

ARCADIS' RESPONSES TO INITIAL COMMENTS FROM WDNR (RESTY PELAYO) ON PAH EVALUATION  
REPORT

1. Comment:

I wondered how Arcadis came up with 2.2 ppm Total-PAHs for the residences near Kipp, and 14.2 ppm for Chicago. In statistics, there is a difference between the 95<sup>th</sup> percentile statistic and the 95% UCL for the mean statistic. However, the report has something they're calling a "95<sup>th</sup> UCL" in Table 4.1. I'm not familiar with such. So, could you ask how their particular "statistic" was determined? I think that it maybe is misinterpreted statistics. This is important because of the comparisons they are trying to do. I think what they meant was 95% UCL for mean – as described in p. 29, but the 95% UCL does not make sense for the IL and Chicago IEPA values they have "summarized" in Table 4.1.

1. Response:

ARCADIS agrees with WDNR that there is a difference between the 95%UCL and the 95th percentile of a dataset. Table 4.1 contained a typographical error. The column headers should read "Summary Statistics" and not "95<sup>th</sup> UCL." An additional column should have been included in Table 4.1 that specifies which statistic is shown for each row, because the published data provide a mix of summary statistics. An updated Table 4.1 (a-d) has been prepared that defines each statistic published in various studies. Please replace Table 4.1 with this updated Table 4.1(a-d). In addition, ARCADIS was able to obtain the raw, sample-by-sample data for several of the studies. When raw data were available, the 95<sup>th</sup> UCL on the mean and the 95<sup>th</sup> percentile of the datasets were both calculated *de novo* and presented in the revised table.

The site data presented in the initial Table 4.1 were 95% UCL values calculated using EPA's proUCL software as well as the maximum value. In addition, the revised Table 4.1 (a-d) also provides 95<sup>th</sup> percentile values. Published values are identified as either 95% UCLs, 95<sup>th</sup> percentile values, or, in the case of the MADEP (2002) policy memorandum values, "Concentrations in "Natural" Soil, No Statistic Given." Thank you for the comment because updated Table 4.1(a-d) is more robust.

2. Comment:

In IL, the soil background value is the 95<sup>th</sup> percentile (not the 95% UCL for mean) of the accepted background samples as explained in:

[http://www.cityofchicago.org/dam/city/depts/doe/general/UrbanManagementAndBrownfields\\_PDFs/USGSBackgroundPNASummary.pdf](http://www.cityofchicago.org/dam/city/depts/doe/general/UrbanManagementAndBrownfields_PDFs/USGSBackgroundPNASummary.pdf).

2. Response:

ARCADIS agrees that the IEPA values are 95<sup>th</sup> percentile values. As noted above, the revised Table 4.1 (a-d) provides this label. In addition, ARCADIS obtained the raw data from the two studies on which IEPA relied. The 95% UCLs and 95<sup>th</sup> percentile values were calculated from the raw data for the "Chicago"

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dataset (USGS, 2003) and the “Metropolitan Illinois” dataset (EPRI, 2004) and are listed in the revised Table 4.1 (a-d).

3. Comment:

Note that you’ll get the 14.2 ppm (tabulated as “IEPA (2007) Chicago”) in Table 4.1 when you add the specific-PAH values under Chicago in the last 2 pages found in the link above. So I think this is what Arcadis did: They simply added the 95<sup>th</sup> percentiles to come up with their “95<sup>th</sup> UCL Total PAH.” If true, then it is NOT a valid procedure.

3. Response:

ARCADIS agrees that the most accurate way to obtain an estimate of the overall level of “total PAHs” is to use all of the raw data individually, calculate the “total PAHs” for each sample, and then perform a statistical analysis. In many cases, however, authors of reference papers do not report raw data that would allow such calculations. For instance, in Table H of IEPA’s Appendix A of the TACO rules, 95<sup>th</sup> percentile values for each PAH are listed, but no raw data are available for further analysis. Faced with a lack of raw data, the approach taken by ARCADIS when drafting the report provides a reasonable estimate of the 95<sup>th</sup> percentile of the “total PAHs” in IEPA’s background datasets.

ARCADIS was, however, able to obtain the raw data sets from which IEPA derived its 95<sup>th</sup> percentile values. IEPA reports that the Chicago TACO values are based on the USGS (2003) study done in consultation with IEPA, and the Metropolitan Illinois TACO values are based on the EPRI (2004) study. ARCADIS obtained these two studies, which included the raw data for each sample point. The revised Table 4.1 includes the estimated values presented in the previous table and the values calculated from the raw data. For the metropolitan Illinois data set, the difference between the two calculations was minimal. The estimated total PAH value obtained from summing the reported 95<sup>th</sup> percentile values was 24.8 ppm and the de novo calculation from the raw data gave a 95<sup>th</sup> percentile total PAH value of 20.3 ppm. On the other hand, the two values for the Chicago datasets were quite different. The estimated total PAH value was 14.2 ppm, but the actual 95<sup>th</sup> percentile value calculated from the raw data was 106 ppm. In either case, ARCADIS’ conclusion was that the MKC site data were far less than typical PAH background levels in published studies. When using the 95<sup>th</sup> percentile statistic, the 95<sup>th</sup> percentile value for total PAHs in the residential properties near the MKC site was 2.5 ppm. The published IEPA 95<sup>th</sup> percentile values were 24.8 or 20.3 ppm for Chicago and 14.2 or 106 ppm for metropolitan Illinois.

