GEORGIA
DEPARTMENT OF NATURAL RESOURCES

ENVIRONMENTAL PROTECTION DIVISION

Forsyth County Air Quality Monitoring Report
January 2020 through January 2022

Prepared for Forsyth County Board of Commissioners
By the Air Protection Branch
Ambient Monitoring Program
July 2022

Table of Contents

List of Figures and Tables

Acronyms and Glossary

AADT	Annual Average Daily Traffic
Aerosols	A gaseous suspension of fine solid or liquid particles
AM	Annual Mean
Anthropogenic	Resulting from human activity
APB	Air Protection Branch
ARITH MEAN	Arithmetic Mean
BAM	Beta Attenuation Monitor
CBSA	Core Based Statistical Area
DNPH	Dinitrophenylhydrazine
EPA	United States Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method- the official measurement technique for a given pollutant
GA AAMP	Georgia Ambient Air Monitoring Program
GA EPD	Georgia Environmental Protection Division
HAP	Hazardous Air Pollutant
HPLC	High Performance Liquid Chromatography
LOD	Limit of Detection
$\mu g/m^3$	Micrograms per cubic meter
m/s	Meter per second
MSA	Metropolitan Statistical Area, as defined by the US Census Bureau
NATTS	National Air Toxics Trends Station
NCore	National Core Multipollutant Monitoring Network
NMHC	Non-Methane Hydrocarbons
NWS	National Weather Service
O_3	Ozone
PAH	Polycyclic Aromatic Hydrocarbons
PAMS	Photochemical Assessment Monitoring Station
$PM_{2.5}$	Particles with an aerodynamic diameter of 2.5 microns or less
PM_{10}	Particles with an aerodynamic diameter of 10 microns or less
$PM_{10-2.5}$	Particles with an aerodynamic diameter between 2.5 and 10 microns
ppb	Parts per Billion
ppm	Parts per Million
Precursor	A substance from which another substance is formed
QTR	Calendar Quarter
Rawinsonde	A source of meteorological data for the upper atmosphere
TBD	To Be Determined
TNMOC	Total Non-Methane Organic Compounds
UV	Ultraviolet
VOC	Volatile Organic Compound
W/m^2	Watts per square meter

Agency Contact

Agency Contacts for Georgia Environmental Protection Division

Regarding this report and questions relating to the collected ambient air quality data:

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470-524-0541

1.0   Executive Summary

The Georgia Ambient Air Monitoring Program (GA AAMP) of the Georgia Environmental Protection Division (GA EPD) is submitting this *2021 Forsyth County Air Quality Monitoring Report* to the Forsyth County Board of Commissioners as part of the *Air Quality Monitoring Agreement* (Agreement) established February 4, 2019. The report provides documentation of the establishment and maintenance of a two-year ambient air quality monitoring station in Forsyth County, Georgia from January 1, 2020, through January 31, 2022.

GA AAMP was tasked with monitoring for 13 ambient air pollutants near the Eagle Point Landfill in Forsyth County. In 2020, 58 samples were collected for each of the hazardous air pollutants (HAPs), and 8760 samples of hourly particulate matter ($PM_{2.5}$) were collected. Of these 13 pollutants, six pollutants were detected at the Forsyth County monitoring station established by GA AAMP: $PM_{2.5}$, benzene, toluene, *o*-xylene, *m/p*-xylene, and TNMOC. These pollutants that were detected at the Forsyth County monitoring station had concentrations that were comparable to the concentrations detected at GA AAMP monitoring sites in the northern metropolitan Atlanta area where similar pollutants are monitored.

For the second part of the study, the Forsyth County data collected from January 1, 2021 through January 31, 2022 was examined. During this timeframe, 65 samples of HAPs were collected and 9504 samples of hourly $PM_{2.5}$ data was collected. Of the same 13 pollutants as monitored in 2020, there were only three pollutants detected at the Forsyth County monitoring station from January 1, 2021, through January 31, 2022: $PM_{2.5}$, toluene and TNMOC.

The Forsyth County Risk Assessment was prepared by the Risk Assessment Program of GA EPD to understand whether long-term exposure to specific air toxics in ambient air around the Forsyth County air monitoring station could be harmful to human health. In both 2020 and 2021, the individual cancer risk for each HAP as well as the cumulative cancer risk estimate do not exceed 1 in 10,000 (10^{-4}) and are at levels considered acceptable to both EPA and EPD from a risk management perspective. None of the target organ specific hazard indexes exceed 1, indicating that there is not a potential for adverse noncancer effects because of exposure to ambient air HAPs measured at the Forsyth County air monitoring station. Based on the two years of measured ambient air HAPs concentrations at the Forsyth County air monitoring station and the process used in preparing this Risk Assessment, it is reasonable to conclude that the HAPs in the ambient air do not present a long-term danger to the vast majority of Forsyth County residents who live near the Eagle Point Landfill. Please see Appendix A for more details of this assessment.

With the assessment of two years of ambient air quality monitoring data collected for the targeted HAPs, along with the risk assessment performed by GA EPD Risk Assessment Program, the GA AAMP has developed this report, which meets the objectives of the Agreement. This report confirms that GA AAMP met the requirement to collect two years of data under this Agreement.

2.0 Background

Forsyth County officials received numerous odor complaints in the vicinity of the Eagle Point Landfill in Forsyth County. Multiple meetings were held with elected officials and residents, and as a result, Forsyth County entered into an agreement that GA AAMP would operate the air quality monitoring station for Forsyth County and provide an annual summary report of the air quality monitoring data collected. The objectives of the study include:
- Provide air quality monitoring data in a timely manner
- Characterizing concentrations in the ambient air near Eagle Point Landfill in Forsyth County for the identified Hazardous Air Pollutants and fine particulate matter
- Providing comparison to nearby GA AAMP network sites
- Providing quality data for risk characterization

2.1 Target Pollutants

Based on discussions with the U.S. Environmental Protection Agency (EPA) and GA EPD, it was decided that the following pollutants would be monitored due to their potential prevalence in landfills. The targeted hazardous air pollutant compounds were selected based on their presence and higher concentrations in a significant number of EPA test results for municipal waste landfills. The relative toxicity of the compounds were also considered as part of the selection criteria. This short-term study focused on:
- Non-methane organic compounds (TNMOCs):
  - Found in landfill gas emissions
  - A large group of chemicals including some volatile organic compounds (VOCs) and odorous compounds
- Eleven selected hazardous air pollutants (HAPs):
  - benzene
  - 1,3-butadiene
  - chloroform
  - ethylene dichloride
  - hexane
  - methylene chloride
  - toluene
  - trichloroethylene
  - vinyl chloride
  - *m/p*-xylene
  - *o*-xylene
- Fine Particulate Matter ($PM_{2.5}$)
  - Mixture of extremely small particles and liquid droplets
  - Combustion of diesel fuels is a known source

In addition, wind speed and wind direction are also monitored at the site. The following image displays the wind speed and wind direction monitor. Combining the pollutant data with the wind data will give insight on the direction the pollutants are flowing across the ambient air monitoring site.

Figure 1. Wind Speed and Wind Direction Monitor

2.2   Hazardous Air Pollutants/Volatile Organic Compounds

2.2.1   Description

Air toxic pollutants, or hazardous air pollutants (HAPs), cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. HAPs are a group of air pollutants that have a wide variety of sources—mobile sources (such as vehicles), stationary industrial sources, small area sources, indoor sources (such as cleaning materials), and other environmental sources (such as volcanoes and wildfires). The lifetime, transportation, and make-up of these pollutants are affected by both weather (rain and wind) and landscape (mountains and valleys). In addition, some HAPs that are no longer used, but were commonly used in the past, can still be found in the environment today.

2.2.2   Health Impacts

Negative effects on human health range from headaches, nausea, and dizziness to cancer, birth defects, problems breathing, and other serious illnesses. These effects can vary depending on frequency of exposure, length of exposure time, health of the person that is exposed, along with the toxicity of the compound. People can be exposed to HAPs by breathing contaminated air, consuming food or water contaminated by air pollutants, or touching contaminated water or soil. Some of the substances tend to have only one critical effect, while others may have several. Some of the effects may occur after a short exposure and others appear after long-term exposure, or many years after being exposed. These air pollutants also affect the environment. Wildlife experience symptoms similar to those in humans and pollutants accumulate in the food chain. Many air pollutants can also be absorbed into waterways and have toxic effects on aquatic wildlife.

2.2.3   Measurement Technique

TNMOCs and HAP volatile organic compounds (VOCs) samples are collected with a stainless steel canister from midnight to midnight for a 24-hour sample, every 6 days. Sampling is conducted once every six (6) days based on U.S. EPA Ambient Monitoring Sampling Calendar (https://www.epa.gov/amtic/sampling-schedule-calendar). The VOCs canister samples are then sent to a contract laboratory, Atmospheric Analysis & Consulting, Inc. in Ventura, CA, for analysis using a gas chromatograph with mass spectroscopy detection (GC/MS) following EPA Method TO-15 for the HAPs and Method TO-12M for TNMOC (see https://xonteck.com/ for more information about the HAPs and TNMOC sampler used in the study).

Figure 2. TNMOC and HAPs Samplers

2.3   PM$_{2.5}$

2.3.1   Description

Fine particulate matter (PM$_{2.5}$) are particles that are 2.5 micrometers in diameter or smaller and can only be seen with an electron microscope. Approximately thirty PM$_{2.5}$ particles would fit on a cross section of a hair. These particles and droplets are invisible to the naked eye, and composition and sources can vary greatly by region. Most particles form in the atmosphere as a result of complex reactions of chemicals such as sulfur dioxide and nitrogen oxides. Fine particles are produced from dust and all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes.

For an area to be in attainment of the National Ambient Air Quality Standard (NAAQS) for PM$_{2.5}$, the three-year average of the annual average concentrations must be less than or equal to 12.0 μg/m^3. In addition, the 24-hour primary and secondary standard requires that the three-year average of the 98th percentile of the 24-hour concentrations be less than or equal to 35 micrograms per cubic meter.

2.3.2   Health Impacts

Fine particulate matter can penetrate deep into lung tissue and even enter the bloodstream. This may cause significant respiratory or cardiovascular problems that can shorten an individual's lifespan. High risk groups include children, the elderly, and people with cardiovascular or lung diseases such as emphysema and asthma.

2.3.3   Measurement Technique

Fine particulate matter is sampled with a continuous monitor in real-time using a beta attenuation monitor (BAM). The BAM is a continuous PM$_{2.5}$ monitor designed with an inlet to cut out particles larger than 2.5 microns in size (see http://www.metone.com/products/air-quality-monitors/ for more information about the PM$_{2.5}$ monitor used in this study).

Figure 3. PM$_{2.5}$ Sampler

2.4   Quality Assurance (QA)

GA AAMP Site Operators and Field Auditors have ensured proper operation of the ambient air monitoring equipment. The Field Auditors of the QA Unit conduct QA audits approximately every 6 months. The Data Validation Specialist, Data Verification Specialists, and QA Unit Manager review the data before it is submitted to the GA AAMP's AirVision database. The Field Auditor of the QA Unit performs an annual site evaluation.

In addition, the VOCs sampler is collocated with another VOCs sampler of the same type for quality assurance purposes. GA AAMP can compare the samples collected side by side on the same days to ensure that the samplers are taking similar readings.

3.0   Site Information

The following wind roses were obtained from GA AAMP's meteorological equipment on site to determine average wind direction and wind speed at the ambient air monitoring location. The wind roses below show the monthly averages of general wind direction and speed. The circular format of the wind rose shows the direction the winds blew from and the length of each "spoke" around the circle shows how often the wind blew from that direction. The different colors of each spoke provide details on the speed, in meters per second (m/sec), of the wind from each direction.

2020 Wind Rose Data

Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
- < 0
- < 0.5
- < 1
- < 1.5
- < 2
- < 3
- < 4
- > 4

N 2.96%
NNW 8.46%
NNE 2.28%
NW 8.74%
NE 2.68%
WNW 20.97%
ENE 6.85%
W 6.99%
E 16.93
Calm 0.00%
WSW 2.28%
ESE 8.47%
SW 2.15%
SE 5.24%
SSW 0.81%
SSE 2.96%
S 1.2%
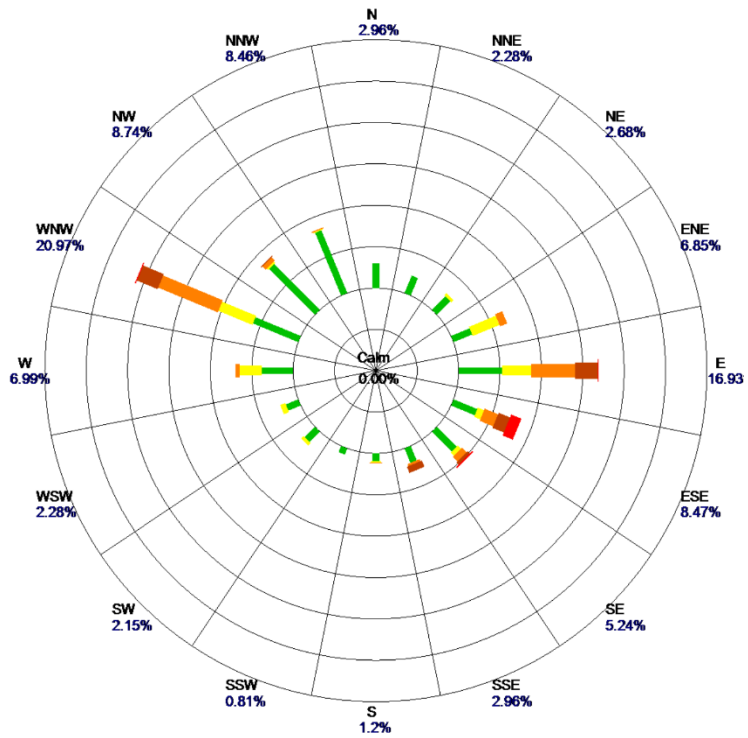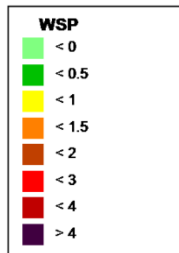
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Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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- < 0.5
- < 1
- < 1.5
- < 2
- < 3
- < 4
- > 4

N 3.07%
NNW 5.55%
NNE 2.34%
NW 6.43%
NE 2.78%
WNW 21.5%
ENE 10.08%
W 6.14%
E 12.86
Calm 0.00%
WSW 3.51%
ESE 11.4%
SW 1.46%
SE 5.41%
SSW 0.87%
SSE 3.95%
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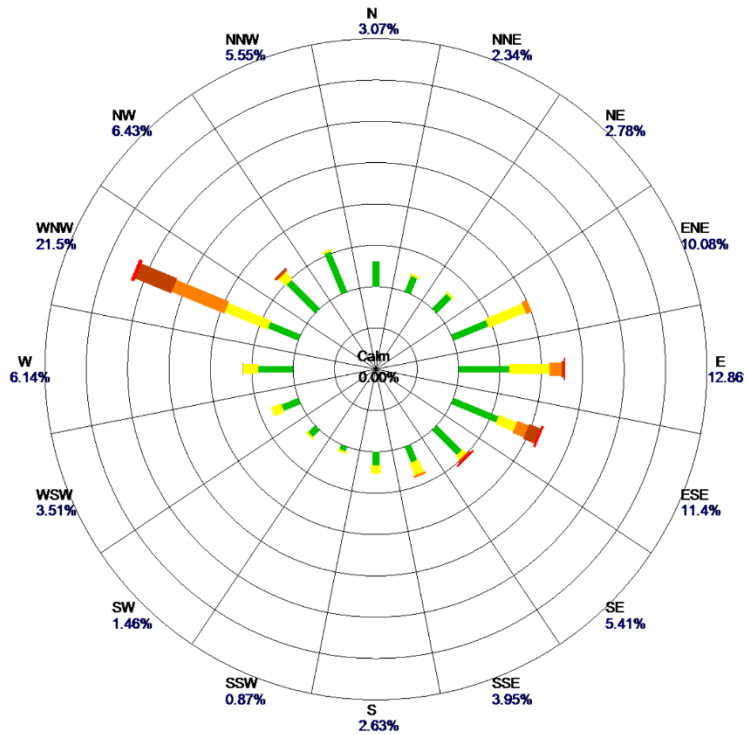
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7

Site: Forsyth County
Parameter: WSP
Units: M/SEC

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- < 1
- < 1.5
- < 2
- < 3
- < 4
- > 4
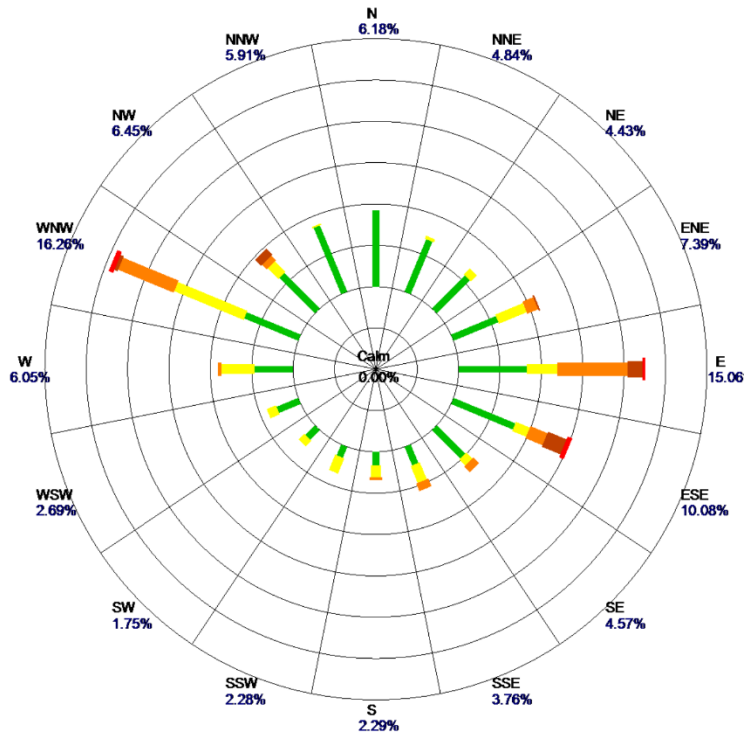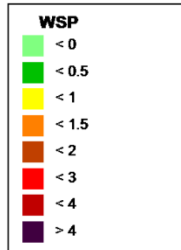
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Units: M/SEC

WSP
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- < 1.5
- < 2
- < 3
- < 4
- > 4
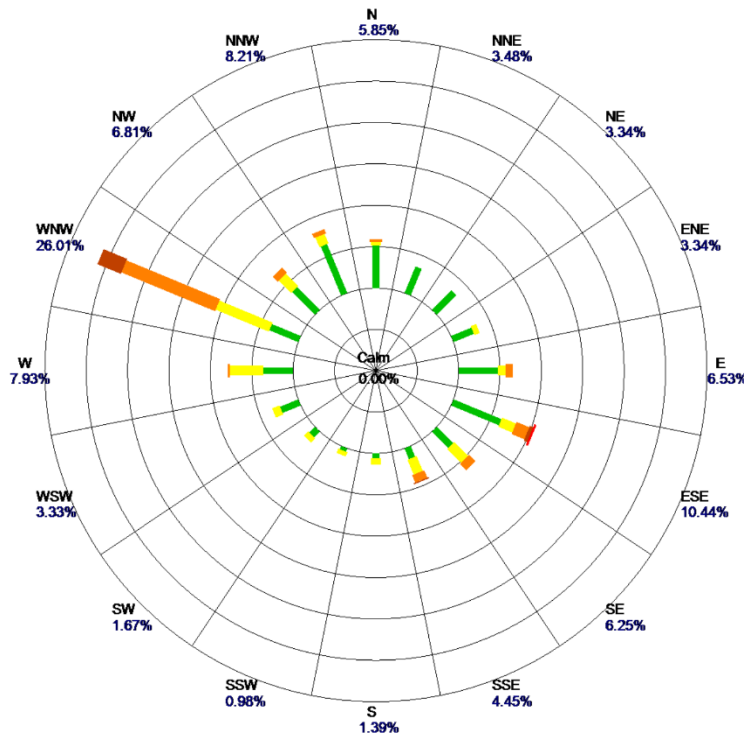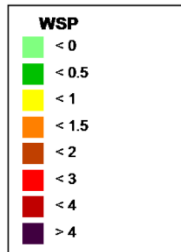
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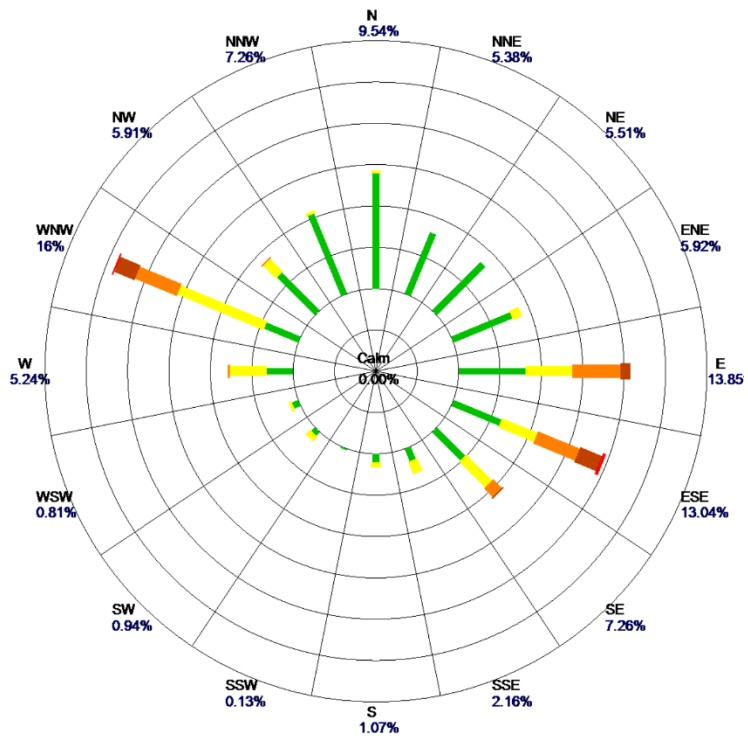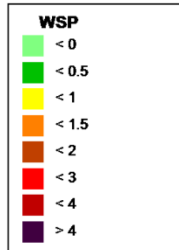
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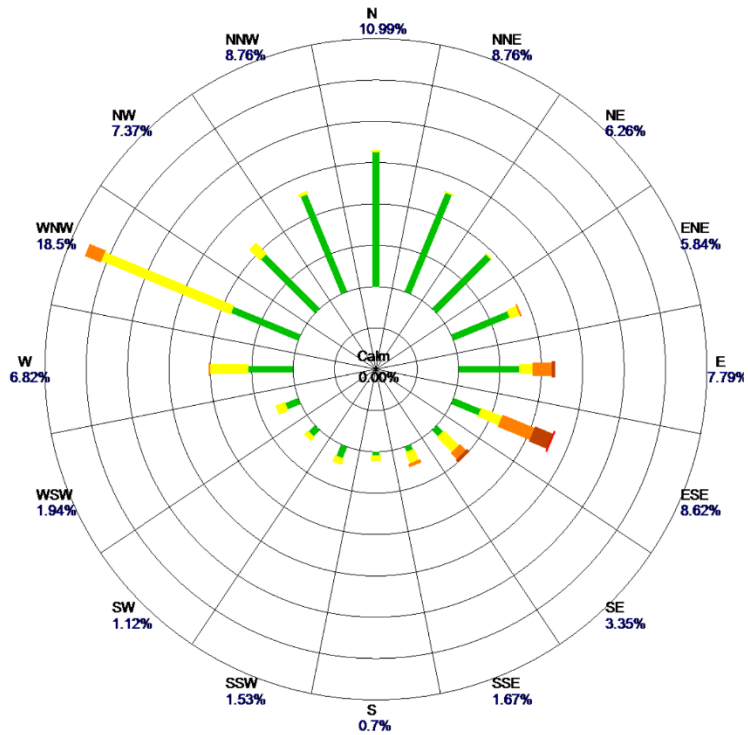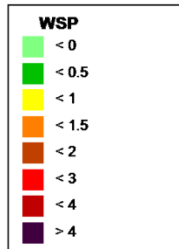
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Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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- < 0.5
- < 1
- < 1.5
- < 2
- < 3
- < 4
- > 4

N 10.76%
NNW 10.36%
NNE 7.8%
NW 9.02%
NE 7.81%
WNW 9.96%
ENE 9.56%
W 5.52%
E 11.43
Calm 0.00%
WSW 2.02%
ESE 6.18%
SW 1.21%
SE 4.17%
SSW 0.54%
SSE 2.29%
S 1.35%
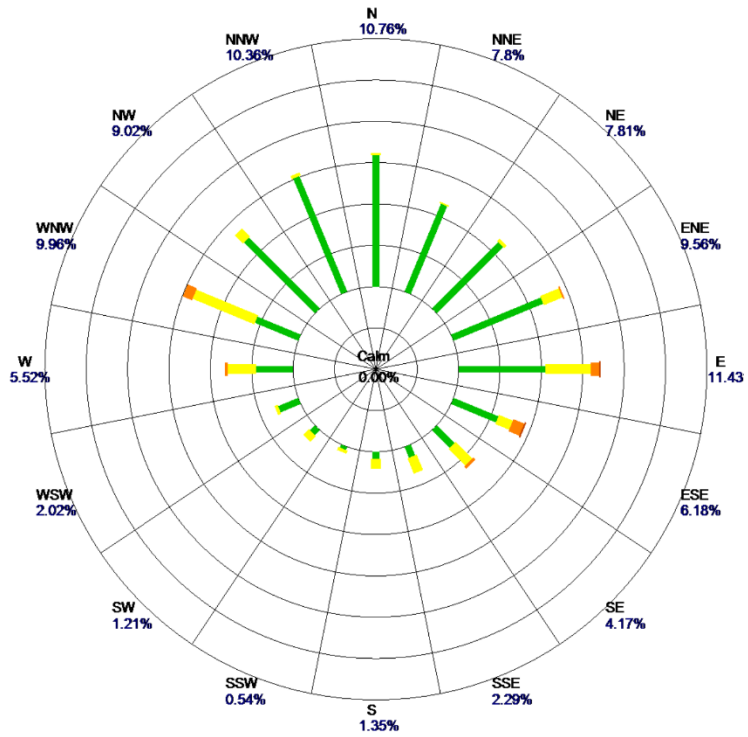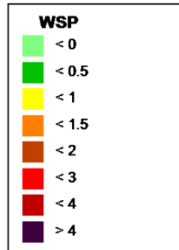
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Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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- < 0.5
- < 1
- < 1.5
- < 2
- < 3
- < 4
- > 4

N 12.53%
NNW 12.53%
NNE 8.89%
NW 7.01%
NE 6.6%
WNW 5.12%
ENE 9.3%
W 3.78%
E 9.29%
Calm 0.00%
WSW 2.96%
ESE 10.1%
SW 1.88%
SE 4.44%
SSW 1.2%
SSE 2.83%
S 1.48%

Period: 8/1/2020-8/31/2020

10

Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
- < 0
- < 0.5
- < 1
- < 1.5
- < 2
- < 3
- < 4
- > 4

N 9.6%
NNW 7.09%
NNE 7.93%
NW 3.62%
NE 6.54%
WNW 7.93%
ENE 12.1%
W 3.2%
E 22.1%
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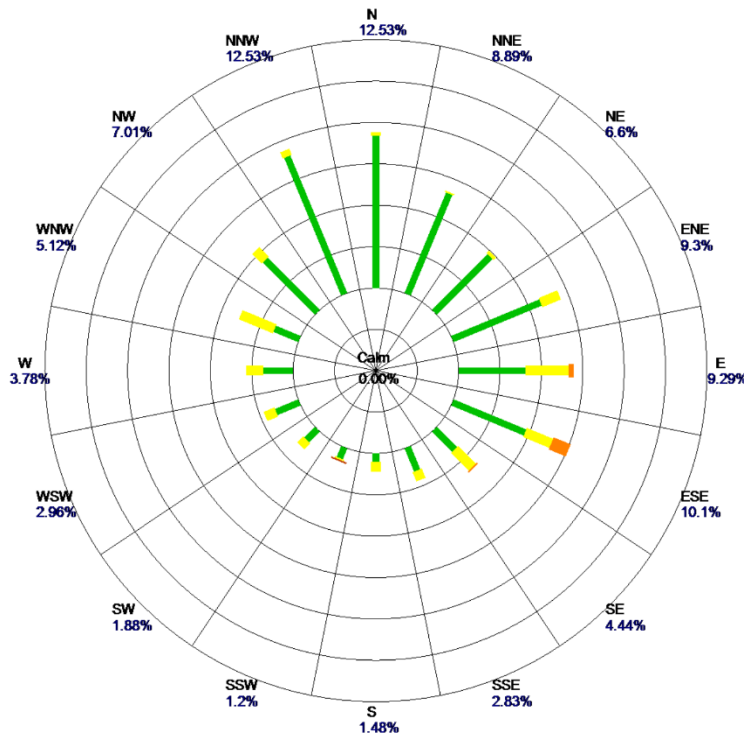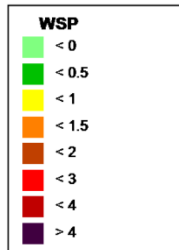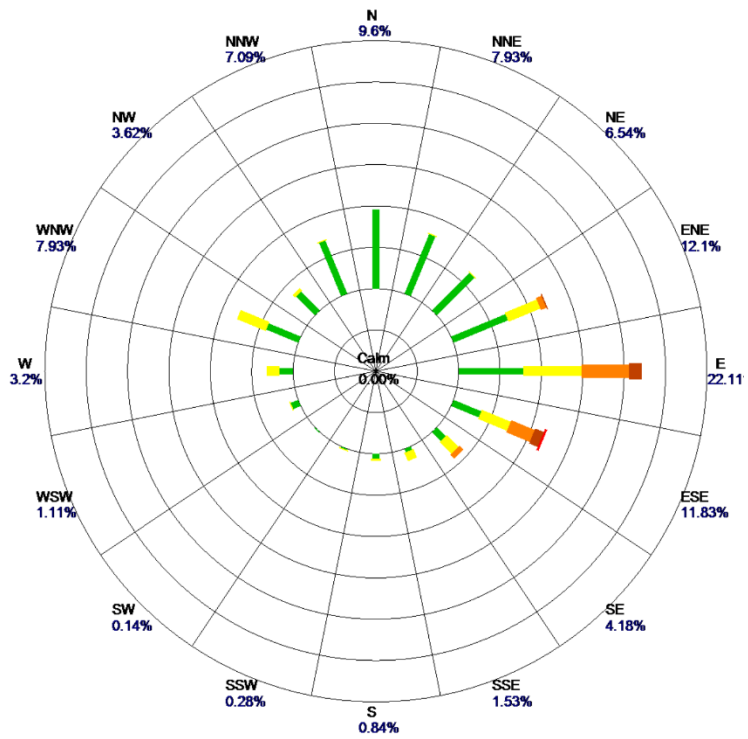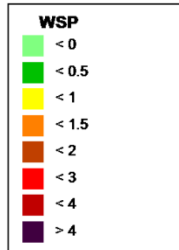
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Units: M/SEC

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- < 1
- < 1.5
- < 2
- < 3
- < 4
- > 4

N 8.76%
NNW 5.79%
NNE 6.06%
NW 4.17%
NE 6.06%
WNW 11.85%
ENE 5.79%
W 3.37%
E 15.9%
Calm 0.00%
WSW 1.08%
ESE 16.31%
SW 0.39%
SE 9.43%
SSW 0.4%
SSE 2.42%
S 2.15%
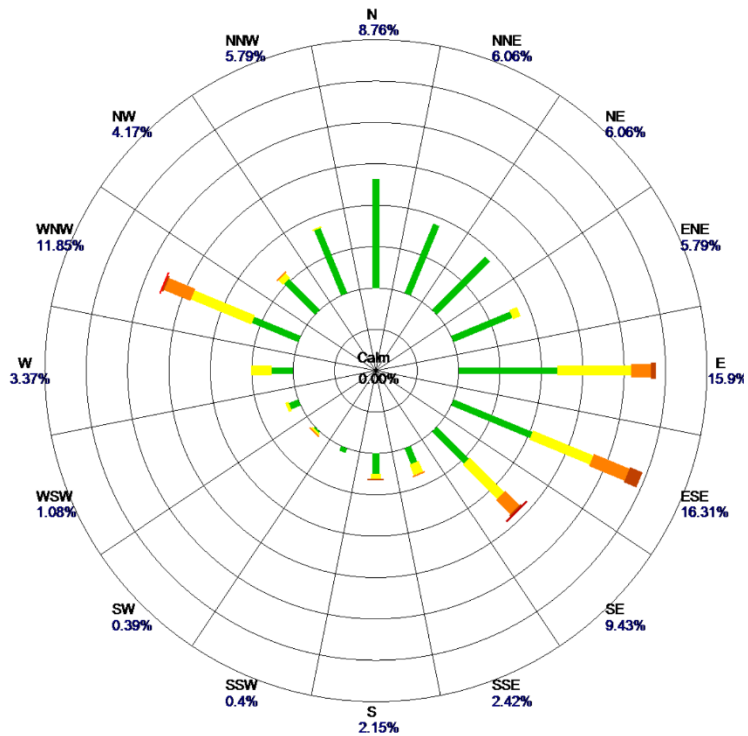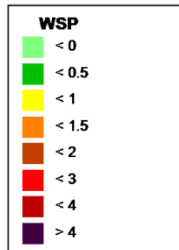
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11

Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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	< 1
	< 1.5
	< 2
	< 3
	< 4
	> 4

N 5.42%
NNW 7.08%
NNE 4.45%
NW 6.67%
NE 4.17%
WNW 19.86
ENE 6.39%
W 5.56%
E 16.26
WSW 2.23%
ESE 12.65%
SW 0.83%
SE 5.7%
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SSE 1.95%
S 0.42%
Calm 0.00%
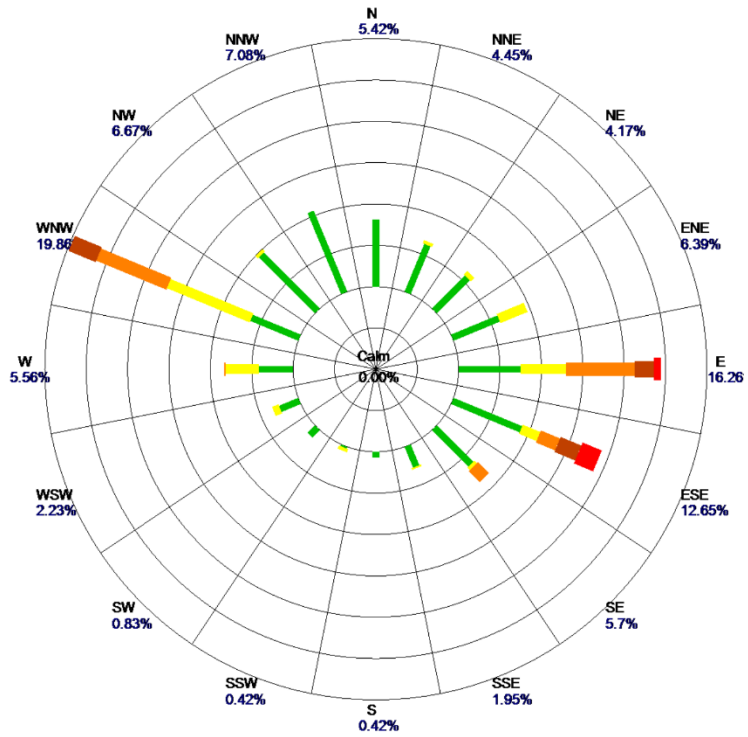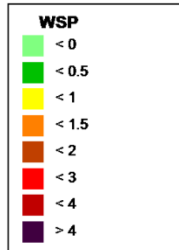
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Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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	< 0.5
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	< 1.5
	< 2
	< 3
	< 4
	> 4

N 4.84%
NNW 5.91%
NNE 2.82%
NW 8.06%
NE 2.41%
WNW 23.4%
ENE 3.22%
W 6.31%
E 11.55
WSW 3.76%
ESE 9.8%
SW 1.48%
SE 7.93%
SSW 1.21%
SSE 5.5%
S 1.75%
Calm 0.00%
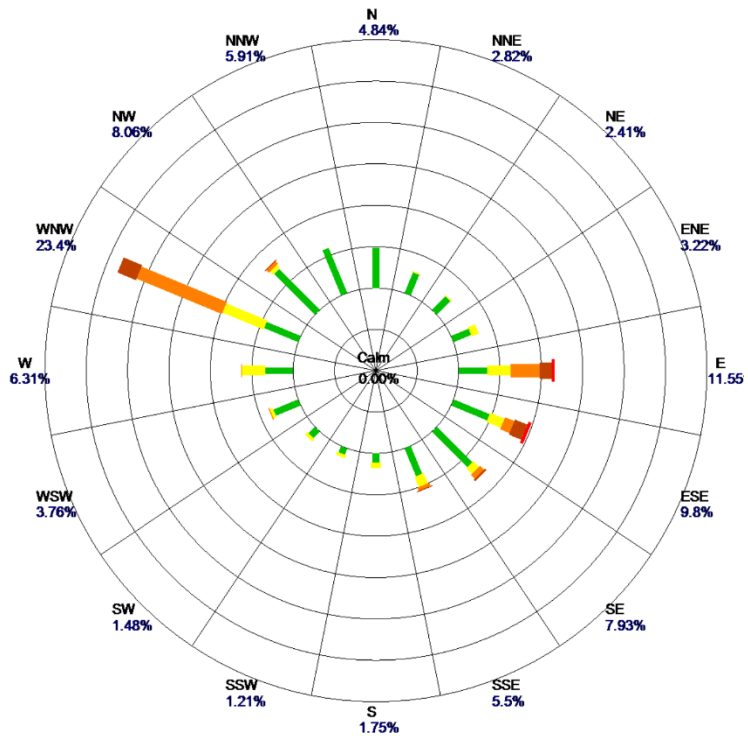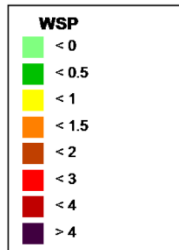
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2021 Wind Rose Data

Site: Forsyth County
Parameter: WSP
Units: M/SEC

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	< 1
	< 1.5
	< 2
	< 3
	< 4
	> 4

N 2.42%
NNW 5.38%
NNE 2.02%
NW 10.35%
NE 3.63%
WNW 28.09%
ENE 4.7%
W 9.54%
E 11.14
WSW 2.56%
ESE 6.19%
SW 2.42%
SE 4.3%
SSW 1.61%
SSE 2.82%
S 2.82%
Calm 0.00%
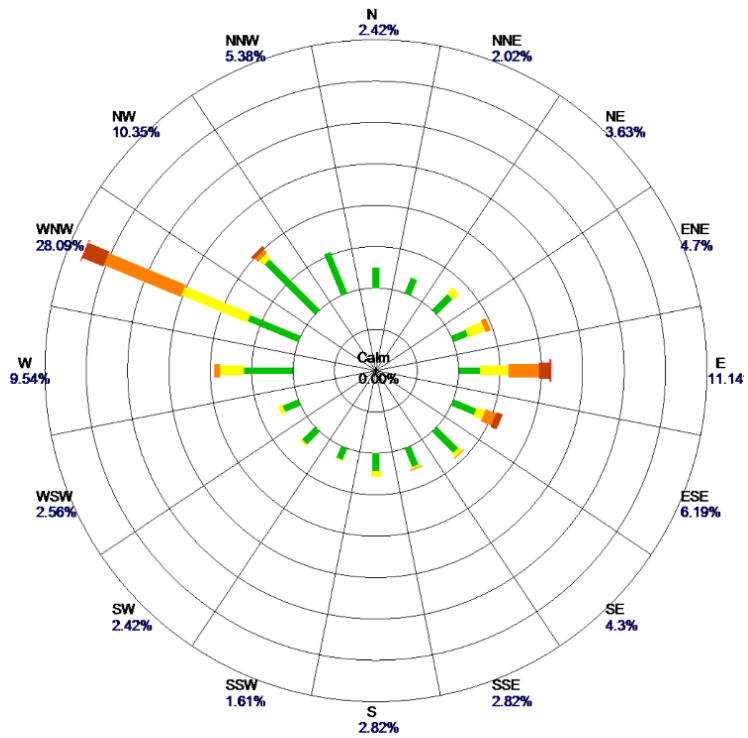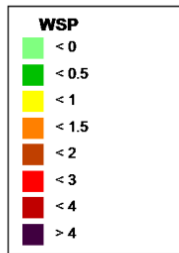
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Site: Forsyth County
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Units: M/SEC

