

TCEQ Interoffice Memorandum

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Subject: Health Effects Review of 2021 Ambient Air Network Monitoring Data in
Region 12, Houston

Key Points

- Approximately 0.000040% (2 out of more than 5,047,847 samples) of measured hourly concentrations exceeded a health-based Air Monitoring Comparison Value (AMCV). These single hourly level exceedances were for benzene and were measured at the Channelview Drive Water Tower site.
- Approximately 0.00034% (17 out of more than 5,047,847 samples) of measured hourly concentrations exceeded an odor-based AMCV. Accordingly, a few hourly levels (e.g., 1,3-butadiene, isoprene, and styrene) at seven Region 12 sites could have resulted in the perception of odors if people were exposed. Assuming exposure, the monitored concentrations would not be expected to cause direct, short-term adverse health effects (e.g., eye irritation), and the infrequency and generally low magnitude of the exceedances are not indicative of persistent, strong odors with the potential to cause odor-related health effects (e.g., nausea, headache).
- Approximately 0.000059% (3 out of more than 5,047,847 samples) of measured hourly concentrations exceeded a vegetation-based AMCV. These single hourly level exceedances were for ethylene and were measured at two monitoring sites in Deer Park (Houston Deer Park #2 and HRM 16 Deer Park).
- Reported 30-minute concentrations of hydrogen sulfide (H₂S) were above the numerical value of the 30-minute state H₂S standard for residential areas (80 ppbv) four times at the Texas City BP 31st Street monitor. The measured levels of H₂S could result in the perception of odors if exposure were to occur.
- Annual average concentrations for all chemicals and metals from 1-hour and 24-hour measurements were below their respective long-term AMCVs.

Background

The primary purpose of this memorandum is to convey the Toxicology, Risk Assessment, and Research Division's (TD) evaluation of ambient air toxics sampling conducted at monitoring sites in Region 12-Houston during 2021. The TD reviewed summary results for volatile organic compounds (VOCs) from 24-hour canister samples, 1-hour automated gas-chromatography (autoGC) VOC samples, 8- and 24-hour carbonyl samples, 30-minute rolling averages of 5-minute hydrogen sulfide samples, and 24-hour metals samples from filters designed to collect particulate matter with an aerodynamic diameter of 2.5 microns or less (PM_{2.5}).

Historically, this memorandum has evaluated data from the TCEQ and Enhanced Industry-Sponsored Monitoring (EISM) sites, which are reported to the TCEQ on a regular basis. Industry-sponsored air monitoring networks that are not routinely reported to the TCEQ are also included. The TD requested these data from the respective industry groups and included them in our evaluation, as detailed below. Only summary data on high values and averages are provided for the Houston Regional Monitoring (HRM) sites; the total number of samples collected over the year is not known. Therefore, a qualifier of 'more than' is used before values that include these data. Except for lead, data for criteria pollutants (i.e., compounds having National Ambient Air Quality Standards [NAAQS]) were not evaluated for this memorandum. Appendix 1. Monitored Air Toxics in Region 12 contains the lists of the target analytes evaluated for this review.

Information regarding monitoring sites and target analyte data reviewed by the TD is presented in Table 1 and summarized below:

- 24-hour canister VOC sampling at:
 - 11 TCEQ sites,
 - 6 HRM sites outside of the EISM sites, and
 - 3 Texas City/La Marque Community Air Monitoring Network (TCLAMN) sites.
- 24-hour carbonyl sampling at 2^a sites.
- 8-hour carbonyl sampling at 1^b site.
- 24-hour metals sampling at 3 sites.
- 1-hour autoGC VOC sampling at:
 - 10 TCEQ sites,
 - 7 EISM sites,
 - 1 TCLAMN site, and
 - 2 HRM sites.
- 5-minute hydrogen sulfide (H₂S) sampling at:
 - 1 TCEQ site,
 - 3 EISM sites, and
 - 1 HRM site.

^a Carbonyl sampling is seasonal, depending on the site, for part of the year with durations of 8 or 24 hours.

