CARBON TETRACHLORIDE (CCl_4)

Chemical Abstracts Service (CAS) Number: 56-23-5

General Information

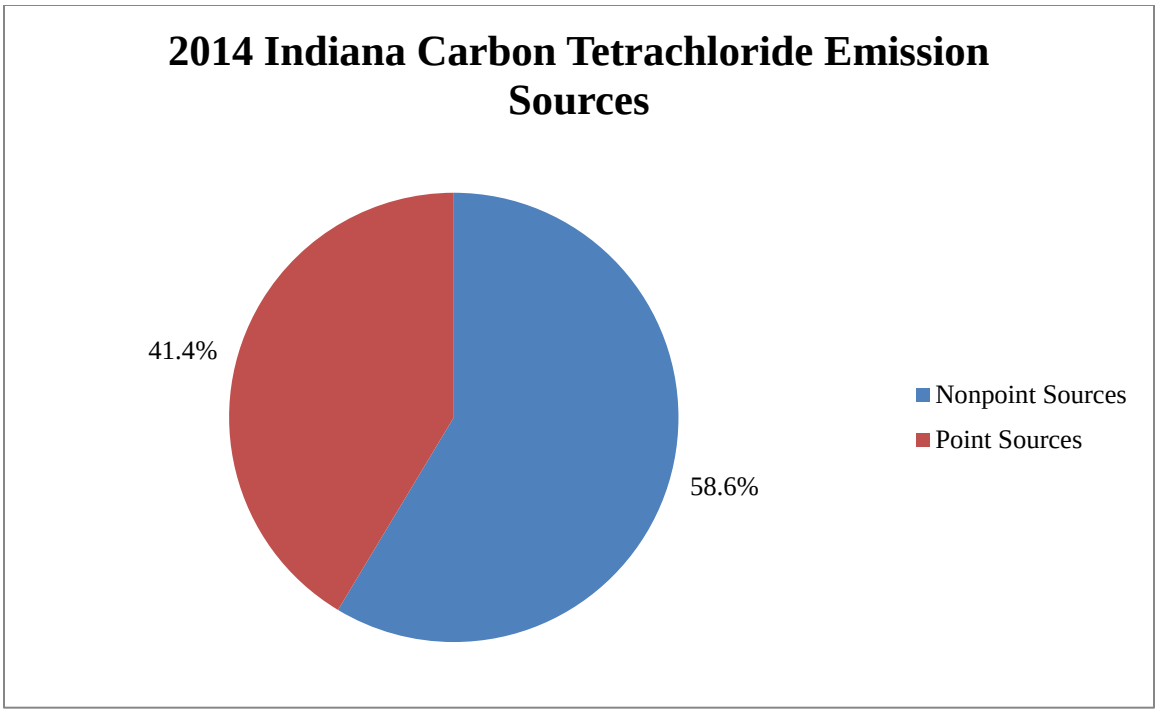
Carbon tetrachloride is a clear, nonflammable liquid which is almost insoluble in water. It may be found in both ambient outdoor and indoor air. The primary effects of carbon tetrachloride in humans are on the liver, kidneys, and central nervous system. Symptoms of acute (short-term) exposure to carbon tetrachloride include headache, weakness, lethargy, nausea, and vomiting. Acute exposure to higher levels and chronic (long-term) exposure to carbon tetrachloride can cause liver and kidney damage in humans. Studies in animals have shown that ingestion of carbon tetrachloride increases the risk of liver cancer. Human data on the carcinogenic effects of carbon tetrachloride are limited and not sufficient to establish a cause-and-effect relationship. U.S. EPA has classified carbon tetrachloride as a Group B2, probable human carcinogen.

Sources

- Carbon tetrachloride was produced in large quantities to make refrigerants and propellants for aerosol cans, as a solvent for oils, lacquers, varnishes, rubber waxes, and resins, and as a grain fumigant and a dry cleaning agent. Consumer and fumigant uses have been discontinued and only industrial uses remain.
- Individuals may be exposed to carbon tetrachloride in the air from accidental releases from production and uses, and from its disposal in landfills where it may evaporate into the air or leach into groundwater.
- Carbon tetrachloride is also a common contaminant of indoor air; the sources of exposure appear to be building materials or products, such as cleaning agents, used in the home.
- Individuals may also be exposed to carbon tetrachloride by drinking contaminated water.

Indiana Emissions

IDEM collects HAP emissions information for the categories of point sources (large stationary sources like power plants and factories), nonpoint sources (aka area sources - smaller stationary sources like gas stations and dry cleaners), and mobile sources (vehicles, airplanes, marine vessels, etc.).* Estimated statewide emissions of carbon tetrachloride totaled 0.28 tons in the 2014 calendar year. Of this total, 58.6% were attributed to nonpoint sources and 41.4% were attributed to point sources.



* For additional examples of types of emission sources, please visit IDEM's Hazardous Air Pollutants page at: http://www.in.gov/idem/toxic/pages/hap/index.html. For specific details on industrial sources of air toxics, please visit U.S. EPA's Toxics Release Inventory (TRI) page at: https://www.epa.gov/toxics-release-inventory-tri-program.

