Environmental Integrity Projec Anonymous

See attached pdfs of comments and three Exhibits from Environmental Integrity Project (EIP), Air Alliance Houston, Public Citizen, and Environment Texas on the Houston-Galveston-Brazoria Severe Area Attainment Demonstration State Implementation Plan Revision for the 2008 Eight-Hour Ozone National Ambient Air Quality Standard, Project No. 2023-110-SIP-NR.

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Submitted via email
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Re: Comments on *Houston-Galveston-Brazoria Severe Area Attainment Demonstration State Implementation Plan Revision for the 2008 Eight-Hour Ozone National Ambient Air Quality Standard,* Project No. 2023-110-SIP-NR.

Dear Ms. De Arman:

On November 29, 2023, the Texas Commission on Environmental Quality (TCEQ) proposed revisions to the State Implementation Plan (SIP) for the Dallas-Fort Worth (DFW) and Houston-Galveston-Brazoria (HGB) areas to demonstrate compliance with the eight-hour ozone limit of 75 parts per billion (ppb) promulgated by the U.S. Environmental Protection Agency in 2008. The proposed SIP revisions were prompted by the U.S. EPA's decision on November 7, 2022, to reclassify DFW and HGB as in "serious" nonattainment with the 75 ppb standard, which should trigger more stringent emission control requirements for nitrogen oxide (NOx) and volatile organic chemical compounds (VOC), the precursors that react with each other to form ozone under meteorological conditions that include sunlight, high temperatures and low wind speeds. The Environmental Integrity Project (EIP), Air Alliance Houston, Public Citizen, and Environment Texas (Commenters) appreciate the opportunity to comment on TCEQ's proposal for the HGB area, which promises to demonstrate full compliance with the 2008 ozone limit no later than July 20, 2027.

As TCEQ explains, compliance with the HGB SIP is achieved when the average of the fourth highest maximum daily 8-hour ozone concentration (MDA8) in each of three succeeding years—the so-called "design value" (DV)—does not exceed 75 ppb at any of the 20 regulatory monitors used that measure hourly ozone concentrations in Brazoria, Chambers, Fort Bend, Galveston, Liberty, Harris, Montgomery, and Waller Counties. The revised SIP is based on an evaluation of the relative contribution of past and projected future precursor emissions from mobile, area and point sources to ozone formation at specific locations and under variable meteorological conditions.

Of particular interest, TCEQ's proposal includes a baseline estimate of NOx and VOC emissions from each source category within the HGB region on June 12, 2019, when six regulatory monitors measured MDA8 ozone above 75 ppb. The model estimated total NOx and VOC emissions of 343.62 and 487.73 tons, respectively, on that day. From that starting point, TCEQ

projects that the maximum daily NOx emissions during the 2026 ozone season will not exceed 319.37 tons, about a 7 percent reduction from the 2019 baseline, while maximum daily VOC emissions will actually increase about 1% to 492.35 tons. All of the reductions will come from on and offroad mobile sources.

Although TCEQ has identified 20 regulatory monitors, the Commission publishes hourly ozone collected from a total of 42 stations spread throughout the HGB area, and frequently cites data from these additional monitors in its proposal. Unless otherwise noted, Commenters' evaluation of MDA8 ozone levels and design values will rely on a subset of 36 monitors analyzed in the report recently published by the Environmental Integrity Project, concerning Houston area ozone.[1]

Summary:

1) Violations of the 75 ppb ozone standard in 2023 were more frequent, more severe, and more widespread than they have been in the past 10 years. In light of the 2023 results, TCEQ should re-evaluate whether the models used to guide its proposed SIP revisions are reliable enough to ensure that the HGB area will attain the 2008 ozone standard by July of 2027.

2) TCEQ models are based on dubious assumptions about annual and short-term NOx and VOC emission rates from sources within the HGB areas. In particular, these assumptions do not account for the under-reporting of ozone precursors, especially highly reactive VOC (HRVOC), wide swings in short-term emission rates, and releases triggered by upsets or other emission events. TCEQ should more clearly address the impact these variables will have on the HGB area's ability to comply with the 75 ppb ozone limit.

3) TCEQ's SIP proposal anticipates a 7% decrease in area-wide NOx by 2026 combined with VOC increases that will fall more heavily on the neighborhoods already adversely affected by pollution from petrochemical plants and the Houston Ship Channel. Yet TCEQ's own conceptual model concludes that reducing VOC emissions can be a more effective way to lower ozone levels in some locations, while in others simultaneous reductions in both VOCs and NOx is the best strategy.

4) TCEQ should acknowledge that in recent years, people of color are more likely to live in areas where violations of the 75 ppb limit occur more frequently and explain how its proposed SIP revisions will address these inequities.

5) While the extremely hot weather in the Houston area contributed to frequent and severe violations of the 2008 ozone limit in 2023, TCEQ should acknowledge that global warming models show that temperatures will continue to rise in the HGB area and propose an attainment plan that reflects this reality.

[1] Environmental Integrity Project, Increase in Houston Ozone Violations Hits Communities of Color Hardest, Nov. 2023, available at: https://environmentalintegrity.org/wp-content/uploads/2023/11/EIP_Report_HoustonOzone_Final.pdf.

Comment 1: TCEQ should revise its proposal to take into account that violations of the 75 ppb limit in 2023 were frequent, widespread, and severe.

TCEQ has identified 2019 ozone values and emissions levels as the starting point for its plan to attain the 2008 standards no later than 2026. But that baseline and the models used to support TCEQ's proposed SIP revisions may no longer suffice given the 2023 ozone data.

- The HGB design value in 2019 was 81 ppb at Deer Park, while the design value was exceeded at five other monitors. The HGB design value in 2023 rose to 83 ppb, based on ozone levels at Bayland Park, while a total of eleven monitors recorded design values exceeding 75 ppb. The 2023 DV is the highest since 2013, which was also the last time that more than eleven monitors recorded design values above 75 ppb.

- The fourth highest ozone value at six monitors exceeded the 75 ppb limit in 2019, with two monitors recording 8 hour averages above 79 ppb. In contrast, the fourth highest value was greater than 75 ppb at 25 locations in 2023, with 16 monitors recording ozone levels ranging from 80 to 90 ppb. That is the highest level since 2012, when the fourth highest ozone level exceeded 75 ppb at 29 monitors. While the exceptionally high levels in 2023 are based on a single year, they will have a significant influence on the three-year rolling averages used to determine the design values in 2024 and 2025.

Based on the results from one or more monitors, the HGB area recorded 8-hour ozone concentrations greater than 75 ppb on 46 days in 2023, or 43 if only data from monitors TCEQ uses for regulatory purposes are included, which is much higher than any year since 2011. The data show that that 2008 ozone limit violations were more frequent and cut a wide swath through the greater Houston area. See Exhibit A for data to compare the number of dates when all HGB monitors exceeded 75 ppb in 2023, Exhibit B for the three-year design values from each monitor since 2010, the fourth highest maximum daily 8-hour ozone average from each monitor since 2008, and the number of days per year each monitor recorded 8 hour averages above the limit. See Exhibit C for a comparison of 2019 to 2023 ozone results at the 20 designated "regulatory monitors." For example, Exhibit C shows that the regulatory monitors recorded 150 MDA8 exceedances of the 75 ppb limit in 2023 versus 53 exceedances in 2019 (note that totals in each year include multiple exceedances at different monitoring locations that occurred on the same day).

The November 29 proposal asserts that, "Based on TCEQ's modeling and available data, the HGB area is expected to attain the 2008 NAAQS by the July 20, 2027 attainment date." Proposal at ES-3. The 2023 ozone season data suggests that TCEQ's confidence may be misplaced, because it did not adequately consider the significant variation in ozone levels from one year to the next that have occurred since the 75 ppb standard took effect for the HGB area in 2011. TCEQ's attainment strategy must consider the likelihood that periods when MDA8 ozone levels are relatively "moderate" will be interspersed with others when ozone violations are frequent and severe. Otherwise, peak ozone years will continue to drive the three-year averages used to demonstrate compliance above the 75 ppb limit.

The 2023 ozone season data will already make it significantly harder for the HGB area to hold the design value at or below the 75 ppb level by 2025. For example, the fourth highest MDA8 at the Bayland Park monitor was 87 ppb in 2023. To demonstrate compliance by 2025, the average of the fourth highest MDA8 this year and next could not exceed 70 ppb. That seems unlikely, as the Bayland Park monitor has never averaged less than 73 ppb over two years since monitoring began in 1998, and most two-year averages at Bayland Park are much higher.

Commenters anticipate that TCEQ may characterize the 2023 ozone season as an "outlier" caused by the extremely hot weather that plagued the Houston area last summer. Unfortunately, global warming models predict that temperatures will continues to rise for HGB and other areas in Texas in future years (see Comment 5).