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	< 2
	< 3
	< 4
	> 4

N 2.83%
NNW 6.1%
NNE 1.94%
NW 7.89%
NE 2.83%
WNW 22.03%
ENE 7.74%
W 4.91%
E 18.76
WSW 2.68%
ESE 11.31%
SW 1.04%
SE 5.81%
SSW 1.64%
SSE 1.19%
S 1.34%
Calm 0.00%
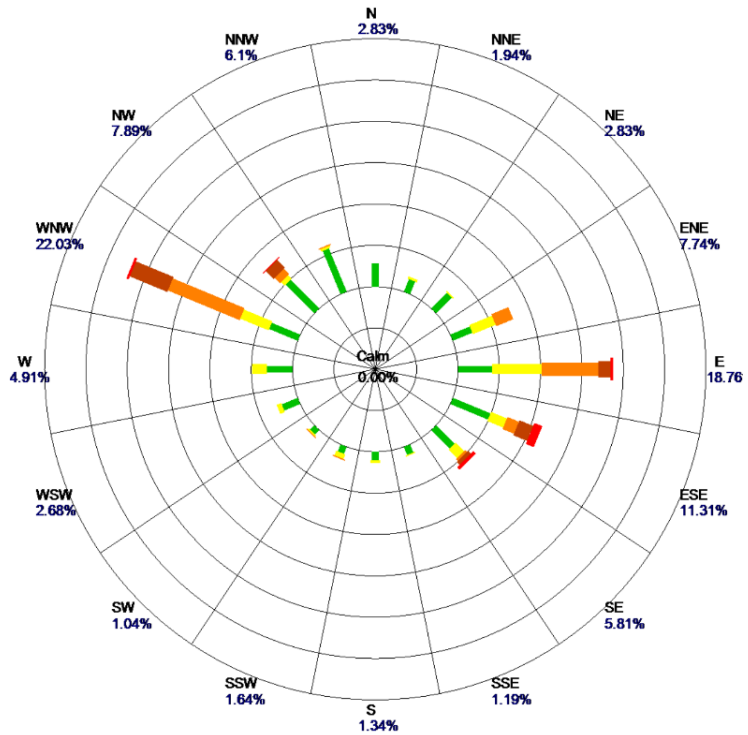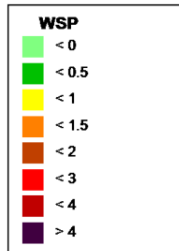
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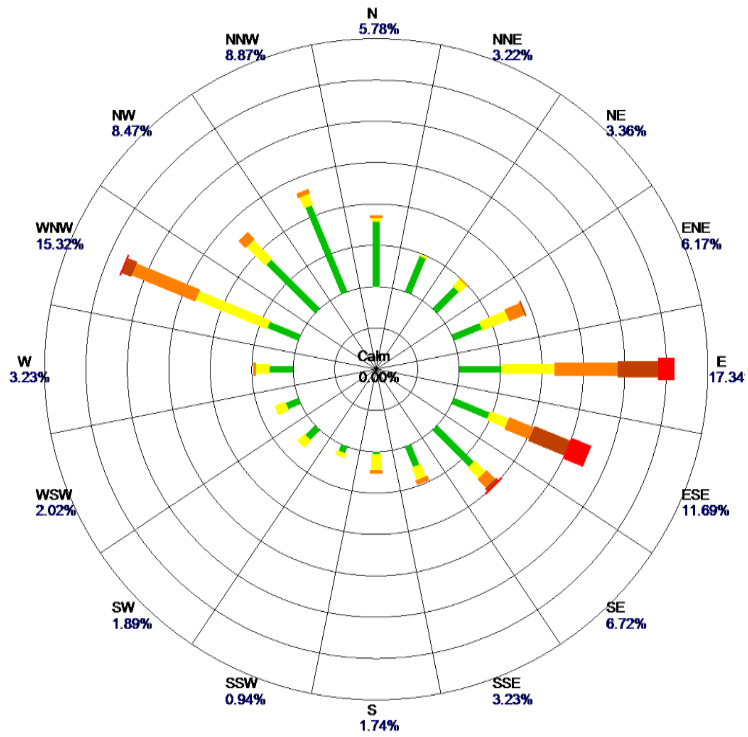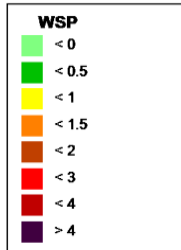
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Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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- < 1
- < 1.5
- < 2
- < 3
- < 4
- > 4
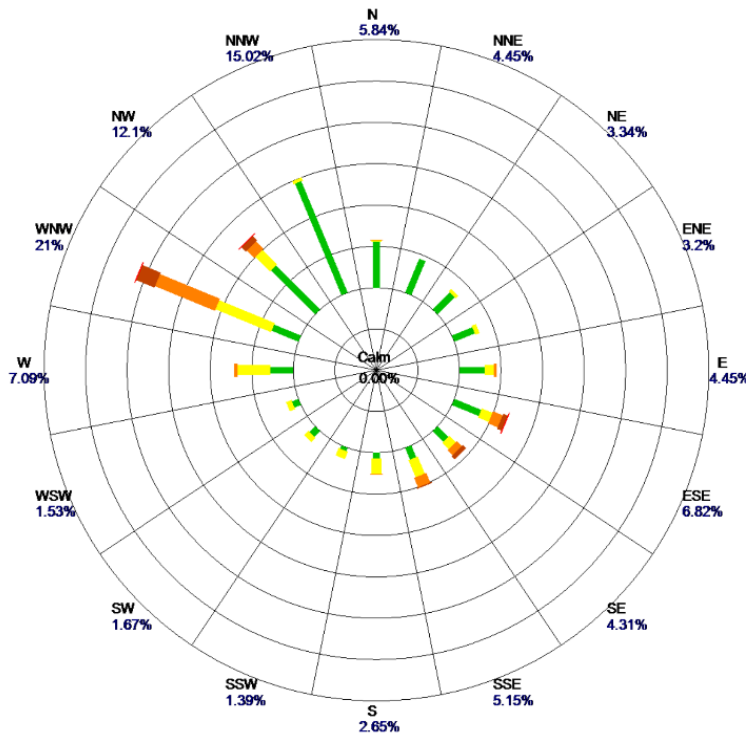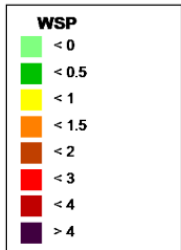
Period: 4/1/2021-4/30/2021

Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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- < 1.5
- < 2
- < 3
- < 4
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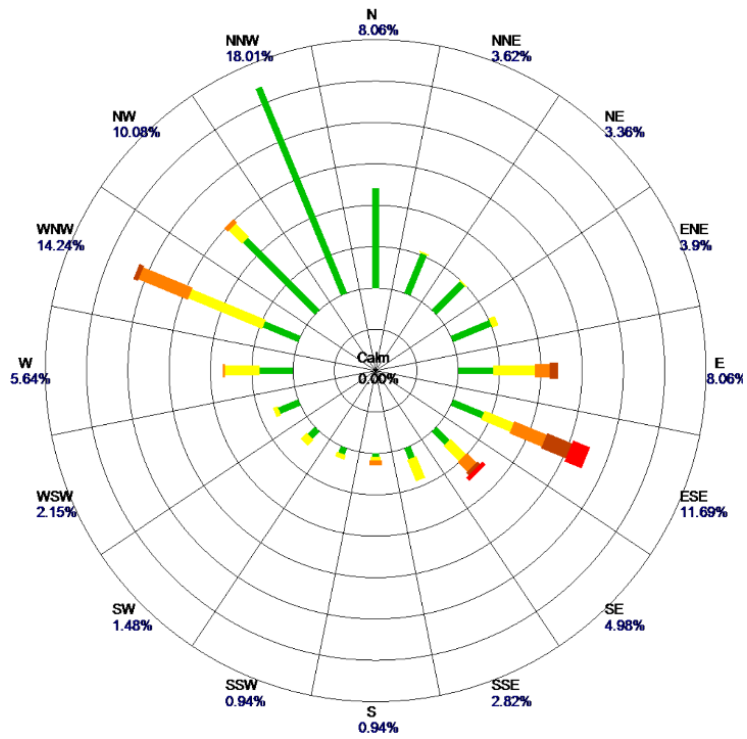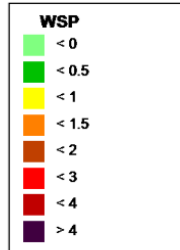
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Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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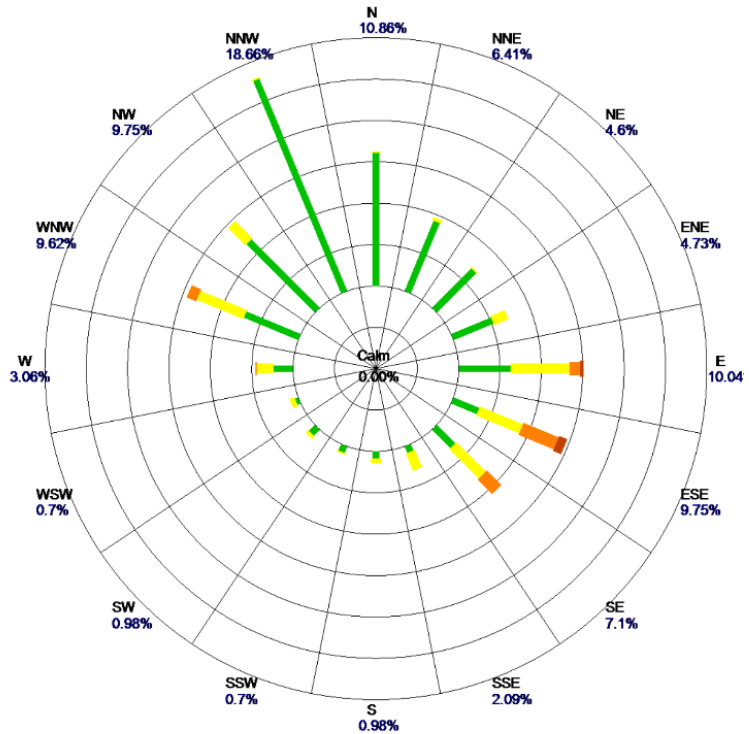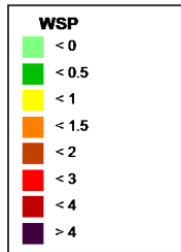
Period: 6/1/2021-6/30/2021

15

Site: Forsyth County
Parameter: WSP
Units: M/SEC

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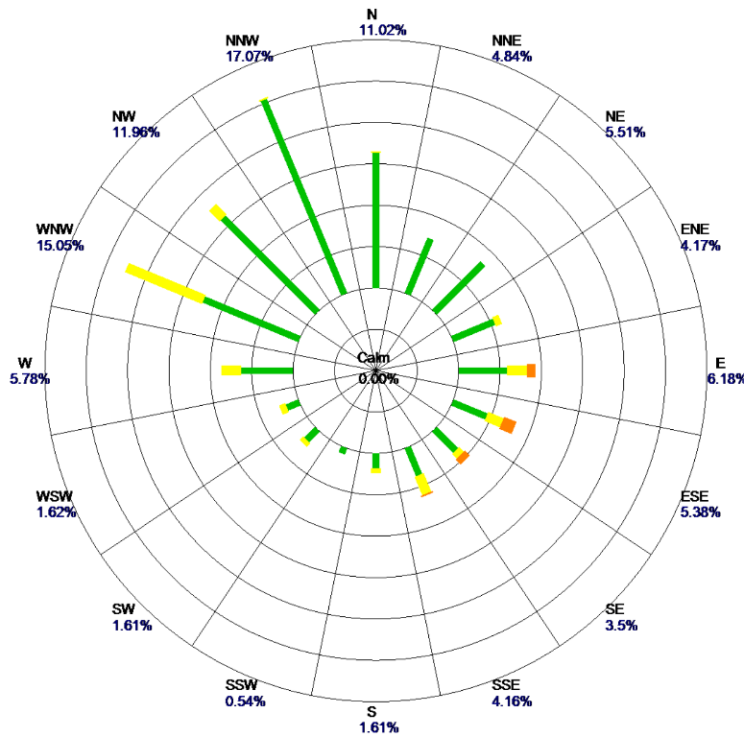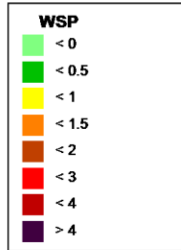
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Site: Forsyth County
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Units: M/SEC

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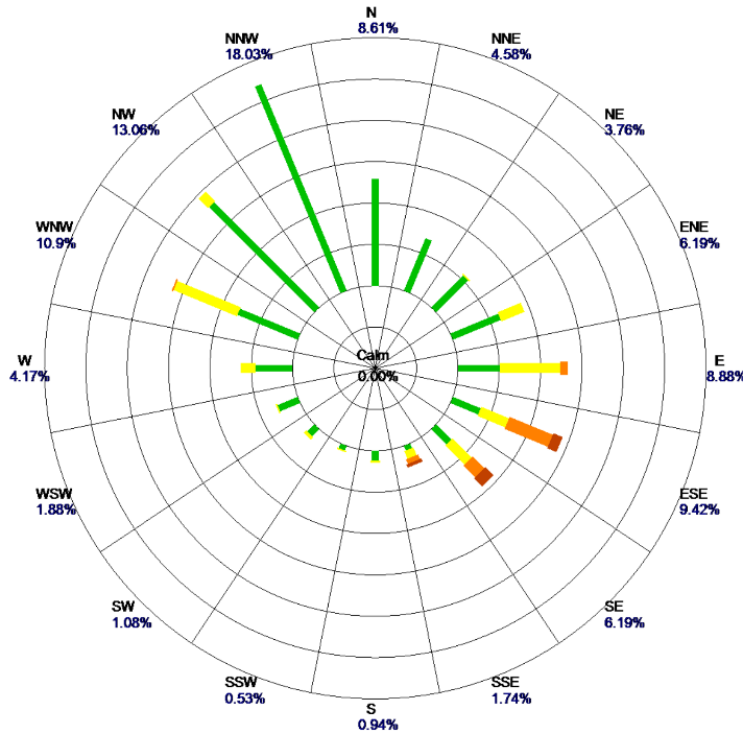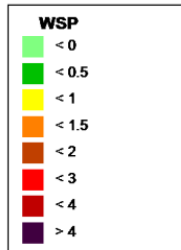
Period: 8/1/2021-8/31/2021

Site: Forsyth County
Parameter: WSP
Units: M/SEC

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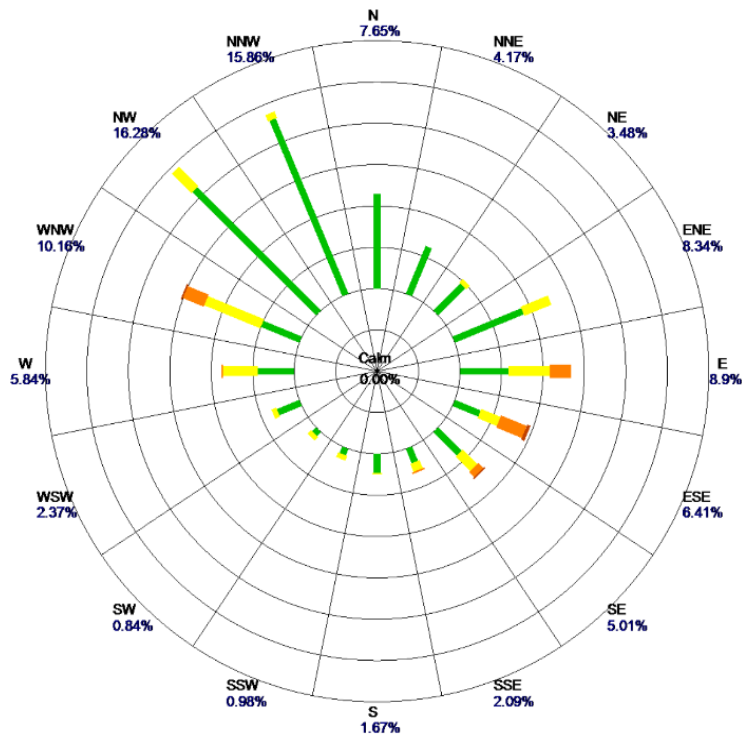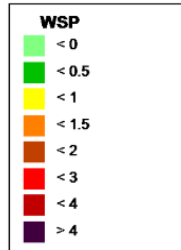
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Site: Forsyth County
Parameter: WSP
Units: M/SEC

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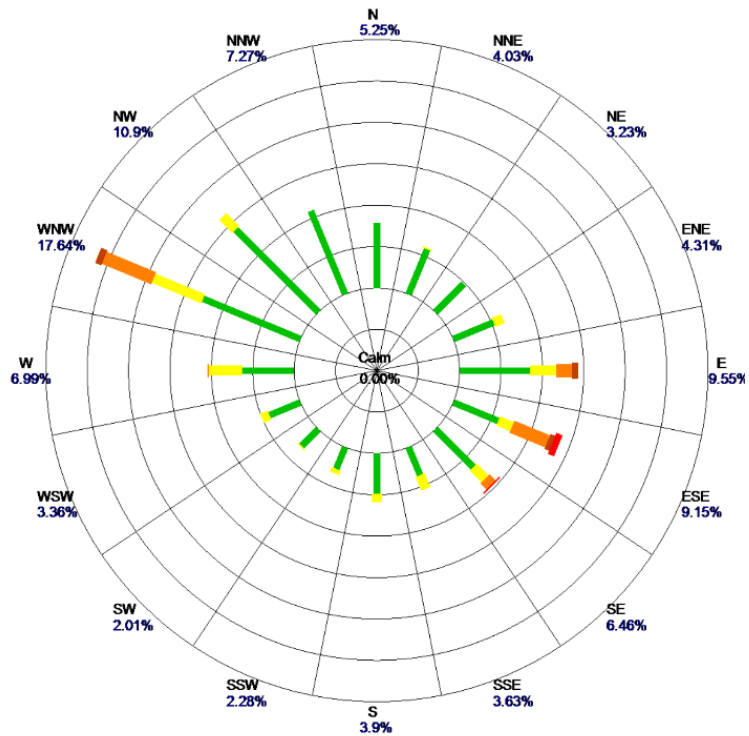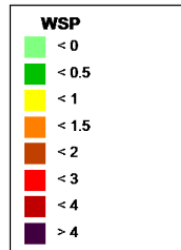
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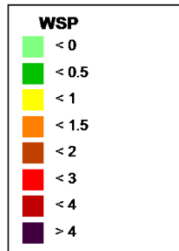
17

Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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- < 1
- < 1.5
- < 2
- < 3
- < 4
- > 4
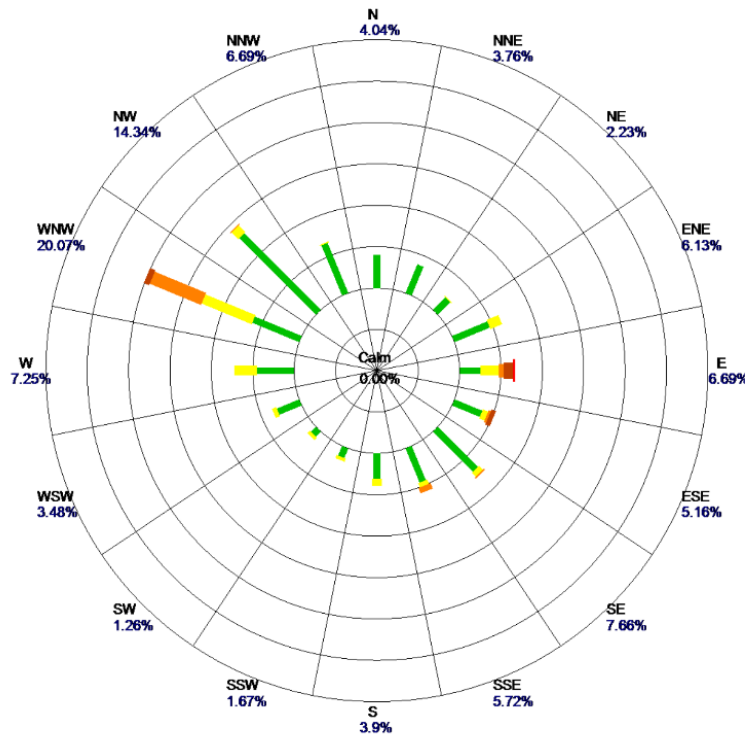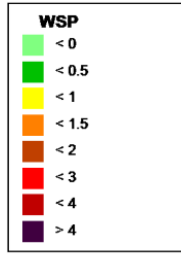
Period: 11/1/2021-11/30/2021

Site: Forsyth County
Parameter: WSP
Units: M/SEC

WSP
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- < 1.5
- < 2
- < 3
- < 4
- > 4
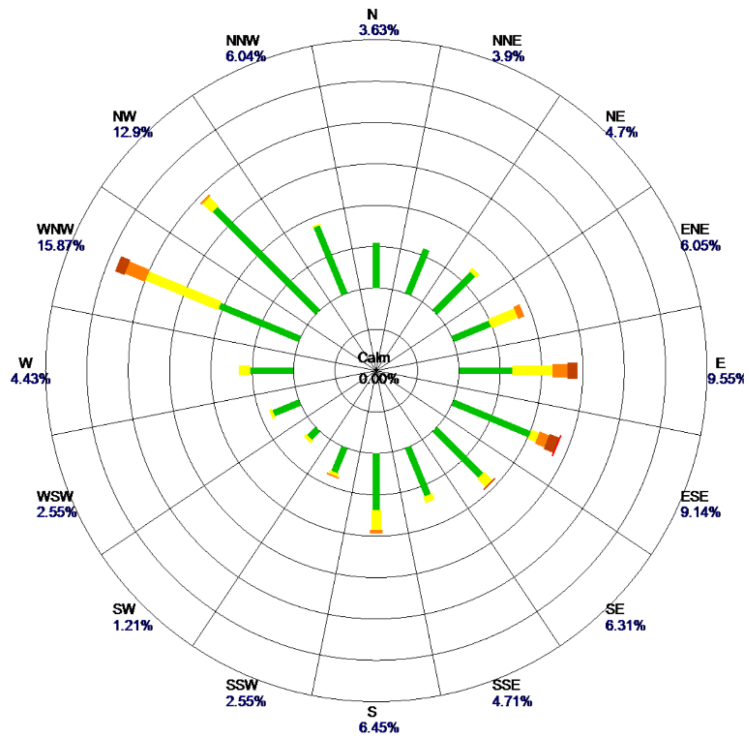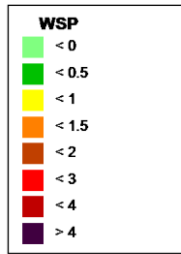
Period: 12/1/2021-12/31/2021
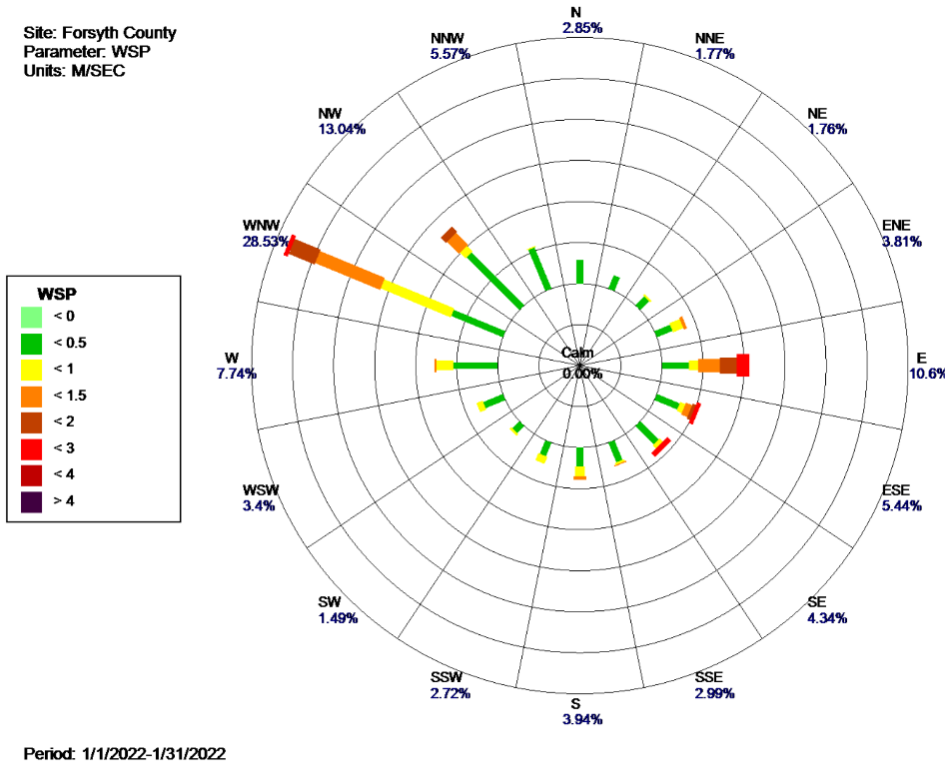
Figure 4. Monthly Averages of Wind Roses in Forsyth County

The ambient air monitoring site was established in the Eagle Beak Park located at 8400 Old Federal Rd., Ball Ground, GA 30107 in Forsyth County (Longitude: W 84.22917 and Latitude: N 34.31250), as indicated by the red circle in the following photo.

Figure 5. Monitoring Location

19

The ambient air monitoring site is located approximately 0.90 mile from the Eagle Point Landfill. This is shown with the red line in the following image.

Figure 6. Monitoring Location in Relation to the Eagle Point Landfill

The following photos show the ambient air monitoring site and immediate surroundings.

Figure 7. Monitoring Site Photos

Forsyth County is shown in yellow in the following map, and the blue dot indicates where the Forsyth County site is located within the county. The GA AAMP ambient air monitoring sites that were used to compare to the Forsyth County data are also indicated with blue dots.
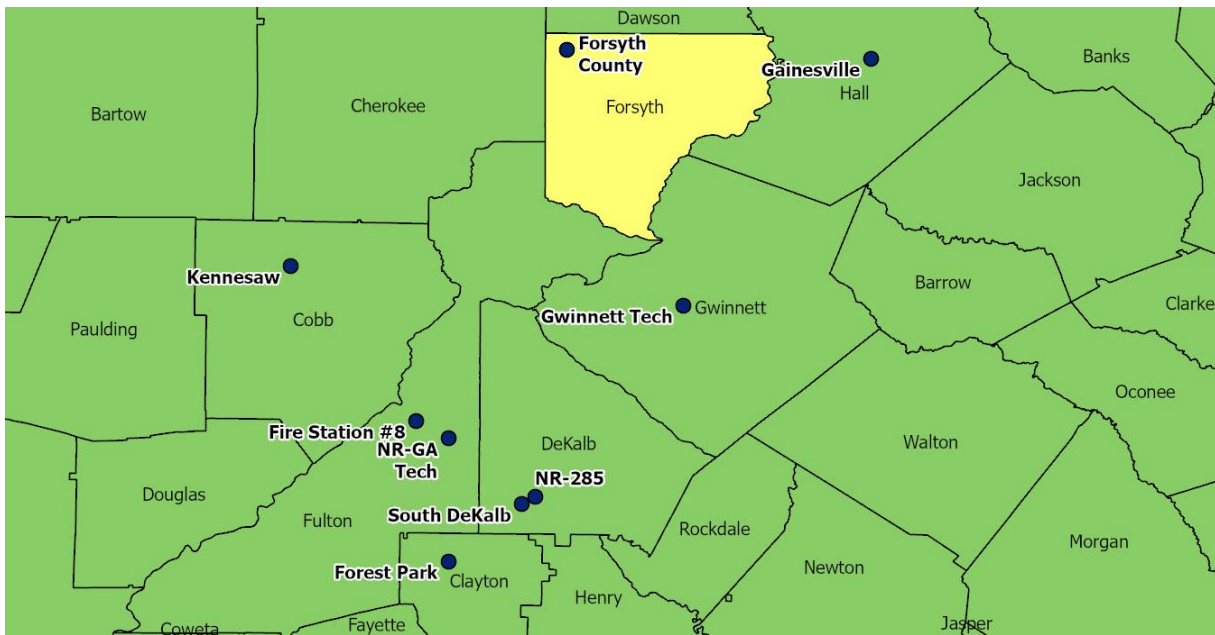
Figure 8. Map of Forsyth County and Surrounding GA AAMP Sites

4.0   Results

The PM$_{2.5}$ data and VOCs data collected at the Forsyth site were analyzed and compared to nearby GA AAMP sites. As stated above, the sites used in the comparison and their locations are indicated in the map in Figure 8. The following section shows the data collected from January 1, 2020 through January 31, 2022.

Figure 9 depicts the 2020 hourly data averaged for 24 hours compared to the South DeKalb, Gwinnett Tech and Gainesville sites, which also collect hourly data. The Forsyth data is shown in red, and this graph shows that the Forsyth PM$_{2.5}$ data and GA AAMP PM$_{2.5}$ data are very comparable.
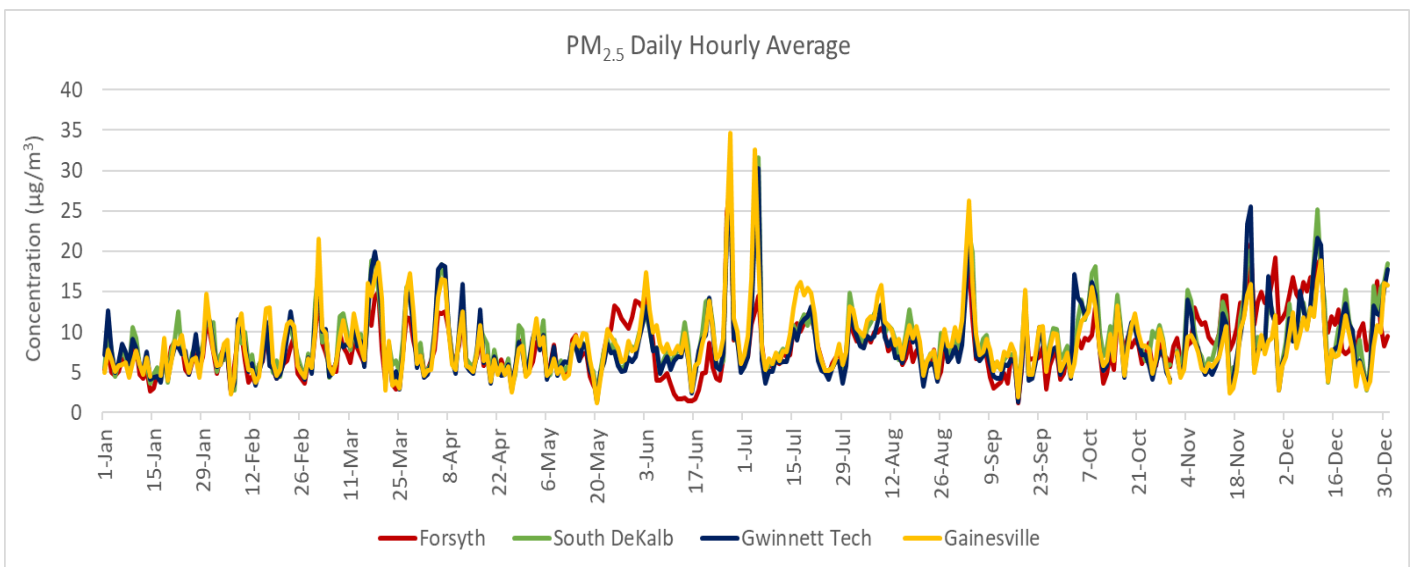
Figure 9. Comparison of PM$_{2.5}$ Daily Hourly Average Data 2020

For the January 2021 through January 2022 data shown in Figure 10, the Forsyth County PM$_{2.5}$ data (shown in red) was again very comparable to the GA AAMP PM$_{2.5}$ data. When the highest concentration of PM$_{2.5}$ was detected at the Forsyth County site in March 2021, the nearby GA AAMP sites also had higher detected concentrations of PM$_{2.5}$ during that same timeframe. This will be shown in more detail below in Figure 16.
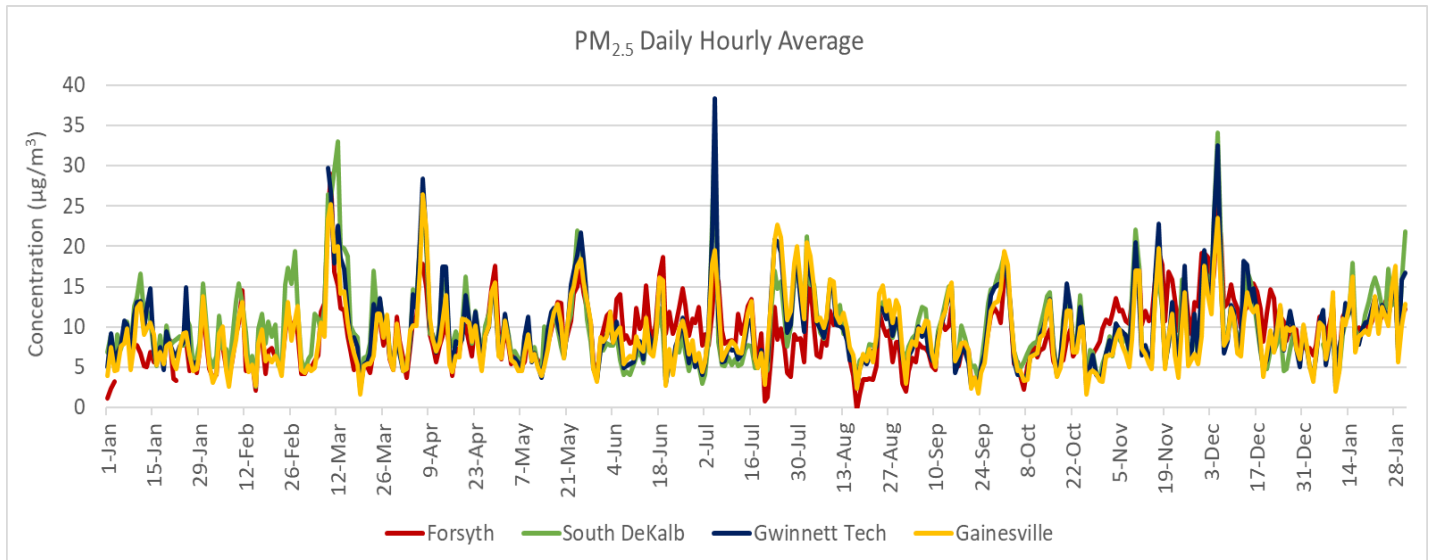
Figure 10. Comparison of PM$_{2.5}$ Daily Hourly Average Data, January 2021 through January 2022

The next two graphs show the Forsyth PM$_{2.5}$ 24-hour average data compared to GA AAMP's sites that collect 24-hour average data for 2020, and for January 2021 through January 2022. Again, Forsyth is shown in red, and the results show the Forsyth PM$_{2.5}$ concentrations very comparable to the GA AAMP PM$_{2.5}$ concentrations.
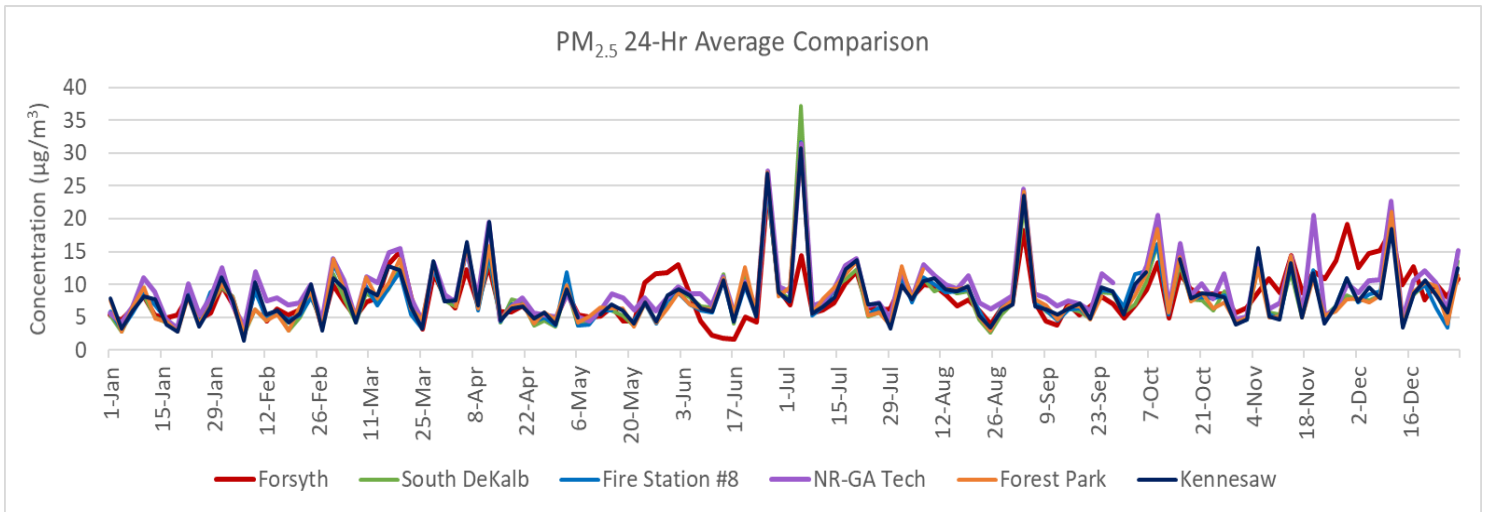
Figure 11. Comparison of PM$_{2.5}$ 24-Hour Average Data 2020
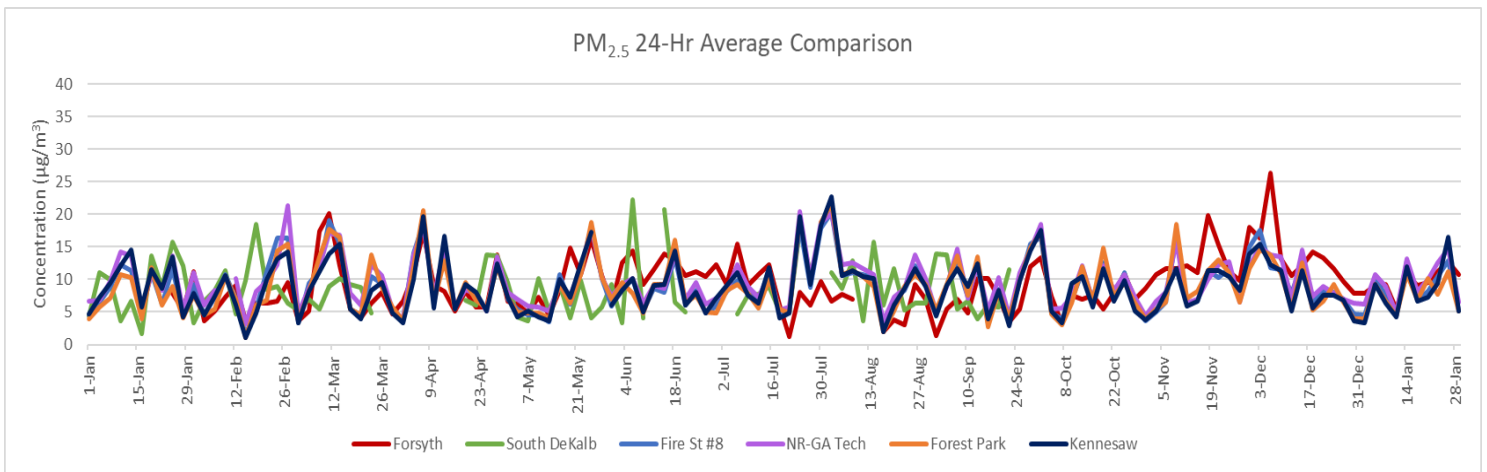
Figure 12. Comparison of PM$_{2.5}$ 24-Hour Average Data, January 2021 through January 2022

PM$_{2.5}$ Box Plot Comparison

For another perspective, the box plots below compare the Forsyth County continuous hourly PM$_{2.5}$ data to the nearby continuous PM$_{2.5}$ monitors at the Gainesville, Gwinnett Tech, and South DeKalb sites. As shown above, the PM$_{2.5}$ data is comparable for all the sites. The colors for each box represent 25-75% of the range of data, and the line in the middle of the box represents the median (or middle value) of the data. The lines outside the boxes represent the data that is one and a half times (1.5 X) the range of data represented by the box. The black dots are considered outliers, which are shown here outside that line.
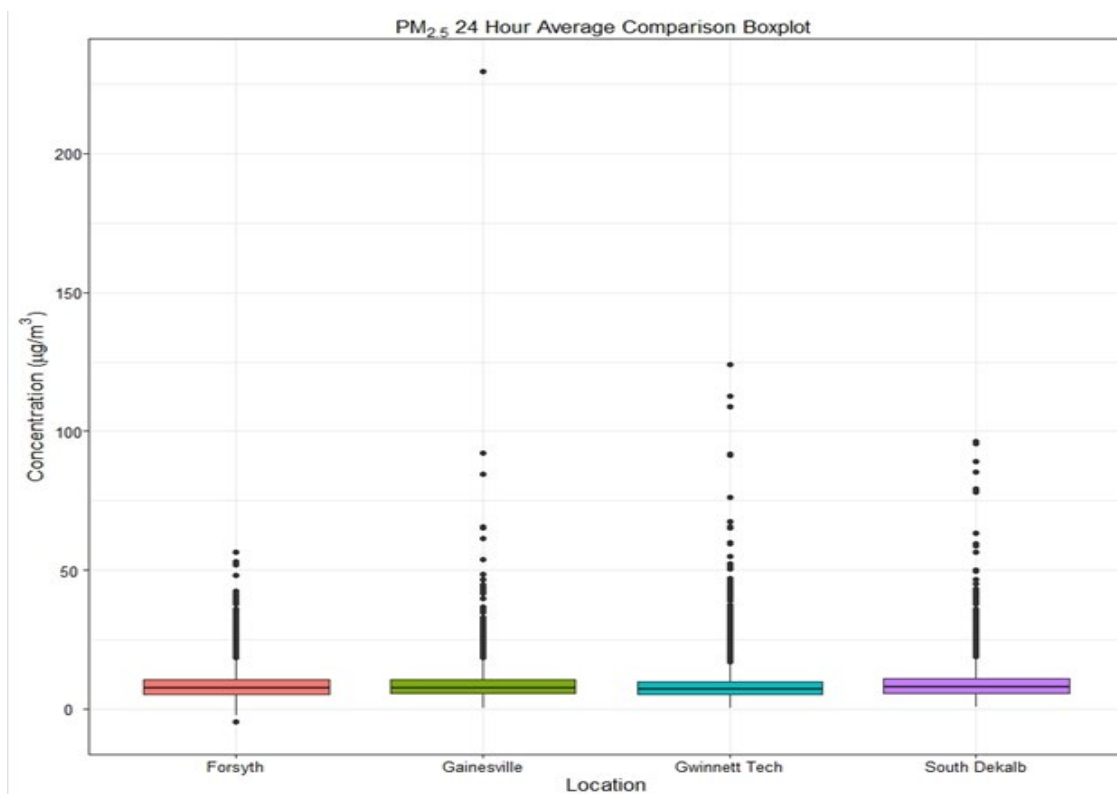
Figure 13. Box Plot Comparison of 2020 PM$_{2.5}$ Data

For the January 2021 through January 2022 PM$_{2.5}$ data shown in Figure 14, comparison of the same monitoring sites shows a continuous trend of Forsyth County having similar PM$_{2.5}$ concentrations to the GA AAMP sites.
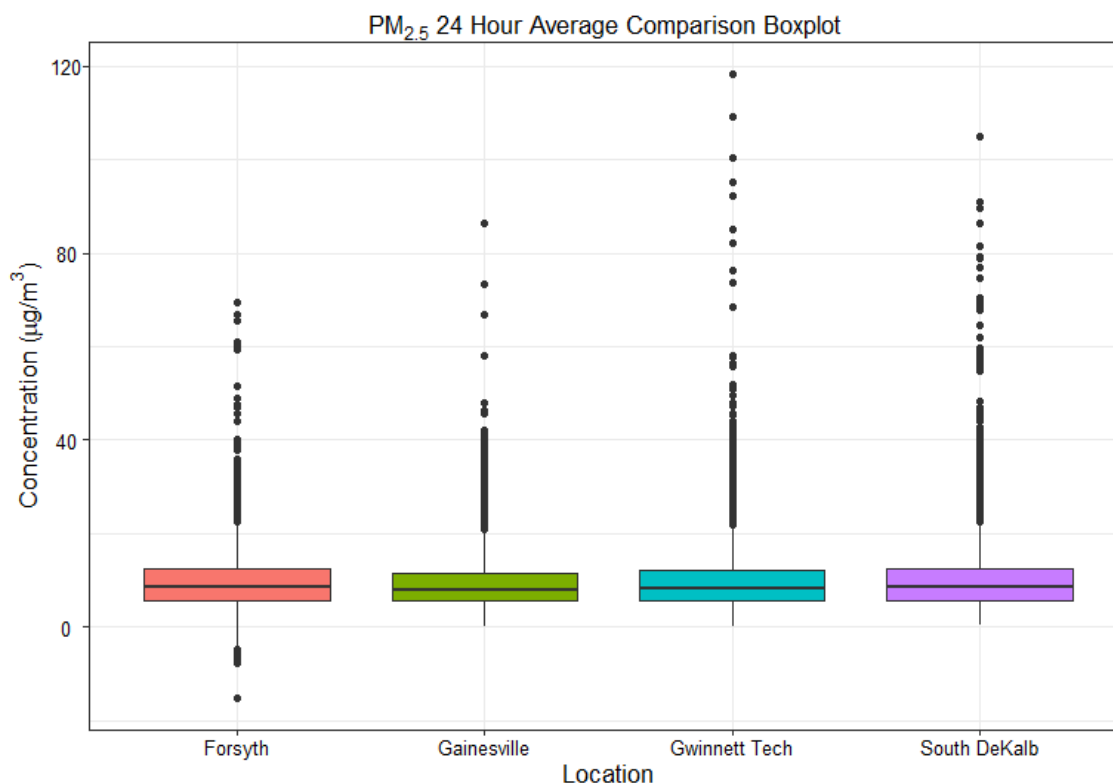
Figure 14. Box Plot Comparison of January 2021 through January 2022 PM2.5 Data

Forsyth PM2.5 Calendar Plot
In the following graphics, the 2020 and January 2021 through January 2022 hourly PM2.5 data was averaged for 24 hours and plotted on a calendar. The lighter days are lower concentrations, and the darker days are higher concentrations.

