

# **Carbon Screening Study 2013-2014**

**Prepared by  
Ambient Monitoring Sections #1 and #2  
Office of Air Quality  
Indiana Department of Environmental Management**

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## **Carbon Screening Study for PM<sub>2.5</sub>**

### **Introduction**

Particulate Matter of 2.5 micron size and smaller (designated as PM<sub>2.5</sub>) is one of the major pollutants in Indiana. One of the species in PM<sub>2.5</sub> is carbon. Over the years, the Indiana Department of Environmental Management, Office of Air Quality (IDEM/OAQ) has tried to determine where pollution sources are located, what monitoring is needed, and what specific locations to locate a site. Throughout Indiana there are various sources which contribute to the release of carbon in the atmosphere. The main instrumentation used for the continuous collection of carbon is an Aethalometer. The Aethalometer can have the capability to read black carbon (most often described as elemental carbon and is a man made source and doesn't occur in nature) and UVC (most often described as organic carbon which is mostly from wood burning processes).

This report summarizes the results of this recent monitoring study. By looking at the data collected some determination can be made if additional monitoring is needed.

### **Project Plan**

In order to determine where additional monitoring may be needed, four sites were chosen for this study. Of the four sites, one of these sites is an existing site that IDEM/OAQ collects intermittent data but not any continuous data. Two of the four sites were picked in areas where IDEM/OAQ have no air monitoring data collection. The goal was to collect data from these four sites over the 2013 year. The goal was for IDEM/OAQ to collect data for one quarter at each site in the study. Some of the data collection was interrupted due to bad weather so there will be some missing data as well as additional monitoring performed in the first quarter of 2014 at the last site in the study.

### **National Ambient Air Quality Standards**

The United States Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants. For each pollutant a primary and a secondary standard is set. The primary NAAQS are set to protect the public health of the population, including the health of sensitive populations such as asthmatics, children, and the elderly. The secondary NAAQS are established to protect the public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. As of the writing of this report, the national primary ambient air quality standards for PM<sub>2.5</sub> are 12.0 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) annual arithmetic mean concentration and 35  $\mu\text{g}/\text{m}^3$  24-hour average concentration measured in the ambient air as PM<sub>2.5</sub> (particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers). It must be noted that although no standard exists for any PM<sub>2.5</sub> speciation data, chemical speciation is encouraged where the chemically resolved data would be useful in developing State implementation plans and supporting atmospheric or health effects related studies.

## Site Locations

The table below lists the four sites for the carbon screening study as well as possible pollution sources and the time frame when monitoring was conducted.

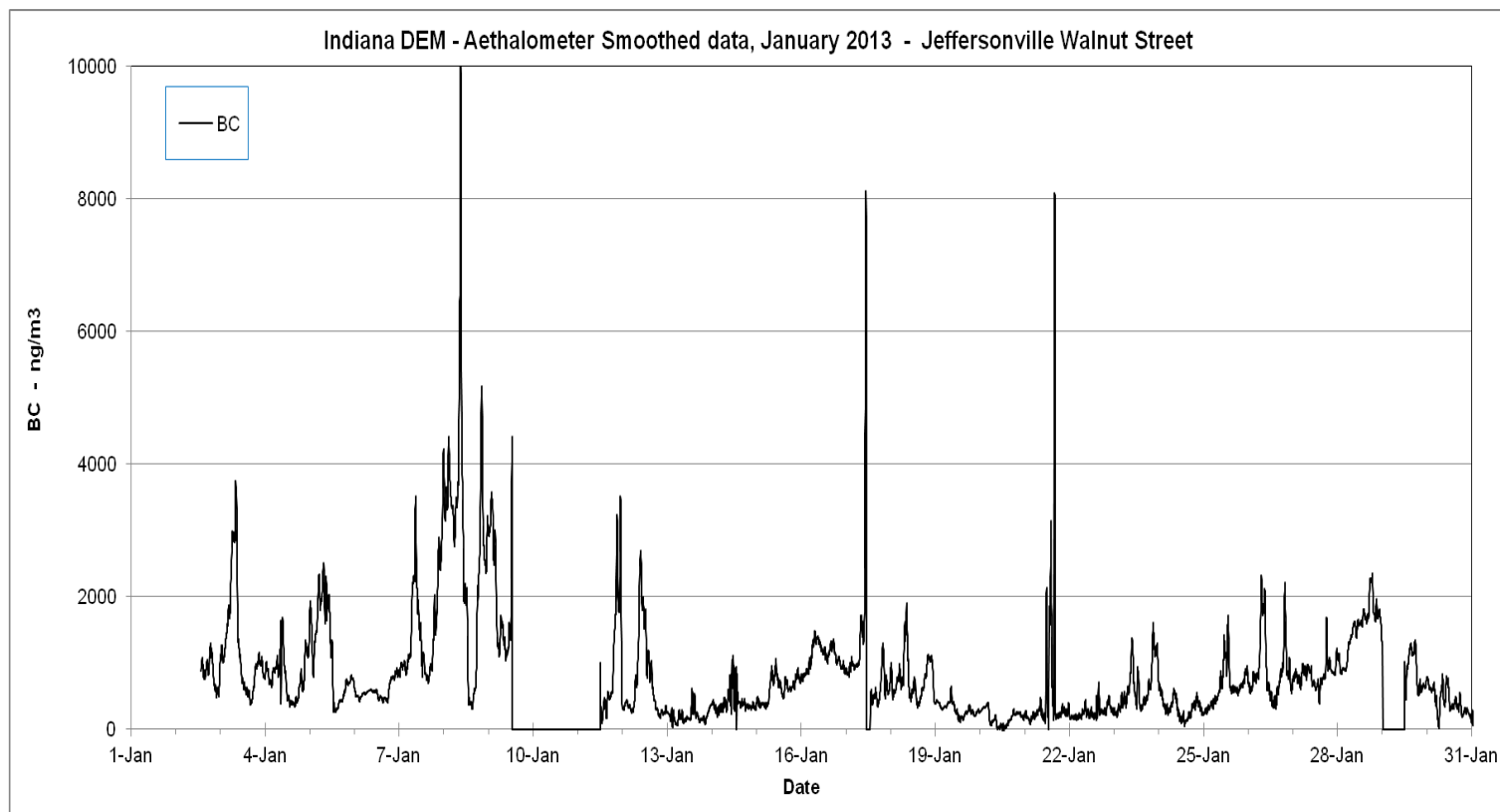
Site	Address and Site Information	Sampling Period	Possible Pollution Sources
Jeffersonville Walnut Street	Jeffersonville PFAU, 719 Walnut Street, Jeffersonville, IN. This is an existing site at ground level in a grassy area. Probe height approximately 1.5 meters.	January 2013 thru March 2013.	The site was chosen due to the proximity of Louisville, Kentucky as well as major interstate routes located nearby.
Hammond Water Works	Hammond Water Works, 925 Casino Center Dr., Hammond, IN. Located on top of a building. Probe height approximately 13 meters.	April 2013 thru June 2013.	The site was chosen due to the amount of carbon collected at the Gary litri site. Lake County is an industrial area as well as having an extensive railway network.
Lawrenceburg	US 50 Flood Gate Structure, Lawrenceburg, IN. Located on top of a small building near major traffic lane. Probe height approximately 4 meters.	July 2013 and August 2013.	The site was chosen due to the proximity of Cincinnati, Ohio as well as major interstate routes located nearby. Additionally, heavy coal burning industry is located in the vicinity.
Angola Toll Booth	Angola Toll Plaza (MP 144), at the I-69 and I80-90 Toll Road, Indiana. This is a ground level site approximately 4 meters from nearest toll booth lane. Probe height approximately 1.5 meters.	October 2013 and January 2014.	This area was chosen to determine how the toll road traffic meeting interstate 69 can have an impact on the local area.

