# Annual Report of Air Quality Monitoring October 1, 2019 to September 30, 2020 at the Gregory - Portland Community Air Monitoring Stations

Prepared by

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# Contents

## Executive Summary

The Gregory Fresnos Community Air Monitoring Station on Fresnos St. began continuous monitoring operations October 1, 2019. Two additional air-monitoring stations in Portland, TX near the intersection of Buddy Ganem Dr. and Wildcat Dr. on the campus of the Gregory-Portland High School and on Broadway Blvd. on the campus of the old East Cliff Elementary School began operations on January 1, 2020.

A large-scale slowdown in the world economy owing to the COVID 19 pandemic has been underway since early 2020, but this has had minimal impact on the project's monitoring operations. The instruments in the stations operate automatically and can be accessed remotely. Station operators are locally based and need only travel a short distance to conduct standard operations and maintenance. Project managers at The University of Texas at Austin (UT Austin) have been working from home with no loss of effectiveness.

Each spring, fires associated with agricultural burning in Southern Mexico and Central America result in elevated concentrations of fine particulate matter ($PM_{2.5}$), as the smoke is blown into South Texas causing concentrations to rise. In March and April, smoke was measured at all project stations and at $PM_{2.5}$ instruments in Corpus Christi operated by the Texas Commission on Environmental Quality (TCEQ). Each summer, dust from Northern Africa is blown across the Atlantic Ocean and deposited across the U.S. Southern states and Eastern Mexico. This also results in elevated concentrations of $PM_{2.5}$ concentrations. In June through August, this dust was measured at all project stations and at $PM_{2.5}$ instruments in Corpus Christi operated by the TCEQ.

In a previous quarterly report, UT Austin described elevated values of oxides of nitrogen (NOx), sulfur dioxide ($SO_2$), and several hydrocarbon species reported at the Gregory Fresnos monitoring station on four dates beginning March 22 and ending May 16, 2020. Based on consultation with the UT Austin monitoring contractor, these reported values were mostly attributed to some unidentified chemical interferent and the values were invalidated. Subsequent efforts to determine the unidentified chemical interferent and its source have been unsuccessful.

The project's public website continues to provide information about air quality and monitoring data from the three stations (https://gpair.ceer.utexas.edu). Incremental improvements to the Website continue to be implemented.

## 1.0 Introduction

This report is jointly funded by Cheniere Energy and Gulf Coast Growth Ventures (GCGV) as part of their separate community air-monitoring programs. This report includes reviews and analyses conducted by The University of Texas at Austin (UT) of the air monitoring data obtained at the three stations since their continuous monitoring operations began. UT established the Gregory Fresnos (GF) station for Cheniere Energy and has managed the station since continuous monitoring operations began on October 1, 2019. AECOM, an engineering company, established the Portland Buddy Ganem (PBG) and Portland Broadway (PBway) stations for GCGV and has managed the stations since continuous monitoring operations began on January 1, 2020.

## 2.0 Summary of Activities for the Period October 1, 2019 through September 30, 2020

The international COVID 19 pandemic has caused a large-scale slowdown in a wide range of activities over recent months. While this has had little impact on the project's monitoring operations, it may have had some effect on activities in the community, which could have effects on air quality.

Project activities during the reporting period have focused on maintenance and operation of the three community air monitoring stations, analysis of the data from all three stations, and maintenance of the public website for reporting of the data from the three stations. The UT project team appointed a focus group composed of community representatives to provide advice on the detailed design and development of the public website to make it user friendly and helpful for the community. The focus group members are listed in Table 1. The website (https://gpair.ceer.utexas.edu) has been fully functional and accessible to the general public since early April 2020.

**Table 1. Public Website Design & Development Focus Group Members and Affiliation**

| Name | Position |
|---|---|
| Troy Bethel | City Council, Portland |
| Randy Cain | City Council, Ingleside on the Bay |
| Brandi Dickey | Gregory-Portland ISD |
| Amelia Flores | Parks & Recreation Board, Gregory |
| Ron Jorgensen | Portland Resident and Regional Health Awareness Board |
| Bob Lacy | HOA Officer, Portland |
| Rudy Rivera | Gregory Resident |
| Kristina Zambrano | City Council, Gregory |

The remainder of this report focuses on the data collected at the three air monitoring stations.

## 3.0 Air Monitoring Station Locations & Information

Currently, there are three air monitoring stations in the Gregory-Portland area in operation, one site operated by UT in Gregory TX and two sites operated by AECOM in Portland TX:

- the Gregory Fresnos (GF) Community Air Monitoring Station at 401 Fresnos Street, Gregory, Texas at the Stephen F. Austin, Elementary School Campus,
- the Portland Buddy Ganem (PBG) station located at the Gregory Portland High School campus at 307 Buddy Ganem St., Portland, TX,
- the Portland Broadway (PBway) station located on the Old East Cliff Elementary School property at 175 Broadway Blvd., Portland, TX.

The parameters measured at the three stations are summarized in Table 2. The locations of the three stations are shown in Figure 1. Also outlined in Figure 1 are the locations of the Cheniere liquefied natural gas facility under expansion and the under-construction GCGV ethane-cracker facility.

**Table 2. Gregory-Portland Community Air Monitoring Stations and Parameters Measured**

| Air Monitoring Station Name & Address | Volatile Organic Compounds (VOCs) 46 compounds | Ethylene oxide (EO) 24 hr canister every 6th day | Nitrogen Oxides (NOx, NO, & NO2) | Sulfur Dioxide ($SO_2$) | Particulate Matter (PM) Mass, particles < 2.5 micron diameter | Wind Speed (WS), Wind Direction (WD), Ambient Temperature (T), Relative Humidity (RH), & Barometric Pressure (BP) |
|---|---|---|---|---|---|---|
| Gregory Fresnos<br>Stephen Austin Elementary<br>401 Fresnos St.<br>Gregory, TX | Yes | No | Yes | Yes | Yes | Yes |
| Portland Buddy Ganem<br>307 Buddy Ganem St.<br>GP High School<br>Portland, TX | Yes | Yes | No | No | Yes | Yes. + precipitation |
| Portland Broadway<br>175 Broadway Blvd.<br>Old East Cliff Elementary School<br>Portland, TX | Yes | Yes | No | No | Yes | Only WS, WD |

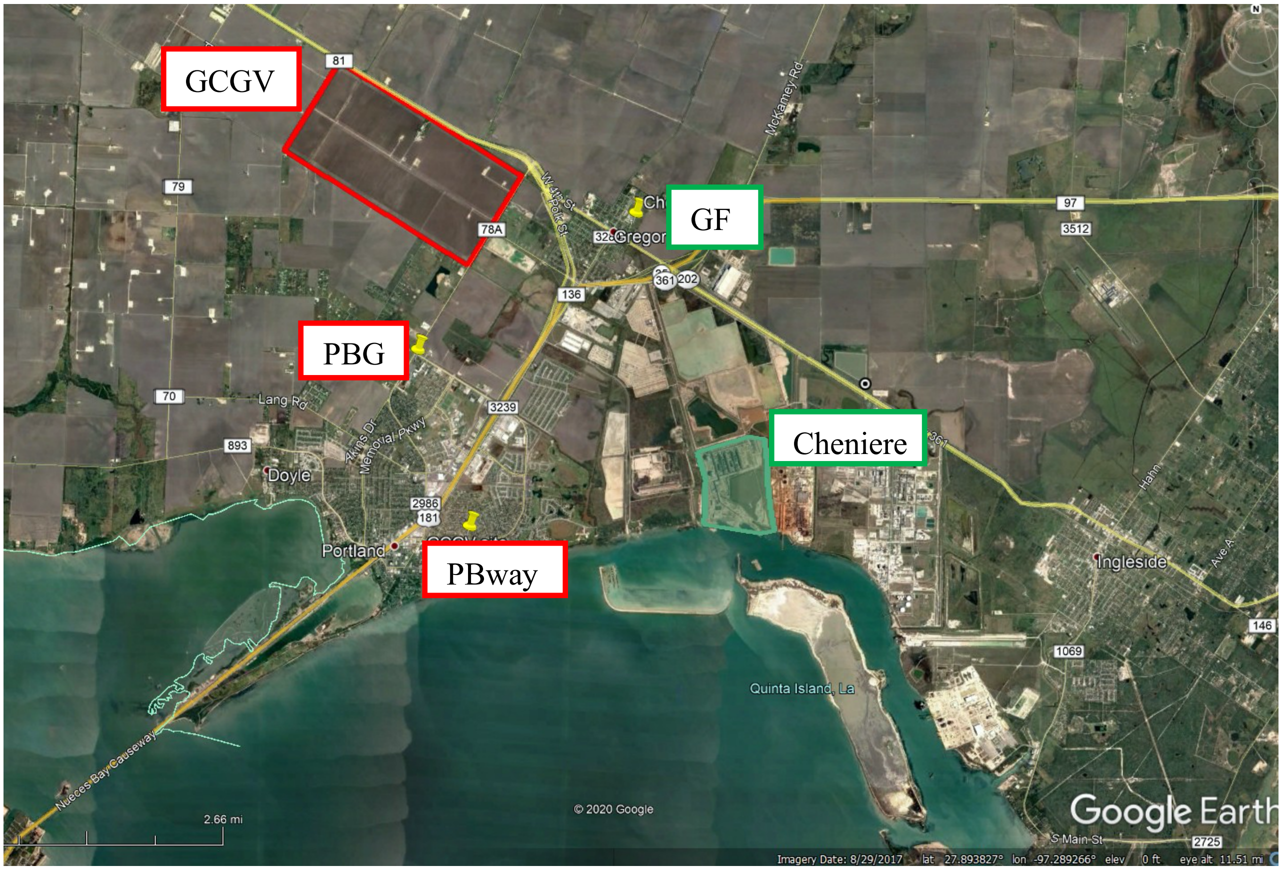


**Figure 1. Location of Gregory-Fresnos Community Air Monitoring Station (GF), and two Portland community stations on GPISD campuses on Buddy Ganem (PBG) and on Broadway (PBway) and two industrial facilities**

## 4.0 Summary of Data

As described in each report, the reader is reminded that pollutant concentrations are affected by several factors. One, of course, is the emission of a gas or smoke from a source or the availability of dust to become airborne. Another is the weather. Regarding weather, rain can reduce concentrations of several pollutants, in particular, particulate matter. The "mixing height" is the lower level of the atmosphere wherein gases and particles mix vertically. Temperature inversions such as those experienced at night have low mixing heights and can lead to air pollutants emitted near the surface being trapped at lower altitudes, thus allowing concentrations to increase. The converse is midday periods when the mixing height of the lower atmosphere rises and air pollutants are diluted in a larger volume of air. The wind plays a significant role in moving air pollutants from a source to other locations. For this reason, a large majority of air monitoring stations operated by the TCEQ and all three Gregory-Portland stations measure wind speed and direction. Under high wind speeds, many gas pollutants are dispersed and diluted; however, under high speed winds, dust on the surface can be picked up and transported, leading to higher particulate concentrations. Higher speed winds passing over the roof of a storage tank can lower the atmospheric pressure on that roof, leading to vapors being drawn out of the tank and into the air. Winds can be thought of as being local – near the surface – and regional – at higher altitudes. The local wind direction affects pollutant concentrations in terms of whether or not a pollution source is in the upwind direction, or along the local upwind path of the air if wind directions are changing. Similarly, but on a larger scale, the regional wind direction affects pollutant concentrations in terms of whether or not a source such as another major city, a large power plant, a forest fire, etc., is along the regional upwind path of the air. In the graphs that follow, some short-term concentration measurements are significantly higher than the balance of the data. In some cases, this is likely the combination of emission and meteorological (Met) factors.

Please note that the measurement data in this report are quality assured site data made available at different frequencies: NOx, NO, & $NO_2$, $SO_2$, PM 2.5 & Met measurements – weekly; auto GC VOC measurements – within 90 days of the measurement; and EO canister data – within 60 days of the date the sample was collected. Hence, the data available at the time the analyses were performed for this report will not all have the same date ranges.

**Gregory Fresnos Station Hydrocarbon Data**

Figure 2 shows the time series for the hourly concentrations of benzene at the Gregory-Fresnos (GF) station. The figure shows benzene hourly average concentrations for each hour from October 1, 2019 through July 31, 2020. Figure 3 shows the hourly time series for 1,3-butadiene, and Figure 4 shows the hourly time series for iso-propylbenzene. Iso-propylbenzene has a relatively low odor threshold and is shown in part because the odor threshold had been crossed at a Corpus Christi monitoring station in the past. Benzene and 1,3-butadiene concentrations in the air can be of health concern but to date their concentrations have been much lower than TCEQ Air Monitoring Comparison Values (AMCV) or Effects Screening Levels (ESL). Note that a straight line or a gap in a time series graph represents missing data.

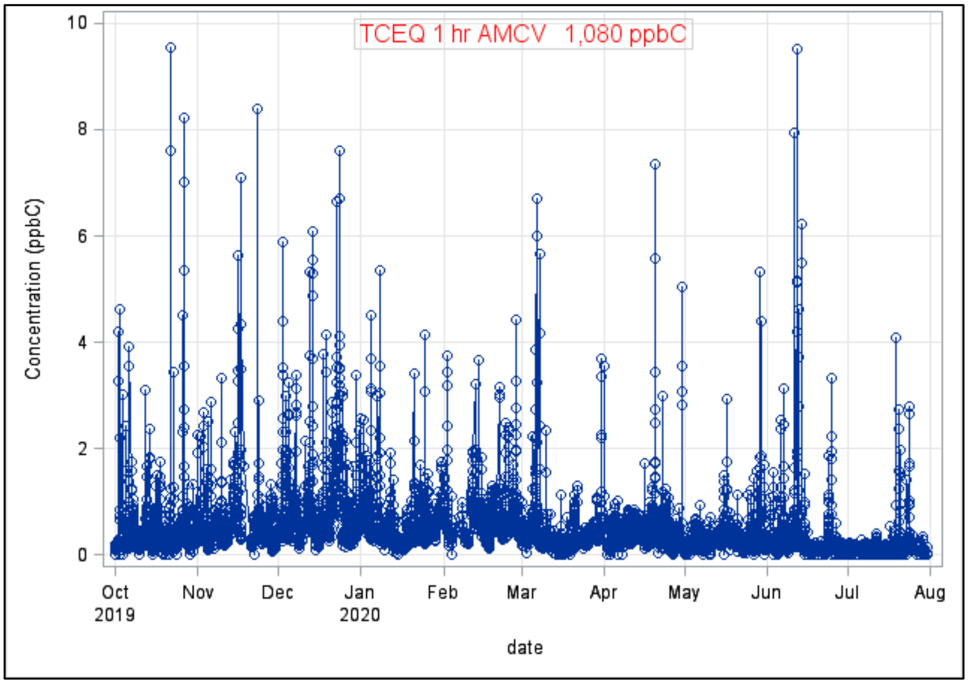


**Figure 2. Hourly benzene concentrations at GF station, Oct. 1, 2019 – July. 31, 2020, ppbC units**

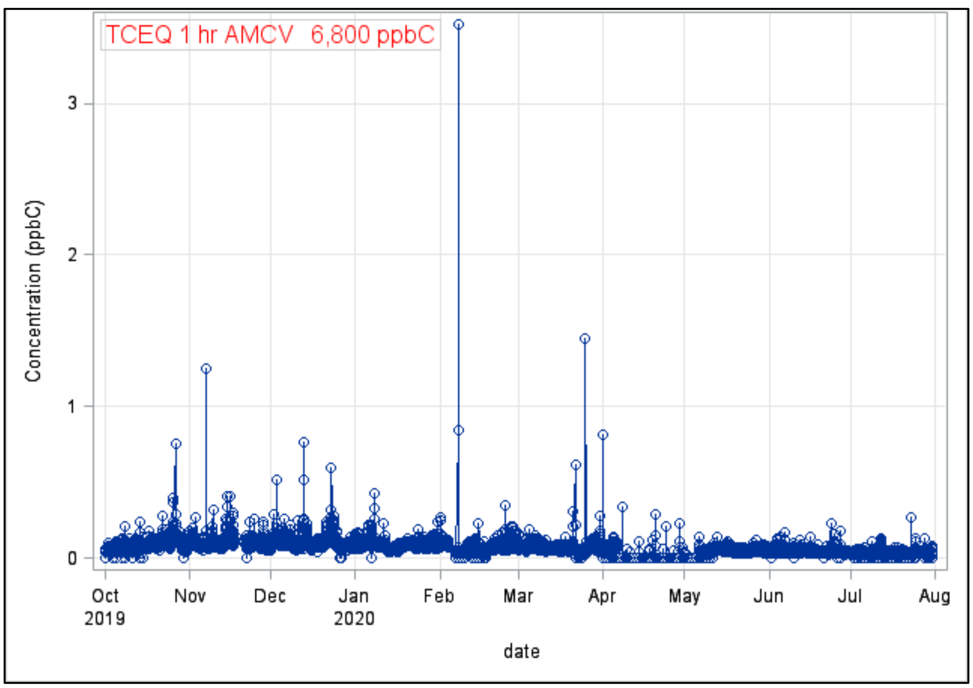


**Figure 3. Hourly 1,3-butadiene concentrations at GF station, Oct. 1, 2019 – July 31, 2020, ppbC units**

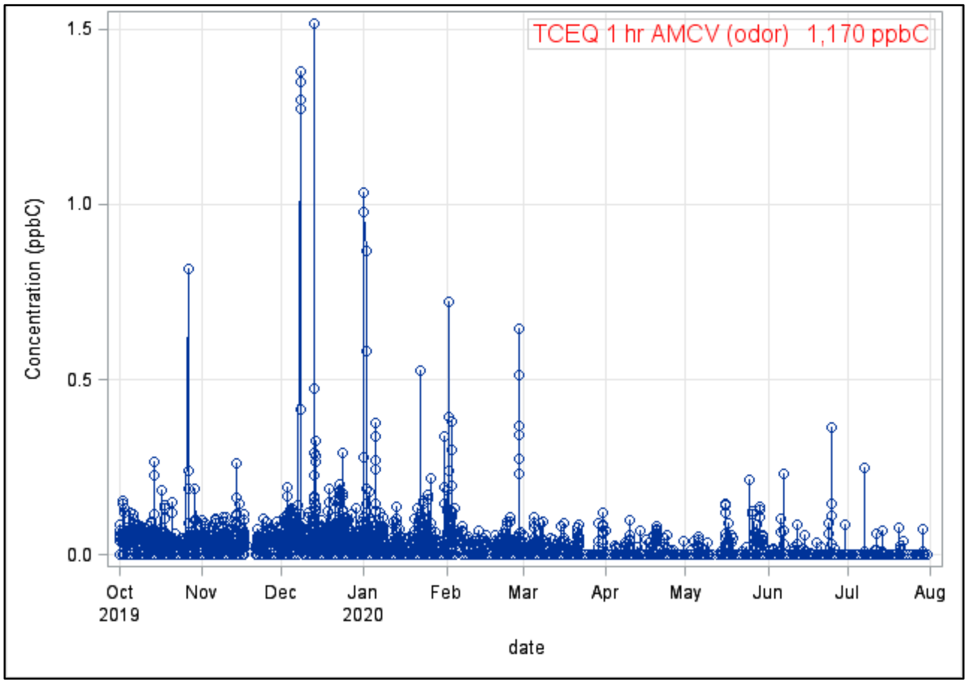


**Figure 4. Hourly iso-propylbenzene concentrations at GF station, Oct. 1, 2019 – July 31, 2020, ppbC units**

Time series graphs of other hydrocarbon species are also available upon request, and any graphs can be made with time scale (x-axis) or concentration scale (y-axis) adjustments. In addition, concentrations can be averaged by day, or week, or month, upon request.

