Quarterly Report of Air Quality Monitoring
October 1 to December 31, 2019
at the
Gregory Fresnos
Community Air Monitoring Station

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Executive Summary

The Gregory Fresnos Community Air Monitoring Station began continuous monitoring operations October 1, 2019. The automated gas chromatograph (auto-GC), the beta-attenuation fine particulate matter instrument (BAMS), and meteorological equipment worked well from the start. Issues were found with the sulfur dioxide (SO2) and nitrogen oxides (NOx) instruments, and they were both replaced mid-October with better performing monitors. Since about Oct. 17, all the instruments have been performing to specifications.

No major air pollution events have been detected, with the exception being a few hours of elevated hydrocarbons and a couple hours of dust associated with nearby parking lot maintenance.

A new public website to provide information about air quality and monitoring data from the station is being developed by The University of Texas at Austin with funding from Cheniere and Gulf Coast Growth Ventures. A focus group composed of community representatives was appointed in December to assist in the design and development of the public website.

1.0 Introduction

This report is funded by Cheniere Energy as part of its community air-monitoring program. It includes reviews and analyses of the air monitoring data obtained at the Gregory Fresnos Community Air Monitoring Station for the period October 1 to December 31, 2019. The University of Texas at Austin (UT Austin) established this station and has managed the monitoring operations since continuous monitoring operations began on October 1. UT Austin conducted an analysis of these data for this report.

2.0 Summary of activities for the Period October 1 through December 31, 2019

Project activities during the reporting period have focused on maintenance and operation of the community air monitoring station, which began continuous monitoring operations on October 1, 2019, and development of the public website for reporting of the data from the community monitors. The UT Austin project team solicited nominations from Cheniere Energy and Gulf Coast Growth Ventures for the formation of a focus group composed of community representatives to assist with the detailed design and development of the public website to help make it user friendly and helpful for the community. The focus group members are listed in Table 1. Their first meeting was scheduled for January and their work will continue through the next quarter.

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

This report will focus on the data collected during the period October 1 through December 31, 2019 and analysis of those data.

3.0 Air Monitoring Station Locations & Information

During the reporting period, there was one air monitoring station in the Gregory-Portland area in operation, the Gregory Fresnos Community Air Monitoring Station at 401 Fresnos Street, Gregory, Texas at the Stephen F. Austin, Elementary School Campus. The parameters measured at this station are summarized in Table 2.

Table 2. Gregory Community Air Monitoring Station Parameters Measured

Air Monitoring Station Name & Address	Volatile Organic Compounds (46 VOCs)	Nitrogen Oxides (NO_x, 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 401 Fresnos Gregory, Texas	✓	✓	✓	✓	✓

The location of the Gregory Fresnos station is shown in Figure 1.

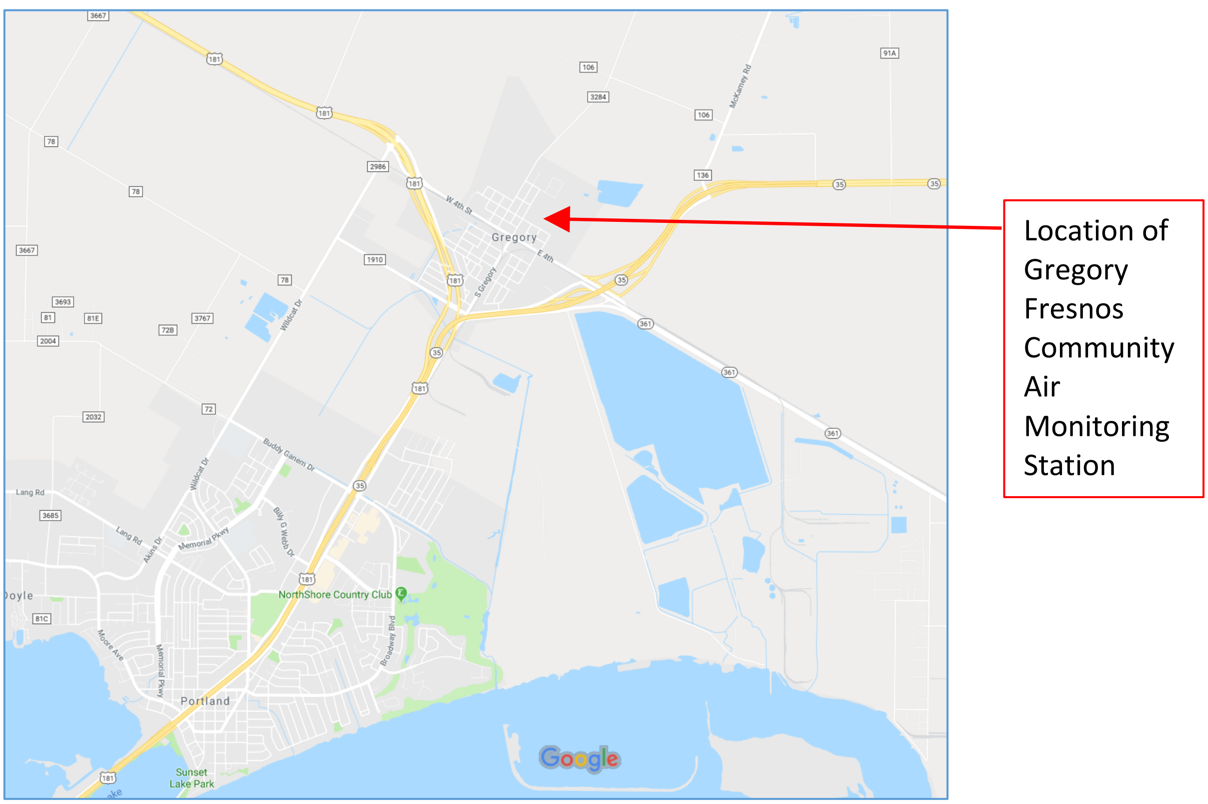

Figure 1. Location of Gregory-Fresnos Community Air Monitoring Station

3.0 Summary of Data

Hydrocarbon Data

Air monitoring hydrocarbon data collection completeness has been relatively high (> 95%) since the start of the project. Figure 2 shows the time series for the hourly concentrations of benzene at the Gregory Fresnos (GF) station at Stephen F. Austin Elementary School in Gregory, TX. The figure shows benzene hourly average concentrations for each hour from October 1, 2019 through December 31, 2019. Not all of the data in this and subsequent figures for other hydrocarbons have undergone full data validation and are subject to change. Figure 3 shows the hourly time series for 1,3-buatadiene, 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 are considered to be air toxics, but concentrations to date are much lower than TCEQ Air Monitoring Comparison Values or Effects Screening Levels.

