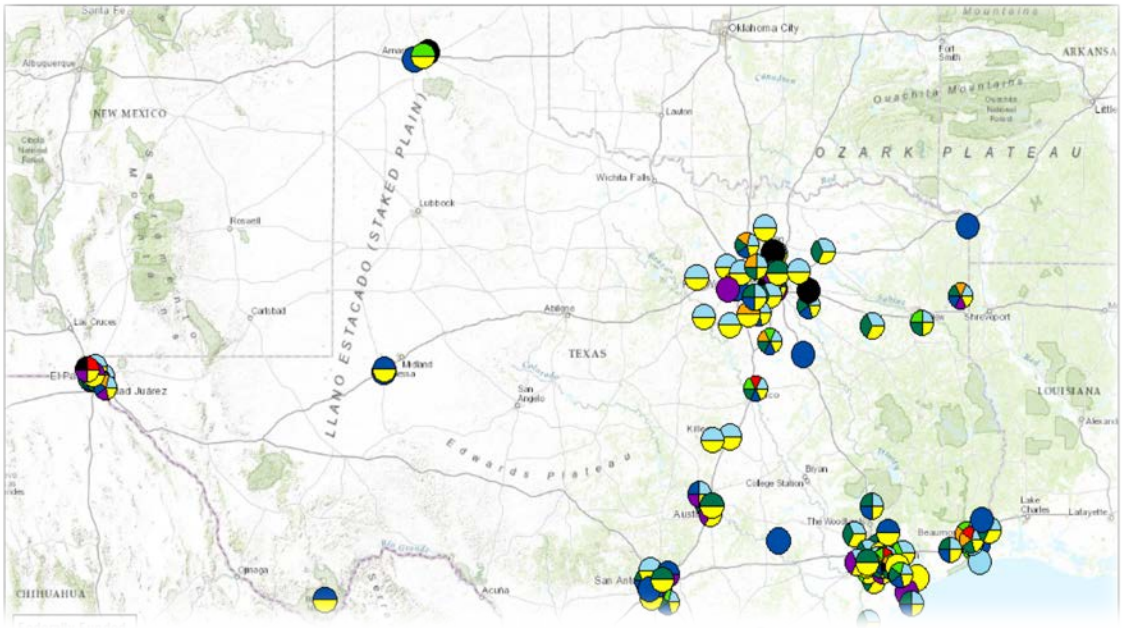
Texas Commission on Environmental Quality

Texas Five-Year Ambient Monitoring Network Assessment



2015

TCEQ

Executive Summary

The Texas Commission on Environmental Quality (TCEQ) conducted an assessment of the Texas air monitoring network in fulfilment of 40 Code of Federal Regulations (CFR) Part 58.10(d). The TCEQ evaluated the existing network of ambient air monitors measuring ozone, carbon monoxide (CO), oxides of nitrogen (NO_x), sulfur dioxide (SO_2), lead (Pb), particulate matter of 10 micrometers or less in diameter (PM_{10}), particulate matter of 2.5 micrometers or less in diameter ($PM_{2.5}$), volatile organic compounds (VOCs), carbonyls, semivolatile organic compounds (SVOCs), and speciated $PM_{2.5}$. Only monitors meeting some federal obligation, either through rule or grant commitment, were included in this evaluation.

This evaluation is intended to determine if the current network continues to meet Texas' needs and federal requirements. Any proposed changes to the monitoring network are provided to the United States Environmental Protection Agency (EPA) in the annual monitoring network plan and are, therefore, not included in this evaluation. A 30-day public comment period is provided for both this five year assessment and the annual monitoring network plan.

The assessment of the Texas air monitoring network indicates that the existing network is adequate for evaluating ambient air quality and meets federal requirements. Monitors are located in areas of dense population and, when appropriate, in areas with the greatest impact(s) from point and international sources of air pollutants.

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Introduction

Since 1970, the United States Environmental Protection Agency (EPA) has been responsible for establishing and, when necessary, updating national ambient air quality standards (NAAQS) under the Federal Clean Air Act (FCAA). The EPA assigned responsibility for designing and implementing ambient air quality surveillance networks to determine compliance with these NAAQS to state air pollution control agencies. As monitors were deployed, air quality issues were addressed, and changes in populations and landscapes occurred, it became necessary to re-evaluate the monitoring network's design. In 2006, the EPA finalized a requirement to conduct an assessment of these networks every five years. The EPA's final regulation, found in 40 CFR Part 58.10, requires:

> (d) The state, or where applicable local, agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in appendix D to this part, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby states and tribes or health effects studies. The state, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator. The assessments are due every five years beginning July 1, 2010.