## Equipment

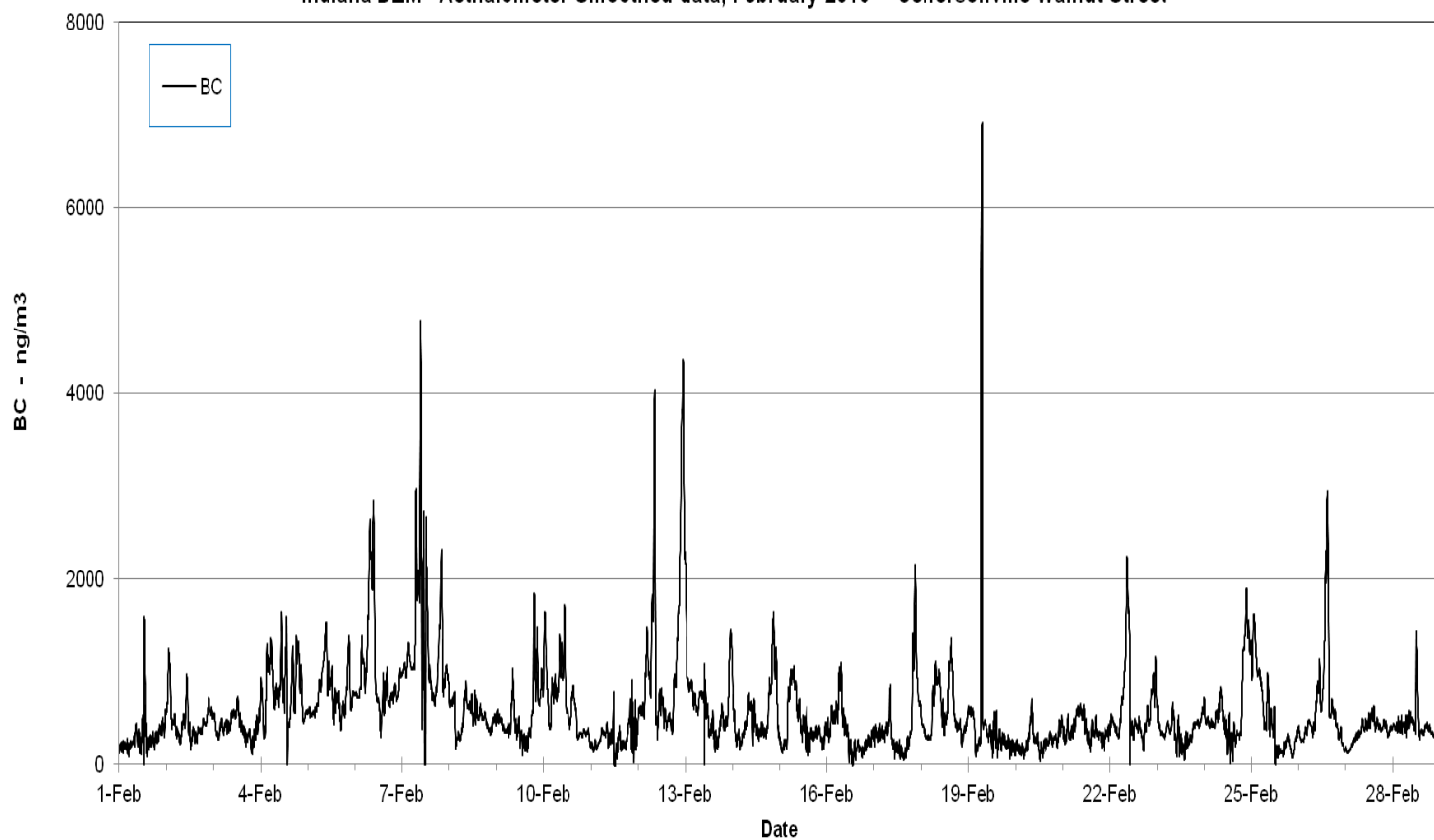
For this study, three different types of Aethalometers were used, depending on how the equipment could be stored at the site and what was available. For the Jeffersonville Walnut Street and Angola Toll Booth sites, an Aethlabs model AE51 unit was used. This unit has real-time analysis by measuring the rate of change in absorption of transmitted light due to continuous collection of aerosol deposit on a filter. Measurement at 880 nm is interpreted as concentration of black carbon. At the Hammond Water Works site, a Magee Scientific model AE22-HS unit was used. This unit measures the light absorption of carbon particles at two wavelengths: 880 nm (IR), quantitative for the mass of 'Black' or Elemental Carbon; and 370 nm (UV), indicating the presence of aromatic organic compounds such as are found in wood smoke, biomass-burning smoke, and tobacco smoke. At the Lawrenceburg site, a Teledyne Advanced Pollution Instrumentation model 633 was used. This unit continuously collects airborne particles onto a fiber filter and actively measures the light absorbing properties of the sample in real-time. The light absorbing properties are measured at multiple wavelengths providing supplemental information about the particle composition and possible sources (i.e. wood smoke versus diesel fumes).

## Monitoring Results

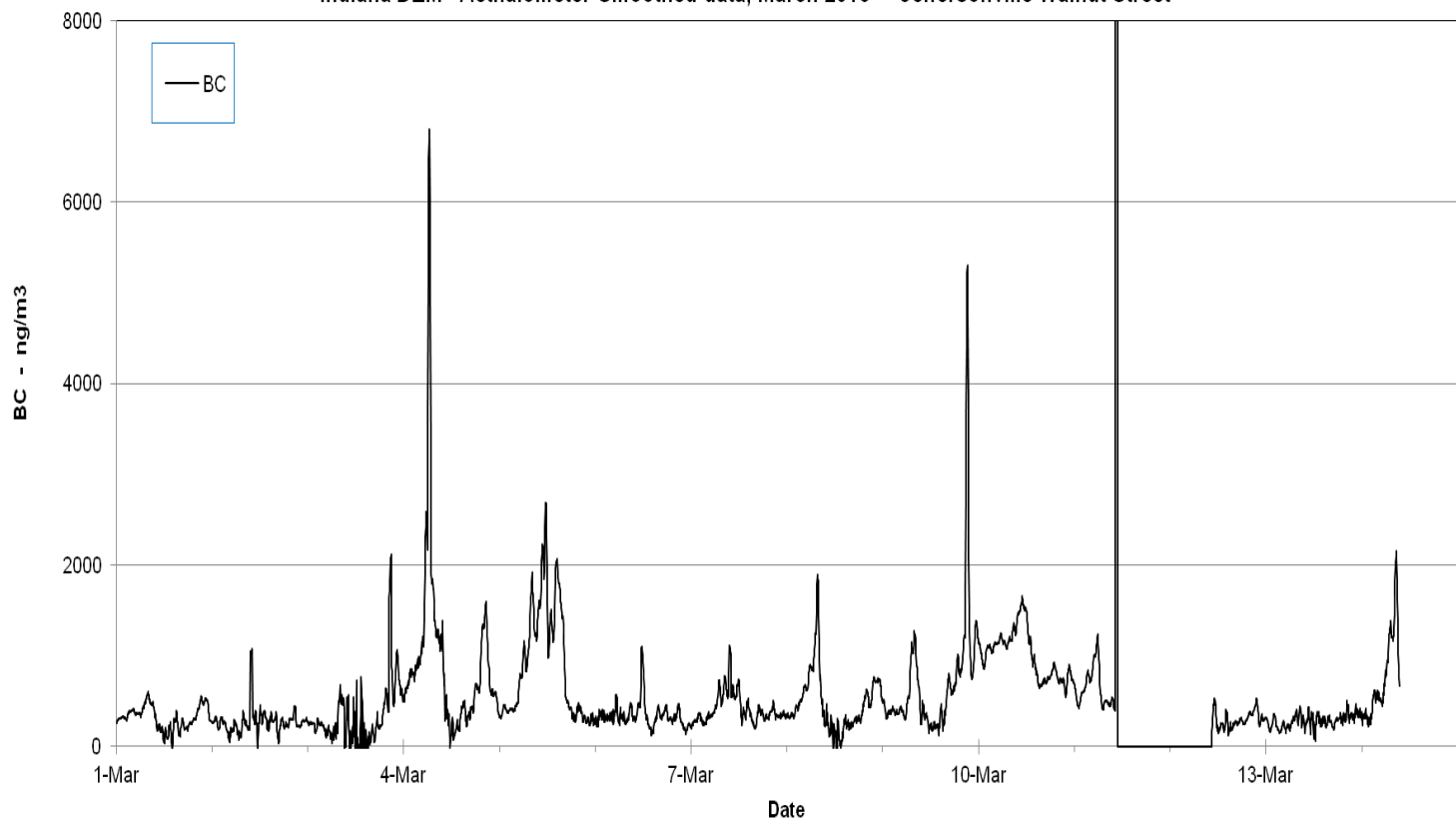
Below are the charts for all data collected for this study. The smoothed data is a continuous 30 minute average of data collected at either 5 minute intervals (Jeffersonville Walnut Street, Hammond Water Works, and Angola Toll Booth) or 1 minute intervals (Lawrenceburg). Actual data values for all sites are available at <http://www.in.gov/idem/airquality/2487.htm>



