Regional Screening Table

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For assistance/questions please use the rsl table contact us page

Welcome

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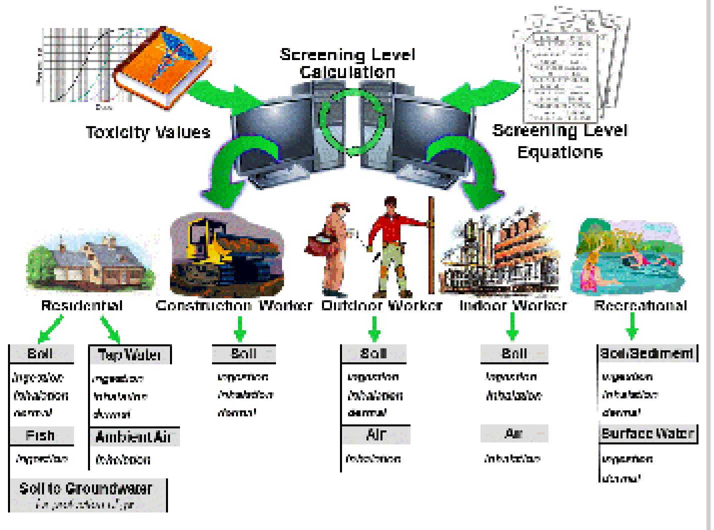
Welcome to the "Regional Screening Levels for Chemical Contaminants at Superfund Sites" screening level/preliminary remediation goal website. This website was developed with DOE's Oak Ridge National Laboratory (ORNL) under an Interagency Agreement as a merger of the EPA Region 3 RBC Table, Region 6 HHMSSL Table and the Region 9 PRG Table. The RSL website is now the source of screening levels for all the EPA regions. The RSL tables provide comparison values for residential and commercial/industrial exposures to soil, air, and tapwater (drinking water). The unified use of the RSLs, to screen chemicals at Superfund sites, promotes national consistency. Here you will find tables of risk-based screening levels, calculated using the latest toxicity values, default exposure assumptions and physical and chemical properties, and a calculator where default parameters can be changed to reflect site-specific risks. To ensure proper use of the screening level tables and the calculator, please review the What's New, User's Guide, Frequently Asked Questions, and Download Area links. Below is a general description of screening levels for chemical contaminants. If the calculator is used with non-default inputs in a decision on a Superfund site, it is recommended that the inputs be clearly identified and justified by the user.

Introduction



Screening Level Calculation Chart

Superfund sites are addressed under the authority of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, which was amended by the 1986 Superfund Amendments and Reauthorization Act. The purpose of this website is to provide a screening level calculation tool to assist risk assessors, remedial project managers, and others involved with risk assessment and decision-making at CERCLA sites in developing or refining screening levels.

This tool is based on Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) (RAGs Part B) and Soil Screening Guidance: User's Guide (PDF), Technical Background Documenrt (PDF) and Supplemental Guidance. RAGs Part B provides guidance on using EPA toxicity values and exposure information to calculate risk-based Screening Levels (SLs). The relationship of Preliminary Remediation Goals (PRGs) to screening levels (SLs) is discussed in more detail in the User's Guide. The Soil Screening Guidance documents expand upon RAGS Part B. Initially used at the scoping phase of a project using readily available information, risk-based screening levels generally are modified based on site-specific data gathered during the RI/FS study. Screening level development and screening should assist staff in streamlining the consideration of remedial alternatives. Chemical-specific SLs are from two general sources: (1) concentrations based on potential Applicable or Relevant and Appropriate Requirements (ARARs) and (2) concentrations based on risk assessment. ARARs include concentration limits set by other environmental regulations, such as Safe Drinking Water Act maximum contaminant levels (MCLs). The second source for SLs, and the focus of this database tool, is risk-based calculations that set concentration limits using carcinogenic or systemic toxicity values under specific exposure conditions.

The recommended approach for developing remediation goals is to identify screening levels at scoping, modify them as needed at the end of the RI or during the FS based on site-specific information from the baseline risk assessment, and ultimately select remediation levels in the ROD.

Screening levels are also used when a potential site is initially investigated to determine if potentially significant levels of contamination are present to warrant further investigation such as an RI/FS.

In order to set chemical-specific SLs in a site-specific context, however, assessors must answer fundamental questions about the site, such as information on the chemicals that are present onsite, the specific contaminated media, land-use assumptions, and the exposure assumptions behind pathways of individual exposure.

Once this web tool is used to retrieve standard screening levels or calculate site-specific screening levels, it is important to clearly demonstrate the equation inputs used in the calculations. Discussion of the assumptions that go into the screening level calculations should be included in the document where the screening levels are presented.

This tool presents standardized risk-based screening levels and variable risk-based screening level calculation equations for chemical contaminants. Screening levels are presented in the default tables for residential soil, outdoor worker soil, residential indoor air, worker indoor air and tap water. In addition, the calculator provides a fish ingestion equation. The risk-based screening levels for chemicals are based on the carcinogenicity and systemic toxicity of the analytes. The standardized or default screening levels used in the tables on this website are based on default exposure parameters and incorporate exposure factors that present RME conditions.

Radionuclides are not addressed on this website. For radionuclide PRGs please go to EPA's PRGs for Radionuclides.

Note: No consideration is given to ecological effects in the values presented in this database tool.

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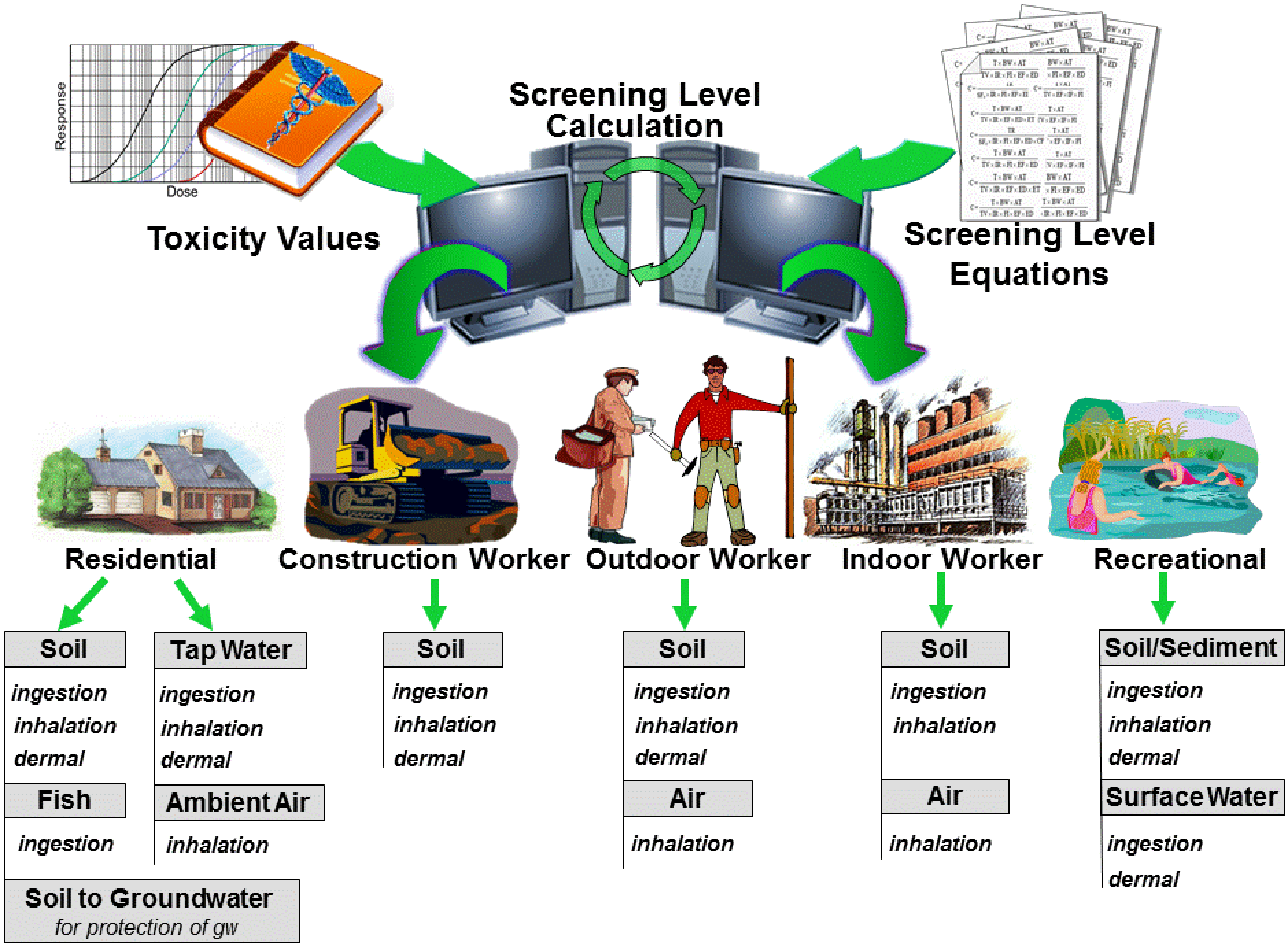

Response
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User's Guide (November 2014)

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Disclaimer

This guidance sets forth a recommended, but not mandatory, approach based upon currently available information with respect to risk assessment for response actions at CERCLA sites. This document does not establish binding rules. Alternative approaches for risk assessment may be found to be more appropriate at specific sites (e.g., where site circumstances do not match the underlying assumptions, conditions and models of the guidance). The decision whether to use an alternative approach and a description of any such approach should be documented for such sites. Accordingly, when comments are received at individual CERCLA sites questioning the use of the approaches recommended in this guidance, the comments should be considered and an explanation provided for the selected approach.

It should also be noted that the screening levels (SLs) in these tables are based upon human health risk and do not address potential ecological risk. Some sites in sensitive ecological settings may also need to be evaluated for potential ecological risk. EPA's guidance "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessment" http://www.epa.gov/oswer/riskassessment/ecorisk/ecorisk.htm contains an eight step process for using benchmarks for ecological effects in the remedy selection process.

1. Introduction

The purpose of this website is to provide default screening tables and a calculator to assist Remedial Project Managers (RPMs), On Scene Coordinators (OSC's), risk assessors and others involved in decision-making concerning CERCLA hazardous waste sites and to determine whether levels of contamination found at the site may warrant further investigation or site cleanup, or whether no further investigation or action may be required.

Users within and outside the CERCLA program should use the tables or calculator results at their own discretion and they should take care to understand the assumptions incorporated in these results and to apply the SLs appropriately.

The SLs presented in the Generic Tables are chemical-specific concentrations for individual contaminants in air, drinking water and soil that may warrant further investigation or site cleanup. The SLs generated from the calculator may be site-specifc concentrations for individual chemicals in soil, air, water and fish. **It should be emphasized that SLs are not cleanup standards**. We also do not recommend that the RSLs be used as cleanup levels for Superfund Sites until the recommendations in EPA's Supplemental Guidance to Risk Assessment Guidance for Superfund, Volume I, Part A ("Community Involvement in Superfund Risk Assessments" http://www.epa.gov/oswer/riskassessment/ragsa/pdf/ci_ra.pdf) have been addressed. SLs should not be used as cleanup levels for a CERCLA site until the other remedy selections identified in the relevant portions of the National Contingency Plan (NCP), 40 CFR Part 300, have been evaluated and considered. PRGs (Preliminary Remediation Goals) is a term used to describe a project team's early and evolving identification of possible remedial goals. PRGs may be initially identified early in the Remedial Investigation/ Feasibility Study (RI/FS) process (e.g., at RI scoping) to select appropriate detection limits for RI sampling. Typically, it is necessary for PRGs to be more generic early in the process and to become more refined and site-specific as data collection and assessment progress. The SLs identified on this website are likely to serve as PRGs early in the process--e.g., at RI scoping and at screening of chemicals of potential concern (COPCs) for the baseline risk assessment. However, once the baseline risk assessment has been performed, PRGs can be derived from the calculator using site-specific risks, and the SLs in the Generic Tables are less likely to apply. PRGs developed in the FS will usually be based on site-specific risks and Applicable or Relevant and Appropriate Requirements (ARARs) and not on generic SLs.

2. Understanding the Screening Tables

2.1 General Considerations

Risk-based SLs are derived from equations combining exposure assumptions with chemical-specific toxicity values.

2.2 Exposure Assumptions

Generic SLs are based on default exposure parameters and factors that represent Reasonable Maximum Exposure (RME) conditions for long-term/chronic exposures and are based on the methods outlined in EPA's Risk Assessment Guidance for Superfund, Part B Manual (1991) and Soil Screening Guidance documents (1996 and 2002).

Site-specific information may warrant modifying the default parameters in the equations and calculating site-specific SLs, which may differ from the values in these tables. In completing such calculations, the user should answer some fundamental questions about the site. For example, information is needed on the contaminants detected at the site, the land use, impacted media and the likely pathways for human exposure.

Whether these generic SLs or site-specific screening levels are used, it is important to clearly demonstrate the equations and exposure parameters used in deriving SLs at a site. A discussion of the assumptions used in the SL calculations should be included in the documentation for a CERCLA site.

2.3 Toxicity Values

In 2003, EPA's Superfund program revised its hierarchy of human health toxicity values, providing three tiers of toxicity values (http://www.epa.gov/oswer/riskassessment/pdf/hhmemo.pdf). Three tier 3 sources were identified in that guidance, but it was acknowledged that additional tier 3 sources may exist. The 2003 guidance did not attempt to rank or put the identified tier 3 sources into a hierarchy of their own. However, when developing the screening tables and calculator presented on this website, EPA needed to establish a hierarchy among the tier 3 sources. The toxicity values used as "defaults" in these tables and calculator are consistent with the 2003 guidance. Chronic and subchronic toxicity values from the following sources, in the order in which they are presented below, are used as the defaults in these tables and calculator.

1. EPA's Integrated Risk Information System (IRIS).
2. The Provisional Peer Reviewed Toxicity Values (PPRTVs) derived by EPA's Superfund Health Risk Technical Support Center (STSC) for the EPA Superfund program.
3. The Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels (MRLs).
4. The California Environmental Protection Agency (OEHHA) Office of Environmental Health Hazard Assessment's Chronic Reference Exposure Levels (RELS) from October 2013 and the Cancer Potency Values from July 21, 2009 with updates in 2011 for dioxin/furans and dioxinlike PCBs. In July 2014 additional cancer and noncancer toxicity values were provided in, " Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values ".
5. In the Fall 2009, this new source of toxicity values used was added: screening toxicity values in an appendix to certain PPRTV assessments. While we have less confidence in a screening toxicity value than in a PPRTV, we put these ahead of HEAST toxicity values because these appendix screening toxicity values are more recent and use current EPA methodologies in the derivation, and because the PPRTV appendix screening toxicity values also receive external peer review. To alert users when these values are used, the key presents an "X" (for Appendix) rather than a "P" (for PPRTV). The following is taken from a PPRTV appendix and states the inteded useage of appendix screening levels.

   > However, information is available for this chemical, which although insufficient to support derivation of a provisional toxicity value, under current guidelines, may be of limited use to risk assessors. In such cases, the Superfund Health Risk Technical Support Center summarizes available information in an appendix and develops a "screening value." Appendices receive the same level of internal and external scientific peer review as the PPRTV documents to ensure their appropriateness within the limitations detailed in the document. Users of screening toxicity values in an appendix to a PPRTV assessment should understand that there is considerably more uncertainty associated with the derivation of an appendix screening toxicity value than for a value presented in the body of the assessment. Questions or concerns about the appropriate use of screening values should be directed to the Superfund Health Risk Technical Support Center.

6. The EPA Superfund program's Health Effects Assessment Summary Table.

   Users of these screening tables and calculator wishing to consider using other toxicity values, including toxicity values from additional sources, may find the discussions and seven preferences on selecting toxicity values in the attached Environmental Council of States paper useful for this purpose (ECOS website, ECOS paper).

   When using toxicity values, users are encouraged to carefully review the basis for the value and to document the basis of toxicity values used on a CERCLA site.

2.3.1 Reference Doses

The current, or recently completed, EPA toxicity assessments used in these screening tables (IRIS and PPRTVs) define a reference dose, or RfD, as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark dose, or using categorical regression, with uncertainty factors generally applied to reflect limitations of the data used. RfDs are generally the toxicity value used most often in evaluating noncancer health effects at Superfund sites. Various types of RfDs are available depending on the critical effect (developmental or other) and the length of exposure being evaluated (chronic or subchronic). Some of the SLs in these tables also use Agency for Toxic Substances and Disease Registry (ATSDR) chronic oral minimal risk levels (MRLs) as an oral chronic RfD. Screening toxicity values in an appendix to certain PPRTV assessments were added to the hierarchy in the fall of 2009. The HEAST RfDs used in these SLs were based upon then current EPA toxicity methodologies, but did not use the more recent benchmark dose or categorical regression methodologies. Chronic oral reference doses and ATSDR chronic oral MRLs are expressed in units of (mg/kg-day).

2.3.1.1 Chronic Reference Doses

Chronic oral RfDs are specifically developed to be protective for long-term exposure to a compound. As a guideline for Superfund program risk assessments, chronic oral RfDs generally should be used to evaluate the potential noncarcinogenic effects associated with exposure periods greater than 7 years (approximately 10 percent of a human lifetime). However, this is not a bright line. Note, that ATSDR defines chronic exposure as greater than 1 year for use of their values. The calculator requires the user to select between chronic and subchronic toxicity values.

2.3.1.2 Subchronic Reference Doses

Subchronic oral RfDs are specifically developed to be protective for short-term exposure to a compound. As a guideline for Superfund program risk assessments, subchronic oral RfDs should generally be used to evaluate the potential noncarcinogenic effects of exposure periods between two weeks and seven years. However, this is not a bright line. Note, that ATSDR defines subchronic exposure as less than 1 year for use of their values. The calculator requires the user to select between chronic and subchronic toxicity values.

