Guidelines for
Assessment and Source Removal
of
Petroleum Contaminated Soil

Prepared by

Florida Department of Environmental Protection

Bureau of Petroleum Storage Systems

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GUIDELINES FOR ASSESSMENT AND SOURCE REMOVAL OF PETROLEUM CONTAMINATED SOIL

1.0 Introduction

The Department of Environmental Protection, Bureau of Petroleum Storage Systems (formerly part of the Bureau of Waste Cleanup), has published five previous editions of this manual. The document has been periodically revised to maintain comprehensive procedures that address assessment and remediation of petroleum contaminated soil and to reflect experience of the Department staff in the implementation of the petroleum contaminated site cleanup programs. The manual will be revised again in the future as necessary to reflect advances in site cleanup technology and changes in site cleanup rules and policies of the Department. This manual is intended to integrate all aspects related to assessment and remediation of soil contamination, that include the following topics:

- Regulatory status of contaminated soil
- Analytical methods to quantify soil contamination
- Field screening methods
- Source mass estimating procedures
- The need for soil remediation
- Source removal activities
- Remedial action technologies
- Cleanup target levels
- Permitting requirements

The intent of this document is to clarify Department regulations, program requirements and procedures dealing with petroleum contaminated soil. The document incorporates existing regulations as applicable, including requirements for commercial treatment or disposal of soil by thermal treatment facilities and other means.

These guidelines reflect the current rules governing petroleum waste cleanup and have been modified to reflect revisions in the rules, particularly with regard to the adoption in September, 1997 of significant changes to Chapter 62-770, Florida Administrative Code (FAC).

2.0 Contaminated Soil in the Environment

The cleanup of contaminated soil is an important part of the corrective action process at petroleum contamination cleanup sites. The contaminated soil that remains in place not only poses an environmental and public health risk, but can prolong significantly the groundwater cleanup effort, resulting in much higher total cleanup cost. Factors that will affect the decisions on when and how to remediate soil include the relative concentrations of petroleum hydrocarbons in the soil, type of product released, how long the soil has been contaminated, the extent of soil contamination, the distribution of contaminant mass, effect of the contaminated soil on groundwater due to site-specific lithology, depth to groundwater, and potential for exposure of the public to the contaminated soil. This section describes the fate and transport characteristics of chemicals of concern in the soil, and the environmental risks associated with petroleum contaminated soil.

2.1 Transport

Once a petroleum product is released to the environment through surface spills, tank or integral piping leaks, or improper disposal practices, its movement is dependent upon the physical and chemical properties of the product and the structure and composition of the subsurface. The rate at which movement occurs is dependent on the viscosity of the product and on the permeability of the soil. The main driving force for vertical movement is gravity, whereas lateral movement is attributed to capillary forces (i.e., adhesive forces between the product and the soil and rock particles). The depth to which the product can migrate is dependent upon the volume discharged, the depth to the water table or an impermeable layer, and the specific gravity of the product. Vertical movement in the unsaturated zone is impeded when the amount of petroleum in the soil is below the residual saturation level or when an impermeable boundary is encountered; or otherwise the product reaches the water table. The product that remains in the unsaturated zone may exist in four phases: 1) as liquid product that remains in pore spaces due to capillary forces; 2) as solutes of product components adsorbed onto soil particles; 3) as vapor in the soil air; and, 4) as dissolved product in the soil water. Once the product reaches the capillary zone, its vertical movement is impeded if the product is less dense than water. As additional product migrates downward, an increasing thickness of free product accumulates until lateral spreading occurs. The most immediately apparent phase is commonly this product that has exceeded residual saturation levels in soil and that has reached the water table and may be measured in monitoring wells. However, a significant mass of phase-separated product may exist regardless of the existence of product observed in monitoring wells. The lateral movement of product that reaches the water table is initially in all directions, with eventual free product movement with the natural gradient of the water table. Because the soil water content increases in the capillary zone, the volatilization (vapor transport) of compounds decreases while dissolution increases.

2.2 Leachate Production

The most significant property that affects the leachability of chemicals of concern from soil is solubility in water. Solubility is defined as the partitioning of a chemical between the non-aqueous and dissolved phases. The solubility of a compound determines the extent to which a compound can dissolve in water, is inversely related to how well a compound can be adsorbed, and directly related to how well it will biodegrade. The water solubilities shown in Table 2-1 illustrate the leachability of various chemicals of concern found in petroleum products. It is important to note, however, that the water solubilities shown do not necessarily represent the solubility of the compounds when present in mixtures, such as gasoline. This difference is due primarily to the partitioning effects between the various organic solvents and water. It is generally understood that partitioning will affect the concentrations of mixed petroleum related compounds in groundwater, resulting in somewhat lower values than shown in Table 2-1.

Table 2-1 shows that MTBE is one of the most water soluble petroleum related chemicals of concern. MTBE leaches readily from the soil into the groundwater, and because of its high solubility it is easily transported by the groundwater and normally is found at the leading edge of the dissolved plume. Unlike the other more soluble petroleum hydrocarbons, MTBE does not readily biodegrade. This property is also responsible for it often being at the leading edge of the groundwater plume.

Leachate production generally is accomplished by the dissolution of chemicals of concern from free product that may be located in the pore spaces of the unsaturated zone. Leachate can be generated by rain infiltrating through contaminated soil.

Another way in which leachate may be generated is due to fluctuations in the water table. Product lying on the water table moves up and down with the water level in response to seasonal recharge and discharge and to local pumping. As a result, the zone contaminated by the product extends over the entire range of water table fluctuations, sometimes referred to as a smear zone. The distribution of the product in this zone will be highly variable, typically ranging from residual amounts to fully saturated lenses. This product may represent a significant source of continued contamination of groundwater but may not be observed in monitoring wells as floating "free product." The free product that follows a declining water table also can be trapped below the water table when the water table recovers because only some of the trapped liquid can be remobilized. The seasonal fluctuations in the water table can mobilize chemicals of concern that exist in the soil located within the area of water table fluctuations, resulting in seasonal variations in concentrations of monitoring well samples.

In most cases, contact time is sufficient to dissolve product located directly on the water table into the saturated zone at concentrations above cleanup target levels. The dissolved product plume then spreads by advection and dispersion within the groundwater.

Soil Cleanup Target Levels based on potential of contaminated soil to leach and contaminate groundwater are contained in Table IV of Chapter 62-770, FAC, and Appendix A of this manual. These target levels were established based on a number of considerations, including default soil characteristics. Rule 62-770.650(2)(a)3., FAC, and Section 3.3 of this manual, describe a process by which site-specific information may be used to establish alternative soil cleanup target levels.

TABLE 2-1. FATE AND TRANSPORT CHARACTERISTICS OF CHEMICALS OF CONCERN

Chemicals of Concern	Water Solubility[1] (mg/l)	Vapor Pressure[1] (Torr)	Koc[2] (mg/l)
Benzene	1780	75.0	50
Toluene	515	22.0	339
Xylene-m	175	5.0	-
Xylene-o	162	6.0	255
Xylene-p	198	6.5	-
Ethylbenzene	152	7.0	565
Naphthalene	31.1	1.0	976
EDB	4310	11.0	44
1,2-dichloroethane	8690	61.0	-
Tetraethyl lead	0.08	0.2	4900
MTBE	42,740	300	-

[1] at 20 degrees C.

[2] Koc is a measure of the tendency for organic chemicals to be adsorbed to the soil. The higher the Koc value for each compound, the lower the mobility and the higher the adsorption.

2.3 Contact with Receptors

Many of the compounds associated with petroleum products have been found to be toxic. Once these compounds enter the groundwater system, they tend to move in the general direction of the groundwater flow. The primary route of exposure for these dissolved constituents is through public and private drinking water supplies. In some cases, the dissolved chemicals of concern are discharged into surface water bodies where they may pose a threat not only to aquatic plant and animal life but also to the general public.

The vapor phase transport of gasoline components in the unsaturated zone also can pose a significant health and safety threat due to inhalation and explosion potential. Volatilization of compounds to the soil air depends on the volatility of the compounds and on soil and environmental conditions that modify the vapor pressure of the chemical.

The soil conditions that influence volatility are water content, clay content and surface area, and the environmental conditions are temperature, wind speed, evaporation rate and precipitation. Typically, the natural vapor flow is by diffusion away from areas of high concentrations to areas of lower concentrations and ultimately to the atmosphere. The gasoline compounds which exhibit the highest volatility are benzene, toluene and xylenes. Rule 62-770.600(2)(c), FAC, requires the determination of the extent of contamination in every medium found to be contaminated. Therefore, consideration should be given to the existence of routes of vapor transport such as buried pipes or electrical conduits, manhole openings, lift stations and utility trenching with permeable backfill. During warm weather, vapors associated with these components are more volatile and should be of a relatively greater concern.

Exposure to contaminated soil also could occur through incidental ingestion of contaminated soil or dermal contact with contaminated soil. This situation would be of concern in sites where surficial soil contamination is present or when soil is stockpiled during site cleanup activities. Soil contamination near the surface of the site is considered to pose a risk to public health. Rule 62-770.680, FAC, No Further Action, requires that soil in the vadose zone be remediated to the lower of the direct exposure I criteria or the applicable leachability criteria of Table IV of Chapter 62-770, FAC, (Appendix A of this manual) or, alternately, that engineering and/or institutional controls be implemented to protect the public from exposure to contaminated soil.

3.0 Regulatory Status of Soil Cleanup Target Levels (SCTLs), Soil Screening Procedures, and Establishment of Site-Specific SCTLs

3.1 Historical Development of Soil Cleanup Target Levels

In the past, procedures for performing field soil screening and remediation in Florida were based on the state of knowledge of the concerns for petroleum contamination, on the available tools for performing soil screening, and on the nature of the Department's funding program for remediation of petroleum contaminated sites. Significant changes to Florida Statutes governing the petroleum cleanup program were enacted in 1995 and 1996, followed by revision of Chapter 62-770, FAC, that became effective September 23, 1997. In conjunction with these changes, the Department has conducted research into the methods for performing field soil screening and on the "action levels" that were included in previous Department rules and guidance documents.

Historically, Initial Remedial Actions could be conducted without prior authorization from the Department and be subsequently reimbursed from the Inland Protection Trust Fund. Under this system, there were numerous instances of Initial Remedial Actions for soil excavation that did not result in meaningful or cost-effective site cleanup results. In response to this problem, the Department instituted some conservative limits on the activities that could be performed during Initial Remedial Actions without prior approval. These restrictions included the requirements that soil removal be limited to soil above the groundwater table, and placed limits on the minimum degree of contamination in soil that was to be excavated and on the maximum volume of soil that could be excavated.

A change in the way the Department manages funding of the cleanup of contaminated sites from a "reimbursement" program to a "preapproval" program has allowed the Department to eliminate these artificial boundary conditions on soil removal activities. Therefore, Chapter 62-770, FAC, and this manual, contain no limits on the volume of soil that may be excavated, or on minimum levels of contamination in soil that is to be excavated, or on excavation boundary limits relative to the groundwater table. For preapproval sites, a demonstration that the source removal is justified on the basis of cost-effectiveness will be required.

Current Florida statutes and changes to Chapter 62-770, FAC, now require that analytical soil data be used to verify that site cleanup criteria for soil have been achieved. The new cleanup criteria can be found in Table IV of Chapter 62-770, FAC, and Appendix A of this manual. The soil cleanup criteria for a site are based on risk associated with direct exposure to the soil in either a residential or an industrial exposure scenario, and on leaching potential of the contaminated soil. The use of an industrial exposure scenario rather than a residential one to justify the direct contact cleanup criteria will necessitate the use of institutional controls to maintain site use in a non-residential manner. In addition to direct exposure considerations, soil criteria for the vadose zone are based on potential for chemicals to leach and contaminate the groundwater at concentrations exceeding groundwater cleanup target levels.

Rule 62-770.680, FAC, No Further Action, allows the enactment of engineering and/or institutional controls as an alternative to achieving the default soil and groundwater cleanup target levels. Rule 62-770.650, FAC, Risk Assessment, describes the risk assessment elements that may be used to establish alternative, site-specific cleanup target levels, provided that the proper risk assessment documentation and site-specific soil and lithological information is submitted to the Department. This process for establishing alternative site-specific target levels is described in section 3.3 below and in the technical report titled “Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-770, FAC” (June 18, 1997 FINAL), a copy of which is available from the Department upon request.

Even though laboratory analyses of contaminated soil are required during assessment and to confirm that site cleanup criteria have been achieved, field soil screening techniques should be used in conjunction with laboratory analyses to perform an adequate soil assessment while minimizing the number of soil samples that must be collected for laboratory analyses.

At the time that Florida’s previous cleanup procedures were established there were limited tools available for performing field soil screening of contaminated sites. This limitation resulted in the selection of a preferred technique, the organic vapor analysis/flame ionization detector (OVA/FID) method, for performing field soil screening. In addition, other similar OVA instruments such as photo ionization detectors

(PIDs) that could be correlated with an OVA/FID were acceptable. In recent years other methods of performing field soil screening have been developed that may offer advantages of greater precision, a wider range of detection, and more reliable correlation with laboratory analysis results. This manual establishes a procedure by which vendors of different field soil assessment methods may obtain acceptance of their methods for use in performing field soil assessment at petroleum contaminated sites in Florida. This process is contained in Appendix B of this manual and summarized in Section 3.2 below.

The removal of limits for performing source removal operations, the inclusion of new field soil screening methods to better establish the boundaries of soil contamination and petroleum mass distribution, and the use of institutional controls and risk management alternatives to soil remediation, will result in more cost-effective decisions for the cleanup of contaminated soil.

3.2 Approval of Field Soil Screening Methods

Appendix B of this manual establishes the process for manufacturers or vendors of methods for field soil screening to obtain acceptance of their technique for use in Florida. The process consists of the manufacturer, vendor or other proponent to submit to the Department documentation which demonstrates the acceptability of a method for field soil screening activities. The Department will review the documentation and make a determination of the acceptability of the soil screening method. Until such time as other methods become accepted, the OVA/FID method shall continue to be used for performing field soil screening. However, there are no regulatory boundary limits on the soil that may be excavated from a site and therefore (except for the purposes of Section 376.3071(11)(b)2., FS) no purpose for the threshold values of “excessively contaminated soil” that appeared previously in Chapter 62-770, FAC, and in previous editions of this manual. Therefore, the term “excessively contaminated soil” will not have a significant purpose in this manual. In the interim until other field soil screening methods are approved, the Department will also continue to allow OVA/PIDs to be used in lieu of OVA/FIDs if a correlation curve of FID/PID values is developed and approved by the Bureau of Petroleum Storage Systems. The procedure for proper use of the OVA/FID is described in Section 4.1 of this manual.

Within one year following the first approval by the Department of an alternative to the OVA/FID method, the OVA/FID method must obtain acceptance for continued use at petroleum contaminated sites in Florida or that method will no longer be considered to be acceptable for soil screening activities (see Appendix B). Periodically, the Bureau of Petroleum Storage Systems will publish a list of methods that have been accepted for use in performing soil screening at petroleum contaminated sites in Florida.

For each method accepted, several factors shall be established, including the range of detection of the method, operation procedures, and quality control considerations. Until the OVA/FID method is reevaluated, the lower limit of detection for the OVA/FID method shall be assumed to be 10 ppm headspace vapor reading. Soil which does not elicit a response of 10 ppm or higher from a properly calibrated and fully functional OVA/FID is considered non-contaminated unless soil laboratory analyses indicate otherwise. As required by Rule 62-770.600, FAC, Site Screening, and described in Section 4.0 of this manual, a minimum of three soil samples must be collected for laboratory analyses at all sites where positive responses on the field instrument are obtained (one representative sample is sufficient if all the screening results are non-detect).

3.3 Establishing Site-specific SCTLs

The following is an abbreviated description of the process for establishing site-specific soil cleanup target levels. More detail and background information is contained in the technical report titled “Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-770, F.A.C” (June 18, 1997 FINAL). This document is available from the Department on request and also available on the Bureau of Petroleum Storage Systems Internet site (www.dep.state.fl.us/waste/programs/pcp/index.htm).

In Florida, soil types vary significantly across the State from quartz sand to muck and, as a result, leaching potential covers a wide range. The default soil characteristics used to develop leachability-based Soil Cleanup Target Levels (SCTLs) (Table IV of Chapter 62-770, FAC, and Appendix A of this manual) lies in the middle of this range. As an alternative to using the Table IV default values, Rule 62-770.650(2)(a)3., FAC, allows site-specific SCTLs for leaching to be determined on the basis of site-specific soil properties or the use of a leaching test to demonstrate that chemicals of concern with concentrations above the Table IV default values will not leach to groundwater at concentrations above their respective groundwater cleanup target levels. It should be recognized, however, that site-specific SCTLs for leachability, calculated using the equilibrium partition equation, can be either higher or lower than the default values because the default assumptions are not skewed toward the conservative end of the range of values possible in Florida. The equation for calculating leachability-based SCTLs is provided in the technical report titled "Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-770, F.A.C".

Site-specific characteristics important in calculating a leachability-based SCTL are the values for the fraction organic carbon in soil, total soil porosity, water-filled soil porosity, and dry soil bulk density. Therefore, it is acceptable to determine the leachability-based SCTL on a site-specific basis by replacing the default values shown in the SCTL equilibrium partition equation with site-specific values for fraction organic carbon in soil, total soil porosity, water-filled soil porosity, and dry soil bulk density. No other parameters (with the possible exception of DAF as described below) may be substituted. If site-specific SCTLs are calculated, all four of these parameters need to be substituted with site-specific data in the equation rather than picking and choosing those parameters with the most favorable result. There may be commercial models available (e.g. SAM) that may be acceptable to the Department which will perform the calculation of the equilibrium partition equation with input of site specific values**.**

It should be noted that the leachability-based SCTL partition equation is for use with organic compounds only. Inorganics, such as metals, present at cleanup sites can also pose risks to an underlying aquifer. Unlike organic compounds, K_d (soil/water partition) values for metals are significantly affected by oily wastes, so FDEP specifically requires TCLP analysis for metals contaminated soils if the contamination is derived from used oil and the concentrations for total metals listed in Table 2 of Chapter 62-770, F.A.C. are exceeded.

Another parameter that is important in calculating leachability-based SCTLs is the dilution-attenuation factor (DAF). The default value for this parameter (20) used by the Department in calculating the leachability-based SCTLs of Chapter 62-770, Table IV (and Appendix A of this manual), was carefully selected using a “weight of evidence” approach which best represents a nationwide average and is therefore regarded as an acceptable default for use at most sites. In special circumstances, a site-specific DAF can be calculated and substituted in the leaching equation along with the other four parameters as described above, but the aquifer hydraulic conductivity, the hydraulic gradient, the mixing zone depth, the infiltration rate, and the source length parallel to groundwater flow must be determined.

In many cases, a leaching test may be more practical and less cumbersome than the partitioning equation method. Therefore, FDEP recommends the use of a leaching test in most instances instead of establishing soil properties and calculating new SCTLs with the soil/water partition equation. For determining site-specific leachate values for organics, the Synthetic Precipitation Leaching Procedure (SPLP) (EPA Test Method 1312) should be used on a minimum of three representative soil samples. The SPLP test was developed to model an acid rain leaching environment and can be used only when the soil contaminants are not resulting from the discharge of oily waste (i.e., used oil or similar petroleum products). If the soil samples are adequately representative of the range of levels of contamination and variability of soil properties, and the leachate concentrations from the SPLP do not exceed the applicable groundwater cleanup target levels of Tables V, VI or VIII of Chapter 62-770, FAC, the soil may be considered not contaminated for leaching considerations. However, the direct exposure criteria of Table IV will still apply to the soil. EPA Method 1312 is an extraction procedure, which must be followed by analysis of the leachate for those chemicals of concern that exceed their respective SCTLs. Because the results of the analyses will be compared to the groundwater cleanup target levels (usually to those specified in Table V of Chapter 62-770, FAC), it is imperative that appropriate detection limits be used during analysis of the leachate.