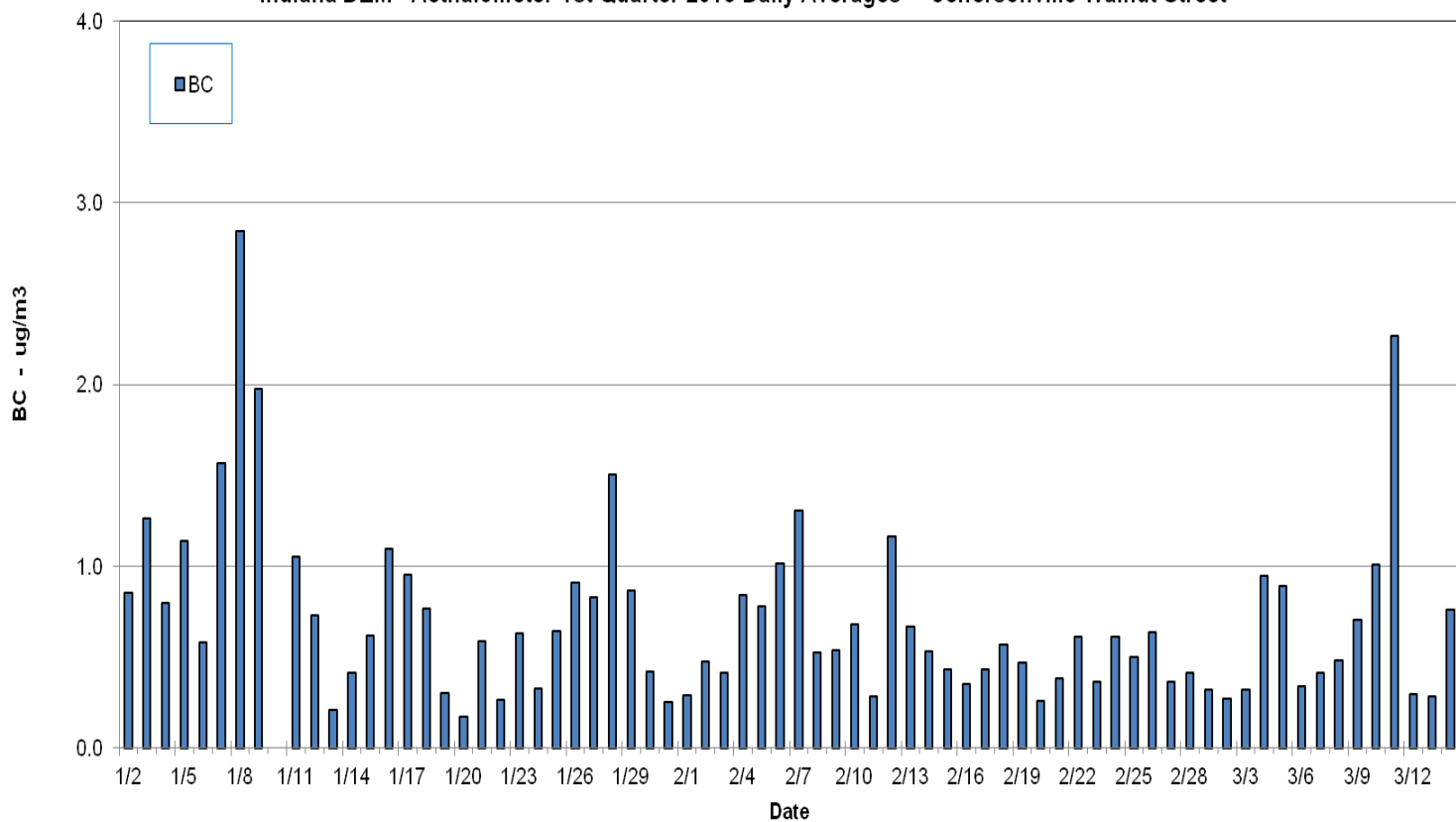
Indiana DEM - Aethalometer Smoothed data, February 2013 - Jeffersonville Walnut Street



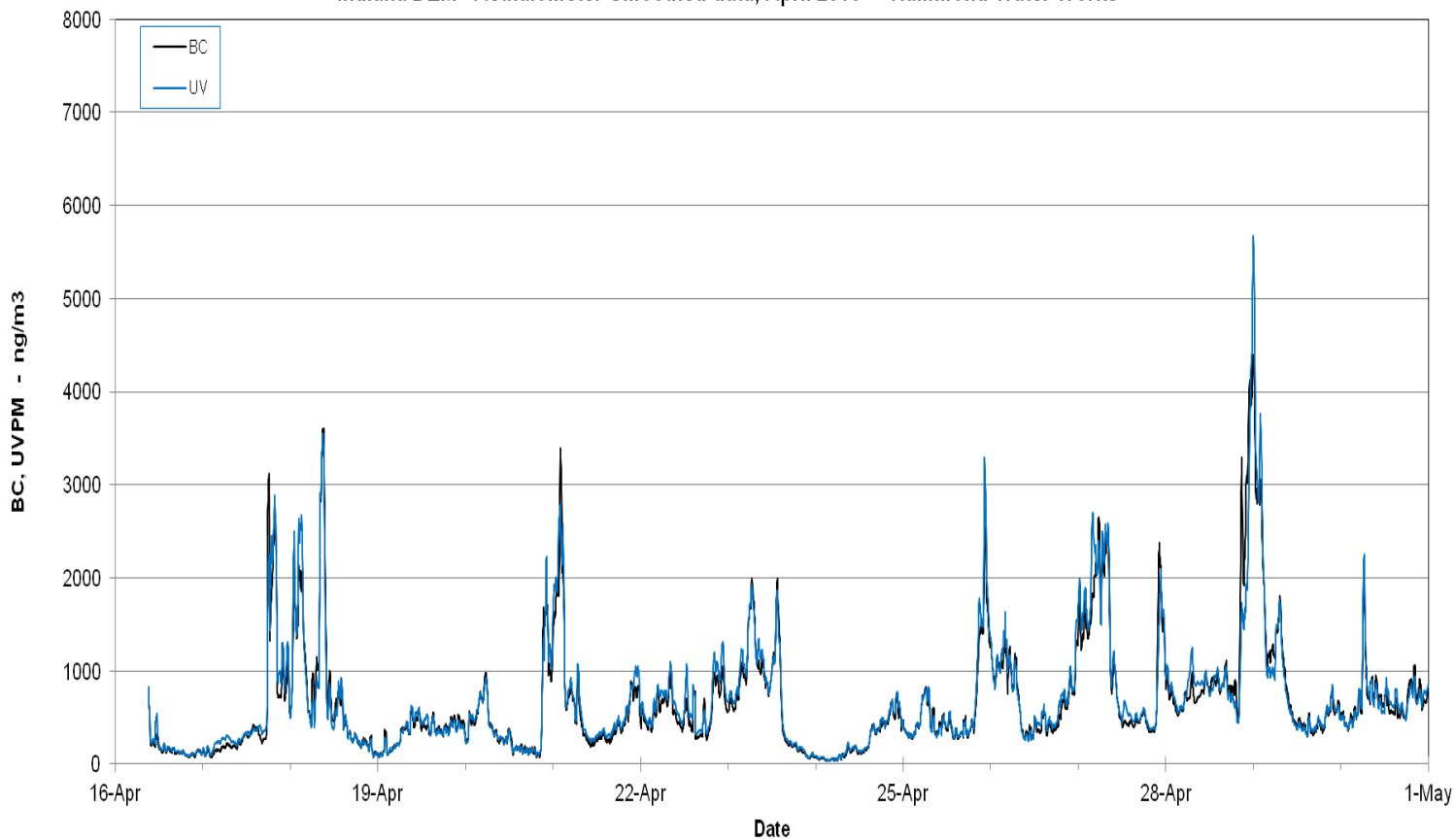
Indiana DEM - Aethalometer Smoothed data, March 2013 - Jeffersonville Walnut Street