Comment 2: TCEQ assumes the HGB area will demonstrate compliance with the 2008 limit by the end of the 2026 ozone season, despite projecting only a 7% decrease in NOx emissions and a slight increase in VOC emissions. But TCEQ's Conceptual Model substantially understates emissions, especially for HRVOC that have the greatest impact on ozone formation.

TCEQ includes detailed emission estimates in its photochemical model for several categories of emissions. For Electric Generating Units (EGU), hourly emissions are calculated from continuous monitoring data. For mobile sources, the emissions are estimated using area-specific parameters as inputs to U.S. EPA's Motor Vehicle Emission Simulator version 3 (MOVES3). For industrial non-EGU sources, TCEQ has apparently relied primarily on the annual emission reports that various sources submit to the State of Texas Air Reporting System (STARS). According to the Technical Support Document, Proposal Appendix A, the STARS data base includes, "four types of emission rates: annual, Ozone Season Daily (OSD) which spans from May to September, annual Emission Events (EE), and annual scheduled maintenance startup and shutdown." Proposal App. A 3.3.1.3 at A-18.

Where sources do not provide sufficient data, TCEQ makes assumptions, e.g., estimating daily emissions based on "summer use percentages" for the months of June, July, and August, although the most frequent and severe ozone exceedances in 2023 occurred in May and September. While Appendix A suggests that OSD emission rates include releases of NOx and VOC caused by EEs—presumably determined based on the daily average of the sum of EE emissions reported to STEERS in a year—elsewhere, in the Conceptual model, TCEQ does not appear to address EEs at all.

Commenters appreciate the difficulty of establishing a reliable baseline of precursor emissions that can provide a basis for the emissions used to predict ozone formation under various meteorological conditions. But the approach adopted by TCEQ is likely to substantially under-predict emissions of VOC and NOx for a variety of reasons:

a. Annual Emission Inventory Reports are Frequently Inaccurate and Undercount VOC

Texas and other states allow even the largest facilities to report annual emissions of VOC based on AP42 and other emission factors, or on "engineering judgments" that are unsupported. The AP42 emission factors are decades out of date, and many are based on data that may not be representative of the sources to which they apply. *See*, *e.g.*, D rated emission factors for refinery cooling towers and oil-water separators at AP 42-5.1-16. Significantly, efforts to predict fenceline concentrations of toxic VOC like benzene or butadiene at refineries or chemical plants based on the emissions reported by those sources have fallen short.

For example, based on refinery emission reports, EPA projected that only one refinery should see net annual concentrations of benzene at 9 micrograms per cubic meter, the action level adopted in the 2015 rule. Since that regulation took effect between 2018 and 2019, 29 refineries have reported annual fenceline concentrations above the nine-microgram level.[2] The extensive sampling at multiple plants that was used to inform EPA's proposed new standards for organic chemical plants revealed the same broad gap, with fenceline concentrations of multiple VOC carcinogens much higher than predicted from emission reports.[3]

b. While reducing HRVOC emissions is critical to reducing ozone levels in or downwind of the Ship Channel, TCEQ has not addressed the under-reporting of these super-charged ozone precursors.

Texas has acknowledged that ethylene, propylene and other highly reactive VOC (HRVOC) have a disproportionate impact on ozone in the greater Houston area. Proposal App. B, 3-12. When weighted for maximum incremental reactivity (MIR), TCEQ estimates that HRVOC account for between 20% and 50% of ozone forming potential in HGB, although a closer look at Table 3-10 in Appendix B suggests that the contribution is significantly higher at some monitoring locations. Taking this data into account, TCEQ concluded that, "The reactivity weighted composition of VOC in the HGB area is composed of mostly HRVOC; reductions in these compounds are likely to be more impactful on the ozone concentrations compared to equal reductions in less reactive VOC." Proposal App. B, Executive Summary.

Despite this awareness, TCEQ has little to say about the undercounting of the HRVOC emissions that are so critical to an ozone attainment strategy, a problem that was uncovered two decades ago. For example, the TexAQS 2000 and TexAQS II air quality studies evaluated trends in concentrations of ozone and ozone in the HGB region. The studies found that the inventory

[2] Environmental Integrity Project, Monitoring for Benzene at Refinery Fencelines: 10 Oil Refineries Across U.S. Emitted Cancer-Causing Benzene Above EPA Action Level, Feb. 6, 2020; Environmental Integrity Project et al, New Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry and National Emission Standards for Hazardous Air Pollutants for the Synthetic Organic Chemical Manufacturing Industry and Group I & II Polymers and Resins Industry, 88 Fed. Reg. 25,080 (Apr. 25, 2023) [Docket No. EPA-HQ-OAR-2022-0730]: Comments of Environmental Integrity Project, Sierra Club, and California Communities Against Toxics, submitted July 7, 2023, Attachments A1a and A1b.

[3] U.S. EPA, Memorandum to EPA Docket No. EPA-HQ-OAR-2022-0730 regarding "Clean Air Act Section 112(d)(6) Technology Review for Fenceline Monitoring located in the SOCMI Source Category that are Associated with Processes Subject to HON and for Fenceline Monitoring that are Associated with Processes Subject to Group I Polymers and Resins NESHAP" (Mar. 2023) at 11-18

undercounted emissions of VOC and HRVOC and verified that observed HRVOC in the Houston area are associated with industrial emissions. Data collected during TexAQS 2000 showed that estimates of VOC emissions from petrochemical facilities, in particular alkenes such as ethylene and propylene, were significantly underestimated.[4] The TexAQS II study, conducted in 2005 and 2006, found that, while emissions of HRVOC had decreased, the inventory estimates were still undercounting regulated HRVOC emissions by approximately an order of magnitude.[5]

These underestimates can arise from a variety of causes. Emissions from flares, for example, may be under-reported due to over-steaming, gusting winds, or other operational factors that reduce combustion efficiency. The destruction efficiency of VOCs by flares is estimated rather than measured—U.S. EPA regulations require monitoring of flare operating parameters, but direct measurement of the emissions is not required.[6] However, the efficiency varies and can be much lower than assumed depending on factors such as wind and operating conditions.[7] As noted earlier, the emission factors used to report HRVOC emissions from many sources are inaccurate and outdated, as evidenced by fenceline monitoring results. Some highly reactive VOC like formaldehyde are not recognized by TCEQ at all.

Apparently, neither reported emissions nor ambient concentrations of HRVOC changed significantly between 2012 and 2021, Proposal App. B at 3-17, although median concentrations increased between 10 and 15% in 2021–2022 compared to 2012. But TCEQ does not examine whether the sources of these super-charged ozone precursors are reporting HRVOC emissions any more accurately than they were in 2005 and 2006. TCEQ suggests several that several large sources are responsible for high HRVOC concentrations at several monitoring sites at 3-10 in Appendix B:

> The other more centralized auto-GC, including Lynchburg, Channelview, CView Water Tower, HRM 3, HRM 16, and Deer Park, all indicate the existence of a large source of propylene and to a lesser extent ethylene. This source appears to be in the area south of Lynchburg, southeast of Cview Water Tower, and northeast of HRM16…. There appears to be a large HRVOC source of mostly butenes to the southeast of Galena Park. There also appears to be a large 1,3-butadiene source to the southwest of Milby Park and the north of Cesar.

Proposal App. B at 3-10. But TCEQ goes no further after deciding that it cannot pinpoint the "exact" source of these emissions. Given the disproportionate impact of these facilities on ozone formation, Commenters respectfully suggest that TCEQ identify these upwind sources, require

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[4] Ryerson, T. B., et al., Effect of petrochemical industrial emissions of reactive alkenes and NOx on tropospheric ozone formation in Houston, Texas, J. Geophys. Rsch., Apr. 2003 at 21.
[5] Parrish, D. D., et al., Overview of the Second Texas Air Quality Study (TexAQS II) and the Gulf of Mexico Atmospheric Composition and Climate Study (GoMACCS), J. Geophys. Rsch., Apr. 2009, at 2, 8.
[6] 40 CFR 60.18(b), 40 CFR 63.670; U.S. EPA, 40 CFR Parts 60 and 63
[Docket No. EPA–HQ–OAR–2022–0730; FRL–9327–01–OAR] RIN 2060–AV71 New Source Performance Standards for the Synthetic Organic Chemical Manufacturing Industry and National Emission Standards for Hazardous Air Pollutants for the Synthetic Organic Chemical Manufacturing Industry and Group I & II Polymers and Resins Industry Section III.D.1 (88 FR 25147, Apr. 23, 2023)
[7] U.S. EPA, Parameters for Properly Designed and Operated Flares, Apr. 2012.

sampling and emissions testing to more accurately characterize their HRVOC emissions and develop appropriate strategies to reduce them.

c. TCEQ's proposed SIP revisions do not address the contribution that Emission Events can make to high ozone levels.

