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Office of Solid Waste and Emergency Response

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Soil Screening Guidance: Fact Sheet

Office of Emergency and Remedial Response

Quick Reference Fact Sheet

This fact sheet summarizes key aspects of the U.S. Environmental Protection Agency's (EPA) Soil Screening Guidance. The Soil Screening Guidance is a tool developed by EPA to help standardize and accelerate the evaluation and cleanup of contaminated soils at sites on the National Priorities List (NPL) where future residential land use is anticipated. The User's Guide provides a simple step-by-step methodology for environmental science/engineering professionals to calculate risk-based, site-specific soil screening levels (SSLs) for contaminants in soil that may be used to identify areas needing further investigation at NPL sites. The Technical Background Document presents the analysis and modeling upon which this approach is based, as well as generic SSLs calculated using conservative default values, and guidance for conducting more detailed analysis of complex site conditions, where needed.

SSLs are not national cleanup standards. SSLs alone do not trigger the need for response actions or define "unacceptable" levels of contaminants in soil. In this guidance, "screening" refers to the process of identifying and defining areas, contaminants, and conditions, at a particular site that do not require further Federal attention. Generally, at sites where contaminant concentrations fall below SSLs, no further action or study is warranted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly known as "Superfund." (Some States have developed screening numbers that are more stringent than the generic SSLs presented here; therefore, further study may be warranted under State programs.) Where contaminant concentrations equal or exceed SSLs, further study or investigation, but not necessarily cleanup, is warranted.

The decision to use the Soil Screening Guidance at a site will be driven by the potential benefits of eliminating areas, exposure pathways, or contaminants from further investigation. By identifying areas where concentrations of contaminated soil are below levels of concern under CERCLA, the guidance provides a means to focus resources on exposure areas, contaminants and exposure pathways of concern.

SSLs are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. Three options for developing screening levels are included in the guidance, depending on how the numbers will be used to screen at a site, and the amount of site-specific information that will be collected or is available. Details of these approaches are presented in the User's Guide (EPA, 1996a) and the Technical Background Document (TBD) (EPA, 1996b). The three options for using SSLs are:

- Applying generic SSLs
- Developing simple, site-specific SSLs
- Developing site-specific SSLs based on more detailed modeling

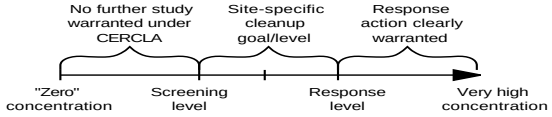
The progression from generic to simple site-specific and more detailed site-specific SSLs

usually involves an increase in investigation costs and, generally a decrease in the stringency of the screening levels because conservative assumptions can be replaced with less conservative site-specific information. Generally, the decision of which method to use involves balancing the increased investigation costs with the potential savings associated with higher (but protective) SSLs. The User's Guide focuses on the application of a simple site-specific approach by providing a step-by-step methodology to calculate site-specific SSLs. The TBD provides more information about the other approaches.

Generic SSLs for the most common contaminants found at NPL sites are included in the TBD. Generic SSLs are calculated from the same equations presented in the User's Guide, but are based on a number of default assumptions chosen to be protective of human health for most site conditions. Generic SSLs can be used in place of site-specific screening levels; however, in general, they are expected to be more stringent than site-specific levels. The site manager should weigh the cost of collecting the data necessary to develop site-specific SSLs with the potential for deriving a higher SSL that provides an appropriate level of protection.

The TBD also includes more detailed modeling approaches for developing screening levels that take into account more complex site conditions than the simple site-specific methodology emphasized in the User's Guide. More detailed approaches may be appropriate when site conditions (e.g., a thick vadose zone) are different from those assumed in the simple site-specific methodology presented here. The technical details supporting the methodology used in the User's Guide are provided in the TBD. SSLs developed in accordance with the User's Guide are based on future residential land use assumptions and related exposure scenarios. Using this guidance for sites where residential land use assumptions do not apply could result in overly conservative screening levels; however, EPA recognizes that some parties responsible for sites with non-residential land use might still find benefit in using the SSLs as a tool to conduct a conservative initial screening.

