

Memorandum

Florida Department of Environmental Protection

TO: Interested Parties

FROM: Thomas Conrardy, PE Administrator *TC*
Bureau of Petroleum Storage Systems

DATE: February 1, 2011

SUBJECT: Chapter 62-770, F.A.C., Soil Cleanup Target Levels
Application to Site Rehabilitation Decisions

The following discussion relates to the Soil Cleanup Target Levels (SCTLs) referenced in Table II of Chapter 62-777, Florida Administrative Code (F.A.C.), as they apply to Chapter 62-770, F.A.C. (a copy of the SCTLs applicable to Chapter 62-770, F.A.C. is attached as Exhibit A). This memo explains how to apply the SCTLs to site rehabilitation and final closure decisions and includes several options to qualify for No Further Action (NFA) without conditions when the default SCTLs are not met [Level I Risk Management Options of Subsection 62-770.680(1), F.A.C.] and provides an explanation of the engineering and/or institutional controls that are applicable for site closure when contaminated soil remains [Level II Risk Management Options of Subsection 62-770.680(2), F.A.C.]. The strategies described in this memorandum are also depicted in flow charts of Risk-Based Corrective Action options which are referenced in Subsection 62-770.140(4), F.A.C. The scope of this memorandum does not include considerations for Level III Risk Management Options of Subsection 62-770.680(3), F.A.C. Prior authorization from the FDEP is required before preparing a Risk Assessment pursuant to Rule 62-770.650, F.A.C. that would propose alternative CTLs for soil and/or groundwater. The options for risk-based closure relative to the CTLs can be discussed during that authorization process. There may be instances where deviations from this guidance are appropriate on a case-by-case basis.

The SCTL Table lists two types of SCTLs; those based on Direct Exposure (human health) and those based on Leachability (protection of groundwater). There are two sets of Direct Exposure SCTLs (columns 1 and 2), based on different land use scenarios. The first set are SCTLs calculated for a residential scenario, and the second set are SCTLs calculated for a commercial/industrial scenario [Table 3 of the "Technical Report: Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C." (Technical Report) lists the default parameters used for the two scenarios]. There are three sets of SCTLs based on Leachability (columns 3 through 5), which are derived (back calculated) from the groundwater cleanup target levels (GCTLs) and surface water cleanup target levels (SWCTLs) referenced in Table I of Chapter 62-777, F.A.C. The headings for the three Leachability columns state that the SCTL values in the columns are "Based on" the Groundwater and Surface Water CTLs or alternative

Groundwater CTLs based on Low Yield/Poor Quality Criteria. This relationship between the SCTL Table and the Groundwater and Surface Water CTLs means that soil with concentrations at or below the concentrations specified in columns 3 through 5 of the SCTL Table should not leach at concentrations exceeding the corresponding CTLs in the Groundwater and Surface Water CTL Table. Except as described below, to qualify for an NFA without conditions the Contaminants of Concern (COCs) detected in soil samples from the unsaturated (vadose) zone must meet both the Direct Exposure SCTLs for a residential scenario and the Leachability SCTLs based on the applicable GCTLs (and, if applicable, on the SWCTLs) specified in the Groundwater and Surface Water CTLs Table.

Verification that SCTLs Have Been Achieved at the Conclusion of Site Rehabilitation

Site rehabilitation may take several years to complete from the initiation of site assessment through active remedial action, Natural Attenuation Monitoring (NAM) or Post Active Remedial Action Monitoring (PARM), to the site finally qualifying for Site Rehabilitation Completion (SRC). Toward the later stages of site rehabilitation, cleanup progress is most commonly gauged on the basis of analysis of groundwater samples collected during Active Remedial Action, NAM, or PARM. For these reasons there may be a tendency to base a determination that a site qualifies for SRC on those groundwater monitoring results alone and overlook the need to verify that soil cleanup objectives have also been achieved.

Paragraph 62-770.680(7)(e), F.A.C., requires that the final Site Rehabilitation Completion Order issued by the FDEP have attached tables from reports submitted to the FDEP which indicate that soil and groundwater CTLs (and surface water CTLs if applicable) have been achieved for each discharge location. If soil samples were previously collected during the early stages of site rehabilitation and the results indicated that soil in the unsaturated zone exceeded soil CTLs at that time, and confirmation samples had not been collected to indicate soil CTLs have been achieved, then there may be a need for collection of additional samples for lab analysis to confirm the soil has been adequately remediated before recommending the site qualifies for SRC.

This guidance document on consideration of SCTLs to remediation decision-making is therefore also a reminder that the environmental professionals providing certification of reports to the FDEP, and the FDEP's environmental professionals who review those reports, need to review the previous site history prior to making a decision to switch from Active Remedial Action to NAM or PARM, or to determine that NAM or PARM has achieved SRC objectives. That determination must include verification that soil CTLs have been achieved, or, in the case of evaluating soil contamination levels prior to beginning NAM, that the soil meets the criteria of Paragraph 62-770.690(1)(b), F.A.C.