In compliance with the 40 CFR Part 58.10 requirement, the TCEQ conducted this assessment of the Texas ambient air monitoring network. The assessment was intended to determine whether the existing network of regulatory ambient air quality monitors still meets the required objectives in 40 CFR Part 58, Appendix D. This assessment also evaluated whether individual monitors within this network should be added, moved, or decommissioned to best understand and evaluate air quality given existing resources.

This assessment does not include an in-depth analysis of the monitoring network's compliance with the federal monitoring network design requirements found in 40 CFR Part 58. The TCEQ provides this detailed analysis of 40 CFR Part 58 network design requirements and how the network meets these requirements in its annual monitoring network plan. In its January 14, 2015, letter, the EPA approved the TCEQ's *2014 Annual Monitoring Network Plan*, indicating that the existing network met the current monitoring requirements. An updated analysis is provided in the TCEQ's *2015 Annual Monitoring Network Plan*, which was made available for public review and comment on May 22, 2015.

Due to the stated purpose of this assessment, the TCEQ did not include an evaluation of monitors that are funded through non-federal mechanisms or are operated for purposes

other than complying with federal monitoring requirements. The TCEQ uses the data from these monitors for many purposes and often locates these monitors to address local public health and welfare concerns. Information and data from these state-initiated monitors are available to the public on the TCEQ's Texas Air Monitoring Information System (TAMIS) (http://www.tceq.texas.gov/goto/tamis).

Evaluation Methods

Overview

Texas has a diverse geography, population, and economy. In addition, each ambient air pollutant evaluated differs in its emission source, transport, and fate in the environment. Due to this pollutant complexity and diverse regional characteristics, the TCEQ divided the statewide monitoring assessment into smaller pollutant assessments within six major areas of Texas: coastal (Houston, Beaumont, and Corpus Christi regions), north and northeast (Dallas-Fort Worth and Tyler regions), central (Waco, Austin, and San Antonio regions), panhandle and west (Amarillo, Lubbock, Abilene, Midland, and San Angelo regions), lower Rio Grande Valley (Laredo and Harlingen regions), and far west (El Paso region).

The TCEQ used multiple techniques in assessing the monitoring network within these areas. Existing and future point sources were evaluated in conjunction with population density data to determine federal monitoring requirements and geographical monitoring coverage. Regional characteristics such as climate and topography were also considered because of their impact on ozone formation, and pollutant transport and dispersion throughout an area. Each monitor in the existing network was assessed for its purpose, history, data trends, and network value.

Evaluation Tools

Anthropogenic Emission Sources

The TCEQ used data from its 2011 National Emissions Inventory (NEI) and 2013 annual point source emissions inventory to evaluate the relative contributions of anthropogenic sources of each primary pollutant, as well as to evaluate the spatial placement of existing ambient air quality monitors in relation to point sources of emissions. The FCAA requires that states submit an emissions inventory (EI) for ozone precursor emissions (NO_x and VOC) every three years. The total inventory of NO_x and VOC emissions for an area is derived from estimates developed for four general categories of emissions sources: point, area, non-road mobile, and on-road mobile. In addition, stationary point source emissions data are collected annually from sites that meet the reporting requirements of 30 Texas Administrative Code (TAC) §101.10. More information about the Texas EI is available to the public on the TCEQ's Point Source Emissions Inventory webpage (http://www.tceq.texas.gov/airquality/point-source-ei/psei.html).

The TCEQ also reviewed its database for pending and issued air permits to evaluate potential geographic trends in the location of new point sources. Because emissions

from existing sources would be included in the EI, this review focused only on the issuance of permitting actions related to the construction of new facilities at new sites from January 1, 2010, to March 2015 and excluded any permitting actions related to existing point source sites. Populated areas with a high density of point sources and areas with larger point source emissions were further evaluated to determine if the existing monitoring network was adequately representative of the airshed.

Correlation Data

The TCEQ used the correlation tool made available through the NetAssess application developed by the Lake Michigan Air Directors Consortium (LADCO) to evaluate eight-hour ozone and 24-hour $PM_{2.5}$ monitoring data. This tool provides analyses that help to identify possible redundant monitors. More information about the NetAssess application is available on LADCO's website at http://ladco.github.io/NetAssessApp/.