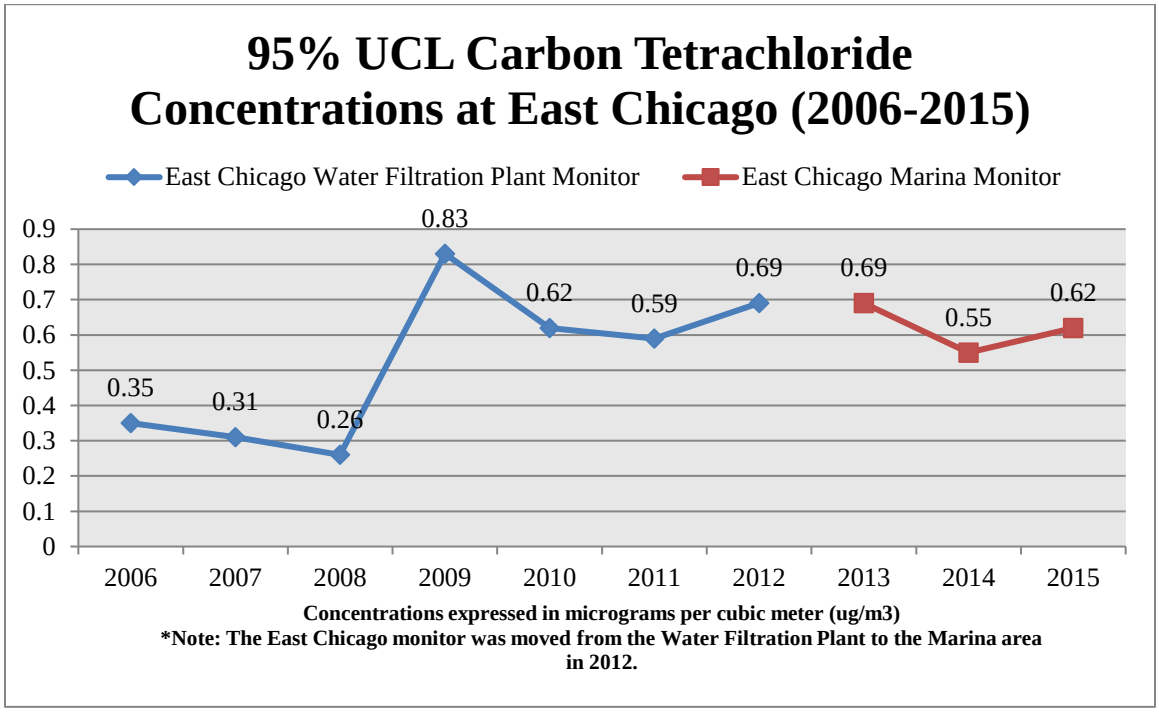
Measured Concentration Trends

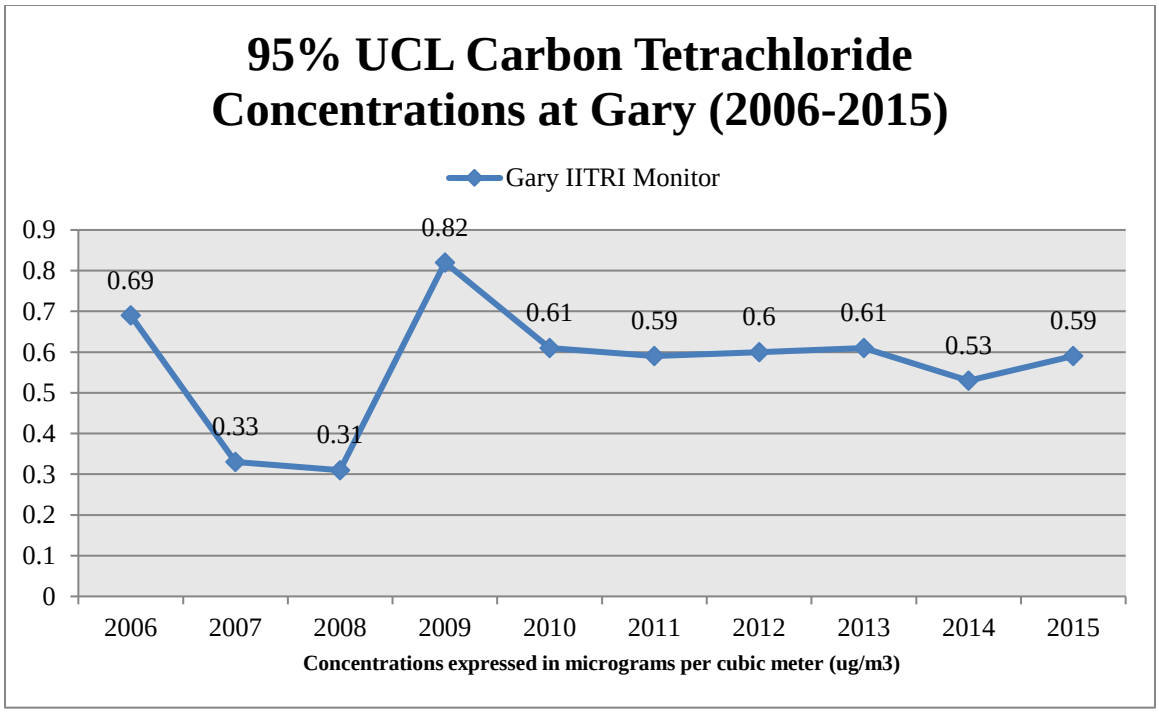
Ambient air monitoring data most accurately represents a limited area near the monitor location. All monitors for air toxics sample every sixth day. The monitoring locations by themselves are not sufficient to accurately characterize air toxic concentrations throughout the entire state, however, results from the monitors will provide exposure concentrations with a great deal of confidence at the monitoring locations.

