Collegeville Area Air Monitoring Report

January 19, 2007

Commonwealth of Pennsylvania
Department of Environmental Protection

Edward G. Rendell, Governor
Commonwealth of Pennsylvania

Kathleen A. McGinty, Secretary
Department of Environmental Protection

www.dep.state.pa.us

Executive Summary

On April 1, 2004, the Pennsylvania Department of Environmental Protection (DEP) conducted ambient air monitoring in Collegeville at a soccer field located on Ursinus College property. The instrument, an Open–Path Fourier Transform Infrared Spectroscopy System, was capable of detecting and quantifying numerous air pollutants in real time. The DEP was especially interested in the ambient air concentrations of trichloroethylene (TCE) for two reasons: historic groundwater contamination in the area due to TCE, and nearby sources that emit TCE into the air. During this sampling event, TCE was detected continuously between 10:30 AM and 11:15 AM, with a peak of 15 parts per billion (ppb) at 10:37 AM. Additional sampling was conducted in the Collegeville area from June 21 through June 24, 2004 with similar results. The DEP decided that the duration and magnitude of the TCE detected warranted further investigation.

To fully evaluate TCE concentrations, the DEP established two air monitoring sites in the Collegeville area. One is located in Evansburg State Park, the other at the former YMCA on College Avenue in Trappe. The purpose of the monitoring is to determine the concentration of TCE and other air toxics in the outdoor air, and to evaluate the risk to residents associated with exposure to those pollutants at the concentrations found. Sampling began on January 4, 2005.

Air samples are collected in evacuated canisters at the Collegeville sites over a 24-hour period from midnight to midnight. Samples are collected in the same manner on the same schedule (every sixth day) at all Pennsylvania air toxics monitoring network sites. The DEP's central laboratory analyzes the samples for 55 volatile organic compounds (VOCs) based on the Environmental Protection Agency (EPA) Method TO-15. Because there are neither state nor national air quality standards for these pollutants, the DEP evaluated the health risks associated with breathing the measured concentrations using risk assessment methods approved by EPA. The DEP also compared Collegeville data to other monitoring sites in Pennsylvania where similar sampling is conducted.

The number of compounds that were detected at the Collegeville sites and the concentrations of most compounds were similar to other sites in urban or industrial areas. However, higher annual average concentrations of TCE significantly increased the aggregate excess lifetime cancer risk in the Collegeville area compared to other sites in Pennsylvania.

The DEP will continue monitoring in the Collegeville area. The DEP is also pursuing reductions of TCE emissions from major TCE-emitting facilities in the area.

Table of Contents

Introduction

Background

On April 1, 2004, the Pennsylvania Department of Environmental Protection (DEP) conducted ambient air monitoring in Collegeville at a soccer field located on Ursinus College property. The instrument, an Open–Path Fourier Transform Infrared Spectroscopy System, was capable of detecting and quantifying numerous air pollutants classified as volatile organic compounds (VOCs). The DEP was especially interested in the ambient air concentrations of trichloroethylene (TCE) because of historic groundwater contamination in the area due to TCE, and the concentration of TCE emitting sources in the area. During this sampling event, TCE was detected continuously between 10:30 AM and 11:15 AM, with a peak of 15 ppb at 10:37 AM. Additional sampling was conducted in the Collegeville area from June 21 through June 24, 2004 with similar results. The DEP decided that the duration and magnitude of the TCE detected warranted further investigation.

To fully evaluate TCE concentrations, the DEP established two air monitoring sites in the Collegeville area. One is located in Evansburg State Park, the other at the former YMCA on College Avenue in Trappe. The purpose of the monitoring is to determine the concentration of TCE and other air toxics in the outdoor air, and to evaluate the risk to residents associated with exposure to those pollutants at the concentrations found. Sampling began on January 4, 2005.

Note that there are neither state nor national air quality standards for these pollutants. Therefore, the DEP evaluated the health risks associated with breathing the measured concentrations of these pollutants using risk assessment methods approved by EPA. The DEP also compared Collegeville data to other monitoring sites in Pennsylvania where similar sampling is conducted.

Details on the monitoring equipment, sampling methods, pollutants monitored, risk assessment and the next steps for this study are described in the following sections of this report.

Monitoring

Since January 4, 2005, the DEP has collected air samples every sixth day, at both sites, in evacuated stainless steel canisters that are analyzed by the DEP laboratory for 55 VOCs. Some samples were missed due to equipment problems, and sampling stopped from September 25, 2005 to October 31, 2005 while the laboratory moved to a new building.

The specific VOCs that can be measured are determined by the analytical method and by the number of compounds in the calibration standards. The DEP Laboratory's method is based on EPA 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). EPA's National Risk Management Research Laboratory developed this "Compendium of Methods for the Determination of Toxic Organic (TO) Compounds in Ambient Air" to assist federal, state, and local regulatory personnel in developing and maintaining necessary expertise and up-to-date monitoring technology for characterizing organic pollutants in the ambient air.

The GC/MS instrument detects very low levels of pollutants, down to a few hundredths of a part per billion, by concentrating the pollutants onto a trap cooled with liquid nitrogen. The GC/MS separates the chemical compounds and then detects and identifies the compounds by matching the ion fragment patterns and retention times to known chemical standards.

The 55 target VOCs include 33 "Hazardous Air Pollutants" listed in the 1990 Clean Air Act Amendments and additional compounds emitted by industry, motor vehicles and other sources. The laboratory reports the concentration of VOCs in parts per billion volume (ppbv). Table 1 lists the target compounds, other commonly used names, each compound's Chemical Abstract Service (CAS) number that uniquely identifies the chemical, and the DEP Laboratory's method detection limits (MDLs). The MDLs are determined by a standard laboratory quality control procedure (40 CFR Part 136, Appendix B). The DEP laboratory also has a reporting limit for each compound, typically ten times the MDL, above which the measured concentrations meet the laboratory standard for accuracy. At concentrations between the MDL and the reporting limit, there is confidence that the compound is actually present but less certainty in the accuracy of the reported concentration.

The Trappe monitoring site is equipped with a 15-foot roof-mounted meteorological system, which measures wind speed and direction, temperature, relative humidity, precipitation and solar radiation (visible sunlight). An electronic datalogger takes a measurement every 10 seconds, and then calculates and stores 15-minute averages and one-hour averages for all parameters, except for precipitation, for which it stores the one-hour total. Wind data for 2005 is summarized in a wind rose format in Appendix D.

Because there are neither state nor national ambient air quality standards for these pollutants, Collegeville data are compared in this report to data collected at the other DEP air toxics monitoring sites including Arendtsville, Chester, Erie, Lancaster, Lewisburg, Marcus Hook, Pottstown and Swarthmore. Sampling began at the Evansburg and Trappe sites in January 2005. Figure 1 shows the locations of DEP air toxic monitoring sites.

Table 1. Volatile organic compounds reported by the DEP laboratory and the 2005 method detection limits (MDL).