When considering whether to calculate SCTLs based on site-specific data, or to use the SPLP leaching test to demonstrate that soil with concentrations above the Table IV default values will not leach, the relative benefit gained by the expense of either method should be carefully evaluated. The direct exposure I or II SCTLs listed in Table IV of Chapter 62-770, FAC (and Appendix A of this manual) must still be achieved at the site, either by cleanup or through the use of engineering and/or institutional controls, regardless of the method of determining leaching SCTLs. Because the direct exposure

SCTL criteria must be met at every site, the need for remedial action, engineering controls, and/or institutional controls to meet those cleanup levels may render a previous calculation of a site-specific leaching SCTL using the SCTL equation (or a demonstration by an SPLP test that soil will not leach) of limited or no value. Therefore, the relative benefit of calculating a new leaching SCTL or performing SPLP analysis should be carefully considered within the context of the overall site cleanup strategy prior to deciding to pursue either course of action.

If SCTLs are to be calculated based on site-specific soil characteristics. Samples of soil should be obtained from one or more soil borings in a location, or locations, representative of the variations of lithology in the area of soil contamination. Each soil sample should be analyzed for fraction organic carbon in soil, total soil porosity, water-filled soil porosity, and dry soil bulk density. The results should be submitted to the Department along with the results of the calculation of SCTLs for each sample based on the equilibrium partitioning equation formula. If there is any question of whether the Department will agree with the selection of soil sample locations and depths, a soil sampling proposal along with a description of the site lithology may be submitted to the Department (or contracted local cleanup program) for concurrence prior to conducting the soil borings. It may be advantageous to take soil samples at depths below the existing extent of soil contamination but above the groundwater table to demonstrate the characteristics of soil at that depth will prevent leaching of contamination to the groundwater.

If the SPLP test is performed on samples of contaminated soil to demonstrate the soil will not leach, a minimum of three grab samples from locations with the highest field soil screening results should be collected for each separate and distinct area of soil contamination for which it is proposed the soil be left in place unremediated. Each sample should be split with one portion being subject to the standard soil analysis and the other for the SPLP. The results should be submitted to the Department along with a site map showing the area(s) of contaminated soil, sample locations of previous field method and analytical sampling, results of previous field method and analytical sampling, and locations of the supplemental samples for SPLP analysis. A description of the site lithology and explanation that the SPLP samples are representative of both the highest levels of soil contamination which will be left in place and variations in soil characteristics should be provided. As with the collecting of data for site-specific soil properties described in the previous paragraph, if there is any question of whether the Department will agree with the selection of soil sample locations and depths, a soil sampling proposal along with a description of the site lithology and soil assessment results (field screening and analytical) may be submitted to the Department (or contracted local cleanup program) for concurrence prior to conducting the soil borings. In situations where soil samples need to be collected utilizing a drill rig or direct push technology, it may be more cost-effective to obtain an additional set of samples for SPLP testing during the soil screening than to remobilize to the site. If this procedure is followed, it is essential to make sure that analyses are performed rapidly to ensure that if SPLP testing is necessary, the extraction and subsequent analysis of the leachate are performed within acceptable holding times.

For information on determining site-specific SCTLs for direct contact considerations, and additional information on determining site-specific SCTLs for leaching considerations, see the technical report titled “Development of Soil Cleanup Target Levels (SCTLs) for Chapter 62-770, F.A.C”.

3.4 Hazardous Waste Status

Petroleum dispensing facilities and petroleum products are specifically exempt from most Resource Conservation and Recovery Act (RCRA) hazardous waste regulations. Contaminated soil from these facilities, therefore, cannot be considered listed hazardous waste. Five specific categories of petroleum refining wastes are listed as hazardous wastes in 40 CFR 261:

a) dissolved air floatation float;
b) slop oil emulsion solids;
c) heat exchanger cleaning sludge;
d) API separator sludge;
e) leaded tank bottom sludge.

These refining wastes normally should not be encountered at petroleum cleanup sites. However, if soil were to become contaminated with these materials, that soil would become a hazardous waste. If the soil fails one of the four hazardous characteristic tests: ignitability, corrosivity, reactivity, or toxicity (EPA Methods 1010 or 1020, 1110, SW846 Sections 7.33 [Cyanide] and 7.34 [Sulfide], and 1311, respectively), the soil also could be considered hazardous. It was assumed that petroleum contaminated soil would not be corrosive or reactive. A solid would be considered ignitable if it met the following definition (40 CFR 261.21): "...is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes and when ignited, burns so vigorously and persistently that it creates a hazard." Petroleum contaminated soil may be assumed to not meet this subjective definition. The soil would be considered toxic if the leachate from the soil fails the Toxicity Characteristic Leaching Procedure (TCLP) test for one of eight metals, six pesticides, or 25 organic compounds; however, the Toxicity Characteristics (TC) final rule specifically exempts petroleum contaminated media and debris from petroleum Underground Storage Tank (UST) corrective actions that are subject to Subtitle I of RCRA. In summary, petroleum contaminated soil from USTs is not a hazardous waste under any of the current RCRA regulations.

4.0 Soil Screening

4.1 Petroleum Contamination Field Soil Screening Standard

Until the time that other methods are accepted as described in Section 3.2 and Appendix B, the OVA/FID jar headspace method should be used for performing field soil screening. The following is a description of the proper application of this method. The method consists of "... sampling the headspace in half-filled, 16-ounce jars. Each soil sample shall be split into two jars, the two samples shall be brought to a temperature of between 20°C. (68°F.) and 32°C. (90°F.) and the readings shall be obtained five minutes thereafter. One of the readings shall be obtained with the use of an activated charcoal filter unless the unfiltered reading is non-detect. The total corrected hydrocarbon measurement shall be determined by subtracting the filtered reading from the unfiltered reading." Temperatures that are higher than the minimum temperature should indicate higher readings and therefore will represent a conservative error. Cooling is required only if the sample's temperature exceeds 32°C. (90°F.). An effort should be made to take all samples from a site at a constant temperature, preferably as close to 20°C. as possible. The most common practice in the field is to use 16-ounce mason jars, with the solid lid replaced with a layer of tin foil. The OVA probe is inserted through the foil after the sample temperature has equilibrated, and the highest reading on the gauge should be noted.

Before an organic vapor analyzer other than an FID is acceptable for the screening of contaminated soil, it must be correlated with an FID instrument. The required correlation procedure consists of simultaneously obtaining readings with an FID and the instrument that is being correlated, at several different organic vapor concentrations. The readings also should be taken at varying humidity levels. A suitable container such as a Tedlar® bag, with the appropriate attachments (valves, tubing, etc.), should be used to obtain the necessary vapor concentrations and subsequent instrument readings. The data then should be presented graphically and forwarded to the Bureau of Petroleum Storage Systems for evaluation. A list of the instruments that are acceptable based on credible correlation data will be maintained by the Bureau of Petroleum Storage Systems, and will be available upon request.

4.2 Perspective on Contaminated Soil Field Screening Data

The criteria for "contaminated" and "excessively contaminated" soil that appeared previously in Chapter 62-770, FAC, and previous editions of this manual, were somewhat arbitrary because they did not take into consideration other site-specific factors that will affect the likelihood that the soil will be a significant source of groundwater contamination if left in place. The potential to contaminate groundwater will be related to soil characteristics, depth to groundwater, existence of a confining layer, how long the soil has already been contaminated, surface covering of the site, etc. Consideration also must be given to risk from direct exposure to the contaminated soil.

The soil type and characteristics, environmental factors such as temperature and humidity, and also operation variability, may affect the relative reading on the field instrument. For this reason, and also in consideration of the general precision of the OVA/FID method and other field instruments, field data should be considered a useful tool for determining boundaries of soil contamination and distribution of contaminant mass, but numerical standards for readings of field instruments alone are not considered a valid means of making remediation, source removal, and site cleanup completion decisions. When performing preliminary screening activities, it is usually not possible to consider all the factors that affect remediation decisions. During development of a comprehensive cleanup strategy in the Remedial Action Plan (RAP), these other factors may be given more detailed consideration. The RAP may consider more practical and less costly soil cleanup methods than excavation, and the feasibility of engineering or institutional controls as an alternative to remediation may also be considered. For these reasons, source removal activities prior to completion of a RAP should generally be limited to immediate response to a recent petroleum release and soil removal necessary for tank removal/installation or other construction activities. An exception to this policy may be in those instances when it has been determined during development of the Site Assessment Report (SAR) that a site would qualify for Natural Attenuation monitoring or No Further Action if a relatively small quantity of contaminated soil is removed, as detailed in Section 5.0. In this case it may be advantageous to perform soil source removal during site assessment so that the SAR may be concluded with a recommendation for No Further Action or monitoring of Natural Attenuation.

4.3 Soil Assessment Strategy

The horizontal and vertical extent of contaminated soil must be defined during the site assessment as required by Rule 62-770.600, FAC, Site Assessment. This task should be accomplished primarily with field soil screening instruments or methods, complemented with several soil samples for laboratory analyses to verify and correlate the field screening data. Each field instrument or method approved for use by the Department will have a lower range of reasonable detection established at the time of equipment acceptance. For the OVA/FID method, this lower limit will be 10 ppm vapor headspace reading until the OVA/FID method is reevaluated. Soil assessment should continue until the lower range of reasonable detection of the instrument or method has delineated the apparent boundary of the area of soil contamination.

QA/QC procedures for users of field screening methods are contained in Appendix E of this manual. Documentation that the QA/QC procedures were followed must be provided, along with soil screening data in the SAR or in the Source Removal Report.

The soil samples may be collected in a number of ways. The most common methods include the use of hand augers or split spoon samplers to collect samples during drilling, or the use of spoons to collect samples from the sides of an excavation. Direct push type techniques are gaining increased frequency of use and are considered acceptable to the Department. In all cases, correct decontamination procedures must be followed. The use of an in-situ soil gas procedure has been proposed by several consultants. Conducting the soil assessment by an in-situ soil gas survey may be acceptable if a proposal describing the data collection and evaluation process is first submitted to the Department (or contracted local cleanup program) for approval. The rationale for this decision must also be discussed in the SAR.

The number of samples required must be determined in the field on a site-specific basis. A general soil sampling procedure that should be followed during soil assessment is as follows. Start sampling at and/or around a location where it is suspected that the source of contamination exists. If necessary, sample from the first soil boring outward in a grid pattern, at 20 foot intervals, until the perimeter of the area of soil contamination is defined. Sampling at less than 20 foot horizontal intervals may be necessary if soil concentrations are changing rapidly over distance or the apparent boundary of soil contamination is reached. For very large areas of soil contamination such as distribution and bulk facilities, horizontal sampling intervals of greater than 20 feet may be appropriate; however, a proposed horizontal screening interval of greater than 20 feet should be verified as appropriate with the Department or contracted local cleanup program prior to conducting the field soil screening.

For shallow water tables of less than six feet, vertical sampling should be performed at one or two foot intervals, where at least two samples are collected from the vadose zone at each location, until approximately one foot into the water table. For areas with deeper groundwater tables, vertical sampling near the source area should be performed at every other foot to ten feet, and every five feet thereafter. As the lateral delineation continues, the vertical sampling interval can be adjusted to focus soil screening activities at the elevations of concern (the depths where positive OVA responses were observed at or near the source areas). In every case, the first sample should be collected approximately one foot below land surface. The records of field instrument readings should clearly identify which samples were collected near the saturated zone (where the degree of water saturation may have affected the field instrument readings).

To some degree, the interpretation of results obtained from samples taken at or immediately above the groundwater table depends on the distribution of soil contamination in the rest of the vadose zone. If the soil above the groundwater table (generally greater than one foot) is contaminated, it can generally be assumed that the soil extending down to the groundwater table is contaminated as well, and samples for field soil screening taken at the capillary fringe can validate this assumption. It is not unusual for volatilization from the contaminated groundwater plume to cause soil gas readings immediately above the groundwater table. For areas where the soil column extending down to the water table is clean or has relatively low levels of contamination, a higher reading from a sample taken in the capillary fringe would not necessarily be considered a valid indication that the soil was a source of contamination that justified a source removal action.

While collecting soil samples for field screening, consideration must be given to the requirements of Rule 62-770.600(3)(e), FAC, and described in Section 4.4 of this manual, to obtain additional samples for laboratory analyses that represent soil with high, medium, and low field soil screening results. A strategy should be developed for determining the means for collecting the representative samples for laboratory analyses in the most efficient and least costly manner. The two extremes of possible strategies might be the following. One is to collect one duplicate for every sample taken for soil screening and to select only those duplicates for laboratory analyses that correspond to the high, medium, and low soil screening results once all the field soil screening is complete. Another approach would be to complete the soil screening and then go back and do additional borings to collect samples for laboratory analyses at some of the locations where high, medium, and low screening results were obtained. This latter strategy could be increasingly costly with increasing depth of the soil contamination. The best strategy may be a compromise in which duplicates are collected for some but not all of the soil screening samples. In that case, the frequency of duplicates should be related to the background information which might be available on which to base assumptions of the extent and degree of soil contamination, to the depth of soil contamination and to other site-specific variables. Whatever strategy is used, soil samples should be properly and expediently handled to minimize loss due to volatilization.

4.4 Soil Samples for Laboratory Analysis

The previous sections described the procedures for determining the extent and relative degree of soil contamination. This task is accomplished by means of field screening methods such as an OVA/FID or similar screening technique approved for use by the Department.

Rule 62-770.600, FAC, Site Assessment, also requires that soil grab samples be collected during the site assessment for laboratory analyses, and that site rehabilitation completion be determined on the basis of laboratory analysis results of confirmatory soil samples to demonstrate that the soil cleanup criteria have been achieved. The cleanup criteria can be found in Table IV of Chapter 62-770, FAC, and also in Appendix A of this manual. The required analytical techniques can be found in Tables I, II and III of Chapter 62-770, FAC, and in Appendix C of this manual.

It is the intent of the Department that the use of field instruments be maximized to delineate the extent of soil contamination in order to minimize the number of soil samples submitted for laboratory analyses. A minimum of three soil samples from areas of high, medium, and low field screening results (Rule 62-770.600(3)(e), FAC) should be taken for laboratory analyses per plume area at least once during site assessment in order to validate field screening data and establish the actual concentrations of contaminants in soil relative to cleanup criteria. If there are no positive responses during the soil screening, one sample for laboratory analysis will be considered sufficient. This sample should be collected from the contamination source area. If information is not available regarding the depth of the suspected discharge, or if there is suspected surface spillage, then the sample should be collected from within two feet of the ground surface. However, if the discharge is suspected to have occurred at depth (such as ruptured line or fuel tank), then the soil sample should be collected at the depth and location suspected to have been most impacted.

The following is a summary of the procedure for selection of sample locations for validation of field data (and correlation of field data with laboratory data). The samples selected shall correspond to soil for which high, medium, and low readings were obtained with the field instrument or method. “Medium” refers to the soil sample location and interval where a soil sample was obtained that corresponds to a field instrument reading that was near the average of the readings. “High” refers to the sample location and interval where a soil sample was obtained for which the field instrument reading was one of the highest readings. Some judgment is involved in selecting a sample to represent the “high” field screening sample if there are several soil samples which are above the detection range of the field instrument, but one of the samples above the range of detection should be selected for the “high” laboratory analysis sample. “Low” refers to a sample location and interval where a soil sample was obtained for which the field instrument reading was among the lower screening results collected but above background (> 10 ppm for the OVA).

The actual number of laboratory samples should be based on the horizontal and vertical extent of contamination and how well the field soil screening results correspond with laboratory results. It is difficult to generalize because many factors may affect the need for additional soil samples for laboratory analyses, (including poor comparison with the field instrument data). As a rule of thumb, a minimum of one sample for laboratory analyses should be obtained for every 20 field soil screening samples (5%). When deciding whether to collect greater than 3 samples or (5% of the number of field screening samples, whichever is greater) for lab analyses, consideration should be given to the potential cost for revisiting the site later to collect more samples for laboratory analyses should the results of the initial samples collected be inconclusive. If additional samples are collected, these samples should either be analyzed along with the primary samples or the primary samples should be analyzed expediently such that the results may be obtained and the need for analysis of the supplemental samples given consideration prior to the expiration of the holding time for the supplemental samples.

At sites where soil contamination has been confirmed from laboratory results, but it has been demonstrated that vadose zone soil contamination is not detected by field soil screening devices, then the extent of the soil contamination will need to be defined by laboratory analyzed samples.

The soil cleanup criteria in Table IV of Chapter 62-770 are applicable to vadose zone soils. However, it may be desirable to take soil samples from below the groundwater table for laboratory analysis as well. If Natural Attenuation monitoring will be considered as a remediation strategy and the criteria in Rule 62-770.690(1)(e), FAC, are not met, then samples for laboratory analyses must be obtained at two foot intervals below the groundwater/soil interface and every four feet thereafter to the depth of the shallow groundwater monitoring wells at the high, medium and low soil boring locations. These data are necessary in order to estimate the total initial mass of contamination in the smear zone. Section 4.7 and Appendix F contain guidance on the selection of sample locations for this smear zone and describe suggested methods for calculation of mass in the smear zone. This information on contaminant mass in the smear zone also may be valuable for other cleanup decisions (see section 4.6 below).

Additional analyses may be necessary for soil that is excavated and transported to a commercial soil treatment facility. Sample frequency requirements and analytical methods for various commercial treatment technologies are described in other department rules applicable to the method of disposal.

If there is any potential for the soil to contain a hazardous waste or hazardous substance, then screening analyses for other chemicals of concern should be performed. These analyses may include: corrosivity, reactivity, toxicity characteristic constituents by TCLP for metals and organics, organic halogens, and PCBs.

4.5 Estimation of Contaminant Mass

The nature of the distribution of petroleum contamination in soil on sites (potentially high variability over short distances), and the inherent limitations of interpreting a limited number of data points, does not lend itself to estimating total contaminant mass and distribution of the mass with a high degree of precision. The process relies on inference and extrapolation of data and judgment in estimating data elements where there is great variability and a high margin of error. Nonetheless, this information could significantly increase the quality of decision-making of remediation strategy when compared to relying on monitoring well data and field soil screening data alone. The information on the quantity of contaminant mass on site and the distribution of the mass is important to considering remediation alternatives, evaluating cleanup progress, and using groundwater models to evaluate natural attenuation or risk-based site closure proposals. Significant source mass on site that is unknown during remedial design can significantly increase the timeframe and cost of remedial action. Rule 62-770.600(2)(d), FAC, includes the following as an objective of the Site Assessment: “To estimate the total mass and mass distribution of petroleum or petroleum products in the subsurface as product entrapped above the water table, free product, and product entrapped below the water table.”

4.6 Level of Effort to Estimate Contaminant Mass

The level of effort used to estimate the contaminant mass during site assessment should be established based on a combination of field soil screening data, soil laboratory analytical data, site historical information, and the anticipated site remediation strategy. In general, an understanding of the quantity and distribution of contaminant mass leads to better cleanup decisions, more effective designs, and more accurate predictions of remediation timeframes, whether remediation is by active remedial action or natural attenuation. The degree of the benefit will vary from one site to the next and the additional cost associated with estimating the mass and mass distribution will be more readily justified in some instances than in others. A degree of judgment is necessary to establish the appropriate level of effort associated with estimating the quantity and distribution of contaminant mass on site. It should be emphasized that the expected savings in remediation costs should outweigh the additional cost of the mass estimation effort. Appendix F describes several techniques that may be considered for estimating contaminant mass. Each method has a corresponding level of complexity and cost. In some cases, the estimation of contaminant mass by following any of the methods described in Appendix F of this manual is not necessary.