2.3.2 Reference Concentrations

The current, or recently completed, EPA toxicity assessments used in these screening tables (IRIS and PPRTV assessments) define a reference concentration (RfC) as an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. It can be derived from a NOAEL, LOAEL, or benchmark concentration, or using categorical regression with uncertainty factors generally applied to reflect limitations of the data used. Various types of RfCs are available depending on the critical effect (developmental or other) and the length of exposure being evaluated (chronic or subchronic). These screening tables also use ATSDR chronic inhalation MRLs as a chronic RfC, intermediate inhalation MRLs as a subchronic RfC and California Environmental Protection Agency (chronic) Reference Exposure Levels (RELs) as chronic RfCs. Screening toxicity values in an appendix to certain PPRTV assessments were added to the hierarchy in the fall of 2009. These screening tables may also use some RfCs from EPA's HEAST tables.

2.3.2.1 Chronic Reference Concentrations

The chronic inhalation reference concentration is generally used for continuous or near continuous inhalation exposures that occur for 7 years or more. However, this is not a bright line, and ATSDR chronic MRLs are based on exposures longer than 1 year. EPA chronic inhalation reference concentrations are expressed in units of (mg/m^3). Cal EPA RELs are presented in $\mu g/m^3$ and have been converted to mg/m^3 for use in these screening tables. Some ATSDR inhalation MRLs are derived in parts per million (ppm) and some in mg/m^3. For use in this table all were converted into mg/m^3. The calculator requires the user to select between chronic and subchronic toxicity values.

2.3.2.2 Subchronic reference Concentrations

The subchronic inhalation reference concentration is generally used for exposures that are between 2 weeks and 7 years. However, this is not a bright line, and ATSDR subchronic MRLs are based on exposures less than 1 year. EPA subchronic inhalation reference concentrations are expressed in units of (mg/m^3). Cal EPA RELs are presented in $\mu g/m^3$ and have been converted to mg/m^3 for use in these screening tables. Some ATSDR intermediate inhalation MRLs are derived in parts per million (ppm) and some in mg/m^3. For use in this table all were converted into mg/m^3. The calculator requires the user to select between chronic and subchronic toxicity values.

2.3.3 Slope Factors

A slope factor and the accompanying weight-of-evidence determination are the toxicity data most commonly used to evaluate potential human carcinogenic risks. Generally, the slope factor is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The slope factor is used in risk assessments to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. Slope factors should always be accompanied by the weight-of-evidence classification to indicate the strength of the evidence that the agent is a human carcinogen.

Oral slope factors are toxicity values for evaluating the probability of an individual developing cancer from oral exposure to contaminant levels over a lifetime. Oral slope factors are expressed in units of $(mg/kg\text{-}day)^{-1}$. When available, oral slope factors from EPA's IRIS or PPRTV assessments are used. The ATSDR does not derive cancer toxicity values (e.g. slope factors or inhalation unit risks). Some oral slope factors used in these screening tables were derived by the California Environmental Protection Agency, whose methodologies are quite similar to those used by EPA's IRIS and PPRTV assessments. Screening toxicity values in an appendix to certain PPRTV assessments were added to the hierarchy in the fall of 2009. When oral slope factors are not available in IRIS then PPRTVs, Cal EPA assessments, PPRTV appendices or values from HEAST are used.

2.3.4 Inhalation Unit Risk

The IUR is defined as the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 $\mu g/m^3$ in air. Inhalation unit risk toxicity values are expressed in units of $(\mu g/m^3)^{-1}$.

When available, inhalation unit risk values from EPA's IRIS or PPRTV assessments are used. The ATSDR does not derive cancer toxicity values (e.g. slope factors or inhalation unit risks). Some inhalation unit risk values used in these screening tables were derived by the California Environmental Protection Agency, whose methodologies are quite similar to those used by EPA's IRIS and PPRTV assessments. Screening toxicity values in an appendix to certain PPRTV assessments were added to the hierarchy in the fall of 2009. When inhalation unit risk values are not available in IRIS then PPRTVs, Cal EPA assessments, PPRTV appendices or values from HEAST are used.

2.3.5 Toxicity Equivalence Factors

Some chemicals are members of the same family and exhibit similar toxicological properties; however, they differ in the degree of toxicity. Therefore, a toxicity equivalence factor (TEF) must first be applied to adjust the measured concentrations to a toxicity equivalent concentration.

The following table contains the various dioxin-like toxicity equivalency factors for Dioxins, Furans and dioxin-like PCBs (Van den Berg et al. 2006), which are the World Health Organization 2005 values. These TEFs are also presented in the May 2013 fact sheet, " Use of Dioxin TEFs in Calculating Dioxin TEQs at CERCLA and RCRA Sites" which references the 2010 EPA report, "Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds"

Dioxin Toxicity Equivalence Factors

	Dioxins and Furans	TEF
Chlorinated dibenzo-p-dioxins		

	2,3,7,8-TCDD		1
	1,2,3,7,8-PeCDD		1
	1,2,3,4,7,8-HxCDD		0.1
	1,2,3,6,7,8-HxCDD		0.1
	1,2,3,7,8,9-HxCDD		0.1
	1,2,3,4,6,7,8-HpCDD		0.01
	OCDD		0.0003
Chlorinated dibenzofurans			
	2,3,7,8-TCDF		0.1
	1,2,3,7,8-PeCDF		0.03
	2,3,4,7,8-PeCDF		0.3
	1,2,3,4,7,8-HxCDF		0.1
	1,2,3,6,7,8-HxCDF		0.1
	1,2,3,7,8,9-HxCDF		0.1
	2,3,4,6,7,8-HxCDF		0.1
	1,2,3,4,6,7,8-HpCDF		0.01
	1,2,3,4,7,8,9-HpCDF		0.01
	OCDF		0.0003
PCBs			
	IUPAC No.	**Structure**	
Non-*ortho*	77	3,3',4,4'-TetraCB	0.0001
	81	3,4,4',5-TetraCB	0.0003
	126	3,3',4,4',5-PeCB	0.1
	169	3,3',4,4',5,5'-HxCB	0.03
Mono-*ortho*	105	2,3,3',4,4'-PeCB	0.00003
	114	2,3,4,4',5-PeCB	0.00003
	118	2,3',4,4',5-PeCB	0.00003
	123	2',3,4,4',5-PeCB	0.00003
	156	2,3,3',4,4',5-HxCB	0.00003
	157	2,3,3',4,4',5'-HxCB	0.00003
	167	2,3',4,4',5,5'-HxCB	0.00003
	189	2,3,3',4,4',5,5'-HpCB	0.00003
Di-*ortho**	170	2,2',3,3',4,4',5-HpCB	0.0001
	180	2,2',3,4,4',5,5'-HpCB	0.00001

* Di-ortho values come from Ahlborg, U.G., et al. (1994), which are the WHO 1994 values from Toxic equivalency factors for dioxin-like PCBs: Report on WHO-ECEH and IPCS consultation, December 1993 Chemosphere, Volume 28, Issue 6, March 1994, Pages 1049-1067.

Carcinogenic polycyclic aromatic hydrocarbons

Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (EPA/600/R-93/089, July 1993), recommends that a toxicity equivalency factor (TEF) be used to convert concentrations of carcinogenic polycyclic aromatic hydrocarbons (cPAHs) to an equivalent concentration of benzo(a)pyrene when assessing the cancer risks posed by these substances from oral exposures. These TEFs are based on the potency of each compound relative to that of benzo(a)pyrene. For the toxicity value database, these TEFs have been applied to the toxicity values. Although this is not in complete agreement with the direction in the aforementioned documents, this approach was used so that toxicity values could be generated for each cPAH. Additionally, it should be noted that computationally it makes little difference whether the TEFs are applied to the concentrations of cPAHs found in environmental samples or to the toxicity values as long as the TEFs are not applied to both. However, if the adjusted toxicity values are used, the user will need to sum the risks from all cPAHs as part of the risk assessment to derive a total risk from all cPAHs. A total risk from all cPAHs is what is derived when the TEFs are applied to the environmental concentrations of cPAHs and not to the toxicity values. These TEFs are not needed and should not be used with the Cal EPA Inhalation Unit Risk Values used, nor should they be used when calculating non-cancer risk. See FAQ no. 14.

The following table presents the TEFs for cPAHs recommended in *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons*.

Toxicity Equivalency Factors for Carcinogenic Polycyclic Aromatic Hydrocarbons

Compound	TEF
Benzo(a)pyrene	1.0
Benz(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1.0
Indeno(1,2,3-c,d)pyrene	0.1

2.4 Chemical-specific Parameters

Several chemical specific parameters are needed for development of the SLs.

2.4.1 Sources

Many sources are used to populate the database of chemical-specific parameters. They are briefly described below.

1. The Estimation Programs Interface (EPI) Suite™ was developed by the US Environmental Protection Agency's Office of Pollution Prevention and Toxics and Syracuse Research Corporation (SRC). These programs estimate various chemical-specific properties. The calculations for these SL tables use the experimental values for a property over the estimated values.
2. EPA Soil Screening Level (SSL) Exhibit C-1.
3. WATER8, which has been replaced with WATER9.
4. Syracuse Research Corporation (SRC). 2005. CHEMFATE Database. SRC. Syracuse, NY. Accessed July 2005.
5. Syracuse Research Corporation (SRC). 2005. PHYSPROP Database. SRC. Syracuse, NY. Accessed July 2005.
6. Yaws' Handbook of Thermodynamic and Physical Properties of Chemical Compounds. Knovel, 2003. (http://www.knovel.com).
7. EPA Soil Screening Level (SSL) Table C.4 (http://www.epa.gov/superfund/health/conmedia/soil/index.htm).
8. Baes, C.F. 1984. Oak Ridge National Laboratory. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. http://homer.ornl.gov/baes/documents/ornl5786.html. Values are also found in Superfund Chemical Data Matrix (SCDM) (http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm).
9. NIOSH Pocket Guide to Chemical Hazards (NPG), NIOSH Publication No. 97-140, February 2004. (http://www.cdc.gov/niosh/npg/npg.html).
10. CRC Handbook of Chemistry and Physics . (Various Editions)
11. Perry's Chemical Engineers' Handbook (Various Editions).McGraw-Hill. Online version available at:http://www.knovel.com/web/portal/browse/display?_EXT_KNOVEL_DISPLAY_bookid=2203&VerticalID=0. Green, Don W.; Perry, Robert H. (2008).

12. Lange's Handbook of Chemistry (Various Editions). Online version available at: http://www.knovel.com/web/portal/browse/display?_EXT_KNOVEL_DISPLAY_bookid=1347&VerticalID=0. Speight, James G. (2005). McGraw-Hill.

13. U.S. EPA 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. OSWER 9285.7-02EP.July 2004. Document and website http://www.epa.gov/oswer/riskassessment/ragse/index.htm

14. The ARS Pesticide Properties Database: U.S. Department of Agriculture, Agricultural Research Service. 2009. Document and website http://www.ars.usda.gov/services/docs.htm?docid=14199".

2.4.2 Hierarchy by Parameter

Generally the hierarchies below will work for organic and inorganic compounds.

1. Organic Carbon Partition Coefficient (K_{oc}) (L/kg). Not applicable for inorganics. EPI estimated values; SSL, Yaw estimated values; EPI experimental values; Yaw Experimental values.
2. Dermal Permeability Coefficient (K_p) (cm/hr). EPI estimated values; RAGS Part E.
3. Effective Predictive Domain (EPD). Calculated based on RAGS Part E criteria for MW and log Kow.
4. Fraction Absorbed (FA). RAGS Part E Exhibit B-3; Calculated.
5. Molecular Weight (MW) (g/mole). EPI; CRC89; PERRY; LANGE; YAWS.
6. Water Solubility (S) (mg/L at 25 °C, unless otherwise stated in the source.). EPI experimental values; SSL; CRC; YAWS experimental values; PERRY; LANGE; Yaws estimated values; EPI estimated values; PHYSPROP.
7. Unitless Henry's Law Constant (H' at 25 °C, unless otherwise stated in the source.). EPI experimental values; SSL; YAWS experimental values; EPI estimated values; PHYSPROP.
8. Henry's Law Constant (atm-m^3/mole at 25 °C, unless otherwise stated in the source.). EPI experimental values; SSL; YAWS experimental values; EPI estimated values; PHYSPROP.
9. Diffusivity in Air (D_{ia}) (cm^2/s). WATER9 equations; SSL.
10. Diffusivity in Water (D_{iw}) (cm^2/s). WATER9 equations; SSL.
11. Fish Bioconcentration Factor (BCF) (L/kg). EPI experimental values; EPI estimated values.
12. Soil-Water Partition Coefficient (K_d) (cm^3/g). SSL; BAES.
13. Density (g/cm^3). CRC; PERRY; LANGE; IRIS.
14. Melting Point (MP °C). EPI experimental values; SSL; CRC; Perry; Lange; EPI estimated values.
15. log Octanol-Water Partition Coefficient (logKow). EPI experimental values; YAWS experimental values; EPI estimated values; Yaws estimated values.

3. Using the SL Tables

The "Generic Tables" page provides generic concentrations in the absence of site-specific exposure assessments. These concentrations can be used for:

- Prioritizing multiple sites or operable units or areas of concern within a facility or exposure units
- Setting risk-based detection limits for contaminants of potential concern (COPCs)
- Focusing future site investigation and risk assessment efforts (e.g., selecting COPCs for the baseline risk assessment)
- Identifying contamination which may warrant cleanup
- Identifying sites, or portions of sites, which warrant no further action or investigation
- Initial cleanup goals when site-specific data are lacking

Generic SLs are provided for multiple exposure pathways and for chemicals with both carcinogenic and noncarcinogenic effects. A Summary Table is provided that contains SLs corresponding to either a 10^{-6} risk level for carcinogens or a Hazard Quotient (HQ) of 1 for non-carcinogens. The summary table identifies whether the SL is based on cancer or noncancer effects by including a "c" or "n" after the SL. The Supporting Tables provide SLs corresponding to a 10^{-6} risk level for carcinogens and an HQ of 1 for noncarcinogens. Site specific SLs corresponding to an HQ of less than 1 may be appropriate for those sites where multiple chemicals are present that have RfDs or RfCs based on the same toxic endpoint. Site specific SLs based upon a cancer risk greater than 10^{-6} can be calculated and may be appropriate based upon site specific considerations. However, caution is recommended to ensure that cumulative cancer risk for all actual and potential carcinogenic contaminants found at the site does not have a residual (after site cleanup, or when it has been determined that no site cleanup is required) cancer risk exceeding 10^{-4}. Also, changing the target risk or HI may change the balance between the cancer and noncancer endpoints. At some concentrations, the cancer-risk concerns predominate; at other concentrations, noncancer-HI concerns predominate. The user must take care to consider both when adjusting target risks and hazards.

Tables are provided in either MS Excel or in PDF format. The following lists the tables provided and a description of what is contained in each:

- Summary Table - provides a list of contaminants, toxicity values, MCLs and the lesser (more protective) of the cancer and noncancer SLs for resident soil, industrial soil, resident air, industrial air and tapwater.
- Residential Soil Supporting Table - provides a list of contaminants, toxicity values and the cancer and noncancer SLs for resident soil.
- Industrial Soil Supporting Table - provides a list of contaminants, toxicity values and the cancer and noncancer SLs for industrial soil.
- Residential Air Supporting Table - provides a list of contaminants, toxicity values and the cancer and noncancer SLs for resident air.
- Industrial Air Supporting Table - provides a list of contaminants, toxicity values and the cancer and noncancer SLs for industrial air.
- Residential Tapwater Supporting Table - provides a list of contaminants, toxicity values, MCLs and the cancer and noncancer SLs for tapwater.

3.1 Developing a Conceptual Site Model

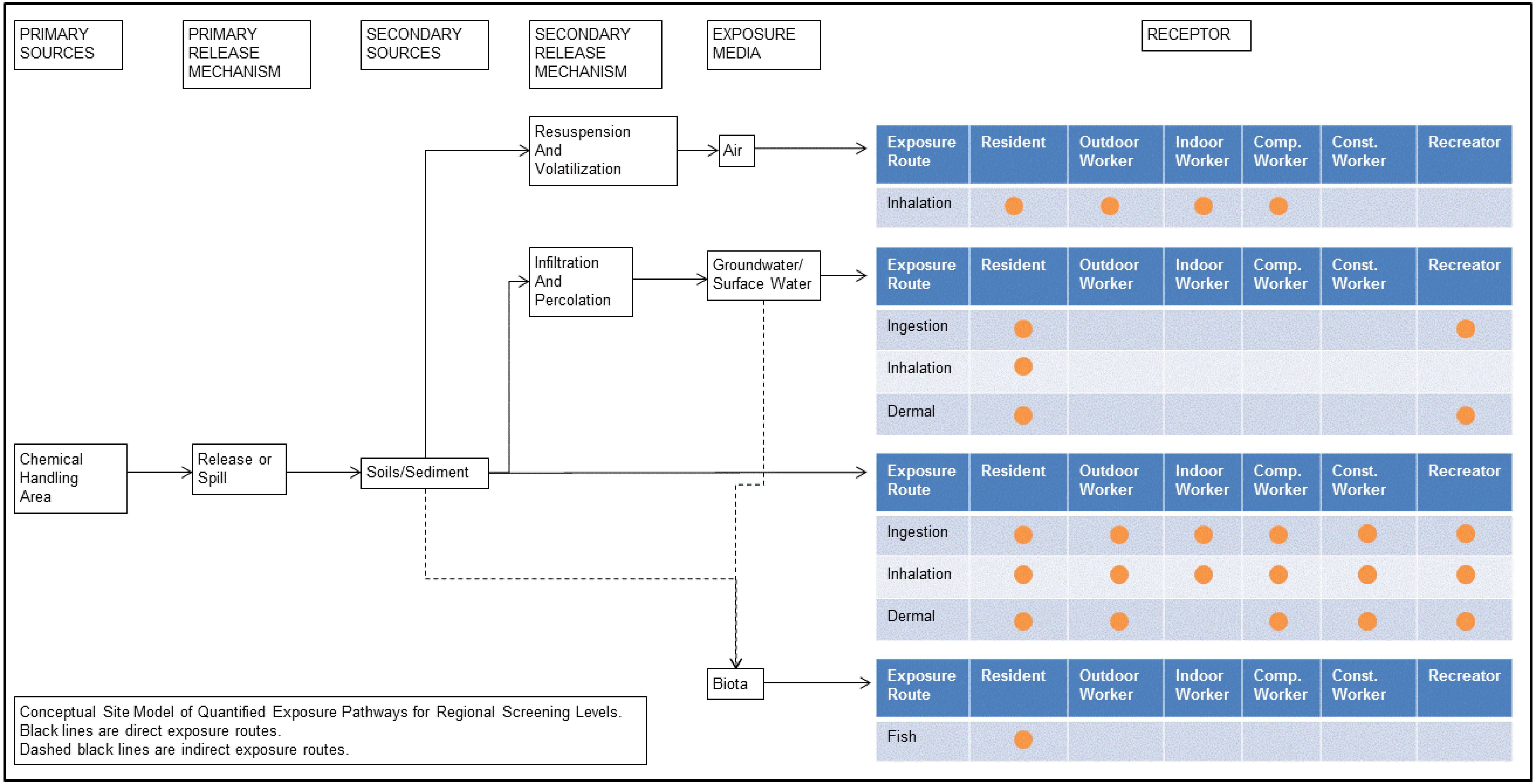
When using generic SLs at a site, the exposure pathways of concern and site conditions should match those used in developing the SLs presented here. (Note, however, that future uses may not match current uses. Future uses are potential site uses that may occur in the future. At Superfund sites, future uses should be considered as well as current uses. RAGS Part A, Chapter 6, provides guidance on selecting future-use receptors.) Thus, it is necessary to develop a conceptual site model (CSM) to identify likely contaminant source areas, exposure pathways, and potential receptors. This information can be used to determine the applicability of SLs at the site and the need for additional information. The final CSM diagram represents linkages among contaminant sources, release mechanisms, exposure pathways, and routes and receptors based on historical information. It summarizes the understanding of the contamination problem. A separate CSM for ecological receptors can be useful. Part 2 and Attachment A of the Soil Screening Guidance for Superfund: Users Guide (EPA 1996) contains the steps for developing a CSM.