Compound*	Synonyms	CAS Number	2005 MDL (ppbv)
1,3-Butadiene		106-99-0	0.04
1,2-Dibromoethane	Ethylene dibromide, EDB	106-93-4	0.04
cis-1,3-Dichloro-1-propene		10061-01-5	0.02
trans-1,3-Dichloro-1-propene		10061-02-6	0.02
1,2-Dichloro-1,1,2,2-tetrafluoroethane	Freon 114	76-14-2	0.04
1,2-Dichlorobenzene		95-50-1	0.16
1,3-Dichlorobenzene		541-73-1	0.14
1,4-Dichlorobenzene	Para-Dichlorobenzene	106-46-7	0.14
1,1-Dichloroethane	Ethylidene chloride	75-34-3	0.04
1,2-Dichloroethane	Ethylene chloride	107-06-2	0.04
1,1-Dichloroethene	Vinylidene chloride	75-35-4	0.04
cis-1,2-Dichloroethene		156-59-2	0.04
trans-1,2-Dichloroethene		156-60-5	0.04
1,2-Dichloropropane		78-87-5	0.04
1-Ethyl-4-methyl benzene		622-96-8	0.16
1,1,2,2-Tetrachloroethane		79-34-5	0.14
1,1,2-Trichloro-1,2,2-trifluoroethane	Freon 113	76-13-1	0.04
1,2,4-Trichlorobenzene		120-82-1	0.2
1,1,1-Trichloroethane	Methyl chloroform	71-55-6	0.04
1,1,2-Trichloroethane		79-00-5	0.04
1,2,4-Trimethylbenzene	Pseudocumene	95-63-6	0.14
1,3,5-Trimethylbenzene		108-67-8	0.14
2-Butanone	Methyl ethyl ketone, MEK	78-93-3	0.16
2-Hexanone	Methyl butyl ketone, MBK	591-78-6	0.38
2-Methoxy-2-methyl propane	Methyl-tert-butyl ether, MTBE	1634-04-4	0.04
4-Methyl-2-pentanone	MIBK	108-10-1	0.88
Acetone		67-64-1	0.14
Benzene	Benzol	71-43-2	0.04
Bromodichloromethane		75-27-4	0.04
Bromoform	Tribromomethane	75-25-2	0.02
Bromomethane		74-83-9	0.04
Carbon disulfide		75-15-0	0.04
Carbon tetrachloride	Tetrachloromethane	56-23-5	0.04
Chlorobenzene		108-90-7	0.04
Chloroethane	Ethyl chloride	75-00-3	0.04
Chloroethene	Vinyl Chloride	75-01-4	0.04
Chloroform	Trichloromethane	67-66-3	0.04

Table 1. (continued).

Compound*	Synonyms	CAS Number	2005 MDL (ppbv)
Chloromethane	Methyl chloride	74-87-3	0.04
Cyclohexane		110-82-7	0.04
Dibromochloromethane		124-48-1	0.04
Dichlorodifluoromethane	Freon 12	75-71-8	0.04
Ethylbenzene		100-41-4	0.04
n-Heptane		142-82-5	0.04
Hexachloro-1,3-butadiene		87-68-3	0.12
n-Hexane		110-54-3	0.04
Methylene chloride	Dichloromethane	75-09-2	0.04
Propene	Propylene	115-07-1	0.16
Styrene		100-42-5	0.02
Tetrachloroethene	Perchloroethylene, PERC	127-18-4	0.04
Tetrahydrofuran	1,4-Epoxybutane, THF	109-99-9	0.04
Toluene	Toluol	108-88-3	0.04
Trichloroethylene	Trichloroethene, TCE	79-01-6	0.04
Trichlorofluoromethane	Freon 11	75-69-4	0.04
m & p- Xylene		108-38-3	0.06
o-Xylene		95-47-6	0.04

* Highlighted compounds are listed in the 1990 Clean Air Act Amendments as Hazardous Air Pollutants.

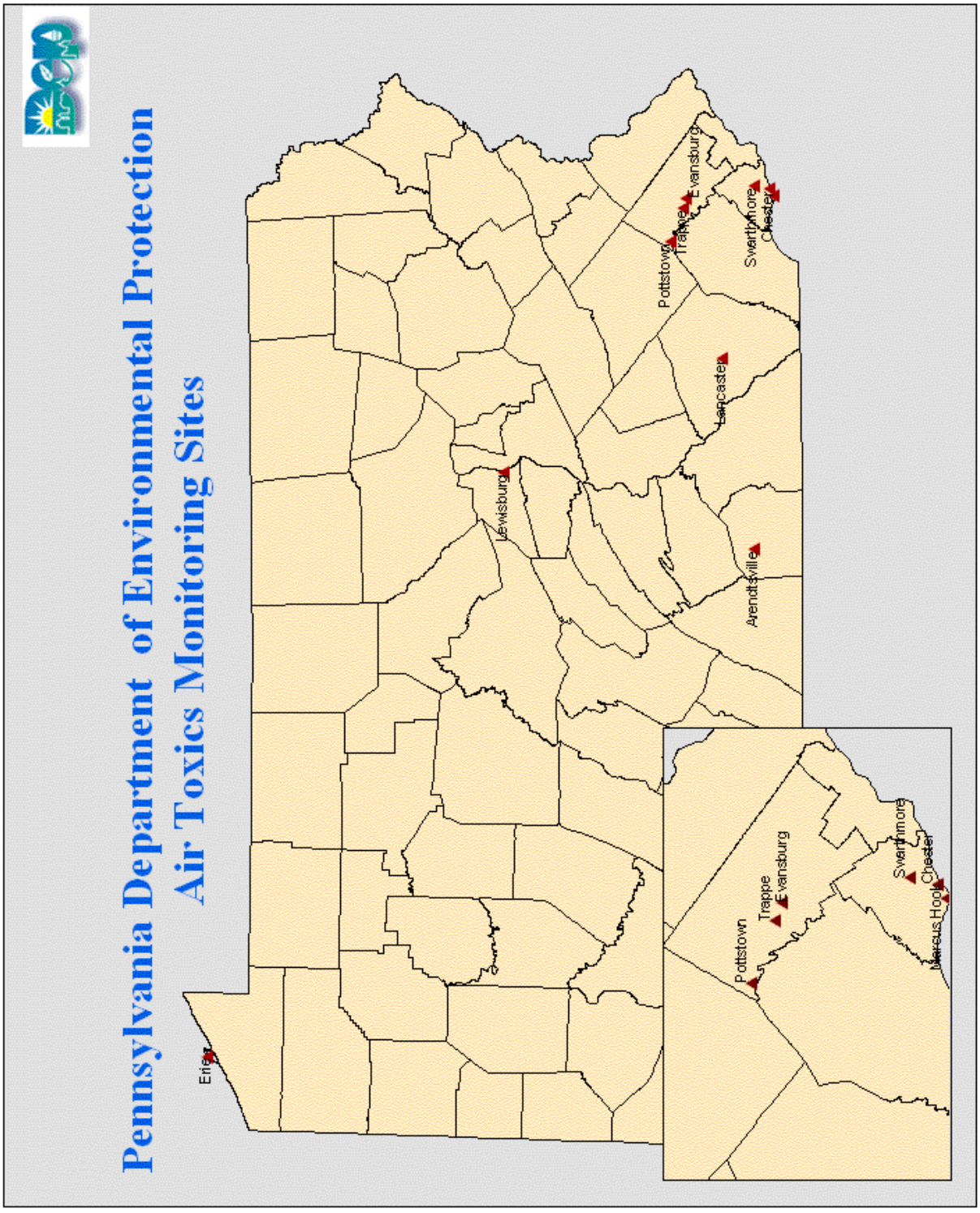


Figure 1. Map of air toxic monitoring sites in Pennsylvania in 2005.

Discussion of Monitoring Results

In summarizing the data, DEP calculated annual average concentrations for each of the 55 VOCs. In an effort to be more conservative with these averages, one-half the MDL was used, rather than zero, whenever a VOC was not detected (ND) in the sample. A VOC is considered non-detected if the concentration is less than its MDL. When concentrations are below the MDL the result cannot be distinguished with statistical confidence from background noise. The MDLs are determined by a standard laboratory quality control procedure (40 CFR Part 136, Appendix B). The definition of MDL is "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte". In addition to the MDL, the lab also uses a reporting limit for each VOC, which is approximately ten times the MDL. If data is between the MDL and the reporting limit, there is confidence that the VOC is actually present, but less certainty in the accuracy of the reported concentration.

