



# Wieambilla Estates Odour Investigation Results

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July – December 2012

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Department of Science, Information Technology, Innovation and the Arts  
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## Summary

The Queensland Government commenced a community sampling program for volatile organic compounds (VOCs) in the Wieambilla Estate in response to community concerns about the impacts of air emissions from the local coal seam gas fields on the health and well-being of the surrounding community. The results of the community sampling program conducted between July – December 2012 indicate that a number of volatile organic compounds (VOCs) were detected in the ambient air, at levels generally well below relevant guidelines and criteria used to assess VOC concentrations.

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## Introduction

People living in the Wieambilla Estate have raised concerns about the impacts of air emissions from the local coal seam gas fields on the health and well-being of the surrounding community. These concerns have primarily focused on odours and the potential health implications from those odours. The Wieambilla Estate is located half-way between Chinchilla to the north and Tara to the south of the estate.

In response to residents' concerns raised about the health impact of odour emissions from the local coal seam gas fields on surrounding residential areas, the Department of Environment and Heritage Protection (DEHP) initiated a community sampling program for odours in July 2012. The Science Delivery Division of the Department of Science, Information Technology, Innovation and the Arts (DSITIA) was commissioned to assist in the study. This report details the results of this study.

## Monitoring study design

The DEHP and DSITIA air monitoring investigation at the Wieambilla Estate focused on acquiring data on the concentration of volatile organic compound species in the air when odour was present in the community.

A very helpful tool used by DSITIA to aid in odour complaint investigations is the summa canister (see Figure 1) which can be supplied to complainants to sample the air when odours are detected. A summa canister is an evacuated canister that is used to collect an instantaneous air sample. This method of obtaining an air sample is simple and can be used by any individual concerned about odours or emissions from a nearby source of air pollution. Participants receive written instructions on how to take a sample of air using the summa canister. It is at the discretion of the participant as to when a sample is taken.

Samples of air for VOC analysis were collected by residents during times when odour was detected at its worst. Residents were supplied with an evacuated summa canister. Air samples were collected by opening the canister valve, allowing the canister to come to atmospheric pressure and closing the valve (typically takes 30 to 60 seconds). The canister was then sent for laboratory analysis using gas chromatography and mass spectrometry (GC/MS) in accordance with USEPA Compendium Method TO-15 *Determination of Volatile Organic Compounds (VOCs) in air collected in specially-prepared canisters and analyzed by Gas*



**Figure 1:** Example of Summa Canister

*Chromatography/Mass Spectrometry (GC/MS)*<sup>1</sup>. The analysis was carried out by the Queensland Government Forensic and Scientific Services Laboratory. The TO-15 analysis method can measure up to 102 VOC compounds.

Four Wieambilla Estate residents participated in the community sampling program using the summa canisters and collected six samples. Samples collected by these residents are identified as:

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

DEHP staff collected two samples associated with the coal seam gas fields. These samples are identified as:

- TO1743;
- Rhyme Pond.

A control sample was also collected by DEHP staff at the Barakula State Forest some 38 km north of Chinchilla.

VOC monitoring was also conducted using passive diffusion samplers to collect airborne VOCs on adsorbent material, followed by extraction of the adsorbed compounds and characterisation using capillary gas chromatography. The passive sampler worked by diffusion of gaseous VOC molecules through a permeable membrane and subsequent capture by Tenax TA adsorbing material positioned inside the permeable membrane. The passive samplers were deployed at four locations in the Wieambilla Estate and a control location in the town of Chinchilla for three weeks to maximise the detection of any VOCs present. Following collection, the passive samplers were sealed and sent for laboratory analysis. The average VOC concentration over the sampling period was calculated from the VOC mass collected, the sampling time and the rate of diffusion of the VOC species through the permeable membrane. Deployment and retrieval of the passive samplers was carried out by DEHP staff and the analysis was carried out by Gradko Environmental in the United Kingdom.

Four passive samplers were located in the Wieambilla Estate and are identified as:

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

A fifth passive sampler was located in the township of Chinchilla as a control.

## Results and Discussion

### Volatile Organic Compounds

Substances that are included in the VOC category include aliphatic hydrocarbons (such as hexane), aromatic hydrocarbons (such as benzene, toluene and the xylenes), and oxygenated compounds (such as acetone and similar ketones).

