PROJECT PLAYGROUND

CLEANER AIR FOR ACTIVE KIDS

BY SHALETEST ENVIRONMENTAL TESTING | FUNDED BY PATAGONIA

SHALETEST
Environmental Testing

SHALETEST

P.O. Box 594, Denton, TX 75026
Telephone: 307-645-3236, Website: www.shaletest.org
Contact: Deb Thomas, Executive Director, dthomas@nemont.net
September 2014

PROJECT PLAYGROUND: CLEANER AIR FOR ACTIVE KIDS

Under a grant from the Patagonia Environmental Fund, ShaleTest Environmental Testing (ShaleTest) conducted ambient air quality tests and gas-finder infra-red video for several children's play areas in North Texas that are located in close proximity to natural gas shale development. In addition, pollution dispersion air modeling has been completed for one location. The data collected will provide a better picture of the exposure and amount of air pollution and toxic contamination for thousands of children. The information gathered will be used to accelerate investigation and action by policymakers and regulators.

METHODOLOGY

Ambient Air Sampling

Air samples were collected in the play areas, or immediately adjacent, using Summa canisters. A Summa canister is a stainless steel vessel that has had the internal surfaces specially passivated (i.e. made less affected by environmental factors such as air and water) using a "Summa" process. This process combines an electropolishing step with chemical deactivation to produce a surface that is chemically inert. The Summa canisters are provided by the testing laboratory under negative pressure. To collect a sample, the valve on the canister is opened, drawing the ambient air in. The valve is then closed before the canister fully reaches atmospheric pressure. The canister is then shipped back to the lab under chain of custody.


Summa Canister

The air samples were analyzed by Columbia Analytic Services for volatile organic compounds in accordance with EPA Method TO-15 from the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/010b), January, 1999. The analytical system was comprised of a gas chromatograph/mass spectrometer (GC/MS) interfaced to a whole-air preconcentrator.

Air sample analysis results were compared to the Texas Commission on Environmental Quality (TCEQ) Effects Screening Levels (ESLs) from March 2014. ESLs are developed by TCEQ for use in evaluating air permits. While ESLs are not ambient air standards, the TCEQ Interoffice Memorandum dated March 17, 2014 that accompanies the ESLs states that they are based on "data concerning health effects, odor/nuisance potential, and

effects on vegetation." In other words, when seeking a permit from TCEQ, emissions resulting in concentrations above the ESLs are of concern to the Toxicology Division. An ESL was not available for all compounds analyzed. Therefore the default short-term ESL of 2 micrograms per cubic meter was used as per the aforementioned TCEQ memorandum.

The air sample results were also compared to the TCEQ Air Monitoring Comparison Values (AMCVs) for long-term health effects. According to the TCEQ, these are chemical-specific air concentrations TCEQ states are "set to protect human health and welfare." According to the document dated May 2010 that accompanies the AMCVs; "exposure to an air concentration at or below the AMCVs is not likely to cause adverse health effects in the general public, including sensitive subgroups such as children, the elderly, pregnant women, and people with preexisting health conditions". However, AMCVs have been established for even fewer compounds than for ESLs.