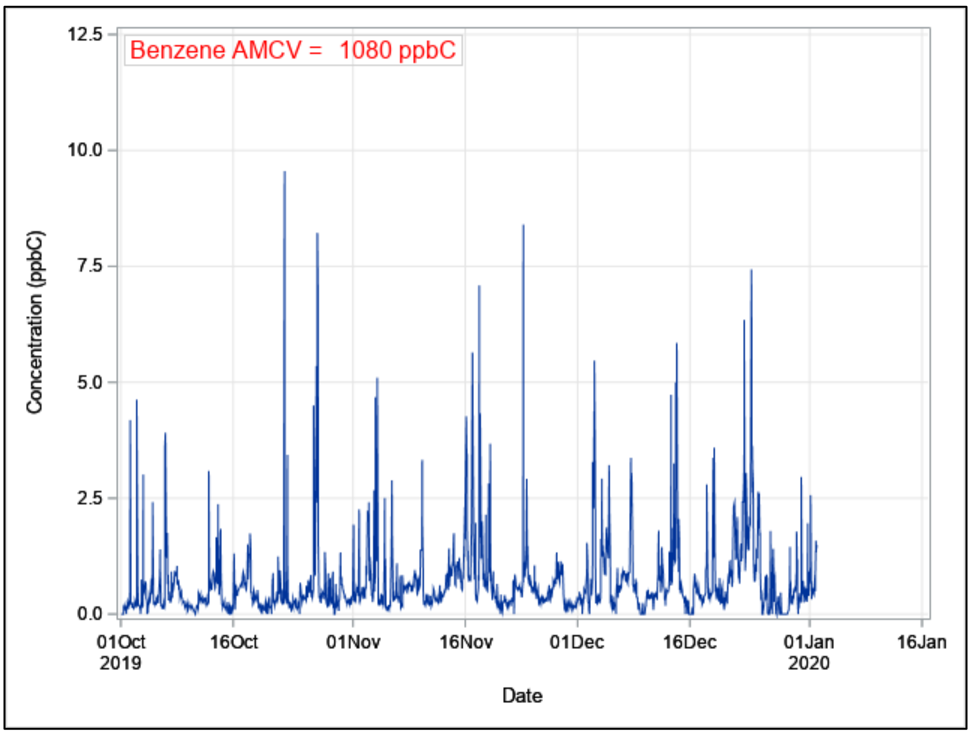

Figure 2. Hourly average benzene concentrations at GF station, Oct. 1 – Dec. 31, 2019, ppbC units

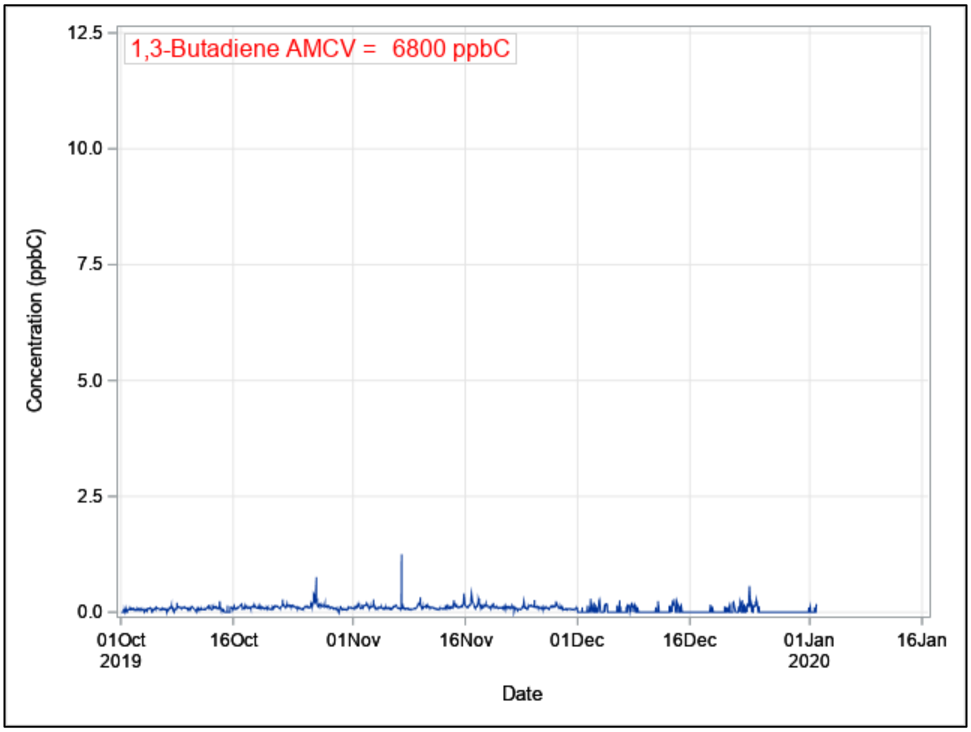

Figure 3. Hourly average 1,3-butadiene concentrations at GF station, Oct. 1 – Dec. 31, 2019, ppbC units

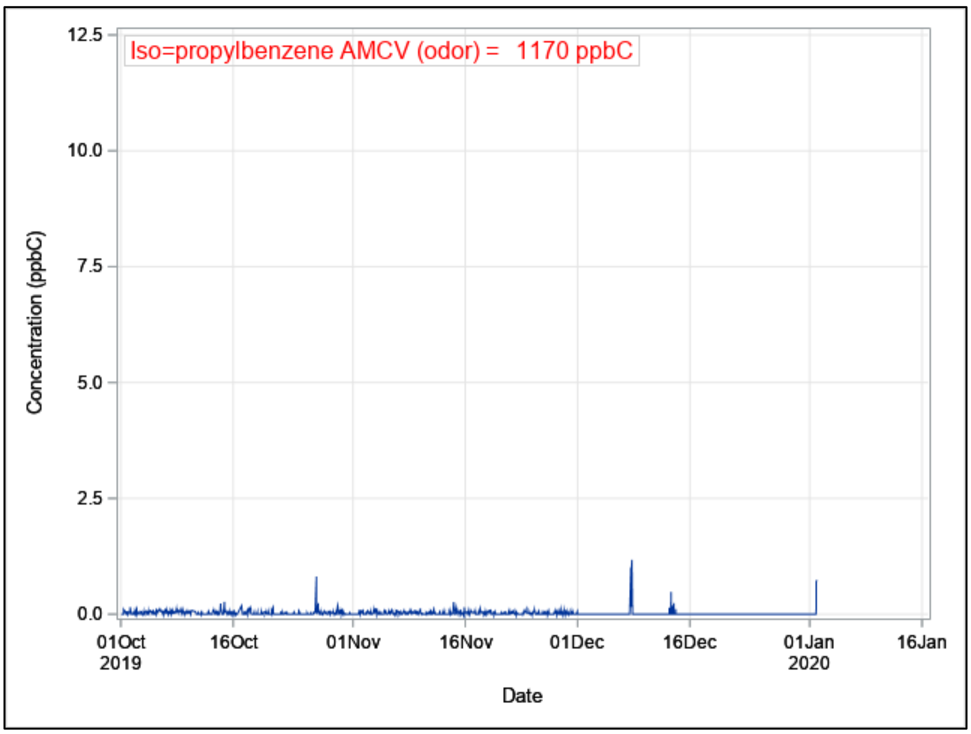

Figure 4. Hourly average iso-propylbenzene concentrations at GF station, Oct. 1 – Dec. 31, 2019, ppbC units

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 near the National Ambient Air Quality Standards (NAAQS) have been seen at the GF station, with the exception of one short period of elevated $PM_{2.5}$ likely associated with parking lot maintenance in early December. This was not enough to cause concern for violating the NAAQS, however.

