

TCEQ Interoffice Memorandum

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Date: August 18, 2015

Subject: Health Effects Review of 2014 Ambient Air Network Monitoring Data in
Region 12, Houston

Key Points

- Notably, annual averages for all chemicals and metals were below their respective long-term air monitoring comparison values (AMCVs) for the fifth consecutive year over many years of sampling.
- The annual benzene concentration at the Texas City 11th St site was below TCEQ's long-term AMCV for the fifth consecutive year since monitoring began in 2005, and the annual benzene averages at other Texas City sites were also below the long-term AMCV.
- TCEQ removed benzene from the Texas City Air Pollutant Watch List (Site# [APWL1202](#)) in November 2014 since data from recent years for the Texas City 11th St site and other Texas City monitoring sites indicate sufficient achievements in reducing ambient air concentrations such that levels are no longer of concern for potential long-term, adverse health effects.
- The TCEQ will continue to evaluate reported benzene concentrations for the Galena Park site to determine if the significant annual benzene level reductions achieved in recent years represent a maintained air quality improvement for consideration in context with the [APWL protocol](#).
- Only approximately 0.0001% of measured hourly concentrations exceeded an odor-based AMCV. A few hourly levels (e.g., styrene) at two Region 12 sites could result 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 0.1222% of measured 24-hour concentrations exceeded their odor-based AMCV. These monitored concentrations would not be expected to cause acute health effects.
- Styrene was removed from the APWL for Lynchburg Ferry (Site# [APWL1204](#)) in May 2014 because of significant improvement in both the frequency and magnitude of odorous styrene concentrations monitored at the site (i.e., the reported levels are no

longer of concern for persistent, strong odors). Zero exceedances of the styrene odor-based AMCV in 2014 represents a maintained air quality improvement in this area.

Background

The primary purpose of this memorandum is to convey the Toxicology Division's (TD) evaluation of ambient air toxics sampling conducted at monitoring sites in Region 12-Houston during 2014. The TD reviewed summary results for volatile organic compounds (VOCs) from 24- canister samples, 1-hour automated gas-chromatography (autoGC) VOC samples, 24- and 3-hour carbonyl samples, 24-hour polycyclic aromatic hydrocarbon (PAH)/semivolatile organic compound (SVOC) 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}), particulate matter with an aerodynamic diameter of 10 microns or less (PM₁₀), and as total suspended particulates (TSP).

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. For this memorandum, 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 it in our evaluation, as detailed below. 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 contains a list 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
 - 2 EISM sites,
 - 6 Houston Regional Monitoring (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 sites.
 - 1 carbonyl site collects eight 3-hour carbonyl samples every three days during the third quarter of the year (July through September).
- 24-hour metals sampling at 5 sites.
 - Lead (TSP) sampling was deactivated at Houston East on 12/31/2014.
- 24-hour PAH/SVOC sampling at 1 site.
- 1-hour autoGC VOC monitoring at:
 - 7 TCEQ sites,
 - 7 EISM sites,
 - 1 TCLAMN site, and
 - 1 HRM site.

Table 1. Monitoring Sites Located in TCEQ Region 12

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Galveston	N/A	2nd Ave (29.386981, -94.919122)	TCLAMN ¹	VOC (24-hour canister, 1/12 days ² ; autoGC)
Galveston	N/A	Ave A (29.374350, -94.963639)	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	48-201-1035	Clinton 9525 ½ Clinton Dr	TCEQ/City of Houston Health Department ³	VOC (autoGC), Carbonyls ⁴ , Metals (PM ₁₀)
Brazoria	48-039-1003	Clute 426 Commerce St	TCEQ	VOC (24-hour canister)
Brazoria	48-039-0618	Danciger Along US Hwy 1459 in Brazoria County	EISM ⁵ - Sweeny Industry Group	VOC (autoGC)
Brazoria	48-039-1012	Freeport South Ave I 207 South Avenue I	TCEQ	Metals (PM _{2.5})
Harris	48-201-0057	Galena Park 304 Stewart St	TCEQ	VOC (24-hour canister)
Harris	48-201-0024	Houston Aldine 4510 ½ Aldine Mail Rd	TCEQ	Metals (PM _{2.5})

¹ TCLAMN – Texas City/La Marque Community Air Monitoring Network

² 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.