For the 2020 data, Figure 15, the scale is shown below the calendar, and the values range from 1.2 μg/m³ to 28.5 μg/m³. A Saharan dust event came through GA on June 26th-June 27th in 2020. The higher values exhibited on those days in June would have been influenced by the dust event. The months of November and December show slightly higher concentrations than the other months. During these months when there are more fires used for heating homes and prescribed fires, PM2.5 concentrations can be elevated. This is explored further in the following sections.
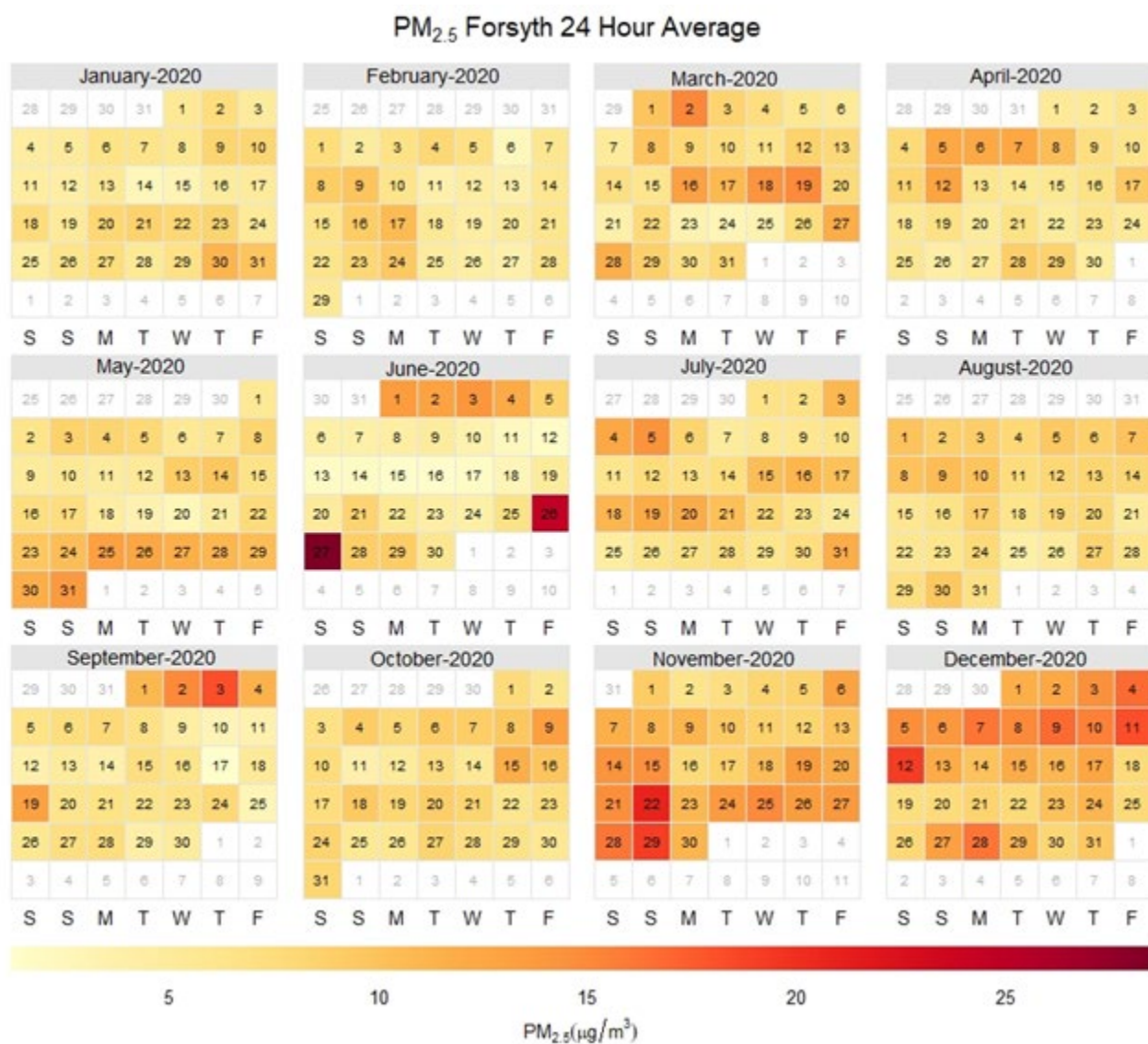
Figure 15. 2020 Calendar Plot of Forsyth County PM₂.₅ Data

For the January 2021 through January 2022 PM$_{2.5}$ data, Figure 16, the values for the PM$_{2.5}$ calendar plot range from -0.3[1] µg/m^3 to 29.0 µg/m^3. The highest value of 29.0 µg/m^3 was detected on March 10, 2021. There was construction taking place near the Forsyth County monitoring station which could have attributed to this; however, as seen in further discussion below (Figure 22), the nearby GA AAMP sites also had peak PM$_{2.5}$ concentrations on March 10, 2021, indicating a regional influence. The PM$_{2.5}$ concentrations collected in June have slightly higher levels. There was another peak in concentration during the months of November and December. The higher PM$_{2.5}$ concentrations in November and December concentrations may be attributed to increases in fires used for heating homes and prescribed fires. Temperatures dropped into the 30s with snow events for the northern parts of Georgia during December.

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[1] For this type of PM$_{2.5}$ sampler (BAM), the method detection limit, which is the lowest value that the sampler confidently reads, is -10.0. While these instruments are checked on a routine basis, occasionally, at very low concentrations, the continuous instrument will read below zero.

PM$_{2.5}$ Forsyth 24 Hour Average
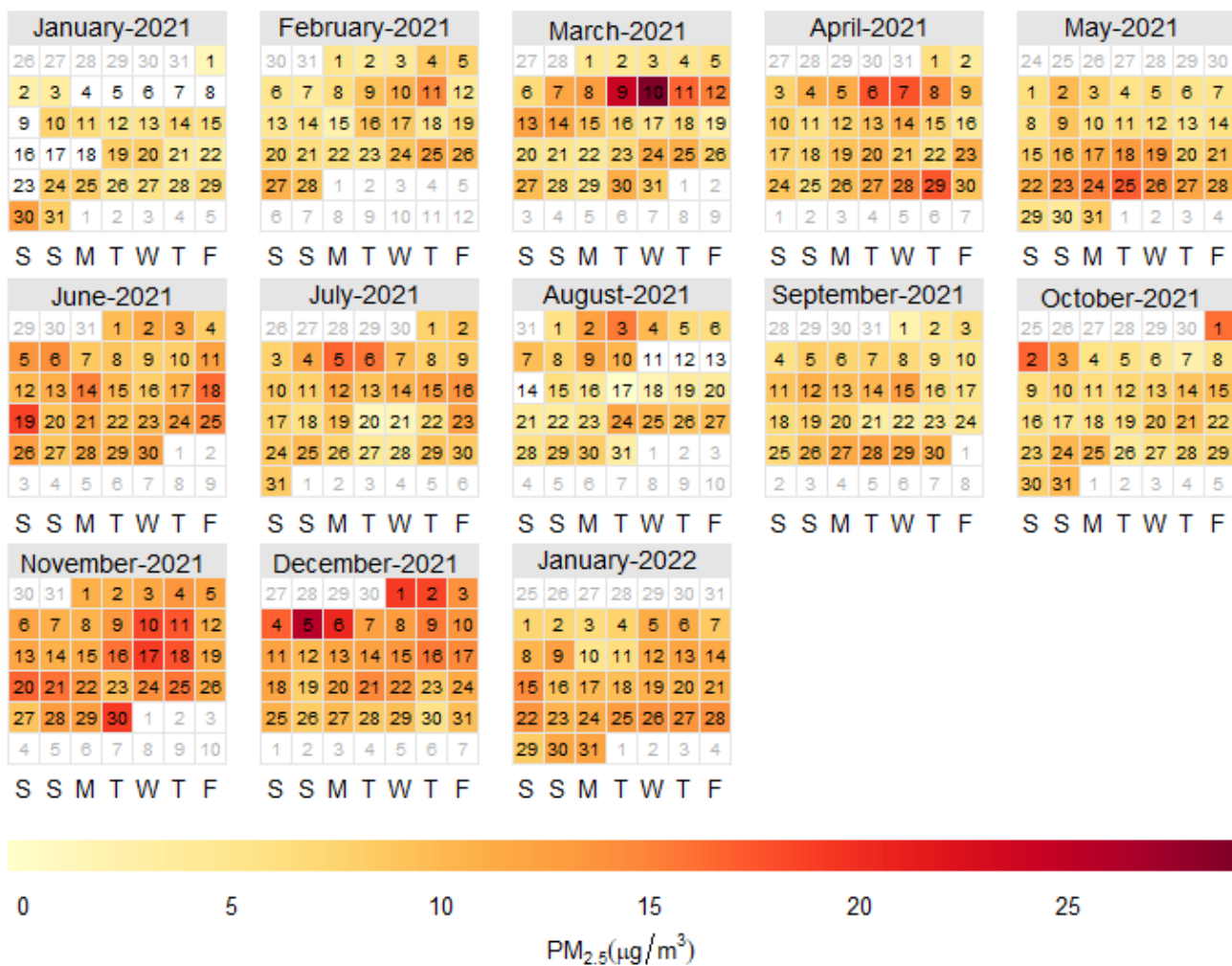
Figure 16. January 2021 through January 2022 Calendar Plot of Forsyth County PM$_{2.5}$ Data

Forsyth PM$_{2.5}$ Diurnal Variation

The continuous PM$_{2.5}$ data that was collected at the Forsyth monitoring site from January 1, 2020 through January 31, 2022 was examined for temporal variations based on diurnal, weekly, monthly, and annual trends. These graphs are shown in Figure 17 and Figure 18. The darker red line represents the average, and the pink area around each darker red line shows the 95% confidence level for that average. Based on the graphs, for 2020, the PM$_{2.5}$ concentrations do not vary significantly throughout the day on most weekdays and weekends with concentrations ranging up to 11 μg/m^3. However, the weekends exhibit a general higher concentration pattern compared to the weekdays. Throughout the week, concentrations tend to peak in the mornings around 6 am, and midday around 12 pm to 3 pm. Additionally, analysis of annual patterns showed that higher concentrations occurred during the months of June, November, and December. The June average would have been affected by the higher values on June 26th and 27th as discussed with the previous figure. The November and December data could have been affected by household heating sources, and prescribed fires.
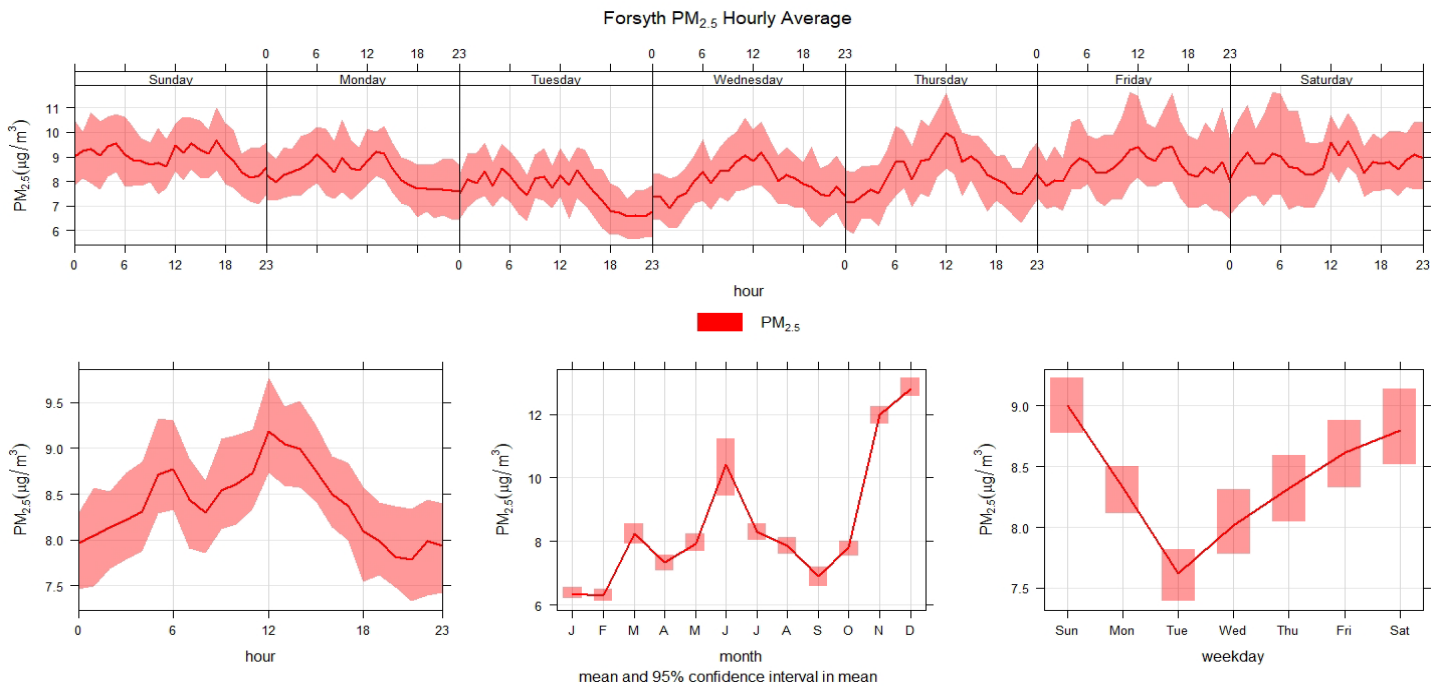
Figure 17. Detailed Trends of Forsyth County PM$_{2.5}$ Data, 2020

For the January 2021 through January 2022 PM$_{2.5}$ data, the peak day is Wednesday from around 1 pm to 5 pm, and this is primarily due to the highest value (29.0 μg/m^3) on March 10th, as seen in the section above. The increases in November and December are possibly attributed to household heating sources, and prescribed fires, as with the 2020 data.
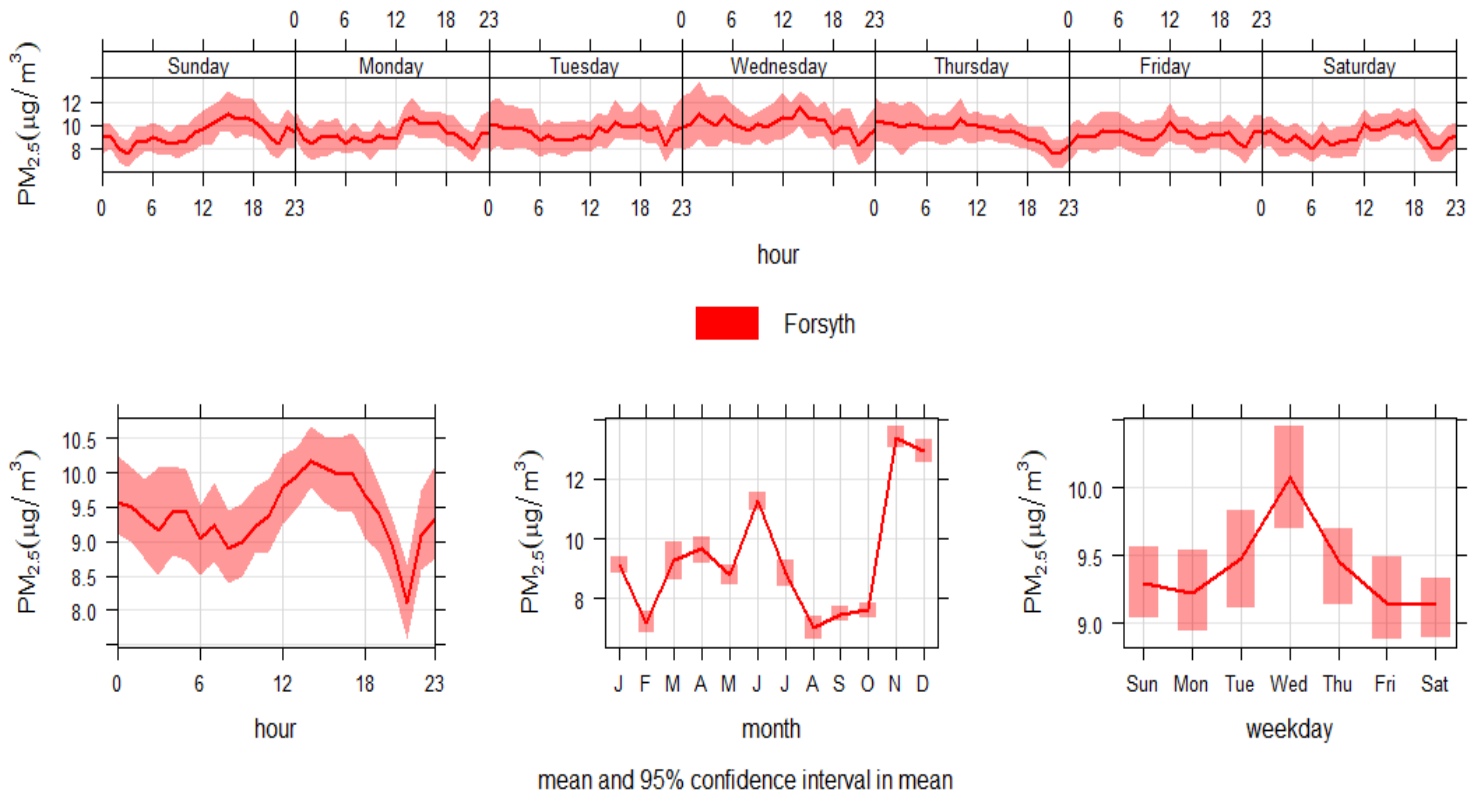
Figure 18. Detailed Trends of Forsyth County PM$_{2.5}$ Data, January 2021 through January 2022

PM2.5 Diurnal Site Comparison

The continuous PM2.5 hourly data that was collected at the Forsyth County monitoring site is compared to nearby continuous PM2.5 monitoring sites in Figure 19 and Figure 20 for the 2020 data and the January 2021 through January 2022 data.

In general, for the 2020 data, weekly concentration measurements tend to remain around 10 µg/m^3 at most sites. However, Gainesville, Gwinnett Tech, and South DeKalb experienced peaks on Saturday in the late afternoon (around 7 pm). The increases in concentration could have been influenced by local combustion events or weekend traffic. During the day, South DeKalb, Gwinnett Tech, and Gainesville experience peaks in concentration in the mid to late afternoon, most likely caused by peak rush hour, whereas Forsyth experiences peak in concentration around 6 am and 12 pm. The weekday trend is similar across all the sites, with the weekends having relatively higher concentrations of PM2.5 compared to during the week. Annual PM2.5 patterns for all sites, except Gainesville, showed similar results where concentration peaks occurred in March, June, and December. Higher concentrations in the summer can be influenced by fireworks and fire events. Winter spikes can be influenced by the utilization of household fireplaces and firepits. There appears to be an increase in November and December data for all the sites, indicating the general trend throughout the region.
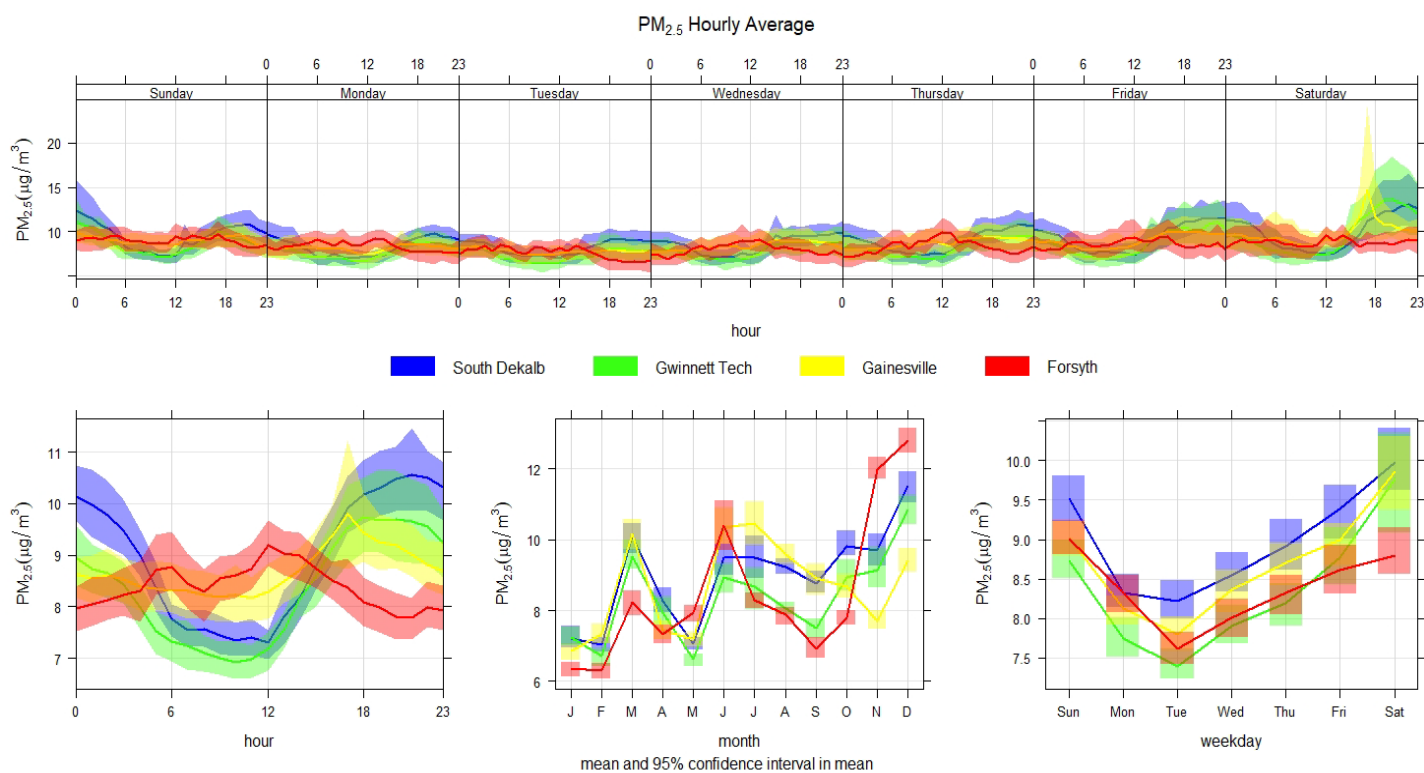
Figure 19. Comparison of Detailed PM2.5 Trends 2020

For January 2021 through January 2022, the highest peak of PM2.5 data at the Forsyth County monitoring site was on March 10, 2021, with a 29.0 µg/m^3, and the lowest detection was -0.3 µg/m^3 on August 17, 2021. The yearly average was 9.4 µg/m^3. The highest measurements are from approximately 12 pm to 6 pm. There is a dramatic drop in concentrations around 9 pm. The

weekday trend is similar across all the sites, with Wednesday having relatively higher concentrations of PM2.5 compared to the rest of the week. Annual PM2.5 patterns show the Forsyth County monitoring site to have the highest concentrations in the months of June and November/December. In November and December weather events possibly increased the use of residential fireplaces. Other peaks in concentrations are possibly attributed to be fireworks displays, construction, and prescribed burning events.
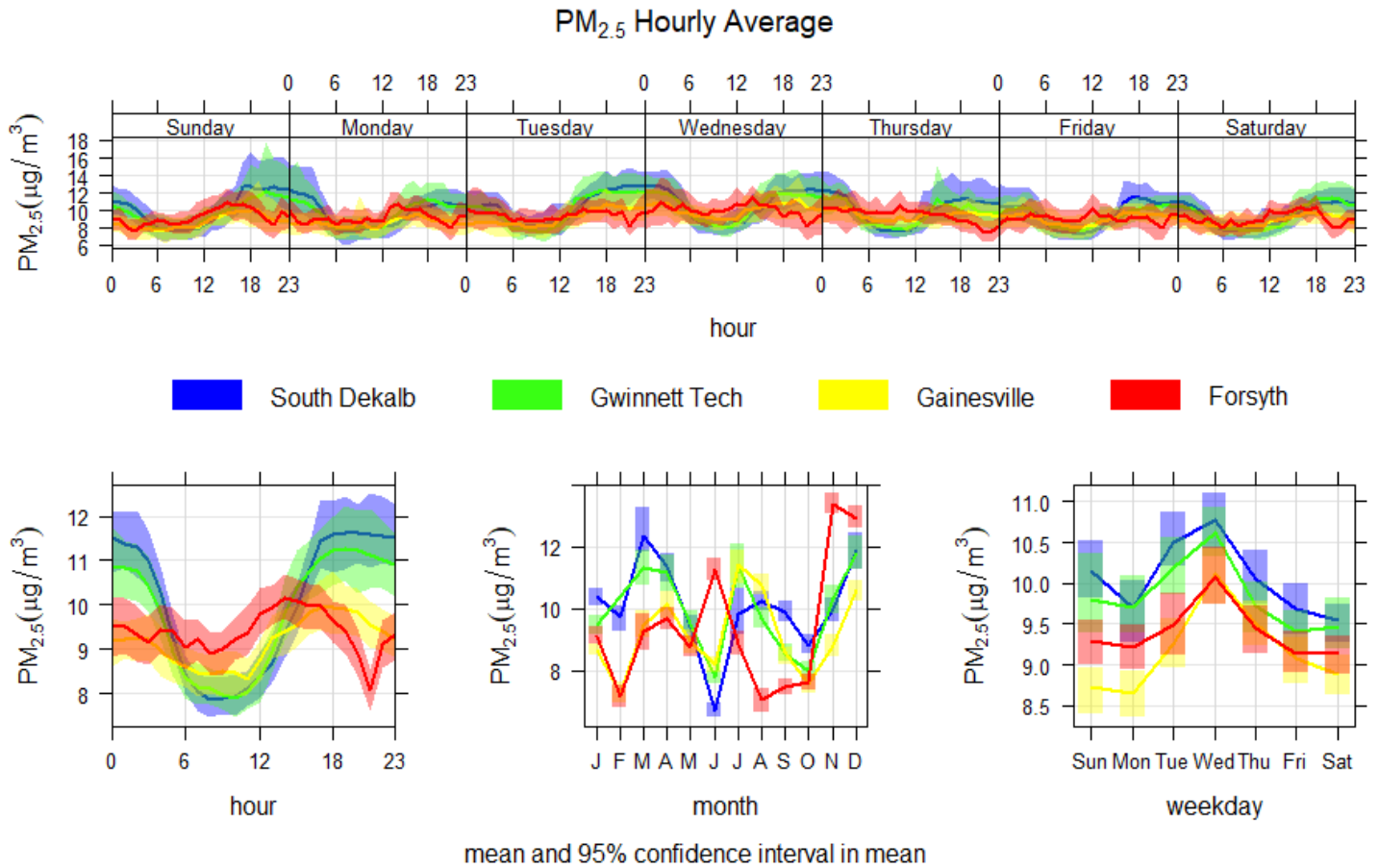
Figure 20. Comparison of Detailed PM2.5 Trends, January 2021 through January 2022

PM₂.₅ Air Quality Index (AQI) Comparison Chart

The Air Quality Index (AQI) is a national air standard rating system developed by the U.S. Environmental Protection Agency. The AQI is used statewide to provide the public, on a daily basis, with an analysis of air pollution levels and possible related health risks. Generally, an index scale of 0 to 500 is used to assess the quality of air, and these numbers are synchronized with a corresponding descriptor word such as: Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, and Very Unhealthy. To protect public health the EPA has set an AQI value of 100 to correspond to the NAAQS for the criteria pollutants. The next two graphs show a comparison of PM₂.₅ AQI values at the Forsyth County site and nearby PM₂.₅ sites for the 2020 data and the January 2021 through January 2022 data.

Figure 21 compares the PM₂.₅ AQI trends at Forsyth County, Gwinnett Tech, South DeKalb, and Gainesville sites for the 2020 data. The black line represents Forsyth County. Among all the sites, the PM₂.₅ concentrations seem to follow a similar pattern throughout the year. AQI values are below 50, or hover around 50, except for those few exceptions in the summer and November and December as noted earlier. There is a noticeable similarity in measurement trends supporting the idea that there is not an independent source effecting PM₂.₅ concentrations at Forsyth. Values may have been affected by combustion events, i.e., prescribed burns and wildfires, firework events, and miscellaneous industrial processes occurring in the area. Based on the graph, there seems to be a general trend at all sites, and it appears that the Eagle Point Landfill is not adversely affecting PM₂.₅ concentrations. In fact, Forsyth's PM₂.₅ values for the year were all-around lower, when compared to the nearby GA AAMP sites.
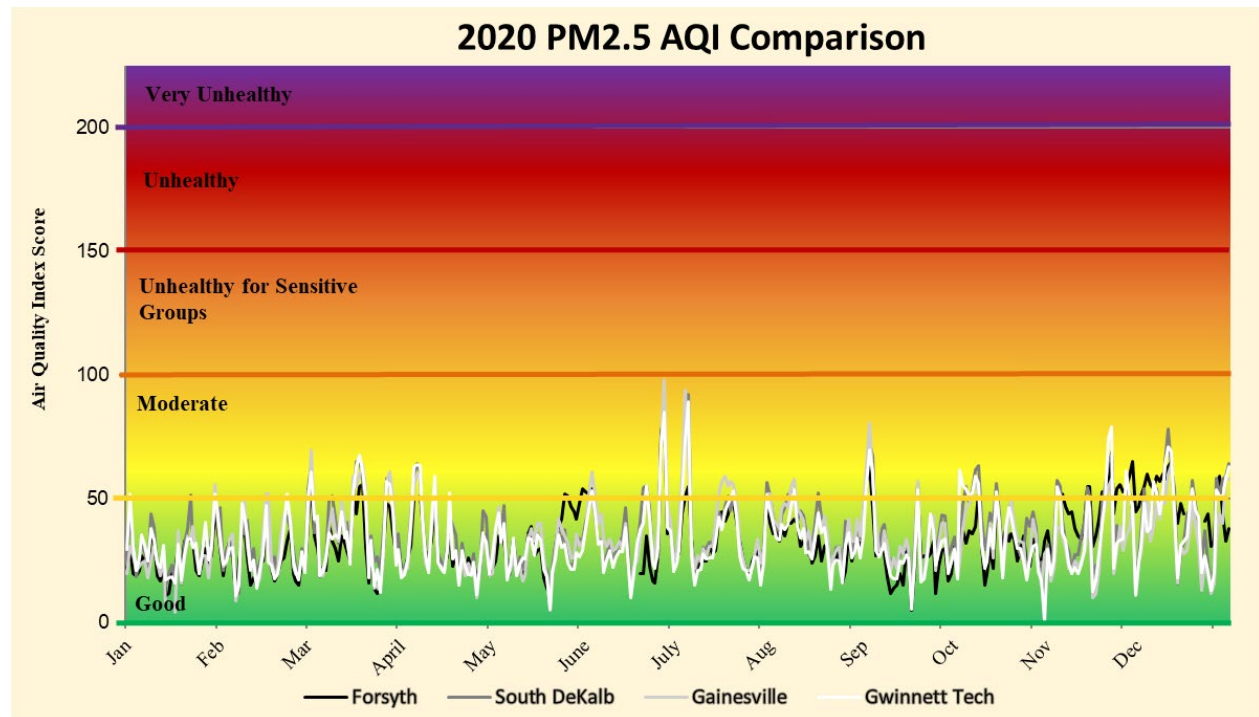
Figure 21. PM₂.₅ AQI Comparison 2020

Figure 22 charts the same comparison of PM₂.₅ AQI trends at Forsyth County, Gwinnett Tech, South DeKalb, and Gainesville sites for the January 2021 through January 2022 data. Again, the

PM$_{2.5}$ concentrations for all four of these sites seem to follow a similar pattern throughout the January 2021 to January 2022 data. As discussed earlier, all four sites show an increase in PM$_{2.5}$ concentrations during March, indicating a regional influence. The majority of the AQI values are below 50, with an occasional spike around 100.
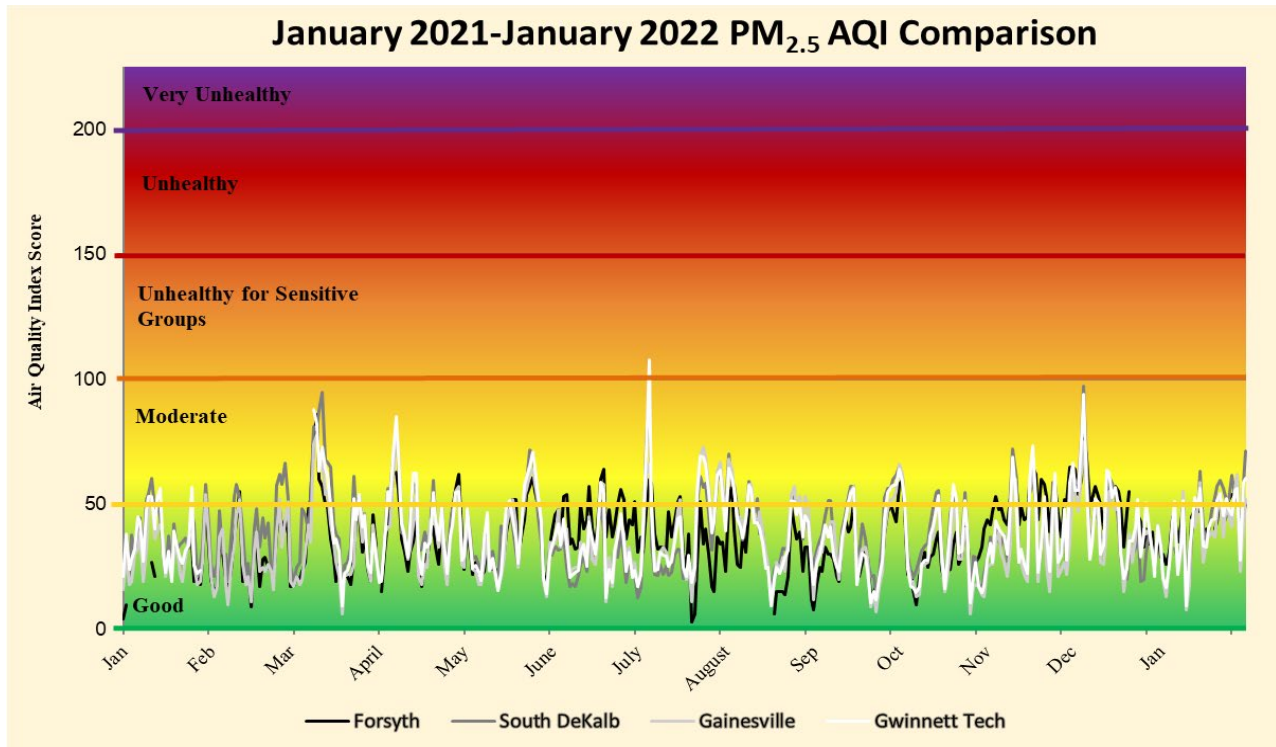
Figure 22. PM$_{2.5}$ AQI Comparison, January 2021 through January 2022

PM$_{2.5}$ Scatterplots for NR-285, South DeKalb, and Forsyth
The following scatterplots and correlations were created to compare continuous hourly PM$_{2.5}$ data at the Forsyth County, South DeKalb, Gainesville, and Gwinnett Tech sites. Scatterplots graph the concentrations measured at two different sites to see how those concentrations compare, or correlate. The coefficient of determination gives an idea of how many data points fall along the line formed by the regression equation. The higher the coefficient, the higher number of data points the line passes through. A 'perfect positive' correlation would show all of the concentrations on the black line, and the coefficient of determination, or R^2 value, would be a 1. In short, the R^2 values show how well the two sites correlate.

