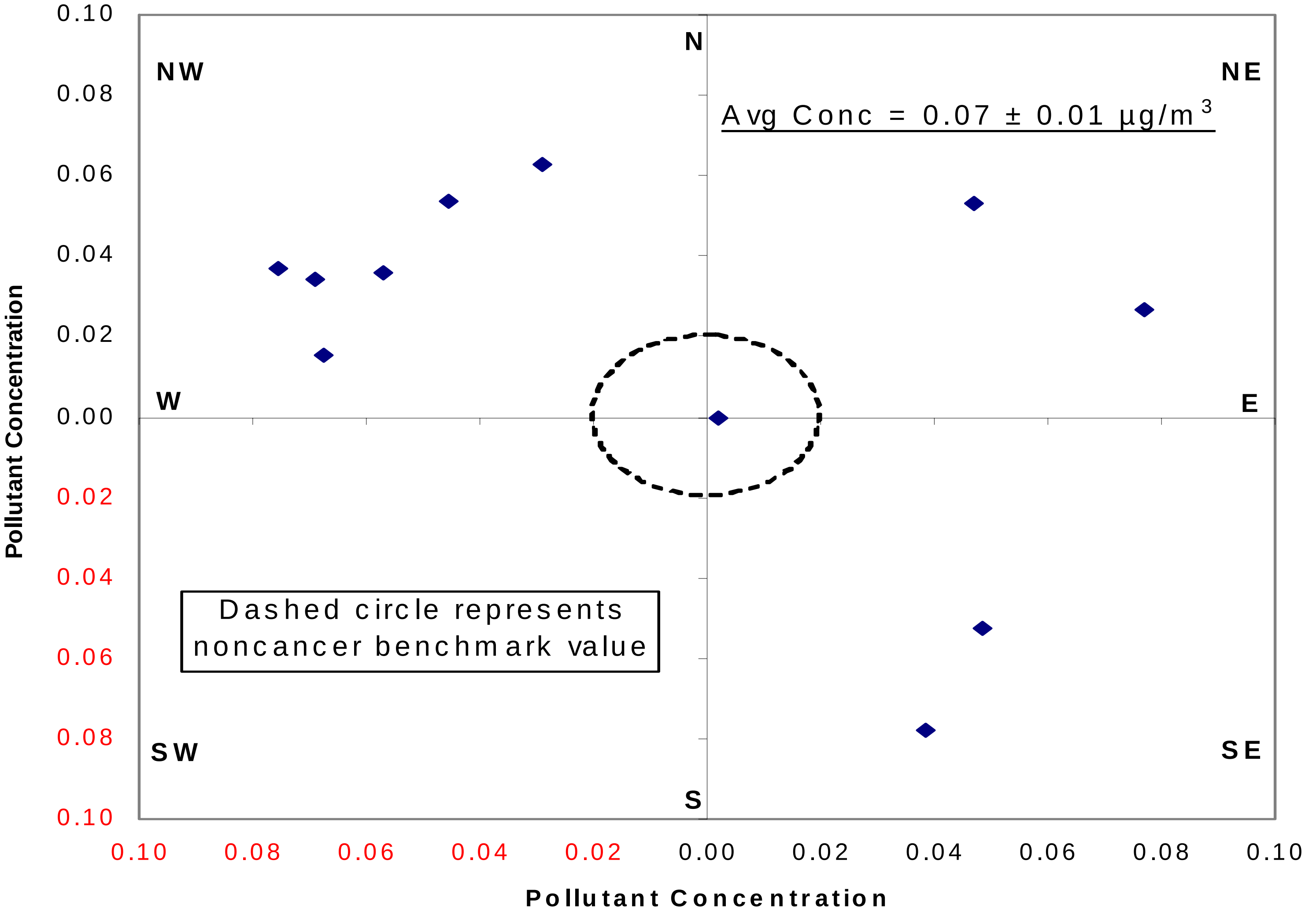


Figure 22-6. Manganese Pollution Rose for BOUT

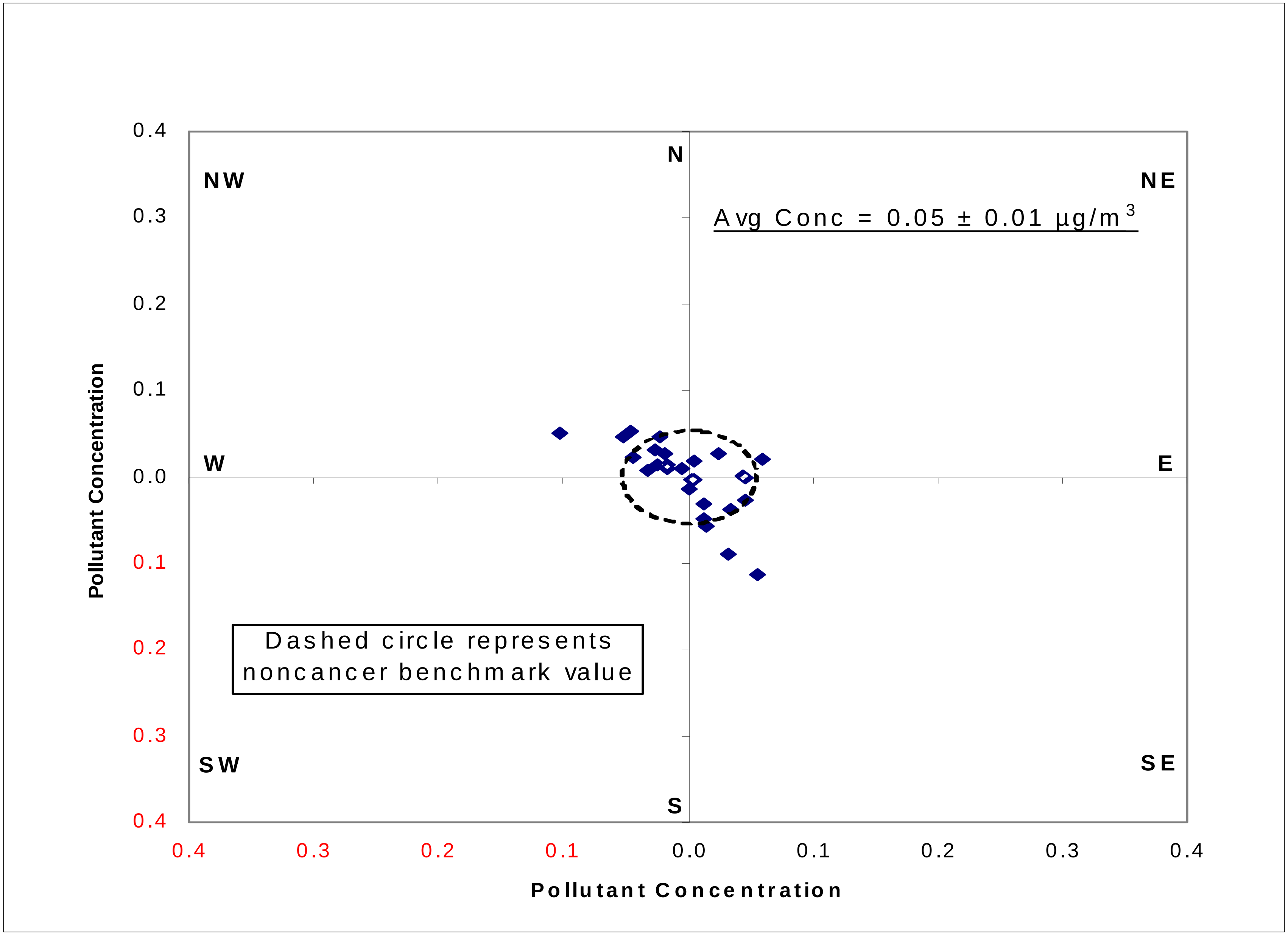


Figure 22-7. Formaldehyde Pollution Rose for BOUT

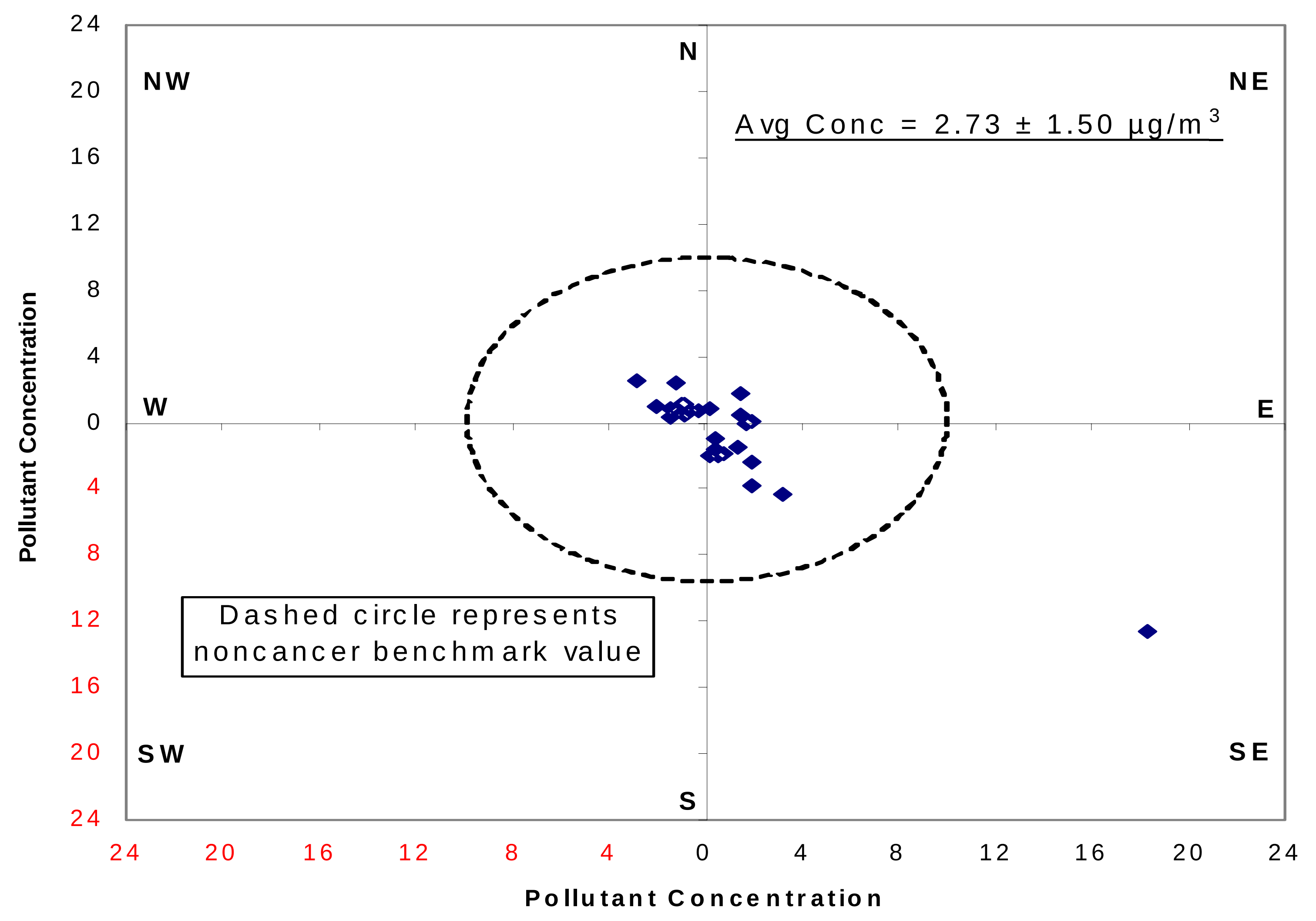


Figure 22-8. Cadmium Sources Southeast of the BOUT Monitoring Site

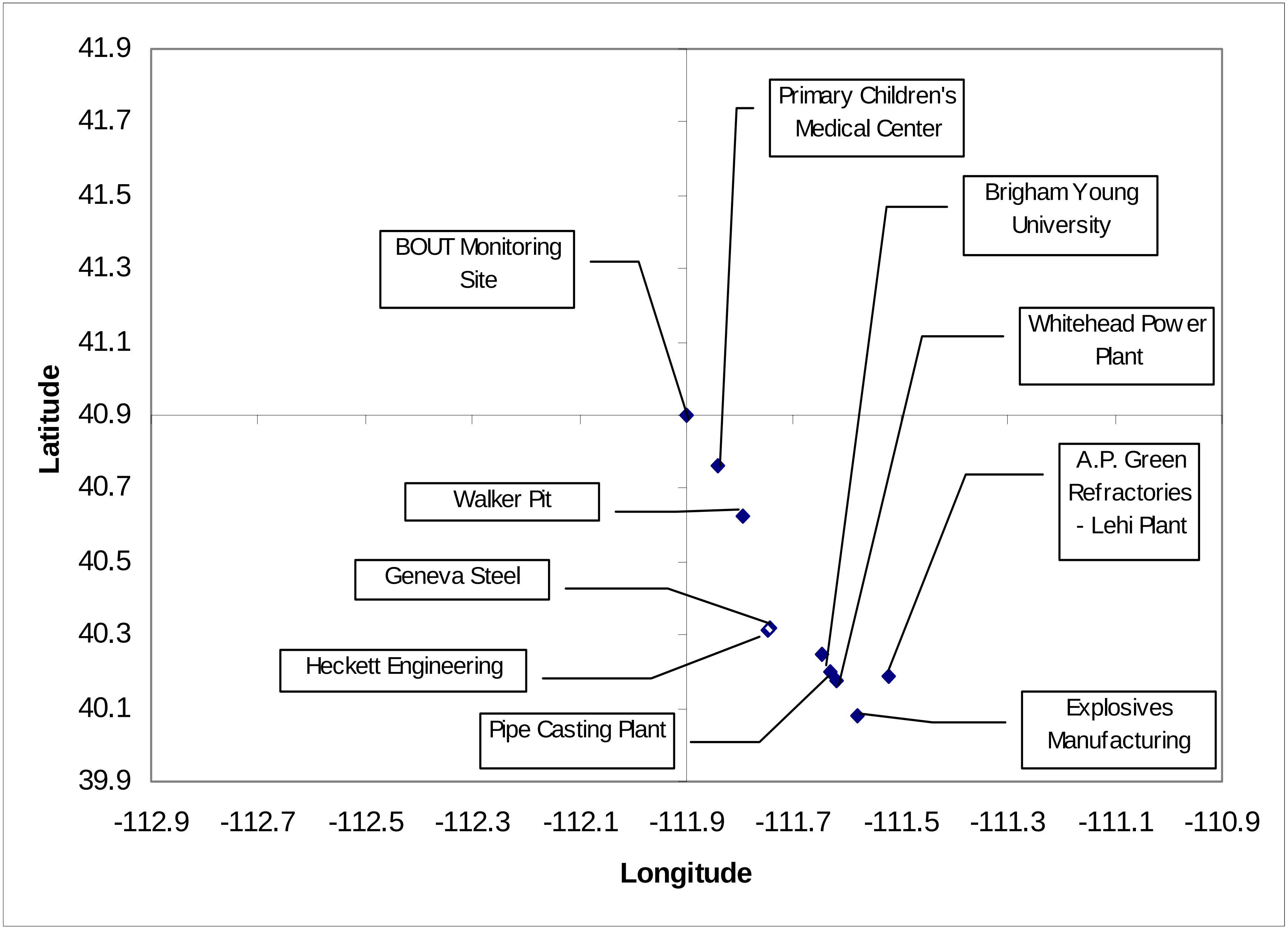


Figure 22-9. Manganese Sources Southeast of the BOUT Monitoring Site

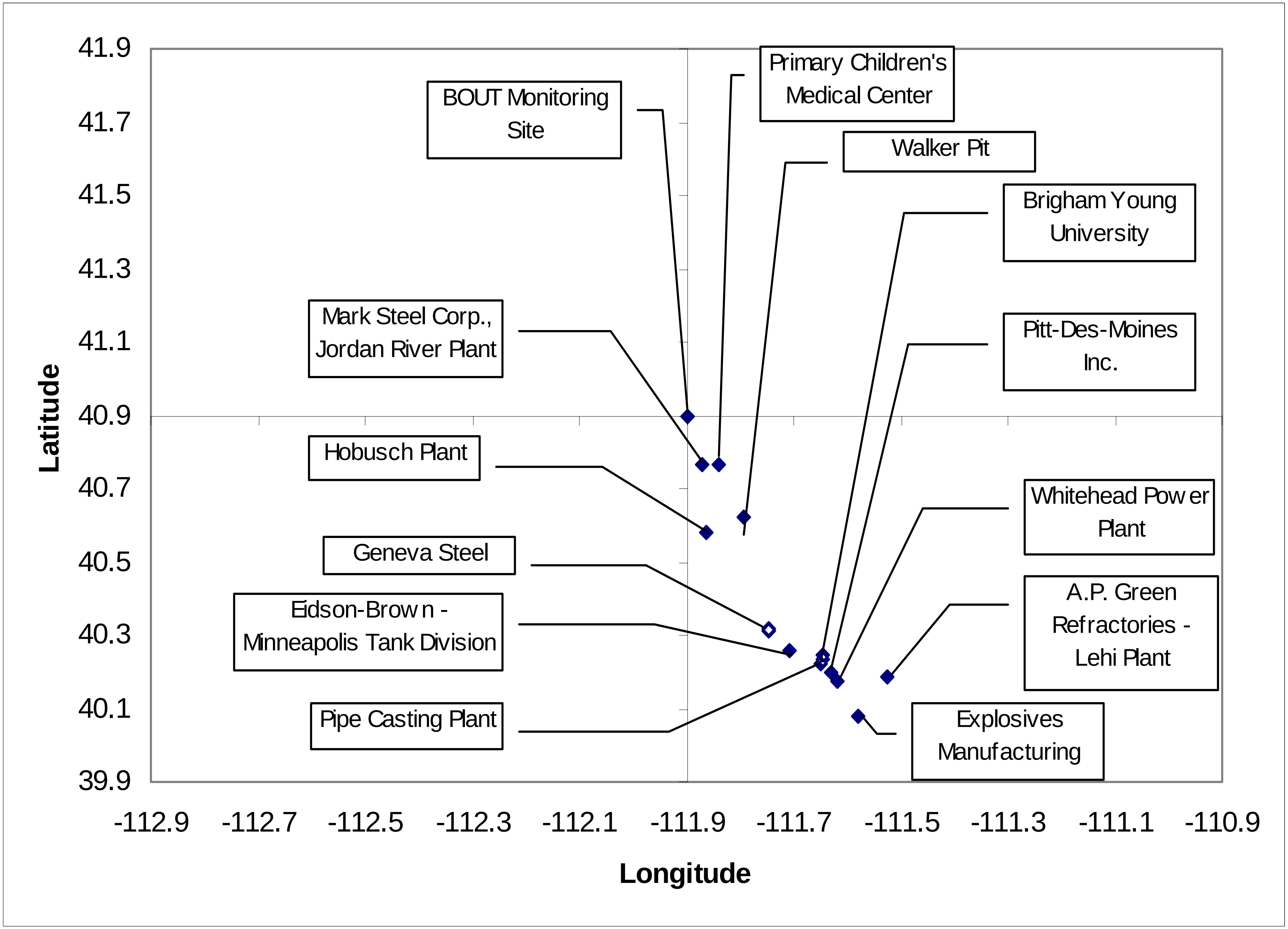


Figure 22-10. 24-Hour Back Trajectory (50, 250, and 500 Meters Aboveground) at BOUT on January 21, 2003

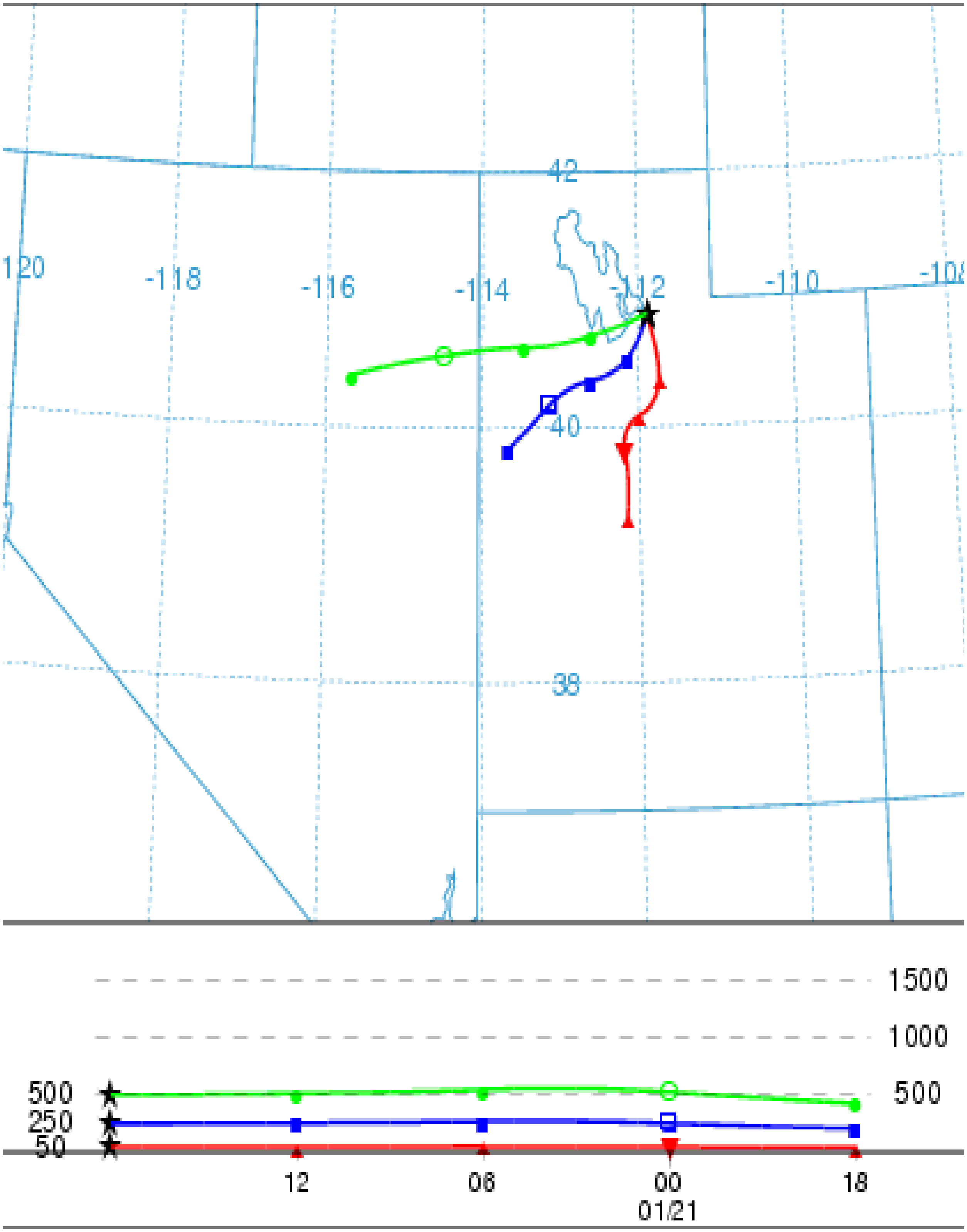


Figure 22-11. Formaldehyde Sources Southeast of the BOUT Monitoring Site

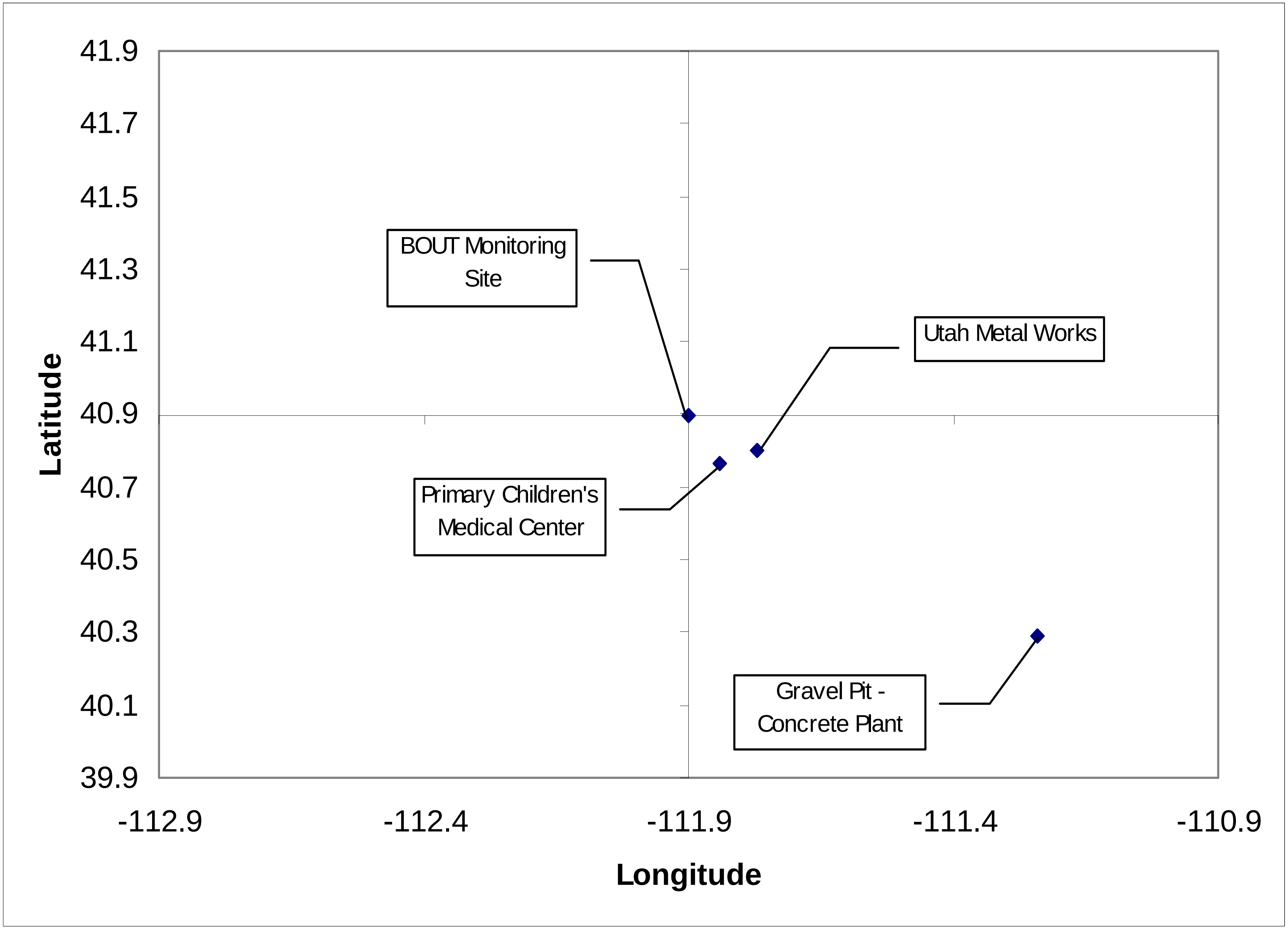


Figure 22-12. 24-Hour Back Trajectory (50, 250, and 500 Meters Aboveground) at BOUT on June 14, 2003