On preapproval program sites, the Department will authorize the scope of activities for estimating mass and mass distribution on a case-by-case basis when the anticipated benefits will outweigh the costs. The level of effort for mass estimation on voluntary cleanup sites should be based on the site specific conditions. In some cases it may be adequate for the consultant to provide a "best guesstimate" of the mass of petroleum and the mass distribution without using the techniques described in Appendix F, and instead base an approximation on a combination of historical information on the volume of the release, interpretation of field soil screening data, and experience. However, estimation of mass and mass distribution using the techniques described in Appendix F is strongly encouraged when cost-effective and appropriate.

The following major points need to be considered when determining the level of effort for estimating contaminant mass:

- the degree and extent of soil and groundwater impacts based on soil screening and groundwater sampling results
- available information on the quantity of petroleum discharged and the probable distribution based on historical site assessment information and the nature of the release
- the anticipated site cleanup strategy

Appendix F contains procedures for estimating the contaminant mass in four phases: vadose zone, floating free product, smear zone, and dissolved phase. The following is general guidance to establish the level of effort associated with estimating the mass and mass distribution in these phases.

1) Whenever the amount of floating product in monitoring wells exceeds the definition of "free product" (greater than 0.01 feet in thickness) in two or more monitoring wells, the quantity of floating product should be estimated using the procedure in Appendix F.

2) Source mass estimation of the smear zone is generally applicable if the groundwater concentrations exceeds 3,000 ug/L Total VOA in one or more monitoring wells.

3) If the quantity of a relatively recent petroleum release at a site is known, and the available screening information allows valid conclusions as to the relative distribution of the petroleum mass (for example, low groundwater concentrations indicate there is no substantial smear zone, suggesting the majority of the mass is in the vadose zone), then conclusions may be made on this information alone without the need for collecting supplemental field data and following the mass estimation procedures described in Appendix F.

4) In general, if excavation of source material is being considered, the value of estimating source mass and mass distribution following the procedures of Appendix F may have value in proportion to the anticipated excavation quantity. As a rule of thumb, use of the source mass estimation procedures of Appendix F should be considered if it is anticipated that greater than 500 cubic yards will be excavated. The additional information may allow more strategic and effective excavation and also will allow for more informed consideration of in situ alternatives to excavation.

5) Estimation of the source mass and mass distribution will have greater value if natural attenuation monitoring will be proposed as a cleanup remedy but the site does not meet the natural attenuation default criteria of Rule 62-770.690(1)(a) through (e). If the site already qualifies for the default criteria for natural attenuation of Rule 62-770.690(1)(a) through (e), source mass estimation in the saturated zone should not be necessary and source mass estimation in the vadose zone may not be necessary, depending on the proximity of the contaminated soil to the groundwater table.

6) If active remediation of the site is proposed, estimating the source mass and mass distribution is beneficial to determining the most cost-effective and appropriate remediation method, and establishing a contamination baseline as well as establishing design details. At a later time, the rate of removal of chemicals of concern can be compared to the total contaminant mass as a means to evaluate cleanup progress and determine an appropriate time to modify the cleanup system or switch from active remediation to remediation by natural attenuation. Estimation of mass and mass distribution in the vadose zone is encouraged if active remediation will be proposed. Estimation of mass and mass distribution in the smear zone is recommended if there are one or more wells with levels of Total VOA of 3,000 ug/L or greater.

4.7 Process to Estimate Contaminant Mass

The field soil screening data, laboratory analysis results of soil samples, and other site assessment information may be used to develop an estimate of contaminant mass in four zones of the site; the vadose (unsaturated) zone, floating free product, product entrained in the smear zone below the groundwater table at the time the soil screening is conducted, and dissolved phase. In most cases, the dissolved phase is insignificant compared to the other phases and may be disregarded. A different technique should be used for each of these zones of contaminant mass, with suggested techniques described in Appendix F. Whenever possible, information that is available on the volume of petroleum that had been released should be used to validate and adjust the mass estimates that are based on interpretation and inference of limited field data. Appendix F describes two separate suggested techniques for converting individual soil screening data points in the vadose zone to estimates of the total mass of petroleum contamination in the vadose zone. Appendix F also describes procedures for interpreting monitoring well product thickness information to estimate the total mass of floating product. There are also procedures described for estimating the mass of petroleum in the smear zone below the groundwater table based on a combination of monitoring well data and representative soil samples. As described in section 4.6 above, less detailed and costly (in terms of laboratory analysis of soil samples) methods for estimating mass may be appropriate for some sites, but as a minimum, the mass in each phase needs to be estimated based on historical release information, site screening information and professional judgment.

5.0 Source Removal Activities

Rule 62-770.300, FAC, Source Removal, provides authorization for source removal actions at petroleum sites where free product or soil contamination is present. Only excavation of contaminated soil and free product recovery following the methods described in Rule 62-770.300(1)(b), FAC, are allowed without prior approval of the Department. Several more aggressive techniques may be used if prior approval from the Deparment is obtained as described in Rule 62-770.300(1)(c), FAC. The authorization of this section of the rule is not intended to allow responsible parties to begin other remedial action activities without Department approval. While developing a SAR and RAP for the entire site, or while performing tank removal or other construction activities, the source removal provisions of Chapter 62-770, FAC, do allow immediate action to minimize the source of contamination. The following paragraphs provide a discussion of the appropriate rationale for performing source removal activities.

There are three general situations in which removal of soil prior to RAP approval would be warranted:

1. **Tank removal or installation or other construction activity:** When removing petroleum storage tanks at a site, petroleum contaminated soil may be encountered. If excavation of contaminated soil is necessary for the construction activity, consideration should be given to the treatment or disposal of the contaminated soil if it will make a meaningful and cost-effective contribution to the rehabilitation of the site. If there is significant soil contamination remaining such that the treatment or disposal of the excavated portion will not contribute significantly to the site rehabilitation, contaminated soil may be used for backfill if suitable for construction material. Unless the soil contamination was a recent occurrence (see item 2. below), or the site will qualify for Natural Attenuation Monitoring or No Further Action as a result of the removal of the contaminated soil (see item 3. below), soil removal should be limited to that necessary for the construction or tank related activity. This decision involves some professional judgment as to the amount of soil being left in place. If a relatively small amount will remain it may be appropriate to remove it during the tank removal or construction activity.

2. **Immediate response to a release:** If a spill or release occurs, it is generally appropriate to recover as much petroleum contamination as possible, as quickly as possible. Initial dispersion and leaching is relatively rapid and eventually slows down considerably to form a relatively stable soil and groundwater contamination plume. The removal of contaminated soil soon after the release, before it has dispersed or impacted groundwater, will significantly reduce the cleanup time and cost. Initiation of product recovery for a new release is required by Rule 62-770.300, FAC, Source Removal, and the Department encourages an immediate and timely response to new soil contamination as well (See Appendix G concerning emergency response procedures).

If the soil contamination has been in existence for some time, however, it may not be justified to implement source removal activities for the sole purpose of contaminated soil removal. After the contamination has existed for several weeks or longer, the soil plume movement and dispersion may have stabilized and groundwater may already have been impacted. Significant soil removal at this point may not be justified if a RAP will be necessary anyway. It should be possible to complete the SAR and RAP to recommend a comprehensive and cost-effective remediation strategy for both soil and groundwater before the impact from soil contamination advancing significantly. The relative change in the status of site contamination during this period generally will not be significant enough to justify excavation which may be more costly than other strategies of soil remediation that may be evaluated in the RAP.

3. **Qualifying for No Further Action:** A site scenario that occurs frequently is when the screening data indicate that the groundwater concentrations of chemicals of concern are below the applicable cleanup target levels and that the site would qualify for No Further Action without conditions or restrictions such as institutional or engineering controls in accordance with Rule 62-770.680, FAC, No Further Action, except for the existence of contaminated soil. If the volume of soil is not significant, usually it is appropriate to remove that soil so the SAR may be concluded with a recommendation for No Further Action, eliminating the need to prepare a RAP for soil remediation. Some professional judgment is necessary, however, relative to the volume of contaminated soil appropriate to be removed. If there is a large volume or the location/depth of the soil may make the cost of excavation prohibitive, it may be better to prepare a RAP to evaluate cost-effective alternatives to excavation.

There may also be instances where, at the conclusion of the site assesment, it is determined that the soil and groundwater contamination are relatively limited in area and the contaminated soil exceeding the Leachability Cleanup Target Levels found in Table IV of Chapter 62-770, FAC, constitutes a continuing source of groundwater contamination. This scenario could occur when phase separate product contamination exists below the groundwater table because a smear zone was created by a fluctuating groundwater table. In this instance, soil excavation (including soil below the groundwater table) as a source removal activity may be justified if it could contribute to site remediation by Natural Attenuation in accordance with Rule 62-770.690, FAC, in a reasonable time frame. In such a case, source removal may allow the SAR to be concluded with a recommendation for monitoring of natural attenuation and thus eliminate the need for preparing a RAP. It is important to reliably determine the extent of soil contamination because a source removal activity that leaves significant contaminated source material on site may have little effect on the time frame needed to reach site rehabilitation completion by natural attenuation.

The following are requirements of Rule 62-770.300, FAC, Source Removal, to ensure that source removal activities do not result in spreading of the contamination:

1. Soil Excavation (and landfarming, or disposal at a permitted commercial treatment facility or landfill) is the only allowable soil remediation option during a source removal activity conducted prior to RAP approval, unless prior written approval from the Department is obtained in the form of an Alternative Procedure Order. Other remedial measures such as vacuum extraction, soil washing, and on-site bioremediation, require design considerations that must be addressed in a RAP or an Alternative Procedure.

2. A Source Removal Report must be completed within 60 days following the source removal activity and submitted to the Bureau of Petroleum Storage Systems (or contracted local cleanup program office). The report will not be considered complete without the information identified in Rule 62-770.300(3)(b), FAC. This report must be detailed in nature as it will be reviewed for its technical merit and compliance with Chapter 62-770, FAC.

3. The disposal option should be identified before excavation takes place. Stockpiling soil during a source removal activity or during active remediation should be limited to 60 days or less, as required by Rule 62-770.300, FAC. The Source Removal Report must be accompanied by documentation of proper disposal or treatment. Rule 62-770.300, FAC, Source Removal, states that during source removal activities, contamination should not be spread into previously

uncontaminated areas through untreated discharges or improper treatment or disposal techniques.

4. Although free product recovery is required in most cases as a source removal activity, removal of contaminated soil is not mandatory prior to preparation of a RAP.

5. The removal criteria for soil during a source removal activity for a site that has been contaminated with used oil, are based upon visual appearance and odor. Part of the rationale for allowing visual appearance and odor as justification is that the volume of soil contaminated with used oil is usually small. This reality is due to the smaller size of used oil storage tanks and to the fact that used oil is more viscous than gasoline or diesel and does not migrate as readily through the soil matrix. Additionally, the low volatility of used oil makes it unsuitable for detection with the OVA/FID and some other field soil screening instruments. For sites that have a significant volume of soil contaminated with used oil, the Department should be contacted for supplemental assessment guidance. Ultimately, site cleanup completion of all petroleum contaminated sites, including those sites contaminated with used oil, will be on the basis of soil analytical results and the Table IV cleanup criteria.

5.1 Thermal Treatment

Since the soil guidance document was first issued in January 1989, a number of changes affecting thermal treatment of petroleum contaminated soil have been initiated. These changes include the adoption of Chapter 62-775, FAC, Soil Thermal Treatment Facilities, and Federal requirements finalizing the Toxicity Characteristics (TC) regulations.

Chapter 62-775, FAC, Soil Thermal Treatment Facilities, requires the issuance of a general permit for handling, storing and testing of petroleum contaminated soil that will be thermally treated; describes proper operations at the treatment facility; and places recordkeeping requirements on these facilities. Chapter 62-775, FAC, should be consulted for specific details. Consideration may be given to consolidating the sampling requirements of Chapter 62-775 for pretreatment soil analysis with the need for laboratory analysis of soil samples for the site assessment to reduce analytical cost, as long as the requirements of both Chapter 62-775, FAC., and Chapter 62-770, FAC., are achieved.

Appendix H is a list of commercial treatment facilities that are permitted to operate under Chapter 62-775, FAC, Soil Thermal Treatment Facilities. Petroleum contaminated soil may also be taken to out of state facilities; however, those facilities must be permitted by the state in which they are located.

5.2 Landfilling

Landfilling of soil that is not considered to be hazardous waste, in a permitted lined landfill, is an acceptable disposal option with acceptance at the discretion of the landfill operator. If the soil meets the criteria outlined in Section 3.4, then the soil would be considered hazardous. If the soil is considered hazardous waste, then the soil should be disposed in accordance with state and federal hazardous waste regulations.

5.3 Land Farming

In some cases, treatment of petroleum contaminated soil may include land farming. This method is generally appropriate for limited quantities of soil at sites with suitable space, and if it is possible to leave the excavation open during land farming. The process involves spreading the soil in a thin layer over an impermeable liner or surface. The reduction in concentrations of chemicals of concern is caused by a combination of volatilization, biodegradation and photodegradation. The following requirements of Rule 62-770.300, FAC, Source Removal, must be met:

1. The land farm operation must be at least 200 feet from any residence, school or park.

2. An area large enough to spread the soil to a thickness of six to 12 inches must be available [on the same property as the source of contaminated soil unless it is land farmed at a permitted stationary facility].

3. The land farming area must be secured in a manner that prevents accidental or intentional entry by the public and prevents human exposure to contaminated soil. [Consideration should be given to fencing the land farming area if in a residential area or otherwise likely to be frequented by the public].

4. The materials used to construct the land farm treatment area must withstand the rigors of the land farming and weather. [Black plastic at least 10 mils thick is recommended.]

5. The land farmed soil must be placed over an impermeable liner or surface, and surrounded at all times by an impermeable liner supported by berms.

6. The land farmed soil must be tilled at least biweekly.

7. The land farmed soil must be covered when not being tilled to prevent water from entering or leaving the area. [These surface water controls (such as an impermeable plastic cover) must be maintained throughout the land farming operation to prevent water from ponding in the bermed area].

8. A monitoring and sampling program must be established to evaluate the effectiveness of the land farming operation and the effect on the environment, including monitoring of groundwater to confirm leaching is not occurring and of off-gas emissions for air regulatory compliance. The monitoring and sampling program, design specifications of the treatment area, and types and amounts of any proposed additives to the soil, must be submitted for approval by the Department or by the appropriate local program before the land farming operation commences. Prior approval is not required for quantities less than 20 cubic yards, but the design specifications and results of the monitoring and sampling program must be submitted in the Source Removal Report.

9. Land farming of soil is limited to 180 days, at the end of which time proper disposal is required except if written approval to exceed this time frame is obtained from the Department or from the appropriate local program.

10. Land farmed soil that does not exceed the lower of the direct exposure I and Leachability Table V cleanup target levels specified in Table IV may be disposed on or off site, as appropriate. Land farmed soil that exceeds the applicable cleanup target levels in Table IV may not be disposed or returned to the original excavation without written approval from the Department or from the appropriate local cleanup program. [Alternative cleanup target levels may be approved for soil disposed in the original area of contamination if prior written approval is granted from the Department (or from the appropriate contracted local program). The Department's experience is that land farming will be effective at reducing the organic chemicals of concern to the required cleanup standards with the exception of Total Recoverable Petroleum Hydrocarbons (TRPHs). If the cleanup target level for TRPHs has not been achieved after other parameters are below the required cleanup levels, the Department should be notified of the analysis results along with a proposal to dispose of the soil in the original excavation or by other appropriate disposal method. Disposal of soil exceeding cleanup target levels back into the original excavation may be subject to the implementation of engineering and/or institutional controls].

11. Land farming must be conducted in accordance with other applicable Department rules and local ordinances.

Permitting requirements for permanent commercial land farming or bioremediation operations or any land farming operation or bioremediation operation that will treat soil from other contamination sites should be as described in applicable Department rules.

5.4 Alternative Procedures

Some activities that may be conducted following approval of a RAP by the Department are prohibited as a source removal activity prior to RAP approval unless prior approval as an Alternative Procedure is obtained. There are limited circumstances where these activities may be justified to be performed as an interim source removal measure. Before implementation, a request for approval of Alternative Procedures must be submitted to the Bureau of Petroleum Storage Systems as described in Rule 62-770.890, FAC. If the Department agrees with the rationale for the action, an Order approving the Alternative Procedure(s) will be issued by the Department. This requirement pertains to the following activities:

1. Use of any in situ means for treating contaminated soil, such as vacuum extraction, bioventing, bioremediation, and soil washing. Such remediation measures require approval of engineering design prior to implementation. An exception would be when soil vapor extraction is necessary to abate an imminent threat to human life, health, safety or welfare within a structure or utility conduit, as per Rule 62-770.300(2)(a)3., FAC.

2. Use of any on-site unpermitted treatment technologies for excavated soil (such as bioremediation and soil washing) that are not specifically described as suitable for source removal activities in Rule 62-770.300, FAC. Low-tech bioremediation enhancements to conventional land farming may be acceptable without the need for an approval of Alternative Procedures. The Bureau of Petroleum Storage Systems should be contacted for guidance.

3. Some amount of groundwater recovery along with free product recovery may be unavoidable, but any system that recovers significant groundwater such that a treatment system is necessary, or that requires significant storage and frequent water disposal, is not permissible without prior Department approval. Rule 62-770.300(1)(b)4., FAC, describes this limitation as the use of “fluid vacuum techniques (for example, vacuum pump trucks) or total fluid displacement pumps when the volume of groundwater recovered is not greater than two times the volume of free product recovered, except that the first 1,000 gallons of the total fluid recovered per discharge are exempt from meeting the required ratio of groundwater to free product.” Groundwater recovery and treatment beyond the scope described above may not be performed as a source removal activity prior to the Department’s approval of a RAP. This prohibition does not apply to pump

tests of a limited duration (generally three days) or to dewatering that is necessary for construction purposes.

6.0 Active Remediation

The following section is a brief description of various technologies currently available for the remediation of petroleum contaminated soil. In lieu of providing a lengthy description for each method, a list is provided of in-depth reference materials to aid in the selection of the appropriate technology and final system design. Additional guidance is also available in the Department's "Guidance Manual for the Review of Petroleum Remedial Action Plans".

6.1 Vacuum Extraction

This technique is used to remove volatile organics from the soil, and free product from the top of the water table. Generally used in situ, it can reduce significantly the degree of soil contamination and enhance further treatment with the intent to reduce cleanup times and subsequent costs.

The extraction is accomplished by applying a vacuum to a well or series of wells, constructed above the water table in the unsaturated or vadose zone. The vacuum draws air to the well(s) from the surrounding soil. As fresh air is brought into the formation, volatile chemicals of concern move from the soil into the air, and are removed by the vacuum. The Department's current policy is that air emissions treatment is mandatory for the first one month of operation. Continued air emissions control after one month is determined based on samples of air emissions and effective capture of the contaminant plume. Air emissions control may be discontinued if the amount of total VOCs from the site is less than 13.7 lbs/day at the appropriate operating condition. As an alternative to this method to determine when air treatment may be discontinued, dispersion modeling of the vent gases may be performed on a case-by-case basis using the **TSCREEN** model. The most appropriate method of air emissions treatment will depend on the concentration of recovered vapors and air flow rate. A pilot study is useful in establishing this information in addition to determining the radius of influence.

The **TSCREEN** model is an IBM-PC based program. At a minimum, the following hardware are required to use the model:

- IBM-PC compatible with at least 640 KB of RAM and a 3½ inch double-sided, high-density disk drive,
- a math coprocessor chip, and
- a minimum of 5 MB hard disk available storage.