^b Carbonyl sampling is seasonal, depending on the site, for part of the year with durations of 8 or 24 hours.

Table 1. Monitoring Sites Located in TCEQ Region 12

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Galveston	N/A	2nd Avenue Monitoring Station (29.386981, -94.91912)	TCLAMN ^c	VOC (24-hour canister, 1/12 days ^d ; autoGC)
Galveston	N/A	Avenue A Monitoring Station (29.37435, -94.96364)	TCLAMN	VOC (24-hour canister)
Harris	48-201-0058	Baytown 7201 ½ Bayway Dr	TCEQ	VOC (24-hour canister)
Harris	48-201-6000	Cesar Chavez 4829A Galveston Rd	TCEQ	VOC (autoGC)
Harris	48-201-0026	Channelview 1405 Sheldon Rd	TCEQ	VOC (autoGC)
Harris	48-201-0036	Channelview Drive Water Tower^e 15913 Channelview Drive	TCEQ	VOC (autoGC)
Harris	48-201-1035	Clinton 9525 ½ Clinton Dr	TCEQ	VOC (autoGC), Carbonyls ^f Metals (PM _{2.5})
Brazoria	48-039-1003	Clute 426 Commerce St	TCEQ	VOC (24-hour canister)
Brazoria	48-039-1012	Freeport South Ave I 207 South Avenue I	TCEQ	Metals (PM _{2.5})
Harris	48-201-0057	Galena Park 1713 2 nd St	TCEQ	VOC (autoGC / 24-hour canister)

^c TCLAMN – Texas City/La Marque Community Air Monitoring Network.

^d The typical schedule for 24-hour canisters is to collect one 24-hour sample every six days. This sampler is collecting one 24-hour sample every twelve days.

^e Site was previously named Jacinto Port, in 2021 it was moved, switched to an autoGC sampler, and re-named as Channelview Drive Water Tower. The site name Jacinto Port does not appear in the Texas Air Monitoring Information System (TAMIS) anymore and all data (old canister and new autoGC) are now associated with the name Channelview Drive Water Tower. Collection of canister data at the old site continued through February 20, 2021 and collection of autoGC data at the new site began on February 22, 2021.

^f This carbonyl sampler collects seasonally. In 2021, one 24-hour sample was collected every six days from April through October. From January through March and November through December no samples were collected.

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Harris	48-201-0055	Houston Bayland Park 6400 Bissonnet St	TCEQ	VOC (24-hour canister)
Harris	48-201-1039	Houston Deer Park #2 4514 ½ Durant St	TCEQ	VOC (autoGC, 24-hour canister), Carbonyls ^g , Metals (PM _{2.5})
Harris	48-201-0803	HRM #3 Haden Rd 1504 ½ Haden Rd	TCEQ/EISM - HRM ^h	VOC (24-hour canister)/VOC (autoGC)
Harris	N/A	HRM 1 Central Street 1501 Central Street, Houston	HRM	VOCs (24-hour canister)
Harris	N/A	HRM 4 Sheldon Rd 16200 Miller Road 1, Channelview	HRM	VOC (24-hour canister)
Harris	48-201-0807	HRM 7 Baytownⁱ 4621-4639 W. Baker Rd	HRM	VOC (autoGC, 24-hour canister)
Harris	N/A	HRM 8 LaPorte 11426 Fairmont Pkwy, La Porte	HRM	VOC (24-hour canister)
Chambers	N/A	HRM 10 Mont Belvieu 13618 Hatcherville Rd, Mont Belvieu	HRM	VOC (24-hour canister)
Chambers	N/A	HRM 11 E Baytown 8620 West Bay Rd, Baytown	HRM	VOC (24-hour canister)
Harris	48-201-1614	HRM 16 Deer Park 600-658 Luella Ave	HRM	VOC (autoGC), H ₂ S
Brazoria	48-039-1016	Lake Jackson 109-B Brazoria Hwy 332- W	EISM – FI Group ^j	VOC (autoGC)

^g This carbonyl sampler collects seasonally. In 2021, one 24-hour sample was collected every six days from April through May and September through October. From June through August, this sampler switched to a more intensive sampling schedule where it collected three 8-hour samples every three days. From January through March and November through December no samples were collected.

