TCEQ Interoffice Memorandum

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Date: September 25, 2014

Subject: Health Effects Review of 2013 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 fourth consecutive year over many years of sampling.
- The annual benzene concentration at the Marathon-sponsored site in Texas City was below TCEQ's long-term AMCV for the fourth 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 proposed removal of benzene from the Texas City Air Pollutant Watch List (Site# APWL1202) in March 2013 since data from recent years for the Marathon-sponsored 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.
- Although benzene is currently on the Galena Park APWL (Site# APWL1206), data from 2008 to date continue to indicate sufficient achievements in reducing ambient air concentrations such that the reported levels are no longer of concern for potential long-term, adverse health effects. This determination should be considered in context with the APWL protocol.
- Only approximately 0.0002% of measured hourly concentrations exceeded an odor-based AMCV. A few hourly levels of styrene and xylene (m+p) at three 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 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).
- 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). Success in achieving this significant and

maintained air quality improvement is likely the result of efforts to reduce styrene emissions in this area that have ultimately led to the removal of styrene from the Lynchburg Ferry APWL area (Site# APWL1204).

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 2013. The TD reviewed summary results for volatile organic compounds (VOCs) from 24-hour 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 ($PM_{2.5}$) and from filters collecting particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}).

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 have also been 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 26 sites, including 1 Chocolate Bayou Industrial Group site, 6 Houston Regional Monitoring sites, and 3 Texas City/La Marque Community Air Monitoring Network sites.
  - 24-hour canister VOC sampling was deactivated at 4 sites: Conroe Relocated, Galveston 99th Street, Houston Aldine, and Northwest Harris County on 5/31/2013.
- 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.
  - Chromium VI (TSP) sampling was deactivated at Houston Deer Park #2 on 6/30/2013.
- 24-hour PAH/SVOC sampling at 1 site.
- 1-hour autoGC VOC monitoring at:
  - 5 TCEQ sites,
  - 9 Enhanced Industry-Sponsored Monitoring (EISM) sites,
  - 1 Texas City/La Marque Community Air Monitoring Network site, and
  - 1 Houston Regional Monitoring 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 Avenue Monitoring Station (29.386981, -94.91912)	TCLMCAMN[1]	VOC (24-hour canister, 1/12 days[2]; autoGC)
Galveston	N/A	Avenue A Monitoring Station (29.37435, -94.96364)	TCLMCAMN	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)
Montgomery	48-339-0078	Conroe Relocated[5] 9472A Hwy 1484	TCEQ	VOC (24-hour canister)
Brazoria	48-039-0618	Danciger Along US Hwy 1459 in Brazoria County	EISM[6] - 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)

[1] TCLMCAMN – 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 PM_{10} 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] 24-hour canister sampling was deactivated at this site 5/31/2013.
[6] 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
Galveston	48-167-1034	Galveston 99th St[7] 9511 Avenue V ½	TCEQ	VOC (24-hour canister)
Harris	48-201-0024	Houston Aldine[8] 4510 ½ Aldine Mail Rd	TCEQ	VOC (24-hour canister), Metals ($PM_{2.5}$)
Harris	48-201-0055	Houston Bayland Park 6400 Bissonnet St	TCEQ	VOC (24-hour canister)
Harris	48-201-1039	Houston Deer Park #2[9] 4514 ½ Durant St	TCEQ	VOC (autoGC, 24-hour canister), Carbonyls, Metals ($PM_{2.5}$, PM_{10}, Chromium VI (TSP)) , PAHs/SVOCs
Harris	48-201-1034	Houston East 1262 ½ Mae Drive	TCEQ	Lead (TSP)
Harris	48-201-0803	HRM #3 Haden Rd 1504 ½ Haden Dr	TCEQ/EISM - HRM[10]	VOC (24-hour canister)/VOC (autoGC,)
Harris	N/A	HRM 1 Central Street 1501 Central Street, Houston	HRM	VOCs (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	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)

[7] 24-hour canister sampling was deactivated at this site 5/31/2013.
[8] 24-hour canister sampling was deactivated at this site 5/31/2013.
[9] Chromium VI (TSP) sampling was deactivated at this site 6/30/2013.
[10] HRM – Houston Regional Monitoring

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
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)
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 Mustang Bayou FM 2917 @ County Road 169	EISM - Chocolate Bayou Industry Group	VOC (24-hour canister)
Harris	48-201-0029	Northwest Harris County[11] 16822 Kitzman St	TCEQ	VOC (24-hour canister)
Galveston	N/A	North Site Canister Sampler Monitoring Station (29.429228, -94.9715)	TCLMCAMN	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	Shoreacres 3903 ½ Old Hwy 146	TCEQ	VOC (24-hour canister)
Galveston	48-167-0683	Texas City 11th St 569 11th Street South	EISM - Marathon Petroleum Co.	Benzene (autoGC)
Galveston	48-167-0056	Texas City 34th St 2212 North 34th St	EISM - TCLMCAMN	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 - BP[12]	Benzene (autoGC)

