Quarterly Report of Air Quality Monitoring January 1 to September 30, 2024, at the Gregory – Portland Community Air Monitoring Stations

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Executive Summary

There are three continuous air quality monitoring stations operating in the Gregory-Portland area. 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, one near the intersection of Buddy Ganem Dr. and Wildcat Dr. on the campus of the Gregory-Portland High School and the other on Broadway Blvd. on the campus of the old East Cliff Elementary School, began operations on January 1, 2020. The U.S. Environmental Protection Agency (EPA) generally uses three years of data collection to assess attainment with the National Ambient Air Quality Standards (NAAQS). This project has now collected and validated data for more than four and a half years at all three stations.

Since monitoring began, some measured pollutant concentrations have exceeded the concentration levels of NAAQS; however, these values have not been sustained long enough or measured frequently enough to violate a NAAQS. Furthermore, measured hydrocarbon concentrations have not exceeded the levels of concern published by the Texas Commission on Environmental Quality (TCEQ). In fact, the measured concentrations of two EPA criteria pollutants – sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) are among the lowest NAAQS concentration averages in the state over the 2021 to 2023 three-year period, and average hydrocarbon concentrations are among the lowest of the Texas automated gas chromatograph monitors (auto-GCs) operated or funded by the TCEQ across the state.

The public website developed as the community's source for information about the community air monitors continues to provide information about air quality and monitoring data from the three air monitoring stations (https://gpair.ceer.utexas.edu accessed October 2024).

UT Austin would be happy to answer any questions or conduct additional analysis at the community's or sponsors' requests. Contact Vincent Torres at vmtorres@mail.utexas.edu for information on the website or Dave Sullivan at sullivan231@mail.utexas.edu with questions about the monitoring data and analyses in this report.

1.0 Introduction

This report is jointly funded by Cheniere Energy and Gulf Coast Growth Ventures LLC (GCGV) as part of their separate Gregory-Portland 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. The primary emphasis in this report is the examination of data collected and validated for the period January 1 to September 30, 2024, and some comparisons to earlier data.

2.0 Summary of Activities July 1 through September 30, 2024

The data completeness acceptable minimum for regulatory monitoring of criteria air pollutants is 75 percent. These three non-regulatory air monitoring stations have generally reported quality assured data at a greater than 75% data completeness.

As was noted in recent quarterly reports, the GCGV ethane-cracking and derivatives facility has been fully operational since January 2022. Operations at the GCGV facility and the Cheniere Energy facility do not appear to have affected the typical hourly average level of pollutants measured at project stations since monitoring operations began. One exception to this last statement was a short period of two hours when elevated concentrations of ethylene oxide (EtO) were detected by the new continuous EtO monitor that has been running since February 2024 at the Portland Buddy Ganem station. This was described in an earlier report. This monitor has not measured similar concentration again since then.

The United States Environmental Protection Agency (EPA) announced earlier this year, that the new level of the PM2.5 NAAQS for the average annual concentration would be reduced from 12 micrograms per cubic meter ($\mu g/m^3$) to 9.0 $\mu g/m^3$. The PM2.5 NAAQS was reduced to 9.0 $\mu g/m^3$ effective May 6, 2024. Currently, the three-year average concentrations at all three stations have averaged lower than this 9.0 $\mu g/m^3$ level.

This report focuses on the data collected at the three air monitoring stations during the period January 1 through September 30, 2024, and also includes some summaries from earlier monitoring.

3.0 Air Monitoring Station Locations & Information

As noted earlier in this report, there are three air monitoring stations in the Gregory-Portland area in operation, one station operated by UT in Gregory, TX and two operated by AECOM in Portland, TX. The locations of the three stations and parameters measured are summarized in Table 1. The locations of the three stations are shown in satellite view in Figure 1. Also shown in Figure 1 are the locations of the Cheniere liquefied natural gas facility and the GCGV ethane-cracking and derivatives facility.

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

Air Monitoring Station Name & Address	Volatile Organic Compounds (VOCs) compounds	Ethylene oxide (EtO) 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 Stephen Austin Elementary 401 Fresnos St. Gregory, TX	Yes	No	Yes	Yes	Yes	Yes
Portland Buddy Ganem 307 Buddy Ganem St. GP High School Portland, TX	Yes	Yes, also continuous hourly data	No	No	Yes	Yes. + precipitation
Portland Broadway 175 Broadway Blvd. Old East Cliff Elementary School Portland, TX	Yes	Yes	No	No	Yes	Only WS, WD

Figure 1. Location of Gregory-Fresnos Community Air Monitoring Station (GF, pin G), and two Portland community stations on GPISD campuses on Buddy Ganem (PBG, pin 1) and on Broadway (PBway, pin 2) and the Cheniere Energy and GCGV industrial facilities

4.0 Summary of Measurement 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 an emission source or the availability of dust to become airborne. Another is the weather. Regarding weather, rain can reduce concentrations of several pollutants, especially particulate matter. The "mixing height" is the lower level of the atmospheric zone 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 an emission 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 wind 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. However, in general, low speed winds and stagnation often lead to higher concentrations of pollutants. Figure 2 shows how higher concentrations of NO_2 and propane at the GF station are associated with low-speed winds, with lower concentrations under higher speed winds. 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 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, and in other cases, normal emissions can result in unusually high concentrations owing to a source being nearby under low wind speeds or air stagnation.

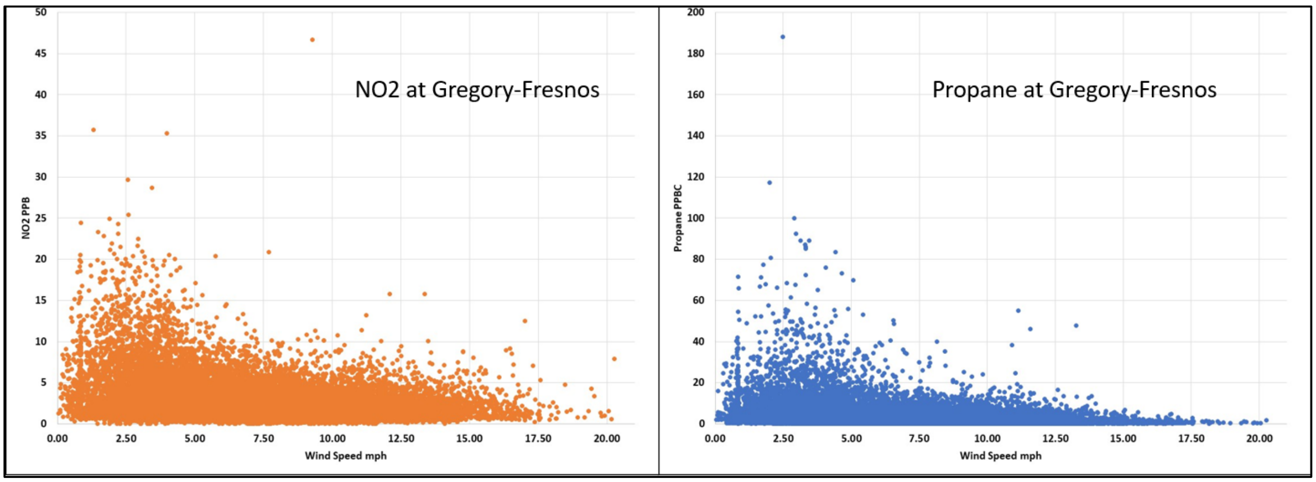

Figure 2. Effect of wind speed on primary pollutants

Please note that the measurement data in this report are quality-assured station data made available at different submission frequencies:

- NOx, NO, & NO_2, SO_2, PM2.5 & Met measurements – weekly; and
- Auto-GC VOC measurements – generally within 60 days of the measurement; and
- EtO canister data – generally within 60 days of the date the sample was collected.

Although all these measurements, except canister EtO, are made in near-real time, the nature of the complexity in quality assuring the auto-GC target hydrocarbons among the thousands of different organic compounds that exist in the air leads to a lengthy delay in releasing the quality-assured target species data. Air samples for EtO data are collected at the station and then sent to a laboratory where EtO concentrations are then derived upon analysis of the air samples. Hence, the data available at the time this report was written will not all have the same date ranges. Auto-GC and EtO data are available through August 2024, and all other data were available through September 30, 2024.

4.1 Gregory Fresnos Station Hydrocarbon Data

Figure 3 shows the time series graph for hourly concentrations of benzene at the Gregory-Fresnos (GF) station in 2024. The graph shows benzene hourly average concentrations for each hour from January 1, 2024, through August 31, 2024. The date and concentration of the highest value in the graph is shown in the graph. Concentrations early in the year tended to be higher owing to work being done on the nearby school building. Benzene concentrations in the air can be of health concern but to date benzene concentrations have been much lower than TCEQ Air Monitoring Comparison Values (AMCV) of 1,080 ppbC for a single one-hour value or 8.4 ppbC for an annual hourly average concentration. Other AMCVs for auto-GC hydrocarbons can be found on the TCEQ Website at https://www.tceq.texas.gov/cgi-bin/compliance/monops/agc_amcvs.pl (accessed October 2024).

Note that a straight line or a gap in a time series graph in this report represents missing data. Data may be missing owing to equipment failure, planned equipment or site maintenance, or external factors such as power loss or severe weather.

Table 2 lists all target hydrocarbon species measured and reported by the GF auto-GC in 2024 through August, with the peak one-hour concentration, maximum 24-hour day concentration, and the January through May 2024 average hourly concentration for each species. Note that the total sum of the target species (TNMTC) and the total sum of the hydrocarbons (target species plus non-target species and unknown species) (TNMHC) are included in the table. In addition, the TCEQ's Air Monitoring Comparison Values (AMCV) are shown in the table. From the TCEQ's Air Monitoring Comparison Values website[1]:

> "AMCVs are used to evaluate the potential for effects to occur as a result of exposure to concentrations of constituents in the air. AMCVs are based on data concerning health effects, odor, and vegetation effects. They are not ambient air standards. If predicted or measured airborne levels of a constituent do not exceed the comparison level, adverse health or welfare effects would not be expected to result. If ambient levels of constituents in air exceed the comparison levels, it does not necessarily indicate a problem, but rather, triggers a more in-depth review. If you have any questions about the potential for health, odor, or vegetation effects from exposure to reported concentrations of any of these compounds, please contact the Toxicology Division by telephone at (512) 239-3900 or by email at tox@tceq.texas.gov."

Data completeness for auto-GCs is based on the planned collection of 22 hours per day – as two hours per day are reserved for quality assurance activities. The GF station has collected data on the individual hydrocarbon compounds with 83 to 90 percent data completeness of the planned collection hours for 2024.

Time series graphs of other hydrocarbon species are also available upon request and any graphs can be made with timescale (x-axis) or concentration-scale (y-axis) adjustments. Also, concentrations can be averaged by day, month, or other time period upon request. A user can also make graphs of data on the project website at https://gpair.ceer.utexas.edu/custom-data-request.php (accessed October 2024). To make a request, contact Dr. Dave Sullivan at sullivan231@mail.utexas.edu or 512-914-4710.

[1] https://www.tceq.texas.gov/cgi-bin/compliance/monops/agc_amcvs.pl accessed October 2024.

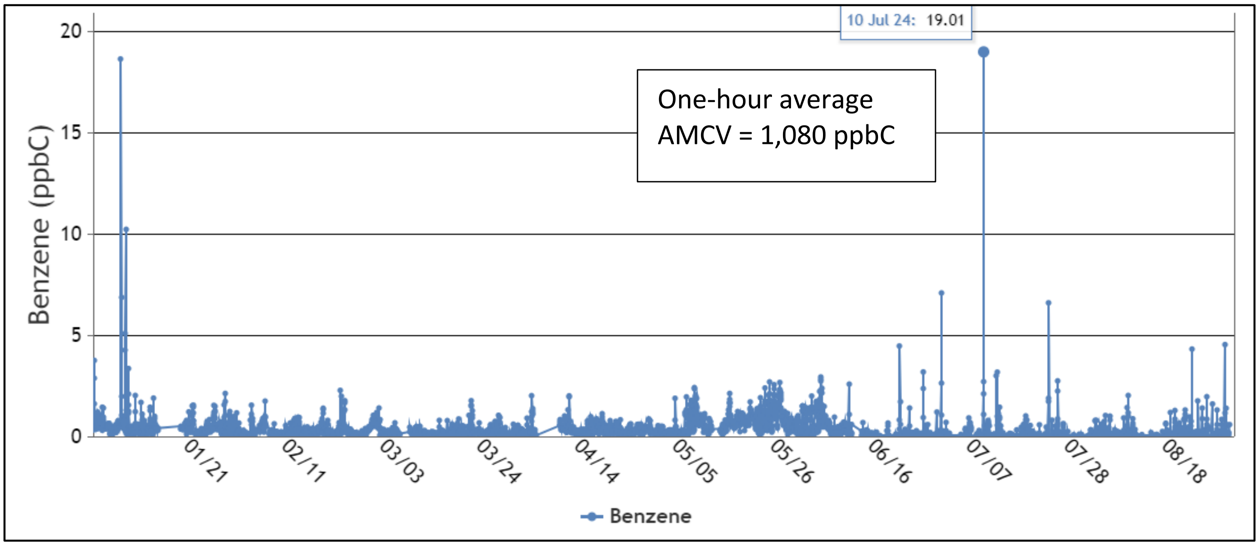

Figure 3. Hourly benzene concentrations at GF station, Jan. 1, 2024 – August 31, 2024, ppbC units