^h HRM – Houston Regional Monitoring.

ⁱ Site was previously named Baytown, in 2021 it was moved, switched to an autoGC sampler and renamed as HRM 7 Baytown. Canister data collection continued at the old site through March 12, 2021 and autoGC data collection began at the new site in January 2021.

^j FI Group – Freeport Industry Group.

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Harris	48-201-1015	Lynchburg Ferry 4364 Independence Parkway South	TCEQ/EISM - HRM	VOC (24-hour canister)/VOC (autoGC)
Harris	48-201-0307	Manchester East Avenue N^k 9401 ½ Manchester Rd/ 9415 East Avenue N	TCEQ	VOC (24-hour canister/ autoGC)
Harris	48-201-0069	Milby Park 2201A Central St	TCEQ	VOC (autoGC)
Galveston	N/A	North Site (29.429228, -94.971503)	TCLAMN	VOC (24-hour canister, 1/12 days)
Brazoria	48-039-1607	Oyster Creek 901 County Road 792	EISM - Freeport LNG	VOC (autoGC), H ₂ S
Harris	48-201-1049	Pasadena Richey Elementary School^l 702 Light Company Rd	TCEQ	VOC (24-hour canister)
Harris	48-201-0061	Shore Acres 3903 ½ Old Hwy 146	TCEQ	VOC (24-hour canister)
Galveston	48-167-0056	Texas City 34th St 2212 North 34th St	EISM - TCLAMN	VOC (autoGC)
Galveston	48-167-0005	Texas City Ball Park 2516 ½ Texas Ave	TCEQ	H ₂ S, VOC (24-hour canister)
Galveston	48-167-0615	Texas City BP 31st Street (Site 1) 302 31st Street South	EISM – Marathon Petroleum Co.	H ₂ S, 4 VOCs (SRIGC)
Galveston	48-167-0621	Texas City BP Logan Street (Site 3) 303 Logan Street	EISM – Marathon Petroleum Co.	H ₂ S, 4 VOCs (SRIGC)

^k Site was previously named Manchester/Central, in 2021 it was moved, switched to an autoGC sampler, and re-named as Manchester East Avenue N. The site name Manchester/Central does not appear in TAMIS anymore and all data (old canister and new autoGC) are now associated with the name Manchester East Avenue N. Collection of canister data at 9401 ½ Manchester Rd ended on October 14, 2021 and collection of autoGC data at 9415 East Avenue N began on November 5, 2021.

^l Site was previously named Pasadena North, in 2022 it was moved, switched to an autoGC sampler and renamed as Pasadena Richey Elementary School. The site name Pasadena North does not appear in TAMIS anymore and all data (old canister collected in 2021 and new autoGC data) are now associated with the name Pasadena Richey Elementary School.

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Galveston	48-167-0683	Texas City 11th Street 569 11th Street South	EISM – Marathon Petroleum Co.	1 VOC (SRIGC)
Harris	48-201-0617	Wallisville Rd 4727 Wallisville Rd	EISM - HRM	VOC (autoGC)

All data collected at TCEQ monitors are analyzed by the TCEQ laboratory and should meet a 75% data completeness objective. At EISM and industry network monitors, data are collected by a third-party contractor and should also meet a 75% data completeness objective. One-hour autoGC VOC, 30-minute H₂S, as well as 8-hour carbonyl data were evaluated for potential acute health (e.g., irritation), odor, and vegetation concerns, as were any 24-hour sample results (e.g., VOCs, carbonyls, metals) that exceeded short-term air monitoring comparison values (AMCVs). Twenty-four-hour air samples collected every 6th day on a yearly basis are designed to provide representative long-term average concentrations. To enable evaluation of 24-hour monitoring data more fully, the TCEQ has developed 24-hour AMCVs for specific chemicals. As such, 24-hour sample results were compared to the available TCEQ 24-hour AMCVs for the following:

- 1,3-Butadiene
- 2,2-Dimethylbutane
- 2,3-Dimethylbutane
- 2-Methylpentane
- 3-Methylpentane
- Acrolein
- Aluminum
- Arsenic
- Benzene
- Cadmium
- Chromium
- Cobalt
- Manganese
- Molybdenum
- Nickel
- Vanadium
- Crotonaldehyde
- Ethylene dibromide
- Ethylene dichloride
- Formaldehyde
- n-Hexane

However, because short-term or peak concentrations may be significantly different than 24-hour sample concentrations, daily concentrations have limited use in evaluating the potential for more acute (e.g., 30-60 minute) health effects, unlike the shorter-term data reviewed herein (e.g., 1-hour autoGC data, 30-minute H₂S data). The annual averages from 1-hour autoGC and 24-hour samples (VOCs, carbonyls, and metals) were evaluated for potential chronic health and vegetation concerns. Measured chemical concentrations were compared to appropriate comparison values (e.g., the National Ambient Air Quality Standards [NAAQS] value, TCEQ health-, odor-, and vegetation-based AMCVs). Hydrogen sulfide samples were compared to the numerical value of the 30-minute residential state standard for H₂S (80 ppbv). Information on AMCVs may be obtained via the internet

(<https://www.tceq.texas.gov/toxicology/amcv/about>) or by contacting the TD (512-239-1795). Exceedance of an AMCV does not necessarily mean that adverse effects would be expected (e.g., health-based AMCVs are set at levels well below concentrations at which adverse effects have been observed), but rather that further evaluation is required.

Evaluation

30-Minute, 1-hour and 8-hour Concentrations

The vast majority of the 1-hour autoGC VOC concentrations were below their respective TCEQ short-term, health-, odor-, and/or vegetation-based AMCVs. For example, about 99.9996% of the more than 5,047,847 1-hour VOC measurements from the TCEQ, EISM, HRM, and TCLAMN network autoGC monitors in Region 12 were below their short-term AMCVs. Only two (approximately 0.000040%) hourly autoGC measurement collected at these Region 12 monitors exceeded a TCEQ short-term, health-based AMCV. Seventeen hourly measurements (approximately 0.00034%) exceeded an odor-based AMCV over this time period (Table 2). Three hourly measurements (approximately 0.000059%) exceeded a vegetation-based AMCV. Four reported 30-minute concentrations of H₂S were above the numerical value of the 30-minute state H₂S standard for residential areas (80 ppbv). Additionally, 100% of the 1,424 8-hour carbonyl concentrations measured in Region 12 were below their respective AMCVs. Therefore, the TD would not expect short-term, adverse health effects, vegetation effects, or odors to be associated with the vast majority of 1-hour, 8-hour, or 30-minute measurements monitored in Region 12. Further evaluation was conducted for the monitored concentrations that exceeded their respective short-term, health-, odor- and/or vegetation-based AMCVs to determine the potential for adverse health effects, odors, or effects on vegetation.

Health-Based AMCV Exceedances

Two concentrations of benzene were the only instances in which any of the monitored 1-hour concentrations exceeded their respective short-term, health-based AMCVs. These benzene exceedances occurred at Channelview Drive Water Tower, where the reported hourly benzene concentrations of 303.0 and 387.8 ppbv were measured on February 23, 2021 at 8 am and November 19, 2021 at 8 pm, respectively. These measured values were 1.7 and 2.2 times higher than the health-based 1-hour AMCV of 180 ppbv. The magnitude of the exceedances is low (no more than 2.2-fold) and transient in nature (the only exceedances measured in 2021). Considering the inherent precautionary nature of the 1-hour AMCV along with the underlying toxicity data, adverse health effects would not be expected if exposure to these concentrations had occurred.