**Portland Buddy Ganem and Portland Broadway Stations Hydrocarbon Data**

Figure 5 shows the time series for the hourly concentrations of benzene at the Portland Buddy Ganem (PBG) station. The figure shows benzene hourly average concentrations for each hour from January 1 through July 31, 2020. Some benzene data were invalidated January 1 to 4 and January 9 to 13, and on January 16 due to failed internal QC for the daily blank recoveries. In the benzene graph, a straight line replaces the January 9 – 13 invalidated data. Figure 6 shows the hourly time series for 1,3-butadiene, and Figure 7 shows the hourly time series for iso-propylbenzene. The concentrations of 1,3-butadiene and iso-propylbenzene have been relatively low, and thus affected by "noise", as reflected in Figure 6 in early January 2020. In gas chromatography, a sample for the air is chilled and hydrocarbons in the air adhere to a fiber, which is then heated in a programmed sequence of steps, at which individual compounds evaporate into a tube, through which the now separated gas compounds flow, until at the end of the tube a flame ionization detector combusts the gas, and the energy produced is measured. This energy is proportional to the gas compound's concentration. A common source of jitter or noisy data with hydrocarbon measurements is close proximity of one compound to another as the instrument goes through this process. An analogy may be the static heard on a radio or phone if another transmission close to the intended receiving frequency is present. This is especially problematic at low concentrations, as the measurement of the target species may be difficult to perfectly differentiate from other nearby low concentration species.

Figure 8 shows the time series for the hourly concentrations of benzene at the Portland Broadway (PBway) station. The figure shows benzene hourly average concentrations for each hour from January 1 through July 31, 2020. Figure 9 shows the hourly time series for 1,3-butadiene, and Figure 10 shows the hourly time series for iso-propylbenzene.

As was the case at the Gregory Fresnos station, concentrations to date are much lower than TCEQ AMCVs or ESLs. Time series graphs of other hydrocarbon species are also available upon request, and any graphs can be made with time scale (x-axis) or concentration scale (y-axis) adjustments. In addition, concentrations can be averaged by day, or week, or month, upon request.

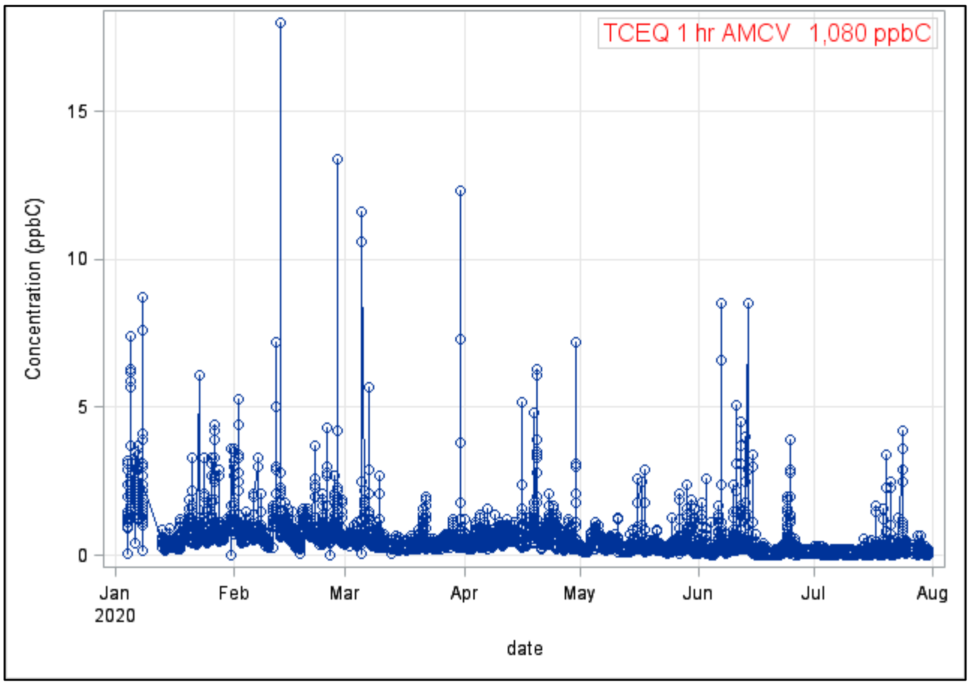


**Figure 5. Hourly benzene concentrations at PBG station, Jan. 1 – July 31, 2020, ppbC units**

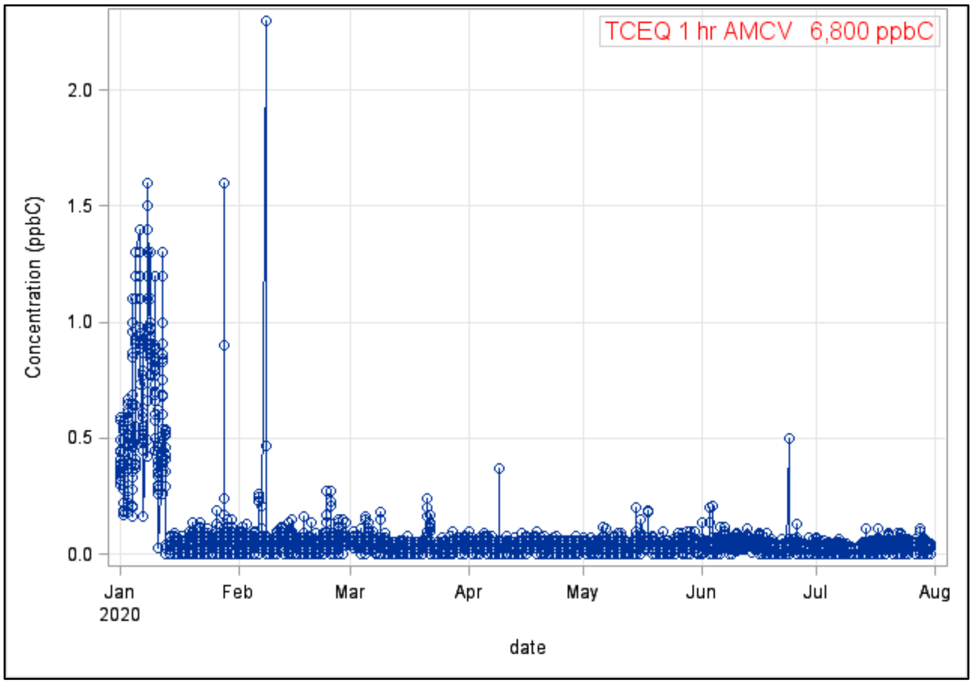


**Figure 6. Hourly 1,3-butadiene concentrations at PBG station, Jan. 1 – July 31, 2020, ppbC units**

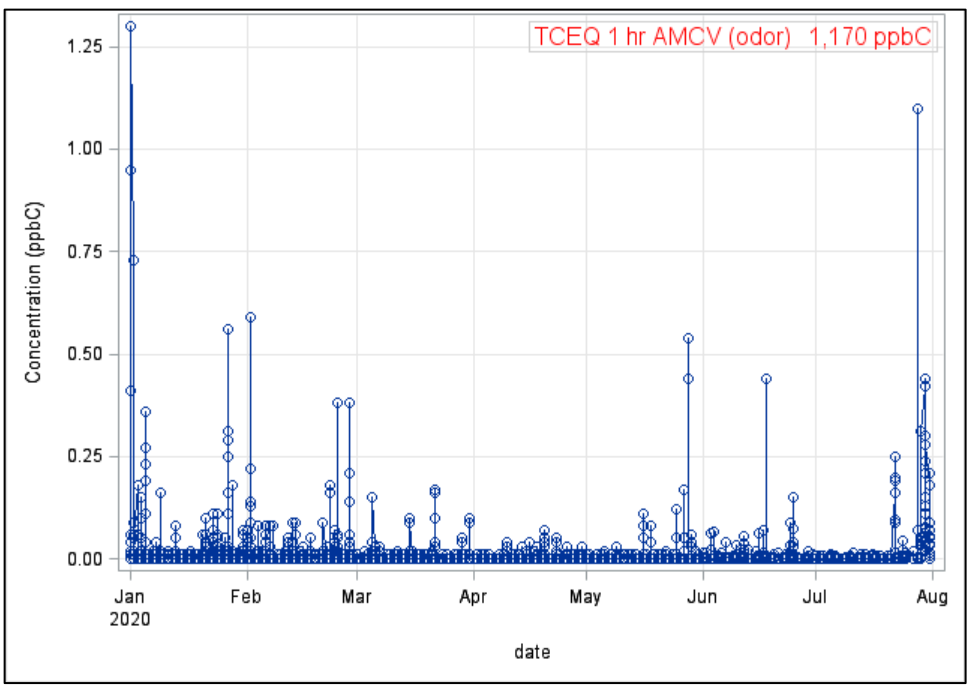


**Figure 7. Hourly iso-propylbenzene concentrations at PBG station, Jan. 1 – July 31, 2020, ppbC units**

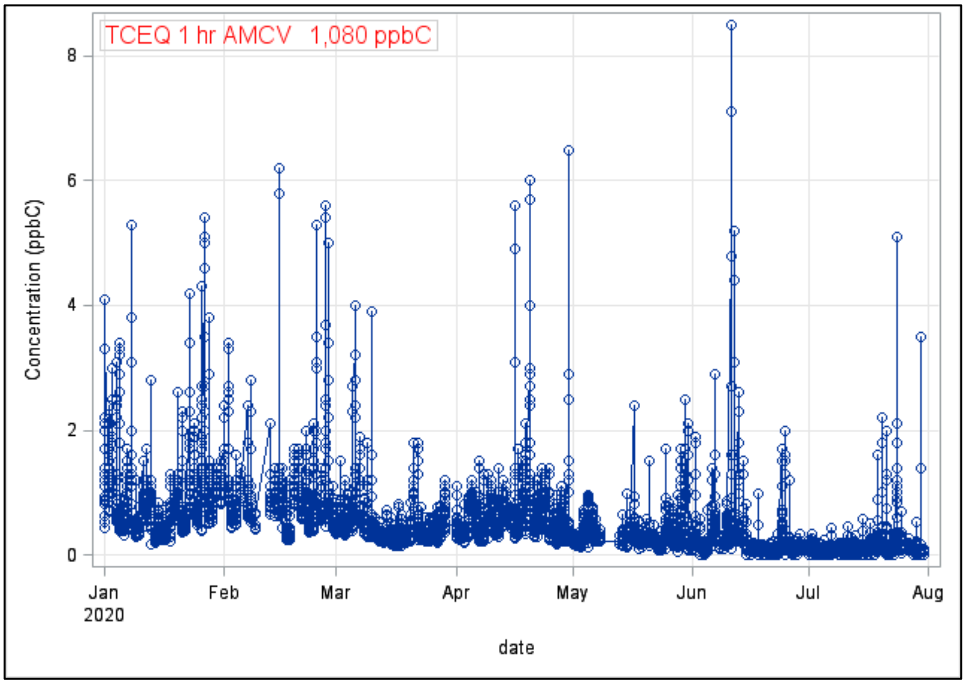


**Figure 8. Hourly benzene concentrations at PBway station, Jan. 1 – July 31, 2020, ppbC units**

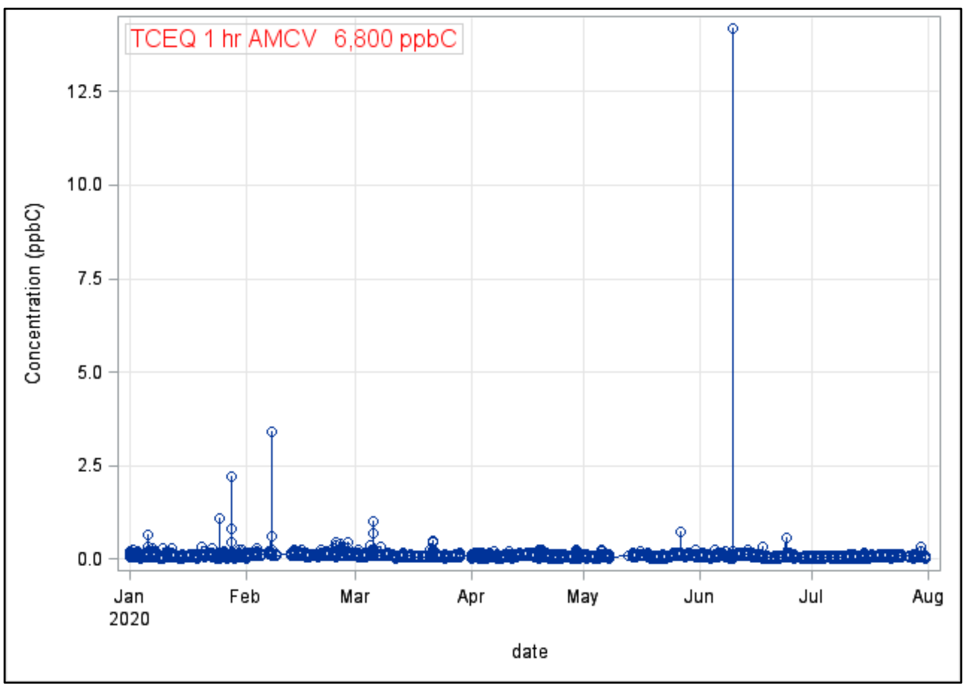


**Figure 9. Hourly 1,3-butadiene at PBway station, Jan. 1 – Jul 31, 2020, ppbC units**

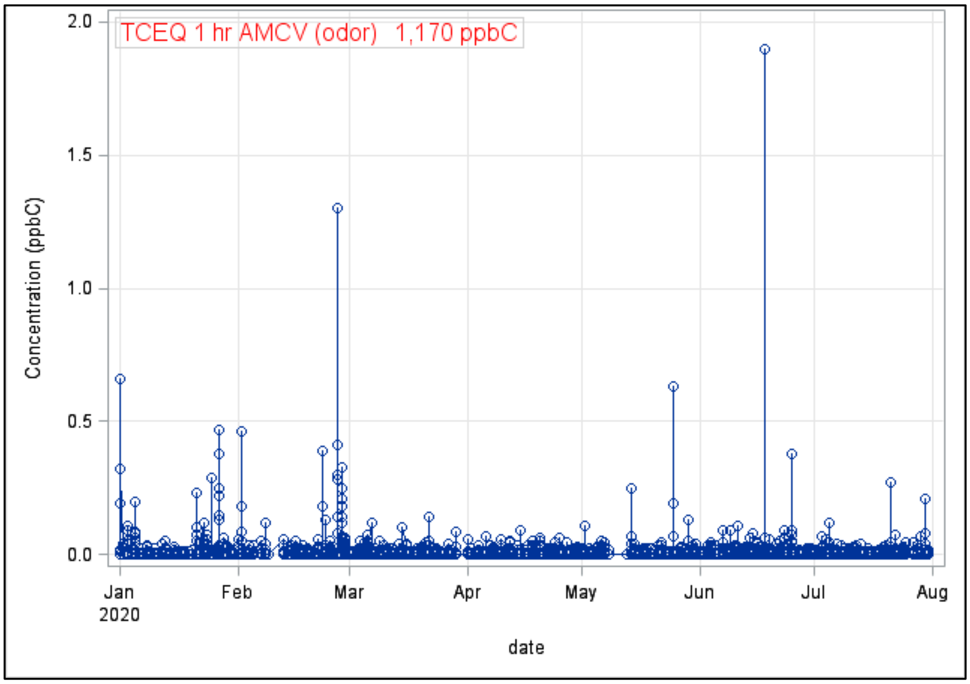


**Figure 10. Hourly iso-propylbenzene at PBway station, Jan. 1 – July 31, 2020, ppbC units**

**Portland Buddy Ganem and Portland Broadway Stations Ethylene Oxide Data**

In May 2020, the TCEQ concluded a study into the toxicity of ethylene oxide (EO), a chemical used in manufacturing processes and as a sterilizing agent in laboratories and medical facilities. Both the PBG and PBway stations measure EO concentration in 24-hour canister samples, obtained on an every 6th day basis. The TCEQ determined the long-term health threshold for exposure to EO to be 4.8 ppbC (2.4 ppbV), and concentrations at both stations are well below this level. Time series of EO concentrations that have been reported to date appear in figures below.