Figure 5 shows the hourly time series for $PM_{2.5}$ at the GF station. The graph shows the aforementioned elevated measurement on December 6, which is diluted in the other 23 hours of the day to result in a 19.6 micro-gram per cubic meter ($\mu g/m^3$) one day concentration. The average $PM_{2.5}$ concentration since October 2019 is only 6.8 $\mu g/m^3$ compared to 12.0 $\mu g/m^3$ annual average.

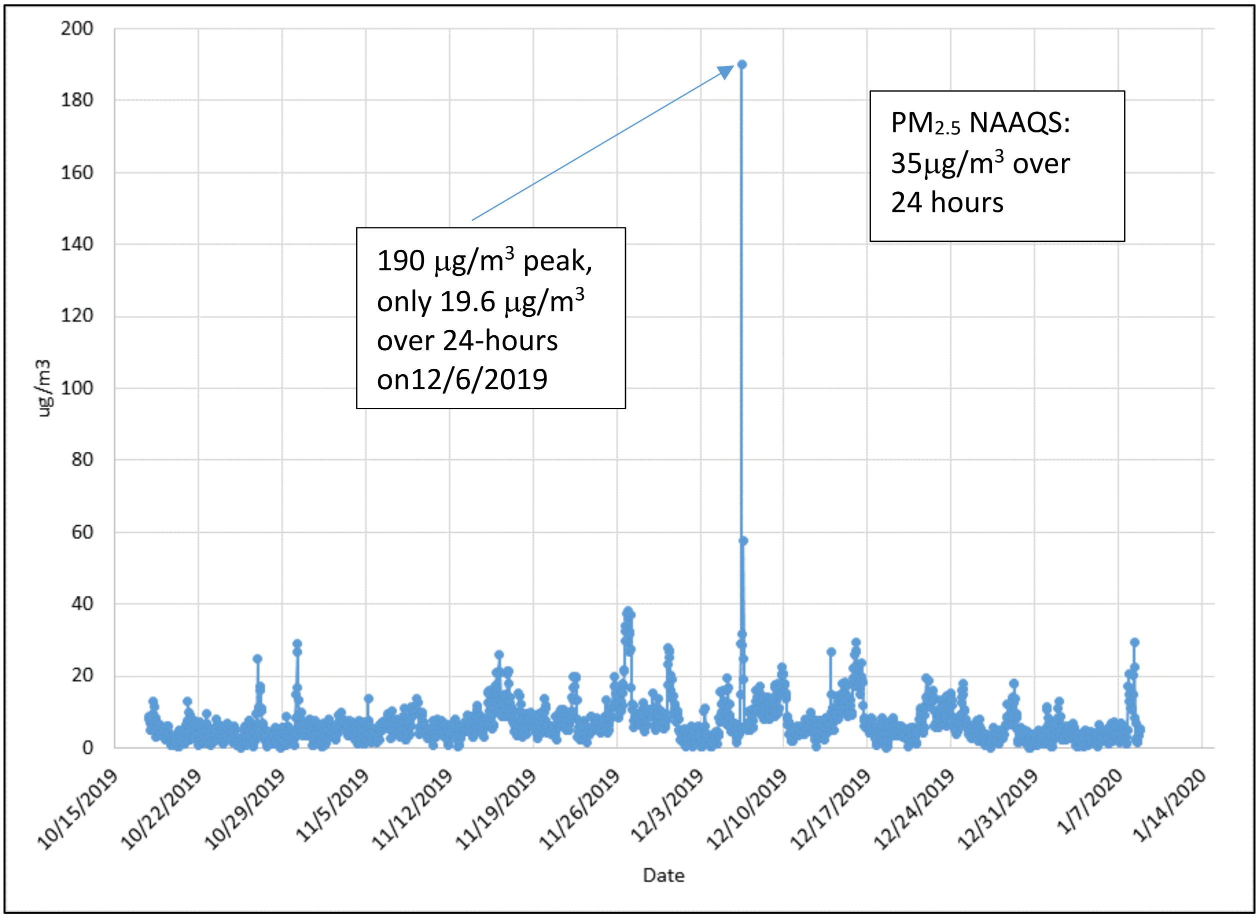

Figure 5. Hourly average $PM_{2.5}$ at GF, micro-grams/cubic meter units, Oct. 17, 2019 – Jan. 8, 2020

Figure 6 shows the hourly time series for NO_2 along with nitric oxide (NO) and total oxides of nitrogen (NOx). The average concentration of NO_2 measured to date is 4.2 parts per billion (ppb) compared to the NAAQS of 53 ppb.