Odor-Based AMCV Exceedances

The monitored 1-hour autoGC VOC concentrations that exceeded their respective odor-based comparison levels are shown below in Table 2. In total, there were 17 odor-based AMCV exceedances by 1-hour autoGC data in Region 12. These exceedances are slightly higher than

the number of exceedances in 2020 (5 exceedances), 2019 (6 exceedances), 2018 (11 exceedances), 2017 (5 exceedances), 2016 (7 exceedances), 2015 and 2014 (5 exceedances each year), and 2013 (8 exceedances), and are similar to the number of exceedances in 2012 (14 exceedances) and 2011 (19 exceedances). Additionally, they are significantly lower compared to 2010 (75 exceedances), 2009 (37 exceedances), 2008 (82 exceedances), and 2007 (103 exceedances).

Table 2. Odor-Based AMCV Exceedances by 1-Hour AutoGC VOC Concentrations

Site	Chemical	Number of 1-Hour Concentrations above Odor-Based AMCV	Maximum Measured Concentration (ppbv)	Odor-Based AMCV (ppbv)
Channelview	styrene	1	38.18	26
Channelview Drive Water Tower	isoprene	3	74.60	47
Channelview Drive Water Tower	styrene	1	26.30	26
Houston Deer Park #2	isoprene	1	51.09	47
HRM 7 Baytown	1,3-butadiene	1	260.7	230
HRM 16 Deer Park	isoprene	4	164.8	47
Lynchburg Ferry	styrene	3	83.31	26
Milby Park	styrene	3	30.32	26

The monitored odor-based AMCV exceedances would not be expected to cause direct acute adverse health effects (e.g., eye irritation). Additionally, the infrequency (approximately 0.00034% of hourly measurements) and generally low magnitude of the exceedances (e.g., ≤ 3.5 times the odor-based AMCV) are not indicative of persistent, strong odors with the potential to cause odor-related health effects (e.g., nausea, headache), although exposure to some chemical concentrations could have resulted in the perception of odors.

Vegetation-Based AMCV Exceedances

Three concentrations of ethylene were the only instances in which any of the monitored 1-hour concentrations exceeded their respective short-term, vegetation-based AMCVs. These ethylene exceedances occurred at Houston Deer Park #2 and HRM 16 Deer Park. The reported hourly ethylene concentrations of 1,319 and 2,545 ppbv were measured on September 27, 2021 at 5 am and 6 am, respectively, at the Houston Deer Park #2 monitor. The reported hourly ethylene concentration of 1,307 ppbv was measured on September 27, 2021 at 3 am at the HRM 16 Deer Park monitor. These measured values were 1.1 to 2.1 times higher than the vegetation-based 1-hour AMCV of 1,200 ppbv. The magnitude of the exceedances is low (no more than 2.1-fold) and transient in nature (the only exceedances measured in 2021). These monitors are located in residential areas and there are no agricultural areas nearby that would be affected by the elevated concentrations. Considering the inherent precautionary nature of the 1-hour AMCV along with the underlying toxicity data, adverse vegetation effects would not be expected if exposure to these concentrations had occurred.

H₂S 30-minute Concentrations

Four reported 30-minute concentrations of H₂S were above the numerical value of the 30-minute state H₂S standard for residential areas (80 ppbv). These occurred at the Texas City BP 31st Street monitor. The 30-minute concentrations were 85.8 to 100.8 ppbv and occurred from 3:30 to 3:45 am on November 21, 2021. Because the odor threshold range for H₂S is 0.5-300 ppbv, the measured levels of H₂S could result in the perception of odors if exposure were to occur. Overall, these measured concentrations are much lower than concentrations that are known to produce adverse health effects; the lowest concentration that has shown H₂S-specific health effects in people (mild respiratory effects in 2 out of 10 asthmatic individuals exposed for 30 minutes) is 2,000 ppbv.

24-Hour Concentrations

More than 56,112 24-hour canister VOC measurements, for which there are 24-hour, chemical-specific AMCVs available, were below their health- and welfare-based AMCVs in Region 12.