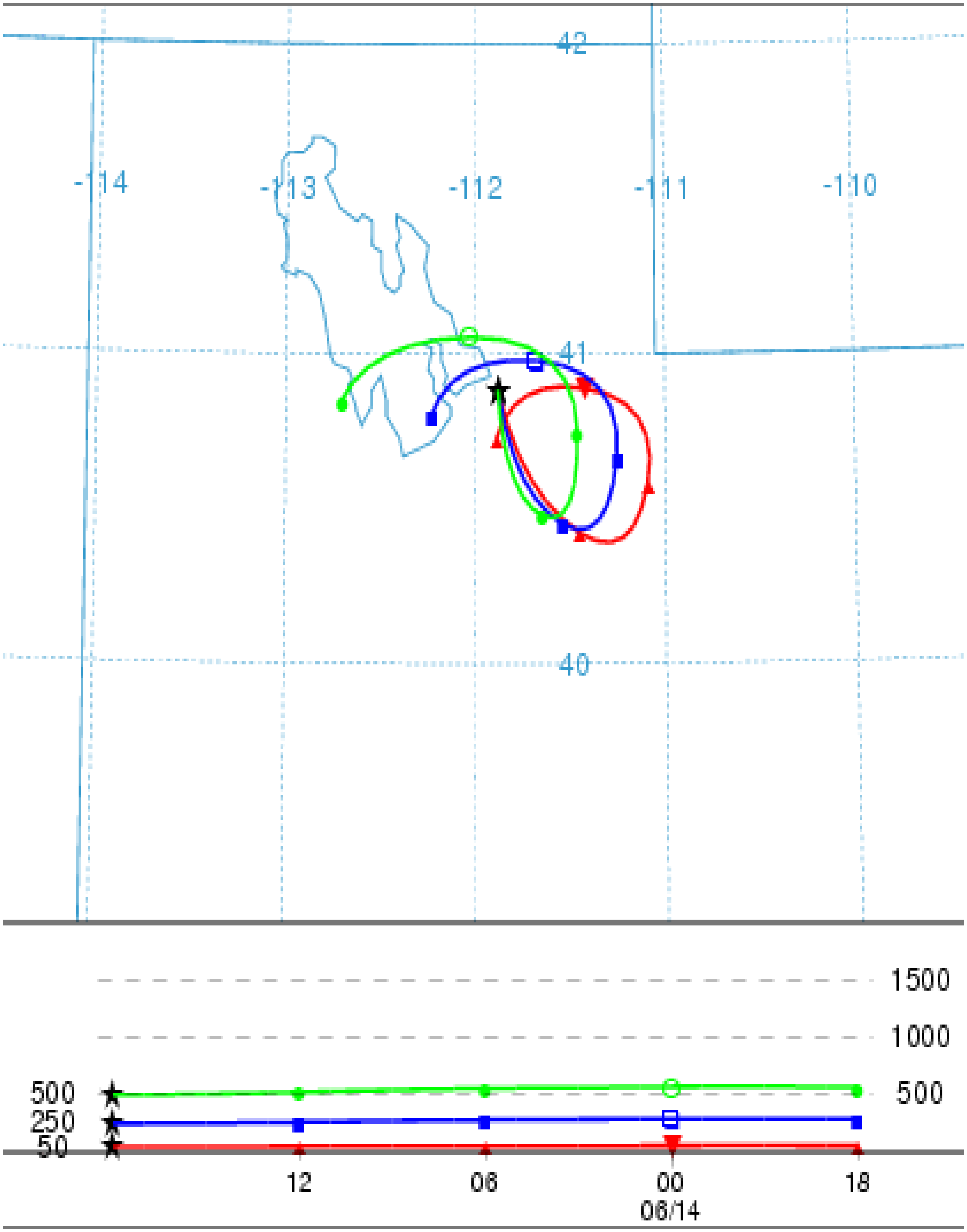


Table 22-1. Average Concentration and Meteorological Parameters for the Sites in Utah

Site Name	**Type**	**Average UATMP Concentration (ppbv)**	**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)**
BOUT	All 2003	▨	65.05 (±2.18)	54.82 (±1.92)	33.31 (±0.91)	43.86 (±1.18)	52.28 (±2.19)	1014.92 (±0.76)	-0.63 (±0.25)	2.10 (±0.47)
	sample day	179.97 (±61.04)	59.67 (±6.57)	49.81 (±5.48)	32.05 (±2.40)	41.15 (±3.36)	58.50 (±7.52)	1013.1 (±2.50)	0.10 (±0.86)	0.79 (±1.63)
BTUT	All 2003	▨	65.05 (±2.18)	54.82 (±1.92)	33.31 (±0.91)	43.86 (±1.18)	52.28 (±2.19)	1014.92 (±0.76)	-0.63 (±0.25)	2.10 (±0.47)
	sample day	121.44 (±33.45)	70.19 (±9.44)	59.49 (±8.38)	35.11 (±4.08)	46.42 (±5.34)	47.76 (±7.87)	1015.93 (±2.22)	-0.81 (±0.95)	1.55 (±2.03)

Table 22-2a. Summary of the Toxic Cancer Compounds at the Bountiful Site 1, Utah Monitoring Site - BOUT

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Cadmium and Compounds	1.23E-04	44.66	44.66	0.068	11	123
Acrylonitrile	6.64E-05	24.16	68.82	0.977	1	66.4
Arsenic and Compounds	2.99E-05	10.90	79.71	0.007	23	29.9
Benzene	1.90E-05	6.92	86.63	2.437	56	19.0
1,3-Butadiene	8.88E-06	3.23	92.90	0.296	29	8.88
Tetrachloroethylene	5.17E-06	2.14	95.13	0.995	3	5.17
Carbon Tetrachloride	8.35E-06	3.04	89.86	0.557	26	8.35
p-Dichlorobenzene	5.29E-06	1.92	96.96	0.481	1	5.29
Acetaldehyde	4.32E-06	1.57	98.53	1.962	29	4.32
Beryllium and Compounds	3.75E-06	1.37	99.89	0.002	14	3.75
Methylene Chloride (Dichloromethane)	2.78E-07	0.10	99.99	0.591	10	<1
Formaldehyde	1.54E-08	0.01	100.00	2.805	29	<1

Table 22-2b. Summary of the Toxic Cancer Compounds at the Bountiful Site 2, Utah Monitoring Site - BTUT

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	6.19E-05	56.89	56.89	0.910	2	61.9
Benzene	1.53E-05	14.04	70.93	1.958	42	15.3
Acetaldehyde	8.32E-06	7.65	78.58	3.783	21	8.32
Carbon Tetrachloride	7.15E-06	6.57	85.15	0.476	15	7.15
1,3-Butadiene	6.25E-06	5.74	90.89	0.208	31	6.25
Arsenic and Compounds	4.44E-06	4.08	94.97	0.001	11	4.44
Tetrachloroethylene	2.18E-06	2.00	96.97	0.370	5	2.18
1,2-Dichloroethane (Ethylene Dichloride)	2.10E-06	1.93	98.90	0.081	1	2.10
Cadmium and Compounds	6.63E-07	0.61	99.51	<0.0001	2	<1
Methylene Chloride (Dichloromethane)	5.15E-07	0.47	99.99	1.097	15	<1
Formaldehyde	1.32E-08	0.01	100.00	2.407	21	<1

Table 22-3a. Summary of the Toxic Noncancer Compounds at the Bountiful Site 1, Utah Monitoring Site - BOUT

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu g/m^3$)	# Detects	Adverse Noncancer Concentrations
Cadmium and Compounds	3.41E+00	50.23	50.23	0.068	11	10
Manganese and Compounds	9.21E-01	13.70	64.44	0.046	27	11
Acrylonitrile	4.88E-01	7.26	71.70	0.977	1	0
Acetonitrile	4.59E-01	6.83	78.53	27.540	1	0
Formaldehyde	2.86E-01	4.26	82.79	2.805	29	1
Arsenic and Compounds	2.32E-01	3.45	86.24	0.007	23	0
Acetaldehyde	2.18E-01	3.24	89.49	1.962	29	0
Nickel and Compounds	1.49E-01	2.21	91.70	0.030	27	0
Cobalt and Compounds	1.40E-01	2.09	93.90	0.014	3	0
1,3-Butadiene	1.48E-01	2.20	95.99	0.296	29	0
Benzene	8.12E-02	1.21	97.20	2.083	56	0
Beryllium and Compounds	7.82E-02	1.16	98.36	0.002	14	0
Xylenes (mixed)	2.55E-02	0.38	98.74	4.016	54	0
Lead and Compounds	1.93E-02	0.29	99.03	0.029	25	0
Hexane	1.54E-02	0.23	99.26	2.417	28	0
Chloromethane (Methyl Chloride)	1.41E-02	0.21	99.47	1.270	28	0
Carbon Tetrachloride	1.39E-02	0.21	99.67	0.566	26	0
Toluene	1.36E-02	0.20	99.88	4.620	56	0
Tetrachloroethylene	3.68E-03	0.05	99.93	1.119	3	0
Methyl Ethyl Ketone (2-Butanone)	1.78E-03	0.03	99.96	8.880	10	0
Ethylbenzene	8.73E-04	0.01	99.97	0.729	49	0
p-Dichlorobenzene	6.01E-04	0.01	99.98	0.481	1	0
Methylene Chloride (Dichloromethane)	5.91E-04	0.01	99.99	0.567	10	0
Selenium and Compounds	4.81E-04	0.01	99.99	0.010	26	0
Styrene	2.67E-04	<0.01	100.00	0.267	32	0
1,1,1-Trichloroethane (Methyl Chloroform)	7.28E-05	<0.01	100.00	0.073	3	0
Mercury and Compounds	0.00E+00	<0.01	100.00	<0.0001	3	0

Table 22-3b. Summary of the Toxic Noncancer Compounds at the Bountiful Site 2, Utah Monitoring Site - BTUT

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (μg/m^3)	# Detects	Adverse Noncancer Concentrations
Manganese and Compounds	5.60E-01	25.98	25.98	0.028	14	3
Acrylonitrile	4.55E-01	21.09	47.07	0.910	2	0
Acetaldehyde	4.20E-01	19.48	66.55	3.783	21	1
Formaldehyde	2.46E-01	11.38	77.94	2.407	21	0
1,3-Butadiene	1.04E-01	4.83	82.76	0.208	31	0
Acetonitrile	8.72E-02	4.04	86.80	5.231	5	0
Benzene	6.53E-02	3.02	89.83	1.958	42	0
Xylenes (*o*-, *m*-, *p*-)	4.47E-02	2.07	91.90	4.469	42	0
Arsenic and Compounds	3.44E-02	1.59	93.49	0.001	11	0
Nickel and Compounds	3.03E-02	1.41	94.90	0.006	14	0
Cobalt and Compounds	2.64E-02	1.22	96.12	0.003	4	0
Cadmium and Compounds	1.84E-02	0.85	96.97	<0.0001	2	0
Chloromethane (Methyl Chloride)	1.46E-02	0.67	97.65	1.311	20	0
Toluene	1.41E-02	0.66	98.31	5.658	42	0
Carbon Tetrachloride	1.19E-02	0.55	98.86	0.476	15	0
Hexane	1.19E-02	0.55	99.41	2.377	21	0
Lead and Compounds	7.97E-03	0.37	99.78	0.012	14	0
Tetrachloroethylene	1.37E-03	0.06	99.84	0.370	5	0
Methylene Chloride (Dichloromethane)	1.10E-03	0.05	99.89	1.097	15	0
Ethylbenzene	7.67E-04	0.04	99.93	0.767	40	0
Methyl Ethyl Ketone (2-Butanone)	6.32E-04	0.03	99.96	3.159	17	0
Styrene	3.88E-04	0.02	99.97	0.388	28	0
Methyl Isobutyl Ketone (Hexone)	2.59E-04	0.01	99.99	0.778	1	0
1,1,1-Trichloroethane (Methyl Chloroform)	1.62E-04	0.01	99.99	0.162	5	0
Selenium Compounds	1.00E-04	<0.0001	100.00	0.002	12	0
1,2-Dichloroethane Ethylene Dichloride	3.37E-05	<0.0001	100.00	0.081	1	0

Table 22-4a. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Bountiful Site 1, Utah Site (BOUT)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.28	-0.38	-0.07	-0.31	0.56	0.42	-0.02	0.01
Acetaldehyde	<0.01	-0.10	-0.33	-0.20	-0.02	0.51	-0.22	0.13
Acetonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic and Compounds	-0.27	-0.33	-0.16	-0.32	0.31	0.32	0.09	-0.06
Benzene	-0.39	-0.49	-0.28	-0.48	0.49	0.53	0.01	0.05
Cadmium and Compounds	-0.63	-0.68	-0.18	-0.55	0.71	0.14	0.11	0.01
Carbon Tetrachloride	0.01	-0.01	-0.10	-0.03	-0.01	-0.10	0.09	-0.24
Cobalt and Compounds	NA	NA	NA	NA	NA	NA	NA	NA
Formaldehyde	0.42	0.39	0.17	0.33	-0.34	0.05	-0.23	0.05
Manganese and Compounds	-0.12	-0.19	-0.01	-0.15	0.22	0.23	-0.14	0.21
Nickel and Compounds	-0.65	-0.70	-0.46	-0.67	0.61	0.57	0.24	-0.21
Tetrachloroethylene	NA	NA	NA	NA	NA	NA	NA	NA

Table 22-4b. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Bountiful Site 2, Utah Site (BTUT)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
1,3-Butadiene	-0.23	-0.27	-0.24	-0.26	0.27	0.37	0.13	-0.19
Acetaldehyde	-0.27	-0.36	-0.43	-0.38	0.19	0.54	0.03	-0.05
Acetonitrile	0.85	0.73	0.62	0.73	-0.66	-0.47	-0.72	0.28
Acrylonitrile	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic and Compounds	-0.02	-0.05	0.15	0.05	0.15	-0.12	0.09	0.14
Benzene	-0.14	-0.19	-0.19	-0.19	0.16	0.49	0.06	-0.11
Carbon Tetrachloride	0.58	0.59	0.49	0.60	-0.54	-0.25	0.02	-0.17
Cobalt and Compounds	0.21	0.11	-0.55	-0.52	-0.53	0.11	0.31	-0.53
Formaldehyde	0.38	0.40	0.44	0.39	-0.21	0.00	-0.31	0.15
Manganese and Compounds	0.49	0.50	-0.09	0.27	-0.62	-0.39	-0.14	0.10
Nickel and Compounds	0.46	0.46	-0.13	0.23	-0.60	-0.37	0.02	0.02
Tetrachloroethyene	-0.22	-0.39	-0.52	-0.42	0.07	0.59	-0.08	-0.28
Xylenes (*o*-, *m*-, *p*-)	-0.05	-0.10	-0.09	-0.09	0.10	0.36	0.10	-0.13

Table 22-5. TNMOC Measured by the Bountiful, UT (BOUT and BTUT) Monitoring Stations

Average Ozone Concentrations (ppbv)	Average TNMOC speciated (ppbC)	Average TNMOC w/ unknown (ppbC)	% TNMOC Identified	SNMOC Compound with the Highest Concentration (ppbC)
BOUT	207.36	323.73	64	Toluene (37.74)
BTUT	195.96	317.98	65	Toluene (28.71)

Table 22-6. Motor Vehicle Information vs. Daily Concentration for the Utah Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Car Registration/ Population Ratio	Population within Ten Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration (μg/m^3)
BOUT	249,224	177,652	0.71	245,409	174,240	11,120	179.97 (±61.04)
BTUT	249,224	177,652	0.71	245,409	174,240	33,310	121.44 (±33.45)

Table 22-7. Summary of Future Regulations That May be Applicable for Nearby Facilities Surrounding BOUT

Facility Name	Primary SIC Code	SIC Code Description	Regulation Citation	Regulation Name
Chevron USA	2911	Petroleum Refining	40 CFR part 63, subpart UUU	Petroleum Refineries-Catalytic Cracking, Catalytic Reforming, and Sulfur Plant Units NESHAP
Flying J Refinery (Big West Oil Co.)	2911	Petroleum Refining	40 CFR part 63, subpart UUU	Petroleum Refineries-Catalytic Cracking, Catalytic Reforming, and Sulfur Plant Units NESHAP
Phillips 66 Co.	2911	Petroleum Refining	40 CFR part 63, subpart UUU	Petroleum Refineries-Catalytic Cracking, Catalytic Reforming, and Sulfur Plant Units NESHAP
Salt Lake City Refinery	2911	Petroleum Refining	40 CFR part 63, subpart UUU	Petroleum Refineries-Catalytic Cracking, Catalytic Reforming, and Sulfur Plant Units NESHAP

23.0 Data Quality

This section discusses the precision and accuracy of ambient air concentration measurements during the 2003 UATMP. As indicators of the reliability of experimental measurements, both precision and accuracy must be considered when interpreting ambient air monitoring results. In general, this section shows that the 2003 UATMP monitoring data are of a known and high quality, particularly for the most program-wide prevalent compounds in urban air. All calculations were based on sample concentrations detected above the method detection limits for each compound. The overall precision level (the average for all sites) is within the UATMP data quality objectives (USEPA, 2003) and guidelines in the EPA Compendium Methods (USEPA, 1999) of 15 % coefficient of variation.

Method precision for the UATMP is determined by replicate analysis 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, Michigan, and Tennessee. At these sites, collocated samples were collected and analyzed in replicate. The difference between duplicate and collocated samples is that the duplicate samples are collected from two canisters using one collection system, whereas collocated samples are collected at the same time but 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.

- Replicate analysis of collocated samples provides 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.

23.1 Precision

Precision refers to the agreement between independent measurements performed according to identical protocols and procedures. To quantify “sampling and analytical precision” (i.e., how precisely the sampling and analytical methods measure ambient air concentrations), concentrations measured during analysis of duplicate samples are compared.

Applied to ambient air monitoring data, precision is a measurement of random errors inherent to the process of sampling and analyzing ambient air.

23.1.1 Analytical Precision

Analytical precision is a measurement of random errors associated with laboratory analysis of 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 2003 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 2003 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:

$$RPD = \frac{/X_1 - X_2/}{\bar{X}} \times 100 \qquad \textbf{(1)}$$

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
$\bar{X}$ is the arithmetic mean of X_1 and X_2.

As Equation 1 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.

$$Cv = \frac{\sigma}{\bar{X}} \times 100 \qquad \textbf{(2)}$$

Where:

σ is the standard deviation of the sets or duplicate or replicate results; and
$\bar{X}$ is the arithmetic mean of the sets or duplicate or replicate results.

The CV is used to measure the imprecision in survey estimates introduced from analysis. A low coefficient of 1 % would indicate that the analytical results could vary slightly due to sampling error, while a variation of 50% means that the results are more imprecise.

The following approach was employed to estimate how precisely the central laboratory analyzed 2003 UATMP samples:

– CVs, RPDs and concentration differences were calculated for every replicate analysis 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 23-1, 23-2, and 23-3 use absolute average concentration differences, RPDs, and CVs to characterize the analytical precision representing all sites for VOC, representing all replicate analyses of duplicate and collocated samples, of collocated samples and of duplicate samples, respectively.

In Table 23-1, the replicate analyses for duplicate and collocated samples show that laboratory VOC analysis precision was within the control limits of 85 to 115 % for CV, with the exception of methylene chloride and *p*-dichlorobenzene at 16.30 and 21.67 %, respectively. The method was most precise when measuring air concentrations for the program-wide prevalent compounds (i.e., compounds consistently found at levels exceeding their detection limits). The poor precision for methylene chloride was due to poor agreement from replicate samples from BTUT, BUND, CUSD, PGMS, S4MO, SJPR, and WECO. These disagreements were due to low detects as shown by the average concentration difference of 0.07 ppbv indicating low variability between concentrations. The *p*-dichlorobenzene was detected in only 2 % of all replicate samples analyzed (12 samples) and had an average concentration difference of 0.06 ppbv, again showing a low variability between concentrations. In terms of overall average concentration difference, the precision of the VOC analytical method ranged from 0.00 ppbv for *trans*-1,3-dichloropropene to 5.80 ppbv for acetonitrile. The overall compound by compound variability average was 9.00 percent.

Table 23-2 shows the results from replicate analyses of collocated VOC samples taken at MCAZ, PSAZ, NBIL, DEMI, HOMI, KITN, EATN, LOTN, and DITN. The replicate results from collocated samples showed variation for the compounds ranging from 2.85 % to 13.80 percent. The overall estimate of method precision, program-average CVs, RPDs, and absolute concentration differences were all within the program’s objectives. The overall compound by compound variability average was 7.86 percent.

Table 23-3 shows the results from replicate analyses of duplicate VOC samples. The replicate results from duplicate samples variation ranged from 6.23 % to 33.78 percent. The CVs over the 15 % target (33.78 for *p*-dichlorobenzene and 17.57 % for methylene chloride) had average concentration differences of 0.10 and 0.08 ppbv, respectively, showing a low variability for each compound. The overall compound by compound variability average was 10.59 percent.

Tables 23-4 and 23-5 present results from VOC replicate analyses for all of the duplicate and collocated samples at the NATTS sites (DEMI and BTUT/BOUT). Table 23-6 presents the overall CV for each site separately, giving the average CV per compound and per site. The replicate results from duplicate samples show low to mid-level variability, ranging from 5.79 to 14.74 % between sites with an average at 8.94 percent, well within the NATTS required 15 % overall CV per site.

Table 23-7 presents replicate analytical data for all duplicate SNMOC samples. Twenty-three out of 78 SNMOCs showed greater variation than the target 15 percent. The average concentration differences observed for replicate analyses of SNMOC compounds ranged from 0.02 to 4.14 ppbC. The total speciated and total hydrocarbons (speciated and unspeciated) showed the greater average concentration differences, 8.50 and 28.01 ppbC, respectively, but low CV at 5.72 and 6.78 percent. The overall compound by compound variability average was 13.22 percent.

Table 23-8 presents the overall CV for each site separately, giving the average CV per compound and per site. The replicate results from duplicate samples show low to mid-level variability between sites, ranging from 5.05 to 19.15 %, with the average at 12.87 percent.

In Table 23-9, the replicate analyses for duplicate and collocated samples show that laboratory carbonyl analysis precision was within the control limits of 15 % CV, with the exception of isovaleraldehyde 18.07 percent. The method was most precise when measuring air concentrations for the program-wide prevalent compounds (i.e., compounds consistently found at levels exceeding their detection limits). Isovaleraldehyde was detected in less than 40% of all replicate samples analyzed (297 samples out of a possible 758) with a relative % difference at 31.44 % and an average concentration difference at 0.004 ppbv. In terms of average concentration difference, the precision of the carbonyl analytical method ranged from 0.003 ppbv for valeraldehyde and 2,5-dimethylbenzaldehyde to 0.034 ppbv for formaldehyde. The overall compound by compound variability average was 6.88 percent.

Table 23-10 shows the results from replicate analyses of collocated carbonyl samples taken at MCAZ, PSAZ, NBIL, DEMI, HOMI, KITN, EATN, LOTN, and DITN. The replicate results from collocated samples showed variation for the compounds ranging from 0.60 to 15.03 percent. The highest CVs calculated (isovaleraldehyde) had an average concentration difference of 0.005 ppbv, showing a low-level variation. The overall compound by compound variability average was 5.49 percent.

Table 23-11 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 0.77 to 18.97 percent. The highest CV (18.97% for isovaleraldehyde) had an average concentration difference of 0.004, showing a low-level variability. The overall compound by compound variability average was 6.92 percent.

Tables 23-12 through 23-14 present results from carbonyl replicate analyses for all of the duplicate and collocated samples at the NATTS sites (AZFL/CWFL/LEFL/GAFL, DEMI and BTUT/BOUT). Table 23-15 presents the overall CV for each site separately, giving the average CV per compound and per site. The replicate results from duplicate samples show low level variability, ranging from 0.85 to 9.12 % between sites and an average of 6.01 percent. This is well within the NATTS requested 15 % overall CV per site.

Overall, replicate analyses of both duplicate and collocated samples of VOC, SNMOC, and carbonyl compounds suggest the precision level is within the UATMP data quality objectives (USEPA, 2003) and guidelines in the Compendium Methods (USEPA, 1999).

23.1.2 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 in the field. This form of precision is most easily evaluated by comparing concentrations measured in duplicate samples collected from the same manifold. During the 2003 UATMP, duplicate and collocated samples were collected at least 10 % 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 their respective duplicate sample. Also, the CV for two duplicate samples was calculated for each compound and each site - the target recovery being 15 %, similar to the replicate analyses. Tables 23-16 through 23-18, 23-22, 23-24 through 23-26, 23-31 and 23-32 present average concentration differences, RPDs, and CVs as estimates of duplicate and collocated sampling and analytical variability for VOC, SNMOC, carbonyls, hexavalent chromium, and metals, respectively. The number of observations from Tables 23-1 through 23-15, in comparison to the respective tables listed for duplicate analyses in Tables 23-16 through 23-32, is approximately twice as high.