The Department has issued some general guidelines, to be used when running the **TSCREEN** model. These guidelines are part of the Engineering Support Section's guidance memorandum BPSS-__.

TSCREEN can be obtained from the following sources:

1) EPA's Support Center for Regulatory Air Models Bulletin Board System. The telephone number for access by modem is 919/541-5742.

2) NTIS (for a nominal charge). The telephone number is 703/487-4650.

3) Internet. The address is "TELNET TTNBBS.RTPNC.EPA.GOV".

In order to run the **TSCREEN** model, the following parameters must be known:

- stack height (meters)
- stack diameter (meters)
- stack gas velocity (meters/second)
- stack gas flow rate (cubic meters/second)
- emission rate (grams/second)

Upon obtaining the computer output, the maximum concentration listed should be multiplied by a factor of 0.7, and this result can be compared to the Acceptable Ambient Concentration (AAC) as explained in the air stripping policy memorandum. The Bureau of Air Regulation may be contacted for information about the model.

Air flow through sections of the vadose zone might be enhanced by installing vent wells at the perimeter of the contaminated soil area. Vacuum extraction is of limited use in areas with very tight soil formations (low permeability). Thin unsaturated zones are also a limitation but may be overcome by using horizontal vacuum wells. Vacuum extraction is generally less effective in soil contaminated with diesel than with gasoline. A cap may be required on the ground surface to prevent air from being drawn down the outside of the well casing or other surface features that could result in air short circuiting.

The radius of influence of the vacuum wells is the most important design factor. To determine the radius of influence, a pilot study with a vacuum well and several closely spaced vacuum monitoring wells is suggested. If the area of soil remediation is relatively small and only two or three vacuum wells are anticipated, the cost and time of performing a pilot study may not be justified and the design may proceed with conservative design assumptions. Depending on the site stratigraphy, the radius of influence may range from 10 to 100 feet. The minimum effective vacuum is believed to be about 0.5 inches of water measured in wells at the perimeter of the radius of influence.

Additional information may be found in:

FDEP Remedial Action Plan Guidelines, BPSS-__, Vacuum Extraction, Pilot Studies, Air Emissions Treatment and Monitoring Requirements, May, 1998

FDEP Remedial Action Plan Checklist, October 1997

Soil Vapor Extraction Technology Reference Handbook, EPA/540/2-91/003, February 1991

How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites, EPA 510-B-94-003, October 1994

Grasso, D., Hazardous Waste Site Remediation, Source Control, CRC Press, 1993

Johnson, P.C., Baehr, A., Hinchee, R., Brown, R.A., and G. Hoag, Innovative Site Remediation Technology, Vacuum Vapor Extraction, American Academy of Environmental Engineers, 1994

6.2 Soil Washing

This is not a commonly employed soil treatment technique in Florida. The technique removes constituents from the soil by leaching the chemicals of concern out of the soil with a leaching medium. The removal technique can be employed either in situ as a water flushing system or by passing the soil through a countercurrent extractor system. The fluid normally used in the soil flushing is water that contains additives such as detergents, acids and alkalis. However, pure organic solvents such as methanol and hexane can be used as the leachate medium. The addition of these additives or organic solvents into the ground normally is prohibited by the State due to the potential for compounding the contamination problem. Since there are no current rules to regulate the activities of soil washing facilities, soil washing should not be performed as a source removal measure. Soil washing may be performed once a RAP that recommends this technology is approved. A pilot test study may be required in order to confirm that this technology is appropriate for the type of soil and contamination present.

Additional information may be found in:

Grasso, D., Hazardous Waste Site Remediation, Source Control, CRC Press, 1993

Mann, M.J., Dahlstrom, D., Esposito, P., Everett, L., Peterson, G., Traver, R.P., Innovative Site Remediation Technology, Soil Washing/Soil Flushing, American Academy of Environmental Engineers, 1994

6.3 Bioventing

Bioventing is an in situ remediation technology that uses indigenous microorganisms to biodegrade organic constituents adsorbed to soil in the unsaturated zone. Soil in the capillary fringe and in the saturated zone are not usually affected significantly. In bioventing, the activity of the indigenous bacteria is enhanced by inducing air (or oxygen) flow into the unsaturated zone (using extraction or injection wells) and, if necessary, by adding nutrients.

When extraction wells are used for bioventing, the process is similar to soil vapor extraction (SVE). However, while SVE removes constituents primarily through volatilization, bioventing systems promote biodegradation of constituents and minimize volatilization (generally by using lower air flow rates than those used for SVE). In practice, some degree of volatilization and biodegradation occurs when either SVE or bioventing is used. However, bioventing is distinguished from SVE by lower air flow rates, generally a few CFM, that result in greatly reduced volatilization.

All aerobically biodegradable constituents can be treated by bioventing. In particular, bioventing has proven to be very effective in remediating releases of petroleum products including gasoline, jet fuels, kerosene, and diesel fuel. Bioventing is most often used at sites with mid-weight petroleum products (i.e., diesel fuel and jet fuel) because lighter products (i.e., gasoline) tend to volatilize readily and can be removed more rapidly using SVE. Heavier products (e.g., lubricating oils) generally take longer to biodegrade than the lighter and mid-weight products. A summary of the advantages and disadvantages of bioventing is shown in Exhibit III-2.

Additional information may be found in:

> **How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites, EPA 510-B-94-003, October 1994**

Test Plan and Technical Protocol for a Field Treatability Test for Bioventing, Air Force Center for Environmental Excellence, May 1992

6.4 Bioremediation

Land farming, as discussed in Section 5.3, is a cleanup technique that takes advantage of the ability of indigenous microorganisms to degrade hydrocarbon compounds. Microbial populations can also be used to degrade hydrocarbon contaminated soil in situ or in a reactor.

The biodegradation of petroleum products by enhanced bioremediation or by introducing acclimated microorganisms can be effective in the vadose zone provided that environmental conditions can sustain microbiological metabolism. The environmental conditions that may potentially limit biodegradation in the subsurface are: oxygen, temperature, pH, salinity, presence of metals, free water (N, P, Trace Minerals), redox potential, alkalinity, inorganic nutrients, and the presence of other organics. The lack of oxygen is the primary factor that limits the rate of degradation in subsurface soil.

In situ bioremediation may not be used prior to approval of a RAP. In situ bioremediation may be implemented once a RAP that recommends this technology is approved. Low-tech bioremediation enhancements to conventional land farming, as described in Section 5.3, may be appropriate for a source removal activity. This process should not involve the use of any mechanical equipment that requires engineering design. Proposals for bioremediation enhancements to land farming should be submitted to the Bureau of Petroleum Storage Systems (or appropriate contracted local cleanup program) for approval prior to implementation.

Additional information may be found in:

Grasso, D., Hazardous Waste Site Remediation, Source Control, CRC Press, 1993

Norris, R.D., Hinchee, R.E., Brown, R.A., McCarty, P.L., Semprini, L., Wilson, J., Kampbell, D.H., Reinhard, M., Bower, E.J., Borden, R.C., Vogel, T.M., Thomas, J.M., and C.H. Ward, Handbook of Bioremediation, CRC Press, 1994

Ward, W., Loehr, R.C., Norris, R., Nyer, E., Piotrowski, M., Spain, J., Thomas, M., and J. Wilson, Innovative Site Remediation Technology, Bioremediation, American Academy of Environmental Engineers, 1994

6.5 Soil Fixation

This is a process where contaminated soil is temporarily removed from the ground, fixed, and returned to the excavation site. Fixation involves mixing contaminated soil with a cementitious grout compound. If needed, a chemical stabilizer is introduced into the grout mixture. The stabilizer "immobilizes" the soluble organics into globules, chemically locking them inside a cementitious monolith.

This method is not normally used at petroleum cleanup sites due to the lack of large volumes of soil that are required to make it economically feasible.

Additional information may be found in:

Grasso, D., Hazardous Waste Site Remediation, Source Control, CRC Press, 1993

Columbo, P., Barth, E., Bishop, P., Buelt, J., and J.R. Conner, Innovative Site Remediation Technology, Stabilization/Solidification, American Academy of Environmental Engineers, 1994

6.6 Thermal Treatment: see Section 5.1

Additional information may be found in:

How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites, EPA 510-B-94-003, October, 1994

Grasso, D., Hazardous Waste Site Remediation, Source Control, CRC Press, 1993

Chapter 62-775, FAC, Soil Thermal Treatment Facilities,

Magee, R.S., Cudahy, J., Dempsey, C.R., Ehrenfield, J.R., Holm, F.W., Miller, D., and M. Modell, Innovative Site Remediation Technology, Thermal Destruction, American Academy of Environmental Engineers, 1994

6.7 Landfilling: see Section 5.2

7.8 Land Farming: see Section 5.3

Additional information may be found in:

How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites, EPA 510-B-94-003, October, 1994

Grasso, D., Hazardous Waste Site Remediation, Source Control, CRC Press, 1993

7.0 Small Petroleum Spills

7.1 Introduction

Small petroleum spills of less than 100 gallons are common occurrences. If mishandled, each spill represents a potential threat to Florida's groundwater. The response to a small petroleum spill requires a cooperative effort between the Department, other state agencies, first responders, and local governments. The Bureau of Emergency Response is there to assist the local governments and first responders with the environmental aspects of the cleanup on an as-needed basis.

The Department cannot physically or financially respond to every spill. Therefore, the Department must rely upon local resources or the responsible party to perform the necessary screening and cleanup of small petroleum spills. The Bureau of Emergency Response will not respond to these spills unless extraneous circumstances exist. Guidance information from the Bureau of Emergency Response is contained in Appendix G.

Rule 62-770.300, FAC, Source Removal, provides the authorization for source removal activities at spill or release sites. The purpose of source removal is to allow the responsible party, or first responder, to initiate immediate actions to protect the environment and public health. If the spill is a recent occurrence, immediate action is of paramount importance. On most small spills, free product recovery and source soil removal is all that is necessary, especially if performed immediately after the release. Long term remedial actions will only be necessary if there is soil contamination or groundwater contamination remaining following the source removal. Screening and remedial measures of contaminated soil are outlined in applicable sections of this document and Appendix G.

7.2 Reporting

Petroleum spills of **25 gallons** or more must be reported to the State Warning Point at 850/488-1320 or to the appropriate district office of the Department. A Discharge Report Form (Form 62-770.900(1)) must be submitted to the Department within one week of discovery of the spill. Forms can be sent to:

Department of Environmental Protection
Bureau of Petroleum Storage Systems
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

or to the appropriate district office.

7.3 Department of Transportation (DOT) Assistance

The DOT will assist with petroleum releases on State and Federally-maintained right-of-ways. The DOT may be requested to provide equipment and absorption materials for release response. When a disposal site is within 50 miles of the release, the DOT may be requested by the Department to provide transportation of the contaminated soil to the disposal site. For roadways under control of a local government, the public roads department often can perform the same services.

7.4 Free Product Recovery and Contaminated Soil Options

Free product recovery is often associated with source removal of soil. The Department requires containment and physical removal of new free product releases whenever possible (Rule 62-770.300, FAC). This task can be accomplished with portable skimmer pumps, hand or mechanical bailing, absorbent pads, and fluid vacuum techniques (for example vacuum pump trucks) or total fluid displacement pumps when the volume of groundwater recovered is not greater than two times the volume of free product recovered, except that the first 1,000 gallons of total fluid recovered per discharge are exempt from meeting the required ratio of groundwater to free product. Other product recovery techniques including systems that are designed to recover significant quantities of groundwater along with free product are not generally appropriate prior to the Department's approval of a RAP, and require prior authorization from the Department in accordance with Rule 62-770.300(1)(c), FAC. An approval of Alternative Procedures may also be requested in accordance with Rule 62-770.890, FAC to use more aggressive techniques if conditions warrant. Appendix I contains a program guidance memorandum concerning product recovery for new releases at sites eligible for cleanup funding from the Inland Protection Trust Fund.

Recovered free product should be stored, transported, and disposed of in a safe and environmentally sound manner. All appropriate federal, state or local authorizations and permits shall be obtained prior to initiation of free product recovery.

Disposal options for recovered product will vary depending upon the resources available in the geographic area of the spill. Incineration, refining, or sale as a fuel are the preferred options for free product disposal. The resulting material must be recovered, drummed and disposed of in accordance with State and Federal regulations.

Chemical dispersants or emulsifiers are not accepted for free product recovery. Dispersants or emulsifiers actually disperse the petroleum in the water column making the ultimate cleanup of the petroleum more difficult and expensive. The use of dispersants or emulsifiers on upland spills is contrary to Florida Law unless authorized by the Department for other more compelling reasons (e.g., to avoid imminent fire or explosion which would pose an immediate threat to human life) prior to use.

Appendix A

Soil Cleanup Target Levels

Table IV from Chapter 62-770, FAC

TABLE IV (Page 1 of 2)
Selected Soil Cleanup Target Levels

Chemicals of Concern (Organic)	Direct Exposure (mg/kg)		Leachability (mg/kg) based on:			
	I #	II ##	Table V[a]	Table VI[b]	Table VII[c]	Table VIII[d]
PAHs:						
Acenaphthene	2300	22000	4	0.6	0.6	40
Acenaphthylene	1100	11000	22	0.003*	0.003*	220
Anthracene	19000	290000	2000	0.3	0.3	20000
Benzo(a)anthracene	1.4	5.1	2.9	0.4	0.4	29
Benzo(a)pyrene	0.1	0.5	7.8	1.2	1.2	78
Benzo(b)fluoranthene	1.4	5	9.8	1.5	1.5	98
Benzo(g,h,i)perylene	2300	45000	13000	2	2	130000
Benzo(k)fluoranthene	15	52	25	1.5	1.5	250
Chrysene	140	490	80	0.5	0.5	800
Dibenzo(a,h)anthracene	0.1	0.5	14	2.2	2.2	140
Fluoranthene	2800	45000	550	0.4	0.4	5500
Fluorene	2100	24000	87	9.4	9.4	870
Indeno(1,2,3-c,d)pyrene	1.5	5.2	28	4.3	4.3	280
Naphthalene	1000	8600	1	1	1.3	10
Phenanthrene	1900	29000	120	0.02*	0.02*	1200
Pyrene	2200	40000	570	0.8	0.8	5700
VOAs:						
Benzene	1.1	1.5	0.007	0.007	0.5	0.07
Ethylbenzene**	240	240	0.4	0.4	7.7	3.8
Toluene	300	2000	0.4	0.4	4.8	4
Total Xylenes**	290	290	0.3	0.3	5.3	2.9
OTHER:						
1,2-dichloroethane	0.6	0.9	0.02	0.02	0.7	0.2
MTBE	350	6100	0.2	0.2	150	1.6
TRPHs	350	2500	340	340	340	3400

TABLE IV (Page 2 of 2)

Chemicals of Concern (Inorganic)	Direct Exposure (mg/kg) I #	II ##	Leachability (mg/l) based on: Table V[a]	Table VI[b]	Table VII[c]	Table VIII[d]
METALS:						
Arsenic	0.8	3.7	TCLP	TCLP	TCLP	TCLP
Barium	5200	87000	TCLP	TCLP	TCLP	TCLP
Cadmium	75	1300	TCLP	TCLP	TCLP	TCLP
Chromium	290	430	TCLP	TCLP	TCLP	TCLP
Lead***	500	1000	TCLP	TCLP	TCLP	TCLP
Mercury	3.7	28	TCLP	TCLP	TCLP	TCLP
Selenium	390	10000	TCLP	TCLP	TCLP	TCLP
Silver	390	9100	TCLP	TCLP	TCLP	TCLP

Values rounded to two significant figures if greater than 1 and to one significant figure if less than 1.

\# Values based on residential use assumptions.
\## Values based on worker industrial exposure assumptions.

* Unless the Method Detection Limit (MDL) using the most sensitive and currently available technology is higher than the specified criterion.
** Direct Exposure values based on Soil Saturation Limit (Csat).
*** Direct Exposure values from USEPA *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*, OSWER Directive 9355.4-12 (1994). Residential value is the middle of the USEPA suggested range of 400-600 mg/kg.

TCLP = Toxicity Characteristic Leaching Procedure. The analyses must be performed if the concentrations listed in Table II are exceeded, and need to pass test (see Table II).

[a] Table V - Groundwater Cleanup Target Levels for Resource Protection/Recovery.
[b] Table VI - Lower of Table V and Freshwater Surface Water Criteria.
[c] Table VII - Surface Water Criteria for Resource Protection/Recovery.
[d] Table VIII - Low Yield/Poor Quality.

Appendix B

RECOMMENDED TEST PROCEDURES FOR VALIDATING FIELD SCREENING METHODS FOR USE IN THE CONDUCTING OF SOIL SCREENING AND DOCUMENTING SOURCE REMOVAL ACTIVITIES

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APPENDICES

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FIGURES

1.0 INTRODUCTION

As described in Chapter 62-770.300, Florida Administrative Code (FAC), a source removal activity may consist of the excavation and removal of petroleum contaminated soil resulting from surface spills, or leakage from underground storage tank systems, together with the removal of petroleum floating on the water table (free product). Only excavation of contaminated soil and free product recovery without water table depression is generally allowed in a source removal phase prior to Department approval.

This guidance document is part of a two part approach being implemented by the DEP to assure that technically sound methods are used in determining the degree to which soils are contaminated with gasoline and/or diesel fuel. The first part of this approach entails instituting the testing procedures in this appendix to assure methods are technically sound. Vendors and manufacturers must validate their methods using the test procedures and criteria provided in this appendix in order to obtain regulatory approval of their field screening methods. The second part of this approach strives to assure that users apply approved methods in a sound fashion. To achieve this objective, the use of approved methods shall be applied in accordance with the guidance document entitled, *Quality Assurance and Quality Control (QA/QC) Guidelines for Users of Field Screening Methods in the Screening of Contaminated Soils*, (Appendix E).

NOTE: This is an abbreviated version of the entire document of procedures for validating field screening methods which does not include a number of attachments and tables listed in the table of contents. These other portions of this document are available upon request to manufacturers or vendors of field methods that wish to prepare and submit an equipment acceptance proposal.

2.0 TEST PROCEDURES

2.1 Overview of Test Procedures and Method Approval Criteria

2.1.1 Summary of Test Procedures

The validation test procedures consist of the following steps:

(1) Upon request, the DEP will provide vendors and manufacturers of field screening methods with four soil samples from Florida for testing.

(2) The tests are designed to assess the ability of the method to determine levels of contamination given variations in the following: soil type, contaminant type and concentration range, and soil moisture content. An initial calibration curve (relating spiked contaminant concentration to method reading) is developed using one of the soil samples, and consists of spiking soil sub-samples in triplicate with fresh product at each of three concentration levels. Then, the other three soil samples are spiked to a concentration halfway between the middle and upper concentrations which were used in developing the calibration curve. The average method reading obtained is used to predict the spiked concentration using the calibration curve. At each concentration, reproducibility is assessed, and the predicted concentration is used to assess accuracy.

(3) Tests on the other soil samples and for different moisture contents may be limited if Tests of Significance are completed that show method results are independent of soil type and moisture content. These tests involve triplicate analyses at a single concentration and the screening as to whether the mean concentration falls within one standard deviation from the same concentration on the calibration curve in Step 2. Since it is not the intent to penalize methods that have high precision (low standard deviations), provisions have been made to adjust the data from the original calibration curve in order to "increase" the standard deviation, thereby allowing highly reproducible methods to eliminate some testing. Tests are also performed at a different moisture content than that used in Step 2. If the mean of the triplicate analyses falls within one standard deviation of the same concentration used to develop the calibration curve in Step 2, then no further tests need to be conducted at this moisture content for any of the remaining three soils.

(4) The statistical results obtained (percent relative standard deviation (%RSD), correlation coefficient (r) and percent difference (%D)) are compared to the validation criteria in Section 2.1.3 to determine if the method passes the test.