For eligible program sites, confirmation soil samples should be collected prior to beginning PARM to demonstrate there is no soil remaining which exceeds soil CTLs. For non-funded sites, it is recommended that confirmation soil samples be collected prior to beginning PARM to demonstrate there is no soil remaining which exceeds soil CTLs. However, in consideration of the provisions of the following section below which may necessitate the collection of additional confirmation samples by the conclusion of PARM due to a lowered groundwater table elevation, the collection of confirmation samples for non-funded sites may be deferred to be collected during PARM if the FDEP technical reviewer and the consultant agree there is a good probability the active remedial action which was conducted had achieved soil cleanup objectives.

In the case of NAM, paragraph 62-770.690(1)(b), F.A.C., requires it be demonstrated that soil contamination is not present prior to beginning NAM except that Leachability soil CTLs may be exceeded if it is demonstrated that the soil does not constitute a continuing source of contamination to the groundwater at concentrations that pose a threat to human health, public safety, and the environment and it is demonstrated that the rate of natural attenuation in the groundwater exceeds the rate at which contaminants are leaching from the soil, and the presence of contaminated soil will not result in increased cleanup costs.

Depth to Which Soil CTLs Apply

Both the Direct Exposure and Leachability soil CTLs apply to soil in the unsaturated zone above the groundwater table only. Commonly there is a benefit for soil samples to be collected from the smear zone below the water table for lab analysis to determine contaminant mass at that depth for remediation strategy decision-making, as knowledge of the mass of contamination below the water table and how that mass is distributed may have a direct bearing on a determination of the most efficient and economical means to accomplish groundwater cleanup objectives. However, soil below the groundwater table does not need to have soil samples collected and analyzed for the purpose of demonstrating this soil meets soil CTLs for a site to qualify for No Further Action. Even though there may be a benefit for analysis of soil samples from below the groundwater table for totals analysis for determining a groundwater remediation strategy, there is rarely a benefit to performing the Level 1 Risk Management Options techniques to establish alternative soil CTLs for soil below the groundwater table described later in this memo, including SPLP, TRPH fractionation, and determining site-specific soil CTLs based on soil properties.

A dilemma which may be encountered at the time of verification that soil CTLs have been achieved is that the elevation of the groundwater table may be substantially different than when soil samples were previously collected, resulting in either a greater depth of unsaturated zone where soil samples have not previously been collected, or that soil which was previously unsaturated when soil samples were collected is now submerged. Chapter 62-770, F.A.C., does not currently specify how to address this consideration. Registered professionals of the

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Bureau of Petroleum Storage Systems have been surveyed in a consensus building process to determine the most appropriate means to address the changing elevation of the groundwater table over the course of site rehabilitation relative to the need to demonstrate that soil CTLs have been achieved. The majority consensus strategy is described below. However, the registered professionals representing the responsible party and the FDEP need to agree that there has been an appropriate demonstration that the soil CTLs have been achieved.

For the purposes of making a recommendation that a site qualifies for SRC on the basis of achieving both soil and groundwater CTLs, it is recommended that the depth of the groundwater table at the time of the last groundwater monitoring event (of either NAM or PARM), which will be the basis for a recommendation for SRC for groundwater, should define the depth to which soil CTLs apply. There are a number of variables to consider and professional judgment needs to be applied to determine the need for additional soil sample collection. It is recommended that the following considerations be used to determine the need for additional soil sample collection:

1. If soil samples were collected previously which exceeded either direct exposure or leachability CTLs at a depth which is later submerged at the time of the final NAM or PARM sampling event, those soil CTL exceedences do not need to be considered in a determination as to whether the site qualifies for SRC. However, the file record must indicate that an adequate number of representative soil samples were collected for lab analysis for the determination that soil concentrations do not exceed SCTLs for each discharge location. The previous assessment history needs to be reviewed and if there was an adequate number of representative soil samples collected for lab analysis from what is now the unsaturated zone, then additional soil samples may not be necessary (unless those previous results showed that soil CTLs were exceeded). If an adequate number of representative soil samples were not analyzed from what is now the unsaturated zone, then supplemental soil assessment may be necessary.
2. If the groundwater table elevation is lower at the conclusion of NAM or PARM than when soil samples were previously collected, and the soil CTLs which were exceeded in the shallower soil were the chemicals which have a lower leachability CTL than direct exposure CTL (most commonly VOAs but includes all organic petroleum products' contaminants of concern except for the 7 carcinogenic PAHs and benzo(g,h,i) perylene), it is recommended that Exhibit B be used as reference to determine the need for additional soil sample collection.