SSLs developed in accordance with this guidance could also be used for Resource Conservation and Recovery Act (RCRA) corrective action sites as "action levels," since the RCRA corrective action program currently views the role of action levels as generally fulfilling the same purpose as soil screening levels.[1] In addition, States may use this guidance in their voluntary cleanup programs, to the extent they deem appropriate. When applying SSLs to RCRA corrective action sites or for sites under State voluntary cleanup programs, users of this guidance should recognize, as stated above, that SSLs are based on residential land use assumptions. Where these assumptions do not apply, other approaches for determining the need for further study might be more appropriate.



Highlight 1. Conceptual Risk Management Spectrum for Contaminated Soil

1.2 Role of Soil Screening Levels

In identifying and managing risks at contaminated sites, EPA considers a spectrum of contaminant concentrations. The level of concern associated with those concentrations depends on the likelihood of exposure to soil contamination at levels of potential concern to human health or to ecological receptors.

Highlight 1 illustrates the spectrum of soil contamination encountered at Superfund sites and the conceptual range of risk management responses. At one end are levels of contamination that clearly warrant a response action; at the other end are levels that are below regulatory concern. Screening levels identify the lower bound of the spectrum—levels below

1 Further information on the role of action levels in the RCRA corrective action program is available in an Advance Notice of Proposed Rulemaking (signed April 12, 1996).

which there is generally no concern under CERCLA, provided conditions associated with the SSLs are met. Appropriate cleanup goals for a particular site may fall anywhere within this range depending on site-specific conditions.

EPA anticipates the use of SSLs as a tool to facilitate prompt identification of contaminants and exposure areas of concern during both remedial actions and some removal actions under CERCLA. However, the application of this or any screening methodology is not mandatory at sites being addressed under CERCLA or RCRA. The framework leaves discretion to the site manager and technical experts (e.g., risk assessors, hydrogeologists) to determine whether a screening approach is appropriate for the site and, if screening is to be used, the proper method of implementation. The decision to use a screening approach should be made early in the process of investigation at the site.

EPA developed the Soil Screening Guidance to be consistent with and to enhance the current Superfund investigation process and anticipates its primary use during the early stages of a remedial investigation (RI) at NPL sites. It does not replace the Remedial Investigation/ Feasibility Study (RI/FS), including the risk assessment portion of the RI, but the use of screening levels can focus sampling and risk assessment on aspects of the site that are likely to be a concern under CERCLA. By screening out areas of sites, potential chemicals of concern, or exposure pathways from further investigation, site managers and technical experts can limit the scope of the field investigation or risk assessment.

SSLs can save resources by helping to determine which areas do not require additional Federal attention early in the process. Furthermore, data gathered during the soil screening process can be used in later Superfund phases, such as the baseline risk assessment, feasibility study, treatability study, and remedial design. This guidance may also be appropriate for use by the removal program when demarcation of soils above residential risk-based numbers coincides with the purpose and scope of the removal action.

The simple, site-specific soil screening levels are likely to be most useful where it is difficult to determine whether areas of soil are contaminated to an extent that warrants further investigation or response (e.g., whether areas of soil at an NPL site require further investigation under CERCLA through an RI/FS). As noted above, the screening levels have been developed assuming residential land use. Although some of the models and methods presented in this guidance could be modified to address exposures under other land uses, EPA has not yet standardized assumptions for exposure scenarios related to those other uses.

This guidance provides the information needed to calculate SSLs for 110 chemicals. Sufficient information may not be available to develop soil screening levels for additional chemicals. These chemicals should not be screened out, but should be addressed in the baseline risk assessment for the site. The *Risk Assessment Guidance for Superfund* (RAGS), *Volume 1: Human Health Evaluation Manual* (HHEM)*, Part A, Interim Final* (U.S. EPA, 1989a) provides guidance on conducting baseline risk assessments for NPL sites. In addition, the baseline risk assessment should address the chemicals, exposure pathways, and areas at the site that are not screened out.