2.1.2 Normalization to Fresh Product Equivalent Concentration

In the report by Robbins et al. issued to the DEP entitled, A *Summary of Field Screening Methods Potentially Useful for Determining "Excessively Contaminated Soil" for Initial Remedial Actions (IRAs),* dated November 12, 1996, it is noted that field screening methods provide different readings when analyzing the same sample contaminated with a fuel. The reasons for this are twofold. Firstly, different methods are calibrated using different standards. Secondly, the methods have different levels of sensitivity to different constituents in fuels. Clearly, these differences create difficulty in achieving uniformity in regulatory decision-making. To resolve this issue, the following approach has been taken:

(1) Validation testing is performed using fresh product obtained locally within the State. Hence, all method readings are calibrated to fresh product equivalent. It is recognized that the composition of fuels may vary seasonally, with supplier, and geographically. However, the variation anticipated in composition and corresponding method readings are expected to be small compared to other sources of error. Consideration has been given to providing "standard fuels" for testing. However, this option was ruled out, given the hazardous nature of fuels and logistical difficulties associated with maintaining and shipping fuels.

2.1.3 Criteria for Regulatory Approval of Field Screening Method

The approval criteria cited below are based on the following considerations: achievable levels of precision and accuracy as noted in the literature (see field screening report cited previously); achievable levels of precision and accuracy in the experiments performed in the development of this guidance document; and the need to balance the obtainment of a high level of precision and accuracy with the need to have a practical, time-efficient method to characterize soil contamination in the field. It is expected that the number of samples to be analyzed in the field will be limited relative to the volume of soil to be characterized (either during an excavation or during exploratory sampling). It is also expected that contamination will be heterogeneously distributed in the soil. These factors result in a high level of inherent uncertainty in the accuracy associated with any type of analytical analysis of soil (field or laboratory). Hence, there is a constraint on the level of precision and accuracy that can be achieved. Further, the approval criteria has been established both in terms of manner and level to help promote the development and application of technically sound field screening methods.

The DEP will approve a field screening method for use in performing soil screening and source removal documentation if the following criteria are met:

(1) Validation tests must be performed and documented in accordance with this guidance document. Alternative validation methods may be acceptable, if the DEP finds they provide an equivalent level of precision and accuracy. To use an alternative validation method, prior approval must be obtained from the DEP.

(2) For all triplicate analyses used in developing the calibrations between method readings and fresh product concentrations, the %RSDs must be 20% or less.

(3) The calibration curves based on linear regression for each soil at each of the two moisture contents must have r values greater than 0.9 (on an absolute basis).

(4) The %D values calculated between the predicted and actual fresh product concentrations must be less than 25% for all soils and moisture contents.

Once the DEP has evaluated the test results of the field screening method, the vendor or manufacturer will be notified of the DEP's approval or disapproval. The DEP may decide to request additional information from the vendor or manufacturer prior to rendering a decision on a method. Further, following the review of the test results, the DEP may place restrictions on the use of the method, e.g., in terms of use with only certain fuels or soil types.

2.2 Sample Preparation and Spiking

2.2.1 Soil Samples

Upon request, the DEP will provide four soil samples for testing. The soil samples were chosen to provide a range in Florida soil types. The soils have been characterized and classified. Specific information on the test soils is included in Attachment A.

2.2.2 Fresh Product

Fresh product (gasoline or diesel fuel) should be obtained within several days of performing tests. Fuels should be kept in relatively small quantities (20 to 40 ml), in sealed glass vials that are completely filled, under refrigeration, and within secondary safety containers. Following withdrawal of product from vials, the fuel should no longer be used for spiking if the headspace in the vial is greater than 10% of the total vial volume.

2.2.3 Soil Spiking Procedures

The soil spiking method outlined in this section is relatively easy to accomplish in terms of timeframe, equipment, and expertise required. The method has been developed with regard to accuracy, reproducibility, and spiking homogeneity. Alternative spiking methods may be used if acceptable levels of accuracy and reproducibility are demonstrated.

Spiked soil samples are to be prepared by a modified version of the spiking method used by Griffith (1988), which in turn is a modified version of that used by Kiang and Grob (1986). Soil spiking, first aqueous and then with product, occurs under a partial vacuum. Prior to spiking with product, all of the equipment used (including soil and product) are kept cold. These measures are taken to maximize the homogeneity of the soil spiking and to minimize volatile losses.

2.2.3.1 Suggested Method - All Soils Except Clayey Sand

Preparation of an ice water bath:

1)Set up two containers with water and ice. A VOA vial holder would be helpful, to keep VOA vials in place.

2) Monitor the temperature of the ice water baths; they should be as close to 0°C as possible. The temperatures of the ice water baths should be monitored throughout this spiking procedure to ensure that they remain relatively constant. Ice may be added as needed to maintain temperature.

3) Put the container holding product into a re-sealable plastic bag, seal the bag, and place in one of the ice water baths. This bath is solely for product; keeping the product separated ensures no cross-contamination can occur.

4) Put any syringes to be used for product injection into a re-sealable plastic bag, seal the bag, and place in the second ice water bath.

5) Put any small I.D. corers to be used for splits into a re-sealable plastic bag, seal the bag, and place in the second ice water bath.

Preparation of 40 mL VOA vials with soil and water:

6) For each soil type to be spiked, weigh three(3) 40 mL VOA vials - record.

7) Weigh 25 g soil into each 40 mL VOA vial - record. (This is a suggested weight - refer to Appendices B and C)

8) Pull a 30 cc vacuum on one of the 40 mL VOA vials.

9) Referring to Table 2.1, inject the applicable amount of water into the VOA vial.

10) Agitate until the soil appears to be homogeneously moist.

11) Re-equilibrate the VOA vial to atmospheric pressure by puncturing the septum with a syringe needle.

12) Weigh the VOA vial (reflects the VOA vial + soil + water) - record.

13) Repeat Steps 8 through 12 for the 2nd and 3rd 40 mL VOA vials.

14) Open each 40 mL VOA vial and make a depression in the top of the soil.

15) Re-seal each VOA vial (can re-weigh as a check).

16) Repeat Steps 7 through 15, as needed for the number of soils to be spiked.

17) The VOA vials should be kept in the ice water bath for a minimum of 10 minutes before starting the product spiking. This time period has been empirically determined for a room temperature of 26☜C and an ice water bath temperature of 3.5☜C.

Spiking of soils with product:

(Note: Steps 18 - 22 should be done as quickly as possible)

18) Pull a 30 cc vacuum on a cold 40 mL VOA vial (vial should be maintained cold).

19) Remove the product from the ice water bath. Product withdrawal and injection should be done with a minimum amount of hand contact with the product syringe. Refer to Table 2.1 and inject the applicable amount of product near the top of the soil (in the depression).

20) Agitate (not vigorously), using gloves that have been kept in a freezer, or in a re-sealable plastic bag in the ice-water bath. This will avoid warming the VOA vial with direct hand contact.

21) After spiking, the 40 mL VOA vial may be kept in the ice water bath prior to field screening method tests, if desired.

2.2.3.2 Suggested Method - Clayey Sand

The clayey sand requires a slightly different spiking method than do the other soils. The clayey sand will not become homogeneously moist with simple agitation. This soil needs to be mechanically mixed. The above method applies with the following exceptions:

- 5 g of soil instead of 25 g
- 20 mL VOA vial instead of a 40-mL vial
- after the water is added, it must be mixed with a small spatula until it appears homogeneously moist
- the 20 mL VOA vial, with moist soil, must be re-weighed after mixing

2.3 Sample Analysis

Field Screening Methods are to be tested on four representative Floridian soils, at two moisture contents, and at four spiked concentrations. Soils are to be spiked with fresh product (gasoline and/or diesel fuel) at concentrations that range over an order of magnitude and that extend toward the upper boundary of the anticpated range of detection of the technique. An initial calibration curve is developed for one soil, and certain tests are compared to this initial curve in order to evaluate whether full calibration curves need to be developed for other parameters. Sample analysis consists of the following steps:

1. An initial calibration curve relating the method reading to spiked concentration is developed using the poorly graded sand, at a moisture content equivalent to 75% of the soil's specific retention. The calibration curve is developed using three (3) sets of triplicate samples, each at a different concentration. Mean method readings, standard deviations, percent relative standard deviations, and concentration ranges within ± 1 standard deviation are calculated for each set of triplicate samples at each concentration. The data are linearly regressed and a correlation coefficient, a slope, and an intercept are obtained.
2. A triplicate "unknown" is tested to assess accuracy at a concentration halfway between the middle and highest concentrations used to develop the calibration curve. Predicted concentrations are calculated using the method reading, the slope, and the intercept. Percent differences are calculated for each sample and then averaged.
3. *Test of Significance of Moisture Content:* A triplicate is run of the poorly graded sand, at the middle concentration, but at a moisture content equivalent to 25% of specific retention. A mean for these samples is calculated. The mean is compared to the concentration range for the same concentration (1 above). If the mean is within the concentration range then the method does not have to be further tested *for any of the four soils* at this moisture content. If the mean is not within the concentration range, then the range from the initial

curve (1 above) may be adjusted if the %RSD for the same concentration is less than 20% (see Section 2.4.5). If the mean is within the adjusted concentration range then the method does not have to be further tested *for any of the four soils* at this moisture content. If the mean does not fall within the adjusted concentration range, then a calibration curve must be developed for all soils at each moisture content.

4. *Test of Significance of Soil Type:* Triplicate samples are analyzed for each of the other soil types, at the middle concentration used in spiking the poorly graded sand and at the same moisture content (equivalent to 75% of specific retention). A mean for these samples is calculated. The mean is compared to the concentration range for the same concentration for the poorly graded sand. If the mean concentration is within the concentration range of the poorly graded sand then the method does not have to be further tested on that soil. If the mean is not within the concentration range, then the range from the initial curve for the poorly graded sand may be adjusted if the %RSD for the same concentration is less than 20% (see Section 2.4.5). If the mean concentration of a soil is within the adjusted concentration range then the method does not have to be further tested on that soil. If the mean concentration of a soil does not fall within the adjusted concentration range, then a calibration curve must be developed for that soil. This is repeated for all the soil types.

2.4 Data Analysis

The data are analyzed in terms of reproducibility (percent relative standard deviation, %RSD), accuracy (percent difference, %D), and correlation of method reading to fresh product concentration (correlation coefficient, r). The manner in which these are to be obtained are defined below. A limited number of field screening methods have been tested with an abbreviated version of this validation procedure. The results of these tests are from the department upon request in a report titled Summary of Field Screening Method Tests and can be used as an example of how the data should be interpreted.

2.4.1 Percent Relative Standard Deviation (%RSD)

To calculate the %RSD of the split analyses proceed as follows.

1. Calculate the mean value using:

Mean (☐) = ▤x_i / n where ▤x_i = sum of the results of the triplicate analyses

n = number of analyses (3 for triplicates)

2. Calculate the standard deviation using:

Standard Deviation (☛) = [▤(x_i - ☐)^2 / (n - 1)]$^{1/2}$

3. Determine the percent relative standard deviation using:

Percent Relative Standard Deviation (% RSD) = 100∗(☛ / ☐)

2.4.2 Percent Difference (%D)

Calculate the percent difference using this formula:

Percent Difference (%D) = {⊠C_s - C_p⊠ / C_s}∗100

where C_s = spiked (known) concentration

C_p = predicted concentration

2.4.3 Linear Regression

A standard linear regression (non-weighted) should be performed. This can be performed using statistical calculators or spreadsheet functions for calculating the best-fit slope, intercept, and correlation coefficient (r). The linear regressions are based on the spiked concentration as the dependent variable (y-axis) and the method readings as the independent variable (x-axis).

2.4.4 Predicted Concentration (C_p)

Calculate the predicted concentration using this formula:

Predicted Concentration (C_p) = slope $*$ (x) + intercept

where x = method reading

slope = slope from calibration curve

intercept = intercept from calibration curve

2.4.5 Tests of Significance

As explained in Section 2.3, some of the required tests may be eliminated based on a comparison of results with those of the poorly graded sand. The adjusted concentration range of the poorly graded sand is calculated based on the following.

1. Calculate a percent relative standard deviation normalization factor using:

   %RSD Normalization Factor (F): = 20 / (%RSD)

   where the %RSD is from the analyses of the poorly graded

   sand at the same concentration

2. Calculate an adjusted standard deviation using:

   Adjusted Standard Deviation (☞$_a$) = (☞) $*$ (F)

   where ☞ = the standard deviation from the analyses of the

   poorly graded sand at the same concentration

3. Calculate an adjusted concentration range using:

   Adjusted Concentration Range = (□ - ☞$_a$) to (□ + ☞$_a$)

   where □ = the mean from the analyses of the

   poorly graded sand at the same concentration

2.5 Reporting Requirements

The vendor or manufacturer conducting the validation tests must supply the Florida Department of Environmental Protection (DEP) with information that is as complete as possible in order to expedite the DEP's decision regarding the method's certification for use during site screening and source removal documentation reports. Any laboratory tests conducted with the field screening method for validation purposes must be documented. Documentation should be on the "Field Screening Method Validation Report Form" attached to this appendix. Analytical results from state or EPA- certified laboratories must be recorded, where appropriate, on the report form. In addition, copies of laboratory results, as originally submitted to the vendor or manufacturer from the laboratory, must be attached to the report form. Additional information not included in the "Field Screening Method Validation Report Form" may be attached as needed.

Table 2.1 - Soil Spiking Parameters

Soil Type	Weight of Soil (g)	Percentage of Specific Retention (%)	Volume of Water to Add (ml)	Wet Weight of Soil (g)	Volume of Product to Add (ul) to Attain the Following Soil Concentrations		
					50 (mg/kg)	275 (mg/kg)	500 (mg/kg)
Poorly Graded Sand	25	75	0.52	25.52	1.75	9.61	17.48
		25	0.17	25.17	1.72	9.48	17.24
Silty Sand	25	75	1.09	26.09	1.79	9.83	17.87
		25	0.36	25.36	1.74	9.55	17.37
Poorly Graded Sand with Gravel (Carbonate)	25	75	1.79	26.79	1.84	10.09	18.35
		25	0.6	25.6	1.75	9.64	17.53
Clayey Sand	25	NA	2.5	27.5	1.88	10.33	18.78

Soil Type	Weight of Soil (g)	Percentage of Specific Retention (%)	Volume of Water to Add (ml)	Wet Weight of Soil (g)	Volume of Product to Add (ul) to Attain the Following Soil Concentrations		
					250 (mg/kg)	500 (mg/kg)	1000 (mg/kg)
Clayey Sand	5	NA	0.5	5.5	1.88	3.76	7.52

NA - Not Applicable.

Appendix C

Soil Analytical Methods - Table III from Chapter 62-770

TABLE III
For petroleum as defined in Section 376.301, F.S.

Chemicals of Concern	Groundwater and Surface Water	Soil and Sediment
Benzene, Ethylbenzene, Toluene, total Xylenes and MTBE	602, 8020 or 8021	8020 or 8021
Naphthalene and the 15 method-listed PAHs	610, 625, 8100, 8250, 8270 or 8310	8100, 8250, 8270 or 8310
1,2-dichloroethane and other listed Priority Pollutant Volatile Organic Halocarbons	601, 8010 or 8021	8010 or 8021
1,2-dibromoethane (EDB)	601 or 8010 with electron capture detector substituted for electrolytic conductivity detector and 2-column confirmation, or 504 or 8011	NOT REQUIRED
Total Arsenic	200.7, 206.2, 206.3, 6010, 7060 or 7061	6010, 7060 or 7061
Total Cadmium	[for groundwater, and Class II and Class III (marine) surface water] 200.7, 213.1, 213.2, 6010, 7130 or 7131 [for Class I and Class III (fresh) surface water] 213.2 or 7131	6010, 7130 or 7131
Total Chromium	200.7, 218.2, 6010 or 7191	6010, 7190 or 7191
Total Lead	200.7, 200.8, 239.2, 6010 or 7421	6010 or 7421
TRPHs	FL-PRO	FL-PRO
Chloride	300.0, 325.1, 325.2, 325.3, 9056, 9250, 9251, 9252 or 9253	NOT REQUIRED
Sulfate	375.1, 375.3, 375.4, 9035, 9038 or 9056	NOT REQUIRED
Total Dissolved Solids (TDS)	160.1	NOT APPLICABLE

NOTE 1: All methods listed (except for FL-PRO) are USEPA methods and the detection limits shall meet the specified cleanup target levels.
NOTE 2: Appropriate sample preparation and cleanup methods (e.g., extraction, digestion) shall be performed prior to analysis.
NOTE 3: The quiescent sampling technique for metals shall be used if turbidity is affecting the total metal results.
NOTE 4: Equivalent methods may be used if approved through protocols described in Rule 62-160.400(6), (7) and (8), F.A.C.

Soil Properties	Methods
Dry Bulk Density	ASTM D-1556, D-2167, D-2922 or D-2937
Infiltration Rate	Double-Ring Infiltrometer
Moisture Content (average)	ASTM D-2216
Organic Carbon Content (%)	Nelson & Sommers 1982
pH	McLean 1982
Texture	Gee & Bauder 1986; USDA Classification

Appendix D

NOTE

Appendix D provides a detailed description of a field calibration and correlation procedure to verify the reliability of field soil data and establish a correlation relationship between laboratory and field data. The procedures described in Appendix D are not recommended at this time. The field instrument currently being used to conduct most site assessments, the OVA jar headspace method, does not always correlate well with laboratory results. Once other more accurate and repeatable field soil screening methods are approved by the Department, the Department will recommend the implementation of the correlation procedure of Appendix D for some site assessment situations. The reference to correlation considerations is included in the soil manual at this time for informational purposes to inform the public of future soil data evaluation procedures, but the correlation procedure described in detail in Appendix D should not be performed during site assessments until further notification by the Department.

FIELD CALIBRATION AND VALIDATION PROCEDURE

When field screening instruments are used at a site, their degree of accuracy and correlation should be evaluated on a site-specific basis. If the assessment or soil source removal activity involves a total volume of soil of less than 200 cubic yards, then the OVA/FID (or equivalent instrument) or other field screening method approved by the Department can be used to document the soil assessment or source removal activity without performing the validation and calibration procedures described in this appendix. For all other soil assessment, data should be obtained utilizing a Department approved field soil screening method, and evaluated for accuracy and the degree of correspondence with laboratory analysis results according to the procedures outlined below.

The instrument operator should collect a minimum of three contaminated soil samples from among those collected for field soil screening at a site and place them in containers provided by a qualified laboratory. The samples should be representative of the range of soil contamination. They should consist of samples with high, intermediate and low concentrations, as further described in Section 4.4 of this manual. After the samples have been collected, they should be sealed and tumbled for several minutes to ensure thorough mixing. The samples should then be split into two separate portions except for the sample with intermediate concentrations, which should be split into four equal portions. One sample representing each concentration (high, intermediate, and low) should be submitted to a Department approved laboratory for analyses in accordance with Table I of Chapter 62-770, FAC. The remaining soil samples should be screened with the field instrument. Care should be taken at all times when collecting, handling, screening and preserving samples to minimize loss of volatiles. The three intermediate split sample field instrument readings should be compared immediately to one another to determine the degree of precision. As an on-site quality assurance goal, field screening methods should have a maximum percent relative standard deviation of 20%. Percent relative standard deviation is described in Appendix E of this manual. If the percent relative standard deviation exceeds 20%, the readings from the field instrument should be considered to have questionable value and consideration should be given to increasing the percentage of soil samples for laboratory analyses. If the percent relative standard deviation is less than 20%, then the site screening operation can proceed.