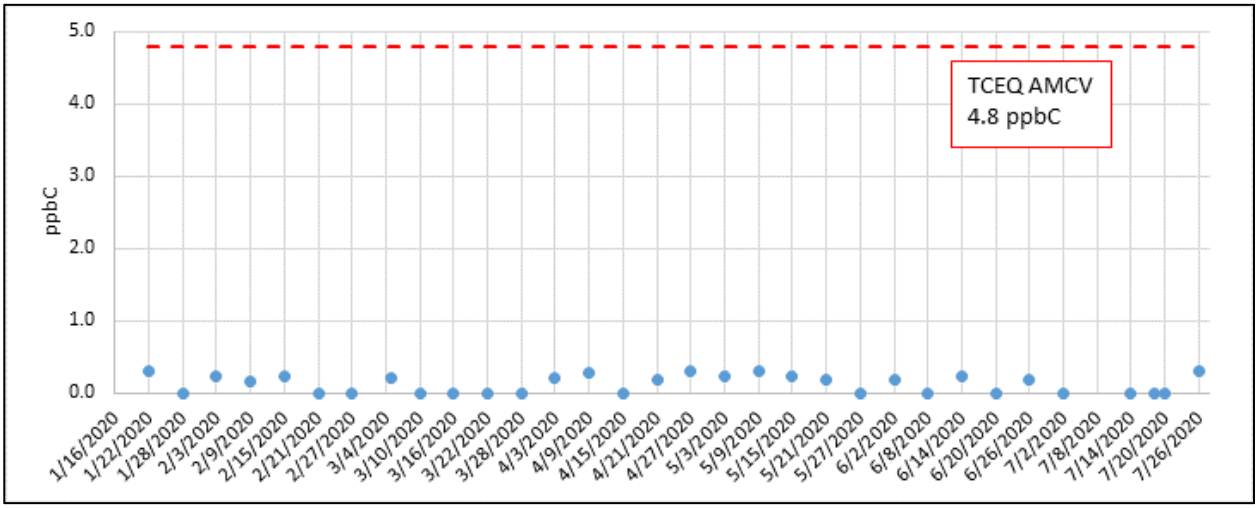


**Figure 11. Canister 24-hour ethylene oxide at PBG station, Jan. 1 – July 31, 2020, ppbC units**

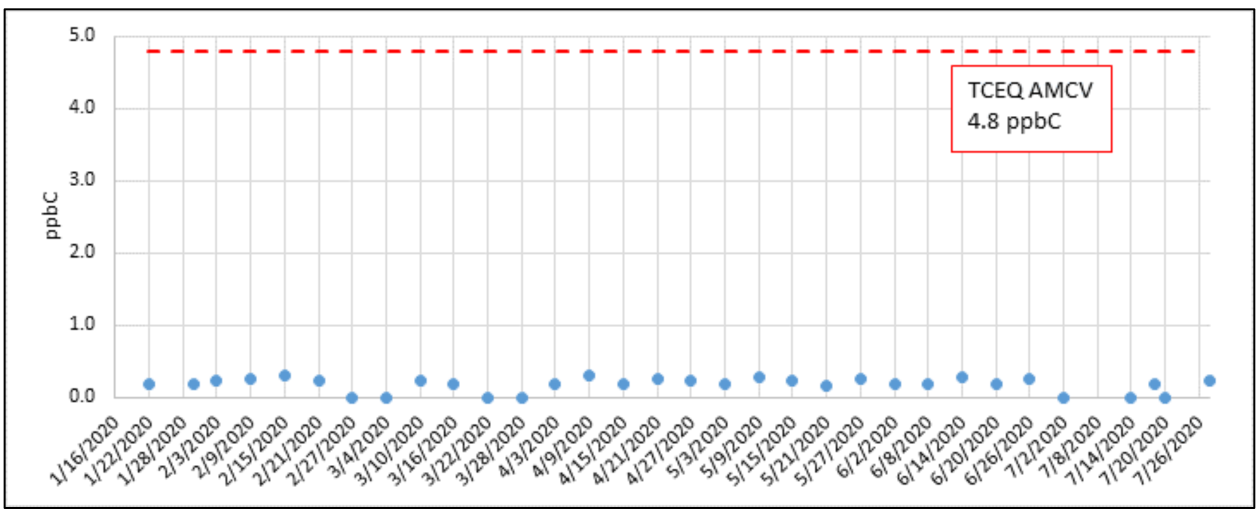


**Figure 12. Canister 24-hour ethylene oxide at PBway station, Jan. 1 – July 31, 2020, ppbC units**

**Gregory Fresnos Station Criteria Pollutant Data**

Sulfur dioxide ($SO_2$), fine particulate matter ($PM_{2.5}$), and nitrogen dioxide ($NO_2$) are three pollutants measured at the GF site that are regulated by the U.S. Environmental Protection Agency (EPA). No concentrations at levels that violate the National Ambient Air Quality Standards (NAAQS) have been seen at the GF station. Several recorded 1-hour values exceeded the level of the 24-hour NAAQS (35 micrograms per cubic meter (μg/m$^3$)), but the NAAQS is not violated unless the number of 24-hour averaged concentrations averaged over three years violates the 24-hour NAAQS, or unless the overall annual average exceeds the level of the annual NAAQS (12 μg/m$^3$).

Figure 13 shows the hourly average time series for $PM_{2.5}$ at the GF station. The average concentration since October 2019 is 9.0 μg/m$^3$, and the average in 2020 through September 13 is 9.8 μg/m$^3$ compared with the primary one-year NAAQS value (annual mean averaged over three years) of 12 μg/m$^3$. The instrument underwent maintenance in mid-February 2020, resulting in two weeks of data loss, shown as a straight line in the graph.

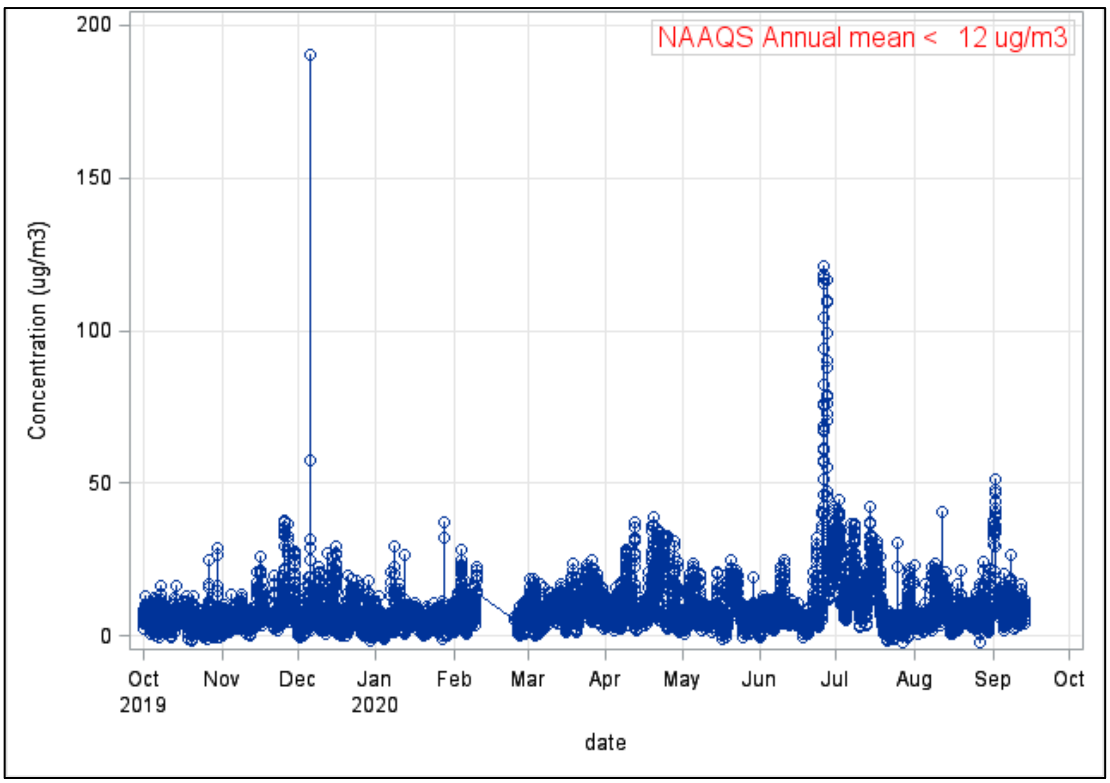


**Figure 13. Hourly average $PM_{2.5}$ at GF, μg/m$^3$, Oct. 17, 2019 – Sept. 13, 2020**

Figure 14 shows the hourly average time series for $NO_2$. The average concentation of $NO_2$ for 2020 measured through mid-September is 5.9 parts per billion (ppb) compared to the NAAQS of 53 ppb. During the early morning hours on April 20, 2020, elevated concentrations of NO, $NO_2$, NOx were measured, believed to have been associated with emissions from compressor engines operating at the site of a natural gas leak based on the coincident auto-GC hydrocarbon measurements. Figure 15 shows the $NO_2$ concentrations on a scale more typical of the measured concentration ranges using a "broken" scale on the y-axis. Concentrations have been lower in the summer than in earlier months.

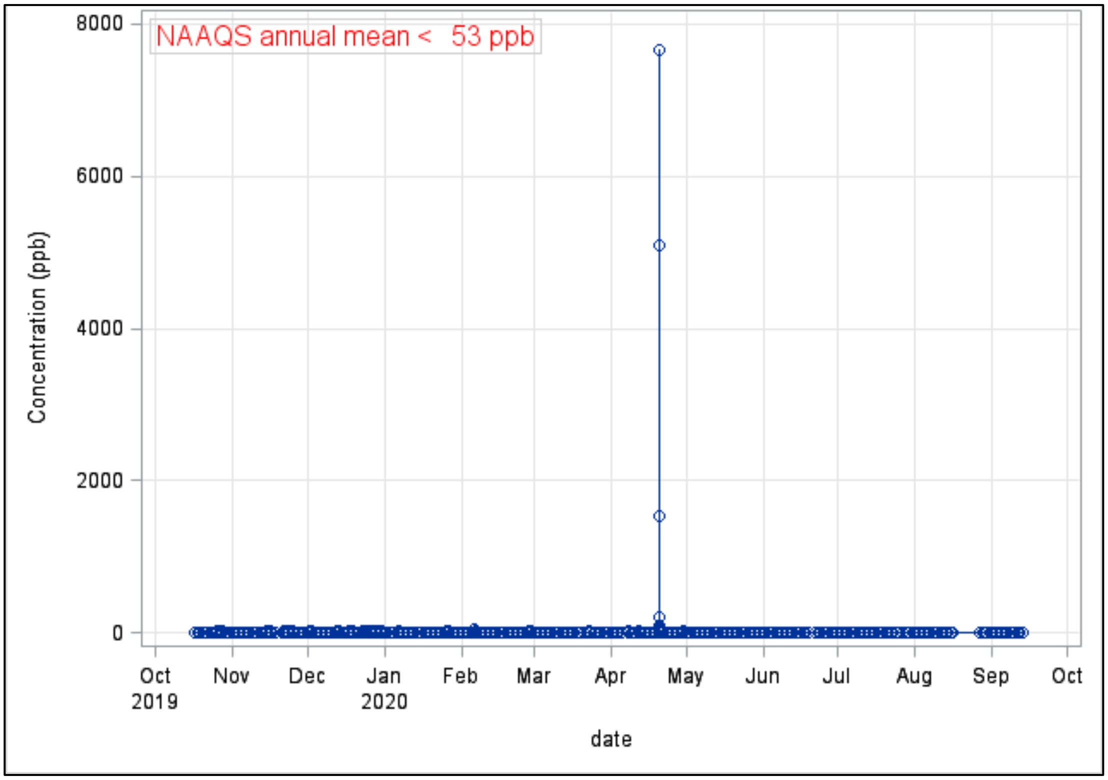


**Figure 14. Hourly $NO_2$ at GF, ppb units, Oct. 17, 2019 – Sept. 13, 2020**

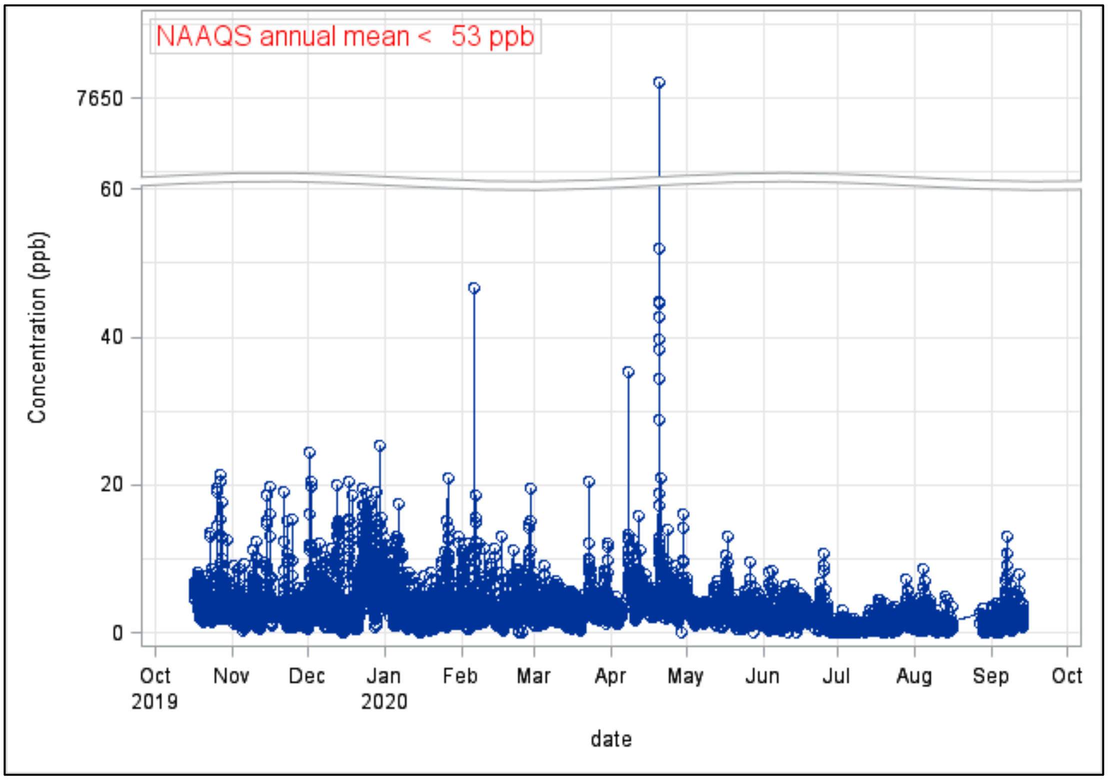


**Figure 15. Hourly $NO_2$ at GF, ppb units, Oct. 17, 2019 – Sept. 13, 2020, note "broken" scale on y-axis**

Figure 16 shows the hourly average time series for $SO_2$. The average concentration of $SO_2$ measured to date is less than 1 part per billion (ppb) and the maximum one-hour concentration has been 12 ppb compared to the primary NAAQS value (99$^{th}$ percentile of daily one-hour maximum averaged over three years) of 75 ppb. Because $SO_2$ is rarely found in ambient air, and the instruments are calibrated to accurately measure high concentrations that are a risk to public health, the concentrations close to 0.0 tend to be very "noisy", as illustrated in the graph. As was described earlier with the hydrocarbon data, many instruments measuring low concentrations will produce time series with much scatter near 0.0 owing to the nature of carrying out the chemical or electrical reaction that is associated with the measurement and converting that to a number representing the concentration. When an instrument has been calibrated to accurately measure high concentrations to safeguard public health, generally at low concentrations near zero there is high relative error.

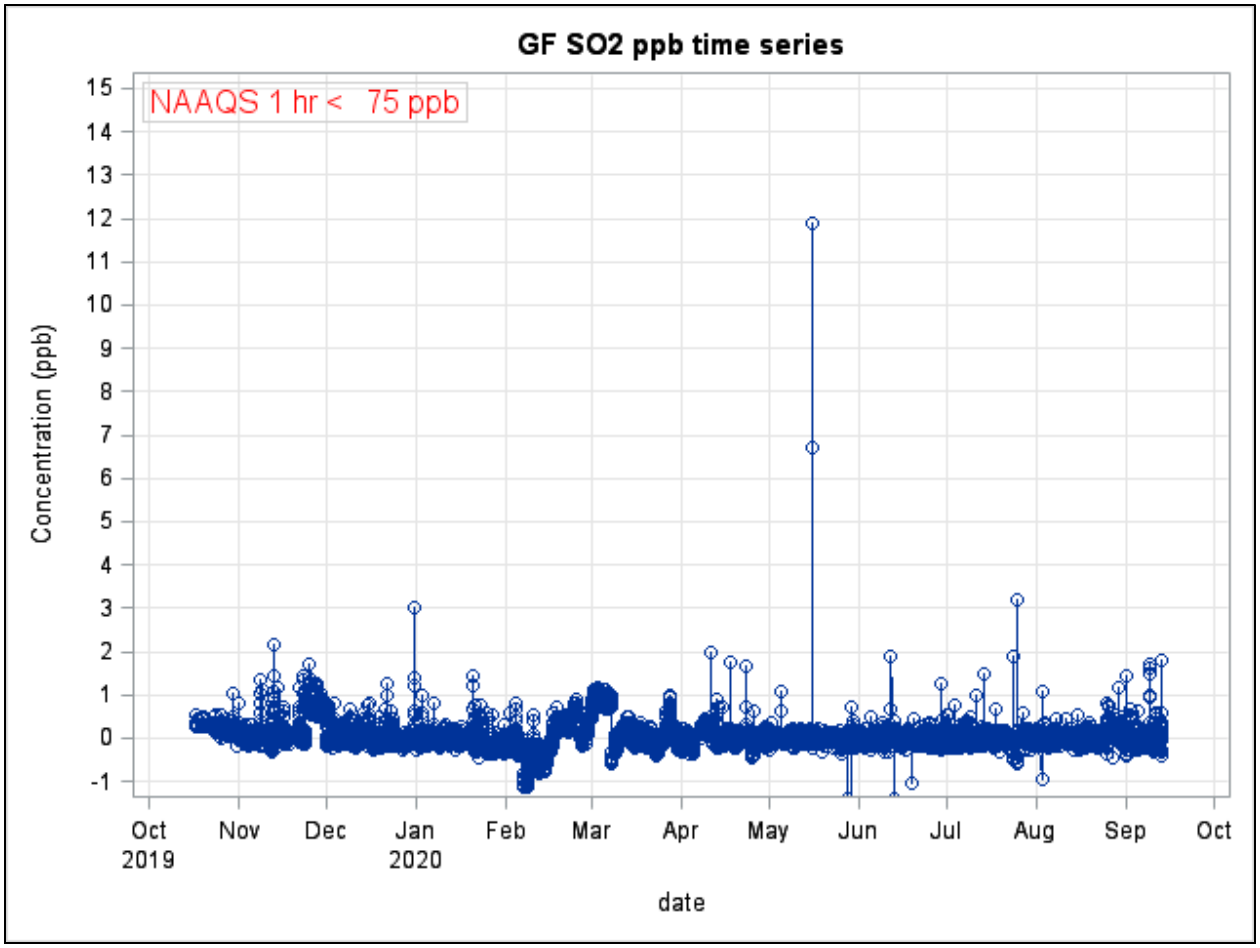


**Figure 16. Hourly average $SO_2$ at GF, ppb units, Oct. 17, 2019 – Sept. 13, 2020**

**Portland Buddy Ganem and Portland Broadway Stations Criteria Pollutant Data**

Fine particulate matter ($PM_{2.5}$) is the only NAAQS-regulated pollutant measured at the PBG and PBway stations. No concentrations near the NAAQS have been seen at the two stations. Figure 17 shows the 24-hour averaged concentrations of $PM_{2.5}$ at the PBG site and Figure 18 shows the same for the PBway site. The average concentration to date at PBG in 2020 is 6.7 $\mu g/m^3$ and is 9.6 $\mu g/m^3$ at PBway, as compared to the NAAQS Annual Average of 12 $\mu g/m^3$.