All 922 24-hour carbonyl measurements were below their health- and welfare-based AMCVs in Region 12.

Therefore, these monitored concentrations would not be expected to cause short-term adverse health effects or odorous conditions.

Annual Average Concentrations

All annual averages were below their respective long-term AMCVs.

- Based on the 4,413 24-hour metals measurements, all monitored annual average concentrations of metals were below their respective long-term comparison values (e.g., long-term AMCVs).
- Based on averages from more than 56,112 24-hour canister measurements (TCEQ, HRM, and TCLAMN network canister sites) and more than 5,047,847 hourly autoGC measurements (TCEQ, EISM, HRM, and TCLAMN network autoGC sites), all annual VOC concentrations were also less than their respective long-term AMCVs. In conclusion, 100% of all annual averages were below their respective long-term AMCVs and no long-term, adverse health or vegetation effects would be expected due to exposure to those concentrations.

Freeport Air Pollutant Watch List (APWL) Area for Arsenic, Cobalt, Nickel, & Vanadium

Elevated short-term nickel, arsenic, vanadium, and cobalt levels exceeding their respective short-term AMCVs were measured near Gulf Chemical and Metallurgical Corporation in Freeport during yearly mobile monitoring trips conducted 2005-2010. Due to the elevated metals concentrations, the Freeport area (Site# 1201^m) was added to the APWL in 2005. In May 2011, the Freeport South Avenue I monitoring site was activated. This site is located northeast of the facility of concern, within a residential area, and monitors for speciated PM_{2.5} metals. Since this site's activation in May of 2011, 100% of all speciated PM_{2.5} metals short-term and annual averages have been below their respective AMCVs; no adverse health effects would be expected due to exposure to these concentrations. The TCEQ will continue to evaluate relevant air monitoring data and any additional information for this APWL site within the context of the APWL ([APWL Protocol Revised \(texas.gov\)](#)).

If you have any questions regarding this memorandum, please contact Janet Hamilton, Ph.D., D.A.B.T. by phone at (512) 239-0557 or email at Janet.Hamilton@tceq.texas.gov, or Stony Lo, Ph.D. by phone at (512) 239-0576 or email at Stony.Lo@tceq.texas.gov. For questions regarding the APWL, you may visit the TCEQ website at <https://www.tceq.texas.gov/toxicology/apwl/apwl.html>.

^m <https://www.tceq.texas.gov/downloads/toxicology/air-pollutant-watch-list/maps/1201freeport.pdf>

Appendix 1. Monitored Air Toxics in Region 12

List 1. Target VOC Analytes in Canister Samplers

1,1,2,2-Tetrachloroethane	4-Methyl-1-Pentene	Methylcyclohexane
1,1,2-Trichloroethane	Acetylene	Methylcyclopentane
1,1-Dichloroethane	Benzene	m-Ethyltoluene
1,1-Dichloroethylene	Bromomethane	n-Butane
1,2,3-Trimethylbenzene	Carbon Tetrachloride ^a	n-Decane
1,2,4-Trimethylbenzene	Chlorobenzene	n-Heptane
1,2-Dichloropropane	Chloroform	n-Hexane
1,3,5-Trimethylbenzene	Chloromethane	n-Nonane
1,3-Butadiene	cis-1,3-Dichloropropene	n-Octane
1-Butene ^a	cis-2-Butene	n-Pentane
1-Hexene & 2-Methyl-1-Pentene ^a	cis-2-Hexene	n-Propylbenzene
1-Pentene	cis-2-Pentene	n-Undecane
2,2,4-Trimethylpentane	Cyclohexane	o-Ethyltoluene
2,2-Dimethylbutane ^a	Cyclopentane	o-Xylene
2,3,4-Trimethylpentane	Cyclopentene	p-Diethylbenzene
2,3-Dimethylbutane	Dichlorodifluoromethane	p-Ethyltoluene
2,3-Dimethylpentane	Dichloromethane ^a	Propane
2,4-Dimethylpentane	Ethane	Propylene
2-Chloropentane ^a	Ethylbenzene	Styrene
2-Methyl-2-Butene	Ethylene	Tetrachloroethylene
2-Methylheptane	Ethylene Dibromide ^a	Toluene
2-Methylhexane ^a	Ethylene Dichloride ^a	trans-1,3-Dichloropropene
2-Methylpentane ^a	Isobutane	trans-2-Butene
3-Methyl-1-Butene	Isopentane	trans-2-Hexene
3-Methylheptane	Isoprene	trans-2-Pentene
3-Methylhexane	Isopropylbenzene ^a	Trichloroethylene
3-Methylpentane	m-Diethylbenzene	Trichlorofluoromethane
	Methyl Chloroform ^a	Vinyl Chloride