Consideration may also be given to collecting three additional soil samples (in addition to the first three minimum required for analysis or 5% of field soil screening samples, whichever is greater) corresponding to locations of other field soil screening samples obtained from high, medium and low field soil screening sample locations and archiving the samples in the event the interpretation of the field screening data based on the laboratory results from the first three (or 5%, whichever is greater) samples alone are inconclusive. These three additional soil samples would only be analyzed in the event of poor correlation of laboratory and field soil screening data. If this option is used, the primary samples collected for laboratory analysis should be analyzed expeditiously in order to not exceed holding times for the supplemental samples.

A comparison of the laboratory analytical data and the field readings should be submitted to the Department in the Source Removal Report or Site Assessment Report.

NOTE: The following discussion describes a procedure to correlate field screening results with laboratory analysis results. The Department's recent experience has shown that there is generally poor correlation when using the OVA jar headspace technique. As a result, we expect that the correlation suggested below will not be possible much of the time when using the OVA jar headspace technique for field soil screening. It will not be necesary to present correlation information as described below in the Site Assessment Report in this case. Other field soil screening techniques the Department accepts for soil assessment in the future may show more promise for correlation with laboratory data.

If it appears that there is good correlation between field screening and laboratory analysis results, the laboratory analytical data and the instrument readings should be compared on a line graph and a "best fit" line should be provided. If the equipment response is not linear, it is acceptable to plot a "best fit" line using a standard logarithmic vertical axis in order to obtain a straight line. Based upon this line, a correlation curve, table, or formula for the contamination range tested and any pertinent statistical calculations to assist the Department in its review of the data should be suggested. After a correlation curve, table and/or formula have been established for the field screening instrument readings/analytical laboratory results, the field screening values previously recorded can be used to obtain the corresponding laboratory concentrations of chemicals of concern. This information should be provided in the Site Assessment Report or Source Removal Report. A written account of the sample collection and testing procedure should also be submitted to the Department for evaluation with the report.

Appendix E

QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC) GUIDELINES FOR USERS OF FIELD SCREENING METHODS IN THE DETERMINATION OF CONTAMINATED SOIL FOR SITE SCREENING AND SOURCE REMOVAL

1.0 INTRODUCTION

As described in Rule 62-770.300, Florida Administrative Code (FAC), Source Removal activities may consist of the excavation and removal of petroleum contaminated soil resulting from surface spills, or leakage from underground storage tank systems, together with the removal of petroleum floating on the water table (free product). Only excavation of contaminated soil and free product recovery without water table depression are allowed without prior to Department approval.

In the past, the degree of soil contamination for source removal determinations was determined by vapor readings measured during performance of jar headspace screening (previously described in Rule 62-770.200, FAC). The Department has revised its rule and has eliminated the use of the term "excessively contaminated soil" in decision making for screening and source removal. The Department has also provided procedures described in Appendix E to correlate field instrument data with laboratory results so that field data can be interpreted in terms of quantifiable levels of contamination. In order to assure that technically sound methods are used in determining extent and degree of contaminated soil, the Department has instituted a procedure for vendors and manufacturers for validating and approving proposed field screening methods.

The purpose of this document is to provide individuals using approved field screening methods, procedures that ensure the following data quality objectives are met:

i) Samples must be properly collected to provide adequate representativeness;
ii) Individuals using an approved method must be technically competent;

iii) Reporting must be complete and adequate to support data obtained, and to justify source removal decisions.

This document has been developed to provide guidance to users of field screening equipment and methods endeavoring to screen gasoline and/or diesel contaminated soil for site assessment and source removal activities. This guidance addresses the following areas:

i) Sampling;
ii) User qualifications;
iii) QA/QC procedures related to analysis and calibration; and
iv) Reporting requirements.

Operators of field screening equipment must document method(s) used, but are not required to submit a Quality Assurance Project Plan (as described in Chapter 62-770, FAC).

2.0 SAMPLING

The purpose of the sampling guidelines is to assist the individual collecting soil samples in obtaining representative samples. Important considerations in obtaining representative samples include defining an adequate number of samples and collecting samples in a manner that minimizes volatile loss and cross-contamination. A number of soil sampling procedures to be followed are described in this section of this appendix. Persons collecting samples should follow both the procedures described in that section of this manual and the guidelines present below.

2.1 Number of Samples

The number of samples, and therefore analyses, needed to obtain representative information is a function of a number of variables, including the size of a release and the migration pathway of the release in the subsurface, as influenced by the geology, hydrology, source conditions, and product type (gasoline or diesel). In establishing the number of samples to be analyzed, consideration should also be given to the impact that sampling and analysis may have on the timeframe and costs associated with an investigation or excavation, as well as with the response time needed in dealing with an emergency situation. The guidance described below aims to achieve the collection of adequate data, given practical consideration inherent to source removal activities.

This document considers provisions for the number of samples needed based on two types of activities: exploratory sampling (delineation of contaminated soil), and excavation sampling. Different situations that initiate source removal activities will inherently involve one (or both) of these sampling routines. Source removal activities are generally warranted in the following circumstances:

i) Tank removal or installation, or other construction activity;
ii) Response to a recent release; and
iii) Qualifying for Natural Attenuation Monitoring or No Further Action.

These three situations are described in Section 5.0 of this manual. Tank removals, installations, and other construction activities will most likely involve excavation sampling. A response to a recent release can lend itself to either delineation or excavation sampling. A site that will quality for Natural Attenuation Monitoring or No Further Action will most likely involve delineation sampling.

Exploratory Sampling (Delineation)

The following is a soil sampling procedure that should be followed for soil screening and soil removal activities: start sampling at and/or around a location where it is suspected that the source of contamination exists. If necessary, sample from the first soil boring outward in a grid pattern, at 20 foot intervals, until the perimeter of the area of soil contamination is defined. For very large areas of soil contamination such as distribution and bulk facilities, horizontal sampling intervals of greater than 20 feet may be appropriate; however, the proposed horizontal screening interval should be verified as appropriate with the Department or contracted local program.

For shallow water tables of less than six feet, vertical sampling should be performed at one or two foot intervals, where at least two samples are normally collected at each location, until the water table is reached. For areas of a deeper groundwater table, vertical sampling should be at every other foot to ten feet, and every five feet thereafter. Soil sampling should continue to the water table, and even one or two feet below the water table if a smear zone is suspected to exist. However, the records of instrument readings should clearly identify which samples were taken within one foot of the water table or lower as the water saturation may affect the field instrument reading.

Excavation Sampling

During excavation, samples are collected from the bucket of the backhoe or excavator (one per bucket, obtained from the center, at least six inches from the surface). Samples to confirm that the contaminated soil has been removed are obtained from the walls of the excavation, and also from the bottom of the excavation if groundwater was not reached during excavation.

2.2 Sampling Method

Primary Sampling

As mentioned in Section 2.1, two sampling routines can be used: exploratory sampling for delineation of the extent and degree of contaminated soil and excavation sampling. The two methods entail different types of primary sampling equipment (equipment that takes the soil out of the ground). Exploratory sampling is typically accomplished with the use of boring and drilling equipment. These may include hollow stem augers with a split spoon sampler, hand augers, and direct push technologies. Excavation sampling is typically accomplished from the bucket of a backhoe or excavator.

Soil boring and drilling equipment decontamination is addressed in "Quality Assurance Standard Operating Procedures for Petroleum Storage System Closure Assessments," FL DEP, February 1994. Decontamination for auger flights, drilling rods, drill bits, hollow stem augers, or other parts of the drilling equipment, is outlined as follows:

1) Clean with a pressurized power washer, steam cleaner, or hand wash using tap water and a reagent grade detergent (Alconox, Liquinox, or equivalent) using a brush if necessary to remove any particulate matter and surface film.

2) Rinse thoroughly with tap water.

3) Rinse thoroughly with deionized water.

Secondary Sampling (Primary Sampler to Analyses)

Secondary sampling entails collection of soil from the primary sampling equipment for analysis. Secondary sampling equipment can be either disposable (wooden spatulas, disposable syringes) or non-disposable (shovel, spoons, scoops, spatulas). Samples should be collected in such a way as to minimize volatile losses and cross-contamination.

Volatile losses can be minimized in several ways. Samples collected from primary sampling equipment such as split spoon samplers or from acetate core-liners should be collected in a timely manner. Once a core barrel or liner has been opened, the sample should be collected immediately for analysis. If samples are not collected immediately, cores should be capped and kept cool. Samples collected from a core should be taken along the center axis of the core. All samples should be placed in containers with a minimum amount of headspace.

The collection of samples from a backhoe or excavator should follow the guidelines in "Quality Assurance Standard Operating Procedures for Petroleum Storage System Closure Assessments," FL DEP, February 1994, which states:

> When using a backhoe to excavate soil, the soil may be placed into discrete piles so that the origin of the sample is known. The sample must be taken immediately after the soil is transferred from the bucket to the sampling location. Samples should not be taken from the surface of the pile, but rather from a point at least six inches into the pile. Sampling from composite piles is not acceptable. When sampling directly from the backhoe bucket, be certain to sample from the middle of the bucket and not the sides, since soil may have adhered to the sides from previous bucket loads.

Although written for site closure, these procedures lend themselves to site screening and source removal documentation as well. It should be noted that samples taken in this manner should be collected from the backhoe bucket whenever possible.

Effort must be made to minimize cross-contamination between samples. Sample collectors and handlers must wear disposable (or washable) gloves at all times, and should change (or wash) gloves frequently. All non-disposable sampling equipment (including sampling jars) must be decontaminated, where possible, between sampling rounds. The following is a minimum decontamination regimen:

1) Wash with soapy tap water and brush.
2) Rinse with tap water.
3) Rinse with deionized (DI) water.

At least once per day, a clean soil sample (blank) should be run through the sample collection procedure. Since running it through on the primary equipment is not practical, it should be run through all sample collection steps of the secondary equipment. An analysis will be done on this soil, using the same method employed for regular samples.

3.0 QUALIFICATIONS OF USERS OF FIELD SCREENING METHODS

Assurance that the user of an approved field screening method is adequately trained helps to ensure proper use of the method during site screening or source removal activities, and will lead to better quality data and improved on site decisions. Users (operators) of an approved field screening method will be required to attach verification of training (certificate or letter from a vendor of an approved method).

4.0 ANALYSIS

Analytical equipment must be in good working order and maintained per manufacturer's instructions. Reagents, standards, or other chemicals used for analysis or for calibration must be used prior to their expiration dates. Quality assurance measures that may be specific to an analytical method must be performed as per the manufacturer's directions.

4.1 Calibration

When soil analysis is performed with instruments that are manufacturer-calibrated, documentation of factory calibration must be attached. Instruments that are not manufacturer-calibrated must be field-calibrated. Manufacturer instructions must be followed as to the frequency of calibration. However, field calibration must be done a minimum of once per day. A calibration check must also be done at least once per day. If either gasoline or diesel fuel is to be used as a calibration standard, it should be a fresh sample of fuel, maintained in a container with no headspace.

4.2 Soil Analysis

All soil analyses using approved methods must be performed according to the manufacturer's instructions. To minimize volatile losses, analyses should be performed in a timely manner relative to sample collection.

Reproducibility

Reproducibility (also known as precision) is determined by the standard deviation of a set of analytical measurements on splits of a soil sample. The percent relative standard deviation (%RSD) is a measure of the relative degree of precision. As an on site quality assurance goal, field screening methods should have a minimum %RSD of 20%, as measured using a minimum of three splits from a contaminated soil sample. This goal provides a means of verifying the workability of a method, given site-specific soil conditions. Also, it provides a level of assurance that the user has been adequately trained. If the %RSD exceeds 20% and cannot be related to site-specific soil conditions, the soil analyses may be considered invalid.

Soil splits for the reproducibility screening may be obtained by dividing a larger soil sample into three or more parts for analysis. If this method is used, the larger soil sample should not be homogenized to avoid volatile loss. As an alternative method, three or more closely spaced samples can be collected from a soil core or an excavator bucket. At a minimum, a reproducibility screening should be conducted once each day. If the type of soil analyzed throughout the course of a day changes significantly in terms of grain size, organic content, or other factors that might influence the results of an analytical method, additional reproducibility screenings should be performed, as warranted.

To calculate the %RSD of the split analyses proceed as follows.

1. Calculate the mean value using:

Mean $(\bar{x}) = \sum x_i/n$ where $\sum x_i$ = the sum of the results of the split analyses

n = number of splits

2. Calculate the standard deviation using:

$$\text{Standard Deviation } (s) = [\sum(x_i - \bar{x})^2/(n-1)]^{1/2}$$

3. Determine the %RSD using:

$$\%\ \text{RSD} = 100*(s/\bar{x})$$

5.0 REPORTING REQUIREMENTS

Any field screening conducted for contaminated soil must be well documented to provide a basis for decisions made during a source removal activity. Documentation should be in the Source Removal Report required by Rule 62-770.300(3), F.A.C. Additional quality assurance information that may be specific to an analytical method may need to be recorded in, or attached to, the report as appropriate.

APPENDIX F

CONTAMINANT MASS ESTIMATION TECHNIQUES

The following techniques can be used to quantify the mass of petroleum contaminants at a site. These techniques were created in an attempt to quantify the mass of contaminants found in the different compartments of the vadose zone, smear zone, dissolved phase, and free product as outlined by Gallagher in a 1995 document. Note that a technique for calculating the mass of contaminants in the soil gas phase is omitted due to its relative insignificance.

DETERMINATION OF CONTAMINANT MASS IN THE VADOSE ZONE

Vadose Zone -Method I is applicable when you have multiple soil samples which will allow you to approximate the average concentration for different elevations in the soil column. When the average concentration can not be calculated due to minimal data, use Method II.

VADOSE ZONE - METHOD I

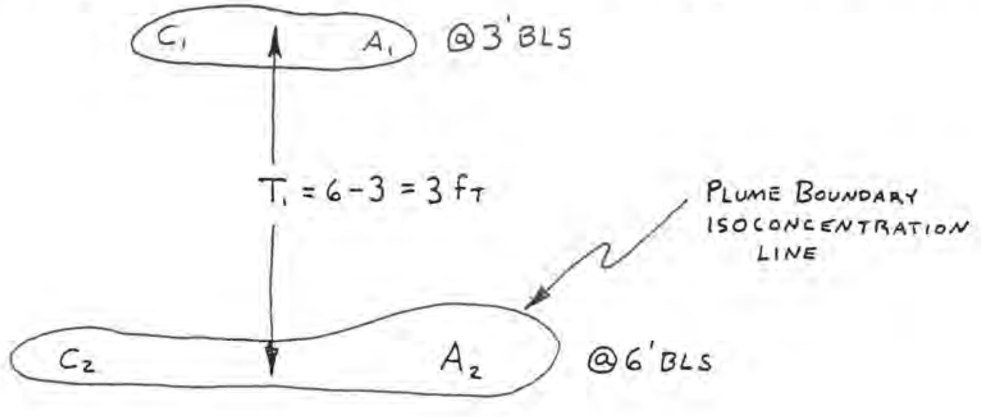
SOIL MASS ESTIMATION USING AVERAGE CONCENTRATIONS

1. Draw an isoconcentration boundary line outlining the contaminant concentrations, expressed in TPH, at various depths (i.e., 2' BLS, 4' BLS, etc.). The concentrations within each boundary line should be expressed in terms of TPH using the Flo-Pro method. These concentrations can be compiled from laboratory analysis of TPH using the Flo-Pro method or by any acceptable field instrument calibrated to TPH concentrations. In the absence of additional information, the location of the zero isoconcentration line can be assumed to correspond to a 10 ppm OVA reading.

2. Determine the averages of each set of TPH concentrations inside the zero concentration line boundaries at each depth. The average can be calculated using the arithmetic mean, geometric mean, or the area weighted mean method. The arithmetic mean may be the preferred method due to its general applicability, simplicity, and conservatism. For further information on Averaging Techniques, see the Averaging Techniques section in Attachment I

3. Multiply the average concentration by the area inside the zero concentration line for each depth. The units of this product will be expressed in units of concentration-area (C*A) (typically mg/Kg-ft^2)

4. Using each value from step #3 as an "end area", use the average end area method to calculate the volume of the plume. This will give a result in units of concentration-volume (typically mg/Kg-ft^3). Convert the units to concentration-soil mass (typically mg/Kg-Kg). This simplifies to mg. Note that one ft^3 of soil weighs approximately 65 Kg. A different soil density may be selected if it is justified and consistently applied in future calculations. The illustration below shows the components of this calculation for the zone between A_1 and A_2 with have contaminant concentrations of C_1 and C_2.



In this calculation the units cancel out as follows: $p*V = Kg/ft^3 * ft * mg/Kg * ft^2 = mg$

The mass of contaminants in the Vadose zone can be calculated with the following formula:

$$\textbf{Mass (mg)} = pV$$

where $V = (T_1(C_1A_1 + C_2A_2)/2) + (T_2(C_2A_2 + C_3A_3)/2) + \text{etc...}$

and p **= soil density in** Kg/ft^3 **= (approximately 65** Kg/ft^3**)**
C_x **= average concentration (mg/kg) for end area** A_x
A_x **= area (**ft^2**) within a specified concentration line at a given depth**
T_x **= The vertical distance between end areas** A_x **and** A_{x+1}

5. The result of the calculation can be converted from units of mg to pounds by multiplying by 2.2×10^{-6}.

VADOSE ZONE - METHOD II

SOIL MASS ESTIMATION WITH ONE DATA POINT PER LAYER

Background

In Vadose Zone - Method I, the product of each end area, A_x ,and its average concentration, C_x ,must be determined beforehand. For the product, A_xC_x, the average concentration must be estimated for each isocontour-bounded area. The average concentration can be determined by conducting multiple soil borings and obtaining several sets of laboratory analytical data for each depth, but this may be considered too costly relative to the value of the source mass estimate. It may be possible to correlate field screening data to laboratory data if there are reliable laboratory results and a field screening method is used which has a adequate accuracy to correlate reasonably well with the laboratory results. The FDEP conducted a pilot study to determine the feasibility of correlating multiple OVA jar headspace results with laboratory analytical results. The results of the pilot study indicate that the OVA results did not correlate well with the laboratory data due to the OVA method's precision and range of detection. Recent information from EPA also calls into question the reliability of the laboratory data using current sample preservation techniques and currently recognized EPA laboratory methods. Therefore, the concentrations of the laboratory analyzed samples may have also contributed to the poor correlation between the field screening and laboratory results in the department's pilot study. The department will soon be requiring new methods for field preservation of samples for laboratory analysis and new laboratory techniques. We will also be approving other field soil screening techniques in the future which may offer the advantage of greater accuracy, precision, and range of detection than the OVA jar headspace technique. It is expected that these improvements will lead to better correlation between lab data and field screening results.

Although the prospect of correlation of field data to lab data looks like a promising method for the future, there does exist a need for a low cost alternative for the determination of contaminant mass in the soil and the smear zone based on lab samples only. The following method, the "Soil Mass Estimation With One Data Point Per Layer", outlines an alternative method for achieving this objective.

Procedure

1. Determine the area and limits of the vadose plume for each layer by finding the location of the isocontour representing the lower range of detection of the field screening method (10 ppm with an OVA).

2. Collect samples from the "hottest" spot in each layer of the vadose zone at depths of 3', 6', 9', etc., or whatever intervals are appropriate. Analyze the samples for TPH using the Flo-Pro method as well as for any other parameters such as VOAs and PAHs that may be required under Chapter 62-770 F.A.C.

3. If C_{h1} and C_{h2} are equal to the highest concentration of TPH found within Areas A_1 and A_2 at different depths, then the mass of the contaminants in the vadose and smear zones can be calculated by the following revised equation: (Note changes in "V")

$$\textbf{Mass (mg)} = pV$$

where $V = (T_1(1/2C_{h1}A_1 + 1/2C_{h2}A_2)/2) + (T_2(1/2C_{h2}A_2 + 1/2C_{h3}A_3)/2) + \text{etc...}$
and p **= soil density in Kg/ft^3 = (approximately 65 Kg/ft^3)**
C_{hx} **= highest concentration (mg/kg) for end area** A_x
A_x **= area (ft^2) within a specified concentration line at a given depth**
T_x **= The vertical distance between end areas** A_x **and** A_{x+1}

4. . Convert the value from mg to pounds by multiplying by 2.2×10^{-6}.