To assess the measured VOC concentrations, a number of sources of environmental and human health guidelines/criteria were considered to cover the full range of VOCs detected in the samples. These included the Queensland Environmental Protection (Air) Policy 2008 (EPP Air) air quality objectives, Ontario's Ambient Air Quality Criteria and the Texas Commission on Environmental Quality Effects Screening Levels (ESLs). For four of the compounds, Pentane, 3-Methylpentane, Methylcyclohexane and 3-Methylhexane there are no environmental and human health guidelines/criteria. For the first three compounds the United States National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (RELs) are provided while Germany's occupational exposure limit is provided for 3-Methylhexane for assessment.

The number of compounds detected in the samples from the summa canister sampling ranged from 3 to 7. It should be noted that the results from the Summa canister are from a 1-minute sampling period and cannot be directly compared with guideline values that have longer averaging periods (10-minute, 1-hour, 24-hours or annual averages). Concentrations determined using short-term sampling techniques relates to times when air quality was considered by the community to be poor (odour present) and pollutant levels are expected to be at a maximum. This means that VOC concentrations in the short term samples are expected to be significantly higher than samples collected over a longer time frame, when air with little or no pollutants would also be sampled. For assessment purposes if the levels of individual VOCs measured in the Summa canister samples are less than the long term averages used to assess the exposure impacts as shown in the column 'Guideline/Criteria' in Table 1, then it can be assumed that the guideline/criteria would be met. However, if the levels of VOCs from the canister are higher than the longer term guideline/criteria it does not necessarily mean that the guideline/criteria was not met (ie. it cannot be demonstrated as meeting the guideline/criteria). It should be noted that none of the measured concentrations of VOCs in the summa canister samples collected over a 1-minute period were higher than the longer term guideline/criteria.

The number of compounds detected in the passive diffusion samples ranged from 4 to 18. The results of the passive diffusion sampling are shown in Table 2. The measurement of Phenylmaleic anhydride could possibly be derived from an ozone-adsorbing artefact of the Tenax TA adsorbing material used in the passive sampler to adsorb the VOCs<sup>2</sup>. Detection limits of <0.17ppb on the three week averaged results were achieved compared with the summa canister of 0.5 – 1.0 ppb on the 1-minute averaged results. This has resulted in more compounds being detected. If the levels of VOCs over the whole year were similar to the concentrations experienced over the three week sampling period then the relevant guidelines and criteria for annual average used to assess VOC concentrations in ambient air would not be exceeded.



**Table 1:** Results from summa canister sampling for chemical compounds with concentrations greater than the Limit of Reporting.

Chemical Compound	TO-1743 (ppb)	[REDACTED] HPV 1 (ppb)	[REDACTED] HPV 1 (ppb)	[REDACTED] (ppb)	[REDACTED] (ppb)	[REDACTED] (ppb)	[REDACTED] (ppb)	Barakula State Forest (ppb)	Rhyme Pond (ppb)	Ambient Air Guideline/Criteria				
										Averaging Period	ppb	µg/m <sup>3</sup>	Source	Effect
<b>Sampling Date</b>	<b>3/07/12</b>	<b>4/07/12</b>	<b>4/07/12</b>	<b>11/09/12</b>	<b>1/11/12</b>	<b>25/11/12</b>	<b>1/12/12</b>	<b>4/12/12</b>	<b>6/12/12</b>					
<b>Compounds detected</b>	3	3	3	4	6	5	7	6	5					
<b>Alkanes</b>														
Hexane	3	19.2	8.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	24 Hour	2,027	7,500	Ontario	Health
										1 Hour	1,500	5,300	Texas	Odour
										Annual	57	200	Texas	Health
<b>Alkenes</b>														
Propene	n/a	n/a	n/a	n/a	n/a	<0.5	7.7	<0.5	<0.5	24 Hour	2,210	4,000	Ontario	Health
<b>Haloalkanes/ alkenes</b>														
Chloromethane	<1.0	<1.0	<1.0	0.7	0.7	0.6	0.6	0.6	0.7	24 Hour	147	320	Ontario	Health
										1 Hour	1,030	500	Texas	Health
										Annual	103	50	Texas	Health
Dichlorodifluoro-methane	<1.0	<1.0	<1.0	0.5	0.6	<0.5	<0.5	<0.5	0.6	1 Hour	10,000	50,000	Texas	Health
										Annual	1,000	5,000	Texas	Health
Methylene chloride	<1.0	<1.0	<1.0	<0.5	<0.5	<0.5	5.2	0.7	0.7	24 Hour	60	220	Ontario	Health
										Annual	12	44	Ontario	Health
										1 Hour	1,100	3,600	Texas	Health
										Annual	100	350	Texas	Health
<b>Alcohols</b>														
Ethanol	<1.0	<1.0	<1.0	0.8	1.5	1.6	5.5	1.5	1.2	1 Hour	10,096	19,000	Ontario	Odour
										1 Hour	10,000	18,800	Texas	Health
										Annual	1,000	1,880	Texas	Health