Last but not least, EEs can suddenly release large clouds of ethylene, propylene, butadiene, butenes, pentenes and other HRVOC without warning over a few days or even a few hours, adding significantly to the load of highly reactive chemicals the state concedes are a major factor in ozone formation. For example:

1) Between July 16 and July 26, 2019, the Chevron Cedar Bayou plant reported releasing 379 tons of VOC during an EE, including 117 tons of ethylene along with 10 tons of 1,3-butadiene and other HRVOC. See Incident 316022, TCEQ Air Emission Event Report Database.
2) Between June 14 and June 20, 2023, Chevron Cedar Bayou reported an EE releasing 175 tons of VOC, including nearly 56 tons of ethylene, 1,3-butadiene, and other HRVOC. See Incident 402354.
3) Between May 5 and August 5 in 2023, the EE caused by the fire and its aftermath at the Shell Deer Park Chemical Plant released more than 410 tons of VOC, including 57 tons of 1,3-butadiene, ethylene, propylene, and other HRVOC. See Incident 400010.
4) Between September 28 and September 30 in 2023, the Chocolate Bayou Plant in Brazoria County released more than 46 tons of ethylene and other HRVOC during a 28-hour EE. See Incident 410557.
5) A 2019 fire at Intercontinental Terminals, located along the Houston Ship Channel, resulted in emissions of thousands of tons of VOC between March 17, when the fire broke out, and July 1, when the emission event was determined to be "complete." Total emissions included more than 2,600 tons of VOC, of which more at least 907 tons were non-regulated HRVOC such as xylenes (522 tons) and toluene (385 tons) along with regulated HRVOC such as 1,3-butadiene (3 tons). See Incident 304871.

These reported emissions are likely lower than actual emissions given that the estimates relied on emission factors and other computational methods rather than actual measurements.[8] Commenters do not argue that each of these EE contributed to exceedances of the 75 ppb MDA8 standard, as the impact that precursor emissions have on ozone formation depends on meteorology and other factors, e.g., the availability of NOx. Nevertheless, Commenters do not believe any proposal for attaining compliance with the 2008 standard in the HGB area can fail to consider the impact that EE releasing HRVOC in large quantities over short periods of time can have on ozone levels in the HGB area. TCEQ's proposal does not address these impacts in any understandable way.

[8] "Basis Used to Determine Quantities and Any Additional Information Necessary to Evaluate the Event: Emission factors, mass balance, and engineering analysis were used to determine the emissions resulting from the event." TCEQ Air Emission Event Report Database Incident 304871 (https://www2.tceq.texas.gov/oce/eer/index.cfm?fuseaction=main.getDetails&target=304871, accessed on Jan. 12, 2024)

While TCEQ includes annualized upset emissions in its photochemical model, as discussed above, the Conceptual Model appears to exclude EE and Maintenance, Startup, and Shutdown (MSS) emissions. In their discussion of point source emissions trends, only "Annual Emissions" reported in the Emissions Inventory are included in the figures showing VOC and HRVOC emissions by site. The figures do not include EE and MSS emissions, as Figure 1 below demonstrates.

Upsets are a fact of life in the petrochemical corridor and represent a significant proportion of total VOC and HRVOC emissions that contribute to ground level ozone formation. The agency's conceptual model should reflect the total VOC and HRVOC emissions from point sources, including EE and MSS events, to provide an accurate accounting of ozone precursor emissions.

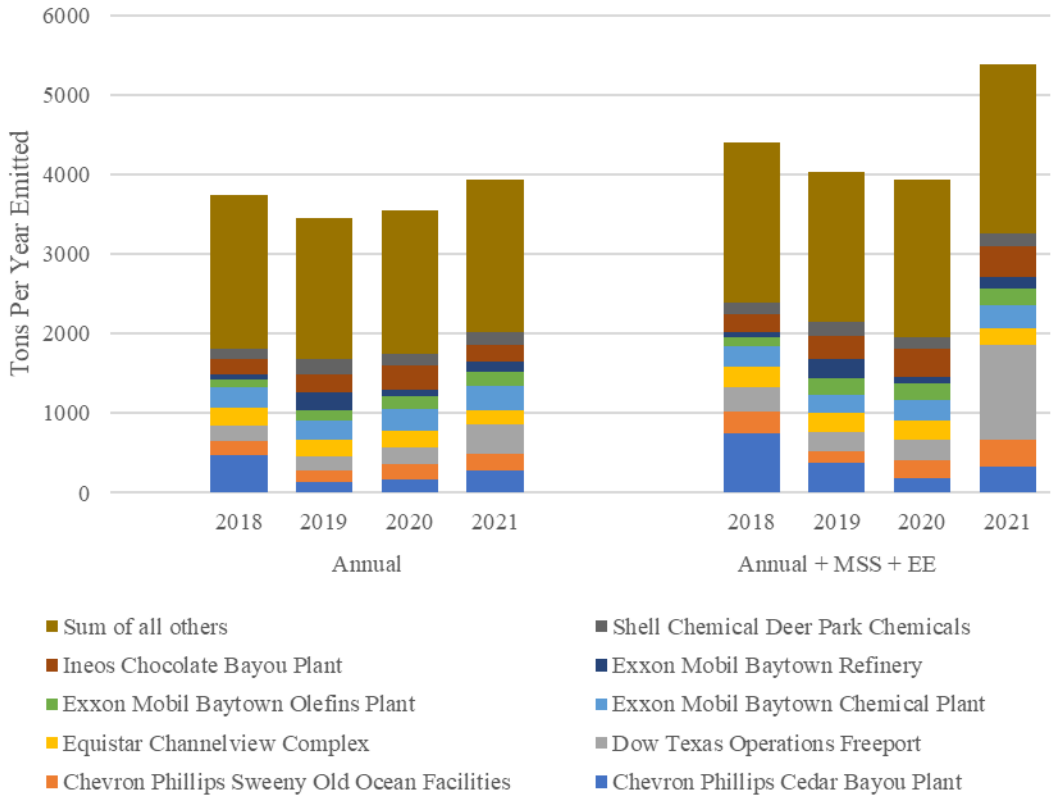

Figure 1. HGB 2008 Nonattainment Area Point Source HRVOC Emissions by Site. Texas Detailed Emissions Inventory 2018–2021. SIP Plan identified only Annual Emissions in its Conceptual Model and should also include Maintenance, Startup and Shutdown emissions and Emission Events. Proposal App. B Fig. 5-10; Proposal App. B Fig. 3-14

Comment 3: VOC-to-NOx ratios show that a balanced approach to controlling both NOx and VOC precursors is needed to reduce ozone formation in the HGB nonattainment area. In particular, the strategy needs to address the VOC-sensitive areas that affect ozone concentrations in communities within or downwind from the industrial sources in the Houston Ship Channel.

TCEQ's assertion that attainment can be achieved by reducing NOx emissions alone is based on photochemical modeling. However, the results of a single modeled scenario should not be relied on to support this assertion. As discussed above, TCEQ's analysis of VOC and NOx observations found that the VOC-to-NOx ratio was primarily in the transitional range, meaning that ozone formation could be reduced by reducing either VOC or NOx. In its modeling guidance, U.S. EPA notes that these ratios should be used with caution as there may be a range of values that can characterize whether the atmospheric chemistry is VOC or NOx limited and, particularly when the observations indicate a transitional regime, "agreement between predictions and observations does not necessarily imply that the response to controls as predicted by the model is correct."[9] To fully test the validity of the model results, TCEQ should conduct a robust analysis of multiple scenarios, including reduction in VOC and HRVOC from point sources, to evaluate options for achieving attainment.

TCEQ explains ozone chemistry in Chapter 4 of its Conceptual Model document, and that the VOC-to-NOx ratio indicates which precursors are most important to ozone formation in the HGB area.

> A NOx limited regime occurs when the radicals from VOC oxidation are abundant, and therefore ozone formation is more sensitive to the amount of NOx present in the atmosphere. In these regimes, controlling NOx would be more effective in reducing ozone concentrations. In VOC limited regimes, NOx is abundant, and therefore ozone formation is more sensitive to the number of radicals from VOC oxidation present in the atmosphere. In VOC limited regimes, controlling VOC emissions would be more effective in reducing ozone concentrations. Areas where ozone formation is not strongly limited by either VOC or NOx are considered transitional and controlling either VOC or NOx emissions would reduce ozone concentrations in these regions.

Proposal App. B at 4-1. Figures 4-1 and 4-2 show that the VOC-to-NOx ratios at several air monitoring stations are on the low end of the "Transitional Region" and cross over into the VOC-Sensitive Region. These VOC-limited monitors (Clinton, Lynchburg Ferry, Haden Rd) are located near the Houston Ship Channel and some of the greatest point sources of VOC and HRVOC emissions.

