FACT SHEET
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INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

The Southwest Indianapolis Air Toxics Study
95% Upper Confidence Limits

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Background:

The Indiana Department of Environmental Management (IDEM) recently concluded a two-year study of air toxics in the Southwest quadrant of Indianapolis. IDEM studied one-hundred-sixty-eight (168) pollutants to determine whether any of them were present in the air in concentrations that would warrant further attention to reduce potential health risks.

IDEM collected samples of the air at two (2) monitor site locations once every six (6) days between October 2006 and October 2008. In all, IDEM recorded the levels of eighty (80) different pollutants in the area over the two (2) year period.

The 95% Upper Confidence Limit of the Mean (95% UCL) was used to represent the exposure concentrations associated with pollutants in the Southwest Indianapolis Air Toxics Study. The 95% UCLs are the standard way of representing exposure concentrations in the environmental field. However, it may not be immediately clear what a 95% UCL is, or how it is used.

Description:

The technical definition of a 95% UCL is "a number that one can be 95% confident that the true mean (average) concentration of the population is below that value." A slightly simpler definition is that it is a level that we are confident is health protective when we use it to calculate risks and hazards.

Why IDEM uses them:

Some people may argue that the average calculated from all the samples taken would be the best scientific estimate of the exposure concentration of a pollutant. If we were only concerned with the average concentration of every 6th day that may be true, but IDEM was interested in the average concentration of all days over the two-year period of the study. Since samples were collected every 6th day, we had no direct information about the concentrations of pollutants the other five (5) out of six (6) days.

Imagine two monitors set up at the exact same location. Both monitors sample the air every 6th day for two (2) years. However, Monitor #1 starts sampling on a Monday, but Monitor #2 does not start until the next day, so they never sample the same day's air. At the end of the two (2) years of sampling you would have two (2) different sets of numbers. Is one set of numbers better than the other? Probably not, they are just two (2) different sample sets from the same "population" of possible sampling days. What a 95% UCL does is takes into account that we do not have all the information about all the possible sampling days and makes a conservative (i.e., health protective) estimate of what the true concentration over all possible sampling days would be.

How they are calculated:

There are many different ways to calculate UCLs, but they all require two main pieces of information about the data: a value that represents the "middle" of the data, and a number that represents how "spread out" the data are. A UCL starts with the middle number and then looks at how spread out the data are to determine how much needs to be added to be adequately conservative. For example, consider the two sets of numbers below:

Table 1 – Sample Data Sets

Set #1	1	2	2	4	6	8	12	14	16	18	18	19
Set #2	7	7	8	9	9	10	10	11	11	12	13	13

Both sets of numbers have an average of ten (10), but Set #1 is much more spread out than Set #2. Because of this, we couldn't be as sure about any missing numbers in the dataset so a UCL calculated from Set #1 would be larger (we would have to add more to the average) than a UCL calculated from Set #2.

What they mean:

This is perhaps the most misunderstood aspect of UCLs. Some people think that a UCL is meant to account for an expected increase in emissions over time or the overall uncertainty of emission rates over time. This is incorrect. The purpose of a UCL is to take an average calculated from a sample of possible sampling days and convert it to a number that represents a health protective estimate of the average concentration on all possible sampling days.

This does add some uncertainty to the values we use in risk assessments. Risk estimates assume that emissions will remain the same over the entire life of a person exposed to them when we know that that is unlikely. It is impossible to guess what emissions rates will be in the future and any attempt to do so would be wild speculation at best. By using current emission rates and extending them into the future, we create a "baseline" which tells us what risks are associated with current emissions. Stakeholders can use this data to make informed decisions about the effects that new industries or technologies may have on the area's air quality.

More Information:

- For more information on the Southwest Indianapolis Air Toxics Study, please visit the study's Web site at http://www.idem.IN.gov/programs/air/workgroups/swindyairtox.
- For questions and concerns, please call IDEM's Office of Air Quality Project Management Section at (317) 234-3499.