Although SSLs are "risk-based," they do not eliminate the need to conduct a site-specific risk assessment for those areas identified as needing further investigation. SSLs are concentrations of contaminants in soil that are designed to be protective of exposures in a residential setting. A site-specific risk assessment is an evaluation of the risk posed by exposure to site contaminants in various media. To calculate SSLs, the exposure equations and pathway models are run in reverse to backcalculate an "acceptable level" of a contaminant in soil. For the ingestion, dermal, and inhalation pathways, toxicity criteria are used to define an acceptable level of contamination in soil, based on a one-in-a-million (10^{-6}) individual excess cancer risk for carcinogens and a hazard quotient (HQ) of 1 for non-carcinogens. SSLs are backcalculated for migration to ground water pathways using ground water concentration limits [nonzero maximum contaminant level goals (MCLGs), maximum contaminant levels (MCLs), or

health-based limits (HBLs) (10^{-6} cancer risk or a HQ of 1) where MCLs are not available].

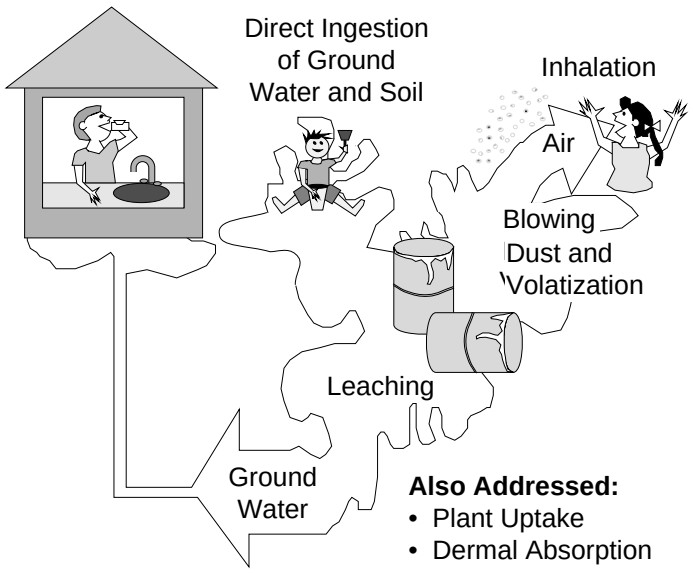
SSLs can be used as Preliminary Remediation Goals (PRGs) provided appropriate conditions are met (i.e., conditions found at a specific site are similar to conditions assumed in developing the SSLs). The concept of calculating risk-based contaminant levels in soils for use as PRGs (or "draft" cleanup levels) was introduced in the RAGS HHEM*, Part B, Development of Risk-Based Preliminary Remediation Goals.* (U.S. EPA, 1991b).

PRGs may then be used as the basis for developing final cleanup levels based on the nine-criteria analysis described in the National Contingency Plan [Section 300.430 (3)(2)(I)(A)]. The directive entitled *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (U.S. EPA, 1991c) discusses the modification of PRGs to generate cleanup levels. The SSLs should only be used as cleanup levels when a site-specific nine-criteria evaluation of the SSLs as PRGs for soils indicates that a selected remedy achieving the SSLs is protective, complies with Applicable or Relevant and Appropriate Requirements (ARARs), and appropriately balances tradeoffs between cleanup options with respect to the other criteria, including cost.

1.3 Scope of Soil Screening Guidance

In a residential setting, potential pathways of exposure to contaminants in soil are as follows (see Highlight 2):

- Direct ingestion
- Inhalation of volatiles and fugitive dusts
- Ingestion of contaminated ground water caused by migration of chemicals through soil to an underlying potable aquifer
- Dermal absorption
- Ingestion of homegrown produce that has been contaminated via plant uptake
- Migration of volatiles into basements.



Highlight 2. Exposure Pathways Addressed by SSLs.

