

## **1,3-BUTADIENE (C<sub>4</sub>H<sub>6</sub>)**

Chemical Abstracts Service (CAS) Number: 106-99-0

### **General Information**

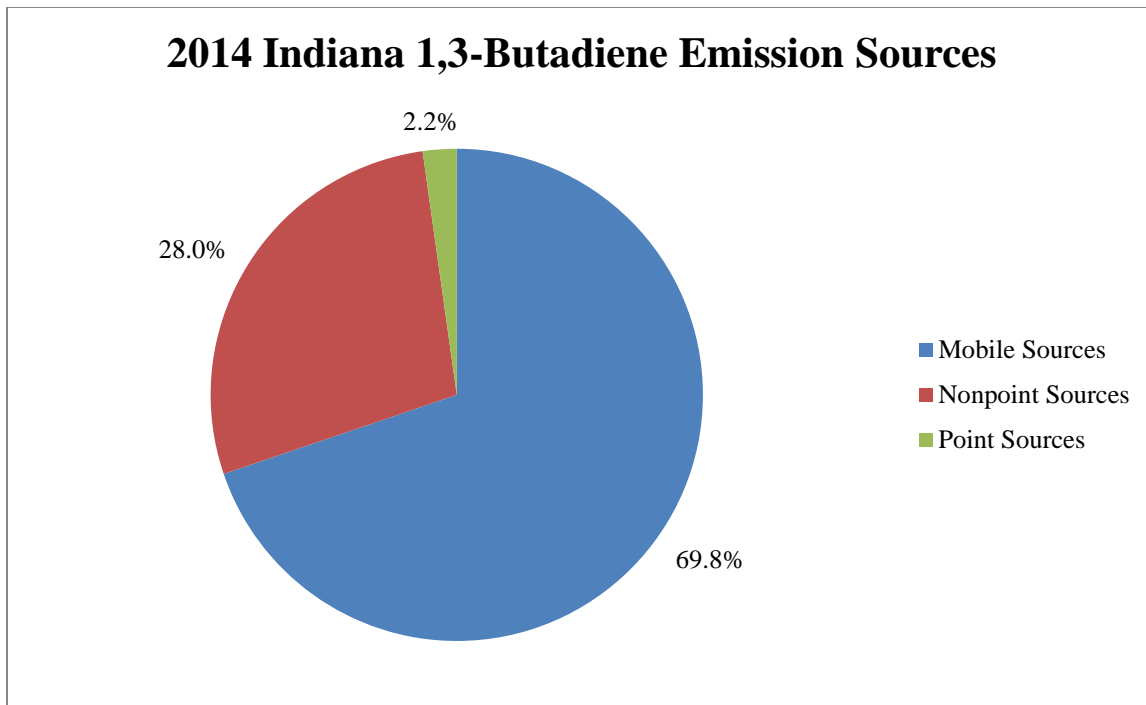
1,3-Butadiene is a colorless gas with a mild gasoline-like odor. Although 1,3-butadiene breaks down quickly in the atmosphere, it is usually found in ambient air at low levels in urban and suburban areas. Acute (short-term) exposure to 1,3-butadiene by inhalation in humans results in irritation of the eyes, nasal passages, throat, and lungs. Epidemiological studies have reported a possible association between 1,3-butadiene exposure and cardiovascular diseases. Epidemiological studies of workers in rubber plants have shown an association between 1,3-butadiene exposure and increased incidence of leukemia. Animal studies have reported tumors at various sites from 1,3-butadiene exposure. U.S. EPA has classified 1,3-butadiene as carcinogenic to humans by inhalation.

### **Sources**

- Sources of 1,3-butadiene released into the air include motor vehicle and airplane exhaust, manufacturing and processing facilities, forest fires and prescribed burning and other wood combustion, and cigarette smoke.
- Higher levels of 1,3-butadiene may be found in highly industrialized cities or near oil refineries, chemical manufacturing plants, and plastic and rubber factories.
- 1,3-Butadiene has been found in drinking water and in plastic or rubber food containers, but not in food samples.
- Occupational exposure to 1,3-butadiene may occur in the rubber, plastics, and resins industries.
- There is no reliable medical test available at this time to assess personal exposure to 1,3-butadiene.