As a final check, the CSM should address the following questions:

- Are there potential ecological concerns?
- Is there potential for land use other than those used in the SL calculations (i.e., residential and commercial/industrial)?
- Are there other likely human exposure pathways that were not considered in development of the SLs?
- Are there unusual site conditions (e.g. large areas of contamination, high fugitive dust levels, potential for indoor air contamination)?

The SLs and later PRGs may need to be adjusted to reflect the answers to these questions.

Below is a potential CSM of the quantified pathways addressed in the SL Tables.



3.2 Background

EPA may be concerned with two types of background at sites: naturally occurring and anthropogenic. Natural background is usually limited to metals whereas anthropogenic (i.e. human-made) "background" includes both organic and inorganic contaminants.

Please note that the SL tables, which are purely risk-based, may yield SLs lower than naturally occurring background concentrations of some chemicals in some areas. However, background considerations may be incorporated into the assessment and investigation of sites, as acknowledged in existing EPA guidance. Background levels should be addressed as they are for other contaminants at CERCLA sites. For further information see EPA's guidance Role of Background in the CERCLA Cleanup Program, April 2002, (OSWER 9285.6-07P) and Guidance for Comparing Background and Chemical Concentration in Soil for CERCLA Sites, September 2002, (OSWER 9285.7-41).

Generally EPA does not clean up below natural background. In some cases, the predictive risk-based models generate SL concentrations that lie within or even below typical background concentrations for the same element or compound. Arsenic, aluminum, iron and manganese are common elements in soils that have background levels that may exceed risk-based SLs. This does not mean that these metals cannot be site-related, or that these metals should automatically be attributed to background. Attribution of chemicals to background is a site-specific decision; consult your regional risk assessor.

Where anthropogenic "background" levels exceed SLs and EPA has determined that a response action is necessary and feasible, EPA's goal will be to develop a comprehensive response to the widespread contamination. This will often require coordination with different authorities that have jurisdiction over the sources of contamination in the area.

3.3 Potential Problems

As with any risk based screening table or tool, the potential exists for misapplication. In most cases, this results from not understanding the intended use of the SLs or PRGs. In order to prevent misuse of the SLs, the following should be avoided:

- Applying SLs to a site without adequately developing a conceptual site model that identifies relevant exposure pathways and exposure scenarios.
- Not considering the effects from the presence of multiple contaminants, where appropriate.
- Use of the SLs as cleanup levels without adequate consideration of the other NCP remedy selection criteria on CERCLA sites.
- Use of SL as cleanup levels without verifying numbers with a toxicologist or regional risk assessor.
- Use of outdated SLs when tables have been superseded by more recent values.
- Not considering the effects of additivity when screening multiple chemicals.
- Applying inappropriate target risks or changing a cancer target risk without considering its effect on noncancer, or vice versa.
- Not performing additional screening for pathways not included in these SLs (e.g,. vapor intrusion, fish consumption).
- Adjusting SLs upward by factors of 10 or 100 without consulting a toxicologist or regional risk assessor.

4. Technical Support Documentation

The SLs consider human exposure to individual contaminants in air, drinking water and soil. The equations and technical discussion are aimed at developing risk-based SLs or PRGs. The following text presents the land use equations and their exposure routes. Table 1 presents the definitions of the variables and their default values. Any alternative values or assumptions used in developing SLs on a site should be presented with supporting rationale in the decision document on CERCLA sites.

4.1 Residential Soil

4.1.1 Noncancer-child

The residential soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{res\text{-}soil\text{-}nc\text{-}ing\text{-}c}\,(mg/kg)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_c\,(6\ years)\right)\times BW_c\,(15\ Kg)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_c\,(6\ year)\times\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)}\times IRS_c\left(\frac{200\ mg}{day}\right)\times\frac{10^{-6}Kg}{1\,mg}}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{res\text{-}soil\text{-}nc\text{-}inh\text{-}c}\,(mg/kg)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_c\,(6\ years)\right)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_c\,(6\ year)\times ET_{rs}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)}$$

- dermal contact with soil,

$$SL_{res\text{-}soil\text{-}nc\text{-}der\text{-}c}\,(mg/kg)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_c\,(6\ years)\right)\times BW_c\,(15\ Kg)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_c\,(6\ year)\times\frac{1}{\left(RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS\right)}\times SA_c\left(\frac{2690\ cm^2}{day}\right)\times AF_c\left(\frac{0.2\ mg}{cm^2}\right)\times ABS_d\times\frac{10^{-6}Kg}{1mg}}$$

- Total.

$$SL_{res\text{-}soil\text{-}nc\text{-}tot\text{-}c}\,(mg/kg)=\frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}ing\text{-}c}}+\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}der\text{-}c}}+\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}inh\text{-}c}}}$$

4.1.2 Noncancer-adult

The residential soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{res\text{-}soil\text{-}nc\text{-}ing\text{-}a}\,(mg/kg)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)\times BW_a\,(80\ Kg)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\,(26\ year)\times\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)}\times IRS_a\left(\frac{100\ mg}{day}\right)\times\frac{10^{-6}Kg}{1mg}}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{res\text{-}soil\text{-}nc\text{-}inh\text{-}a}\,(mg/kg)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\,(26\ year)\times ET_{rs}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^3\right)}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)}$$

- dermal contact with soil,

$$SL_{res\text{-}soil\text{-}nc\text{-}der\text{-}a}\,(mg/kg)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)\times BW_a\,(80\ Kg)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\,(26\ year)\times\frac{1}{\left(RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS\right)}\times SA_a\left(\frac{6032\ cm^2}{day}\right)\times AF_a\left(\frac{0.07\ mg}{cm^2}\right)\times ABS_d\times\frac{10^{-6}Kg}{1mg}}$$

- Total.

$$SL_{res\text{-}soil\text{-}nc\text{-}tot\text{-}a}\,(mg/kg)=\frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}ing\text{-}a}}+\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}der\text{-}a}}+\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}inh\text{-}a}}}$$

4.1.3 Carcinogenic

The residential soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{res\text{-}soil\text{-}ca\text{-}ing}\left(mg/kg\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFS_{adj}\left(\frac{36750\ mg}{Kg}\right)\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$IFS_{adj}\left(\frac{36750\ mg}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_c\left(6\ years\right)\times IRS_c\left(\frac{200\ mg}{day}\right)}{BW_c\left(15\ Kg\right)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_r\text{-}ED_c\left(20\ years\right)\times IRS_a\left(\frac{100\ mg}{day}\right)}{BW_a\left(80\ Kg\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{res\text{-}soil\text{-}ca\text{-}inh}\left(mg/kg\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}{IUR\left(\mu g/m^3\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_r\left(\frac{350\ days}{year}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)\times ED_r\left(26\ years\right)\times ET_{rs}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)}$$

- dermal contact with soil,

$$SL_{res\text{-}soil\text{-}ca\text{-}der}\left(mg/kg\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFS_{adj}\left(\frac{112266\ mg}{Kg}\right)\times ABS_d\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$DFS_{adj}\left(\frac{112266\ mg}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_c\left(6\ years\right)\times SA_c\left(\frac{2690\ cm^2}{day}\right)\times AF_c\left(\frac{0.2\ mg}{cm^2}\right)}{BW_c\left(15\ Kg\right)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_r\text{-}ED_c\left(20\ years\right)\times SA_a\left(\frac{6032\ cm^2}{day}\right)\times AF_a\left(\frac{0.07\ mg}{cm^2}\right)}{BW_a\left(80\ Kg\right)}$$

- Total.

$$SL_{res\text{-}soil\text{-}ca\text{-}tot}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}inh}}}$$

4.1.4 Mutagenic

The residential soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{res\text{-}soil\text{-}mu\text{-}ing}\left(mg/kg\right)=\frac{TR\times AT_{r}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}{CSF_{o}\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFSM_{adj}\left(\frac{166833.33\ mg}{Kg}\right)\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$IFSM_{adj\text{-}}\left(\frac{166833.33\ mg}{Kg}\right)=\frac{EF_{ressc\ 0\text{-}2}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\left(yr\right)\times IRS_{c}\left(\frac{200\ mg}{day}\right)\times 10}{BW_{c}\left(15\ Kg\right)}+\frac{EF_{ressc\ 2\text{-}6}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\left(yr\right)\times IRS_{c}\left(\frac{200\ mg}{day}\right)\times 3}{BW_{c}\left(15\ Kg\right)}+\frac{EF_{ressa\ 6\text{-}16}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\left(yr\right)\times IRS_{a}\left(\frac{100\ mg}{day}\right)\times 3}{BW_{a}\left(80\ Kg\right)}+\frac{EF_{ressa\ 16\text{-}26}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\left(yr\right)\times IRS_{a}\left(\frac{100\ mg}{day}\right)\times 1}{BW_{a}\left(80\ Kg\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{res\text{-}soil\text{-}mu\text{-}inh}\left(mg/kg\right)=\frac{TR\times AT_{r}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}{ET_{rs}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\begin{array}{l}\left(EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\left(yrs\right)\times IUR\left(\mu g/m^{3}\right)^{-1}\times 10\right)+\\\left(EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\left(yrs\right)\times IUR\left(\mu g/m^{3}\right)^{-1}\times 3\right)+\\\left(EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\left(yrs\right)\times IUR\left(\mu g/m^{3}\right)^{-1}\times 3\right)+\\\left(EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\left(yrs\right)\times IUR\left(\mu g/m^{3}\right)^{-1}\times 1\right)\end{array}\right)\times\left(\frac{1}{VF_{s}\left(\frac{m^{3}}{Kg}\right)}+\frac{1}{PEF_{w}\left(\frac{m^{3}}{Kg}\right)}\right)}$$

- dermal contact with soil,

$$SL_{res\text{-}soil\text{-}mu\text{-}der}\left(mg/kg\right)=\frac{TR\times AT_{r}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}{\left(\frac{CSF_{o}\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFSM_{adj}\left(\frac{475598.67\ mg}{Kg}\right)\times ABS_{d}\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$DFSM_{adj}\left(\frac{475598.67\ mg}{Kg}\right)=\frac{EF_{ressc\ 0\text{-}2}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\left(yr\right)\times AF_{c}\left(\frac{0.2\ mg}{cm^{2}}\right)\times SA_{c}\left(\frac{2690\ cm^{2}}{day}\right)\times 10}{BW_{c}\left(15\ Kg\right)}+\frac{EF_{ressc\ 2\text{-}6}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\left(yr\right)\times AF_{c}\left(\frac{0.2\ mg}{cm^{2}}\right)\times SA_{c}\left(\frac{2690\ cm^{2}}{day}\right)\times 3}{BW_{c}\left(15\ Kg\right)}+\frac{EF_{ressa\ 6\text{-}16}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\left(yr\right)\times AF_{a}\left(\frac{0.07\ mg}{cm^{2}}\right)\times SA_{a}\left(\frac{6032\ cm^{2}}{day}\right)\times 3}{BW_{a}\left(80\ Kg\right)}+\frac{EF_{ressa\ 16\text{-}26}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\left(yr\right)\times AF_{a}\left(\frac{0.07\ mg}{cm^{2}}\right)\times SA_{a}\left(\frac{6032\ cm^{2}}{day}\right)\times 1}{BW_{a}\left(80\ Kg\right)}$$

- Total.

$$SL_{res\text{-}soil\text{-}mu\text{-}tot}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}mu\text{-}ing}}+\frac{1}{SL_{res\text{-}soil\text{-}mu\text{-}der}}+\frac{1}{SL_{res\text{-}soil\text{-}mu\text{-}inh}}}$$

4.1.5 Vinyl Chloride - Carcinogenic

The residential soil land use equations, presented here, contain the following exposure routes:

- incidental ingestion of soil,

$$SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}ing}\left(mg/kg\right)=\frac{TR}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFS_{adj}\left(\frac{36750\ mg}{kg}\right)\times\frac{10^{-6}Kg}{1\ mg}}{AT_r\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}\right)+\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IRS_c\left(\frac{200\ mg}{day}\right)\times\frac{10^{-6}Kg}{1\ mg}}{BW_c\ (15\ kg)}\right)}$$

where:

$$IFS_{adj}\left(\frac{36750\ mg}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_c\ (6\ years)\times IRS_c\left(\frac{200\ mg}{day}\right)}{BW_c\ (15\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_r\text{-}ED_c\ (20\ years)\times IRS_a\left(\frac{100\ mg}{day}\right)}{BW_a\ (80\ Kg)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}inh}\left(mg/kg\right)=\frac{TR}{\left(\frac{IUR\left(\mu g/m^3\right)^{-1}\times EF_r\left(\frac{350\ days}{year}\right)\times ED\ (26\ years)\times ET_{rs}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{AT_r\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)\times VF_s\left(\frac{m^3}{kg}\right)}\right)+\left(\frac{IUR\left(\mu g/m^3\right)^{-1}}{VF_s\left(\frac{m^3}{kg}\right)}\times\left(\frac{1000\ \mu g}{mg}\right)\right)}$$

- dermal contact with soil,

$$SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}der}\,(mg/kg)=\frac{TR}{\left(\frac{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times DFS_{adj}\left(\frac{112266\ mg}{kg}\right)\times ABS_d\times\frac{10^{-6}Kg}{1\ mg}}{AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}\right)+\left(\frac{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times SA_c\left(\frac{2690\ cm^2}{day}\right)\times AF_c\left(\frac{0.2\ mg}{cm^2}\right)\times ABS\times\frac{10^{-6}Kg}{1\ mg}}{BW_c\,(15\ kg)}\right)}$$

where:

$$DFS_{adj}\left(\frac{112266\ mg}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_c\,(6\ years)\times SA_c\left(\frac{2690\ cm^2}{day}\right)\times AF_c\left(\frac{0.2\ mg}{cm^2}\right)}{BW_c\,(15\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_r\text{-}ED_c\,(20\ years)\times SA_a\left(\frac{6032\ cm^2}{day}\right)\times AF_a\left(\frac{0.07\ mg}{cm^2}\right)}{BW_a\,(80\ Kg)}$$

- Total.

$$SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}ing}}+\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}der}}+\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}inh}}}$$

4.1.6 Trichloroethylene - Carcinogenic and Mutagenic

The residential soil land use equations, presented here, contain the following exposure routes:

- incidental ingestion of soil,

$$PRG_{res\text{-}soil\text{-}tce\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{ress}\left(\frac{365\ days}{year}\right)\times LT\,(70\ years)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times\left(\frac{10^{-6}Kg}{mg}\right)\times\left(\left(CAF_o\,(0.804)\times IFS_{res\text{-}adj}\left(\frac{37650\ mg}{Kg}\right)\right)+\left(MAF_o\,(0.202)\times IFSM_{res\text{-}adj}\left(\frac{166833.33\ mg}{Kg}\right)\right)\right)}$$

where:

$$IFS_{res\text{-}adj}\left(\frac{36750\ mg}{Kg}\right)=\frac{ED_{ressc}\,(6\ years)\times EF_{ressc}\left(\frac{350\ days}{year}\right)\times IRS_{ressc}\left(\frac{200\ mg}{day}\right)}{BW_{ressc}\,(15\ Kg)}+\frac{ED_{ress}\,(26\ years)-ED_{ressc}\,(6\ years)\times EF_{ressa}\left(\frac{350\ days}{year}\right)\times IRS_{ressa}\left(\frac{100\ mg}{day}\right)}{BW_{ressa}\,(80\ Kg)}$$

where:

$$IFSM_{res\text{-}adj\text{-}}\left(\frac{166833.33\ mg}{Kg}\right)=\frac{ED_{0\text{-}2}\,(2years)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times IRS_{0\text{-}2}\left(\frac{200\ mg}{day}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+\frac{ED_{2\text{-}6}\,(4years)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times IRS_{2\text{-}6}\left(\frac{200\ mg}{day}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+\frac{ED_{6\text{-}16}\,(10years)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times IRS_{6\text{-}16}\left(\frac{100\ mg}{day}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+\frac{ED_{16\text{-}26}\,(10\ years)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times IRS_{16\text{-}26}\left(\frac{100\ mg}{day}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- inhalation of volatiles and particulates emitted from soil,

$$PRG_{res\text{-}soil\text{-}tce\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{ress}\left(\frac{365\ days}{year}\right)\times LT\,(70\ years)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\left(\begin{array}{l}CAF_i\,(0.756)\times EF_{ress}\left(\frac{350\ days}{year}\right)\times\\ ED_{ress}\,(26\ years)\times ET_{ress}\left(\frac{24\ hours}{day}\right)\end{array}\right)+\left(\begin{array}{l}\left(ED_{0\text{-}2}\,(2\ years)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ET_{0\text{-}2}\left(\frac{24\ hours}{day}\right)\times MAF_i\,(0.244)\times 10\right)+\\ \left(ED_{2\text{-}6}\,(4\ years)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ET_{2\text{-}6}\left(\frac{24\ hours}{day}\right)\times MAF_i\,(0.244)\times 3\right)+\\ \left(ED_{6\text{-}16}\,(10\ years)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times ET_{6\text{-}16}\left(\frac{24\ hours}{day}\right)\times MAF_i\,(0.244)\times 3\right)+\\ \left(ED_{16\text{-}26}\,(10\ years)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times ET_{16\text{-}26}\left(\frac{24\ hours}{day}\right)\times MAF_i\,(0.244)\times 1\right)\end{array}\right)\right)}$$