Table 23-16 presents the sampling and analytical data precision for duplicates and collocated VOC samples. Twelve 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 ranged from 0.01 to 42.65 ppbv. To present the distribution associated with some of the compounds with higher CVs (CVs over 15 % and detected over 30 %) scatter graphs were created for each of the compounds. Toluene (16.7 % CV, 99 % detected), methylene chloride (22.64 % CV, 60 % detected), acetonitrile (30.41 % CV, 34 % detected) and methyl ethyl ketone (MEK, 32.13 % CV, 64 % detected) scatter plots are shown in Figures 23-1 through 23-4, respectively. As the % 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 appears to have been affected by the sample generation procedures. The toluene figure shows a close correlation for the duplicate comparisons whereas the MEK figure shows a wider scatter for the duplicate sample comparisons.

The collocated VOC sampling and analytical data are presented in Table 23-17, and the duplicate samples are shown in Table 23-18. Again, high average CVs are present for each collection (duplicate and collocated) showing the combination (collocated and dupliate) table, Table 23-16, was affected by both sampling techniques. The collocated comparisons did show more compounds than those presented in Table 23-16, however. Propylene (18.24 %), 1,1,1-trichloroethane (24.26 %), *n*-octane (27.69 %), *m,p,*-xylene (19.17 %), *o*-xylene (15.15 %) and 1,2,4-trimethylbenzene (15.03 %) were above the 15 % program objective.

Tables 23-19 and 23-20 present the results from VOC duplicate analysis for all of the NATTS sites (DEMI and BTUT/BOUT). Table 23-21 presents the overall CV for each site separately, giving the average CV per compound and per site. The results from duplicate samples show low to high-level variability, ranging from 6.20 to 25.96 % between sites with an average at 14.73 percent. This value is just inside the NATTS-required 15 % overall CV per site.

The SNMOC precision for duplicate samples is presented in Table 23-22. Coefficient of variation for duplicate samples ranged from 1.31 % for *cis*-2-hexene to 37.76 % for α-pinene. 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 2-methyl-2-butene target analyte) 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 differ 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 2003 UATMP did not affect random errors associated with sampling procedures.

Table 23-23 presents the overall CV for each site separately, giving the average CV per compound and per site. The duplicate samples vary for the majority of the compounds showing mid- to high-level variability, ranging from 10.34 to 22.41 % between sites with an average at 15.39 percent, only slightly outside the NATTS-required 15 % overall CV per site.

Table 23-24, presenting the sampling and analytical data for carbonyl compounds, shows that the total duplicate and collocated samples collected during the 2003 UATMP varied with 4 compounds above the 15 % target criterion (isovaleraldehyde (23.86%), valeraldehyde (17.56%), tolualdehydes (17.92%), and 2,5-dimethylbenzaldehyde (17.23%)). The 2,5-dimethylbenzaldehyde was collected in less than 6 % of the samples. The average concentration difference ranged from 0.003 ppbv for 2,5-dimethylbenzaldehyde to 0.422 ppbv for formaldehyde.

The collocated carbonyl sampling and analytical data are presented in Table 23-25, and the duplicate samples results are shown in Table 23-26. Isovaleraldehyde and 2,5-dimethylbenzaldehyde exceeded the 15 % criterion for both collocated and duplicate samples.

Tables 23-27 through 23-29 present results from carbonyl duplicate sample analyses for the NATTS sites (AZFL/CWFL/LEFL/GAFL, DEMI and BTUT/BOUT). Table 23-30 presents the overall CV for each site separately, giving the average CV per compound and per site. The duplicate sample results show low to high level variability, ranging from 2.85 to 48.20 % between sites and an average of 12.33 percent. The carbonyl sampling and analytical precision data differ 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 2003 UATMP did not affect random errors associated with sampling procedures.

Duplicate analytical data for hexavalent chromium (Cr^{6+}) samples are presented in Table 23-31. The CV is 13.54 % for this collocated site in Portland, OR. The sampling and analytical variation for duplicate metals samples are presented in Table 23-32. The average CV values, as well as the average RPD values, are show low- to high-level variability, ranging from 6.83 to

28.58 % between sites with an average at 13.59 percent, just inside the NATTS required 15 % overall CV per site.

23.2 Accuracy

Highly accurate air sampling and analytical methods can measure air concentrations in very close agreement to actual ambient levels. Laboratories typically evaluate their accuracy by analyzing external audit samples and comparing measured concentrations to the known concentrations of the audit samples.

> *Accuracy* indicates the extent to which experimental measurements represent their corresponding “true” or “actual” values.

Air Toxics Pilot Laboratory Intercomparison studies were performed in August 2003. A Quality Assurance Report for all laboratories that participated in this study is available on EPA’s AMTIC web site: http://www.epa.gov/ttn/amtic/files. ERG has also prepared audit standards for different State laboratories.

The accuracy of the 2003 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 2003 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 2003 UATMP monitoring data accurately represent ambient air quality.

Figure 23-1. Scatter Plot for Toluene Duplicate Samples

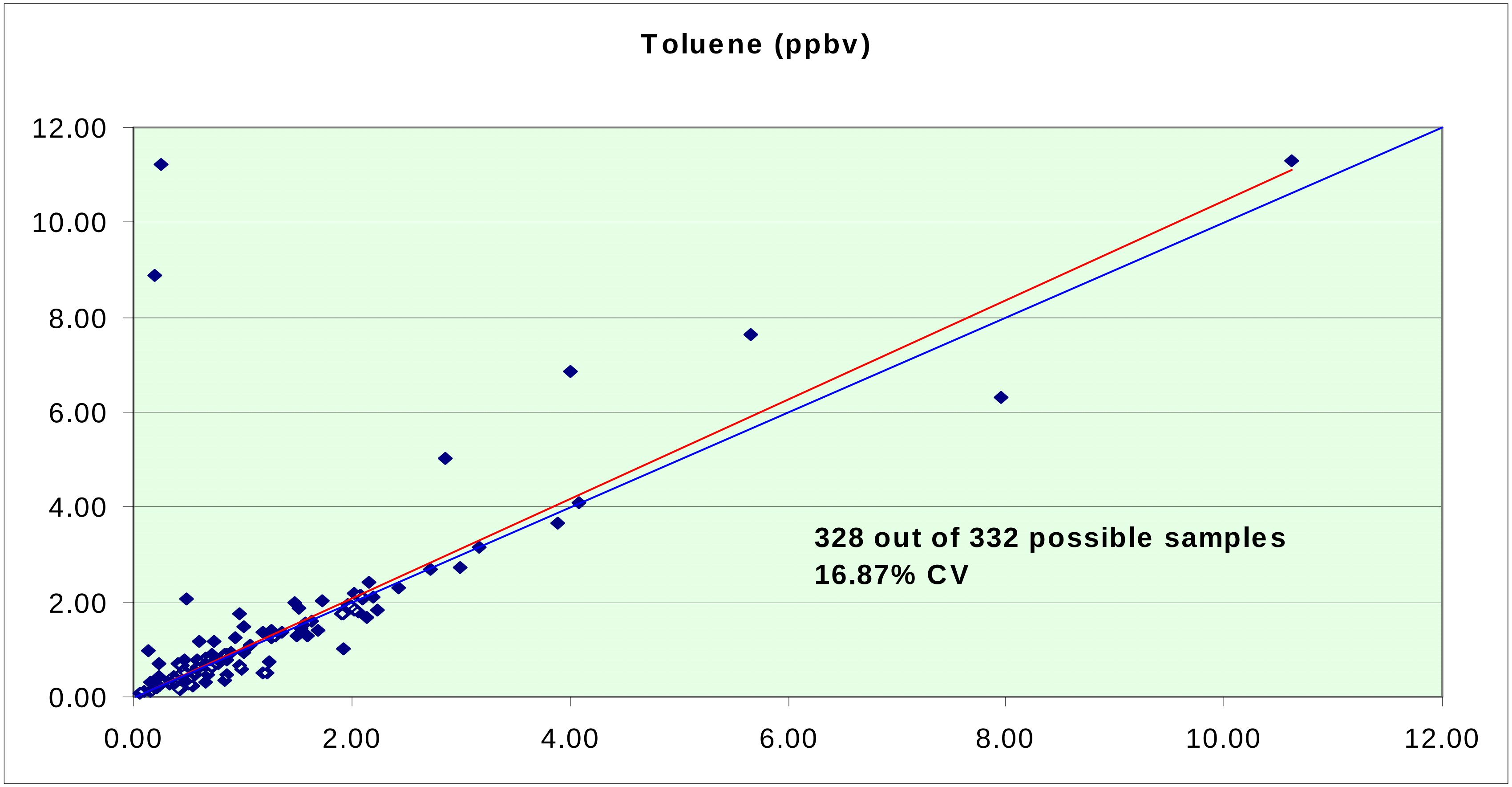


Figure 23-2. Scatter Plot for Methylene Chloride Duplicate Samples

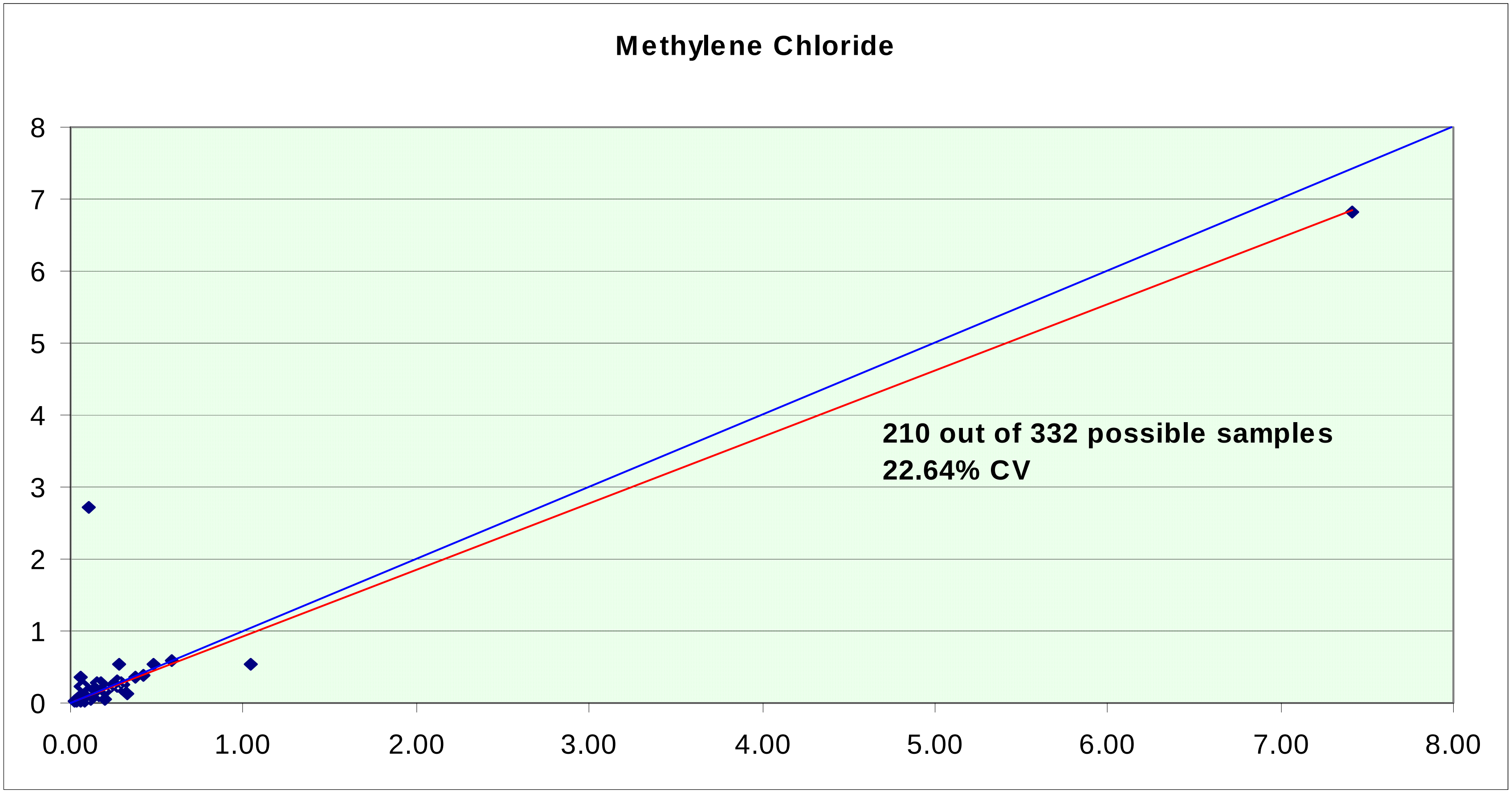


Figure 23-3. Scatter Plot for Acetonitrile Duplicate Samples

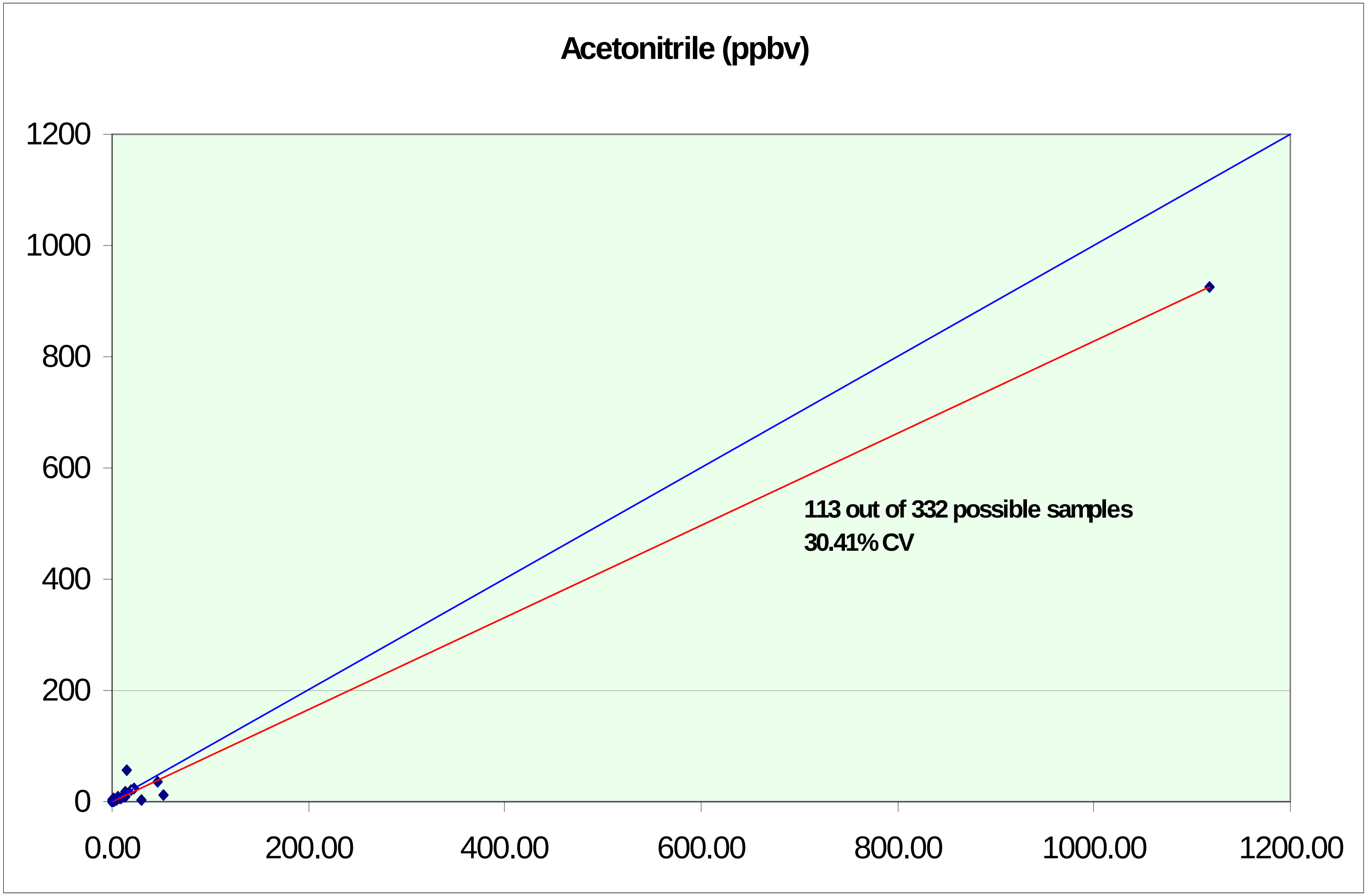


Figure 23-4. Scatter Plot for Methyl Ethyl Ketone Duplicate Samples

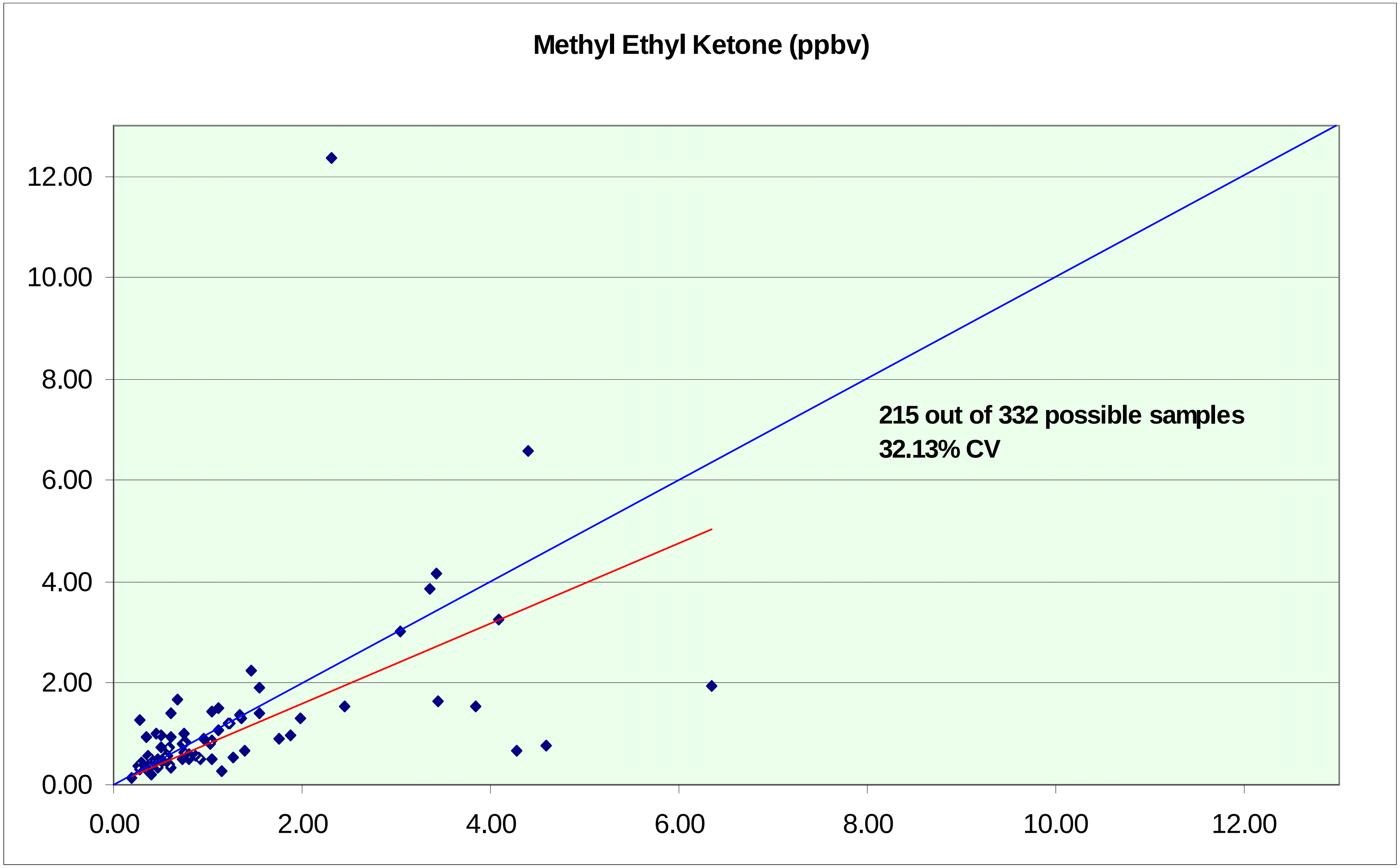


Table 23-1. VOC Sampling and Analytical Precision: 515 Replicate Analyses for all Duplicate and Collocated Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	515	10.72	0.19	7.28
Propylene	515	16.32	0.10	10.26
Dichlorodifluoromethane	515	9.75	0.08	7.19
Chloromethane	514	8.01	0.07	6.07
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	4	NA	NA	NA
1,3-Butadiene	86	11.42	0.08	11.64
Bromomethane	4	5.67	0.09	4.13
Chloroethane	1	NA	0.10	NA
Acetonitrile	221	10.19	5.80	8.76
Trichlorofluoromethane	516	16.16	0.07	8.87
Acrylonitrile	3	9.85	0.30	6.64
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	318	22.14	0.07	**16.30**
Trichlorotrifluoroethane	475	14.74	0.02	11.48
trans - 1,2 - Dichloroethylene	0	NA	NA	NA
1,1 - Dichloroethane	0	NA	NA	NA
Methyl *tert*-Butyl Ether	167	16.77	0.11	6.10
Methyl Ethyl Ketone	305	14.92	0.29	11.00
Chloroprene	0	NA	NA	NA
cis-1,2-Dichloroethylene	1	0.21	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	44	14.73	0.04	8.64
Ethyl *tert*-Butyl Ether	0	NA	NA	NA
1,2 - Dichloroethane	0	NA	NA	NA
1,1,1 - Trichloroethane	30	8.14	0.04	7.22
Benzene	515	9.94	0.05	6.49
Carbon Tetrachloride	131	8.47	0.08	7.36
tert-Amyl Methyl Ether	1	NA	0.34	NA
1,2 - Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	17	13.58	0.06	10.16
Methyl Methacrylate	15	15.84	0.15	12.67
cis -1,3 - Dichloropropene	2	8.12	0.01	5.52
Methyl Isobutyl Ketone	15	14.53	0.11	10.24
trans - 1,3 - Dichloropropene	2	4.12	0.00	2.85
1,1,2 - Trichloroethane	0	NA	0.10	NA

Table 23-1. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	507	12.02	0.19	7.18
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
n-Octane	54	12.16	0.09	7.75
Tetrachloroethylene	67	15.07	0.67	11.05
Chlorobenzene	4	12.68	0.05	9.64
Ethylbenzene	373	13.08	0.05	8.23
m,p - Xylene	483	12.92	0.09	8.36
Bromoform	0	NA	0.15	NA
Styrene	93	13.74	0.06	10.74
1,1,2,2 - Tetrachloroethane	0	NA	0.05	NA
o - Xylene	380	12.52	0.05	8.39
1,3,5-Trimethylbenzene	97	9.30	0.05	8.11
1,2,4-Trimethylbenzene	262	15.14	0.06	8.90
m - Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - Dichlorobenzene	12	25.69	0.06	**21.67**
o - Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-2. VOC Sampling and Analytical Precision: 216 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	216	10.64	0.16	8.25
Propylene	215	16.11	0.08	11.60
Dichlorodifluoromethane	215	9.00	0.07	6.88
Chloromethane	214	7.67	0.06	5.90
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	34	6.82	0.06	6.80
Bromomethane	2	5.67	0.01	4.13
Chloroethane	1	NA	0.10	NA
Acetonitrile	58	7.80	9.75	6.08
Trichlorofluoromethane	216	15.89	0.06	8.51
Acrylonitrile	3	9.85	0.30	6.64
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	131	16.27	0.05	13.80
Trichlorotrifluoroethane	198	13.42	0.02	11.08
trans - 1,2 - Dichloroethylene	0	NA	NA	NA
1,1 - Dichloroethane	0	NA	NA	NA
Methyl *tert*-Butyl Ether	63	18.54	0.09	6.57
Methyl Ethyl Ketone	165	10.69	0.21	8.44
Chloroprene	0	NA	NA	NA
cis-1,2-Dichloroethylene	1	0.21	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	37	9.27	0.03	8.06
Ethyl *tert*-Butyl Ether	0	NA	NA	NA
1,2 - Dichloroethane	0	NA	NA	NA
1,1,1 - Trichloroethane	18	5.36	0.05	7.21
Benzene	216	9.25	0.04	6.67
Carbon Tetrachloride	62	7.06	0.06	6.33
tert-Amyl Methyl Ether	1	NA	0.34	NA
1,2 - Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	6	11.56	0.01	7.41
Methyl Methacrylate	0	NA	NA	NA
cis -1,3 - Dichloropropene	2	8.12	0.01	5.52
Methyl Isobutyl Ketone	4	16.45	0.07	11.80

Table 23-2. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
trans - 1,3 - Dichloropropene	2	4.12	0.00	2.85
1,1,2 - Trichloroethane	0	NA	0.10	NA
Toluene	216	11.18	0.21	7.53
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
n-Octane	14	8.71	0.07	8.52
Tetrachloroethylene	34	12.85	0.34	8.59
Chlorobenzene	0	NA	0.07	NA
Ethylbenzene	172	12.61	0.04	7.90
m,p - Xylene	206	12.72	0.08	8.28
Bromoform	0	NA	0.15	NA
Styrene	64	9.63	0.03	9.64
1,1,2,2 - Tetrachloroethane	0	NA	0.05	NA
o - Xylene	160	11.38	0.04	7.59
1,3,5-Trimethylbenzene	42	6.87	0.05	6.21
1,2,4-Trimethylbenzene	115	15.26	0.05	9.31
m - Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - Dichlorobenzene	8	14.97	0.03	9.55
o - Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font .