Figure 23 and Figure 24 show that the majority of samples collected are relatively close in concentration, with the majority of colored dots falling along or close to the black line. The continuous PM$_{2.5}$ concentrations collected at the Forsyth County site have a 'moderate positive' correlation to the South DeKalb, Gwinnett Tech, and Gainesville sites. This can be seen with the r values, or coefficient of correlation, in the range between 0.50 and 0.70. If the r values were above 0.70, this would be considered a 'strong positive' correlation, and again, if the r values were 1.0, this would be a 'perfect positive' correlation. Therefore, with the r values ranging from 0.41 to 0.56 (as shown in the tables below), this indicates that the PM$_{2.5}$ concentrations in Forsyth County are not exactly the same but are comparable to other areas in the region.
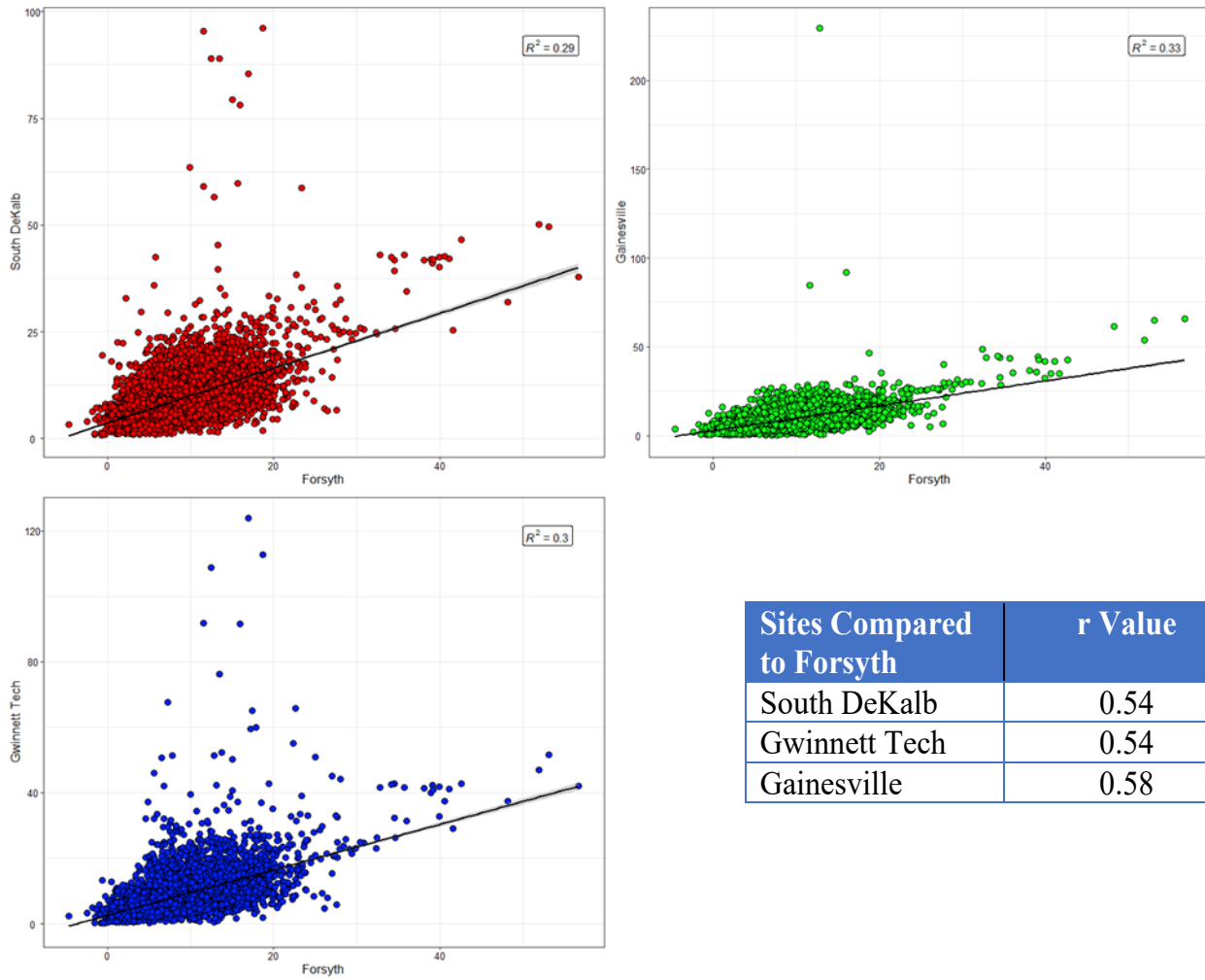
Sites Compared to Forsyth	r Value
South DeKalb	0.54
Gwinnett Tech	0.54
Gainesville	0.58

Figure 23: Scatterplots and Correlation Values for PM2.5 Data, 2020
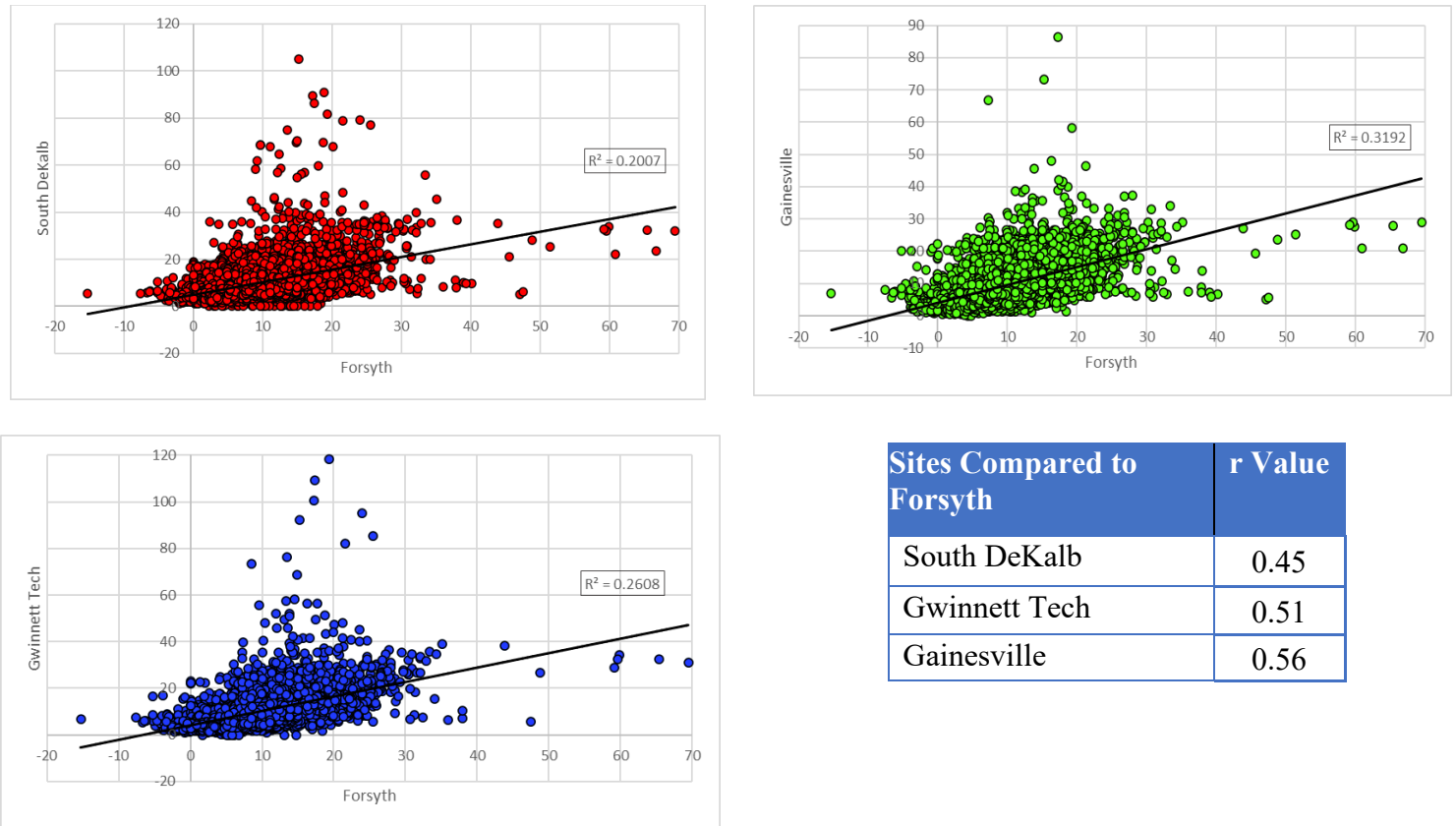
Sites Compared to Forsyth	r Value
South DeKalb	0.45
Gwinnett Tech	0.51
Gainesville	0.56

Figure 24: Scatterplots and Correlation Values for PM$_{2.5}$ Data, January 2021 through January 2022

Polar Plots

Figure 25 through Figure 33 are polar plots that show the location of the Forsyth monitoring station, $PM_{2.5}$ and VOCs concentrations for each pollutant that had detections, wind speed and wind direction. The polar plots were mapped in ArcGIS to show the location of Eagle Point Landfill with respect to the Forsyth monitoring station.

The first polar plot shows the 2020 $PM_{2.5}$ data. The average concentrations are 8-10 µg/m^3 (green and yellow circles). The circles further away from the center of the plot, where the monitoring station is located, indicate a higher wind speed. Circles NW of the center of the plot mean that the wind was blowing from the landfill area to the monitor. The higher concentrations (yellow circles) were measured when the wind was blowing from the south or southeast or towards the landfill. Concentrations measured are generally lower (green circles) when the wind is blowing from the landfill towards the monitor. This means that the landfill does not appear to be causing an increase in $PM_{2.5}$ concentrations at the monitoring station.
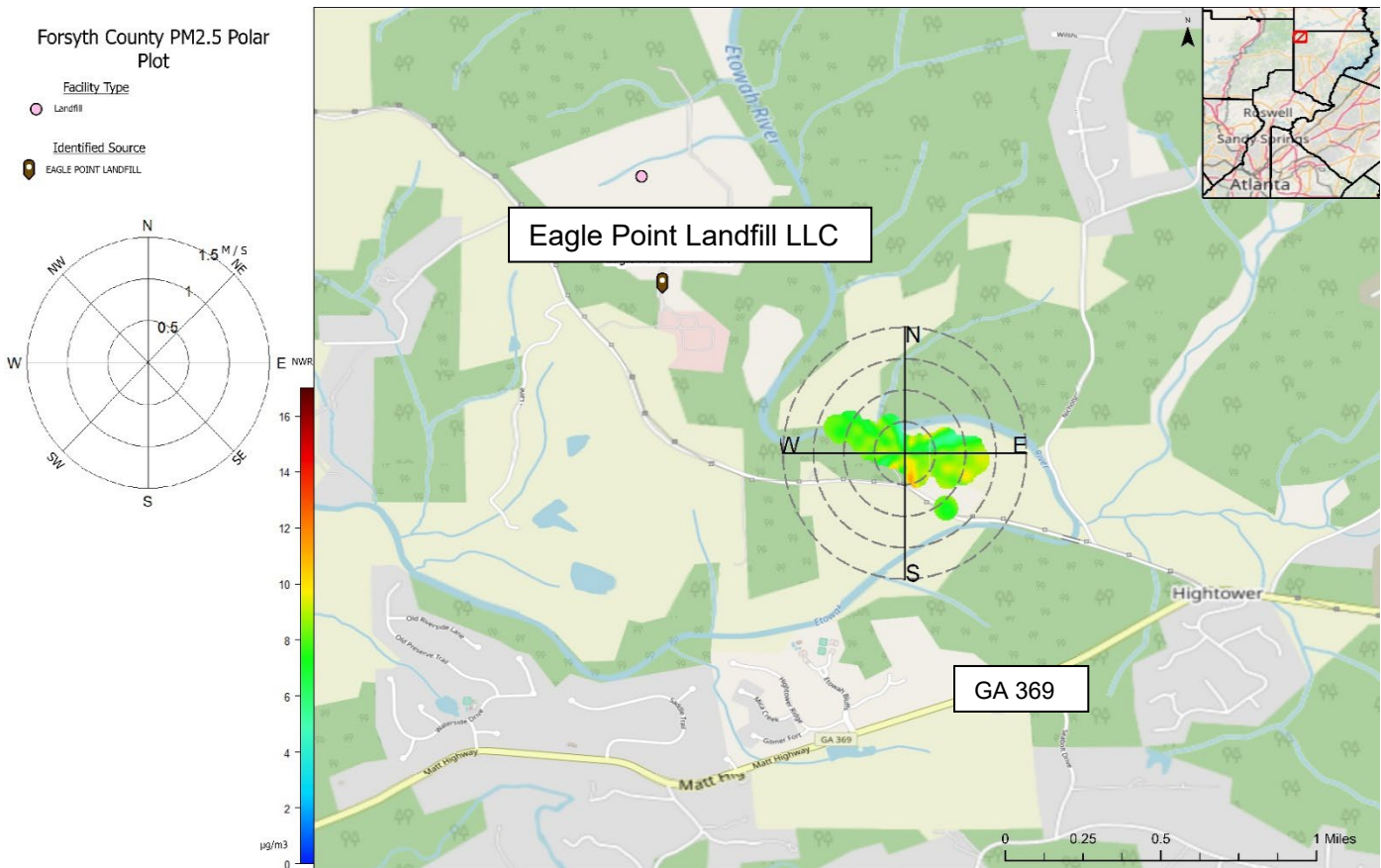
Figure 25. Polar Plot of Forsyth County PM2.5 Data, 2020

For the January 2021 through January 2022 $PM_{2.5}$ data, the wind speed and wind direction appear to be variable, while the concentrations appear to come from the WNW. The concentrations are depicted in light blue and light green, with the higher value on March 10th visible in the red and orange on the January 2021 through January 2022 polar plot in Figure 26.
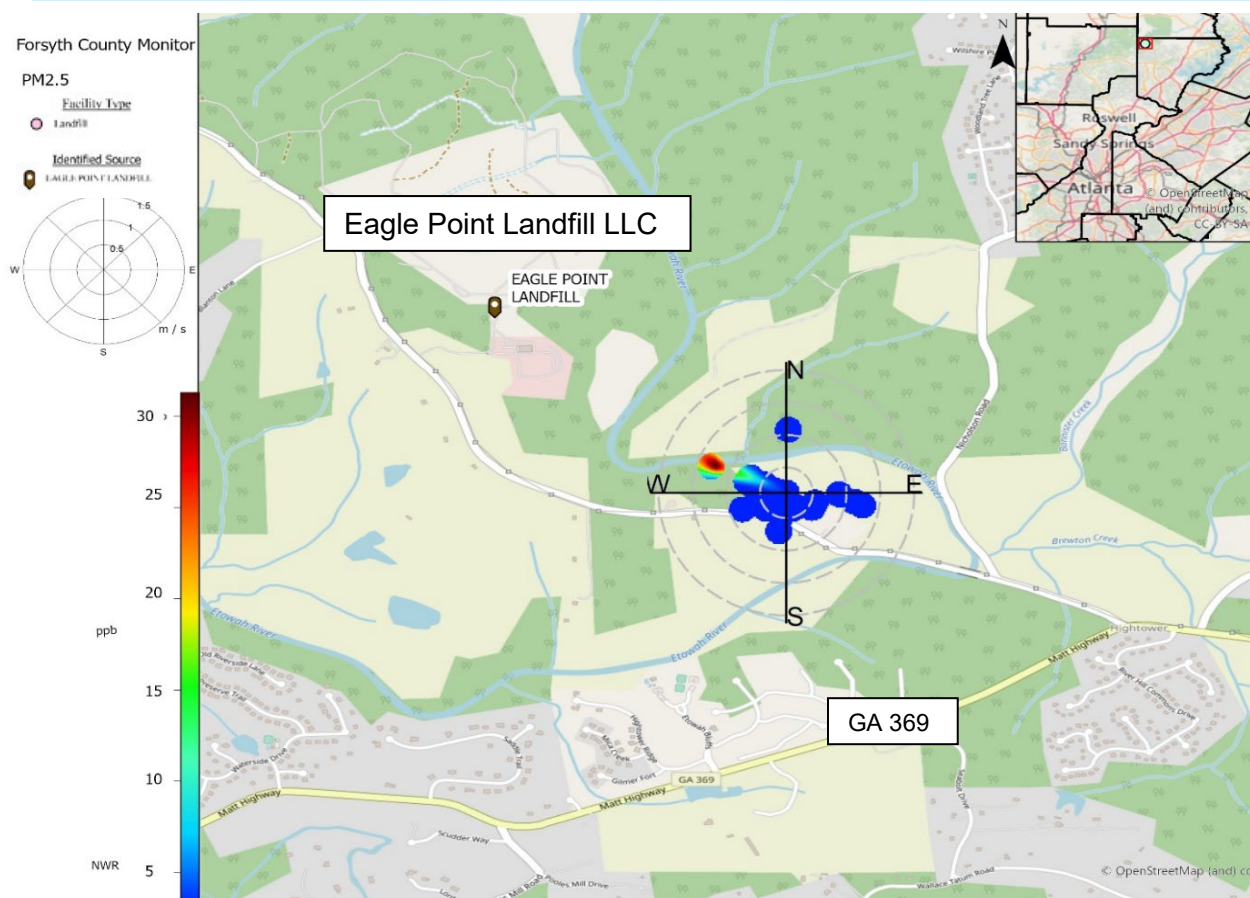
Figure 26. Polar Plot of Forsyth County PM₂.₅ Data, January 2021 through January 2022

With the volatile organic compounds (HAPs) sampling at the Forsyth County site, only four compounds had detections for the 2020 data: *o*-xylene, benzene, *m/p*-xylene, and toluene. The HAPs that were not detected are: 1,3-butadiene, chloroform, ethylene dichloride, hexane, methylene chloride, and trichloroethylene. HAPs have a wide variety of sources—mobile sources (such as vehicles), stationary industrial sources, small area sources, indoor sources (such as cleaning materials), and other environmental sources (such as volcanoes and wildfires).

With the January 2021 through January 2022 data, only two VOCs were detected: TNMOC and Toluene. The polar plots for these two pollutants are shown below the corresponding 2020 data for comparison.

Figure 27 shows the polar plot of 2020 *o*-xylene data. This polar plot is based on one detection for *o*-xylene, which was 1.11 parts per billion (ppb) (light blue area). The dark blue circles further away from the center of the plot, where the monitoring station is located, indicate a higher wind speed. Circles NW of the center of the plot would mean that the wind was blowing from the landfill area to the monitor. The *o*-xylene value (light blue area) was measured when the wind was blowing from the WNW and does not appear to be coming directly from the Eagle Point Landfill.
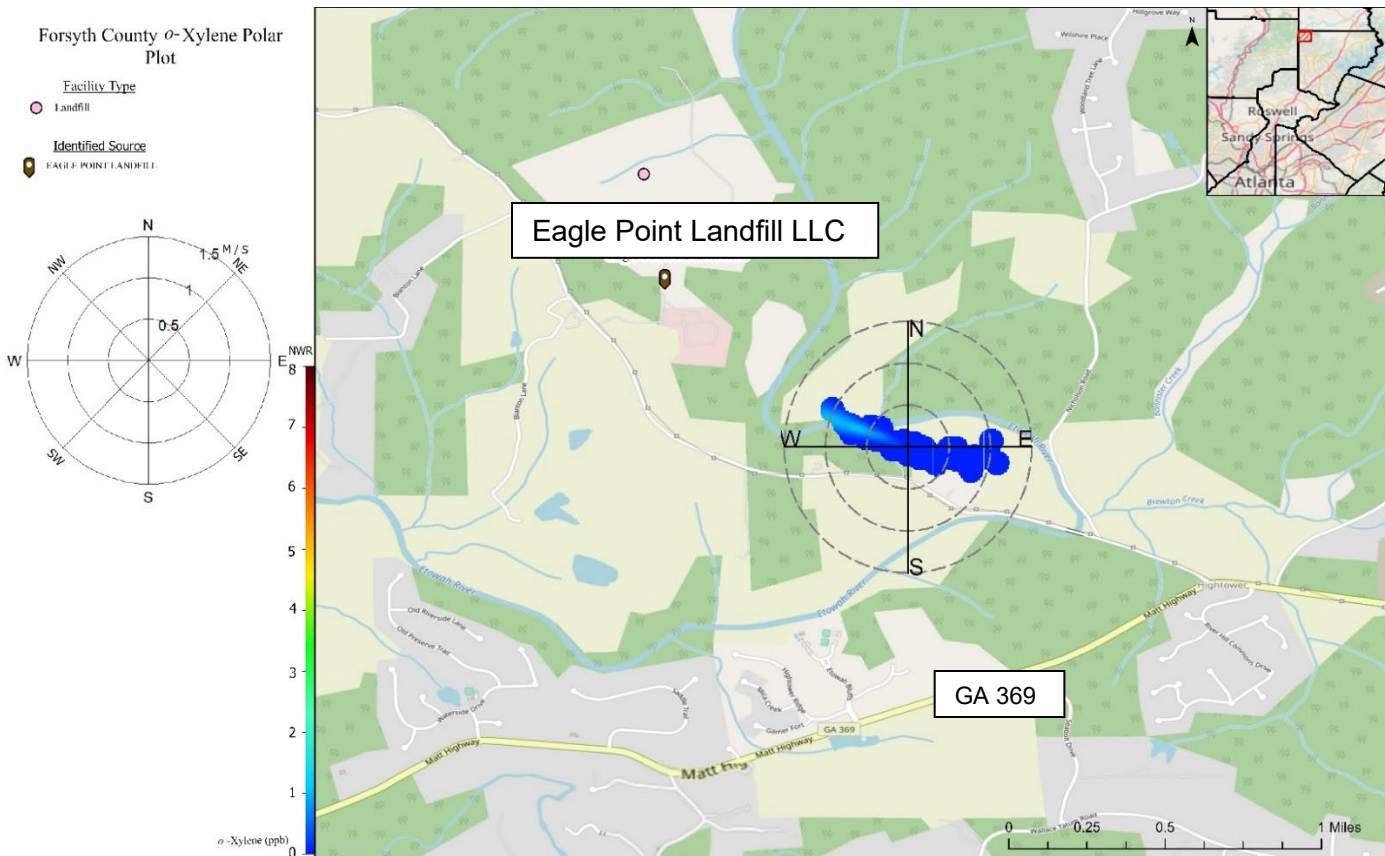
Figure 27. Polar Plot of Forsyth County *o*-Xylene Data, 2020

With the January 2021 through January 2022 data, there were no detections of *o*- xylene at the Forsyth County monitoring site.

The following polar plot, Figure 28, shows the 2020 *m/p*-xylene data. This polar plot is based on one detection for *m/p*-xylene, which was 3.91 parts per billion (ppb) (light green area). The circles further away from the center of the plot, where the monitoring station is located, indicate a higher wind speed. Circles NW of the center of the plot would mean that the wind was blowing from the landfill area to the monitor. Like the *o*-xylene polar plot, the *m/p*-xylene concentration (light green color) appears to be blowing towards the monitor from the WNW and appear to be coming from a source other than the Eagle Point Landfill.
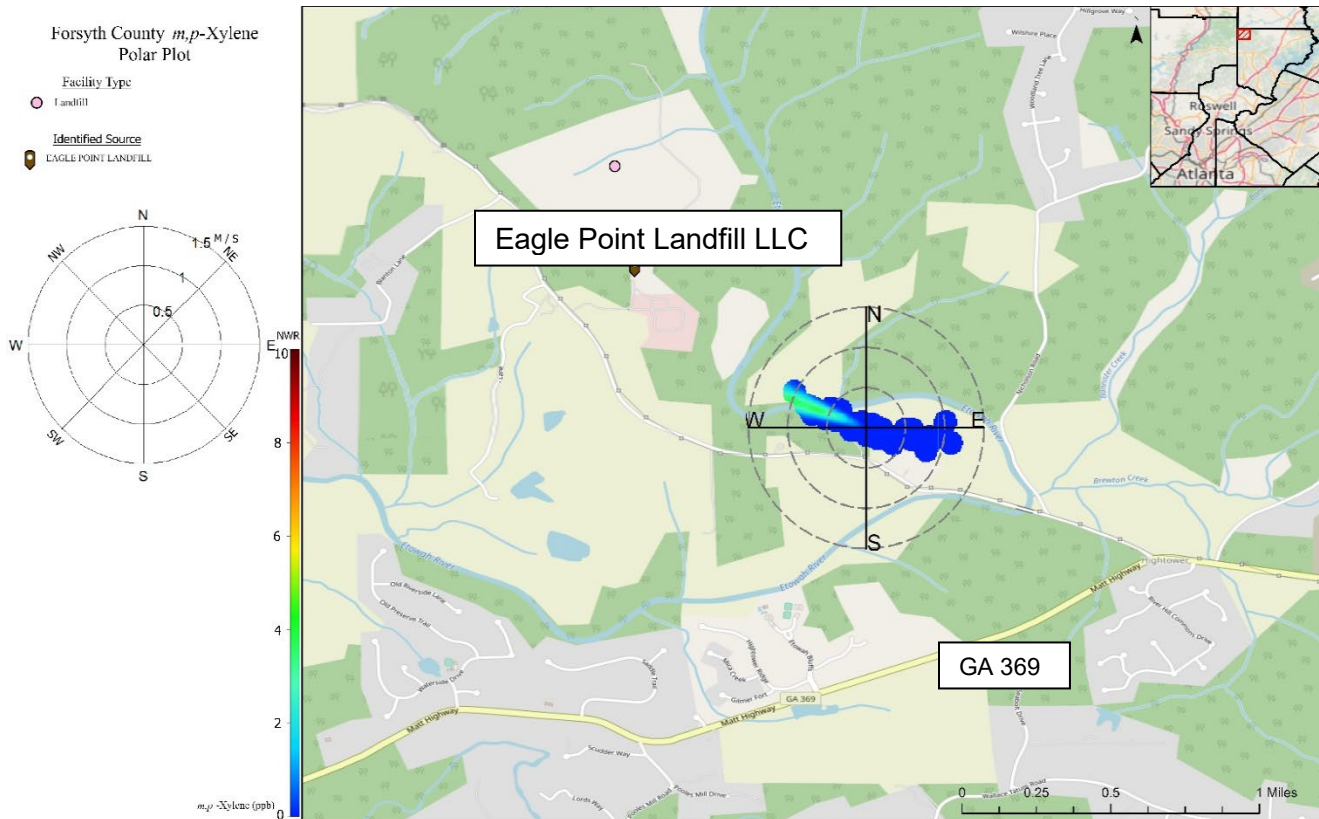
Figure 28. Polar Plot of Forsyth County *m/p*-Xylene Data, 2020

With the January 2021 through January 2022 data, there were no detections of *m/p*- xylene at the Forsyth County monitoring site.

Figure 29 displays the polar plot of 2020 benzene data, with concentrations ranging from 0.0 to 1.18 ppb (dark blue to dark red area areas). The highest benzene concentrations appear to be blowing towards the monitor from the northeast (dark red area) and southwest (yellow area) at very slow wind speeds (less than 0.5 meters per second). Therefore, it can be inferred that benzene concentrations are not coming from the Eagle Beak Landfill to the NW of the monitoring station.
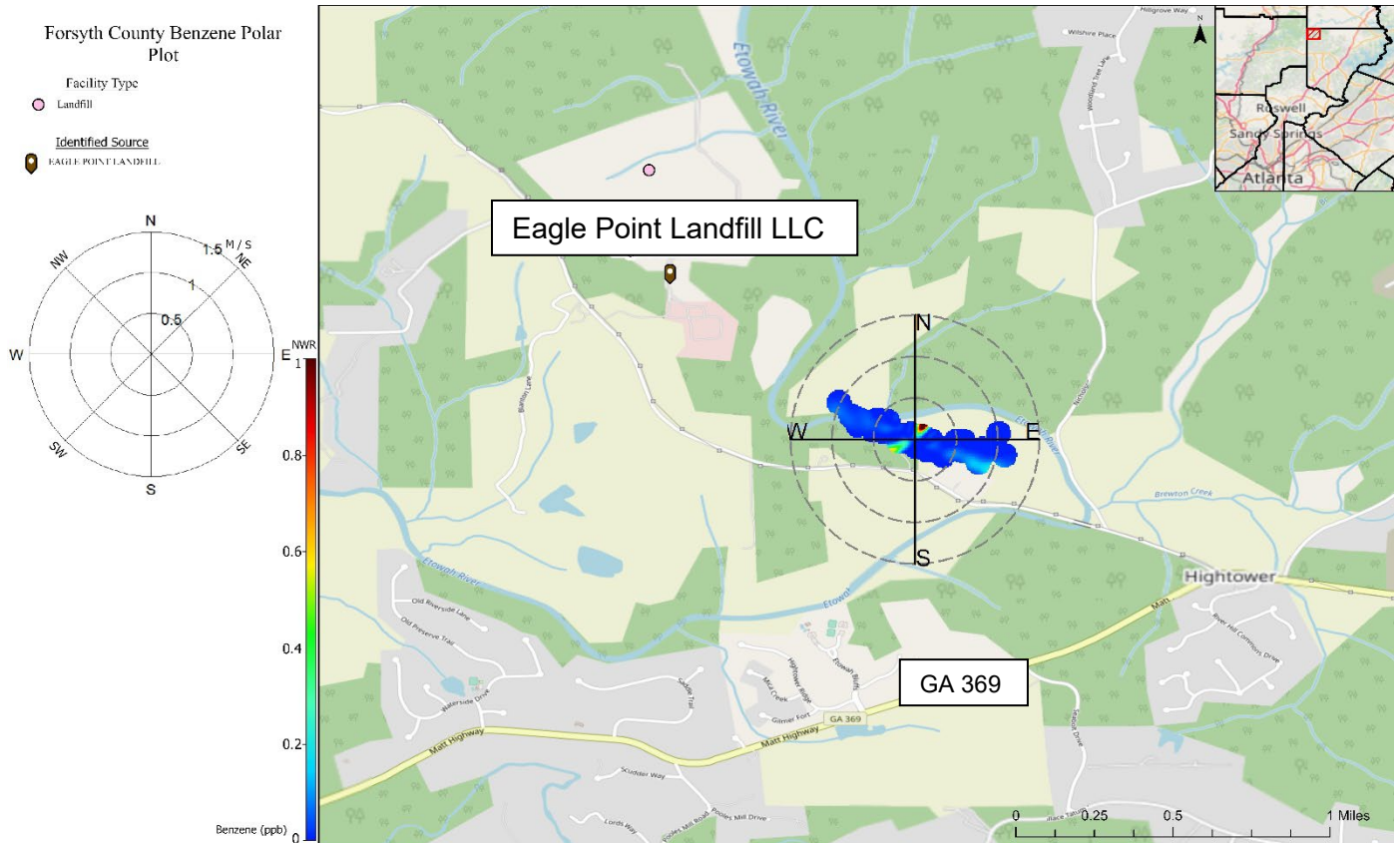
Figure 29. Polar Plot of Forsyth County Benzene Data, 2020

With the January 2021 through January 2022 data, there were no detections of benzene at the Forsyth County monitoring site.

The following polar plot, Figure 30, shows the 2020 toluene concentrations ranging from approximately 0.0 to 3.91 ppb (dark blue to dark orange color areas). The circles further away from the center of the plot, where the monitoring station is located, indicate a higher wind speed. Circles NW of the center of the plot mean that the wind was blowing from the landfill area to the monitoring station. The higher concentrations (dark orange area) were measured when the wind was blowing at very low wind speed (less than 0.5 meters per second) from the southwest towards the landfill. The toluene concentrations shown in light blue to green areas appear to be coming from the WNW and ESE. This means that the landfill does not appear to be causing an increase in toluene concentrations at the monitoring station.
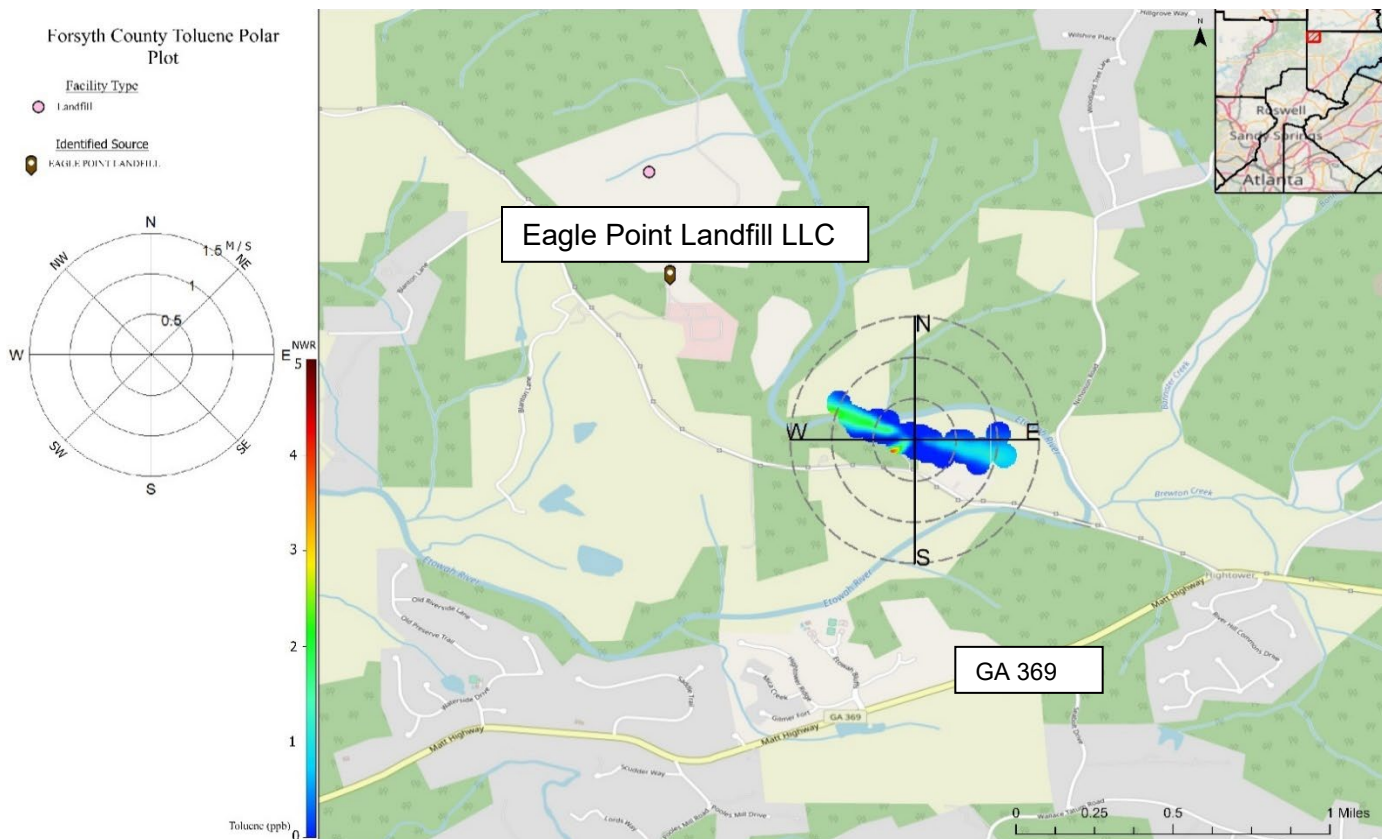
Figure 30. Polar Plot of Forsyth County Toluene Data, 2020

For the January 2021 to January 2022 toluene data, concentrations dropped compared to the 2020 data. There were only four detections for the January 2021 through January 2022 data. The toluene concentrations decreased from a high of 3.91 ppb in 2020 to a high of 1.1 ppb for the January 2021 through January 2022. The following polar plot, Figure 31, shows the winds coming primarily from the WNW and the ESE, and it appears most of the four toluene detections (lighter blue and light green colors) are coming from the ESE. This means that the landfill does not appear to be causing an increase in toluene concentrations at the monitoring station.
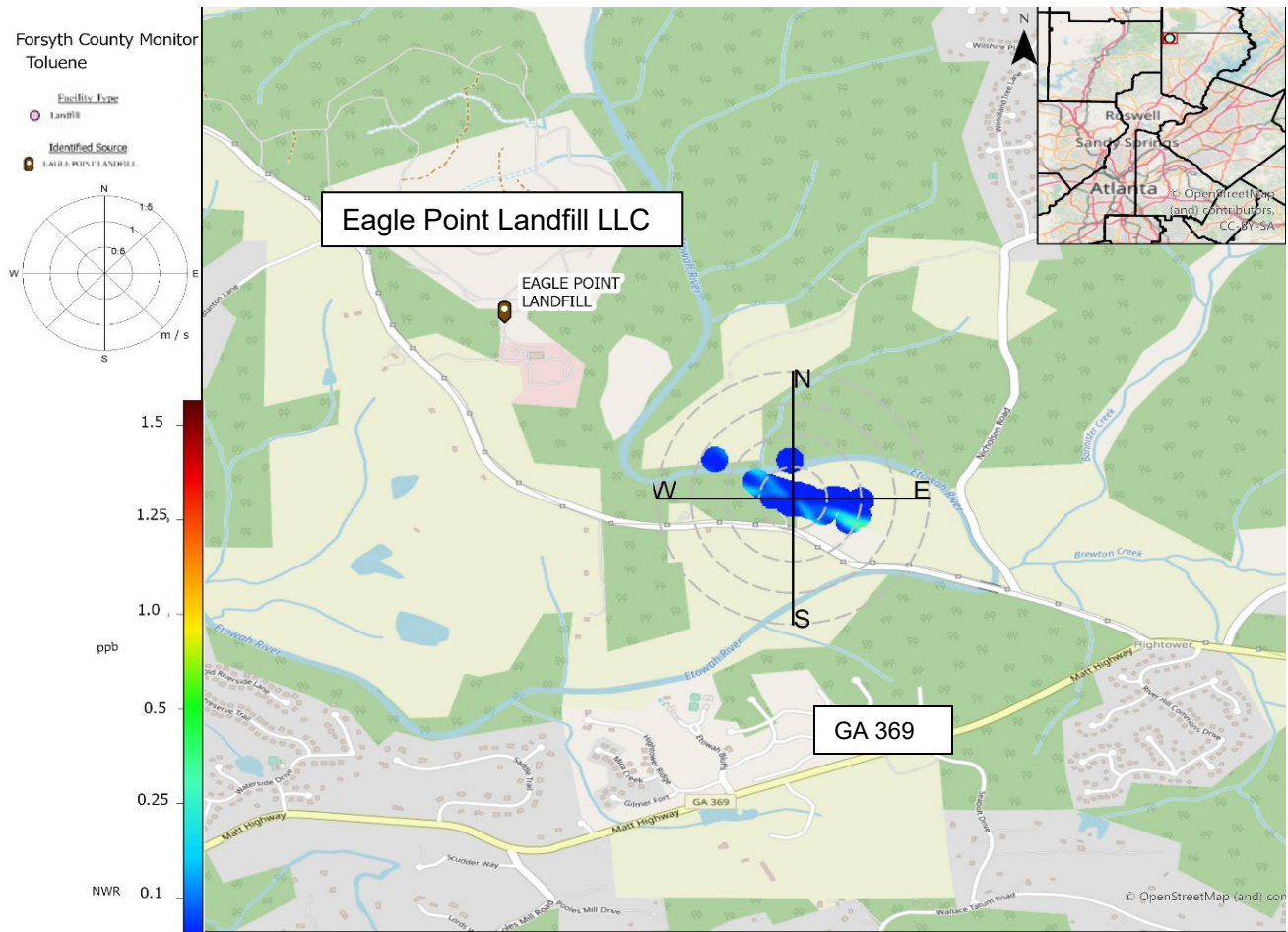
Figure 31. Polar Plot of Forsyth County Toluene Data, January 2021 through January 2022

Figure 32 shows the polar plot of TNMOC concentrations that were detected at the Forsyth monitoring station. The concentrations range from approximately 20 to greater than 70 ppb (light blue to red areas) at wind speeds less than 0.5 meters per second. The highest TNMOC concentrations (dark red color) appear to be blowing from the northwest, southwest, and south. The concentrations shown in red coming from the northwest could possibly be coming from the area around the Eagle Point Landfill.
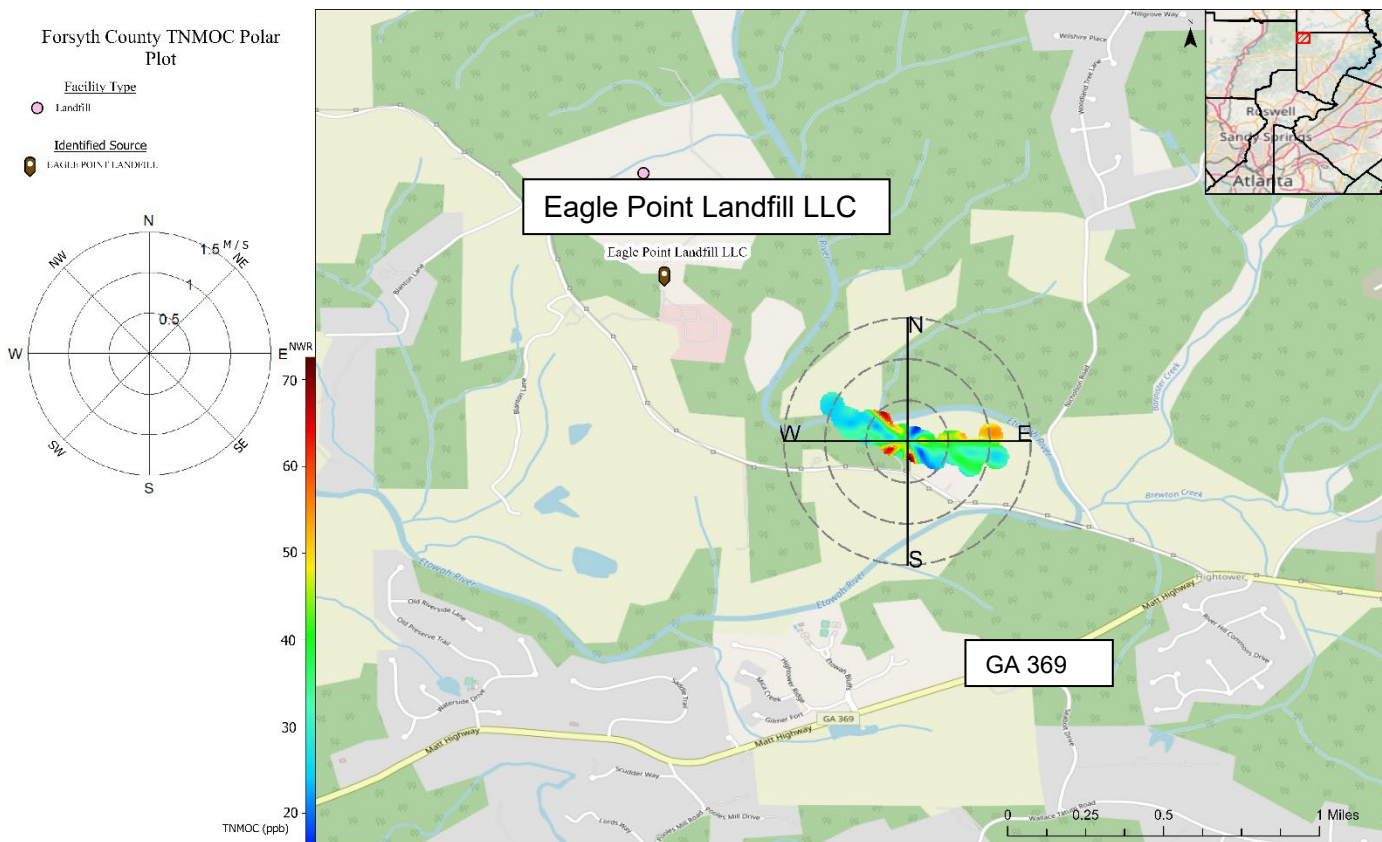
Figure 32. Polar Plot of Forsyth County TNMOC Data, 2020

For the January 2021 through January 2022 TNMOC data, there was an increase in detected concentrations. Most of the detected concentrations were between 35-170 ppb represented again in lighter blues to greens. The higher concentrations above 175 ppb and are shown in dark red. The highest concentration of 205.8 ppb was detected on August 14, 2021, and appears to be coming from the northeast, while the landfill is located to the northwest of the monitor. The lowest concentration of 10.7 ppb was detected on February 3, 2021.
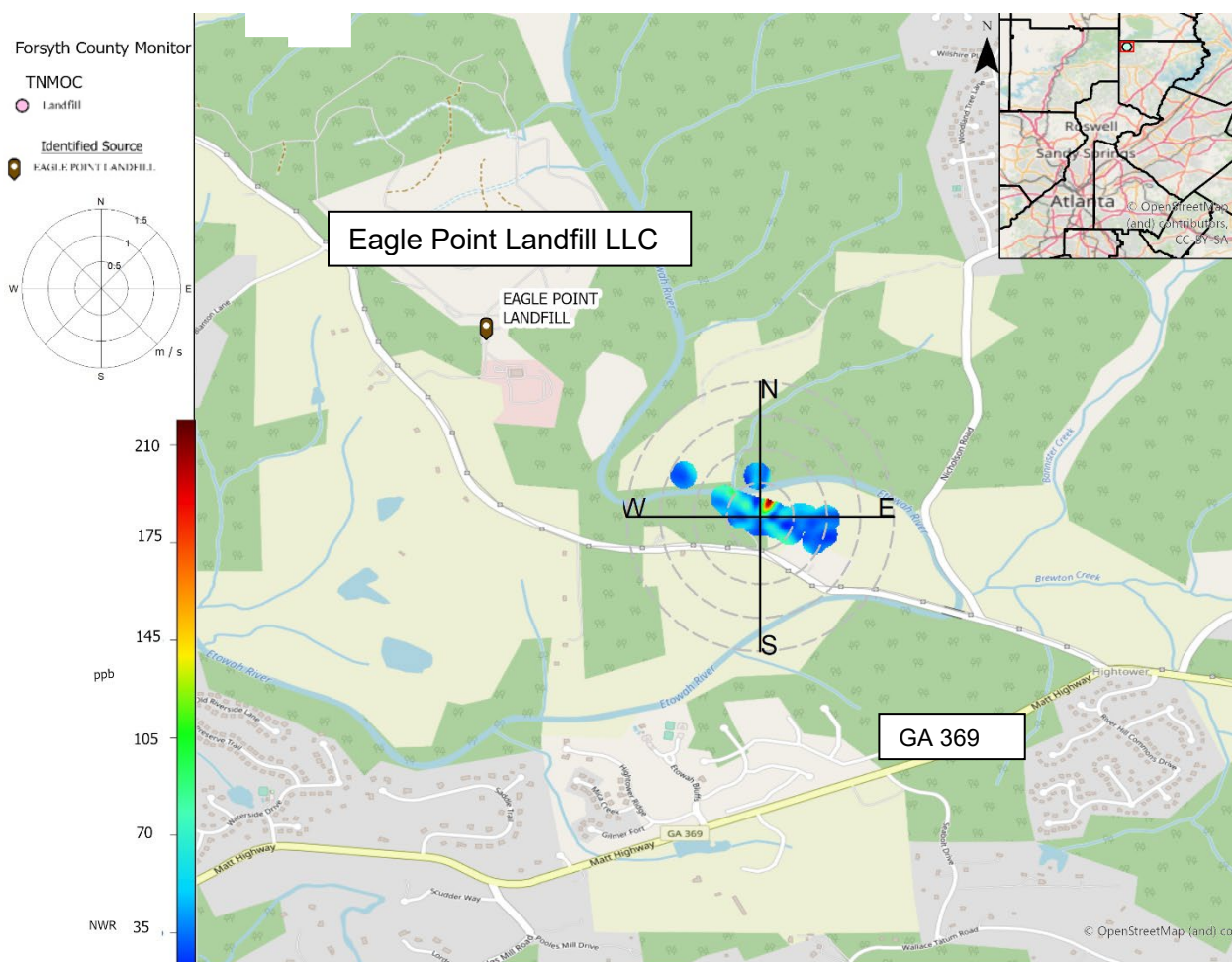
Figure 33. Polar Plot of Forsyth County TNMOC Data, January 2021 through January 2022

VOCs Comparisons

Of the eleven volatile organic compounds that were monitored at the Forsyth County site, only five compounds had any detections for the 2020 data: *o*-xylene, benzene, *m/p*-xylene, toluene, and TNMOC. Further, there were only a few days within 2020 with data above zero for these five compounds. The next graphs show trends of these detections, and comparisons to GA AAMP's sites that also collect VOCs: South DeKalb and NR-285 sites (locations shown in Figure 8). It should be noted that the Forsyth County monitor collected data every six days, the South DeKalb site collected data every six days, and the NR-285 site collected data every twelve days with the canister method. There is a noticeable increase of the detected VOCs in April. This was investigated; however, no abnormalities were found in the area on this day.