The logic of the suggestions of the Exhibit B table as to whether or not additional soil samples need to be collected when the groundwater table surface is deeper than it was when soil samples were previously collected is based on the following:

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- The leachability CTLs are much lower than the direct exposure CTLs for the Volatile Organic Aromatic chemicals, and
 - The results of a groundwater sample which indicates groundwater CTLs were not exceeded, collected while the soil in question was below the groundwater table during one or more of the NAM or PARM sampling events, may later be used as empirical evidence to demonstrate that the soil will not leach and cause groundwater contamination if that soil is again part of the unsaturated zone at the time of the last NAM or PARM groundwater sampling event.
3. It is suggested that collection of additional soil samples when the groundwater elevation is lower at the time of the last PARM or NAM sampling event than when previous soil samples were collected is only necessary if the changed groundwater elevation is 2 or more feet lower. If the depth to groundwater has changed by less than 2 feet, and previous soil samples were collected near the previous water table depth, then those previous sample analysis results can usually be considered representative, as typically soil samples for lab analysis are collected at 2 foot intervals or greater when performing site assessment.
 4. When the groundwater table is relatively shallow (e.g. – less than 5 feet below land surface) and there is the possibility of exceedences of direct exposure CTLs in the shallow soil based on previous assessment which was performed, it may be appropriate to make more conservative assumptions about the depth to which soil CTLs apply and the need for confirmation samples to demonstrate soil CTLs have been achieved regardless of the depth of groundwater at the time of the last PARM or NAM sampling event because of the increased probability of exposure to shallow soil contamination.
 5. The depth to groundwater at the time of the final NAM or PARM sampling event should be considered to be within normal seasonal variation and not the result of a short term event such as a tropical storm or hurricane which may result in several feet of groundwater elevation depth change over a short cycle of a few weeks.
 6. The attached table (Exhibit B) should be used as a reference but should not replace professional judgment. Consideration needs to be given to the range of depth of groundwater during the course of site rehabilitation and the range of depth of groundwater during NAM or PARM to determine whether a groundwater sampling event represents the potential for soil to leach, as well as the possibility that chemicals are present which have direct exposure CTLs lower than leachability CTLs.

The remainder of this memorandum concerns closure options once it is verified that the default soil CTLs for either Direct Exposure or Leachability are exceeded.

DIRECT EXPOSURE:

Although Direct Exposure (DE) SCTLs apply to the entire vadose zone, if the soil is not remediated to levels at or below the DE levels (or site-specific background concentrations for inorganic chemicals) there are different options for engineering and/or institutional controls depending on whether the contamination is in the top two feet or below the top two feet and also whether the COC concentrations only exceed the DE Residential or exceed both DE Residential and DE Commercial/Industrial SCTLs. The following are examples of several common scenarios of direct exposure SCTL exceedences along with a description of the conditional closure options.

1. If the concentrations of COCs in the top two feet exceed the DE Residential values but do not exceed the DE Commercial/Industrial values, a conditional NFA would be appropriate if the property is currently in commercial/industrial use and an institutional control (deed restriction) is implemented to provide assurance that the property will remain commercial/industrial (even if the property is in an area zoned commercial or industrial, the deed restriction is necessary) and that if the contaminated soil is ever excavated it will be handled and disposed of properly.
2. A conditional NFA may also be appropriate in a situation where a property does not qualify for a commercial/industrial use restriction or where the concentrations in the top two feet exceed DE Commercial/Industrial SCTLs provided the site is paved or that it can be paved over or covered with two feet of clean fill. In this case, a conditional NFA would be appropriate if an institutional control (deed restriction) is implemented to provide assurance that the pavement or two feet of cover will be properly maintained or left undisturbed; that if subterranean construction activities are ever implemented on the property, construction workers will be notified that contamination exists and that they need to use proper protective equipment based on OSHA requirements; and that if the contaminated soil is ever excavated it will be handled and disposed of properly. If clean soil is applied to a site to provide a two foot cover for surface soil contamination, it will be necessary to properly grade and provide vegetative cover such as sod or take other measures to control erosion due to weather conditions or traffic over the site.
3. If the concentrations of COCs only exceed the DE Residential SCTLs at depths below two feet (top two or more feet meet DE Residential values), a conditional NFA would be appropriate if an institutional control (deed restriction) is implemented to provide assurance that the two feet of clean soil above the level at which soil contamination begins will be maintained or left undisturbed in the event of future property development and that if the contaminated soil below two feet is ever excavated it will be handled and disposed of properly.

4. If the concentrations of COCs exceed the residential SCTLs but do not exceed DE Commercial/Industrial SCTLs and the property is in commercial/industrial use, there is no need to maintain the soil located above the contaminated soil undisturbed as long as an institutional control (deed restriction) is implemented to provide assurance that the property will remain commercial/industrial and that if the contaminated soil is ever excavated it will be disposed of properly.

These concepts for options and mandatory requirements to obtain an NFA with conditions are depicted in the attached table labeled Exhibit C. The left side of the table describes 5 general scenarios for contaminated soil exceeding residential and/or commercial/industrial direct exposure SCTLs at different depths. For an NFA with conditions one of the two or more institutional or institutional and engineering control "options" indicated by an "O" in a cell need to be selected in addition to the mandatory institutional control indicated by an "M".