Table 23-3. VOC Sampling and Analytical Precision: 299 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	299	10.81	0.22	7.32
Propylene	300	16.54	0.12	10.39
Dichlorodifluoromethane	300	10.51	0.09	7.29
Chloromethane	300	8.35	0.08	6.23
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	4	NA	NA	NA
1,3-Butadiene	52	16.02	0.09	11.38
Bromomethane	2	NA	0.18	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	163	12.58	1.86	9.12
Trichlorofluoromethane	300	16.43	0.07	8.71
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	187	28.01	0.08	**17.57**
Trichlorotrifluoroethane	277	16.06	0.02	11.91
trans - 1,2 - Dichloroethylene	0	NA	NA	NA
1,1 - Dichloroethane	0	NA	NA	NA
Methyl *tert*-Butyl Ether	104	15.01	0.13	6.89
Methyl Ethyl Ketone	140	19.15	0.37	13.47
Chloroprene	0	NA	NA	NA
cis-1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	7	20.19	0.05	12.91
Ethyl *tert*-Butyl Ether	0	NA	NA	NA
1,2 - Dichloroethane	0	NA	NA	NA
1,1,1 - Trichloroethane	12	10.92	0.02	7.36
Benzene	299	10.64	0.07	6.84
Carbon Tetrachloride	69	9.88	0.09	6.91
tert-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	11	15.61	0.10	11.54
Methyl Methacrylate	15	15.84	0.15	12.67
cis -1,3 - Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	11	12.62	0.15	9.53
trans - 1,3 - Dichloropropene	0	NA	NA	NA

Table 23-3. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
1,1,2 - Trichloroethane	0	NA	NA	NA
Toluene	291	12.86	0.16	7.14
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
n-Octane	40	15.62	0.11	11.66
Tetrachloroethylene	33	17.29	1.00	12.32
Chlorobenzene	4	12.68	0.03	9.64
Ethylbenzene	201	13.54	0.05	8.36
m,p - Xylene	277	13.11	0.09	8.37
Bromoform	0	NA	NA	NA
Styrene	29	17.85	0.09	11.98
1,1,2,2 - Tetrachloroethane	0	NA	NA	NA
o - Xylene	220	13.66	0.06	8.70
1,3,5-Trimethylbenzene	55	11.73	0.05	7.94
1,2,4-Trimethylbenzene	147	15.02	0.07	9.24
m - Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - Dichlorobenzene	4	36.41	0.10	**33.78**
o - Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-4. VOC Sampling and Analytical Precision: 52 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	52	19.75	0.52	13.83
Propylene	52	11.48	0.11	8.06
Dichlorodifluoromethane	52	9.35	0.06	6.99
Chloromethane	51	12.14	0.10	8.95
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	18	20.53	0.05	11.81
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	15	24.87	0.44	**17.59**
Trichlorofluoromethane	52	10.15	0.03	7.40
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	43	17.85	0.04	12.02
Trichlorotrifluoroethane	46	17.81	0.02	12.98
trans - 1,2 - Dichloroethylene	0	NA	NA	NA
1,1 - Dichloroethane	0	NA	NA	NA
Methyl *tert*-Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	32	33.95	0.16	**19.35**
Chloroprene	0	NA	NA	NA
cis-1,2-Dichloroethylene	1	NA	0.42	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	1	NA	0.06	NA
Ethyl *tert*-Butyl Ether	0	NA	NA	NA
1,2 - Dichloroethane	0	NA	NA	NA
1,1,1 - Trichloroethane	1	NA	0.07	NA
Benzene	52	10.85	0.07	8.06
Carbon Tetrachloride	16	7.46	0.07	5.06
tert-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
cis -1,3 - Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	0	NA	NA	NA

Table 23-4. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
trans - 1,3 - Dichloropropene	0	NA	NA	NA
1,1,2 - Trichloroethane	0	NA	NA	NA
Toluene	52	9.68	0.15	7.47
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
n-Octane	2	NA	0.15	NA
Tetrachloroethylene	18	11.88	1.58	7.95
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	43	17.91	0.04	13.38
m,p - Xylene	52	10.73	0.05	8.30
Bromoform	0	NA	NA	NA
Styrene	9	3.03	0.06	2.24
1,1,2,2 - Tetrachloroethane	0	NA	NA	NA
o - Xylene	42	15.52	0.04	11.48
1,3,5-Trimethylbenzene	17	22.18	0.05	13.09
1,2,4-Trimethylbenzene	41	13.71	0.04	10.01
m - Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - Dichlorobenzene	0	NA	NA	NA
o - Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-5. VOC Sampling and Analytical Precision: 20 Replicate Analyses for all Duplicate Samples in Bountiful, UT (BOUT & BTUT)

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	20	7.04	0.14	5.06
Propylene	20	13.68	0.10	8.88
Dichlorodifluoromethane	20	7.40	0.05	5.12
Chloromethane	20	7.69	0.05	5.56
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	9	27.38	0.03	**20.99**
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	1	NA	1.20	NA
Trichlorofluoromethane	20	8.94	0.06	6.26
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	10	20.89	0.06	**16.28**
Trichlorotrifluoroethane	19	16.73	0.02	13.82
trans - 1,2 - Dichloroethylene	0	NA	NA	NA
1,1 - Dichloroethane	0	NA	NA	NA
Methyl *tert*-Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	10	1.81	0.17	1.29
Chloroprene	0	NA	NA	NA
cis-1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	0	NA	NA	NA
Ethyl *tert*-Butyl Ether	0	NA	NA	NA
1,2 - Dichloroethane	0	NA	NA	NA
1,1,1 - Trichloroethane	0	NA	NA	NA
Benzene	20	6.25	0.04	4.29
Carbon Tetrachloride	0	NA	NA	NA
tert-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
cis -1,3 - Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	0	NA	NA	NA

Table 23-5. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
trans - 1,3 - Dichloropropene	0	NA	NA	NA
1,1,2 - Trichloroethane	0	NA	NA	NA
Toluene	20	3.55	0.05	2.53
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
n-Octane	7	8.50	0.04	5.99
Tetrachloroethylene	0	NA	NA	NA
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	15	7.60	0.03	5.36
m,p - Xylene	20	5.50	0.03	3.81
Bromoform	0	NA	NA	NA
Styrene	0	NA	NA	NA
1,1,2,2 - Tetrachloroethane	0	NA	NA	NA
o - Xylene	19	7.43	0.02	5.09
1,3,5-Trimethylbenzene	0	NA	NA	NA
1,2,4-Trimethylbenzene	13	11.78	0.03	9.15
m - Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - Dichlorobenzene	0	NA	NA	NA
o - Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-6. VOC Sampling and Analytical Precision: Coefficient of Variation for all Replicate Analyses, All Sites

Compound	Average	Barceloneta, PR (BAPR)	Beulah, ND (BUND)	Bountiful, UT (Site1 - BOUT)	Bountiful, UT (Site 2 - BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Denver, CO Site 1 - DECO)	Denver, CO (Site 2 - WECO)	Detroit, MI (DEMI)
Acetylene	*7.28*	3.15	7.70	4.75	5.36	5.38	8.79	**15.15**	2.86	7.31	13.83
Propylene	*10.26*	10.70	9.30	13.39	4.36	6.72	**17.78**	14.17	3.15	10.00	8.06
Dichlorodifluoromethane	*7.19*	6.40	8.99	5.99	4.26	5.25	6.28	2.60	3.38	9.73	6.99
Chloromethane	*6.07*	4.69	7.01	5.58	5.54	4.22	8.29	4.01	2.19	12.91	8.95
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	*11.64*	NA	NA	NA	**20.99**	**18.45**	NA	NA	6.76	NA	11.81
Bromomethane	*4.13*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	*8.76*	4.70	NA	NA	NA	4.35	10.25	6.45	4.40	11.56	**17.59**
Trichlorofluoromethane	*8.87*	6.07	7.84	6.03	6.49	6.74	12.29	3.90	6.02	8.51	7.40
Acrylonitrile	*6.64*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	***16.30***	11.94	**20.05**	NA	**16.28**	13.59	12.44	**16.82**	10.02	**34.62**	12.02
Trichlorotrifluoroethane	*11.48*	**19.38**	13.40	12.83	14.82	7.52	12.79	12.56	8.79	11.97	12.98
trans - 1,2 - Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1 - Dichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl *tert*-Butyl Ether	*6.10*	NA	NA	NA	NA	6.35	7.33	1.74	NA	NA	NA
Methyl Ethyl Ketone	*11.00*	NA	**19.75**	NA	1.29	5.67	**17.81**	12.77	NA	NA	19.35
Chloroprene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 23-6. Continued

Compound	Average	Barceloneta, PR (BAPR)	Beulah, ND (BUND)	Bountiful, UT (Site 1 - BOUT)	Bountiful, UT (Site 2 - BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Denver, CO (Site 1 - DECO)	Denver, CO (Site 2 - WECO)	Detroit, MI (DEMI)
Bromochloromethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	*8.64*	NA	NA	NA	NA	NA	NA	NA	12.91	NA	NA
Ethyl *tert*-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	*7.22*	NA	NA	NA	NA	7.64	NA	NA	NA	NA	NA
Benzene	*6.49*	3.76	10.71	5.40	3.18	3.70	10.94	8.37	4.51	8.93	8.06
Carbon Tetrachloride	*7.36*	**15.93**	6.15	NA	NA	3.07	12.51	NA	NA	NA	5.06
tert-Amyl Methyl Ether	*NA*	NA	NA	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	*10.16*	NA	NA	NA	NA	NA	**18.11**	NA	5.51	NA	NA
Methyl Methacrylate	*12.67*	NA	NA	NA	NA	NA	**15.40**	2.62	NA	NA	NA
cis -1,3 - Dichloropropene	*5.52*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	*10.24*	NA	NA	NA	NA	9.87	NA	NA	NA	NA	NA
trans - 1,3 - Dichloropropene	*2.85*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2 - Trichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	*7.18*	4.92	12.53	3.41	1.65	9.08	**16.11**	6.85	5.96	9.65	7.47
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
n-Octane	*7.75*	NA	NA	6.15	5.84	NA	11.91	NA	6.43	NA	NA
Tetrachloroethylene	*11.05*	NA	NA	NA	NA	6.97	NA	**28.28**	6.20	NA	7.95
Chlorobenzene	*9.64*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 23-6. Continued

Compound	Average	Barceloneta, PR (BAPR)	Beulah, ND (BUND)	Bountiful, UT (Site 1 - BOUT)	Bountiful, UT (Site 2 - BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Denver, CO (Site 1 - DECO)	Denver, CO (Site 2 - WECO)	Detroit, MI (DEMI)
Ethylbenzene	*8.23*	7.51	10.35	5.57	5.15	7.39	9.06	8.68	3.13	2.83	13.38
m,p - Xylene	*8.36*	3.72	2.53	5.96	1.65	6.15	11.32	11.77	4.59	10.42	8.30
Bromoform	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	*10.74*	NA	NA	NA	NA	NA	3.79	**18.20**	12.78	NA	2.24
1,1,2,2 - Tetrachloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o - Xylene	*8.39*	**16.42**	7.23	4.91	5.26	9.70	9.01	9.90	3.12	4.07	11.48
1,3,5-Trimethylbenzene	*8.11*	NA	10.88	NA	NA	2.83	**15.49**	NA	5.70	2.83	13.09
1,2,4-Trimethylbenzene	*8.90*	11.17	12.36	8.99	9.31	7.83	10.47	NA	6.38	8.61	10.01
m - Dichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
p - Dichlorobenzene	***21.67***	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o - 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	*9.00*	*8.70*	*10.42*	*6.84*	*6.96*	*7.20*	*11.73*	*10.27*	*5.94*	*10.26*	*10.30*

Table 23-6. Continued

Compound	Average	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Granada, MS (GRMS)	Gulf Port, MS (GPMS)	Houghton Lake, MI (HOMI)	Jackson, MS (JAMS)	Kingsport, TN (KITN)	Lincoln, NE (LONE)	North Brook, IL (NBIL)
Acetylene	*7.28*	1.89	11.11	6.05	8.65	4.96	5.62	8.13	8.13	6.70
Propylene	*10.26*	10.05	11.80	13.51	**16.91**	10.00	4.58	12.64	12.64	8.80
Dichlorodifluoromethane	*7.19*	5.01	5.83	14.80	9.37	9.72	8.98	1.72	1.72	6.44
Chloromethane	*6.07*	6.22	7.90	10.67	5.55	4.05	3.20	2.11	2.11	7.14
Dichlorotetrafluoroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Butadiene	*11.64*	NA	**15.80**	NA	6.15	NA	NA	NA	NA	NA
Bromomethane	*4.13*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	*8.76*	10.42	9.10	7.21	**20.35**	4.45	10.12	6.48	6.48	13.92
Trichlorofluoromethane	*8.87*	9.20	11.99	**15.32**	10.91	9.14	9.33	NA	NA	8.81
Acrylonitrile	*6.64*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	***16.30***	NA	14.95	NA	NA	14.28	NA	12.86	12.86	9.70
Trichlorotrifluoroethane	*11.48*	3.72	10.23	10.79	4.48	13.82	10.37	NA	NA	14.68
trans - 1,2 - Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1 - Dichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl *tert*-Butyl Ether	*6.10*	NA	11.18	NA	NA	NA	4.72	NA	NA	NA
Methyl Ethyl Ketone	*11.00*	8.05	**17.53**	14.56	5.89	7.86	13.98	NA	NA	6.22
Chloroprene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromochloromethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	*8.64*	NA	NA	NA	NA	17.31	NA	NA	NA	7.64

Table 23-6. Continued

Compound	Average	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Granada, MS (GRMS)	Gulf Port, MS (GPMS)	Houghton Lake, MI (HOMI)	Jackson, MS (JAMS)	Kingsport, TN (KITN)	Lincoln, NE (LONE)	North Brook, IL (NBIL)
Ethyl *tert*-Butyl Ether	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2 - Dichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1 - Trichloroethane	*7.22*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	*6.49*	1.81	8.62	NA	11.90	4.16	4.09	3.98	3.98	10.75
Carbon Tetrachloride	*7.36*	NA	11.79	NA	5.66	NA	NA	NA	NA	5.44
tert-Amyl Methyl Ether	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2 - Dichloropropane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	*10.16*	NA	10.88	NA	NA	NA	NA	NA	NA	3.65
Methyl Methacrylate	*12.67*	NA	**19.98**	NA	NA	NA	NA	NA	NA	NA
cis -1,3 - Dichloropropene	*5.52*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	*10.24*	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans - 1,3 - Dichloropropene	*2.85*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2 - Trichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	*7.18*	1.50	5.98	**15.08**	3.96	10.79	3.99	3.60	3.60	7.71
Dibromochloromethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Octane	*7.75*	NA	6.73	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	*11.05*	NA	9.24	NA	NA	NA	NA	NA	NA	10.23
Chlorobenzene	*9.64*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	*8.23*	NA	7.41	**18.56**	6.43	NA	9.55	NA	NA	12.66
m,p - Xylene	*8.36*	NA	7.11	**26.02**	7.60	NA	5.60	9.40	9.40	10.41

Table 23-6. Continued

Compound	**Average**	**Dickson, TN (DITN)**	**Elizabeth, NJ (ELNJ)**	**Granada, MS (GRMS)**	**Gulf Port, MS (GPMS)**	**Houghton Lake, MI (HOMI)**	**Jackson, MS (JAMS)**	**Kingsport, TN (KITN)**	**Lincoln, NE (LONE)**	**North Brook, IL (NBIL)**
Bromoform	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	*10.74*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2 - Tetrachloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
o - Xylene	*8.39*	NA	7.96	**24.24**	9.73	NA	10.14	2.44	2.44	NA
1,3,5-Trimethylbenzene	*8.11*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	*8.90*	NA	**17.00**	NA	5.74	NA	7.49	6.43	6.43	NA
m - Dichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
p - Dichlorobenzene	**21.67**	NA	NA	NA	NA	NA	**33.78**	NA	NA	NA
o - Dichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	*9.00*	*5.79*	*10.92*	*14.74*	*8.70*	*9.21*	*9.10*	*6.34*	*6.34*	*8.88*

Table 23-6. Continued

Compound	Average	Nashville, TN (EATN)	Nashville, TN (LOTN)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Pheonix, AZ (Site 1 - PSAZ)	Pheonix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	San Juan, PR (SJPR)	Sioux Falls, SD (SFSD)	Tupelo, MS (TUMS)
Acetylene	*7.28*	7.86	11.74	8.30	3.87	7.07	7.25	9.08	3.10	3.10	8.14
Propylene	*10.26*	5.15	**20.74**	9.19	12.11	7.48	9.16	6.31	9.30	9.30	4.58
Dichlorodifluoromethane	*7.19*	7.88	**20.36**	5.50	13.45	5.74	6.30	4.64	8.16	8.16	9.23
Chloromethane	*6.07*	8.18	5.80	5.42	4.45	6.85	7.40	5.72	9.24	9.24	1.70
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	*11.64*	*12.29*	NA	NA	NA	5.58	2.52	10.46	14.44	14.44	NA
Bromomethane	*4.13*	4.13	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	*8.76*	3.39	NA	14.17	9.64	8.46	NA	11.11	8.69	8.69	6.21
Trichlorofluoromethane	*8.87*	8.34	13.79	9.66	13.34	10.12	7.17	6.46	7.89	7.89	12.84
Acrylonitrile	*6.64*	NA	NA	NA	NA	6.64	NA	NA	NA	NA	NA
1,1-Dichloroethene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	***16.30***	8.82	7.42	9.25	**32.64**	4.83	8.66	**18.56**	**36.73**	**36.73**	2.72
Trichlorotrifluoroethane	*11.48*	7.52	9.10	12.04	14.85	9.62	14.80	10.76	10.22	10.22	14.02
trans - 1,2 - Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1 - Dichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl *tert*-Butyl Ether	*6.10*	5.26	NA	3.68	NA	5.96	10.85	4.66	NA	NA	NA
Methyl Ethyl Ketone	*11.00*	4.63	8.75	8.91	5.46	9.34	8.21	8.24	**15.97**	**15.97**	**16.32**
Chloroprene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-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
Chloroform	*8.64*	NA	NA	NA	NA	4.15	0.42	NA	NA	NA	NA
Ethyl *tert*-Butyl Ether	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 23-6. Continued

Compound	Average	Nashville, TN (EATN)	Nashville, TN (LOTN)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Pheonix, AZ (Site 1 - PSAZ)	Pheonix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	San Juan, PR (SJPR)	Sioux Falls, SD (SFSD)	Tupelo, MS (TUMS)
1,2 - Dichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1 - Trichloroethane	*7.22*	NA	NA	NA	7.86	7.21	NA	5.06	NA	NA	8.32
Benzene	*6.49*	3.63	8.33	4.67	4.61	5.60	8.00	7.87	4.65	4.65	9.06
Carbon Tetrachloride	*7.36*	6.14	NA	NA	NA	6.61	3.62	5.66	NA	NA	NA
tert-Amyl Methyl Ether	*NA*	NA	NA	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	*10.16*	NA	NA	11.65	NA	11.16	NA	NA	NA	NA	NA
Methyl Methacrylate	*12.67*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis -1,3 - Dichloropropene	*5.52*	NA	NA	NA	NA	5.52	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	*10.24*	NA	NA	NA	NA	9.92	NA	7.86	10.52	10.52	NA
trans - 1,3 - Dichloropropene	*2.85*	NA	NA	NA	NA	2.85	NA	NA	NA	NA	NA
1,1,2 - Trichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	*7.18*	6.90	9.17	8.02	5.34	4.85	7.46	5.32	8.32	8.32	6.18
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
n-Octane	*7.75*	NA	NA	NA	5.24	5.55	11.49	10.39	NA	NA	NA
Tetrachloroethylene	*11.05*	10.86	NA	NA	**18.63**	5.94	7.33	9.94	NA	NA	NA
Chlorobenzene	*9.64*	NA	NA	NA	NA	NA	NA	9.64	NA	NA	NA
Ethylbenzene	*8.23*	4.25	6.96	2.81	5.92	3.88	11.29	9.99	11.99	11.99	9.22
m,p - Xylene	*8.36*	4.18	10.43	9.79	8.66	5.00	9.16	7.19	13.27	13.27	2.35
Bromoform	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	*10.74*	6.93	NA	NA	*NA*	4.67	7.22	NA	**18.45**	**18.45**	NA
1,1,2,2 - Tetrachloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 23-6. Continued

Compound	Average	Nashville, TN (EATN)	Nashville, TN (LOTN)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Pheonix, AZ (Site 1 - PSAZ)	Pheonix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	San Juan, PR (SJPR)	Sioux Falls, SD (SFSD)	Tupelo, MS (TUMS)
o - Xylene	*8.39*	3.22	6.93	6.22	6.05	4.58	12.23	11.06	11.66	11.66	3.07
1,3,5-Trimethylbenzene	*8.11*	6.28	NA	7.44	12.50	4.91	7.44	4.46	9.87	9.87	NA
1,2,4-Trimethylbenzene	*8.90*	5.69	12.26	4.82	5.12	4.56	15.94	2.47	12.25	12.25	NA
m - Dichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
p - Dichlorobenzene	***21.67***	NA	NA	NA	NA	9.55	NA	NA	NA	NA	NA
o - 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	*9.00*	*6.43*	*10.84*	*7.86*	*9.99*	*6.47*	*8.36*	*8.04*	*11.83*	*11.83*	*7.60*

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-7. SNMOC Sampling and Analytical Precision: 138 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 (%)
Ethylene	138	6.37	0.25	4.34
Acetylene	138	8.05	0.27	5.44
Ethane	136	2.85	0.44	2.06
Propylene	138	8.84	0.14	5.89
Propane	138	5.91	0.72	3.14
Propyne	0	NA	NA	NA
Isobutane	138	6.91	0.27	4.55
Isobutene/1-Butene	138	10.05	0.23	7.20
1,3-Butadiene	77	9.55	0.05	6.79
n-Butane	138	5.63	0.35	3.86
trans-2-Butene	107	24.03	0.20	**17.17**
cis-2-Butene	116	28.24	0.19	**18.37**
3-Methyl-1-butene	10	3.58	0.16	2.59
Isopentane	135	9.04	0.55	6.60
1-Pentene	120	16.95	0.22	10.66
2-Methyl-1-butene	96	12.59	0.11	10.07
n-Pentane	138	6.34	0.29	4.41
Isoprene	120	17.22	0.20	10.75
trans-2-Pentene	119	16.35	0.15	11.33
cis-2-Pentene	98	20.48	0.20	**15.91**
2-Methyl-2-butene	86	12.42	4.14	8.96
2,2-Dimethylbutane	136	29.91	0.18	**16.26**
Cyclopentene	78	17.26	0.12	12.46
4-Methyl-1-pentene	15	14.99	0.12	10.99
Cyclopentane	127	16.62	0.15	12.12
2,3-Dimethylbutane	130	19.53	0.28	**15.14**
2-Methylpentane	138	13.96	0.39	8.79
3-Methylpentane	138	27.19	0.49	**15.22**
2-Methyl-1-pentene	2	NA	0.81	NA
1-Hexene	96	34.00	0.41	**23.82**
2-Ethyl-1-butene	0	NA	NA	NA
n-Hexane	138	12.09	0.41	8.58
trans-2-Hexene	4	4.67	0.02	3.30
cis-2-Hexene	6	13.46	0.09	10.39
Methylcyclopentane	137	14.12	0.19	9.50
2,4-Dimethylpentane	120	17.78	0.20	12.63

Table 23-7. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Benzene	138	6.99	0.18	4.97
Cyclohexane	133	25.95	0.21	13.86
2,3-Dimethylpentane	133	26.42	0.28	**15.98**
3-Methylhexane	110	32.73	0.38	18.06
1-Heptene	38	11.38	0.17	7.74
2,2,4-Trimethylpentane	138	18.19	0.25	10.71
n-Heptane	134	17.39	0.16	10.87
Methylcyclohexane	129	18.89	0.20	12.11
2,2,3-Trimethylpentane	71	20.20	0.19	13.75
2,3,4-Trimethylpentane	129	13.42	0.13	9.25
Toluene	138	6.84	0.47	4.71
2-Methylheptane	122	25.75	0.20	**19.82**
3-Methylheptane	112	24.60	0.18	**17.08**
1-Octene	29	15.02	0.21	13.54
n-Octane	133	22.41	0.14	13.05
Ethylbenzene	137	16.23	0.15	10.60
m-Xylene/p-Xylene	138	27.56	0.34	9.15
Styrene	115	37.98	0.25	**15.48**
o-Xylene	138	18.75	0.20	12.02
1-Nonene	19	13.01	0.10	8.81
n-Nonane	138	25.56	0.10	**15.22**
Isopropylbenzene	86	22.40	0.21	**17.37**
a-Pinene	66	40.30	0.25	**19.51**
n-Propylbenzene	111	22.91	0.14	**16.21**
m-Ethyltoluene	137	17.38	0.10	10.90
p-Ethyltoluene	123	29.40	0.14	**16.95**
1,3,5-Trimethylbenzene	122	24.46	0.11	**15.51**
o-Ethyltoluene	116	18.43	0.16	13.18
b-Pinene	14	8.64	0.27	6.36
1,2,4-Trimethylbenzene	134	14.69	0.15	9.51
1-Decene	0	NA	NA	NA
n-Decane	117	36.05	0.41	**18.41**
1,2,3-Trimethylbenzene	95	21.90	0.21	14.32
m-Diethylbenzene	99	27.43	0.18	**19.46**
p-Diethylbenzene	82	26.33	0.21	**18.50**
1-Undecene	11	25.23	0.22	**15.83**
n-Undecane	122	15.39	0.21	9.81

Table 23-7. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
1-Dodecene	2	NA	0.57	NA
n-Dodecane	52	14.78	0.42	11.16
1-Tridecene	0	NA	NA	NA
n-Tridecane	2	43.74	0.76	**39.58**
TNMOC (speciated)	138	8.54	8.50	5.72
TNMOC (w/ unknowns)	138	9.84	28.01	6.78

NA: Not applicable
NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font

Table 23-8. SNMOC Sampling and Analytical Precision: Coefficient of Variation for all Replicate Analyses, All Sites