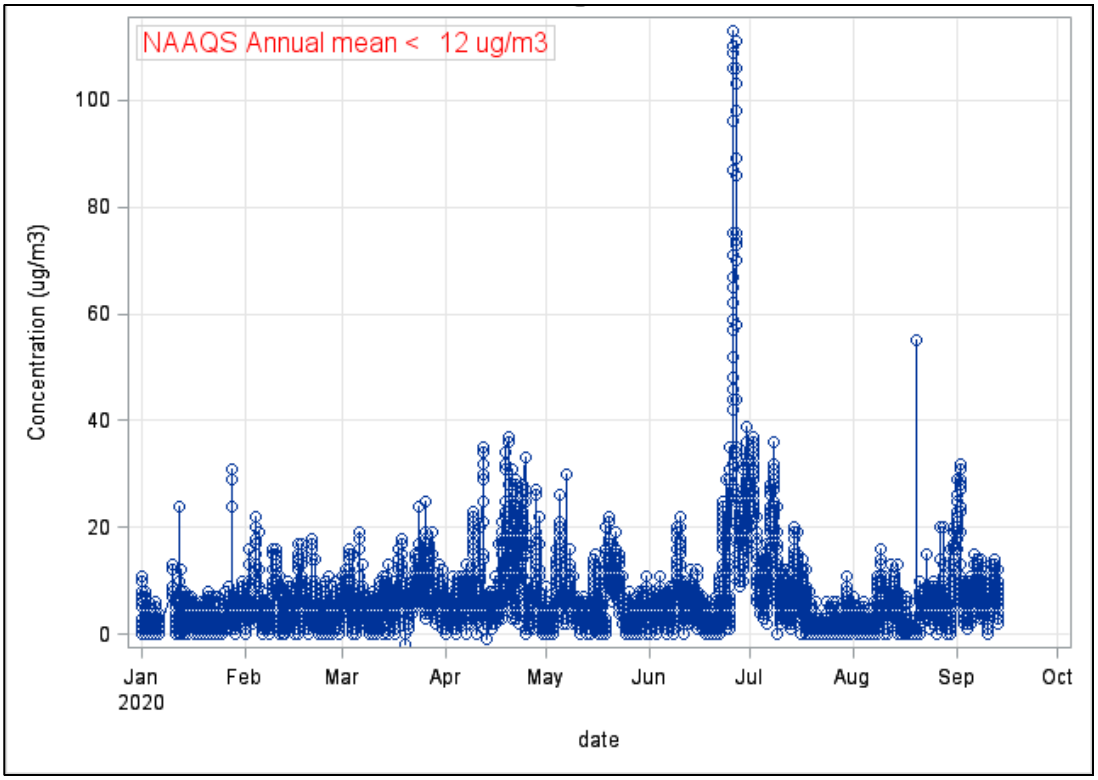


**Figure 17. Daily average PM2.5 at PBG, μg/m³, Jan. 1 – Sept. 13, 2020**

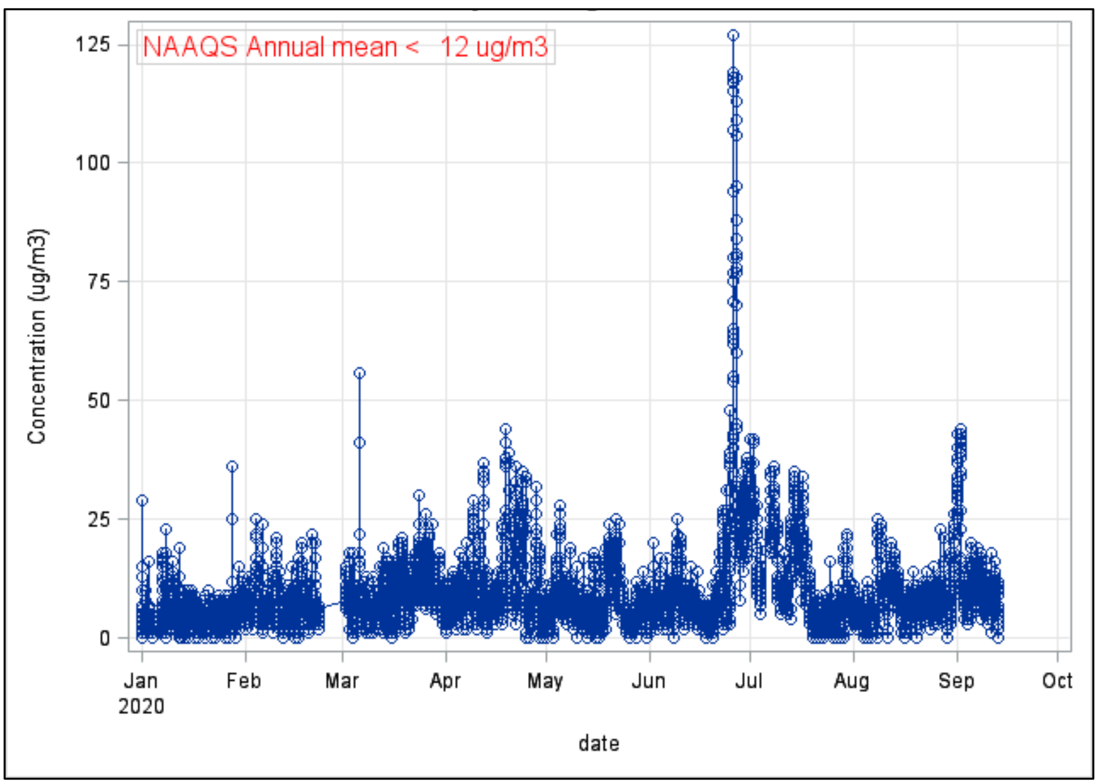


**Figure 18. Daily average PM2.5 at PBway, μg/m³, Jan. 1 – Sept. 13, 2020**

## 5.0 Analysis of Data

**Winds in San Patricio County**

As was noted earlier in this report, pollutant concentrations are strongly affected by meteorological conditions, and the wind speeds and directions are critical factors. Figure 19, Figure 20, and Figure 21 show the frequency for wind direction measurements in 10 degree wind bins, for the Gregory Fresnos, Portland Buddy Ganem, and Portland Broadway stations, respectively. Note that the Gregory Fresnos station has more winter season winds (from Oct. – Dec. 2019) and thus more northerly winds than the two Portland stations. The point of these graphs is to illustrate that the largest majority of surface winds are southerly in San Patricio County.

Figure 22, Figure 23, and Figure 24 show the average wind speed by 10 degree wind bins at the Gregory Fresnos, Portland Buddy Ganem, and Portland Broadway stations, respectively. These graphs show that the southerly winds tend to be faster and the westerly winds tend to be slower. This suggests that -- *all else held equal* -- one would expect gaseous emissions from the west to produce higher concentrations at the stations than gaseous emissions from the south.

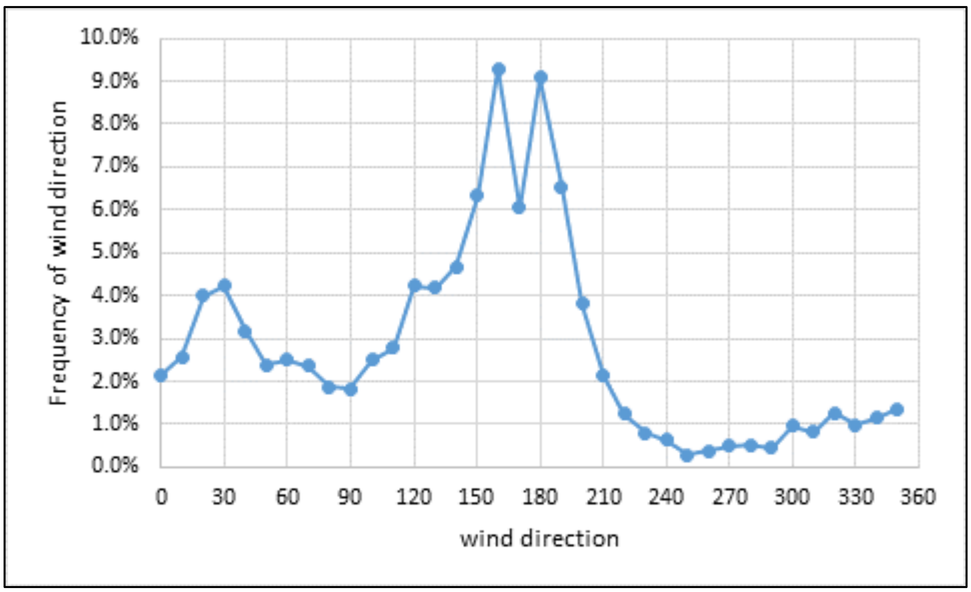


**Figure 19. GF wind direction distribution Oct. 2019 – Sept. 2020**

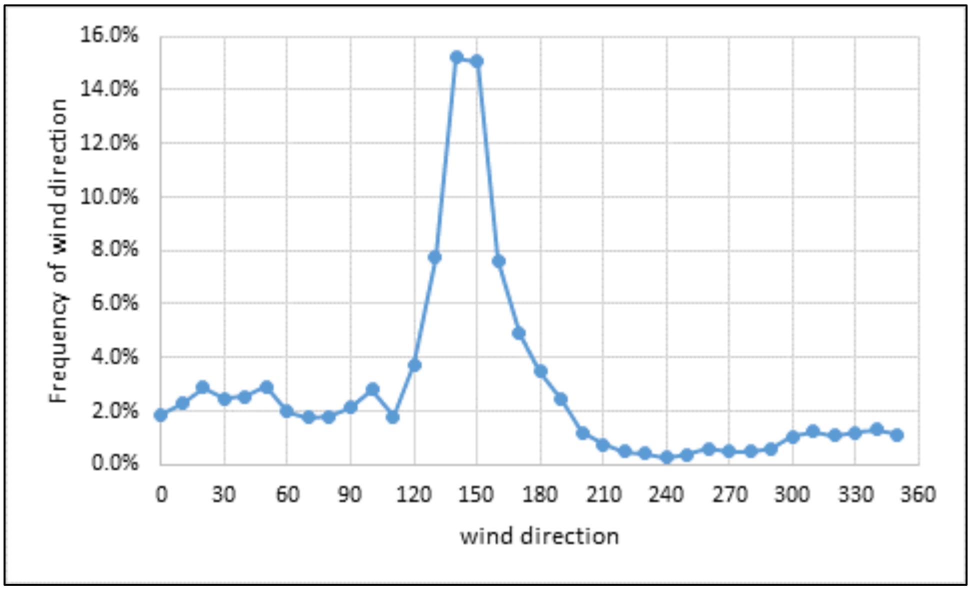


**Figure 20. PBG wind direction distribution Jan. – Sept. 2020**

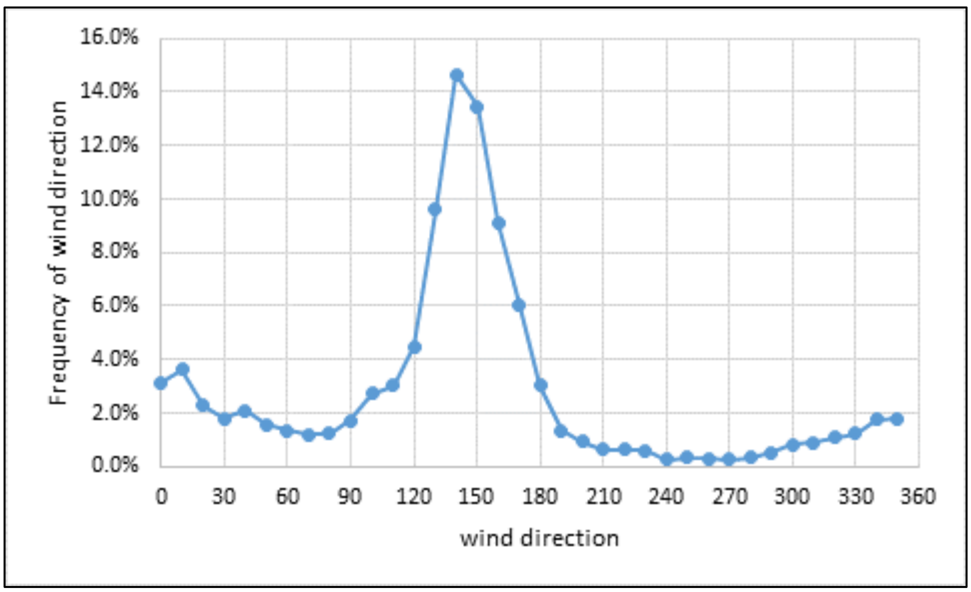


**Figure 21. PBway wind direction distribution Jan. – Sept. 2020**

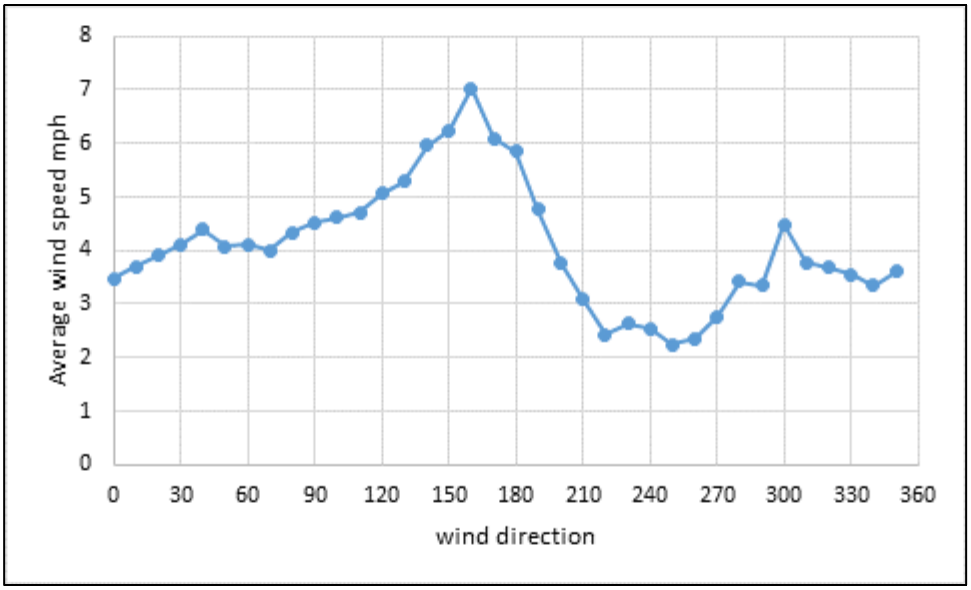


**Figure 22. GF average wind speed by wind direction**

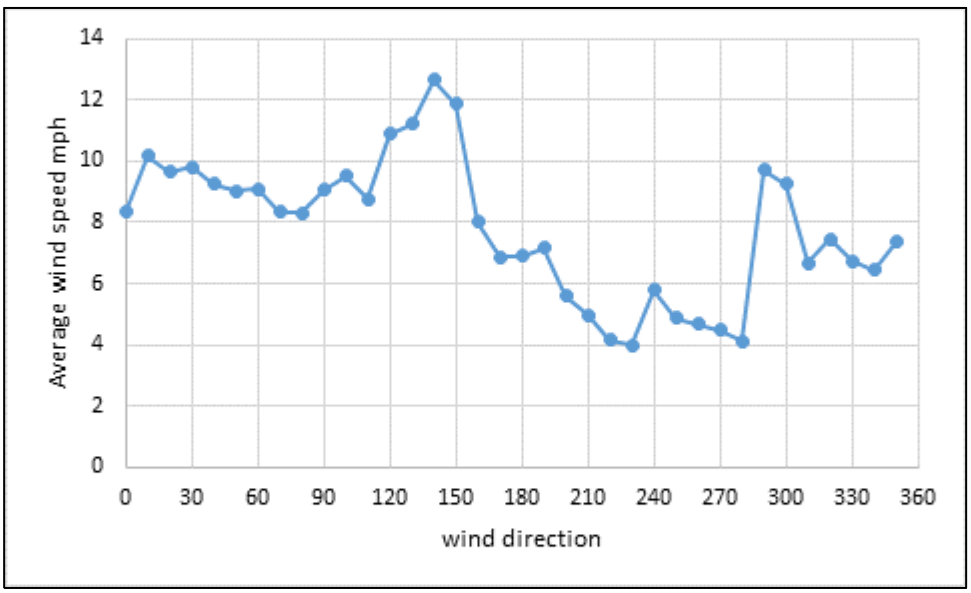


**Figure 23. PBG average wind speed by wind direction**

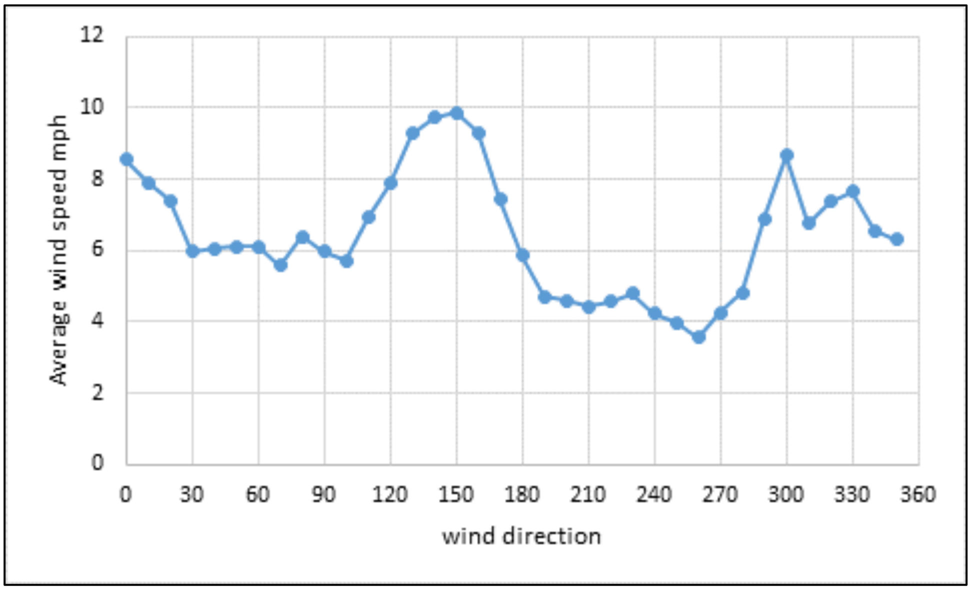


**Figure 24. PBway average wind speed by wind direction**

**$PM_{2.5}$ Data Analysis**

As illustrated in the graphs for $PM_{2.5}$ at all three stations shown earlier, late June to mid-July saw elevated $PM_{2.5}$ concentrations. These high concentrations were associated with transported North African dust. Similar high concentration were measured at many monitoring stations in south and east Texas. The TCEQ Monitoring Division issues a daily air quality forecast, and on Thursday, June 25 the forecast for June 27 was for elevated $PM_{2.5}$ in the range of "unhealthy for sensitive groups" for 9 out of 15 TCEQ Regions. The text of the forecast read:

> *"…heavy amounts of African dust will continue to expand across most of the state with the exception of Far West Texas and the Upper Panhandle. Overall, depending on the intensity and coverage of the intense African dust and continuing wildfire smoke, the daily $PM_{2.5}$ AQI is forecast to reach the lower to middle end of the "Unhealthy for Sensitive Groups" range in parts of the Austin, Corpus Christi, Laredo, San Antonio, and Victoria areas; possibly the lower end of the "Unhealthy for Sensitive Groups" range in parts of the Brownsville-McAllen, Dallas-Fort Worth, Houston, and Waco-Killeen areas; the upper end of the "Moderate" range or possibly higher in parts of the Lubbock, Midland-Odessa, and Tyler-Longview areas; the middle to upper end of the "Moderate" range in parts of the Amarillo, Beaumont-Port Arthur, and Big Bend areas; and the lower to middle end of the "Moderate" range in parts of the El Paso area. "*

If interested, anyone can sign up for air quality email forecast by registering at https://public.govdelivery.com/accounts/TXTCEQ/subscriber/new (accessed September 2020).