It may also be possible to establish alternative SCTLs for direct exposure which might allow NFA with No Conditions based on site-specific soil characteristics (see "Physical/chemical parameters" beginning on page 25 of the Technical Report). A word of caution concerning this strategy, however, is that only relatively minor changes to the direct exposure SCTLs are possible due to the nature of the effect of the soil physical properties in the equations for developing acceptable risk-based concentrations in soil for carcinogens and non-carcinogens (Figures 4 and 5 of the Technical Report). An Excel based application for performing this calculation can be found at the Petroleum Cleanup Program web site at www.dep.state.fl.us/waste/categories/pcp/pages/pg_documents.htm under the title "Alternative SCTL Calculation Spreadsheet" in the General Technical section.

LEACHABILITY:

This section describes the interpretation and application of the Leachability based on groundwater column of the SCTL Table, and not the columns for leachability based on surface water or based on groundwater of low yield/poor quality, since the Leachability based on groundwater CTLs will be the most commonly used.

The Leachability based on groundwater column SCTLs are COC concentration levels for soil that (assuming the average soil properties for Florida as the default) would produce a leachate equivalent to the groundwater criteria of the groundwater CTL table. For example, in order to ensure that soil at a site does not produce a leachate to the groundwater in excess of the GCTLs (e.g., 1 µg/L for benzene), a lab analysis of soil must document a COC concentration in the soil that does not exceed the value listed in the SCTL table "Leachability Based on Groundwater" column (e.g., 0.007 mg/kg or less for benzene). In other words, if sufficient moisture is present, soil with a benzene concentration of 0.007 mg/kg should leach 1 µg/L or less of benzene into groundwater, assuming the default characteristics for soil in Florida. An NFA without conditions cannot be allowed if the leachability SCTLs listed in the Leachability

Based on Groundwater column of the SCTL table are not met, unless site-specific data can demonstrate the appropriateness of an NFA without conditions, as outlined in the section below titled "Alternative Risk Management Options to Substitute SCTLs."

The DE SCTLs discussed earlier in this memo must be met, or institutional controls will be necessary (*with the exception of calculating DE SCTLs based on soil properties, which as described above, cannot be expected to result in meaningful changes to the default SCTLs*). With Leachability SCTLs, there are several options to establish site-specific SCTLs or otherwise demonstrate that contaminated soil will not produce leachate with concentrations exceeding the GCTLs. However, the concentrations of COCs in soil relative to both the Leachability and DE SCTLs must be considered before attempting to establish alternative leachability SCTLs. Generally speaking, in the case of Volatile Organic Aromatic chemicals and some PAHs, the SCTLs for leaching are lower than the SCTLs for DE Residential. For carcinogenic PAHs the DE Residential CTLs are lower than the Leachability CTLs. Since both DE and Leachability SCTLs need to be met, if concentrations of COCs exceed the DE SCTLs, except for TRPHs, there may be no benefit to develop site-specific SCTLs for leaching unless the DE SCTL exceedences are going to be addressed by means of institutional controls/engineering controls or by a soil source removal.

If the COCs found in the soil do not exceed DE Residential SCTLs, or an institutional control/engineering control is going to be used to address direct exposure, and the COCs exceed the Leachability Based on Groundwater values, then leachability may be evaluated further as described in the following discussion.

Alternative Level I Risk Management Options to Substitute Leachability SCTLs:

If the concentration levels of column 3 of the SCTL Table are exceeded, but not by a significant degree, it may be possible to qualify for an NFA without conditions by using one of several Level I Risk Management Options. The options to demonstrate an acceptable exception from the default SCTLs of column 3 of the SCTL Table (to demonstrate that soil at a site with concentrations of COCs that exceed SCTL Table default values will not leach to groundwater) are to:

1. Perform a leachability test [Sub-subparagraph 62-770.680(1)(c)2.c., F.A.C.], or
2. Use site-specific soil properties to develop site-specific SCTLs using the soil/water partition equation [Sub-subparagraph 62-770.680(1)(c)2.d., F.A.C.], or
3. It is demonstrated that soil will not leach and cause groundwater CTL exceedences through representative monitoring of groundwater when the site is not paved [Sub-subparagraph 62-770.680(1)(c)2.f., F.A.C.], or

4. TRPH Fractionation is performed [Sub-subparagraph 62-770.680(1)(c)2.e., F.A.C.]. (*applicable to both leachability and DE SCTLs*)

It is instructive to review the Technical Report beginning on page 43 in addition to the information in this memorandum for a more complete understanding of the considerations and procedures for development of site-specific SCTLs.