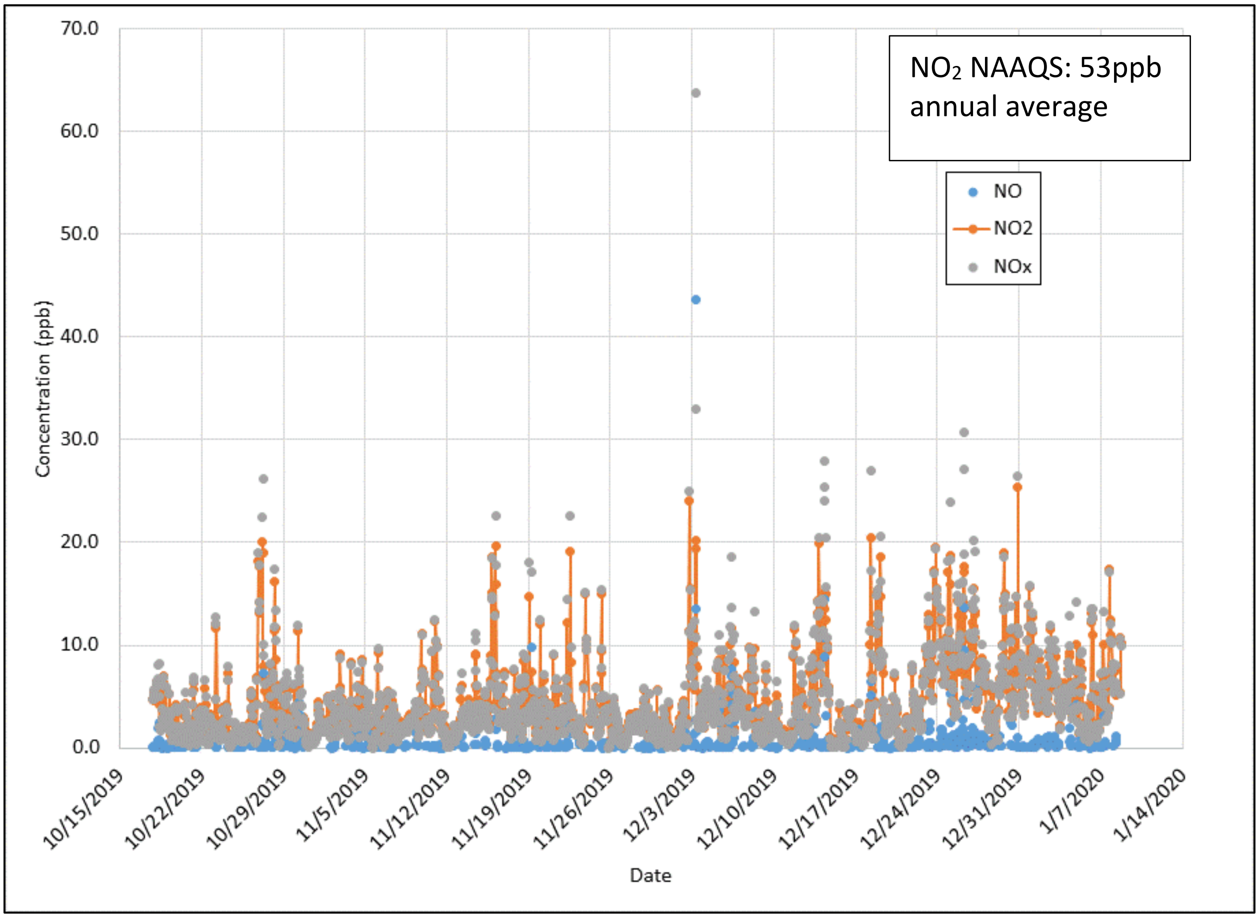

Figure 6. Hourly NO_2, NO, and NOx at GF, ppb units, Oct. 17, 2019 – Jan. 8, 2020

Figure 7 shows the hourly 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 3 ppb compared to the NAAQS of 75 ppb.

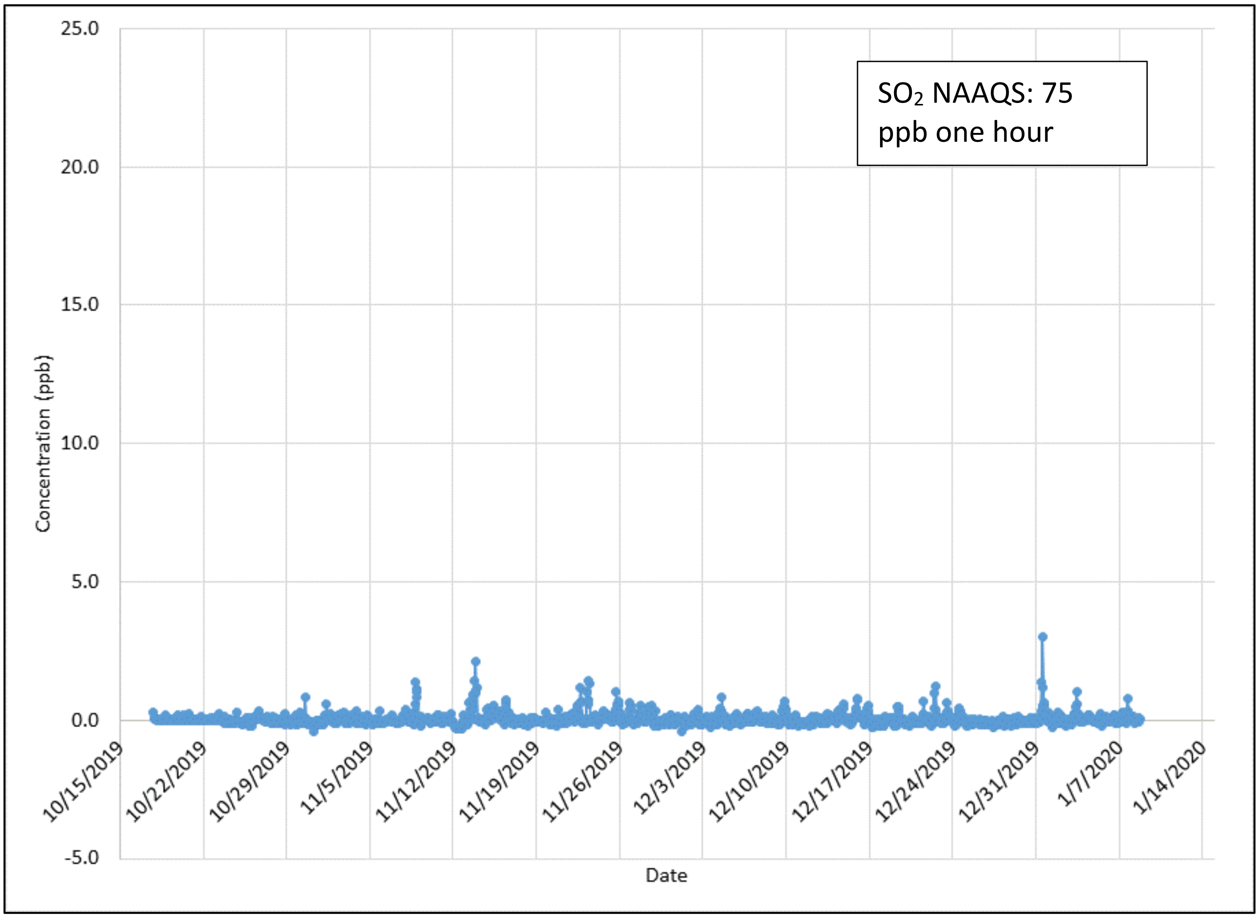

Figure 7. Hourly average SO_2 at GF, ppb units, Oct. 17, 2019 – Dec. 31, 2019

4.0 Analysis of Data

Comparisons with other Sites

The State of Texas through the Texas Commission on Environmental Quality (TCEQ) operates hundreds of air pollution and meteorological monitors across the state. In this report, the hydrocarbon data collected at the GF station is compared to the hydrocarbon data at the TCEQ's Palm station in Corpus Christi, which is about 11.5 miles to the southwest. In later reports more comparisons will be done to compare the GF station to other stations in different settings around the state.

Table 3 shows the hourly average concentrations in parts per billion-carbon (ppbC) units of hydrocarbon species measured at the GF station and at the TCEQ's Palm station in Corpus Christi from October 1, 2019 through December 31, 2019. Figure 8 is a graphical comparison between the 46 hydrocarbon hourly average concentrations from the two sites. As might be expected, the concentrations at the GF station tend to be lower, and this is reflected in the line fit to the data in the graph, and the side-by side comparison in the table. Table 3 also lists the long-term health Air Monitoring Comparison Values (AMCVs) for these species used by TCEQ to assess possible health risks. All concentrations shown in the table are well below the AMCVs.