[11] 24-hour canister sampling was deactivated at this site 5/31/2013.
[12] BP – British Petroleum

County	EPA Site ID	Site Name and Location	Network	Monitored Compounds
Galveston	48-167-0621	Texas City BP Logan Street (Site 3) 303 Logan Street	EISM - BP	Benzene (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. 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 three Texas City/La Marque air monitoring sites since air sample results are available for no more than half the year. Consequently, the 24-hour samples from these three sites could only be evaluated for exceedances of short-term AMCVs. 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 99.9997% of the approximately 4,293,900 1-hour VOC measurements from TCEQ, EISM, and industry-sponsored autoGC monitors in Region 12 in 2013 were below their short-term AMCVs. Only three (approximately 0.00007%) hourly autoGC measurements collected in Region 12 in 2013 exceeded a TCEQ short-term, health-based AMCV (see discussion below). Approximately 0.0002% exceeded an odor-based AMCV, with no more than six exceedances for a chemical at any one site. Additionally, 100% of the approximately 3,160 3-hour carbonyl concentrations measured in Region 12 in 2013 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 2013.

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 2013. Two of these exceedances occurred at the Lynchburg Ferry site monitor, where hourly isoprene concentrations of 29.8 and 42.0 ppb_v were above the current interim short-term, health-based AMCV of 20 ppb_v. The other exceedance occurred at the Haden Rd. monitor, where the hourly isoprene concentration of 37.1 ppb_v was above the current interim short-term, health-based AMCV. 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 currently 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 2013 are shown below in Table 2. The total number of odor-based AMCV autoGC exceedances in Region 12 in 2013 (8 exceedances) is 43% lower than that in 2012 (14 exceedances), 58% lower than that in 2011 (19 exceedances), 89% lower than that in 2010 (75 exceedances), and also significantly lower compared to 2009 (37 exceedances), 2008 (82 exceedances), and 2007 (103 exceedances). In regard to 3-hour carbonyl sample results, as in 2012, zero 3-hour concentrations of isovaleraldehyde exceeded its odor-based AMCV at Clinton Dr. in 2013, which represents a significant reduction (i.e., 100%) compared to historical exceedances (i.e., 3 exceedances in 2011, 18 in 2010, and 8 in 2009).

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 (ppb_v)	Odor-Based AMCV (ppb_v)
Milby Park	Styrene	6	50.6	25
Lynchburg Ferry	Styrene	1	43.3	25
Haden Rd.	Xylene (m+p)	1	141.8	80

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 low magnitude of the exceedances (e.g., all essentially ≤ 2 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).

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 2013 (one) was significantly (83%) fewer than even the number in 2012 (six), and remains very low compared to the historical number of exceedances (e.g., range of 27-92 exceedances for 2005-2010). Additionally, maximum hourly styrene concentrations at the Lynchburg Ferry site in recent years (2011-2013: 38.4-56.6 ppb_v) are much lower than those in previous years (2005-2010: 102.0-494.4 ppb_v). Success in achieving this significant and maintained air quality improvement at Lynchburg Ferry is likely the result of efforts to reduce styrene emissions in this area that have ultimately led to the removal of styrene from the Lynchburg Ferry APWL (Site# APWL1204).

24-Hour Concentrations

About 99.9730% of the approximately 118,600 24-hour VOC measurements from TCEQ, EISM, and industry-sponsored canister monitors in Region 12 in 2013 were below odor-based AMCVs. However, about 0.027% exceeded their odor-based AMCV. At the Mustang Bayou site in 2013, twenty-one acetaldehyde concentrations (8.56-22.5 ppb_v) and two butyraldehyde concentrations (1.64 and 1.86 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 nine acetaldehyde concentrations (8.58-26.8 ppb_v) exceeded the odor-based AMCV (i.e., one at 2nd Ave., two at Ave. A, and six at North Ave.). 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 the exceedances (all butryaldehyde samples were < 2 times the odor-based AMCV, all but two of the acetaldehyde samples were < 2 times), and their odor characteristics (e.g., used in fragrances).

Annual Average Concentrations

In 2013, all annual averages were below their respective long-term AMCVs for the fourth consecutive year in many years of sampling in Region 12:

- Based on the approximately 6,520 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 1,710 24-hour measurements, all annual average concentrations of carbonyls were also below their respective long-term AMCVs;
- Based on approximately 1,840 24-hour measurements, all annual average concentrations for PAHs/SVOCs were below long-term AMCVs; and
- Based on averages from approximately 118,600 24-hour canister measurements and approximately 4,293,900 hourly autoGC measurements (TCEQ, EISM, and industry-sponsored autoGC sites), all annual VOC concentrations were also less than their respective long-term AMCVs.