The application pulled monitor location and concentration data from the EPA's Air Quality System (AQS) database and used the R statistical package to calculate a Pearson correlation coefficient, average relative difference, and distance between monitors for monitor pairs that were active between January 1, 2011, and December 31, 2013. The referenced time period was defined by the tool designers and was not customizable. Evaluation of correlation output is provided in the ozone and $PM_{2.5}$ network evaluation sections of this report. When more than two monitors were evaluated, a figure showing the correlation output is provided. Although the TCEQ's convention is to use site name, the tool only allows for the display of AQS numbers in the output. The AQS numbers associated with each site name are provided in Appendix A. The shape of the ellipses represents the Pearson correlation coefficient between sites. The circular ellipses have the weakest correlation indicating monitors are unique. The flatter, narrower ellipses have a stronger correlation indicating potential monitor redundancies. The color of the ellipse represents the average relative difference between monitors. Purple and red ellipses indicate higher average relative differences of 1 and 0.8, respectively. Lighter yellow and white ellipses indicate lower average relative differences of 0.2 and 0, respectively. The average relative difference indicates if monitors measure pollutant concentrations at levels substantially higher or lower compared to each other. Data from site pairs with a lower average relative difference are more similar to each other than pairs with a larger difference and could indicate a level of redundancy. The number in each ellipse is the distance in kilometers between the two sites.

The TCEQ used the results of the NetAssess tool to rate the uniqueness of each monitor's data on a three-point scale. Monitor pairs that were located greater than 10 kilometers (6.2 miles) apart, weakly correlated (e.g., had a Pearson correlation coefficient of less than 0.6), and had a relative percent difference greater than 0.2 were considered highly unique (not redundant). Medium value monitors were moderately correlated with nearby monitors (e.g., had a Pearson correlation coefficient of between 0.6 and 0.9), had a relative percent difference between 0.1 and 0.2, and were located between 5 and 10 kilometers (3.1 and 6.2 miles). Low value monitors were highly correlated (e.g., had a Pearson correlation coefficient of greater than 0.9) with a relative percent difference of less than 0.1, and were located less than 5 kilometers (3.1 miles) apart, and possessed the potential to be redundant with nearby monitors.

Population Data

A review of population trends was conducted to ensure that monitors with the objective of measuring pollutant concentrations in populated areas were still properly sited. The TCEQ predominantly relied on population counts from the most recent decennial census and 2014 population estimates from the United States Census Bureau in this assessment. In Texas, the United States Census Bureau defines core based statistical areas and metropolitan statistical areas (MSAs) as the same area. Only MSA is used in this assessment.

Evaluating future population projections was also necessary because ozone, CO, nitrogen dioxide (NO_2), SO_2, $PM_{2.5}$, and PM_{10} monitoring requirements are at least partially based on metropolitan statistical area population. The TCEQ evaluated population projection data available from the Texas State Data Center to evaluate potential future monitoring needs based on changing populations. The Texas State Data Center uses three projection scenarios to forecast populations. According to the Texas State Data Center, Texas experienced an uncharacteristically high urban growth rate from 2000 to 2010 as compared to the previous 10 years. One population projection scenario assumed that this growth rate would continue through 2020. The other scenarios assumed half of the 2000 to 2010 growth rate and a zero migration growth. The TCEQ conservatively used the scenario with the highest growth rate to determine if an area's projected population in 2020 was likely to trigger additional monitoring requirements. More information about these state population projections is available online at http://txsdc.utsa.edu/.

Monitor History and Data

The TCEQ relied on TAMIS for evaluating historical changes to the monitoring network, objectives, and locations. All monitoring information discussed in this evaluation is available to the public online at http://www.tceq.texas.gov/goto/tamis. The TCEQ verified monitoring network information against the information in AQS to ensure consistency.

Monitor Value Calculation

At the completion of each pollutant network evaluation, the TCEQ scored each existing monitor on a three-point scale (high, medium, and low) based on the value the monitor provides to the network. The monitor's overall value was calculated by considering the following metrics.

- Regulatory value of the monitor was assessed based on federal monitoring requirements. High value monitors met an explicit federal requirement, medium value monitors supported the number of monitors required in an area, and low value monitors supported monitoring efforts but did not satisfy an explicit requirement.
- The value of the monitoring data was assessed by evaluating the importance of the data to the network. Factors considered in this evaluation included the proximity of design values to the NAAQS, representativeness of a particular area (such as sensitive populations or incoming background), or historical trends. High value monitors provided data critical to the understanding of air quality in an area.