During 2005, 29 out of 55 target VOCs were detected at the Evansburg site and 30 out of 55 at the Trappe site. Table 2 shows the percent of the time each VOC was detected at each Pennsylvania air toxics site. Fifteen VOCs were detected at all ten monitoring sites. The number of compounds detected at the two Collegeville sites is similar to other sites in industrial or urban areas. However, different compounds are present at different sites reflecting local influences. Arendtsville is a rural background site in Adams County, and as would be expected, fewer pollutants were detected. Note that there are neither state nor national air quality standards for these pollutants. Instead, the DEP evaluated the health risks associated with breathing the measured concentrations of these pollutants using risk assessment methods approved by EPA. The DEP also compared Collegeville data to other monitoring sites in Pennsylvania where similar sampling is conducted.

Annual average concentrations are used to compare the toxic air pollutants at different sites, and to estimate the cancer and non-cancer risk from inhalation exposure to ambient air. Table 3 shows these comparisons for 2005.

Collegeville data can be downloaded from the DEP web site. Go to www.dep.state.pa.us; click "Search", "Toxics", "Toxics Monitoring Sites", and then "Collegeville".

Table 2. Percentage of 2005 samples where compound concentrations were above the method detection limit.

Compound*	Arendtsville	Chester	Erie	Evansburg	Lancaster	Lewisburg	Marcus Hook	Pottstown	Swarthmore	Trappe
1,3-Butadiene	0	0	0	0	0	7	0	49	0	5
1,2-Dibromoethane (EDB)	0	0	0	0	0	0	0	0	0	0
cis-1,3-Dichloro-1-propene	0	0	0	0	0	0	0	0	0	0
trans-1,3-Dichloro-1-propene	0	0	0	0	0	0	0	0	0	0
1,2-Dichloro-1,1,2,2,tetrafluoroethane	0	0	0	0	0	0	0	0	0	0
1,2-Dichlorobenzene	0	0	0	0	0	0	0	0	0	0
1,3-Dichlorobenzene	0	0	0	0	0	0	0	0	0	0
1,4-Dichlorobenzene	0	6	0	0	0	0	4	0	0	0
1,1-Dichloroethane	0	0	0	0	0	0	0	0	0	0
1,2-Dichloroethane	0	3	0	0	0	0	4	0	0	0
1,1-Dichloroethene	0	0	0	0	0	0	0	0	0	0
cis-1,2-Dichloroethene	0	0	0	0	0	0	0	0	0	0
trans-1,2-Dichloroethene	0	0	0	0	0	0	0	0	0	0
1,2-Dichloropropane	0	0	0	0	0	0	0	0	0	0
1-Ethyl-4-methyl benzene	0	6	0	0	10	7	21	5	0	2
1,1,2,2-Tetrachloroethane	0	0	0	0	0	0	0	0	0	0
1,1,2-Trichloro-1,2,2-trifluoroethane	100	100	100	100	100	100	100	100	100	100
1,2,4-Trichlorobenzene	0	0	0	0	0	0	0	0	0	0
1,1,1-Trichloroethane	0	100	0	0	0	0	0	0	0	0
1,1,2-Trichloroethane	0	0	0	0	0	0	0	0	0	0
1,2,4-Trimethylbenzene	0	44	10	10	46	27	75	34	19	30
1,3,5-Trimethylbenzene	2	29	3	10	17	13	25	32	11	5
2-Butanone (MEK)	100	100	97	98	98	100	100	100	100	100
2-Hexanone (MBK)	20	3	0	5	0	0	4	0	0	3
2-Methoxy-2-methyl propane (MTBE)	36	97	0	86	49	23	100	95	96	91
4-Methyl-2-pentanone (MIBK)	10	0	0	4	2	0	7	2	4	5
Acetone	100	100	100	100	100	100	100	100	100	100
Benzene	100	100	100	100	100	100	100	100	100	100
Bromodichloromethane	0	0	0	0	0	0	0	0	0	0
Bromoform	0	0	0	0	0	0	0	0	0	0
Bromomethane	0	6	0	2	0	0	11	0	7	5
Carbon disulfide	21	29	10	24	15	33	29	37	41	39
Carbon tetrachloride	100	100	100	100	100	100	100	100	100	100
Chlorobenzene	0	0	0	0	100	0	4	0	0	0
Chloroethane	43	18	0	12	0	0	21	0	7	7
Chloroethene	0	6	0	2	0	0	7	2	0	0
Chloroform	0	0	3	0	5	0	0	2	0	0

Table 2. (continued).

Compound*	Arendtsville	Chester	Erie	Evansburg	Lancaster	Lewisburg	Marcus Hook	Pottstown	Swarthmore	Trappe
Chloromethane	100	100	100	100	100	100	100	100	100	100
Cyclohexane	0	44	6	10	17	7	93	15	19	20
Dibromochloromethane	0	0	0	0	0	0	0	0	0	0
Dichlorodifluoromethane	100	100	100	100	100	100	100	100	100	100
Ethylbenzene	0	56	13	18	63	40	100	100	33	45
n-Heptane	26	100	26	84	83	73	100	93	89	75
Hexachloro-1,3-butadiene	0	0	0	0	0	0	0	0	0	0
n-Hexane	57	100	77	80	100	80	100	98	100	86
Methylene chloride	43	91	61	88	88	67	89	71	100	75
Propene	88	100	87	98	100	97	100	100	100	98
Styrene	0	6	13	0	22	23	100	100	4	5
Tetrachloroethene (PERC)	0	35	6	12	12	7	32	7	26	25
Tetrahydrofuran (THF)	0	100	0	4	5	7	7	27	0	0
Toluene	79	100	97	100	98	97	100	100	100	98
Trichloroethylene (TCE)	0	9	10	76	0	7	7	32	22	82
Trichlorofluoromethane	100	100	100	100	100	100	100	100	100	100
m & p- Xylene	0	85	32	46	80	67	100	100	44	82
o-Xylene	0	47	16	28	59	47	100	98	33	66
Number of Compounds Detected	19	33	24	29	28	27	34	30	27	30

* Highlighted compounds were not detected at any site.

Table 3. Summary of 2005 annual average concentrations and excess lifetime cancer risks from inhalation of targeted VOCs across all Pennsylvania monitoring sites.