Table 2. Gregory-Fresnos Auto-GC statistics for Jan. – Aug. 2024

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Short-term AMCV	Mean ppbC	Long-term AMCV
TNMHC	4,820	4,452.94	298.186	N/A	41.011	N/A
TNMTC	4,820	4,281.59	285.646	N/A	37.3508	N/A
Ethane	4,820	1,377.16	91.369	N/A	10.1914	N/A
Ethylene	4,820	77.64	6.059	1,000,000	0.7874	10,600
Propane	4,820	1,222.23	79.069	N/A	7.7174	N/A
Propylene	4,820	13.25	2.807	N/A	0.7081	N/A
Isobutane	4,820	450.54	29.759	132,000	2.5689	40,000
n-Butane	4,820	516.52	51.274	368,000	4.6825	40,000
Acetylene	4,745	5.84	1.212	50,000	0.4748	5,000
trans-2-Butene	4,820	85.41	4.835	60,000	0.1646	2,800
1-Butene	4,820	4.72	0.512	108,000	0.1769	9,200
cis-2-Butene	4,820	22.83	1.797	60,000	0.0765	2,800
Cyclopentane	4,820	67.74	3.623	29,500	0.1479	2,950
Isopentane	4,820	218.96	21.795	340,000	2.4071	40,500
n-Pentane	4,820	260.7	23.312	340,000	1.9557	40,500
1,3-Butadiene	4,820	149.89	12.285	6,800	0.0898	36
trans-2-Pentene	4,820	4.46	0.29	60,000	0.033	2,800
1-Pentene	4,820	10.17	0.734	60,000	0.0466	2,800
cis-2-Pentene	4,820	3.33	0.405	60,000	0.0168	2,800
2,2-Dimethylbutane	4,820	13.31	0.917	32,400	0.1057	1,140
Isoprene	4,820	1.94	0.463	7,000	0.1145	700
n-Hexane	4,820	93.45	8.196	32,400	0.7707	1,140
Methylcyclopentane	4,820	45.96	3.847	4,500	0.3437	450
2,4-Dimethylpentane	4,820	3.33	0.84	58,100	0.0094	15,400
Benzene	4,820	19.01	1.799	1,080	0.334	8.4
Cyclohexane	4,820	45.83	3.806	6,000	0.3403	600
2-Methylhexane	4,820	12.82	0.799	58,100	0.0864	15,400
2,3-Dimethylpentane	4,820	6.23	0.374	58,100	0.0278	15,400
3-Methylhexane	4,820	14.68	1.283	58,100	0.148	15,400
2,2,4-Trimethylpentane	4,820	16.08	1.494	32,800	0.1863	3,040
n-Heptane	4,819	30.47	2.293	58,100	0.2278	15,400
Methylcyclohexane	4,820	48.69	3.538	28,000	0.3493	2,800
2,3,4-Trimethylpentane	4,820	0.87	0.133	32,800	0.02	3,040
Toluene	4,820	94.72	7.785	28,000	0.4843	7,700
2-Methylheptane	4,820	12.15	0.645	32,800	0.0557	3,040
3-Methylheptane	4,820	5.65	0.298	32,800	0.0399	3,040
n-Octane	4,820	15.78	0.865	32,800	0.1145	3,040
Ethyl Benzene	4,820	4.62	0.83	160,000	0.0498	3,520
p-Xylene + m-Xylene	4,820	8.21	1.003	13,600	0.1998	1,120
Styrene	4,820	0.83	0.071	41,600	0.0034	880
o-Xylene	4,820	2.69	0.267	13,600	0.0551	1,120
n-Nonane	4,820	7.59	0.507	27,000	0.0568	2,520
Isopropyl benzene	4,820	0.57	0.051	4,590	0.0051	459
n-Propylbenzene	4,820	1.29	0.231	4,590	0.0161	459
1,3,5-Trimethylbenzene	4,468	1.48	0.12	27,000	0.0122	333
1,2,4-Trimethylbenzene	4,444	2.6	0.66	27,000	0.221	333
n-Decane	4,468	6.16	0.573	10,000	0.0694	1,900
1,2,3-Trimethylbenzene	4,468	1.79	0.334	27,000	0.0419	333

4.2 Portland Buddy Ganem & Portland Broadway Stations Hydrocarbon Data

Figure 4 shows the time series graph for hourly concentrations of benzene at the Portland Buddy Ganem (PBG) station, and Figure 5 shows the time series graph for the hourly concentrations of benzene at the Portland Broadway (PBway) station. Both graphs show benzene hourly average concentrations for each hour from January 1, 2024, through August 31, 2024.

As was the case at the Gregory Fresnos station, hydrocarbon concentrations to date are much lower than the TCEQ AMCVs. Table 3 lists the target hydrocarbon species measured and reported by the Portland Buddy Ganem (PBG) auto-GC and Table 4 lists the target hydrocarbon species measured and reported by the Portland Broadway (PBway) auto-GC with the peak one-hour concentration, maximum 24-hour day concentration, and average hourly concentration for each species for January through August 2024. Also shown in the two tables are the TCEQ's AMCVs.

Based on the 22 hours per day planned ambient measurements, the PBG station has collected data with 85 to 89 percent data completeness based on planned collection hours for 2024, with exception of acetylene, which was at 69 percent. The PBway station has 91 to 95 percent data completeness of the planned collection hours for 2024, also with the exception for acetylene at 60percent. Acetylene is a particularly difficult species to measure by the auto-GC.[2]

Time series graphs of other hydrocarbon species are also available upon request, and any graphs can be made with timescale (x-axis) or concentration-scale (y-axis) adjustments. In addition, concentrations can be averaged by day, week, or month upon request. As mentioned earlier in the report, a user can also make graphs on the project website.

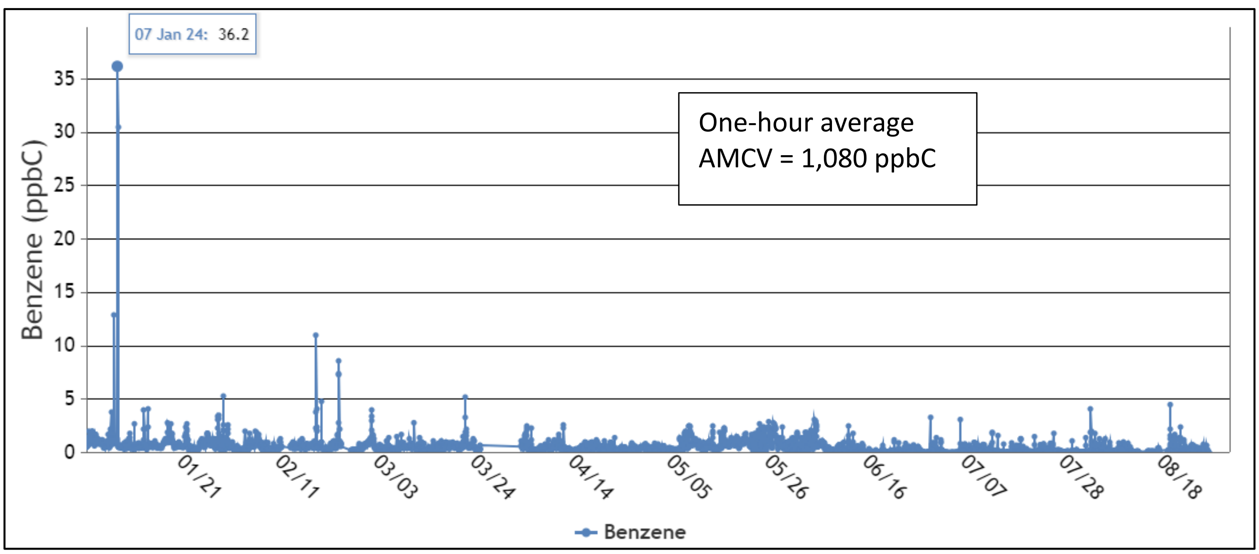

Figure 4. Hourly benzene concentrations at PBG station, Jan. 1, 2024 – Aug. 31, 2024, ppbC units

[2] See https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/auto-gcs/tceq-agc-audit.pdf accessed October 2024

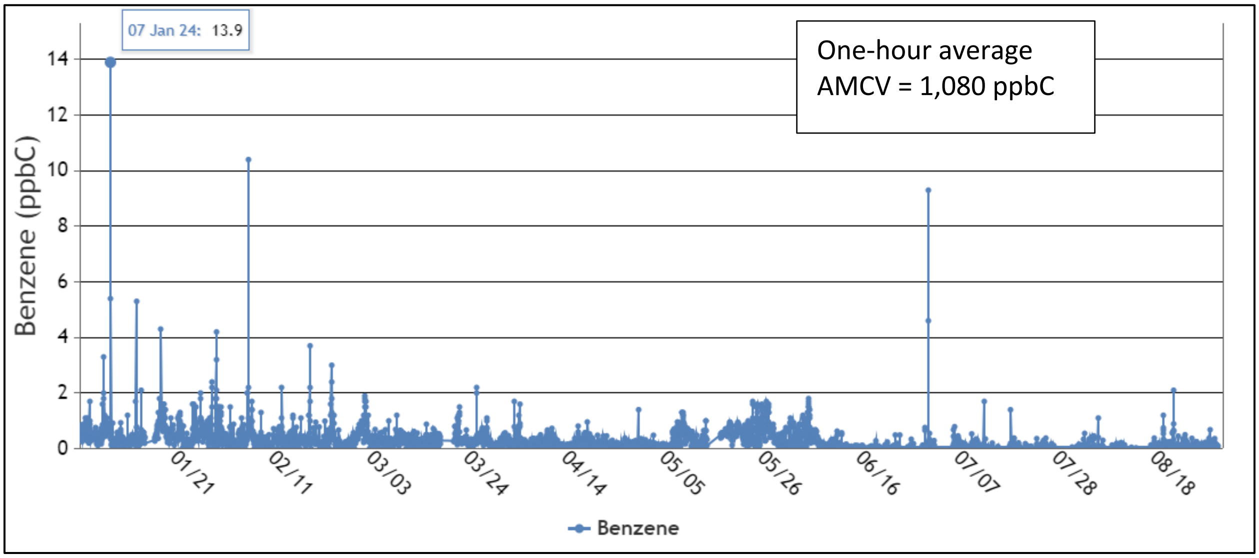

Figure 5. Hourly benzene concentrations at PBway station, Jan. 1, 2024 – Aug. 31, 2024, ppbC units

Table 3. PBG Auto-GC statistics for Jan. – Aug. 2024

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Short-term	Mean ppbC	Long-term AMCV
TNMHC	4,763	1,736.00	243.944	N/A	42.1366	N/A
TNMTC	4,763	1,475.16	230.467	N/A	38.9463	N/A
Ethane	4,763	278	77.891	N/A	12.62	N/A
Ethylene	4,763	88.5	6.01	1,000,000	1.0126	10,600
Propane	4,763	241	54.685	N/A	7.3606	N/A
Propylene	4,763	13.6	1.955	N/A	0.9716	N/A
Isobutane	4,763	156	25.245	132,000	2.1773	40,000
n-Butane	4,763	258	34.065	368,000	4.3399	40,000
Acetylene	3,698	9.6	1.086	50,000	0.3661	5,000
trans-2-Butene	4,761	0.99	0.185	60,000	0.0923	2,800
1-Butene	4,762	3.7	0.468	108,000	0.1928	9,200
cis-2-Butene	4,763	0.83	0.108	60,000	0.0533	2,800
Cyclopentane	4,763	21	2.062	29,500	0.1298	2,950
Isopentane	4,763	143	15.695	340,000	2.3027	40,500
n-Pentane	4,763	207	20.648	340,000	2.01	40,500
1,3-Butadiene	4,763	11.8	0.643	6,800	0.0555	36
trans-2-Pentene	4,657	2.6	0.213	60,000	0.0291	2,800
1-Pentene	4,662	1.4	0.134	60,000	0.0468	2,800
cis-2-Pentene	4,662	1.1	0.097	60,000	0.0119	2,800
2,2-Dimethylbutane	4,662	2.6	0.418	32,400	0.0472	1,140
Isoprene	4,662	2.3	0.782	7,000	0.2351	700
n-Hexane	4,772	120	11.213	32,400	0.5148	1,140
Methylcyclopentane	4,772	57.7	5.404	4,500	0.1969	450
2,4-Dimethylpentane	4,772	9.9	0.881	58,100	0.0083	15,400
Benzene	4,769	36.2	4.054	1,080	0.5045	8.4
Cyclohexane	4,772	93.4	8.79	6,000	0.3303	600
2-Methylhexane	4,772	22	2.134	58,100	0.1274	15,400
2,3-Dimethylpentane	4,772	12.6	1.195	58,100	0.0503	15,400
3-Methylhexane	4,771	35.6	3.373	58,100	0.1787	15,400
2,2,4-Trimethylpentane	4,772	31.9	3.184	32,800	0.2594	3,040
n-Heptane	4,764	66.2	6.376	58,100	0.2964	15,400
Methylcyclohexane	4,772	119	11.246	28,000	0.4162	2,800
2,3,4-Trimethylpentane	4,770	8.1	0.536	32,800	0.0451	3,040
Toluene	4,772	58.6	5.358	28,000	0.7122	7,700
2-Methylheptane	4,737	17.6	1.593	32,800	0.0499	3,040
3-Methylheptane	4,737	13.2	0.811	32,800	0.0382	3,040
n-Octane	4,737	30.5	2.9	32,800	0.1789	3,040
Ethyl Benzene	4,737	12	1.057	160,000	0.1018	3,520
p-Xylene + m-Xylene	4,737	58.6	4.782	13,600	0.3586	1,120
Styrene	4,721	1.8	0.273	41,600	0.0202	880
o-Xylene	4,721	20.8	1.505	13,600	0.0837	1,120
n-Nonane	4,721	8.8	0.719	27,000	0.0979	2,520
Isopropyl Benzene -	4,721	3.7	0.25	4,590	0.0126	459
n-Propylbenzene	4,753	4.9	0.32	4,590	0.0238	459
1,3,5-Trimethylbenzene	4,556	10.2	0.635	27,000	0.0278	333
1,2,4-Trimethylbenzene	4,574	20.7	1.313	27,000	0.0811	333
n-Decane	4,574	3.5	0.58	10,000	0.1809	1,900
1,2,3-Trimethylbenzene	4,574	4.5	0.305	27,000	0.0355	333