In summary, 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

The 2013 annual average benzene concentration of 0.98 ppb_v (based on every 6th day 24-hour canister data) at the Galena Park site and the annual average of 0.62 ppb_v (based on autoGC data) at the Marathon-sponsored Texas City site remain well below the long-term AMCV, representing significant and maintained air quality improvements in these areas. Although benzene in the Galena Park area is currently on the APWL (Site# APWL1206), monitoring site data from 2008 to date indicate sufficient achievements in reducing ambient air concentrations such that the reported benzene concentrations are no longer of concern for potential long-term, adverse health effects. The Lynchburg Ferry APWL area (Site# APWL1204) also had monitoring site annual benzene concentrations that were no longer of concern beginning in 2008. However, benzene was removed from that APWL in 2010. Furthermore, in March 2013 the TCEQ proposed that benzene be removed from the Texas City APWL area (Site# APWL1202) 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). The improvements achieved at the Marathon-sponsored site in recent years are similar to those achieved at the Galena Park site since 2008. These considerations should be taken into account for the Galena Park area APWL (Site# APWL1206) in context with the APWL protocol.

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, M.P.H. by phone at (512) 239-0154 or by email at Heather.Reddick@tceq.texas.gov. For questions regarding the APWL, you may visit the TCEQ website at http://www.tceq.state.tx.us/implementation/tox/AirPollutantMain/APWL_index.html.

Appendix 1. Monitored Air Toxics in Region 12 in 2013

List 1. Target VOC Analytes in Canister Samples*

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

* 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.
** Not monitored at the Mustang Bayou Site and HRM 1, 4, 7, 8, 10 and 11 sites.
*** Not monitored at the HRM 1, 4, 7, 8, 10 and 11 sites.
**** Not monitored at the Mustang Bayou Site.

List 2. Target Carbonyl Analytes

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

List 3. Target Metal Analytes

Aluminum ($PM_{2.5}$, PM_{10})	Chromium VI (TSP*)	Molybdenum ($PM_{2.5}$, PM_{10})
Antimony ($PM_{2.5}$, PM_{10})	Cobalt ($PM_{2.5}$, PM_{10})	Nickel ($PM_{2.5}$, PM_{10})
Arsenic ($PM_{2.5}$, PM_{10})	Copper ($PM_{2.5}$, PM_{10})	Selenium ($PM_{2.5}$, PM_{10})
Barium ($PM_{2.5}$, PM_{10})	Lead ($PM_{2.5}$**, PM_{10}***, TSP****)	Tin ($PM_{2.5}$, PM_{10})
Cadmium ($PM_{2.5}$, PM_{10})		Vanadium ($PM_{2.5}$ *****)
Chromium ($PM_{2.5}$, PM_{10})	Manganese ($PM_{2.5}$, PM_{10})	Zinc ($PM_{2.5}$, PM_{10})

* Only monitored at the Deer Park monitoring site; TSP = total suspended particulate.
** Only monitored at the Clinton and Houston Deer Park #2 sites.
*** Only monitored at the Houston Deer Park #2, Houston Aldine, and Freeport South Avenue 1 sites.
**** Only monitored at the Houston Deer Park #2 and Houston East monitoring sites.
***** Only monitored at the Houston Deer Park #2, Houston Aldine, and Freeport South Avenue monitoring 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*	Benzene**,****,*****	n-Heptane
1-Pentene	c-2-Butene	n-Hexane****
1,2,3-Trimethylbenzene	c-2-Pentene	n-Nonane
1,2,4-Trimethylbenzene	Cyclohexane	n-Octane
1,3-Butadiene**	Cyclopentane	n-Pentane****
1,3,5-Trimethylbenzene	Ethane	n-Propylbenzene
2-Methyl-2-Butene***	Ethyl Benzene	n-Undecane***
2-Methylheptane	Ethylene	o-Xylene
2-Methylhexane*	Isobutane	p-Xylene + m-Xylene
2,2-Dimethylbutane*	Isopentane	Propane
2,2,4-Trimethylpentane	Isoprene	Propylene
2,3-Dimethylpentane	Isopropyl Benzene – Cumene*	Styrene
2,3,4-Trimethylpentane	Methylcyclohexane	t-2-Butene
2,4-Dimethylpentane	Methylcyclopentane	t-2-Pentene
3-Methylheptane	n-Butane	Toluene*,****
3-Methylhexane	n-Decane	
Acetylene		

* Not monitored at the HRM 16 Deer Park monitoring site.
** 2nd Avenue Monitoring Station only monitored for these componds, in addition to those listed in List 8.
*** Only monitored at the Danciger, Lake Jackson, Texas City 34th St., Wallisville Rd., Haden Rd., Lynchburg Ferry, HRM 16 Deer Park monitoring sites.
**** These are the only compounds monitored at the TX City BP Logan and TX City BP 31st sites.
***** This is the only compound monitored at the TX City 11th St 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-Proponol	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	Naphthalene
1-Methylcyclohexene	Butyraldehyde	

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

Vinyl Chloride	Vinyl Acetate	Acrylonitrile