Compound	Arendtsville			Chester			Erie			Evansburg[2]		
	Annual Avg[1]		Cancer Risk	Annual Avg[1]		Cancer Risk	Annual Avg[1]		Cancer Risk	Annual Avg[1]		Cancer Risk
	ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3	
1,3-Butadiene	0.02	0.04	1.3E-06	0.02	0.04	1.3E-06	0.02	0.04	1.3E-06	**0.02**	**0.04**	1.3E-06
1,2-Dibromoethane	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	**0.02**	**0.15**	8.8E-05
cis-1,3-Dichloro-1-propene	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07	**0.01**	**0.05**	1.8E-07
trans-1,3-Dichloro-1-propene	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07	**0.01**	**0.05**	1.8E-07
1,2-Dichlorobenzene	0.08	0.48	----------	0.08	0.48	----------	0.08	0.48	----------	**0.08**	**0.48**	----------
1,4-Dichlorobenzene	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06	**0.07**	**0.42**	2.6E-06
1,1-Dichloroethane	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07	**0.02**	**0.08**	1.3E-07
1,2-Dichloroethane	0.02	0.08	2.1E-06	0.02	0.08	2.2E-06	0.02	0.08	2.1E-06	**0.02**	**0.08**	2.1E-06
1,1-Dichloroethene	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------	**0.02**	**0.08**	----------
1,2-Dichloropropane	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	**0.02**	**0.09**	----------
1,1,2,2-Tetrachloroethane	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05	**0.07**	**0.48**	2.8E-05
1,1,2-Trichloro-1,2,2-trifluoroethane	0.06	0.50	----------	0.08	0.61	----------	0.06	0.45	----------	0.06	0.48	----------
1,2,4-Trichlorobenzene	0.10	0.74	----------	0.10	0.74	----------	0.10	0.74	----------	**0.10**	**0.74**	----------
1,1,2-Trichloroethane	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	**0.02**	**0.11**	1.7E-06
Benzene	0.14	0.45	3.5E-06	0.27	0.86	6.7E-06	0.18	0.56	4.4E-06	0.18	0.58	4.5E-06
Bromoform	0.01	0.10	1.1E-07	0.01	0.10	1.1E-07	0.01	0.10	1.1E-07	**0.01**	**0.10**	1.1E-07
Bromomethane	0.02	0.08	----------	0.04	0.16	----------	0.02	0.08	----------	0.02	0.09	----------
Carbon Tetrachloride	0.08	0.51	7.6E-06	0.07	0.45	6.8E-06	0.08	0.52	7.8E-06	0.09	0.55	8.2E-06
Chlorobenzene	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	**0.02**	**0.09**	----------
Chloroethane	0.04	0.11	----------	0.03	0.09	----------	0.02	0.05	----------	0.03	0.07	----------
Chloroethene	0.02	0.05	4.5E-07	0.02	0.06	4.9E-07	0.02	0.05	4.5E-07	0.02	0.05	4.6E-07
Chloroform	0.02	0.10	2.2E-06	0.02	0.10	2.2E-06	0.02	0.12	2.8E-06	**0.02**	**0.10**	2.2E-06
Chloromethane	0.54	1.11	----------	0.48	0.99	----------	0.48	0.99	----------	0.48	0.98	----------
Cyclohexane	0.02	0.07	----------	0.05	0.19	----------	0.02	0.08	----------	0.02	0.08	----------
Dichlorodifluoromethane	0.43	2.14	----------	0.43	2.14	----------	0.43	2.11	----------	0.43	2.11	----------
Ethylbenzene	0.02	0.09	----------	0.05	0.20	----------	0.03	0.12	----------	0.03	0.12	----------
Hexachloro-1,3-butadiene	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05	**0.06**	**0.64**	1.4E-05
Methylene Chloride	0.03	0.12	5.6E-08	0.08	0.26	1.2E-07	0.04	0.15	6.9E-08	0.07	0.25	1.2E-07
Styrene	0.01	0.04	----------	0.01	0.05	----------	0.01	0.06	----------	**0.01**	**0.04**	----------
Tetrachloroethylene	0.02	0.14	7.7E-07	0.04	0.30	1.7E-06	0.05	0.34	1.9E-06	0.02	0.16	9.4E-07
Tetrahydrofuran	0.02	0.06	1.1E-07	0.90	2.66	5.2E-06	0.02	0.06	1.1E-07	0.02	0.07	1.4E-07
Toluene	0.09	0.35	----------	0.51	1.92	----------	0.19	0.73	----------	0.34	1.29	----------
Trichloroethylene (TCE)	0.02	0.11	1.2E-05	0.03	0.15	1.7E-05	0.02	0.12	1.4E-05	0.14	0.77	8.8E-05
Trichlorofluoromethane	0.21	1.20	----------	0.22	1.23	----------	0.21	1.15	----------	0.21	1.19	----------
m,p-Xylene	0.03	0.13	----------	0.16	0.68	----------	0.07	0.28	----------	0.07	0.32	----------
o-Xylene	0.02	0.09	----------	0.05	0.21	----------	0.03	0.13	----------	0.03	0.13	----------
	Total Risk		1.7E-04			1.8E-04			1.7E-04			2.4E-04

Table 3. (continued).

Compound	Lancaster			Lewisburg			Marcus Hook			Pottstown		
	Annual Avg[1]		Cancer Risk	Annual Avg[1]		Cancer Risk	Annual Avg[1]		Cancer Risk	Annual Avg[1]		Cancer Risk
	ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3		ppbv	µg/m^3	
1,3-Butadiene	0.02	0.04	1.3E-06	0.03	0.07	2.2E-06	0.02	0.04	1.3E-06	0.19	0.42	1.3E-05
1,2-Dibromoethane	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05	0.02	0.15	8.8E-05
cis-1,3-Dichloro-1-propene	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07
trans-1,3-Dichloro-1-propene	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07	0.01	0.05	1.8E-07
1,2-Dichlorobenzene	0.08	0.48	----------	0.08	0.48	----------	0.08	0.48	----------	0.08	0.48	----------
1,4-Dichlorobenzene	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06	0.07	0.42	2.6E-06
1,1-Dichloroethane	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07	0.02	0.08	1.3E-07
1,2-Dichloroethane	0.02	0.08	2.1E-06	0.02	0.08	2.1E-06	0.02	0.08	2.2E-06	0.02	0.08	2.1E-06
1,1-Dichloroethene	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------	0.02	0.08	----------
1,2-Dichloropropane	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------	0.02	0.09	----------
1,1,2,2-Tetrachloroethane	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05	0.07	0.48	2.8E-05
1,1,2-Trichloro-1,2,2-trifluoroethane	0.06	0.48	----------	0.06	0.46	----------	0.06	0.49	----------	0.07	0.50	----------
1,2,4-Trichlorobenzene	0.10	0.74	----------	0.10	0.74	----------	0.10	0.74	----------	0.10	0.74	----------
1,1,2-Trichloroethane	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06	0.02	0.11	1.7E-06
Benzene	0.30	0.95	7.4E-06	0.24	0.76	6.0E-06	0.72	2.29	1.8E-05	0.32	1.02	7.9E-06
Bromoform	0.01	0.10	1.1E-07	0.01	0.00	0.0E+00	0.01	0.10	1.1E-07	0.01	0.10	1.1E-07
Bromomethane	0.02	0.08	----------	0.02	0.08	----------	0.06	0.21	----------	0.02	0.08	----------
Carbon Tetrachloride	0.09	0.56	8.4E-06	0.09	0.56	8.4E-06	0.08	0.51	7.6E-06	0.09	0.58	8.7E-06
Chlorobenzene	0.08	0.38	----------	0.02	0.09	----------	0.02	0.10	----------	0.02	0.09	----------
Chloroethane	0.02	0.05	----------	0.02	0.05	----------	0.06	0.15	----------	0.02	0.05	----------
Chloroethene	0.02	0.05	4.5E-07	0.02	0.05	4.5E-07	0.02	0.06	5.1E-07	0.02	0.06	4.9E-07
Chloroform	0.02	0.10	2.4E-06	0.02	0.10	2.2E-06	0.02	0.10	2.2E-06	0.02	0.10	2.4E-06
Chloromethane	0.49	1.02	----------	0.44	0.91	----------	0.53	1.10	----------	0.50	1.03	----------
Cyclohexane	0.03	0.10	----------	0.03	0.11	----------	0.20	0.69	----------	0.03	0.09	----------
Dichlorodifluoromethane	0.43	2.13	----------	0.44	2.16	----------	0.45	2.24	----------	0.44	2.19	----------
Ethylbenzene	0.06	0.26	----------	0.06	0.25	----------	0.20	0.89	----------	0.21	0.93	----------
Hexachloro-1,3-butadiene	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05	0.06	0.64	1.4E-05
Methylene Chloride	0.08	0.28	1.3E-07	0.06	0.19	9.1E-08	0.13	0.45	2.1E-07	0.08	0.28	1.3E-07
Styrene	0.02	0.08	----------	0.09	0.40	----------	0.20	0.87	----------	0.33	1.42	----------
Tetrachloroethylene	0.02	0.16	9.4E-07	0.02	0.15	8.4E-07	0.04	0.24	1.4E-06	0.02	0.17	9.6E-07
Tetrahydrofuran	0.08	0.22	4.4E-07	0.06	0.19	3.6E-07	0.02	0.07	1.4E-07	0.04	0.10	2.0E-07
Toluene	0.58	2.20	----------	0.33	1.26	----------	1.14	4.30	----------	0.58	2.19	----------
Trichloroethylene (TCE)	0.02	0.11	1.2E-05	0.02	0.13	1.5E-05	0.03	0.14	1.6E-05	0.04	0.20	2.3E-05
Trichlorofluoromethane	0.22	1.23	----------	0.22	1.22	----------	0.22	1.26	----------	0.22	1.23	----------
m,p-Xylene	0.20	0.86	----------	0.22	0.96	----------	0.57	2.46	----------	0.38	1.66	----------
o-Xylene	0.07	0.30	----------	0.07	0.30	----------	0.22	0.94	----------	0.13	0.57	----------
	Total Risk		1.7E-04			1.7E-04			1.8E-04			1.9E-04

Table 3. (continued).