Leachability Test

The leachability test is performed by the Synthetic Precipitation Leaching Procedure (SPLP, USEPA Test Method 1312) except for contamination derived from used oil or similar petroleum products, as described in Subparagraph 62-770.600(4)(f)4., F.A.C. Two samples should be collected from at least one representative location that exceeds leachability SCTLs specified in the SCTL Table. One sample should be used for a totals analysis and the other should be subject to a leaching procedure and the leachate analyzed for the applicable COCs that were exceeded in the soil sample. This leachate analysis will provide site-specific documentation of whether the COC concentrations in the soil will result in leaching of COCs into the groundwater at concentrations that exceed GCTLs based on actual contaminated soil characteristics (not based on default soil characteristics). The COC concentrations obtained from the leachate are equivalent to groundwater values, not soil values, and the concentrations of the COCs leached from the sample are compared to the groundwater criteria column of the Groundwater and Surface Water Cleanup Target Levels Table, not to the SCTL Table values. An analytical method with a detection limit adequate to demonstrate the leachate does not exceed the applicable GCTLs of the Groundwater and Surface Water Cleanup Target Levels Table must be used for analysis of the leachate.

Though sample collection from only one sample location may be necessary, typically the number of samples will be related to the extent of soil contamination, range of contaminant concentrations and variability of soil characteristics across the area of soil contamination. This technique as well as other techniques for establishing alternative Leachability SCTLs are not necessarily an all or nothing proposition and may result in establishment of alternative SCTLs for a portion but not all of the area of contamination and may, for example, limit the extent of a contaminated soil excavation which will be necessary. For this reason, a greater number of samples may be beneficial to adequately identify the areas for which the alternative SCTLs can be established. There should be communication between the FDEP (or local program) and the consultant responsible for site rehabilitation concerning the number, location, and analysis techniques for supplemental soil samples to obtain agreement prior to conducting the supplemental soil assessment. For required field and laboratory procedures, see the March 8, 2010 guidance document titled "SPLP Procedures for Petroleum-Contaminated Sites."

Determination of Alternative SCTLs based on Site-Specific Soil Properties

A second option is to collect site-specific soil characteristic parameters to insert into the "Equation for the Determination of Soil Cleanup Target Levels (SCTLs) Based on Leachability" obtained from Figure 8 of the Technical Report. This equation was used to derive all of the leachability SCTL values in the SCTL Table (chemical-specific values are listed in Table 4 of the Technical Report). The default values for the equation assume that the soil is a loam with certain characteristics of the "average" Florida soil. By determining site-specific soil properties, including moisture content, dry bulk density, and organic carbon content (as specified in Subparagraph 62-770.600(4)(f)2., F.A.C., and the Technical Report) the default SCTLs in the SCTL Table can be substituted with site-specific SCTLs. The SCTLs derived from the substitutions of site-specific soil characteristics values into the equation may be high enough to allow an NFA without conditions at the site. However, in order to allow the use of site-specific soil characteristics to replace default values in the equation, all three values (fraction of organic carbon, dry soil bulk density, and average soil moisture content) which allow substitutions in Figure 8 of the Technical Report must be used. A minimum of one sample is necessary; however, if alternative SCTLs for different strata with different soil characteristics will be calculated, then one sample per stratum will be needed. If previous soil samples have been collected for lab analysis, the laboratory determination of moisture content in the lab reports for the previous samples may be used in conjunction with moisture content of the new sample to establish average moisture content. An Excel based application for performing this calculation can be found at the petroleum cleanup program web site at www.dep.state.fl.us/waste/categories/pcp/pages/pg_documents.htm under the title "Alternative SCTL Calculation Spreadsheet" in the General Technical section.

It may also be acceptable to obtain samples of soil from below the contaminated soil but above the groundwater table and to characterize the soil properties and calculate SCTLs for the soil to demonstrate the intermediate soil will prevent leachate with concentrations greater than the GCTLs from reaching the groundwater. If these alternative SCTLs are higher than the actual concentrations in the contaminated soil, this information could be used as a demonstration that the soil with concentrations that exceed leachability SCTLs could be left in place without affecting groundwater. A soil attenuation model may also be suitable for this purpose. However, since COCs from the contaminated soil could leach in excess of their GCTLs if the contaminated soil is removed, an institutional control (deed restriction) will be necessary to provide assurance that if the contaminated soil is ever excavated it will be handled and disposed of properly.

TRPH Fractionation

This technique is generally only useful in a circumstance in which only the TRPH CTLs for either or both of direct exposure and leachability are exceeded. If other CTLs for individual COCs are also exceeded the soil may still need to be addressed by either remediation or

institutional controls regardless of the outcome of the TRPH fractionation. Either of two laboratory methods for fractionation may be used, the MADEP or the TPHCWG. A table which indicates maximum allowable concentrations for specific carbon ranges for a demonstration that the soil which exceeded TRPHs by FL-PRO does not need to be remediated may be found at the petroleum cleanup program web site at

www.dep.state.fl.us/waste/categories/pcp/pages/pg_documents.htm under the title "Calculated SCTLs for TRPH Fractions Based on the TPHCWG and MADEP Methods" in the General Technical section. A minimum of one sample per source area needs to be collected from the location(s) with TRPH exceedences and each sample needs to be split in two sub-samples, with one analyzed for FL-PRO and the other for fractionation.