- dermal contact with soil,

$$PRG_{res\text{-}soil\text{-}tce\text{-}der}\,(mg/kg)=\frac{TR\times AT_{ress}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times\left(\frac{10^{-6}Kg}{mg}\right)\times\left(\left(CAF_o\,(0.804)\times DFS_{res\text{-}adj}\left(\frac{112266\ mg}{Kg}\right)\times ABS_d\right)+\left(MAF_o\,(0.202)\times DFSM_{res\text{-}adj}\left(\frac{475598.67\ mg}{Kg}\right)\times ABS_d\right)\right)}$$

where:

$$DFS_{res\text{-}adj}\left(\frac{112266\ mg}{Kg}\right)=\frac{ED_{ressc}\,(6\ years)\times EF_{ressc}\left(\frac{350\ days}{year}\right)\times SA_{ressc}\left(\frac{2690\ cm^2}{day}\right)\times AF_{ressc}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{ressc}\,(15\ Kg)}+\frac{ED_{ress}\,(26\ years)-ED_{ressc}\,(6\ years)\times EF_{ressa}\left(\frac{350\ days}{year}\right)\times SA_{ressa}\left(\frac{6032\ cm^2}{day}\right)\times AF_{ressa}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{ressa}\,(80\ Kg)}$$

where:

$$DFSM_{res\text{-}adj}\left(\frac{475598.67\ mg}{Kg}\right)=\frac{ED_{0\text{-}2}\,(2\ years)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times AF_{0\text{-}2}\left(\frac{0.2\ mg}{cm^2}\right)\times SA_{0\text{-}2}\left(\frac{2690\ cm^2}{day}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+\frac{ED_{2\text{-}6}\,(4\ years)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times AF_{2\text{-}6}\left(\frac{0.2\ mg}{cm^2}\right)\times SA_{2\text{-}6}\left(\frac{2690\ cm^2}{day}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+\frac{ED_{6\text{-}16}\,(10\ years)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times AF_{6\text{-}16}\left(\frac{0.07\ mg}{cm^2}\right)\times SA_{6\text{-}16}\left(\frac{6032\ cm^2}{day}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+\frac{ED_{16\text{-}26}\,(10\ years)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times AF_{16\text{-}26}\left(\frac{0.07\ mg}{cm^2}\right)\times SA_{16\text{-}26}\left(\frac{6032\ cm^2}{day}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- Total.

$$PRG_{res\text{-}soil\text{-}tce\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{PRG_{res\text{-}soil\text{-}tce\text{-}ing}}+\frac{1}{PRG_{res\text{-}soil\text{-}tce\text{-}der}}+\frac{1}{PRG_{res\text{-}soil\text{-}tce\text{-}inh}}}$$

A number of studies have shown that inadvertent ingestion of soil is common among children 6 years old and younger (Calabrese et al. 1989, Davis et al. 1990, Van Wijnen et al. 1990). Therefore, the dose method uses an age-adjusted soil ingestion factor that takes into account the difference in daily soil ingestion rates, body weights, and exposure duration for children from 1 to 6 years old and others from 7 to 26 years old. The equation is presented below. This health-protective approach is chosen to take into account the higher daily rates of soil ingestion in children as well as the longer duration of exposure that is anticipated for a long-term resident. For more on this method, see RAGS Part B.

4.1.7 Supporting Equations

- Child

$$ED_c\left(6\text{ years}\right)=ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)$$

$$BW_c\left(15\text{ kg}\right)=\frac{BW_{0\text{-}2}\left(15\text{ kg}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+BW_{2\text{-}6}\left(15\text{ kg}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$EF_c\left(\frac{350\text{ days}}{\text{year}}\right)=\frac{EF_{0\text{-}2}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+EF_{2\text{-}6}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$AF_c\left(\frac{0.2\text{ mg}}{\text{cm}^2}\right)=\frac{AF_{0\text{-}2}\left(\frac{0.2\text{ mg}}{\text{cm}^2}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+AF_{2\text{-}6}\left(\frac{0.2\text{ mg}}{\text{cm}^2}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$SA_c\left(\frac{2690\text{ cm}^2}{\text{day}}\right)=\frac{SA_{0\text{-}2}\left(\frac{2690\text{ cm}^2}{\text{day}}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+SA_{2\text{-}6}\left(\frac{2690\text{ cm}^2}{\text{day}}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$IRS_c\left(\frac{200\text{ mg}}{\text{day}}\right)=\frac{IRS_{0\text{-}2}\left(\frac{200\text{ mg}}{\text{day}}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+IRS_{2\text{-}6}\left(\frac{200\text{ mg}}{\text{day}}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

- Adult

$$ED_a\left(20\text{ years}\right)=ED_{6\text{-}16}\left(10\text{ years}\right)+ED_{16\text{-}26}\left(10\text{ years}\right)$$

$$BW_a\left(80\text{ kg}\right)=\frac{BW_{6\text{-}16}\left(80\text{ kg}\right)\times ED_{6\text{-}16}\left(10\text{ years}\right)+BW_{16\text{-}26}\left(80\text{ kg}\right)\times ED_{16\text{-}26}\left(10\text{ years}\right)}{ED_{6\text{-}16}\left(10\text{ years}\right)+ED_{16\text{-}26}\left(10\text{ years}\right)}$$

$$EF_a\left(\frac{350\text{ days}}{\text{year}}\right)=\frac{EF_{6\text{-}16}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{6\text{-}16}\left(10\text{ years}\right)+EF_{16\text{-}26}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{16\text{-}26}\left(10\text{ years}\right)}{ED_{6\text{-}16}\left(10\text{ years}\right)+ED_{16\text{-}26}\left(10\text{ years}\right)}$$

$$AF_a\left(\frac{0.07\text{ mg}}{\text{cm}^2}\right)=\frac{AF_{6\text{-}16}\left(\frac{0.07\text{ mg}}{\text{cm}^2}\right)\times ED_{6\text{-}16}\left(10\text{ years}\right)+AF_{16\text{-}26}\left(\frac{0.07\text{ mg}}{\text{cm}^2}\right)\times ED_{16\text{-}26}\left(10\text{ years}\right)}{ED_{6\text{-}16}\left(10\text{ years}\right)+ED_{16\text{-}26}\left(10\text{ years}\right)}$$

$$SA_a\left(\frac{6032\text{ cm}^2}{\text{day}}\right)=\frac{SA_{6\text{-}16}\left(\frac{6032\text{ cm}^2}{\text{day}}\right)\times ED_{6\text{-}16}\left(10\text{ years}\right)+SA_{16\text{-}26}\left(\frac{6032\text{ cm}^2}{\text{day}}\right)\times ED_{16\text{-}26}\left(10\text{ years}\right)}{ED_{6\text{-}16}\left(10\text{ years}\right)+ED_{16\text{-}26}\left(10\text{ years}\right)}$$

$$IRS_a\left(\frac{100\text{ mg}}{\text{day}}\right)=\frac{IRS_{6\text{-}16}\left(\frac{100\text{ mg}}{\text{day}}\right)\times ED_{6\text{-}16}\left(10\text{ years}\right)+IRS_{16\text{-}26}\left(\frac{100\text{ mg}}{\text{day}}\right)\times ED_{16\text{-}26}\left(10\text{ years}\right)}{ED_{6\text{-}16}\left(10\text{ years}\right)+ED_{16\text{-}26}\left(10\text{ years}\right)}$$

- Age-adjusted

$$ED_r\,(26\text{ years}) = ED_{0-2}\,(2\text{ years}) + ED_{2-6}\,(4\text{ years}) + ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})$$

$$EF_r\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{EF_{0-2}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{0-2}\,(2\text{ years}) + EF_{2-6}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{2-6}\,(4\text{ years}) + EF_{6-16}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{6-16}\,(10\text{ years}) + EF_{16-26}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{16-26}\,(10\text{ years})}{ED_{0-2}\,(2\text{ years}) + ED_{2-6}\,(4\text{ years}) + ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})}$$

$$ET_{ress}\left(\frac{24\text{ hour}}{\text{day}}\right)$$

4.2 Composite Worker Soil

This land use is for developing industrial default screening levels that are presented in the Generic Tables.

4.2.1 Noncancer

The composite worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{w\text{-soil-nc-ing}}\,(\text{mg/kg}) = \frac{THQ \times AT_{ow}\left(\frac{365\text{ days}}{\text{year}} \times ED_{ow}\,(25\text{ years})\right) \times BW_{ow}\,(80\text{ Kg})}{EF_{iw}\left(250\ \frac{\text{days}}{\text{year}}\right) \times ED_{ow}\,(25\text{ years}) \times \frac{1}{RfD_o\left(\frac{\text{mg}}{\text{kg-day}}\right)} \times IR_{ow}\left(100\ \frac{\text{mg}}{\text{day}}\right) \times \left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{w\text{-soil-nc-inh}}\,(\text{mg/kg}) = \frac{THQ \times AT_{ow}\left(\frac{365\text{ days}}{\text{year}} \times ED_{ow}\,(25\text{ years})\right)}{EF_{iw}\left(250\ \frac{\text{days}}{\text{year}}\right) \times ED_{ow}\,(25\text{ years}) \times ET_{ws}\left(\frac{8\text{ hours}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hours}}\right) \times \frac{1}{RfC\left(\text{mg}/\text{m}^3\right)} \times \left(\frac{1}{VF_s\left(\frac{\text{m}^3}{\text{kg}}\right)} + \frac{1}{PEF_w\left(\frac{\text{m}^3}{\text{kg}}\right)}\right)}$$

- dermal exposure,

$$SL_{w\text{-soil-nc-der}}\,(\text{mg/kg}) = \frac{THQ \times AT_{ow}\left(\frac{365\text{ days}}{\text{year}} \times ED_{ow}\,(25\text{ years})\right) \times BW_{ow}\,(80\text{ Kg})}{EF_{iw}\left(250\ \frac{\text{days}}{\text{year}}\right) \times ED_{ow}\,(25\text{ years}) \times \left(\frac{1}{RfD_o\left(\frac{\text{mg}}{\text{kg-day}}\right) \times GIABS}\right) \times SA_{ow}\left(\frac{3470\text{ cm}^2}{\text{day}}\right) \times AF_{ow}\left(\frac{0.12\text{ mg}}{\text{cm}^2}\right) \times ABS_d \times \left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

- Total.

$$SL_{w\text{-soil-nc-tot}}\,(\text{mg/kg}) = \frac{1}{\frac{1}{SL_{w\text{-soil-nc-ing}}} + \frac{1}{SL_{w\text{-soil-nc-der}}} + \frac{1}{SL_{w\text{-soil-nc-inh}}}}$$

4.2.2 Carcinogenic

The composite worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{w\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{ow}\left(100\ \frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{w\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_{s}\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_{w}\left(\frac{m^3}{kg}\right)}\right)}$$

- dermal exposure,

$$SL_{w\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times\left(\frac{CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times SA_{ow}\left(\frac{3470\ cm^2}{day}\right)\times AF_{ow}\left(\frac{0.12\ mg}{cm^2}\right)\times ABS_{d}\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Total.

$$SL_{w\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{w\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{w\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{w\text{-}soil\text{-}ca\text{-}inh}}}$$

4.3 Indoor Worker Soil

The indoor worker soil land use is not provided in the Generic Tables but SLs can be created by using the Calculator.

4.3.1 Noncancer

The indoor worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{iw\text{-}soil\text{-}nc\text{-}ing}\,(mg/kg)=\frac{THQ\times AT_{iw}\left(\frac{365\ days}{year}\times ED_{iw}\,(25\ years)\right)\times BW_{iw}\,(80\ Kg)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{iw}\,(25\ years)\times\frac{1}{RfD_{o}\left(\frac{mg}{kg\text{-}day}\right)}\times IR_{iw}\left(50\ \frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{iw\text{-}soil\text{-}nc\text{-}inh}\,(mg/kg)=\frac{THQ\times AT_{iw}\left(\frac{365\ days}{year}\times ED_{iw}\,(25\ years)\right)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{iw}\,(25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\times\left(\frac{1}{VF_{s}\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_{w}\left(\frac{m^3}{kg}\right)}\right)}$$

- Total.

$$SL_{iw\text{-}soil\text{-}nc\text{-}tot}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{iw\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{iw\text{-}soil\text{-}nc\text{-}inh}}}$$

4.3.2 Carcinogenic

The indoor worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{iw\text{-}soil\text{-}ca\text{-}ing}\left(mg/kg\right)=\frac{TR\times AT_{iw}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)\times BW_{iw}\ (80\ Kg)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{iw}\ (25\ years)\times CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{iw}\left(50\ \frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{iw\text{-}soil\text{-}ca\text{-}inh}\left(mg/kg\right)=\frac{TR\times AT_{iw}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{iw}\ (25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\mu g/m^{3}\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_{s}\left(\frac{m^{3}}{kg}\right)}+\frac{1}{PEF_{w}\left(\frac{m^{3}}{kg}\right)}\right)}$$

- Total.

$$SL_{iw\text{-}soil\text{-}ca\text{-}tot}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{iw\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{iw\text{-}soil\text{-}ca\text{-}inh}}}$$

4.4 Outdoor Worker Soil

The outdoor worker soil land use is not provided in the Generic Tables but SLs can be created by using the Calculator.

4.4.1 Noncancer

The outdoor worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{ow\text{-}soil\text{-}nc\text{-}ing}\left(mg/kg\right)=\frac{THQ\times AT_{ow}\left(\frac{365\ days}{year}\times ED_{ow}\ (25\ years)\right)\times BW_{ow}\ (80\ Kg)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\ (25\ years)\times\frac{1}{RfD_{o}\left(\frac{mg}{kg\text{-}day}\right)}\times IR_{ow}\left(100\ \frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{ow\text{-}soil\text{-}nc\text{-}inh}\left(mg/kg\right)=\frac{THQ\times AT_{ow}\left(\frac{365\ days}{year}\times ED_{ow}\ (25\ years)\right)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\ (25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^{3}\right)}\times\left(\frac{1}{VF_{s}\left(\frac{m^{3}}{kg}\right)}+\frac{1}{PEF_{w}\left(\frac{m^{3}}{kg}\right)}\right)}$$

- dermal exposure,

$$SL_{ow\text{-}soil\text{-}nc\text{-}der}\,(mg/kg)=\frac{THQ\times AT_{ow}\left(\frac{365\ days}{year}\times ED_{ow}\,(25\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times\left(\frac{1}{RfD_{o}\left(\frac{mg}{kg\text{-}day}\right)\times GIABS}\right)\times SA_{ow}\left(\frac{3470\ cm^{2}}{day}\right)\times AF_{ow}\left(\frac{0.12\ mg}{cm^{2}}\right)\times ABS_{d}\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Total.

$$SL_{ow\text{-}soil\text{-}nc\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{ow\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{ow\text{-}soil\text{-}nc\text{-}der}}+\frac{1}{SL_{ow\text{-}soil\text{-}nc\text{-}inh}}}$$

4.4.2 Carcinogenic

The outdoor worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{ow\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{ow}\left(100\ \frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{ow\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\frac{\mu g}{m^{3}}\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_{s}\left(\frac{m^{3}}{kg}\right)}+\frac{1}{PEF_{w}\left(\frac{m^{3}}{kg}\right)}\right)}$$

- dermal exposure,

$$SL_{ow\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times\left(\frac{CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times SA_{ow}\left(\frac{3470\ cm^{2}}{day}\right)\times AF_{ow}\left(\frac{0.12\ mg}{cm^{2}}\right)\times ABS_{d}\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Total.

$$SL_{ow\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{ow\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{ow\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{ow\text{-}soil\text{-}ca\text{-}inh}}}$$

4.5 Construction Worker Soil

The construction worker worker soil land use is not provided in the Generic Tables but SLs can be created by using the Calculator. The construction land use is described in the supplemental soil screening guidance. This land use is limited to an exposure duration of 1 year and is thus, subchronic. Other unique aspects of this scenario are that the PEF is based on mechanical disturbance of the soil and a special VF equation is used. Two types of mechanical soil disturbance are addressed: standard vehicle traffic and other than standard vehicle traffic (e.g. wind, grading, dozing, tilling and excavating). In general, the intakes and contact rates are all greater than the outdoor worker. Exhibit 5-1 in the supplemental soil screening guidance presents the exposure parameters.

