Guidance for

Determining Leachability by Analysis of SPLP Results

Florida Department of Environmental Protection (FDEP)

Bureau of Waste Cleanup

Program & Technical Support Section

Tallahassee, FL

DRAFT-Ver 1.8

June 2009

Purpose

The purpose of this guidance is to provide direction on an acceptable approach to determining the site specific leachability concentration for a contaminant in soil. Default leachability concentrations are provided for many contaminants typically found at sites which come under the regulatory authority of the FDEP. These values are found in Table II of Chapter 62-777, Florida Administrative Code (F.A.C.). However, some of the contaminants listed in Table II of Chapter 62-777, F.A.C. require that leachability threshold soil concentrations be established utilizing the Synthetic Precipitation Leaching Procedure (SPLP) laboratory extraction by EPA Method 1312, or the Toxicity Characteristic Leaching Procedure (TCLP) by EPA Method 1311 if the contamination is an oily waste material. Also, the substitution of default leachability values found in Table II, Chapter 62-777, F.A.C. with leachability concentrations determined by SPLP or TCLP analysis is allowed on a site-specific basis.

Scope

This guidance is intended to address the typical situation for using SPLP analysis results in establishing site-specific leachability values for contaminants in soil. It is assumed that the potential for leaching of a contaminant from site soil to groundwater has already been established during site assessment required per Chapter 62-780.600(5)(c)4, F.A.C. The scenario would be that of a site where corrective action is either being required by the FDEP, or initiated on a voluntary basis by the property owner, and one or more contaminants in site soil are being evaluated to determine the total concentration of a contaminant in soil above which the appropriate leachability test indicates the potential for leaching to local groundwater at concentrations above acceptable criteria. It is not the purpose of this guidance to address associated topics such as soil sampling protocols that are covered by other FDEP guidance documents, standard operating procedures (SOPs), or Rules. Also, this guidance does not address the leaching of contaminants from media classified as sediment. The use of Professional judgment is also a significant component needed for evaluating information and actions integral to the restoration of a contaminated site.

Soil Sampling Requirements

Once it is decided that a leaching test is needed or required, then the task becomes a matter of where to sample, and just how many samples are needed. Judgmental sampling locations, and not randomly selected ones, are recommended in order to obtain a range of leachability results. Sampling should begin at locations of the site that have been minimally affected by releases of the contaminants being assessed, and proceed towards the area(s) known to have the highest contaminant concentrations. This will maximize the likelihood that a graph of the SPLP results versus the corresponding total contaminant concentrations will provide a sufficient scatter of data points allowing for clear depiction of where the leachability threshold exists. At a minimum, 10 discrete samples per soil investigation interval of interest are recommended. The expected vertical soil sampling interval for leachability testing will be surface to two feet below land surface (0’-2’ bls) and every two feet thereafter down to the local water table, unless the contaminants are metals or semi-volatile organic compounds in which case a shallow (land surface to six inches) and near-surface (six inches to two feet) sampling intervals are required. As a matter of professional judgment, other sampling intervals may be appropriate depending on site-specific conditions and should take into account soil profile characteristics that would be expected to influence the retention or concentration of contaminants.