Table 4. PBway Auto-GC statistics for Jan. – Aug. 2024

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Short-term AMCV	Mean ppbC	Long-term AMCV
TNMHC	4,886	2,906.38	290.812	N/A	35.9837	N/A
TNMTC	4,886	2,747.68	277.364	N/A	32.9552	N/A
Ethane	5,061	273	46.655	N/A	8.978	N/A
Ethylene	5,060	30.2	4.264	1,000,000	0.6623	10,600
Propane	5,061	133	44.9	N/A	6.667	N/A
Propylene	4,889	16.2	3.109	N/A	0.9177	N/A
Isobutane	5,061	431	31.327	132,000	2.2555	40,000
n-Butane	5,061	1084	74.641	368,000	4.6601	40,000
Acetylene	3,188	20.1	2.227	50,000	0.3513	5,000
trans-2-Butene	5,051	31.1	2.081	60,000	0.172	2,800
1-Butene	5,058	5.1	0.599	108,000	0.2505	9,200
cis-2-Butene	5,061	12.2	0.765	60,000	0.0727	2,800
Cyclopentane	5,061	8.7	1.391	29,500	0.3953	2,950
Isopentane	5,061	523	34.173	340,000	2.4962	40,500
n-Pentane	5,061	150	15.109	340,000	1.8102	40,500
1,3-Butadiene	5,061	4.9	0.312	6,800	0.0643	36
trans-2-Pentene	5,061	23.8	1.12	60,000	0.0323	2,800
1-Pentene	5,059	24.3	1.215	60,000	0.0713	2,800
cis-2-Pentene	5,057	8.4	0.382	60,000	0.0164	2,800
2,2-Dimethylbutane	5,061	7.5	0.886	32,400	0.0851	1,140
Isoprene	5,061	5.6	1.794	7,000	0.6147	700
n-Hexane	5,024	57.6	4.802	32,400	0.3013	1,140
Methylcyclopentane	5,024	27	2.074	4,500	0.1338	450
2,4-Dimethylpentane	5,024	8.7	0.451	58,100	0.0028	15,400
Benzene	5,024	13.9	1.39	1,080	0.2423	8.4
Cyclohexane	5,024	36.8	2.893	6,000	0.214	600
2-Methylhexane	5,024	8.5	0.565	58,100	0.0314	15,400
2,3-Dimethylpentane	5,024	7.6	0.429	58,100	0.0163	15,400
3-Methylhexane	5,024	12.5	0.924	58,100	0.0609	15,400
2,2,4-Trimethylpentane	5,024	22.7	1.46	32,800	0.1579	3,040
n-Heptane	5,024	21.6	1.501	58,100	0.0947	15,400
Methylcyclohexane	5,024	39	2.995	28,000	0.2422	2,800
2,3,4-Trimethylpentane	5,024	3.6	0.388	32,800	0.0258	3,040
Toluene	5,024	114	9.859	28,000	0.442	7,700
2-Methylheptane	5,024	3.6	0.294	32,800	0.018	3,040
3-Methylheptane	5,024	2.4	0.179	32,800	0.0114	3,040
n-Octane	5,024	7.2	0.761	32,800	0.0568	3,040
Ethyl Benzene	5,024	2.5	0.173	160,000	0.0137	3,520
p-Xylene + m-Xylene	5,024	11.3	1.321	13,600	0.17	1,120
Styrene	5,024	0.73	0.264	41,600	0.005	880
o-Xylene	5,024	3.9	0.287	13,600	0.0197	1,120
n-Nonane	5,024	17.5	0.865	27,000	0.0279	2,520
Isopropyl Benzene -	5,024	2.2	0.107	4,590	0.0051	459
n-Propylbenzene	5,024	2	0.15	4,590	0.0055	459
1,3,5-Trimethylbenzene	5,024	4.5	0.215	27,000	0.0066	333
1,2,4-Trimethylbenzene	5,022	5.9	0.689	27,000	0.1242	333
n-Decane	5,024	30.9	1.536	10,000	0.0509	1,900
1,2,3-Trimethylbenzene	5,024	1.1	0.188	27,000	0.0195	333

4.3 Ethylene Oxide Measurements

As was noted earlier in this report, the GCGV ethane-cracking and derivatives facility began operating in late 2021 through early 2022. As shown in Figure 6 through Figure 9, the levels of EtO measured in every sixth-day canister samples at the two GCGV stations have remained low. The value obtained is an average concentration for a midnight to midnight (standard time) 24-hour period. Note that values of 0.0 ppbC were recorded from the laboratory as non-detects. The TCEQ effects screening level (ESL) and Air Monitoring Comparative Value (AMCV) for chronic exposure to EtO is 2.4 ppbV or 4.8 ppbC. The terms AMCV and ESL are defined in Appendix A.2. The TCEQ report on EtO toxicity can be found at https://www.tceq.texas.gov/downloads/toxicology/dsd/final/eto.pdf (accessed July 2024). In Appendix A.3 of this report, there is more information on the toxicity and potentials for exposure to EtO in modern society.

At the two GCGV/AECOM stations, it is notable that there has been little change in the EtO 24-hour average concentrations over the past two plus years while the GCGV industrial facility has been in operation. In fact, there has been an increased frequency of non-detects over time. This is illustrated in Figure 10 and Figure 11, showing the count of non-detects over time since 2020 for EtO in canisters at the two GCGV stations.

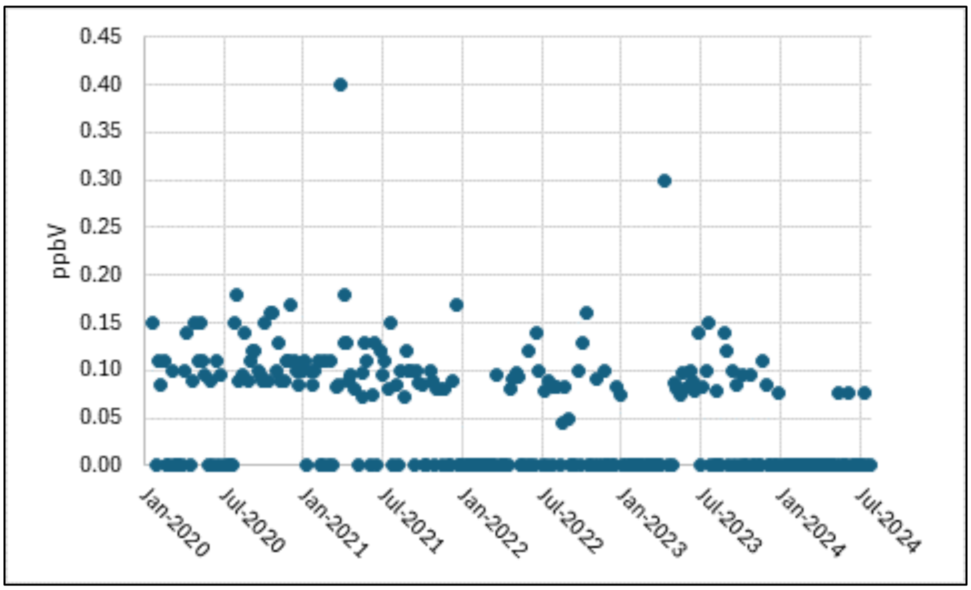

Figure 6. PBG EtO 24-hour average concentrations, every 6th day samples Jan. 2020 through July 2024

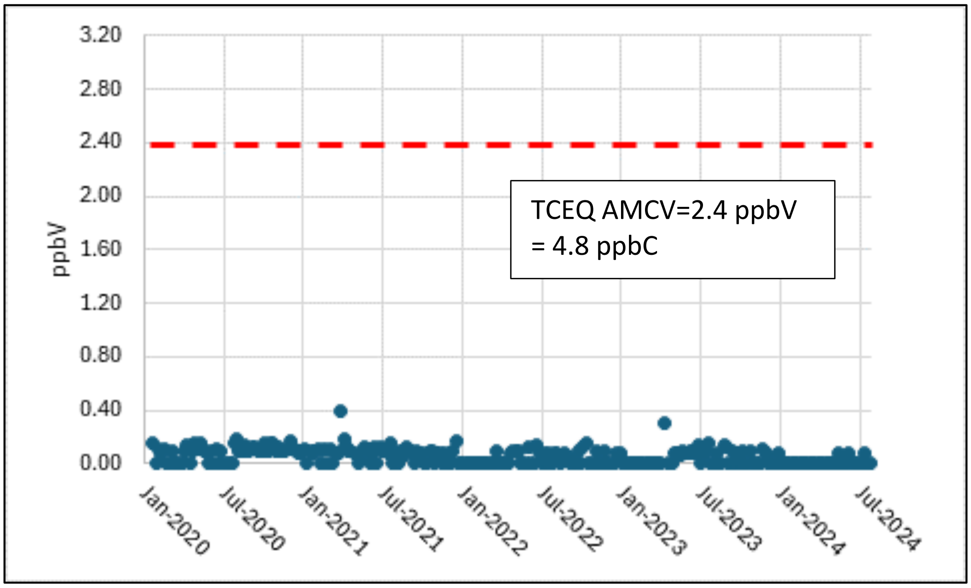

Figure 7. PBG EtO 24-hour average concentrations, every 6th day samples Jan. 2020 through May 2024 in comparison to TCEQ Air Monitoring Comparative Value

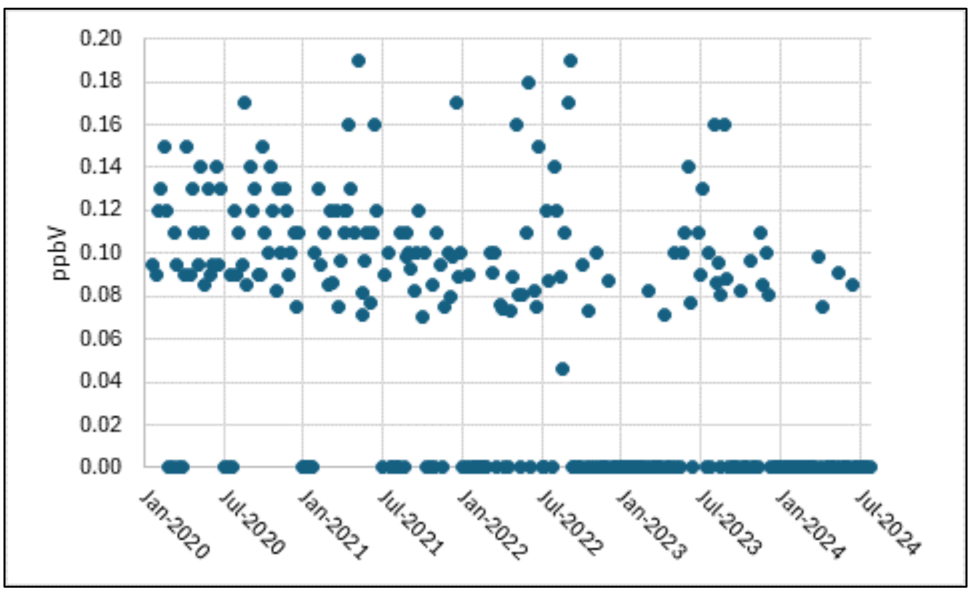

Figure 8. PBway EtO 24-hour average concentrations, every 6th day samples Jan. 2020 through July 2024