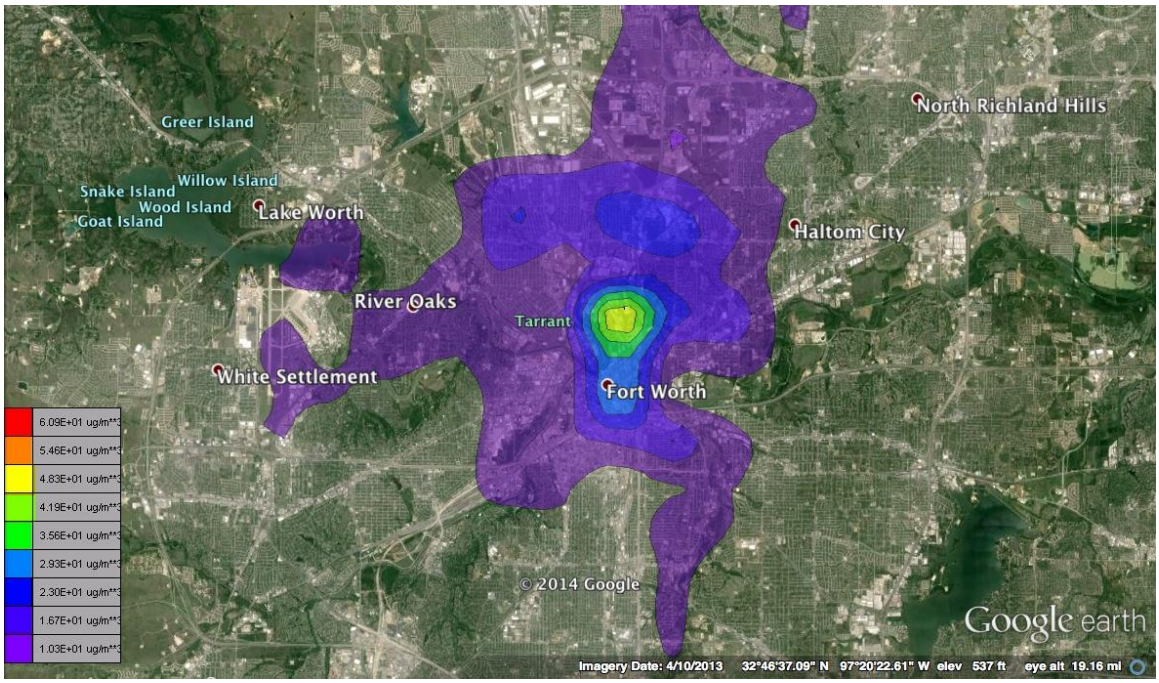
Infra-Red Video

Video of emissions from natural gas development equipment adjacent to children's play areas was produced using a FLIR ThermaCAM GasFindIR HSX. This equipment allows visual observation of emissions not normally visible to the human eye. While it does not provide quantitative results, the resulting video is dramatic, useful in educating the public and decision makers about the potential risk of such emissions. The FLIR equipment also allows for the identification of natural gas equipment that is leaking or otherwise emitting large quantities of volatiles, which can then be reported to the responsible companies or regulatory agencies, or to identify locations for further air sampling.

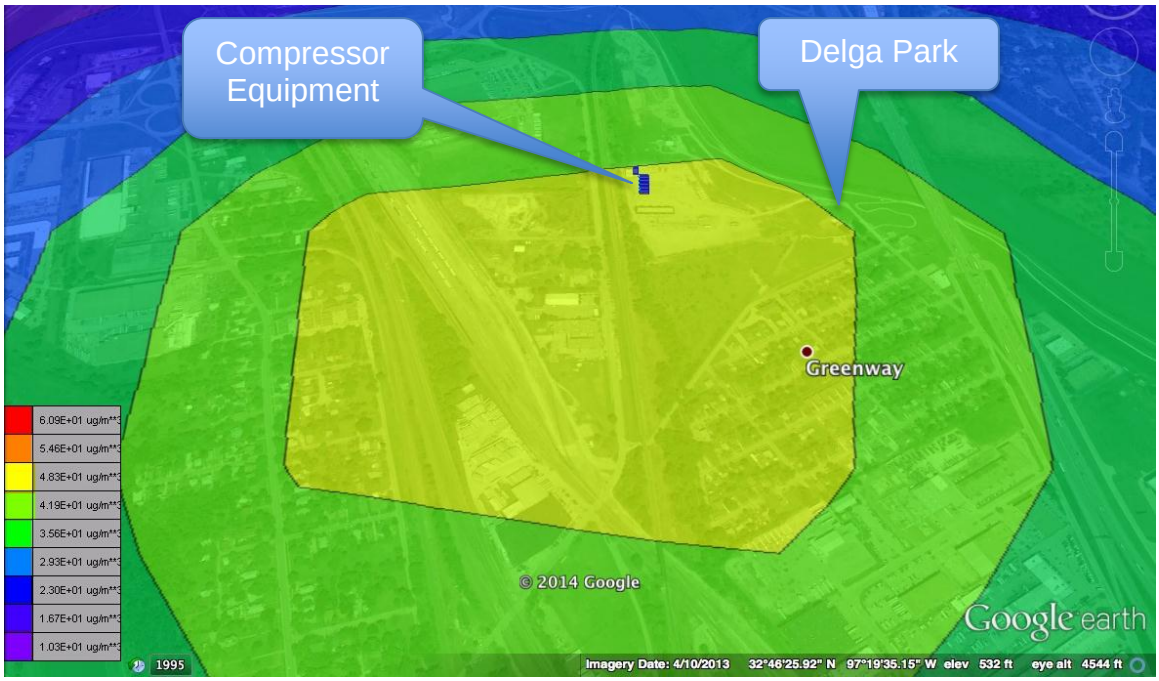
Still image from FLIR GasFindIR video taken adjacent to Delga Park in Forth Worth, Texas. Note the plume of volatile emissions venting from the top of the produced water tanks.