The Soil Screening Guidance addresses each of these pathways to the greatest extent practical. The first three pathways -- direct ingestion, inhalation of volatiles and fugitive dusts, and ingestion of potable ground water -- are the most common routes of human exposure to contaminants in the residential setting. These pathways have generally accepted methods, models, and assumptions that lend themselves to a standardized approach. The additional pathways of exposure to soil contaminants, dermal absorption, plant uptake, and migration of volatiles into basements, may also contribute to the risk to human health from exposure to specific contaminants in a residential setting. The guidance addresses these pathways to a limited extent based on available empirical data. (See Step 5 and the TBD for further discussion).

The Soil Screening Guidance addresses the human exposure pathways listed previously and will be appropriate for most residential settings. The presence of additional pathways or unusual site conditions does not preclude the use of SSLs in areas of the site that are currently residential or likely to be residential in the future. However, the risks associated with additional pathways or conditions (e.g., fish consumption, raising of livestock, heavy truck traffic on unpaved roads)

should be considered in the RI/FS to determine whether SSLs are adequately protective.

An ecological assessment should also be performed as part of the RI/FS to evaluate potential risks to ecological receptors.

The Soil Screening Guidance should not be used for areas with radioactive contaminants.

Highlight 3 provides key attributes of the Soil Screening Guidance: User's Guide.

Highlight 3: Key Attributes of the User's Guide

- Standardized equations are presented to address human exposure pathways in a residential setting consistent with Superfund's concept of "Reasonable Maximum Exposure" (RME).
- Source size (area and depth) can be considered on a site-specific basis using mass-limit models.
- Parameters are identified for which site-specific information is needed to develop SSLs.
- Default values are provided to calculate generic SSLs when site-specific information is not available.
- SSLs are based on a 10^{-6} excess risk for carcinogens or a hazard quotient of 1 for noncarcinogens. SSLs for migration to ground water are based on (in order of preference): nonzero maximum contaminant level goals (MCLGs), maximum contaminant levels (MCLs), or the aforementioned risk-based targets.

2.0 SOIL SCREENING PROCESS

Applying site-specific screening levels involves developing a conceptual site model (CSM), collecting a few easily obtained site-specific soil parameters (such as the dry bulk density and percent moisture), and sampling to measure contaminant concentrations in surface and subsurface soils. Often, much of the information needed to develop the CSM can be derived from previous site investigations [e.g., the Preliminary Assessment/Site Inspection (PA/SI)] and, if properly planned, SSL sampling can be accomplished in one mobilization. This fact sheet provides a brief overview of the steps in the process. A full discussion of the steps and their implementation is available in the User's Guide.

The soil screening process (outlined in Highlight 4) is a step-by-step approach that involves:

- Developing a conceptual site model (CSM)
- Comparing the CSM to the SSL scenario
- Defining data collection needs
- Sampling and analyzing soils at site
- Deriving site-specific SSLs, as appropriate
- Comparing site soil contaminant concentrations to SSLs
- Determining which areas of the site require further study.

The overall outline is fundamentally the same, whether you are using the simple site-specific approach, the generic levels, or a more detailed approach. However, the details of any specific application will be different. In particular, developing the simple site specific SSLs is obviously more involved than using the generic screening levels available in the TBD.

Highlight 4

Soil Screening Process

Step One: Develop Conceptual Site Model

- Collect existing site data (historical records, aerial photographs, maps, PA/SI data, available background information, State soil surveys, etc.)
- Organize and analyze existing site data
  - Identify known sources of contamination
  - Identify affected media
  - Identify potential migration routes, exposure pathways, and receptors
- Construct a preliminary diagram of the CSM
- Perform site reconnaissance
  - Confirm and/or modify CSM
  - Identify remaining data gaps

Step Two: Compare Soil Component of CSM to Soil Screening Scenario

- Confirm that future residential land use is a reasonable assumption for the site
- Identify pathways present at the site that are addressed by the guidance
- Identify additional pathways present at the site not addressed by the guidance
- Compare pathway-specific generic SSLs with available concentration data
- Estimate whether background levels exceed generic SSLs