With the January 2021 through January 2022 data, there were only two VOCs detected at the Forsyth County monitoring site: toluene and TNMOC. Comparisons are made to the 2020 data for these two corresponding pollutants below.
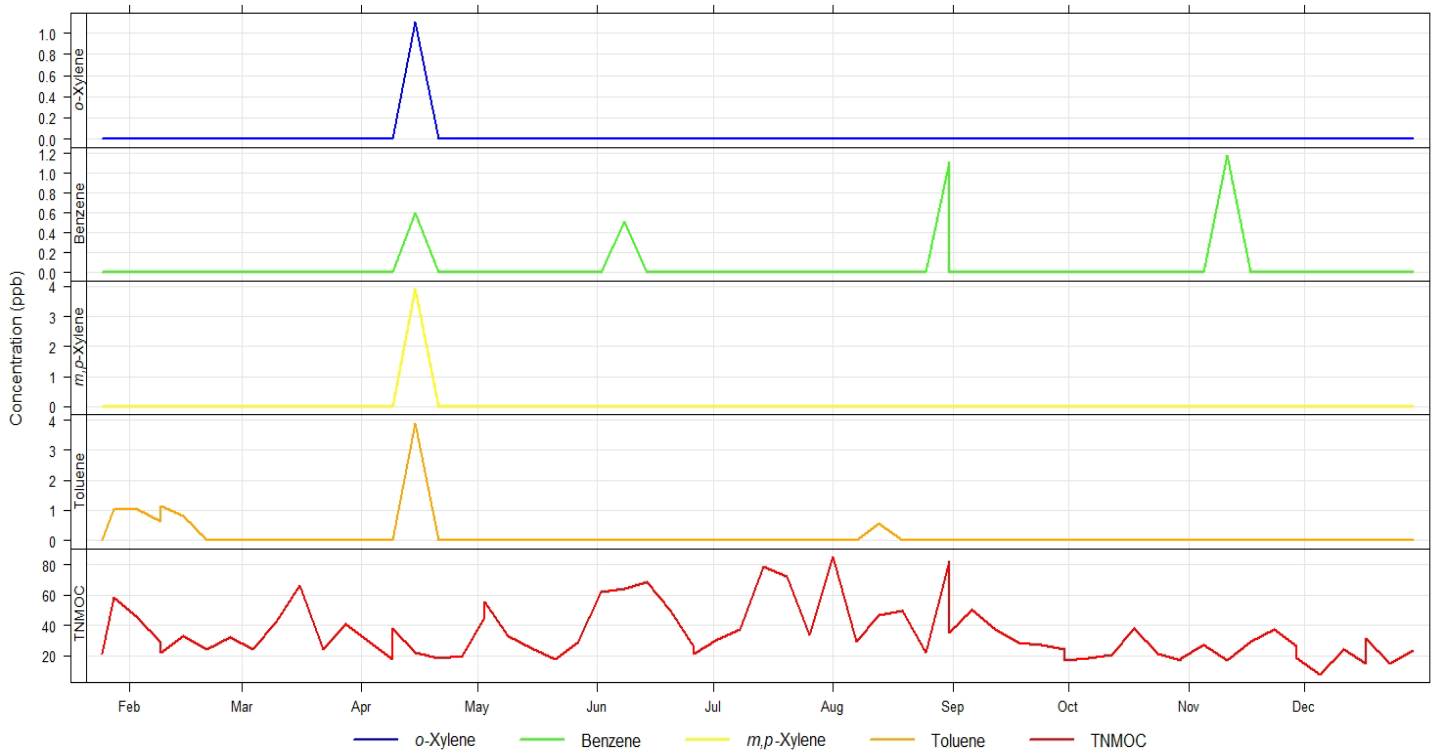
Figure 34. VOCs/TNMOC Concentrations at Forsyth County 2020
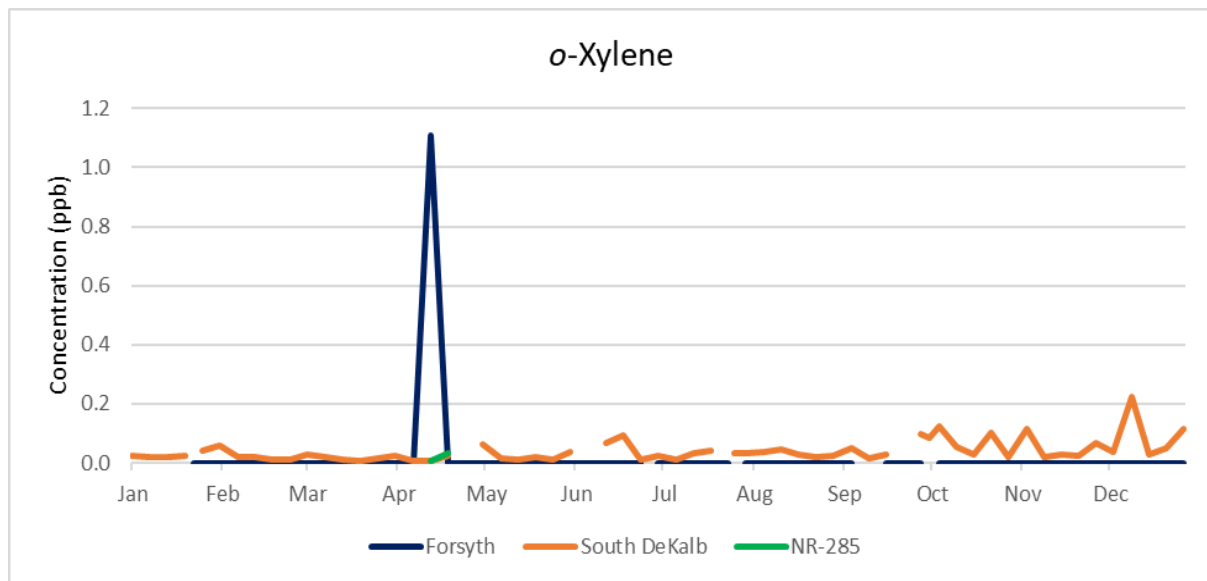
Figure 35. *o*-Xylene Comparisons 2020

With the January 2021 through January 2022 data, there were no detections of *o*-xylene at the Forsyth County monitoring site.
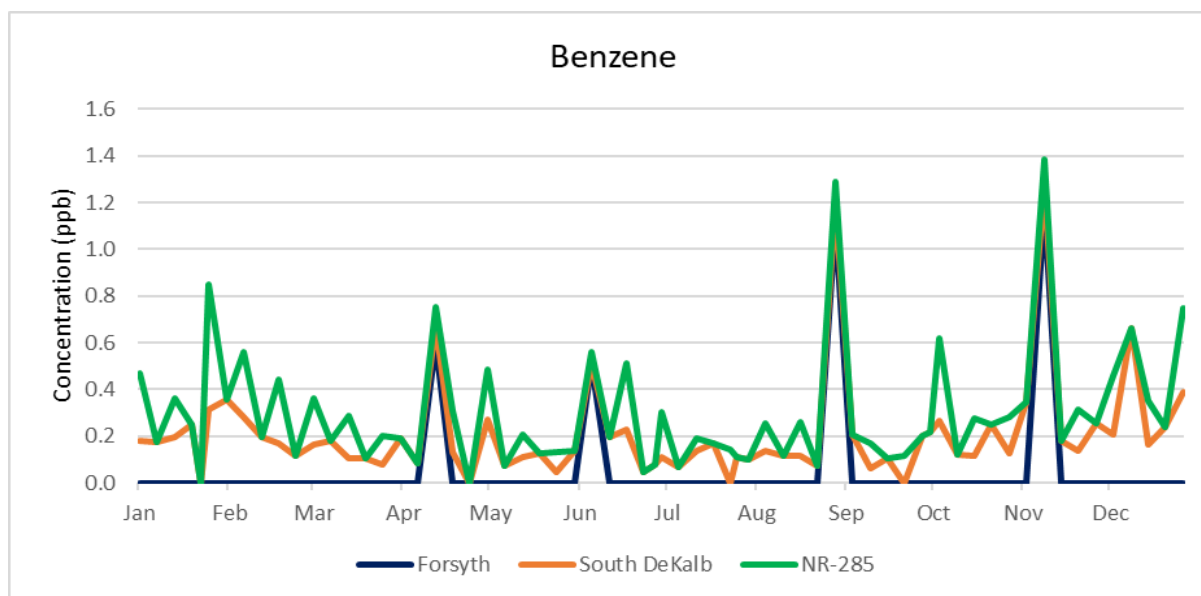
Figure 36. Benzene Comparisons 2020

With the January 2021 through January 2022 data, there were no detections of benzene at the Forsyth County monitoring site.
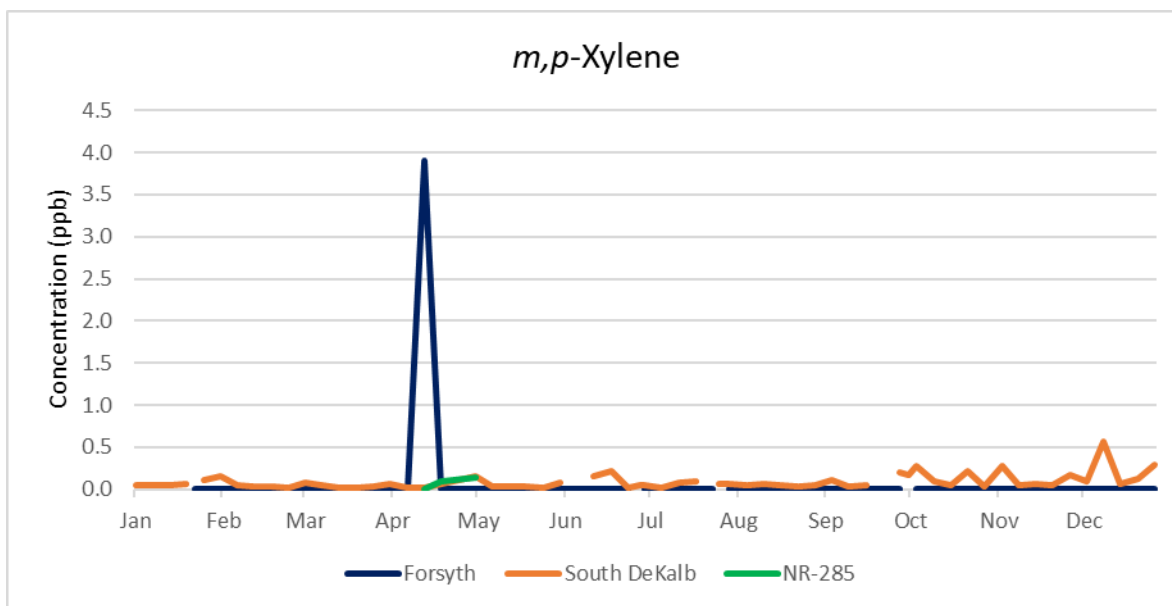
Figure 37. *m/p*-Xylene Comparisons 2020

With the January 2021 through January 2022 data, there were no detections of *m/p*-xylene at the Forsyth County monitoring site.
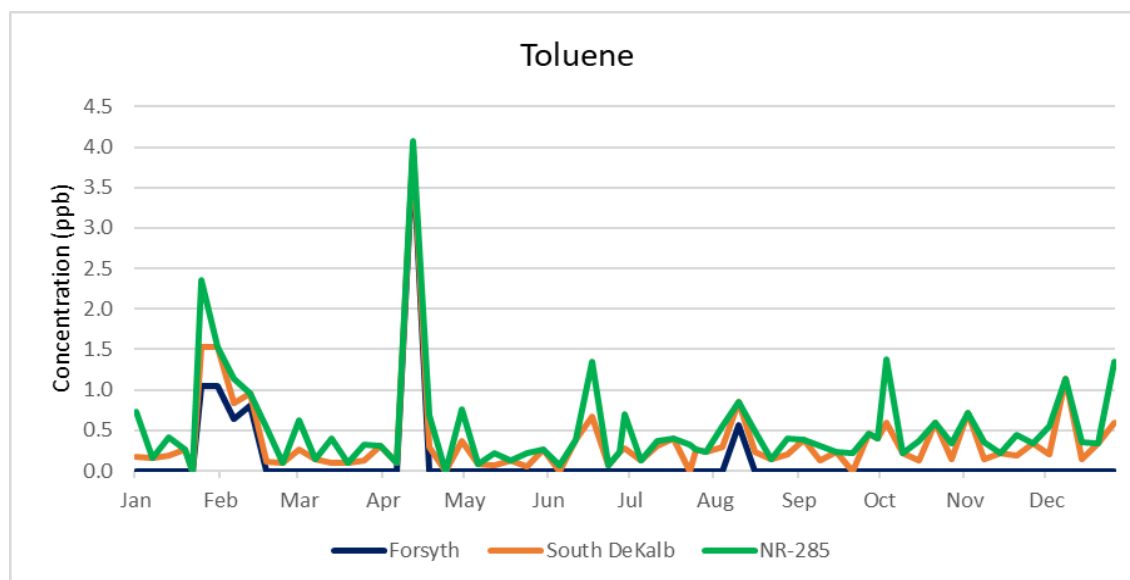
Figure 38. Toluene Comparisons 2020

Figure 39 and Figure 40 show the January 2021 through January 2022 for Forsyth County toluene and TNMOC compared to the GA AAMP sites that also collect toluene and TNMOC data, as applicable.

In Figure 39, the toluene data collected at the Forsyth County monitor (shown in dark blue) is compared to the South DeKalb (shown in orange) and NR-285 (shown in green) sites. The Forsyth County monitor had four detections of toluene, while the South DeKalb site had 65 detections, and the NR-285 site had 33 detections of toluene. The highest concentration of toluene detected at the Forsyth County monitor was 1.10 ppb, while the highest concentration at the South DeKalb site was 0.91 ppb, and the highest concentration at the NR-285 site was 1.08 ppb. It should be noted again that the Forsyth County and South DeKalb monitors collect this data every six days, while the NR-285 site collects data every twelve days.

For the TNMOC data comparison, the South DeKalb site collects data throughout the summer months (June through August); therefore, Figure 40 compares the TNMOC data detected at the Forsyth County site and the South DeKalb site for those three months. The highest concentration of TNMOC detected at the Forsyth County site (shown in blue) was 205.85 ppb. Although detected on another day, the South DeKalb site's (shown in orange) highest concentration detected was a comparable 197.43 ppb.
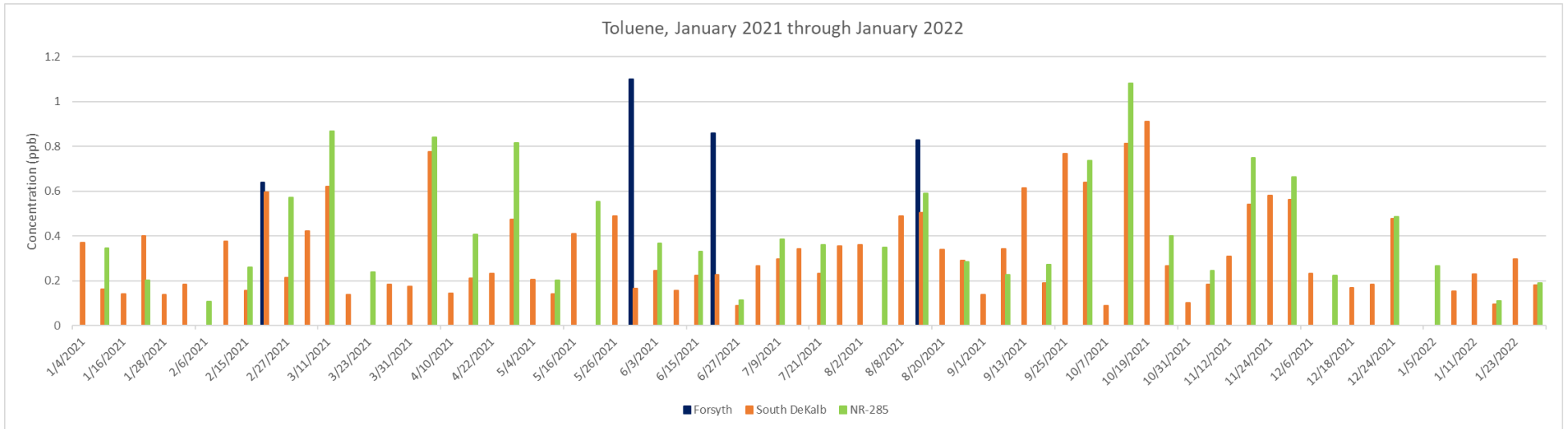
Figure 39. Toluene Comparisons January 2021 through January 2022
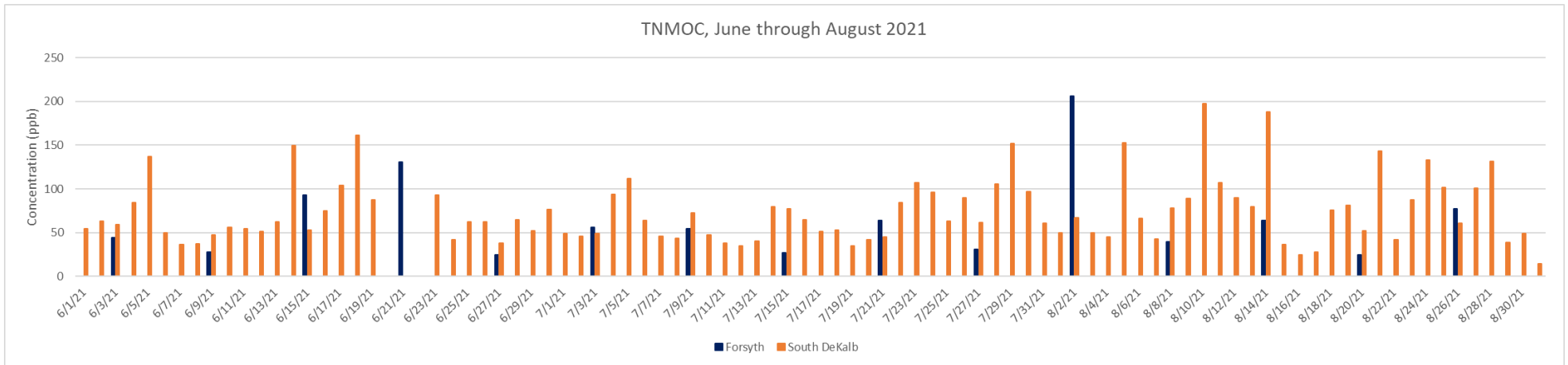
Figure 40. Forsyth and South DeKalb TNMOC, June through August 2021

VOCs Correlations

Correlations were performed between the 2020 VOCs detected at both Forsyth County and South DeKalb sites. The r values show no correlation of the VOCs detected at these two sites.

Table 1. VOCs Correlations for Forsyth County and South DeKalb Sites

Forsyth/South DeKalb	r Value
Benzene	-0.190
o-Xylene	-0.120
m/p-Xylene	-0.110
Toluene	-0.072

Correlations were performed between the 2020 VOCs detected at both Forsyth County and NR-285 sites. The r values show no correlation of the VOCs detected at these two sites.

Table 2. VOCs Correlations for Forsyth County and NR-285 Sites

Forsyth/NR-285	r Value
Benzene	-0.330
o-Xylene	-0.210
m/p-Xylene	-0.200
Toluene	-0.089

Correlations were performed between the January 2021 through January 2022 VOCs detected at both Forsyth County and NR-285 sites. Toluene and TNMOC were the only two VOCs detected. The r values show no correlation of the toluene or TNMOC detected at these two sites.

Table 3. VOCs Correlations for Forsyth County and South DeKalb Sites

Forsyth/South DeKalb	r Value
Toluene	0.015
TNMOC	0.079

Correlations were performed between the January 2021 to January 2022 VOCs detected at both Forsyth County and NR-285 sites. Toluene was the only VOC found at both these sites. The r value shows no correlation of the VOCs detected at these two sites.

Table 4. VOCs Correlations for Forsyth County and NR-285 Sites

Forsyth/NR-285	r Value
Toluene	0.116

5.0   Risk Assessment

The Forsyth County Risk Assessment was prepared by the Risk Assessment Program of EPD to understand whether long-term exposure to specific air toxics in ambient (outdoor) air around the Forsyth County air monitoring site could be harmful to human health. In summary, the overall cumulative potential cancer risk for the January 2020 through January 2022 hazardous air pollutants monitored at the Forsyth County site is 8×10^{-5} and the noncarcinogenic hazard index

is 2. Compared to the previous timeframe of January 2020 through December 2020, the overall cumulative potential cancer risk for hazardous air pollutants monitored at the Forsyth County site was 7 x 10^{-5} and the noncarcinogenic hazard index was 2. In comparison to risk assessments that have been done for the GA AAMP sites, the South DeKalb site, which was most recently assessed for all 2020 air toxics data (including metals, semi-VOCs, and VOCs) had an overall cumulative potential cancer risk of 2 x 10^{-3} and noncarcinogenic hazard index of 20. Refer to GA AAMP's *2020 Ambient Air Surveillance Report* for more detail about this GA AAMP risk assessment. For much more explanation and detail about the Forsyth County risk assessment, refer to the full report, which is included as Appendix A of this document.

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6.0   Summary Data

Table 5. 2020 Summary Data

Pollutant Name	Number of Samples	Number Detects	Maximum Value	Annual Arithmetic Mean
$PM_{2.5}$ ($\mu g/m^3$)	8760	8278	56.7	8.38
Benzene (ppb)	58	4	1.18	0.06
1,3-Butadiene (ppb)	58	0	N/A	N/A
Chloroform (ppb)	58	0	N/A	N/A
1,2-Dichloroethane (ppb)	58	0	N/A	N/A
N-Hexane (ppb)	58	0	N/A	N/A
Methylene Chloride (ppb)	58	0	N/A	N/A
Toluene (ppb)	58	6	3.91	0.14
Trichloroethylene (ppb)	58	0	N/A	N/A
Vinyl Chloride (ppb)	58	0	N/A	N/A
m/p-Xylene (ppb)	58	1	3.91	0.07
o-Xylene (ppb)	58	1	1.11	0.02
TNMOC (ppb)	58	58	85.3	35.33

Table 6. January 2021 through January 2022 Summary Data

Pollutant Name	Number of Samples	Number Detects	Maximum Value	Annual Arithmetic Mean
$PM_{2.5}$ ($\mu g/m^3$)	9504	8863	69.5	9.40
Benzene (ppb)	65	0	N/A	N/A
1,3-Butadiene (ppb)	65	0	N/A	N/A
Chloroform (ppb)	65	0	N/A	N/A
1,2-Dichloroethane (ppb)	65	0	N/A	N/A
N-Hexane (ppb)	65	0	N/A	N/A
Methylene Chloride (ppb)	65	0	N/A	N/A
Toluene (ppb)	65	4	1.1	0.05
Trichloroethylene (ppb)	65	0	N/A	N/A
Vinyl Chloride (ppb)	65	0	N/A	N/A
m/p-Xylene (ppb)	65	0	N/A	N/A
o-Xylene (ppb)	65	0	N/A	N/A
TNMOC (ppb)	65	65	205.85	36.05

Appendix A. Risk Assessment Prepared by the Risk Assessment Program of GA EPD

5 Main Takeaways from the *Ambient Air Monitoring Report: Risk Assessment for Select Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation* ("24 Months Risk Assessment")

Below are 5 major takeaways from the 24 Months Risk Assessment to help Forsyth County residents understand whether the ambient air concentrations of specific Hazardous Air Pollutants (HAPs) that were measured around the Eagle Point Landfill pose a concern. It is recommended that the 24 Months Risk Assessment is read in its entirety for more information.

1) This risk assessment was prepared using the results from 65 ambient air samples collected from January 2021-January 2022. Only 10 specific HAPs[1] were selected to be measured in these samples based on previous data from the United States Environmental Protection Agency. The samples were collected at an air monitoring station installed at Eagle's Beak Park, which is next to the Landfill.

2) This risk assessment found that if a hypothetical Forsyth County resident (someone who resides in the vicinity of Eagle's Beak Park and the Landfill) is exposed to the 10 HAPs for a long period of time:

    a. Out of 100,000 residents, 8 cancer cases could be expected to occur (cumulative cancer risk of 8×10^{-5})

        i. The *Ambient Air Monitoring Report: Risk Assessment for Select Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, First 12 Months of Operation* ("12 Months Risk Assessment") in the 2020 *Forsyth County Air Quality Monitoring Report* found that out of 100,000 residents, 7 cancer cases could be expected to occur (cumulative cancer risk of 7×10^{-5}). This difference is a result of how the ambient air exposure concentration (EC) was determined for Vinyl Chloride in the 24 Months Risk Assessment compared to the 12 Months Risk Assessment and does not necessarily indicate that the concentrations of HAPs in ambient air increased from January 2020 to January 2022.

    b. Given what is currently known, it is unlikely that a resident would experience other adverse health effects solely because of exposure to the 10 HAPs.

        i. This finding is consistent with the 12 Months Risk Assessment.

3) This risk assessment cannot determine whether someone who has cancer or a noncancer health effect (e.g. eye cataracts) developed cancer/noncancer health effect as a result of exposure to HAPs in ambient air.

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[1] Benzene, 1,3-Butadiene, Chloroform, Ethylene Dichloride (1,2-Dichloroethane, 1,2-DCE), Hexane, Methylene Chloride (Dichloromethane), Toluene, Trichloroethylene, Vinyl Chloride, and Xylenes (as m,p-Xylene and o-Xylene)

4) It is important to emphasize that the concentrations of the 10 HAPs in ambient air may not necessarily be attributable either in whole or part to landfill gas emissions from the Eagle Point Landfill and could also have originated from other sources.

5) It is important to note that the cancer risks (for each HAP and for all 10 HAPs cumulatively) determined in the 24 Months Risk Assessment are within the Georgia Environmental Protection Division (EPD) Air Protection Branch acceptable cancer risk range ($1x10^{-4}$ to $1x10^{-6}$). EPD considers risks that fall within the acceptable cancer risk range to be acceptable, meaning that concentrations of HAPs in ambient air at or in the vicinity of the Eagle Point Landfill/Eagle Beak Park are not expected to pose a concern to the vast majority of Forsyth County residents.

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

Prepared to fulfill requirements under the Georgia Environmental Protection Division (GA EPD) Air Quality Monitoring Agreement with Forsyth County, Georgia (Entered February 4, 2019)

Appendix to the 2021 *Forsyth County Air Quality Monitoring Report*

Table of Contents

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

Tables

Figures

Appendices
Appendix A – HAPs Sample Results
Appendix B – Toxicity Values, Cancer RSLs/Noncancer RSLs, and Equations
Appendix C – Supporting RSL Calculator Output
Appendix D – TOSHI Technical Documentation

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

Acronyms

- $\mu g/m^3$ – micrograms per cubic meter
- 1,2-DCE –1,2- Dichloroethane
- AAMP – EPD Air Protection Branch Ambient Air Monitoring Program
- AQMA – Air Quality Monitoring Agreement
- ATSDR – Agency for Toxic Substances and Disease Registry
- AQS – Air Quality System
- CA – Contaminant Concentration in Air
- CalEPA – California Environmental Protection Agency Office of Environmental Health Hazard Assessment
- EC – Exposure Concentration
- EBP – Eagle's Beak Park
- EPL – Eagle Point Landfill
- GAEPD, EPD – Georgia Environmental Protection Division
- HAP – Hazardous Air Pollutant
- HEAST - USEPA Superfund Program Health Effects Assessment Summary Table
- HI – Hazard Index
- HQ – Hazard Quotient
- IUR – Inhalation Unit Risk
- MDC – Maximum Detected Concentration
- MRL – ATSDR Minimal Risk Levels
- NMOC – Non-methane organic compounds
- OAQPS – EPA's Office of Air Quality Planning and Standards
- ppb (v/v) – parts per billion volume
- PPRTV – USEPA Provisional Peer-Reviewed Toxicity Value
- RAP – EPD Risk Assessment Program
- RfC – Reference Concentration
- RSL – USEPA May 2022 Resident Air Regional Screening Level
- SRL – Sample Reporting Limit
- TCE – Trichloroethylene
- USEPA, EPA – United States Environmental Protection Agency
- 95% UCL – 95% upper confidence limit of the arithmetic mean

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

Important Definitions

- Air Toxics: Defined "*Any air pollutant that causes or may cause cancer, respiratory, cardiovascular, or developmental effects, reproductive dysfunctions, neurological disorders, heritable gene mutations, or other serious or irreversible chronic or acute health effects in humans.*" (USEPA, 2004, glossary)

- Ambient Air: outdoor air external to buildings

- Cancer Risk: also referred to as "risk"; the predicted risk of cancer "*from the exposure being analyzed that is above the risk that the individuals in the population have already (i.e., due to non-air toxics related issues)*" (USEPA, 2004; pg. 13-5)

- Cumulative Cancer Risk: The total cancer risk which is obtained by summing the cancer risk of individual air toxics

- Contaminant Concentration in Air (CA): An estimate of the chronic (long-term) ambient air concentration of that air toxic at the Station.

- Exposure Concentration (EC): Generally defined as the "*concentration of a chemical in the air at the point where a person breathes the air*" (USEPA, 2004, pg. 6-17). In the context of this Risk Assessment, the EC is a time-weighted contaminant concentration in air (CA) which takes into account the frequency, duration, and time of exposure as well as the time period over which the exposure is averaged (USEPA, 2009, pg. 13 to 17). The EC is the ambient air concentration of a HAP that an individual resident could be exposed to.

- Hazardous Air Pollutant (HAP): Refers to any of the 10 air toxics (m/p-Xylene and o-Xylene are considered as Xylenes but are assessed separately) that are being assessed.

- Hazard: Also referred to as "noncancer hazard". Defined as the potential harm from noncarcinogenic air toxics (USEPA, 2004; pg. 13-4)

- Hazard Index (HI): A value which describes the total noncancer hazard which is derived by summing the hazard quotients (HQs) determined for individual HAPs.

- Hazard Quotient (HQ): A value obtained by dividing the exposure concentration (EC) by the reference concentration (RfC). An HQ above 1 indicates that there may be a potential for an adverse noncancer effect.

- High-End Risk Estimate: an "*estimate [of the cancer] risk that is expected to occur in the upper range of the distribution (e.g., risk above about the 90th percentile of the population distribution)*" (USEPA, 2004, pg. 13-4)

- Inhalation Unit Risk (IUR): "*the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 μg/m³ in air*" (USEPA, 2009, pg. 10)

- Maximum Detected Concentration (MDC): out of all ambient air samples in which a particular HAP was detected, the MDC is the largest of those detected results

- Reasonable Maximum Exposure (RME): "*highest exposure that is reasonably expected to occur at a site*" (USEPA, 1989; pg. 6-5).

- 12 Months Risk Assessment: Refers to the document, *Ambient Air Monitoring Report: Risk Assessment for Select Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, First 12 Months of Operation*

4

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

- 24 Months Risk Assessment: Refers to the *Ambient Air Monitoring Report: Risk Assessment for Select Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation*, which is this document and all supporting appendices.
- Risk Manager: "*persons or groups with the authority to make the decisions about the acceptability of risk and how an unacceptable risk may be mitigated, avoided, or reduced*" (USEPA, 2004, pg. 5-10)
- Reference Concentration (RfC): "*defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer health effects during a lifetime*" (USEPA, 1994; pg. 1-2 to 1-4)
- Resident Air Regional Screening Level (RSL): Air screening levels developed by USEPA. The Cancer RSL is derived at a cancer risk of 10^{-6} and the Noncancer RSL is derived at a hazard quotient of 0.1
- Sample Reporting Limit (SRL): The lowest concentration for a particular HAP that the analytical laboratory will report on an analytical laboratory report. Concentrations below the SRL are not reported.
- 95% Upper Confidence Limit (UCL): the "*upper boundary (or limit) of a confidence interval [95% in this case] of a parameter of interest such as the population mean*" (USEPA, 2015; pg. 22).

5

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

Disclaimer

Every effort has been made to use current and technically defensible risk assessment methodologies to prepare the *Ambient Air Monitoring Report: Risk Assessment for Select Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation* ("24 Months Risk Assessment"). However, the methodologies used herein may not necessarily be applicable or relevant when preparing human health or ecological risk assessments required under State or Federal statutes and regulations (e.g. Georgia Hazardous Site Response Act, Resource Conservation and Recovery Act, etc.). Under no circumstances should the 24 Months Risk Assessment be construed as EPD risk assessment policy. The 24 Months Risk Assessment does not substitute State or Federal statutes and regulations and is not a regulation itself.

6

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

Section 1 - Introduction

This *Ambient Air Monitoring Report: Risk Assessment for Select Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation* (hereafter referred to as "24 Months Risk Assessment")[1] was prepared on behalf of the Georgia Environmental Protection Division (GAEPD) Air Protection Branch Ambient Air Monitoring Program (AAMP) by the GAEPD Land Protection Branch Risk Assessment Program (RAP). This Risk Assessment was prepared per the requirements of GAEPD's Air Quality Monitoring Agreement (AQMA)[2] with Forsyth County, Georgia, a political subdivision of the State of Georgia acting by and through its Board of Commissioners (hereafter referred to as "County"). GAEPD entered into the AQMA with the County on February 4, 2019.

The AQMA stemmed from the County's desire to address the issue of ambient air quality around Eagle Point Landfill (EPL), which is in northwest Forsyth County (address: 8880 Old Federal Rd, Ball Ground, GA, 30107). The County recognized the air quality in the vicinity of EPL as a matter of public health concern and decided to set up an air quality monitoring station ("Station") next to the EPL at Forsyth County's Eagle's Beak Park (address: 8400 Old Federal Rd. Ball Ground, GA. 30107). Please refer to the maps and pictures in the main text of the 2021 *Forsyth County Air Quality Monitoring Report* for more information.

Per the AQMA, it was decided that the following hazardous air pollutants (HAPs) would be monitored at the Station:

- Benzene
- 1,3-Butadiene
- Chloroform
- Ethylene Dichloride (1,2-Dichloroethane, 1,2-DCE)
- Hexane
- Methylene Chloride (Dichloromethane)
- Toluene
- Trichloroethylene
- Vinyl Chloride
- Xylenes – analyzed as:
    - m/p-Xylene
    - o-Xylene

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[1] The term "12 Months Risk Assessment" will be used to refer to the *Ambient Air Monitoring Report: Risk Assessment for Select Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, First 12 Months of Operation*, which is Appendix A of the 2020 *Forsyth County Air Monitoring Report* that can be found on the Forsyth County, Georgia government website at: https://www.forsythco.com/Departments-Offices/Recycling-Solid-Waste/Environmental-Compliance.

[2] A copy of the AQMA can be found on the Forsyth County local government website: https://www.forsythco.com/Departments-Offices/Recycling-Solid-Waste/Environmental-Compliance. An executed amendment of the AQMA was provided to the County by EPD on August 5, 2020. Please contact AAMP concerning the executed amendment.

As mentioned in the AQMA, these HAPs were selected for monitoring based on the following criteria (determined after a review of landfill gas test results from USEPA[3]):

- Are present in a significant number in USEPA's test results
- Present in higher concentrations in USEPA's test results
- The relative toxicity of the HAP

HAPs, along with fine inhalable particles 2.5 μm and smaller (PM$_{2.5}$) and non-methane organic compounds (NMOC), have been monitored at the Station. The 24 Months Risk Assessment focuses on assessing the cancer risk and noncancer hazard that could result from long-term (chronic) inhalation of the monitored HAPs by analyzing samples collected at the Station from January 4, 2021 to January 30, 2022. The results from the 12 Months Risk Assessment (samples collected from January 25, 2020 to December 29, 2020) are also presented and any differences between those results and the results of the 24 Months Risk Assessment have been explained. The 24 Months Risk Assessment was primarily prepared in accordance with USEPA's *Air Toxics Risk Assessment Reference Library: Volume 1 Technical Resource Manual* (USEPA, 2004). However, other risk assessment guidance documents have been consulted as necessary to ensure that the Risk Assessment reflects current technical recommendations and best practices. Supporting information necessary to understand the conclusions of the 24 Months Risk Assessment have been referenced or included in the Appendices. Section 4 describes the uncertainties inherent to the 24 Months Risk Assessment.

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[3] An explanation into the analysis of USEPA landfill gas test results is beyond the scope of this Risk Assessment. Please contact AAMP for further information concerning how the 10 HAPs were selected.

Section 2: Data Collection and Evaluation

Section 2.1 – Sample Collection and Quality Assurance

Individual ambient air samples were collected over a 24-hour period through a stainless-steel air canister and analyzed at the laboratory for NMOCs and HAPs (only risk and hazard estimates are determined for HAPs in the 24 Months Risk Assessment). HAPs were analyzed by EPA Method TO-15[4]. Samples were collected from January 4, 2021 to January 30, 2022 once every 6 calendar days[5]. The rotating sampling frequency helps to account for possible sample variation due to human activity or traffic patterns and allows for the determination of a representative contaminant concentration in air (CA). All sample results have been quality assured by the AAMP Quality Assurance Unit.

During the quality assurance process, the AAMP Quality Assurance Unit qualified all sample results using the data qualifiers from EPA's Air Quality System (AQS)[6]. All HAPs data were qualified with a "2" (Operational Deviation) qualifier due to one or more of the following reasons: 1) there was > 0.5 psi difference between the air canister pressure measured during retrieval of the air canister from the Station and the air canister pressure measured upon receipt at the laboratory, 2) the relative percent difference (RPD) between the primary and collocated sample was greater than 25%, and 3) the laboratory took more than 30 days to analyze the sample. One or more of these operational deviations did not result in any sample results being deemed unusable by the AAMP Quality Assurance Unit.

Section 2.2 – Conversion of the Ambient Air Monitoring Results

The HAP sample results and corresponding Sample Reporting Limits (SRLs)[7] were provided by the laboratory in units of parts per billion volume (ppb v/v) and were converted to units of micrograms per cubic meter ($\mu g/m^3$) using the following formula:

$$\frac{MW \times ppb\ (v/v)}{24.45} = \text{HAP concentration in } \mu g/m^3$$

Where:

- MW = Molecular weight of HAP in g/mole
- ppb (v/v) = HAP concentration, in parts per billion (v/v)
- 24.45 = "*volume in liters of one mole of an ideal gas at 1 atmosphere and 25 degrees Celsius*" (see USEPA, 2004, pg. 9-8)

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[4] Please contact AAMP if more information is required concerning this analytical method.

[5] At the Station, another set of ambient air samples (known as "collocated samples") were collected. Collocated sample results have not been used to prepare the 24 Months Risk Assessment since collocated samples were not necessarily collected at the same frequency and are collected for quality assurance purposes. Sample results from the collocated air monitor have been included with the sample results in Appendix A (collocated samples are marked with a 2 next to the HAP name).

[6] Please see: https://aqs.epa.gov/aqsweb/documents/codetables/qualifiers.html

[7] In the dataset provided in Appendix A, SRLs are referred to as "minimum detectable limits" due to a slight difference in terminology used by the laboratory and the Quality Assurance Unit. To avoid confusion with the term method detection limit, MDL, which is used in various regulatory programs and described in Appendix B Revision 2 of 40 C.F.R. 136 (https://www.ecfr.gov/cgi-bin/text-idx?SID=984728bcf594005272018e017af94327&mc=true&node=ap40.25.136_17.b&rgn=div9) , the laboratory's terminology has been used throughout the 24 Months Risk Assessment.

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

The sample results have been included in Appendix A and contain the unconverted NMOC and collocated sample results which were not used to prepare the 24 Months Risk Assessment.