Compound	Average	Bountiful, UT (Site 1 - BOUT)	Bountiful, UT (Site 2 - BTUT)	Custer, SD (CUSD)	Ponca City, OK (POOK)	St. Louis, MO (Site 1 - SLMO)	St. Louis, MO (Site 4 - S4MO)	St. Louis, MO (BTMO)	Sioux Falls, SD (SFSD)
Ethylene	*4.34*	1.77	1.55	7.25	6.63	8.67	2.68	3.06	3.11
Acetylene	*5.44*	1.18	3.51	8.85	7.45	7.55	3.99	4.78	6.19
Ethane	*2.06*	1.16	1.22	3.08	0.55	4.30	1.69	1.21	3.24
Propylene	*5.89*	1.97	3.49	9.31	0.44	11.21	4.20	8.70	7.81
Propane	*3.14*	1.10	2.89	2.50	1.26	9.58	2.65	2.22	2.91
Propyne	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
Isobutane	*4.55*	0.72	2.90	9.42	1.45	7.37	3.93	6.76	3.83
Isobutene/1-Butene	*7.20*	1.26	2.66	11.40	3.08	12.52	5.92	13.21	7.55
1,3-Butadiene	*6.79*	9.36	6.98	3.43	4.31	7.68	8.87	NA	6.93
n-Butane	*3.86*	1.40	1.71	9.08	0.69	7.66	3.62	3.59	3.11
trans-2-Butene	***17.17***	7.40	**20.86**	**15.89**	10.53	**31.62**	**24.60**	NA	9.25
cis-2-Butene	***18.37***	10.59	**19.51**	13.60	1.58	**34.44**	**26.30**	NA	**22.54**
3-Methyl-1-butene	*2.59*	1.98	NA	NA	3.20	NA	NA	NA	NA
Isopentane	*6.60*	9.37	2.09	16.74	0.23	6.52	7.62	7.03	3.15
1-Pentene	*10.66*	5.66	5.60	6.56	6.44	**29.17**	14.97	9.89	7.03
2-Methyl-1-butene	*10.07*	6.80	6.06	5.51	7.29	11.26	7.50	NA	**26.11**
n-Pentane	*4.41*	2.03	2.31	9.30	1.37	8.03	3.89	4.76	3.61
Isoprene	*10.75*	12.73	**19.30**	12.13	4.55	14.84	14.04	2.95	5.45
trans-2-Pentene	*11.33*	9.33	6.24	11.89	6.42	**19.43**	**17.57**	NA	8.45
cis-2-Pentene	**15.91**	11.69	13.11	7.35	5.27	**27.83**	**15.52**	NA	**30.61**
2-Methyl-2-butene	*8.96*	8.95	13.72	3.10	4.52	8.27	14.56	NA	9.62
2,2-Dimethylbutane	**16.26**	6.28	**15.83**	**22.26**	0.60	**25.92**	**16.59**	**23.33**	**19.31**
Cyclopentene	*12.46*	10.33	8.17	5.26	8.82	7.32	**19.05**	**26.64**	14.07

Table 23-8. Continued

Compound	Average	Bountiful, UT (Site 1 - BOUT)	Bountiful, UT (Site 2 - BTUT)	Custer, SD (CUSD)	Ponca City, OK (POOK)	St. Louis, MO (Site 1 - SLMO)	St. Louis, MO (Site 4 - S4MO)	St. Louis, MO (BTMO)	Sioux Falls, SD (SFSD)
4-Methyl-1-pentene	*10.99*	9.30	NA	NA	NA	11.99	**18.78**	NA	3.90
Cyclopentane	*12.12*	9.85	9.05	**16.14**	2.06	**19.64**	11.69	**20.96**	7.58
2,3-Dimethylbutane	***15.14***	8.78	9.12	13.73	3.54	**20.48**	**18.11**	**24.76**	**22.57**
2-Methylpentane	*8.79*	4.12	2.00	**15.16**	4.79	10.70	9.06	**16.94**	7.52
3-Methylpentane	***15.22***	7.58	3.34	14.70	5.03	**18.44**	**19.81**	**25.86**	**26.98**
2-Methyl-1-pentene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
1-Hexene	***23.82***	8.88	**42.39**	9.65	NA	**28.08**	**20.15**	**19.39**	**38.20**
2-Ethyl-1-butene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
n-Hexane	*8.58*	3.60	1.97	9.34	6.32	11.64	5.81	**20.84**	9.13
trans-2-Hexene	*3.30*	NA	3.24	NA	NA	NA	3.35	NA	NA
cis-2-Hexene	*10.39*	NA	9.09	NA	NA	NA	11.70	NA	NA
Methylcyclopentane	*9.50*	4.17	3.72	**15.04**	4.95	11.85	7.89	10.97	**17.41**
2,4-Dimethylpentane	*12.63*	6.81	6.55	12.36	5.35	**24.62**	**16.62**	6.56	**22.14**
Benzene	*4.97*	1.64	3.24	9.68	2.99	8.15	5.86	3.74	4.45
Cyclohexane	*13.86*	6.75	8.97	**19.02**	3.18	**28.67**	**17.50**	6.79	**19.98**
2-Methylhexane	***16.14***	10.12	5.36	12.93	3.06	**25.68**	**16.26**	**29.04**	**26.65**
2,3-Dimethylpentane	***15.98***	7.31	3.94	**28.62**	1.53	**27.50**	**15.06**	**19.96**	**23.90**
3-Methylhexane	***18.06***	**15.37**	4.06	**29.71**	5.30	10.17	12.20	**35.27**	**32.39**
1-Heptene	*7.74*	8.68	1.57	2.72	11.83	NA	4.21	10.34	14.81
2,2,4-Trimethylpentane	*10.71*	10.06	2.78	**16.47**	2.32	11.84	7.13	**25.95**	9.16
n-Heptane	*10.87*	7.62	3.22	**16.33**	1.63	14.56	8.57	**22.13**	12.89
Methylcyclohexane	*12.11*	2.13	4.41	14.95	3.39	**21.99**	**16.35**	**16.01**	**17.63**
2,2,3-Trimethylpentane	*13.75*	**23.41**	**19.19**	NA	3.19	12.34	**15.34**	NA	9.05
2,3,4-Trimethylpentane	*9.25*	4.28	6.06	13.07	0.76	**20.08**	9.25	9.07	11.43

Table 23-8. Continued

Compound	**Average**	**Bountiful, UT (Site 1 - BOUT)**	**Bountiful, UT (Site 2 - BTUT)**	**Custer, SD (CUSD)**	**Ponca City, OK (POOK)**	**St. Louis, MO (Site 1 - SLMO)**	**St. Louis, MO (Site 4 - S4MO)**	**St. Louis, MO (BTMO)**	**Sioux Falls, SD (SFSD)**
Toluene	*4.71*	2.91	1.89	6.85	1.14	10.37	4.24	4.82	5.47
2-Methylheptane	***19.82***	8.62	**21.56**	**18.34**	3.33	**26.08**	**18.13**	13.96	**48.53**
3-Methylheptane	***17.08***	11.40	**18.27**	**19.32**	6.24	**30.05**	**18.19**	**23.23**	9.94
1-Octene	*13.54*	**49.00**	NA	6.17	NA	5.96	3.24	3.32	NA
n-Octane	*13.05*	2.57	8.85	**21.34**	1.04	**26.56**	13.22	14.60	**16.20**
Ethylbenzene	*10.60*	7.33	3.92	**16.77**	2.33	**15.46**	12.04	12.35	14.64
m,p - Xylene	*9.15*	5.08	3.01	12.91	1.14	12.11	7.15	10.35	**21.46**
Styrene	***15.48***	**22.37**	9.76	**27.80**	7.85	**19.88**	8.65	7.02	**20.54**
o-Xylene	*12.02*	6.95	3.72	**18.17**	1.91	**24.95**	10.66	12.98	**16.80**
1-Nonene	*8.81*	12.86	NA	12.40	NA	NA	8.80	1.19	NA
n-Nonane	***15.22***	5.53	7.03	**25.50**	0.48	**26.86**	**15.34**	**17.73**	**23.28**
Isopropylbenzene	***17.37***	10.12	NA	**16.57**	NA	**34.11**	**22.82**	4.73	**15.85**
a-Pinene	***19.51***	9.16	11.23	14.17	**59.04**	**26.50**	**21.03**	10.47	4.47
n-Propylbenzene	***16.21***	8.54	13.18	**19.63**	6.48	**22.97**	**19.69**	**21.16**	**18.02**
m-Ethyltoluene	*10.90*	5.15	4.15	**15.77**	4.01	**15.19**	8.23	**18.92**	**15.78**
p-Ethyltoluene	***16.95***	9.31	**15.79**	**25.09**	2.88	**19.47**	**16.01**	**27.23**	**19.79**
1,3,5-Trimethylbenzene	***15.51***	7.11	12.01	**27.80**	1.74	**18.03**	11.53	**25.94**	**19.98**
o-Ethyltoluene	*13.18*	11.57	13.67	11.25	9.66	**21.80**	**16.11**	1.25	**20.11**
b-Pinene	*6.36*	NA	NA	7.26	NA	NA	NA	NA	5.45
1,2,4-Trimethylbenzene	*9.51*	3.28	7.83	13.81	2.35	11.17	8.11	**15.38**	14.11
1-Decene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
n-Decane	***18.41***	**28.74**	11.34	**41.48**	6.45	**24.04**	**22.86**	4.49	7.90
1,2,3-Trimethylbenzene	*14.32*	6.99	**16.78**	9.56	4.56	**27.19**	**21.76**	6.68	**21.01**
m-Diethylbenzene	***19.46***	**16.94**	**20.41**	9.28	NA	**29.24**	**21.28**	**17.56**	**21.46**

Table 23-8. Continued

Compound	Average	Bountiful, UT (Site 1 - BOUT)	Bountiful, UT (Site 2 - BTUT)	Custer, SD (CUSD)	Ponca City, OK (POOK)	St. Louis, MO (Site 1 - SLMO)	St. Louis, MO (Site 4 - S4MO)	St. Louis, MO (BTMO)	Sioux Falls, SD (SFSD)
p-Diethylbenzene	***18.50***	**17.84**	**27.25**	14.33	NA	**20.07**	**18.25**	NA	13.28
1-Undecene	***15.83***	**15.83**	NA	NA	NA	NA	NA	NA	NA
n-Undecane	*9.81*	7.51	11.23	11.97	1.10	11.37	9.56	7.26	**18.50**
1-Dodecene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
n-Dodecane	*11.16*	10.61	NA	5.07	NA	**25.72**	6.49	NA	7.88
1-Tridecene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
n-Tridecane	***39.58***	NA	NA	NA	NA	NA	NA	NA	**39.58**
TNMOC (speciated)	*5.72*	1.19	3.48	9.71	1.14	9.29	4.95	8.39	7.60
TNMOC (w/ unknowns)	*6.78*	2.15	9.57	8.28	0.93	8.96	7.14	9.47	7.76
	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	*11.85*	*9.73*	*9.30*	***15.57***	*5.05*	***19.15***	*12.78*	*14.54*	***16.88***

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-9. Carbonyl Sampling and Analytical Precision: 758 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	758	1.08	0.034	0.74
Acetaldehyde	757	1.20	0.015	0.87
Acetone	754	1.30	0.013	0.94
Propionaldehyde	710	4.49	0.004	3.83
Crotonaldehyde	694	9.86	0.011	7.30
Butyr/Isobutyraldehyde	756	5.40	0.006	3.21
Benzaldehyde	756	9.11	0.004	7.02
Isovaleraldehyde	297	31.44	0.004	**18.07**
Valeraldehyde	754	9.59	0.003	7.64
Tolualdehydes	758	17.95	0.005	11.90
Hexaldehyde	754	10.06	0.004	7.60
2,5-Dimethylbenzaldehyde	58	15.85	0.003	13.45

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-10. Carbonyl Sampling and Analytical Precision: 168 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	168	1.03	0.053	0.71
Acetaldehyde	168	0.86	0.012	0.60
Acetone	168	0.96	0.024	0.68
Propionaldehyde	156	4.59	0.006	3.39
Crotonaldehyde	160	7.36	0.010	4.95
Butyr/Isobutyraldehyde	168	2.86	0.009	1.97
Benzaldehyde	168	12.90	0.010	7.90
Isovaleraldehyde	94	22.45	0.005	**15.03**
Valeraldehyde	168	9.86	0.006	6.74
Tolualdehydes	168	9.26	0.005	6.44
Hexaldehyde	168	5.99	0.004	4.14
2,5-Dimethylbenzaldehyde	24	20.35	0.004	13.34

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-11. Carbonyl Sampling and Analytical Precision: 590 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	590	1.11	0.031	0.77
Acetaldehyde	589	1.29	0.015	0.92
Acetone	586	1.40	0.011	0.98
Propionaldehyde	554	4.81	0.004	3.38
Crotonaldehyde	534	10.50	0.011	7.54
Butyr/Isobutyraldehyde	588	5.79	0.005	3.81
Benzaldehyde	588	9.01	0.003	6.24
Isovaleraldehyde	203	34.64	0.004	**18.97**
Valeraldehyde	586	10.04	0.003	7.33
Tolualdehydes	590	19.98	0.005	12.47
Hexaldehyde	586	11.13	0.003	7.88
2,5-Dimethylbenzaldehyde	34	17.39	0.003	12.78

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-12. Carbonyl Sampling and Analytical Precision: 184 Replicate Analyses for Duplicate Samples in Tampa and St. Petersburg, FL

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	184	0.75	0.018	0.53
Acetaldehyde	184	0.71	0.009	0.50
Acetone	183	1.72	0.011	1.23
Propionaldehyde	172	6.27	0.005	4.50
Crotonaldehyde	173	6.79	0.004	4.78
Butyr/Isobutyraldehyde	184	5.22	0.006	3.60
Benzaldehyde	184	9.54	0.004	6.60
Isovaleraldehyde	112	21.13	0.002	13.32
Valeraldehyde	184	10.12	0.002	7.03
Tolualdehydes	184	16.38	0.005	12.32
Hexaldehyde	184	14.20	0.003	10.33
2,5-Dimethylbenzaldehyde	11	28.69	0.002	**20.70**

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-13. Carbonyl Sampling and Analytical Precision: 84 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	84	1.01	0.030	0.63
Acetaldehyde	84	0.99	0.011	0.69
Acetone	84	1.25	0.011	0.86
Propionaldehyde	84	5.83	0.008	4.03
Crotonaldehyde	82	11.57	0.006	7.50
Butyr/Isobutyraldehyde	84	3.15	0.005	2.19
Benzaldehyde	84	7.38	0.003	4.99
Isovaleraldehyde	56	28.50	0.005	**16.48**
Valeraldehyde	84	5.19	0.002	3.39
Tolualdehydes	84	13.93	0.004	9.08
Hexaldehyde	84	8.19	0.005	5.74
2,5-Dimethylbenzaldehyde	16	21.94	0.002	11.74

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-14. Carbonyl Sampling and Analytical Precision: 28 Replicate Analyses for all Duplicate Samples in Bountiful, UT (BOUT & BTUT)

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	28	0.89	0.021	0.62
Acetaldehyde	28	1.34	0.021	0.95
Acetone	28	1.11	0.019	0.78
Propionaldehyde	28	9.61	0.004	6.57
Crotonaldehyde	26	13.80	0.016	8.84
Butyr/Isobutyraldehyde	28	5.50	0.005	3.59
Benzaldehyde	28	9.82	0.004	6.65
Isovaleraldehyde	0	NA	NA	NA
Valeraldehyde	28	11.42	0.004	8.27
Tolualdehydes	28	16.80	0.007	10.03
Hexaldehyde	28	16.69	0.009	12.36
2,5-Dimethylbenzaldehyde	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-15. Carbonyl Sampling and Analytical Precision: Coefficient of Variation for all Replicate Analyses, All Sites

Compound	**Average**	**Barceloneta, PR (BAPR)**	**Belle Glade, FL (BGFL)**	**Bountiful, UT (Site 1 - BOUT)**	**Bountiful, UT (Site 2 - BTUT)**	**Camden, NJ (CANJ)**	**Chester, NJ (CHNJ)**	**Custer, SD (CUSD)**	**Clearwater, FL (CWFL)**	**Delray Beach, FL (DBFL)**
Formaldehyde	*0.74*	0.67	1.19	0.36	0.88	0.60	0.85	0.80	0.65	1.24
Acetaldehyde	*0.87*	0.24	1.54	1.01	0.90	2.71	0.70	0.84	0.66	1.24
Acetone	*0.94*	0.22	1.37	0.52	1.03	1.50	0.49	0.56	1.16	1.39
Propionaldehyde	*3.83*	2.08	7.25	5.79	7.35	10.85	2.70	2.98	3.46	5.24
Crotonaldehyde	*7.30*	11.65	13.65	6.77	10.90	13.41	4.67	**17.30**	4.25	**32.44**
Butyr/Isobutyraldehyde	*3.21*	5.77	2.67	3.98	3.19	4.98	1.49	3.28	3.06	4.38
Benzaldehyde	*7.02*	3.10	10.29	8.78	4.52	9.96	12.41	3.33	4.53	8.06
Isovaleraldehyde	***18.07***	**20.26**	NA	NA	NA	NA	11.39	**37.44**	12.28	NA
Valeraldehyde	*7.64*	8.81	**25.88**	10.10	6.44	8.39	12.39	4.79	8.83	8.74
Tolualdehydes	*11.90*	**24.37**	**18.97**	11.23	8.83	8.08	**15.67**	11.29	**15.72**	**19.41**
Hexaldehyde	*7.60*	12.71	6.04	**18.90**	5.82	6.51	9.86	11.62	7.34	7.53
2,5-Dimethylbenzaldehyde	*13.45*	NA	NA	NA	NA	NA	NA	NA	**15.47**	NA
Average	*6.88*	*8.17*	*8.89*	*6.74*	*4.99*	*6.70*	*6.60*	*8.57*	*6.45*	*8.97*

Table 23-15. Continued

Compound	Average	Denver, CO (Site 1 - DECO)	Denver, CO (Site 2 - WECO)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Pompano Beach, FL (FLFL)	Tampa (Gandy), FL (GAFL)	Gulf Port, MS (GPMS)	Granada, MS (GRMS)
Formaldehyde	*0.74*	0.33	0.31	0.63	0.98	0.90	0.17	0.54	1.58	2.85
Acetaldehyde	*0.87*	0.28	0.18	0.69	0.47	3.29	0.22	0.30	1.40	3.56
Acetone	*0.94*	0.32	0.41	0.86	0.21	1.64	1.33	0.77	3.64	2.72
Propionaldehyde	*3.83*	1.62	2.29	4.03	1.24	5.37	3.89	2.91	6.94	3.36
Crotonaldehyde	*7.30*	0.82	13.70	7.50	2.59	7.52	4.96	5.40	3.61	3.57
Butyr/Isobutyraldehyde	*3.21*	0.52	1.19	2.19	1.61	3.13	3.82	5.34	7.73	3.13
Benzaldehyde	*7.02*	0.15	8.75	4.99	2.49	5.69	7.08	5.42	**17.40**	7.89
Isovaleraldehyde	***18.07***	NA	NA	**16.48**	NA	**38.51**	5.66	**19.89**	NA	**28.34**
Valeraldehyde	*7.64*	3.65	**17.10**	3.39	14.72	5.29	12.03	5.87	5.81	4.16
Tolualdehydes	*11.90*	0.49	11.23	9.08	7.87	11.39	**15.15**	6.94	**32.38**	13.59
Hexaldehyde	*7.60*	0.36	8.94	5.74	6.94	8.34	2.70	9.33	10.71	3.65
2,5-Dimethylbenzaldehyde	*13.45*	NA	NA	11.74	NA	6.91	NA	**25.92**	NA	NA
Average	*6.88*	*0.85*	*6.41*	*5.61*	*3.91*	*8.16*	*5.18*	*7.39*	*9.12*	*6.98*

Table 23-15. Continued

Compound	Average	Hartford, CT (HACT)	Jackson, MS (JAMS)	Kingsport, TN (KITN)	Loudon, TN (LDTN)	Lincoln, NE (LONE)	Tampa (Lewis), FL (LEFL)	Nashville, TN (EATN)	Nashville, TN (LOTN)	Miami, FL (MDFL)
Formaldehyde	*0.74*	0.59	0.68	0.88	1.21	0.17	0.61	0.30	0.39	0.30
Acetaldehyde	*0.87*	0.99	0.66	0.75	0.67	0.15	0.64	0.23	0.43	0.40
Acetone	*0.94*	0.64	0.56	0.93	0.92	0.17	0.97	0.41	0.76	2.03
Propionaldehyde	*3.83*	4.46	2.56	0.92	8.22	1.03	3.19	2.26	2.61	8.46
Crotonaldehyde	*7.30*	4.33	4.96	6.62	3.93	7.59	1.52	6.69	3.00	7.93
Butyr/Isobutyraldehyde	*3.21*	1.83	2.42	1.84	0.42	2.36	3.20	4.45	1.45	2.81
Benzaldehyde	*7.02*	1.38	3.83	8.91	**21.06**	8.15	5.86	4.91	11.57	10.60
Isovaleraldehyde	***18.07***	**22.53**	**18.55**	14.51	NA	NA	7.78	**18.70**	2.93	NA
Valeraldehyde	*7.64*	10.56	3.72	5.07	2.58	3.25	5.51	7.43	3.45	7.93
Tolualdehydes	*11.90*	3.83	8.69	9.12	2.66	**15.55**	6.31	3.25	9.26	**20.31**
Hexaldehyde	*7.60*	5.72	9.88	3.75	0.56	**16.35**	8.19	2.18	4.06	**16.46**
2,5-Dimethylbenzaldehyde	*13.45*	**16.40**	NA	NA	11.86	NA	NA	NA	NA	NA
Average	*6.88*	*6.10*	*5.14*	*4.84*	*4.92*	*5.48*	*3.98*	*4.62*	*3.63*	*7.72*

Table 23-15. Continued

Compound	Average	Orlando, FL (ORFL)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	St. Louis, MO (Site 4 - S4MO)	St. Louis, MO (Site 1 - SLMO)	St. Louis, MO (BTMO)	San Juan, PR (SJPR)	Sioux Falls, SD (SFSD)	Tupelo, MS (TUMS)
Formaldehyde	*0.74*	0.54	0.70	1.07	0.86	0.70	0.34	0.47	0.63	1.45
Acetaldehyde	*0.87*	0.35	0.36	1.51	0.79	0.91	0.48	0.45	0.62	1.66
Acetone	*0.94*	0.41	0.34	1.23	0.87	1.03	0.41	0.61	0.60	1.70
Propionaldehyde	*3.83*	1.55	2.85	3.17	1.58	2.72	5.10	1.81	2.29	1.70
Crotonaldehyde	*7.30*	1.11	5.66	9.22	7.65	2.31	2.16	2.54	13.52	2.66
Butyr/Isobutyraldehyde	*3.21*	2.78	3.41	4.68	2.05	3.32	8.31	2.05	3.61	10.79
Benzaldehyde	*7.02*	5.67	4.13	9.37	5.32	4.00	8.53	3.88	3.58	3.17
Isovaleraldehyde	***18.07***	**21.75**	7.92	**16.55**	**29.21**	7.64	NA	**21.16**	NA	**24.15**
Valeraldehyde	*7.64*	7.70	2.23	3.43	5.84	5.70	13.01	9.85	3.79	3.76
Tolualdehydes	*11.90*	14.64	14.08	8.36	9.45	7.92	11.02	**19.21**	11.23	7.55
Hexaldehyde	*7.60*	4.99	5.60	4.11	4.11	4.82	9.66	12.33	10.32	4.67
2,5-Dimethylbenzaldehyde	*13.45*	11.48	7.44	13.78	NA	NA	NA	NA	NA	NA
Average	*6.88*	*6.08*	*4.56*	*6.37*	*6.16*	*3.73*	*5.90*	*6.76*	*5.02*	*5.75*

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-16. VOC Sampling and Analytical Precision: 332 Duplicate and Collocated Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	332	12.95	0.20	8.73
Propylene	332	22.42	0.12	14.77
Dichlorodifluoromethane	332	7.25	0.05	6.08
Chloromethane	331	9.08	0.06	6.94
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	2	NA	NA	NA
1,3-Butadiene	55	24.51	0.06	**19.14**
Bromomethane	1	NA	0.16	NA
Chloroethane	3	NA	0.11	NA
Acetonitrile	113	64.84	42.65	**30.41**
Trichlorofluoromethane	332	24.82	0.10	13.73
Acrylonitrile	3	NA	1.95	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	201	69.60	0.10	**22.64**
Trichlorotrifluoroethane	304	16.35	0.03	13.95
trans - 1,2 - Dichloroethylene	0	NA	NA	NA
1,1 - Dichloroethane	0	NA	NA	NA
Methyl *tert*-Butyl Ether	92	12.44	0.14	8.49
Methyl Ethyl Ketone	215	60.40	0.89	**32.13**
Chloroprene	0	NA	NA	NA
cis-1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	27	13.49	0.05	11.20
Ethyl *tert*-Butyl Ether	0	NA	NA	NA
1,2 - Dichloroethane	0	NA	NA	NA
1,1,1 - Trichloroethane	15	30.68	0.09	12.33
Benzene	331	16.38	0.06	10.56
Carbon Tetrachloride	66	8.43	0.08	6.17
tert-Amyl Methyl Ether	1	NA	0.34	NA
1,2 - Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	13	16.72	0.12	**15.94**
Methyl Methacrylate	9	34.20	0.43	**31.16**
cis -1,3 - Dichloropropene	1	NA	0.12	NA
Methyl Isobutyl Ketone	9	23.99	0.26	**16.75**
trans - 1,3 - Dichloropropene	1	NA	0.10	NA