Chemical Compound	TO-1743 (ppb)	[REDACTED] HPV 1 (ppb)	[REDACTED] HPV 1 (ppb)	[REDACTED] (ppb)	[REDACTED] (ppb)	[REDACTED] (ppb)	[REDACTED] (ppb)	Barakula State Forest (ppb)	Rhyme Pond (ppb)	Ambient Air Guideline/Criteria				
										Averaging Period	ppb	µg/m <sup>3</sup>	Source	Effect
<b>Sampling Date</b>	<b>3/07/12</b>	<b>4/07/12</b>	<b>4/07/12</b>	<b>11/09/12</b>	<b>1/11/12</b>	<b>25/11/12</b>	<b>1/12/12</b>	<b>4/12/12</b>	<b>6/12/12</b>					
<b>Carbonyls</b>														
Acetone	<1.0	<1.0	<1.0	2.4	1.5	5.6	10	6.7	2.0	24 Hour	5,007	11,880	Ontario	Health
										1 Hour	2,500	5,900	Texas	Health
										Annual	250	590	Texas	Health
Methyl ethyl ketone	1.5	1.5	4.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	24 Hour	400	1,000	Ontario	Health
										1 Hour	440	1,300	Texas	Odour
										Annual	900	2,600	Texas	Health
Acrolein	<1.0	<1.0	<1.0	<0.5	<0.5	0.5	0.6	0.5	<0.5	1 Hour	2.0	4.5	Ontario	Health
										24 Hour	0.17	0.4	Ontario	Health
										1 Hour	1.6	3.2	Texas	Health
										Annual	0.066	0.14	Texas	Health
Vinyl acetate	4.4	3.9	4.6	<0.5	<0.5	1.0	0.6	0.7	<0.5	1 Hour	40	150	Texas	Health
										Annual	4	15	Texas	Health
<b>Aromatics</b>														
Tolulene	<1.0	<1.0	<1.0	<0.5	1.5	<0.5	<0.5	<0.5	<0.5	24 Hour	1,000	4,112	EPP Air	Health
										Annual	100	410	EPP Air	Health
										30 Minute	260	1,069	EPP Air	Odour
										24 Hour	504	2,000	Ontario	Odour
										1 Hour	170	640	Texas	Odour
1,2,4-Trimethylbenzene	<1.0	<1.0	<1.0	<0.5	0.7	<0.5	<0.5	<0.5	<0.5	24 Hour	43	220	Ontario	Health
										1 Hour	250	1,250	Texas	Health
										Annual	25	125	Texas	Health

**Table 2:** Results from passive diffusion sampling for chemical compounds with concentrations greater than the Limit of Reporting.