In general, the “total PAH” concentrations in residential soils adjacent to the MKC site, whether one focuses on the 95% UCL on the mean, the 95<sup>th</sup> percentile or even the maximum, are all much lower than the published “total PAH” background levels cited above and in the report. In most cases, the residential property concentrations are five- to ten-fold *lower* than published background levels.

4. Comment:

First, in IL, the summed-up 14.2 ppm Total-PAHs value does not mean anything. The 0.04-ppm soil-naphthalene has more meaning in Chicago where background is concerned. The basis in IL is each

specific-PAH, and not Total PAHs. As stated by an IL regulator who sent me this response when I asked about Total-PAH background: "... we do not look at total polynuclear aromatic hydrocarbon concentration—we look at the individual compounds ..."

4. Response:

The comment appears to relate to regulatory compliance decision making in Illinois under the TACO program. IEPA may very well perform a PAH-by-PAH comparison to its published Illinois background values. That, however, does not make the use of "total PAH" values meaningless in the context of this report. When analyzing and summarizing background PAH data, all samples are analyzed for each individual PAH separately, and then many reports summarize the data in each sample as "total PAH." When comparing an entire data set for one area to an entire dataset for another area, comparisons are very frequently made on the basis of "total PAH," "total potentially carcinogenic PAH," or "benzo(a)pyrene toxic equivalents".

ARCADIS has prepared a brief reference list of government documents and published reports that report and make decisions on the basis of "total PAH" data. For instance, the U.S. EPA's Ecological Screening Levels (ESLs) are based on "total PAHs" (EPA, 2007). EPRI's summary report of background PAH levels in Illinois, New York and Pennsylvania (EPRI, 2008) summarizes individual PAHs as well as "total PAHs" and "total priority pollutant PAHs." Teaf (2008) summarized background PAHs and presents data on "total PAHs" through his publication. Site investigations and feasibility reports also routinely report individual PAH data and "total PAH" data. The Feasibility Study for the Burnham Canal Site in Milwaukee, Wisconsin (Natural Resource Technology, 2011) presents and discusses individual and "total PAHs" throughout the report. MADEP (2002) in their background PAH policy document reports individual PAHs, "total PAHs", "total potentially carcinogenic PAHs" and "total noncarcinogenic PAHs" for background locations. The USGS and others have been studying the effects of coal tar based driveway sealants on the environment since 2000. All of these studies, such as Van Metre, et al. (2008), Mahler et al., (2005), and Mahler et al. (2012) report "total PAHs" exclusively. These reports do not present any data on individual PAHs, only "total PAHs." Other documents are presented in the reference list that demonstrate that "total PAH" data are used quite commonly and have considerable utility in environmental risk-management decision making.

Comment 5:

Second, adding up the different specific-PAHs' 95<sup>th</sup> percentiles is a wrong procedure to determine either the 95<sup>th</sup> percentile or the 95% UCL for the Total-PAH concentrations. In fact, merely adding the statistics from each specific-PAH will not provide the correct statistics for the Total-PAHs. Briefly, it doesn't work because the range of some of the specific-PAHs will not be the same as the Total-PAHs' range. Just send me an email if you want me to provide you with a simple numerical example to illustrate that it (adding individual statistics to come up with "total" statistics) doesn't work. As determined, the "total" statistics is meaningless, and any comparison to it will not make sense.

Response 5:

As noted above, ARCADIS agrees with WNDR that the ideal way to determine 95% UCLs or 95<sup>th</sup> percentiles is to calculate them from the raw data sets. When raw data are not available, however, making estimates of these values by adding the reported 95% UCLs or 95<sup>th</sup> percentile values is commonly done when making comparisons between sets of published data. Fortunately, ARCADIS was able to obtain the raw data for many of the published studies presented in Table 4.1, including the data sets that form the basis of the IEPA published PAH background values. The 95% UCL and 95<sup>th</sup> percentile values for each of these data sets were calculated from these raw data sets and presented in the revised Table 4.1 (a-d). ARCADIS would be pleased to provide the full reports that include the raw data to WNDR if so requested

Comment 6:

Third, Arcadis' use of Total-PAHs is misplaced. PAH background studies in IL (IEPA and USGS references in the Arcadis' report) looked at individual PAHs. You can read the USGS report, as well as Illinois administrative codes, and you will find that neither of them mentions Total-PAHs. Yet, Total-PAHs is the most prominent aspect in the Arcadis report. I think that if Arcadis want to do what IEPA and USGS did for PAH background in IL, they'll need to look at BaP, naphthalene, etc., individually, and forgo their background approach with Total-PAHs.