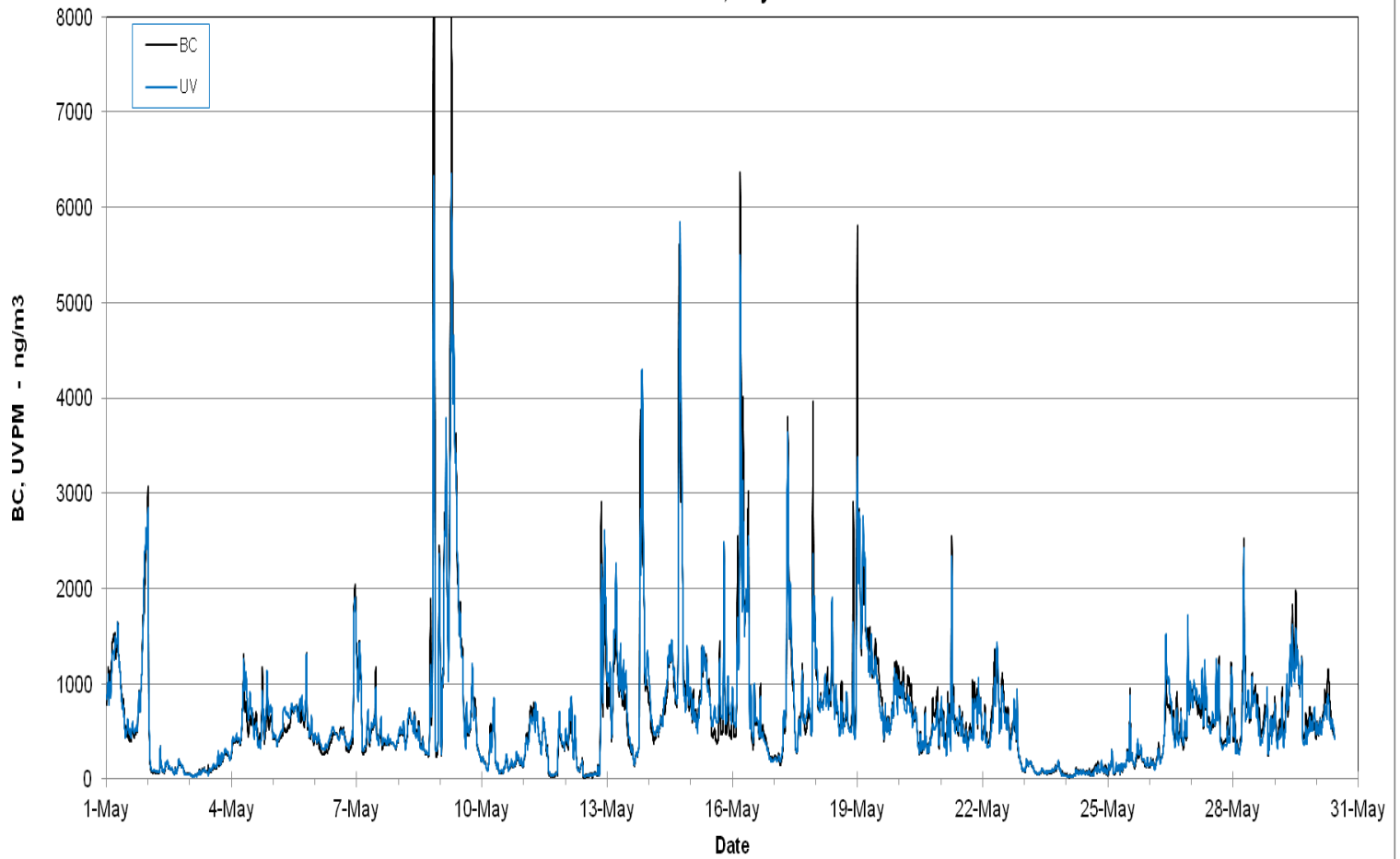
Indiana DEM - Aethalometer 1st Quarter 2013 Daily Averages - Jeffersonville Walnut Street



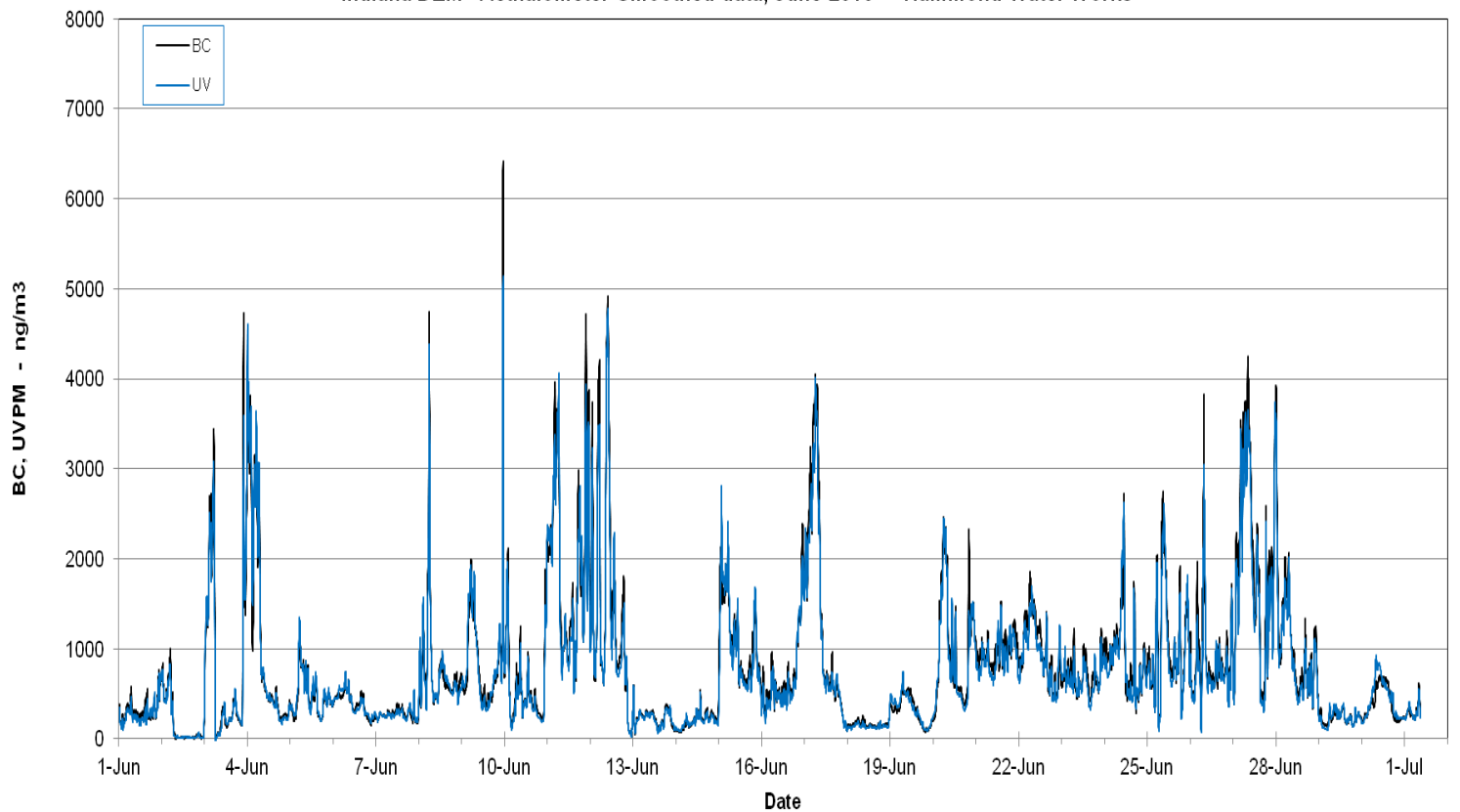
Indiana DEM - Aethalometer Smoothed data, April 2013 - Hammond Water Works