Medium value monitors supported other area monitors by providing meaningful data, but were not essential to the network. Low value monitors provided data of minimal use to the evaluation of air quality (such as monitoring for a specific point source pollutant in an area without that point source).

- Monitor uniqueness was scored based on monitor-by-monitor correlation, as discussed in the correlation section. The NetAssess application only provided correlation data for ozone and $PM_{2.5}$; therefore, other pollutant monitors were not rated according to this metric. High value monitors provided unique data that was only marginally correlated with nearby monitors. Data from medium value monitors indicated some correlation with nearby monitors. Data from low value monitors were potentially redundant with nearby monitors.
- Source impact value was assessed based on the monitor's value in evaluating the impacts of pollutant sources to the area's air quality. High value monitors provided important data on the impact of sources, such as a monitor downwind of a point source or a monitor placed to evaluate incoming transport of area sources. Medium value monitors helped provide information about source contribution but were not specifically sited to measure source impacts, such as speciation monitors providing data on dust composition. Low value monitors were minimally impacted by sources.
- Monitor appropriateness was assessed by comparing the intended monitoring objective to existing conditions near the location. A table detailing summary information on the monitor name, location, objective, and monitoring scale as required in 40 CFR Part 58, Appendix D, is provided in Appendix A. High value monitors continued to meet their intended objective and monitoring scale. Medium value monitors had some indication that the area may be in a transition, such as a neighborhood that was slowly changing from residential homes to commercial/industrial facilities. Low value monitors no longer met their intended objective or monitoring scale.
- Historical value was assessed based on the number of years the parameter has been monitored at the site. High value monitors have provided more than 16 years of data. Medium value monitors have provided 6 to 15 years of data. Low value monitors have provided 5 or fewer years of data.

A summary of each monitor's value assessment is provided in Appendix C. Consistent with the purpose of this document, low monitor values do not necessarily mean that the monitor will be decommissioned. The TCEQ will continue to use the annual monitoring network plan to recommend any changes to the monitoring network.

Monitoring Technology Review

The TCEQ continually evaluates advances in ambient air monitoring technology. However, because regulatory monitors used for determination of compliance with the NAAQS are required to meet federal reference method (FRM), federal equivalent method (FEM), or approved regional method requirements, a full review of available technology was not detailed in this assessment. All of the TCEQ's regulatory monitors comply with existing monitoring method requirements and, in the vast majority of cases, provide consistent, high quality data return. When the TCEQ encounters

mechanical or logistical problems, they are addressed promptly to restore data collection. The TCEQ continues to evaluate newer technologies as they become available and will propose any method changes through the annual monitoring network plan process.

Background Information

Population

As a general trend, the Texas population has increased by over 20 percent (%) from 2000 to 2010. As indicated in Figure 1, most of the largest population increases occurred in urban areas such as Austin-Round Rock, Dallas-Fort Worth, San Antonio, Houston, and Laredo.