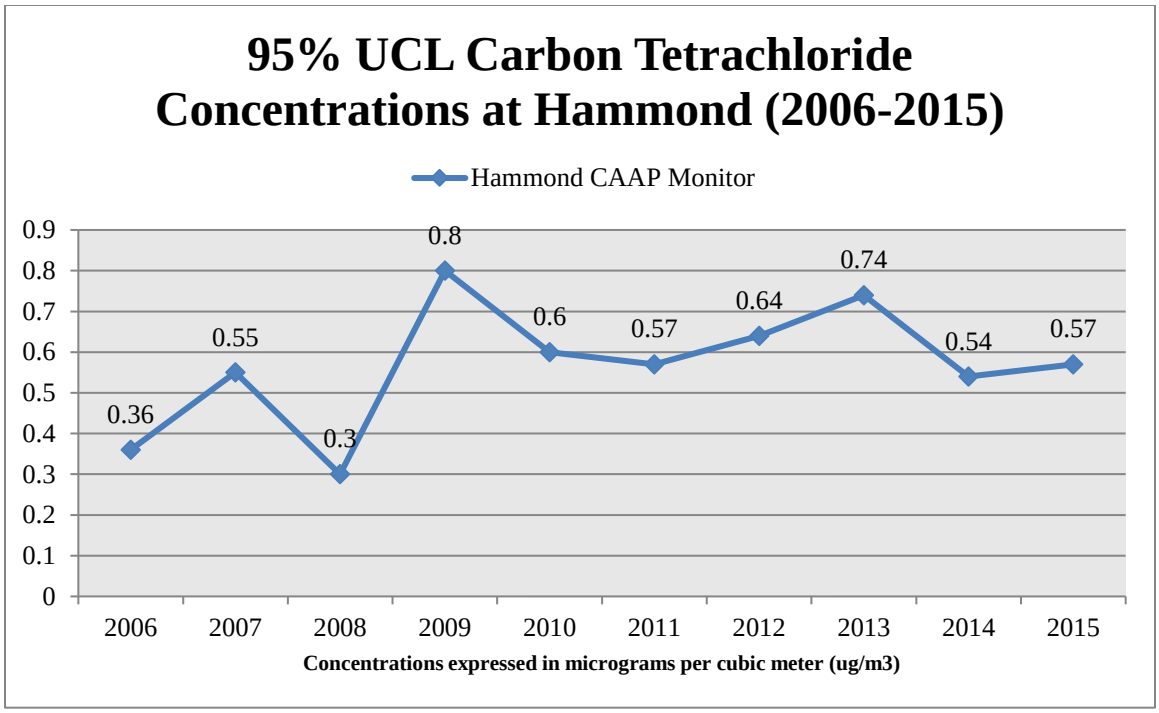
The ambient air monitoring results were analyzed using U.S. EPA recommended statistical methods. IDEM evaluated the data so that a 95% upper confidence limit of the mean (UCL) could be determined. A 95% UCL represents a value which one can be 95% confident that the true mean of the population is below that value.