Chemical Compound	[REDACTED] (ppb)	[REDACTED] (ppb)	[REDACTED] (ppb)	[REDACTED] (ppb)	Chinchilla Control (ppb)	Ambient Air Guideline/Criteria				
						Averaging Period	ppb	µg/m <sup>3</sup>	Source	Effect
<b>Sampling Date</b>	<b>26/09/12 – 16/10/12</b>	<b>26/09/12 – 16/10/12</b>	<b>26/09/12 – 16/10/12</b>	<b>26/09/12 – 16/10/12</b>	<b>26/09/12 – 16/10/12</b>					
<b>Compounds detected</b>	5	4	5	18	5					
<b>Alkanes</b>										
Pentane	<0.17	<0.17	<0.09	<b>0.3</b>	<0.17	8 Hour	120,000	350,000	NIOSH	REL
Hexane	<0.17	<0.17	<0.17	<b>0.5</b>	<0.17	24 Hour	2,027	7,500	Ontario	Health
						1 Hour	1,500	5,300	Texas	Odour
						Annual	57	200	Texas	Health
Heptane	<0.17	<0.17	<0.17	<b>0.3</b>	<0.17	24 Hour	2,552	11,000	Ontario	Health
						1 Hour	850	3,500	Texas	Health
						Annual	85	350	Texas	Health
Tetradecane	<0.17	<0.17	<0.17	<0.17	<b>0.2</b>	1 Hour	432	3,500	Texas	Health
						Annual	43	350	Texas	Health
Hexadecane	<b>0.2</b>	<0.17	<0.17	<0.17	<0.17	1 Hour	108	1,000	Texas	Health
						Annual	11	100	Texas	Health
Heptadecane	<0.17	<0.17	<0.17	<b>0.4</b>	<0.17	1 Hour	10	100	Texas	Health
						Annual	1	10	Texas	Health
Cyclohexane	<0.17	<b>0.6</b>	<0.17	<0.17	<0.17	24 Hour	1,685	6,100	Ontario	Health
						1 Hour	1,000	3,400	Texas	Health
						Annual	100	340	Texas	Health
2-methylbutane (Isopentane)	<0.18	<0.18	<0.18	<b>0.4</b>	<0.18	1 Hour	1,300	3,800	Texas	Odour
						Annual	2,400	7,200	Texas	Health

Chemical Compound	██████	██████	██████	██████	Chinchilla Control (ppb)	Ambient Air Guideline/Criteria				
	(ppb)	(ppb)	(ppb)	(ppb)		Averaging Period	ppb	µg/m <sup>3</sup>	Source	Effect
<b>Sampling Date</b>	26/09/12 – 16/10/12	26/09/12 – 16/10/12	26/09/12 – 16/10/12	26/09/12 – 16/10/12	26/09/12 – 16/10/12					
3-Methylpentane	<0.17	<0.17	<0.17	<b>0.3</b>	<0.17	8 Hour	100,000	350,000	NIOSH	REL
3-Methylhexane	<0.17	<0.17	<0.17	<b>0.3</b>	<0.17	8 Hour	500,000	1,500,00	Germany Occ. Health	OEL
2,2,4,6,6-pentamethyl-heptane	<b>1.2</b>	<0.17	<0.17	<b>0.2</b>	<0.17	1 Hour	503	3,500	Texas	Health
						Annual	50	350	Texas	Health
Methylcyclohexane	<0.17	<0.17	<0.17	<b>0.2</b>	<0.17	8 Hour	400,000	1,600,000	NIOSH	REL
<b>Haloalkanes/alkenes</b>										
Tetrachloroethylene	<0.17	<0.17	<0.17	<b>0.4</b>	<0.17	24 Hour	50	360	Ontario	Health
						1 Hour	300	2,000	Texas	Health
						Annual	3.8	26	Texas	Health
<b>Alcohols</b>										
2-ethyl-1-Hexanol	<b>0.2</b>	<0.17	<b>0.3</b>	<0.17	<0.17	1 Hour	107	600	Ontario	Odour
						1 Hour	500	2,700	Texas	Health
						Annual	50	270	Texas	Health
<b>Carbonyls</b>										
Ethyl Acetate	<0.18	<0.18	<0.18	<b>0.2</b>	<0.18	1 Hour	5,013	19,000	Ontario	Odour
						1 Hour	4,000	14,400	Texas	Health
						Annual	400	1,440	Texas	Health
<b>Aromatics</b>										
Benzene	<0.17	<0.17	<0.17	<b>0.6</b>	<0.17	Annual	3	10	EPP Air	Health
						24 Hour	0.69	2.3	Ontario	Health
						Annual	0.13	0.45	Ontario	Health
						1 Hour	54	170	Texas	Health
						Annual	1.4	4.5	Texas	Health