DETERMINATION OF CONTAMINANT MASS IN THE SMEAR ZONE

For the purposes of this calculation only, the "smear zone" consists of the soil located between the current groundwater table elevation and the lowest groundwater table elevation observed since the release. The contamination found in the soil above the groundwater table will be accounted for in the calculation of vadose zone contamination.

1. Utilizing groundwater concentration data, draw a plume map of the groundwater contamination. Draw an isoconcentration line delineating BTEX concentrations of 3000 in the groundwater plume. For the purposes of this calculation, the area inside the 3000 ppb BTEX groundwater isoconcentration line constitutes the horizontal extent of the smear zone ppb (as recommended by Gallagher, 1995). If site groundwater concentrations do not exceed 3000 ppb, then the site smear zone may be considered negligible.

2. The smear zone area should be calculated by determining the total area inside the 3000 ppb BTEX groundwater isoconcentration line.

3. Soil samples should then be collected from soil borings drilled to a depth halfway approximately between the current elevation of the water table and the lowest known post-release elevation of the water table. All samples should be collected inside the 3000 ppb BTEX groundwater isoconcentration line. One of the samples should be collected from the area where the greatest level of contamination is suspected. The remaining samples should be collected in locations that will provide contaminant levels representative of potentially variable smear zone concentrations including one near the assumed boundary. The number of samples collected should approximate one sample for every 2500 ft^2 with a minimum of 3 samples collected.

4. The soil samples should then be analyzed for TRPH using the FLO-PRO (as well as VOAs and PAHs when required in Chapter 62-770 F.A.C.).

5. The concentrations obtained from the soil borings should then be averaged using arithmetic mean (preferred), geometric mean, or the area weighted average method. A less reliable but less expensive estimate of the average concentration within the smear zone can be obtained by determining the

concentration of a single soil boring collected from the "hottest" location and assuming that the average concentration is one half of the single "hottest" concentration. This assumption is based on the same premise as the technique, "Soil Mass Estimation With One Data Point Per Layer" as described above.

6. Multiply the average concentration by the area inside the 3000 ppb BTEX groundwater concentration line (A_x). The units of this product will be expressed in units of concentration-area (CxAx) (typically mg/Kg-ft^2).

7. To determine the volume of the plume, the concentration-area obtained in step #6 (above) should be multiplied by the depth of the smear zone (Tx). The depth, for the purposes of this calculation, is the distance from the top of the current water table to the lowest observed post-release water table elevation. This will give a result in units of concentration-volume (typically mg/Kg-ft^3). Convert the units to concentration-soil mass (typically mg/Kg-Kg). This simplifies to mg. Convert the value of mg to lbs by multiplying by 2.2×10^{-6}.

Equations:

$$\textbf{Mass (mg)} = \mathbf{pV}$$

where $V = (T_x * C_x * A_x)$

and p = soil density in Kg/ft^3 = (approximately 65 Kg/ft^3)
C_x = average concentration (mg/kg) for end area A_x
A_x = area (ft^2) within the 3000 ppb BTEX isoconcentration line
T_x = The thickness of the smear zone

8. Convert the value of mg to pounds by multiplying by 2.2×10^{-6}.

DETERMINATION OF CONTAMINANT MASS IN FREE PRODUCT PLUMES

The actual thickness of a free product plume is a function of its observed thickness the type of soil. The following self-explanatory formula is provided for calculating the total mass of measurable free product. To perform this calculation, the aerial extent of measurable free product (A), but first be determined, and the thickness at each monitor well possessing an appropriate screen interval must be recorded. These thicknesses must be averaged to arrive at a value for Average Observed Thickness (T). If the Porosity of the soil (n) is known, the total mass of the free product plume can then be determined using the worksheet provided below:

Average Observed Thickness, (T) _____ ft
Total Area of Plume (A) _____ ft^2
Porosity (n) _____
Correction Factor (Cf) _____ Note: Cf = 1 for gravel, 0.50 for sand, 0.30 for silt, and 0.25 for clay

Total Mass of Free Product Plume = A * T * n * Cf * 49.12 lb/ft^3
Total Mass of Free Product Plume _____ lb

DETERMINATION OF CONTAMINANT MASS IN THE GROUNDWATER

In most cases, the effort expended in determining the mass of contaminants in the groundwater may far exceed the value of that information. The mass of contaminants in the groundwater plume typically constitutes approximately 1% of the total mass of contaminants in the vadose and smear zones. In most cases, it is satisfactory to make this "1%" assumption because site cleanup strategies are not driven by the mass of contaminants in the groundwater, but rather their concentrations. These concentrations, are typically a function of the contaminants entrained in the soil, which implies that the mass of contaminants in the soils should always be addressed first. The procedure presented below should rarely be used, but it is presented anyway. This method makes very broad-based assumptions about the ratio of BTEX concentrations versus whole product and dilution factors.

EPA studies have shown that the vast majority of contamination in the groundwater resides in top 4' of the water column. A wetted screen length greater than 4' tends to cause dilution of the sample. For simplicity, the dilution of the sample is a factor of 4 divided by the wetted screen length if it is assumed that the well water is well mixed prior to sampling. Because of this, the total mass of contaminants in a plume can be approximated by multiplying the "diluted" concentration from a well sample by one fourth of the total submerged screen length (measured in feet) times the aerial extent of the plume. This procedure is outlined below:

1. Utilizing groundwater concentration data, draw a plume map of the groundwater contamination. Draw an isoconcentration line delineating the "zero" BTEX concentration. For the purposes of this calculation, the area inside the "zero" BTEX groundwater isoconcentration line constitutes the horizontal extent of the groundwater plume.

2. The plume area should be calculated by determining the total area inside the "zero" BTEX groundwater isoconcentration line.

3. If the product at the site is gasoline, the groundwater samples should be analyzed for total BTEX concentration. To determine the "whole" concentration of product, multiply the BTEX concentrations by the fresh product/BTEX ratio of 5. An analysis and ratio for Diesel is not available at this time. The conversion of total naphthalene concentrations to whole product concentrations is under consideration.

4. The whole concentrations obtained from the groundwater samples should then be averaged. Ideally, an area weighted average should be used if possible.

5. Multiply the average concentration by the total area inside the zero ppb BTEX groundwater concentration line. The units of this product will be expressed in units of concentration-area (typically mg/Kg-ft^2).

6. To determine the volume of the plume, the concentration-area obtained in step #5 (above) should be multiplied by the undiluted vertical extent of the plume and the porosity. The undiluted vertical extent, for the purposes of this calculation, is **one fourth** of the average of the wetted screen lengths of the surficial monitor wells located inside the zero BTEX isoconcentration contour. Please note that "deep" monitor wells, should not be used in this calculation.. This will give a result in units of concentration-volume (typically mg/Kg-ft^3). Convert the units to concentration-soil mass (typically mg/Kg-Kg). This simplifies to mg. Convert the value of mg to lbs by multiplying by 2.2×10^{-6}.

ATTACHMENT I

AVERAGING TECHNIQUES AND MASS ESTIMATION THEORY

Averaging Techniques:

Use of the Direct Method of source mass calculation requires that data points within each layer of the surface soil zone, the smear zone, and the water-bearing unit be averaged together to get a concentration representative of the entire layer. An explanation of averaging techniques is described below. These techniques are also incorporated into the Florida Soil and Groundwater Modeling Software.

Arithmetic mean: The simplest averaging technique is the arithmetic mean. The user may average all data located within the compartment or depth interval, or may alternately censor closely spaced samples to create a more representative statistical sample. With this method, the mass is very sensitive to the total source area, and is often the least accurate of the methods provided. the equation for the arithmetic mean for n data points is:

$$c = (c_1+c_2+...+c_n)/n$$

Geometric Mean: Another option for averaging multiple data points within a compartment or depth interval is the geometric mean. The geometric mean is useful for a dataset which is logarithmically distributed or whose members vary over orders of magnitude. It is often used in the analysis of environmental data to reduce the influence of outlying data. With this method also, the user may censor data to allow for a more geographically representative data set and the result is very sensitive to the estimate of source area. The equation of the geometric mean for n data points is:

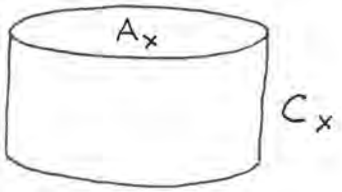
$$c = \sqrt[n]{c_1*c_2*...*c_n}$$

Area-Weighted Mean: A third averaging technique is area-weighted averaging. This technique addresses a major weakness of the other techniques discussed above because each data set is given a weight based on the area it represents. No data censoring is necessary because closely spaced data does not bias the results. the RNA Tool Kit allows the user to specify the area, A, which applied to each sample, or it will approximate the area if the user has not already done so. The equation for the area-weighted average for n data points, each being representative of an area, A, is:

$$c = \frac{(c_1*A_1 + c_2*A_2+...+c_n*A_n)}{(A_1+A_2...+A_n)}$$

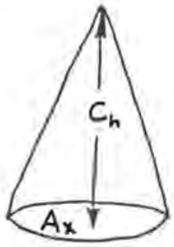
Theory

The product, C_xA_x, can be represented spatially as a volume, where A_x represents the area of the base of a three dimensional object and the C_x represents the height of that object. The drawing below represents this assumed contaminant distribution in three dimensional form:



The product, C_xA_x represents the volume of the object. If the area, A_x was a circle, the formula for the volume of this cylinder would be: $\pi r^2 h = A_x C_x = C_x A_x$

If you do not know the average concentration, C_x, but you do know the highest concentration within an isocontour, and furthermore assume that the concentrations drop linearly to as you move from the highest concentration (C_h) to the edge of the plume, the distribution would look like the following:



This distribution of contaminants is conical, with the highest concentration representing the height of the cone and the area within the isoconcentration representing the base. If the area, A_x was a circle, the formula for the volume of this cone is approximated by the following equation:

$$\frac{1}{3}\pi r^2 h = \frac{1}{3}A_x C_h = \frac{1}{3} C_h A_x$$

Note that if C_h=C_x is the average concentration of area A_x, the formula for the volume of the cylinder is exactly three times the volume of the cone formed from the C_h, the highest concentration of the end area within the isoconcentration line.

Practice

At almost all sites, the location of the highest concentration is known. This is especially true if isoconcentration drawings have been generated as required by either method. However, for a given end area contamination distribution, $C_x A_x$, it is not always apparent whether the contamination distribution is relatively constant throughout area A_x, (like a cylinder) or whether the highest concentration C_h, "falls off", like a conical distribution. In many cases, the distribution has properties of both. There are many factors that govern the plume concentration distribution such as aerobic and anaerobic bacteria, diffusion, dilution, etc. This creates error when it is assumed that the distribution is conical or cylindrical.

There are two primary sources of error with assuming that the distribution is conical ($1/3\ C_hA_x = C_xA_x$ assumption). The first error results from assuming the distribution is conical when the distribution is actually cylindrical or bell-shaped. This will cause an under-estimation of mass. The second source of error is the assumption that the "hottest" sample collected is actually the "hottest" sample for the site. If the assumption is made that the sample collected is the absolute "hottest" site sample, but the sample is not collected from the hottest location, this will also create an under-estimation of contaminant mass. In either case, the ratio of the volumes of a cone to a cylinder, 1/3, for the conversion, $1/3\ C_hA_x = C_xA_x$ may be too low because it tends to underestimate the contaminant mass.

Soil Mass Estimation With One Data Point Per Layer

To offset these errors, a "fudge factor" must be brought into the equation. The empirical data from the FDEP pilot study supports a ratio of approximately 1/2 (i.e., $1/2\ C_hA_x = C_xA_x$). The value of 1/2 was selected because it is a convenient ratio, and because the sample size in the FDEP pilot study is too low to further refine this ratio between the average concentration within a zero isoconcentration contour and the assumed highest concentration for that contour.

Conclusion:

Therefore, when a contaminant distribution within an isocontour can't be determined without laboratory analysis of several soil samples, C_xA_x should be approximated by substituting $C_x A_x = 1/2\ C_h\ A_x$, after determining the concentration of the hottest boring, C_h. The following formulas are presented for the calculation of soil mass with one data point per layer. Note that the value for the highest concentrations, C_{h1}, C_{h2} and C_{h3} are modified by multiplying by 1/2 prior to multiplication by the area inside the isocontour. The result can then be converted from mg to pounds by multiplying by 2.2×10^{-6}.

$$\textbf{Mass (mg)} = pV$$

where $V = (T_1(1/2C_{h1}A_1 + 1/2C_{h2}A_2)/2) + (T_2(1/2C_{h2}A_2 + 1/2C_{h3}A_3)/2) + \text{etc...}$
and p **= soil density in** $\mathrm{Kg/ft^3}$ **= (approximately 65** $\mathrm{Kg/ft^3}$**)**
C_{hx} **= highest concentration (mg/l or mg/kg) for end area** A_x
A_x **= area** ($\mathrm{ft^2}$) **within a specified concentration line at a given depth**
T_x **= The V vertical distance between end areas** A_x **and** A_{x+1}

Appendix G

Emergency Response Considerations

Chapter 62-770, F.A.C., Implementation Guidance

Florida Department of Environmental Protection
Bureau of Emergency Response

The revised Chapter 62-770, F.A.C., contains many important changes, although not many will actually impact emergency response operations. I have summarized the points that I felt were important for first responders that will be handling the initial cleanup of a release. I recommend everyone should still read and become familiar with 62-770 so we can correctly advise our customers. The rule became effective September 23, 1997.

- BER will continue to address the emergency phase of an incident. If the cleanup can be accomplished by product and soil removal alone and all the contamination is removed, BER will work these cases from start to finish. Cases that involve extensive soil contamination, free product, groundwater contamination, or any residual contamination will be referred to the regulatory district petroleum cleanup program. BER may still initiate cleanup actions at the site but will terminate work as soon as the emergency phase is complete.

- The cleanup criteria contained in 62-770 applies to **any** cleanup of a site contaminated with petroleum or petroleum products (including vehicle accidents). **Exceptions** to this are:

  1. Petroleum or petroleum products contaminated with significant quantities of other substances;
  2. Refined derivatives or by-products of crude oil, natural gas, or other naturally occurring hydrocarbons (except those defined as petroleum products in Chapter 376.301, FS);
  3. Discharges **less than** 25 gallons as long as the discharge is cleaned up so that no contamination remains.

Reference 62-770.160(1)

- The reporting requirements are 25 gallons or more of petroleum, petroleum products, or used oil on a pervious surface. The discharge must be reported within one week of discovery (unless the discharge is from a regulated storage tank system - notification must be made within 24 hours per Chapter 62-761, F.A.C.) by the discharger, or owner or operator if the discharger is unknown or if the discovery was the result of a previously unreported discharge. Reference 62-770.200(7) & 62-770.250(1)(b)

- Notification shall be by using the *Discharge Report Form # 62-761.900(1).* Reference 62-770.250(1)

- When free product from a new discharge is discovered, the responsible party or owner/operator must notify the county tank program within 24 hours. Reference 62-770.300(1)(a)

- The responsible party must take steps to obtain the services of a cleanup contractor, or initiate product recovery within 3 days of free product discovery. (**Note**: This is reasonable for a petroleum storage system leak but not for a transportation accident. Free product recovery and contaminated soil removal should be initiated immediately due to the fact that the longer one waits, the more it will cost to cleanup.) Reference 62-770.300

- Within 10 days after initiation of product recovery, the responsible party shall submit the *Free Product Removal Notification Form # 62-770.900(1)* to the FDEP or the local program. Reference 62-770.300(1)(e)

- Excavated soil must be secured in such a manner to prevent human exposure and prevents the soil from being exposed to precipitation. Contaminated soil cannot be stored on site for more than 60 days, unless it is to be landfarmed. If the soil is containerized, it can be stored on site for 90 days. Reference 62-770.300(2)(a)4 & 5

- Field screening techniques (OVA) can be used to identify the locations for sampling, determine the number of samples needed at a site, and **assist** with verifying if a site is cleaned up and ready for closure. An OVA can no longer exclusively be used to verify if a site is cleaned up, only laboratory analysis is acceptable. Reference 62-770.600(3)(e) & (f)

> **For the Gasoline and Kerosene Analytical Groups.** If contamination is still suspected to be present based on field screening results, a minimum of three samples for laboratory analyses must be taken that yield high, medium and low screening results. The samples must be gathered from the undisturbed soil that yielded the highest screening results. If field screening indicates contamination is not present, at least one representative sample must be taken in the area of the discharge, or at least one sample must be taken from the bottom of the excavation, whichever is appropriate. Additional samples may be taken depending upon the size of the excavation. If groundwater is encountered, a sample must be taken from the water in the bottom of the excavation.
>
> **For the Used Oil Group.** The use of visual observation is permitted. To identify areas of contamination at least one sample must be collected from the most visibly stained area. If the soil has been excavated, at least one sample from the bottom, and at least one sample from the wall of the excavation must be taken. If the excavation is relatively shallow, one sample from the bottom is sufficient.

- The parameters needed to verify when a site is cleaned up depends upon the source of the discharge. Reference 62-770.600(4)

For the Gasoline and Kerosene Analytical Groups:

Volatiles: EPA 8020 or 8021
PAH : EPA 8100, 8250, 8270, or 8310
TRPH: FL-PRO

For Used Oil, or Unknowns:

Total Metals: EPA 6010 and 7471
Priority Pollutant Volatile Organics: EPA 8240 or 8260
Priority Pollutant Extractable Organics: EPA 8250 or 8270
Non-priority Pollutant Organics: EPA 8240 or 8260 and 8250 or 8270
TRPH: FL-PRO

If the total metals analysis exceeds the cleanup levels, TCLP will be performed. See Table II of 62-770.

- Cleanup levels for petroleum products' chemicals of concern found in soil are listed in Table IV of 62-770.

- If possible, the excavation should be left open until the laboratory results of the analyses are available. Additional soil removal and confirmation sampling may be necessary. It will obviously be less expensive from an open hole rather than to re-excavate the area or do some other form of remediation.

- Within 60 days of completion of product removal and proper disposal and/or soil treatment or disposal, two copies of a Source Removal Report must be submitted by the responsible party to the BER for review. Reference 62-770.300(3)

- Site rehabilitation completion will be achieved when :
    1) free product does not exist,
    2) excessively contaminated soil does not exist,
    3) contaminated soil does not exist as demonstrated by analysis (must be less than background concentrations or lower than the cleanup target levels in Table IV),
    4) all petroleum products' chemicals of concern in groundwater are less than background or less than the levels in Table V, or,
    5) all petroleum products' chemicals of concern in surface water samples are less than background or less than the levels in Table VII.

If 4 and 5 are applicable, a formal site assessment will also be necessary.
Reference 62-770.680(1)

- BER has 60 days to review the Source Removal Report (SRR). If the SRR demonstrates the cleanup is complete and no further contamination exists, BER shall notify the responsible party in writing of its adequacy. If the SRR does not clearly demonstrate the cleanup was adequate, the BER shall notify the responsible party in writing and refer the case to the FDEP regulatory district petroleum cleanup program. Reference 62-770.300(3)(c)

- If the release impacts groundwater, or additional soil contamination exists, BER shall refer the case to the FDEP regulatory district petroleum cleanup program. The FDEP regulatory district office will notify the responsible party of any additional work that may be necessary.