Sample Analysis

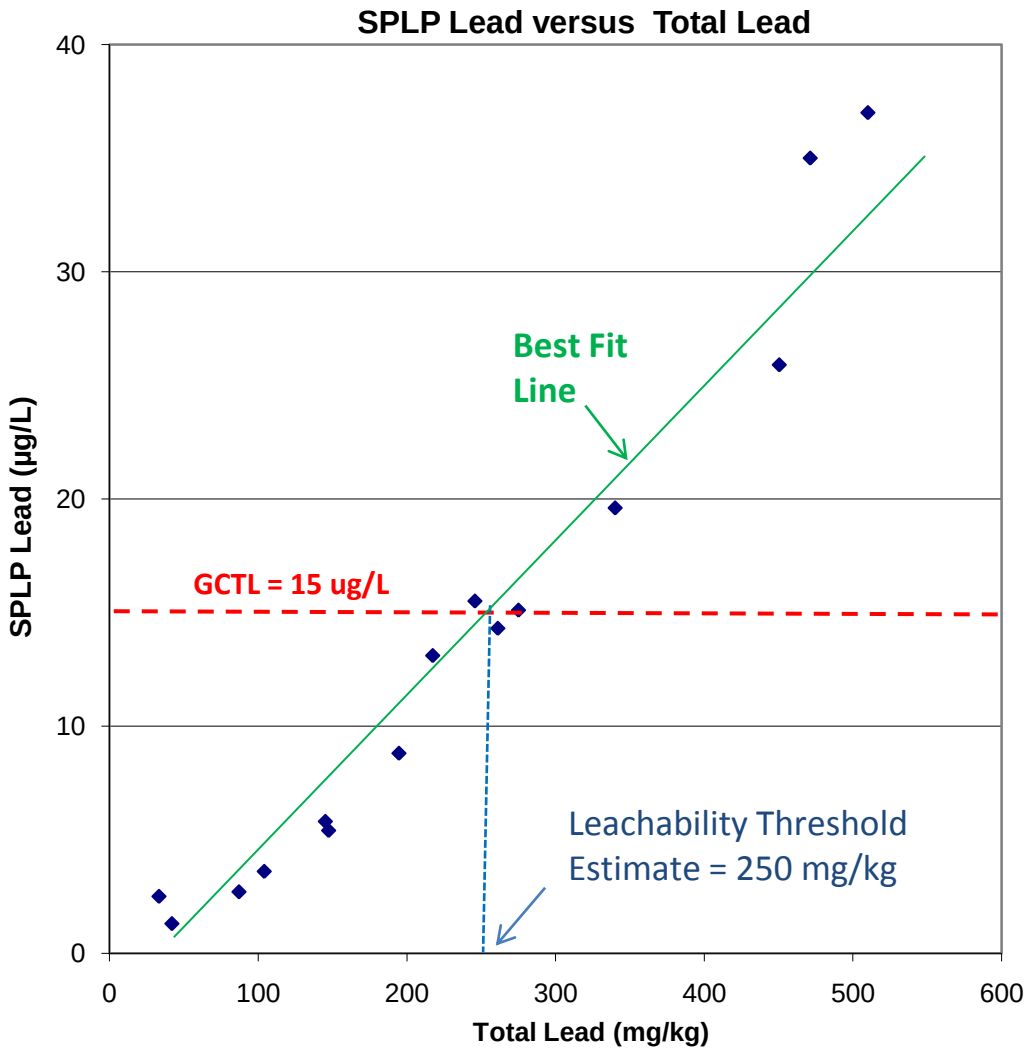
Each discrete soil sample is divided into two sub-samples; one is analyzed for total contaminant concentration by the appropriate analytical method(s), and the other is used to perform the leachate test. The specified laboratory extraction for SPLP leachability is EPA Method 1312, and is recommended unless the contamination is used oil or similar petroleum products in which case EPA Method 1311 (TCLP extraction) is required. Once the leachate extraction has been performed on the soil sample, the laboratory follows up with the appropriate analytical test for the specific contaminant(s) of interest. Special contaminant-specific sample holding time requirements may apply and so the applicable analytical method(s) should be reviewed to ensure proper quality assurance is achieved.

Evaluation of Laboratory Data

A simple statistical treatment of the total contaminant and leachability sampling results is all that is required to evaluate the data. This procedure consists of constructing a graph that plots paired results for total soil contaminant concentration versus SPLP for each sampling location. This can be done manually, or with the aid of widely available computer applications like the spreadsheet Excel. Interpretation is made easier if the SPLP leachate results are plotted on the Y-axis, and total soil contaminant concentrations on the X-axis. This way the corresponding applicable criteria for groundwater plots as a horizontal line on the graph which is visually easier to read and extrapolate from to mark the indicated leachability threshold concentration in terms of total contaminant concentration in soil. The example graph on the following page shows paired SPLP results versus the total contaminant concentration in soil for the example data set in the table below. As seen on the graph, the estimated leachability threshold for this set of soil sampling data is 250 mg/kg. This value can be used to guide remedial action or design a risk- based approach to prevent potential groundwater contamination above applicable criteria, which in this case is 15 μg/L for the metal lead.