Dispersion Air Modeling

Pollutant dispersion air modeling for nitrous oxides (NOx) was conducted using the Breeze AERMOD atmospheric dispersion modeling software. The dispersion modeling results are viewable in the Google Maps desktop application, allowing the user to zoom into areas of interest to see NOx levels for 1-hour, 4-hour, 24-hour, and annual averages. The dispersion modeling can only be conducted for NOx and only at locations that have natural gas compressor equipment. Only two subject locations had compressor equipment, and analysis was only conducted at the location with multiple large compressors.



Dispersion modeling of the 1-hour concentration of NOx from the natural gas compressor equipment adjacent to Delga Park in Fort Worth, TX.



Closer view of dispersion modeling for the compressor equipment adjacent to Delga Park.

SUBJECT LOCATIONS

Air samples and FLIR GasFinderIR video were collected near natural gas development equipment adjacent to the following children's play facilities:

- McKenna Park in Denton, TX
- Several parks/playgrounds in Mansfield, TX
- Trinity Park in Fort Worth, TX
- Dish City Park in Dish, TX
- Delga Park in Forth Worth, TX

Maps of each of the locations showing adjacent natural gas development equipment are provided in Attachment 1 below.

RESULTS

Laboratory analysis results for the air samples are summarized in Attachment 2 below. The results show a large number of compounds detected above the Method Reporting Limit (the minimum quantity of the compound that can be confidently determined by the laboratory). Additionally, there were a number of results above the TCEQ ESLs and AMCVs.

Locations Exceeding the TCEQ ESLs and/or AMCVs for Certain Compounds

	LOCATION			
COMPOUND	Denton	Mansfield	Dish	Fort Worth
Benzene	XX		XX	XX
Propene		X		
m,p-Xylenes			X	X

X – Exceeded the ESL
XX – Exceeded both the ESL and the AMCV

Benzene was found at all but one sampling location, and it was found at levels above the TCEQ ESL and the AMCV at three locations. This particularly noteworthy as benzene is a known carcinogen (based on evidence from studies in both people and lab animals), AND because it exceeds both the TCEQ ESL and AMCV. Benzene has been linked largely to leukemia and cancers of other blood cells. Benzene can also cause excessive bleeding and can affect the immune system, increasing the chance for infection.

Methylene chloride, also a known carcinogen, was found at the Mansfield, TX location, but below the TCEQ ESL. Other than cancer, methylene chloride can have adverse effects on the heart, central nervous system and liver, and can cause skin or eye irritation.

Tetrachloroethene, a suspected carcinogen based on human and animal data, was also found at the Mansfield location. In addition to potentially causing cancer, tetracholorethene can cause respiratory tract irritation, skin irritation, eye irritation, and central nervous system depression.

Other compounds identified are of concern due to non-cancer health effects:

N-Hexane was found at four of the five subject locations, and can cause eye and nose irritation, nausea, dizziness, headaches, numb extremities, muscle weakness, and dermatitis.

Acetone was found at three of the five locations, and may affect the central nervous system and be toxic to kidneys, the reproductive system, liver, and skin.