Table 23-16. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
1,1,2 - Trichloroethane	0	NA	NA	NA
Toluene	328	129.77	0.48	**16.87**
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
n-Octane	34	36.41	0.13	13.61
Tetrachloroethylene	57	28.17	19.04	**23.96**
Chlorobenzene	2	4.17	0.01	3.01
Ethylbenzene	246	23.79	0.08	**15.40**
m,p - Xylene	315	21.81	0.13	12.35
Bromoform	0	NA	NA	NA
Styrene	54	28.42	0.14	**16.27**
1,1,2,2 - Tetrachloroethane	0	NA	NA	NA
o - Xylene	252	20.87	0.07	12.81
1,3,5-Trimethylbenzene	61	14.35	0.04	11.10
1,2,4-Trimethylbenzene	176	16.51	0.07	11.11
m - Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - Dichlorobenzene	6	51.40	0.10	**35.13**
o - Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-17. VOC Sampling and Analytical Precision: 176 Collocated Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	176	15.09	0.21	11.45
Propylene	176	23.86	0.13	**18.24**
Dichlorodifluoromethane	176	5.53	0.04	4.70
Chloromethane	175	8.75	0.06	6.98
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	29	16.18	0.05	**15.35**
Bromomethane	1	NA	0.16	NA
Chloroethane	3	NA	0.11	NA
Acetonitrile	31	75.40	79.23	**28.60**
Trichlorofluoromethane	176	17.70	0.06	11.63
Acrylonitrile	3	NA	1.95	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	103	78.16	0.07	**25.56**
Trichlorotrifluoroethane	163	16.08	0.02	13.03
trans - 1,2 - Dichloroethylene	0	NA	NA	NA
1,1 - Dichloroethane	0	NA	NA	NA
Methyl *tert*-Butyl Ether	35	13.05	0.19	8.57
Methyl Ethyl Ketone	144	78.06	0.97	**34.95**
Chloroprene	0	NA	NA	NA
cis-1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	22	22.39	0.05	12.59
Ethyl *tert*-Butyl Ether	0	NA	NA	NA
1,2 - Dichloroethane	0	NA	NA	NA
1,1,1 - Trichloroethane	9	52.76	0.07	**24.26**
Benzene	175	20.08	0.07	12.55
Carbon Tetrachloride	37	5.02	0.06	3.77
tert-Amyl Methyl Ether	1	NA	0.34	NA
1,2 - Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	6	0.67	0.14	0.48
Methyl Methacrylate	2	15.38	0.02	11.79
cis -1,3 - Dichloropropene	1	NA	0.12	NA
Methyl Isobutyl Ketone	3	NA	0.33	NA
trans - 1,3 - Dichloropropene	1	NA	0.10	NA

Table 23-17. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
1,1,2 - Trichloroethane	0	NA	NA	NA
Toluene	176	223.45	0.73	**20.72**
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
n-Octane	9	56.22	0.09	**27.69**
Tetrachloroethylene	38	32.94	38.02	**33.76**
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	143	27.83	0.08	**19.39**
m,p - Xylene	173	30.43	0.12	**19.17**
Bromoform	0	NA	NA	NA
Styrene	40	33.75	0.18	**17.00**
1,1,2,2 - Tetrachloroethane	0	NA	NA	NA
o - Xylene	139	21.34	0.06	**15.15**
1,3,5-Trimethylbenzene	32	16.20	0.04	12.39
1,2,4-Trimethylbenzene	100	20.48	0.07	**15.03**
m - Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - Dichlorobenzene	4	61.42	0.09	**33.38**
o - Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

NA: Not applicable
NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-18. VOC Sampling and Analytical Precision: 156 Duplicate Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	156	10.81	0.19	7.68
Propylene	156	20.98	0.10	13.16
Dichlorodifluoromethane	156	8.97	0.06	6.98
Chloromethane	156	9.41	0.07	6.86
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	2	NA	NA	NA
1,3-Butadiene	26	32.84	0.08	**20.59**
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	82	54.29	6.08	**30.65**
Trichlorofluoromethane	156	31.94	0.14	**15.41**
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	98	61.05	0.13	**20.35**
Trichlorotrifluoroethane	141	16.63	0.03	13.18
trans - 1,2 - Dichloroethylene	0	NA	NA	NA
1,1 - Dichloroethane	0	NA	NA	NA
Methyl *tert*-Butyl Ether	57	11.83	0.08	8.19
Methyl Ethyl Ketone	71	42.73	0.81	**27.32**
Chloroprene	0	NA	NA	NA
cis-1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	5	4.60	0.04	3.14
Ethyl *tert*-Butyl Ether	0	NA	NA	NA
1,2 - Dichloroethane	0	NA	NA	NA
1,1,1 - Trichloroethane	6	8.60	0.11	6.37
Benzene	156	12.67	0.05	8.72
Carbon Tetrachloride	29	11.83	0.10	8.39
tert-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	7	32.77	0.10	**23.67**
Methyl Methacrylate	7	53.02	0.84	**37.62**
cis -1,3 - Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	6	23.99	0.20	**16.75**
trans - 1,3 - Dichloropropene	0	NA	NA	NA

Table 23-18. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
1,1,2 - Trichloroethane	0	NA	NA	NA
Toluene	152	36.09	0.23	13.58
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
n-Octane	25	16.59	0.16	13.17
Tetrachloroethylene	19	23.40	0.06	**15.19**
Chlorobenzene	2	4.17	0.01	3.01
Ethylbenzene	103	19.75	0.08	13.55
m,p - Xylene	142	13.19	0.14	9.49
Bromoform	0	NA	NA	NA
Styrene	14	23.09	0.09	**18.40**
1,1,2,2 - Tetrachloroethane	0	NA	NA	NA
o - Xylene	113	20.41	0.08	12.97
1,3,5-Trimethylbenzene	29	12.50	0.05	9.07
1,2,4-Trimethylbenzene	76	12.54	0.08	9.94
m - Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - Dichlorobenzene	2	41.38	0.12	**36.89**
o - Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-19. VOC Sampling and Analytical Precision: 32 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	32	6.96	0.13	12.23
Propylene	32	9.16	0.06	13.48
Dichlorodifluoromethane	32	4.28	0.03	10.96
Chloromethane	31	10.69	0.09	13.75
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl chloride	0	NA	NA	NA
1,3-butadiene	12	10.57	0.02	**28.48**
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	6	23.84	0.70	**15.08**
Trichlorofluoromethane	32	4.30	0.01	11.03
Acrylonitrile	0	NA	NA	NA
1,1-dichloroethene	0	NA	NA	NA
Methylene chloride	24	14.30	0.03	**19.25**
Trichlorotrifluoroethane	27	11.08	0.02	**17.14**
trans - 1,2 - dichloroethylene	0	NA	NA	NA
1,1 - dichloroethane	0	NA	NA	NA
Methyl *tert*-butyl ether	0	NA	NA	NA
Methyl ethyl ketone	21	22.07	0.16	**23.34**
Chloroprene	0	NA	NA	NA
cis-1,2-dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	1	NA	0.06	NA
Ethyl *tert*-butyl ether	0	NA	NA	NA
1,2 - dichloroethane	0	NA	NA	NA
1,1,1 - trichloroethane	0	NA	NA	NA
Benzene	32	5.97	0.04	12.09
Carbon tetrachloride	8	3.47	0.08	2.53
tert-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
cis -1,3 - dichloropropene	0	NA	NA	NA
Methyl isobutyl ketone	0	NA	NA	NA

Table 23-19. Continued

Compound	**Number of Observations**	**Average RPD for Replicate Analyses (%)**	**Average Concentration Difference for Replicate Analyses (ppbv)**	**Coefficient of Variation (%)**
trans - 1,3 - dichloropropene	0	NA	NA	NA
1,1,2 - trichloroethane	0	NA	NA	NA
Toluene	32	6.75	0.08	11.82
Dibromochloromethane	0	NA	NA	NA
1,2-dibromoethane	0	NA	NA	NA
n-octane	1	NA	0.11	NA
Tetrachloroethylene	13	6.83	0.50	14.69
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	27	18.94	0.03	**23.24**
m,p - xylene	32	7.15	0.03	13.14
Bromoform	0	NA	NA	NA
Styrene	4	9.09	0.08	6.73
1,1,2,2 - tetrachloroethane	0	NA	NA	NA
o - xylene	27	9.56	0.02	**17.99**
1,3,5-trimethylbenzene	12	8.95	0.04	**20.98**
1,2,4-trimethylbenzene	24	9.08	0.04	**15.73**
m - dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - dichlorobenzene	0	NA	NA	NA
o - dichlorobenzene	0	NA	NA	NA
1,2,4-trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-butadiene	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-20. VOC Sampling and Analytical Precision: 12 Duplicate Samples in Bountiful, UT (BOUT & BTUT)

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	12	9.80	0.22	7.45
Propylene	12	12.56	0.10	9.77
Dichlorodifluoromethane	12	7.47	0.04	4.94
Chloromethane	12	4.36	0.03	3.19
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	3	28.57	0.08	**17.68**
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	3	28.65	1.15	**17.72**
Trichlorofluoromethane	12	182.95	0.65	**40.40**
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	8	408.87	0.45	**31.11**
Trichlorotrifluoroethane	11	20.55	0.04	**15.96**
trans - 1,2 - Dichloroethylene	0	NA	NA	NA
1,1 - Dichloroethane	0	NA	NA	NA
Methyl *tert*-Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	6	104.26	0.53	**48.30**
Chloroprene	0	NA	NA	NA
cis-1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	0	NA	NA	NA
Ethyl *tert*-Butyl Ether	0	NA	NA	NA
1,2 - Dichloroethane	0	NA	NA	NA
1,1,1 - Trichloroethane	0	NA	NA	NA
Benzene	12	7.85	0.05	5.90
Carbon Tetrachloride	0	NA	NA	NA
tert-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
cis -1,3 - Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	0	NA	NA	NA
trans - 1,3 - Dichloropropene	0	NA	NA	NA

Table 23-20. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
1,1,2 - Trichloroethane	0	NA	NA	NA
Toluene	12	14.22	0.20	10.10
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
n-Octane	6	7.91	0.02	5.52
Tetrachloroethylene	0	NA	NA	NA
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	9	9.80	0.04	8.13
m,p - Xylene	12	7.97	0.04	6.28
Bromoform	0	NA	NA	NA
Styrene	0	NA	NA	NA
1,1,2,2 - Tetrachloroethane	0	NA	NA	NA
o - Xylene	12	18.19	0.04	13.43
1,3,5-Trimethylbenzene	0	NA	NA	NA
1,2,4-Trimethylbenzene	8	23.68	0.05	**19.91**
m - Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
p - Dichlorobenzene	0	NA	NA	NA
o - Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-21. VOC Sampling and Analytical Precision: Coefficient of Variation for all Duplicate Samples, All Sites

Compound	Average	Barceloneta, PR (BAPR)	Beulah, ND (BUND)	Bountiful, UT (Site 1 - BOUT)	Bountiful, UT (Site 2 - BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Chicago, IL (NBIL)	Custer, SD (CUSD)	Denver, CO (Site 1 - DECO)	Denver, CO (Site 2 - WECO)
Acetylene	*8.73*	1.08	7.59	5.46	9.44	6.08	**17.24**	4.63	4.42	2.13	1.39
Propylene	*14.77*	5.09	13.64	12.07	7.48	6.18	**28.70**	**16.31**	13.05	6.12	12.35
Dichlorodifluoromethane	*6.08*	2.07	11.78	6.96	2.93	6.96	**17.46**	3.01	3.16	7.98	13.39
Chloromethane	*6.94*	14.15	10.60	4.49	1.89	7.60	**18.03**	4.60	2.45	3.23	9.50
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	***19.14***	NA	NA	NA	**17.68**	NA	NA	NA	NA	**24.15**	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	***30.41***	**35.50**	NA	NA	**17.72**	3.95	**43.14**	NA	**18.11**	**89.83**	9.56
Trichlorofluoromethane	*13.73*	5.84	7.91	**40.39**	**40.42**	8.39	**24.58**	5.85	**20.31**	1.00	5.50
Acrylonitrile	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	***22.64***	14.19	**35.36**	10.88	**51.35**	**31.36**	**21.81**	**27.76**	9.43	6.52	**31.04**
Trichlorotrifluoroethane	*13.95*	**24.75**	10.78	8.84	**23.08**	8.42	**17.85**	8.56	11.66	7.09	**15.71**
trans - 1,2 - Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1 - Dichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl *tert*-Butyl Ether	*8.49*	NA	NA	NA	NA	3.25	7.66	NA	**23.22**	NA	NA
Methyl Ethyl Ketone	***32.13***	NA	**18.70**	NA	**48.30**	**32.52**	**27.68**	**34.13**	**49.43**	NA	NA
Chloroprene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-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
Chloroform	*11.20*	NA	NA	NA	NA	NA	NA	**22.92**	NA	5.66	NA

Table 23-21. Continued

Compound	**Average**	**Barceloneta, PR (BAPR)**	**Beulah, ND (BUND)**	**Bountiful, UT (Site 1 - BOUT)**	**Bountiful, UT (Site 2 - BTUT)**	**Camden, NJ (CANJ)**	**Chester, NJ (CHNJ)**	**Chicago, IL (NBIL)**	**Custer, SD (CUSD)**	**Denver, CO (Site 1 - DECO)**	**Denver, CO (Site 2 - WECO)**
Ethyl *tert*-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	*12.33*	NA	NA	NA	NA	7.86	NA	NA	NA	NA	NA
Benzene	*10.56*	5.47	**32.18**	4.07	7.74	12.20	**21.48**	11.42	10.29	7.71	2.24
Carbon Tetrachloride	*6.17*	14.63	11.79	NA	NA	6.15	6.15	6.15	NA	NA	NA
tert-Amyl Methyl Ether	*NA*	NA	NA	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	***15.94***	NA	NA	NA	NA	NA	NA	NA	NA	**27.14**	NA
Methyl Methacrylate	***31.16***	NA	NA	NA	NA	NA	**44.22**	NA	**64.93**	NA	NA
cis -1,3 - Dichloropropene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	***16.75***	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans - 1,3 - Dichloropropene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2 - Trichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	***16.87***	2.34	**107.69**	7.28	12.92	**21.43**	**20.91**	**72.80**	**37.38**	2.03	1.42
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
n-Octane	*13.61*	NA	NA	5.66	5.39	NA	0.25	NA	NA	7.44	NA
Tetrachloroethylene	***23.96***	NA	NA	NA	NA	NA	NA	NA	**21.76**	6.64	NA
Chlorobenzene	*3.01*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	***15.40***	8.75	NA	NA	8.13	7.25	14.05	**15.71**	**65.27**	7.26	8.32
m,p - Xylene	*12.35*	2.66	NA	3.41	9.15	**15.12**	10.86	**28.74**	**42.88**	2.76	4.72
Bromoform	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 23-21. Continued

Compound	**Average**	**Barceloneta, PR (BAPR)**	**Beulah, ND (BUND)**	**Bountiful, UT (Site 1 - BOUT)**	**Bountiful, UT (Site 2 - BTUT)**	**Camden, NJ (CANJ)**	**Chester, NJ (CHNJ)**	**Chicago, IL (NBIL)**	**Custer, SD (CUSD)**	**Denver, CO (Site 1 - DECO)**	**Denver, CO (Site 2 - WECO)**
Styrene	***16.27***	NA	NA	NA	NA	NA	**19.25**	NA	3.75	13.22	NA
1,1,2,2 - Tetrachloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o - Xylene	*12.81*	10.10	NA	10.55	**16.30**	14.35	7.07	14.14	**22.33**	5.22	5.24
1,3,5-Trimethylbenzene	*11.10*	NA	NA	NA	NA	6.15	10.18	NA	NA	6.67	**18.45**
1,2,4-Trimethylbenzene	*11.11*	4.88	NA	NA	**19.91**	1.64	9.31	NA	NA	3.33	2.67
m - Dichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
p - Dichlorobenzene	***35.13***	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o - 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	***15.61***	*10.10*	***24.36***	*10.00*	***17.64***	*10.89*	***18.47***	***18.45***	***23.55***	*11.58*	*9.43*

Table 23-21. Continued

Compound	**Average**	**Detroit, MI (DEMI)**	**Detroit, MI (Allen Park - APMI)**	**Dickson, TN (DITN)**	**Elizabeth, NJ (ELNJ)**	**Granada, MS (GRMS)**	**Gulf Port, MS (GPMS)**	**Houghton Lake, MI (HOMI)**	**Jackson, MS (JAMS)**	**Kingsport, TN (KITN)**
Acetylene	*8.73*	12.23	23.91	7.78	6.59	5.24	13.36	5.05	2.30	6.09
Propylene	*14.77*	13.48	**22.34**	**33.67**	7.77	**36.89**	6.36	0.00	3.63	7.05
Dichlorodifluoromethane	*6.08*	10.96	6.45	1.30	6.36	5.09	9.84	7.44	2.30	2.17
Chloromethane	*6.94*	13.75	8.72	2.89	8.41	5.72	10.91	5.09	3.09	1.46
Dichlorotetrafluoroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Butadiene	***19.14***	**28.48**	11.87	NA	**26.19**	NA	**20.20**	NA	NA	NA
Bromomethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	***30.41***	**15.08**	NA	**80.68**	5.88	**98.77**	8.05	3.74	10.68	NA
Trichlorofluoromethane	*13.73*	11.03	**15.80**	**39.60**	11.67	2.18	11.45	7.44	5.34	5.12
Acrylonitrile	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	***22.64***	**19.25**	**29.63**	NA	12.57	NA	NA	**17.68**	NA	**51.61**
Trichlorotrifluoroethane	*13.95*	**17.14**	14.19	7.44	8.74	7.44	**23.57**	7.44	**27.42**	11.40
trans - 1,2 - Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1 - Dichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl *tert*-Butyl Ether	*8.49*	NA	NA	NA	7.71	NA	NA	NA	4.72	NA
Methyl Ethyl Ketone	***32.13***	**23.34**	**46.09**	**30.00**	**31.58**	**30.74**	NA	1.63	**43.13**	**35.09**
Chloroprene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromochloromethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	*11.20*	NA	NA	NA	NA	NA	NA	6.15	NA	NA

Table 23-21. Continued

Compound	**Average**	**Detroit, MI (DEMI)**	**Detroit, MI (Allen Park - APMI)**	**Dickson, TN (DITN)**	**Elizabeth, NJ (ELNJ)**	**Granada, MS (GRMS)**	**Gulf Port, MS (GPMS)**	**Houghton Lake, MI (HOMI)**	**Jackson, MS (JAMS)**	**Kingsport, TN (KITN)**
Ethyl *tert*-Butyl Ether	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2 - Dichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1 - Trichloroethane	*12.33*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	*10.56*	12.09	10.31	7.86	5.22	6.73	**23.93**	8.32	4.50	5.67
Carbon Tetrachloride	*6.17*	2.53	2.39	NA	8.97	NA	NA	NA	NA	NA
tert-Amyl Methyl Ether	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2 - Dichloropropane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	***15.94***	NA	NA	NA	**20.20**	NA	NA	NA	NA	NA
Methyl Methacrylate	***31.16***	NA	NA	NA	3.72	NA	NA	NA	NA	NA
cis -1,3 - Dichloropropene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	***16.75***	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans - 1,3 - Dichloropropene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2 - Trichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	***16.87***	11.82	**18.13**	1.49	7.25	3.82	5.56	6.73	3.17	5.80
Dibromochloromethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Octane	*13.61*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethylene	***23.96***	14.69	**99.24**	NA	13.47	NA	NA	NA	NA	NA
Chlorobenzene	*3.01*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	***15.40***	**23.24**	**15.24**	NA	4.02	4.04	9.87	NA	4.87	10.05
m,p - Xylene	*12.35*	13.14	**15.56**	NA	9.38	1.68	6.84	NA	3.28	6.39

Table 23-21. Continued

Compound	Average	Detroit, MI (DEMI)	Detroit, MI (Allen Park - APMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Granada, MS (GRMS)	Gulf Port, MS (GPMS)	Houghton Lake, MI (HOMI)	Jackson, MS (JAMS)	Kingsport, TN (KITN)
Bromoform	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	***16.27***	6.73	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2,2 - Tetrachloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
o - Xylene	*12.81*	**17.99**	**16.42**	NA	8.11	5.44	**16.44**	NA	5.83	4.99
1,3,5-Trimethylbenzene	*11.10*	**20.98**	6.10	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	*11.11*	**15.73**	13.26	NA	4.80	NA	11.47	NA	4.92	5.85
m - Dichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
p - Dichlorobenzene	***35.13***	NA	NA	NA	NA	NA	NA	NA	**36.89**	NA
o - Dichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	***15.61***	***15.18***	***20.87***	***21.27***	*10.41*	***16.45***	*12.70*	*6.39*	*10.38*	*11.34*

Table 23-21. Continued

Compound	Average	Lincoln, NE (LONE)	Nashville, TN (EATN)	Nashville, TN (LOTN)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Pheonix, AZ (Site 1 - PSAZ)	Pheonix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	San Juan, PR (SJPR)	Sioux Falls, SD (SFSD)	Tupelo, MS (TUMS)
Acetylene	*8.73*	10.77	6.05	9.85	3.60	**16.43**	**17.78**	11.44	1.85	6.01	7.83	**15.91**
Propylene	*14.77*	**18.93**	9.18	**16.99**	8.25	8.70	**28.24**	13.28	10.15	2.58	**33.72**	**15.50**
Dichlorodifluoromethane	*6.08*	4.35	4.02	2.48	2.17	3.32	7.03	1.70	2.83	5.82	14.54	7.39
Chloromethane	*6.94*	1.08	13.73	4.65	3.74	12.08	12.16	2.77	4.27	5.40	4.76	7.05
Dichlorotetrafluoroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Butadiene	***19.14***	*NA*	8.68	NA	12.86	**34.69**	**23.61**	4.13	17.91	**18.34**	NA	NA
Bromomethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	***30.41***	**33.57**	**15.14**	NA	11.96	**31.50**	**28.39**	NA	**21.80**	**68.53**	**38.51**	9.33
Trichlorofluoromethane	*13.73*	2.57	6.75	5.89	8.60	12.05	13.21	3.87	10.63	7.65	**25.51**	**45.81**
Acrylonitrile	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	***22.64***	NA	6.69	**36.89**	7.01	NA	**27.30**	5.55	**20.65**	**24.51**	**22.38**	11.31
Trichlorotrifluoroethane	*13.95*	**28.28**	**15.26**	11.56	11.00	14.28	**39.38**	1.27	6.69	**19.80**	3.14	10.44
trans - 1,2 - Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1 - Dichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl *tert*-Butyl Ether	*8.49*	NA	2.73	NA	2.96	NA	**17.84**	3.03	4.93	NA	5.99	**15.71**
Methyl Ethyl Ketone	***32.13***	NA	2.95	**96.72**	7.73	**23.29**	**71.33**	14.13	**18.46**	**16.64**	**38.57**	NA
Chloroprene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis-1,2-Dichloroethylene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromochloromethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	*11.20*	NA	NA	NA	NA	NA	**20.67**	0.62	NA	NA	NA	NA

Table 23-21. Continued

Compound	**Average**	**Lincoln, NE (LONE)**	**Nashville, TN (EATN)**	**Nashville, TN (LOTN)**	**New Brunswick, NJ (NBNJ)**	**Pascagoula, MS (PGMS)**	**Pheonix, AZ (Site 1 - PSAZ)**	**Pheonix, AZ (Site 2 - MCAZ)**	**St. Louis, MO (S4MO)**	**San Juan, PR (SJPR)**	**Sioux Falls, SD (SFSD)**	**Tupelo, MS (TUMS)**
Ethyl *tert*-Butyl Ether	*NA*	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	NA
1,1,1 - Trichloroethane	*12.33*	NA	NA	NA	NA	NA	**24.26**	NA	4.88	NA	NA	NA
Benzene	*10.56*	2.72	5.14	**17.35**	3.91	11.40	**31.01**	10.95	5.13	6.93	8.28	6.97
Carbon Tetrachloride	*6.17*	NA	4.05	NA	NA	NA	4.94	2.69	NA	NA	NA	NA
tert-Amyl Methyl Ether	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2 - Dichloropropane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	***15.94***	NA	NA	NA	NA	NA	0.48	NA	NA	NA	NA	NA
Methyl Methacrylate	***31.16***	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis -1,3 - Dichloropropene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	***16.75***	NA	NA	NA	NA	NA	NA	NA	**16.64**	**16.87**	NA	NA
trans - 1,3 - Dichloropropene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,2 - Trichloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	***16.87***	1.23	6.29	**18.43**	5.17	**25.82**	**33.11**	**26.80**	7.87	6.20	10.21	5.41
Dibromochloromethane	*NA*	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	NA
n-Octane	*13.61*	NA	NA	NA	NA	NA	**48.07**	7.32	**21.13**	NA	NA	NA
Tetrachloroethylene	***23.96***	NA	NA	NA	NA	**19.11**	**18.89**	2.25	**19.58**	NA	NA	NA
Chlorobenzene	*3.01*	NA	NA	NA	NA	NA	NA	NA	3.01	NA	NA	NA
Ethylbenzene	***15.40***	NA	5.20	**22.63**	3.05	**40.15**	**32.32**	10.21	4.40	7.45	10.44	**18.45**
m,p - Xylene	*12.35*	2.89	3.85	**30.72**	4.41	**22.97**	**31.20**	14.94	3.82	8.38	**15.79**	2.32