³ City of Houston Health Department owns and is responsible for the PM₁₀ metals monitor at this site.

⁴ This carbonyl sampler collects one 24-hour sample every six days from January through June and October through December. From July through September, this sampler switches to a more intensive sampling schedule where it collects eight 3-hour samples every three days.

⁵ EISM – Enhanced Industry-Sponsored Monitoring, this acronym is followed by the industry group responsible for the sampling.

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, Metals (PM _{2.5} , PM ₁₀ , Lead TSP), PAHs/SVOCs
Harris	48-201-1034	Houston East⁶ 1262 ½ Mae Drive	TCEQ	Lead (TSP)
Harris	48-201-0803	HRM #3 Haden Rd 1504 ½ Haden Dr	TCEQ/EISM - HRM ⁷	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	N/A	HRM 7 W Baytown 4606 W. Baker Rd, Baytown	HRM	VOC (24-hour canister)
Harris	N/A	HRM 8 LaPort 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	N/A	HRM 16 Deer Park 601 East 8th Street, Deer Park	HRM	VOC (autoGC)
Harris	48-201-0036	Jacinto Port 1st St and Elsbeth St	TCEQ	VOC (24-hour canister)
Brazoria	48-039-1016	Lake Jackson 109-B Brazoria Hwy 332- W	EISM - Freeport Industry Group	VOC (autoGC)
Harris	48-201-1015	Lynchburg Ferry 1001 B Lynchburg Rd	TCEQ/EISM - HRM	VOC (24-hour canister)/VOC (autoGC)

⁶ Lead TSP sampling was deactivated at this site 12/31/2014

⁷ HRM – Houston Regional Monitoring

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Harris	48-201-0307	Manchester/Central 9401 ½ Manchester Rd	TCEQ	VOC (24-hour canister)
Harris	48-201-0069	Milby Park 2201-a Central St	TCEQ	VOC (autoGC)
Brazoria	48-039-0619	Mustang Bayou FM 2917 @ County Road 169	EISM - Chocolate Bayou Industry Group	VOC (24-hour canister)
Galveston	N/A	North Site (29.429228, -94.971503)	TCLAMN	VOC (24-hour canister, 1/12 days)
Harris	48-201-1049	Pasadena North 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	48-167-0683	Texas City 11th St 569 11 th Street South	EISM - Marathon Petroleum Co.	Benzene (autoGC)
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	VOC (24-hour canister)
Galveston	48-167-0615	Texas City BP 31st Street (Site 1) 302 31st Street South	EISM - Marathon Petroleum Co.	4 VOCs (autoGC)
Galveston	48-167-0621	Texas City BP Logan Street (Site 3) 303 Logan Street	EISM - Marathon Petroleum Co.	4 VOCs (autoGC)
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 monitors, data are collected by a third party contractor and should also meet a 75% data completeness objective. However, the following did not meet 75% data completeness:

- Acetylene at Channelview, Lake Jackson, Wallisville Rd, HRM #3 Haden Rd, Lynchburg Ferry, Milby Park, and Cesar Chavez
- 1,2,3-Trimethylbenzene at Channelview, Houston Deer Park #2, Clinton, Lynchburg Ferry, Milby Park, and Cesar Chavez

- 1,2,4-Trimethylbenzene at Lynchburg Ferry and Milby Park
- 1,3,5-Trimethylbenzene at Channelview
- 1,3-Butadiene at Cesar Chavez
- 2-Methylheptane at Clinton
- Isoprene at Channelview
- Lead TSP at Houston East
- All analytes at Galena Park

One-hour autoGC VOC and 3-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 sixth-day for a year are designed to provide representative long-term average concentrations. In order to be able to evaluate 24-hour monitoring data more fully, the TCEQ has developed 24-hour AMCVs for specific chemicals. As such, 24-hour samples were compared to the available TCEQ 24-hour AMCVs for formaldehyde, 1,3-butadiene, and benzene. 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 acute health effects. The annual averages from 1-hour autoGC and 24-hour samples (VOCs, carbonyls, and metals) were evaluated for potential chronic health and vegetation concerns. However, representative annual averages could not be calculated for the Galena Park monitoring site since air sample results were only available for 59% of the year (36 samples) due to monitoring site equipment issues. 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). Information on AMCVs may be obtained via the internet (<http://www.tceq.state.tx.us/implementation/tox/AirToxics.html>) or by contacting the TD (512-239-3900).