Compound	Swarthmore			Trappe[3]		
	Annual Avg[1]		Cancer Risk	Annual Avg[1]		Cancer Risk
	ppbv	µg/m³		ppbv	µg/m³	
1,3-Butadiene	0.02	0.04	1.3E-06	0.03	0.06	1.8E-06
1,2-Dibromoethane	0.02	0.15	8.8E-05	**0.02**	**0.15**	8.8E-05
cis-1,3-Dichloro-1-propene	0.01	0.05	1.8E-07	**0.01**	**0.05**	1.8E-07
trans-1,3-Dichloro-1-propene	0.01	0.05	1.8E-07	**0.01**	**0.05**	1.8E-07
1,2-Dichlorobenzene	0.08	0.48	----------	**0.08**	**0.48**	----------
1,4-Dichlorobenzene	0.07	0.42	2.6E-06	**0.07**	**0.42**	2.6E-06
1,1-Dichloroethane	0.02	0.08	1.3E-07	**0.02**	**0.08**	1.3E-07
1,2-Dichloroethane	0.02	0.08	2.1E-06	**0.02**	**0.08**	2.1E-06
1,1-Dichloroethene	0.02	0.08	----------	**0.02**	**0.08**	----------
1,2-Dichloropropane	0.02	0.09	----------	**0.02**	**0.09**	----------
1,1,2,2-Tetrachloroethane	0.07	0.48	2.8E-05	**0.07**	**0.48**	2.8E-05
1,1,2-Trichloro-1,2,2-trifluoroethane	0.07	0.50	----------	0.06	0.50	----------
1,2,4-Trichlorobenzene	0.10	0.74	----------	**0.10**	**0.74**	----------
1,1,2-Trichloroethane	0.02	0.11	1.7E-06	**0.02**	**0.11**	1.7E-06
Benzene	0.26	0.82	6.4E-06	0.23	0.74	5.8E-06
Bromoform	0.01	0.10	1.1E-07	**0.01**	**0.10**	1.1E-07
Bromomethane	0.02	0.09	----------	0.02	0.09	----------
Carbon Tetrachloride	0.08	0.48	7.3E-06	0.09	0.58	8.8E-06
Chlorobenzene	0.02	0.09	----------	**0.02**	**0.09**	----------
Chloroethane	0.02	0.06	----------	0.02	0.06	----------
Chloroethene	0.02	0.05	4.5E-07	**0.02**	**0.05**	4.5E-07
Chloroform	0.02	0.10	2.2E-06	**0.02**	**0.10**	2.2E-06
Chloromethane	0.52	1.08	----------	0.47	0.97	----------
Cyclohexane	0.03	0.10	----------	0.03	0.09	----------
Dichlorodifluoromethane	0.44	2.18	----------	0.43	2.13	----------
Ethylbenzene	0.04	0.16	----------	0.04	0.18	----------
Hexachloro-1,3-butadiene	0.06	0.64	1.4E-05	**0.06**	**0.64**	1.4E-05
Methylene Chloride	0.11	0.38	1.8E-07	0.06	0.22	1.0E-07
Styrene	0.01	0.05	----------	0.01	0.04	----------
Tetrachloroethylene	0.03	0.23	1.3E-06	0.03	0.24	1.3E-06
Tetrahydrofuran	0.02	0.06	1.1E-07	**0.02**	**0.06**	1.1E-07
Toluene	0.51	1.92	----------	0.37	1.38	----------
Trichloroethylene (TCE)	0.03	0.17	1.9E-05	0.26	1.37	1.6E-04
Trichlorofluoromethane	0.35	1.94	----------	0.22	1.22	----------
m,p-Xylene	0.10	0.43	----------	0.15	0.63	----------
o-Xylene	0.04	0.17	----------	0.07	0.29	----------
	Total Risk		1.8E-04			3.1E-04

[1] Annual Avg is the arithmetic mean of valid samples with 1/2 the MDL substituted for non-detects.
[2] A highlighted concentration indicates the compound was not detected at the Evansburg site in 2005.
[3] A highlighted concentration indicates the compound was not detected at the Trappe site in 2005.

Risk Characterization

Overview of Risk Factors and Reference Doses

The excess lifetime cancer risk for each of the chemical compounds was calculated using unit risk factors (URFs), and the risk for non-cancer health effects was calculated using reference air concentrations (RfCs). The URF is a measure of the probability of developing cancer from exposure over a lifetime to a specified concentration of a given chemical. The RfC is the concentration below which no (non-cancer) adverse health affects are expected to occur over a lifetime of continuous exposure. The EPA Region III Superfund Technical Support Section's risk-based concentration (RBC) table was the primary source for the risk factors. In some cases, there were no inhalation risk data for a chemical in the RBC table, so other sources, such as the Boilers and Industrial Furnaces (BIF) Regulation, had to be referenced. Table 7 in Appendix C lists the URFs and RfCs, and summarizes their sources. A total of 36 of the targeted VOCs had data for either the inhalation reference dose or inhalation cancer slope factor (from which the RfC and URF are derived).

The URF and RfC are derived by assuming an adult weighing 70 kilograms (154 pounds) will breathe 20 m^3 (706 ft^3) of air each day for 365 days a year, over a 70-year lifetime of exposure. (For more details on these calculations, see Appendix C.) The excess lifetime cancer risk is calculated for each chemical by multiplying its URF by the average concentration of all the valid air samples collected during the year. The individual risks for each chemical are added to get the total excess lifetime cancer risk at that site.

The excess lifetime cancer risk numbers are written in an exponential format (e.g. 1.0E-04). Refer to Table 4 when interpreting these numbers. For example, an excess lifetime cancer risk of 1.9E-04 means that 1.9 more people in a population of 10,000 are likely to develop cancer.

Table 4. Interpreting the risk numbers.

Risk	Exponential	Decimal	Read as…
1.0E-08	$1x10^{-8}$	0.00000001	1 in 100 million
1.0E-07	$1x10^{-7}$	0.0000001	1 in 10 million
1.0E-06	$1x10^{-6}$	0.000001	1 in 1 million
1.0E-05	$1x10^{-5}$	0.00001	1 in 100,000
1.0E-04	$1x10^{-4}$	0.0001	1 in 10,000
1.0E-03	$1x10^{-3}$	0.001	1 in 1,000
1.0E-02	$1x10^{-2}$	0.01	1 in 100
1.0E-01	$1x10^{-1}$	0.1	1 in 10

Any risk estimate is based on a number of assumptions and some of the assumptions made for this study include:

- The measured annual average concentration is the concentration that the individual will be exposed to over a lifetime;
- The concentrations measured at the sampling site are representative of exposures to the population in the area;
- The effects from exposure to multiple chemicals are additive;
- The exposure is based on a typical adult;
- The only excess risk considered in this report is due to inhalation;
- The cancer slope factor for each compound is assumed to be correct although reliability ratings vary greatly from compound to compound. Some are based on many well-controlled studies, while others are based on limited data and listed as provisional values.

The non-cancer risk associated with each of the relevant compounds is calculated by simply dividing the measured air concentration by the compound's respective RfC. If this value is less than one, and inhalation is the only source of exposure, then that chemical is not likely to cause adverse non-cancer health affects.