Use of Empirical Evidence to Demonstrate Soil will not Cause Exceedences of GCTLs

This technique is allowed by Sub-subparagraph 62-770.680(1)(c)2.f., F.A.C., for a circumstance in which the area with soil that has contaminant concentrations above leachability SCTLs is not paved or does not have a surface covering which impedes natural infiltration of precipitation. The minimum criteria are that the area of soil contamination must have been unpaved for at least two years prior to the determination that the contaminated soil is not resulting in groundwater contamination, followed by a demonstration based on a minimum of one year of quarterly groundwater monitoring. However, professional judgment also needs to be applied to consider factors such as the amount of precipitation prior to and during the year of monitoring compared to the average, the depth of the contaminated soil and the contaminant concentrations, the soil lithology, and the depth of the groundwater table to determine whether two years without surface covering and one year of monitoring are adequate to demonstrate leaching from the soil will not eventually result in groundwater contamination.

These four concepts for establishing alternative Leachability SCTLs are depicted in the attached table labeled Exhibit D and the primary requirements/procedures are summarized in bullet form in attachment E. Note that in Exhibit D, the mandatory restrictions on the property are only applicable when alternative leachability CTLs are established by maintenance of pavement or by monitoring groundwater at a site without pavement to demonstrate that contaminants in the soil will not leach to groundwater. If SPLP is used or alternative SCTLs are calculated based on site-specific soil properties, then there is no mandatory restriction.

There may be instances in which an in situ remediation method such as vapor extraction is able to achieve the Direct Exposure SCTLs but reaches diminishing returns of effectiveness before achieving the Leachability SCTLs. Some of the same characteristics of soil that limit the effectiveness of the vapor extraction system at achieving the Leachability SCTLs may prevent the soil from leaching at concentrations greater than the GCTLs. Performing the SPLP or soil characterization to establish site-specific SCTLs based on soil properties may be an appropriate means to define the endpoint of operation of an in situ soil remediation system and

obtain an NFA without conditions for soil in this instance. See BPSS-4 (Vapor Extraction, Multi-Phase Extraction, Air Emissions Treatment, and Monitoring Requirements) for more details.

A final reminder, the leachability (SPLP) determination and equilibrium partition equation substitutions are a means to evaluate the appropriateness of an NFA if the default leachability-based SCTLs are not met, but only if the SCTLs are only moderately exceeded. If the contaminant levels at a site are high enough to also exceed the direct exposure SCTLs, there may be no advantage to run the leachability test or collect site-specific data, unless the owner of the property is willing to agree to engineering and/or institutional controls for the direct exposure exceedences.

Attachments

Exhibit A
Soil Cleanup Target Levels
for Petroleum Products' Contaminants of Concern
 [from Table II of Chapter 62-777, F.A.C. (effective April 17, 2005)]

Contaminants of Concern	Direct Exposure Residential (mg/kg)	Direct Exposure Commercial/Industrial (mg/kg)	Leachability Based on Groundwater Criteria (mg/kg)	Leachability Based on Freshwater / Marine Surface Water Criteria (mg/kg)	Leachability Based on Groundwater of Low Yield/Poor Quality Criteria (mg/kg)
PAHs:					
Acenaphthene	2,400	20,000	2.1	0.3 / 0.3	21
Acenaphthylene	1,800	20,000	27	NA / NA	270
Anthracene	21,000	300,000	2,500	0.4 / 0.4	25,000
Benzo(a)anthracene	#	#	0.8	NA / NA	8
Benzo(a)pyrene	0.1	0.7	8	NA / NA	80
Benzo(b)fluoranthene	#	#	2.4	NA / NA	24
Benzo(g,h,i)perylene	2,500	52,000	32,000	NA / NA	320,000
Benzo(k)fluoranthene	#	#	24	NA / NA	240
Chrysene	#	#	77	NA / NA	770
Dibenz(a,h)anthracene	#	#	0.7	NA / NA	7
Fluoranthene	3,200	59,000	1,200	1.3 / 1.3	12,000
Fluorene	2,600	33,000	160	17 / 17	1,600
Indeno(1,2,3-cd)pyrene	#	#	6.6	NA / NA	66
Methylnaphthalene, 1-	200	1800	3.1	10 / 10	31
Methylnaphthalene, 2-	210	2100	8.5	9.1 / 9.1	85
Naphthalene	55	300	1.2	2.2 / 2.2	12
Phenanthrene	2,200	36,000	250	NA / NA	2,500
Pyrene	2,400	45,000	880	1.3 / 1.3	8,800
VOAs:					
Benzene	1.2	1.7	0.007	0.5 / 0.5	0.07
Ethylbenzene	1,500	9,200	0.6	12 / 12	6
Toluene	7,500	60,000	0.5	5.6 / 5.6	5
Xylenes, total	130	700	0.2	3.9 / 3.9	2
OTHER ORGANICS:					
Dichloroethane, 1,2-	0.5	0.7	0.01	0.2 / 0.2	0.1
MTBE	4,400	24,000	0.09	150 / 150	0.9
TRPHs	460	2,700	340	340 / 340	3,400
METALS:					
Arsenic	2.1	12	*	* / *	*
Cadmium	82	1,700	7.5	NA / 14	75
Chromium (total)	210	470	38	4.2 / 19	380
Lead	400	1400	*	NA / *	*

NA = Not Available.

