ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SPILL PREVENTION AND RESPONSE
CONTAMINATED SITES PROGRAM

Technical Memorandum DATE: March 6, 2017

DETERMINING THE FRACTION OF ORGANIC CARBON (*f*oc) FOR METHODS THREE AND FOUR

PURPOSE:

The Alaska Department of Environmental Conservation (DEC) allows for a site-specific alternative soil cleanup level under the site cleanup rules, 18 AAC 75.340(e) and (f). 18 AAC 75.340(e), referred to as method three, specifies that the soil migration to groundwater or human health levels listed in 18 AAC 75.341 Tables B1 and B2 may be modified based on the use of approved site-specific data and the equations set out in the department's *Procedures for Calculating Cleanup Levels.* 18 AAC 75.340(f), referred to as method four, specifies that an alternative cleanup level may be approved by the department based upon a site-specific risk assessment following the department's *Risk Assessment Procedures Manual*. The collection and use of site-specific fraction of organic carbon (*f*oc) data is common for method three or method four determinations. This memo provides clarification on the department's requirements for *f*oc sample collection and analysis for proposed site specific method three or method four evaluations.

BACKGROUND:

In Alaska, a default value of 0.1% fractional organic carbon is adopted statewide in the soil-water partitioning model to provide a conservative assumption of the percentage of organic carbon likely to be present at a site.

The following methodology has been developed to ensure consistency when collecting and analyzing *f*oc data for the purpose of developing a defensible site-specific cleanup level under method three or method four. For additional information on developing alternative cleanup levels under method three, consult the *Guidance on Developing Cleanup Levels under Methods Two and Three* (ADEC, 2017). For information on developing cleanup levels under a site specific risk assessment, consult the department's *Risk Assessment Procedures Manual* (ADEC, 2015).

Sample Collection:

In order to calculate a site-specific *f*oc, enough soil samples must be collected to derive a 95% lower confidence level (LCL) of the mean except in instances with high *f*oc variability (e.g. relative standard deviation greater than 100 percent), where DEC may specify the use of the lowest measured *f*oc result.

Samples for *f*oc must be collected from a minimum of four (4) borings or test pits adjacent to but outside of the zone of contamination and include a minimum of 8 discrete samples. Incremental sampling methodology (ISM) can be proposed to determine foc concentrations, but must be approved by DEC on a site-specific basis. For soils with higher than normal heterogeneity, it is advisable to collect more samples in order to generate a more stable 95% LCL. Soil type(s) analyzed for *f*oc must be representative of the soil type(s) that is (are) contaminated. It is recommended that the sampling locations be selected at points surrounding (on each side of) the contaminated zone to ensure adequate characterization of the soil *f*oc variability. If high soil type variability is observed, calculating soil-type specific *f*oc may be necessary. A spill onto tundra that runs onto a gravel bar is an example. To determine what *f*oc would be input into method three modeling in such situations, consult with the DEC project manager who will consider where the mass of the source is located

and other influential factors. Depending on the depth of contamination and its proximity to seasonal groundwater levels, additional samples may need to be collected from the soil horizon below the impacted soils, as described in the following bullets.

- If the depth to seasonal high groundwater is more than five feet below the deepest contaminated vadose soil stratum, one sample must be collected from the deepest contaminated vadose soil stratum and a second sample collected from five feet below the contaminated soil stratum. This will result in a total of eight (8) *f*oc samples (two per boring or test pit).

- If the contamination extends to within five feet, but not to the seasonal high groundwater level, one sample must be collected from the deepest contaminated soil stratum and one sample immediately adjacent to the groundwater interface. This will result in a total of eight (8) *f*oc samples (two per boring or test pit).

- If the contamination extends to or below the seasonal high groundwater level, the *f*oc samples must be collected adjacent to the groundwater interface and at a shallower depth in the vadose zone, preferably where the mass/concentration of the source is largest. This will result in a total of eight (8) *f*oc samples (two per boring or test pit).

For additional guidance on sampling techniques, consult DEC's 2016 *Field Sampling Guidance* and EPA's 2003 *Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples.*

Sample Analysis

The appropriate analysis method can vary depending on site conditions and soil type. For most sites DEC recommends one of the following methods:

- Lloyd-Kahn
- Walkley-Black method as modified in Wang, et. al (2012)
- EPA Method 9060
- Another method using a dry combustion with an elemental analyzer as approved by a DEC PM

The department does not allow loss on ignition (LOI) gravimetric methods. The sampling and analysis plan should include the analysis method that will be used and justification for the use of that method.

For questions on this guidance, please contact CSP chemist, Brian Englund, at (907) 269-7526.

References:

ADEC Field Sampling Guidance March 2016
http://dec.alaska.gov/spar/csp/guidance_forms/docs/Field-Sampling-Guidance-Final-5-13-2016.pdf

ADEC Risk Assessment Procedures Manual October 2015
http://dec.alaska.gov/spar/csp/guidance_forms/docs/RAPM%202015%20Final%20October%201%202015.pdf

ADEC Guidance on Developing Soil Cleanup Levels Under Methods Two and Three Draft 2017

EPA Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples, October 2003

Wang X, Wang J, Zhang J (2012) Comparisons of Three Methods for Organic and Inorganic Carbon in Calcareous Soils of Northwestern China. PLoS ONE 7(8): e44334. doi:10.1371/journal.pone.0044334