Step Three: Define Data Collection Needs for Soils to Determine Which Site Areas Exceed SSLs

- Develop hypothesis about distribution of soil contamination (i.e., which areas of the site have soil contamination that exceed appropriate SSLs?)
- Develop sampling and analysis plan for determining soil contaminant concentrations
  - Sampling strategy for surface soils (includes defining study boundaries, developing a decision rule, specifying limits on decision errors, and optimizing the design)
  - Sampling strategy for subsurface soils (includes defining study boundaries, developing a decision rule, specifying limits on decision errors, and optimizing the design)
  - Sampling to measure soil characteristics (bulk density, moisture content, organic carbon content, porosity, pH)
- Determine appropriate field methods and establish QA/QC protocols

Step Four: Sample and Analyze Soils at Site

- Identify contaminants
- Delineate area and depth of sources
- Determine soil characteristics
- Revise CSM, as appropriate

Step Five: Derive Site-specific SSLs, if needed

- Identify SSL equations for relevant pathways
- Identify chemical of concern for dermal exposure and plant uptake
- Obtain site-specific input parameters from CSM summary
- Replace variables in SSL equations with site-specific data gathered in Step 4
- Calculate SSLs
  - Account for exposure to multiple contaminants

Step Six: Compare Site Soil Contaminant Concentrations to Calculated SSLs

- For surface soils, screen out exposure areas where all composite samples do not exceed SSLs by a factor of 2
- For subsurface soils, screen out source areas where the highest average soil core concentration does not exceed the SSLs
- Evaluate whether background levels exceed SSLs

Step Seven: Decide How to Address Areas Identified for Further Study

- Consider likelihood that additional areas can be screened out with more data
- Integrate soil data with other media in the baseline risk assessment to estimate cumulative risk at the site
- Determine the need for action
- Use SSLs as PRGs

However, developing site specific levels may be worthwhile given the less stringent but equally protective levels that will generally result.

An important part of this guidance is a recommended sampling approach that balances the need for more data to reduce uncertainty with the need to limit data collection costs. Where data are limited such that use of the "maximum test" (Max test) presented in the User's Guide is not appropriate, the guidance also provides direction on the use of other conservative estimates of contaminant concentrations for comparison with the SSLs.

2.1 Step 1: Developing a Conceptual Site Model

The conceptual site model (CSM) is a three-dimensional "picture" of site conditions that illustrates contaminant distributions, release mechanisms, exposure pathways and migration routes, and potential receptors. The CSM documents current site conditions and is supported by maps, cross sections, and site diagrams that illustrate human and environmental exposure through contaminant release and migration to potential receptors. Developing an accurate CSM is critical to proper implementation of the Soil Screening Guidance.

As a key component of the RI/FS and EPA's Data Quality Objectives (DQO) process, the CSM should be updated and revised as investigations produce new information about a site. *Data Quality Objectives for Superfund: Interim Final Guidance* (U.S. EPA, 1993a) and *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (U.S. EPA, 1989c) provide a general discussion about the development and use of the CSM during RIs.

2.2 Step 2: Comparing the CSM to SSL Scenario

In this step, the conceptual site model for a particular site is compared to the conceptual site model assumed for the development of the Soil Screening Guidance. This comparison should determine whether the SSL scenario is sufficiently similar to the CSM so that use of the guidance is appropriate. The Soil Screening Guidance was developed assuming residential land use. The primary exposure pathways associated with residential land use (given in section 1.3) are (1) direct ingestion, (2) inhalation of volatile and fugitive dusts, and (3) ingestion of contaminated ground water caused by migration of chemicals through soil to an underlying potable aquifer. The residential exposure assumptions associated with these pathways are given in Highlight 5.