TCEQ acknowledges that "The area around the Houston Ship Channel exhibits more VOC limited conditions while other parts of the HGB area exhibit more transitional to NOx limited conditions." The final sentence of TCEQ's conceptual model concludes that ozone formation

[9] U.S. EPA, Modeling Guidance for Demonstrating Air Quality Goals for Ozone *(*EPA 454/R-18-009), Nov. 2018 at 93.

may respond to VOC, in particular HRVOC, emissions reductions in some parts of the metro area (i.e. the Ship Channel). However, TCEQ proposes no strategies to achieve such reductions in VOC and HRVOC emissions.

HRVOC emissions, in particular, may have an even greater influence on ozone formation than is currently understood. TCEQ currently does not account for the reactivity of the VOC species in their calculations of VOC-to-NOx ratios. TCEQ should calculate reactivity-weighted VOC-to-NOx ratios to more accurately account for VOC and NOx limitation across the nonattainment area. TCEQ identified a 12 percent median increase of HRVOCs between 2012 and 2022, which has some potential to shift our understanding of VOC and NOx limitation across the area. Since the selection of appropriate ozone reduction strategies will rely on an accurate understanding of VOC and NOx limitation, TCEQ should consider maximum incremental reactivity (MIR) weighted VOC-to-NOx ratios.

As a potential ozone control strategy, Texas should evaluate expanding the current definition of HRVOC to include more compounds. HRVOC are currently defined as ethylene, propylene, 1,3-butadiene, and butenes in Harris County, and as ethylene and propylene throughout the rest of the nonattainment area. 30 TAC § 115.10. However, the MIR-weighted percentages of VOC species at HGB monitoring stations, presented in Conceptual Model Figure 3-10, show that butanes and pentanes make up an even greater proportion of reactive VOCs observed in the HGB. Butanes and pentanes are not included in the existing definition of HRVOC even though they appear to contribute more to the ozone soup than do butenes, which are classified as HRVOC. Compounds including pentanes, butanes, and aromatics, may have an as great or greater impact on ozone formation than do compounds currently regulated as HRVOCs. TCEQ should update their analysis of the contributions of HRVOC species and consider updating its regulations accordingly to bring more VOC emissions under the hourly HRVOC emission limits and annual caps.

Formaldehyde is another HRVOC of particular concern in Houston, not only for its toxicity and carcinogenicity but also for its role in ozone formation.[10] Formaldehyde is only measured at two of TCEQ's ambient air quality monitors, and was measured at both in higher concentrations than ethylene. During the 2023 ozone season, the average concentrations of formaldehyde exceeded those of ethylene at both the Houston Deer Park and Clinton monitors, as shown in Table 1. Formaldehyde has a very similar MIR value to ethylene and is therefore similarly efficient at producing ground-level ozone. TCEQ should expand its formaldehyde monitoring throughout the HGB, further study the contributions of formaldehyde and other compounds not currently regulated as HRVOC, and consider amending its HRVOC rules to incorporate other highly reactive compounds promoting ozone formation in the HGB nonattainment area.

[10] Environmental Integrity Project, Formaldehyde Air Pollution in Houston, Nov. 2021, available at https://environmentalintegrity.org/wp-content/uploads/2021/07/Houston-Formaldehyde-Report-Final-2021.pdf

Table 1: 24-hr Canister sample measurements at Houston Deer Park #2, March–October 2023

Parameter	Average concentration (ppb)	Max concentration (ppb)	Currently regulated as HRVOCs?	Maximum Incremental Reactivity (MIR) value
Formaldehyde	2.45	5.32	No	8.97
Ethylene	1.59	5.85	Yes	9.08
Propylene	0.94	5.77	Yes	11.58

Comment 4: Addressing ozone is an environmental justice issue. Communities of color and low-income communities experience high-ozone conditions more frequently.

In a recently published report by EIP about ozone levels in the Greater Houston Area, EIP discovered that people of color and low-income residents were more likely to live where ozone concentrations reached the highest levels in the summer of 2023 and over the three years from 2021 to 2023.

The report identified six locations in the Houston area that recorded at least one 8-hour ozone level higher than 100 ppb in 2023, which is far above the current ozone limits. At least 90 percent of those living within three miles of four of these monitors—Houston East, Clinton, Haden Road, and Park Place—are people of color, who also account for 73 percent of the population near a fifth monitor at Baytown Garth. While 34 percent of Texans statewide live in low-income households, the proportion is much higher among the populations within three miles of four of these six locations, ranging from 46 percent (Haden Road) to 53 percent (Park Place).

Based on the three-year average from 2021 to 2023, eleven locations measured ozone levels high enough to exceed 75 ppb for 2021–2023. People of color account for more than three quarters of those living within three miles of eight of these eleven locations and more than 90 percent at five of them. Measured in percentages, the proportion of people of color within 10 of these eleven ozone hotspots is significantly higher than either the state or county-wide averages. More than 40 percent of the people living in neighborhoods that surround seven of the eleven monitoring locations with the highest 2021–2023 ozone levels qualify as low-income, according to EPA's EJScreen, which is significantly more than the statewide average.

Ozone at eight of the 10 locations with the highest concentrations in 2021–2023 are about the same or even a little worse than they were in 2008–2010. People of color account for between 76 and 94 percent of the population within three miles of six of the eight monitors where high ozone levels in 2021–2023 are unchanged or have worsened since 2008–2010.

The ozone data used in this analysis was downloaded from the Texas Commission on Environmental Quality yearly air quality monitor summary reports for each monitoring location and the demographic data estimates within three miles of the monitors mentioned came from EPA's Environmental Justice Screening and Mapping Tool Version 2.2 (EJSCREEN 2.2). For

more information, see EIP's report, *Increase in Houston Ozone Violations Hits Communities of Color Hardest*.[11]

Comment 5: Meteorological trends, including increasing temperatures, demonstrate the importance of reducing local emissions of ozone precursors.

Temperature is an important indicator of conditions that promote ozone formation. As TCEQ notes in its conceptual model, high temperatures are often also associated with sunny, cloudless conditions which contribute to ozone formation. Proposal App. B at 5-1. The annual number of days of extreme heat in Texas and in the Houston area have increased and are projected to continue to do so. In a recent climate impact assessment conducted for the City of Houston, the authors found that temperatures were expected to increase leading not only to more days with extreme heat, but also extending the duration of the warm weather seasons that make up the ozone season.[12] This is corroborated by the State Climatologist's prediction of increasing numbers of days with extreme heat, particularly in urban areas, with the yearly number of 100-degree days nearly doubled by 2036 when compared with 2001–2020 temperatures.[13] As ozone season temperatures continue to trend higher, the pattern of ozone exceedances experienced in 2023—when the design value exceeded 75 ppb at eight monitors, with a the highest value of 87 ppb at Bayland Park—can be expected to occur more frequently, as discussed in Comment 1. An appropriate episode year should include more such days, reflecting these well-documented trends.

High ozone days are also associated with low-winds, consistent with the findings of TCEQ's conceptual model. TCEQ observed that on high ozone days there were low wind speeds (less than 10 mph), particularly in the morning and that the winds originate from areas near the Houston Ship Channel. Proposal App. B p 5-5 – 5-9. The conceptual model also evaluates upper-level winds, which represent potential sources outside the region. This analysis found that, in the 72-hour period preceding nearly half of the days in with MDA8 ozone greater than 70 ppb (120 of 251 days), there were slow, recirculating winds which allow locally generated pollution to accumulate and recirculate through the area. Proposal App B, Section 5.4.3. Both of these wind patterns demonstrate the influence of local sources on the region's ozone and the importance of addressing locally produced precursor emissions from industrial point sources.

Conclusion:

The number of high-ozone days experienced in the HGB area this past summer, particularly in communities along the Houston Ship Channel, highlight the importance of addressing emissions

[11] Environmental Integrity Project, Increase in Houston Ozone Violations Hits Communities of Color Hardest, Nov. 2023, available at: https://environmentalintegrity.org/wp-content/uploads/2023/11/EIP_Report_HoustonOzone_Final.pdf.
[12] Stoner, A. and Hayhoe, K, Climate Impact Assessment for the City of Houston, Aug. 2020, at 21, available at https://www.houstontx.gov/mayor/Climate-Impact-Assessment-2020-August.pdf.
[13] Nielsen-Gammon, J. et al, Assessment of Historic and Future Trends of Extreme Weather in Texas, 1900–2036, Office of the State Climatologist, Texas A&M University, Oct. 7, 2021.

of VOC and NOx to reduce ozone formation in the HGB region. As discussed above, reducing industrial emissions, in particular VOC and HRVOC emissions, must be a component of TCEQ's plan to achieve ozone attainment. While the control strategies implemented by TCEQ to date have reduced emissions of ozone precursors in the region, the ongoing occurrence of high-ozone days and MDA8 exceedances demonstrate the importance of aggressively controlling precursor emissions from local industrial sources to prevent ozone formation and protect the health of local residents.