Evaluation

1- and 3-Hour Concentrations

The vast majority of the 1-hour autoGC VOC and 3-hour carbonyl concentrations were below their respective TCEQ short-term, health-, odor-, and/or vegetation-based AMCVs. More specifically, about 99.99982% of the more than 3,881,987 1-hour VOC measurements from TCEQ, EISM, and industry-sponsored autoGC monitors in Region 12 in 2014 were below their short-term AMCVs. Only three (approximately 0.00008%) hourly autoGC measurements collected in Region 12 in 2014 exceeded a TCEQ short-term, health-based AMCV (see discussion below). Approximately 0.0001% exceeded an odor-based AMCV, with no more than three exceedances for a chemical at any one site. Additionally, 100% of the approximately 4,080 3-hour carbonyl concentrations measured in Region 12 in 2014 were below their respective AMCVs. Therefore, we would not expect short-term, adverse health effects, vegetation effects, or odors to be associated with the vast majority of 1- and 3-hour measurements monitored in Region 12 in 2014.

Further evaluation was conducted for the monitored concentrations that exceeded their respective short-term, health- and/or odor-based AMCVs to determine the potential for adverse health

effects or odors. Three concentrations of isoprene were the only instances in which any of the monitored 1-hour concentrations exceeded their respective short-term, health-based AMCVs in 2014. All three of these exceedances occurred at the HRM 3 Haden Rd site monitor, where hourly isoprene concentrations of 22.9, 29.7, and 89.2 ppb_v were above the current interim short-term, health-based AMCV of 20 ppb_v. However, this short-term AMCV was simply designed to help ensure that the long-term average at a site remains low (i.e., < 2 ppb_v) as opposed to being a short-term concentration of actual potential health concern. The TCEQ is presently in the final stages of assessing the health hazards/risks of isoprene, including deriving a final health-protective, short-term AMCV more representative of the actual potential for short-term, adverse health effects. Using the latest scientific assessment methods, the final short-term, health-based AMCV will likely be at least an order of magnitude higher than the current interim value. In addition, these monitored hourly exceedances are significantly below isoprene levels attributable to short-term, adverse health effects. Therefore, exposure to these hourly concentrations would not be expected to cause short-term, adverse health effects.

The monitored 1-hour autoGC VOC concentrations that exceeded their respective odor-based comparison levels in 2014 are shown below in Table 2. The total number of odor-based AMCV autoGC exceedances in Region 12 in 2014 (5 exceedances) is approximately 38% lower than in 2013 (8 exceedances), 64% lower than in 2012 (14 exceedances), 74% lower than in 2011 (19 exceedances), and 93% lower than in 2010 (75 exceedances). It is also significantly lower compared to 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)
Milby Park	Styrene	1	29.2	25
	1,3-butadiene	1	1,207.9	230
	1-butene	1	694.0	360
Haden Rd.	Isoprene	1	89.2	48
	Styrene	1	31.3	25

The monitored odor-based AMCV exceedances would not be expected to cause direct acute adverse health effects (e.g., eye irritation). Additionally, the infrequency and generally low magnitude of the exceedances (e.g., < 2 times the odor-based AMCV, except for 1,3-butadiene, which has a mild aromatic odor) are not indicative of persistent, strong odors with the potential

to cause odor-related health effects (e.g., nausea, headache).