Highlight 5
Residential Exposure Assumptions

Exposure frequency ..... 350 days/year
Exposure duration ..... 30 years

For Noncarcinogens
Body weight ..... 15 kg
Ingestion rate ..... 200 mg/day

For Carcinogens
Body weight .. age adjusted from 15 -70 kg
Ingestion rate ..... age adjusted from ..... 200 - 100 mg/day
Drinking water ingestion rate ..... 2 L/day
Inhalation rate ..... 20 m^3/day

The CSM may include other sources and exposure pathways that are not covered by this guidance. Compare the CSM with the assumptions and limitations inherent in the SSLs to determine whether additional or more detailed assessments are needed for any exposure pathways or chemicals. The Soil Screening Guidance can be used to screen those sources and exposures pathways that are covered by the guidance. Early identification of areas or conditions where SSLs are not applicable is important so that other characterization and response efforts can be considered when planning the sampling strategy.

Where the following conditions exist, a more detailed site-specific investigation will be needed:

- site adjacent to surface water,
- potential terrestrial or aquatic ecological concerns
- other human exposure pathways likely (e.g. local fish consumption, homegrown dairy, livestock or other agricultural use, or
- unusual site conditions (e.g., presence of non-aqueous phase liquids, unusually high fugitive dust levels from site activities.)

A consideration of background concentrations should be made to determine whether SSLs are likely to be useful, since the SSLs have much less utility where background concentrations exceed the SSLs. Background concentrations exceeding generic SSLs do not necessarily indicate that a health threat exists, but may suggest that additional analysis is appropriate. For example, it may be important to determine whether the high background concentrations are anthropogenic or naturally occuring. Generally, EPA does not clean up below natural background; however, where anthropogenic background levels exceed SSLs, EPA may determine that some type of comprehensive response is necessary and feasible.

2.3 Step 3: Defining Data Collection Needs for Soils

Once the CSM has been developed and the site manager has determined that the Soil Screening Guidance is appropriate to use at a site, a Sampling and Analysis Plan (SAP) should be developed. Highlight 4 outlines the general strategy for developing sampling plans likely to be needed to apply the Soil Screening Guidance. A different sampling approach is used for the surface and subsurface because different exposure pathways are being addressed. Sampling should also provide site characteristics data necessary to develop site-specific SSLs. The User's Guide provides information on the development of SAPs for these three types of information.

To develop sampling strategies that will properly assess site contamination, EPA recommends that site managers consult with the technical experts in their Region, including risk assessors, toxicologists, chemists and hydrogeologists, who can assist the site manager to use the DQO process to satisfy Superfund program objectives. The DQO process is a systematic planning process developed by EPA to ensure that sufficient data are collected to support EPA decision making. A full discussion of the DQO process is provided in *Data Quality Objectives for Superfund: Interim Final Guidance* (U.S. EPA, 1993a) and the *Guidance for the Data Quality Objectives Process* (U.S. EPA, 1994a). Many of the key elements have been incorporated as part of the guidance.

One of the critical decisions to make before developing the SAP is to define the specific area to which the Soil Screening Guidance will be applied. Existing data (e.g., preliminary assessment, other site investigation data, historical documents discussing site activities) can be used to determine what level and type of investigation may be appropriate. Areas known to be important sources of ground water contamination should be sampled for subsurface contamination, but it often will not be necessary to develop screening levels based on surface contamination for these areas. Sampling in known source areas will focus on developing remedial alternatives with some sampling to confirm expected problems, as necessary. Other areas may have good historical information to indicate that no waste handling activities occurred there and it is expected that these areas are unlikely to be contaminated. A few samples may be taken to confirm this hypothesis. Much of the sampling effort for soil screening is likely to focus on areas of uncertain contamination levels and history. The User's Guide provides more information about the use of historical information, the statistical basis for the sampling strategy, and the soil characteristics that are needed to develop site-specific screening levels.

2.4 Step 4: Sampling and Analyzing Site Soils

Once the sampling strategies have been developed and implemented, the samples should be analyzed according to the analytical laboratory and field methods specified in the SAP. An important outcome of these analyses is the estimation of the concentrations of potential contaminants of concern which will be compared to the SSLs. At this point, the generic SSLs may be useful for comparison purposes. Where estimated concentrations are above the generic SSLs, site-specific SSLs can be calculated to provide another, less stringent but still conservative comparison.