### **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 1,3-butadiene totaled 516.33 tons in the 2014 calendar year. Of this total, 69.8% were attributed to mobile sources, 28.0% were attributed to nonpoint sources, and 2.2% 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

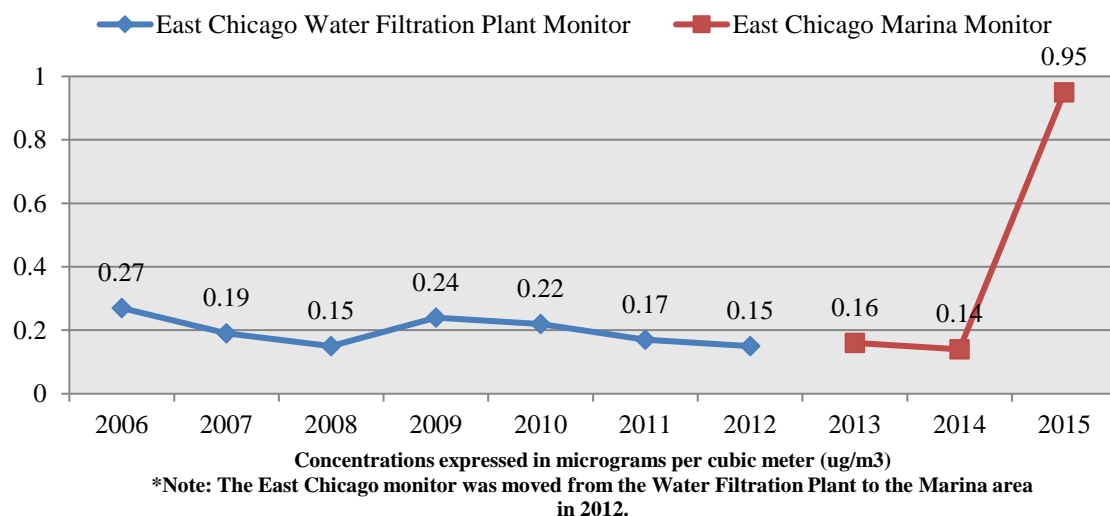
Ambient air monitoring data most accurately represents a limited area near the monitor location. All monitors for air toxics sample every sixth day. The monitoring locations by themselves are not sufficient to accurately characterize air toxic concentrations throughout the entire state, however, results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

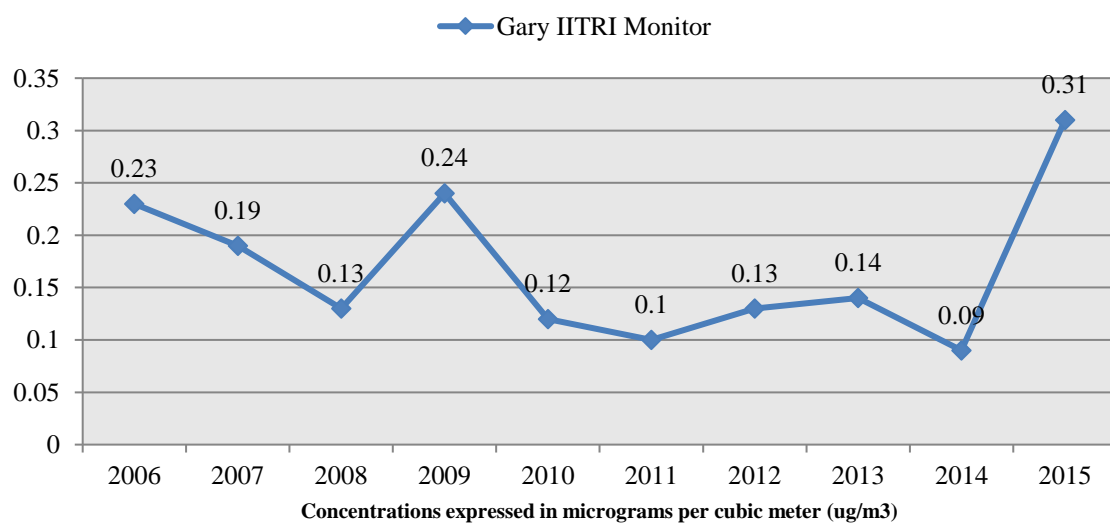
To learn more about the current monitoring locations, please visit IDEM's Air Toxics Monitor Siting webpage at: <http://www.in.gov/idem/toxic/2337.htm>