Thank you for your consideration of these comments.

Sincerely,

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CC: Exhibits
Exhibit A: Dates in 2023 where at least one monitor in HGB region exceeded an MDA8 value of 75ppb
Exhibit B: Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023
Exhibit C: Exceedance days and ozone conditions at HGB regulatory monitors April to October, 2019 and 2023

Exhibit A: Dates in 2023 where at least one monitor in HGB region exceeded an MDA8 value of 75ppb

Exhibit A. Dates in 2023 where at least one monitor in HGB region exceeds an MDA8 value of 75ppb			
Date	**Includes Regulatory Monitor?**	**Monitors with MDA8 exceeding 75 ppb**	**MDA8 Range (ppb)**
5/1/2023	Yes	Baytown Garth, Channelview, Clinton, Houston Deer Park #2, Houston East, Houston Harvard Street, HRM-3 Haden Road, Lang, Park Place, UH Launch Trailer, UH Moody Tower, West Houston	76 - 91
5/3/2023	Yes	Baytown Garth, Galveston 99th St., Northwest Harris Co., Texas City 34th St, West Houston	76 - 79
5/17/2023	No	Texas City 34th St	80 - 80
5/18/2023	Yes	Baytown Garth, Baytown Wetlands Center, Bunker Hill Village, Channelview, Clinton, Houston Aldine, Houston Bayland Park, Houston Croquet, Houston Deer Park #2, Houston East, Houston Harvard Street, Houston Monroe, Houston North Wayside, Houston Westhollow, HRM-3 Haden Road, Lang, Lynchburg Ferry, Manvel Croix Park, Park Place, Tom Bass, UH Launch Trailer, UH Moody Tower, UH Smith Point, West Houston	77 - 114
5/19/2023	Yes	Conroe Relocated, Liberty Sam Houston Library, Mercer Arboretum, UH WG Jones Forest	76 - 85
5/22/2023	Yes	Manvel Croix Park, Texas City 34th St	79 - 80
5/23/2023	Yes	Bunker Hill Village, Galveston 99th St., Houston Bayland Park, Houston Croquet, Houston Deer Park #2, Houston Harvard Street, Manvel Croix Park, Park Place, Texas City 34th St, Tom Bass, UH Launch Trailer, UH Moody Tower	76 - 98
5/24/2023	Yes	Galveston 99th St., Manvel Croix Park	76 - 79
5/26/2023	Yes	Galveston 99th St., Houston Bayland Park, Manvel Croix Park, Texas City 34th St, Tom Bass	76 - 79
5/27/2023	Yes	Bunker Hill Village, Clinton, Galveston 99th St., Houston Bayland Park, Houston Croquet, Houston Westhollow, Katy Park, Park Place, Texas City 34th St, UH Launch Trailer, UH Moody Tower, West Houston	76 - 85
5/31/2023	Yes	Northwest Harris Co.	82 - 82
6/1/2023	No	UH WG Jones Forest	80 - 80
6/2/2023	Yes	Baytown Garth, Conroe Relocated, Houston Aldine, Houston East, HRM-3 Haden Road, Meyer Park, Northwest Harris Co., UH WG Jones Forest	77 - 84
6/3/2023	Yes	Baytown Garth	78 - 78
6/4/2023	Yes	Galveston 99th St., Texas City 34th St	80 - 90
6/7/2023	Yes	Baytown Garth, Houston Deer Park #2, Houston East, Houston Harvard Street, Houston Monroe, HRM-3 Haden Road, Lynchburg Ferry, Park Place, Texas City 34th St, Tom Bass, UH Launch Trailer, UH Moody Tower	76 - 89
6/8/2023	Yes	Baytown Garth	79 - 79

Exhibit A. Dates in 2023 where at least one monitor in HGB region exceeds an MDA8 value of 75ppb			
Date	**Includes Regulatory Monitor?**	**Monitors with MDA8 exceeding 75 ppb**	**MDA8 Range (ppb)**
6/9/2023	Yes	Baytown Garth, Channelview, Crosby Library, Houston Aldine, Houston East, Houston Harvard Street, Houston North Wayside, HRM-3 Haden Road, Lynchburg Ferry, Mercer Arboretum, Sheldon, Wallisville Road	76 - 104
7/23/2023	Yes	Channelview, Lynchburg Ferry	76 - 78
7/31/2023	Yes	Baytown Garth, Houston East	77 - 79
8/1/2023	Yes	Baytown Garth, Channelview, Houston Aldine, Houston East, HRM-3 Haden Road, Lynchburg Ferry, Sheldon, Wallisville Road	77 - 100
8/2/2023	No	Mercer Arboretum, Meyer Park, UH WG Jones Forest	78 - 89
8/15/2023	Yes	Baytown Garth, Texas City 34th St	77 - 79
8/16/2023	Yes	Baytown Garth, Houston Bayland Park, Houston Croquet, Houston Deer Park #2, Houston Monroe, Manvel Croix Park, Park Place, Tom Bass, UH Launch Trailer, UH Moody Tower	76 - 84
8/17/2023	Yes	Baytown Garth	83 - 83
8/18/2023	Yes	Baytown Garth, Mercer Arboretum, UH WG Jones Forest	79 - 83
8/19/2023	Yes	Baytown Garth	78 - 78
8/20/2023	Yes	Baytown Garth	78 - 78
8/24/2023	Yes	Houston Bayland Park, Park Place, UH Launch Trailer, UH Moody Tower	76 - 83
8/25/2023	Yes	Northwest Harris Co.	79 - 79
8/26/2023	Yes	Houston East, Houston Harvard Street, Lang, UH Launch Trailer, West Houston	76 - 78
8/28/2023	Yes	Galveston 99th St., Houston Bayland Park, Lake Jackson, Manvel Croix Park, Oyster Creek, Texas City 34th St, Tom Bass	78 - 89
8/30/2023	Yes	Galveston 99th St.	80 - 80
8/31/2023	Yes	Galveston 99th St., Houston Bayland Park, Houston Deer Park #2, Manvel Croix Park, Oyster Creek, Texas City 34th St, Tom Bass, UH Smith Point	76 - 84
9/1/2023	Yes	Bunker Hill Village, Galveston 99th St., Houston Bayland Park, Houston Croquet, Houston Deer Park #2, Houston East, Houston Westhollow, Lang, Manvel Croix Park, Park Place, Texas City 34th St, Tom Bass, UH Launch Trailer, West Houston	76 - 88
9/2/2023	Yes	Clinton, Houston Bayland Park, Houston East, Houston Harvard Street, Lang, Park Place, UH Launch Trailer, UH Moody Tower, West Houston	77 - 82
9/9/2023	Yes	Houston Bayland Park, Houston Deer Park #2, Houston Westhollow, Katy Park, Lang, Tom Bass, West Houston	76 - 85
9/10/2023	Yes	Galveston 99th St.	76 - 76

Exhibit A. Dates in 2023 where at least one monitor in HGB region exceeds an MDA8 value of 75ppb			
Date	**Includes Regulatory Monitor?**	**Monitors with MDA8 exceeding 75 ppb**	**MDA8 Range (ppb)**
9/11/2023	Yes	Clinton, Houston Bayland Park, Houston Croquet, Houston Deer Park #2, Houston East, Houston Harvard Street, Houston Monroe, Houston Westhollow, HRM-3 Haden Road, Lang, Lynchburg Ferry, Manvel Croix Park, Meyer Park, Park Place, Texas City 34th St, Tom Bass, UH Launch Trailer, UH Moody Tower, Wallisville Road, West Houston	77 - 97
9/12/2023	Yes	Atascocita, Baytown Wetlands Center, Channelview, Clinton, Crosby Library, Houston Aldine, Houston Bayland Park, Houston Deer Park #2, Houston East, Houston Harvard Street, HRM-3 Haden Road, Lang, Lynchburg Ferry, Mercer Arboretum, Sheldon, UH Launch Trailer, UH Moody Tower, Wallisville Road	76 - 97
9/17/2023	Yes	Galveston 99th St., Oyster Creek	78 - 83
9/18/2023	Yes	Houston Bayland Park, Houston Croquet, Houston Westhollow, Katy Park, Manvel Croix Park, Park Place, Tom Bass, UH Moody Tower, West Houston	76 - 97
9/19/2023	Yes	Houston Bayland Park, Lang, Meyer Park, Northwest Harris Co., UH WG Jones Forest, West Houston	77 - 89
9/26/2023	Yes	Galveston 99th St., Houston Deer Park #2	80 - 86
9/27/2023	Yes	Park Place	76 - 76
9/28/2023	Yes	Houston Bayland Park	80 - 80