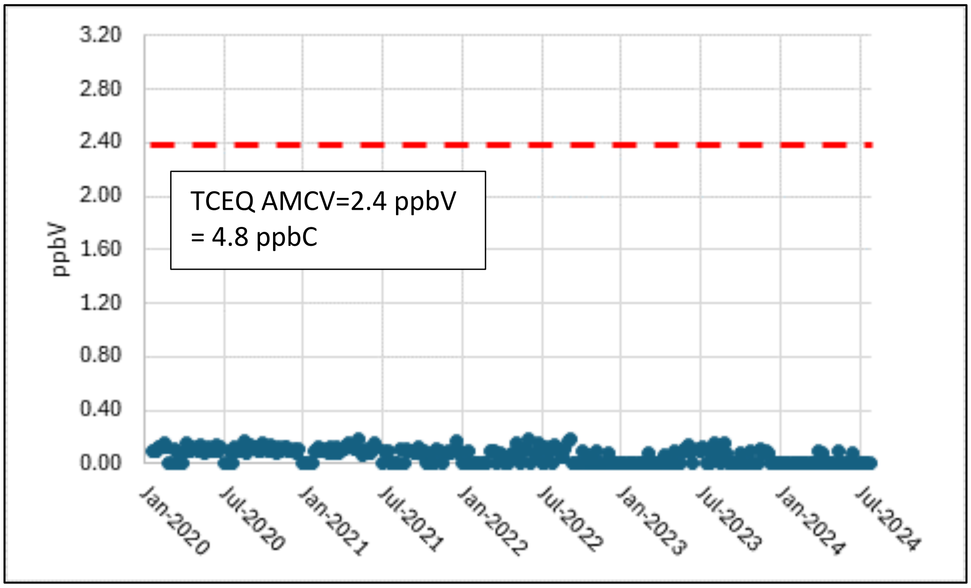

Figure 9. PBway EtO 24-hour average concentrations, every 6th day samples Jan. 2020 through July 2024 in comparison to TCEQ Air Monitoring Comparative Value

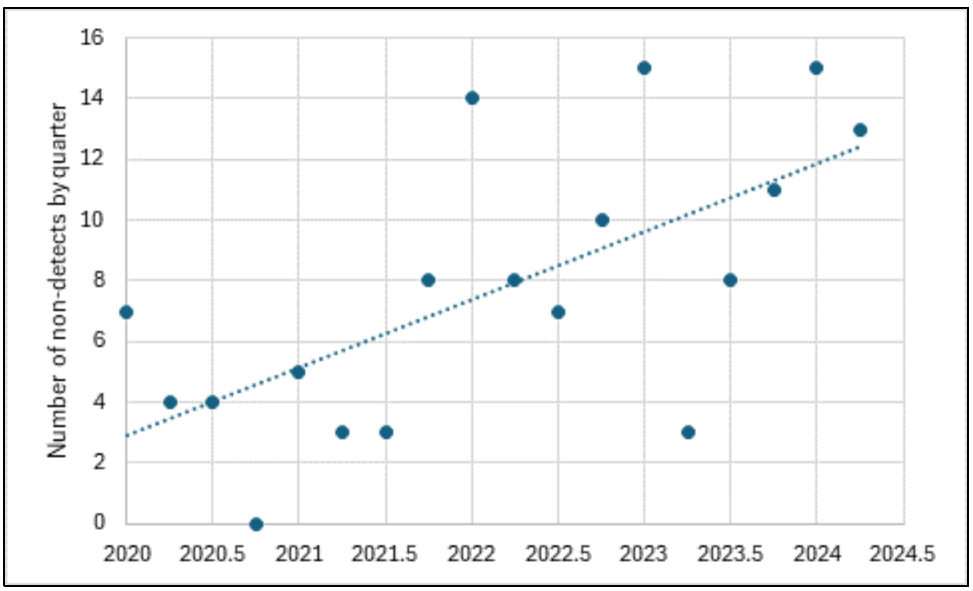

Figure 10. Count of nondetects at PBG by quarter of the year, 1st quarter of 2020 through 2nd quarter of 2024

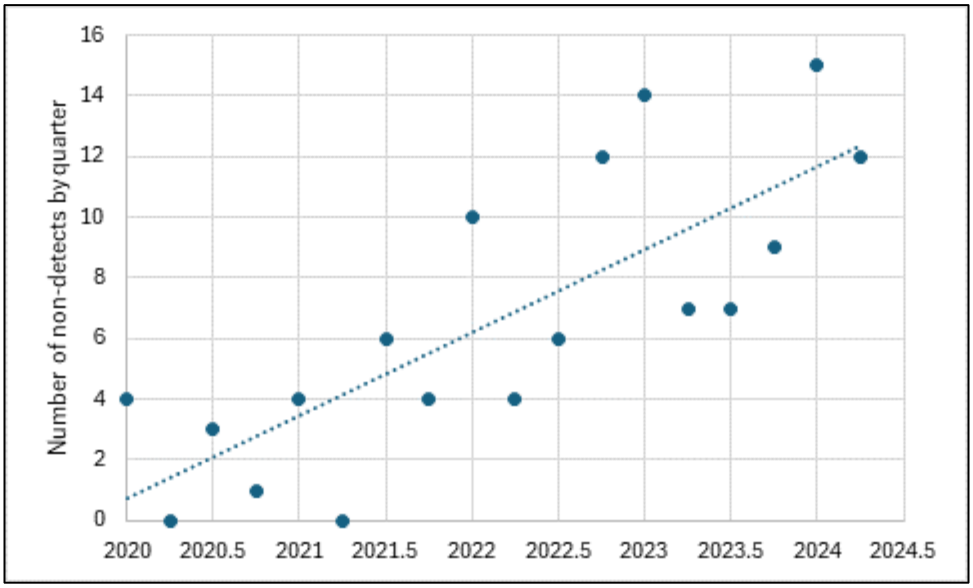

Figure 11. Count of nondetects at PBway by quarter of the year, 1st quarter of 2020 through 2nd quarter of 2024

4.4 Comparing Hydrocarbon Data between Stations

Figure 12 shows a bar graph comparison between the average concentrations for 2024 through July of the hydrocarbons measured by auto-GC, including TNMTC and TNMHC, at the three stations. The graph shows relatively close correlation among the three stations, although the Portland Buddy Gamen (PBG) is trending higher than the other two stations. A close examination of PBG benzene concentrations compared to the other two stations was presented in the October 2023 Quarterly Report, and it was shown that wind speed had a big effect on the concentrations, and adjusting for it made the difference between PBG and the other stations smaller.

Figure 13 is a similar graph excluding TNMTC and TNMHC. This second graph allows for a better comparison of the similarity among the stations. The most common nonmethane hydrocarbons in the atmosphere in urban areas are ethane and propane, followed by other alkane species such as butanes and pentanes. These species have low chemical reactivities and thus can persist in the air longer than more reactive species. Based on modeled back-trajectories using both upper air and surface wind direction and speed data, some ethane, propane, and other light alkanes are likely transported into the region from nearby oil and gas extraction fields.

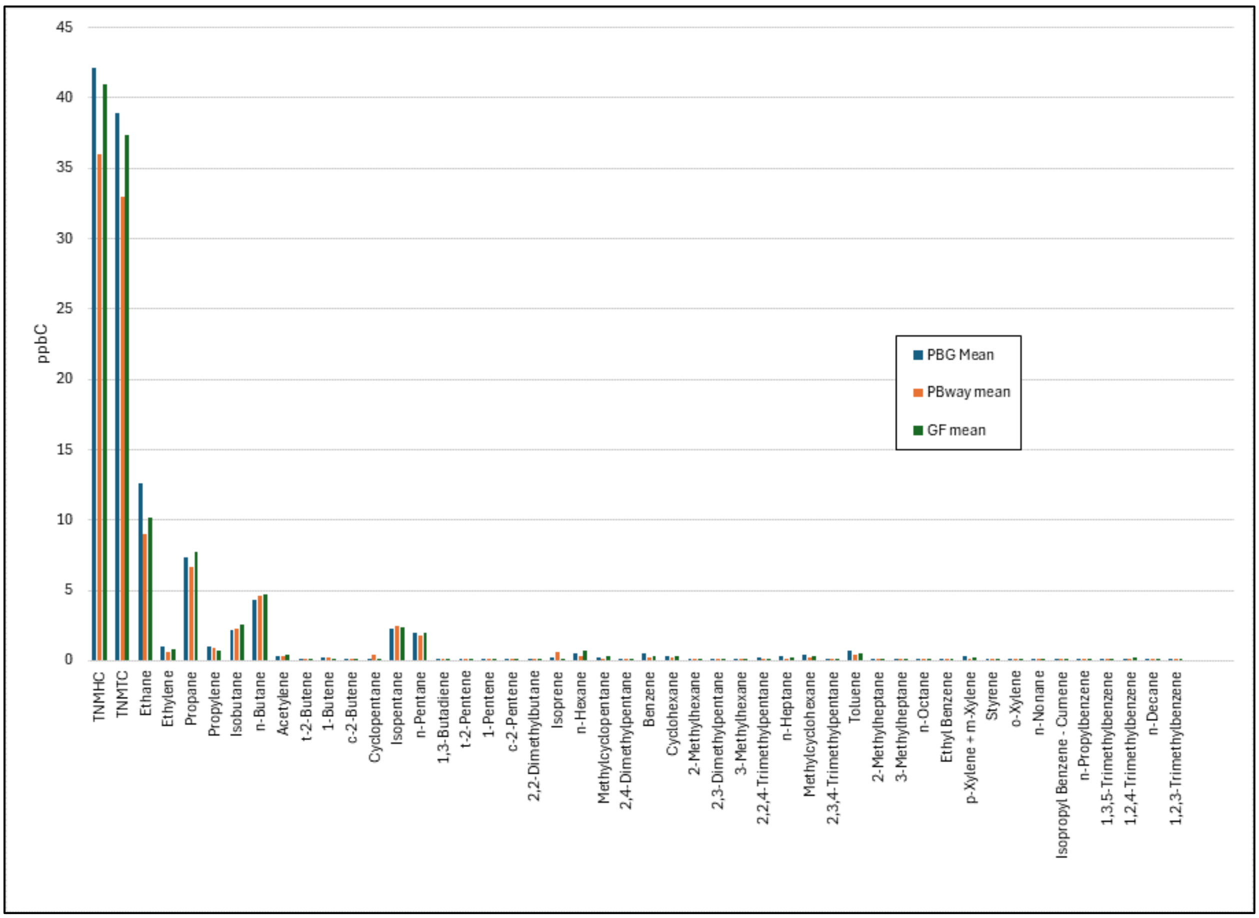

Figure 12. January through August 2024 mean concentrations of TNMTC, TNMHC, and hydrocarbon species at three stations.

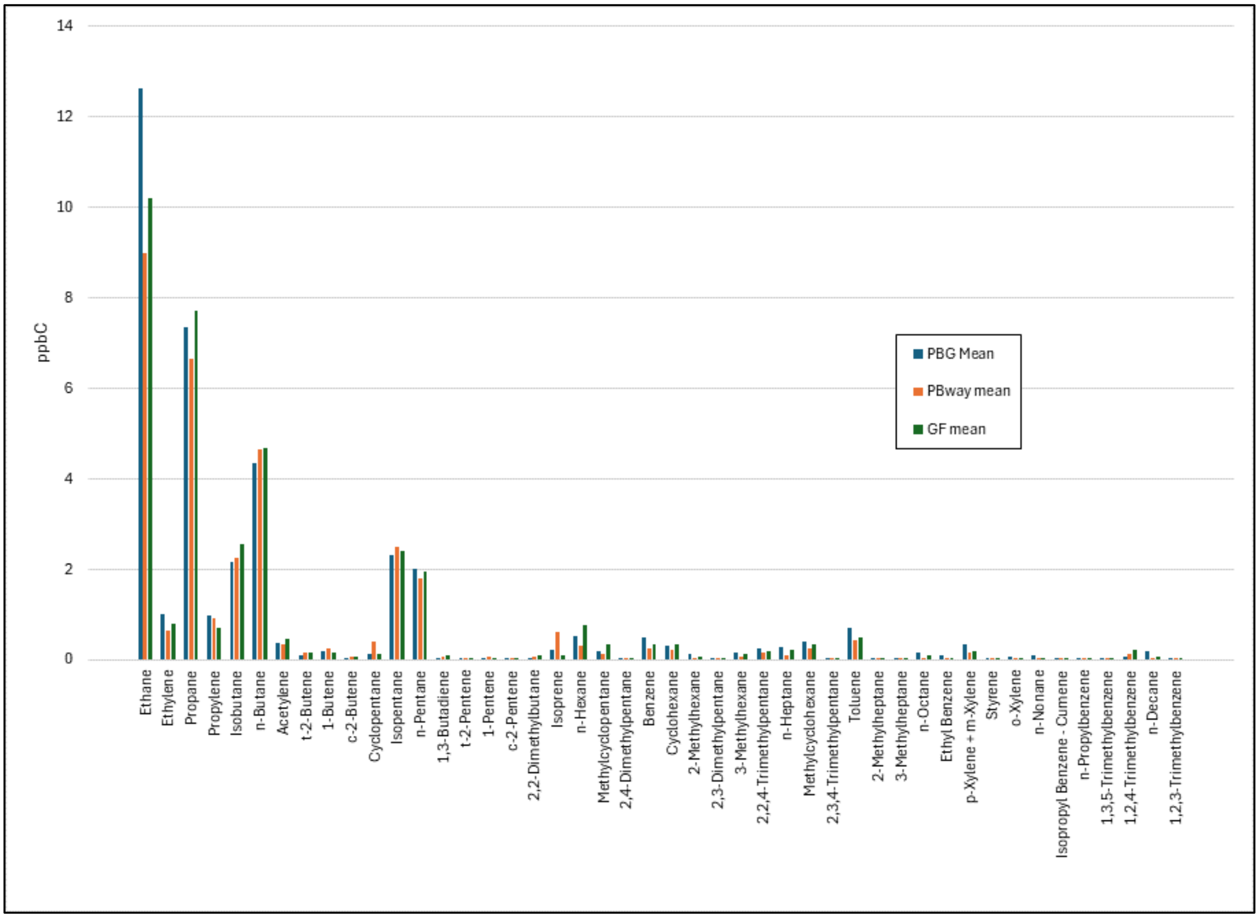

Figure 13. January through July 2024 mean concentrations of hydrocarbon species at three air monitoring stations.