4.5.1 Noncancer for Standard Vehicle Traffic

The construction worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{cw\text{-}soil\text{-}nc\text{-}ing}\left(mg/kg\right)=\frac{THQ\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times ED_{cw}\left(1\ year\right)\right)\times BW_{cw}\left(80\ Kg\right)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\frac{5\ days}{week}\right)\times ED_{cw}\left(1\ year\right)\times\frac{1}{RfD_{o}\left(\frac{mg}{kg\text{-}day}\right)}\times IR_{cw}\left(330\frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{cw\text{-}soil\text{-}nc\text{-}inh}\left(mg/kg\right)=\frac{THQ\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times ED_{cw}\left(1\ year\right)\right)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\frac{5\ days}{week}\right)\times ED_{cw}\left(1\ year\right)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^{3}\right)}\times\left(\frac{1}{VF_{sc}\left(\frac{m^{3}}{kg}\right)}+\frac{1}{PEF_{sc}\left(\frac{m^{3}}{kg}\right)}\right)}$$

- dermal exposure,

$$SL_{cw\text{-}soil\text{-}nc\text{-}der}\left(mg/kg\right)=\frac{THQ\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times ED_{cw}\left(1\ year\right)\right)\times BW_{cw}\left(80\ Kg\right)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\frac{5\ days}{week}\right)\times ED_{cw}\left(1\ year\right)\times\left(\frac{1}{RfD_{o}\left(\frac{mg}{kg\text{-}day}\right)\times GIABS}\right)\times SA_{cw}\left(\frac{3470\ cm^{2}}{day}\right)\times AF_{cw}\left(\frac{0.3\ mg}{cm^{2}}\right)\times ABS_{d}\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Total.

$$SL_{cw\text{-}soil\text{-}nc\text{-}tot}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}der}}+\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}inh}}}$$

4.5.2 Carcinogenic for Standard Vehicle Traffic

The construction worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{cw\text{-}soil\text{-}ca\text{-}ing}\left(mg/kg\right)=\frac{TR\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times LT\left(70\ years\right)\right)\times BW_{cw}\left(80\ Kg\right)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\frac{5\ days}{week}\right)\times ED_{cw}\left(1\ year\right)\times CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{cw}\left(330\frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{cw\text{-}soil\text{-}ca\text{-}inh}\left(mg/kg\right)=\frac{TR\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times LT\left(70\ years\right)\right)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\frac{5\ days}{week}\right)\times ED_{cw}\left(1\ year\right)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\mu g/m^{3}\right)^{-1}\times\left(\frac{1}{VF_{sc}\left(\frac{m^{3}}{kg}\right)}+\frac{1}{PEF_{sc}\left(\frac{m^{3}}{kg}\right)}\right)}$$

- dermal exposure,

$$SL_{cw\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\,\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times LT\,(70\ years)\right)\times BW_{cw}\,(80\ Kg)}{EF_{cw}\left(EW_{cw}\,\frac{50\ weeks}{year}\times DW_{cw}\,\frac{5\ days}{week}\right)\times ED_{cw}\,(1\ year)\times\left(\frac{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times SA_{cw}\left(\frac{3470\ cm^2}{day}\right)\times AF_{cw}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Total.

$$SL_{cw\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}inh}}}$$

4.5.3 Noncancer for Other than Standard Vehicle Traffic

The construction worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{cw\text{-}soil\text{-}nc\text{-}ing}\,(mg/kg)=\frac{THQ\times AT_{cw}\left(EW_{cw}\,\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times ED_{cw}\,(1\ year)\right)\times BW_{cw}\,(80\ Kg)}{EF_{cw}\left(EW_{cw}\,\frac{50\ weeks}{year}\times DW_{cw}\,\frac{5\ days}{week}\right)\times ED_{cw}\,(1\ year)\times\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}day}\right)}\times IR_{cw}\left(330\,\frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{cw\text{-}soil\text{-}nc\text{-}inh}\,(mg/kg)=\frac{THQ\times AT_{cw}\left(EW_{cw}\,\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times ED_{cw}\,(1\ year)\right)}{EF_{cw}\left(EW_{cw}\,\frac{50\ weeks}{year}\times DW_{cw}\,\frac{5\ days}{week}\right)\times ED_{cw}\,(1\ year)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\times\left(\frac{1}{VF_{sc}\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF'_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

- dermal exposure,

$$SL_{cw\text{-}soil\text{-}nc\text{-}der}\,(mg/kg)=\frac{THQ\times AT_{cw}\left(EW_{cw}\,\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times ED_{cw}\,(1\ year)\right)\times BW_{cw}\,(80\ Kg)}{EF_{cw}\left(EW_{cw}\,\frac{50\ weeks}{year}\times DW_{cw}\,\frac{5\ days}{week}\right)\times ED_{cw}\,(1\ year)\times\left(\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}day}\right)\times GIABS}\right)\times SA_{cw}\left(\frac{3470\ cm^2}{day}\right)\times AF_{cw}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Total.

$$SL_{cw\text{-}soil\text{-}nc\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}der}}+\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}inh}}}$$

4.5.2 Carcinogenic for Other than Standard Vehicle Traffic

The construction worker soil land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil,

$$SL_{cw\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{year}\times\frac{7\text{ days}}{week}\times LT\,(70\text{ years})\right)\times BW_{cw}\,(80\text{ Kg})}{EF_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{year}\times DW_{cw}\,\frac{5\text{ days}}{week}\right)\times ED_{cw}\,(1\text{ year})\times CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{cw}\left(330\,\frac{mg}{day}\right)\times\left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

- inhalation of volatiles and particulates emitted from soil,

$$SL_{cw\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{year}\times\frac{7\text{ days}}{week}\times LT\,(70\text{ years})\right)}{EF_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{year}\times DW_{cw}\,\frac{5\text{ days}}{week}\right)\times ED_{cw}\,(1\text{ year})\times ET_{ws}\left(\frac{8\text{ hours}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hours}}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left(\frac{1000\,\mu g}{mg}\right)\times\left(\frac{1}{VF_{sc}\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF'_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

- dermal exposure,

$$SL_{cw\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{year}\times\frac{7\text{ days}}{week}\times LT\,(70\text{ years})\right)\times BW_{cw}\,(80\text{ Kg})}{EF_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{year}\times DW_{cw}\,\frac{5\text{ days}}{week}\right)\times ED_{cw}\,(1\text{ year})\times\left(\frac{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times SA_{cw}\left(\frac{3470\text{ cm}^2}{day}\right)\times AF_{cw}\left(\frac{0.3\text{ mg}}{cm^2}\right)\times ABS_d\times\left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

- Total.

$$SL_{cw\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}inh}}}$$

4.6 Recreational Soil or Sediment

4.6.1 Noncancer - Child

The recreational soil or sediment land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil or sediment,

$$SL_{rec\text{-}soil\text{-}nc\text{-}ing\text{-}c}\,(mg/kg)=\frac{THQ\times AT_{rec}\left(\frac{365\text{ days}}{year}\times ED_{recsc}\,(years)\right)\times BW_{recsc}\,(15\text{ Kg})}{EF_{recsc}\left(\frac{days}{year}\right)\times ED_{recsc}\,(years)\times\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)}\times IRS_{recsc}\left(\frac{200\text{ mg}}{day}\right)\times\frac{10^{-6}\text{Kg}}{1\text{ mg}}}$$

- inhalation of volatiles and particulates emitted from soil or sediment,

$$SL_{rec\text{-}soil\text{-}nc\text{-}inh\text{-}c}\,(mg/kg)=\frac{THQ\times AT_{rec}\left(\frac{365\text{ days}}{year}\times ED_{recsc}\,(years)\right)}{EF_{recsc}\left(\frac{days}{year}\right)\times ED_{recsc}\,(year)\times ET_{recsc}\left(\frac{hours}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hours}}\right)\times\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)}$$

- dermal contact with soil or sediment,

$$SL_{rec\text{-}soil\text{-}nc\text{-}der\text{-}c}\,(mg/kg)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recsc}\,(years)\right)\times BW_{recsc}\,(15\ Kg)}{EF_{recsc}\left(\frac{days}{year}\right)\times ED_{recsc}\,(year)\times\frac{1}{\left(RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS\right)}\times SA_{recsc}\left(\frac{2690\ cm^2}{day}\right)\times AF_{recsc}\left(\frac{0.2\ mg}{cm^2}\right)\times ABS_d\times\frac{10^{-6}Kg}{1mg}}$$

- Total.

$$SL_{rec\text{-}soil\text{-}nc\text{-}tot\text{-}c}\,(mg/kg)=\frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}der}}+\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}inh}}}$$

4.6.2 Noncancer - Adult

The recreational soil or sediment land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil or sediment,

$$SL_{rec\text{-}soil\text{-}nc\text{-}ing\text{-}a}\,(mg/kg)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recsa}\,(years)\right)\times BW_{recsa}\,(80\ Kg)}{EF_{recsa}\left(\frac{days}{year}\right)\times ED_{recsa}\,(years)\times\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)}\times IRS_{recsa}\left(\frac{100\ mg}{day}\right)\times\frac{10^{-6}Kg}{1mg}}$$

- inhalation of volatiles and particulates emitted from soil or sediment,

$$SL_{rec\text{-}soil\text{-}nc\text{-}inh\text{-}a}\,(mg/kg)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recsa}\,(years)\right)}{EF_{recsa}\left(\frac{days}{year}\right)\times ED_{recsa}\,(year)\times ET_{recsa}\left(\frac{hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)}$$

- dermal contact with soil or sediment,

$$SL_{rec\text{-}soil\text{-}nc\text{-}der\text{-}a}\,(mg/kg)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recsa}\,(years)\right)\times BW_{recsa}\,(80\ Kg)}{EF_{recsa}\left(\frac{days}{year}\right)\times ED_{recsa}\,(year)\times\frac{1}{\left(RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS\right)}\times SA_{recsa}\left(\frac{6032\ cm^2}{day}\right)\times AF_{recsa}\left(\frac{0.07\ mg}{cm^2}\right)\times ABS_d\times\frac{10^{-6}Kg}{1mg}}$$

- Total.

$$SL_{rec\text{-}soil\text{-}nc\text{-}tot\text{-}a}\,(mg/kg)=\frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}ing\text{-}a}}+\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}der\text{-}a}}+\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}inh\text{-}a}}}$$

4.6.3 Carcinogenic

The recreational soil or sediment land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil or sediment,

$$SL_{rec\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{rec}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$IFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)=\frac{ED_{recsc}\,(years)\times EF_{recsc}\left(\frac{days}{year}\right)\times IRS_{recsc}\left(\frac{200\ mg}{day}\right)}{BW_{recsc}\,(15\ Kg)}+\frac{ED_{recsa}\,(years)\times EF_{recsa}\left(\frac{days}{year}\right)\times IRS_{recsa}\left(\frac{100\ mg}{day}\right)}{BW_{recsa}\,(80\ Kg)}$$

- inhalation of volatiles and particulates emitted from soil or sediment,

$$SL_{rec\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{rec}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{IUR\left(\mu g/m^3\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_{recs}\left(\frac{days}{year}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)\times ED_{recs}\,(years)\times ET_{recs}\left(\frac{hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)}$$

- dermal contact with soil or sediment,

$$SL_{rec\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_{rec}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)\times ABS_d\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$DFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)=\frac{ED_{recsc}\,(years)\times EF_{recsc}\left(\frac{days}{year}\right)\times SA_{recsc}\left(\frac{2690\ cm^2}{day}\right)\times AF_{recsc}\left(\frac{0.2mg}{cm^2}\right)}{BW_{recsc}\,(15\ Kg)}+\frac{ED_{recsa}\,(years)\times EF_{recsa}\left(\frac{days}{year}\right)\times SA_{recsa}\left(\frac{6032\ cm^2}{day}\right)\times AF_{recsa}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{recsa}\,(80\ Kg)}$$

- Total.

$$SL_{rec\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}inh}}}$$

4.6.4 Mutagenic

The recreational soil or sediment land use equation, presented here, contains the following exposure routes:

- incidental ingestion of soil or sediment,

$$SL_{rec\text{-}soil\text{-}mu\text{-}ing}\left(mg/kg\right)=\frac{TR\times AT_{rec}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$IFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)=\frac{ED_{0\text{-}2}\,(yr)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times IRS_{0\text{-}2}\left(\frac{200\ mg}{day}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+\frac{ED_{2\text{-}6}\,(yr)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times IRS_{2\text{-}6}\left(\frac{200\ mg}{day}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+\frac{ED_{6\text{-}16}\,(yr)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times IRS_{6\text{-}16}\left(\frac{100\ mg}{day}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+\frac{ED_{16\text{-}26}\,(yr)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times IRS_{16\text{-}26}\left(\frac{100\ mg}{day}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- inhalation of volatiles and particulates emitted from soil or sediment,

$$SL_{rec\text{-}soil\text{-}mu\text{-}inh}\left(mg/kg\right)=\frac{TR\times AT_{rec}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{\left(\frac{1\ day}{24\ hours}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)\times\left(\begin{array}{l}\left(ED_{0\text{-}2}\,(yrs)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times ET_{0\text{-}2}\left(\frac{hours}{day}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 10\right)+\left(ED_{2\text{-}6}\,(yrs)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times ET_{2\text{-}6}\left(\frac{hours}{day}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 3\right)+\\\left(ED_{6\text{-}16}\,(yrs)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times ET_{6\text{-}16}\left(\frac{hours}{day}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 3\right)+\left(ED_{16\text{-}26}\,(yrs)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times ET_{16\text{-}26}\left(\frac{hours}{day}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 1\right)\end{array}\right)}$$

- dermal contact with soil or sediment,

$$SL_{rec\text{-}soil\text{-}mu\text{-}der}\left(mg/kg\right)=\frac{TR\times AT_{rec}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)\times ABS_d\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$DFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)=\frac{ED_{0\text{-}2}\,(yr)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times AF_{0\text{-}2}\left(\frac{0.2\ mg}{cm^2}\right)\times SA_{0\text{-}2}\left(\frac{2690\ cm^2}{day}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+\frac{ED_{2\text{-}6}\,(yr)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times AF_{2\text{-}6}\left(\frac{0.2\ mg}{cm^2}\right)\times SA_{2\text{-}6}\left(\frac{2690\ cm^2}{day}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+\frac{ED_{6\text{-}16}\,(yr)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times AF_{6\text{-}16}\left(\frac{0.07\ mg}{cm^2}\right)\times SA_{6\text{-}16}\left(\frac{6032\ cm^2}{day}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+\frac{ED_{16\text{-}26}\,(yr)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times AF_{16\text{-}26}\left(\frac{0.07\ mg}{cm^2}\right)\times SA_{16\text{-}26}\left(\frac{6032\ cm^2}{day}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- Total.

$$SL_{rec\text{-}soil\text{-}mu\text{-}tot}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}mu\text{-}ing}}+\frac{1}{SL_{rec\text{-}soil\text{-}mu\text{-}der}}+\frac{1}{SL_{rec\text{-}soil\text{-}mu\text{-}inh}}}$$

4.6.5 Vinyl Chloride - Carcinogenic

The recreational soil or sediment land use equations, presented here, contain the following exposure routes:

- incidental ingestion of soil or sediment,

$$SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}ing}\left(mg/kg\right)=\frac{TR}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFS_{rec\text{-}adj}\left(\frac{mg}{kg}\right)\times\frac{10^{-6}Kg}{1\ mg}}{AT_{recs}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}\right)+\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IRS_{recsc}\left(\frac{200\ mg}{day}\right)\times\frac{10^{-6}Kg}{1\ mg}}{BW_{recsc}\ (15\ kg)}\right)}$$

- inhalation of volatiles and particulates emitted from soil or sediment,

$$SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}inh}\left(mg/kg\right)=\frac{TR}{\left(\frac{IUR\left(\mu g/m^3\right)^{-1}\times EF_{recs}\left(\frac{days}{year}\right)\times ED_{recs}\ (years)\times ET_{recs}\left(\frac{hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{AT_{rec}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)\times VF_s\left(\frac{m^3}{kg}\right)}\right)+\left(\frac{IUR\left(\mu g/m^3\right)^{-1}}{VF_s\left(\frac{m^3}{kg}\right)}\times\left(\frac{1000\ \mu g}{mg}\right)\right)}$$

- dermal contact with soil or sediment,

$$SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}der}\left(mg/kg\right)=\frac{TR}{\left(\frac{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times DFS_{rec\text{-}adj}\left(\frac{mg}{kg}\right)\times ABS_d\times\frac{10^{-6}Kg}{1\ mg}}{AT_{recs}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}\right)+\left(\frac{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times SA_{recsc}\left(\frac{2690\ cm^2}{day}\right)\times AF_{recsc}\left(\frac{0.2\ mg}{cm^2}\right)\times ABS\times\frac{10^{-6}Kg}{1\ mg}}{BW_{recsc}\ (15\ kg)}\right)}$$

- Total.

$$SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}tot}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}ing}}+\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}der}}+\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}inh}}}$$

4.6.6 Trichloroethylene - Carcinogenic and Mutagenic

The recreational soil or sediment land use equations, presented here, contain the following exposure routes:

- incidental ingestion of soil or sediment,

$$PRG_{rec\text{-}soil\text{-}tce\text{-}ing}(mg/kg)=\frac{TR\times AT_{recs}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times\left(\frac{10^{-6}\ Kg}{mg}\right)\times\left(\left(CAF_o\ (0.804)\times IFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)\right)+\left(MAF_o\ (0.202)\times IFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)\right)\right)}$$

where:

$$IFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)=\frac{ED_{recsc}\ (years)\times EF_{recsc}\left(\frac{days}{year}\right)\times IRS_{recsc}\left(\frac{200\ mg}{day}\right)}{BW_{recsc}\ (15\ Kg)}+\frac{ED_{recs}\ (years)-ED_{recsc}\ (years)\times EF_{recsa}\left(\frac{days}{year}\right)\times IRS_{recsa}\left(\frac{100\ mg}{day}\right)}{BW_{recsa}\ (80\ Kg)}$$

where:

$$IFSM_{rec\text{-}adj\text{-}}\left(\frac{mg}{Kg}\right)=\frac{ED_{0\text{-}2}\ (years)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times IRS_{0\text{-}2}\left(\frac{200\ mg}{day}\right)\times 10}{BW_{0\text{-}2}\ (15\ Kg)}+\frac{ED_{2\text{-}6}\ (years)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times IRS_{2\text{-}6}\left(\frac{200\ mg}{day}\right)\times 3}{BW_{2\text{-}6}\ (15\ Kg)}+\frac{ED_{6\text{-}16}\ (years)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times IRS_{6\text{-}16}\left(\frac{100\ mg}{day}\right)\times 3}{BW_{6\text{-}16}\ (80\ Kg)}+\frac{ED_{16\text{-}26}\ (years)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times IRS_{16\text{-}26}\left(\frac{100\ mg}{day}\right)\times 1}{BW_{16\text{-}26}\ (80\ Kg)}$$