Figure 25 shows a map for National Oceanic and Atmospheric Administration (NOAA) modeled paths of air parcels arriving in the Corpus Christi area on the morning of June 27, 2020 around the time that all three project stations measured $PM_{2.5}$ concentrations above 100 $\mu g/m^3$. The TCEQ air quality forecast used modeling similar to NOAA's as well as satellite imagery to predict the elevated concentrations. The reader can run other NOAA trajectories from the website at https://www.ready.noaa.gov/HYSPLIT_traj.php (accessed September 2020).

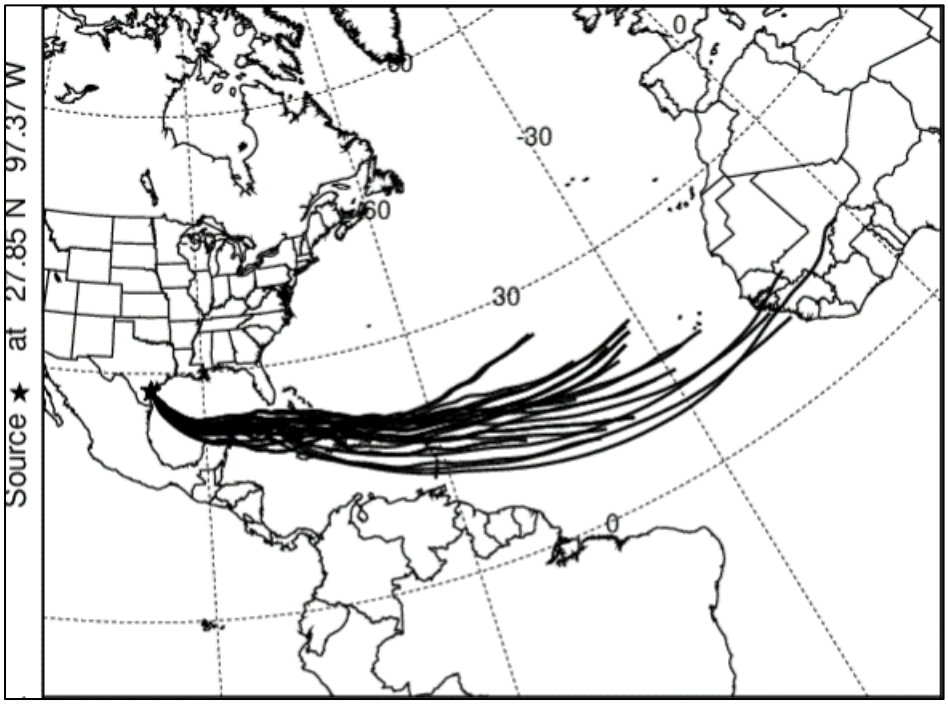


**Figure 25. Ten-day back-trajectories run from 7:00 CST June 27, 2020 from the Corpus Christi area**

Figure 26 through Figure 30 show graphs of the average (mean) $PM_{2.5}$ concentrations as a function of wind direction[1] at the Gregory-Fresnos station combining data in two-month blocks to illustrate seasonal changes in the behavior of the measurements. So, for example, in November-December 2019 concentrations were somewhat higher from the south compared to other directions. $PM_{2.5}$ averages by wind direction were generally lower and "flatter" in the January to February time frame, but the average concentration from the west-southwest (240 degrees) was significantly higher in March and April, the period in which the region experienced elevated $PM_{2.5}$ concentrations associated with smoke from fires in Central America and Southern Mexico. The graphs for May-June and July-August show the highest mean concentration associated with southerly flow (180 degrees), which, as shown earlier, is owing to dust transported across the Atlantic from desert regions in North Africa.

Following the Gregory-Fresnos station figures, Figure 31 through Figure 34 show similar two-month $PM_{2.5}$ means by wind direction graphs for the Portland Buddy Ganem station and Figure 35 through Figure 38 show similar two-month $PM_{2.5}$ means by wind direction graphs for the Portland Broadway station. As was mentioned earlier, the two Portland stations, began operating in January 2020. Not surprisingly, the graphs for these two stations resemble the Gregory Fresnos station graphs, since the transported smoke and transported dust are regional factors.

In these figures, in order to reduce the effect of statistical outliers on this analysis, all $PM_{2.5}$ values greater than the $99^{th}$ percentile concentration have been set equal to the $99^{th}$ percentile.

[1] In this application, wind directions have been combined by 30 degree bins, so winds between 345 and 15 degrees bin to 0 degrees (due north), winds between 15 and 45 degrees bin to 30 degrees (north-northeast), etc.

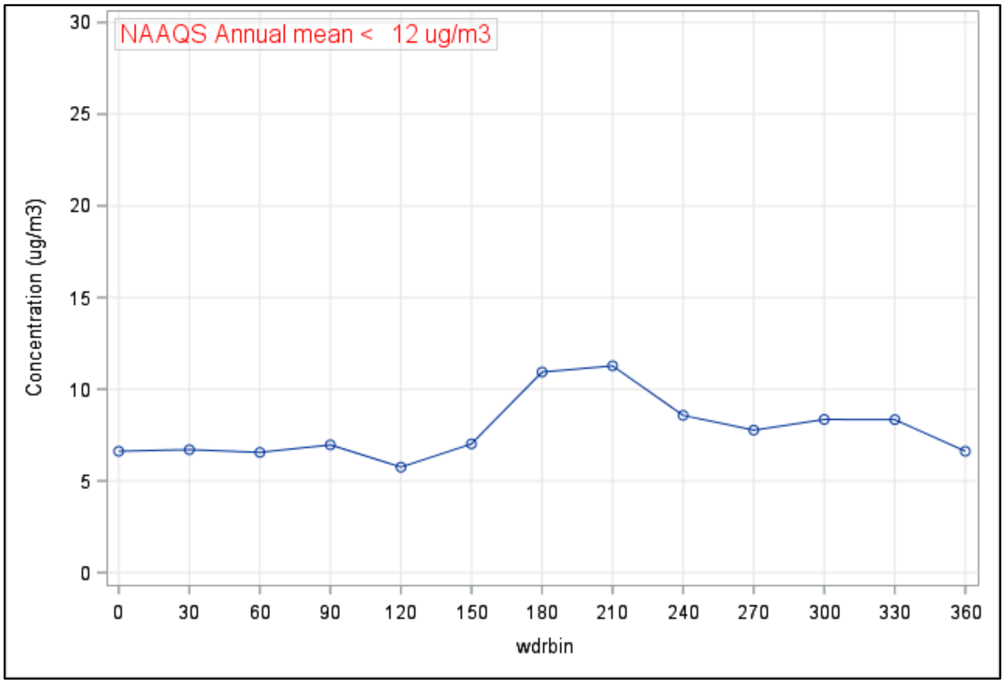


Figure 26. Mean $PM_{2.5}$ at Gregory-Fresnos in Nov.-Dec. 2019 by wind direction

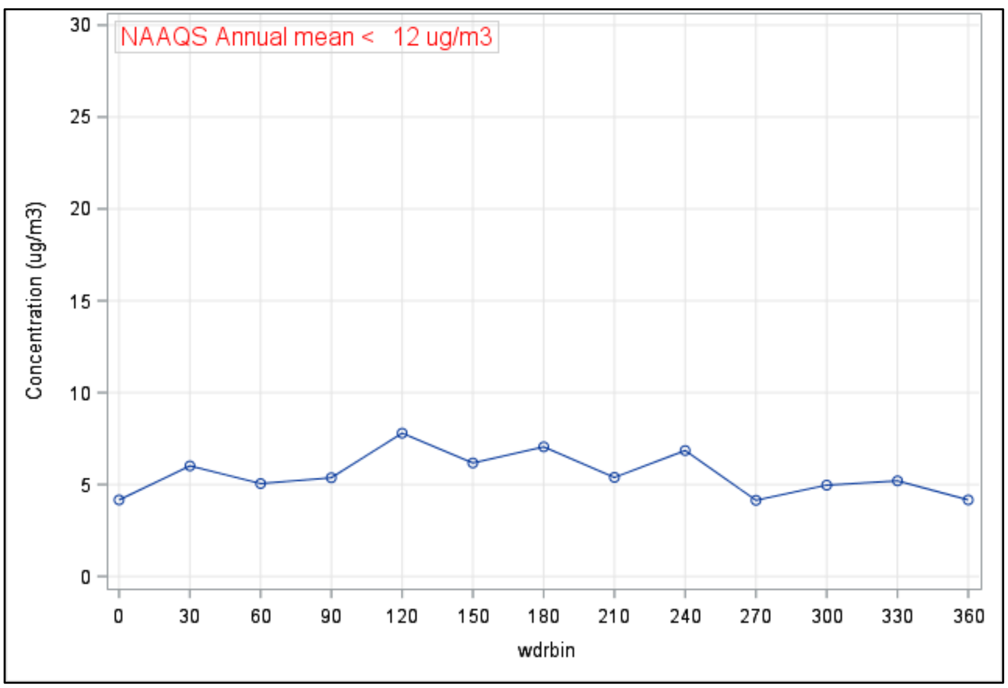


Figure 27. Mean $PM_{2.5}$ at Gregory-Fresnos in Jan.-Feb. 2020 by wind direction

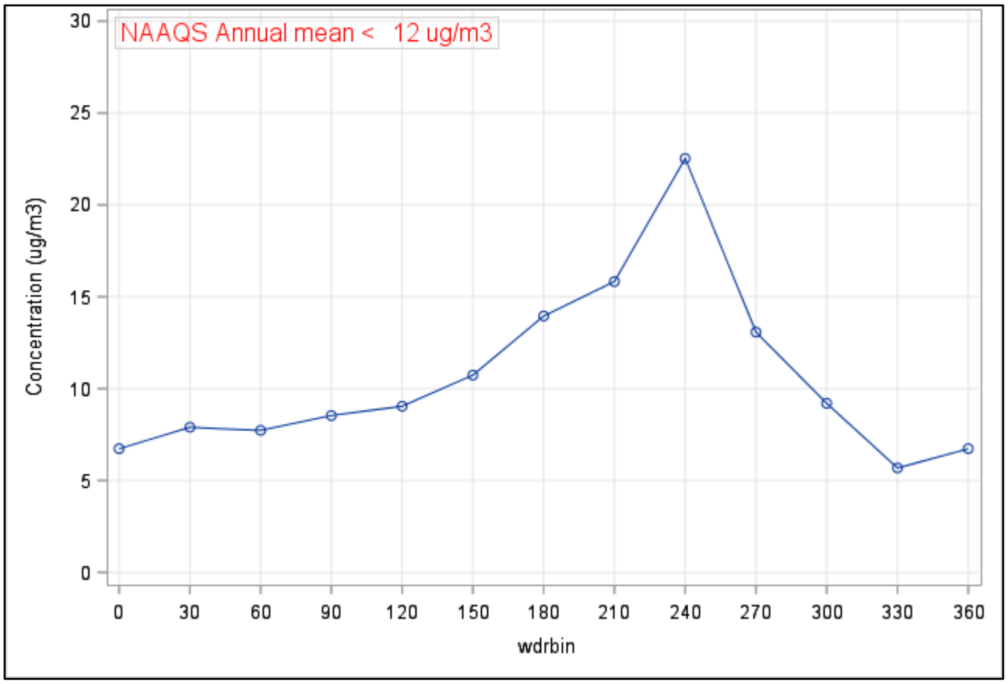

Figure 28. Mean $PM_{2.5}$ at Gregory-Fresnos in Mar.-Apr. 2020 by wind direction