N-Heptane was found at three of the five locations, and can affect the liver, upper respiratory tract, skin, and central nervous system.

Toluene was also found at three of the locations, and can cause irritation of the eyes, skin and mucous membranes, and can cause headaches, drowsiness or other effects to the central nervous system.

Xylenes were found at two locations, with m,p-xylenes over the default TCEQ ESL. Xylenes can cause developmental effects on unborn children, and has been associated with low birth weight or size, and learning disabilities. In addition, xylenes can cause moderate or severe skin irritation, and central nervous system effects.

Ethyl acetate was found at two of the five subject locations, and can affect mucous membranes, upper respiratory tract, blood, kidneys, liver, central nervous system.

Cyclohexane was also found at two of the locations, and can affect the kidneys, central nervous system, liver, and cardiovascular system.

Propene was found at the Mansfield, TX location at levels above the default TCEQ ESL. Propene is a flammable gas that can cause lung irritation and asphyxiation at higher concentrations.

1,1,2-Trichloroethane was found at the Mansfield, TX location, and can cause respiratory tract irritation, skin irritation, eye irritation, and central nervous system depression.

1,2,4-Trimethylbenzene was found at the Delga Park location in Forth Worth, TX, and can be irritating to eyes, skin, lungs and respiratory system.

1,3,5-Trimethylbenzene was also found at the Delga Park location, and can cause eye irritation, skin and respiratory tract irritation and central nervous system effects.

Dichlorodifluoromethane (CFC 12) and trichlorofluoromethane (CFC 11) were found at all five locations. However these are chlorofluorocarbons were banned in 1996[1], and thus these results appear to reflect the remaining background levels of these materials, unrelated to natural gas development activities.

The air dispersion analysis of natural gas compression equipment adjacent the Delga Park location indicated that there would be a very wide dispersion of **nitrogen oxides (NOx)** across Fort Worth and surrounding communities. The predicted 1-hour average concentration in the immediate area of Delga Park was 48.3 micrograms per cubic meter. While this is below the recommended EPA exposure limit for sensitive individuals[2], NOx contributes to ground-level ozone (smog) affecting a wide swath of Fort Worth. Ground-level ozone is created through a chemical reaction of NOx and volatile organic compounds (VOCs), which are also emitted by natural gas development equipment. Ground level ozone can cause acute respiratory problems, aggravate asthma, cause significant temporary decreases in lung capacity of 15 to over 20 percent in some healthy adults; and cause inflammation of lung tissue. Children are particularly sensitive to the health effects of ground-level ozone.[3]

[1] http://www.epa.gov/ozone/title6/phaseout/classone.html
[2] http://www.epa.gov/airnow/no2.pdf
[3] http://www.epa.gov/region7/air/quality/o3health.htm

CONCLUSION

Sampling and dispersion analysis conducted as part of Project Playground clearly show there is reason for concern when natural gas development equipment is located near areas where children play.

Air sampling found three known/suspected carcinogens, and a number of other compounds with significant health effects. Benzene results from Denton, Dish, and Fort Worth are particularly alarming since they exceeded the long-term ambient air limits set by the TCEQ, and benzene is a known carcinogen.

While most of the sampling results did not exceed the TCEQ ESLs or AMCVs, and the ESLs are not even ambient air quality standards, there is still reason for concern. While exposure limits have been established for occupational exposures (applicable to adults with exposures limited to 40 hour work weeks) for many of the chemicals detected as part of this project, there has been little progress in development of standards applicable to children and others exposed 24 hours a day, 7 days a week. The TCEQ ESLs and the AMCVs only establish standards for individual compounds, and do not consider synergetic effects of the compounds. In other words: they do not consider the potential that the health effects of exposure to combinations of certain compounds may be more significant than the simple addition of the effects of individual compounds. Research on exposure to multiple chemicals from oil and gas facilities is just beginning. Therefore, it is important for parents and decision makers to be aware of all of the potential health effects of chemicals released by natural gas development activities.