4.5 Gregory Fresnos Station Criteria Pollutant Data

Sulfur dioxide (SO_2), fine particulate matter (PM2.5), and nitrogen dioxide (NO_2) are three pollutants measured at the GF site that are regulated by the U.S. Environmental Protection Agency (EPA). These pollutants, along with ozone, lead, combined coarse and fine particulate matter (PM10), and carbon monoxide are referred to as "criteria pollutants" and are governed by National Ambient Air Quality Standards (NAAQS). Some NAAQS are based on annual average concentrations, and some are based on the frequency with which very high concentrations are measured. The rationale is that different pollutants affect human health in different ways.

- PM2.5 has both an annual average NAAQS and 24-hour NAAQS. For the PM2.5 24-hour NAAQS, the three-year average of the 98th percentile 24-hour (midnight to midnight, using standard time) concentration each year must be less than 35 micrograms per cubic meter ($\mu g/m^3$). The annual average, averaged over three years, is calculated by first averaging 24-hour averages by quarter and then averaging the four quarters, must be less than 9 $\mu g/m^3$, which is the new standard, and is stricter than the previous 12 $\mu g/m^3$ standard.
- The NAAQS for NO_2 is for the one-hour values to average less than 53 ppb in a calendar year averaged over three years and for the three-year average of the 98th percentile daily maximum values to be less than 100 ppb.
- SO_2 has a 1-hour NAAQS, based on ranking the daily maximum one-hour values for

each day in a year, selecting the 99th percentile daily maximum values, and then calculating a three-year average, which must be less than 75 ppb.

No concentrations high enough, of sufficient duration or frequent enough to violate the NAAQS have been seen at the GF station. Several recorded PM2.5 one-hour values exceeded the level of the 24-hour NAAQS, 35 µg/m^3, but as noted above, the NAAQS is not violated unless the 98th percentile of 24-hour averaged concentrations in a year, averaged over three years violates the 24-hour NAAQS, or unless the overall annual average, averaged over three years, exceeds the level of the annual NAAQS (9 µg/m^3).

Figure 14 shows the 24-hour averaged daily PM2.5 concentrations since the start of monitoring in October 2019. This graph is provided to illustrate the roughly seasonal pattern of PM2.5, with higher concentrations in the summers associated with transported dust from Northern Africa. The average concentration for 2023 was 8.4 µg/m^3. In 2024 through September, the average is 9.4 µg/m^3. During early 2024, a significant amount of smoke from agricultural fires in Southern Mexico and Central America affected South and Central Texas. Table 5 lists the annual mean PM2.5 concentration from each of the past four years and first nine months of 2024 and the most recent three-year average for the GF station.

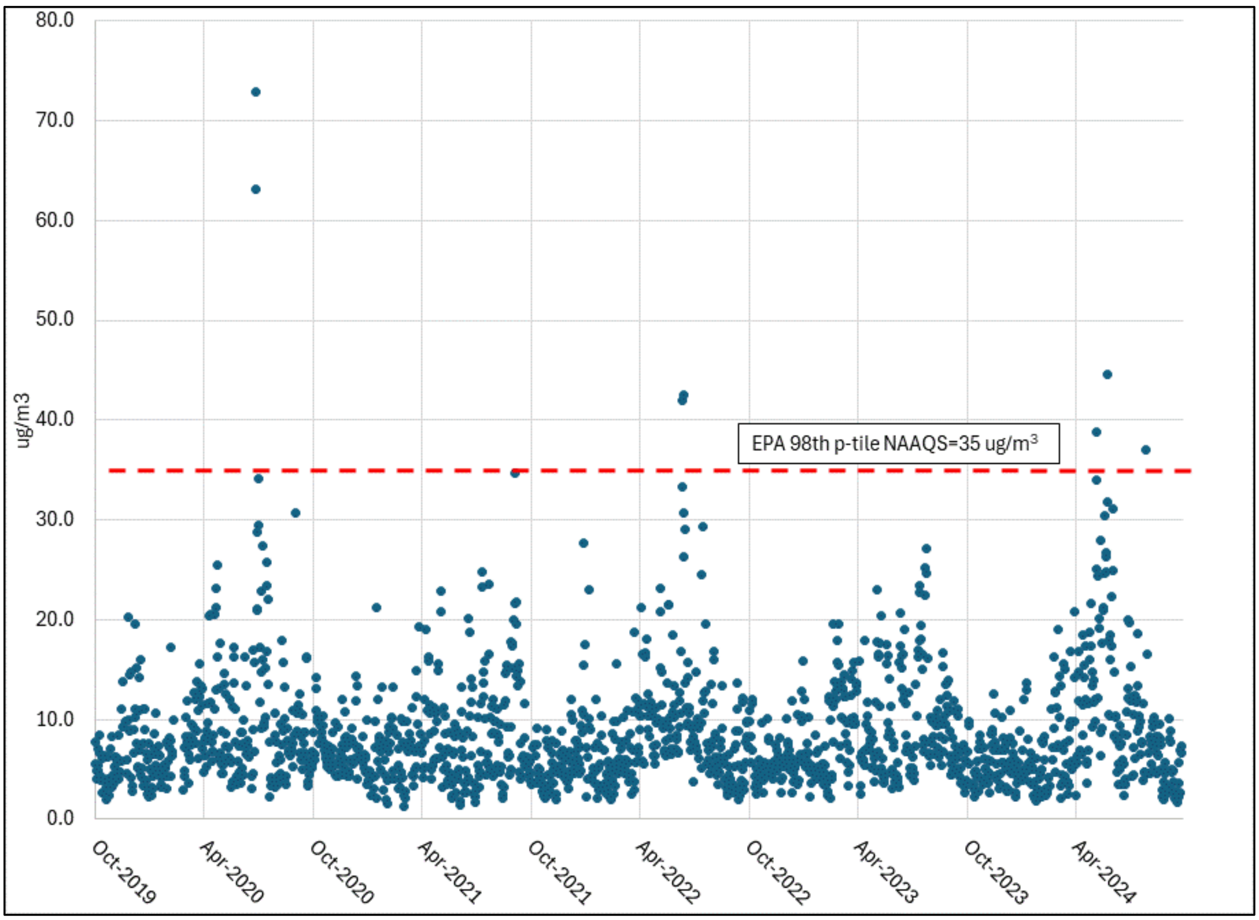

Figure 14. Averaged 24-Hour PM2.5 at GF, Oct. 1, 2019 – Sept. 30, 2024, with NAAQS

Table 5. GF PM2.5 annual means and three-year averages showing NAAQS compliance.

Year	Annual Mean $\mu g/m^3$	NAAQS 3-Year Annual Average Value, $\mu g/m^3$	Annual 98th Percentile Value $\mu g/m^3$	NAAQS 3-Year 98th Percentile Average Value, $\mu g/m^3$
2020	8.9		27.4	
2021	7.6		21.7	
2022	8.2		24.3	
2023	8.4		20.9	
Q1,2,3 of 2024	9.4		31.0	
2021-2023 3-year average	8.0	9.0	22.3	35.0

Figure 15 shows the hourly average time series graph for daily maximum NO_2 at the Gregory Fresnos station from October 1, 2019, through September 30, 2024. The figure also shows the 24-hour 100 ppb NAAQS level. The figure shows measured concentrations have been well below the level of the NAAQS. Table 6 lists for the past four years the NO_2 annual 98th percentile and the annual averages showing NAAQS compliance of these standards by large margins.

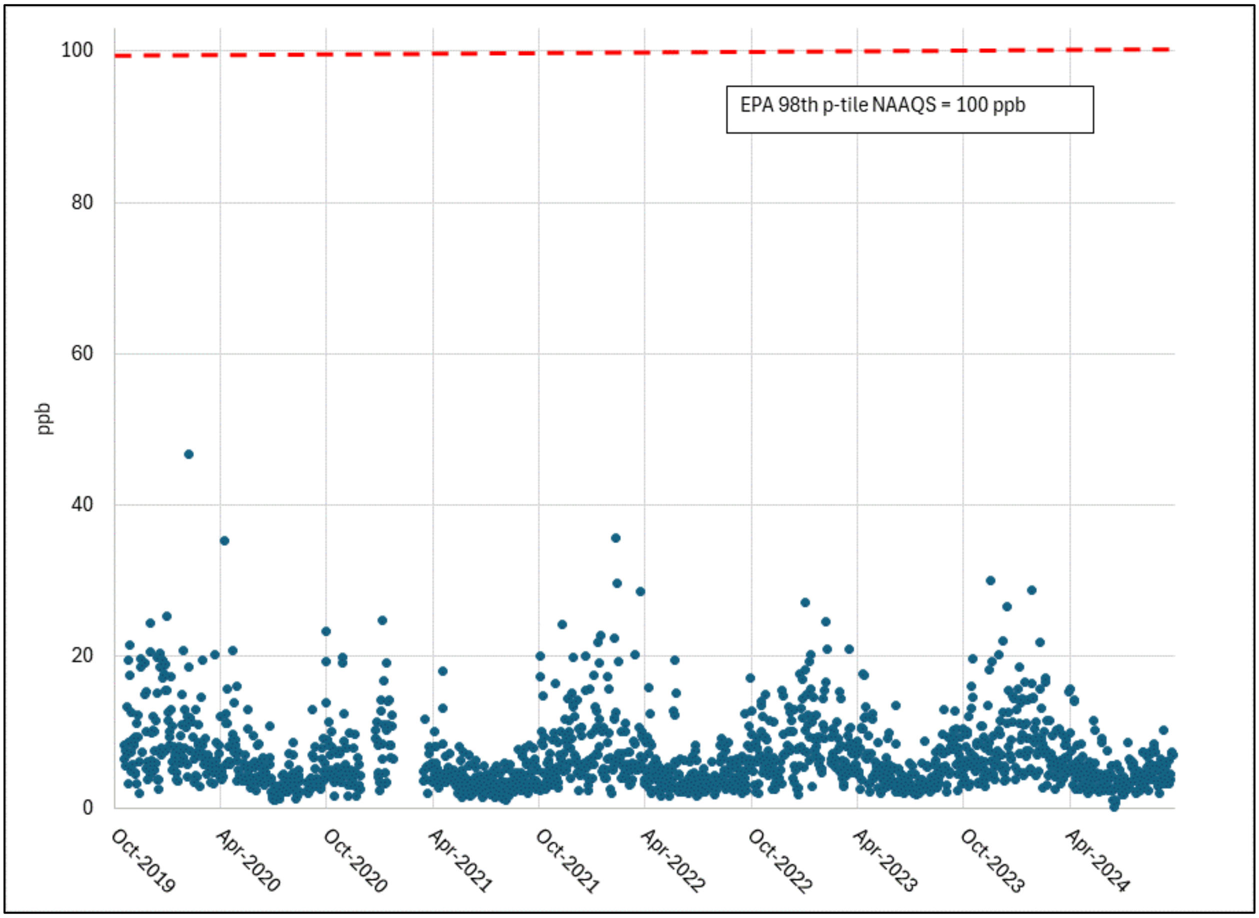

Figure 15. Daily maximum NO_2 at GF, ppb units, Oct. 1, 2019 – Sept. 30, 2024, with NAAQS

Table 6. GF NO_2 annual 98th p-tile values, three-year mean showing NAAQS compliance.

Year	Annual Average Values, ppb	NAAQS Annual Average Value, ppb	Annual 98th percentile ppb	NAAQS 3-Year 98th Percentile Average Value, ppb
2020	6.4		19.4	
2021	5.7		18.5	
2022	6.5		19.7	
2023	7.3		20.6	
Q1,2,3 of 2024	6.2		16.4	
3-year Avg 2021-2023	6.5	53	19.6	100

SO_2 is rarely found in ambient air, and the SO_2 instruments are calibrated to accurately measure high concentrations that are a risk to public health. As a result, the large majority of SO_2 concentrations measurements are close to 0.0. 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 can be high relative error. The time series graph for SO_2 since Oct. 2019 at the GF station is shown in Figure 16. The graph is scaled to illustrate how low the concentrations have been compared to the 75-ppb level of the NAAQS. Table 7 lists the annual 99th percentile values of daily maximum SO_2 for the past three complete years, again showing compliance between the level of the NAAQS and measured concentrations by a margin more than 70 ppb.