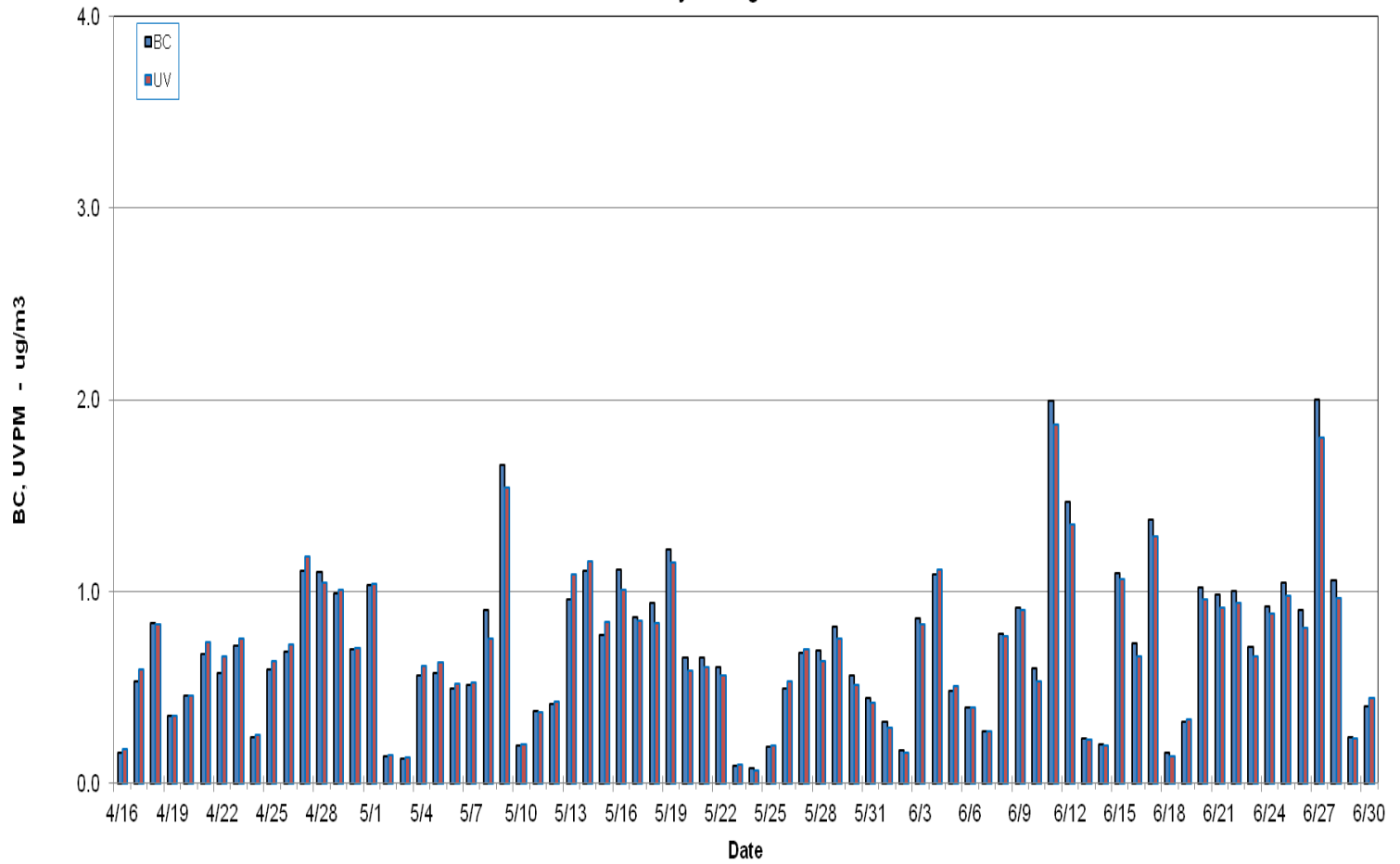
Indiana DEM - Aethalometer Smoothed data, May 2013 - Hammond Water Works



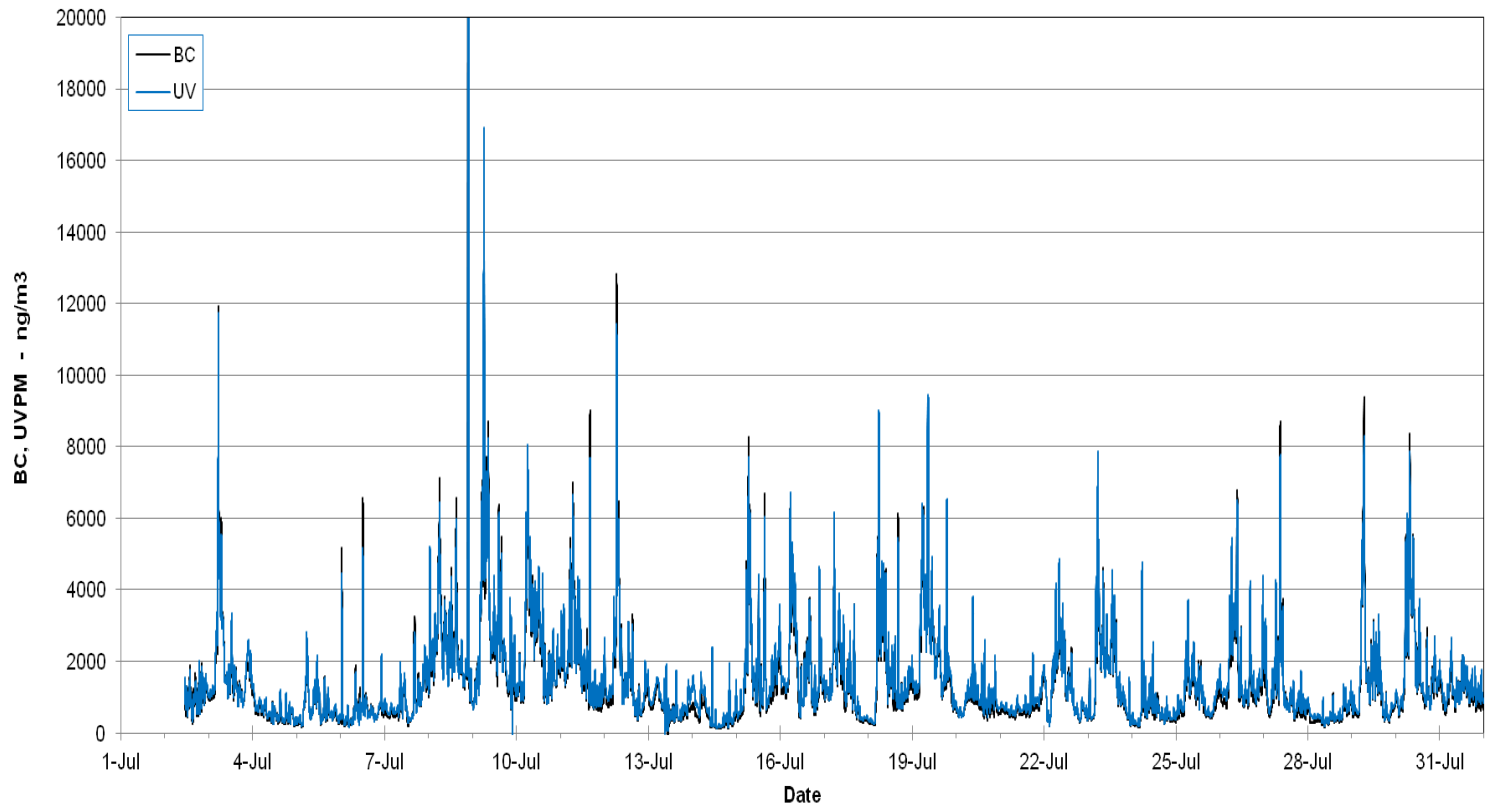
Indiana DEM - Aethalometer Smoothed data, June 2013 - Hammond Water Works