Air dispersion modeling shows that natural gas compression stations can significantly contribute to ground-level ozone in adjacent play areas, as well as wider surrounding metropolitan areas.

NEXT STEPS

ShaleTest will hold community meetings in each of the municipalities where the testing was conducted. The purpose of these meetings will be to inform the public about the testing that was conducted. We will also spend time with residents who are affected to make sure they understand the results in the report. We will direct them to additional resources that identify potential health problems of the air toxics they and their children are breathing so they can make informed decisions.

Copies of the report will be provided at the meetings, as well as copies of (or internet links to) the FLIR GasFindIR videos. We will also use these reports to gain the attention of the media, regulators and policymakers, increasing awareness of the impacts of shale oil and gas development near children. We aim to promote action and further investigation by the public health community.

ATTACHMENT 1
SUBJECT LOCATION MAPS


McKenna Park
Denton, TX
Range Resources, Razor Ranch
P-P 522 ft.
Census Tract - 735 kids
N Bonnie Brae St
N Bonnie Brae St
N Bonnie Brae St
Old Bonnie Brae St
Old Bonnie Brae St
Old Bonnie Brae St

MANSFIELD PARKS

NANCY NIEL ELM.
PLAYGROUND

PIEDMONT DR.
PLAYGROUND

BEN BARBER SCHOOL -DAYCARE/PLAYGROUND


Fairfield Inn & Suites Fort Worth
Old University Dr
Mistletoe Dr
Chili's Grill & Bar
Raising Cane's
S University Dr
Merrimac Cir
Fort Worth Branch (Trinity Trails System)
Zoës Kitchen
McKinley's Fine
Trinity Park
Fort Worth, TX
Locating In Public Park
20 miles of hiking trails,


DISH Playground
DISH, TX
Operators ?
P-P 301 ft & 693 ft
Census Tract - 49 kids
Tim Donald Rd
Wilton Terrace
Wilton Terrace


Nixon St
1244
Delga Park
Delga Park,
Ft. Worth, TX
Chesapeake, Nixon Facility
P-P 602 ft.
Census Tract: 378 kids