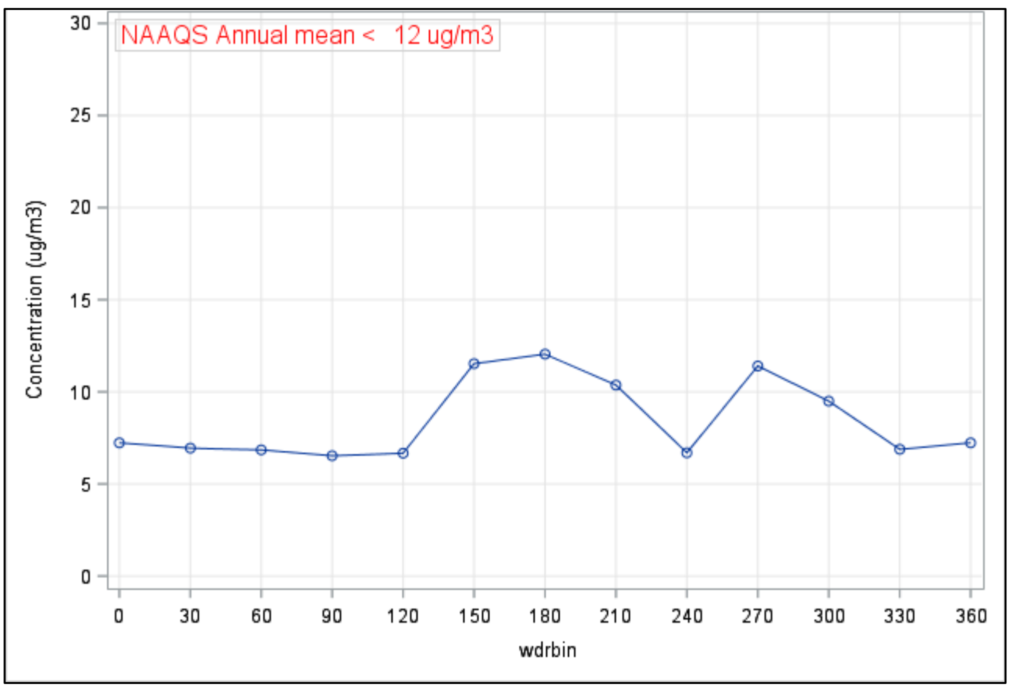

Figure 29. Mean $PM_{2.5}$ at Gregory-Fresnos in May-Jun. 2020 by wind direction

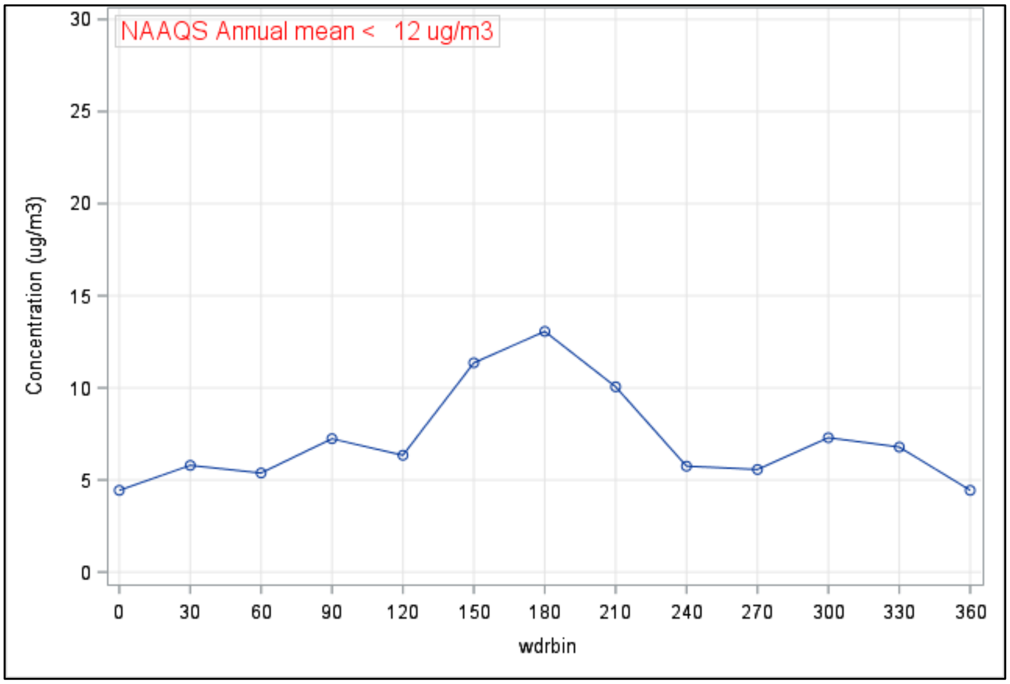


**Figure 30. Mean $PM_{2.5}$ at Gregory-Fresnos in Jul.-Aug. 2020 by wind direction**

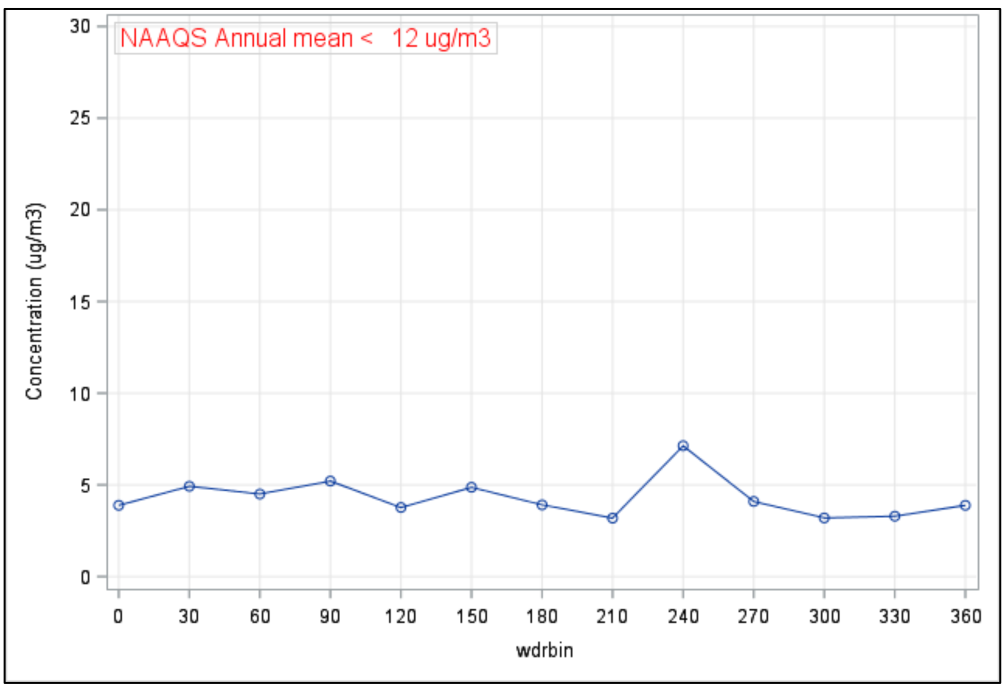


**Figure 31. Mean $PM_{2.5}$ at Portland Buddy Ganem in Jan.-Feb. 2020 by wind direction**

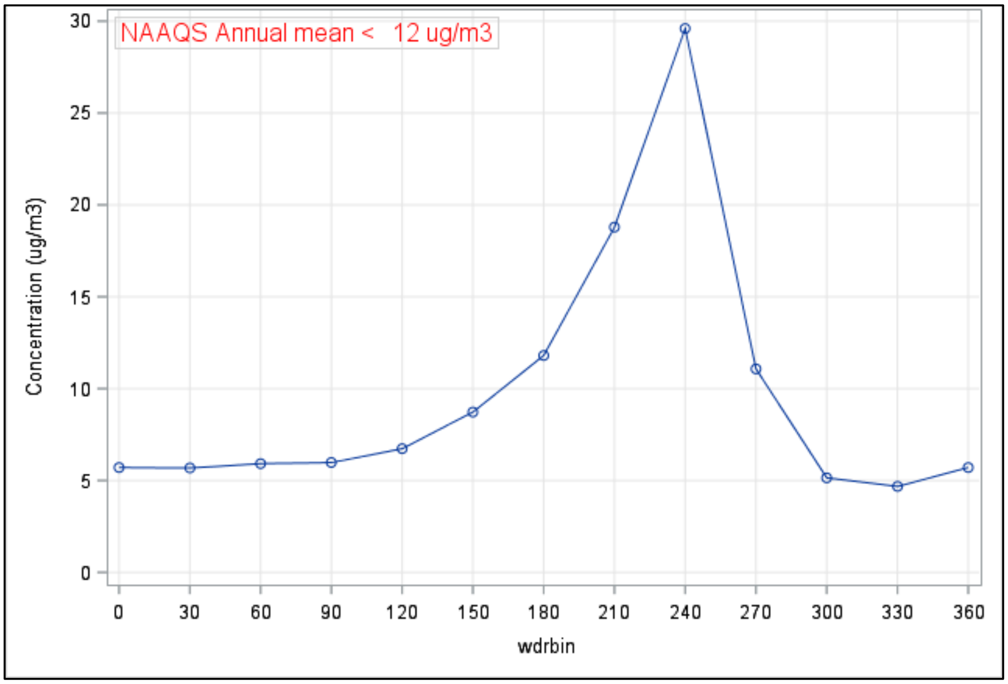


**Figure 32. Mean $PM_{2.5}$ at Portland Buddy Ganem in Mar.-Apr. 2020 by wind direction**

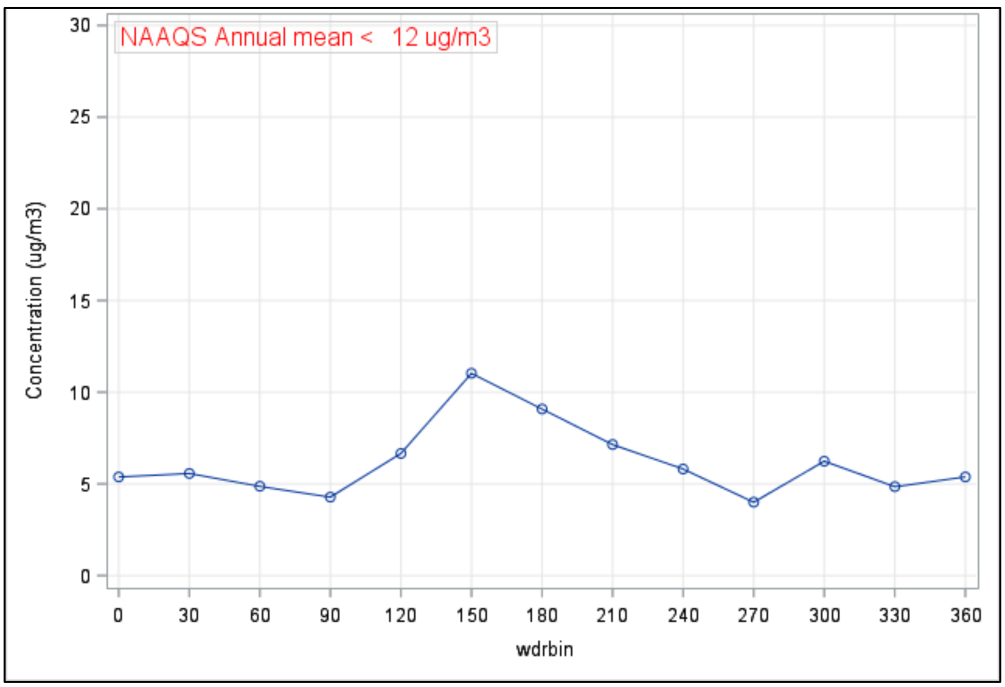


**Figure 33. Mean $PM_{2.5}$ at Portland Buddy Ganem in May-Jun. 2020 by wind direction**

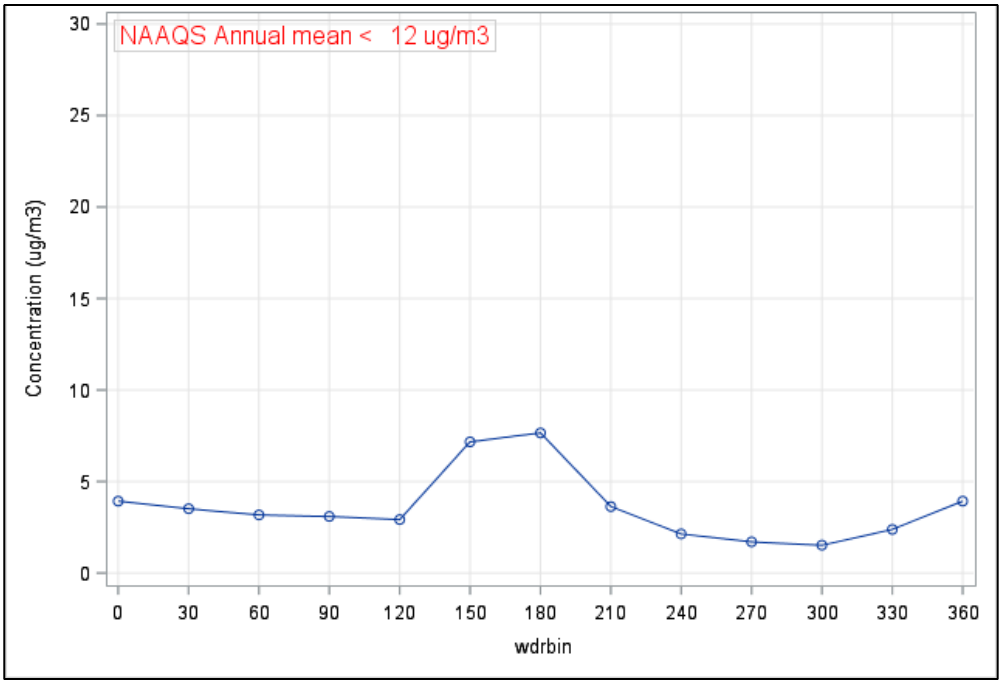


**Figure 34. Mean $PM_{2.5}$ at Portland Buddy Ganem in Jul.-Aug. 2020 by wind direction**

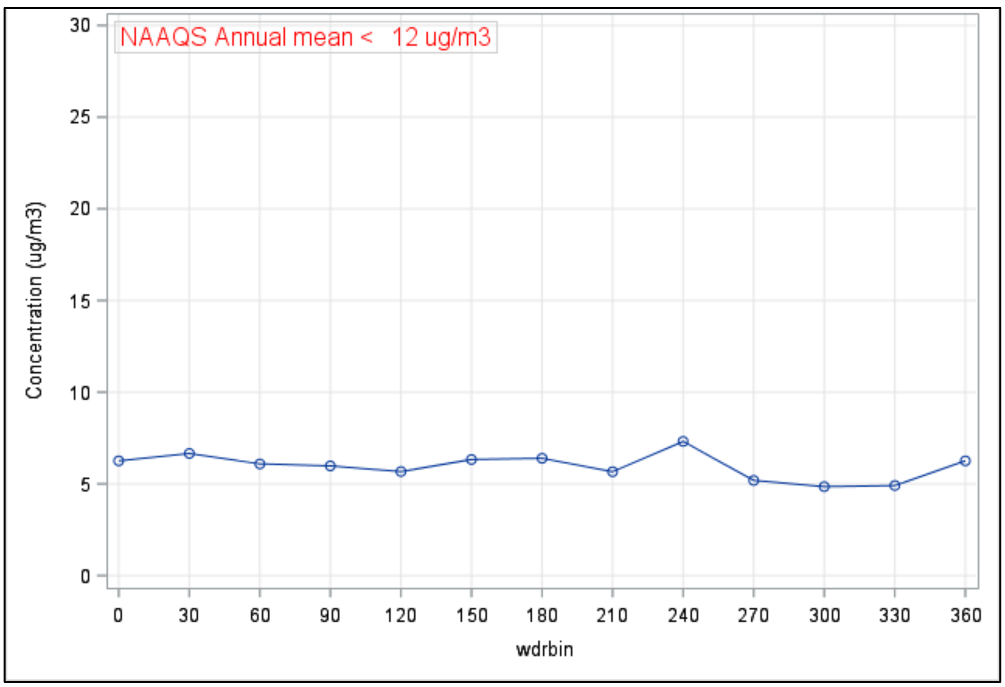


**Figure 35. Mean $PM_{2.5}$ at Portland Broadway in Jan.-Feb. 2020 by wind direction**

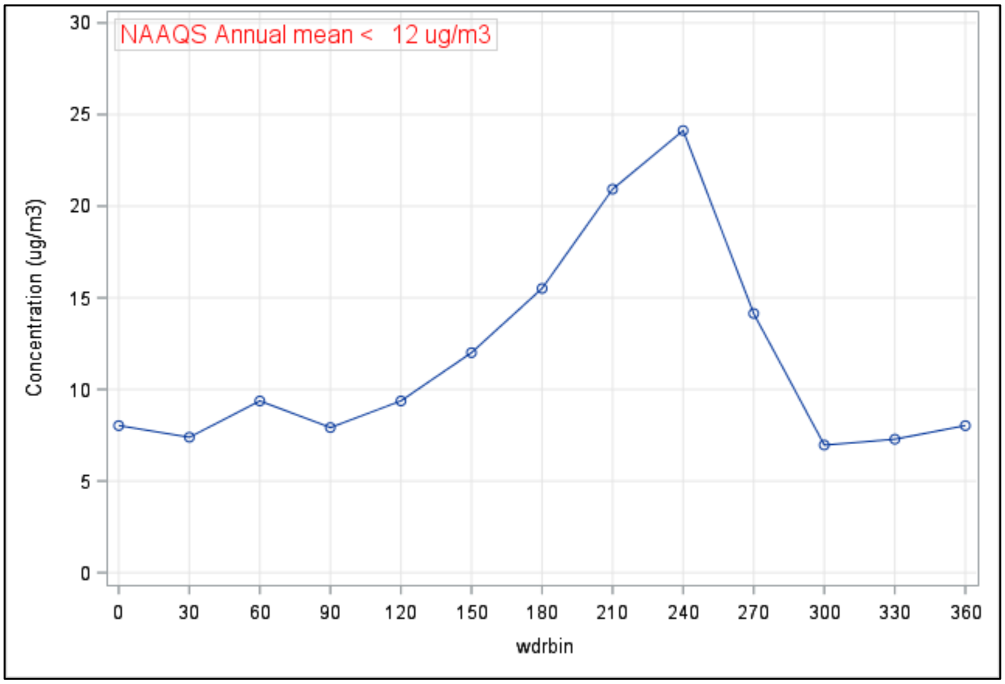


**Figure 36. Mean $PM_{2.5}$ at Portland Broadway in Mar.-Apr. 2020 by wind direction**

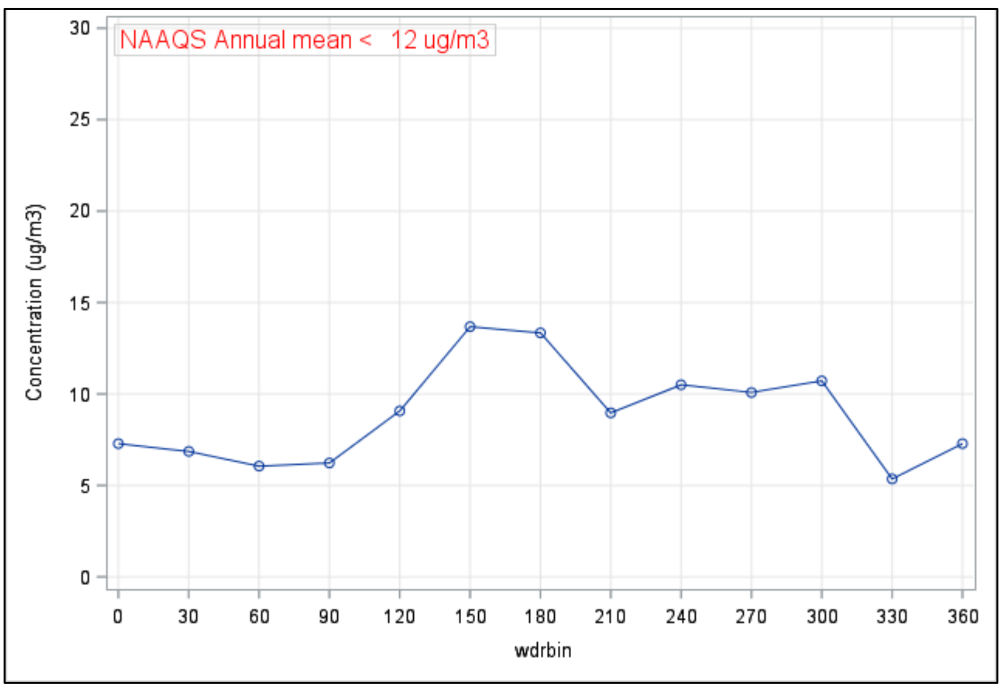


**Figure 37. Mean $PM_{2.5}$ at Portland Broadway in May-Jun. 2020 by wind direction**

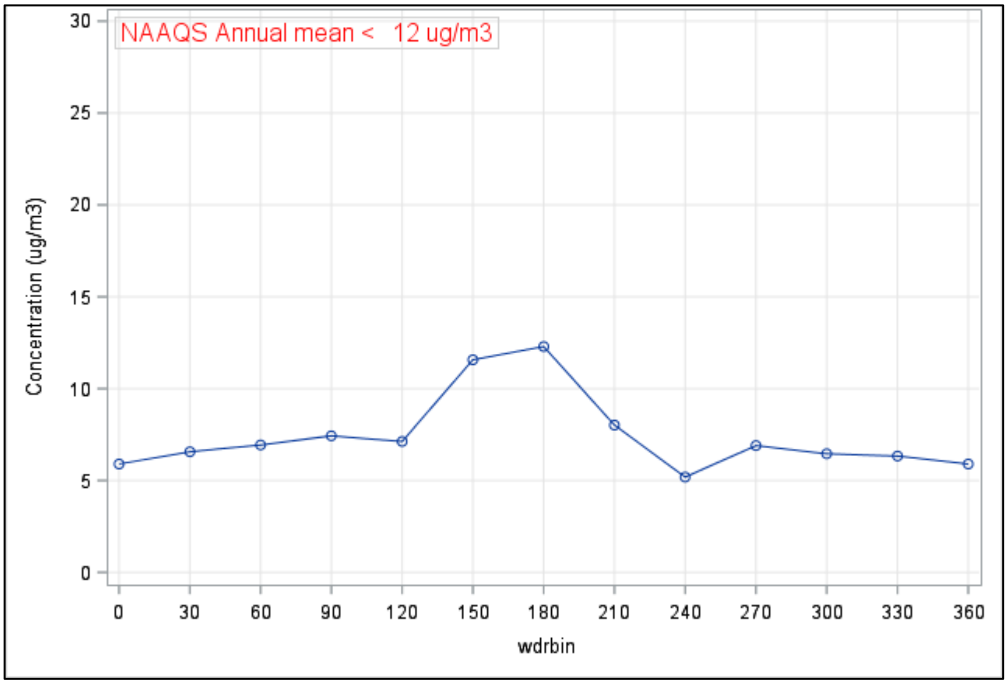


**Figure 38. Mean $PM_{2.5}$ at Portland Broadway in Jul.-Aug. 2020 by wind direction**

**NOx Data Analysis**
Because motor vehicles contribute heavily to NOx concentrations, one way to assess the motor vehicle contribution is to compare concentrations by time of day and day type (weekday/weekend) to motor vehicle use. Many pollutants measurements tend to have higher concentration in the early morning hours owing to the combined effects of the overnight temperature inversion that tends to prevent vertical mixing plus lighter surface winds, both of which limit dilution, and the morning motor vehicle traffic rush hour. For example, Figure 39 shows the average concentrations of NOx by hour for weekdays and weekends over the October 2019 to September 2020 time frame, with the highest average concentrations at 6:00 CST. From just after midnight to mid-afternoon, the weekday averages are higher than the weekend averages. From mid-afternoon on, there is little difference. The higher weekday averages support the hypothesis that motor vehicles play a major role in NOx emissions.