- inhalation of volatiles and particulates emitted from soil or sediment,

$$PRG_{rec\text{-}soil\text{-}tce\text{-}inh}(mg/kg)=\frac{TR\times AT_{recs}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\left(\begin{array}{l}CAF_i\,(0.756)\times EF_{recs}\left(\frac{days}{year}\right)\times\\ ED_{recs}\,(years)\times ET_{recs}\left(\frac{hours}{day}\right)\end{array}\right)+\left(\begin{array}{l}\left(ED_{0\text{-}2}\,(years)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times ET_{0\text{-}2}\left(\frac{hours}{day}\right)\times MAF_i\,(0.244)\times 10\right)+\\ \left(ED_{2\text{-}6}\,(years)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times ET_{2\text{-}6}\left(\frac{hours}{day}\right)\times MAF_i\,(0.244)\times 3\right)+\\ \left(ED_{6\text{-}16}\,(years)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times ET_{6\text{-}16}\left(\frac{hours}{day}\right)\times MAF_i\,(0.244)\times 3\right)+\\ \left(ED_{16\text{-}26}\,(years)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times ET_{16\text{-}26}\left(\frac{hours}{day}\right)\times MAF_i\,(0.244)\times 1\right)\end{array}\right)\right)}$$

- dermal contact with soil or sediment,

$$PRG_{rec\text{-}soil\text{-}tce\text{-}der}\,(mg/kg) = \frac{TR \times AT_{recs}\left(\frac{365\ days}{year}\right) \times LT\,(70\ years)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}Kg}{mg}\right) \times \left(\left(CAF_o\,(0.804) \times DFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) \times ABS_d\right) + \left(MAF_o\,(0.202) \times DFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) \times ABS_d\right)\right)}$$

where:

$$DFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) = \frac{ED_{recsc}\,(years) \times EF_{recsc}\left(\frac{days}{year}\right) \times SA_{recsc}\left(\frac{2690\ cm^2}{day}\right) \times AF_{recsc}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{recsc}\,(15\ Kg)} + \frac{ED_{recs}\,(years) - ED_{recsc}\,(years) \times EF_{recsa}\left(\frac{days}{year}\right) \times SA_{recsa}\left(\frac{6032\ cm^2}{day}\right) \times AF_{recsa}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{recsa}\,(80\ Kg)}$$

where:

$$DFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) = \frac{ED_{0\text{-}2}\,(years) \times EF_{0\text{-}2}\left(\frac{days}{year}\right) \times AF_{0\text{-}2}\left(\frac{0.2\ mg}{cm^2}\right) \times SA_{0\text{-}2}\left(\frac{2690\ cm^2}{day}\right) \times 10}{BW_{0\text{-}2}\,(15\ Kg)} + \frac{ED_{2\text{-}6}\,(years) \times EF_{2\text{-}6}\left(\frac{days}{year}\right) \times AF_{2\text{-}6}\left(\frac{0.2\ mg}{cm^2}\right) \times SA_{2\text{-}6}\left(\frac{2690\ cm^2}{day}\right) \times 3}{BW_{2\text{-}6}\,(15\ Kg)} + \frac{ED_{6\text{-}16}\,(years) \times EF_{6\text{-}16}\left(\frac{days}{year}\right) \times AF_{6\text{-}16}\left(\frac{0.07\ mg}{cm^2}\right) \times SA_{6\text{-}16}\left(\frac{6032\ cm^2}{day}\right) \times 3}{BW_{6\text{-}16}\,(70\ Kg)} + \frac{ED_{16\text{-}26}\,(years) \times EF_{16\text{-}26}\left(\frac{days}{year}\right) \times AF_{16\text{-}26}\left(\frac{0.07\ mg}{cm^2}\right) \times SA_{16\text{-}26}\left(\frac{6032\ cm^2}{day}\right) \times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- Total.

$$PRG_{rec\text{-}soil\text{-}tce\text{-}tot}\,(mg/kg) = \frac{1}{\frac{1}{PRG_{rec\text{-}soil\text{-}tce\text{-}ing}} + \frac{1}{PRG_{rec\text{-}soil\text{-}tce\text{-}der}} + \frac{1}{PRG_{rec\text{-}soil\text{-}tce\text{-}inh}}}$$

A number of studies have shown that inadvertent ingestion of soil is common among children 6 years old and younger (Calabrese et al. 1989, Davis et al. 1990, Van Wijnen et al. 1990). Therefore, the dose method uses an age-adjusted soil ingestion factor that takes into account the difference in daily soil ingestion rates, body weights, and exposure duration for children from 1 to 6 years old and others from 7 to 26 years old. The equation is presented below. This health-protective approach is chosen to take into account the higher daily rates of soil ingestion in children as well as the longer duration of exposure that is anticipated for a long-term resident. For more on this method, see RAGS Part B.

4.6.7 Supporting Equations

- Child

$$ED_{recsc}\,(yr) = ED_{0-2}\,(yr) + ED_{2-6}\,(yr)$$

$$BW_{recsc}\,(kg) = \frac{BW_{0-2}\,(kg) \times ED_{0-2}\,(yr) + BW_{2-6}\,(kg) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$EF_{recsc}\left(\frac{days}{year}\right) = \frac{EF_{0-2}\left(\frac{days}{year}\right) \times ED_{0-2}\,(yr) + EF_{2-6}\left(\frac{days}{year}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$AF_{recsc}\left(\frac{events}{day}\right) = \frac{AF_{0-2}\left(\frac{events}{day}\right) \times ED_{0-2}\,(yr) + AF_{2-6}\left(\frac{events}{day}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$ET_{recsc}\left(\frac{hr}{day}\right) = \frac{ET_{0-2}\left(\frac{hr}{day}\right) \times ED_{0-2}\,(yr) + ET_{2-6}\left(\frac{hr}{day}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$SA_{recsc}\left(\frac{cm^2}{day}\right) = \frac{SA_{0-2}\left(\frac{cm^2}{day}\right) \times ED_{0-2}\,(yr) + SA_{2-6}\left(\frac{cm^2}{day}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$IRS_{recsc}\left(\frac{mg}{day}\right) = \frac{IRS_{0-2}\left(\frac{mg}{day}\right) \times ED_{0-2}\,(yr) + IRS_{2-6}\left(\frac{mg}{day}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

- Adult

$$ED_{recsa}\,(yr) = ED_{6-16}\,(yr) + ED_{16-26}\,(yr)$$

$$BW_{recsa}\,(kg) = \frac{BW_{6-16}\,(kg) \times ED_{6-16}\,(yr) + BW_{16-26}\,(kg) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$EF_{recsa}\left(\frac{days}{year}\right) = \frac{EF_{6-16}\left(\frac{days}{year}\right) \times ED_{6-16}\,(yr) + EF_{16-26}\left(\frac{days}{year}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$AF_{recsa}\left(\frac{events}{day}\right) = \frac{AF_{6-16}\left(\frac{events}{day}\right) \times ED_{6-16}\,(yr) + AF_{16-26}\left(\frac{events}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$ET_{recsa}\left(\frac{hr}{day}\right) = \frac{ET_{6-16}\left(\frac{hr}{day}\right) \times ED_{6-16}\,(yr) + ET_{16-26}\left(\frac{hr}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$SA_{recsa}\left(\frac{cm^2}{day}\right) = \frac{SA_{6-16}\left(\frac{cm^2}{day}\right) \times ED_{6-16}\,(yr) + SA_{16-26}\left(\frac{cm^2}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$IRS_{recsa}\left(\frac{mg}{day}\right) = \frac{IRS_{6-16}\left(\frac{mg}{day}\right) \times ED_{6-16}\,(yr) + IRS_{16-26}\left(\frac{mg}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

- Age-adjusted

$$ED_{recs}(yr) = ED_{0-2}(yr) + ED_{2-6}(yr) + ED_{6-16}(yr) + ED_{16-26}(yr)$$

$$EF_{recs}\left(\frac{days}{year}\right) = \frac{EF_{0-2}\left(\frac{days}{year}\right) \times ED_{0-2}(yr) + EF_{2-6}\left(\frac{days}{year}\right) \times ED_{2-6}(yr) + EF_{6-16}\left(\frac{days}{year}\right) \times ED_{6-16}(yr) + EF_{16-26}\left(\frac{days}{year}\right) \times ED_{16-26}(yr)}{ED_{0-2}(yr) + ED_{2-6}(yr) + ED_{6-16}(yr) + ED_{16-26}(yr)}$$

$$ET_{recs}\left(\frac{hr}{day}\right) = \frac{ET_{0-2}\left(\frac{hr}{day}\right) \times ED_{0-2}(yr) + ET_{2-6}\left(\frac{hr}{day}\right) \times ED_{2-6}(yr) + ET_{6-16}\left(\frac{hr}{day}\right) \times ED_{6-16}(yr) + ET_{16-26}\left(\frac{hr}{day}\right) \times ED_{16-26}(yr)}{ED_{0-2}(yr) + ED_{2-6}(yr) + ED_{6-16}(yr) + ED_{16-26}(yr)}$$

4.7 Recreational Surface Water

4.7.1 Noncarcinogenic - Child

The surface water land use equation, presented here, contains the following exposure routes:

- incidental ingestion of water,

$$SL_{rec\text{-}water\text{-}nc\text{-}ing\text{-}c}(\mu g/L) = \frac{THQ \times AT_{rec}\left(\frac{365\ days}{year} \times ED_{recwc}(years)\right) \times BW_{recwc}(15\ Kg) \times \left(\frac{1000\ \mu g}{mg}\right)}{EF_{recwc}\left(\frac{days}{year}\right) \times ED_{recwc}(years) \times \frac{1}{RfD_o\left(\frac{mg}{kg\text{-}d}\right)} \times IRW_{recwc}\left(\frac{0.05\ L}{hr}\right) \times EV_{recwc}\left(\frac{events}{day}\right) \times ET_{recwc}\left(\frac{hours}{event}\right)}$$

- dermal,

FOR INORGANICS:

$$SL_{rec\text{-}water\text{-}nc\text{-}der\text{-}c}(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times ET_{recwc}\left(\frac{hours}{event}\right)}$$

FOR ORGANICS:

$$IF\ ET_{recwc}\left(\frac{hours}{event}\right) \le t^*(hr), then\ SL_{rec\text{-}water\text{-}nc\text{-}der}(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6 \times \tau_{event}\left(\frac{hours}{event}\right) \times ET_{recwc}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$IF\ ET_{recwc}\left(\frac{hours}{event}\right) > t^*(hr), then\ SL_{rec\text{-}water\text{-}nc\text{-}der}(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{recwc}\left(\frac{hours}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hours}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) = \frac{THQ \times AT_{recw}\left(\frac{365\ days}{year} \times ED_{recwc}(years)\right) \times \left(\frac{1000\ \mu g}{mg}\right) \times BW_{recwc}(15\ Kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right) \times GIABS}\right) \times EV_{recwc}\left(\frac{events}{day}\right) \times ED_{recwc}(years) \times EF_{recwc}\left(\frac{days}{year}\right) \times SA_{recwc}(6378\ cm^2)}$$

- Total.

$$SL_{rec\text{-}water\text{-}nc\text{-}tot\text{-}c}\left(\mu g/L\right)=\frac{1}{\frac{1}{SL_{rec\text{-}water\text{-}nc\text{-}ing\text{-}c}}+\frac{1}{SL_{rec\text{-}water\text{-}nc\text{-}der\text{-}c}}}$$

4.7.2 Noncarcinogenic - Adult

The surface water land use equation, presented here, contains the following exposure routes:

- incidental ingestion of water,

$$SL_{rec\text{-}water\text{-}nc\text{-}ing\text{-}a}\left(\mu g/L\right)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recwa}\left(years\right)\right)\times BW_{recwa}\left(80\ Kg\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_{recwa}\left(\frac{days}{year}\right)\times ED_{recwa}\left(years\right)\times\frac{1}{RfD_{o}\left(\frac{mg}{kg\text{-}d}\right)}\times IRW_{recwa}\left(\frac{0.05\ L}{hr}\right)\times EV_{recwa}\left(\frac{events}{day}\right)\times ET_{recwa}\left(\frac{hours}{event}\right)}$$

- dermal,

FOR INORGANICS:

$$SL_{rec\text{-}water\text{-}nc\text{-}der\text{-}a}\left(\mu g/L\right)=\frac{DA_{event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right)\times\left(\frac{1000\ cm^{3}}{L}\right)}{K_{p}\left(\frac{cm}{hr}\right)\times ET_{recwc}\left(\frac{hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{recwc}\left(\frac{hours}{event}\right)\leq t^{*}\left(hr\right),\text{then } SL_{rec\text{-}water\text{-}nc\text{-}der}\left(\mu g/L\right)=\frac{DA_{event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right)\times\left(\frac{1000\ cm^{3}}{L}\right)}{2\times FA\times K_{p}\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{recwa}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recwc}\left(\frac{hours}{event}\right)>t^{*}\left(hr\right),\text{then } SL_{rec\text{-}water\text{-}nc\text{-}der}\left(\mu g/L\right)=\frac{DA_{event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right)\times\left(\frac{1000\ cm^{3}}{L}\right)}{FA\times K_{p}\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{recwa}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^{2}}{\left(1+B\right)^{2}}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right)=\frac{THQ\times AT_{recw}\left(\frac{365\ days}{year}\times ED_{recwa}\left(years\right)\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times BW_{recwa}\left(70\ Kg\right)}{\left(\frac{1}{RfD_{o}\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS}\right)\times EV_{recwa}\left(\frac{events}{day}\right)\times ED_{recwa}\left(years\right)\times EF_{recwa}\left(\frac{days}{year}\right)\times SA_{recwa}\left(20900\ cm^{2}\right)}$$

- Total.

$$SL_{rec\text{-}water\text{-}nc\text{-}tot\text{-}a}\left(\mu g/L\right)=\frac{1}{\frac{1}{SL_{rec\text{-}water\text{-}nc\text{-}ing\text{-}a}}+\frac{1}{SL_{rec\text{-}water\text{-}nc\text{-}der\text{-}a}}}$$

4.7.3 Carcinogenic

The surface water land use equation, presented here, contains the following exposure routes:

- incidental ingestion of water,

$$SL_{rec\text{-}water\text{-}ca\text{-}ing}\left(\mu g/L\right)=\frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)}$$

where:

$$IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)=\frac{EV_{recwc}\left(\frac{events}{day}\right)\times ED_{recwc}\left(years\right)\times EF_{recwc}\left(\frac{days}{year}\right)\times ET_{recwc}\left(\frac{hours}{event}\right)\times IRW_{recwc}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwc}\left(15\ Kg\right)}+\frac{EV_{recwa}\left(\frac{events}{day}\right)\times ED_{recwa}\left(years\right)\times EF_{recwa}\left(\frac{days}{year}\right)\times ET_{recwa}\left(\frac{hours}{event}\right)\times IRW_{recwa}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwa}\left(80\ Kg\right)}$$

- dermal,

FOR INORGANICS:

$$SL_{rec\text{-}water\text{-}ca\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) \le t^*\,(hr), \text{then } SL_{rec\text{-}water\text{-}ca\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6 \times \tau_{event}\left(\frac{hours}{event}\right) \times ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) > t^*\,(hr), \text{then } SL_{rec\text{-}water\text{-}ca\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hours}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) = \frac{TR \times AT_{recw}\left(\frac{365\ days}{year} \times LT\,(70\ years)\right) \times \left(\frac{1000\ \mu g}{mg}\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right) \times DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right)}$$

where:

$$DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right) = \frac{EV_{recwc}\left(\frac{events}{day}\right) \times ED_{recwc}\,(years) \times EF_{recwc}\left(\frac{days}{year}\right) \times SA_{recwc}\left(6378\ cm^2\right)}{BW_{recwc}\,(15\ Kg)} + \frac{EV_{recwa}\left(\frac{events}{day}\right) \times ED_{recwa}\,(years) \times EF_{recwa}\left(\frac{days}{year}\right) \times SA_{recwa}\left(20900\ cm^2\right)}{BW_{recwa}\,(80\ Kg)}$$

and:

$$ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) = \frac{\left(ET_{recwc}\left(\frac{hours}{event}\right) \times ED_{recwc}\,(years) + ET_{recwa}\left(\frac{hours}{event}\right) \times ED_{recwa}\,(years)\right)}{ED_{recwc}\,(years) + ED_{recwa}\,(years)}$$

- Total.

$$SL_{rec\text{-}water\text{-}ca\text{-}tot}\,(\mu g/L) = \frac{1}{\frac{1}{SL_{rec\text{-}water\text{-}ca\text{-}ing}} + \frac{1}{SL_{rec\text{-}water\text{-}ca\text{-}der}}}$$

4.7.4 Mutagenic

The surface water land use equation, presented here, contains the following exposure routes:

-

incidental ingestion of water,

$$SL_{rec\text{-}water\text{-}mu\text{-}ing}\,(\mu g/L)=\frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFWM_{rec\text{-}adj}\left(\frac{L}{Kg}\right)}$$

where:

$$IFWM_{rec\text{-}adj}\left(\frac{L}{Kg}\right)=\frac{ED_{0\text{-}2}\,(yr)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times IRW_{0\text{-}2}\left(\frac{0.05\ L}{hr}\right)\times EV_{0\text{-}2}\left(\frac{events}{day}\right)\times ET_{0\text{-}2}\left(\frac{hours}{event}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+$$

$$\frac{ED_{2\text{-}6}\,(yr)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times IRW_{2\text{-}6}\left(\frac{0.05\ L}{hr}\right)\times EV_{2\text{-}6}\left(\frac{events}{day}\right)\times ET_{2\text{-}6}\left(\frac{hours}{event}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+$$

$$\frac{ED_{6\text{-}16}\,(yr)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times IRW_{6\text{-}16}\left(\frac{0.05\ L}{hr}\right)\times EV_{6\text{-}16}\left(\frac{events}{day}\right)\times ET_{6\text{-}16}\left(\frac{hours}{event}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+$$

$$\frac{ED_{16\text{-}26}\,(yr)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times IRW_{16\text{-}26}\left(\frac{0.05\ L}{hr}\right)\times EV_{16\text{-}26}\left(\frac{events}{day}\right)\times ET_{16\text{-}26}\left(\frac{hours}{event}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- dermal,

FOR INORGANICS:

$$SL_{rec\text{-}water\text{-}mu\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)}$$