- All sampling and analyses completed under this rule must be performed by a contractor and laboratory with an FDEP approved QA plan, in accordance with Chapter 62-160, F.A.C., Quality Assurance. Reference 62-770.400

Revised December, 1997

RECEIVED
DEPARTMENT OF
ENVIRONMENTAL PROTECTION

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BUREAU OF PETROLEUM
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CENTER

EXAMPLE

Bureau of Emergency Response
3900 Commonwealth Blvd., MS 659
Tallahassee, Florida 32399-3000
(850)488-2974; fax (850)488-5957

February 26, 1998

Car Quest
1206 Greenville Avenue
Albany, Georgia 31707

Re: BER Incident # 98-05-6002
Date: January 8, 1998 Location: I-75 at mm 467, near Jennings, Florida

Dear Sir or Madam:

The FDEP Bureau of Emergency Response (BER) District 5E Office has reviewed the *Source Removal Report* and the supporting analyses for the above referenced incident. Based upon the information received, BER has made the following determination as indicated below, in accordance with Chapter 62-770.300, Florida Administrative Code.

___ The report indicates that the cleanup appears satisfactory. No further action is required at this time. The BER case is hereby closed. However, please note that FDEP does not certify that the site is uncontaminated, and reserves the right to require future actions if necessary.

___ The report indicates that further remedial work or information is needed. Submission of the following items within thirty (30) days will enable BER to close this case: **Confirmation sampling results for BATX & MTBE, FL-PRO & PAHs analyses with supporting site map and chain of custody form. See 62-770.600(3)(e).**

___ The report indicates further remedial work is needed. BER is hereby referring the case to the FDEP Tanks Program for follow-up. They will provide further direction for any additional action necessary to bring the incident to closure.

BER appreciates your cooperation in this matter. Please call me or one of my staff if there are any questions.

Sincerely,

Douglas C. White
Manager, Bureau of Emergency Response

cc: File 98-05-6002

SOURCE REMOVAL REPORT

The Florida Department of Environmental Protection, Bureau of Emergency Response (BER) Source Removal Report may be used as a cleanup report for any type of discharge, including the cleanup of discharges regulated under 62-770, F.A.C. Within 60 days of completion of free product removal and disposal, and/or soil treatment or disposal, send two copies of this report and attachments to **Florida Department of Environmental Protection, Bureau of Emergency Response, 3900 Commonwealth Boulevard - MS 659, Tallahassee FL. 32399**

Incident Date: __________
Date Cleanup Initiated: __________
Date Cleanup Completed: __________

Location of Incident: ______________________________
Nearest City/Town: ____________________ County: ____________________

Material Discharged: ____________________ Volume Discharged: __________

Cause of Discharge (Check All That Apply):

- ___ Vehicle Accident
- ___ Cargo Tank Leak
- ___ Valve Leak
- ___ Fuel Tank Leak
- ___ UST/AST Overfill
- ___ Vessel Causality
- ___ Container Leak (Drum)
- ___ Pipeline Leak
- ___ UST/AST Line Leak

Environment Affected (Check All That Apply):

- ___ Soil
- ___ Sanitary Sewer
- ___ Roadside Ditch
- ___ Groundwater
- ___ Impervious Surface
- ___ Air
- ___ Storm Drain
- ___ Coastal Beach
- ___ Wetland Area
- ___ Surface Water Body (Name): ______________________________

Responsible Party/Spiller Information:
Name: ______________________________
Mailing Address: ______________________________
City: ____________________ State: ____________________ Zip: __________
Contact: ____________________
Telephone Number: ____________________ FAX Number: ____________________

Cleanup Contractor Information:
Name: ______________________________
Mailing Address: ______________________________
City: ____________________ State: ____________________ Zip: __________
Contact: ____________________
Telephone Number: ____________________ FAX Number: ____________________

Method of Cleanup (Check All That Apply):

- ___ Soil Excavation
- ___ Skimmer
- ___ Carbon Adsorption
- ___ Absorbents/Booms
- ___ Neutralization
- ___ Air Stripping
- ___ Vacuum Truck
- ___ Bioremediation
- ___ In-Situ Burning
- ___ Other: ______________________________

____

Appendix H

List of Permitted Petroleum Contaminated Soil Treatment Facilities

SOIL THERMAL TREATMENT FACILITIES
QUALIFIED TO OPERATE UNDER A GENERAL PERMIT
CHAPTER 17-775, F.A.C.

Stationary Facilities:

Central District:

Southern Soil Services, Inc.
3505 Pug Mill Road
Kissimmee, FL 32741
(407)933-8414

C.A. Myer Paving & Construction
Post Office Box 555727
Orlando, FL 32855-5727
(407)849-0770

Northwest District:

Sonas Systems of Florida
(Capital Asphalt, Inc.)
Post Office Box 7387
Tallahassee, FL 32314-7387
(904)575-8102

Industrial Waste, Inc.
Ellyson Industrial Park
Post Office Box 34
Pensacola, FL 32514
(904)479-1788

Southeast District:

Rinker Materials Corporation
1200 Northwest 137th Avenue
Post Office Box 650679
Miami, FL 33265-0679
(305)221-7645

TPS Technologies, Inc.
9401 Fairgrounds Road
West Palm Beach, FL 33411
(407)433-2650

Northeast District:

Anderson Columbia Company
Post Office Box 1386
Lake City, FL 32056
(904)752-7585

South District:

South Florida Thermal Services
1 Foxmoor Lane
Post Office Box 309
Moore Haven, FL 33471
(813)946-3300

Southwest District:

Kleen Soil International, Inc.
13838 Harlee Road
Palmetto, FL 34221
1-800-926-9677

Geologic Recovery Systems
2300 Highway 60 West
Mulberry, FL 33860
(813)425-0184

Mobile Facilities:

Carlo Environmental Technologies
Model No. 64MT, Serial No. 43543
Post Office Box 744
Clinton, MI 48038-0744
(313)468-9580

D.R.E. Environmental, Inc.
Model No. 528
Post Office Box 1386
2 Guerdon Road
Lake City, FL 32056
(904)755-1196

Mobile Reclaim, Inc.
Serial No. SR-202
Post Office Box 4189
Gainesville, FL 32613-4189
(904)373-4614

Thermotech Systems Corp.
Model No. 625
5201 N. Orange Blossom Trail
Orlando, FL 32810
(407)290-6000

TPS Technologies, Inc.
Serial No. SRU-200P-103 thru
SRU-200P-110
2070 South Orange Blossom Trail
Apopka, FL 32703
(407)886-2000

Appendix I

Free Product Recovery Program Guidance Memorandum

Memorandum

Florida Department of
Environmental Protection

TO: Interested Parties

FROM: Michael Sole, Chief MS
Bureau of Petroleum Storage Systems

DATE: September 23, 1997

SUBJECT: Guidance for Identification of Reasonable Scope of Free Product Recovery Efforts

---

This is the second revision of the memorandum concerning free product recovery for new releases on sites with discharges eligible for state funding. This most recent revision is a result of changes to Chapter 62-770, F.A.C. which will become effective September 23, 1997. This memo replaces the previous version dated October 30, 1995.

Sections 376.305(1) and 376.3071(5)(c), F.S., and Rule 62-761.820, F.A.C., require that the owner or operator of a facility with a new discharge "immediately undertake to contain, remove, and abate the discharge". In accordance with the statute and rule, free product recovery must be initiated immediately upon its discovery as a new release.

New releases at sites that are not eligible for state funding assistance must comply with the source removal requirements established in Rule 62-770.300, F.A.C. (effective date 9/23/97). At sites eligible for state funding assistance, compliance with 62-770.300, F.A.C. is also required, however, in accordance with Section 376.30711, F.S., prior approval of scope of work and costs must be obtained before new petroleum contamination cleanup tasks are initiated. The section also directs the Department to allow for the recovery of free product from new eligible releases with subsequent compensation from the Inland Protection Trust Fund without regard to priority score.

This guidance memorandum describes what will be considered reasonable scope and cost of cleanup activities for free product recovery associated with new releases that are determined to be eligible for funding in the preapproval program. Free product recovery that is consistent with this guideline may be initiated once the attached "Request To Begin Free Product Recovery For a New Discharge" form has been signed by staff from a DEP district office or the appropriate contracted local program for petroleum contamination site cleanup or county compliance verification program. If free product recovery activities for a new release are conducted in accordance with this memorandum and the release is subsequently determined to be eligible, compensation for free product recovery expenses may be claimed through the preapproval program. In anticipation of a determination of eligibility, costs should be incurred by a contractor working for the owner such that the expense for free product recovery activities may be paid by the Department directly to the contractor through a preapproval program after-the-fact work order and invoice. Alternately, the site owner may keep records of his own expenses associated with free product recovery for a new release to be used as payment-in-kind credit for the preapproval program deductible. If the discharge is subsequently determined to be eligible, documentation may be provided to the Department that the free product recovery activities were performed in accordance with this memo and the Department will credit the documented eligible expenses toward the deductible.

Site owners must clearly understand beforehand that obtaining the concurrence of the Department or local program representative on the "Request To Begin Free Product Recovery For a New Discharge" form does not in-and-of-itself constitute either an eligibility determination or a guarantee of compensation under the petroleum cleanup pre-approval program. Only after the discharge is determined to be eligible for funding, will an after-the-fact work order be drafted, and the contractor be able to submit an invoice for the work.

Free product recovery proposals that exceed the scope described below and in Rule 62-770.300, F.A.C., must be submitted to the Bureau of Petroleum Storage Systems in Tallahassee or the appropriate designated cleanup local program for approval prior to implementation. A proposal to exceed the scope below must include a site specific evaluation of free product recovery alternatives along with cost analysis, and technical and cost justification for selection of the recommended alternative. Additional guidance for free product recovery beyond the scope described below is provided in Attachment A to this memo. Compliance with the following source removal actions and guidelines is required in order to pursue state funding assistance at eligible sites in accordance with section 376.30711, F.S.

1. A local program tank compliance inspector shall verify a new release has occurred, the existence of measurable

free product, and verify the need for initiation of product recovery. Evidence of this verification shall be the completion of the "Request To Begin Free Product Recovery For a New Discharge" form.

2. Acceptable free product recovery techniques to be initiated without prior site specific approval of scope are:

   (a) manual bailing

   (b) portable low-rate product recovery pumps

   (c) absorbent materials placed in monitor wells,

   (d) fluid vacuum techniques (for example vacuum pump trucks) or total fluids displacement pumps when the volume of groundwater is not greater than two times the volume of free product recovered, except that the first 1,000 gallons of total fluids recovered per discharge are exempt from meeting the required ratio of groundwater to free product.

3. In order to respond as quickly as possible to new releases of petroleum, the Department waives the requirements to have a Contractor Designation Form on file and for the contractor to be formally qualified. The contractor, however, must be able to perform free product recovery properly and safely.

4. Initial site visits may be conducted daily for the first 5 days. Product recovery may not continue beyond 5 days unless authorized by the Department or contracted local cleanup program (county). A letter should be sent to the Bureau Chief at the Bureau of Petroleum Storage Systems or directly to the contracted local cleanup program (if the site is located in one of the 12 delegated cleanup program counties) as soon as it is established that there may be a need to continue product recovery beyond 5 days. The letter should contain:

   (a) the estimated volume of product released
   (b) estimate volume of product recovered to date
   (c) the recovery technique being used
   (d) most recent measured thickness of product in monitoring wells as of date of letter

(e) brief explanation of the justification to continue product recovery beyond 5 days

The Department (or contracted local program) will respond in a timely manner that we concur with the continued product recovery efforts beyond 5 days or recommend discontinuation of product recovery efforts.

5. For techniques 2.(a) through (c) above, once product recovery rates drop to less than 1 gallon per site visit, the frequency shall be reduced to weekly. Once product recovery rates drop to less than 1 gallon per weekly event, the site visit frequency shall be reduced to once every two weeks. Once product recovery rates drop to less than 1 gallon per two week event, the site visit frequency shall be reduced to monthly. Records of the volume of product recovered from each monitor well per site visit and documentation of proper disposal of recovered product shall be maintained. If the recovery rate from each well on site is less than .1 gallons/well/month or the free product recovery operation has been conducted for a period of 6 months, a report shall be submitted to the Bureau of Petroleum Storage Systems office or contracted local cleanup program office with a recommendation to continue or cease product recovery operations. Product recovery may continue if authorized by the Bureau of Petroleum Storage Systems or the local cleanup program office.

6. Approval for scope of work and costs for free product recovery for techniques 2.(a) through (c) above shall be limited to reasonable rates for a field technician at one hour per well per visit plus local mobilization and demobilization and reasonable rates for: a vehicle, the initial cost of a disposable bailer (must be dedicated to the site), the absorbent material, rental for a portable pump and an oil/water interface probe, rubber gloves, tyvec suit, and proper disposal of the product recovered. Local response action contractors shall be used for routine site visits to the maximum extent practical. Please refer to the back of the "Request To Begin Free Product Recovery For a New Discharge" form for a detailed listing of allowable costs (specific dollar amounts) for approved free product recovery efforts.

7. For technique 2.(d) above, the scope of work shall be consistent with the guidance on the reverse side of the

"Request To Begin Free Product Recovery For a New Discharge" form.

8. Once the site owner has been informed the discharge has been determined to be eligible for funding, and the time frame and scope of free product recovery efforts has been established, then the remediation contractor shall request the Department to prepare an after-the-fact petroleum cleanup program work order. The completed "Request To Begin Free Product Recovery For a New Discharge" form must be included with the work order proposal. (If the discharge was determined to be ineligible, then there will be no compensation provided by the State for the work.)

9. The Department (or contracted local program) will review the proposal, prepare a work order, and will forward the after-the-fact work order to the remediation contractor. It is fully executed and binding upon the DEP only after being signed by all parties. The executed work order, along with a petroleum cleanup preapproval program invoice (including records of product disposal) for the work order amount should then be submitted by the remediation contractor to the Department for final approval and payment.

10. No other work which constitutes site rehabilitation activities, including monitoring well installation and passive "monitoring-only", will be funded until a priority score is calculated and state funding for the site becomes available. A site owner is not prevented from operating a free product recovery system beyond the terms of the work order, or performing monitoring, however, such operation or monitoring is at the site owner's expense and is not compensable from the state trust fund.

Attachments

MS/tc

Attachment A

Procedures For Free Product Recovery: Situations Where Activity Will Exceed the Scope of Activity Allowed by September 23, 1997 Memo and Rule 62-770.300(1)(b), F.A.C.

Occasionally, when there is a new discharge involving a significant quantity of petroleum at a site, there may be a need to conduct free product recovery on a scale or in a manner which is beyond the scope of those methods which may be implemented without prior Department or local program approval, as described in the September 23, 1997 Memorandum and Rule 62-770.300(1)(b), Florida Administrative Code (F.A.C.).

This supplemental guidance pertains only to larger-scale, free product recovery at sites having a new petroleum discharge, where the discharge, by virtue of the site's enrollment in FPLIRP, is entitled to a determination of eligibility for a state-funded cleanup, but such a determination has not yet been made.

- **No guarantee:** Site owners must clearly understand beforehand that negotiation of scope and a maximum cost for free product recovery of a new discharge, and receipt of a letter from the Department indicating agreement on scope and cost, prior to an eligibility determination, does not constitute a guarantee of compensation or a determination of eligibility under the petroleum cleanup pre-approval program. Only after the discharge is determined to be eligible for funding, will an after-the-fact work order be drafted, and the contractor be able to submit an invoice for the work.

- **New vs. newly discovered discharges:** Site owners and their remediation consultants may wish to evaluate whether free product recovery work beyond the limited scope methods authorized in Rule 62-770.300(1)(b), F.A.C., is absolutely necessary, before committing time and effort, and risking the owner's funds. If the free product on site is truly a "new" discharge, occurring very recently, and not just an additional discharge to a site that is already grossly contaminated, then it may be worthwhile to conduct a significant free product recovery effort, thereby minimizing the spread of contamination and the cost of subsequent cleanup tasks. However, if free product has existed for some time and there has been a new release of additional product, then there may not be a meaningful benefit to an aggressive effort to recover the more recent product release. In such a case, there may not be an urgent need to conduct an intensive, large-scale free product recovery effort.

- **Contractor Designation and Qualification:** In order to respond as quickly as possible to new releases of petroleum, the Department waives the requirements to have a Contractor Designation Form on file and for the contractor to be formally qualified. The contractor, however, must be able to perform free product recovery properly and safely.

- **Procedure:** The following is an outline of the steps involved when free product recovery beyond the scope of those listed in the September 23, 1997 memorandum and Rule 62-770.300(1)(b), F.A.C., is performed as a potentially compensable activity for a new discharge, should that discharge later be determined eligible for available state funding.

  1. Site owner takes action to stop the further discharging of the petroleum, i.e. leak fixed, or leaking piping or tanks taken out of service, removed, etc. This is the obligation of the site owner but is not an allowable cost for state funding assistance.

  2. Site owner's contractor begins limited free product recovery using one of the methods listed on Rule 62-770.300(1)(b), F.A.C., as a temporary measure while a more aggressive method for the situation is evaluated.

  3. Site owner or contractor should make request at this time, or as soon as possible, for a determination of the eligibility for the discharge.

  4. Site owner's contractor submits a free product recovery proposal for the more aggressive method, pursuant to Rule 62-770.300(1)(c), F.A.C., describing the scope of activities and including a cost estimate, to the Bureau Chief of the Bureau of Petroleum Storage Systems, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400. For sites located in areas covered by the Department's contracted local cleanup programs, the proposal should be submitted to the local program office. Given that time is of the essence for free product recovery associated with a new discharge, the scope and cost proposal does not have to be as detailed and formal as those for other tasks performed under the pre-approval program. It should, however, be descriptive and capable of serving as a basis for determining compensation later, if the discharge is determined to be eligible for funding. The completed "Request To Begin Free Product Recovery For a New Discharge" form must be included with the proposal.

  5. The Department (or local program) reviews proposal. If a proposal revision is necessary, then negotiations with the remediation contractor regarding the change are to be made quickly, thereby limiting migration of free product.

6. Department (or local program) approves the free product recovery proposal and issues a letter of agreement which clearly indicates: (a) the negotiated maximum dollar amount the State is willing to pay for the work; (b) the time allowed for implementation of the work upon receipt of approval; (c) the duration of the work; (d) a disclaimer that negotiation of costs and approval of work, prior to an eligibility determination for a site, does not constitute a guarantee of compensation from the state trust fund; and (e) terms of the agreement. Terms may be as follows: free product recovery via the approved method, pursuant to Rule 62-770.300(1)(c), F.A.C., is the extent of work that the Department will fund as a potentially compensable activity.

7. At this time the Department may also issue an Approval of Alternate Procedures Order, if necessary, to allow the scope of activities in Rule 62-770.300, F.A.C., to be exceeded.

8. Site owner or remediation contractor implements and completes the approved free product recovery, then notifies the Department in writing. Notification after completion of the work that is potentially compensable should include free product thickness readings, the amount of free product recovered, and its disposition.

9. If the discharge is determined to be eligible for funding, then the site owner or remediation contractor requests the Department to prepare an after-the-fact petroleum cleanup program work order. (If the discharge was determined to be ineligible, then there will be no compensation provided by the State for the work.)

10. Department forwards the after-the-fact work order to the remediation contractor. It is fully executed only after being signed by all parties. The signed work order, along with a petroleum cleanup program invoice for the negotiated amount, and a copy of the cost estimate should then be submitted by the site owner or remediation contractor to the Department for final approval and payment.

11. No other work which constitutes site rehabilitation activities, including monitoring well installation and passive "monitoring-only", will be funded until a priority score is calculated and state funding for sites bearing such a score becomes available. A site owner is not prevented from operating a free product recovery system beyond a negotiated potentially compensable period, or performing monitoring, provided such operation or monitoring is at the site owner's expense.