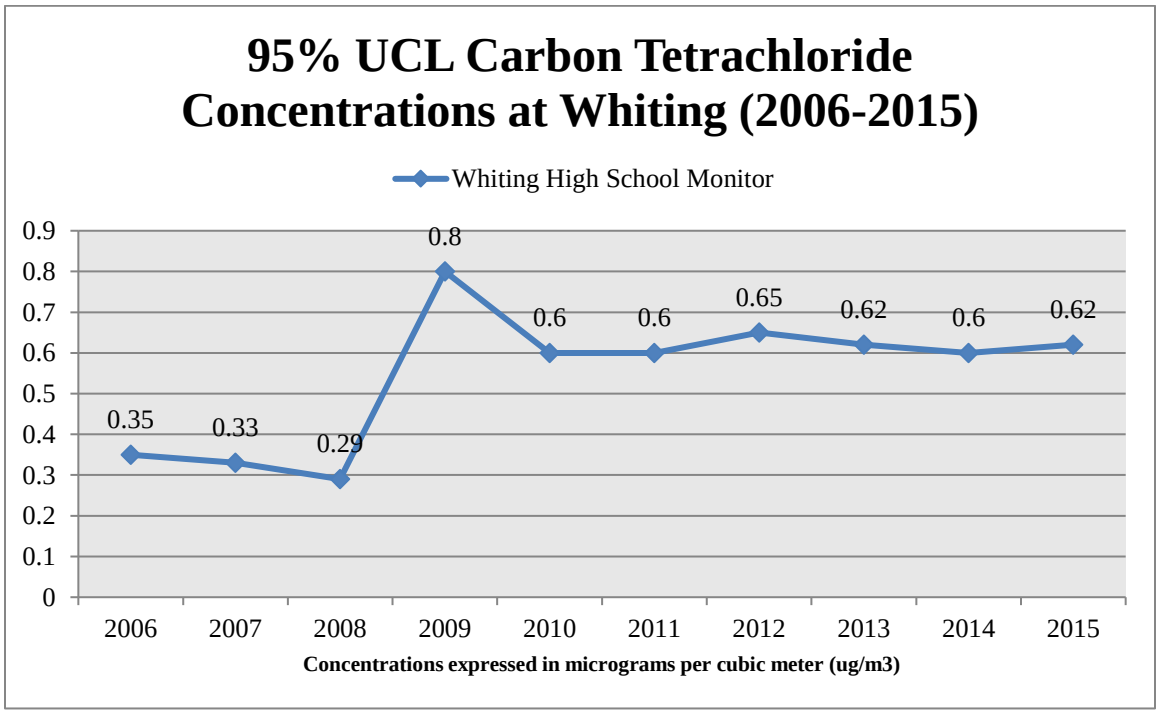
To learn more about the current monitoring locations, please visit IDEM's Air Toxics Monitor Siting webpage at: http://www.in.gov/idem/toxic/2337.htm

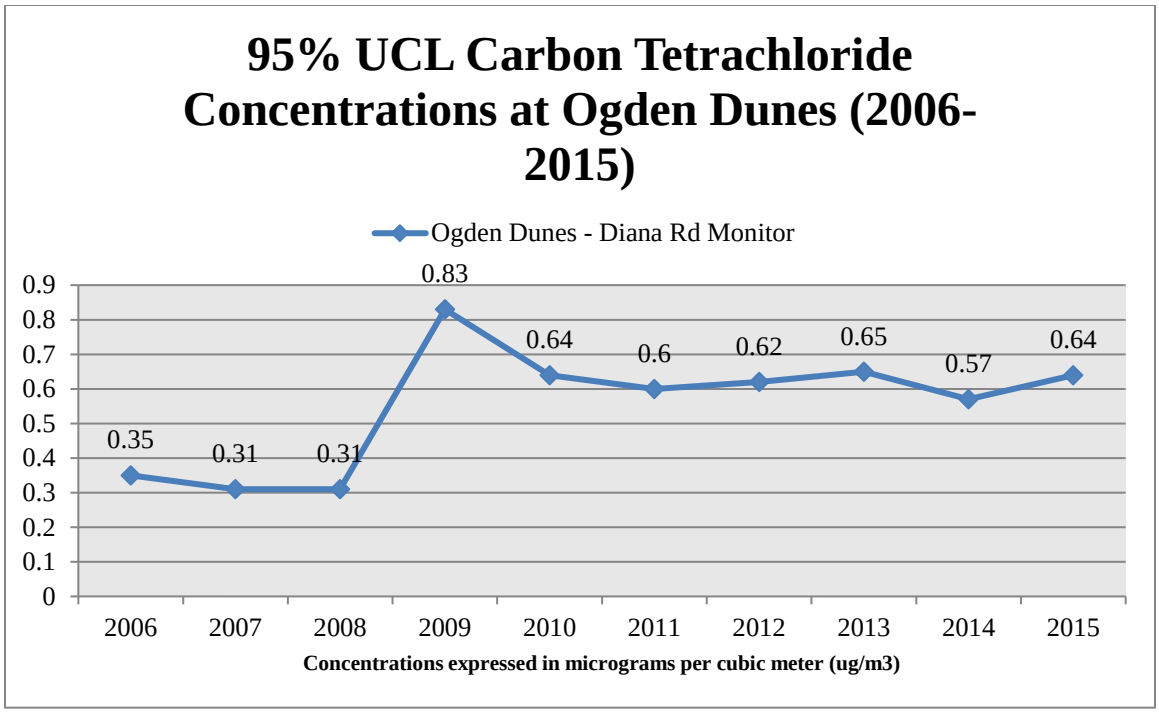
Data analysis was performed for each monitor that operated for a significant portion of the analysis period. This analysis determined the detection rate, which is defined as the percentage of valid samples taken statewide that had a quantifiable concentration of the pollutant. The statewide detection rate of carbon tetrachloride for the monitors analyzed from 2006-2015 was 78.9%. Trend graphs for each of these monitors are provided below.