Styrene Removed from the Air Pollutant Watch List (APWL) Area for Lynchburg Ferry

Styrene was removed from the APWL for Lynchburg Ferry (Site# [APWL1204](#)) in May 2014 because of significant improvement in both the frequency and magnitude of odorous styrene concentrations monitored at the Lynchburg Ferry site (i.e., the reported levels are no longer of concern for persistent, strong odors). The number of 1-hour exceedances of the styrene odor-based AMCV at the Lynchburg Ferry site in 2014 was zero, which remains very low compared to the historical number of exceedances (e.g., range of 27-92 exceedances for 2005-2010). This represents a significant and maintained air quality improvement at Lynchburg Ferry that was likely achieved through successful efforts to reduce styrene emissions in this area, ultimately leading to the removal of styrene from the Lynchburg Ferry APWL (Site# [APWL1204](#)).

24-Hour Concentrations

About 99.8777% of the greater than 73,622 24-hour VOC measurements from TCEQ, EISM, and industry-sponsored network canister monitors in Region 12 in 2014 were below their health- and odor-based AMCVs. However, about 0.1222% exceeded their odor-based AMCV. At the Mustang Bayou site in 2014, eighteen acetaldehyde concentrations (10.1-32.4 ppb_v) and nine butyraldehyde concentrations (1.52-9.33 ppb_v) exceeded their respective odor-based AMCVs (8.5 and 1.4 ppb_v, respectively). At the three Texas City/La Marque air monitoring sites, a total of twenty-four acetaldehyde concentrations (9.02-21.5ppb_v) exceeded the odor-based AMCV (i.e., thirteen at 2nd Ave, four at Ave A, and seven at North Site). In addition, a total of thirty-nine butyraldehyde concentrations (1.41-9.12 ppb_v) exceeded the odor-based AMCV (i.e., twenty-two at Ave A, seven at 2nd Ave, and ten at North Site). These monitored concentrations would not be expected to cause direct acute health effects. Additionally, although the perception of sufficiently strong and persistent unpleasant odors has the potential to cause odor-related health effects (e.g., nausea, headache), these concentrations are not indicative of strong odors with the potential to cause odor-related health effects due to the likely conservative nature of the odor-based AMCVs (e.g., upper end of the 50% odor threshold detection ranges are 48.65 and 3.1 ppb_v for acetaldehyde and butyraldehyde, respectively), low magnitude of most exceedances, all but eight of the acetaldehyde samples were < 2 times the odor-based AMCV, (all but ten butyraldehyde samples were < 2 times), and their odor characteristics (e.g., used in fragrances).

Annual Average Concentrations

In 2014, all annual averages were below their respective long-term AMCVs for the fifth consecutive year in many years of sampling in Region 12:

- Based on the approximately 7,233 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 the approximately 1,768 24-hour carbonyl measurements, all annual average concentrations of carbonyls were also below their respective long-term AMCVs;
- Based on approximately 1,840 24-hour PAHs/SVOCs measurements, all annual average concentrations for PAHs/SVOCs were below long-term AMCVs; and

- Based on averages from approximately 73,622 24-hour canister measurements and approximately 3,881,987 hourly autoGC measurements (TCEQ, EISM, and industry-sponsored sites), all annual VOC concentrations were also less than their respective long-term AMCVs.

The 2014 means reported for total chromium (PM_{2.5}) at the Houston Deer Park #2 site collocated monitors (0.0039 and 0.005 µg/m³) are within historical site means (0.00022-0.00655 µg/m³ for 2007-2013) and are well below the applicable, long-term AMCV for total chromium (0.14 µg/m³). This is the only truly appropriate comparison based on the type of sampling conducted. Although one of the 2014 means (0.005 µg/m³) for *total chromium* slightly exceeds the new *hexavalent chromium* long-term AMCV of 0.0043 µg/m³ (replacing the historical value of 0.01 µg/m³ in 2014), which is an unrealistic comparison, historical hexavalent chromium (TSP) data (2007-2012, sampling was discontinued in 2013) show annual hexavalent chromium means (0.00003-0.00019 µg/m³) over 20-fold lower than the new hexavalent chromium long-term AMCV. More specifically, while the highest total chromium (PM_{2.5}) mean at the site was also 0.005 µg/m³ in 2009, the highest hexavalent chromium (TSP) mean at the site in 2009 was 0.00004 µg/m³, over 100 times lower than the new hexavalent chromium long-term AMCV. Lastly, while the maximum reported 2014 concentrations of total chromium (PM_{2.5}) at the Deer Park site (0.238 and 0.114 µg/m³) are significantly less than the short-term AMCV for total chromium of 12 µg/m³ (and even the short-term AMCV for hexavalent chromium of 1.3 µg/m³), they are higher than the maximum historical total chromium (PM_{2.5}) values for recent years at this site (i.e., 0.0106-0.0795 µg/m³ for 2010-2013). The TD will continue to monitor and appropriately evaluate chromium sampling data at the Houston Deer Park #2 site.