Table 3. Average concentrations of hydrocarbon species at Gregory Fresnos (GF) and the TCEQ Palm station in Corpus Christi, October 1, 2019 – December 31, 2019

Species	Palm Average ppbC	GF Average ppbC	TCEQ Long-term AMCV
Ethane	26.179	23.937	N/A
Ethylene	1.549	0.759	10,600
Propane	26.541	19.190	N/A
Propylene	1.475	0.684	N/A
Isobutane	12.059	7.534	40,000
n-Butane	25.140	11.154	40,000
Acetylene	0.480	0.430	5,000
t-2-Butene	0.398	0.181	2,800
1-Butene	0.569	0.218	9,200
c-2-Butene	0.319	0.107	2,800
Cyclopentane	0.622	1.046	2,950
Isopentane	14.751	10.062	40,500
n-Pentane	9.546	17.129	40,500
1,3-Butadiene	0.113	0.076	36
t-2-Pentene	0.380	0.029	2,800
1-Pentene	0.172	0.051	2,800
c-2-Pentene	0.222	0.017	2,800
2,2-Dimethylbutane	0.422	0.190	1,140
Isoprene	0.289	0.059	700
n-Hexane	3.883	1.467	1,140
Methylcyclopentane	1.760	0.644	450
2,4-Dimethylpentane	0.100	0.010	15,400
Benzene	1.740	0.669	8
Cyclohexane	1.505	0.740	600
2-Methylhexane	0.984	0.220	15,400
2,3-Dimethylpentane	0.319	0.086	15,400
3-Methylhexane	1.273	0.327	15,400
2,2,4-Trimethylpentane	1.758	0.340	3,040
n-Heptane	1.693	0.521	15,400
Methylcyclohexane	1.827	0.823	2,800
2,3,4-Trimethylpentane	0.335	0.036	3,040
Toluene	2.780	0.879	7,700
2-Methylheptane	0.584	0.088	3,040
3-Methylheptane	0.445	0.087	3,040
n-Octane	0.913	0.259	3,040
Ethyl Benzene	0.330	0.153	3,520
p-Xylene + m-Xylene	1.400	0.616	1,120
Styrene	0.038	0.100	880
o-Xylene	0.332	0.166	1,120
n-Nonane	0.452	0.115	2,520
Isopropyl Benzene - Cumene	0.080	0.020	459
n-Propylbenzene	0.092	0.043	459
1,3,5-Trimethylbenzene	0.099	0.030	333

Species	Palm Average ppbC	GF Average ppbC	TCEQ Long-term AMCV
1,2,4-Trimethylbenzene	0.552	0.156	333
n-Decane	0.322	0.118	1,900
1,2,3-Trimethylbenzene	0.124	0.209	333

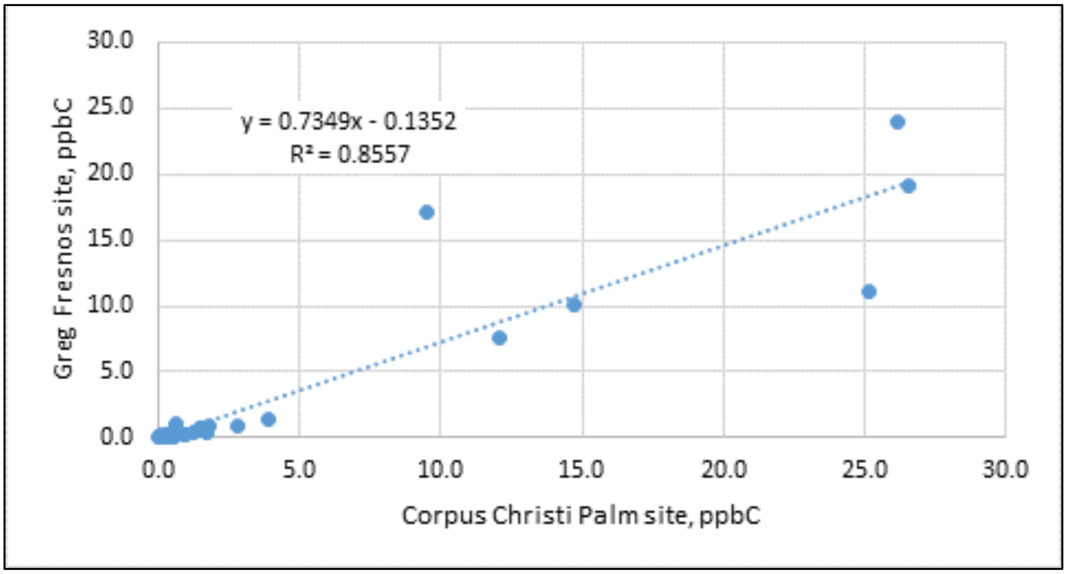

Figure 8. Comparison of hourly average hydrocarbon concentrations at Gregory-Fresnos to TCEQ Palm hourly average hydrocarbon concentrations, October 1, 2019 – December 31, 2019

Case Studies

In each quarterly report, individual case studies of elevated concentrations are examined and, if possible, explained. Since monitoring at the GF station began around October 1, 2019, there have not been any major incidents detected by the monitoring at the station. However, two interesting cases are described in this section.

Elevated hydrocarbons on Dec. 8, 2019

The highest concentration for total non-methane hydrocarbons at the GF station was recorded in the morning of Sunday, December 8, 2019. Figure 9 shows the hourly time series for all 46 hydrocarbons measured at the GF station for the first two weeks of December 2019, and Figure 10 is a close-up view for Dec. 7 and 8. Three alkane species – n-pentane, cyclopentane, and isopentane – stand out. UT Austin was contacted by the Gregory-Portland Independent School District that work was being done on the parking lot north of the monitoring station on Friday Dec. 6. Since the concentrations measured were so close to this date and winds on the morning of Dec. 8 were light and variable, it is very likely that the concentrations measured at the site were related to emission from the paving material from the parking lot.