Chemical Compound	██████	██████	██████	██████	Chinchilla Control (ppb)	Ambient Air Guideline/Criteria				
	(ppb)	(ppb)	(ppb)	(ppb)		Averaging Period	ppb	µg/m <sup>3</sup>	Source	Effect
<b>Sampling Date</b>	<b>26/09/12</b> – <b>16/10/12</b>	<b>26/09/12</b> – <b>16/10/12</b>	<b>26/09/12</b> – <b>16/10/12</b>	<b>26/09/12</b> – <b>16/10/12</b>	<b>26/09/12</b> – <b>16/10/12</b>					
Toluene	<0.17	<b>6.6</b>	<0.17	<b>7.0</b>	<b>0.5</b>	24 Hour	1,000	4,112	EPP Air	Health
						Annual	100	410	EPP Air	Health
						30 Minute	260	1,069	EPP Air	Odour
						24 Hour	504	2,000	Ontario	Odour
						1 Hour	170	640	Texas	Odour
						Annual	330	1,200	Texas	Health
Xylene	<0.17	<b>1.8</b>	<0.17	<b>1.3</b>	<b>0.8</b>	24 Hour	250	1,184	EPP Air	Health
						Annual	200	950	EPP Air	Health
						24 Hour	160	730	Ontario	Health
						10 Minute	657	3,000	Ontario	Odour
						1 Hour	80	350	Texas	Odour
						Annual	42	180	Texas	Health
Ethylbenzene	<0.17	<b>0.8</b>	<0.17	<b>0.2</b>	<b>0.6</b>	24 Hour	231	1,000	Ontario	Health
						10 Minute	438	1,900	Ontario	Odour
						1 Hour	170	740	Texas	Odour
						Annual	135	570	Texas	Health
1,2,4-Trimethylbenzene	<0.17	<0.17	<0.17	<b>0.2</b>	<0.17	24 Hour	43	220	Ontario	Health
						1 Hour	250	1,250	Texas	Health
						Annual	25	125	Texas	Health
Phenol	<0.17	<0.17	<b>0.12</b>	<b>0.3</b>	<0.17	24 Hour	7.4	30	Ontario	Health
						1 Hour	40	150	Texas	Odour
						Annual	5	19	Texas	Health

Chemical Compound	████████	████████	████████	████████	Chinchilla Control (ppb)	Ambient Air Guideline/Criteria				
	(ppb)	(ppb)	(ppb)	(ppb)		Averaging Period	ppb	µg/m <sup>3</sup>	Source	Effect
<b>Sampling Date</b>	<b>26/09/12</b> – <b>16/10/12</b>	<b>26/09/12</b> – <b>16/10/12</b>	<b>26/09/12</b> – <b>16/10/12</b>	<b>26/09/12</b> – <b>16/10/12</b>	<b>26/09/12</b> – <b>16/10/12</b>					
Benzothiazole	<0.18	<0.18	<b>0.12</b>	<0.18	<0.18	24 Hour	12	70	Ontario	Health
						1 Hour	9.1	50	Texas	Health
						Annual	0.9	5	Texas	Health
Naphthalene	<b>0.4</b>	<0.17	<0.17	<0.17	<0.17	24 Hour	4.3	22.5	Ontario	Health
						10 Minute	9.5	50	Ontario	Odour
						1 Hour	90	440	Texas	Odour
						Annual	10	50	Texas	Health
<sup>1</sup> Phenylmaleic anhydride	<b>0.6</b>	<0.17	<b>0.4</b>	<b>0.5</b>	<b>0.4</b>					
<b>Terpenes</b>										
Alpha-Pinene	<0.17	<0.17	<b>0.2</b>	<0.17	<0.17	1 Hour	10	60	Texas	Odour
						Annual	63	350	Texas	Health

<sup>1</sup> Suspected ozone-adsorbing artefact of the Tenax TA adsorbing material used in the passive sampler to adsorb the VOCs.

## Conclusion

This investigation is based on limited air sampling conducted in the residential area in the Wieambilla Estate during July - December 2012. The results of the community sampling program indicate that a number of VOCs were detected in the ambient air, at levels generally well below relevant guidelines and criteria used to assess VOC concentrations in ambient air.