Data analysis was performed for each monitor that operated for a significant portion of the analysis period. The detection rate for 1,3-butadiene over the course of this study was 60.1%, allowing for a trend analysis to be performed with moderate confidence. Trend graphs for each of these monitors are provided below.

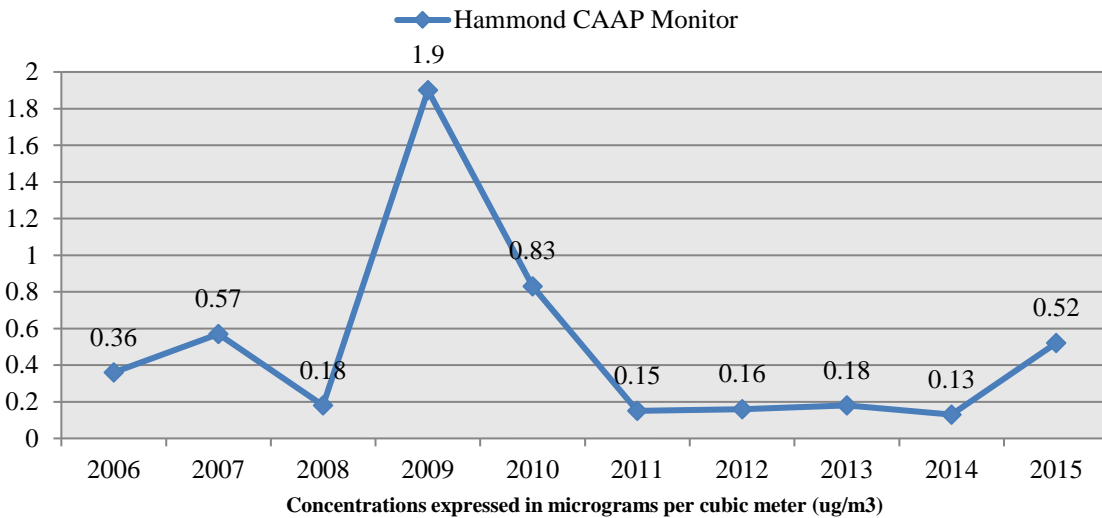
## 95% UCL 1,3-Butadiene Concentrations at East Chicago (2006-2015)