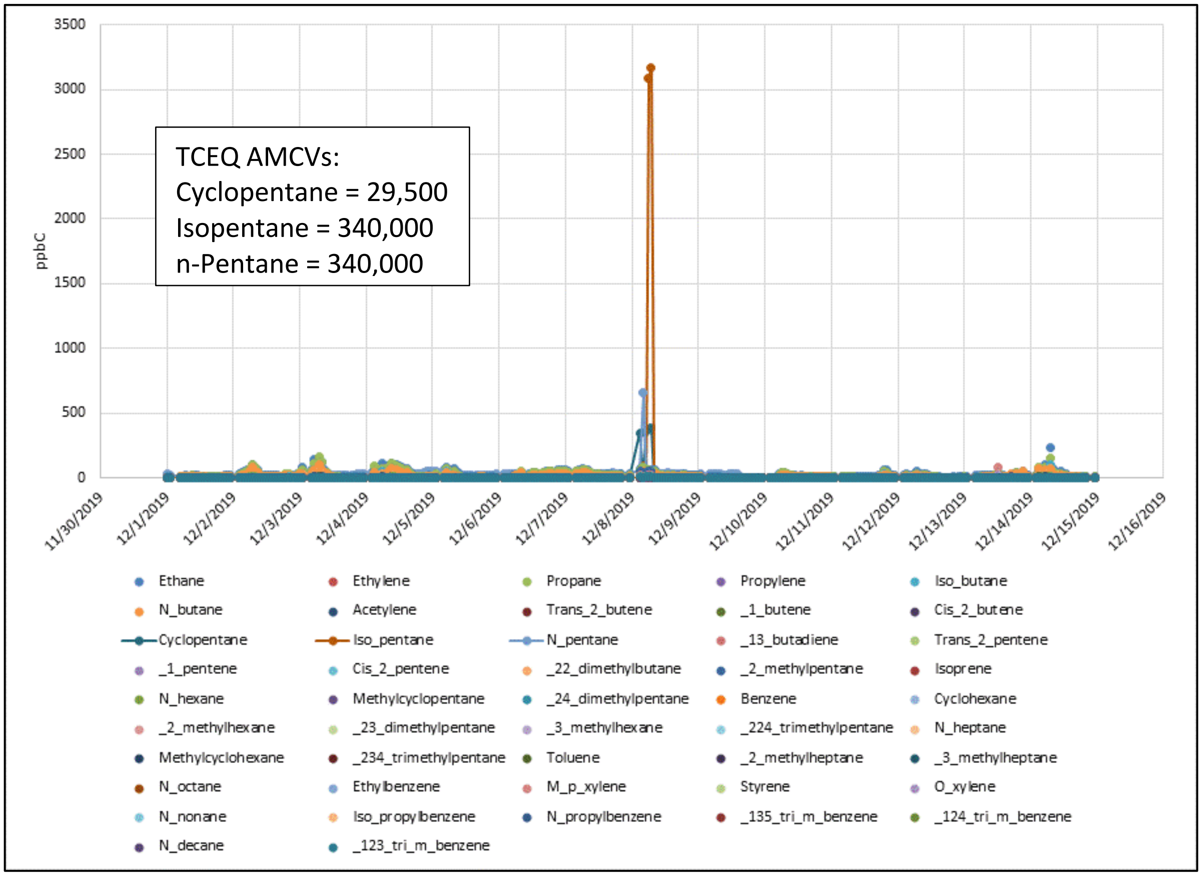

Figure 9. Elevated alkane species measured at the GF station coincident with paving work being done on an adjacent parking lot Dec. 8. 2019

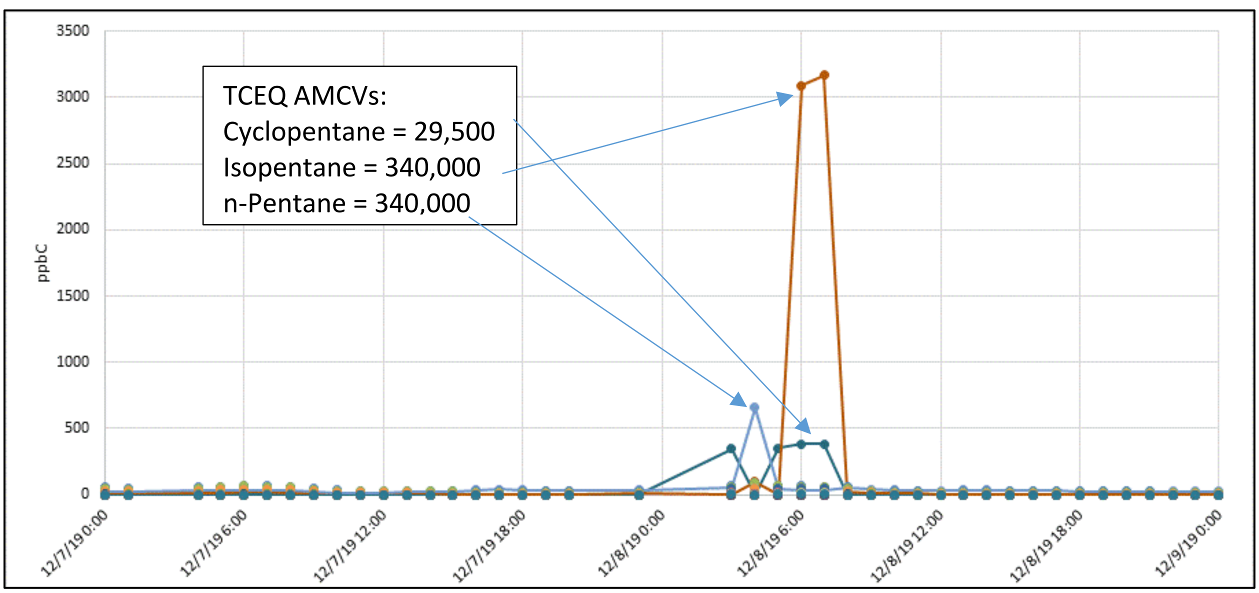

Figure 10. Elevated concentrations of alkane species measured coincident with paving work being done on an adjacent parking lot Dec. 8, 2019

New Year's Eve SO_2 Plume

The highest quality assured-sulfur dioxide concentration measured at the GF site since November was a very modest 3 ppb one-hour concentration on Dec. 31 early afternoon at 13 CST. In looking at the 5-minute time scale data the concentrations peaked at 4.4 ppb at 13:20 CST on Dec. 31. A look at the other SO_2 monitoring sites in Nueces County showed a similar small impulse of SO_2 at about the same time. Figure 11 shows the 5-minute time scale SO_2 concentrations from that day at GF and two Corpus Christi sites: CAMS 4 Corpus Christ West site and CAMS 98 Huisache, which show coincident peaks in SO_2. Winds at this time were from the northeast. Figure 12 shows a set of back-trajectories using the NOAA HySPLIT model, that suggest the air mass coming into the area during mid-day on Dec. 31 had passed over much of East Texas over the previous 24-hours. One hypothesis is that SO_2 was transported into the area having been emitted by a coal-burning power plant somewhere in East Texas, or by a crude oil burning ship near the Texas coast.