Table 3 shows the excess lifetime cancer risks for inhalation exposure calculated using 2005 annual average VOC concentrations. The total risk for each site includes compounds that were not detected. As explained earlier, it is accepted practice to include non-detected compounds in risk calculations by substituting a concentration defined as one-half the MDL. Thus, by conservatively including these non-detected compounds in the aggregate risk at concentrations of one-half the MDL, the risks in Table 3 are a "worst-case-scenario" risk calculation. To emphasize this practice, note that the highlighted concentrations for the Collegeville sites in Table 3 were never detected, but are reported at one-half the MDL.

Excess Lifetime Cancer Risk

The total excess lifetime cancer risk for inhalation using the annual average concentration of VOCs detected in 2005 was significantly higher at the Collegeville sites than other monitoring sites across Pennsylvania (Table 5). This was mainly driven by higher concentrations of trichloroethylene (TCE) in the Collegeville area, a chemical primarily used to clean and degrease metals.

The annual average TCE concentrations in 2005 at the Trappe and Evansburg sites were 0.26 ppbv and 0.14 ppbv, respectively. In comparison, most other Pennsylvania sites in 2005 were near or below the 0.04 ppbv detection limit. The excess lifetime cancer risk due to TCE in 2005 was 1.60 in 10,000 at the Trappe site and 0.88 in 10,000 at the Evansburg site (Table 6). Note that at the Trappe site, TCE (one compound) is accounting for over half the excess lifetime cancer risk.

Table 5. Excess lifetime cancer risk for inhalation of ambient VOC concentrations per population of 10,000.

Site	Excess Lifetime Cancer Risk per 10,000 (Total VOC)			
	2002	2003	2004	2005
Arendtsville	0.73	1.2	1.3	1.7
Chester	0.82	1.3	1.5	1.8
Erie	0.79	1.2	1.3	1.7
Evansburg	----------	----------	----------	2.4
Lancaster	0.79	1.3	1.4	1.7
Lewisburg	----------	----------	1.4	1.7
Marcus Hook	0.93	1.3	1.4	1.8
Pottstown	2.00	1.6	1.5	1.9
Swarthmore	0.81	1.3	1.4	1.8
Trappe	----------	----------	----------	3.1

Table 6. Excess lifetime cancer risk for inhalation of ambient trichloroethylene (TCE) concentrations per population of 10,000.

Site	Excess Lifetime Cancer Risk per 10,000 (TCE)			
	2002	2003	2004	2005
Arendtsville	0.12	0.12	0.12	0.12
Chester	0.17	0.15	0.17	0.17
Erie	0.20	0.12	0.12	0.14
Evansburg	----------	----------	----------	0.88
Lancaster	0.13	0.13	0.14	0.12
Lewisburg	----------	----------	0.14	0.15
Marcus Hook	0.15	0.13	0.14	0.16
Pottstown	1.30	0.42	0.26	0.23
Swarthmore	0.12	0.13	0.18	0.19
Trappe	----------	----------	----------	1.60

It is important to note that the laboratory MDLs for VOCs in 2005 were higher than MDLs in 2002 due to changes in the GC/MS analytical equipment. Because any compound that was not detected was given a value of one-half the MDL for excess lifetime cancer risk calculations (as explained in the previous section), the calculated risks across all sites are greater in 2005 than in 2002 (Table 5).

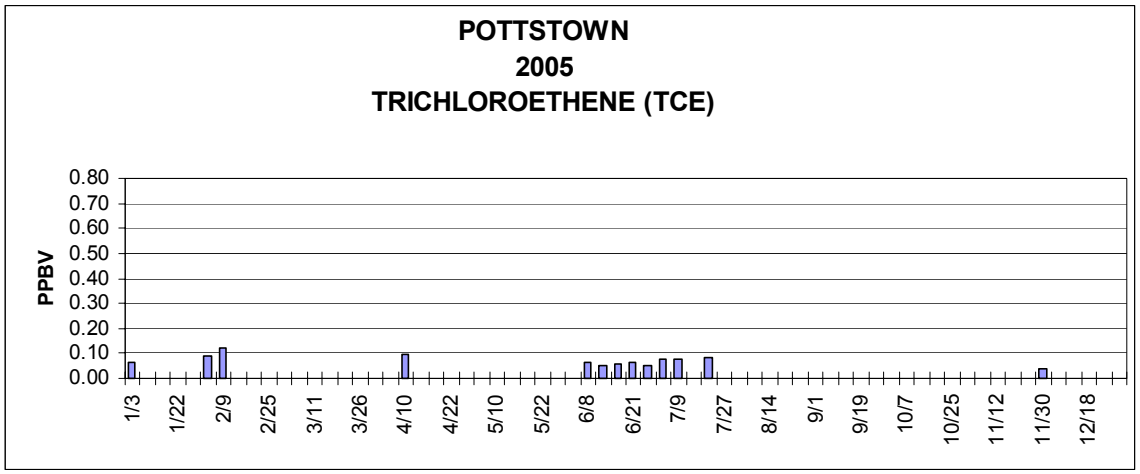
Non-Cancer Health Effects

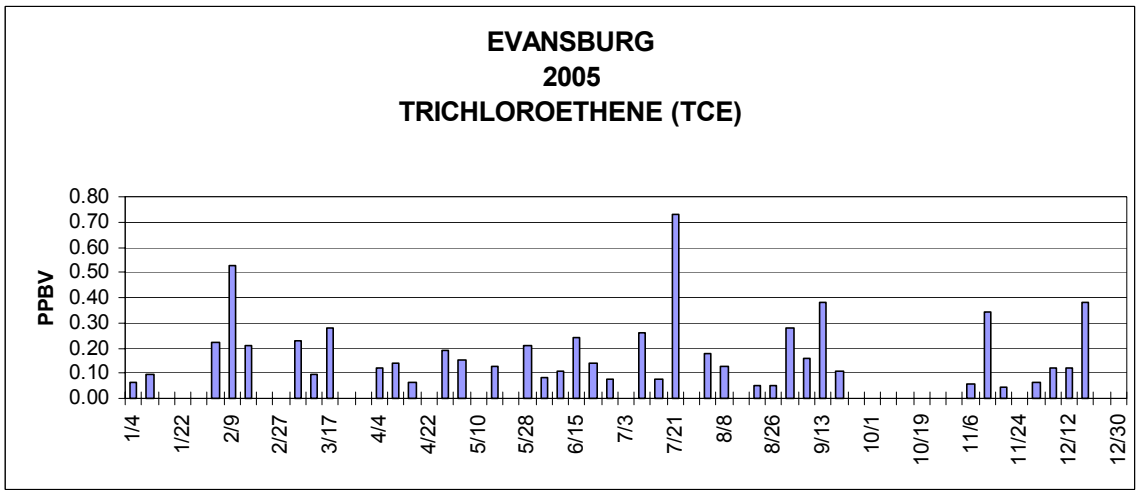
There were no VOCs with annual average concentrations (Table 3) above their respective RfC (Table 7). Consequently, non-cancer health effects are not expected from breathing the air in the Collegeville area.