Indiana DEM - Aethalometer Daily Averages - Hammond Water Works

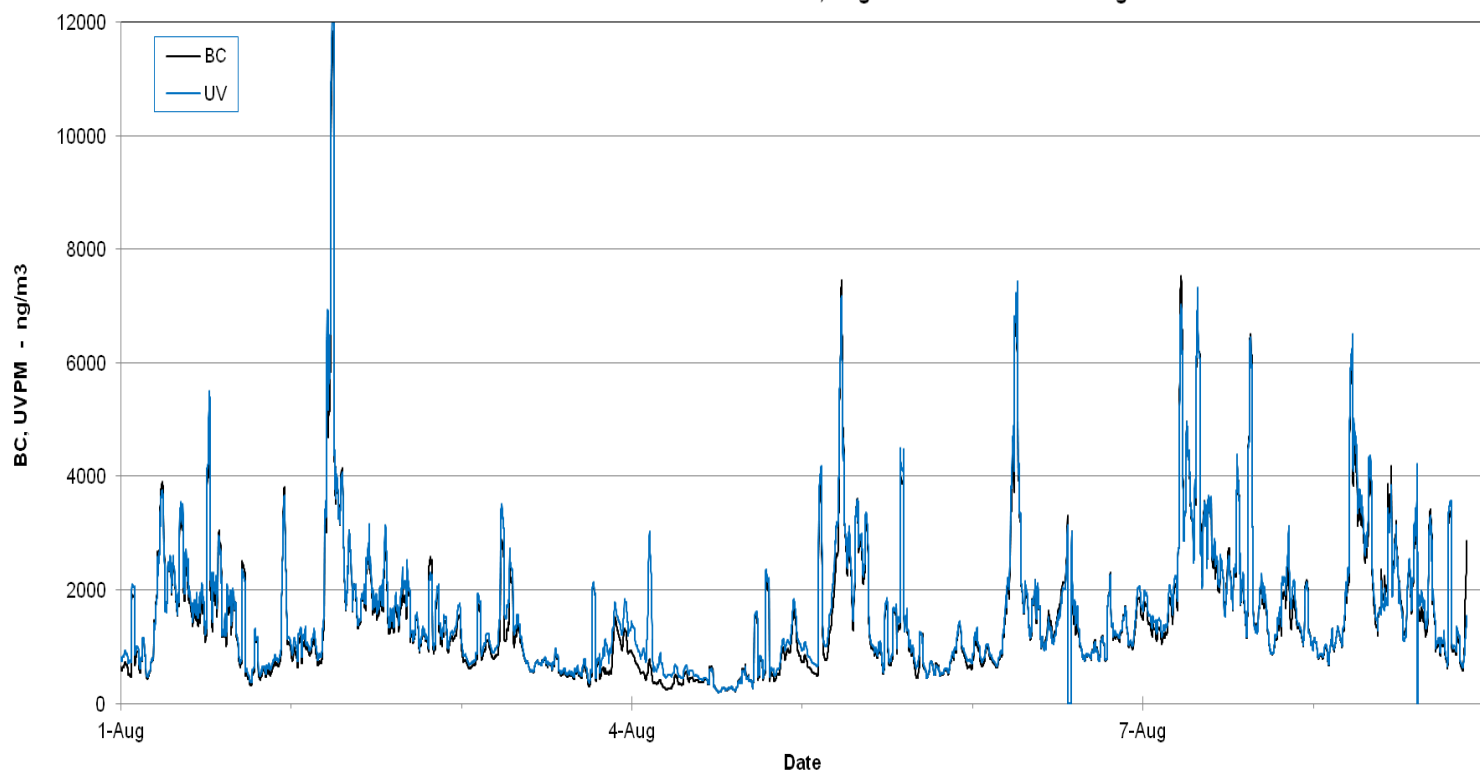


Indiana DEM - Aethalometer Smoothed data, July 2013 - Lawrenceburg

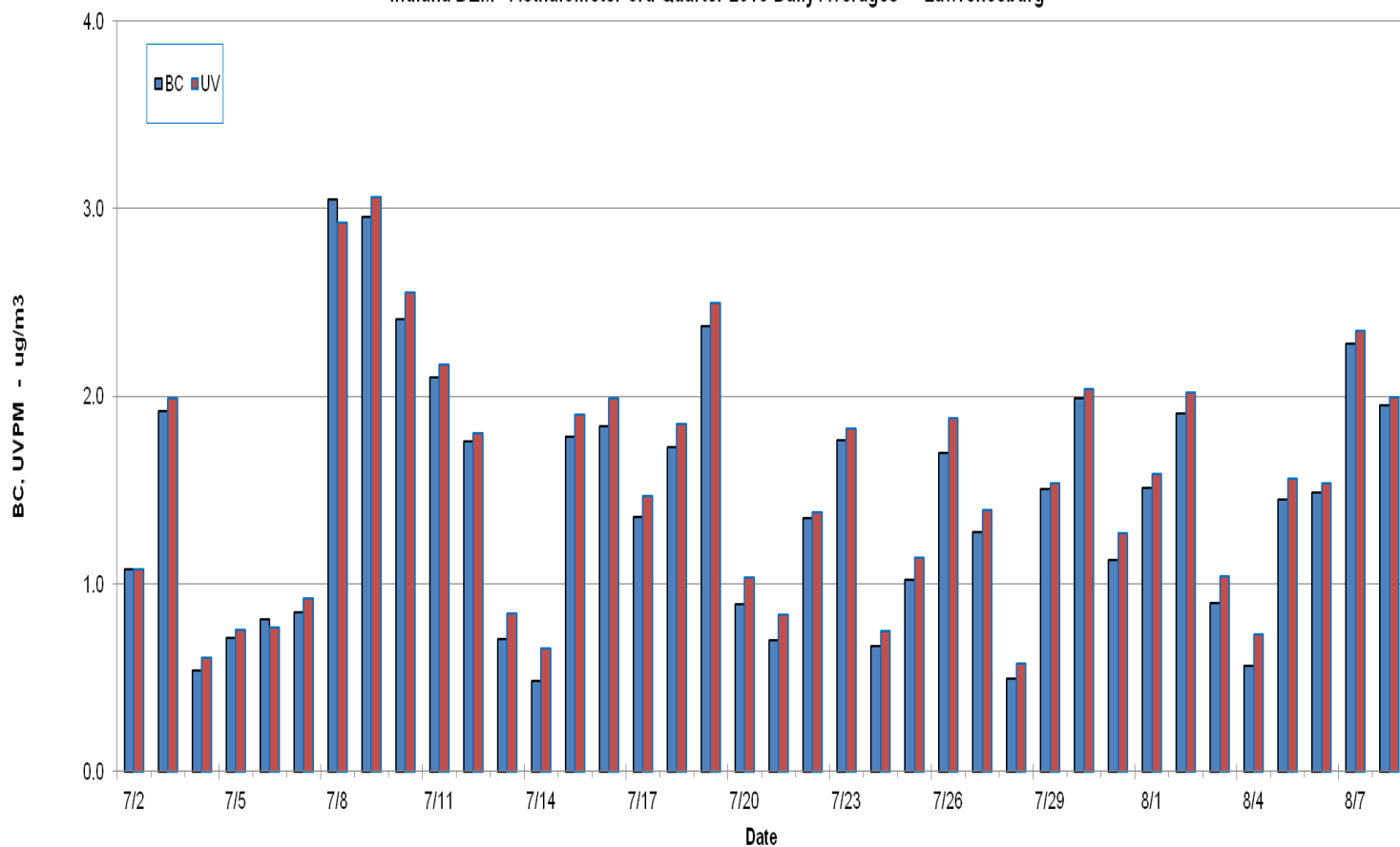




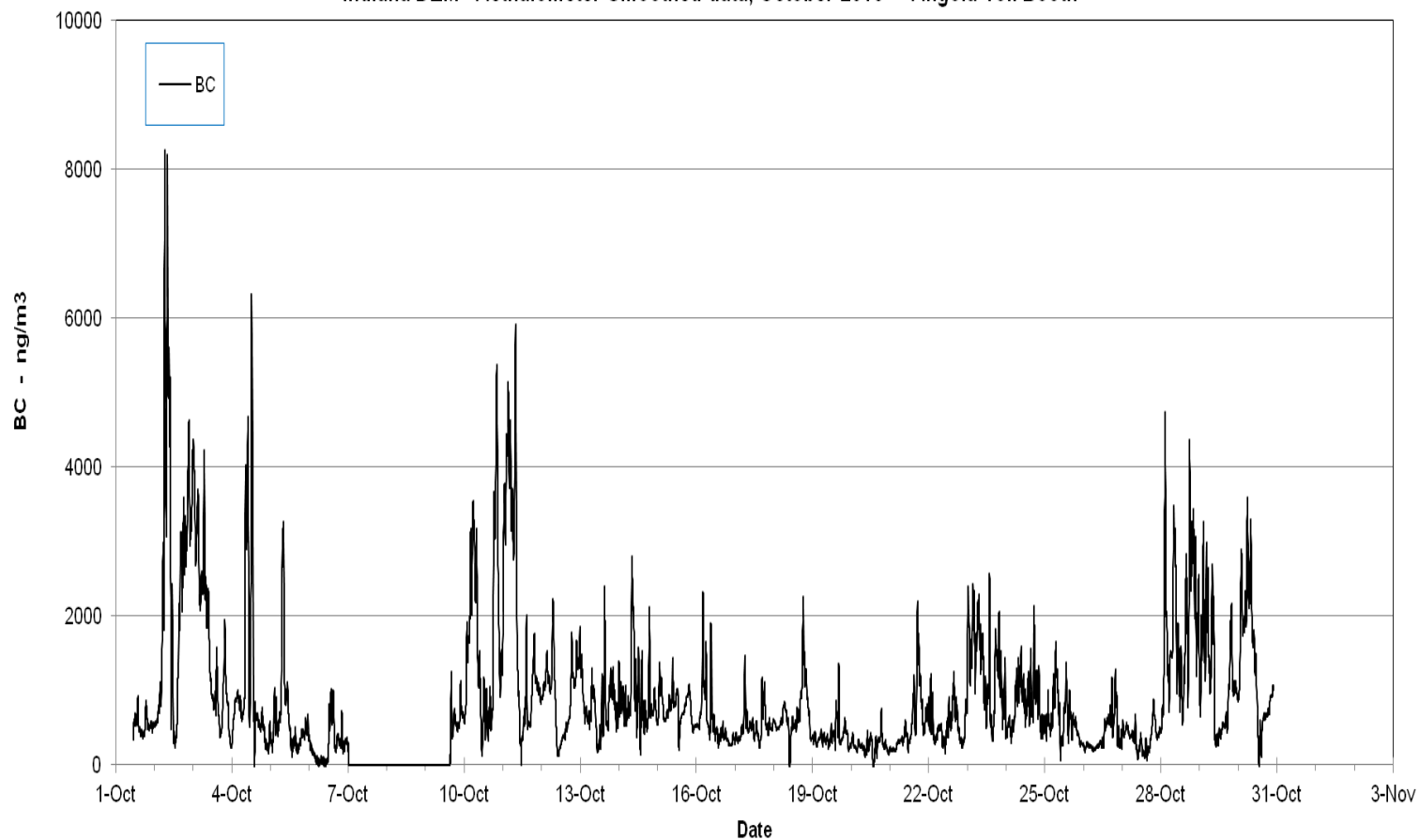
Indiana DEM - Aethalometer Smoothed data, August 2013 - Lawrenceburg