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.

APWL Areas for Annual Benzene Concentrations – Galena Park and Texas City

Galena Park APWL

Although the Galena Park site did not meet the data completeness objective (75%) in 2014 due to monitoring site equipment issues, based on the available every 6th-day 24-hour canister data (36 samples, 59% completeness) the 2014 annual average benzene concentration is 1.09 ppb_v. As of May 2015, a new Galena Park autoGC has been installed. While benzene in the Galena Park area is currently on the APWL (Site# [APWL1206](#)), Galena Park monitoring site data meeting annual data completeness objectives from recent years (2008-2013) have shown representative annual benzene concentrations less than those of concern for potential long-term (i.e., lifetime), adverse health effects. The TD will continue to evaluate reported benzene concentrations for the Galena Park site to determine if the significant annual benzene level reductions achieved in recent years represent a maintained air quality improvement for consideration in context with the [APWL protocol](#).

Texas City APWL

The benzene annual average of 0.61 ppb_v (based on autoGC data) at the Texas City 11th St site remains well below the long-term AMCV, representing a significant and maintained air quality improvement in this area. Benzene was removed from the Texas City APWL area (Site#

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[APWL1202](#)) in November 2014 due to significant improvements in ambient air concentrations at the Marathon-sponsored site beginning in 2010 (since 2006, no other ambient air monitoring site in the Texas City APWL had annual benzene concentrations of potential long-term health concern).

For more information regarding the above APWL areas, please visit the TCEQ website at <http://www.tceq.texas.gov/permitting/air/apwl>.

If you have any questions regarding this memorandum, please contact Joseph T. Haney, Jr., M.S. by phone at (512) 239-5691 or by email at Joseph.Haney@tceq.texas.gov, Tracie Phillips, Ph.D. by phone at (512) 239-2269 or by email at Tracie.Phillips@tceq.texas.gov, or Heather Reddick, Dr.PH by phone at (512) 239-0154 or by email at Heather.Reddick@tceq.texas.gov.

Appendix 1. Monitored Air Toxics in Region 12 in 2014

List 1. Target VOC Analytes in Canister Samples^a

1,1,2,2-Tetrachloroethane	Bromomethane	Methylcyclohexane
1,1,2-Trichloroethane	c-1,3-Dichloropropylene	Methylcyclopentane
1,1-Dichloroethane	c-2-Butene	m-Ethyltoluene
1,1-Dichloroethylene	c-2-Hexene	n-Butane
1,2,3-Trimethylbenzene	c-2-Pentene	n-Decane
1,2,4-Trimethylbenzene	Carbon Tetrachloride	n-Heptane
1,2-Dichloropropane	Chlorobenzene	n-Hexane
1,3,5-Trimethylbenzene	Chloroform	n-Nonane
1,3-Butadiene	Chloromethane (Methyl Chloride)	n-Octane
1-Butene ^{b,c,d}	Cyclohexane	n-Pentane
1-Hexene + 2-Methyl-1-Pentene ^{b,c,d}	Cyclopentane	n-Propylbenzene
1-Pentene	Cyclopentene	n-Undecane
2,2,4-Trimethylpentane	Dichlorodifluoromethane ^b	o-Ethyltoluene ^b
2,2-Dimethylbutane (Neohexane) ^b	Dichloromethane (Methylene Chloride)	o-Xylene
2,3,4-Trimethylpentane	Ethane	p-Diethylbenzene
2,3-Dimethylbutane	Ethyl Benzene	p-Ethyltoluene
2,3-Dimethylpentane	Ethylene	Propane
2,4-Dimethylpentane	Ethylene Dibromide (1,2-Dibromoethane) ^b	Propylene
2-Chloropentane ^{b,c,d}	Ethylene Dichloride (1,2-Dichloroethane) ^b	Styrene
2-Methyl-2-Butene ^{c,d}	Isobutane	t-1,3-Dichloropropylene
2-Methylheptane	Isopentane (2-Methylbutane)	t-2-Butene
2-Methylhexane ^{b,c}	Isoprene	t-2-Hexene
2-Methylpentane (Isohexane) ^b	Isopropylbenzene (Cumene) ^b	t-2-Pentene
3-Methyl-1-Butene	m & p-Xylene	Tetrachloroethylene ^b
3-Methylheptane	m-Diethylbenzene	Toluene ^b
3-Methylhexane	Methyl Chloroform (1,1,1-Trichloroethane) ^b	Trichloroethylene
3-Methylpentane		Trichlorofluoromethane
4-Methyl-1-Pentene		Vinyl Chloride
Acetylene		
Benzene		