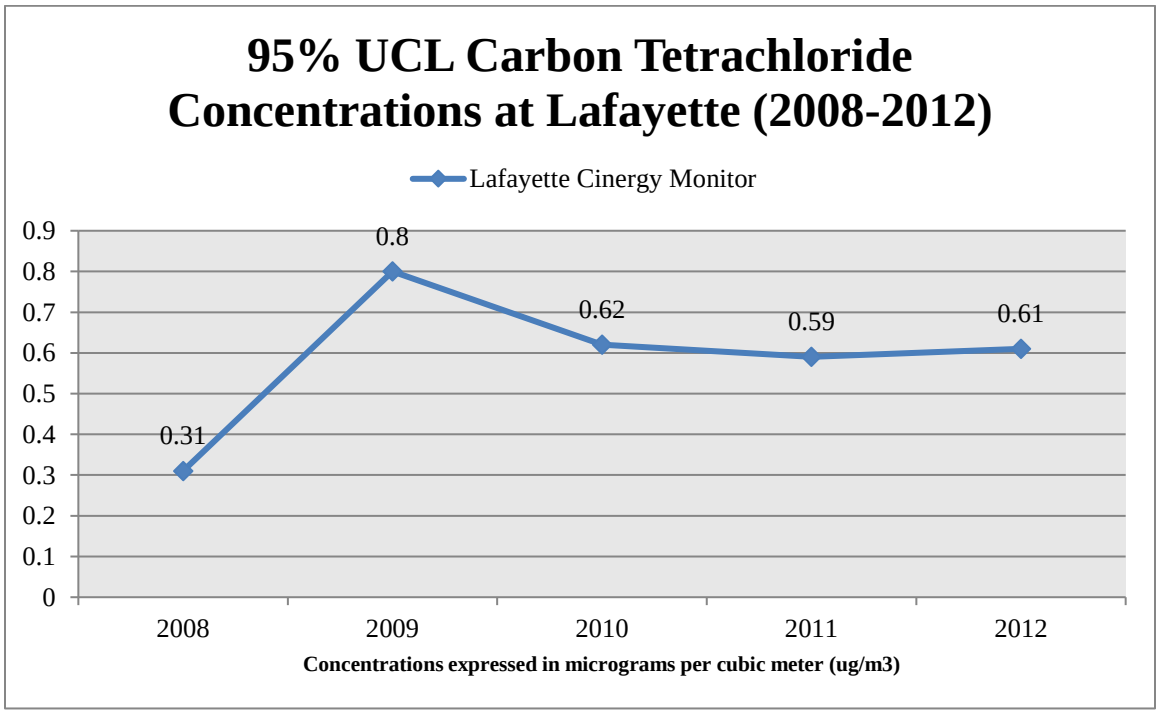

95% UCL Carbon Tetrachloride Concentrations at East Chicago (2006-2015)
East Chicago Water Filtration Plant Monitor
East Chicago Marina Monitor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.35
0.31
0.26
0.83
0.62
0.59
0.69
0.69
0.55
0.62
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Concentrations expressed in micrograms per cubic meter (ug/m3)
*Note: The East Chicago monitor was moved from the Water Filtration Plant to the Marina area in 2012.

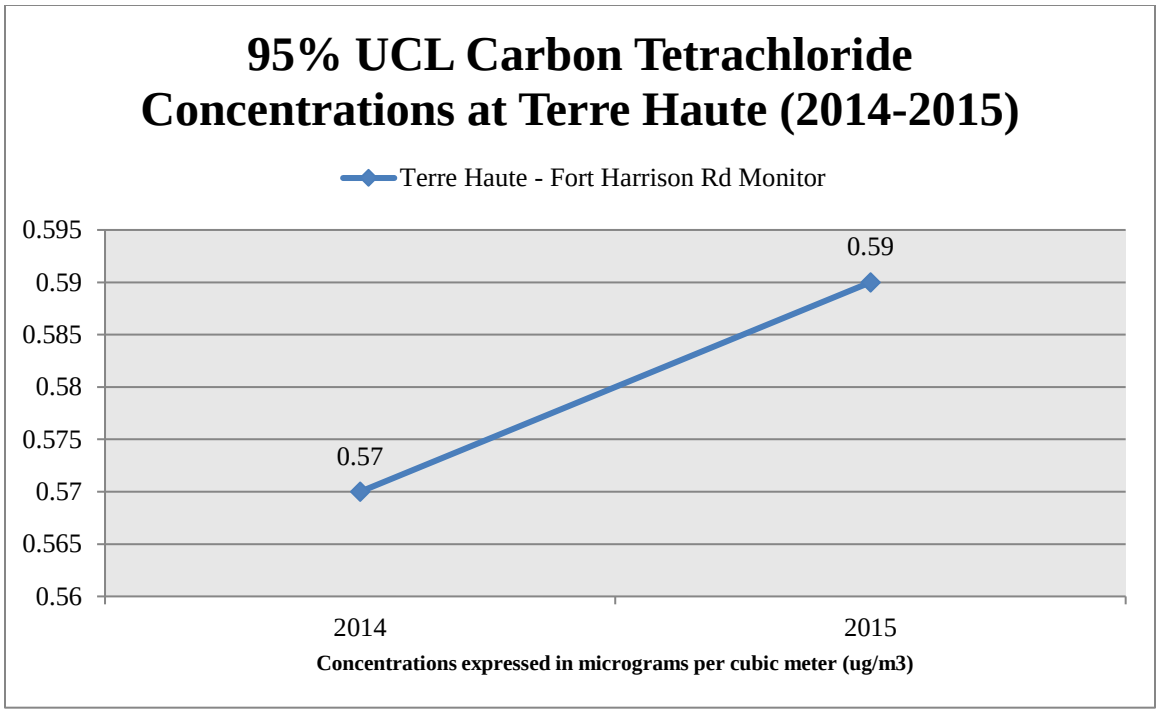

95% UCL Carbon Tetrachloride Concentrations at Gary (2006-2015)
Gary IITRI Monitor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.69
0.33
0.31
0.82
0.61
0.59
0.6
0.61
0.53
0.59
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Concentrations expressed in micrograms per cubic meter (ug/m3)