Section 2.3 – Detects and Non-detects

A HAP in an ambient air sample is considered not detected (nondetect) if the HAP result is qualified with an ND ("No Value Detected, Zero Reported") qualifier. The laboratory only reports the concentration of a HAP if that concentration is equal to or above the Sample Reporting Limit (SRL); a reported concentration is considered to have been detected (detect). In a particular ambient air sample, an ND-qualified HAP result indicates that the HAP was not present in that sample at or above the HAP's SRL. During quality assurance of the laboratory data, the AAMP Quality Assurance Unit assigned all nondetect HAP results a concentration of 0 ppb(v/v) to be consistent with the AQS. However, it is necessary to emphasize that even if a HAP was nondetect, the HAP could be present in the sample at any concentration below the SRL.

Section 3: Chronic, Inhalation Risk Assessment

Section 3.1 – Study-Specific Conceptual Model

The study-specific conceptual model "*explicitly identifies the sources, receptors, exposure pathways, and potential adverse human health effects that the risk assessment will evaluate*" (USEPA, 2004, pg. 6-1). This allows risk managers and the public to understand exactly what is being evaluated. USEPA (2004) recommends specific elements that should be included in a conceptual model, which has been graphically displayed in Figure 1 and further explained below.

Source	Multiple sources, possibly including landfill gas emissions from Eagle Point Landfill but also background concentrations
Stressor	10 Hazardous Air Pollutants (HAPs) measured at the Eagle Beak Park air quality monitoring station
Exposure Pathway	Exposure to HAPs in ambient air
Exposure Route	Inhalation
Subpopulation	Hypothetical Forsyth County resident residing near Eagle Point Landfill and Eagle Beak Park for an extended period
Endpoint	Cancer risk and noncancer hazard
Metrics	Estimated by deriving cancer risk and noncancer hazard estimates for individual chemicals with toxicity values and using these estimates to derive cumulative cancer risk and hazard index

Figure 1: Study-specific conceptual model made similar to the conceptual model in Exhibit 6-1 of USEPA (2004).

Section 3.1.1 – Sources of Air Toxics

The HAPs present in ambient air are a "*combination of background concentrations and the same chemical released from possibly multiple sources*" (USEPA, 2004, pg. 10-37). The HAPs measured at the Station could possibly represent landfill gas emissions from EPL (or the landfill gas emissions from EPL could contribute partly to the HAPs concentrations observed), but the 24 Months Risk Assessment is not able to directly attribute the measured HAPs in ambient air to EPL.

Section 3.1.2 – Stressors

The stressors are the specific air toxics that will be evaluated, which in this case are the 10 HAPs.

Section 3.1.3 – Exposure Pathway/Exposure Route

This risk assessment only evaluates exposure to HAPs resulting from inhalation of ambient (outdoor) air since only validated air monitoring data is available. Though indoor air has not been evaluated, "*indoor air concentrations of air toxics are expected to be the same or lower than the outdoor concentrations*" (USEPA, 2004, pg. 11-2). An individual could possibly be exposed to air toxics that have deposited out of the ambient air onto water bodies, plants, soil, and/or other surfaces (USEPA, 2004, pg. 6-2), but other exposure pathways and routes have not been evaluated since atmospheric deposition data is not available.

Section 3.1.4 – Subpopulation

The estimates discussed in Section 3.4.1 of the 24 Months Risk Assessment could be said to represent the risk and/or hazard to a hypothetical Forsyth County resident who lives in the vicinity of EBP and EPL. More specifically, the 24 Months Risk Assessment theoretically assumes that the hypothetical resident is continuously inhaling HAPs in ambient air around-the-clock at the air monitoring Station for an upper-bound length of time (i.e. longer than an average length of time that a resident would be expected to reside in one area[8]). Deriving risk/hazard estimates in such a manner ensures that any risk management decisions based on these estimates would also protect individuals (e.g. visitors to Forsyth County) who might be exposed to HAPs in ambient air for a shorter length of time.

Section 3.1.5 – Endpoints and Metrics

Endpoints are specific harmful effects that could occur because of being exposed to air toxics in ambient air. This risk assessment will not evaluate specific endpoints but will provide quantitative estimates of the cancer risk and noncancer hazard from exposure to HAPs. Cancer risk and noncancer hazard for all HAPs have been estimated using USEPA's RSL Calculator[9], and the cancer risk estimates and hazard quotients are summed to obtain the cumulative cancer risk and hazard index (HI), respectively.

Section 3.2 – Exposure Assessment

To determine the risk and/or hazard for each HAP, an exposure concentration (EC) must be estimated for each HAP. The EC generally can be defined as the "*concentration of a chemical in*

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[8] As shown in Table 2 of this Risk Assessment, 26 years is the exposure duration based on the 90th percentile value in Table 16-108 of USEPA (2011a). According to Table 16-108, an estimate of the average (arithmetic mean) residential occupancy period is 11.7 years. Thus 11.7 years is an estimate of the average time that a resident could reside near the Station, but this Risk Assessment assumes that the resident is residing for a longer than average time to ensure that the risk/hazard estimates would also be protective of residents who may be residing for less time. Please also see the following link to Table 16-108: https://www.epa.gov/sites/production/files/2015-09/documents/efh-chapter16.pdf#page=195

[9] Link to USEPA RSL Calculator: https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search

the air at the point where a person breathes the air" (USEPA, 2004, pg. 6-17). The EC is estimated as a time-weighted contaminant concentration in air (CA) which considers the frequency, duration, and time of exposure as well as the time over which the exposure is averaged (USEPA, 2009, pg. 13 to 17)[10] and is an estimate of the amount of HAP that a hypothetical resident (as defined in Section 3.2.2) *has the potential* to inhale if they are in the vicinity of Eagle Beak Park/EPL (technically, if the resident is exactly at the Station).

Section 3.2.1 – Estimating the Contaminant Concentration in Air (CA) for a HAP
The CA for a particular HAP is an estimate of the chronic (long-term) ambient air concentration of a HAP. A list of all CAs has been provided in Table 1. The CA is time-weighted to obtain the EC.

Table 1: Contaminant Concentration in Air (CA) for each HAP

HAP	CAS Number	Detection Frequency	Contaminant Concentration in Air (CA) ($\mu g/m^3$)	Basis
Benzene	71-43-2	0/65	1.60	Highest Sample Reporting Limit (SRL)
Butadiene, 1,3-	106-99-0	0/65	1.11	Highest SRL
Chloroform	67-66-3	0/65	2.44	Highest SRL
Dichloroethane, 1,2- (Ethylene Dichloride)	107-06-2	0/65	2.02	Highest SRL
Hexane	110-54-3	0/65	1.76	Highest SRL
Methylene Chloride (Dichloromethane)	75-09-2	0/65	3.47	Highest SRL
Toluene	108-88-3	4/65	4.15	Maximum Detected Concentration (MDC)
Trichloroethylene	79-01-6	0/65	2.69	Highest SRL
Vinyl Chloride	75-01-4	0/65	2.56	Highest SRL
Xylene, m,p-*	108-38-3	0/65	4.34	Highest SRL
Xylene, o-	95-47-6	0/65	4.34	Highest SRL

*Inputted into the RSL Calculator as m-Xylene; please see Section 3.3.4 for more explanation
Detection Frequency: the number of samples where a HAP was detected (i.e. had a result that was not ND-qualified) out of the total number of samples

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[10] It is important to clarify that the term exposure concentration (EC) is interpreted in USEPA (2004) to be equivalent to the contaminant concentration in air (CA) as defined in this risk assessment. This is because USEPA (2004) recommends deriving risk and/or hazard estimates by directly using the CA. However, the RSL Calculator follows the methodology from USEPA (2009) and uses a time-weighted CA as an estimate of the EC that is subsequently used to derive the final risk and/or hazard estimate.

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

To obtain a CA, USEPA (2004) recommends deriving the 95% upper confidence limit of the arithmetic mean (95% UCL) of all valid ambient air sample results collected over 12 months and using the 95% UCL as an estimate of the CA (USEPA, 2004, pg. I-4 and I-5). The 95% UCL is intended to be a "*public health protective estimate of the true annual average*" of all valid ambient air sample results collected over the 12 months since a "*simple arithmetic mean of sampling results may underestimate, approach, or overestimate the true annual average*" (USEPA, 2004, pg. I-4). Even though rotating sampling frequency helps to curb variations due to human activity or traffic patterns, USEPA (2004) indicates that there are still uncertainties to using an arithmetic mean to determine the CA for reasons such as potential inaccuracies with individual measurements and daily variability in concentrations (USEPA, 2004, pg. I-4).

A 95% UCL could not be determined for any of the HAPs since all or most of the sample results were nondetect. EPA guidance indicates that a reliable 95% UCL necessitates greater than or equal to 4 detects in a sample dataset (USEPA, 2015, pg. 59). For the HAPs except Toluene where all sample results were nondetect, the highest sample reporting limit (SRL) was used as an estimate of the CA. Though Toluene had exactly 4 detects, the maximum detected concentration (MDC) was used as a public health protective estimate of the CA since the large proportion of nondetects in the Toluene dataset increases the uncertainty in the 95% UCL.

Section 3.2.2 – How the Exposure Concentration (EC) is Determined from the CA
As previously mentioned, the EC is a time-weighted CA which considers the frequency, duration, and time of exposure as well as the time period over which the exposure is averaged (USEPA, 2009, pg. 13 to 17). However, the EC has not been directly calculated in the 24 Months Risk Assessment since the risk and/or hazard estimates provided in Section 3.4.1 were derived using USEPA's RSL Calculator. According to Section 2.6.1 of the RSL User's Guide, the RSL Calculator derives risk/hazard estimates for each HAP in accordance with the following equations which only requires the contaminant concentration in air (CA) as the input.

Cancer Risk = (C × TR) / Cancer RSL

Noncancer Hazard Quotient (HQ) = (C × THQ) / Noncancer RSL

Where:

- C = contaminant concentration in air (CA) of the HAP
- TR = 1×10^{-6}
- THQ = 0.1
- Cancer RSL = May 2022 USEPA Cancer Resident Air Regional Screening Level (RSL) of the HAP derived at a cancer risk level of 1×10^{-6}.
- Noncancer RSL: May 2022 USEPA Noncancer Resident Air Regional Screening Level (RSL) of the HAP derived at a hazard quotient (HQ) of 0.1.

The Cancer RSLs and Noncancer RSLs were already derived using the default residential parameters in Table 2. Please see Appendix B for a table with the Cancer RSLs and Noncancer RSLs and the equations used to derive these RSLs. Dividing by the RSL automatically time-weights the CA so that the final risk and/or hazard estimate accounts for the residential parameters

in Table 2 and thus is based on a residential exposure scenario. These residential exposure parameters are recommended in EPA guidance and represent reasonable maximum exposure (RME) conditions that "*account for daily exposure over the long term and generally result in the highest potential exposures and risk*" but do not represent the worst possible risk and/or hazard (USEPA, 1991, pg. 2-3). The risk and/or hazard estimates discussed in Section 3.4.1 of the Risk Assessment represent a hypothetical resident inhaling ambient air at the Station for longer than an average length of time and where that hypothetical resident could be exposed to concentrations of HAPs. Deriving risk/hazard estimates based on a residential scenario ensures that risk management decisions based on these estimates would also be protective of others (visitors, workers, etc.) who would be expected to have lower exposure to the HAPs present in ambient air around EPL and EBP.

Table 2: Default Residential Parameters used in the RSL Calculator to Determine the Exposure Concentration (EC)

ED	Exposure duration	26 years	26 years is a default exposure duration value used in the residential exposure scenario. The value is obtained from Table 16-108; 90th percentile for current residence time in USEPA (2011a). 26 years is a conservative assumption for the total length of time an individual resident could inhale ambient air chemicals in the vicinity of (technically, exactly at) the Station.
EF	Exposure frequency	350 days/year	This value is from page 15 of USEPA (1991) and is a residential exposure frequency. Though 365 days/year (every day per year) is a more conservative exposure frequency, USEPA believes that "*the common assumption that workers take two weeks of vacation per year can be used to support a value of 15 days per year spent away from home (i.e., 350 days/year spent at home)*" (USEPA, 1991, pg. 5). 350 days/year is still a conservative EF but better represents RME conditions.
ET	Exposure time	24 hours/day	A resident is assumed to be able to be exposed to environmental chemicals for a maximum of 24 hours a day (USEPA, 1989, pg. 6-6). 24 hours/day is the maximum amount of time per day that an individual could inhale an air toxic within the spatial scale of an air monitoring Site. Thus, this exposure factor is conservative.
LT	Lifetime	70 years	70 years is a standard assumption used by USEPA (USEPA, 1989, pg. 6-22) to represent a hypothetical individual's lifetime and is the length of time over which exposure to a carcinogenic HAP is prorated. This assumes that exposure to a higher amount of carcinogen over a short period of time is equivalent to exposure to a corresponding lower concentration of carcinogen spread out over a lifetime (USEPA, 2005a, pg. 3-26).

Section 3.3 – Toxicity Assessment
The purpose of the toxicity assessment is to identify the cancer and noncancer effects of a chemical [hazard identification] and to quantify its toxicity [dose-response assessment] (USEPA, 2004, pg. 12-1). For many of the chemicals, toxicity assessments have already been conducted by toxicologists either at USEPA or another Federal/State agency. Thus, the focus of this section is to briefly explain the toxicity values that are used to derive risk/hazard estimates.

Section 3.3.1 – Toxicity Values
During the toxicity assessment, the information from the hazard identification and dose-response assessment are translated into specific toxicity values. Two kinds of toxicity values are used in the risk assessment to evaluate inhalation: the reference concentration (RfC) and the inhalation unit risk (IUR).

The RfC "*is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncarcinogenic health effects during a lifetime*" (USEPA, 1994, pg. 1-2 to 1-4). Please consult USEPA (1994) and a chemical's noncancer toxicity assessment for more information on how a RfC is derived.

The IUR is defined as "*the upper-bound excess lifetime carcinogenic risk estimated to result from continuous exposure to an agent at a concentration of 1 μg/m³ in air*" (USEPA, 2009, pg. 10). Please consult USEPA (2005a) and a chemical's cancer toxicity assessment for more information on how an IUR is derived.

Appendix B lists the toxicity values for all HAPs. Since the purpose of this risk assessment is to assess long-term (chronic) exposure to ambient air, only chronic toxicity values have been used. IURs were used in deriving the Cancer RSL while RfCs were used in deriving the Noncancer RSL. As explained in Section 3.2.2, the cancer risk was derived by dividing by the Cancer RSL while the hazard quotient (HQ) was derived by dividing by the Noncancer RSL.

Section 3.3.2 – USEPA Human Health Toxicity Values Hierarchy
Many different State and Federal organizations publish toxicity values. For some air toxics, one organization may have published an IUR while another organization may have published an RfC, and it is necessary to organize the sources from which toxicity values are selected so that the toxicity values used to assess a particular air toxic are determined using a consistent procedure.

EPA's OAOPS has a published list of chronic toxicity values that it recommends for use in air risk assessment[11] which prioritizes using EPA Integrated Risk Information System (IRIS) toxicity values whenever they are available[12]. However, OAOPS does not consider USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs), which are derived for USEPA's Superfund program and are not considered USEPA consensus values. To ensure that all technically defensible toxicity values available for air toxics are being considered, including the PPRTVs which are derived by EPA scientists and are both internally and externally peer-reviewed[13], the 24 Months Risk

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[11] https://www.epa.gov/fera/dose-response-assessment-assessing-health-risks-associated-exposure-hazardous-air-pollutants
[12] https://www.epa.gov/fera/prioritization-data-sources-chronic-exposure
[13] https://www.epa.gov/pprtv/basic-information-about-provisional-peer-reviewed-toxicity-values-pprtvs#basicinfo

Assessment deviates from the OAOPS hierarchy and has selected the toxicity values in Appendix B following USEPA's Human Health Toxicity Values Hierarchy recommended for Superfund risk assessments, summarized below (USEPA, 2003a):

- Tier 1 toxicity values: USEPA's Integrated Risk Information System (IRIS), found at: https://www.epa.gov/iris, is consulted first. USEPA considers IRIS to be its preferred source for toxicity information on air toxics and "*IRIS health assessments contain [USEPA] consensus toxicity values*" (USEPA, 2003a, pg. 2).
- Tier 2 toxicity values: If a chemical does not have a toxicity value listed in IRIS, USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) are consulted next. USEPA PPRTVs are developed by USEPA's Office of Research and Development Center for Public Health and Environmental Assessment and USEPA's Human Health Risk Assessment National Research Program. These values are peer-reviewed but are developed primarily for the Superfund program and not necessarily considered a consensus toxicity value within USEPA. For more information on PPRTVs, please refer to: https://www.epa.gov/pprtv/basic-information-about-provisional-peer-reviewed-toxicity-values-pprtvs.
- Tier 3 toxicity values: If a chemical does not have a PPRTV (or an IRIS toxicity value), then toxicity values from other sources may be used. Though USEPA's Toxicity Values Hierarchy does not have clear criteria to prioritize which Tier 3 toxicity values should be considered first, USEPA generally recommends that Tier 3 values be obtained from "*sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed*" (USEPA, 2003a, pg. 3). The RSL User's Guide defines a hierarchy for Tier 3 toxicity values in Section 2.3 of USEPA (2022). The hierarchy is described below:

  o EPA's Office of Pesticide Programs (OPP) Human Health Benchmarks for Pesticides were considered if a Tier 1 or Tier 2 toxicity value is not available.
  o If an OPP benchmark was not available, then chronic inhalation minimal risk levels (MRLs) from the Agency for Toxic Substances and Disease Registry (ATSDR), found at https://wwwn.cdc.gov/TSP/MRLS/mrlsListing.aspx[14], are selected. MRLs are considered equivalent to RfCs.
  o Toxicity values derived by EPA's Office of Water for some chemicals.
  o If an MRL is not available, chronic RfCs published by the California Environmental Protection Agency Office of Environmental Health Hazard Assessment (CalEPA) were used. If an IUR was not available from a Tier 1 or 2 source, then the IUR published by CalEPA was used. CalEPA toxicity values can be found here: https://oehha.ca.gov/chemicals.
  o For some chemicals, the toxicity assessments used to obtain a PPRTV ("PPRTV Assessments") also contain "screening" toxicity values which although published are considered to have more uncertainty in their derivation than a PPRTV. These are used for chemicals when an MRL or CalEPA toxicity value is not available.

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[14] Only the chronic inhalation MRLs are obtained from ATSDR.

o If a chemical does not have a toxicity value in the aforementioned Tier 3 sources, then toxicity values listed in the USEPA Superfund program's Health Effects Assessment Summary Table (HEAST), found at https://epa-heast.ornl.gov/ were used.

Section 3.3.3 – HAPs that Act Through a Mutagenic Mode of Action

Methylene Chloride, Vinyl Chloride, and Trichloroethylene are carcinogens that have been accepted to act through a mutagenic mode of action (MMOA) and a hypothetical resident could potentially have an increased susceptibility to cancer from exposure to these carcinogens earlier in life (starting from birth to generally up to age 16) relative to exposure later in life (USEPA, 2005b, pg. 30-33; USEPA, 2022, Section 5.17). To ensure that the cancer risk estimates presented in Section 3.4.1 are reflective of the MMOA of these HAPs, the RSL Calculator makes some modifications to the standard Cancer RSL equation (USEPA, 2022, Section 4.1.3.2) used to derive the Cancer RSLs (please see Section 3.2.2).

Based on USEPA recommendations, the equation used to derive the Cancer RSL for Methylene Chloride (Dichloromethane) is an adjustment of the standard Cancer RSL equation with incorporation of default age-dependent adjustment factors (ADAFs) (USEPA, 2005b, pg. 37; USEPA, 2022, Section 4.1.3.3).

USEPA's IRIS website lists two IURs for Vinyl Chloride, 4.4E-06 per µg/m^3 (which represents the risk resulting from continuous lifetime exposure during adulthood) and 8.8E-06 per µg/m^3 (which represents the risk from continuous lifetime exposure from birth)[15]. The latter IUR is derived by adjusting the former IUR using a two-fold uncertainty factor. Instead of using the more conservative IUR in the standard Cancer RSL equation, the RSL Calculator uses an alternative equation to derive the Cancer RSL (USEPA, 2022, Section 4.1.3.4). The alternate equation is derived based on an example in the *Toxicological Review of Vinyl Chloride* where early life risk is calculated separately from adult risk (both using the less conservative IUR of 4.4E-06 per µg/m^3) and summed to obtain a total cancer risk (USEPA, 2000b, pg. 56). Since early life risk is calculated separately, the total risk accounts for the potential for increased susceptibility to cancer resulting from exposure to Vinyl Chloride in early life.

The Cancer RSL for Trichloroethylene (TCE) is derived using a modified equation (USEPA, 2022, Section 4.1.3.5) that reflects USEPA's conclusion that TCE only acts through a MMOA for kidney cancer and that the default ADAFs suggested in USEPA (2005b) only apply to the "*kidney cancer component of the total risk*" even though the TCE IRIS IUR of 4.1E-06 per µg/m^3 was derived to also be reflective of the potential risk for Non-Hodgkin's lymphoma (NHL) and liver cancer (USEPA, 2011b, pg. 5-156 to 5-157).

Section 3.3.4 – Xylenes

As explained in the IRIS *Toxicological Review of Xylenes*, the IRIS Xylenes RfC of 1 x 10^{-1} mg/m^3 is intended to be used for Xylenes (CAS # 1330-20-7), which refers to a mixture of the m-, p-, and o- isomers (USEPA, 2003b, pg. 2-3). The RSL Calculator assesses the m-, p-, and o-

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[15] Please see: https://iris.epa.gov/ChemicalLanding/&substance_nmbr=1001

Xylene isomers separately and uses the Xylenes RfC as a surrogate to derive the Noncancer RSLs for the individual isomers (USEPA, 2022, Section 5.9).

In the ambient air samples used to prepare this risk assessment, the laboratory analyzed "Xylenes" as m,p-Xylene (represents a mixture of the m- and p- isomers) and o-Xylene. In accordance with the RSL Calculator's methodology, the o-Xylene Noncancer RSL was used to determine the o-Xylene HQ. Since the RSL Calculator only assesses each of the Xylene isomers separately and does not list m,p-Xylene, m,p-Xylene was entered into the RSL Calculator as m-Xylene so that the m-Xylene Noncancer RSL was used to determine the m,p-Xylene HQ (please see Section 3.2.2 for an explanation into how the RSL Calculator determines the HQ).

Section 3.4 – Risk Characterization

In the risk characterization step, the information from the exposure assessment and the toxicity assessment are integrated to obtain a cancer risk and/or hazard quotient (HQ) for each HAP as well as a cumulative cancer risk and hazard index (HI). USEPA's RSL calculator was used to obtain these estimates by inputting the CA (the toxicity values in Appendix B are automatically populated by the RSL Calculator and are used in deriving the Cancer and Noncancer RSLs). An explanation into the equations that the RSL Calculator uses to obtain risk/hazard estimates was provided in Section 3.2.2.

Section 3.4.1 – Risk and/or Hazard Estimates

For each HAP, an estimate of the cancer risk and/or hazard quotient (HQ) has been provided in Table 3, which also shows the cancer risks/noncancer HQs determined in the 12 Months Risk Assessment. Cancer risk for individual air toxics was reported to 1 significant figure, while HQs were reported to 3 or more significant figures so that enough digits can be seen.

The cumulative cancer risk and hazard index (HI) was determined by summing the cancer risk of individual HAPs, which assumes response addition, and summing the HQs, which assumes concentration addition (USEPA, 2000, pg. 76, 125; USEPA, 2004, pg. 13-6, 13-9). Please see Section 4 of this Risk Assessment for more discussion on response and concentration addition. As recommended by USEPA, the cumulative cancer risk and HI that have been determined in this have been reported to 1 significant figure (USEPA, 2004, pg. 13-7).

Cumulative Cancer Risk	Hazard Index (HI)
8×10^{-5}	2

Supporting RSL Calculator outputs can be found in Appendix C.

The cancer risks for individual HAPs range from 3×10^{-8} to 2×10^{-5}. The cumulative cancer risk of 8×10^{-5} indicates out of 100,000 hypothetical residents exposed to the 10 ambient air HAPs (in the manner as explained in Section 3.2), 8 cases of cancer could be expected to occur (USEPA, 2004, pg. 13-6). Given that IURs are upper-bound estimates of cancer risk and response addition is a conservative method to assess exposure to chemical mixtures (see Section 4), the actual number of cases could be lower than 8 or even zero. In implementing air toxics standards under the Clean Air Act, EPA has ordinarily considered cancer risk as high as 1 in 10,000 (10^{-4}) and as

low or lower than 1 in 1 million (10^{-6}) to be acceptable (USEPA, 1999, pg. 119). The cancer risk range of 10^{-4} to 10^{-6}, which has also been used by EPA in setting site-specific remedial goals under USEPA's Superfund program[16], has been accepted by EPD's Air Protection Branch in making risk management decisions.

Though none of the individual HQs exceed 1 (at 1 significant figure, the TCE HQ of 1.29 is 1), the HI is above 1. The HI is the sum of all the individual HQs determined for each HAP. An HI of 2 indicates that there may be a potential for adverse noncancer effects resulting from exposure to all 10 HAPs (in the manner as explained in Section 3.2). However, since all 10 HAPs do not induce the same toxicological effect by the same mode of action, the assumption of concentration additivity used as the basis to calculate the HI does not hold (USEPA, 2000, pg. A-8) and the HI of all HAPs inaccurately describes the potential for adverse noncancer effects. In accordance with EPA guidance, a target-organ (or effect)-specific-hazard index (TOSHI) for each target organ/toxicological effect was developed (USEPA, 2004, pg. 13-10). As all TOSHIs are below 1, HAPs measured at the Station are not considered to pose an unacceptable noncancer hazard.

Target Organ or Toxicological Effect	TOSHI (reported to 1 significant figure)
Immunological	1
Reproductive	0.5
Neurological	0.4
Liver	0.1

Please see Appendix D for more information on how the TOSHIs were derived.

Section 3.4.2 – Comparison between 12 Months Risk Assessment and 24 Months Risk Assessment
Table 3 shows that the cumulative cancer risk increased by 1×10^{-5} in the 24 Months Risk Assessment compared to the 12 Months Risk Assessment. This is attributable to the use of a larger SRL for Vinyl Chloride (from samples collected August 14, 2021 and August 20, 2021) as an estimate of the CA which increased the individual cancer risk from 8×10^{-6} to 2×10^{-5}. When rounded to 1 significant figure, this resulted in the cumulative cancer risk increasing by 1×10^{-5}. In all samples collected since January 25, 2020, Vinyl Chloride is nondetect. Thus, the increased risk does not necessarily suggest that ambient air concentrations of Vinyl Chloride have increased at the Station and is only an artifact of how risk has been calculated in this risk assessment. As previously stated, the cumulative cancer risk derived in the 24 Months Risk Assessment is within the acceptable cancer risk range and the true risk is likely much lower or even zero given that IURs are upper-bound estimates of cancer risk.

Though some of the TOSHIs have changed (e.g. Neurological TOSHI slightly decreased), the HI determined in the 24 Months Risk Assessment is consistent with what has been determined in the 12 Months Risk Assessment and after deriving TOSHIs, both risk assessments have determined that HAPs measured at the Station are not considered to pose an unacceptable noncancer hazard.

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[16] Please see 40 C.F.R § 300.430(e)(2)(i)(A)(2) (2019)

Table 3: Comparison of Cancer Risks and Hazard Quotients Derived in the 12 Months Risk Assessment with the 24 Months Risk Assessment

Chemical	CAS Number	Cancer Risk – 24 Months Risk Assessment	Noncancer Hazard Quotient (HQ) – 24 Months Risk Assessment	Cancer Risk – 12 Months Risk Assessment	Noncancer Hazard Quotient (HQ) – 12 Months Risk Assessment
Benzene	71-43-2	4E-06	0.0511	5E-06	0.057
Butadiene, 1,3-	106-99-0	1E-05	0.532	1E-05	0.532
Chloroform	67-66-3	2E-05	0.024	2E-05	0.024
Dichloroethane, 1,2-	107-06-2	2E-05	0.277	2E-05	0.277
Hexane	110-54-3	-	0.0024	-	0.002
Methylene Chloride	75-09-2	3E-08	0.0056	3E-08	0.006
Toluene	108-88-3	-	0.0008	-	0.0004
Trichloroethylene (TCE)	79-01-6	6E-06	1.29	6E-06	1.29
Vinyl Chloride	75-01-4	2E-05	0.031	8E-06	0.012
Xylene, m,p- (entered into the RSL Calculator as Xylene, m-)	108-38-3 (m-Xylene CAS Number)	-	0.042	-	0.163
Xylene, o-	95-47-6	-	0.042	-	0.046
Cumulative Cancer Risk		**8E-05**		**7E-05**	
Hazard Index (HI)			**2**		**2**
Immunological TOSHI			1		1
Reproductive TOSHI			0.5		0.5
Neurological TOSHI			0.4		0.5
Liver TOSHI			0.1		0.04

Section 3.5 – Limitations of this Risk Assessment

It is important to highlight the limitations as to the information that can be obtained from the risk and/or hazard estimates that have been provided. It is important to understand that these estimates:

- Only reflect the 10 HAPs analyzed.
- Represent an individual risk and/or hazard but not necessarily the risk and/or hazard to a specific individual.
- Cannot determine if an individual diagnosed with cancer or a noncarcinogenic disorder developed illness due to inhaling ambient air within the vicinity of the Station.
- Cannot be used to estimate potential risks and/or hazards at any other location.
- Do not represent risks/hazards from generally inhaling ambient air chemicals.
- Cannot necessarily attribute the ambient air concentrations measured at the Station in whole or part to EPL. The source of the HAPs in ambient air are "*a combination of background concentrations and the same chemical released from possibly multiple sources*" (USEPA, 2004, pg. 10-37).

Section 4 – Uncertainty Section

An integral part of any risk assessment is the uncertainty section, where "*major uncertainties associated with determining the nature and extent of the risk are identified and discussed*" (USEPA, 2004, pg. 13-1). Uncertainties are inherent to all risk assessments due to the procedures used to obtain risk and/or hazard estimates. The purpose of this section is to discuss specific uncertainties so that the results of the risk assessment can be properly understood and utilized.

Section 4.1 – Scope

Since the 24 Months Risk Assessment only covers 10 HAPs selected for monitoring at the Station, it is unknown how the cumulative cancer risk or hazard index would be affected if additional air toxics were monitored at the Station. Thus, the risk and/or hazard estimates provided in Section 3 should only be interpreted to be representative of the 10 HAPs as measured at the Station and not for any other air toxics.

Section 4.2 – Representativeness

Ambient air monitoring "*only provides estimates of concentrations at the point at which samples are taken, and it is often difficult to clearly define the spatial coverage that those measured concentrations represent*" (USEPA, 2004, pg. 10-7). The true ambient air concentrations of a HAP can vary even near the Station due to various factors, including:

- Meteorological factors, such as wind speed and direction and ambient air temperature;
- Physical factors, such as buildings/structures or variability in terrain elevation; and
- Chemical transformation of chemicals which may attenuate or increase the concentrations of air pollutants.

Since ambient air monitoring data cannot adequately capture the variability of ambient air concentrations near an air monitor, the CA (and thus the EC) could be an overestimation. Realistically, a resident would possibly be exposed to ambient air concentrations at levels far less than the EC.

Section 4.3 – Only Inhalation Exposure Route is Assessed

Since only ambient air monitoring data is available, only the inhalation exposure route has been assessed. As previously mentioned, it is possible for air toxics to deposit onto soil, water bodies, and other surfaces and for individuals to encounter these chemicals. There could be risks/hazards associated with other routes of exposure that have not been quantified. Ecological risk has also not been assessed since there is no available data.

Section 4.4 – Toxicity Values

There are several uncertainties involved in the use of toxicity values that have been pointed out in separate paragraphs below.

Toxicity values are derived based on an analysis of the available human and animal studies for a particular HAP. Thus, the toxicity values for different HAPs differ in quality in terms of the scientific literature that lends support to and/or forms the basis for the toxicity value. To provide quantitative risk estimates, a consistent process as outlined in USEPA (2003a) is used to select the

toxicity values. However, there is greater confidence in some toxicity values than others due to the quality of scientific evidence upon which the toxicity value is based. The actual risk/hazard for a particular HAP could be different if there was more evidence and/or a higher quality of evidence to derive that HAP's toxicity value. However, risk and/or hazard estimates provided for individual HAPs are probably overestimations due to the conservative methodology used in deriving toxicity values.

According to the Weight of Evidence description provided in Appendix B, EPA's IRIS determined that there is "*inadequate information to assess carcinogenic potential*" for Hexane, Toluene, m,p-Xylene, and o-Xylene. Thus, a cancer risk was not obtained using the RSL Calculator for any of these HAPs. It is possible that these HAPs may be carcinogenic and pose a cancer risk, but the evidence was deemed by EPA toxicologists to not be sufficient to make a definitive determination. If these HAPs are carcinogenic, the cumulative cancer risk may be underestimated but it is not known by how much.

For Benzene, the IRIS database lists an IUR of 2.2×10^{-6} (per 1 µg/m³)[17]. However, documentation on the IRIS database website indicates EPA's determination that "*the choice of cancer unit risk estimates narrows to a range between 7.1 x 10^{-3} and 2.5 x 10^{-2} at 1 ppm (2.2 x 10^{-6} to 7.8 x 10^{-6} at 1 µg/m³ of benzene in air)*"[18] with 7.8×10^{-6} per µg/m³ representing the highest risk number within the range. As further indicated by EPA, all IUR estimates within this range are scientifically plausible[19]. The highest IUR of 7.8×10^{-6} was used to produce the Benzene cancer risk in this risk assessment since this is the most conservative value and is the value used in the RSL Calculator to derive the Benzene Cancer RSL (USEPA, 2022, Frequent Question #35). The individual cancer risk for Benzene and the cumulative cancer risk are within the EPD Air Protection Branch acceptable risk range, which suggests that even the use of the least conservative IUR would not change the conclusion of this risk assessment.

The Xylenes RfC was used as a surrogate toxicity value for each of the individual m-, p-, and o-isomers and m,p-Xylene was assessed as m-Xylene in the RSL Calculator. After further review into the IRIS toxicity assessment for Xylenes, it is noted that the critical animal study that serves as the basis for the IRIS Xylenes RfC only exposed test rats to m-Xylene (USEPA, 2003b, pg. 53). Though it is not definitively clear whether m,p-Xylene and o-Xylene are toxicologically similar to m-Xylene, EPA cited a study which found that the "*potencies of individual xylene isomers were similar in affecting neurobehavior, as shown in a study of rats following acute exposures*" (USEPA, 2003b, pg. 66). Since the critical study that forms the basis for the Xylenes RfC found neurobehavioral effects due to exposure ("*Impaired motor coordination (decreased rotarod performance)*"), the use of the Xylenes RfC as a surrogate was deemed acceptable for the 24 Months Risk Assessment even though is uncertainty with the use of this value.

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[17] Please see: https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=276
[18] Please see page 34 of: https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0276_summary.pdf#nameddest=cancerinhal
[19] Ibid, pg. 35

Section 4.5 – Response and Concentration Addition
The cumulative cancer risk is derived assuming that the individual HAP cancer risks can be added since it is assumed that each carcinogenic HAP acts toxicologically independent of the other at low exposure levels (relative to exposure levels measured in scientific studies) so that the body's response to a particular HAP is not influenced by exposure to the other HAPs (USEPA, 2000a, pg. 12, 71, 119). Termed response addition, this process of aggregating the cancer risk estimates of individual carcinogens has been established in EPA guidance as a method to obtain a cumulative cancer risk estimate that is not "*overly conservative*" (USEPA, 2000a, pg. 125; USEPA, 2004, pg. 13-6). Toxicological interactions between multiple carcinogens may result in greater or lesser risk for cancer than suggested by the cumulative cancer risk estimate (USEPA, 2000, pg. 127). One study cited by EPA determined that response addition produces an "*improbable, but not misleading*" estimate of cumulative cancer risk as the number of chemicals whose risks are summed together increase (USEPA, 2000a, pg. 126). However, given EPA's general acceptance and use of response addition and the lack of detailed, definitive information on possible interactions between the HAPs measured at the Station, the cumulative cancer risk provided in this risk assessment could be considered to provide an estimate for making a defensible risk management decision considering various data uncertainties.

Based on concentration addition, the HI is derived by summing the HQs determined for individual noncarcinogenic HAPs. (USEPA, 2004, pg. 13-9). This assumes that each noncancer HAP behaves the same (same/similar toxicokinetics) and induces the same/similar toxicological effects, which EPA has determined can be relaxed to acting on the same target organ (USEPA, 2000a, pg. 28, 80). Since all HAPs do not induce the same toxic effect and/or act on the same organ, the HI determined for all 10 HAPs does not fit the assumptions underlying concentration addition. Thus, TOSHIs were developed for each target organ/toxicological effect and all TOSHIs were either at or below 1, suggesting that there is not an unacceptable noncancer hazard. However, there are various assumptions that were made to determine the TOSHIs. For more information, please see Appendix D.

Section 4.6 – Using SRLs or the MDC as an Estimate of the CA
For most of the HAPs assessed in the 24 Months Risk Assessment, the SRL was used as an estimate of the CA that was ultimately used in deriving the risk and/or hazard estimates. As previously mentioned, the SRL is a value set by the analytical laboratory and represents the concentration at or above which the laboratory will report a value for a particular HAP in a laboratory analytical report. Though the concentrations for nondetect HAPs have been reported as zero in Appendix A, the true concentration of the HAP in the sample could very well be any value that is below the SRL but above zero. Assessing the risk/hazard at the highest SRL determined from the dataset for each HAP is a public health protective approach to ensure that risk/hazard is not underestimated. Since the estimates presented in Section 3.4.1 show that the cancer risk and/or noncancer hazard for individual nondetect HAPs are not of concern at the highest SRL, it is evident that exposure to these HAPs at ambient air concentrations lower than the SRL would likely not result in deleterious noncancer effects and possibly result in a zero to very small number of cancer cases.

For Toluene, the MDC was used as an estimate of the CA due to uncertainty in deriving a 95% UCL to serve as an estimate of the CA. Assessing the risk/hazard at the MDC ensures that the hazard is not underestimated since EPA guidance indicates that the MDC can overestimate the EC for larger datasets (USEPA, 2015 pg. 57). Since the estimates presented on Table 3 show that at the MDC the noncancer HQ was below 1, it is evident that exposure to these HAPs at ambient air concentrations lower than the MDC would likely not result in deleterious noncancer effects.

Section 5 – Conclusion

The 24 Months Risk Assessment was prepared consistent with relevant, publicly available USEPA risk assessment guidance and has strived to properly represent the validated air monitoring results from the Station while providing risk and or hazard estimates that are derived in a public health protective manner. The estimates derived in the 24 Months Risk Assessment could be said to be representative of the risk and/or hazard to a hypothetical resident residing near the Station (technically at the Station) for a longer than average length of time. The purpose behind deriving risk/hazard estimates in this manner is to be consistent with EPA guidance and to ensure that any risk management decision made based on these estimates would be protective of individuals who may be exposed to lower concentrations of HAPs measured at the Station.

The individual cancer risk or each HAP as well as the cumulative cancer risk estimate do not exceed 1 in 10,000 (10^{-4}) and are at levels considered acceptable to both EPA and EPD from a risk management perspective. Though this risk assessment estimates that 8 cases of cancer out of 100,000 residents exposed to HAPs present in ambient air within the vicinity of the Station could be expected (1 case larger than what was estimated in the 12 Months Risk Assessment), in actuality the number of cases could be lower or even zero. None of the TOSHIs exceed 1, consistent with the results of the 12 Months Risk Assessment, indicating that there is not a potential for adverse noncancer effects because of exposure to ambient air HAPs measured at the Station.

Based on the 12 Months Risk Assessment and this 24 Months Risk Assessment, it is reasonable to conclude that the 10 HAPs in ambient air do not pose a long-term danger to the vast majority of Forsyth County residents who live near EPL. However, there are uncertainties involving the dataset and the parameters selected and those uncertainties should be kept in mind when interpreting the findings. The uncertainties have been discussed in Section 4. It is also important that this risk assessment be evaluated in context with other pieces of information (regulatory policies, social values, economics, etc.) and should not be the sole driver for making risk management decisions.

References

United States Environmental Protection Agency (USEPA). 1989. *Risk Assessment Guidance for Superfund (RAGS), (Part A) Volume I, Human Health Evaluation Manual*. EPA/540/1-89/002. Washington, D.C.: United States Environmental Protection Agency, Office of Emergency and Remedial Response.