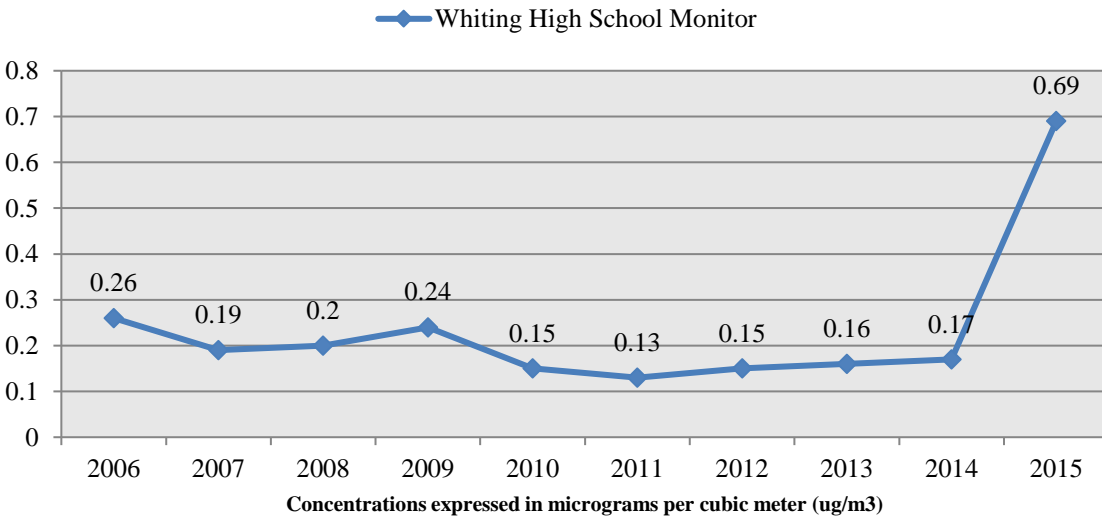
## 95% UCL 1,3-Butadiene Concentrations at Gary (2006-2015)



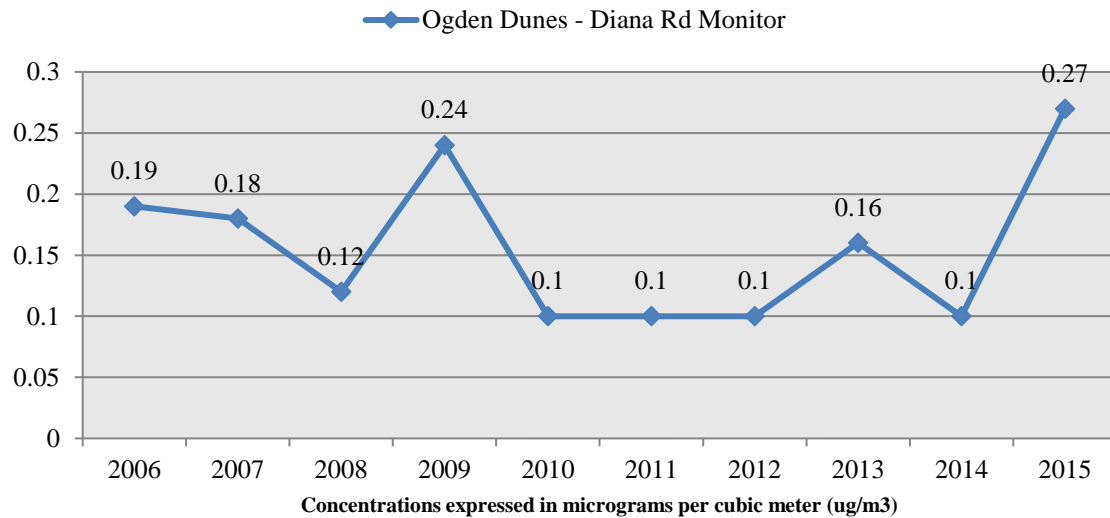
## 95% UCL 1,3-Butadiene Concentrations at Hammond (2006-2015)