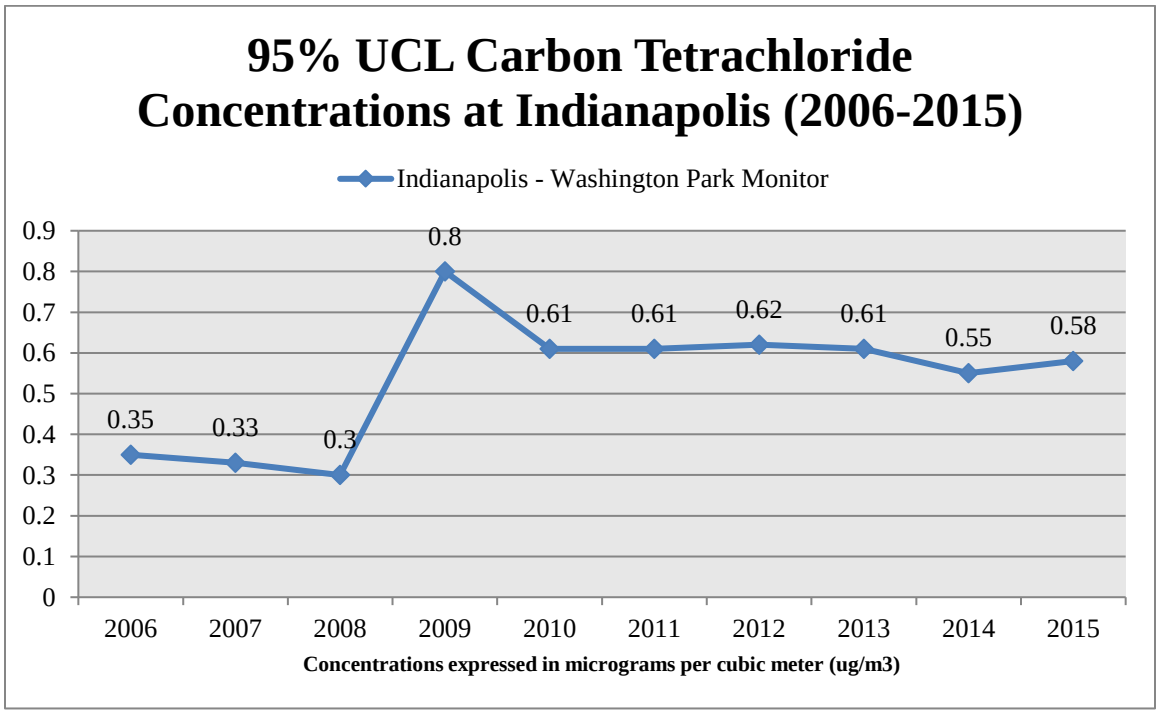

95% UCL Carbon Tetrachloride Concentrations at Hammond (2006-2015)
Hammond CAAP Monitor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.36
0.55
0.3
0.8
0.6
0.57
0.64
0.74
0.54
0.57
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Concentrations expressed in micrograms per cubic meter (ug/m3)