Table of SPLP and Total Concentration Results

Sample #	Total Lead (mg/kg) in soil sample	SPLP Lead (μg/L) in leachate sample
SS-01	41.9	1.3
SS-02	33.2	2.5
SS-03	87	2.7
SS-04	104	3.6
SS-05	147.3	5.4
SS-06	145.1	5.8
SS-07	194.6	8.8
SS-08	217.3	13.1
SS-09	245.7	15.5
SS-10	261.1	14.3
SS-11	275	15.1
SS-12	340.2	19.6
SS-13	450.4	25.9
SS-14	471.2	35
SS-15	510	37.1



Constructing The Graph

The data from the paired sub-samples is plotted following the conventions described above for listing the leachate concentrations along the Y-axis and the soil contaminant concentrations along the X-axis. A best fit line is then calculated using these data points. A horizontal line is drawn from the GCTL value on the Y-axis until it intersects the best fit line. A vertical line is then drawn from the intersection of the best fit line and the GCTL line down to the X-axis. The site-specific leachability value is then read directly from the X-axis.

Alternatively, the equation of the line can be determined and solved for x. If you plot the data in Excel, it will calculate the equation of the line for you. Rearrange the standard y=mx+b equation for a line to x=(y-b)/m, use m and b from the equation of the line and use the GCTL for y. For the data set above this gives x=(15+3.6)/0.0738≈252. The 252 mg/kg then becomes the site-specific soil cleanup target level for protection of groundwater.

Issues/Exceptions

It is likely that some data sets for total contaminant concentration versus SPLP results will not show an acceptable correlation allowing for regression analysis. The rule-of-thumb for this determination is whether or not the pared data set has a correlation coefficient (r) within the range of 0.8 to 1.0. If not, then it is recommended that the highest contaminant concentration having a corresponding SPLP value that is below the applicable groundwater criteria be designated as the alternative leachability based soil cleanup level. However, if there is a lower total contaminant concentration in the data set with a corresponding SPLP value that exceeds the applicable groundwater criteria, the lower contaminant concentration is selected.

Some contaminants, such as pesticides and other man-made compounds, have relatively low default leachability concentrations due to the associated groundwater protection criteria. It is much more likely when dealing with these contaminants that laboratory analysis will not detect low concentrations resulting in a "non-detect" or "ND" being reported for one or more sample results. Environmental regulatory agencies have typically allowed the use of a surrogate value equal to ½ of the reported detection limit so that all sampling results are represented in an evaluation of a given data set. However, for the leachability analysis, the actual reported detection limit for analysis by either EPA Methods 1311 or 1312 should be used as the surrogate value for reported non-detects.

There are situations where impacts to site groundwater are not detected even though contaminants in soil are above both default and/or SPLP leachability concentrations. Depending on such factors as the history of releases of contaminants at the site, proposed future land use, and the nature of the contaminant(s) of concern, the FDEP may concur with a recommendation of no further action for contaminants in soil above the default leachability criteria (see Ch. 62-780.680(1)(b)2.f, F.A.C.).

Risk-based corrective action is also an option whereby closure can be achieved utilizing an engineering control to prevent the generation of leachate from site soil. However, this risk-based strategy would require the use of an institutional control to ensure that whatever engineered feature was constructed will remain in place as long as needed to prevent leaching to groundwater.

Contacts

For any additional information or clarification regarding the appropriate use of this guidance, or questions related to leachability not covered by this guidance, staff in the Department's section of Program and Technical Support can be contacted on the web at http://www.dep.state.fl.us/waste/categories/wc/pages/ProgramTechnicalSupport, by phone at (850) 245-7503, or by the following:

Mail: Department of Environmental Protection
Program & Technical Support Section
2600 Blair Stone Road, MS-4535
Tallahassee, FL 32399-2400