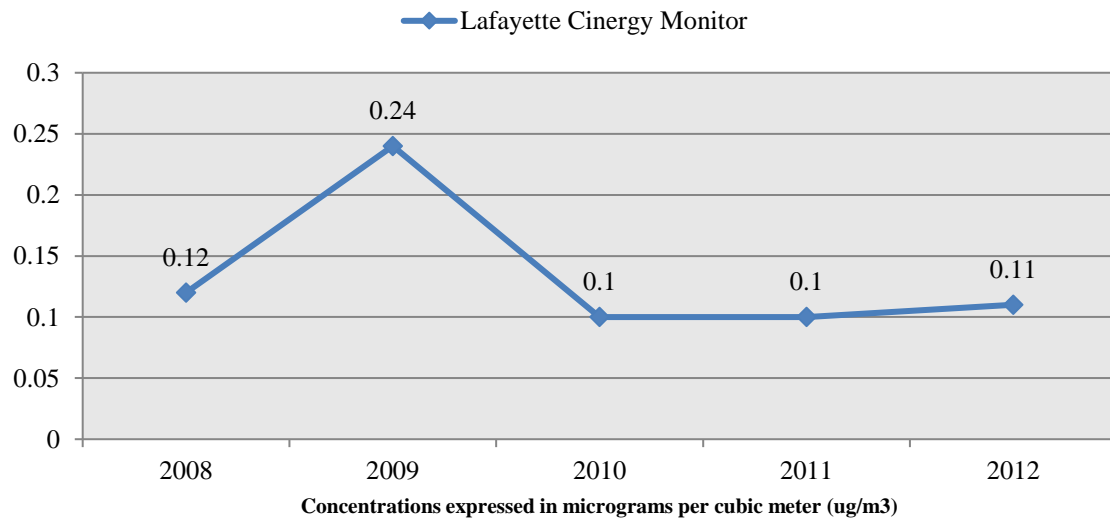
## 95% UCL 1,3-Butadiene Concentrations at Whiting (2006-2015)



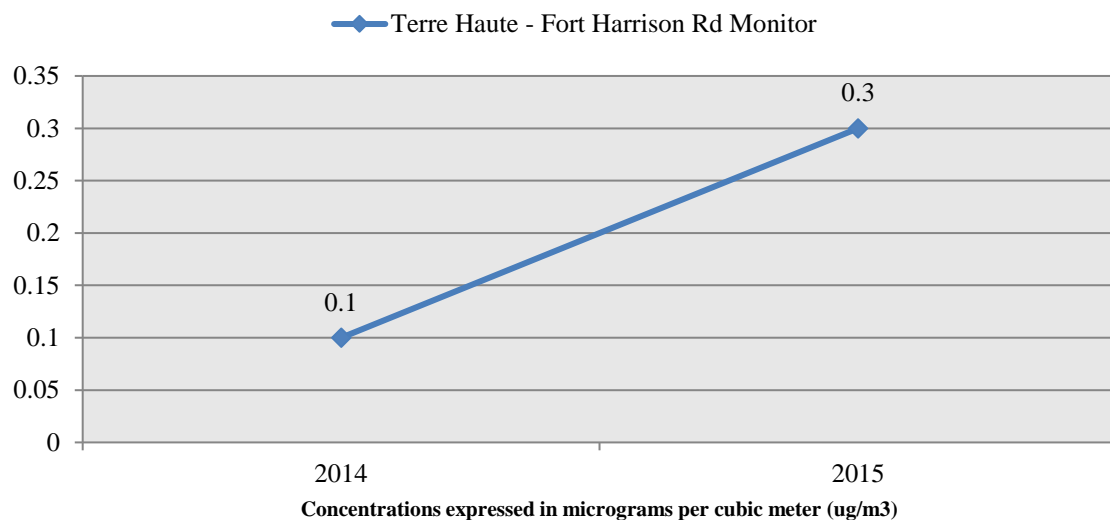
## 95% UCL 1,3-Butadiene Concentrations at Ogden Dunes (2006-2015)