* Leachability value may be determined using TCLP.

Each concentration must be converted to Benzo(a)pyrene equivalent (see pp. 61-62 of the February 2005 Technical Report). In the "BaP Conversion Table" enter the appropriate analytical result for each carcinogenic PAH using the instructions provided; the spreadsheet calculates the equivalent concentrations, adds them up, compares the total to the Benzo(a)pyrene Direct Exposure Residential CTL (default) and Direct Exposure Commercial/Industrial CTL and indicates whether they are exceeded or not.

Exhibit B*

Reference for Determining Whether Supplemental Soil Samples are Necessary When Groundwater Table is Deeper at the Time of the Last NAM or PARM Sampling Event Than When Soil Samples Were Previously Collected		
	The recently exposed vadose soil which had not been sampled was submerged during at least one sampling event of NAM or PARM such that the effect of contaminants leaching from the soil would be manifested in groundwater sampling analysis results.	For the duration of PARM or NAM sampling the groundwater elevations were as deep as or deeper than at the time of the final NAM or PARM sampling event such that the effect of contaminants leaching from the soil would not be manifested in groundwater sampling analysis results.
BTEX, MTBE, 1,2-dichloroethane and other target chemicals with leachability CTL much lower than direct exposure CTL	Additional soil samples may not be necessary if groundwater CTLs were not exceeded during the sampling event when the soil was submerged	Additional soil samples are recommended
Carcinogenic PAHs and other target chemicals with direct exposure CTLs lower than leachability CTLs	Additional soil samples are recommended	Additional soil samples are recommended

* This reference table is generally useful for circumstances in which it has been established that the target COCs for remediation are the VOCs with leachability CTLs much lower than DE CTLs. If there is any question as to the presence of chemicals with DE CTLs lower than leachability CTLs then soil samples may need to be collected.

If the site is not paved or does not have a surface covering which impedes natural rainfall infiltration, in addition to the above strategy to determine the necessity of soil samples, then empirical evidence that soil will not leach may also be used to demonstrate the soil will not leach as described in Sub-subparagraph 62-770.680(1)(c)2.f. and this guidance memo.

Exhibit C

Institutional/Engineering Controls to Qualify for an NFA With Conditions when Direct Exposure CTLs in Soil are Exceeded

	Deed Restriction to keep site in commercial/industrial use	Cap-type engineering control such as pavement along with deed restriction to maintain pavement	Deed Restriction to not permanently change grade of site to within 2 feet of contaminated soil	Engineering control of adding 2 feet of clean soil along with deed restriction to maintain	Deed restriction to properly dispose of soil if ever excavated
Soil contamination in top two feet greater than DE residential but less than DE commercial/industrial SCTLs	O	O	N/A	O	M
Soil contamination in top two feet greater than DE commercial/industrial SCTLs	N/A	O	N/A	O	M ^B
Soil contamination greater than DE residential but less than DE commercial/industrial SCTLs only deeper than two feet below surface	O	O ^A	O	N/A	M
Soil contamination greater than DE commercial/industrial SCTLs only deeper than 2 feet below surface	N/A	O ^A	O	N/A	M ^B
Soil contamination greater than DE Residential but less than alternative SCTLs justified pursuant to Rule 62-770.650, FAC	Institutional control to keep site in use consistent with parameters used to justify alternative SCTLs for Direct Exposure				M

M - Mandatory to get an NFA with conditions. This applies only to the options of maintaining pavement above soil which exceeds leachability CTLs and when alternative leachability CTLs are established by monitoring groundwater at a site without pavement to demonstrate that the soil will not affect groundwater. If SPLP is used or alternative leachability SCTLs are calculated based on soil properties, there are no mandatory deed restrictions.

O - One of two or more options to get an NFA with conditions. One or more of the options (O) in a row must be selected, and if the option used is pavement or demonstrating soil will not leach by monitoring groundwater at a site without pavement, then the Mandatory restriction also applies.

A - It may be possible to agree to always maintain an engineering control of pavement on the site regardless of whether the site is ever regraded to within two feet of the contaminated soil in lieu of keeping the site commercial/industrial or in lieu of agreeing to always maintain two feet of clean soil above the level at which contaminated soil begins.

B - For this situation the deed restriction will also have to stipulate that if subterranean construction activities are ever implemented on the site, construction workers will be notified that contamination exists and that they need to use proper protective equipment based on OSHA requirements.