Because these analyses reveal new information about the site, update the CSM accordingly.

2.5 Step 5: Calculating Site-specific SSLs

With the soil properties data collected in Step 4 of the screening process, site-specific soil screening levels can now be calculated using the equations presented in the User's Guide. The Soil Screening Guidance provides the equations necessary to develop a simple site-specific soil screening levels. For a description of how these equations were developed, as well as background on their assumptions and limitations, consult the TBD. When generic SSLs are being used as for comparison to site concentration, this step may be omitted.

All SSL equations were developed to be consistent with reasonable maximum exposure (RME) for the residential setting. The Superfund program estimates the RME for chronic exposures on a site-specific basis by combining an average exposure-point concentration with reasonably conservative values for intake and duration (U.S. EPA, 1989a; RAGS HHEM, *Supplemental Guidance: Standard Default Exposure Factors*, U.S. EPA, 1991a). Thus, all site-specific parameters (soil, aquifer, and meteorologic parameters) used to calculate SSLs should reflect average or typical site conditions in order to calculate average exposure concentrations at the site.

Exposure pathways addressed in the process for screening surface soils include direct ingestion, dermal contact, and inhalation of fugitive dusts. While the guidance provides all the relevant toxicity from EPA sources necessary to calculate site-specific SSLs, Integrated Risk Information System (IRIS) (U.S. EPA, 1995a) or Health Effects Assessment Summary Tables (HEAST) (U.S. EPA, 1995b) should be checked for current values. Only the most current values should be used to calculate SSLs.

The Soil Screening Guidance addresses two exposure pathways for subsurface soils: inhalation of volatiles and ingestion of ground water contaminated by the migration of contaminants through soil to an underlying potable aquifer. Because the equations developed to calculate SSLs for these pathways assume an infinite source, they can violate mass-balance considerations, especially for small sources. To address this concern, the guidance also includes equations for calculating mass-limit SSLs for each of these pathways when the size (i.e., area and depth) of the contaminated soil source is known or can be estimated with confidence.

The Soil Screening Guidance uses a simple linear equilibrium soil/water partition equation or a leach test to estimate contaminant release in soil leachate. It also uses a simple water-balance equation to calculate a dilution factor to account for reduction of soil leachate concentration from mixing in an aquifer.

The methodology for developing SSLs for the migration to ground water pathway was designed for use during the early stages of a site evaluation when information about subsurface conditions may be limited. Hence, the methodology is based on rather conservative, simplified assumptions about the release and transport of contaminants in the subsurface (Highlight 6). These assumptions are inherent in the SSL equations and should be reviewed for consistency with the conceptual site model (see

Step 2) to determine the applicability of SSLs to the migration to ground water pathway.

Highlight 6: Simplifying Assumptions for the SSL Migration to Ground Water Pathway

- Infinite source (i.e., steady-state concentrations are maintained over the exposure period)
- Uniformly distributed contamination from the surface to the top of the aquifer
- No contaminant attenuation (i.e., adsorption, biodegradation, chemical degradation) in soil
- Instantaneous and linear equilibrium soil/water partitioning
- Unconfined, unconsolidated aquifer with homogeneous and isotropic hydrologic properties
- Receptor well at the downgradient edge of the source and screened within the plume
- No contaminant attenuation in the aquifer
- No NAPLs present (if NAPLs are present, the SSLs do not apply).

Address Exposure to Multiple Chemicals. The SSLs generally correspond to a 10^{-6} excess risk level for carcinogens and a hazard quotient of 1 for noncarcinogens. This "target" hazard quotient is used to calculate a soil concentration below which it is unlikely that sensitive populations will experience adverse health effects. The potential for additive effects has not been "built in" to the SSLs through apportionment. For carcinogens, EPA believes that setting a 10^{-6} excess risk level for individual chemicals and pathways generally will lead to cumulative site risks within the 10^{-4} to 10^{-6} risk range for the combinations of chemicals typically found at NPL sites.