FOR ORGANICS:

$$IF\ ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)\le t^*\ (hr),\ then\ SL_{rec\text{-}water\text{-}mu\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$IF\ ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)>t^*\ (hr),\ then\ SL_{rec\text{-}water\text{-}mu\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)=\frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFWM_{rec\text{-}adj}\left(\frac{events\text{-}\ cm^2}{kg}\right)}$$

$$\text{where: } DFWM_{rec\text{-}adj}\left(\frac{\text{events - cm}^2}{\text{kg}}\right)=\left[\begin{array}{l}\left(\frac{EV_{recw\,0\text{-}2}\left(\frac{\text{events}}{\text{day}}\right)\times ED_{0\text{-}2}\,(\text{years})\times EF_{recw\,0\text{-}2}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{0\text{-}2}\left(6378\text{ cm}^2\right)\times 10}{BW_{0\text{-}2}\,(15\text{ Kg})}\right)+\\ \left(\frac{EV_{recw\,2\text{-}6}\left(\frac{\text{events}}{\text{day}}\right)\times ED_{2\text{-}6}\,(\text{years})\times EF_{recw\,2\text{-}6}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{2\text{-}6}\left(6378\text{ cm}^2\right)\times 3}{BW_{2\text{-}6}\,(15\text{ Kg})}\right)+\\ \left(\frac{EV_{recw\,6\text{-}16}\left(\frac{\text{events}}{\text{day}}\right)\times ED_{6\text{-}16}\,(\text{years})\times EF_{recw\,6\text{-}16}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{6\text{-}16}\left(20900\text{ cm}^2\right)\times 3}{BW_{6\text{-}16}\,(80\text{ Kg})}\right)+\\ \left(\frac{EV_{recw\,16\text{-}26}\left(\frac{\text{events}}{\text{day}}\right)\times ED_{16\text{-}26}\,(\text{years})\times EF_{recw\,16\text{-}26}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{16\text{-}26}\left(20900\text{ cm}^2\right)\times 1}{BW_{16\text{-}26}\,(80\text{ Kg})}\right)\end{array}\right]$$

and:

$$ET_{recw\text{-}madj}\left(\frac{\text{hours}}{\text{event}}\right)=\frac{\left(\begin{array}{l}ET_{recw\,0\text{-}2}\left(\frac{\text{hours}}{\text{event}}\right)\times ED_{0\text{-}2}\,(\text{years})+ET_{recw\,2\text{-}6}\left(\frac{\text{hours}}{\text{event}}\right)\times ED_{2\text{-}6}\,(\text{years})+\\ ET_{recw\,6\text{-}16}\left(\frac{\text{hours}}{\text{event}}\right)\times ED_{6\text{-}16}\,(\text{years})+ET_{recw\,16\text{-}26}\left(\frac{\text{hours}}{\text{event}}\right)\times ED_{16\text{-}26}\,(\text{years})\end{array}\right)}{ED_{0\text{-}2}\,(\text{years})+ED_{2\text{-}6}\,(\text{years})+ED_{6\text{-}16}\,(\text{years})+ED_{16\text{-}26}\,(\text{years})}$$

- Total.

$$SL_{rec\text{-}water\text{-}mu\text{-}tot}\,(\mu g/L)=\frac{1}{\frac{1}{SL_{rec\text{-}water\text{-}mu\text{-}ing}}+\frac{1}{SL_{rec\text{-}water\text{-}mu\text{-}der}}}$$

4.7.5 Vinyl Chloride - Carcinogenic

The surface water land use equation, presented here, contains the following exposure routes:

- incidental ingestion of water,

$$SL_{rec\text{-}water\text{-}ca\text{-}vc\text{-}ing}\left(\mu g/L\right)=\frac{TR}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)\times\left(\frac{mg}{1000\ \mu g}\right)}{AT_{rec}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}\right)+\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times ET_{recwc}\left(\frac{hr}{day}\right)\times IRW_{recwc}\ \frac{0.05\ L}{hr}\times\left(\frac{mg}{1000\ \mu g}\right)}{BW_{recwc}\left(15\ kg\right)}\right)+}$$

where:

$$IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)=\frac{EV_{recwc}\left(\frac{events}{day}\right)\times ED_{recwc}\left(years\right)\times EF_{recwc}\left(\frac{days}{year}\right)\times ET_{recwc}\left(\frac{hours}{event}\right)\times IRW_{recwc}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwc}\left(15\ Kg\right)}+\frac{EV_{recwa}\left(\frac{events}{day}\right)\times ED_{recwa}\left(years\right)\times EF_{recwa}\left(\frac{days}{year}\right)\times ET_{recwa}\left(\frac{hours}{event}\right)\times IRW_{recwa}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwa}\left(80\ Kg\right)}$$

- dermal,

$$\text{IF } ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) \le t^{*}\,(hr), \text{then } SL_{rec\text{-}water\text{-}vc\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) > t^{*}\,(hr), \text{then } SL_{rec\text{-}water\text{-}vc\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) = \frac{TR}{\left(\frac{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right)}{AT_{recw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}\right)+\left(\frac{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times EV_{recwa}\left(\frac{events}{day}\right)\times SA_c\,(6600\ cm^2)}{BW_c\,(15\ Kg)\times\left(\frac{1000\ \mu g}{mg}\right)}\right)}$$

where:

$$DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right) = \frac{EV_{recwc}\left(\frac{events}{day}\right)\times ED_{recwc}\,(years)\times EF_{recwc}\left(\frac{days}{year}\right)\times SA_c\,(6378\ cm^2)}{BW_c\,(15\ Kg)} + \frac{EV_{recwa}\left(\frac{events}{day}\right)\times ED_{recwa}\,(years)\times EF_{recwa}\left(\frac{days}{year}\right)\times SA_a\,(20900\ cm^2)}{BW_a\,(80\ Kg)}$$

and:

$$ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) = \frac{\left(ET_{recwc}\left(\frac{hours}{event}\right)\times ED_{recwc}\,(years)\right)+\left(ET_{recwa}\left(\frac{hours}{event}\right)\times ED_{recwa}\,(years)\right)}{ED_{recwc}\,(years)+ED_{recwa}\,(years)}$$

- Total.

$$SL_{rec\text{-}water\text{-}ca\text{-}vc\text{-}tot}\,(\mu g/L) = \frac{1}{\frac{1}{SL_{rec\text{-}water\text{-}ca\text{-}vc\text{-}ing}}+\frac{1}{SL_{rec\text{-}water\text{-}ca\text{-}vc\text{-}der}}}$$

4.7.6 Trichloroethylene - Carcinogenic and Mutagenic

The surface water land use equation, presented here, contains the following exposure routes:

- incidental ingestion of water,

$$PRG_{rec\text{-}water\text{-}tce\text{-}ing}(\mu g/L)=\frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times\left(\left(CAF_o\,(0.804)\times IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)\right)\right)+\left(MAF_o\,(0.202)\times IFWM_{rec\text{-}adj}\left(\frac{L}{Kg}\right)\right)}$$

where:

$$IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)=\frac{EV_{recwc}\left(\frac{event}{day}\right)\times ED_{recwc}\,(years)\times EF_{recwc}\left(\frac{days}{year}\right)\times ET_{recwc}\left(\frac{hour}{event}\right)\times IRW_{recwc}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwc}\,(15\ Kg)}+\frac{EV_{recwa}\left(\frac{event}{day}\right)\times ED_{recwa}\,(years)\times EF_{recwa}\left(\frac{days}{year}\right)\times ET_{recwa}\left(\frac{hour}{event}\right)\times IRW_{recwa}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwa}\,(80\ Kg)}$$

where:

$$IFWM_{rec\text{-}adj}\left(\frac{L}{Kg}\right)=\frac{ED_{0\text{-}2}\,(years)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times IRW_{0\text{-}2}\left(\frac{0.05\ L}{hr}\right)\times EV_{0\text{-}2}\left(\frac{event}{day}\right)\times ET_{0\text{-}2}\left(\frac{hour}{event}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+\frac{ED_{2\text{-}6}\,(years)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times IRW_{2\text{-}6}\left(\frac{0.05\ L}{hr}\right)\times EV_{2\text{-}6}\left(\frac{event}{day}\right)\times ET_{2\text{-}6}\left(\frac{hour}{event}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+\frac{ED_{6\text{-}16}\,(years)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times IRW_{6\text{-}16}\left(\frac{0.05\ L}{hr}\right)\times EV_{6\text{-}16}\left(\frac{event}{day}\right)\times ET_{6\text{-}16}\left(\frac{hours}{event}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+\frac{ED_{16\text{-}26}\,(years)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times IRW_{16\text{-}26}\left(\frac{0.05\ L}{hr}\right)\times EV_{16\text{-}26}\left(\frac{event}{day}\right)\times ET_{16\text{-}26}\left(\frac{hour}{event}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- dermal,

FOR ORGANICS:

$$\text{IF } ET_{recw\text{-}madj}\left(\frac{1\ hour}{event}\right)\le t^*\ (hr)\text{, then } PRG_{rec\text{-}water\text{-}tce\text{-}der}(\mu g/L)=\frac{DA_{tce\text{-}event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{recw\text{-}madj}\left(\frac{hour}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recw\text{-}madj}\left(\frac{hour}{event}\right)>t^*\ (hr)\text{, then } PRG_{rec\text{-}water\text{-}tce\text{-}der}(\mu g/L)=\frac{DA_{tce\text{-}event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{tce\text{-}event}\left(\frac{ug}{cm^2\text{-}\ event}\right)=\frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times\left(\left(AF_o\,(0.804)\times DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right)\right)\right)+\left(MAF_o\,(0.202)\times DFWM_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right)\right)}$$

where:

$$DFW_{rec\text{-}adj}\left(\frac{events - cm^2}{kg}\right)=\frac{EV_{recwc}\left(\frac{event}{day}\right)\times ED_{recwc}\,(years)\times EF_{recwc}\left(\frac{days}{year}\right)\times SA_{recwc}\left(6378\ cm^2\right)}{BW_{recwc}\,(15\ Kg)}+\frac{EV_{recwa}\left(\frac{event}{day}\right)\times ED_{recwa}\,(years)\times EF_{recwa}\left(\frac{days}{year}\right)\times SA_{recwa}\left(20900\ cm^2\right)}{BW_{recwa}\,(80\ Kg)}$$

where:

$$DFWM_{rec\text{-}adj}\left(\frac{events - cm^2}{kg}\right)=\left[\begin{array}{l}\left(\frac{EV_{recw\ 0\text{-}2}\left(\frac{event}{day}\right)\times ED_{0\text{-}2}\,(years)\times EF_{recw\ 0\text{-}2}\left(\frac{days}{year}\right)\times SA_{0\text{-}2}\left(6378\ cm^2\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}\right)+\\ \left(\frac{EV_{recw\ 2\text{-}6}\left(\frac{event}{day}\right)\times ED_{2\text{-}6}\,(years)\times EF_{recw\ 2\text{-}6}\left(\frac{days}{year}\right)\times SA_{2\text{-}6}\left(6378\ cm^2\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}\right)+\\ \left(\frac{EV_{recw\ 6\text{-}16}\left(\frac{event}{day}\right)\times ED_{6\text{-}16}\,(years)\times EF_{recw\ 6\text{-}16}\left(\frac{days}{year}\right)\times SA_{6\text{-}16}\left(20900\ cm^2\right)\times 3}{BW_{6\text{-}16}\,(70\ Kg)}\right)+\\ \left(\frac{EV_{recw\ 16\text{-}26}\left(\frac{event}{day}\right)\times ED_{16\text{-}26}\,(years)\times EF_{recw\ 16\text{-}26}\left(\frac{days}{year}\right)\times SA_{16\text{-}26}\left(20900\ cm^2\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}\right)\end{array}\right]$$

and:

$$ET_{recw\text{-}madj}\left(\frac{hour}{event}\right)=\frac{\left(\begin{array}{l}ET_{recw\ 0\text{-}2}\left(\frac{hour}{event}\right)\times ED_{0\text{-}2}\,(years)+ET_{recw\ 2\text{-}6}\left(\frac{hour}{event}\right)\times ED_{2\text{-}6}\,(years)+\\ ET_{recw\ 6\text{-}16}\left(\frac{hour}{event}\right)\times ED_{6\text{-}16}\,(years)+ET_{recw\ 16\text{-}26}\left(\frac{1\ hour}{event}\right)\times ED_{16\text{-}26}\,(years)\end{array}\right)}{ED_{0\text{-}2}\,(years)+ED_{2\text{-}6}\,(years)+ED_{6\text{-}16}\,(years)+ED_{16\text{-}26}\,(years)}$$

- Total.

$$PRG_{rec\text{-}water\text{-}tce\text{-}tot}\,(\mu g/L)=\frac{1}{\frac{1}{PRG_{rec\text{-}water\text{-}tce\text{-}ing}}+\frac{1}{PRG_{rec\text{-}water\text{-}tce\text{-}der}}}$$

4.7.7 Supporting Equations

- Child

$$ED_{recwc}\,(yr) = ED_{0-2}\,(yr) + ED_{2-6}\,(yr)$$

$$BW_{recwc}\,(kg) = \frac{BW_{0-2}\,(kg) \times ED_{0-2}\,(yr) + BW_{2-6}\,(kg) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$EF_{recwc}\left(\frac{days}{year}\right) = \frac{EF_{0-2}\left(\frac{days}{year}\right) \times ED_{0-2}\,(yr) + EF_{2-6}\left(\frac{days}{year}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$EV_{recwc}\left(\frac{events}{day}\right) = \frac{EV_{0-2}\left(\frac{events}{day}\right) \times ED_{0-2}\,(yr) + EV_{2-6}\left(\frac{events}{day}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$ET_{recwc}\left(\frac{hr}{event}\right) = \frac{ET_{0-2}\left(\frac{hr}{event}\right) \times ED_{0-2}\,(yr) + ET_{2-6}\left(\frac{hr}{event}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$SA_{recwc}\left(cm^2\right) = \frac{SA_{0-2}\left(cm^2\right) \times ED_{0-2}\,(yr) + SA_{2-6}\left(cm^2\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$IRW_{recwc}\left(\frac{L}{hr}\right) = \frac{IRW_{0-2}\left(\frac{L}{hr}\right) \times ED_{0-2}\,(yr) + IRW_{2-6}\left(\frac{L}{hr}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

- Adult

$$ED_{recwa}\,(yr) = ED_{6-16}\,(yr) + ED_{16-26}\,(yr)$$

$$BW_{recwa}\,(kg) = \frac{BW_{6-16}\,(kg) \times ED_{6-16}\,(yr) + BW_{16-26}\,(kg) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$EF_{recwa}\left(\frac{days}{year}\right) = \frac{EF_{6-16}\left(\frac{days}{year}\right) \times ED_{6-16}\,(yr) + EF_{16-26}\left(\frac{days}{year}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$EV_{recwa}\left(\frac{events}{day}\right) = \frac{EV_{6-16}\left(\frac{events}{day}\right) \times ED_{6-16}\,(yr) + EV_{16-26}\left(\frac{events}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$ET_{recwa}\left(\frac{hr}{event}\right) = \frac{ET_{6-16}\left(\frac{hr}{event}\right) \times ED_{6-16}\,(yr) + ET_{16-26}\left(\frac{hr}{event}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$SSA_{recwa}\left(cm^2\right) = \frac{SA_{6-16}\left(cm^2\right) \times ED_{6-16}\,(yr) + SA_{16-26}\left(cm^2\right) \times ED_{16-30}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$IRW_{recwa}\left(\frac{L}{hr}\right) = \frac{IRW_{6-16}\left(\frac{L}{hr}\right) \times ED_{6-16}\,(yr) + IRW_{16-26}\left(\frac{L}{hr}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

4.8 Tapwater

4.8.1 Noncarcinogenic-child

The tapwater land use equation, presented here, contains the following exposure routes:

- ingestion of water,

$$SL_{water\text{-}nc\text{-}ing\text{-}c}\,(\mu g/L)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_c\ (6\ years)\right)\times BW_c\ (15\ Kg)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_r\left(350\ \frac{days}{year}\right)\times ED_c\ (6\ years)\times\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}d}\right)}\times IRW_c\left(\frac{0.78\ L}{day}\right)}$$

- dermal,

FOR INORGANICS:

$$SL_{water\text{-}nc\text{-}der\text{-}c}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{rwc}\left(\frac{0.54\ hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{rwc}\left(\frac{0.54\ hours}{event}\right)\leq t^*\ (hr),\text{then } SL_{water\text{-}nc\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{rwc}\left(\frac{0.54\ hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{rwc}\left(\frac{0.54\ hours}{event}\right)>t^*\ (hr),\text{then } SL_{water\text{-}nc\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{rwc}\left(\frac{0.54\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_c\ (6\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times BW_c\ (15\ Kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS}\right)\times EV_c\left(\frac{1\ events}{day}\right)\times ED_c\ (6\ years)\times EF\left(\frac{350\ days}{year}\right)\times SA_c\ (6378\ cm^2)}$$

- inhalation of volatiles,

$$SL_{water\text{-}nc\text{-}inh\text{-}c}\,(\mu g/L)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_c\ (6\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_r\left(350\ \frac{days}{year}\right)\times ED_c\ (6\ years)\times ET_{rw}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^3\right)}\times K\left(\frac{0.5\ L}{m^3}\right)}$$

- Total.

$$SL_{res\text{-}water\text{-}nc\text{-}tot\text{-}c}\,(\mu g/L)=\frac{1}{\frac{1}{SL_{water\text{-}nc\text{-}ing\text{-}c}}+\frac{1}{SL_{water\text{-}nc\text{-}der\text{-}c}}+\frac{1}{SL_{water\text{-}nc\text{-}inh\text{-}c}}}$$

4.8.2 Noncarcinogenic-adult

The tapwater land use equation, presented here, contains the following exposure routes:

- ingestion of water,

$$SL_{water\text{-}nc\text{-}ing\text{-}a}\,(\mu g/L)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)\times BW_a\,(80\ Kg)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_r\left(350\ \frac{days}{year}\right)\times ED_r\,(26\ years)\times\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}d}\right)}\times IRW_a\left(\frac{2.5\ L}{day}\right)}$$

- dermal,

FOR INORGANICS:

$$SL_{water\text{-}nc\text{-}der\text{-}a}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{rwa}\left(\frac{0.71\ hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{rwa}\left(\frac{0.71\ hours}{event}\right)\le t^*\,(hr),\text{then } SL_{water\text{-}nc\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{rwa}\left(\frac{0.71\ hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{rwa}\left(\frac{0.71\ hours}{event}\right)> t^*\,(hr),\text{then } SL_{water\text{-}nc\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{rwa}\left(\frac{0.71\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times BW_a\,(80\ Kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS}\right)\times EV_a\left(\frac{1\ events}{day}\right)\times ED_r\,(26\ years)\times EF\left(\frac{350\ days}{year}\right)\times SA_a\left(20900\ cm^2\right)}$$