All ozone data was downloaded from the Texas Commission on Environmental Quality (TCEQ) Eight-Hour Ozone High Value Days for 2023.
Texas Commission on Environmental Quality web page, "Eight-Hour Ozone High Value Days for 2023"

Exhibit B: Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Atascocita	2023	62	70	1
Atascocita	2022	59	58	
Atascocita	2021	57	59	1
Atascocita	2020	63	59	
Atascocita	2019	65	54	
Atascocita	2018	68	77	5
Atascocita	2017	65	64	1
Atascocita	2016	64	64	
Atascocita	2015	68	66	
Atascocita	2014	73	63	
Atascocita	2013	79	74	1
Atascocita	2012	82	82	6
Atascocita	2011	80	81	10
Atascocita	2010	80	82	8
Atascocita	2009		76	4
Atascocita	2008		81	4
Baytown Garth	2023	75	83	15
Baytown Garth	2022	69	71	2
Baytown Garth	2021	69	71	2
Baytown Garth	2020	72	66	2
Baytown Garth	2019	74	69	1
Baytown Garth	2018	73	81	7
Baytown Garth	2017	72	73	2
Baytown Garth	2016	70	65	
Baytown Garth	2015	68	77	4
Baytown Garth	2014	66	67	
Baytown Garth	2013		61	
Baytown Garth	2012		71	1
Baytown Wetlands Center	2023	65	72	2
Baytown Wetlands Center	2022	62	61	
Baytown Wetlands Center	2021	62	63	
Baytown Wetlands Center	2020	59	63	1
Baytown Wetlands Center	2019	56	61	
Baytown Wetlands Center	2018	53	54	
Baytown Wetlands Center	2017	55	53	
Baytown Wetlands Center	2016	58	52	
Baytown Wetlands Center	2015	62	60	
Baytown Wetlands Center	2014	68	61	
Baytown Wetlands Center	2013	72	65	1
Baytown Wetlands Center	2012	76	77	7
Baytown Wetlands Center	2011	75	74	2
Baytown Wetlands Center	2010	74	78	7
Baytown Wetlands Center	2009		72	2

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Baytown Wetlands Center	2008		72	3
Bunker Hill Village	2023	72	76	4
Bunker Hill Village	2022	67	67	1
Bunker Hill Village	2021	64	73	1
Bunker Hill Village	2020	60	61	
Bunker Hill Village	2019	64	58	
Bunker Hill Village	2018	69	62	
Bunker Hill Village	2016	70	71	3
Bunker Hill Village	2015	71	74	2
Bunker Hill Village	2014	72	65	
Bunker Hill Village	2013	79	73	2
Bunker Hill Village	2012	81	77	5
Bunker Hill Village	2011	84	88	9
Bunker Hill Village	2010	81	78	5
Bunker Hill Village	2009		85	10
Bunker Hill Village	2008		81	11
Channelview	2023	72	85	6
Channelview	2022	64	63	
Channelview	2021	66	68	2
Channelview	2020	69	62	1
Channelview	2019	70	67	1
Channelview	2018	68	79	5
Channelview	2017	69	65	1
Channelview	2016	69	61	
Channelview	2015	69	81	5
Channelview	2014	67	64	
Channelview	2013	73	61	1
Channelview	2012	79	77	4
Channelview	2011	80	81	8
Channelview	2010	78	79	4
Channelview	2009		80	4
Channelview	2008		76	5
Clinton	2023	76	82	6
Clinton	2022	72	76	4
Clinton	2021	71	70	1
Clinton	2020	71	71	
Clinton	2019	73	73	3
Clinton	2018	70	68	1
Clinton	2017	75	77	4
Clinton	2016	69	65	
Clinton	2015	70	84	7
Clinton	2014	69	58	
Clinton	2013	76	67	

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Clinton	2012	80	81	4
Clinton	2011	79	80	5
Clinton	2010	76	79	4
Clinton	2009		78	5
Clinton	2008		71	2
Conroe Relocated	2023	72	72	2
Conroe Relocated	2022	73	73	2
Conroe Relocated	2021	73	70	1
Conroe Relocated	2020	75	75	3
Conroe Relocated	2019	76	74	2
Conroe Relocated	2018	75	75	3
Conroe Relocated	2017	74	79	5
Conroe Relocated	2016	72	71	1
Conroe Relocated	2015	73	73	1
Conroe Relocated	2014	76	72	1
Conroe Relocated	2013	79	75	3
Conroe Relocated	2012	80	82	6
Conroe Relocated	2011	74	80	8
Conroe Relocated	2010	72	77	4
Conroe Relocated	2009		65	
Conroe Relocated	2008		73	2
Crosby Library	2023	65	71	2
Crosby Library	2022	60	60	
Crosby Library	2021	60	64	
Crosby Library	2020	66	57	
Crosby Library	2019	70	59	
Crosby Library	2018	73	82	8
Crosby Library	2017	69	69	2
Crosby Library	2016	67	67	
Crosby Library	2015	69	70	
Crosby Library	2014	71	65	
Crosby Library	2013	75	71	1
Crosby Library	2012	79	77	4
Crosby Library	2011	78	78	9
Crosby Library	2010	78	83	14
Crosby Library	2009		73	2
Crosby Library	2008		77	4
Galveston 99th Street	2023	75	81	13
Galveston 99th Street	2022	70	73	2
Galveston 99th Street	2021	72	70	1
Galveston 99th Street	2020	74	68	2
Galveston 99th Street	2019	76	79	4
Galveston 99th Street	2018	74	76	4

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Galveston 99th Street	2017	77	73	2
Galveston 99th Street	2016	76	74	2
Galveston 99th Street	2015	73	84	10
Galveston 99th Street	2014	72	71	1
Galveston 99th Street	2013	75	64	
Galveston 99th Street	2012	80	81	5
Galveston 99th Street	2011	78	79	5
Galveston 99th Street	2010	75	80	8
Galveston 99th Street	2009		76	4
Galveston 99th Street	2008		69	2
Houston Aldine	2023	72	78	5
Houston Aldine	2022	69	64	
Houston Aldine	2021	75	75	3
Houston Aldine	2020	79	68	
Houston Aldine	2019	81	81	4
Houston Aldine	2018	79	88	8
Houston Aldine	2017	81	74	3
Houston Aldine	2016	79	74	2
Houston Aldine	2015	79	95	14
Houston Aldine	2014	72	68	
Houston Aldine	2013	77	74	2
Houston Aldine	2012	82	75	3
Houston Aldine	2011	83	83	11
Houston Aldine	2010	83	87	11
Houston Aldine	2009		80	8
Houston Aldine	2008		83	12
Houston Bayland Park	2023	83	87	16
Houston Bayland Park	2022	78	84	7
Houston Bayland Park	2021	77	78	6
Houston Bayland Park	2020	77	73	2
Houston Bayland Park	2019	77	80	8
Houston Bayland Park	2018	76	77	4
Houston Bayland Park	2017	77	74	2
Houston Bayland Park	2016	75	78	4
Houston Bayland Park	2015	76	80	7
Houston Bayland Park	2014	75	67	
Houston Bayland Park	2013	82	81	7
Houston Bayland Park	2012	81	77	5
Houston Bayland Park	2011	84	87	9
Houston Bayland Park	2010	82	78	6
Houston Bayland Park	2009		86	7
Houston Bayland Park	2008		83	6
Houston Croquet	2023	78	80	7

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Houston Croquet	2022	74	72	1
Houston Croquet	2021	75	83	8
Houston Croquet	2020	70	66	2
Houston Croquet	2019	71	75	3
Houston Croquet	2018	68	70	1
Houston Croquet	2017	71	67	
Houston Croquet	2016	71	67	
Houston Croquet	2015	75	79	7
Houston Croquet	2014	75	67	1
Houston Croquet	2013	81	79	6
Houston Croquet	2012	80	79	9
Houston Croquet	2011	81	85	11
Houston Croquet	2010	78	77	6
Houston Croquet	2009		80	6
Houston Croquet	2008		76	4
Houston Deer Park #2	2023	75	83	11
Houston Deer Park #2	2022	72	68	1
Houston Deer Park #2	2021	74	74	3
Houston Deer Park #2	2020	78	73	2
Houston Deer Park #2	2019	76	76	4
Houston Deer Park #2	2018	71	85	6
Houston Deer Park #2	2017	68	66	2
Houston Deer Park #2	2016	67	62	
Houston Deer Park #2	2015	70	77	6
Houston Deer Park #2	2014	72	63	1
Houston Deer Park #2	2013	79	69	1
Houston Deer Park #2	2012	84	85	8
Houston Deer Park #2	2011	83	83	10
Houston Deer Park #2	2010	81	85	8
Houston Deer Park #2	2009		82	7
Houston Deer Park #2	2008		76	5
Houston East	2023	80	90	12
Houston East	2022	72	73	2
Houston East	2021	71	76	5
Houston East	2020	73	67	1
Houston East	2019	74	70	2
Houston East	2018	73	82	6
Houston East	2017	75	70	1
Houston East	2016	74	67	
Houston East	2015	74	88	11
Houston East	2014	73	66	
Houston East	2013	80	69	1
Houston East	2012	82	83	7