ATTACHMENT 2
AIR SAMPLING ANALYTICAL RESULTS

		City	*Denton*	*Mansfield*	*Fort Worth*	*Dish*	*Fort Worth*	TCEQ ESLs	TCEQ AMCVs
		Location	McKenna Park	Various Parks	Trinity Park	City Park	Delga Park	Long Term	Long Term Health
		Date	2/9/14	9/13/13	10/28/12	10/28/12	6/1/14	3/17/14	March 2014
CAS #	**Compound**		**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**
115-07-1	Propene		<0.61	**2.8**	<0.71	<0.77	<0.67	2*	Simple Asphyxiant^
75-71-8	Dichlorodifluoromethane (CFC 12)		**2.2**	**2.3**	**2.2**	**2.5**	**2.1**	5000	4943
74-87-3	Chloromethane		<0.61	<0.65	<0.71	<0.77	<0.67	103	103
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)		<0.61	<0.65	<0.71	<0.77	<0.67	7000	Not Established
75-01-4	Vinyl Chloride		<0.61	<0.65	<0.71	<0.77	<0.67	1.2	1.15
106-99-0	1,3-Butadiene		<0.61	<0.65	<0.71	<0.77	<0.67	9.9	20.1
74-83-9	Bromomethane		<0.61	<0.65	<0.71	<0.77	<0.67	12	12
75-00-3	Chloroethane		<0.61	<0.65	<0.71	<0.77	<0.67	50	Not Established
64-17-5	Ethanol		<6.1	**38**	<7.1	<7.7	<6.7	1880	Not Established
75-05-8	Acetonitrile		<0.61	<0.65	<0.71	<0.77	<0.67	34	Not Established
107-02-8	Acrolein		<2.4	<2.6	<2.8	<3.1	<2.7	0.82	2.75
67-64-1	Acetone		**8.9**	**26**	<7.1	<7.7	**15**	4800	15909
75-69-4	Trichlorofluoromethane		**1.1**	**1.2**	**1.1**	**1.3**	**1.1**	5600	5616
67-63-0	2-Propanol (Isopropyl Alcohol)		<6.1	<6.5	<7.1	<7.7	<6.7	492	Not Established
107-13-1	Acrylonitrile		<0.61	<0.65	<0.71	<0.77	<0.67	2.1	Not Established
75-35-4	1,1-Dichloroethene		<0.61	<0.65	<0.71	<0.77	<0.67	100	341
75-09-2	Methylene Chloride		<0.61	**1.0**	<0.71	<0.77	<0.67	350	347
107-05-1	3-Chloro-1-propene (Allyl Chloride)		<0.61	<0.65	<0.71	<0.77	<0.67	3	Not Established
76-13-1	Trichlorotrifluoroethane		<0.61	<0.65	<0.71	<0.77	<0.67	3800	Not Established
75-15-0	Carbon Disulfide		<6.1	<6.5	<7.1	<7.7	<6.7	3	Not Established
156-60-5	trans-1,2-Dichloroethene		<0.61	<0.65	<0.71	<0.77	<0.67	793	Not Established
75-34-3	1,1-Dichloroethane		<0.61	<0.65	<0.71	<0.77	<0.67	400	405
1634-04-4	Methyl tert-Butyl Ether		<0.61	<0.65	<0.71	<0.77	<0.67	180	180
108-05-4	Vinyl Acetate		<6.1	<6.5	<7.1	<7.7	<6.7	15	Not Established
78-93-3	2-Butanone (MEK)		<6.1	<6.5	<7.1	<7.7	<6.7	2600	8844
156-59-2	cis-1,2-Dichloroethene		<0.61	<0.65	<0.71	<0.77	<0.67	2	Not Established
141-78-6	Ethyl Acetate		**3.3**	**4.4**	<1.4	<1.5	<1.3	1440	1441
110-54-3	n-Hexane		**2.5**	**0.91**	<0.71	**1.3**	**4.0**	200	669
67-66-3	Chloroform		<0.61	<0.65	<0.71	<0.77	<0.67	10	10
109-99-9	Tetrahydrofuran (THF)		<0.61	<0.65	<0.71	<0.77	<0.67	150	Not Established
107-06-2	1,2-Dichloroethane		<0.61	<0.65	<0.71	<0.77	<0.67	4	4
71-55-6	1,1,1-Trichloroethane		<0.61	<0.65	<0.71	<0.77	<0.67	1500	5127
71-43-2	Benzene		**6.5**	<0.65	**0.72**	**12**	**32**	4.5	4.5
56-23-5	Carbon Tetrachloride		<0.61	<0.65	<0.71	<0.77	<0.67	13	13
110-82-7	Cyclohexane		**3.0**	<1.3	<1.4	<1.5	**4.5**	340	344
78-87-5	1,2-Dichloropropane		<0.61	<0.65	<0.71	<0.77	<0.67	46	46
75-27-4	Bromodichloromethane		<0.61	<0.65	<0.71	<0.77	<0.67	70	Not Established
79-01-6	Trichloroethene		<0.61	<0.65	<0.71	<0.77	<0.67	54	54