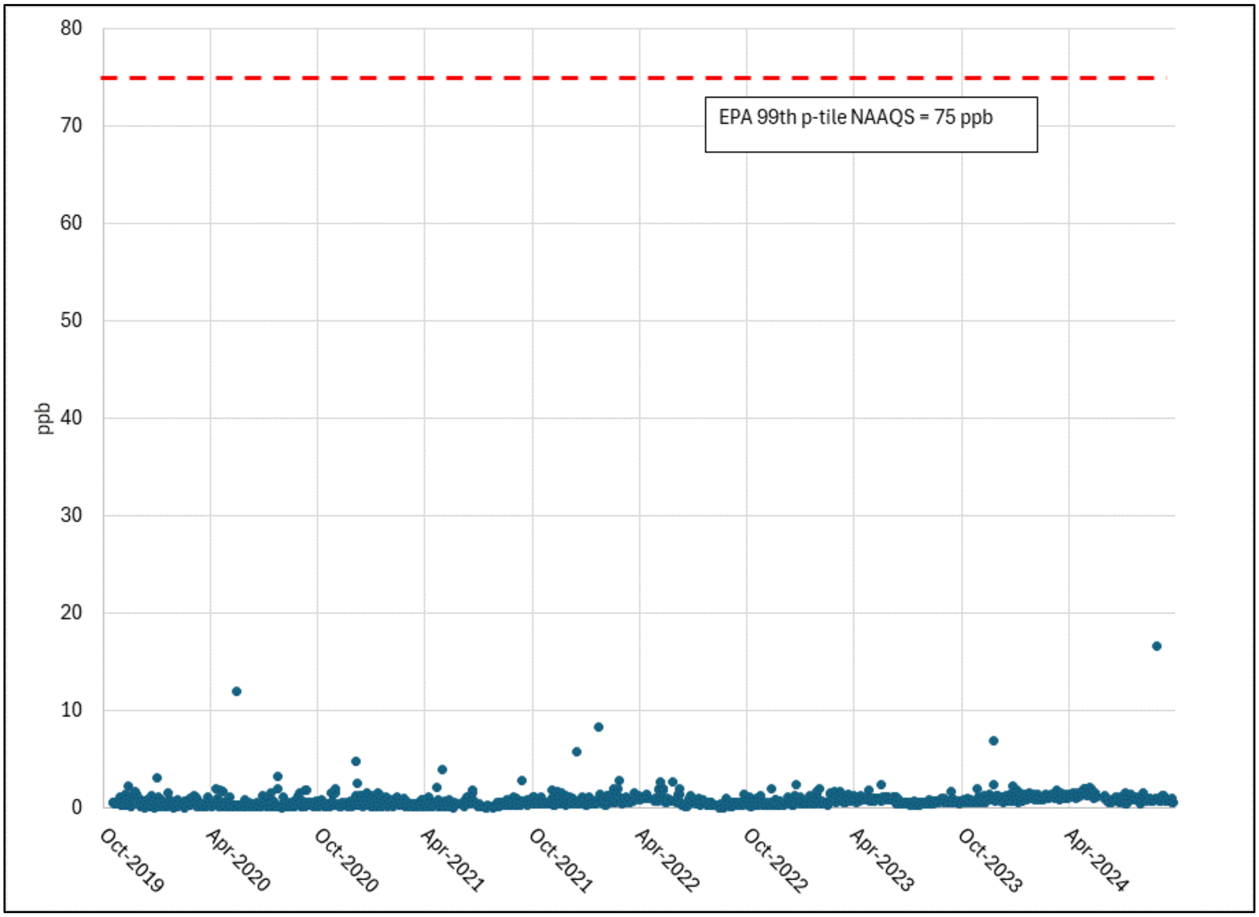

Figure 16. Daily maximum SO_2 at GF, Oct. 1, 2019 – Sept. 30, 2024, with NAAQS at 75 ppb

Table 7. GF SO_2 annual 99th percentile values of daily maximums three-year average showing NAAQS compliance.

Year	Annual 99th percentile ppb	NAAQS 99th Percentile Average Value, ppb
2020	2.5	
2021	2.0	
2022	2.3	
2023	1.9	
Q1,2,3 of 2024	2.0	
3-year Avg. 2021 - 2023	2.1	75

4.6 Portland Buddy Ganem & Portland Broadway Stations Criteria Pollutant Data

Fine particulate matter (PM2.5) is the only NAAQS-regulated pollutant measured at the PBG and PBway stations. Figure 17 shows the 24-hour average concentrations at the PBG site from January 2020 through September 2024, and Figure 18 shows the same time series for the PBway site. The most recent 3-year average concentration PBG is 7.4 $\mu g/m^3$ and is 8.0 $\mu g/m^3$ at PBway. Table 8 and Table 9 summarize the average annual PM2.5 concentrations for the PBG and PBway stations and the three-year average annual concentrations. Table 8 and Table 9 also show the average PM2.5 concentration for the first three quarters of 2024 with 10.4 $\mu g/m^3$ at PBG and 9.2 $\mu g/m^3$ at PBway.

To a large extent, PM2.5 concentrations are of a regional nature, in that transported dust or smoke, or locally formed aerosols generally affect a multi-county or larger area. As was the case with the GF station, there have been periods of elevated PM2.5 in summer months associated with transported dust from Northern Africa and in spring months associated with transported smoke from Central America and Southern Mexico. As an example of the regional nature of PM2.5, all three stations exceeded the 35 $\mu g/m^3$ 24-hour NAAQS on the same two dates, June 12, 2022, and June 16, 2022, owing to the transported North African dust. Across the State of Texas, with 66 regulatory PM2.5 monitors, 22 stations had elevated PM2.5 on June 12, 2022, and 48 stations had elevated PM2.5 on June 16, 2022. Among TCEQ regions, all parts of the state had some elevated concentrations between June 12 and June 16, 2022.

The quarterly mean concentrations for all three stations are shown in Table 10. The PBG station has generally had a 1 $\mu g/m^3$ or thereabout higher concentration all year over the other two stations. Figure 19 and Figure 20 show graphs of the PBG 24-hour PM2.5 concentrations versus the other two stations, showing very high correlations (slope close to 1.0 and R^2 close to 1.0), but y-intercept values of 1.5 and 1.8, suggesting generally higher concentrations at PBG.

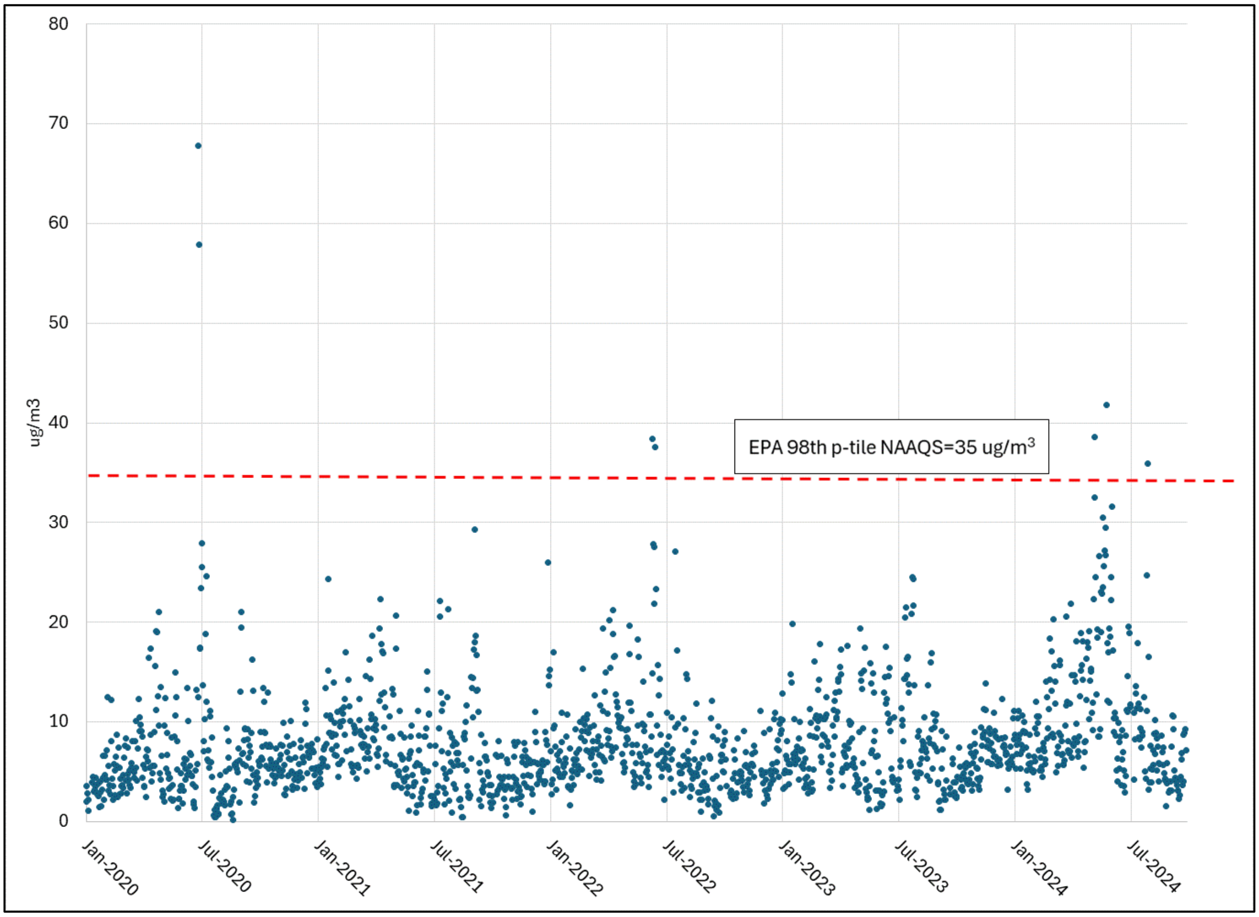

Figure 17. Mean 24-Hour PM2.5 at PBG, Jan. 1, 2020 – Sept. 30, 2024, NAAQS scale.

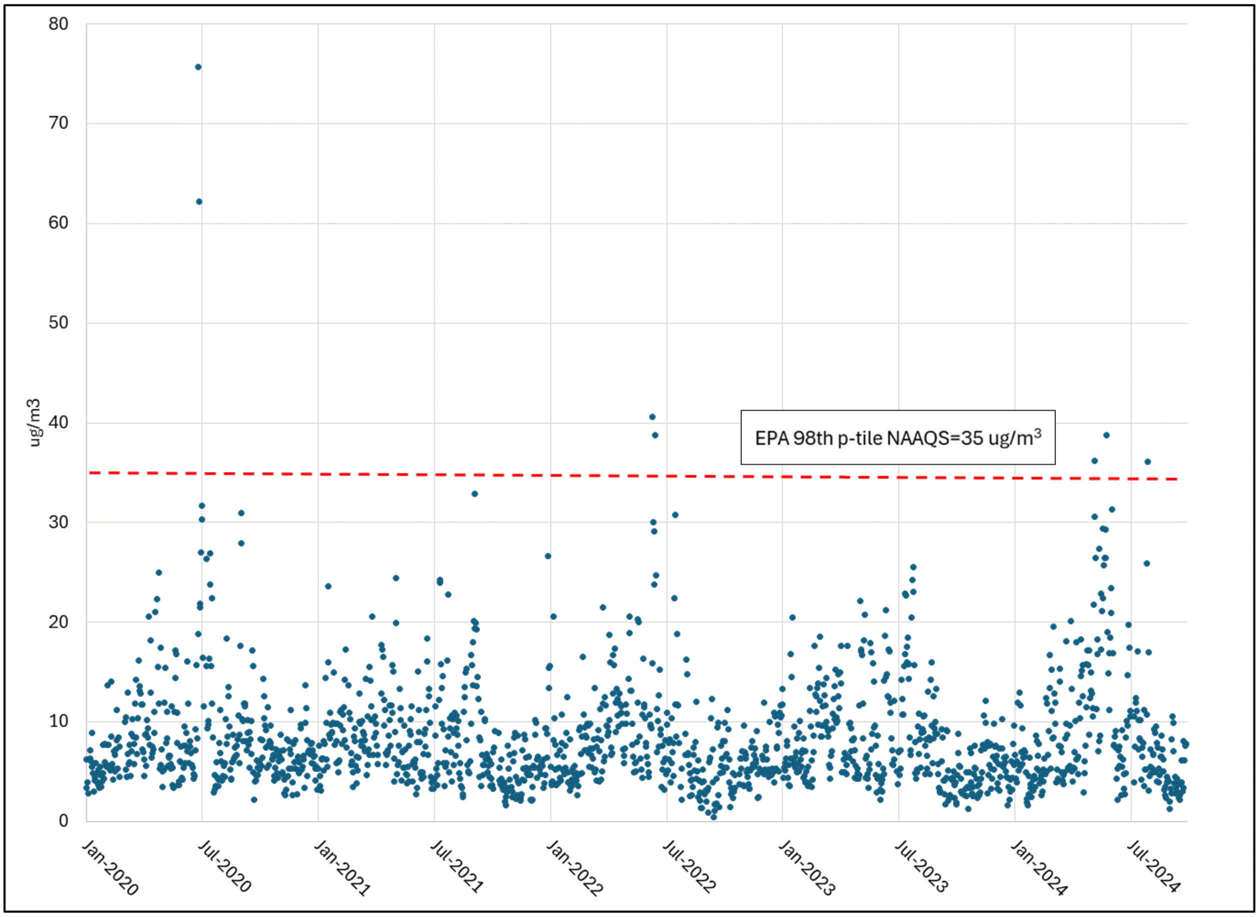

Figure 18. Mean 24-Hr PM2.5 at PBway, Jan. 1, 2020 – Sept 30, 2024, with NAAQS value.