TRPH - If the only soil CTL exceeded is for TRPH, then fractionation may be used to demonstrate that site specific fractions of TRPHs do not exceed the residential soil CTLs for the TRPH fractions provided in Appendix C of the Technical Report in which case no institutional or engineering controls are necessary. If the site specific fractions exceed the residential soil CTLs for the TRPH fractions but do not exceed the commercial/industrial CTLs, then a mandatory institutional control restriction to keep the site commercial/industrial will be necessary.

Exhibit D

Means to Justify Alternative Leachability SCTLs

	Engineering control of pavement along with deed restriction to maintain pavement	Do SPLP to show soil will not leach above GCTLs	Do soil characterization to calculate site-specific SCTLs w/ equilibrium partition equation	Monitor groundwater to demonstrate leaching from soil in area without pavement will not result in groundwater contamination	Deed restriction to properly dispose of soil if ever excavated
Soil contamination in excess of Leachability-based SCTLs on a site with pavement	O ^A	O	O	N/A	M ^C
Soil contamination in excess of Leachability-based SCTLs on a site without pavement	N/A	O	O	O ^B	M ^C

M - Mandatory to get an NFA with conditions. This applies only to the options of maintaining pavement above soil which exceeds leachability CTLs and when alternative leachability CTLs are established by monitoring groundwater at a site without pavement to demonstrate that the soil will not affect groundwater. If SPLP is used or alternative leachability SCTLs are calculated based on soil properties, there are no mandatory deed restrictions.

O - One of two or more options to get an NFA with conditions. One or more of the options (O) in a row must be selected, and if the option used is pavement or demonstrating soil will not leach by monitoring groundwater at a site without pavement, then the Mandatory restriction also applies.

A - There must be evidence to demonstrate that the pavement is currently preventing leaching above GCTLs. Generally, one year of groundwater monitoring which demonstrates plume is stable is sufficient

B - Area of soil contamination must be unpaved for at least two years prior to beginning one year of quarterly groundwater monitoring
Consideration needs to be given to depth of contamination, depth to groundwater, soil characteristics, and actual precipitation during the period of monitoring.

C - If SPLP or soil characterization demonstrates soil will not leach at concentrations that exceed the applicable GCTLs, a mandatory deed restriction to properly dispose of the soil if it is ever excavated is only required if SCTLs for direct exposure are exceeded for one or more chemicals of concern.

TRPH - If the only soil CTL exceeded is for TRPH, then fractionation may be used to demonstrate that site specific fractions of TRPHs do not exceed the Leachability soil CTLs for the TRPH fractions provided in Appendix C of the Technical Report, in which case no institutional or engineering controls are necessary.

Exhibit E

Summary of Alternative Level 1 Risk Management Options for Soil

The following is a summary of the salient points of four techniques for establishing alternative soil CTLs for Level 1 Risk Management (no engineering or institutional controls). For more details see the text of the memo.

Leachability Test (SPLP)

- Should only be used when soil in question exceeds leachability CTLs but not direct exposure.
- Variability of soil characteristics and contaminant concentrations should be considered for determining location and number of samples.
- Need a minimum of 2 samples from each location, one analyzed for totals and the other SPLP.
- The concentration of COCs in the leachate should be compared with the groundwater CTLs.
- For extensive areas of soil contamination, and especially if soil excavation is proposed, a higher number of samples for SPLP is recommended to refine the area of soil contamination and reduce the scope of the excavation.

Alternative SCTLs Based on Soil Properties

- Should only be used when soil in question exceeds leachability CTLs but not direct exposure.
- Variability of soil characteristics and contaminant concentrations should be considered for determining location and number of samples.
- Soil samples should be tested to determine fraction of organic carbon, dry soil bulk density, and average soil moisture content.
- Use FDEP provided Excel spreadsheet to calculate alternative leachability CTLs at:
www.dep.state.fl.us/waste/categories/pcp/pages/pg_documents.htm

TRPH Fractionation

- Should only be used when only when the TRPH CTLs for direct exposure and/or leachability are exceeded and not individual chemical CTLs.
- Need a minimum of 2 samples from each location, one analyzed for FL-PRO and the other fractionation.
- Use either MADEP method or TPHCWG method for fractionation.
- Compare results of fractionation with FDEP table of maximum allowable concentrations in fraction ranges at:
www.dep.state.fl.us/waste/categories/pcp/pages/pg_documents.htm

Empirical Evidence that Soil will not Leach and Result in Exceedence of Groundwater CTLs

- Should only be used when soil in question exceeds leachability CTLs but not direct exposure.
- Area of soil contamination should not currently be paved or had been paved for at least 2 years preceding the groundwater monitoring to determine leaching potential.
- Depth of groundwater, soil characteristics, and recent rainfall data should be considered as to whether the period of time the site has not been paved is reasonably representative of timeframe necessary for contaminated soil to have affected groundwater by leaching.
- Monitor groundwater for one year with no groundwater CTL exceedences.