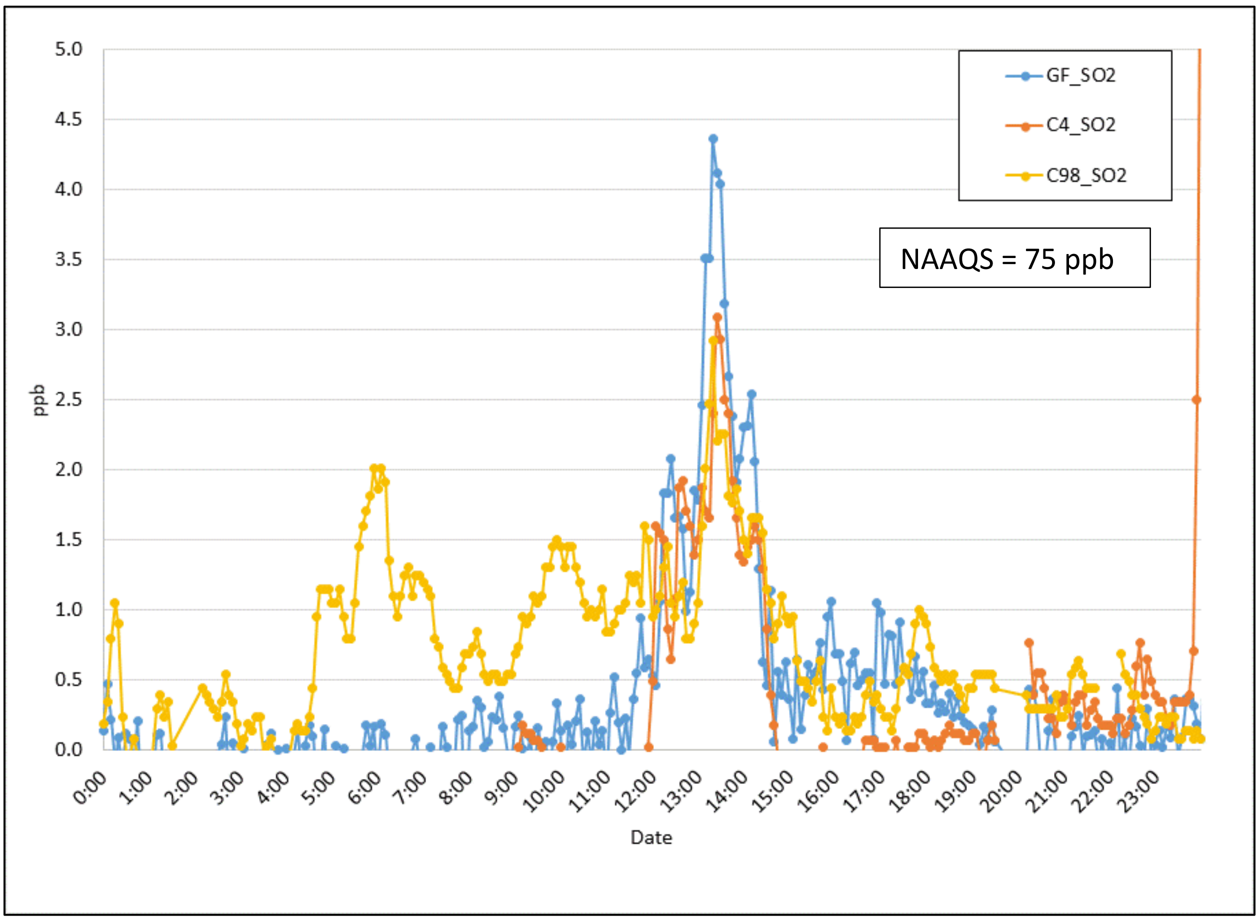

Figure 11. Highest SO_2 measurement to date, coincident with rise in SO_2 at Corpus Christi stations on Dec. 31, 2019, early afternoon under northeast winds

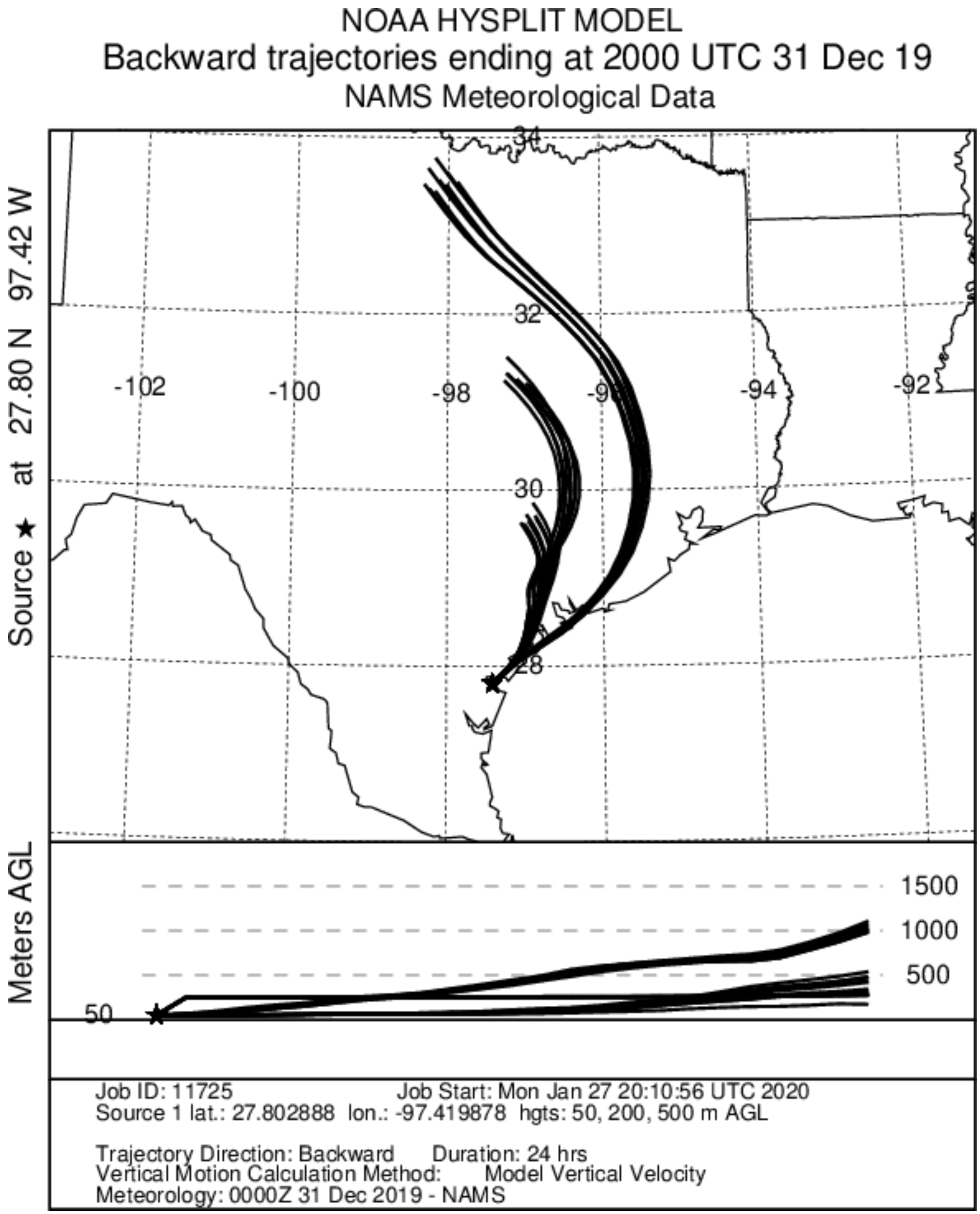

Figure 12. Upper air 24-hour back trajectory from Corpus Christi starting 14 CST on Dec. 31, 2019 at 50 meters (m), 200 m and 500 m

Temporal Effects

In many cases, air pollutant concentrations respond to the time of day, day of week, and season of the year, as well as to meteorological factors. In the monitoring to date, there has not been enough data collected to assess all the temporal factors. Figure 13 shows the diurnal pattern – i.e., the average concentration by hour of the day – for NOx since October at the GF station. It shows a more or less expected pattern of highest average concentrations associated with the morning and evening heavy motor vehicle traffic periods, which are coupled with the nighttime temperature inversions which can cause pollutant concentrations to be higher at night, all else held equal.