Figure 40 through Figure 44 show the mean concentrations of NO and $NO_2$ by hour of the day for two-month blocks. Again, the two-month blocks are used to illustrate the change in behavior of the two NOx species. In the cooler months, $NO_2$ concentrations are generally greater than NO concentrations, but in warmer weather this order tends to shift. This is largely owing to increased photochemistry in the atmosphere, causing $NO_2$ to dissociate into NO and atomic oxygen ion ($O^-$).

In these figures, in order to reduce the effect of statistical outliers on this analysis, all NO, $NO_2$, and NOx values greater than the $99^{th}$ percentile concentration have been set equal to the $99^{th}$ percentile.

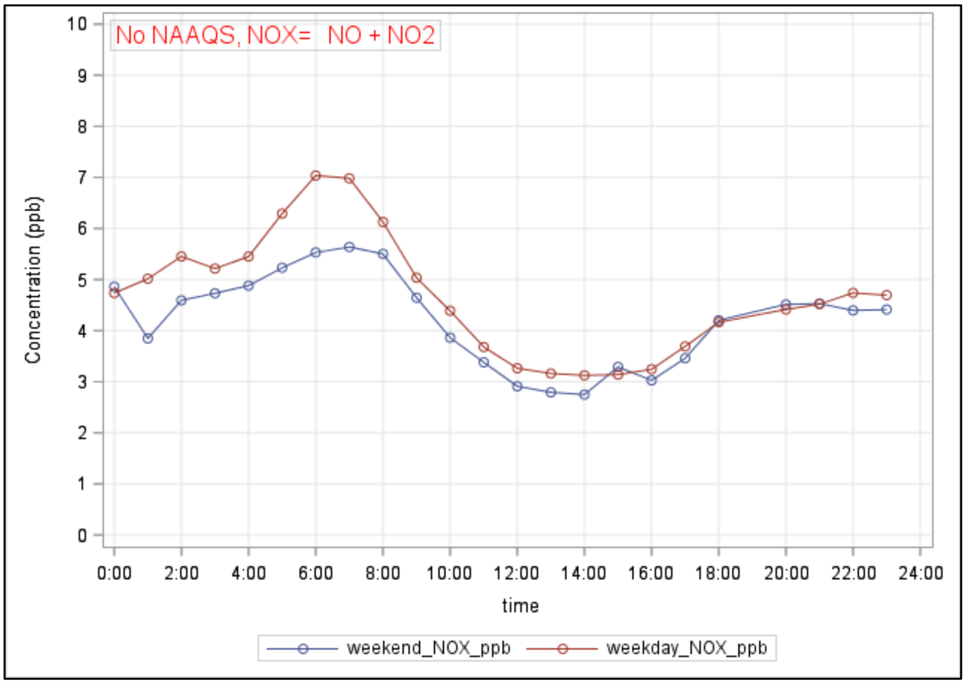


**Figure 39. Mean weekday and weekend NOx at Gregory-Fresnos by time of day**

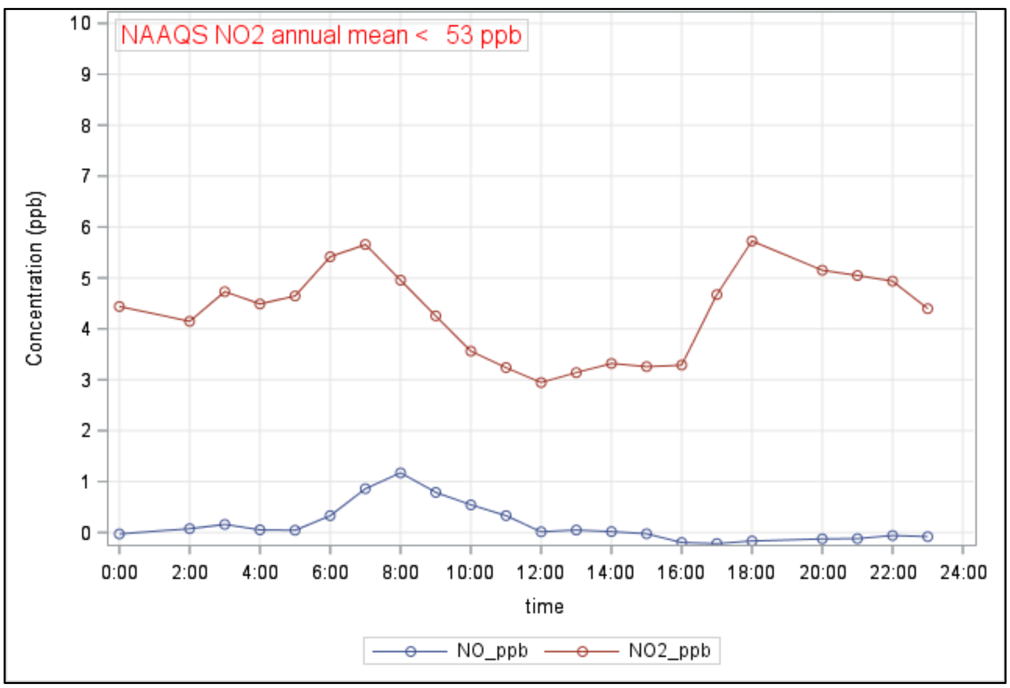


**Figure 40. Mean $NO_2$ and NO at Gregory-Fresnos in Nov.-Dec. 2019 by time of day**

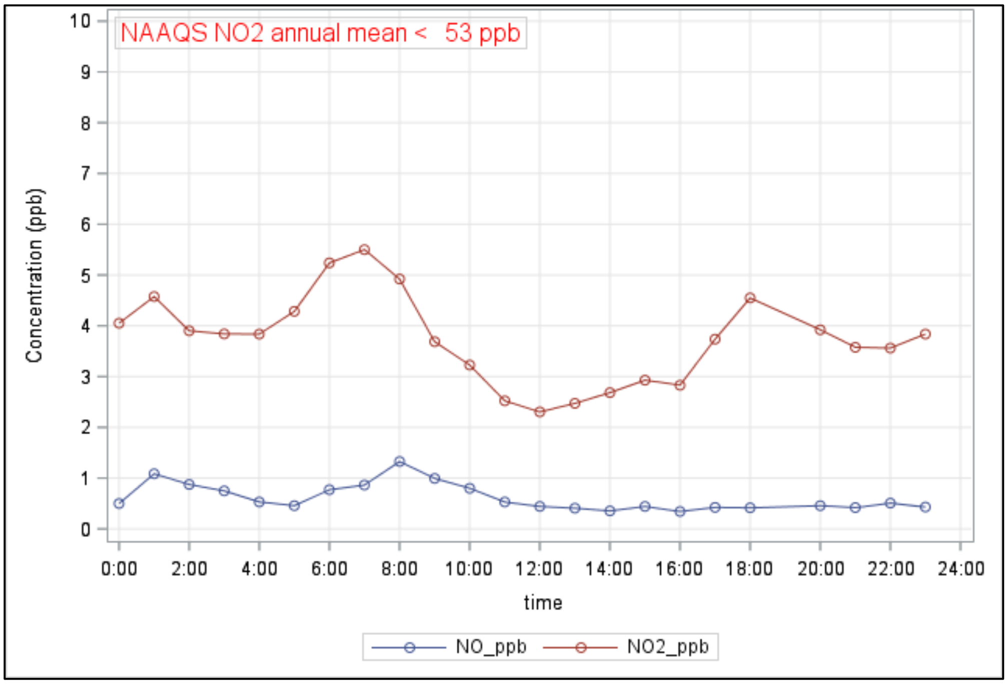


**Figure 41. Mean $NO_2$ and NO at Gregory-Fresnos in Jan.-Feb. 2020 by time of day**

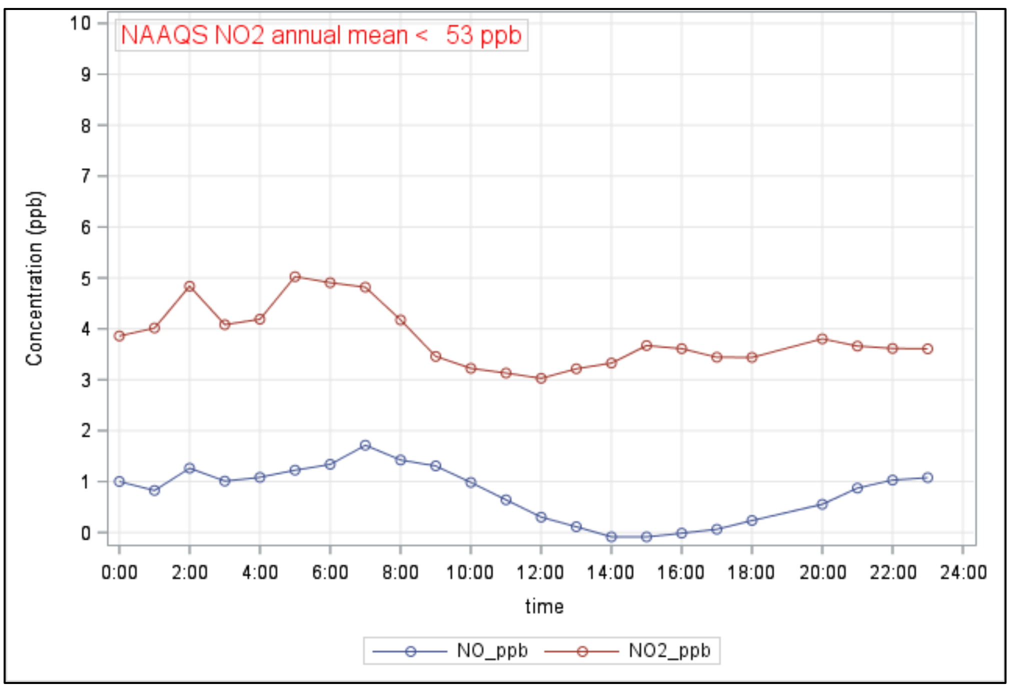


**Figure 42. Mean $NO_2$ and NO at Gregory-Fresnos in Mar.-Apr. 2020 by time of day**

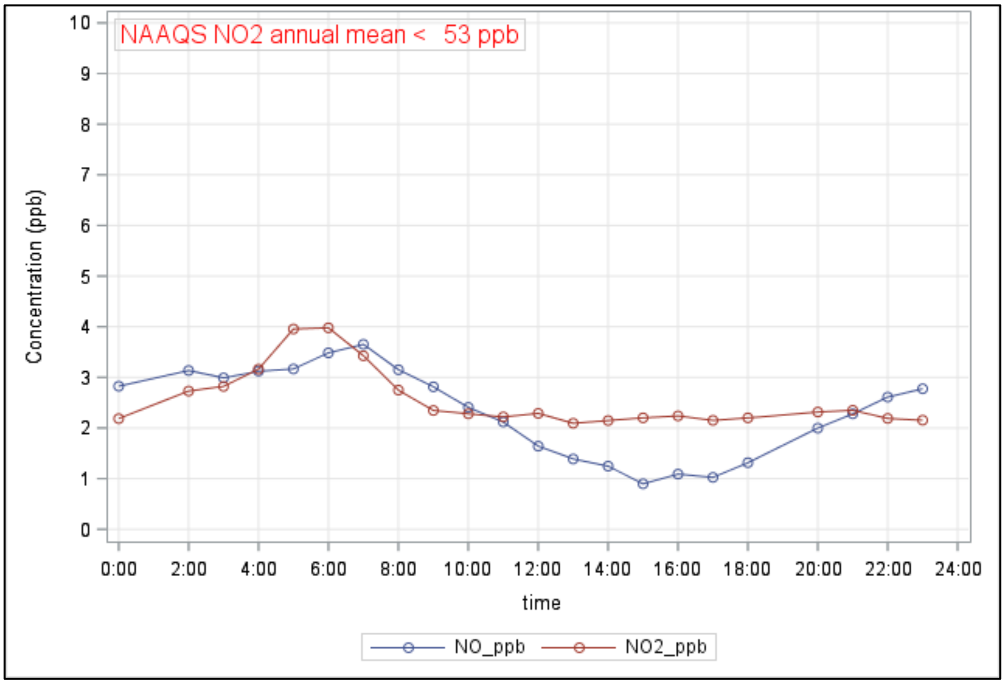


**Figure 43. Mean $NO_2$ and NO at Gregory-Fresnos in May-Jun. 2020 by time of day**

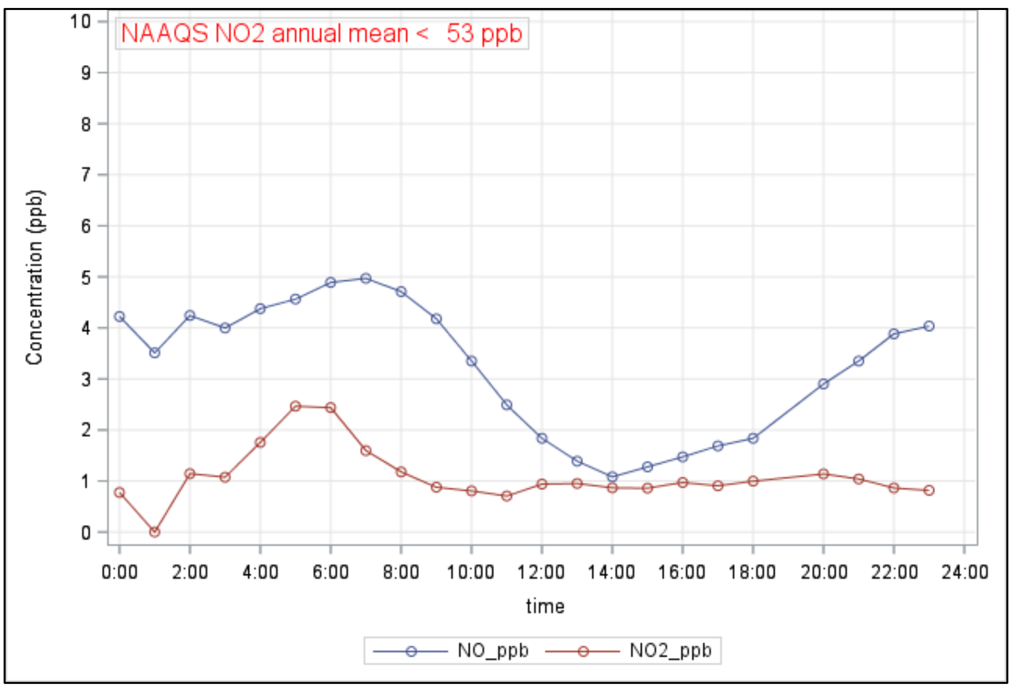


**Figure 44. Mean $NO_2$ and NO at Gregory-Fresnos in Jul.-Aug. 2020 by time of day**

**Benzene Data Analysis**

Among the hydrocarbons measured by the three auto-GCs in San Patricio County, and at most, if not all of the auto-GCs operated in Texas, benzene is the species that is generally found to be closest to its long term Air Monitoring Comparison Value (AMCV) of 8.4 ppbC, which is the lowest AMCV used by the TCEQ. Figure 45, Figure 46, and Figure 47 show the mean concentrations of benzene by wind direction using all data from October 1, 2019 to July 31, 2020 for the Gregory Fresnos station and from January 1 to July 31, 2020 for the Portland Buddy Ganem and Portland Broadway stations. For all three stations, the highest average concentrations are associated with westerly winds (270 degrees). This is a very infrequent wind direction and may be driven by the fact that westerly winds generally have lower speed winds, which leads to accumulation of pollutants and higher concentrations.