Response 6:

ARCADIS agrees that benzo(a)pyrene and other individual potentially carcinogenic PAHs are important to include in any comparisons between data sets, because they are the PAHs that pose the greatest risk to human health. This is why ARCADIS presented in Table 4.1 both "total PAHs" and "benzo(a)pyrene toxic equivalents." When human health risk assessments are prepared for WNDR, the PAH concentrations for the seven potentially carcinogenic PAHs are multiplied by EPA's Relative Potency Factors to convert them all into concentrations that are equivalent to the toxicity of benzo(a)pyrene, hence the term "benzo(a)pyrene toxic equivalents." This is an important measure when comparing a site data set to a published background data set, because two data sets might have similar "total PAH" levels but very different levels of the seven PAHs of most concern. Table 4.1 as originally submitted in the ARCADIS report presented the "benzo(a)pyrene toxic equivalent" concentrations, and the revised Table 4.1 does the same.

As noted in the Revised Table 4.1, the 95% UCL on the mean for the residential property "benzo(a)pyrene toxic equivalent" concentration is 0.2 ppm and the published background 95% UCLs range from 1-4 ppm. The 95<sup>th</sup> percentile for the residential property "benzo(a)pyrene toxic equivalent" concentrations is 0.3 ppm and the published background 95<sup>th</sup> percentile values range from 3-13 ppm. The residential property "benzo(a)pyrene toxic equivalent" concentrations are much less than all of the published background "benzo(a)pyrene toxic equivalent" concentrations. This is true even of the worst case residential property. In general, the "benzo(a)pyrene toxic equivalent" concentrations in residential soils adjacent to the site, whether one focuses on the 95% UCL on the mean, the 95<sup>th</sup> percentile or even the maximum, are all much higher than the published "benzo(a)pyrene toxic equivalent" background

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levels. In most cases, the residential property concentrations are five- to ten-fold *lower* than published background levels.

Comment 7:

Lastly, their PCA results hinged on separating out the NDs. I don't know that I agree in background analysis where more than 50% of the data (NDs) were not included, especially because skewed background statistics (leading to higher percentile values) would result if NDs were excluded.

Response 7:

Forensic fingerprinting analyses of any type can only be performed on samples in which PAHs are detected. If PAHs are not present in a sample, the question: "What is the source of the PAHs in the sample?" cannot be answered, because there are no PAHs in that sample. Accordingly, forensic fingerprinting to identify contaminant source can only be performed on those samples in which PAHs *are* present.

Background statistics are not involved in the forensic fingerprinting analysis. When performing the background analysis presented in Table 4.1, ARCADIS considered both detects and non-detects as is consistent with standard risk assessment guidance.

Conclusion

We thank WDNR for its initial comments and welcome the opportunity to discuss the report further. Although WDNR has raised some questions about the detailed aspects of summarizing data from published PAH background studies, the specific manner by which such data are summarized does not change the conclusions presented in the ARCADIS report. Any way the PAH data from the residential properties abutting the Madison Kipp site are compared to published PAH urban background studies, the conclusion is the same. The concentration ranges are within (and lower than) the general reported ranges of background PAHs and the forensic "fingerprint" of this mixture of PAHs is consistent with what is found in background locations.

Citations for Use of Total PAH Statistics

Bradley, L.J.N., Magee, B.H., and Allen, S.L. 1994. Background Levels of Polycyclic Aromatic Hydrocarbons (PAH) and Selected Metals in New England Urban Soils. *Journal of Soil Contamination*, 3(4).

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Mahler, B.J., Van Metre, P.C., Bashara, T.J., Wilson, J.T., and Johns, D.A. 2005. Parking Lot Sealcoat: An Unrecognized Source of Urban Polycyclic Aromatic Hydrocarbons. *Environ. Sci. Technol.* 39(1): 5560-5566.

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U.S. Department of Environmental Protection. 2007. Ecological Soil Screening Levels for Polycyclic Aromatic Hydrocarbons (PAH). OSWER Directive 9285.7 -78. Access via <http://www.epa.gov/ecotox/ecossl/>.

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Van Metre, PC, Mahler, BJ, Wilson, JT, and Burbank, TL. 2008. Collection and analysis of samples for polycyclic aromatic hydrocarbons in dust and other solids related to sealed and unsealed pavement from 10 cities across the United States, 2005–07: U.S. Geological Survey Data Series 361, 5 p.

Washington State Department of Health. 2012. Draft PAH Chemical Action Plan. Publication no. 12-07-038. Department of Ecology. Olympia, WA. July.