For noncarcinogens, there is no widely accepted risk range, and EPA recognizes that cumulative risks from noncarcinogenic contaminants at a site could exceed the target hazard quotient. However, EPA also recognizes that noncancer risks should be added only for those chemicals with the same toxic endpoint or mechanism of action.

If more than one chemical detected at a site affects the same target organ (i.e., has the same critical effect as defined by the RfD methodology), an overall hazard index (HI) for the source (or exposure area) can be calculated. If this HI exceeds 1, further investigation is needed. The guidance provides a list of target organs for all chemicals with SSLs based on noncarcinogenic effect.

2.6 Step 6: Comparing Site Soil Contaminant Concentrations to Calculated SSLs

Now that the site-specific SSLs have been calculated for the potential contaminants of concern, compare them with the site contaminant concentrations. At this point, it is reasonable to review the CSM with the actual site data to confirm its accuracy and the overall applicability of the Soil Screening Guidance.

Thus, for surface soils, the contaminant concentrations in each composite sample from an exposure area are compared to 2 times the SSL. (When SSL DQOs were developed, 2 times the SSL was determined to a reasonable upper limit for comparison that would still be protective of human health. Use of this decision rule is appropriate only when the quantity and quality of data are comparable to the levels discussed in the User's Guide. For a complete discussion for the SSL DQOs, see the TBD.) If any composite has concentrations that equal or exceed 2 times the SSL, the area cannot be screened out, and further study is needed.

However, if all composite samples are below 2 times the SSLs, no further study is needed.

For data sets of lesser quality, the 95% upper confidence level on the arithmetic mean of contaminant soil concentration can be compared directly to the SSLs. The TBD discusses strengths and weaknesses of different calculations of the mean and when they are appropriate for making screening decisions.

Since subsurface soils are not characterized to the same extent as surface soils, there is less confidence that the concentrations measured are representative of the entire source. Thus, a more conservative approach to screening is warranted. Because it may not be protective to allow for comparison to values above the SSL, mean contaminant concentrations from each soil boring taken in a source area are compared with the calculated SSLs. Source areas with any mean soil boring contaminant concentration greater than the SSLs generally warrant further consideration. On the other hand, where the mean soil boring contaminant concentrations within a source are all less than the SSLs, that source area is generally screened out.

2.7 Step 7: Addressing Areas Identified for Further Study

Areas that have been identified for further study become a subject of the RI/FS (U.S. EPA, 1989c). The results of the baseline risk assessment conducted as part of the RI/FS will establish the basis for taking remedial action. The threshold for taking action differs from the criteria used for screening. As outlined in *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (U.S. EPA, 1991c), remedial action at NPL sites is generally warranted where cumulative risks for current or future land use exceed $1x10^{-4}$ for carcinogens or an HI of 1 for noncarcinogens. The data collected for soil screening are useful in the RI and baseline risk assessment. However, additional data will probably need to be collected during future site investigations. This additional data will better define the risks and threats at the site and could conceivably indicate that no action is required.

Once the decision has been made that remedial action may be appropriate, the SSLs can then serve as PRGs. This process is referenced in Section 1.2 of this document.

FOR FURTHER INFORMATION

The technical details (e.g, equations and assumptions necessary to implement the soil screening guidance are available in the *Soil Screening Guidance: User's Guide* (U.S. EPA, 1996a). More detailed discussions of the technical background and assumptions supporting the development of the Soil Screening Guidance are presented in the *Soil Screening Guidance: Technical Background Document* (U.S. EPA, 1996b). The final portion of the guidance package is the *Soil Screening Guidance: Response to Comments*, (U.S. EPA, 1996c) which describes changes made to the guidance following peer review and public comment. For additional copies of this fact sheet, the User's Guide, the Technical Background Document, Response to Comments, or other EPA documents, call the National Technical Information Service (NTIS) at (703) 487-4650 or 1-800-553-NTIS (6847).

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