123-91-1	1,4-Dioxane		<0.61	<0.65	<0.71	<0.77	<0.67	90	Not Established
80-62-6	Methyl Methacrylate		<1.2	<1.3	<1.4	<1.5	<1.3	210	Not Established
142-82-5	n-Heptane		**0.82**	<0.65	<0.71	**0.88**	**2.8**	350	348
10061-01-5	cis-1,3-Dichloropropene		<0.61	<0.65	<0.71	<0.77	<0.67	4.5	4.5
108-10-1	4-Methyl-2-pentanone		<0.61	<0.65	<0.71	<0.77	<0.67	82	82
10061-02-6	trans-1,3-Dichloropropene		<0.61	<0.65	<0.71	<0.77	<0.67	4.5	4.5
79-00-5	1,1,2-Trichloroethane		<0.61	**3.7**	<0.71	<0.77	<0.67	55	55
108-88-3	Toluene		**5.2**	<0.65	<0.71	**14**	**83**	1200	4144
591-78-6	2-Hexanone		<0.61	<0.65	<0.71	<0.77	**0.78**	4	4
124-48-1	Dibromochloromethane		<0.61	<0.65	<0.71	<0.77	<0.67	70	Not Established
106-93-4	1,2-Dibromoethane		<0.61	<0.65	<0.71	<0.77	<0.67	0.4	0.4
123-86-4	n-Butyl Acetate		<0.61	<0.65	<0.71	<0.77	**1.2**	1400	4701
111-65-9	n-Octane		<0.61	<0.65	<0.71	<0.77	<0.67	350	350
127-18-4	Tetrachloroethene		<0.61	**1.0**	<0.71	<0.77	<0.67	26	26
108-90-7	Chlorobenzene		<0.61	<0.65	<0.71	<0.77	<0.67	46	46
100-41-4	Ethylbenzene		<0.61	<0.65	<0.71	<0.77	**2.2**	570	1953
179601-23-1	m,p-Xylenes		<1.2	<1.3	<1.4	**3.8**	**30**	2*	Not Established
75-25-2	Bromoform		<0.61	<0.65	<0.71	<0.77	<0.67	5	Not Established
100-42-5	Styrene		<0.61	<0.65	<0.71	<0.77	<0.67	140	468
95-47-6	o-Xylene		<0.61	<0.65	<0.71	**0.78**	**5.1**	180	608
111-84-2	n-Nonane		<0.61	<0.65	<0.71	<0.77	<0.67	1050	1048
79-34-5	1,1,2,2-Tetrachloroethane		<0.61	<0.65	<0.71	<0.77	<0.67	7	7
98-82-8	Cumene		<0.61	<0.65	<0.71	<0.77	<0.67	250	246
80-56-8	alpha-Pinene		<0.61	<0.65	<0.71	<0.77	<0.67	350	351
103-65-1	n-Propylbenzene		<0.61	<0.65	<0.71	<0.77	<0.67	250	246
622-96-8	4-Ethyltoluene		<0.61	<0.65	<0.71	<0.77	<0.67	125	123
108-67-8	1,3,5-Trimethylbenzene		<0.61	<0.65	<0.71	<0.77	**1.7**	125	123
95-63-6	1,2,4-Trimethylbenzene		<0.61	<0.65	<0.71	<0.77	**1.4**	125	123
100-44-7	Benzyl Chloride		<0.61	<0.65	<0.71	<0.77	<0.67	5	Not Established
541-73-1	1,3-Dichlorobenzene		<0.61	<0.65	<0.71	<0.77	<0.67	60	Not Established
106-46-7	1,4-Dichlorobenzene		<0.61	<0.65	<0.71	<0.77	<0.67	160	Not Established
95-50-1	1,2-Dichlorobenzene		<0.61	<0.65	<0.71	<0.77	<0.67	60	Not Established
5989-27-5	d-Limonene		<0.61	<0.65	<0.71	<0.77	<0.67	110	Not Established
96-12-8	1,2-Dibromo-3-chloropropane		<0.61	<0.65	<0.71	<0.77	<0.67	0.01	Not Established
120-82-1	1,2,4-Trichlorobenzene		<0.61	<0.65	<0.71	<0.77	<0.67	40	Not Established
91-20-3	Naphthalene		<0.61	<0.65	<0.71	<0.77	<0.67	50	262000
87-68-3	Hexachlorobutadiene		<0.61	<0.65	<0.71	<0.77	<0.67	0.2	Not Established

* A long term ESL has not been established for this compound by the TCEQ, so the default ESL of 2 ug/m3 is used.

^ A Simple Asphyxiant displaces air, lowering the partial pressure of oxygen and causing hypoxia at sufficiently high concentrations.

Light yellow highlighted cells (with dashed borders) indicate an result over the Method Reporting Limit (the minimum quantity of the compound can be confidently determined by the method used).

Pink higlighted cells (with heavy borders) indicate that the result was over the TCEQ ESL or AMCV listed in the two right-hand columns.