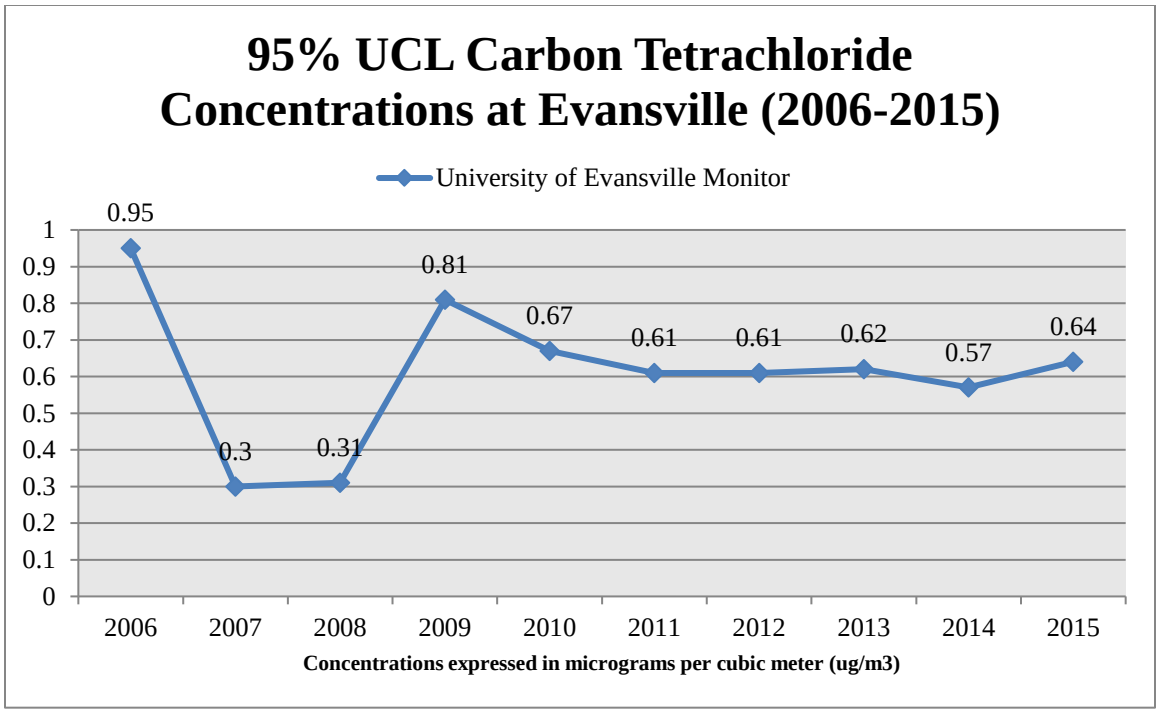

95% UCL Carbon Tetrachloride Concentrations at Whiting (2006-2015)
Whiting High School Monitor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.35
0.33
0.29
0.8
0.6
0.6
0.65
0.62
0.6
0.62
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Concentrations expressed in micrograms per cubic meter (ug/m3)

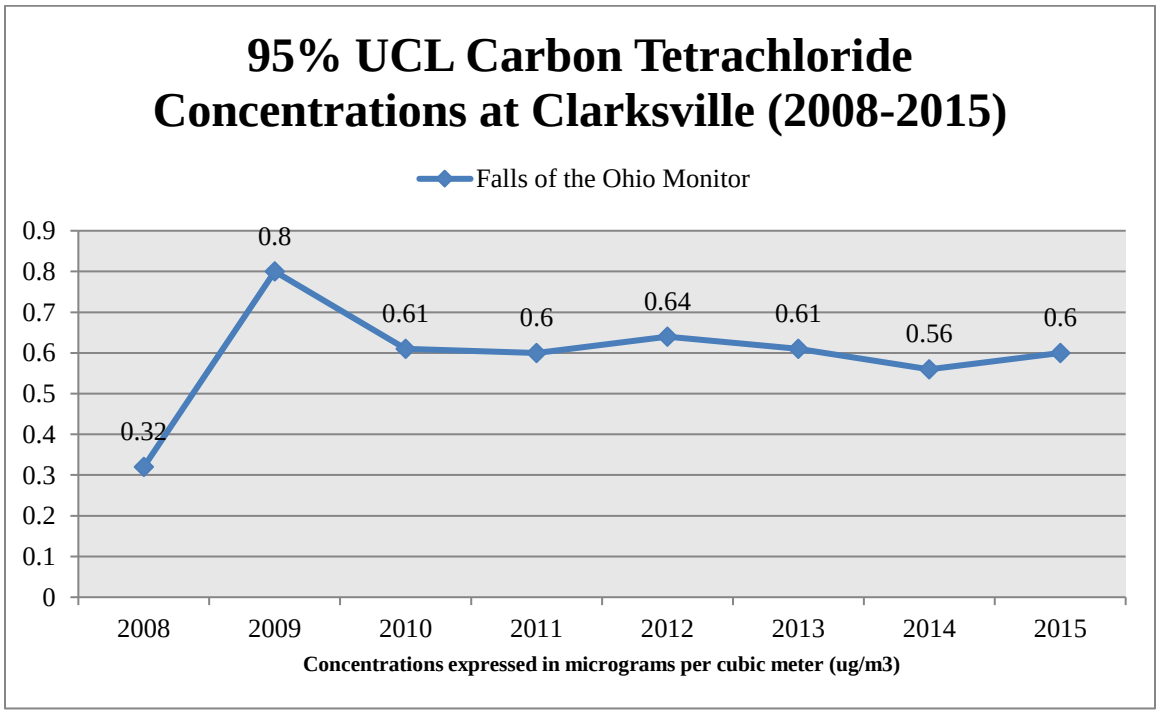

95% UCL Carbon Tetrachloride Concentrations at Ogden Dunes (2006-2015)
Ogden Dunes - Diana Rd Monitor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.35
0.31
0.31
0.83
0.64
0.6
0.62
0.65
0.57
0.64
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Concentrations expressed in micrograms per cubic meter (ug/m3)


95% UCL Carbon Tetrachloride Concentrations at Lafayette (2008-2012)
Lafayette Cinergy Monitor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.31
0.8
0.62
0.59
0.61
2008
2009
2010
2011
2012
Concentrations expressed in micrograms per cubic meter (ug/m3)