^a See Lists 6 and 7 for additional canister analytes monitored only at the Mustang Bayou and HRM 1, 4, 7, 8, 10 and 11 sites.

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

^c Not monitored at the TCLAMN sites.

^d Not monitored at the Mustang Bayou Site.

List 2. Target Carbonyl Analytes

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

List 3. Target Metal Analytes

Aluminum (PM _{2.5} ^a , PM ₁₀ ^b)	Cobalt (PM _{2.5} ^a , PM ₁₀ ^b)	Selenium (PM _{2.5} ^a , PM ₁₀ ^b)
Antimony (PM _{2.5} ^a , PM ₁₀ ^b)	Copper (PM _{2.5} ^a , PM ₁₀ ^b)	Tin (PM _{2.5} ^a , PM ₁₀ ^b)
Arsenic (PM _{2.5} ^a , PM ₁₀ ^b)	Lead (PM _{2.5} ^a , PM ₁₀ ^b , TSP ^c)	Vanadium (PM _{2.5} ^a , PM ₁₀ ^b)
Barium (PM _{2.5} ^a , PM ₁₀ ^b)	Manganese (PM _{2.5} ^a , PM ₁₀ ^b)	Zinc (PM _{2.5} ^a , PM ₁₀ ^b)
Cadmium (PM _{2.5} ^a , PM ₁₀ ^b)	Molybdenum (PM _{2.5} ^a , PM ₁₀ ^b)	
Chromium (PM _{2.5} ^a , PM ₁₀ ^b)	Nickel (PM _{2.5} ^a , PM ₁₀ ^b)	

^a Only monitored at the Houston Deer Park #2, Houston Aldine, and Freeport South Ave I sites.

^b Only monitored at the Houston Deer Park #2 and Clinton sites.

^c Only monitored at the Houston Deer Park #2 and Houston East sites.

List 4. Target PAH Analytes

Acenaphthene	Benzo(g,h,i)perylene	Indeno(1,2,3-cd)pyrene
Acenaphthylene	Benzo(k)fluoranthene	Naphthalene
Anthracene	Chrysene	Phenanthrene
Benzo(a)anthracene	Dibenzo(a,h)anthracene	Pyrene
Benzo(a)pyrene	Fluoranthene	
Benzo(b)fluoranthene	Fluorene	

List 5. Target VOC Analytes in AutoGC

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

^{a*} Not monitored at the Cesar Chavez, Channelview, Clinton, Houston Deer Park #2, and Milby Park monitoring sites.

^b Compounds monitored at the Texas City 34th St and Texas City Logan St monitoring sites (4 compounds total).

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

^d Not monitored at the Texas City 34th St monitoring site.

^e Not monitored at the HRM 16 Deer Park monitoring site.