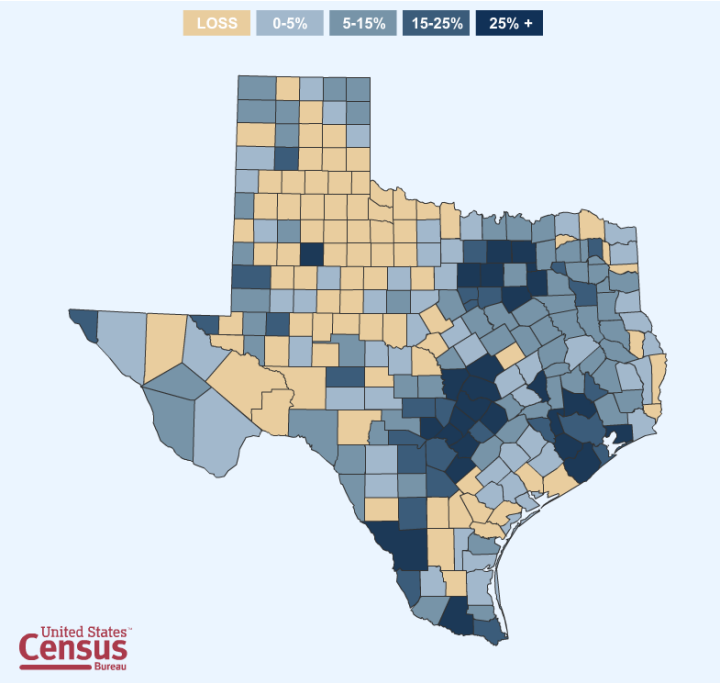

Figure 1: Population Change by Texas County, 2000-2010

As indicated, the period between the last two decennial censuses was marked by expansive growths in urban population. According to the Texas State Data Center, it is unlikely that the population will continue to grow at this rate in the long term. However, the TCEQ conservatively used projections made with this continued growth rate assumption as a worst-case scenario to evaluate the potential for increases in the number of monitors required in the future. The MSA population projections are provided in Table 1. According to these projections, five MSAs will continue to experience a 20% or greater increase in population by 2020.

Table 1: Texas Population Projections, 2010-2020

Metropolitan Statistical Area	2010	2015	2020	Percent Change (2010-2015)	Percent Change (2015-2020)	Percent Change (2010-2020)
Abilene	165,252	170,761	175,333	3	3	6
Amarillo	251,933	268,893	287,313	7	6	12
Austin-Round Rock	1,716,289	1,990,437	2,306,857	16	14	26
Beaumont-Port Arthur	403,190	417,449	432,734	4	4	7
Brownsville-Harlingen	406,220	449,166	493,571	11	9	18
College Station-Bryan	228,660	251,252	278,843	10	10	18
Corpus Christi	428,185	449,323	470,995	5	5	9
Dallas-Fort Worth-Arlington	6,426,214	7,117,896	7,920,671	11	10	19
El Paso	804,123	877,248	956,347	9	8	16
Houston-The Woodlands-Sugar Land	5,920,416	6,622,047	7,413,214	12	11	20
Killeen-Temple	405,300	454,994	504,546	12	10	20
Laredo	250,304	282,143	317,733	13	11	21
Longview	214,369	229,176	245,142	7	7	13
Lubbock	290,805	307,992	327,424	6	6	11
McAllen-Edinburg-Mission	774,769	883,903	1,005,539	14	12	23
Midland	141,671	152,835	164,862	8	7	14
Odessa	137,130	148,260	159,521	8	7	14
San Angelo	111,823	114,262	116,707	2	2	4
San Antonio-New Braunfels	2,142,508	2,380,005	2,635,183	11	10	19
Sherman-Denison	120,877	127,097	133,647	5	5	10
Texarkana	92,565	93,848	95,118	1	1	3
Tyler	209,714	225,731	243,064	8	7	14
Victoria	94,003	97,687	101,363	4	4	7
Waco	252,772	263,208	274,757	4	4	8
Wichita Falls	151,306	153,005	154,865	1	1	2
State of Texas	25,145,561	27,695,284	30,541,978	10	9	18

Source: Texas State Data Center, 2014
Projections are based on the continuation of the rapid growth rates documented in 2000-2010.

Pollutants

Ozone

Ground-level ozone is not emitted directly into the air, but is created by chemical reactions between NO_x and VOCs in the presence of sunlight. Therefore, there are no source-oriented ozone monitors. Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of NO_x and VOCs. In addition, biogenic sources (mainly trees) also release VOCs that can contribute to ground-level ozone. Because it takes time for ozone to form, a dispersed network of monitors across urban areas is necessary to fully evaluate contributing sources and regional ozone levels.

Carbon Monoxide

CO is a colorless, odorless gas formed by the incomplete reaction of air with fuel. CO is primarily emitted from fossil fuel powered engines, including motor vehicles and non-road engines and vehicles (such as construction equipment and boats). Higher levels of CO generally occur in areas with heavy traffic congestion such as downtown areas, at border crossings, and near or on major highways. Other CO emission sources can include industrial processes, residential wood burning, residential trash burning, and natural sources such as forest fires. For these reasons, the highest value is placed on source-oriented monitors in urban areas.

Oxides of Nitrogen

The sum of nitric oxide (NO) and NO_2 is commonly called NO_x. NO_2 is regulated on its own as a primary pollutant, but NO_x is also important as a contributor to ozone and $PM_{2.5}$ formation. NO_x is most commonly emitted from on-road emissions sources such as cars, trucks, and buses as well as electric power plants and industrial combustion. For these reasons, NO_x monitors are sited to evaluate emission sources and regional concentrations across ozone nonattainment areas.