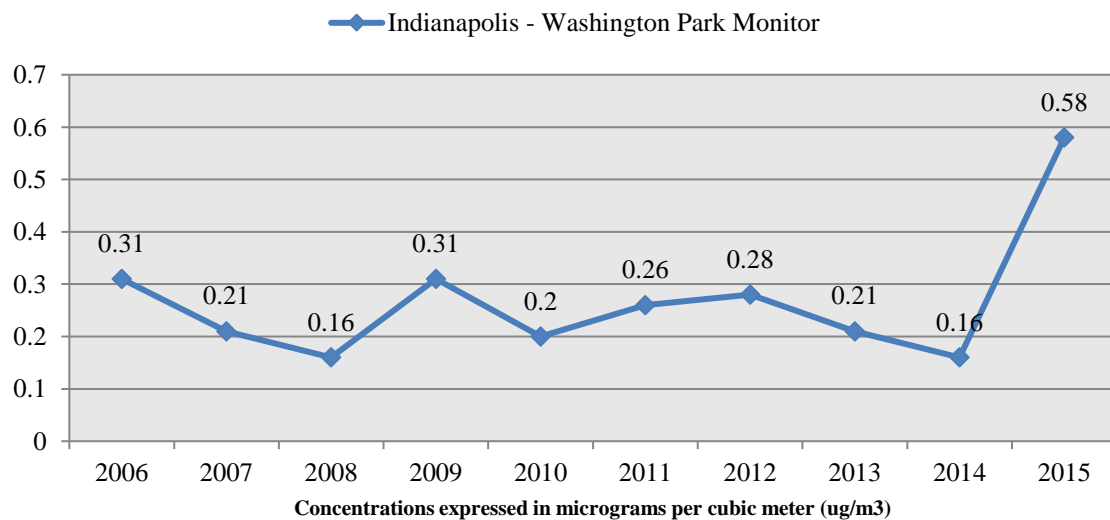
## 95% UCL 1,3-Butadiene Concentrations at Lafayette (2008-2012)



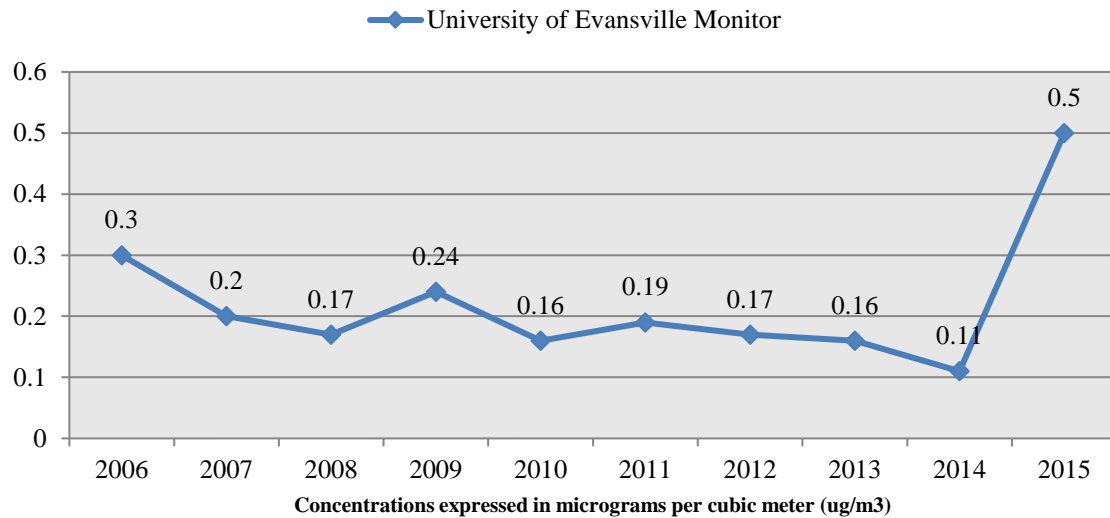
## 95% UCL 1,3-Butadiene Concentrations at Terre Haute (2014-2015)