Table 8. PBG PM2.5 annual means and 3-year averages showing NAAQS compliance.

Year	Annual Mean μg/m^3	NAAQS 3-Year Annual Average Value, μg/m^3	Annual 98th Percentile Value μg/m^3	NAAQS 3-Year 98th Percentile Average Value, μg/m^3
2020	6.6		20.8	
2021	7.2		20.5	
2022	7.4		21.3	
2023	7.6		19.3	
Q1,2,3 of 2024	10.4		31.0	
3-year Avg. 2021-2023	7.4	9.0	20.4	35.0

Table 9. PBway PM2.5 annual means and 3-year averages showing NAAQS compliance.

Year	Annual Mean μg/m³	NAAQS 3-Year Annual Average Value, μg/m³	Annual 98th Percentile Value μg/m³	NAAQS 3-Year 98th Percentile Average Value, μg/m³
2020	8.7		26.9	
2021	8.2		20.5	
2022	7.8		22.5	
2023	8.1		20.7	
Q1,2,3 of 2024	9.2		29.9	
3-year Avg. 2021-2023	8.0	9.0	21.2	35.0

Table 10. First three quarters of 2024 PM2.5 averages at three stations

Quarter	PBG	PBway	GF
1st Qtr	8.84	6.97	6.62
2nd Qtr	14.45	13.34	14.06
3rd Qtr	8.54	7.85	8.10

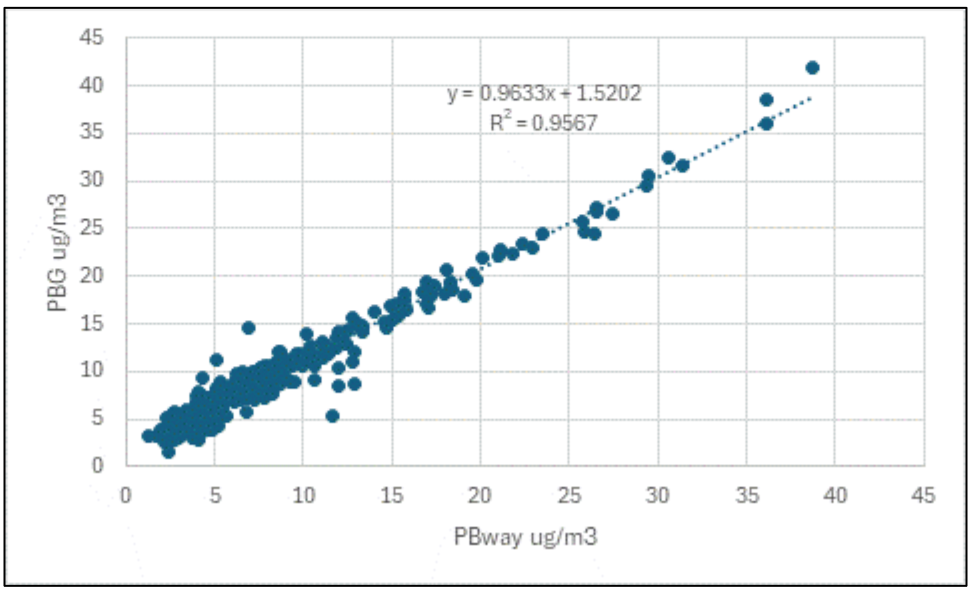

Figure 19. Daily mean PM2.5 at PBG vs PBway in 2024 through Sept.

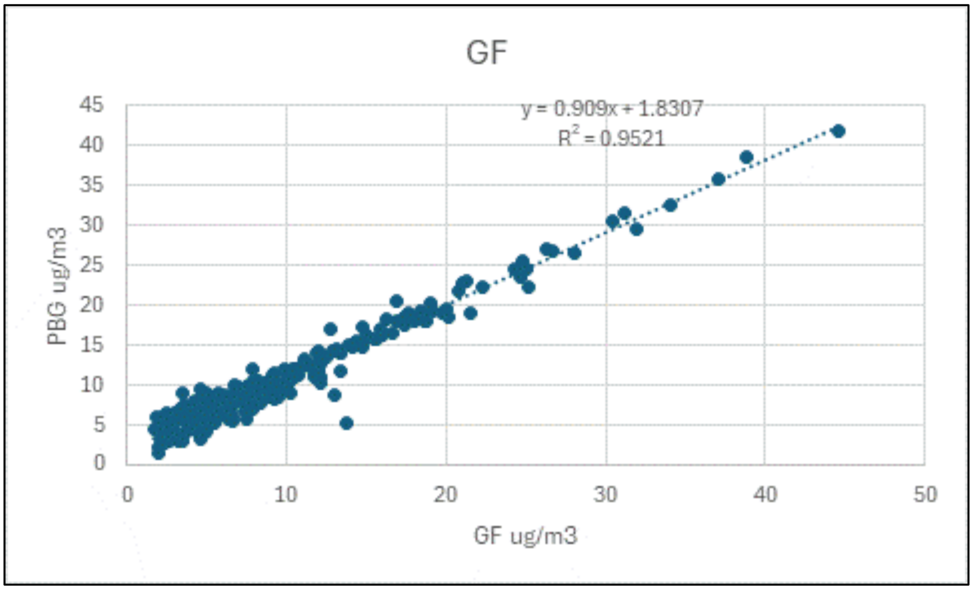

Figure 20. Daily mean PM2.5 at PBG vs GF in 2024 through Sept.

5.0 Data Analysis

5.1 Air Pollutant Periodicity

An interesting feature of air pollutants is their temporal behavior – that is, how concentrations are related to time. By time, we can be referring to time of day; for example, it is well known that ozone concentrations are high during the afternoon and low at night, since sunlight plays a role in ozone formation in the atmosphere. Time can also be referring to the time of the year; for example, ozone concentrations are higher in the summer and lower in the winter, again because of greater sunlight intensity in the summer compared to winter.

In San Patricio County and in many other places, the temporal effects are present in particulate matter concentrations. The largest effects in South Texas are associated with the long range transport of particles that enter Texas. In the springtime, southerly winds often bring fine particles in smoke from agricultural fires in southern Mexico and Central America to the Gulf Coast, and in the summer, winds from the Gulf of Mexico often carry fine sand, or "crustal material", picked up from desert regions in North Africa and carried across the Atlantic Ocean.

In Figure 21 the quarterly average PM2.5 concentrations at the GF station are shown, from the fourth quarter of 2019 to the third quarter of 2024. The pattern is more-or-less up and down and up and down, with the higher average concentrations in the second and third quarters (spring and summer), and in Figure 22 the average of the average quarterly concentrations are shown by quarter. Figure 23 to Figure 26 show similar graphs for the PBG and PBway stations, and one sees a remarkable similarity in the patterns. The recent second quarter of 2024 was the highest quarterly average to date at all three stations, in part owing to a particularly heavy and sustained smoke plume from the agricultural fires far to the south. The daily air quality forecasts from the Texas Commission on Environmental Quality in 2024 contained 15 references to "widespread seasonal burning" from April 11 to June 25, compared to only 5 mentions in 2023.