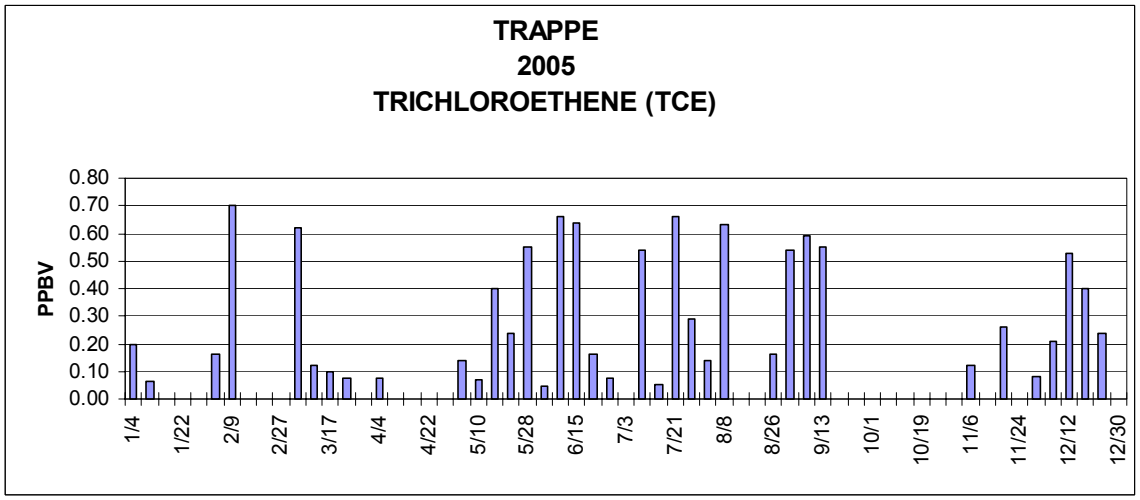
Next Steps

Figure 2 is an additional illustration of higher TCE concentrations at the Trappe and Evansburg sites compared to the other Montgomery County site in Pottstown. These higher TCE concentrations are contributing to higher total excess lifetime cancer risks compared to the other sites. Consequently, DEP is pursuing reductions of TCE emissions from two large TCE emitting facilities in the Collegeville area. DEP will continue to sample at both locations, however, a new location is being sought in Trappe due to the closure of the YMCA building.

Figure 2. Trichloroethylene (TCE) concentrations at three sites in Montgomery County.







Appendix

A. Monitoring

Equipment

Canister Sampler - Andersen Instruments, Inc. AVOCS

Canisters - Six-liter, SUMMA-polished from various suppliers

Wind Sensors - Climatronics model F460 low-threshold anemometer and tail vane, 10-meter tower height, wind direction referenced to True North

Temperature and Relative Humidity - Vaisala model HMP-45

Solar Radiation: Silicon Cell, Matrix, Inc. model Mk 1-G

Precipitation - Texas Electronics, Inc. model TE-525 tipping bucket, 0.01 inches per tip, unheated, rain only

Datalogger: Campbell Scientific model CR-10X, 10-second measurement interval, calculates 15-minute averages, 15-minute sigma theta (standard deviation of horizontal wind direction), 1-hour averages and 1-hour total precipitation

Canister Analysis - Entech 7000 or 7100A sample concentrator, Agilent 6890 gas chromatograph, 5973 quadrupole mass spectrometer

Samples were collected over a 24-hour period once every six days. This same schedule is used at other toxic monitoring sites across the state to allow for comparison between sites.

The automated Andersen sampler pumps air into an evacuated stainless steel canister, at a constant flow rate, over a 24-hour sampling period. The filled canister is returned the DEP laboratory for analysis.

Calibration and Analysis

The laboratory GC/MS system is calibrated using working standards prepared from a 500 ppbv, 60-component commercial gas cylinder standard (Spectra Gases, Inc.) diluted with humidified nitrogen. In addition, a 15-component primary standard (National Institute of Standards and Technology, NIST SRM-1800) is analyzed to verify the calibration. Each run consists of standards, blanks and continuing calibration standards after every ten samples.

After analysis, canisters are cleaned and evacuated by the laboratory. After each batch is cleaned, at least one canister is filled and retested as a blank to verify they are clean.

Canisters are not dedicated to a specific site, so canisters used at the Collegeville sites may be cleaned and sent to other ambient monitoring sites.

B. Definitions

Blank – Sampling materials and chemicals analyzed without collecting a sample to test for contaminants that might interfere with the analysis. The analytical protocol specifies acceptable blank levels and how these values are used.

Chronic — Occurs over a long period of time. Cancer is the primary health effect considered when evaluating the risk from chronic exposure to a chemical compound.

Excess Risk — The increased risk of disease above the normal background rate.

Mean — The arithmetic average. For example: (2.2 +2.6 +4.8)/3 = 3.2

Method Detection Limit (MDL) — The MDLs are determined by a standard laboratory quality control procedure (40 CFR Part 136, Appendix B). The definition of MDL is "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte".

Microgram — A microgram is one millionth of a gram weight. (The symbol μg is commonly used for microgram). Ambient air concentrations are commonly expressed in micrograms per cubic meter of air ($\mu g/m^3$). Because air expands and contracts with changes in temperature and pressure, the cubic meter volume must be referenced to a specific temperature and pressure. Standard conditions for ambient air measurements are 25° C (77° F) and one atmosphere (29.92 inches of mercury).

ppbv — Parts per billion by volume – The concentration units commonly used for gaseous pollutants in ambient air. These units are not used for non-gaseous pollutants.

Reference Air Concentration (RfC) — The concentration of a specific chemical in the air below which no (non-cancer) adverse health affects are expected to occur over a lifetime of continuous exposure.

Reporting Limit (RL) — The RL of a compound is approximately ten times its MDL. Concentrations at or above the RL are considered quantifiably accurate. If data is between the RL and the MDL, there is confidence that the compound is actually present, but less certainty in the accuracy of the reported concentration.

Unit Risk Factor (URF) — A measure of the probability of an individual developing cancer as a result of exposure to a specified unit concentration of a specific chemical. In air, the unit concentration is 1.0 μg/m^3. For example, an inhalation URF of 3.0E-04 implies that if 10,000 people breathe that chemical for 70 years at a concentration of 1.0 μg/m^3, three of the 10,000 may develop cancer as a result of the exposure.

Volatile Organic Chemical (VOC) — A chemical compound containing carbon that can be present in the atmosphere as a vapor at normal temperatures. Generally, chemicals with vapor pressures greater than 0.1 mmHg at 20° C (0.0001316 atmospheres at 68° F) are classified as volatile, and chemicals with measurable vapor pressures that are less than 0.1 mmHg are classified as semi-volatile.

C. Risk Calculation

The excess lifetime cancer risk for each of the chemical compounds was calculated using unit risk factors (URFs), and the risk for non-cancer health effects was calculated using reference air concentrations (RfCs) (Table 7). The EPA Region III Superfund Technical Support Section has established a risk-based concentration (RBC) table for nearly 500 chemicals. Four different chronic toxicological constants are examined for each chemical compound: 1) Oral Reference Dose (RfDo), 2) Inhalation Reference Dose (RfDi), 3) Oral Cancer Slope Factor (CSFo), and 4) Inhalation Cancer Slope Factor (CSFi). For this study, only the RfDi and CSFi were used. In some cases, there were no inhalation risk data for the chemicals in the RBC table, so other sources, such as the Boilers and Industrial Furnaces (BIF) Regulation, had to be referenced.

The URF and the RfC are derived from the CSFi and RfDi, respectively, by assuming that an adult weighing 70 kilograms (154 pounds) will breathe 20 m^3 (706 ft^3) of air a day for 365 days a year, over a 70-year lifetime of exposure. From this standard 70-year exposure scenario for an adult, excess lifetime cancer risk is calculated for each chemical by multiplying the measured air concentrations by their respective URFs. The individual risks for each chemical are added to get the total excess lifetime cancer risk at that site. The non-cancer risk associated with each of the relevant chemicals is calculated by simply dividing the measured air concentration by the chemical's respective RfC. If the result is less than 1, non-cancer health effects are not expected.