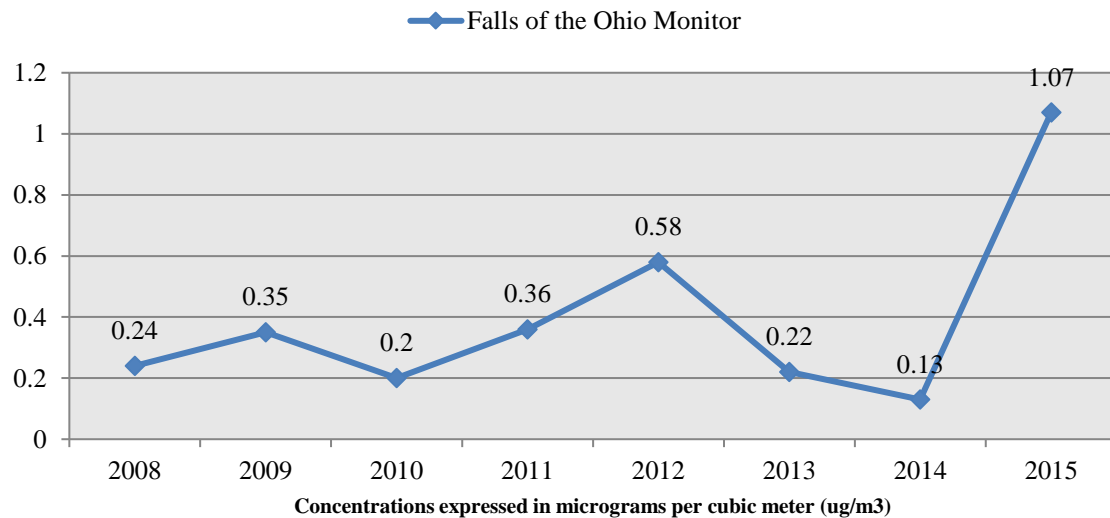
## 95% UCL 1,3-Butadiene Concentrations at Indianapolis (2006-2015)



### 95% UCL 1,3-Butadiene Concentrations at Evansville (2006-2015)



### 95% UCL 1,3-Butadiene Concentrations at Clarksville (2008-2015)



The analysis of monitoring data from 2006 to 2015 indicates that concentrations of 1,3-butadiene have generally declined or held steady over the course of this study until 2015. Observations from monitors around the state indicate a sharp increase in 1,3-butadiene concentrations between 2014 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 1,3-butadiene 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 1,3-butadiene do not present a risk for non-cancer health effects.

**Table 1. 1,3-Butadiene 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	0.19	2.0	0.095
East Chicago Marina	2013-2015	0.35	2.0	0.175
Gary IITRI	2006-2015	0.16	2.0	0.080
Hammond CAAP	2006-2015	0.42	2.0	0.210
Whiting High School	2006-2015	0.26	2.0	0.130
Ogden Dunes – Diana Rd	2006-2015	0.15	2.0	0.075
Lafayette Cinergy	2008-2012	0.13	2.0	0.065
Terre Haute – Fort Harrison Rd	2014-2015	0.20	2.0	0.100
Indianapolis – Washington Park	2006-2015	0.24	2.0	0.120
University of Evansville	2006-2015	0.20	2.0	0.100
Clarksville - Falls of the Ohio	2008-2015	0.34	2.0	0.170

\* 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.

1,3-Butadiene has been classified as a probable human carcinogen. The estimated risk of contracting cancer from 1,3-butadiene consistently runs greater than one in a million at monitors across the state. Based on the calculated risk levels, 1,3-butadiene is one of the most significant cancer risk drivers related to Indiana air quality.

**Table 2. 1,3-Butadiene 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	0.19	5.7
East Chicago Marina	2013-2015	0.35	10.5
Gary IITRI	2006-2015	0.16	4.8
Hammond CAAP	2006-2015	0.42	12.6
Whiting High School	2006-2015	0.26	7.8
Ogden Dunes – Diana Rd	2006-2015	0.15	4.5
Lafayette Cinergy	2008-2012	0.13	3.9
Terre Haute – Fort Harrison Rd	2014-2015	0.20	6.0
Indianapolis – Washington Park	2006-2015	0.24	7.2
University of Evansville	2006-2015	0.20	6.0
Clarksville - Falls of the Ohio	2008-2015	0.34	10.2

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