Sulfur Dioxide

Based on Texas' EI data, the largest source of SO_2 emissions is fossil fuel combustion at power plants and other industrial facilities. SO_2 emissions also come from extraction of metal from ore and burning high-sulfur fuels in locomotives, large ships, and non-road equipment. SO_2 monitoring, therefore, has been focused on populated areas near larger emission sources. Because of major reductions required in the sulfur content of liquid fuels, solid fossil fuel electric power plants and a few industrial plants are now the major SO_2 sources.

Lead

Pb is a point-source pollutant with concentrations dropping rapidly with distance from the source. Pb can be released directly into the air as suspended particles. Since the ban of Pb gasoline in on-road vehicles in the 1990s, there have been no regional Pb air quality issues. Therefore, Pb monitoring is only required near large point sources and

airports reporting large Pb emissions. Pb monitoring is also required at three locations in Texas for long-term trends analysis.

Particulate Matter

$PM_{2.5}$ and PM_{10} are composed of a complex mixture of particles and liquid droplets and can be made up of acids, salts, organic chemicals, metal, dust, or soil. Both fractions of particulate matter can be emitted from a variety of natural and anthropogenic sources. Most of the $PM_{2.5}$ in the air comes from long range transport and from atmospheric reactions that form $PM_{2.5}$ in the air from gaseous emissions including SO_2, NO_x, and both anthropogenic and biogenic VOCs. Elevated particulate matter can impact air quality locally, such as when soil is disturbed on unpaved roads, or distant from the source, such as when smoke or dust is transported from out-of-state and international sources. Therefore, monitoring is generally conducted over dispersed areas with an emphasis on placing monitors in upwind locations to evaluate incoming particulate matter concentrations.

Particulate monitoring occurs via either collection of a filter over a discrete 24-hour time period or continuous one-hour measurements. Although the PM_{10} NAAQS is set to be protective of exposures to particles that are between 2.5 and 10 micrometers in size ($PM_{10-2.5}$), regulatory ambient air monitors measure all particles less than 10 micrometers in size as PM_{10}. In compliance with existing rules, $PM_{10-2.5}$ is only monitored at the sites of Dallas Hinton, Houston Deer Park #2, and El Paso Chamizal sites.

Air Toxics Pollutants

The term “air toxics” includes air pollutants that may be associated with adverse health effects or environmental effects, but with no federal ambient air quality standards. Air toxics are emitted from a variety of natural and anthropogenic sources. Most air toxics monitors are deployed to evaluate regional air quality, trends in ozone precursors, and potential population exposures, rather than to evaluate a particular source.

Texas currently monitors ambient air concentrations of 142 air toxic pollutants, including VOCs, carbonyls, SVOCs, and metals at the sites provided in Appendix A. The full list of air toxics for which the TCEQ monitors is provided in Appendix B. The TCEQ collects ambient VOC data in two ways: discrete canister sampling and near-real-time automated gas chromatograph (autoGC) monitoring. Canister samplers collect ambient air in a stainless steel canister over a 24-hour period, and the sample is analyzed for 84 targeted VOCs in a laboratory. Most canister sampling sites collect one 24-hour sample every six days. AutoGCs collect a 40-minute ambient air sample every hour. The sample is analyzed onsite by the autoGC for 46 targeted VOCs. Carbonyls, SVOCs, and metals samples are typically collected once every six days.

The TCEQ uses screening levels that are set to protect human health and welfare, termed Air Monitoring Comparison Values (AMCVs), to evaluate monitored concentrations of ambient pollutants. AMCVs are used by the TCEQ to determine if there is a potential health concern. Although this evaluation focuses on federal ambient monitoring requirements and conclusions from the TCEQ Toxicology Division’s annual monitoring data evaluations for regulatory monitors, full Toxicology Division

evaluations of ambient air toxic data for monitors that are operated in addition to these requirements are available online at https://www.tceq.texas.gov/toxicology/regmemo/AirMain.html.

When ambient concentrations are measured above the AMCVs, the TCEQ conducts a more in-depth review of the data and conditions during sampling. This review may include focusing additional agency resources, such as in areas on the Air Pollutant Watch List (APWL). The APWL is the TCEQ's program to address areas in Texas where monitoring data show persistent, elevated concentrations of air toxics. The TCEQ uses the APWL process to focus its resources, notify the public, engage stakeholders, and develop strategic actions to reduce emissions. More information about the APWL can be found online at http://www.tceq.texas.gov/permitting/air/apwl/apwl-index.html.