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	**Year**	**Design Value (ppb)**	**Fourth Highest MDA8 Value (ppb)**	**Number of days where MDA8 was > 75 ppb**
Houston East	2011	81	88	15
Houston East	2010	76	76	4
Houston East	2009		79	6
Houston East	2008		73	3
Houston Harvard Street	2023	78	78	9
Houston Harvard Street	2022		78	8
Houston Harvard Street	2021		79	7
Houston Monroe	2023	69	78	4
Houston Monroe	2022	63	60	
Houston Monroe	2021	67	68	1
Houston Monroe	2020	67	62	1
Houston Monroe	2019	66	71	3
Houston Monroe	2018	61	68	1
Houston Monroe	2017	63	59	
Houston Monroe	2016	65	57	
Houston Monroe	2015	71	73	3
Houston Monroe	2014	75	65	1
Houston Monroe	2013	78	74	3
Houston Monroe	2012	79	85	7
Houston Monroe	2011	74	76	5
Houston Monroe	2010	73	75	3
Houston Monroe	2009		71	3
Houston Monroe	2008		72	
Houston North Wayside	2023	67	74	2
Houston North Wayside	2022	63	62	
Houston North Wayside	2021	64	65	
Houston North Wayside	2020	65	61	
Houston North Wayside	2019	67	67	
Houston North Wayside	2018	65	66	3
Houston North Wayside	2017	69	68	1
Houston North Wayside	2016	67	62	
Houston North Wayside	2015	70	78	5
Houston North Wayside	2014	69	62	
Houston North Wayside	2013	75	70	1
Houston North Wayside	2012	77	75	3
Houston North Wayside	2011	75	80	7
Houston North Wayside	2010	72	76	5
Houston North Wayside	2009		70	1
Houston North Wayside	2008		70	2
Houston Westhollow	2023	74	77	6
Houston Westhollow	2022	71	73	1
Houston Westhollow	2021	71	71	1
Houston Westhollow	2020	70	69	

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Houston Westhollow	2019	71	73	3
Houston Westhollow	2018	73	69	3
Houston Westhollow	2017	76	71	1
Houston Westhollow	2016	76	79	6
Houston Westhollow	2015	75	79	4
Houston Westhollow	2014	76	70	1
Houston Westhollow	2013	80	77	5
Houston Westhollow	2012	78	81	7
Houston Westhollow	2011	75	81	7
Houston Westhollow	2010	75	72	2
Houston Westhollow	2009		71	2
Houston Westhollow	2008		82	5
HRM #3 Haden Road	2023	77	86	8
HRM #3 Haden Road	2022	69	72	1
HRM #3 Haden Road	2021	69	74	3
HRM #3 Haden Road	2020	70	61	1
HRM #3 Haden Road	2019	73	71	1
HRM #3 Haden Road	2018	72	77	5
HRM #3 Haden Road	2017	78	70	1
HRM #3 Haden Road	2016	77	69	1
HRM #3 Haden Road	2015	78	95	11
HRM #3 Haden Road	2014	73	68	
HRM #3 Haden Road	2013	78	70	1
HRM #3 Haden Road	2012	79	82	7
HRM #3 Haden Road	2011	77	81	8
HRM #3 Haden Road	2010	74	75	3
HRM #3 Haden Road	2009		76	4
HRM #3 Haden Road	2008		71	2
Huffman Wolf Road	2023	65	71	
Huffman Wolf Road	2022	64	63	
Huffman Wolf Road	2021	65	62	
Huffman Wolf Road	2020	58	68	
Huffman Wolf Road	2019	52	64	1
Huffman Wolf Road	2018	52	43	
Huffman Wolf Road	2017	59	49	
Huffman Wolf Road	2016	64	65	
Huffman Wolf Road	2015	64	64	
Huffman Wolf Road	2014	69	64	
Huffman Wolf Road	2013	74	65	1
Huffman Wolf Road	2012	78	79	6
Huffman Wolf Road	2011		79	5
Huffman Wolf Road	2010		76	4
Katy Park	2023	71	75	3

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Katy Park	2022	67	70	
Katy Park	2021	67	67	
Katy Park	2020	64	64	
Katy Park	2019	62	71	1
Katy Park	2018	61	57	
Katy Park	2017	63	59	
Katy Park	2016	63	68	1
Katy Park	2015	61	63	
Katy Park	2014	64	59	1
Katy Park	2013	69	60	
Katy Park	2012	73	73	3
Katy Park	2011	73	75	3
Katy Park	2010	75	70	1
Katy Park	2009		73	3
Katy Park	2008		83	7
La Porte Sylvan Beach	2023	64	69	
La Porte Sylvan Beach	2022	61	60	
La Porte Sylvan Beach	2021	58	62	2
La Porte Sylvan Beach	2020	53	60	1
La Porte Sylvan Beach	2019	52	52	
La Porte Sylvan Beach	2018	54	46	
La Porte Sylvan Beach	2017	68	58	1
La Porte Sylvan Beach	2016	71	59	
La Porte Sylvan Beach	2015	74	86	8
La Porte Sylvan Beach	2014	74	67	
La Porte Sylvan Beach	2013	78	68	1
La Porte Sylvan Beach	2012	82	87	9
La Porte Sylvan Beach	2011	81	80	6
La Porte Sylvan Beach	2010	79	80	6
La Porte Sylvan Beach	2009		84	6
La Porte Sylvan Beach	2008		72	2
Lake Jackson	2023	70	73	1
Lake Jackson	2022	68	69	
Lake Jackson	2021	66	69	1
Lake Jackson	2020	65	65	
Lake Jackson	2019	65	63	
Lake Jackson	2018	66	68	1
Lake Jackson	2017	65	65	
Lake Jackson	2016	64	66	
Lake Jackson	2015	64	65	
Lake Jackson	2014	66	61	
Lake Jackson	2013	70	67	
Lake Jackson	2012	72	71	2

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Lake Jackson	2011	74	73	3
Lake Jackson	2010	75	72	1
Lake Jackson	2009		76	4
Lake Jackson	2008		76	4
Lang	2023	75	83	9
Lang	2022	70	71	3
Lang	2021	72	71	2
Lang	2020	73	69	
Lang	2019	73	75	2
Lang	2018	71	74	3
Lang	2017	77	70	1
Lang	2016	75	69	2
Lang	2015	78	91	9
Lang	2014	75	64	
Lang	2013	79	79	4
Lang	2012	79	81	8
Lang	2011	79	78	6
Lang	2010	76	77	6
Lang	2009		81	4
Lang	2008		71	
Lynchburg Ferry	2023	70	82	7
Lynchburg Ferry	2022	63	63	
Lynchburg Ferry	2021	65	65	1
Lynchburg Ferry	2020	68	61	1
Lynchburg Ferry	2019	62	68	1
Lynchburg Ferry	2018	59	74	3
Lynchburg Ferry	2017	61	44	
Lynchburg Ferry	2016	66	59	
Lynchburg Ferry	2015	67	79	4
Lynchburg Ferry	2014	66	59	
Lynchburg Ferry	2013	71	64	1
Lynchburg Ferry	2012	77	75	3
Lynchburg Ferry	2011	76	73	2
Lynchburg Ferry	2010	74	83	5
Lynchburg Ferry	2009		73	3
Lynchburg Ferry	2008		65	
Manvel Croix Park	2023	77	82	11
Manvel Croix Park	2022	73	72	1
Manvel Croix Park	2021	75	77	5
Manvel Croix Park	2020	73	70	2
Manvel Croix Park	2019	76	79	5
Manvel Croix Park	2018	72	71	3
Manvel Croix Park	2017	77	77	5