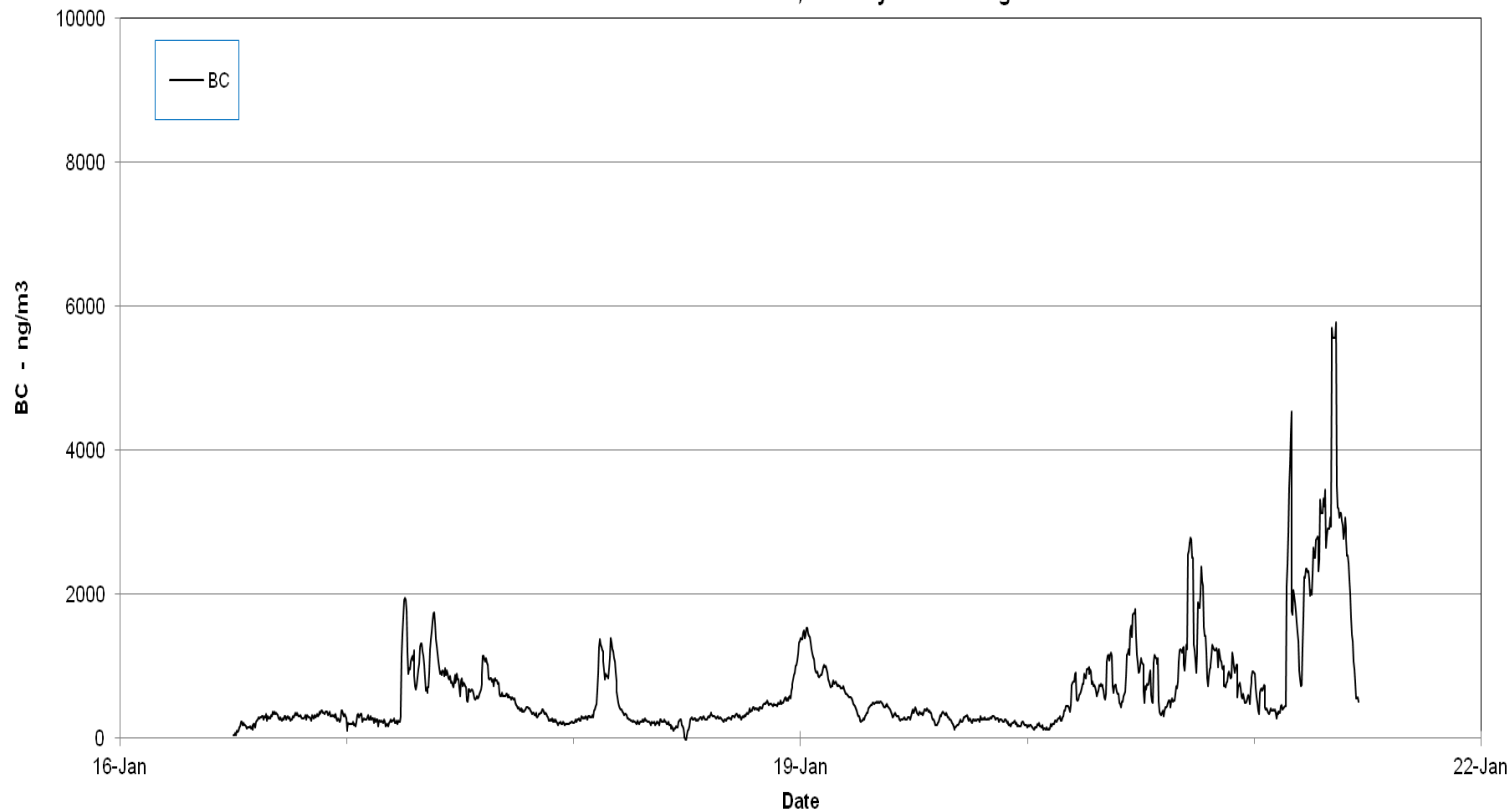
Indiana DEM - Aethalometer 3rd Quarter 2013 Daily Averages - Lawrenceburg



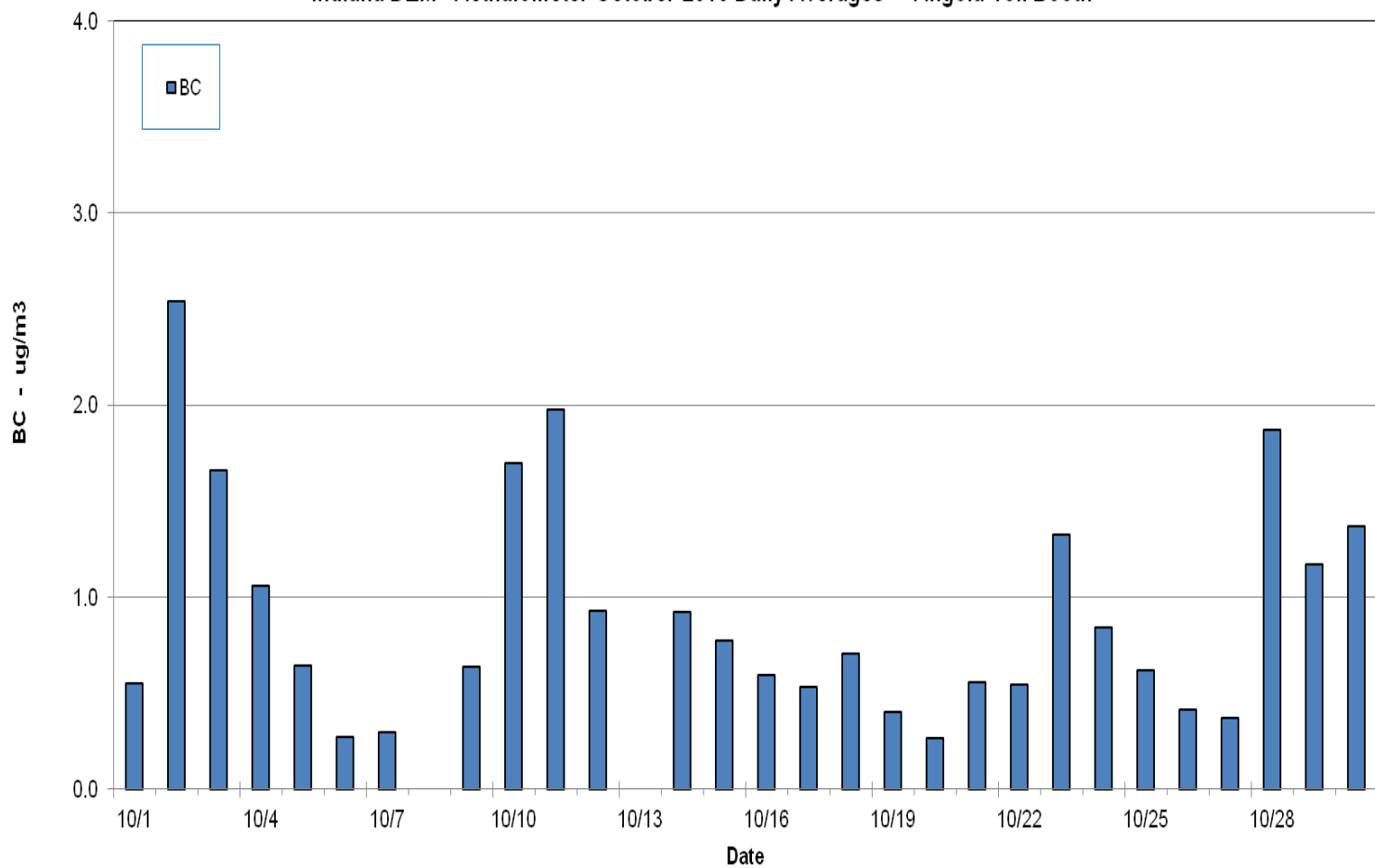
Indiana DEM - Aethalometer Smoothed data, October 2013 - Angola Toll Booth