Table 23-21. Continued

Compound	Average	Lincoln, NE (LONE)	Nashville, TN (EATN)	Nashville, TN (LOTN)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Pheonix, AZ (Site 1 - PSAZ)	Pheonix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	San Juan, PR (SJPR)	Sioux Falls, SD (SFSD)	Tupelo, MS (TUMS)
Bromoform	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	***16.27***	NA	7.64	NA	*NA*	NA	NA	7.44	NA	NA	**25.89**	NA
1,1,2,2 - Tetrachloroethane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
o - Xylene	*12.81*	4.88	0.43	**19.41**	4.35	**38.52**	**28.17**	12.36	6.30	7.39	**21.02**	NA
1,3,5-Trimethylbenzene	*11.10*	NA	0.38	NA	NA	5.66	**32.42**	2.08	5.91	7.54	**21.76**	NA
1,2,4-Trimethylbenzene	*11.11*	**23.57**	9.05	**18.86**	4.56	3.97	**23.87**	**18.61**	4.83	3.52	**35.83**	NA
m - Dichlorobenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
p - Dichlorobenzene	***35.13***	NA	NA	NA	NA	NA	**33.38**	NA	NA	NA	NA	NA
o - Dichlorobenzene	*NA*	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	NA
Hexachloro-1,3-Butadiene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	***15.61***	*11.24*	*6.66*	***22.32***	*6.20*	***19.06***	***25.96***	*8.07*	*9.72*	*13.31*	***19.12***	*13.20*

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-22. SNMOC Sampling and Analytical Precision: 74 Duplicate Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Ethylene	74	11.04	0.40	7.48
Acetylene	74	4.95	0.22	3.62
Ethane	74	4.28	0.65	3.14
Propylene	74	13.22	0.40	9.29
Propane	74	7.95	1.79	6.39
Propyne	0	NA	NA	NA
Isobutane	74	28.85	1.74	10.71
Isobutene/1-Butene	74	27.69	0.56	**15.54**
1,3-Butadiene	40	9.66	0.05	7.06
n-Butane	74	9.47	1.29	6.67
trans-2-Butene	56	13.66	0.14	8.34
cis-2-Butene	60	9.47	0.06	6.96
3-Methyl-1-butene	5	7.64	0.13	5.61
Isopentane	72	26.27	3.78	11.24
1-Pentene	62	61.80	0.57	**26.64**
2-Methyl-1-butene	54	21.70	0.13	11.60
n-Pentane	74	29.28	2.01	11.14
Isoprene	64	17.30	0.32	11.42
trans-2-Pentene	62	10.86	0.11	8.14
cis-2-Pentene	49	12.79	0.12	10.09
2-Methyl-2-butene	47	21.34	5.63	**19.03**
2,2-Dimethylbutane	73	18.00	0.12	12.63
Cyclopentene	42	31.20	0.22	**18.83**
4-Methyl-1-pentene	9	58.15	0.41	**30.37**
Cyclopentane	64	33.76	0.48	**18.07**
2,3-Dimethylbutane	67	15.98	0.28	11.38
2-Methylpentane	74	28.50	1.05	**19.47**
3-Methylpentane	74	34.56	0.98	**19.00**
2-Methyl-1-pentene	1	NA	1.08	NA
1-Hexene	51	31.81	0.24	**17.29**
2-Ethyl-1-butene	0	NA	NA	NA
n-Hexane	74	20.08	1.16	14.52
trans-2-Hexene	3	NA	0.38	NA
cis-2-Hexene	3	1.87	0.32	1.31
Methylcyclopentane	73	14.40	0.32	9.69
2,4-Dimethylpentane	62	8.55	0.09	6.40

Table 23-22. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Benzene	74	8.14	0.24	5.81
Cyclohexane	70	14.85	0.17	8.86
2-Methylhexane	73	32.65	0.42	**21.60**
2,3-Dimethylpentane	69	19.58	0.29	**15.88**
3-Methylhexane	59	31.15	0.56	**21.15**
1-Heptene	22	32.01	0.28	**24.46**
2,2,4-Trimethylpentane	74	16.09	0.29	10.32
n-Heptane	72	22.83	0.43	13.98
Methylcyclohexane	66	19.21	0.24	11.67
2,2,3-Trimethylpentane	40	20.69	0.23	14.16
2,3,4-Trimethylpentane	68	12.29	0.11	8.86
Toluene	74	21.68	1.47	13.72
2-Methylheptane	63	15.57	0.11	11.30
3-Methylheptane	57	22.53	0.14	14.83
1-Octene	18	41.68	0.39	**28.75**
n-Octane	71	11.92	0.12	8.98
Ethylbenzene	74	17.70	0.16	12.70
m-Xylene/*p*-Xylene	74	19.02	0.77	**16.52**
Styrene	65	94.05	0.37	**34.27**
o-Xylene	74	18.37	0.22	14.19
1-Nonene	13	27.03	0.23	**16.51**
n-Nonane	74	20.50	0.10	14.72
Isopropylbenzene	45	19.30	0.13	13.72
a-Pinene	36	60.00	0.51	**37.76**
n-Propylbenzene	58	21.07	0.10	11.78
m-Ethyltoluene	74	16.20	0.11	11.66
p-Ethyltoluene	66	15.68	0.09	10.23
1,3,5-Trimethylbenzene	66	17.64	0.09	10.64
o-Ethyltoluene	61	21.42	0.13	13.52
b-Pinene	7	52.10	0.58	**24.18**
1,2,4-Trimethylbenzene	73	22.33	0.21	**16.38**
1-Decene	0	NA	NA	NA
n-Decane	60	35.82	0.44	**20.06**
1,2,3-Trimethylbenzene	49	26.89	0.14	**15.49**
m-Diethylbenzene	53	27.30	0.17	**17.78**
p-Diethylbenzene	44	29.19	0.24	**17.58**
1-Undecene	8	15.69	0.19	10.19
n-Undecane	66	20.32	0.38	14.76

Table 23-22. Continued

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
1-Dodecene	0	NA	NA	NA
n-Dodecane	29	20.94	0.67	**18.49**
1-Tridecene	0	NA	NA	NA
n-Tridecane	1	NA	1.74	**NA**
TNMOC (speciated)	74	12.24	15.96	7.46
TNMOC (w/ unknowns)	74	15.96	39.05	10.46

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-23. SNMOC Sampling and Analytical Precision: Coefficient of Variation for all Duplicate Analyses, All Sites

Compound	Average	Bountiful, UT (Site 1 - BOUT)	Bountiful, UT (Site 2 - BTUT)	Custer, SD (CUSD)	Ponca City, OK (POOK)	St. Louis, MO (Site 1 - SLMO)	St. Louis, MO (Site 4 - S4MO)	St. Louis, MO (BTMO)	Sioux Falls, SD (SFSD)
Ethylene	*7.48*	5.10	12.79	6.76	7.68	4.39	4.88	6.36	11.89
Acetylene	*3.62*	3.05	8.01	3.24	3.29	3.81	1.13	4.02	2.43
Ethane	*3.14*	2.17	6.69	3.28	6.13	3.09	0.91	2.01	0.82
Propylene	*9.29*	5.80	10.62	8.12	12.35	5.01	6.66	9.76	15.99
Propane	*6.39*	3.13	8.80	6.41	7.62	3.61	1.52	2.51	17.52
Propyne	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
Isobutane	*10.71*	3.14	9.88	**25.97**	0.18	4.01	2.04	6.02	**34.44**
Isobutene/1-Butene	*15.54*	8.24	8.08	11.95	7.64	**29.39**	**15.50**	**23.24**	**20.29**
1,3-Butadiene	*7.06*	8.74	13.56	1.94	9.23	5.14	9.37	NA	1.46
n-Butane	*6.67*	1.60	8.63	**16.05**	8.15	3.61	1.38	2.11	11.86
trans-2-Butene	8.34	5.66	4.65	6.51	8.90	**15.21**	11.91	NA	5.55
cis-2-Butene	6.96	4.00	13.74	7.76	4.88	4.11	8.44	4.81	7.96
3-Methyl-1-butene	*5.61*	NA	NA	NA	5.61	NA	NA	NA	NA
Isopentane	*11.24*	1.55	**22.09**	**37.89**	1.01	4.34	7.40	9.47	6.18
1-Pentene	***26.64***	**43.35**	**36.45**	**34.81**	**17.26**	5.86	**19.11**	NA	**29.66**
2-Methyl-1-butene	*11.60*	7.27	12.31	9.74	7.20	5.28	9.16	NA	**30.20**
n-Pentane	*11.14*	6.54	11.65	**22.97**	6.19	5.02	2.02	4.36	**30.40**
Isoprene	*11.42*	**26.10**	5.99	9.12	NA	2.70	4.20	4.52	**27.34**
trans-2-Pentene	*8.14*	5.25	11.94	6.98	5.62	5.99	7.81	3.67	**17.88**
cis-2-Pentene	10.09	10.53	10.46	8.36	6.60	3.95	3.31	NA	**27.43**
2-Methyl-2-butene	***19.03***	3.21	**24.18**	7.83	7.07	9.34	11.88	NA	**69.70**
2,2-Dimethylbutane	12.63	3.39	**15.81**	12.75	**18.36**	6.04	7.45	**18.95**	**18.29**
Cyclopentene	***18.83***	**30.07**	**45.67**	**22.13**	1.97	6.46	11.02	14.69	**18.61**

Table 23-23. Continued

Compound	**Average**	**Bountiful, UT (Site 1 - BOUT)**	**Bountiful, UT (Site 2 - BTUT)**	**Custer, SD (CUSD)**	**Ponca City, OK (POOK)**	**St. Louis, MO (Site 1 - SLMO)**	**St. Louis, MO (Site 4 - S4MO)**	**St. Louis, MO (BTMO)**	**Sioux Falls, SD (SFSD)**
4-Methyl-1-pentene	***30.37***	NA	NA	NA	NA	10.31	**44.37**	NA	**36.44**
Cyclopentane	***18.07***	10.25	11.63	12.19	10.36	8.13	3.95	**32.13**	**55.89**
2,3-Dimethylbutane	*11.38*	10.64	13.19	6.29	**18.51**	4.68	3.22	**26.69**	7.78
2-Methylpentane	***19.47***	6.06	11.48	**24.19**	**21.60**	7.62	6.96	**44.01**	**33.85**
3-Methylpentane	***19.00***	**26.26**	5.84	**17.05**	**28.05**	6.80	14.51	**20.45**	**33.00**
2-Methyl-1-pentene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
1-Hexene	***17.29***	**29.80**	**18.41**	**17.44**	NA	10.04	**21.12**	9.17	**15.02**
2-Ethyl-1-butene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
n-Hexane	*14.52*	8.19	8.09	12.77	**25.30**	6.25	6.25	**29.04**	**20.25**
trans-2-Hexene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
cis-2-Hexene	*1.31*	NA	NA	NA	NA	NA	1.31	NA	NA
Methylcyclopentane	*9.69*	3.07	9.33	9.51	13.45	6.30	6.23	9.99	**19.62**
2,4-Dimethylpentane	*6.40*	7.38	11.16	7.15	0.59	4.31	4.60	3.72	12.29
Benzene	*5.81*	3.66	10.15	7.49	5.07	4.92	3.39	6.06	5.77
Cyclohexane	*8.86*	3.96	7.55	**19.59**	1.62	6.45	4.65	14.67	12.37
2-Methylhexane	***21.60***	7.49	**23.50**	8.56	**32.45**	**18.47**	**17.84**	**15.87**	**48.65**
2,3-Dimethylpentane	***15.88***	12.49	**15.18**	5.00	13.38	**17.12**	6.38	13.35	**44.18**
3-Methylhexane	***21.15***	9.02	8.19	**23.62**	**37.42**	6.53	13.10	**37.69**	**33.66**
1-Heptene	***24.46***	**20.93**	11.54	NA	**27.88**	NA	**30.52**	**32.52**	**23.36**
2,2,4-Trimethylpentane	*10.32*	4.36	9.67	12.68	5.39	6.32	13.86	**19.25**	11.04
n-Heptane	*13.98*	**16.46**	5.10	14.95	**40.93**	6.80	6.59	13.27	7.72
Methylcyclohexane	*11.67*	7.01	6.66	7.88	10.15	6.10	13.63	11.11	**30.83**
2,2,3-Trimethylpentane	*14.16*	NA	**21.77**	NA	**21.39**	8.56	10.94	NA	8.14
2,3,4-Trimethylpentane	*8.86*	8.72	12.78	10.20	1.52	7.33	8.71	4.02	**17.60**

Table 23-23. Continued

Compound	**Average**	**Bountiful, UT (Site 1 - BOUT)**	**Bountiful, UT (Site 2 - BTUT)**	**Custer, SD (CUSD)**	**Ponca City, OK (POOK)**	**St. Louis, MO (Site 1 - SLMO)**	**St. Louis, MO (Site 4 - S4MO)**	**St. Louis, MO (BTMO)**	**Sioux Falls, SD (SFSD)**
Toluene	*13.72*	6.44	8.80	**36.67**	**21.64**	12.16	6.22	7.47	10.40
2-Methylheptane	*11.30*	4.12	11.66	**17.50**	5.56	11.93	13.33	**19.18**	7.10
3-Methylheptane	*14.83*	10.36	12.10	**15.47**	12.86	11.82	3.86	**33.54**	**18.62**
1-Octene	***28.75***	**28.37**	**48.60**	**27.86**	NA	4.29	14.77	**48.60**	NA
n-Octane	*8.98*	4.20	10.35	**16.25**	8.02	7.45	8.75	11.47	5.35
Ethylbenzene	*12.70*	10.23	12.42	**37.61**	4.95	**16.73**	5.06	11.78	2.83
m,p - Xylene	***16.52***	0.89	11.32	**32.40**	6.97	**15.20**	4.41	**21.36**	**39.59**
Styrene	***34.27***	**17.52**	**18.05**	**38.81**	**94.71**	12.27	11.79	**37.31**	**43.66**
o-Xylene	*14.19*	3.05	12.54	**45.64**	5.25	**23.97**	6.35	8.29	8.44
1-Nonene	***16.51***	5.75	**22.85**	NA	NA	NA	**20.94**	NA	NA
n-Nonane	*14.72*	6.55	9.81	**24.88**	2.48	**15.22**	10.91	**26.96**	**20.94**
Isopropylbenzene	*13.72*	9.15	NA	12.14	NA	7.50	8.03	**27.23**	**18.27**
a-Pinene	***37.76***	**32.77**	**38.97**	**57.75**	NA	**18.88**	**28.90**	**38.90**	**48.12**
n-Propylbenzene	*11.78*	8.00	2.94	**28.43**	13.95	9.61	14.57	NA	4.98
m-Ethyltoluene	*11.66*	7.09	8.02	**29.50**	2.62	7.16	7.81	**18.32**	12.75
p-Ethyltoluene	*10.23*	9.29	13.80	13.75	4.13	5.23	6.61	11.33	**17.73**
1,3,5-Trimethylbenzene	*10.64*	7.86	4.54	**16.22**	1.07	8.50	11.35	NA	**24.95**
o-Ethyltoluene	*13.52*	7.68	**20.06**	14.27	8.93	10.13	14.91	NA	**18.66**
b-Pinene	***24.18***	NA	NA	**43.41**	NA	NA	NA	NA	4.96
1,2,4-Trimethylbenzene	***16.38***	11.14	11.32	**24.72**	10.38	8.45	5.67	**40.22**	**19.12**
1-Decene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
n-Decane	***20.06***	**16.91**	13.79	**34.35**	NA	9.18	14.02	9.57	**42.62**
1,2,3-Trimethylbenzene	*15.49*	12.89	11.47	NA	1.83	**27.35**	**24.56**	NA	14.85
m-Diethylbenzene	***17.78***	**23.32**	**20.70**	6.06	NA	**20.80**	**27.14**	2.29	**24.13**

Table 23-23. Continued

Compound	**Average**	**Bountiful, UT (Site 1 - BOUT)**	**Bountiful, UT (Site 2 - BTUT)**	**Custer, SD (CUSD)**	**Ponca City, OK (POOK)**	**St. Louis, MO (Site 1 - SLMO)**	**St. Louis, MO (Site 4 - S4MO)**	**St. Louis, MO (BTMO)**	**Sioux Falls, SD (SFSD)**
p-Diethylbenzene	***17.58***	13.34	10.44	**20.08**	NA	**21.14**	14.48	NA	**25.98**
1-Undecene	*10.19*	4.66	**15.71**	NA	NA	NA	NA	NA	NA
n-Undecane	*14.76*	12.61	9.06	**29.36**	3.39	12.50	7.55	NA	**28.88**
1-Dodecene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
n-Dodecane	***18.49***	1.25	NA	**18.81**	NA	4.44	9.99	NA	**57.94**
1-Tridecene	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
n-Tridecane	*NA*	NA	NA	NA	NA	NA	NA	NA	NA
TNMOC (speciated)	*7.46*	1.07	8.99	**18.64**	1.76	4.80	2.92	5.44	**16.08**
TNMOC (w/ unknowns)	*10.46*	4.99	13.50	**18.02**	3.58	5.72	6.97	14.51	**16.42**
Average	*13.95*	*10.38*	*13.40*	***20.82***	*14.30*	***10.34***	*11.54*	***19.91***	***22.41***

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-24. Carbonyl Sampling and Analytical Precision: 430 Duplicate and Collocated Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	430	15.31	0.422	7.08
Acetaldehyde	429	13.92	0.137	7.64
Acetone	429	16.57	0.131	10.26
Propionaldehyde	406	15.48	0.012	10.44
Crotonaldehyde	410	20.72	0.020	11.71
Butyr/Isobutyraldehyde	429	12.83	0.021	8.65
Benzaldehyde	429	20.43	0.010	11.43
Isovaleraldehyde	165	42.13	0.008	**23.86**
Valeraldehyde	428	30.80	0.008	**17.56**
Tolualdehydes	430	33.01	0.010	**17.92**
Hexaldehyde	428	19.32	0.012	13.30
2,5-Dimethylbenzaldehyde	27	22.82	0.003	**17.23**

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-25. Carbonyl Sampling and Analytical Precision: 84 Collocated Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	84	4.66	0.239	4.60
Acetaldehyde	84	4.12	0.062	4.11
Acetone	84	8.21	0.228	6.90
Propionaldehyde	78	11.59	0.013	8.46
Crotonaldehyde	83	8.58	0.007	6.80
Butyr/Isobutyraldehyde	84	6.80	0.060	6.08
Benzaldehyde	84	17.90	0.020	11.73
Isovaleraldehyde	47	37.33	0.007	**26.29**
Valeraldehyde	84	11.93	0.006	9.57
Tolualdehydes	84	15.40	0.010	11.11
Hexaldehyde	84	7.80	0.005	6.35
2,5-Dimethylbenzaldehyde	10	22.80	0.005	**18.34**

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-26. Carbonyl Sampling and Analytical Precision: 298 Duplicate Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Anlyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	298	17.88	0.413	7.50
Acetaldehyde	297	16.46	0.146	7.44
Acetone	297	18.79	0.117	10.18
Propionaldehyde	280	15.97	0.011	9.79
Crotonaldehyde	279	22.74	0.020	13.00
Butyr/Isobutyraldehyde	297	13.58	0.015	9.03
Benzaldehyde	297	21.68	0.008	11.25
Isovaleraldehyde	106	39.85	0.007	**24.14**
Valeraldehyde	296	33.42	0.009	**19.23**
Tolualdehydes	298	36.88	0.010	**20.19**
Hexaldehyde	296	20.78	0.013	14.45
2,5-Dimethylbenzaldehyde	17	21.31	0.002	**17.37**

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-27. Carbonyl Sampling and Analytical Precision: 96 Duplicate Samples in Tampa and St. Petersburg, FL

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	96	6.74	0.141	5.93
Acetaldehyde	96	8.75	0.120	7.18
Acetone	96	17.37	0.071	11.98
Propionaldehyde	90	10.15	0.009	8.66
Crotonaldehyde	91	10.97	0.012	8.69
Butyr/Isobutyraldehyde	96	14.00	0.016	10.44
Benzaldehyde	96	9.88	0.004	7.76
Isovaleraldehyde	60	20.87	0.003	**17.03**
Valeraldehyde	96	23.83	0.004	**17.80**
Tolualdehydes	96	25.85	0.006	**17.47**
Hexaldehyde	96	27.80	0.006	**17.84**
2,5-Dimethylbenzaldehyde	5	14.84	0.002	11.34

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-28. Carbonyl Sampling and Analytical Precision:
42 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	42	10.05	0.462	**16.24**
Acetaldehyde	42	10.38	0.147	**15.56**
Acetone	42	10.98	0.120	**15.41**
Propionaldehyde	42	10.18	0.018	**16.01**
Crotonaldehyde	41	12.52	0.013	14.84
Butyr/Isobutyraldehyde	42	10.47	0.023	**15.10**
Benzaldehyde	42	15.34	0.007	**19.06**
Isovaleraldehyde	28	29.12	0.006	**22.15**
Valeraldehyde	42	11.96	0.007	**16.44**
Tolualdehydes	42	30.45	0.011	**23.32**
Hexaldehyde	42	13.38	0.010	14.92
2,5-Dimethylbenzaldehyde	6	21.06	0.002	**16.99**

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-29. Carbonyl Sampling and Analytical Precision:
14 Duplicate Samples in Bountiful, UT (BOUT & BTUT)

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	14	2.32	0.047	1.54
Acetaldehyde	14	3.18	0.088	3.05
Acetone	14	3.32	0.053	2.23
Propionaldehyde	14	11.39	0.007	10.35
Crotonaldehyde	14	15.19	0.003	6.73
Butyr/Isobutyraldehyde	14	8.90	0.009	6.99
Benzaldehyde	14	12.39	0.006	8.46
Isovaleraldehyde	0	NA	NA	NA
Valeraldehyde	14	17.32	0.011	**18.77**
Tolualdehydes	14	22.41	0.011	13.38
Hexaldehyde	14	13.22	0.017	13.61
2,5-Dimethylbenzaldehyde	0	NA	NA	NA

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-30. Carbonyl Sampling and Analytical Precision: Coefficient of Variation for all Duplicate Analyses, All Sites

Compound	Average	Barceloneta, PR (BAPR)	Belle Glade, FL (BGFL)	Bountiful, UT (Site 1 - BOUT)	Bountiful, UT (Site 2 - BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Clearwater, FL (CWFL)	Delray Beach, FL (DBFL)
Formaldehyde	*7.08*	**18.43**	10.45	2.34	0.74	**43.73**	2.59	5.69	10.14	5.43
Acetaldehyde	*7.64*	13.54	12.60	3.47	2.64	**47.74**	2.49	7.50	12.26	**16.44**
Acetone	*10.26*	**15.53**	3.98	3.45	1.02	**52.46**	8.05	4.23	13.94	8.86
Propionaldehyde	*10.44*	13.08	**20.42**	8.39	12.30	**52.62**	6.93	10.02	13.87	11.94
Crotonaldehyde	*11.71*	12.89	2.96	8.37	5.09	**50.64**	10.85	**20.03**	13.42	4.20
Butyr/Isobutyraldehyde	*8.65*	6.69	4.26	8.40	5.57	**25.87**	10.60	8.57	**15.19**	4.23
Benzaldehyde	*11.43*	13.46	**16.87**	11.87	5.04	**63.73**	7.82	11.96	14.17	4.61
Isovaleraldehyde	***23.86***	**40.05**	NA	NA	NA	NA	10.44	NA	**29.08**	NA
Valeraldehyde	***17.56***	**19.77**	**49.31**	**15.75**	**21.79**	**56.33**	**16.71**	13.03	**35.60**	**20.38**
Tolualdehydes	***17.92***	**30.12**	**37.95**	**16.87**	9.89	**58.91**	**17.69**	10.34	**30.03**	3.56
Hexaldehyde	*13.30*	**29.52**	**24.16**	14.45	12.77	**29.98**	**16.57**	8.59	**22.96**	9.07
2,5-Dimethylbenzaldehyde	***17.23***	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	*13.09*	***19.37***	***18.30***	*9.34*	*7.69*	***48.20***	*10.07*	*10.00*	***19.15***	*8.87*

Table 23-30. Continued

Compound	Average	Denver, CO (Site 1 - DECO)	Denver, CO (Site 2 - WECO)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Pompano Beach, FL (FLFL)	Tampa (Gandy), FL (GAFL)	Gulf Port, MS (GPMS)	Granada, MS (GRMS)
Formaldehyde	*7.08*	0.03	2.64	**16.24**	4.46	14.71	3.03	6.29	2.60	3.16
Acetaldehyde	*7.64*	0.36	2.44	**15.56**	0.51	8.50	5.28	10.56	10.24	7.84
Acetone	*10.26*	0.05	1.90	**15.41**	0.94	**18.00**	14.41	**20.23**	8.11	**15.85**
Propionaldehyde	*10.44*	5.21	4.15	**16.01**	0.19	14.38	11.11	5.83	7.54	7.05
Crotonaldehyde	*11.71*	7.16	**20.32**	14.84	3.13	**19.31**	11.09	12.74	6.32	5.28
Butyr/Isobutyraldehyde	*8.65*	1.71	5.39	**15.10**	1.23	12.35	14.58	12.77	**16.04**	8.18
Benzaldehyde	*11.43*	2.00	**15.11**	**19.06**	3.90	13.27	9.90	8.86	8.16	4.41
Isovaleraldehyde	***23.86***	NA	NA	**22.15**	NA	**31.34**	NA	12.31	NA	5.58
Valeraldehyde	***17.56***	2.93	**30.40**	**16.44**	11.34	**21.16**	**22.43**	**15.14**	**15.75**	**20.84**
Tolualdehydes	***17.92***	6.97	**27.54**	**23.32**	12.77	**20.48**	**15.48**	**17.00**	**17.31**	**17.45**
Hexaldehyde	*13.30*	2.09	4.44	14.92	11.39	**20.45**	**15.08**	**19.79**	12.28	**19.21**
2,5-Dimethylbenzaldehyde	***17.23***	NA	NA	**16.99**	NA	3.48	NA	11.34	NA	NA
Average	*13.09*	*2.85*	*11.43*	***17.17***	*4.99*	***16.45***	*12.24*	*12.74*	*10.43*	*10.44*