The conversion from CSFi to URF is carried out as follows:

$$(\text{kg-day})/\text{mg} \times (1/70\ \text{kg}) \times (20\ m^3/\text{day}) \times (\text{mg}/1000\ \mu\text{g}) = m^3/\mu\text{g}$$

The conversion from RfDi to RfC is carried out as follows:

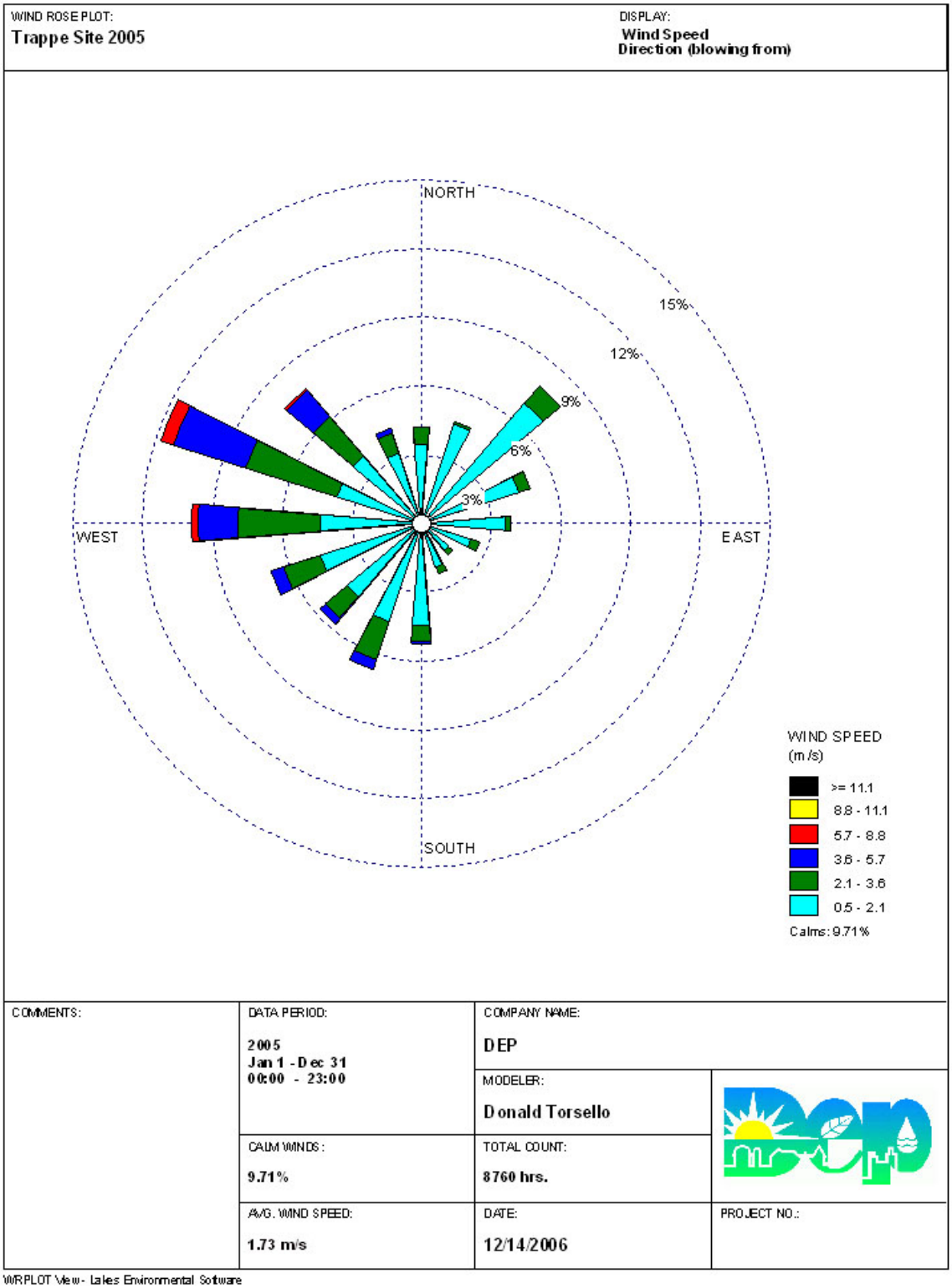
$$\text{mg}/(\text{kg-day}) \times (70\ \text{kg}) \times (\text{day}/20\ m^3) \times (1000\ \mu\text{g}/\text{mg}) = \mu\text{g}/m^3$$

Table 7. Cancer Unit Risk Factors and Reference Air Concentrations.

Compound	Unit Risk Factor $m^3/\mu g$	Reference Air Concentration $\mu g/m^3$	Molecular Weight	Source URF[1]	Source RfC[1]
1,3-Butadiene	3.00E-05	2.00E+00	54.1	I	I
1,2-Dibromoethane	5.71E-04	9.00E+00	187.9	I	I
cis-1,3-Dichloro-1-propene	4.00E-06	2.00E+01	111.0	I	I
trans-1,3-Dichloro-1-propene	4.00E-06	2.00E+01	111.0	I	I
1,2-Dichlorobenzene	-	1.40E+02	147.0		O
1,4-Dichlorobenzene	6.29E-06	8.00E+02	147.0	O	I
1,1-Dichloroethane	1.60E-06	5.00E+02	99.0	O	O
1,2-Dichloroethane	2.60E-05	2.45E+03	99.0	I	O
1,1-Dichloroethene	-	2.00E+02	97.0		I
1,2-Dichloropropane	-	4.00E+00	113.0		I
1,1,2,2-Tetrachloroethane	5.80E-05	-	167.9	I	
1,1,2-Trichloro-1,2,2-trifluoroethane	-	3.00E+04	187.4		O
1,2,4-Trichlorobenzene	-	3.50E+00	181.4		O
1,1,2-Trichloroethane	1.60E-05	-	133.4	I	
Benzene	7.80E-06	3.00E+01	78.1	I	I
Bromoform	1.11E-06	-	252.7	I	
Bromomethane	-	5.00E+00	95.0		I
Carbon Tetrachloride	1.50E-05	1.75E+02	153.8	I	O
Chlorobenzene	-	6.00E+01	112.6		O
Chloroethane	-	1.00E+04	64.5		I
Chloroethene	8.80E-06	1.00E+02	62.5	I	I
Chloroform	2.30E-05	4.90E+01	119.4	I	O
Chloromethane	-	9.00E+01	50.5		I
Cyclohexane	-	6.00E+03	84.2		I
Dichlorodifluoromethane	-	1.75E+02	120.9		O
Ethylbenzene	-	1.00E+03	106.2		I
Hexachloro-1,3-butadiene	2.20E-05	-	260.7	I	
Methylene Chloride	4.70E-07	1.00E+03	84.9	I	O
Styrene	-	1.00E+03	104.2		I
Tetrachloroethylene	5.71E-06	2.80E+02	165.8	O	O
Tetrahydrofuran	1.94E-06	3.00E+02	72.1	O	O
Toluene	-	4.90E+03	92.1		I
Trichloroethylene (TCE)	1.14E-04	3.50E+01	131.4	O	O
Trichlorofluoromethane	-	7.00E+02	137.4		O
m,p-Xylene	-	1.00E+02	106.2		I
o-Xylene	-	1.00E+02	106.2		I

[1] I - Integrated Risk Information System (IRIS)
O - Other sources

D. Wind Rose


WIND ROSE PLOT:
Trappe Site 2005
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
EAST
SOUTH
WEST
3%
6%
9%
12%
15%
WIND SPEED
(m/s)
>= 11.1
8.8 - 11.1
5.7 - 8.8
3.6 - 5.7
2.1 - 3.6
0.5 - 2.1
Calms: 9.71%
COMMENTS:
DATA PERIOD:
2005
Jan 1 - Dec 31
00:00 - 23:00
COMPANY NAME:
DEP
MODELER:
Donald Torsello
CALM WINDS:
9.71%
TOTAL COUNT:
8760 hrs.
AVG. WIND SPEED:
1.73 m/s
DATE:
12/14/2006
PROJECT NO.:
WRPLOT View - Lakes Environmental Software