United States Environmental Protection Agency (USEPA). 1991. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance "Standard Default Exposure Factors" Interim Final.* OSWER 9285.6-03. Washington, DC.: United States Environmental Protection Agency, Office of Emergency and Remedial Response Toxics Integration Branch

United States Environmental Protection Agency (USEPA). 1994. *Methods For Derivation Of Inhalation Reference Concentrations And Application Of Inhalation Dosimetry.* EPA-600-8-90-066F. Research Triangle Park, NC: United States Environmental Protection Agency, Environmental Criteria and Assessment Office

United States Environmental Protection Agency (USEPA). 1999. *RESIDUAL RISK Report to Congress.* EPA/635R-00/004. Research Triangle Park, N.C.: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards

United States Environmental Protection Agency (USEPA). 2000a. *Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures.* EPA/630/R-00/002. Washington, D.C.: U.S. Environmental Protection Agency, Risk Assessment Forum

United States Environmental Protection Agency (USEPA). 2000b. *Toxicological Review of Vinyl Chloride.* EPA/635R-00/004. Washington, D.C.: U.S. Environmental Protection Agency, National Center for Environmental Assessment, Office of Research and Development

United States Environmental Protection Agency (USEPA). 2003a. *Human Health Toxicity Values in Superfund Risk Assessments*. OSWER 9285.7-53. Washington D.C.: United States Environmental Protection Agency, Office of Solid Waste and Emergency Response

United States Environmental Protection Agency (USEPA). 2003b. *Toxicological Review of Xylenes.* EPA 635/R-03/001. Washington, D.C.: U.S. Environmental Protection Agency, National Center for Environmental Assessment, Office of Research and Development

United States Environmental Protection Agency (USEPA). 2004. *Air Toxics Risk Assessment Reference Library: Volume 1 Technical Resource Manual.* EPA-453-K-04-001A. Research Triangle Park, NC.: United States Environmental Protection Agency, Office of Air Quality Planning and Standards

United States Environmental Protection Agency (USEPA). 2005a. *Guidelines for Carcinogen Risk Assessment*. EPA/630/P-03/001F. Washington D.C.: United States Environmental Protection Agency, Risk Assessment Forum

United States Environmental Protection Agency (USEPA). 2005b. *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens*. EPA/630/R-03/003F. Washington D.C.: United States Environmental Protection Agency, Risk Assessment Forum

United States, Environmental Protection Agency (USEPA). 2009. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment).* EPA-540-R-070-002. Washington, D.C.: United States Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation

United States Environmental Protection Agency (USEPA). 2011a. *Exposure Factors Handbook 2011 Edition (Final Report)*. EPA/600/R-09/052F. Washington D.C.: United States Environmental Protection Agency, Office of Research and Development's National Center for Environmental Assessments (NCEA)

United States Environmental Protection Agency (USEPA). 2011b. *Toxicological Review of Trichloroethylene.* EPA/635/R-09/011F. Washington, D.C.: U.S. Environmental Protection Agency, National Center for Environmental Assessment, Office of Research and Development

United States Environmental Protection Agency (USEPA). 2015. *ProUCL Version 5.1 User Guide.* EPA/600/R-07/041. Washington D.C.: United States Environmental Protection Agency, Office of Research and Development Site Characterization and Monitoring Technical Support Center

United States Environmental Protection Agency (USEPA). 2022. *Regional Screening Levels (RSLs) - User's Guide and Frequent Questions.* https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide and https://www.epa.gov/risk/regional-screening-levels-frequent-questions (Accessed 6/16/22 - since the User's Guide and FAQ go through semi-annual updates, a PDF copy of the version used to prepare the 24 Months can be provided on request)

29

Ambient Air Monitoring Report: Risk Assessment for Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation

Appendix A

HAPs Sample Results

Please see the PDF file attachments (paper-clip icon in Adobe Acrobat/Reader) for .xlsx (Microsoft Excel) versions of the HAPs sample results. The file is labeled as:

Appendix A - HAPs Sample Results.xlsx

Appendix B

Toxicity Values, Cancer RSLs/Noncancer RSLs and Risk/Hazard Equations

Cancer Toxicity Values Used in the 24 Months Risk Assessment

Constituent	CAS Number	IUR (µg/m^3)$^{-1}$	Source	EPA Mode of Action	EPA Weight of Evidence (WOE) Description	Information on Tumor Site and Type	Link to Toxicity Assessment	Link to WOE Description
1,3-Butadiene	106-99-0	3.00E-05	IRIS		Carcinogenic to humans	Hematologic; Leukemia	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=139	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=139
Methylene chloride (Dichloromethane)	75-09-2	1.00E-08	IRIS	M	Likely to be carcinogenic to humans	Hepatic, Respiratory; Hepatocellular carcinomas or adenomas, bronchoalveolar carcinomas or adenomas	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=70	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=70
Chloroform	67-66-3	2.30E-05	IRIS		B2 (Probable human carcinogen - based on sufficient evidence of carcinogenicity in animals)	Hepatic; hepatocellular carcinoma	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=25	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=25
Dichloroethane, 1,2- (Ethylene dichloride)	107-06-2	2.60E-05	IRIS		B2 (Probable human carcinogen - based on sufficient evidence of carcinogenicity in animals)	Other; Hemangiosarcomas	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=149	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=149
Trichloroethylene	79-01-6	4.10E-06	IRIS	M	Carcinogenic to humans	Hematologic, Hepatic, Urinary; Renal cell carcinoma, non-Hodgkin's lymphoma, and liver tumors	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=199	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=199
Vinyl chloride	75-01-4	4.40E-06	IRIS	M	Known/likely human carcinogen	Hepatic; Liver angiosarcomas, angiomas, hepatomas, and neoplastic nodules	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=1001	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=1001
m/p-Xylene	N/A (assessed as m-Xylene in the RSL calculator)				Data are inadequate for an assessment of human carcinogenic potential			https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=270
Benzene	71-43-2	7.80E-06	IRIS		A (Human carcinogen)	Hematologic; Leukemia	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=276	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=276
Toluene	108-88-3				Inadequate information to assess carcinogenic potential			https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=118
o-Xylene	95-47-6				Data are inadequate for an assessment of human carcinogenic potential			https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=270
Hexane	110-54-3				Inadequate information to assess carcinogenic potential			https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=486

Noncancer Toxicity Values Used in this Risk Assessment

Constituent	CAS Number	RfC (mg/m^3)	RfC Source	Critical Effect (from the Critical Study)	Link to Noncancer Toxicity Assessment
1,3-Butadiene	106-99-0	2.00E-03	IRIS	Ovarian atrophy	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=139
Methylene chloride (Dichloromethane)	75-09-2	6.00E-01	IRIS	Hepatic effects (hepatic vacuolation)	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=70
Chloroform	67-66-3	9.77E-02	ATSDR	Hepatomegaly	https://www.atsdr.cdc.gov/toxprofiles/tp6.pdf
Dichloroethane, 1,2-	107-06-2	7.00E-03	PPRTV	Neurobehavioral impairment	https://cfpub.epa.gov/ncea/pprtv/chemicalLanding.cfm?pprtv_sub_id=1682
Trichloroethylene	79-01-6	2.00E-03	IRIS	Decreased thymus weight in female B6C3F1 mice (immunotoxicity)	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=199
Vinyl chloride	75-01-4	1.00E-01	IRIS	Liver cell polymorphism	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=1001
m/p Xylene	N/A	1.00E-01	IRIS	Impaired motor coordination (decreased rotarod performance)	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=270
Benzene	71-43-2	3.00E-02	IRIS	Decreased lymphocyte count	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=276
Toluene	108-88-3	5.00E+00	IRIS	Neurological effects in occupationally-exposed workers	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=118
o-Xylene	95-47-6	1.00E-01	IRIS	Impaired motor coordination (decreased rotarod performance)	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=270
Hexane	110-54-3	7.00E-01	IRIS	Peripheral neuropathy (decreased MCV at 12 weeks)	https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=486

Notes

Please see Section 3.3 of the *Ambient Air Monitoring Report: Risk Assessment for Select Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation* ("24 Months Risk Assessment") for more information on how toxicity values were selected and additional information about the sources of these toxicity values.

EPA's Cancer Weight of Evidence descriptor, Mode of Action, noncancer critical effect description, and tumor site/type were obtained from the toxicity assessment for each air toxic. Links to the toxicity assessment for individual air toxics have been provided in the tables.

Acronyms

IUR = Inhalation Unit Risk

RfC = Reference Concentration

M = Air Toxic is considered to have a mutagenic Mode of Action.

Toxicity Value Sources

- IRIS = USEPA Integrated Risk Information System (IRIS); https://www.epa.gov/iris

- PPRTV = USEPA Provisional Peer Reviewed Toxicity Value (PPRTV); https://www.epa.gov/pprtv/provisional-peer-reviewed-toxicity-values-pprtvs-assessments

- CalEPA = California Environmental Protection Agency Office of Environmental Health Hazard Assessment (CalEPA); https://oehha.ca.gov/chemicals

- ATSDR = Minimal Risk Level (considered equivalent to a RfC) from Agency for Toxic Substances and Disease Registry (ATSDR); https://www.atsdr.cdc.gov/mrls/mrllist.asp

- SCREEN = PPRTV Screening Value; https://www.epa.gov/pprtv/provisional-peer-reviewed-toxicity-values-pprtvs-assessments

- HEAST = Health Effects Assessment Summary Tables; https://epa-heast.ornl.gov/

Regional Screening Level (RSL) Resident Ambient Air Table (TR=1E-06, HQ=0.1) May 2022

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; D = OW; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; W = TEF applied; E = RPF applied; G = user's guide Section 5; M = mutagen; V = volatile; R = RBA applied ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = ceiling limit exceeded; s = Csat exceeded.

IUR (ug/m³)⁻¹	key	RfCᵢ (mg/m³)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m³)	Noncancer SL THI=0.1 (ug or fibers/m³)
						Acephate	30560-19-1		
2.2E-06	I	9.0E-03	I	V		Acetaldehyde	75-07-0	1.3E+00	9.4E-01
						Acetochlor	34256-82-1		
				V		Acetone	67-64-1		
		2.0E-03	X			Acetone Cyanohydrin	75-86-5		2.1E-01
		6.0E-02	I	V		Acetonitrile	75-05-8		6.3E+00
1.3E-03	C			V		Acetophenone	98-86-2		
						Acetylaminofluorene, 2-	53-96-3	2.2E-03	
		2.0E-05	I	V		Acrolein	107-02-8		2.1E-03
1.0E-04	I	6.0E-03	I		M	Acrylamide	79-06-1	1.0E-02	6.3E-01
		2.0E-04	P	V		Acrylic Acid	79-10-7		2.1E-02
6.8E-05	I	2.0E-03	I	V		Acrylonitrile	107-13-1	4.1E-02	2.1E-01
		6.0E-03	P			Adiponitrile	111-69-3		6.3E-01
						Alachlor	15972-60-8		
						Aldicarb	116-06-3		
						Aldicarb Sulfone	1646-88-4		
						Aldicarb sulfoxide	1646-87-3		
4.9E-03	I			V		Aldrin	309-00-2	5.7E-04	
		1.0E-04	X	V		Allyl Alcohol	107-18-6		1.0E-02
6.0E-06	C	1.0E-03	I	V		Allyl Chloride	107-05-1	4.7E-01	1.0E-01
		5.0E-03	P			Aluminum	7429-90-5		5.2E-01
						Aluminum Phosphide	20859-73-8		
						Ametryn	834-12-8		
6.0E-03	C					Aminobiphenyl, 4-	92-67-1	4.7E-04	
						Aminophenol, m-	591-27-5		
						Aminophenol, o-	95-55-6		
						Aminophenol, p-	123-30-8		
						Amitraz	33089-61-1		
		5.0E-01	I	V		Ammonia	7664-41-7		5.2E+01
						Ammonium Picrate	131-74-8		
						Ammonium Sulfamate	7773-06-0		
		3.0E-03	X	V		Amyl Alcohol, tert-	75-85-4		3.1E-01
1.6E-06	C	1.0E-03	I			Aniline	62-53-3	1.8E+00	1.0E-01
						Anthraquinone, 9,10-	84-65-1		
		3.0E-04	A			Antimony (metallic)	7440-36-0		3.1E-02
						Antimony Pentoxide	1314-60-9		
						Antimony Tetroxide	1332-81-6		
		2.0E-04	I			Antimony Trioxide	1309-64-4		2.1E-02
4.3E-03	I	1.5E-05	C			Arsenic, Inorganic	7440-38-2	6.5E-04	1.6E-03
		5.0E-05	I			Arsine	7784-42-1		5.2E-03
						Asbestos (units in fibers)	1332-21-4		
						Asulam	3337-71-1		
2.5E-04	C					Atrazine	1912-24-9		
						Auramine	492-80-8	1.1E-02	
						Avermectin B1	65195-55-3		
3.1E-05	I	1.0E-02	A			Azinphos-methyl	86-50-0		1.0E+00
				V		Azobenzene	103-33-3	9.1E-02	
		7.0E-06	P			Azodicarbonamide	123-77-3		7.3E-04
		5.0E-04	H			Barium	7440-39-3		5.2E-02
				V		Benfluralin	1861-40-1		
						Benomyl	17804-35-2		
						Bensulfuron-methyl	83055-99-6		
						Bentazon	25057-89-0		
				V		Benzaldehyde	100-52-7		
7.8E-06	I	3.0E-02	I	V		Benzene	71-43-2	3.6E-01	3.1E+00
						Benzenediamine-2-methyl sulfate, 1,4-	6369-59-1		
				V		Benzenethiol	108-98-5		
6.7E-02	I				M	Benzidine	92-87-5	1.5E-05	
						Benzoic Acid	65-85-0		
				V		Benzotrichloride	98-07-7		
						Benzyl Alcohol	100-51-6		
4.9E-05	C	1.0E-03	P	V		Benzyl Chloride	100-44-7	5.7E-02	1.0E-01
2.4E-03	I	2.0E-05	I			Beryllium and compounds	7440-41-7	1.2E-03	2.1E-03
						Bifenox	42576-02-3		
						Biphenthrin	82657-04-3		
		4.0E-04	X	V		Biphenyl, 1,1'-	92-52-4		4.2E-02
				V		Bis(2-chloro-1-methylethyl) ether	108-60-1		
						Bis(2-chloroethoxy)methane	111-91-1		
3.3E-04	I			V		Bis(2-chloroethyl)ether	111-44-4	8.5E-03	
6.2E-02	I			V		Bis(chloromethyl)ether	542-88-1	4.5E-05	
						Bisphenol A	80-05-7		
		2.0E-02	H			Boron And Borates Only	7440-42-8		2.1E+00
		2.0E-02	P	V		Boron Trichloride	10294-34-5		2.1E+00
		1.3E-02	C	V		Boron Trifluoride	7637-07-2		1.4E+00
						Bromate	15541-45-4		
		6.0E-05	X	V		Bromo-2-chloroethane, 1-	107-04-0		6.3E-03
				V		Bromo-3-fluorobenzene, 1-	1073-06-9		
				V		Bromo-4-fluorobenzene, 1-	460-00-4		
						Bromoacetic acid	79-08-3		
		6.0E-02	I	V		Bromobenzene	108-86-1		6.3E+00
		4.0E-02	X	V		Bromochloromethane	74-97-5		4.2E+00
3.7E-05	C			V		Bromodichloromethane	75-27-4	7.6E-02	

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IUR (ug/m^3)$^{-1}$	key	RfC$_i$ (mg/m^3)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m^3)	Noncarcinogenic SL THI=0.1 (ug or fibers/m^3)
1.1E-06	I			V		Bromoform	75-25-2	2.6E+00	
		5.0E-03	I	V		Bromomethane	74-83-9		5.2E-01
				V		Bromophos	2104-96-3		
		1.0E-01	A	V		Bromopropane, 1-	106-94-5		1.0E+01
						Bromoxynil	1689-84-5		
				V		Bromoxynil Octanoate	1689-99-2		
3.0E-05	I	2.0E-03	I	V		Butadiene, 1,3-	106-99-0	9.4E-02	2.1E-01
				V		Butanol, N-	71-36-3		
		5.0E+00	I	V		Butyl Alcohol, t-	75-65-0		5.2E+02
		3.0E+01	P	V		Butyl alcohol, sec-	78-92-2		3.1E+03
				V		Butylate	2008-41-5		
5.7E-08	C					Butylated hydroxyanisole	25013-16-5	4.9E+01	
						Butylated hydroxytoluene	128-37-0		
				V		Butylbenzene, n-	104-51-8		
				V		Butylbenzene, sec-	135-98-8		
				V		Butylbenzene, tert-	98-06-6		
						Cacodylic Acid	75-60-5		
1.8E-03	I	1.0E-05	A			Cadmium (Diet)	7440-43-9	1.6E-03	1.0E-03
1.8E-03	I	1.0E-05	A			Cadmium (Water)	7440-43-9	1.6E-03	1.0E-03
		2.2E-03	C			Caprolactam	105-60-2		2.3E-01
4.3E-05	C					Captafol	2425-06-1	6.5E-02	
6.6E-07	C					Captan	133-06-2	4.3E+00	
						Carbaryl	63-25-2		
						Carbofuran	1563-66-2		
		7.0E-01	I	V		Carbon Disulfide	75-15-0		7.3E+01
6.0E-06	I	1.0E-01	I	V		Carbon Tetrachloride	56-23-5	4.7E-01	1.0E+01
		1.0E-01	P	V		Carbonyl Sulfide	463-58-1		1.0E+01
						Carbosulfan	55285-14-8		
						Carboxin	5234-68-4		
		9.0E-04	I			Ceric oxide	1306-38-3		9.4E-02
				V		Chloral Hydrate	302-17-0		
						Chloramben	133-90-4		
						Chloramines, Organic	E701235		
						Chloranil	118-75-2		
				V		Chlordane (alpha)	5103-71-9		
				V		Chlordane (gamma)	5103-74-2		
1.0E-04	I	7.0E-04	I	V		Chlordane (technical mixture)	12789-03-6	2.8E-02	7.3E-02
4.6E-03	C					Chlordecone (Kepone)	143-50-0	6.1E-04	
						Chlorfenvinphos	470-90-6		
						Chlorimuron, Ethyl-	90982-32-4		
		1.5E-04	A	V		Chlorine	7782-50-5		1.5E-02
		2.0E-04	I	V		Chlorine Dioxide	10049-04-4		2.1E-02
						Chlorite (Sodium Salt)	7758-19-2		
		5.0E+01	I	V		Chloro-1,1-difluoroethane, 1-	75-68-3		5.2E+03
3.0E-04	I	2.0E-02	I	V		Chloro-1,3-butadiene, 2-	126-99-8	9.4E-03	2.1E+00
						Chloro-2-methylaniline HCl, 4-	3165-93-3		
7.7E-05	C					Chloro-2-methylaniline, 4-	95-69-2	3.6E-02	
				V		Chloroacetaldehyde, 2-	107-20-0		
						Chloroacetic Acid	79-11-8		
		3.0E-05	I			Chloroacetophenone, 2-	532-27-4		3.1E-03
						Chloroaniline, p-	106-47-8		
		5.0E-02	P	V		Chlorobenzene	108-90-7		5.2E+00
						Chlorobenzene sulfonic acid, p-	98-66-8		
3.1E-05	C					Chlorobenzilate	510-15-6	9.1E-02	
						Chlorobenzoic Acid, p-	74-11-3		
8.6E-06	C	3.0E-01	P	V		Chlorobenzotrifluoride, 4-	98-56-6	3.3E-01	3.1E+01
				V		Chlorobutane, 1-	109-69-3		
		5.0E+01	I	V		Chlorodifluoromethane	75-45-6		5.2E+03
				V		Chloroethanol, 2-	107-07-3		
2.3E-05	I	9.8E-02	A	V		Chloroform	67-66-3	1.2E-01	1.0E+01
		9.0E-02	I	V		Chloromethane	74-87-3		9.4E+00
6.9E-04	C			V		Chloromethyl Methyl Ether	107-30-2	4.1E-03	
		1.0E-05	X			Chloronitrobenzene, o-	88-73-3		1.0E-03
		2.0E-03	P			Chloronitrobenzene, p-	100-00-5		2.1E-01
				V		Chlorophenol, 2-	95-57-8		
		4.0E-04	C	V		Chloropicrin	76-06-2		4.2E-02
						Chlorothalonil	1897-45-6		
				V		Chlorotoluene, o-	95-49-8		
				V		Chlorotoluene, p-	106-43-4		
6.9E-02	C					Chlorozotocin	54749-90-5	4.1E-05	
						Chlorpropham	101-21-3		
						Chlorpyrifos	2921-88-2		
						Chlorpyrifos Methyl	5598-13-0		
						Chlorsulfuron	64902-72-3		
						Chlorthal-dimethyl	1861-32-1		
						Chlorthiophos	60238-56-4		
						Chromium(III), Insoluble Salts	16065-83-1		
8.4E-02	G	1.0E-04	I		M	Chromium(VI)	18540-29-9	1.2E-05	1.0E-02
						Chromium, Total	7440-47-3		
						Clofentezine	74115-24-5		
9.0E-03	P	6.0E-06	P			Cobalt	7440-48-4	3.1E-04	6.3E-04
6.2E-04	I			V	M	Coke Oven Emissions	E649830	1.6E-03	

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IUR (ug/m³)⁻¹	key	RfC$_i$ (mg/m³)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m³)	Noncarcinogenic SL THI=0.1 (ug or fibers/m³)
						Copper	7440-50-8		
		6.0E-01	C			Cresol, m-	108-39-4		6.3E+01
		6.0E-01	C			Cresol, o-	95-48-7		6.3E+01
		6.0E-01	C			Cresol, p-	106-44-5		6.3E+01
						Cresol, p-chloro-m-	59-50-7		
		6.0E-01	C			Cresols	1319-77-3		6.3E+01
				V		Crotonaldehyde, trans-	123-73-9		
		4.0E-01	I	V		Cumene	98-82-8		4.2E+01
6.3E-05	C					Cupferron	135-20-6	4.5E-02	
						Cyanazine	21725-46-2		
						Cyanides			
						~Calcium Cyanide	592-01-8		
						~Copper Cyanide	544-92-3		
		8.0E-04	G	V		~Cyanide (CN-)	57-12-5		8.3E-02
				V		~Cyanogen	460-19-5		
				V		~Cyanogen Bromide	506-68-3		
				V		~Cyanogen Chloride	506-77-4		
		8.0E-04	I	V		~Hydrogen Cyanide	74-90-8		8.3E-02
						~Potassium Cyanide	151-50-8		
						~Potassium Silver Cyanide	506-61-6		
						~Silver Cyanide	506-64-9		
						~Sodium Cyanide	143-33-9		
				V		~Thiocyanates	E1790665		
						~Thiocyanic Acid	463-56-9		
						~Zinc Cyanide	557-21-1		
		6.0E+00	I	V		Cyclohexane	110-82-7		6.3E+02
						Cyclohexane, 1,2,3,4,5-pentabromo-6-chloro-	87-84-3		
		7.0E-01	P	V		Cyclohexanone	108-94-1		7.3E+01
		1.0E+00	X	V		Cyclohexene	110-83-8		1.0E+02
				V		Cyclohexylamine	108-91-8		
						Cyfluthrin	68359-37-5		
						Cypermethrin	52315-07-8		
						Cyromazine	66215-27-8		
6.9E-05	C					DDD, p,p`- (DDD)	72-54-8	4.1E-02	
9.7E-05	C			V		DDE, p,p'-	72-55-9	2.9E-02	
9.7E-05	I					DDT	50-29-3	2.9E-02	
						Dalapon	75-99-0		
5.1E-06	C					Daminozide	1596-84-5	5.5E-01	
						Decabromodiphenyl ether, 2,2',3,3',4,4',5,5',6,6'- (BDE-209)	1163-19-5		
						Demeton	8065-48-3		
						Di(2-ethylhexyl)adipate	103-23-1		
						Diallate	2303-16-4		
						Diazinon	333-41-5		
				V		Dibenzothiophene	132-65-0		
6.0E-03	P	2.0E-04	I	V	M	Dibromo-3-chloropropane, 1,2-	96-12-8	1.7E-04	2.1E-02
						Dibromoacetic acid	631-64-1		
				V		Dibromobenzene, 1,3-	108-36-1		
				V		Dibromobenzene, 1,4-	106-37-6		
				V		Dibromochloromethane	124-48-1		
6.0E-04	I	9.0E-03	I	V		Dibromoethane, 1,2-	106-93-4	4.7E-03	9.4E-01
		4.0E-03	X	V		Dibromomethane (Methylene Bromide)	74-95-3		4.2E-01
						Dibutyltin Compounds	E1790661		
						Dicamba	1918-00-9		
						Dichloramine	3400-09-7		
4.2E-03	P			V		Dichloro-2-butene, 1,4-	764-41-0	6.7E-04	
4.2E-03	P			V		Dichloro-2-butene, cis-1,4-	1476-11-5	6.7E-04	
4.2E-03	P			V		Dichloro-2-butene, trans-1,4-	110-57-6	6.7E-04	
						Dichloroacetic Acid	79-43-6		
		2.0E-01	H	V		Dichlorobenzene, 1,2-	95-50-1		2.1E+01
1.1E-05	C	8.0E-01	I	V		Dichlorobenzene, 1,4-	106-46-7	2.6E-01	8.3E+01
3.4E-04	C					Dichlorobenzidine, 3,3'-	91-94-1	8.3E-03	
						Dichlorobenzophenone, 4,4'-	90-98-2		
		1.0E-01	X	V		Dichlorodifluoromethane	75-71-8		1.0E+01
1.6E-06	C			V		Dichloroethane, 1,1-	75-34-3	1.8E+00	
2.6E-05	I	7.0E-03	P	V		Dichloroethane, 1,2-	107-06-2	1.1E-01	7.3E-01
		2.0E-01	I	V		Dichloroethylene, 1,1-	75-35-4		2.1E+01
				V		Dichloroethylene, cis-1,2-	156-59-2		
		4.0E-02	X	V		Dichloroethylene, trans-1,2-	156-60-5		4.2E+00
						Dichlorophenol, 2,4-	120-83-2		
						Dichlorophenoxy Acetic Acid, 2,4-	94-75-7		
3.7E-06	P	4.0E-03	I	V		Dichloropropane, 1,2-	78-87-5	7.6E-01	4.2E-01
				V		Dichloropropane, 1,3-	142-28-9		
						Dichloropropanol, 2,3-	616-23-9		
4.0E-06	I	2.0E-02	I	V		Dichloropropene, 1,3-	542-75-6	7.0E-01	2.1E+00
8.3E-05	C	5.0E-04	I			Dichlorvos	62-73-7	3.4E-02	5.2E-02
						Dicrotophos	141-66-2		
		3.0E-04	X	V		Dicyclopentadiene	77-73-6		3.1E-02
4.6E-03	I					Dieldrin	60-57-1	6.1E-04	
3.0E-04	C	5.0E-03	I			Diesel Engine Exhaust	E17136615	9.4E-03	5.2E-01
		2.0E-04	P			Diethanolamine	111-42-2		2.1E-02
		1.0E-04	P			Diethylene Glycol Monobutyl Ether	112-34-5		1.0E-02
		3.0E-04	P			Diethylene Glycol Monoethyl Ether	111-90-0		3.1E-02

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IUR (ug/m^3)$^{-1}$	key	RfC$_i$ (mg/m^3)	key	v/o/l	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m^3)	Noncarcinogenic SL THI=0.1 (ug or fibers/m^3)
				V		Diethylformamide	617-84-5		
1.0E-01	C			V		Diethylstilbestrol	56-53-1	2.8E-05	
						Difenzoquat	43222-48-6		
						Diflubenzuron	35367-38-5		
		4.0E+01	I	V		Difluoroethane, 1,1-	75-37-6		4.2E+03
		3.0E+01	X	V		Difluoropropane, 2,2-	420-45-1		3.1E+03
1.3E-05	C			V		Dihydrosafrole	94-58-6	2.2E-01	
		7.0E-01	P	V		Diisopropyl Ether	108-20-3		7.3E+01
				V		Diisopropyl Methylphosphonate	1445-75-6		
						Dimethipin	55290-64-7		
						Dimethoate	60-51-5		
						Dimethoxybenzidine, 3,3'-	119-90-4		
						Dimethyl methylphosphonate	756-79-6		
1.3E-03	C					Dimethylamino azobenzene [p-]	60-11-7	2.2E-03	
						Dimethylaniline HCl, 2,4-	21436-96-4		
						Dimethylaniline, 2,4-	95-68-1		
				V		Dimethylaniline, N,N-	121-69-7		
						Dimethylbenzidine, 3,3'-	119-93-7		
		3.0E-02	I	V		Dimethylformamide	68-12-2		3.1E+00
		2.0E-06	X	V		Dimethylhydrazine, 1,1-	57-14-7		2.1E-04
1.6E-01	C			V		Dimethylhydrazine, 1,2-	540-73-8	1.8E-05	
						Dimethylphenol, 2,4-	105-67-9		
						Dimethylphenol, 2,6-	576-26-1		
						Dimethylphenol, 3,4-	95-65-8		
1.3E-05	C			V		Dimethylvinylchloride	513-37-1	2.2E-01	
						Dinitro-o-cresol, 4,6-	534-52-1		
						Dinitro-o-cyclohexyl Phenol, 4,6-	131-89-5		
		2.0E-03	X			Dinitroaniline, 3,5-	618-87-1		2.1E-01
						Dinitrobenzene, 1,2-	528-29-0		
						Dinitrobenzene, 1,3-	99-65-0		
						Dinitrobenzene, 1,4-	100-25-4		
						Dinitrophenol, 2,4-	51-28-5		
						Dinitrotoluene Mixture, 2,4/2,6-	E1615210		
8.9E-05	C					Dinitrotoluene, 2,4-	121-14-2	3.2E-02	
						Dinitrotoluene, 2,6-	606-20-2		
						Dinitrotoluene, 2-Amino-4,6-	35572-78-2		
						Dinitrotoluene, 4-Amino-2,6-	19406-51-0		
						Dinitrotoluene, Technical grade	25321-14-6		
						Dinoseb	88-85-7		
5.0E-06	I	3.0E-02	I	V		Dioxane, 1,4-	123-91-1	5.6E-01	3.1E+00
						Dioxins			
1.3E+00	I					~Hexachlorodibenzo-p-dioxin, Mixture	34465-46-8	2.2E-06	
3.8E+01	C	4.0E-08	C	V		~TCDD, 2,3,7,8-	1746-01-6	7.4E-08	4.2E-06
						Diphenamid	957-51-7		
		4.0E-04	X	V		Diphenyl Ether	101-84-8		4.2E-02
						Diphenyl Sulfone	127-63-9		
						Diphenylamine	122-39-4		
2.2E-04	I					Diphenylhydrazine, 1,2-	122-66-7	1.3E-02	
						Diquat	2764-72-9		
2.1E-03	C					Direct Black 38	1937-37-7	1.3E-03	
2.1E-03	C					Direct Blue 6	2602-46-2	1.3E-03	
1.9E-03	C					Direct Brown 95	16071-86-6	1.5E-03	
						Disulfoton	298-04-4		
				V		Dithiane, 1,4-	505-29-3		
						Diuron	330-54-1		
						Dodine	2439-10-3		
				V		EPTC	759-94-4		
				V		Endosulfan	115-29-7		
						Endosulfan Sulfate	1031-07-8		
						Endothall	145-73-3		
						Endrin	72-20-8		
1.2E-06	I	1.0E-03	I	V		Epichlorohydrin	106-89-8	2.3E+00	1.0E-01
		2.0E-02	I	V		Epoxybutane, 1,2-	106-88-7		2.1E+00
						Ethanol, 2-(2-methoxyethoxy)-	111-77-3		
						Ethephon	16672-87-0		
						Ethion	563-12-2		
		6.0E-02	P	V		Ethoxyethanol Acetate, 2-	111-15-9		6.3E+00
		4.0E-01	P	V		Ethoxyethanol, 2-	110-80-5		4.2E+00
		7.0E-02	P	V		Ethyl Acetate	141-78-6		7.3E+00
		8.0E-03	P	V		Ethyl Acrylate	140-88-5		8.3E-01
		4.0E+00	P	V		Ethyl Chloride (Chloroethane)	75-00-3		4.2E+02
				V		Ethyl Ether	60-29-7		
		3.0E-01	P	V		Ethyl Methacrylate	97-63-2		3.1E+01
8.0E-08	I	4.0E+01	I	V		Ethyl Tertiary Butyl Ether (ETBE)	637-92-3	3.5E+01	4.2E+03
						Ethyl-p-nitrophenyl Phosphonate	2104-64-5		
2.5E-06	C	1.0E+00	I	V		Ethylbenzene	100-41-4	1.1E+00	1.0E+02
						Ethylene Cyanohydrin	109-78-4		
				V		Ethylene Diamine	107-15-3		
		4.0E-01	C			Ethylene Glycol	107-21-1		4.2E+01
		1.6E+00	I			Ethylene Glycol Monobutyl Ether	111-76-2		1.7E+02
3.0E-03	I	3.0E-02	C	V	M	Ethylene Oxide	75-21-8	3.4E-04	3.1E+00
1.3E-05	C					Ethylene Thiourea	96-45-7	2.2E-01	

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IUR (ug/m³)⁻¹	key	RfCi (mg/m³)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m³)	Noncarcinogenic SL THI=0.1 (ug or fibers/m³)
1.9E-02	C			V		Ethyleneimine	151-56-4	1.5E-04	
						Ethylphthalyl Ethyl Glycolate	84-72-0		
						Fenamiphos	22224-92-6		
						Fenpropathrin	39515-41-8		
						Fenvalerate	51630-58-1		
						Fluometuron	2164-17-2		
		1.3E-02	C			Fluoride	16984-48-8		1.4E+00
		1.3E-02	C			Fluorine (Soluble Fluoride)	7782-41-4		1.4E+00
						Fluridone	59756-60-4		
						Flurprimidol	56425-91-3		
						Flusilazole	85509-19-9		
						Flutolanil	66332-96-5		
						Fluvalinate	69409-94-5		
						Folpet	133-07-3		
						Fomesafen	72178-02-0		
						Fonofos	944-22-9		
1.3E-05	I	9.8E-03	A	V		Formaldehyde	50-00-0	2.2E-01	1.0E+00
		3.0E-04	X	V		Formic Acid	64-18-6		3.1E-02
						Fosetyl-AL	39148-24-8		
						Furans			
				V		~Dibenzofuran	132-64-9		
				V		~Furan	110-00-9		
		2.0E+00	I	V		~Tetrahydrofuran	109-99-9		2.1E+02
						Furazolidone	67-45-8		
		5.0E-02	H	V		Furfural	98-01-1		5.2E+00
4.3E-04	C					Furium	531-82-8	6.5E-03	
8.6E-06	C					Furmecyclox	60568-05-0	3.3E-01	
						Glufosinate, Ammonium	77182-82-2		
		8.0E-05	C			Glutaraldehyde	111-30-8		8.3E-03
		1.0E-03	X	V		Glycidaldehyde	765-34-4		1.0E-01
						Glyphosate	1071-83-6		
				V		Guanidine	113-00-8		
						Guanidine Chloride	50-01-1		
						Guanidine Nitrate	506-93-4		
						Haloxyfop, Methyl	69806-40-2		
1.3E-03	I			V		Heptachlor	76-44-8	2.2E-03	
2.6E-03	I			V		Heptachlor Epoxide	1024-57-3	1.1E-03	
		3.0E-03	X	V		Heptanal, n-	111-71-7		3.1E-01
		4.0E-01	P	V		Heptane, N-	142-82-5		4.2E+01
				V		Hexabromobenzene	87-82-1		
						Hexabromodiphenyl ether, 2,2',4,4',5,5'- (BDE-153)	68631-49-2		
4.6E-04	I			V		Hexachlorobenzene	118-74-1	6.1E-03	
2.2E-05	I			V		Hexachlorobutadiene	87-68-3	1.3E-01	
1.8E-03	I					Hexachlorocyclohexane, Alpha-	319-84-6	1.6E-03	
5.3E-04	I					Hexachlorocyclohexane, Beta-	319-85-7	5.3E-03	
3.1E-04	C					Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9	9.1E-03	
5.1E-04	I					Hexachlorocyclohexane, Technical	608-73-1	5.5E-03	
		2.0E-04	I	V		Hexachlorocyclopentadiene	77-47-4		2.1E-02
1.1E-05	C	3.0E-02	I	V		Hexachloroethane	67-72-1	2.6E-01	3.1E+00
						Hexachlorophene	70-30-4		
						Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4		
		1.0E-05	I	V		Hexamethylene Diisocyanate, 1,6-	822-06-0		1.0E-03
		4.0E-04	C			Hexamethylene diisocyanate biuret	4035-89-6		4.2E-02
		4.0E-04	C			Hexamethylene diisocyanate isocyanurate	3779-63-3		4.2E-02
						Hexamethylphosphoramide	680-31-9		
2.0E-07	X	6.0E-01	P	V		Hexane, Commercial	E5241997	1.4E+01	6.3E+01
		7.0E-01	I	V		Hexane, N-	110-54-3		7.3E+01
						Hexanedioic Acid	124-04-9		
		4.0E-04	P	V		Hexanol, 1-,2-ethyl- (2-Ethyl-1-hexanol)	104-76-7		4.2E-02
		3.0E-02	I	V		Hexanone, 2-	591-78-6		3.1E+00
						Hexazinone	51235-04-2		
						Hexythiazox	78587-05-0		
						Hydramethylnon	67485-29-4		
4.9E-03	I	3.0E-05	P	V		Hydrazine	302-01-2	5.7E-04	3.1E-03
4.9E-03	I					Hydrazine Sulfate	10034-93-2	5.7E-04	
		2.0E-02	I	V		Hydrogen Chloride	7647-01-0		2.1E+00
		1.4E-02	C	V		Hydrogen Fluoride	7664-39-3		1.5E+00
		2.0E-03	I	V		Hydrogen Sulfide	7783-06-4		2.1E-01
						Hydroquinone	123-31-9		
						Imazalil	35554-44-0		
						Imazaquin	81335-37-7		
						Imazethapyr	81335-77-5		
						Iodine	7553-56-2		
						Iprodione	36734-19-7		
						Iron	7439-89-6		
				V		Isobutyl Alcohol	78-83-1		
		2.0E+00	C			Isophorone	78-59-1		2.1E+02
				V		Isopropalin	33820-53-0		
		2.0E-01	P	V		Isopropanol	67-63-0		2.1E+01
						Isopropyl Methyl Phosphonic Acid	1832-54-8		
						Isoxaben	82558-50-7		
		3.0E-01	A	V		JP-7	E1737665		3.1E+01

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IUR (ug/m³)⁻¹	key	RfC_i (mg/m³)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m³)	Noncarcinogenic SL THI=0.1 (ug or fibers/m³)
						Lactofen	77501-63-4		
						Lactonitrile	78-97-7		
						Lanthanum	7439-91-0		
						Lanthanum Acetate Hydrate	100587-90-4		
						Lanthanum Chloride Heptahydrate	10025-84-0		
						Lanthanum Chloride, Anhydrous	10099-58-8		
						Lanthanum Nitrate Hexahydrate	10277-43-7		
						Lead Compounds			
1.2E-05	C					~Lead Phosphate	7446-27-7	2.3E-01	
8.0E-05	C					~Lead acetate	301-04-2	3.5E-02	
						~Lead and Compounds	7439-92-1		1.5E-01
1.1E-05	C					~Lead subacetate	1335-32-6	2.6E-01	
				V		~Tetraethyl Lead	78-00-2		
				V		Lewisite	541-25-3		
						Linuron	330-55-2		
						Lithium	7439-93-2		
						MCPA	94-74-6		
						MCPB	94-81-5		
						MCPP	93-65-2		
						Malathion	121-75-5		
		7.0E-04	C			Maleic Anhydride	108-31-6		7.3E-02
						Maleic Hydrazide	123-33-1		
						Malononitrile	109-77-3		
						Mancozeb	8018-01-7		
						Maneb	12427-38-2		
		5.0E-05	I			Manganese (Diet)	7439-96-5		5.2E-03
		5.0E-05	I			Manganese (Non-diet)	7439-96-5		5.2E-03
						Mephosfolan	950-10-7		
						Mepiquat Chloride	24307-26-4		
						Mercaptobenzothiazole, 2-	149-30-4		
						Mercury Compounds			
		3.0E-04	G			~Mercuric Chloride (and other Mercury salts)	7487-94-7		3.1E-02
		3.0E-04	I	V		~Mercury (elemental)	7439-97-6		3.1E-02
						~Methyl Mercury	22967-92-6		
				V		~Phenylmercuric Acetate	62-38-4		
						Merphos	150-50-5		
						Metalaxyl	57837-19-1		
		3.0E-02	P	V		Methacrylonitrile	126-98-7		3.1E+00
						Methamidophos	10265-92-6		
		2.0E+01	I	V		Methanol	67-56-1		2.1E+03
						Methidathion	950-37-8		
						Methomyl	16752-77-5		
						Methoxy-5-nitroaniline, 2-	99-59-2		
						Methoxychlor	72-43-5		
		1.0E-03	P	V		Methoxyethanol Acetate, 2-	110-49-6		1.0E-01
		7.0E-03	P	V		Methoxyethanol, 2-	109-86-4		7.3E-01
				V		Methyl Acetate	79-20-9		
		2.0E-02	P	V		Methyl Acrylate	96-33-3		2.1E+00
		5.0E+00	I	V		Methyl Ethyl Ketone (2-Butanone)	78-93-3		5.2E+02
1.0E-03	X	2.0E-05	X	V		Methyl Hydrazine	60-34-4	2.8E-03	2.1E-03
		3.0E+00	I	V		Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1		3.1E+02
		1.0E-03	C	V		Methyl Isocyanate	624-83-9		1.0E-01
		7.0E-01	I	V		Methyl Methacrylate	80-62-6		7.3E+01
						Methyl Parathion	298-00-0		
						Methyl Phosphonic Acid	993-13-5		
		4.0E-02	H	V		Methyl Styrene (Mixed Isomers)	25013-15-4		4.2E+00
2.8E-05	C					Methyl methanesulfonate	66-27-3	1.0E-01	
2.6E-07	C	3.0E+00	I	V		Methyl tert-Butyl Ether (MTBE)	1634-04-4	1.1E+01	3.1E+02
						Methyl-1,4-benzenediamine dihydrochloride, 2-	615-45-2		
		3.0E+00	X	V		Methyl-2-Pentanol, 4-	108-11-2		3.1E+02
						Methyl-5-Nitroaniline, 2-	99-55-8		
2.4E-03	C					Methyl-N-nitro-N-nitrosoguanidine, N-	70-25-7	1.2E-03	
3.7E-05	C					Methylaniline Hydrochloride, 2-	636-21-5	7.6E-02	
						Methylarsonic acid	124-58-3		
						Methylbenzene,1-4-diamine monohydrochloride, 2-	74612-12-7		
						Methylbenzene-1,4-diamine sulfate, 2-	615-50-9		
6.3E-03	C				M	Methylcholanthrene, 3-	56-49-5	1.6E-04	
1.0E-08	I	6.0E-01	I	V	M	Methylene Chloride	75-09-2	1.0E+02	6.3E+01
4.3E-04	C				M	Methylene-bis(2-chloroaniline), 4,4'-	101-14-4	2.4E-03	
1.3E-05	C					Methylene-bis(N,N-dimethyl) Aniline, 4,4'-	101-61-1	2.2E-01	
4.6E-04	C	2.0E-02	C			Methylenebisbenzenamine, 4,4'-	101-77-9	6.1E-03	2.1E+00
		6.0E-04	I			Methylenediphenyl Diisocyanate	101-68-2		6.3E-02
				V		Methylstyrene, Alpha-	98-83-9		
						Metolachlor	51218-45-2		
						Metribuzin	21087-64-9		
						Metsulfuron-methyl	74223-64-6		
4.5E-06	X	1.0E-01	P	V		Midrange Aliphatic Hydrocarbon Streams	E1790669	6.2E-01	1.0E+01
				V		Mineral oils	8012-95-1		
5.1E-03	C			V		Mirex	2385-85-5	5.5E-04	
						Molinate	2212-67-1		
		2.0E-03	A			Molybdenum	7439-98-7		2.1E-01
						Monochloramine	10599-90-3		