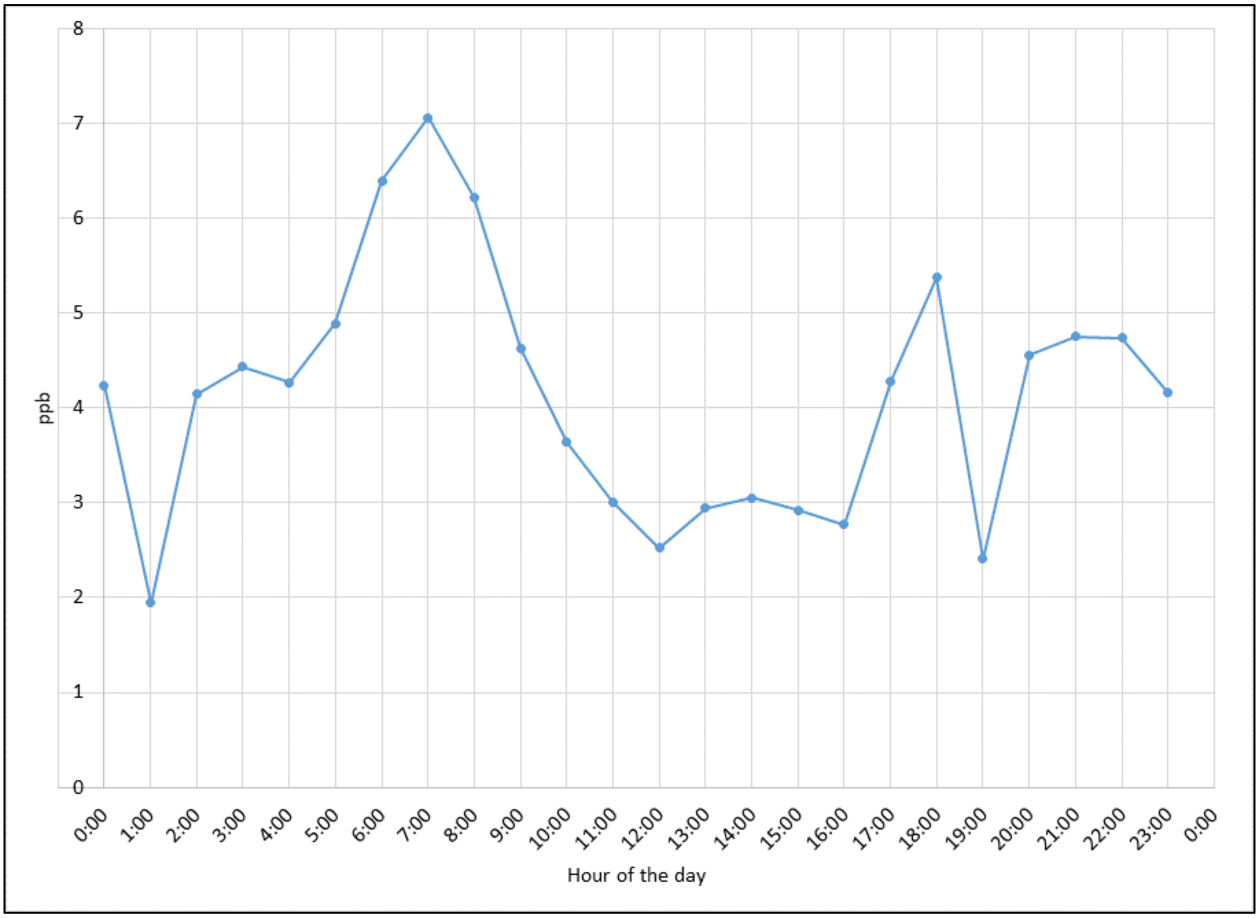

Figure 13. Hourly average NOx concentrations over the course of the day at the GF station, ppb units, Oct. 17, 2019 to Jan. 8, 2020

5.0 Conclusions

The monitoring to date has been very successful. No concentrations have violated any NAAQS or exceeded and TCEQ AMCV. UT Austin would be happy to answer any questions or conduct additional analysis at the community's or Cheniere's requests.

Appendices

A.1 Air Monitoring Station Locations & Information

Table A-1. Gregory Community Air Monitoring Station Parameters Measured

Air Monitoring Station Name & Address	Volatile Organic Compounds (46 VOCs)	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 401 Fresnos Gregory, Texas	✓	✓	✓	✓	✓

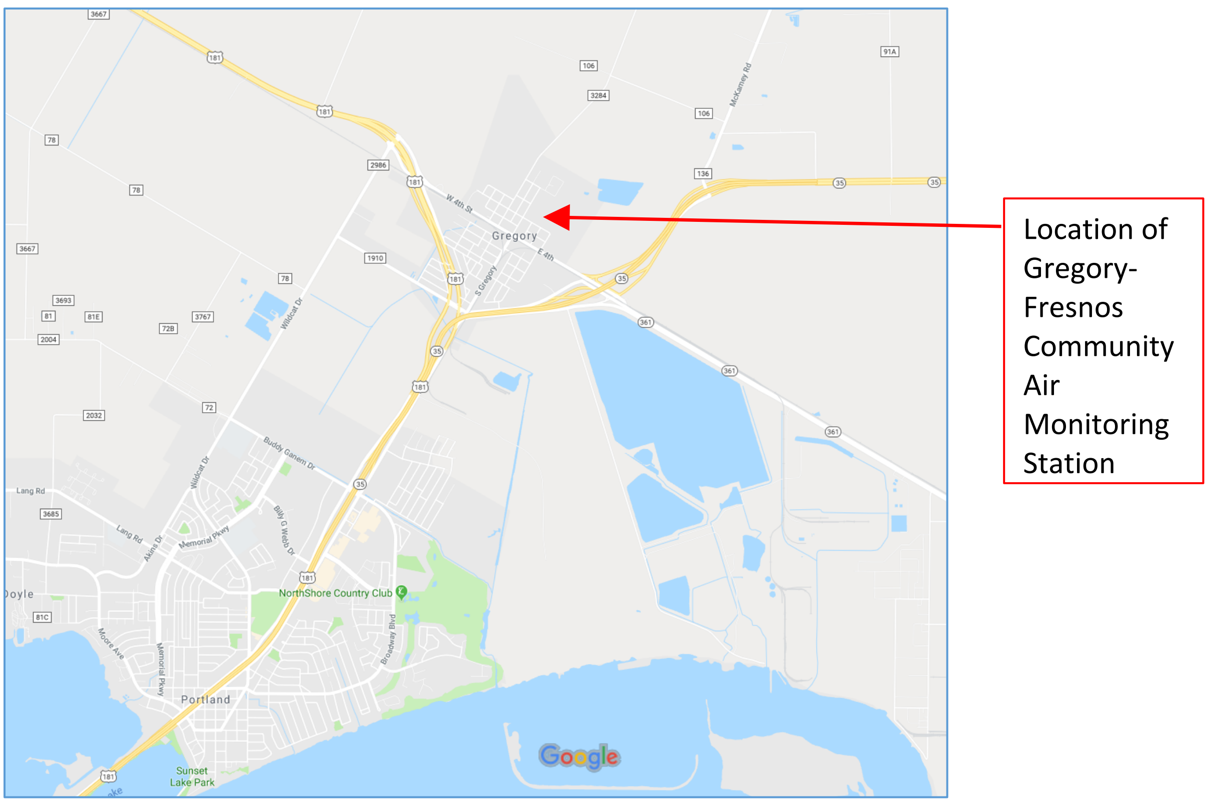

Figure A-14. Location of Gregory-Fresnos Air Monitoring Station

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 2.5 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 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 occurrence of a violation of a health-based standard. A discussion of "elevated concentrations" and "statistical significance" by pollutant type follows:

- For SO2, 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 SO2, 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.