Table 23-30. Continued

Compound	**Average**	**Hartford, CT (HACT)**	**Jackson, MS (JAMS)**	**Kingsport, TN (KITN)**	**Loudon, TN (LDTN)**	**Lincoln, NE (LONE)**	**Tampa (Lewis), FL (LEFL)**	**Nashville, TN (EATN)**	**Nashville, TN (LOTN)**	**Miami, FL (MDFL)**
Formaldehyde	*7.08*	1.49	1.52	0.86	4.28	11.74	3.50	1.51	3.38	3.81
Acetaldehyde	*7.64*	5.43	0.82	1.60	0.09	12.93	3.14	1.39	4.21	2.77
Acetone	*10.26*	5.35	2.66	1.27	9.09	8.31	5.77	6.62	9.62	7.97
Propionaldehyde	*10.44*	4.73	3.85	2.07	**28.08**	14.77	4.76	5.93	2.25	10.19
Crotonaldehyde	*11.71*	9.59	8.66	5.59	2.26	**25.08**	2.97	5.81	6.40	5.64
Butyr/Isobutyraldehyde	*8.65*	4.30	2.55	1.76	4.29	9.23	4.96	5.20	10.69	8.84
Benzaldehyde	*11.43*	5.19	2.67	6.68	**38.52**	11.02	5.65	4.06	4.73	2.34
Isovaleraldehyde	***23.86***	**52.67**	7.96	**23.46**	NA	NA	9.70	**30.68**	2.50	NA
Valeraldehyde	***17.56***	14.68	3.89	6.57	1.47	13.11	5.07	11.18	5.28	15.41
Tolualdehydes	***17.92***	8.87	9.15	12.84	4.69	1.18	5.00	3.76	11.51	**17.84**
Hexaldehyde	*13.30*	5.73	2.52	6.03	0.44	**19.82**	7.04	3.00	2.93	**21.56**
2,5-Dimethylbenzaldehyde	***17.23***	**21.38**	NA	NA	**16.65**	NA	NA	NA	NA	NA
Average	*13.09*	*11.62*	*4.20*	*6.25*	*9.99*	*12.72*	*5.23*	*7.19*	*5.77*	*9.64*

Table 23-30. Continued

Compound	Average	Orlando, FL (ORFL)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	St. Louis, MO (Site 4 - S4MO)	St. Louis, MO (Site 1 - SLMO)	St. Louis, MO (BTMO)	San Juan, PR (SJPR)	Sioux Falls, SD (SFSD)	Tupelo, MS (TUMS)
Formaldehyde	*7.08*	10.58	5.82	8.17	4.53	**28.09**	5.44	0.56	3.90	3.13
Acetaldehyde	*7.64*	13.85	4.85	10.18	2.71	10.47	10.56	2.86	2.76	4.41
Acetone	*10.26*	**32.57**	12.31	9.75	4.65	10.19	10.02	2.25	8.41	**16.09**
Propionaldehyde	*10.44*	14.21	5.10	2.79	3.05	**21.00**	10.23	8.47	7.79	5.72
Crotonaldehyde	*11.71*	**16.57**	14.76	14.73	7.28	10.17	**18.78**	9.37	**18.05**	11.21
Butyr/Isobutyraldehyde	*8.65*	8.41	9.98	2.98	3.30	**22.03**	12.01	3.11	5.59	**15.54**
Benzaldehyde	*11.43*	**18.64**	9.00	4.54	9.85	**37.51**	4.96	2.69	6.21	3.18
Isovaleraldehyde	***23.86***	**21.49**	12.08	11.39	**32.46**	**36.36**	NA	**29.56**	NA	**55.90**
Valeraldehyde	***17.56***	**17.87**	10.13	10.06	6.78	**46.64**	14.06	**16.18**	14.58	14.28
Tolualdehydes	***17.92***	**21.01**	**15.26**	**18.89**	**15.61**	**36.47**	**30.77**	**19.59**	**15.73**	**23.40**
Hexaldehyde	*13.30*	12.59	**15.81**	6.93	5.47	**53.56**	7.98	11.14	5.08	3.57
2,5-Dimethylbenzaldehyde	***17.23***	**25.28**	**29.21**	13.55	NA	NA	NA	NA	NA	NA
Average	*13.09*	***17.75***	*12.02*	*9.50*	*8.70*	***28.41***	*12.48*	*9.62*	*8.81*	*14.22*

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-31. Hexavalent Chromium Sampling and Analytical Precision: 6 Collocated Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Hexavalent Chromium	6	6.84	0.05	13.54

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

Table 23-32. Metal Sampling and Analytical Precision: 6 Collocated Samples

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Anlyses (ppbv)	Coefficient of Variation (%)
Antimony and Compounds	78	10.92	173.30	10.75
Arsenic and Compounds	78	12.40	122.27	12.10
Beryllium and Compounds	38	33.57	20.04	**28.58**
Cadmium and Compounds	72	32.30	245.09	**16.86**
Chromium and Compounds	78	6.47	312.54	7.51
Cobalt and Compounds	72	15.45	79.75	14.51
Lead and Compounds	78	9.50	819.58	9.71
Manganese and Compounds	78	5.06	1501.32	6.83
Mercury and Compounds	61	26.98	17.61	**20.59**
Nickel and Compounds	78	16.01	607.45	12.50
Selenium and Compounds	74	15.73	100.15	9.51

NA: Not applicable

NOTE: Coefficients of variation greater than the program target of 15 percent are presented in bold font.

24.0 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.

24.1 Conclusions

Analyses of the 2003 UATMP monitoring data identified the following notable trends and patterns in national-level and state-by-state urban air pollution:

24.1.1 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. Only eight of ninety-six data sets failed to comply with the data quality objective of 85% completeness. Twenty-six of ninety-six data sets achieved 100% completeness.

- *Several UATMP sites are also NATTS sites.* Seven of the fifty-four sites are EPA-designated NATTS sites (PSAZ, LEFL, NBIL, BOMA, DEMI, SLMO, and BOUT). These sites have more detailed analyses included in their respective sections.

- *Total number of samples for UATMP compounds.* Nearly 118,600 measurements of VOC and carbonyl compounds were made: 36,894 measurements of SNMOC; 551 measurements of SVOC; 2,255 measurements of metals and compounds; and 85 measurements of hexavalent chromium. This total number of samples is about 25% less than the 2002 sampling season.

- *Total number of samples for VOC and carbonyl compounds.* Of the 118,600 measurements of VOC and carbonyl compounds, 30.8% were hydrocarbons, 23.3% were halogenated hydrocarbons, 5.5% were polar compounds, and 40.4% were carbonyl compounds.

- *Ambient air concentrations of VOC and carbonyl compounds.* Nearly 86% of the measured concentrations of VOC and carbonyl compounds were less than 1 ppbv. Less than 5% 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 2003, ten compounds (chloromethylbenzene, 1,2-dibromoethane, *m*-dichlorobenzene, 1,1-dichloroethane, 1,2-dichloropropane, hexachloro-1,3-butadiene, 1,1,2,2-tetrachloroethane, 1,2,4-trichlorobenzene, ethyl acrylate, and ethyl *tert*-butyl ether) were not detected at any of the participating sites.

- *Nationwide Prevalent Cancer Compounds.* Prevalence was determined differently for the 2003 program year. Toxicity values were used to determine which compounds were most detrimental to human health. Seven cancer compounds (tetrachloroethylene, acrylonitrile, benzene, 1,3-butadiene, carbon tetrachloride, *p*-dichlorobenzene, and acetaldehyde) were considered prevalent, based on weighted toxicity, across the entire program.

- *Nationwide Prevalent Noncancer Compounds*. Nine noncancer compounds (acetonitrile, acrylonitrile, formaldehyde, acetaldehyde, bromomethane, 1,3-butadiene, tetrachloroethylene, xylenes (total), and benzene) 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), as well as the highest onroad and nonroad emissions (21,526 and 6,715 tpy, respectively) of all the participating sites. The Barceloneta site (BAPR) in Puerto Rico has the lowest daily traffic volume (10).

- *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. Sixteen participating UATMP sites are in RFG areas: the New Jersey, Connecticut, and Chicago sites (CHNJ, ELNJ, HACT, NBIL, NBNJ, and SPIL) are required to participate in RFG programs year-round. The Colorado and Arizona sites (DECO, MCAZ, PSAZ, QVAZ, SJAZ, SPAZ, and WECO) are required to participate only during the winter season. The Boston and St. Louis sites 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 42 times at the above sites, with the exceptions of HACT and BOMA. These sites did not sample VOC and therefore no assessment can be made of TAME concentrations.

    - MTBE (methyl *tert*-butyl ether) is also a gasoline additive and was used near the BOMA, CANJ, CHNJ, ELNJ, HACT, NBIL, NBNJ, S4MO, SLMO, and SPIL sites. This compound was detected on 394 occasions at these sites, with the exception of BOMA and HACT. These sites did not sample VOC and therefore no assessment can be made of MTBE concentrations.

- *Multi-Year Trends Analysis.* The following observations were made:

    - Since 2001, average formaldehyde concentrations have decreased every year at the following sites: AZFL, BAPR, BUND, CANJ, CHNJ, GPMS, JAMS, LEFL, PGMS, SLMO, and TUMS.

    - Since 2001, average benzene concentrations have slightly decreased every year at the following sites: DECO, ELNJ, SFSD, SPAZ, and TUMS.

24.1.2 State-level Conclusions

- *Arizona*.

    - The prevalent compounds at each site are:
        - MCAZ: 1,3-butadiene, 1,3-dichloropropene, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, chloroprene, chloromethane, *p*-dichlorobenzene, tetrachloroethylene, toluene, and xylenes (total).

        - PSAZ: 1,3-butadiene, 1,3-dichloropropene, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, *p*-dichlorobenzene, tetrachloroethylene, toluene, and xylenes (total).

        - QVAZ: 1,3-butadiene, acrylonitrile, tetrachloroethylene, and xylenes (total).

        - SPAZ: 1,3-butadiene, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, *p*-dichlorobenzene, tetrachloroethylene, and xylenes (total).

- 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: -0.69 between *p*-dichlorobenzene and relative humidity

    - PSAZ: -0.63 between 1,3-butadiene and dew point temperature

    - QVAZ: 0.74 between acrylonitrile and dew point temperature

    - SPAZ: 0.58 between benzene and sea-level pressure

- The Phoenix MSA sites are subject to RFG regulations during the winter season. Analysis of VOC concentrations indicated that there was not a decrease in the mobile source VOC HAPs or total VOCs during this season.

- PSAZ is a NATTS site. As illustrated by the its composite 24-hour back trajectory map, the airshed domain reached greater than 600 miles. However, 71% of the trajectories were within 200 miles of the site and 87% were within 300 miles.

- A high acrylonitrile concentration was measured at PSAZ on October 12, 2003. The emission tracer analysis determined that the air being sampled on this day originated to the east of the monitoring site. According to the NEI, there are two nearby acrylonitrile-emitting landfills to the east of the site that may have contributed to the high concentration.

- *Colorado*.

    - The prevalent compounds at each site are:

        - DECO: 1,3-butadiene, acetaldehyde, acetonitrile, arsenic and compounds, benzene, carbon tetrachloride, 1,2-dichloroethane, formaldehyde, manganese and compounds, tetrachloroethylene, trichloroethylene, and xylenes (total).

        - WECO: 1,3-butadiene, acetaldehyde, acetonitrile, arsenic and compounds, benzene, carbon tetrachloride, formaldehyde, manganese and compounds, *p*-dichlorobenzene, tetrachloroethylene, and xylenes (total).

    - 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:

        - DECO: -0.62 between tetrachloroethylene and relative humidity.

        - WECO: -0.68 between tetrachloroethylene and wet bulb temperature and the u-component of the wind.

    - The Denver MSA sites are subject to RFG regulations during the winter season. Analysis of VOC concentrations indicated that there was not a decrease in the mobile source VOC HAPs or total VOCs during this season.

- *Connecticut*.

    - The prevalent compounds at HACT are formaldehyde and acetaldehyde.

    - Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for the site. The strongest correlation is 0.49 between formaldehyde and the v-component of the wind.

    - 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.

    - 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: -0.43 between acetaldehyde and the u-component of the wind.

        - BGFL: -0.50 between formaldehyde and relative humidity.

        - CWFL: -0.43 between acetaldehyde and relative humidity.

        - DBFL: -0.79 between acetaldehyde and average temperature.

        - FLFL: 0.69 between acetaldehyde and the u-component of the wind.

        - GAFL: -0.43 between acetaldehyde and relative humidity.

        - LEFL: -0.56 between acetaldehyde and dew point temperature.

        - MDFL: 0.43 between acetaldehyde and the u-component of the wind.

        - ORFL: -0.60 between acetaldehyde and relative humidity.

  - LEFL is a NATTS site. As illustrated by the its composite 24-hour back trajectory map, the airshed domain reached greater than 700 miles. However, 63% of the trajectories were within 300 miles of the site, and 84% were within 400 miles.

- *Illinois.*

  - The prevalent compounds at each site are:

    - NBIL: acetonitrile, acrylonitrile, benzene, carbon tetrachloride, tetrachloroethylene, and trichloroethylene.

    - SPIL are: 1,3-butadiene, acrylonitrile, benzene, carbon tetrachloride, 1,2-dichloroethane, bromomethane, chloromethane, tetrachloroethylene, toluene, trichloroethylene, and xylenes (total).

  - 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: 0.60 between acetonitrile and the u-component of the wind.

    - SPIL: 0.96 between methyl bromide and sea level pressure.

  - The Chicago MSA sites are subject to RFG regulations year-round. For comparison:

    - The SPIL 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 a third less than the BTUT concentrations (7.90 $\mu g/m^3$ vs. 25.63 $\mu g/m^3$). The RFG requirements may be effective at NBIL.

    - The NBIL 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 higher than the ELNJ concentrations (7.03 $\mu g/m^3$ vs. 14.80 $\mu g/m^3$). The RFG requirements may be effective at NBIL.

  - NBIL is a NATTS site. As illustrated by its composite 24-hour back trajectory map, the airshed domain reached greater than 700 miles. However, 60% of the trajectories were within 300 miles of the site, and 66% were within 400 miles.

  - A high acetonitrile concentration was measured at NBIL on June 26, 2003. The emission tracer analysis determined that the air being sampled on this day originated to the west of the monitoring site. According to the NEI, there is one nearby acetonitrile-emitting source to the west of the site that may have contributed to the high concentration**.**

- *Massachusetts.*
  - The BOMA site sampled for metals and compounds only. The prevalent compounds at BOMA are arsenic and compounds, cadmium and compounds, manganese and compounds, and nickel and compounds.
  - Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed was -0.81 between nickel and compounds and maximum temperature.
  - 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.
  - BOMA is a NATTS site. As illustrated by its composite 24-hour back trajectory map, the airshed domain reached greater than 600 miles. However, 50% of the trajectories were within 300 miles of the site, and 63% were within 400 miles.
- *Michigan.*
  - The prevalent compounds at each site are:
    - <u>APMI</u>: 1,3-butadiene, acrylonitrile, benzene, and tetrachloroethylene.
    - <u>DEMI</u>: 1,3-butadiene, acetaldehyde, acetonitrile, benzene, carbon tetrachloride, formaldehyde, tetrachloroethylene, and xylenes (total).
    - <u>E7MI</u>: 1,3-butadiene, benzene, toluene, and xylenes (total).
    - <u>HOMI</u>: Acetonitrile, formaldehyde, bromomethane, and tetrachloroethylene.
    - <u>ITCMI</u>: 1,3-butadiene, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, chloromethane, *p*-dichlorobenzene, trichloroethylene, and xylenes (total).
  - 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:
    - <u>APMI</u>: 0.65 between benzene and sea level pressure.
    - <u>DEMI</u>: -0.79 between acetonitrile and both maximum and wet bulb temperature.

    - E7MI: -0.31 between 1,3-butadiene and the u-component of the wind.

    - HOMI: 0.83 between formaldehyde and both maximum and average temperature.

    - ITCMI: -0.79 between *p*-dichlorobenzene and relative humidity.

  - DEMI is a NATTS site. As illustrated by its composite 24-hour back trajectory map, the airshed domain reached greater than 600 miles. However, 56% of the trajectories were within 300 miles of the site, and 76% were within 400 miles.

  - A high tetrachloroethylene concentration was measured at DEMI on October 6, 2003. The emission tracer analysis determined that the air being sampled on this day originated to the east of the monitoring site. According to the NEI, there are five nearby tetrachloroethylene-emitting sources to the east of the site that may have contributed to the high concentration.

- *Mississippi.*

  - The prevalent compounds at each site are:

    - GPMS: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, and xylenes (total).

    - GRMS: acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, and xylenes (total).

    - JAMS: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, and xylenes (total).

    - PGMS: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, chloromethane, methylene chloride, tetrachloroethylene, trichloroethylene, and xylenes (total).

    - TUMS: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, and xylenes (total).

  - 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: -0.73 between 1,3-butadiene and relative humidity.

    - GRMS: 0.73 between formaldehyde and wet-bulb temperature.

        - <u>JAMS</u>: -0.59 between 1,3-butadiene and maximum temperature.

        - <u>PGMS</u>: -0.97 between tetrachloroethylene and dew point temperature.

        - <u>TUMS</u>: 0.62 between methyl chloride and dew point and wet-bulb temperature.

- *Missouri.*

    - The prevalent compounds at each site are:

        - <u>BTMO</u>: 1,3-butadiene, acetaldehyde, benzene, and formaldehyde.

        - <u>S4MO</u>: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, arsenic and compounds, benzene, cadmium and compounds, carbon tetrachloride, formaldehyde, manganese and compounds, *p*-dichlorobenzene, tetrachloroethylene, toluene, trichloroethylene, and xylenes (total).

        - <u>SLMO</u>: 1,3-butadiene, acetaldehyde, benzene, 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:

        - <u>BTMO</u>: 0.82 between formaldehyde and maximum temperature.

        - <u>S4MO</u>: -0.78 between tetrachloroethylene and maximum temperature.

        - <u>SLMO</u>: 0.36 between acetaldehyde and maximum temperature.

    - 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 (18.96 μg/m^3 vs. 12.01 μg/m^3). The RFG requirements may not be effective at S4MO.

    - SLMO is a NATTS site. As illustrated by its composite 24-hour back trajectory map, the airshed domain reached greater than 900 miles. However, 52% of the trajectories were within 300 miles of the site, and 66% were within 400 miles.

    - Acetaldehyde and formaldehyde measured high concentrations at SLMO on April 9, 2003. The emission tracer analysis determined that the air being sampled on this day originated to the north of the monitoring site. According to the NEI, there are three nearby acetaldehyde-emitting sources and eight formaldehyde-emitting sources to the north of the site that may have contributed to the high concentration**.**

- *Nebraska.*

  - The prevalent compounds at LONE are 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, and bromomethane.

  - Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are 0.64 between acetonitrile and both average and wet bulb temperature.

- *New Jersey.*

  - The prevalent compounds at each site are:

    - CANJ: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, bromomethane, *p*-dichlorobenzene, tetrachloroethylene, and xylenes (total).

    - CHNJ: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, chloromethane, tetrachloroethylene, and xylenes (total).

    - ELNJ: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, bromomethane, tetrachloroethylene, and xylenes (total).

    - NBNJ: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, bromomethane, tetrachloroethylene, and xylenes (total).

  - 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: -0.83 between acrylonitrile and wet bulb temperature.

    - CHNJ: -0.98 between acrylonitrile and both average and dew point temperature.

    - ELNJ: 0.91 between acrylonitrile and maximum temperature.

        - NBNJ: -0.83 between acrylonitrile and wet-bulb 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 are similar as well (CANJ = 8.93 $\mu g/m^3$; NBNJ = 8.59 $\mu g/m^3$; and APMI = 9.51 $\mu g/m^3$). 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 = 5.28 $\mu g/m^3$; JAMS = 11.53 $\mu g/m^3$). 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 nearly double the NBIL concentrations (14.80 $\mu g/m^3$ vs. 7.90 $\mu g/m^3$). 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.

- *North Carolina.*

    - The prevalent compounds at CANC are acetaldehyde and formaldehyde.

    - Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlation computed is 0.67 between acetaldehyde and the v-component of the wind.

- *North Dakota.*

    - The prevalent compounds at BUND are acetaldehyde, benzene, carbon tetrachloride, formaldehyde, chloromethane, and xylenes (total).

    - Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlation computed is -0.83 between benzene and both maximum and average temperature.

- *Oklahoma.*
  - The prevalent compounds at POOK are 1,3-butadiene, benzene, hexane, toluene, and xylenes (total).
  - Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed is 0.62 between hexane and maximum temperature.
- *Oregon.*
  - The prevalent compound at both PLOR and PNW is hexavalent chromium.
  - Pearson Correlations were computed between the site-specific prevalent compound and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
    - <u>PLOR</u>: 0.30 between hexavalent chromium and relative humidity.
    - <u>PNW</u>: -0.24 between hexavalent chromium and the v-component of the wind.
- *Puerto Rico.*
  - The prevalent compounds at each site are:
    - <u>BAPR</u>: 1,3-butadiene, acetaldehyde, acetonitrile, benzene, carbon tetrachloride, formaldehyde, chloromethane, methylene chloride, *p*-dichlorobenzene, and xylenes (total).
    - <u>SJPR</u>: 1,3-butadiene, acetaldehyde, acetonitrile, benzene, carbon tetrachloride, chloroprene, formaldehyde, *p*-dichlorobenzene, and xylenes (total).
  - 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:
    - <u>BAPR</u>: -0.81 between 1,3-butadiene and dew point temperature.
    - <u>SJPR</u>: -0.69 between *p*-dichlorobenzene and average temperature.
- *South Dakota.*
  - The prevalent compounds at each site are:

    - <u>CUSD</u>: 1,3-butadiene, acetaldehyde, acetonitrile, benzene, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, and tetrachloroethylene (total).

    - <u>SFSD</u>: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, and tetrachloroethylene (total).

  - 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:

    - <u>CUSD</u>: -0.98 between formaldehyde and the average and wet-bulb temperature.

    - <u>SFSD</u>: 0.67 between acetonitrile and the u-component of the wind.

- *Tennessee.*

  - The prevalent compounds at each site are:

    - <u>DITN</u>: acetaldehyde, acetonitrile, benzene, carbon tetrachloride, formaldehyde, and xylenes (total).

    - <u>EATN</u>: 1,3-butadiene, acetaldehyde, acetonitrile, arsenic and compounds, benzene, cadmium and compounds, carbon tetrachloride, formaldehyde, manganese and compounds, bromomethane, *p*-dichlorobenzene, tetrachloroethylene, and xylenes (total).

    - <u>KITN</u>: 1,3-butadiene, acetaldehyde, acetonitrile, benzene, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, tetrachloroethylene, and xylenes (total).

    - <u>LDTN</u>: acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, and formaldehyde.

    - <u>LOTN</u>: 1,3-butadiene, acetaldehyde, acetonitrile, arsenic and compounds, benzene, cadmium and compounds, carbon tetrachloride, formaldehyde, manganese and compounds, bromomethane, *p*-dichlorobenzene, tetrachloroethylene, and xylenes (total).

  - 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: none (only two sample days).
    - EATN: -0.80 between bromomethane and maximum temperature.
    - KITN: -0.76 between *p*-dichlorobenzene and relative humidity.
    - LDTN: 0.94 between benzene and both wet bulb and dew point temperature.
    - LOTN: -0.89 between 1,3-butadiene and wet bulb temperature.

- *Utah.*
  - The prevalent compounds at each site are:
    - BOUT: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, arsenic and compounds, benzene, cadmium and compounds, carbon tetrachloride, cobalt and compounds, formaldehyde, manganese and compounds, nickel and compounds, and tetrachloroethylene.
    - BTUT are: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, arsenic and compounds, benzene, carbon tetrachloride, cobalt and compounds, formaldehyde, manganese and compounds, nickel and compounds, tetrachloroethylene, and xylenes (total).
  - 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:
    - BOUT: -0.70 between nickel and compounds and average temperature.
    - BTUT: -0.79 between acetonitrile and both maximum and wet bulb temperature.
  - As illustrated by a composite 24-hour back trajectory map, the airshed domain reached over 400 miles. However, 70% of the trajectories generally originated within 200 miles away from the site, and 93% were within 300 miles.
  - At BOUT, the emission tracer analysis suggests that the high cadmium and compounds and manganese and compounds concentrations that occurred on January 21, 2003 were contributed by nine cadmium and twelve manganese sources southeast of the monitoring location. The high formaldehyde concentrations that occurred on June 14, 2003 was contributed by three formaldehyde sources to the southeast of the monitor.

24.1.3 Data Quality

The precision of the sampling methods and concentration measurements was analyzed for the 2003 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 Compendium Method guidelines. Sampling and analytical method accuracy is assured by using proven methods and following strict quality control and quality assurance guidelines.

24.2 Recommendations

In light of the lessons learned from the 2003 UATMP, a number of recommendations for future ambient air monitoring are warranted:

- *Encourage state/local/tribal agencies to develop 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 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 <u>only</u> 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.

25.0 References

CARB, 1993. California Air Resources Board Standard Operating Procedure 039-3.0. Extraction and Analysis of Hexavalent Chromium by Ion Chromatography. August 1, 1993. Available at http://www.arb.ca.gov/aaqm/sop/SOP039_fin.pdf.

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.

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.

EIA, 2003. Energy Information Administration. Car Registration by State. October 2003.

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.

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.

Topozone. Maps a la Carte, Inc. 2003. www.topozone.com

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, 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.

TECHNICAL REPORT DATA

(Please read Instructions on reverse before completing)

1. REPORT NO.
EPA-454/R-04-003

2.

3. RECIPIENT'S ACCESSION NO.

4. TITLE AND SUBTITLE
2003 Urban Air Toxics Monitoring Program (UATMP)
Final Report

5. REPORT DATE
July 2004

6. PERFORMING ORGANIZATION CODE
OAQPS-EMAD-MQAG

7. AUTHOR(S)
Eastern Research Group
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 2003

14. SPONSORING AGENCY CODE
EPA/200/04

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Reporting data results for the Urban Air Toxics Monitoring Program (UATMP) for 2003.

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	Air Pollution control	

18. DISTRIBUTION STATEMENT

Release Unlimited

19. SECURITY CLASS *(Report)*
Unclassified

20. SECURITY CLASS *(Page)*
Unclassified

21. NO. OF PAGES
758 + 1223

22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

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-04-003
July 2004