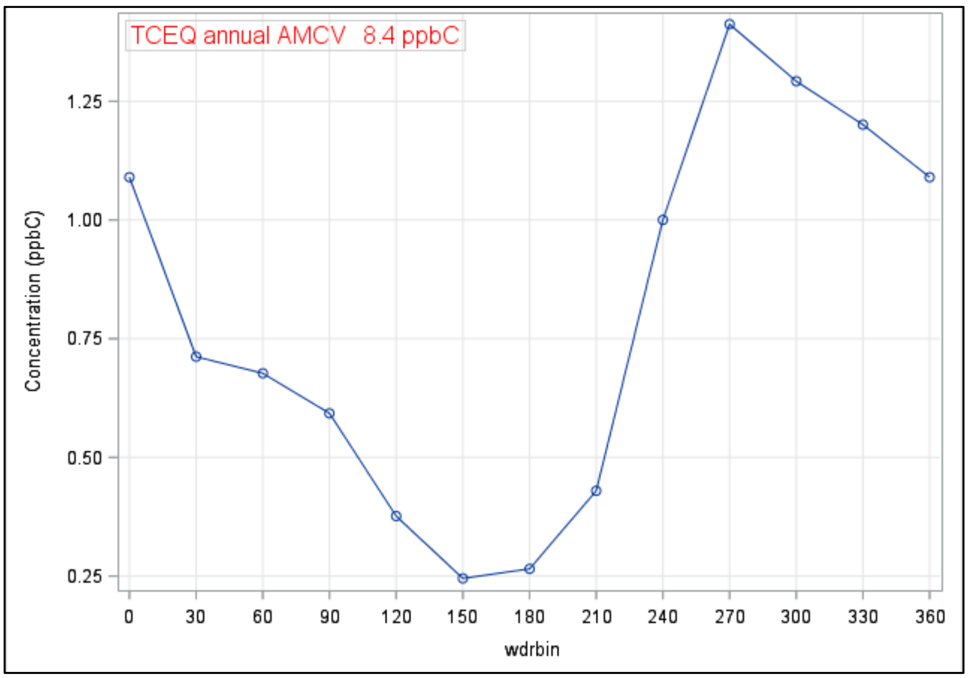


**Figure 45. Mean benzene at Gregory Fresnos Oct. 2019 – July 2020 by wind direction**

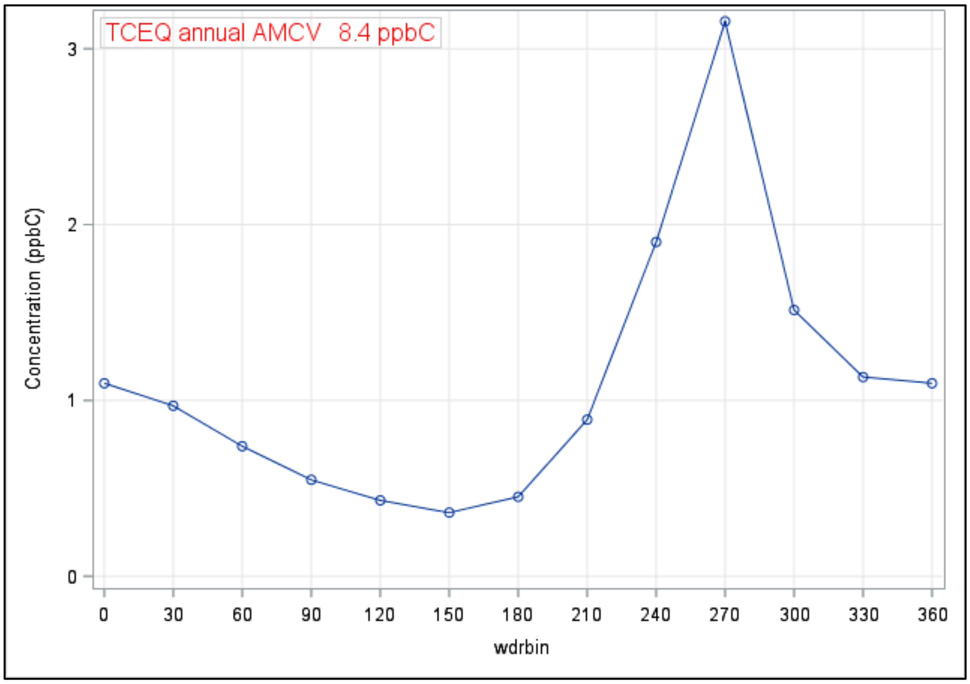


**Figure 46. Mean benzene at Portland Buddy Ganem Jan. – July 2020 by wind direction**

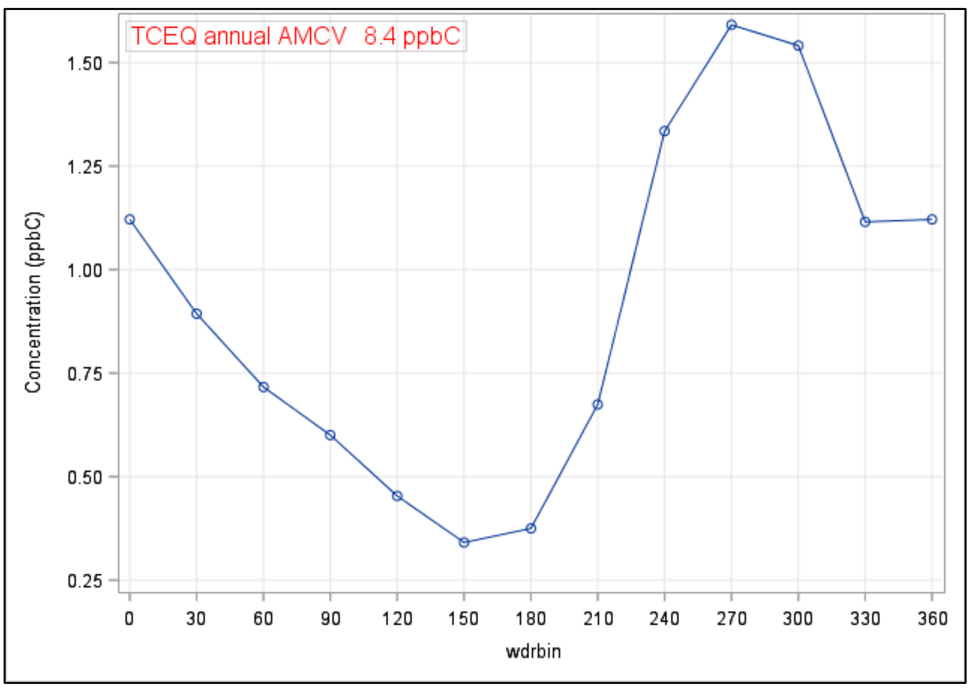


**Figure 47. Mean benzene at Portland Broadway Jan. – July 2020 by wind direction**

## 6.0 Conclusions

The air monitoring to date has been very successful. Although some concentrations have occasionally exceeded the concentration levels of the NAAQS, to date, the NAAQS have not been violated. Furthermore, measured hydrocarbon concentrations have not exceeded TCEQ long-term or short-term AMCVs. UT Austin would be happy to answer any questions or conduct additional analysis at the community's or sponsors' requests.

# Appendices

## A.1 Air Monitoring Station Locations & Information

Table A-1. Gregory-Portland Community Air Monitoring Stations and Parameters Measured

| Air Monitoring Station Name & Address | Volatile Organic Compounds (VOCs) 46 compounds | Ethylene oxide (EO) 24 hr canister every 6th day | Nitrogen Oxides (NOx, NO, & $NO_2$) | Sulfur Dioxide ($SO_2$) | Particulate Matter (PM) Mass, particles < 2. 5 micron diameter | Wind Speed (WS), Wind Direction (WD), Ambient Temperature (T), Relative Humidity (RH), & Barometric Pressure (BP) |
|---|---|---|---|---|---|---|
| Gregory Fresnos<br>Stephen Austin Elementary<br>401 Fresnos St.<br>Gregory, TX | Yes | No | Yes | Yes | Yes | Yes |
| Portland Buddy Ganem<br>307 Buddy Ganem St.<br>GP High School<br>Portland, TX | Yes | Yes | No | No | Yes | Yes. + precipitation |
| Portland Broadway<br>175 Broadway Blvd.<br>Old East Cliff Elementary School<br>Portland, TX | Yes | Yes | No | No | Yes | Only WS, WD |

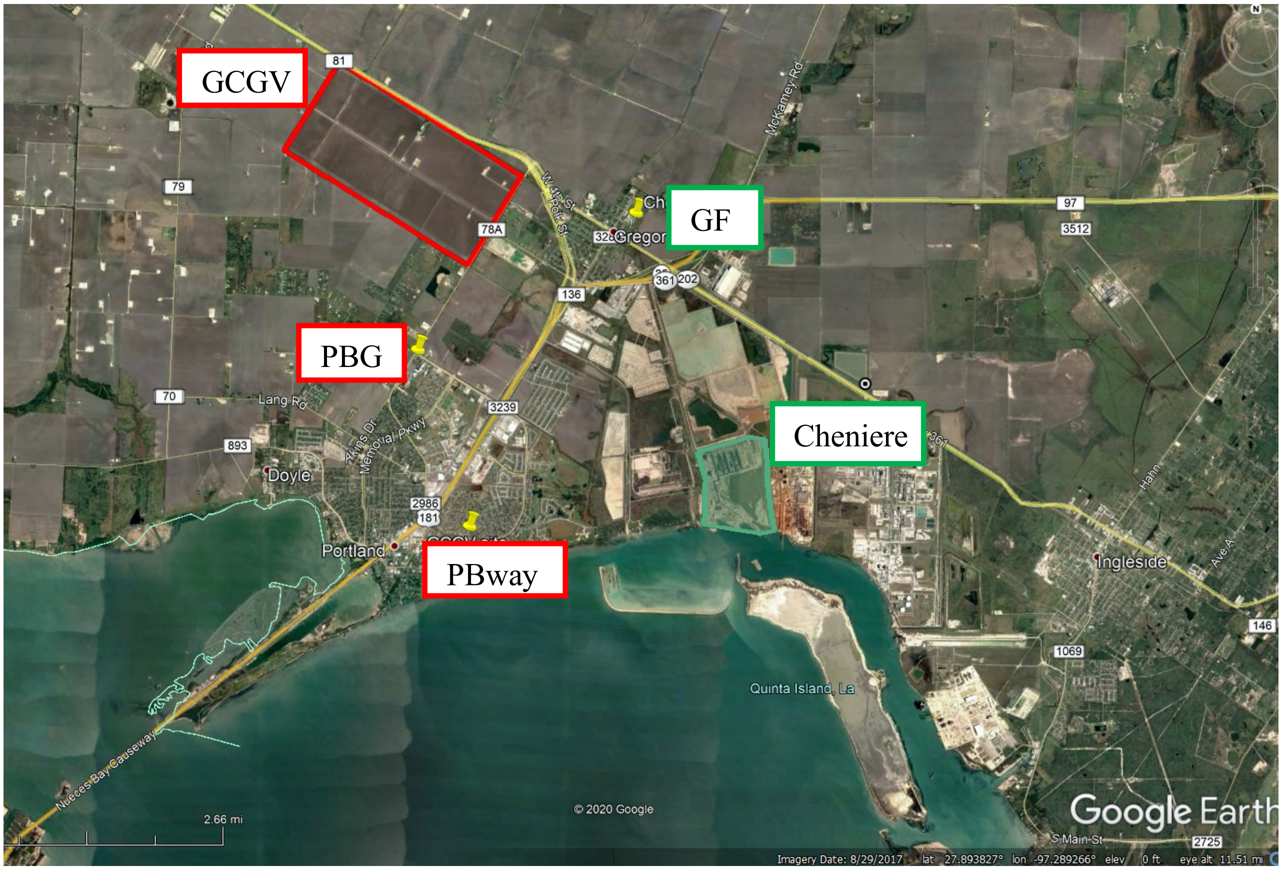


**Figure 48. Location of Gregory-Fresnos Community Air Monitoring Station (GF), and two Portland community stations on GPISD campuses on Buddy Ganem Dr. (PBG) and on Broadway Ave. (PBway) and two industrial facilities**

## A.2 Glossary of Terms and Terminology

**Pollutant concentrations** – Concentrations of most gaseous pollutants are expressed in units denoting their "mixing ratio" in air; i.e., the ratio of the number molecules of the pollutant to the total number of molecules per unit volume of air. Because concentrations for all gases other than molecular oxygen, nitrogen, and argon are very low, the mixing ratios are usually scaled to express a concentration in terms of "parts per million" (ppm) or "parts per billion" (ppb).

Sometimes the units are explicitly expressed as ppm-volume (ppmV) or ppb-volume (ppbV) where 1 ppmV indicates that one molecule in one million molecules of ambient air is the compound of interest and 1 ppbV indicates that one molecule in one billion molecules of ambient air is the compound of interest. In general, air pollution standards and health effects screening levels are expressed in ppmV or ppbV units. Because hydrocarbon species may have a chemical reactivity related to the number of carbon atoms in the molecule, mixing ratios for these species are often expressed in ppb-carbon (ppbV times the number of carbon atoms in the molecule), to reflect the ratio of carbon atoms in that species to the total number of molecules in the volume. This is relevant to our measurement of auto-GC species and TNMHC, which are reported in ppbC units. For the purpose of relating hydrocarbons to health effects, this report notes hydrocarbon concentrations in converted ppbV units. However, because TNMHC is a composite of all species with different numbers of carbons, it cannot be converted to ppbV. Pollutant concentration measurements are time-stamped based on the start time of the sample, in Central Standard Time (CST), with sample duration noted.

**Auto-GC** – The automated gas chromatograph collects a sample for 40 minutes, and then automatically analyzes the sample for a target list of 46 hydrocarbon species. These include benzene and 1,3-butadiene, which are air toxics, various species that have relatively low odor thresholds, and a range of gasoline and vehicle exhaust components.

**Total non-methane hydrocarbons (TNMHC)** – TNMHC represent a large fraction of the total volatile organic compounds released into the air by human and natural processes. TNMHC is an unspeciated total of all hydrocarbons, and individual species must be resolved by other means, such as with canisters or auto-GCs.

**Canister** – Electro-polished stainless steel canisters are filled with air samples when an independent sensor detects that *elevated* (see below) levels of hydrocarbons (TNMHC) are present. Samples are taken for a set time period to capture the chemical make-up of the air.

**Air Monitoring Comparison Values (AMCV) –** The TCEQ uses AMCVs in assessing ambient data. Two valuable online documents ("Fact Sheet" and "Uses of ESLs and AMCVs Document") that explain AMCVs are at http://www.tceq.texas.gov/toxicology/AirToxics.html (accessed July 2015). The following text is an excerpt from the TCEQ "Fact Sheet" document:

Effects Screening Levels are chemical-specific air concentrations set to protect human health and welfare. Short-term ESLs are based on data concerning acute health effects, the potential for odors to be a nuisance, and effects on vegetation, while long-term ESLs are based on data concerning chronic health and vegetation effects. Health-based ESLs are set below levels where health effects would occur whereas welfare-based ESLs (odor and vegetation) are set based on effect threshold concentrations. The ESLs are screening levels, **not ambient air standards.**

Originally, the same long- and short-term ESLs were used for both air permitting and air monitoring.

There are significant differences between performing health effect reviews of air permits using ESLs, and the various forms of ambient air monitoring data. The Toxicology Division is using the term “air monitoring comparison values” (AMCVs) in evaluations of air monitoring data in order to make more meaningful comparisons. “AMCVs” is a collective term and refers to all odor-, vegetative-, and health-based values used in reviewing air monitoring data. Similar to ESLs, AMCVs are chemical-specific air concentrations set to protect human health and welfare. Different terminology is appropriate because air *permitting* and air *monitoring* programs are different.

**Rationale for Differences between ESLs and AMCVs** – A very specific difference between the permitting program and monitoring program is that permits are applied to one company or facility at a time, whereas monitors may collect data on emissions from several companies or facilities or other source types (e.g., motor vehicles). Thus, the protective ESL for permitting is set lower than the AMCV in anticipation that more than one permitted emission source may contribute to monitored concentrations.

**National Ambient Air Quality Standards (NAAQS) –** U.S. Environmental Protection Agency (EPA) has established a set of standards for several air pollutions described in the Federal Clean Air Act. NAAQS are defined in terms of *levels* of concentrations and particular *forms*. For example, the NAAQS for particulate matter with size at or less than microns ($PM_{2.5}$) has a *level* of 12 micrograms per cubic meter averaged over 24- hours, and a *form* of the annual average based on four quarterly averages, averaged over three years. Individual concentrations measured above the level of the NAAQS are called *exceedances*. The number calculated from a monitoring site’s data to compare to the level of the standard is called the site’s *design value*, and the highest design value in the area for a year is the regional design value used to assess overall NAAQS compliance. A monitor or a region that does not comply with a NAAQS is said to be *noncompliant*. At some point after a monitor or region has been in noncompliance, the U.S. EPA may choose to label the region as *nonattainment*. A nonattainment designation triggers requirements under the Federal Clean Air Act for the development of a plan to bring the region back into compliance. A more detailed description of NAAQS can be found on the EPA’s Website at http://www.epa.gov/air/criteria.html (accessed July 2015).

One species measured by this project and regulated by a NAAQS is sulfur dioxide ($SO_2$). EPA set the $SO_2$ NAAQS to include a level of 75 ppb averaged over one hour, with a form of the three year average of the annual 99$^{th}$ percentiles of the daily maximum one- hour averages. If measurements are taken for a full year at a monitor, then the 99$^{th}$ percentile would be the fourth highest daily one hour maximum. There is also a secondary $SO_2$ standard of 500 ppb over three hours, not to be exceeded more than once in any one year.

**Elevated Concentrations** – In the event that measured pollutant concentrations are above a set threshold they are referred to as "elevated concentrations." The values for these thresholds are summarized by pollutant below. As a precursor to reviewing the data, the reader should understand the term "*statistical significance*." In the event that a concentration is higher than one would typically measure over, say, the course of a week, then one might conclude that a specific transient assignable cause may have been a single upwind pollution source, because experience shows the probability of such a measurement occurring under normal operating conditions is small. Such an event may be labeled "statistically significant" at level 0.01, meaning the observed event is rare enough that it is not expected to happen more often than once in 100 trials. This does not necessarily imply the failure to meet a health-based standard. A discussion of "elevated concentrations" and "statistical significance" by pollutant type follows:

- For $SO_2$, any measured concentration greater than the level of the NAAQS, which is 75 ppb over one hour, is considered "elevated." Note that the concentrations of SO2 need not persist long enough to constitute an exceedance of the standard to be regarded as elevated. In addition, any closely spaced values that are statistically significantly (at 0.01 level) greater than the long-run average concentration for a period of one hour or more will be considered "elevated" because of their unusual appearance, as opposed to possible health consequence. The rationale for doing so is that unusually high concentrations at a monitor may suggest the existence of unmonitored concentrations closer to the source area that are potentially above the state's standards.
- For TNMHC, any measured concentration greater than the threshold of 2000 ppbC is considered "elevated."
- For benzene and other air toxics in canister samples or auto-GC measurements, any concentration above the AMCV is considered "elevated." Note that 40-minute auto-GC measurements are compared with the short-term AMCV.
- Some hydrocarbon species measured by the auto-GC generally appear in the air in very low concentrations close to the method detection level. Similar to the case above with $SO_2$, any values that are statistically significant (at 0.01 level) greater than the long-run average concentration at a given time or annual quarter will be considered "elevated" because of their unusual appearance, as opposed to possible health consequence. The rationale for doing so is that unusually high concentrations at a monitor may suggest an unusual emission event in the area upwind of the monitoring site.