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| Toxicity and Chemical-specific Information | | | | | | Contaminant | | Carcinogenic Target Risk (TR) = 1E-06 | Noncancer Hazard Index (HI) = 0.1 |
IUR $(ug/m^3)^{-1}$	key	RfC_i (mg/m^3)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m^3)	Noncarcinogenic SL THI=0.1 $(ug$ or $fibers/m^3)$
						Monomethylaniline	100-61-8		
						Myclobutanil	88671-89-0		
						N,N'-Diphenyl-1,4-benzenediamine	74-31-7		
				V		Naled	300-76-5		
		1.0E-01	P	V		Naphtha, High Flash Aromatic (HFAN)	64742-95-6		1.0E+01
0.0E+00	C					Naphthylamine, 2-	91-59-8		
						Napropamide	15299-99-7		
2.6E-04	C	1.4E-05	C			Nickel Acetate	373-02-4	1.1E-02	1.5E-03
2.6E-04	C	1.4E-05	C			Nickel Carbonate	3333-67-3	1.1E-02	1.5E-03
2.6E-04	C	1.4E-05	C	V		Nickel Carbonyl	13463-39-3	1.1E-02	1.5E-03
2.6E-04	C	1.4E-05	C			Nickel Hydroxide	12054-48-7	1.1E-02	1.5E-03
2.6E-04	C	2.0E-05	C			Nickel Oxide	1313-99-1	1.1E-02	2.1E-03
2.4E-04	I	1.4E-05	C			Nickel Refinery Dust	E715532	1.2E-02	1.5E-03
2.6E-04	C	9.0E-05	A			Nickel Soluble Salts	7440-02-0	1.1E-02	9.4E-03
4.8E-04	I	1.4E-05	C			Nickel Subsulfide	12035-72-2	5.8E-03	1.5E-03
2.6E-04	C	1.4E-05	C			Nickelocene	1271-28-9	1.1E-02	1.5E-03
						Nitrate (measured as nitrogen)	14797-55-8		
						Nitrate + Nitrite (measured as nitrogen)	E701177		
						Nitrite (measured as nitrogen)	14797-65-0		
		5.0E-05	X			Nitroaniline, 2-	88-74-4		5.2E-03
		6.0E-03	P			Nitroaniline, 4-	100-01-6		6.3E-01
4.0E-05	I	9.0E-03	I	V		Nitrobenzene	98-95-3	7.0E-02	9.4E-01
						Nitrocellulose	9004-70-0		
						Nitrofurantoin	67-20-9		
3.7E-04	C					Nitrofurazone	59-87-0	7.6E-03	
						Nitroglycerin	55-63-0		
						Nitroguanidine	556-88-7		
8.8E-06	P	5.0E-03	P	V		Nitromethane	75-52-5	3.2E-01	5.2E-01
5.8E-04	X	2.0E-02	I	V		Nitropropane, 2-	79-46-9	4.8E-03	2.1E+00
7.7E-03	C				M	Nitroso-N-ethylurea, N-	759-73-9	1.3E-04	
3.4E-02	C				M	Nitroso-N-methylurea, N-	684-93-5	3.0E-05	
1.6E-03	I			V		Nitroso-di-n-butylamine, N-	924-16-3	1.8E-03	
2.0E-03	C					Nitroso-di-N-propylamine, N-	621-64-7	1.4E-03	
8.0E-04	C					Nitrosodiethanolamine, N-	1116-54-7	3.5E-03	
4.3E-02	I				M	Nitrosodiethylamine, N-	55-18-5	2.4E-05	
1.4E-02	I	4.0E-05	X	V	M	Nitrosodimethylamine, N-	62-75-9	7.2E-05	4.2E-03
2.6E-06	C					Nitrosodiphenylamine, N-	86-30-6	1.1E+00	
6.3E-03	C			V		Nitrosomethylethylamine, N-	10595-95-6	4.5E-04	
1.9E-03	C					Nitrosomorpholine [N-]	59-89-2	1.5E-03	
2.7E-03	C					Nitrosopiperidine [N-]	100-75-4	1.0E-03	
6.1E-04	I					Nitrosopyrrolidine, N-	930-55-2	4.6E-03	
						Nitrotoluene, m-	99-08-1		
				V		Nitrotoluene, o-	88-72-2		
						Nitrotoluene, p-	99-99-0		
		2.0E-02	P	V		Nonane, n-	111-84-2		2.1E+00
						Norflurazon	27314-13-2		
						Octabromodiphenyl Ether	32536-52-0		
						Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0		
						Octamethylpyrophosphoramide	152-16-9		
						Oryzalin	19044-88-3		
						Oxadiazon	19666-30-9		
						Oxamyl	23135-22-0		
						Oxyfluorfen	42874-03-3		
						Paclobutrazol	76738-62-0		
						Paraquat Dichloride	1910-42-5		
						Parathion	56-38-2		
				V		Pebulate	1114-71-2		
						Pendimethalin	40487-42-1		
				V		Pentabromodiphenyl Ether	32534-81-9		
						Pentabromodiphenyl ether, 2,2',4,4',5- (BDE-99)	60348-60-9		
				V		Pentachlorobenzene	608-93-5		
				V		Pentachloroethane	76-01-7		
				V		Pentachloronitrobenzene	82-68-8		
5.1E-06	C					Pentachlorophenol	87-86-5	5.5E-01	
						Pentaerythritol tetranitrate (PETN)	78-11-5		
						Pentamethylphosphoramide (PMPA)	10159-46-3		
		1.0E+00	P	V		Pentane, n-	109-66-0		1.0E+02
						Per- and Polyfluoroalkyl Substances (PFAS)			
						~Ammonium perfluoro-2-methyl-3-oxahexanoate	62037-80-3		
				V		~Hexafluoropropylene oxide dimer acid (HFPO-DA)	13252-13-6		
						~Perfluorobutanesulfonate	45187-15-3		
						~Perfluorobutanesulfonic acid (PFBS)	375-73-5		
						~Perfluorohexanesulfonate	108427-53-8		
						~Perfluorohexanesulfonic acid (PFHxS)	355-46-4		
						~Perfluorononanoate	72007-68-2		
						~Perfluorononanoic acid (PFNA)	375-95-1		
						~Perfluorooctanesulfonate	45298-90-6		
						~Perfluorooctanesulfonic acid (PFOS)	1763-23-1		
						~Perfluorooctanoate	45285-51-6		
						~Perfluorooctanoic acid (PFOA)	335-67-1		
						~Potassium perfluorobutanesulfonate	29420-49-3		
						~Potassium perfluorooctanesulfonate	2795-39-3		

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IUR (ug/m³)⁻¹	key	RfCi (mg/m³)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m³)	Noncarcinogenic SL THI=0.1 (ug or fibers/m³)
						Perchlorates			
						~Ammonium Perchlorate	7790-98-9		
						~Lithium Perchlorate	7791-03-9		
						~Perchlorate and Perchlorate Salts	14797-73-0		
						~Potassium Perchlorate	7778-74-7		
						~Sodium Perchlorate	7601-89-0		
						Permethrin	52645-53-1		
6.3E-07	C					Phenacetin	62-44-2	4.5E+00	
						Phenmedipham	13684-63-4		
		2.0E-01	C			Phenol	108-95-2		2.1E+01
						Phenol, 2-(1-methylethoxy)-, methylcarbamate	114-26-1		
						Phenothiazine	92-84-2		
				V		Phenyl Isothiocyanate	103-72-0		
						Phenylenediamine, m-	108-45-2		
						Phenylenediamine, o-	95-54-5		
						Phenylenediamine, p-	106-50-3		
						Phenylphenol, 2-	90-43-7		
						Phorate	298-02-2		
		3.0E-04	I	V		Phosgene	75-44-5		3.1E-02
						Phosmet	732-11-6		
		3.0E-04	I	V		Phosphine	7803-51-2		3.1E-02
		1.0E-02	I			Phosphoric Acid	7664-38-2		1.0E+00
				V		Phosphorus, White	7723-14-0		
						Phthalates			
2.4E-06	C					~Bis(2-ethylhexyl)phthalate	117-81-1	1.2E+00	
						~Butyl Benzyl Phthalate	85-68-7		
						~Butylphthalyl Butylglycolate	85-70-1		
						~Dibutyl Phthalate	84-74-2		
						~Diethyl Phthalate	84-66-2		
				V		~Dimethylterephthalate	120-61-6		
						~Octyl Phthalate, di-N-	117-84-0		
						~Phthalic Acid, p-	100-21-0		
		2.0E-02	C			~Phthalic Anhydride	85-44-9		2.1E+00
						Picloram	1918-02-1		
						Picramic Acid (2-Amino-4,6-dinitrophenol)	96-91-3		
						Picric Acid (2,4,6-Trinitrophenol)	88-89-1		
						Pirimiphos, Methyl	29232-93-7		
8.6E-03	C					Polybrominated Biphenyls	36355-01-8	3.3E-04	
						Polychlorinated Biphenyls (PCBs)			
2.0E-05	G			V		~Aroclor 1016	12674-11-2	1.4E-01	
5.7E-04	G			V		~Aroclor 1221	11104-28-2	4.9E-03	
5.7E-04	G			V		~Aroclor 1232	11141-16-5	4.9E-03	
5.7E-04	G			V		~Aroclor 1242	53469-21-9	4.9E-03	
5.7E-04	G			V		~Aroclor 1248	12672-29-6	4.9E-03	
5.7E-04	G			V		~Aroclor 1254	11097-69-1	4.9E-03	
5.7E-04	G			V		~Aroclor 1260	11096-82-5	4.9E-03	
				V		~Aroclor 5460	11126-42-4		
1.1E-03	W	1.3E-03	W	V		~Heptachlorobiphenyl, 2,3,3',4,4',5,5'- (PCB 189)	39635-31-9	2.5E-03	1.4E-01
1.1E-03	W	1.3E-03	W	V		~Hexachlorobiphenyl, 2,3',4,4',5,5'- (PCB 167)	52663-72-6	2.5E-03	1.4E-01
1.1E-03	W	1.3E-03	W	V		~Hexachlorobiphenyl, 2,3,4,4',5- (PCB 157)	69782-90-7	2.5E-03	1.4E-01
1.1E-03	W	1.3E-03	W	V		~Hexachlorobiphenyl, 2,3,3',4,4',5- (PCB 156)	38380-08-4	2.5E-03	1.4E-01
1.1E+00	W	1.3E-06	W	V		~Hexachlorobiphenyl, 3,3',4,4',5,5'- (PCB 169)	32774-16-6	2.5E-06	1.4E-04
1.1E-03	W	1.3E-03	W	V		~Pentachlorobiphenyl, 2',3,4,4',5- (PCB 123)	65510-44-3	2.5E-03	1.4E-01
1.1E-03	W	1.3E-03	W	V		~Pentachlorobiphenyl, 2,3',4,4',5- (PCB 118)	31508-00-6	2.5E-03	1.4E-01
1.1E-03	W	1.3E-03	W	V		~Pentachlorobiphenyl, 2,3,3',4,4'- (PCB 105)	32598-14-4	2.5E-03	1.4E-01
1.1E-03	W	1.3E-03	W	V		~Pentachlorobiphenyl, 2,3,4,4',5- (PCB 114)	74472-37-0	2.5E-03	1.4E-01
3.8E+00	W	4.0E-07	W	V		~Pentachlorobiphenyl, 3,3',4,4',5- (PCB 126)	57465-28-8	7.4E-07	4.2E-05
5.7E-04	I			V		~Polychlorinated Biphenyls (high risk)	1336-36-3	4.9E-03	
1.0E-04	I			V		~Polychlorinated Biphenyls (low risk)	1336-36-3	2.8E-02	
2.0E-05	I			V		~Polychlorinated Biphenyls (lowest risk)	1336-36-3	1.4E-01	
3.8E-04	W	4.0E-04	W			~Tetrachlorobiphenyl, 3,3',4,4'- (PCB 77)	32598-13-3	7.4E-04	4.2E-02
1.1E-02	W	1.3E-04	W	V		~Tetrachlorobiphenyl, 3,4,4',5- (PCB 81)	70362-50-4	2.5E-04	1.4E-02
		6.0E-04	I			Polymeric Methylene Diphenyl Diisocyanate (PMDI)	9016-87-9		6.3E-02
						Polynuclear Aromatic Hydrocarbons (PAHs)			
				V		~Acenaphthene	83-32-9		
				V		~Anthracene	120-12-7		
6.0E-05	E			V	M	~Benz[a]anthracene	56-55-3	1.7E-02	
		2.0E-06	X			~Benzo(e)pyrene	192-97-2		2.1E-04
1.1E-04	C					~Benzo(j)fluoranthene	205-82-3	2.6E-02	
6.0E-04	I	2.0E-06	I		M	~Benzo[a]pyrene	50-32-8	1.7E-03	2.1E-04
6.0E-05	E				M	~Benzo[b]fluoranthene	205-99-2	1.7E-02	
6.0E-06	E				M	~Benzo[k]fluoranthene	207-08-9	1.7E-01	
				V		~Chloronaphthalene, Beta-	91-58-7		
6.0E-07	E				M	~Chrysene	218-01-9	1.7E+00	
6.0E-04	E				M	~Dibenz[a,h]anthracene	53-70-3	1.7E-03	
1.1E-03	C					~Dibenzo(a,e)pyrene	192-65-4	2.6E-03	
7.1E-02	C				M	~Dimethylbenz(a)anthracene, 7,12-	57-97-6	1.4E-05	
				V		~Fluoranthene	206-44-0		
				V		~Fluorene	86-73-7		
6.0E-05	E				M	~Indeno[1,2,3-cd]pyrene	193-39-5	1.7E-02	
				V		~Methylnaphthalene, 1-	90-12-0		
				V		~Methylnaphthalene, 2-	91-57-6		

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IUR (ug/m³)⁻¹	key	RfCᵢ (mg/m³)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m³)	Noncarcinogenic SL THI=0.1 (ug or fibers/m³)
3.4E-05	C	3.0E-03	I	V		~Naphthalene	91-20-3	8.3E-02	3.1E-01
1.1E-04	C					~Nitropyrene, 4-	57835-92-4	2.6E-02	
						~Pyrene	129-00-0		
						Prochloraz	67747-09-5		
				V		Profluralin	26399-36-0		
						Prometon	1610-18-0		
						Prometryn	7287-19-6		
						Pronamide	23950-58-5		
						Propachlor	1918-16-7		
						Propanil	709-98-8		
						Propargite	2312-35-8		
				V		Propargyl Alcohol	107-19-7		
						Propazine	139-40-2		
						Propham	122-42-9		
						Propiconazole	60207-90-1		
		8.0E-03	I	V		Propionaldehyde	123-38-6		8.3E-01
		1.0E+00	X	V		Propyl benzene	103-65-1		1.0E+02
		3.0E+00	C	V		Propylene	115-07-1		3.1E+02
						Propylene Glycol	57-55-6		
		2.7E-04	A			Propylene Glycol Dinitrate	6423-43-4		2.8E-02
		2.0E+00	I	V		Propylene Glycol Monomethyl Ether	107-98-2		2.1E+02
3.7E-06	I	3.0E-02	I	V		Propylene Oxide	75-56-9	7.6E-01	3.1E+00
				V		Pyridine	110-86-1		
						Quinalphos	13593-03-8		
						Quinoline	91-22-5		
						Quizalofop-ethyl	76578-14-8		
		3.0E+04	A			Refractory Ceramic Fibers (units in fibers)	E715557		3.1E+03
						Resmethrin	10453-86-8		
				V		Ronnel	299-84-3		
						Rotenone	83-79-4		
6.3E-05	C				M	Safrole	94-59-7	1.6E-02	
						Selenious Acid	7783-00-8		
		2.0E-02	C			Selenium	7782-49-2		2.1E+00
		2.0E-02	C			Selenium Sulfide	7446-34-6		2.1E+00
						Sethoxydim	74051-80-2		
		3.0E-03	C			Silica (crystalline, respirable)	7631-86-9		3.1E-01
						Silver	7440-22-4		
						Simazine	122-34-9		
						Sodium Acifluorfen	62476-59-9		
						Sodium Azide	26628-22-8		
						Sodium Diethyldithiocarbamate	148-18-5		
		1.3E-02	C			Sodium Fluoride	7681-49-4		1.4E+00
						Sodium Fluoroacetate	62-74-8		
						Sodium Metavanadate	13718-26-8		
						Sodium Tungstate	13472-45-2		
						Sodium Tungstate Dihydrate	10213-10-2		
						Stirofos (Tetrachlorovinphos)	961-11-5		
						Strontium, Stable	7440-24-6		
						Strychnine	57-24-9		
		1.0E+00	I	V		Styrene	100-42-5		1.0E+02
						Styrene-Acrylonitrile (SAN) Trimer (THNA isomer)	57964-39-3		
						Styrene-Acrylonitrile (SAN) Trimer (THNP isomer)	57964-40-6		
		2.0E-03	X			Sulfolane	126-33-0		2.1E-01
						Sulfonylbis(4-chlorobenzene), 1,1'-	80-07-9		
		1.0E-03	C	V		Sulfur Trioxide	7446-11-9		1.0E-01
		1.0E-03	C			Sulfuric Acid	7664-93-9		1.0E-01
7.1E-06	I					Sulfurous acid, 2-chloroethyl 2-[4-(1,1-dimethylethyl)phenoxy]-1-methylethyl ester	140-57-8	4.0E-01	
						TCMTB	21564-17-0		
						Tebuthiuron	34014-18-1		
						Temephos	3383-96-8		
						Terbacil	5902-51-2		
				V		Terbufos	13071-79-9		
						Terbutryn	886-50-0		
1.3E-06	C			V		Tert-Butyl Acetate	540-88-5	2.2E+00	
						Tetrabromodiphenyl ether, 2,2',4,4'- (BDE-47)	5436-43-1		
				V		Tetrachlorobenzene, 1,2,4,5-	95-94-3		
7.4E-06	I			V		Tetrachloroethane, 1,1,1,2-	630-20-6	3.8E-01	
5.8E-05	C			V		Tetrachloroethane, 1,1,2,2-	79-34-5	4.8E-02	
2.6E-07	I	4.0E-02	I	V		Tetrachloroethylene	127-18-4	1.1E+01	4.2E+00
						Tetrachlorophenol, 2,3,4,6-	58-90-2		
				V		Tetrachlorotoluene, p- alpha, alpha, alpha-	5216-25-1		
						Tetraethyl Dithiopyrophosphate	3689-24-5		
		8.0E+01	I	V		Tetrafluoroethane, 1,1,1,2-	811-97-2		8.3E+03
						Tetramethylphosphoramide, -N,N,N',N" (TMPA)	16853-36-4		
						Tetryl (Trinitrophenylmethylnitramine)	479-45-8		
						Thallic Oxide	1314-32-5		
						Thallium (I) Nitrate	10102-45-1		
						Thallium (Soluble Salts)	7440-28-0		
				V		Thallium Acetate	563-68-8		
						Thallium Carbonate	6533-73-9		
						Thallium Chloride	7791-12-0		

IUR (ug/m³)⁻¹	key	RfCᵢ (mg/m³)	key	v/o/l	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m³)	Noncancer HI=0.1 THI=0.1 (ug or fibers/m³)

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; D = OW; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; W = TEF applied; E = RPF applied; G = user's guide Section 5; M = mutagen; V = volatile; R = RBA applied ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = ceiling limit exceeded; s = Csat exceeded.

Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 0.1
IUR (ug/m³)⁻¹	key	RfCᵢ (mg/m³)	key	v/o/l	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m³)	Noncancer SL THI=0.1 (ug or fibers/m³)
						Thallium Selenite	12039-52-0		
						Thallium Sulfate	7446-18-6		
						Thifensulfuron-methyl	79277-27-3		
						Thiobencarb	28249-77-6		
						Thiodiglycol	111-48-8		
						Thiofanox	39196-18-4		
						Thiophanate, Methyl	23564-05-8		
						Thiram	137-26-8		
						Tin	7440-31-5		
		1.0E-04	A	V		Titanium Tetrachloride	7550-45-0		1.0E-02
		5.0E+00	I	V		Toluene	108-88-3		5.2E+02
1.1E-05	C	8.0E-06	C	V		Toluene-2,4-diisocyanate	584-84-9	2.6E-01	8.3E-04
						Toluene-2,5-diamine	95-70-5		
1.1E-05	C	8.0E-06	C	V		Toluene-2,6-diisocyanate	91-08-7	2.6E-01	8.3E-04
						Toluenediamine, 2,3-	2687-25-4		
						Toluenediamine, 3,4-	496-72-0		
						Toluic Acid, p-	99-94-5		
5.1E-05	C					Toluidine, o- (Methylaniline, 2-)	95-53-4	5.5E-02	
						Toluidine, p-	106-49-0		
				V		Total Petroleum Hydrocarbons (Aliphatic High)	E1790670		
		6.0E-01	P	V		Total Petroleum Hydrocarbons (Aliphatic Low)	E1790666		6.3E+01
		1.0E-01	P	V		Total Petroleum Hydrocarbons (Aliphatic Medium)	E1790668		1.0E+01
		3.0E-02	P	V		Total Petroleum Hydrocarbons (Aromatic High)	E1790676		3.1E+00
		3.0E-03	P	V		Total Petroleum Hydrocarbons (Aromatic Low)	E1790672		3.1E-01
						Total Petroleum Hydrocarbons (Aromatic Medium)	E1790674		
3.2E-04	I					Toxaphene	8001-35-2	8.8E-03	
						Toxaphene, Weathered	E1841606		
						Tralomethrin	66841-25-6		
				V		Tri-n-butyltin	688-73-3		
						Triacetin	102-76-1		
						Triadimefon	43121-43-3		
				V		Triallate	2303-17-5		
						Triasulfuron	82097-50-5		
						Tribenuron-methyl	101200-48-0		
				V		Tribromobenzene, 1,2,4-	615-54-3		
						Tribromophenol, 2,4,6-	118-79-6		
						Tribufos	78-48-8		
						Tributyl Phosphate	126-73-8		
						Tributyltin Compounds	E1790679		
						Tributyltin Oxide	56-35-9		
						Trichloramine	10025-85-1		
		5.0E+00	P	V		Trichloro-1,2,2-trifluoroethane, 1,1,2-	76-13-1		5.2E+02
						Trichloroacetic Acid	76-03-9		
						Trichloroaniline HCl, 2,4,6-	33663-50-2		
						Trichloroaniline, 2,4,6-	634-93-5		
				V		Trichlorobenzene, 1,2,3-	87-61-6		
		2.0E-03	P	V		Trichlorobenzene, 1,2,4-	120-82-1		2.1E-01
		5.0E+00	I	V		Trichloroethane, 1,1,1-	71-55-6		5.2E+02
1.6E-05	I	2.0E-04	X	V		Trichloroethane, 1,1,2-	79-00-5	1.8E-01	2.1E-02
4.1E-06	I	2.0E-03	I	V	M	Trichloroethylene	79-01-6	4.8E-01	2.1E-01
				V		Trichlorofluoromethane	75-69-4		
						Trichlorophenol, 2,4,5-	95-95-4		
3.1E-06	I					Trichlorophenol, 2,4,6-	88-06-2	9.1E-01	
						Trichlorophenoxyacetic Acid, 2,4,5-	93-76-5		
						Trichlorophenoxypropionic acid, -2,4,5	93-72-1		
				V		Trichloropropane, 1,1,2-	598-77-6		
		3.0E-04	I	V	M	Trichloropropane, 1,2,3-	96-18-4		3.1E-02
		3.0E-04	P	V		Trichloropropene, 1,2,3-	96-19-5		3.1E-02
						Tricresyl Phosphate (TCP)	1330-78-5		
						Tridiphane	58138-08-2		
		7.0E-03	I	V		Triethylamine	121-44-8		7.3E-01
						Triethylene Glycol	112-27-6		
		2.0E+01	P	V		Trifluoroethane, 1,1,1-	420-46-2		2.1E+03
				V		Trifluralin	1582-09-8		
						Trimethyl Phosphate	512-56-1		
		6.0E-02	I	V		Trimethylbenzene, 1,2,3-	526-73-8		6.3E+00
		6.0E-02	I	V		Trimethylbenzene, 1,2,4-	95-63-6		6.3E+00
		6.0E-02	I	V		Trimethylbenzene, 1,3,5-	108-67-8		6.3E+00
				V		Trimethylpentene, 2,4,4-	25167-70-8		
						Trinitrobenzene, 1,3,5-	99-35-4		
						Trinitrotoluene, 2,4,6-	118-96-7		
						Triphenylphosphine Oxide	791-28-6		
						Tris(1,3-Dichloro-2-propyl) Phosphate	13674-87-8		
						Tris(1-chloro-2-propyl)phosphate	13674-84-5		
6.6E-04	C			V		Tris(2,3-dibromopropyl)phosphate	126-72-7	4.3E-03	
						Tris(2-chloroethyl)phosphate	115-96-8		
						Tris(2-ethylhexyl)phosphate	78-42-2		
						Tungsten	7440-33-7		
		4.0E-05	A			Uranium	7440-61-1		4.2E-03
2.9E-04	C				M	Urethane	51-79-6	3.5E-03	
8.3E-03	P	7.0E-06	P			Vanadium Pentoxide	1314-62-1	3.4E-04	7.3E-04
		1.0E-04	A			Vanadium and Compounds	7440-62-2		1.0E-02

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; D = OW; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; W = TEF applied; E = RPF applied; G = user's guide Section 5; M = mutagen; V = volatile; R = RBA applied ; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL; SSL values are based on DAF=1; m = ceiling limit exceeded; s = Csat exceeded.

Toxicity and Chemical-specific Information						Contaminant		Carcinogenic Target Risk (TR) = 1E-06	Noncancer Hazard Index (HI) = 0.1
IUR (ug/m^3)$^{-1}$	key	RfC$_i$ (mg/m^3)	key	vol	mutagen	Analyte	CAS No.	Carcinogenic SL TR=1E-06 (ug/m^3)	Noncarcinogenic SL THI=0.1 (ug or fibers/m^3)
				V		Vernolate	1929-77-7		
						Vinclozolin	50471-44-8		
		2.0E-01	I	V		Vinyl Acetate	108-05-4		2.1E+01
1.5E-05	P	3.0E-03	I	V		Vinyl Bromide	593-60-2	1.9E-01	3.1E-01
4.4E-06	I	8.0E-02	A	V	M	Vinyl Chloride	75-01-4	1.7E-01	8.3E+00
						Warfarin	81-81-2		
		1.0E-01	G	V		Xylene, m-	108-38-3		1.0E+01
		1.0E-01	G	V		Xylene, o-	95-47-6		1.0E+01
		1.0E-01	G	V		Xylene, p-	106-42-3		1.0E+01
		1.0E-01	I	V		Xylenes	1330-20-7		1.0E+01
						Zinc Phosphide	1314-84-7		
						Zinc and Compounds	7440-66-6		
						Zineb	12122-67-7		
						Zirconium	7440-67-7		

○ Age-adjusted

$$ED_{res}(26\ yr) = ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr) + ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)$$

$$EF_{res}\left(\frac{350\ days}{yr}\right) = \frac{\left(\begin{array}{l} ED_{0-2}(2\ yr) \times EF_{0-2}\left(\frac{350\ days}{yr}\right) + ED_{2-6}(4\ yr) \times EF_{2-6}\left(\frac{350\ days}{yr}\right) + \\ ED_{6-16}(10\ yr) \times EF_{6-16}\left(\frac{350\ days}{yr}\right) + ED_{16-26}(10\ yr) \times EF_{16-26}\left(\frac{350\ days}{yr}\right) \end{array}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr) + ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$ET_{res}\left(\frac{24\ hrs}{day}\right) = \frac{\left(\begin{array}{l} ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) + ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) + \\ ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) + ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \end{array}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr) + ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

Resident Air

This land use is for developing residential default screening levels that are presented in the RSL Generic Tables.

- Noncarcinogenic
  ○ Inhalation

$$SL_{res-air-inhn}\left(\frac{\mu g}{m^3}\right) = \frac{THQ \times AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

- Noncarcinogenic - Refractory Ceramic Fibers

  - Inhalation

$$SL_{res-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{THQ \times AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{f}{m^3}\right)}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

- Carcinogenic

  - Inhalation

$$SL_{res-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

- Mutagenic

  - Inhalation

$$SL_{res-air-inhmu}\left(\frac{\mu g}{m^3}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \begin{bmatrix} \left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 1\right) \end{bmatrix}}$$

- Vinyl Chloride
  - Inhalation

$$SL_{res\text{-}air\text{-}inhvc}\left(\frac{\mu g}{m^3}\right) = \cfrac{TR}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} + \left(\cfrac{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right)}$$

- Trichloroethylene
  - Inhalation

$$SL_{res\text{-}air\text{-}inhtce}\left(\frac{\mu g}{m^3}\right) = \cfrac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \begin{bmatrix} \left(EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times CAF_i(0.756)\right) + \\ \left(EF_{0\text{-}2}\left(\frac{350\ days}{yr}\right) \times ED_{0\text{-}2}(2\ yr) \times ET_{0\text{-}2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 10\right) + \\ \left(EF_{2\text{-}6}\left(\frac{350\ days}{yr}\right) \times ED_{2\text{-}6}(4\ yr) \times ET_{2\text{-}6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{6\text{-}16}\left(\frac{350\ days}{yr}\right) \times ED_{6\text{-}16}(10\ yr) \times ET_{6\text{-}16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{16\text{-}26}\left(\frac{350\ days}{yr}\right) \times ED_{16\text{-}26}(10\ yr) \times ET_{16\text{-}26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 1\right) \end{bmatrix}}$$

Composite Worker

Composite Worker Soil

This land use is for developing industrial default screening levels that are presented in the RSL Generic Tables.

Appendix C

Supporting RSL Calculator Output

Variable	Resident Air Default Value	Site-Specific Value
ED_{res} (exposure duration) years	26	26
ED_{0-2} (mutagenic exposure duration first phase) years	2	2
ED_{2-6} (mutagenic exposure duration second phase) years	4	4
ED_{6-16} (mutagenic exposure duration third phase) years	10	10
ED_{16-26} (mutagenic exposure duration fourth phase) years	10	10
EF_{res} (exposure frequency) days/year	350	350
EF_{0-2} (mutagenic exposure frequency first phase) days/year	350	350
EF_{2-6} (mutagenic exposure frequency second phase) days/year	350	350
EF_{6-16} (mutagenic exposure frequency third phase) days/year	350	350
EF_{16-26} (mutagenic exposure frequency fourth phase) days/year	350	350
ET_{res} (exposure time) hours/day	24	24
ET_{0-2} (mutagenic exposure time first phase) hours/day	24	24
ET_{2-6} (mutagenic exposure time second phase) hours/day	24	24
ET_{6-16} (mutagenic exposure time third phase) hours/day	24	24
ET_{16-26} (mutagenic exposure time fourth phase) hours/day	24	24
THQ (target hazard quotient) unitless	0.1	0.1
LT (lifetime) years	70	70
TR (target risk) unitless	1.0E-06	1.0E-06

Resident Regional Screening Levels (RSL) for Air

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = OW; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	IUR (ug/m^3)$^{-1}$	IUR Ref	RfC (mg/m^3)	RfC Ref	Carcinogenic SL TR=1E-06 (ug/m^3)	Noncarcinogenic SL THI=0.1 (ug or fibers/m^3)	Screening Level (ug or fibers/m^3)
Benzene	71-43-2	No	Yes	Organics	7.80E-06	I	3.00E-02	I	3.60E-01	3.13E+00	3.60E-01 ca**
Butadiene, 1,3-	106-99-0	No	Yes	Organics	3.00E-05	I	2.00E-03	I	9.36E-02	2.09E-01	9.36E-02 ca**
Chloroform	67-66-3	No	Yes	Organics	2.30E-05	I	9.77E-02	A	1.22E-01	1.02E+01	1.22E-01 ca*
Dichloroethane, 1,2-	107-06-2	No	Yes	Organics	2.60E-05	I	7.00E-03	P	1.08E-01	7.30E-01	1.08E-01 ca**
Hexane, N-	110-54-3	No	Yes	Organics	-		7.00E-01	I	-	7.30E+01	7.30E+01 nc
Methylene Chloride	75-09-2	Yes	Yes	Organics	1.00E-08	I	6.00E-01	I	1.01E+02	6.26E+01	6.26E+01 nc
Toluene	108-88-3	No	Yes	Organics	-		5.00E+00	I	-	5.21E+02	5.21E+02 nc
Trichloroethylene	79-01-6	Yes	Yes	Organics	4.10E-06	I	2.00E-03	I	4.78E-01	2.09E-01	2.09E-01 nc
Vinyl Chloride	75-01-4	Yes	Yes	Organics	4.40E-06	I	8.00E-02	A	1.68E-01	8.34E+00	1.68E-01 ca*
Xylene, m-	108-38-3	No	Yes	Organics	-		1.00E-01	G	-	1.04E+01	1.04E+01 nc
Xylene, o-	95-47-6	No	Yes	Organics	-		1.00E-01	G	-	1.04E+01	1.04E+01 nc

Site-specific
Resident Risk for Air

Chemical	IUR (ug/m^3)$^{-1}$	IUR Ref	RfC (mg/m^3)	RfC Ref	Concentration (ug or fibers/m^3)	Carcinogenic Risk	Noncarcinogenic HI
Benzene	7.80E-06	I	3.00E-02	I	1.60E+00	4.44E-06	5.11E-02
Butadiene, 1,3-	3.00E-05	I	2.00E-03	I	1.11E+00	1.19E-05	5.32E-01
Chloroform	2.30E-05	I	9.77E-02	A	2.44E+00	2.00E-05	2.40E-02
Dichloroethane, 1,2-	2.60E-05	I	7.00E-03	P	2.02E+00	1.87E-05	2.77E-01
Hexane, N-	-		7.00E-01	I	1.76E+00	-	2.41E-03
Methylene Chloride	1.00E-08	I	6.00E-01	I	3.47E+00	3.42E-08	5.55E-03
Toluene	-		5.00E+00	I	4.15E+00	-	7.96E-04
Trichloroethylene	4.10E-06	I	2.00E-03	I	2.69E+00	5.62E-06	1.29E+00
Vinyl Chloride	4.40E-06	I	8.00E-02	A	2.56E+00	1.53E-05	3.07E-02
Xylene, m-	-		1.00E-01	G	4.34E+00	-	4.16E-02
Xylene, o-	-		1.00E-01	G	4.34E+00	-	4.16E-02
Total Risk/HI	-		-		-	*7.59E-05*	*2.30E+00*

Appendix D

TOSHI Technical Documentation

Appendix D: TOSHI Technical Documentation

Disclaimer: The purpose of this TOSHI Technical Documentation is to explain the process that was used in the 24 Months Risk Assessment for deriving TOSHIs. The processes provided here should not be construed as an instructional manual for determining TOSHIs. EPA or EPD guidance on this matter may change in the future and the processes provided here may no longer be considered applicable.

HAP	CAS Number	Hazard Quotient (HQ)	Target Organ or Toxicological Effect	Critical Effect	Notes
Benzene	71-43-2	0.057	Immunological	Decreased lymphocyte count	
Butadiene, 1,3-	106-99-0	0.532	Reproductive	Ovarian atrophy	
Chloroform	67-66-3	0.024	Liver	Hepatomegaly	
Dichloroethane, 1,2-	107-06-2	0.277	Neurological	Neurobehavioral impairment	Target Organ Listed as "Liver" in HEM4; Since RfC is a PPRTV and PPRTVs are not considered in HEM4, the critical effect of the critical study (Neurological effects) is used as the target endpoint
Hexane	110-54-3	0.002	Neurological	Peripheral neuropathy (decreased MCV at 12 weeks)	
Methylene Chloride	75-09-2	0.006	Liver	Hepatic effects (hepatic vacuolation)	
Toluene	108-88-3	0.0004	Neurological	Neurological effects in occupationally-exposed workers	
Trichloroethylene	79-01-6	1.29	Immunological	Decreased thymus weight in female B6C3F1 mice (immunotoxicity)	
Vinyl Chloride	75-01-4	0.012	Liver	Liver cell polymorphism	
Xylene, m-	108-38-3	0.163	Neurological	Impaired motor coordination (decreased rotarod performance)	
Xylene, o-	95-47-6	0.046	Neurological	Impaired motor coordination (decreased rotarod performance)	

The purpose of this document is to provide an explanation into how the target-organ (or effect)-specific hazard indices (TOSHIs) was determined in the *Ambient Air Monitoring Report: Risk Assessment for Select Hazardous Air Pollutants (HAPs) Measured at the Forsyth County Air Monitoring Site, 24 Months of Operation* ("24 Months Risk Assessment"). TOSHIs were derived since the Hazard Index (HI) of all 10 HAPs exceeds 1.

It is important to emphasize that EPA prefers toxicologists with experience in developing TOSHIs undertake this practice to avoid any potential underestimation of hazard that could occur if TOSHIs are not developed correctly (USEPA, 2004, pg. 13-10). Thus, EPA air risk assessment guidance does not specify clear procedures on how to separate air toxics by toxicological effects and/or by the organs they target except to indicate that all the major effects that a particular HAP can induce should be identified (USEPA, 2004, pg. 13-10). To provide more refined TOSHIs that could better represent the noncancer hazard, a process for target organ/effect separation was developed for this Risk Assessment that would be simple, not require intensive toxicological research, and would be grounded in documentation from EPA sources. The steps of this process are outlined below:

1) For each of the 10 HAPs, the critical effect was noted:
   a. For all 10 HAPs, the toxicity values have been provided in Appendix B of this Risk Assessment. When compiling the toxicity values used, information on the critical effect/critical study was also compiled from the information provided in the sources for each toxicity value.
2) The list of target organs/effects from the HEM4 software was consulted.
   a. EPA has a publicly available air risk assessment software known as the Human Exposure Model (HEM). The most current version of the software is HEM4. The HEM4 is generally used to produce estimates of risk and hazard on modeled ambient air data and can be found here: https://www.epa.gov/fera/risk-assessment-and-modeling-human-exposure-model-hem. The HEM4 calculates TOSHIs as part of the software and groups air toxics into the following target organs or generalized toxicological effects (referred to as "organ systems" in *The HEM4 Users Guide*): respiratory; liver; neurological; developmental; reproductive; kidney; ocular; endocrine; hematological; immunological; skeletal; spleen; thyroid; and whole body (USEPA, 2021 pg. 109-110). Though ideally similarity in toxicological effects should be the basis for grouping HAPs together when deriving a TOSHI, in practice EPA indicates that air toxics that affect the same organ can be grouped together (USEPA, 2000, pg. 80). In the case of the HEM4, the classifications used in separating air toxics to determine a TOSHI are a mixture of target organs and general toxicological effects. The Excel file listing the target organs/effects (Target_Organ_Endpoints.xlsx) for all air toxics is found in the resources folder that is part of the HEM4 software and also has been included with Appendix D.

3) For each of the 10 HAPs, all the target organ(s)/toxicological effect(s) listed in Target_Organ_Endpoints.xlsx ("Excel file") were identified. For each air toxic, the Excel file codes "1" if that particular target organ/toxicological effect is applicable to the air toxic and codes "0" if it does not.

4) The target organs/toxicological effects identified using the HEM4 Excel file were compared to the critical effect identified for each HAP. The target organ/toxicological effect listed for a particular HAP in the HEM4 Excel file that best coincided with the critical effect was considered as the target organ/toxicological effect of that HAP for the purposes of determining the TOSHIs. All HAPs were separated into 4 target organs/toxicological effects: Immunological, Reproductive, Liver, and Neurological.

    a. Since the hazard quotient (HQ) for each HAP is derived based on the reference concentration (RfC) of that HAP, an assumption that can be made about the HQ is that in practicality it only considers the adverse noncancer effect that was found in the critical (or principal) study—the study that forms the basis of the RfC— as the only toxicological effect of concern. It is assumed that if the critical toxic effect is prevented, then all other toxic effects of a chemical would be prevented (USEPA, 1994, 4-69). Thus, it is assumed for the purposes of developing the TOSHI that each HAP only induces the critical toxic effect.

    b. Please see the Notes section in the table above for various exceptions that were made to this procedure.

    c. Since the Xylenes RfC was used as a surrogate for m,p-Xylene and o-Xylene to derive the HQ, the "Neurological" Toxicological Effect is also assumed for m-,p- isomer mixture and for the o- isomer.

5) TOSHIs were derived (within an assumption of concentration addition as explained in the 24 Months Risk Assessment main text) for each of the 4 target organs/toxicological effects. All TOSHIs were at or below 1 (at 1 significant figure).

Chemical	CAS Number	Target Organ or Toxicological Effect	Noncancer Hazard Quotient (HQ)
Benzene	71-43-2	Immunological	0.0511
Butadiene, 1,3-	106-99-0	Reproductive	0.532
Chloroform	67-66-3	Liver	0.024
Dichloroethane, 1,2-	107-06-2	Neurological	0.277
Hexane, N-	110-54-3	Neurological	0.0024
Methylene Chloride	75-09-2	Liver	0.0056
Toluene	108-88-3	Neurological	0.0008
Trichloroethylene (TCE)	79-01-6	Immunological	1.29
Vinyl Chloride	75-01-4	Liver	0.031
Xylene, m,p- (entered into the RSL Calculator as Xylene, m-)	108-38-3 (m-Xylene CAS Number)	Neurological	0.042
Xylene, o-	95-47-6	Neurological	0.042
Immunological TOSHI			**1**
Reproductive TOSHI			**0.5**
Neurological TOSHI			**0.4**
Liver TOSHI			**0.1**

Sources Cited:

United States Environmental Protection Agency (USEPA). 1994. *Methods For Derivation Of Inhalation Reference Concentrations And Application Of Inhalation Dosimetry.* EPA-600-8-90-066F. Research Triangle Park, NC: United States Environmental Protection Agency, Environmental Criteria and Assessment Office

United States Environmental Protection Agency (USEPA). 2000. *Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures.* EPA/630/R-00/002. Washington, D.C.: U.S. Environmental Protection Agency, Risk Assessment Forum

United States Environmental Protection Agency (USEPA). 2021. *The HEM4 User's Guide.* EP-W-12-011. Research Triangle Park, N.C.: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. https://www.epa.gov/system/files/documents/2021-09/hem4_1_users_guide_0.pdf