List 6. Additional Canister Analytes Monitored at Mustang Bayou

1,2,4-Trichlorobenzene	2,4,4-Trimethyl-1-Pentene	Benzaldehyde
1,2-Dichlorobenzene	2,4,4-Trimethyl-2-Pentene	Benzyl Chloride
1,3-Dichlorobenzene	2,5-Dimethylhexane	beta-Pinene
1,4-Dichlorobenzene	2,2,3-Trimethylpentane	Bromochloromethane
1,4-Dioxane	2-Ethyl-1-Butene	Bromodichloromethane
1-Decene	2-Methyl-1-Pentene	Bromoform
1-Heptene	2-Methyl-2-Pentene	Butyl Benzene
1-Hexene	2-Propanol	Butyraldehyde
1-Methylcyclohexene	4-Nonene	Chlorodifluoromethane
1-Nonene	Acetaldehyde	Chloroethane
1-Octene	Acetone	Chloroprene
1-Undecene	Acetonitrile	cis-1,2-Dichloroethene
2,2,5-Trimethylhexane	Acrylonitrile	cis-2-Octene
2,2-Dimethylpropane	alpha-Pinene	cis-3-Hexene

cis-3-Methyl-2-Pentene	Hexanal	n-Butyl Acrylate
cis-4-Methyl-2-Pentene	Indan	n-Butyl Alcohol
Cyclohexene	Indene	n-Propyl Alcohol
Dichlorofluoromethane	Isobutene & 1-Butene	p-Chlorotoluene
Diethyl Ether	Isobutylbenzene	p-Isopropyltoluene
Ethyl Alcohol	Methanol	tert-Butylbenzene
Fluorobenzene	Methyl Ethyl Ketone	trans-1,2-Dichloroethylene
Freon 113	Methyl Isobutyl Ketone	Vinyl Acetate
Freon 114	Methyl Tert-Butyl Ether	Vinyl Bromide
Heptanal	Methylcyclopentene	
Hexachlorobutadiene	Naphthalene	

List 7. Additional Canister Analytes Monitored at HRM 1, 4, 7, 8, 10 and 11 sites

1-Hexene	Butyl Acrylate	Dichlorofluoromethane
1-Methylcyclohexene	Butyraldehyde	Naphthalene

List 8. Additional AutoGC Analytes Monitored at 2nd Avenue Monitoring Station

Vinyl Chloride	Acrylonitrile
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List 9. Additional Canister Analytes Monitored at TCLAMN sites

1,2,4-Trichlorobenzene	2-Methyl-2-Pentene	c-3-Methyl-2-Pentene
1,4-Dioxane	2-Propanol	c-4-Methyl-2-Pentene
1-Butanol	4-Nonene	Chlorodifluoromethane
1-Decene	Acetaldehyde	Chloroethane
1-Heptene	Acetone (+)	Chloroprene
1-Hexene	Acetonitrile	Cyclohexene
1-Methylcyclohexene	Acrylonitrile	Dichlorofluoromethane
1-Nonene	a-Pinene	Diethyl Ether
1-Octene	Benzaldehyde	Ethanol
1-Propanol	Benzyl Chloride	Freon 113
1-Undecene	b-Pinene	Freon 114
2,2,3-Trimethylpentane	Bromochloromethane	Heptanal
2,2,5-Trimethylhexane	Bromodichloromethane	Hexachloro-1,3-Butadiene
2,4,4-Trimethyl-1-Pentene	Bromoform	Hexanal
2,4,4-Trimethyl-2-Pentene	Butyl Acrylate	Indan
2,5-Dimethylhexane	Butyraldehyde	Indene
2-Butanone	c-1,2-Dichloroethylene	Isobutene + 1-Butene
2-Ethyl-1-Butene	c-2-Octene	Isobutylbenzene
2-Methyl-1-Pentene	c-3-Hexene	Isoheptane

m-Dichlorobenzene
Methanol (+)
Methyl t-Butylether
Methylcyclopentene
Methylisobutylketone
Naphthalene

n-Butylbenzene
Neopentane
o-Dichlorobenzene
p-Chlorotoluene
p-Dichlorobenzene
p-Isopropyltoluene

t-1,2-Dichloroethylene
t-Butylbenzene
Vinyl Acetate
Vinyl Bromide