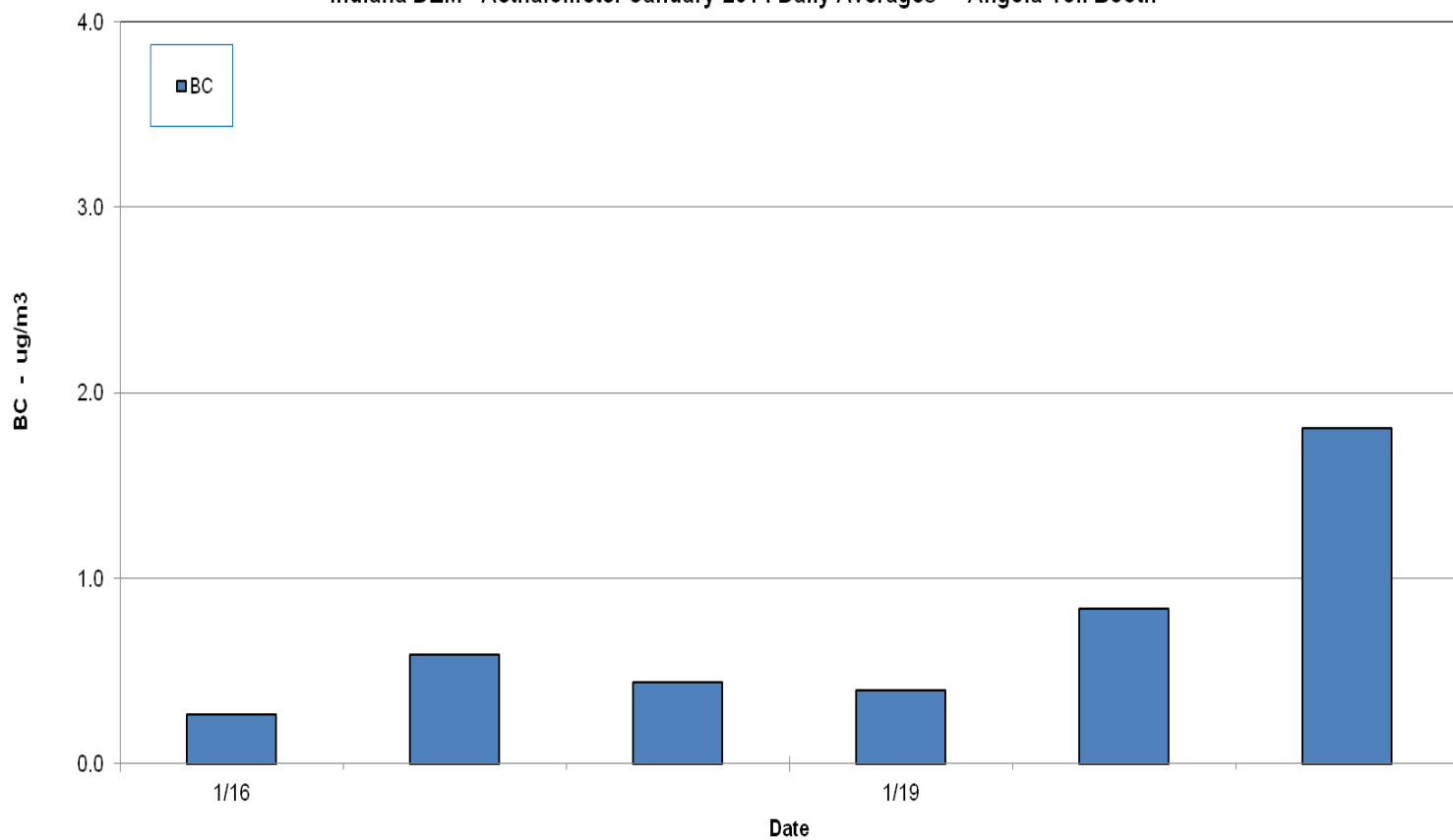
Indiana DEM - Aethalometer Smoothed data, January 2014 - Angola Toll Booth



Indiana DEM - Aethalometer October 2013 Daily Averages - Angola Toll Booth



Indiana DEM - Aethalometer January 2014 Daily Averages - Angola Toll Booth



## Data Analysis

Site	Highest BC 1 or 5 minute Value, $\mu\text{g}/\text{m}^3$	Highest UVC 1 or 5 minute Value, $\mu\text{g}/\text{m}^3$	Highest BC Smooth Value, $\mu\text{g}/\text{m}^3$	Highest UVC Smooth Value, $\mu\text{g}/\text{m}^3$	Highest BC daily average, $\mu\text{g}/\text{m}^3$	Highest UVC Daily Average, $\mu\text{g}/\text{m}^3$
Jeffersonville Walnut Street	176.1	NA	176.1	NA	2.8	NA
Hammond Water Works	25.2	19.4	9.5	6.4	2.0	1.9
Lawrenceburg	833.3	677.2	34.3	28.5	3.0	3.1
Angola Toll Booth	26.5	NA	8.2	NA	2.5	NA

Site	Day and time with highest 1 or 5 minute BC value	Day and time with highest UVC value	Day and time with highest BC smooth value	Day and time with highest UVC smooth value	Day with highest daily BC average	Day with highest daily UVC average
Jeffersonville Walnut Street	Monday, March 11, 2013, 10:35 am	NA	Monday, March 11, 2013, 10:50 am	NA	Tuesday, January 8, 2013	NA
Hammond Water Works	Sunday, June 9, 2013, 11:05 pm	Sunday, June 9, 2013, 11:05 pm	Wednesday, May 8, 2013, 8:20 pm	Thursday, May 9, 2013, 6:30 am	Thursday, June 27, 2013	Tuesday, June 11, 2013
Lawrenceburg	Monday, July 8, 2013, 9:39 pm	Monday, July 8, 2013, 9:39 pm	Monday, July 8, 2013, 9:38 pm	Monday, July 8, 2013, 9:38 pm	Monday, July 8, 2013	Tuesday, July 9, 2013
Angola Toll Booth	Wednesday, October 2, 2013, 6:09:59 am	NA	Wednesday, October 2, 2013, 6:24:59 am	NA	Wednesday, October 2, 2013	NA

Of the four sites, Lawrenceburg measured the highest carbon concentrations. Being near a major highway would account for a lot of the carbon as well as the site's vicinity in relation to nearby power plant stacks. The 833.3  $\mu\text{g}/\text{m}^3$  black carbon reading at Lawrenceburg was not a single event episode. On that day there were additional high black carbon readings. Some of these include 35.6  $\mu\text{g}/\text{m}^3$  at 0:38 am; 24.4  $\mu\text{g}/\text{m}^3$  at 0:39 am; 19.9  $\mu\text{g}/\text{m}^3$  at 0:58 am; 23.2  $\mu\text{g}/\text{m}^3$  at 3:30 am; 41.2  $\mu\text{g}/\text{m}^3$  at 5:13 am; 17.0  $\mu\text{g}/\text{m}^3$  at 5:57 am; 23.8  $\mu\text{g}/\text{m}^3$  at 5:59 am; 17.5  $\mu\text{g}/\text{m}^3$  at 6:14 am; 19.5  $\mu\text{g}/\text{m}^3$  at 6:15 am; 21.7  $\mu\text{g}/\text{m}^3$  at 8:41 am; 28.1  $\mu\text{g}/\text{m}^3$  at 8:57 am; 18.9  $\mu\text{g}/\text{m}^3$  at

9:30 am; 30.4  $\mu\text{g}/\text{m}^3$  at 10:30 am; 37.9  $\mu\text{g}/\text{m}^3$  at 12:36 pm; 24.4  $\mu\text{g}/\text{m}^3$  at 12:37 pm; 25.6  $\mu\text{g}/\text{m}^3$  at 2:48 pm; 74.7  $\mu\text{g}/\text{m}^3$  at 2:55 pm; 53.0  $\mu\text{g}/\text{m}^3$  at 3:24 pm; and 17.9  $\mu\text{g}/\text{m}^3$  at 6:18 pm. However, values leading up to and following the 833  $\mu\text{g}/\text{m}^3$  at 9:39 am do seem to indicate possible vehicle exhaust. While no wind data was collected at the site, wind data from Mechanicsburg, one of several sites in the State that collects meteorological data, does indicate light to moderate wind speeds from the southwest direction. The intersection close to the site is southwest direction from the site, indicating a lot of potential vehicle pollution.

The Jeffersonville Walnut Street site also seemed influenced by local interstate traffic.

## **Conclusion**

The data collected was to see if any sites warranted additional monitoring, before spending time and excess funds blindly. From this study the State has determined that additional monitoring for black carbon and UVC would be beneficial in the Jeffersonville and Lawrenceburg areas. However, the current Jeffersonville site does not have a shelter to place an Aethalometer so additional monitoring would not take place until a trailer is located in the area. The site does have filter-based PM<sub>2.5</sub> collection every day as well as PM<sub>2.5</sub> filter-based speciation every six days at the Jeffersonville site. For the Lawrenceburg site, there is some question as to how much the traffic near the site had an effect on the data collection and how much local air pollution from stacks played a part. There is also the question as to how much total PM<sub>2.5</sub> is in the area for a daily and annual average. A need for additional monitoring in this area will be discussed during the 2015 Network Review meeting.