^a Not monitored at the HRM 1, 4, 7, 8, 10, and 11 sites.

List 2. Target Carbonyl Analytes

2,5-Dimethylbenzaldehyde	Crotonaldehyde	Methacrolein
Acetaldehyde	Formaldehyde	o-Tolualdehyde
Acetone	Heptanal	Propionaldehyde
Acrolein - Unverified	Hexanaldehyde	Valeraldehyde
Benzaldehyde	Isovaleraldehyde	m & p-Tolualdehyde
Butyraldehyde	Methyl Ethyl Ketone (MEK)	

List 3. Target Metal Analytes

Aluminum (PM _{2.5})	Cobalt (PM _{2.5})	Selenium (PM _{2.5})
Antimony (PM _{2.5})	Copper (PM _{2.5})	Tin (PM _{2.5})
Arsenic (PM _{2.5})	Lead (PM _{2.5})	Vanadium (PM _{2.5})
Barium (PM _{2.5})	Manganese (PM _{2.5})	Zinc (PM _{2.5})
Cadmium (PM _{2.5})	Molybdenum (PM _{2.5})	
Chromium (PM _{2.5})	Nickel (PM _{2.5})	

List 4. Target VOC Analytes in AutoGC

1,2,3-Trimethylbenzene ^a	Acetylene	Toluene ^b
1,2,4-Trimethylbenzene	Benzene ^{b,c,d}	cis-2-Butene
1,3,5-Trimethylbenzene	Cyclohexane	cis-2-Pentene
1,3-Butadiene ^d	Cyclopentane	m/p Xylene
1-Butene	Ethane	n-Butane
1-Pentene	Ethylbenzene	n-Decane
2,2,4-Trimethylpentane	Ethylene	n-Heptane
2,2-Dimethylbutane	Isobutane	n-Hexane ^b
2,3,4-Trimethylpentane	Isopentane	n-Nonane
2,3-Dimethylpentane	Isoprene	n-Octane
2,4-Dimethylpentane	Isopropylbenzene	n-Pentane ^b
2-Methyl-2-Butene ^e	Methylcyclohexane	n-Propylbenzene
2-Methylheptane	Methylcyclopentane	n-Undecane ^e
2-Methylhexane	Propane	o-Xylene
3-Methylheptane	Propylene	trans-2-Butene
3-Methylhexane	Styrene	trans-2-Pentene

^a Only monitored at the Channelview Drive Water Tower, Galena Park, HRM #3 Haden Rd, HRM 16 Deer Park, Lake Jackson, Lynchburg Ferry, Manchester East Avenue N, Milby Park, Oyster Creek, Texas City 34th St, and Wallisville Rd monitoring sites.

^b These are the only compounds monitored at the Texas City BP Logan St and Texas City BP 31st St sites.

^c This is the only compound monitored at the Texas City 11th St site.

^d 2nd Avenue Monitoring Station only monitored for these compounds, in addition to that in List 5.

^e Only monitored at the HRM #3 Haden Rd, HRM 7 Baytown, HRM 16 Deer Park, Lake Jackson, Lynchburg Ferry, Oyster Creek, Texas City 34th St, and Wallisville Rd monitoring sites.

List 5. Additional AutoGC Analyte Monitored at 2nd Avenue Monitoring Site

Vinyl Chloride