## References

<sup>1</sup>U.S. Environmental Protection Agency. (1999) Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air. Second Edition. Compendium Method TO-15 Determination of Volatile Organic Compounds (VOCs) in air collected in specially-prepared canisters and analyzed by Gas Chromatography/Mass Spectrometry (GC/MS).

<sup>2</sup> Lee, J. H.; Batterman, S. A.; Jia, C.; Chernyak, S. Ozone Artefacts and Carbonyl Measurements Using Tenax GR, Tenax TA, Carbopack B and Carbopack X Adsorbents; *J Air and Waste Management Association* 2006, 56, 1503-151.



# Appendix

## Appendix 1: List of all VOCs monitored

In addition to the key pollutants measured, a range of additional pollutants were analysed for with the TO15 method. The full range of VOCs analysed for include:

<b>Propene</b>	Trichloroethylene	<b>2-Methylbutane</b>
<b>Dichlorodifluoromethane</b>	1,4 Dioxane	1-Pentene
<b>Chloromethane</b>	Methyl methacrylate	<b>Pentane</b>
Ethane, 1,2-dichloro-1,1,2,2-tetrafluoro-	<b>Heptane</b>	Isoprene
Ethene, chloro-	1-Propene, 1,3-dichloro-, (Z)-	trans-2-Pentene
1,3-Butadiene	2-Hexanone	cis-2-Pentene
Methane, bromo-	1-Propene, 1,3-dichloro-, (E)-	2,2-Dimethylbutane
Ethyl Chloride	Ethane, 1,1,2-trichloro-	Cyclopentane
<b>Ethanol</b>	<b>Toluene</b>	2,3-Dimethylbutane
<b>2-Propenal</b>	Methane, dibromochloro-	2-Methylpentane
<b>Acetone</b>	Ethane, 1,2-dibromo-	<b>3-Methylpentane</b>
Trichloromonofluoromethane	<b>Tetrachloroethylene</b>	1-Hexene
Isopropyl Alcohol	<b>m- &amp; p-Xylene</b>	Methylcyclopentane
Ethene, 1,1-dichloro-	Styrene	2,4-Dimethylpentane
<b>Methylene chloride</b>	Benzene, chloro-	2-Methylhexane
Carbon disulfide	<b>Ethylbenzene</b>	2,3-Dimethylpentane
Ethane, 1,1,2-trichloro-1,2,2-trifluoro-	Methane, tribromo	3-Methylhexane
<b>Ethyl acetate</b>	Ethane, 1,1,2,2-tetrachloro-	2,2,4-Trimethylpentane
Ethylene, 1,2-dichloro-, (E)-	<b>o-Xylene</b>	<b>Methylcyclohexane</b>
Ethane, 1,1-dichloro-	Toluene, 4-ethyl-	2,3,4-Trimethylpentane
Methy tert-butyl ether	Benzene, 1,3,5-trimethyl-	2-Methylheptane
<b>Vinyl acetate</b>	<b>Benzene, 1,2,4-trimethyl-</b>	3-Methylheptane
2-Butanone	Benzene, 1,3-dichloro-	Octane
Ethylene, 1,2-dichloro-, (Z)-	Benzene, 1,4-dichloro-	Nonane
<b>n-Hexane</b>	Benzene, 1,2-dichloro-	Cumene
Trichloromethane	Benzene, 1,2,4-trichloro-	Propylbenzene
Tetrahydrofuran	<b>Naphthalene</b>	3-Ethyltoluene
Ethane, 1,2-dichloro	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	2-Ethyltoluene
Ethane 1,1,1-trichloro-	Propane	Decane
<b>Benzene</b>	Isobutane	1,2,3-Trimethylbenzene
Carbon Tetrachloride	1-Butene	1,3-Diethylbenzene

<b>Cyclohexane</b>	Butane	1,4-Diethylbenzene
Propane, 1,2-dichloro-	trans-2-Butene	Undecane
Methane, bromodichloro-	Cis-2-Butene	Dodecane
<b>Methyl ethyl ketone</b>		

Compounds in bold type were present at concentrations greater than the minimum measurable concentration.