95% UCL Carbon Tetrachloride Concentrations at Terre Haute (2014-2015)
Terre Haute - Fort Harrison Rd Monitor
0.595
0.59
0.585
0.58
0.575
0.57
0.565
0.56
0.57
0.59
2014
2015
Concentrations expressed in micrograms per cubic meter (ug/m3)


95% UCL Carbon Tetrachloride Concentrations at Indianapolis (2006-2015)
Indianapolis - Washington Park Monitor
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.35
0.33
0.3
0.8
0.61
0.61
0.62
0.61
0.55
0.58
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Concentrations expressed in micrograms per cubic meter (ug/m3)





The analysis of monitoring data from 2006 to 2015 indicates that concentrations of carbon tetrachloride were at their lowest levels between 2006 and 2008. Since then, concentrations have increased but have remained fairly stable between 2010 and 2015.

Hazard Quotient

IDEM evaluates chronic (lifetime) non-cancer hazard assuming a threshold for each pollutant at which a health effect can be observed. That is, it assumes safe exposure to the pollutant up to a certain level before it is possible to experience a health effect from breathing the pollutant. IDEM uses health protective assumptions by taking into account people who might be more sensitive to the pollutants. The hazard quotient is a ratio that divides the measured concentration of a pollutant by the reference concentration (RfC). A hazard quotient under 1.0 is commonly recognized to be below the health-protective level. Hazard quotients over 1.0 indicate that further investigation may be necessary and does not necessarily mean that health effects are expected. Given the many health-protective assumptions used in the evaluation, most non-cancer hazards over 1.0 are still unlikely to be associated with observable adverse health effects.

The average concentration of carbon tetrachloride was evaluated for each air pollutant monitor over the span of this study. The results for each monitor are displayed in the table below. The calculated hazard quotient is well below 1.0 at all monitors, which indicates that the measured concentrations of carbon tetrachloride do not present a risk for non-cancer health effects.

Table 1. Carbon Tetrachloride Hazard Quotients (concentrations expressed in micrograms per cubic meter)

Monitor	Years	Average Concentration	Reference Concentration (RfC)*	Hazard Quotient
East Chicago Water Filtration Plant	2006-2012	0.54	100.00	0.005
East Chicago Marina	2013-2015	0.61	100.00	0.006
Gary IITRI	2006-2015	0.56	100.00	0.006
Hammond CAAP	2006-2015	0.56	100.00	0.006
Whiting High School	2006-2015	0.55	100.00	0.006
Ogden Dunes – Diana Rd	2006-2015	0.56	100.00	0.006
Lafayette Cinergy	2008-2012	0.61	100.00	0.006
Terre Haute – Fort Harrison Rd	2014-2015	0.58	100.00	0.006
Indianapolis – Washington Park	2006-2015	0.55	100.00	0.006
University of Evansville	2006-2015	0.58	100.00	0.006
Clarksville – Falls of the Ohio	2008-2015	0.60	100.00	0.006

* Reference Concentration Source: Integrated Risk Information Service (IRIS)

Cancer Risk

IDEM uses U.S. EPA methods and toxicological information from reliable sources when calculating potential cancer risk estimates. Potential lifetime cancer risk estimates are obtained by multiplying ambient air concentrations by cancer slope factors. The resulting calculations give a number that is expressed using the term "lifetime cancer cases per number of people." U.S. EPA uses a range between one in a million and one hundred in a million (1 to 100) when evaluating whether the estimated risk is at a level where action should be taken. Generally, U.S. EPA considers lifetime cancer risk estimates over one hundred in a million to be at levels where action or more investigation is required. Lifetime cancer risks that fall between the one in a million and 100 in a million range generate decisions and actions taking into account the assumptions used to determine the estimate. Lifetime cancer risk estimates below one in a million are usually considered not to require further action.

Carbon tetrachloride has been classified as a probable human carcinogen. The estimated risk of contracting cancer from carbon tetrachloride consistently runs within a range of 3.2-3.7 in a million at monitors across the state. Based on the calculated risk levels, carbon tetrachloride is not a priority for immediate action but trends in concentrations should be closely monitored in the future.

Table 2. Carbon Tetrachloride Additional Lifetime Cancer Risk (concentrations expressed in micrograms per cubic meter)

Monitor	Years	Average Concentration	Cancer Risk (in one million)*
East Chicago Water Filtration Plant	2006-2012	0.54	3.24
East Chicago Marina	2013-2015	0.61	3.66
Gary IITRI	2006-2015	0.56	3.36
Hammond CAAP	2006-2015	0.56	3.36
Whiting High School	2006-2015	0.55	3.30
Ogden Dunes – Diana Rd	2006-2015	0.56	3.36
Lafayette Cinergy	2008-2012	0.61	3.66
Terre Haute – Fort Harrison Rd	2014-2015	0.58	3.48
Indianapolis – Washington Park	2006-2015	0.55	3.30
University of Evansville	2006-2015	0.58	3.48
Clarksville – Falls of the Ohio	2008-2015	0.60	3.60

* Additional Cancer Risk Factor Source: Integrated Risk Information Service (IRIS).