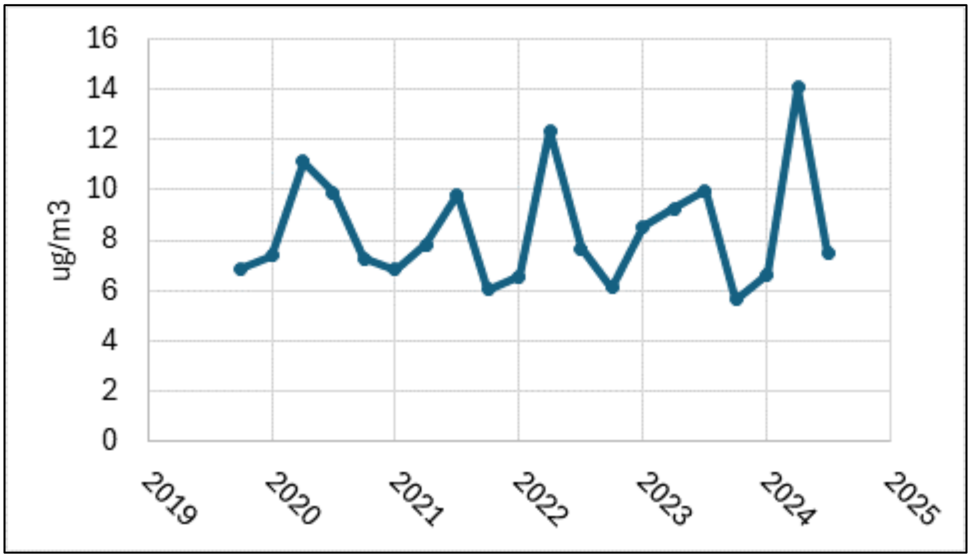

Figure 21. GF quarterly PM2.5 averages

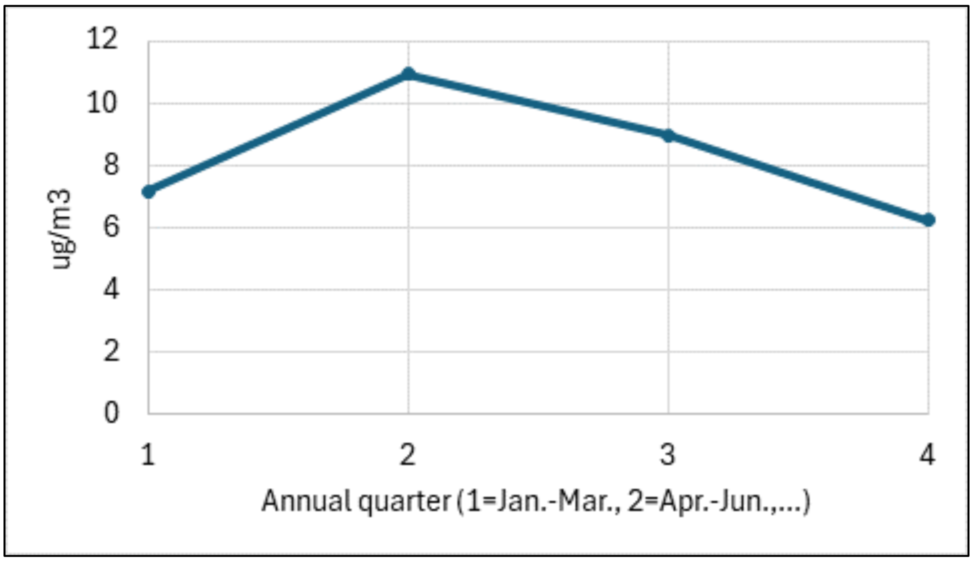

Figure 22. GF mean PM2.5 by annual quarter

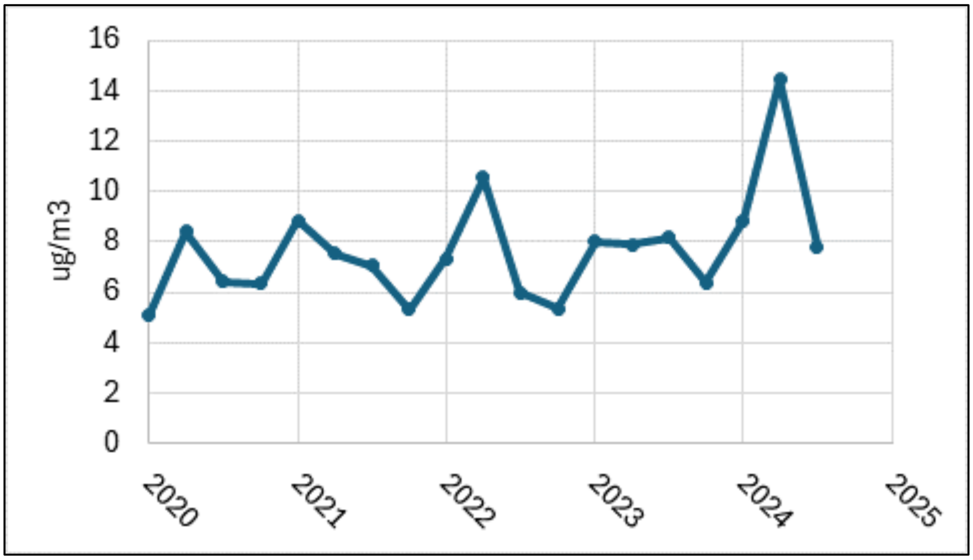

Figure 23. PBG quarterly PM2.5 averages

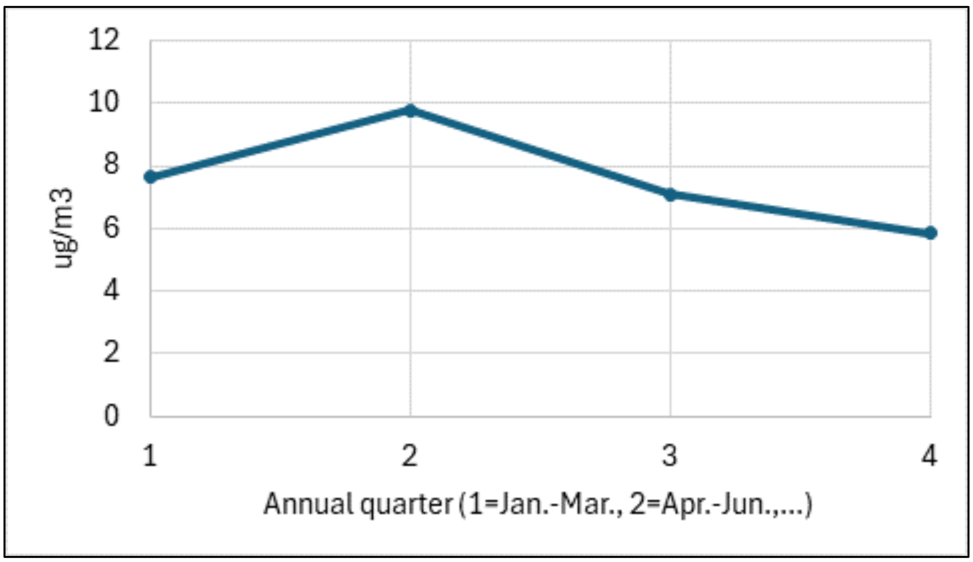

Figure 24. PBG mean PM2.5 by annual quarter

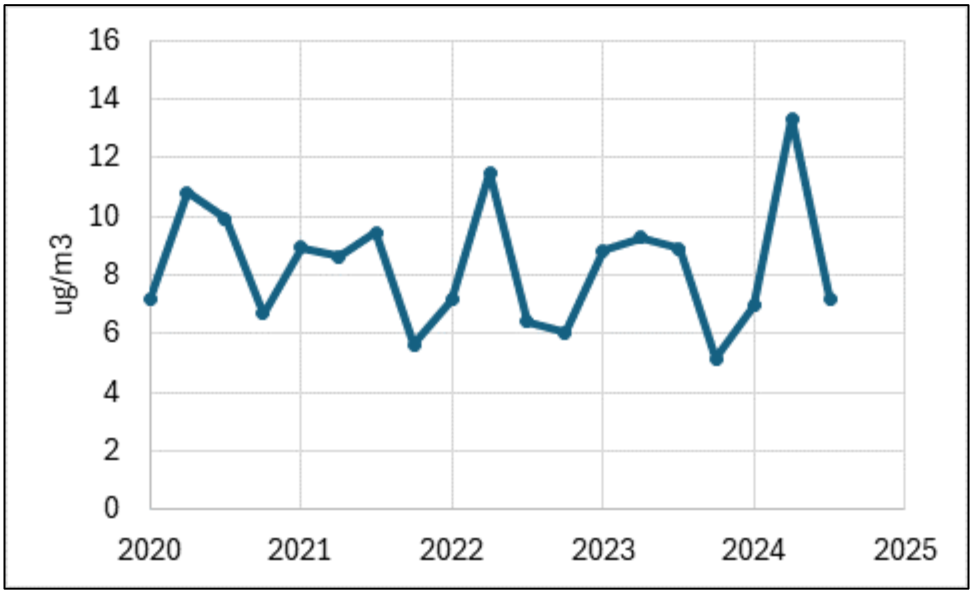

Figure 25. PBway quarterly PM2.5 averages

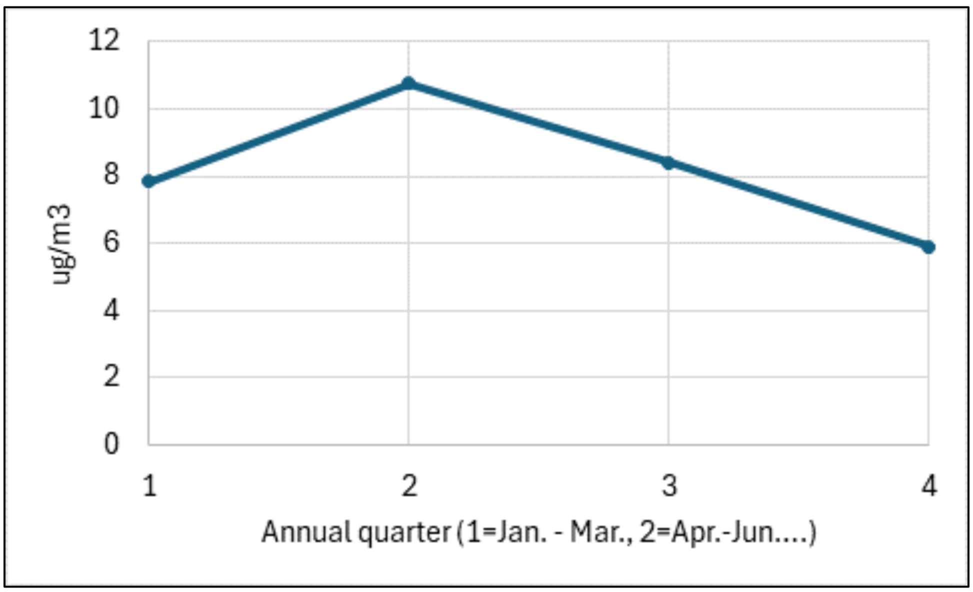

Figure 26. PBway mean PM2.5 by annual quarter

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. To date, operations at the GCGV facility and the Cheniere Energy facility do not appear to have significantly affected the level of pollutants measured at project stations. 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 (EtO) 24 hr canister every sixth 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 Stephen Austin Elementary 401 Fresnos St. Gregory, TX	Yes	No	Yes	Yes	Yes	Yes
Portland Buddy Ganem 307 Buddy Ganem St. GP High School Portland, TX	Yes	Yes, also continuous hourly data	No	No	Yes	Yes. + precipitation
Portland Broadway 175 Broadway Blvd. Old East Cliff Elementary School Portland, TX	Yes	Yes	No	No	Yes	Only WS, WD

Figure 27. Location of Gregory-Fresnos Community Air Monitoring Station (GF, pin G), and two Portland community stations on GPISD campuses on Buddy Ganem (PBG, pin 1) and on Broadway (PBway, pin 2) and the Cheniere Energy and GCGV 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 (pp<u>mV</u>) or ppb-volume (pp<u>bV</u>) 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 24-hour air samples on a regular every sixth-day schedule, or, at some monitoring stations, when an independent sensor detects that *elevated* (see below) levels of hydrocarbons (TNMHC or a specific chemical species) are present. Event-triggered 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 https://www.tceq.texas.gov/toxicology/amcv/about (accessed July 2024). 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.

On October 10, 2023, the TCEQ announced:

The National Academies is seeking suggestions for experts to conduct a scientific review of the Texas Commission on Environmental Quality's carcinogenic dose-response assessment for ethylene oxide, a carcinogenic air pollutant. The study will review the methods, results, and conclusions of the assessment document developed for ethylene oxide by the Texas Commission on Environmental Quality.

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 (PM2.5) 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 https://www.epa.gov/criteria-air-pollutants#self (accessed July 2024)

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 99th percentiles of the daily maximum one- hour averages. If measurements are taken for a full year at a monitor, then the 99th 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 SO_2 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.

A.3 Ethylene Oxide (EtO)
Health and Exposure Hazards
Information Sheet

What is EtO

Ethylene oxide is a flammable, colorless and reactive gas used in industry. Our body also produces EtO in small quantities when it metabolizes ethylene. It is categorized by the US Environmental Protection Agency (EPA) as a hazardous air pollutant because the EPA has concluded that EtO is carcinogenic (can cause cancer) to humans by breathing ambient air containing EtO above critical levels over specified time periods.

Ethylene oxide is used at the GCGV facility in Gregory. As such, air monitoring has been conducted at two of the Gregory Portland air monitors since January 2020. All EtO concentration levels measured by these air monitors to date have been below the Texas Commission on Environmental Quality's (TCEQ) Air Monitoring Comparison Value (AMCV). The AMCV is the measure the TCEQ uses to evaluate the potential for health and vegetation effects to occur from exposure to air containing this gas.

The purpose of this information sheet is to provide information Gregory Portland area residents may find helpful in understanding the health hazards that can be caused by this gas when breathing ambient air containing EtO and to provide sources of information where additional information can be found.

Uses of EtO

Ethylene oxide is used mainly in the process of manufacturing ethylene glycol (antifreeze), textiles, detergents, polyurethane foam, solvents, medicine, adhesives, and other products. (1,2)

It is also used in relatively small amounts as a fumigant (a gas used to disinfect or purify an area), as a sterilant (destroys or inactivates microorganisms) for spices and cosmetics, and in hospital sterilization of surgical equipment and plastic devices that cannot be sterilized by steam. (1,2)

How Might You be Exposed to EtO

- Through uncontrolled emissions or venting with other gases from industrial settings. (2)
- From use as a sterilizer of medical equipment and its release from commodity-fumigated materials. (2)
- By breathing contaminated air or from smoking tobacco or being near someone who is smoking. Certain occupational groups (e.g., workers in ethylene oxide manufacturing or processing plants, sterilization technicians, and workers involved in fumigation) may be exposed in the workplace. (2)

Applicability of this Information

There are several agencies – the US EPA, (https://www.epa.gov/sites/default/files/2016-09/documents/ethylene-oxide.pdf), the TCEQ (https://www.tceq.texas.gov/downloads/toxicology/dsd/fact-sheets/eto.pdf), and the Occupational Safety and Health Administration (https://www.osha.gov/sites/default/files/publications/ethylene-oxide-factsheet.pdf) – that provide detailed information on the health and exposure risks of EtO. A copy of the TCEQ EtO Fact Sheet has been reproduced at the end of this information sheet for your convenience.

References

1. U.S. Environmental Protection Agency. Evaluation of the Inhalation Carcinogenicity of Ethylene Oxide (CASRN75-21-8) In Support of Summary Information on the Integrated Risk Information System (IRIS). National Center for Environmental Assessment, Office of Research and Development. Washington, DC. EPA/635/R-16/350Fa. 2016. https://cfpub.epa.gov/ncea/iris/iris_documents/documents/toxreviews/1025tr.pdf

2. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Ethylene Oxide. U.S. Department of Health and Human Services, August 2022, available at https://www.atsdr.cdc.gov/toxprofiles/tp137.pdf

FACT SHEET

Ethylene Oxide

CAS Number: 75-21-8

This fact sheet provides a summary of the Development Support Document (DSD) created by the TCEQ Toxicology, Risk Assessment, and Research Division (TRARD) for the development of Regulatory Guidelines (effects screening levels (ESLs), air monitoring comparison values (AMCVs), and reference values (ReVs)) for ambient exposure to this chemical. For more detailed information, please see the DSD or contact the TRARD by phone (1-877-992-8370) or e-mail (tox@tceq.texas.gov).

What is ethylene oxide?

Ethylene oxide (EtO) is used as a chemical intermediate in the manufacture of ethylene glycol (antifreeze), polyester, detergents, polyurethane foam, solvents, medicine, adhesives, and other products. The conversion of EtO to ethylene glycols represents a major use for EtO in the US. Although relatively small amounts of EtO are used for sterilization, more than 20 billion medical devices sold in the U.S. every year are sterilized with EtO, accounting for approximately 50 percent of the medical devices that require sterilization.

How is EtO released into ambient air?

The general population may be exposed to EtO through breathing ambient air containing EtO, smoking tobacco products, and breathing secondhand cigarette smoke. EtO is also normally produced endogenously in the body due to the oxidation of ethylene. Sources of EtO emissions into the air include, but are not limited to, industrial emissions or venting with other gases. Other sources of EtO air emissions include its use as a sterilizer of medical equipment and its release from commodity-fumigated materials (such as spices and cosmetics).

How can EtO affect my health?

Permitted levels of EtO should not cause adverse health effects. Some workers exposed to long-term air concentrations of EtO up to millions of times higher than environmental levels have experienced increased cancer risk, particularly for lymphoid cancers, while other highly-exposed workers have not. The carcinogenic potential of EtO, however, has been confirmed by its ability to mutate DNA and in long-term laboratory animal studies at high EtO exposure concentrations. As a result, the TCEQ has classified EtO as likely to be carcinogenic to humans.

Why does the TCEQ set Regulatory Guidelines for EtO?

The TCEQ sets various air quality guideline levels (ESLs, AMCVs, and ReVs) to protect human health and welfare. Please see Definitions of ESLs, ReVs, and AMCVs located on the TCEQ final DSD webpage for more information. The TCEQ air quality guideline level (i.e., long-term ESL) for EtO has been designed to protect the general public (including sensitive populations such as children, the elderly, pregnant women, and people with preexisting health conditions) from the potential long-term carcinogenic effects of EtO exposure. If you would like to know more about the specific ESLs, AMCVs and ReVs developed for EtO, what the values are, and what they are used for, please consult the DSD.