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Manvel Croix Park	2016	75	69	
Manvel Croix Park	2015	80	86	8
Manvel Croix Park	2014	81	71	3
Manvel Croix Park	2013	87	84	7
Manvel Croix Park	2012	88	87	13
Manvel Croix Park	2011	90	90	20
Manvel Croix Park	2010	85	88	15
Manvel Croix Park	2009		91	8
Manvel Croix Park	2008		75	3
Mercer Arboretum	2023	67	78	5
Mercer Arboretum	2022	62	66	1
Mercer Arboretum	2021	57	58	
Mercer Arboretum	2020	54	62	
Mercer Arboretum	2019	52	50	
Mercer Arboretum	2017	59	49	
Mercer Arboretum	2016	65	58	1
Mercer Arboretum	2015	72	71	1
Mercer Arboretum	2014	75	65	
Mercer Arboretum	2013	82	81	6
Mercer Arboretum	2012	85	78	4
Mercer Arboretum	2011	84	88	15
Mercer Arboretum	2010	80	89	10
Mercer Arboretum	2009		76	4
Mercer Arboretum	2008		76	4
Meyer Park	2023	70	77	4
Meyer Park	2022	66	68	
Meyer Park	2021	67	66	1
Meyer Park	2020	61	65	2
Meyer Park	2019	57	69	2
Meyer Park	2018	53	50	
Meyer Park	2017	62	52	
Meyer Park	2016	65	58	
Meyer Park	2015	73	75	3
Meyer Park	2014	73	63	
Meyer Park	2013	80	81	10
Meyer Park	2012	80	74	2
Meyer Park	2011	82	86	8
Meyer Park	2010	79	81	7
Meyer Park	2009		80	7
Meyer Park	2008		76	4
Northwest Harris County	2023	74	79	5
Northwest Harris County	2022	71	74	3
Northwest Harris County	2021	71	69	

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	Year	Design Value (ppb)	Fourth Highest MDA8 Value (ppb)	Number of days where MDA8 was > 75 ppb
Northwest Harris County	2020	74	71	2
Northwest Harris County	2019	75	73	3
Northwest Harris County	2018	73	77	4
Northwest Harris County	2017	73	74	3
Northwest Harris County	2016	69	67	2
Northwest Harris County	2015	74	78	4
Northwest Harris County	2014	75	63	
Northwest Harris County	2013	83	80	4
Northwest Harris County	2012	83	82	9
Northwest Harris County	2011	85	86	15
Northwest Harris County	2010	81	82	7
Northwest Harris County	2009		86	6
Northwest Harris County	2008		76	4
Park Place	2023	78	85	12
Park Place	2022	73	72	2
Park Place	2021	73	78	5
Park Place	2020	73	70	2
Park Place	2019	74	72	3
Park Place	2018	71	77	4
Park Place	2017	75	72	1
Park Place	2016	73	65	
Park Place	2015	77	87	8
Park Place	2014	74	66	
Park Place	2013	78	79	4
Park Place	2012	80	77	7
Park Place	2011	79	79	5
Park Place	2010	78	84	8
Park Place	2009		73	3
Park Place	2008		76	4
Seabrook Friendship Park	2023	64	73	
Seabrook Friendship Park	2022	61	59	
Seabrook Friendship Park	2021	63	60	2
Seabrook Friendship Park	2020	70	64	
Seabrook Friendship Park	2019	71	64	1
Seabrook Friendship Park	2018	71	82	6
Seabrook Friendship Park	2017	71	67	2
Seabrook Friendship Park	2016	71	64	
Seabrook Friendship Park	2015	72	83	5
Seabrook Friendship Park	2014	73	65	
Seabrook Friendship Park	2013	77	67	2
Seabrook Friendship Park	2012	81	86	8
Seabrook Friendship Park	2011	78	79	7
Seabrook Friendship Park	2010	76	77	4

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	**Year**	**Design Value (ppb)**	**Fourth Highest MDA8 Value (ppb)**	**Number of days where MDA8 was > 75 ppb**
Seabrook Friendship Park	2009		79	5
Seabrook Friendship Park	2008		71	1
Sheldon	2023	63	71	3
Sheldon	2022	58	62	
Sheldon	2021	54	57	
Sheldon	2020	50	56	
Sheldon	2019	51	49	
Sheldon	2017	58	44	
Sheldon	2016	67	61	
Sheldon	2015	69	70	3
Sheldon	2014	70	71	
Sheldon	2013	73	65	
Sheldon	2012	76	73	3
Sheldon	2011	76	80	6
Sheldon	2010	74	76	4
Sheldon	2009		71	3
Sheldon	2008		75	3
Texas City 34th Street	2023	78	83	13
Texas City 34th Street	2022	75	76	4
Texas City 34th Street	2021	74	74	1
Texas City 34th Street	2020	75	75	3
Texas City 34th Street	2019	74	73	2
Texas City 34th Street	2018	72	78	5
Texas City 34th Street	2017	75	70	2
Texas City 34th Street	2016	73	67	1
Texas City 34th Street	2015	74	87	8
Texas City 34th Street	2014	72	65	
Texas City 34th Street	2013	76	69	1
Texas City 34th Street	2012	80	83	8
Texas City 34th Street	2011	77	77	4
Texas City 34th Street	2010	75	80	8
Texas City 34th Street	2009		73	3
Texas City 34th Street	2008		72	3
Tom Bass	2023	76	85	11
Tom Bass	2022	70	68	
Tom Bass	2021	74	76	4
Tom Bass	2020	67	67	2
Tom Bass	2019	64	79	5
Tom Bass	2018	58	55	1
Tom Bass	2017	62	59	
Tom Bass	2016	63	59	
Tom Bass	2015	67	69	2
Tom Bass	2014	70	61	

Exhibit B. Fourth highest MDA8 ozone levels and three-year design values for HGB monitors, 2008 to 2023				
Monitor Name	**Year**	**Design Value (ppb)**	**Fourth Highest MDA8 Value (ppb)**	**Number of days where MDA8 was > 75 ppb**
Tom Bass	2013	77	72	3
Tom Bass	2012	80	77	4
Tom Bass	2011	84	82	11
Tom Bass	2010	83	80	9
Tom Bass	2009		89	6
Tom Bass	2008		81	7
Wallisville Road	2023	70	78	4
Wallisville Road	2022	66	66	
Wallisville Road	2021	67	67	1
Wallisville Road	2020	72	66	1
Wallisville Road	2019	73	68	1
Wallisville Road	2018	72	81	9
Wallisville Road	2017	69	70	1
Wallisville Road	2016	69	65	
Wallisville Road	2015	72	72	1
Wallisville Road	2014	75	71	2
Wallisville Road	2013	81	72	2
Wallisville Road	2012	85	82	5
Wallisville Road	2011	83	89	13
Wallisville Road	2010	82	85	11
Wallisville Road	2009		75	2
Wallisville Road	2008		85	7
West Houston	2023	79	84	11
West Houston	2022	72	76	4
West Houston	2021	69	77	6
West Houston	2020	65	63	
West Houston	2019	65	67	2
West Houston	2017	67	64	
West Houston	2016	67	63	2
West Houston	2015	72	75	3
West Houston	2014	74	64	
West Houston	2013	81	78	4
West Houston	2012	81	81	5
West Houston	2011	81	84	10
West Houston	2010	81	78	7
West Houston	2009		82	9
West Houston	2008		82	7

All ozone data was downloaded from the Texas Commission on Environmental Quality (TCEQ) yearly summary reports for each monitoring location.

Texas Commission on Environmental Quality web page, "Data by Year by Parameter"

Exhibit C: Exceedance days and ozone conditions at HGB regulatory monitors April to October, 2019 and 2023

Exhibit C. Exceedance days and ozone conditions at HGB regulatory monitors April to October, 2019 and 2023						
Monitor Name	Maximum Eight Hour Ozone Concentration (ppb)		Number of days where max 8-hour average was > 75 ppb		Design Value (ppb)	
	2019	2023	2019	2023	2019	2023
Baytown Garth	76	104	1	15	74	75
Channelview	76	91	1	6	70	72
Clinton	92	108	3	6	73	76
Conroe Relocated	83	77	2	2	76	72
Galveston 99th Street	81	89	4	13	76	75
Houston Aldine	93	81	4	5	81	72
Houston Bayland Park	91	97	8	16	77	83
Houston Croquet	84	92	3	7	71	78
Houston Deer Park #2	107	95	4	11	76	75
Houston East	88	110	2	12	74	80
Houston Monroe	82	83	3	4	66	69
Houston North Wayside	74	84	0	2	67	67
Houston Westhollow	77	86	3	6	71	74
Lake Jackson	68	80	0	1	65	70
Lang	88	96	2	9	73	75
Lynchburg Ferry	77	99	1	7	62	70
Manvel Croix Park	90	88	5	11	76	77
Northwest Harris County	86	89	3	5	75	79
Park Place	88	101	3	12	74	78
Seabrook Friendship Park	90	75	1	0	71	64

All ozone data was downloaded from the Texas Commission on Environmental Quality (TCEQ) yearly summary reports for each monitoring location.

Texas Commission on Environmental Quality web page, "Data by Year by Parameter"