- inhalation of volatiles,

$$SL_{water\text{-}nc\text{-}inh\text{-}a}\,(\mu g/L)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_r\left(350\ \frac{days}{year}\right)\times ED_r\,(26\ years)\times ET_{rw}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^3\right)}\times K\left(\frac{0.5\ L}{m^3}\right)}$$

- Total.

$$SL_{res\text{-}water\text{-}nc\text{-}tot\text{-}a}\,(\mu g/L)=\frac{1}{\frac{1}{SL_{water\text{-}nc\text{-}ing\text{-}a}}+\frac{1}{SL_{water\text{-}nc\text{-}der\text{-}a}}+\frac{1}{SL_{water\text{-}nc\text{-}inh\text{-}a}}}$$

4.8.3 Carcinogenic

The tapwater land use equation, presented here, contains the following exposure routes:

- ingestion of water,

$$SL_{water\text{-}ca\text{-}ing}\,(\mu g/L) = \frac{TR \times AT_r\left(\frac{365\ days}{year} \times LT\,(70\ years)\right) \times \left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1} \times \left(IFW_{adj}\left(\frac{327.95\ L}{Kg}\right)\right)}$$

where:

$$IFW_{adj}\left(\frac{327.95\ L}{Kg}\right) = \frac{EF_{ressc}\left(\frac{350\ days}{year}\right) \times ED_c\,(6\ years) \times IRW_c\left(\frac{0.78\ L}{day}\right)}{BW_c\,(15\ Kg)} + \frac{EF_{ressa}\left(\frac{350\ days}{year}\right) \times ED_r\text{-}ED_c\,(20\ years) \times IRW_a\left(\frac{2.5\ L}{day}\right)}{BW_a\,(80\ Kg)}$$

- dermal,

FOR INORGANICS:

$$SL_{water\text{-}ca\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times ET_{rw\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}$$

FOR ORGANICS:

$$IF\ ET_{rw\text{-}adj}\left(\frac{hours}{event}\right) \leq t^*\,(hr), then\ SL_{water\text{-}ca\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6 \times \tau_{event}\left(\frac{hours}{event}\right) \times ET_{rw\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}{\pi}}}$$

or,

$$IF\ ET_{rw\text{-}adj}\left(\frac{hours}{event}\right) > t^*\,(hr), then\ SL_{water\text{-}ca\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{rw\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hours}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right) = \frac{TR \times AT_r\left(\frac{365\ days}{year} \times LT\,(70\ years)\right) \times \left(\frac{1000\ \mu g}{mg}\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right) \times DFW_{adj}\left(\frac{2721670\ events\text{-}cm^2}{kg}\right)}$$

where:

$$DFW_{adj}\left(\frac{2721670\ events\text{-}cm^2}{kg}\right) = \frac{EF_{ressc}\left(\frac{350\ days}{year}\right) \times EV_c\left(\frac{1\ events}{day}\right) \times ED_c\,(6\ years) \times SA_c\,(6378\ cm^2)}{BW_c\,(15\ Kg)} + \frac{EF_{ressa}\left(\frac{350\ days}{year}\right) \times EV_a\left(\frac{1\ events}{day}\right) \times ED_a\,(20\ years) \times SA_a\,(20900\ cm^2)}{BW_a\,(80\ Kg)}$$

and:

$$ET_{rw\text{-}adj}\left(\frac{0.6708\ hours}{event}\right) = \frac{\left(ET_{rwc}\left(\frac{0.54\ hours}{event}\right) \times ED_c\,(6\ years) + ET_{rwa}\left(\frac{0.71\ hours}{event}\right) \times ED_r\text{-}ED_c\,(20\ years)\right)}{ED_r\,(26\ years)}$$

- inhalation of volatiles,

$$SL_{water\text{-}ca\text{-}inh}\left(\mu g/L\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\ (26\ years)\times ET_{rw}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times K\left(\frac{0.5\ L}{m^3}\right)}$$

- Total.

$$SL_{water\text{-}ca\text{-}tot}\left(\mu g/L\right)=\frac{1}{\frac{1}{SL_{water\text{-}ca\text{-}ing}}+\frac{1}{SL_{water\text{-}ca\text{-}der}}+\frac{1}{SL_{water\text{-}ca\text{-}inh}}}$$

4.8.4 Mutagenic

The tapwater land use equation, presented here, contains the following exposure routes:

- ingestion of water,

$$SL_{water\text{-}mu\text{-}ing}\left(\mu g/L\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFWM_{adj}\left(\frac{1019.9\ L}{Kg}\right)}$$

where:

$$IFWM_{adj}\left(\frac{1019.9\ L}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\ (yr)\times IRW_c\left(\frac{0.78\ L}{day}\right)\times 10}{BW_c\ (15\ Kg)}+\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\ (yr)\times IRW_c\left(\frac{0.78\ L}{day}\right)\times 3}{BW_c\ (15\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\ (yr)\times IRW_a\left(\frac{2.5\ L}{day}\right)\times 3}{BW_a\ (80\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\ (yr)\times IRW_a\left(\frac{2.5\ L}{day}\right)\times 1}{BW_a\ (80\ Kg)}$$

- dermal,

FOR INORGANICS:

$$SL_{water\text{-}mu\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{rw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{rw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right) \le t^*\ (hr), \text{then } SL_{water\text{-}mu\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{rw\text{-}madj}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{rw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right) > t^*\ (hr), \text{then } SL_{water\text{-}mu\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{rdw\text{-}madj}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right) = \frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFWM_{adj}\left(\frac{8419740\ events\text{ - }cm^2}{kg}\right)}$$

where:

$$DFWM_{adj}\left(\frac{8419740\ events\text{ - }cm^2}{kg}\right) = \left[\left(\frac{EV_{0\text{-}2}\left(\frac{1\ events}{day}\right)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\,(years)\times SA_c\left(6378\ cm^2\right)\times 10}{BW_c\,(15\ Kg)}\right)+\left(\frac{EV_{2\text{-}6}\left(\frac{1\ events}{day}\right)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\,(years)\times SA_c\left(6378\ cm^2\right)\times 3}{BW_c\,(15\ Kg)}\right)+\left(\frac{EV_{6\text{-}16}\left(\frac{1\ events}{day}\right)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\,(years)\times SA_a\left(20900\ cm^2\right)\times 3}{BW_a\,(80\ Kg)}\right)+\left(\frac{EV_{16\text{-}26}\left(\frac{1\ events}{day}\right)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\,(years)\times SA_a\left(20900\ cm^2\right)\times 1}{BW_a\,(80\ Kg)}\right)\right]$$

and:

$$ET_{rw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right) = \frac{\left(\begin{array}{l}ET_{0\text{-}2}\left(\frac{0.54\ hours}{event}\right)\times ED_{0\text{-}2}\,(years)+ET_{2\text{-}6}\left(\frac{0.54\ hours}{event}\right)\times ED_{2\text{-}6}\,(years)+\\ ET_{6\text{-}16}\left(\frac{0.71\ hours}{event}\right)\times ED_{6\text{-}16}\,(years)+ET_{16\text{-}26}\left(\frac{0.71\ hours}{event}\right)\times ED_{16-26}\,(years)\end{array}\right)}{ED_{0\text{-}2}\,(years)+ED_{2\text{-}6}\,(years)+ED_{6\text{-}16}\,(years)+ED_{16\text{-}26}\,(years)}$$

- inhalation of volatiles,

$$SL_{water\text{-}mu\text{-}inh}\,(\mu g/L)=\frac{TR\times AT_{r}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{EF_{r}\left(\frac{350\ days}{year}\right)\times K\left(\frac{0.5\ L}{m^{3}}\right)\times ET_{rw}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\begin{array}{l}\left(ED_{0\text{-}2}\,(yrs)\times IUR\left(\mu g/m^{3}\right)^{-1}\times 10\right)+\left(ED_{2\text{-}6}\,(yrs)\times IUR\left(\mu g/m^{3}\right)^{-1}\times 3\right)+\\\left(ED_{6\text{-}16}\,(yrs)\times IUR\left(\mu g/m^{3}\right)^{-1}\times 3\right)+\left(ED_{16\text{-}26}\,(yrs)\times IUR\left(\mu g/m^{3}\right)^{-1}\times 1\right)\end{array}\right)}$$

- Total.

$$SL_{water\text{-}mu\text{-}tot}\,(\mu g/L)=\frac{1}{\frac{1}{SL_{water\text{-}mu\text{-}ing}}+\frac{1}{SL_{water\text{-}mu\text{-}der}}+\frac{1}{SL_{water\text{-}mu\text{-}inh}}}$$

4.8.5 Vinyl Chloride - Carcinogenic

The tapwater land use equation, presented here, contains the following exposure routes:

- ingestion of water,

$$SL_{water\text{-}ca\text{-}vc\text{-}ing}\,(\mu g/L)=\frac{TR}{\left(\frac{CSF_{o}\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times FW_{adj}\left(\frac{327.95\ L}{kg}\right)\times\left(\frac{mg}{1000\ \mu g}\right)}{AT\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}\right)+\left(\frac{CSF_{o}\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IRW_{c}\left(\frac{0.78\ L}{day}\right)\times\left(\frac{mg}{1000\ \mu g}\right)}{BW_{c}\,(15\ kg)}\right)}$$

where:

$$IFW_{adj}\left(\frac{327.95\ L}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times IED_{c}\,(6\ years)\times IRW_{c}\left(\frac{0.78\ L}{day}\right)}{BW_{c}\,(15\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times IED_{r}\text{-}ED_{c}\,(20\ years)\times IRW_{a}\left(\frac{2.5\ L}{day}\right)}{BW_{a}\,(80\ Kg)}$$

- dermal,

$$\text{IF } ET_{rw\text{-}adj}\left(\frac{0.6708\text{ hours}}{\text{event}}\right) \le t^*\ (\text{hr}),\text{then } SL_{water\text{-}vc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{rw\text{-}adj}\left(\frac{0.6708\text{ hours}}{\text{event}}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{rw\text{-}adj}\left(\frac{0.6708\text{ hours}}{\text{event}}\right) > t^*\ (\text{hr}),\text{then } SL_{water\text{-}vc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{rw\text{-}adj}\left(\frac{0.6708\text{ hours}}{\text{event}}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right) = \frac{TR}{\left(\frac{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFW_{adj}\left(\frac{2721670\text{ events-}cm^2}{kg}\right)}{AT_r\left(\frac{365\text{ days}}{year}\times LT\ (70\text{ years})\right)\times\left(\frac{1000\ \mu g}{mg}\right)}\right)+\left(\frac{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times EV_{rdwc}\left(\frac{1\text{events}}{day}\right)\times SA_c\left(6378\ cm^2\right)}{BW_c\ (15\text{ Kg})\times\left(\frac{1000\ \mu g}{mg}\right)}\right)}$$

where:

$$DFW_{adj}\left(\frac{2721670\text{ events-}cm^2}{kg}\right) = \frac{EF_{ressc}\left(\frac{350\text{ days}}{year}\right)\times EV_c\left(\frac{1\text{ events}}{day}\right)\times ED_c\ (6\text{ years})\times SA_c\left(6378\ cm^2\right)}{BW_c\ (15\text{ Kg})}+\frac{EF_{ressa}\left(\frac{350\text{ days}}{year}\right)\times EV_a\left(\frac{1\text{ events}}{day}\right)\times ED_a\ (20\text{ years})\times SA_a\left(20900\ cm^2\right)}{BW_a\ (80\text{ Kg})}$$

and:

$$ET_{rw\text{-}adj}\left(\frac{0.6708\text{ hours}}{\text{event}}\right) = \frac{\left(ET_{rwc}\left(\frac{0.54\text{ hours}}{event}\right)\times ED_c\ (6\text{ years})\right)+\left(ET_{rwa}\left(\frac{0.71\text{ hours}}{event}\right)\times ED_r-ED_c\ (20\text{ years})\right)}{ED_r\ (26\text{ years})}$$

- inhalation of volatiles,

$$SL_{water\text{-}ca\text{-}vc\text{-}inh}\ (\mu g/L) = \frac{TR}{\left(\frac{IUR\left(\mu g/m^3\right)^{-1}\times EF\left(\frac{350\text{ days}}{year}\right)\times ED\ (30\text{ years})\times ET_{rw}\left(\frac{24\text{ hours}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hours}}\right)\times K\left(\frac{0.5\ L}{m^3}\right)}{AT\left(\frac{365\text{ days}}{year}\times LT\ (70\text{ years})\right)}\right)+\left(IUR\left(\mu g/m^3\right)^{-1}\times K\left(\frac{0.5\ L}{m^3}\right)\right)}$$

- Total.

$$SL_{water\text{-}ca\text{-}vc\text{-}tot}\ (\mu g/L) = \frac{1}{\frac{1}{SL_{water\text{-}ca\text{-}vc\text{-}ing}}+\frac{1}{SL_{water\text{-}ca\text{-}vc\text{-}der}}+\frac{1}{SL_{water\text{-}ca\text{-}vc\text{-}inh}}}$$

4.8.6 Trichloroethylene - Carcinogenic and Mutagenic

The tapwater land use equation, presented here, contains the following exposure routes:

- ingestion of water,

$$PRG_{water\text{-}tce\text{-}ing}\,(\mu g/L)=\frac{TR\times AT_{resw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times\left(\left(CAF_o\,(0.804)\times IFW_{resw\text{-}adj}\left(\frac{327.95\ L}{Kg}\right)\right)\right)+\left(MAF_o\,(0.202)\times IFWM_{res\text{-}adj}\left(\frac{1019.9\ L}{Kg}\right)\right)}$$

where:

$$IFW_{resw\text{-}adj}\left(\frac{327.95\ L}{Kg}\right)=\frac{ED_{reswc}\,(6\ years)\times EF_{reswc}\left(\frac{350\ days}{year}\right)\times IRW_{reswc}\left(\frac{0.78\ L}{day}\right)}{BW_c\,(15\ Kg)}+\frac{ED_{resw}\,(26\ years)-ED_{reswc}\,(6\ years)\times EF_{reswa}\left(\frac{350\ days}{year}\right)\times IRW_{reswa}\left(\frac{2.5\ L}{day}\right)}{BW_{reswa}\,(80\ Kg)}$$

where:

$$IFWM_{res\text{-}adj\text{-}}\left(\frac{1019.9\ L}{Kg}\right)=\frac{ED_{0\text{-}2}\,(2\ years)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times IRW_{0\text{-}2}\left(\frac{0.78\ L}{day}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+\frac{ED_{2\text{-}6}\,(4\ years)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times IRW_{2\text{-}6}\left(\frac{0.78\ L}{day}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+\frac{ED_{6\text{-}16}\,(10\ years)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times IRW_{6\text{-}16}\left(\frac{2.5\ L}{day}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+\frac{ED_{16\text{-}26}\,(10\ years)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times IRW_{16\text{-}26}\left(\frac{2.5\ L}{day}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- dermal,

FOR ORGANICS:

$$\text{IF } ET_{resw\text{-}adj}\left(\frac{hours}{event}\right)\leq t^*\,(hr),\text{then } PRG_{water\text{-}tce\text{-}der}\,(\mu g/L)=\frac{DA_{tce\text{-}event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{resw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{resw\text{-}adj}\left(\frac{hours}{event}\right)>t^*\,(hr),\text{then } PRG_{water\text{-}tce\text{-}der}\,(\mu g/L)=\frac{DA_{tce\text{-}event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{resw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{tce\text{-}event}\left(\frac{ug}{cm^2\text{-}\ event}\right)=\frac{TR\times AT_{resw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times\left(\left(AF_o\,(0.804)\times DFW_{res\text{-}adj}\left(\frac{2721670\ events\ \text{-}\ cm^2}{kg}\right)\right)+\left(MAF_o\,(0.202)\times DFWM_{res\text{-}adj}\left(\frac{8419740\ events\ \text{-}\ cm^2}{kg}\right)\right)\right)}$$

where:

$$DFW_{res\text{-}adj}\left(\frac{2721670\ \text{events - cm}^2}{\text{kg}}\right)=\frac{EV_{reswc}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{reswc}(6\ \text{years})\times EF_{reswc}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{reswc}\left(6378\ \text{cm}^2\right)}{BW_{resw}(15\ \text{Kg})}+\frac{EV_{reswa}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{reswa}(20\ \text{years})\times EF_{reswa}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{reswa}\left(20900\ \text{cm}^2\right)}{BW_{reswa}(80\ \text{Kg})}$$

where:

$$DFWM_{res\text{-}adj}\left(\frac{8419740\ \text{events - cm}^2}{\text{kg}}\right)=\left[\begin{array}{l}\left(\frac{EV_{0\text{-}2}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{0\text{-}2}(2\ \text{years})\times EF_{0\text{-}2}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{0\text{-}2}\left(6378\ \text{cm}^2\right)\times 10}{BW_{0\text{-}2}(15\ \text{Kg})}\right)+\\ \left(\frac{EV_{2\text{-}6}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{2\text{-}6}(4\ \text{years})\times EF_{2\text{-}6}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{2\text{-}6}\left(6378\ \text{cm}^2\right)\times 3}{BW_{2\text{-}6}(15\ \text{Kg})}\right)+\\ \left(\frac{EV_{6\text{-}16}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{6\text{-}16}(10\ \text{years})\times EF_{6\text{-}16}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{6\text{-}16}\left(20900\ \text{cm}^2\right)\times 3}{BW_{6\text{-}16}(80\ \text{Kg})}\right)+\\ \left(\frac{EV_{16\text{-}26}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{16\text{-}26}(10\ \text{years})\times EF_{16\text{-}26}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{16\text{-}26}\left(20900\ \text{cm}^2\right)\times 1}{BW_{16\text{-}26}(80\ \text{Kg})}\right)\end{array}\right]$$

and:

$$ET_{resw\text{-}madj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right)=\frac{\left(\begin{array}{l}ET_{0\text{-}2}\left(\frac{0.54\ \text{hours}}{\text{event}}\right)\times ED_{0\text{-}2}(2\ \text{years})+ET_{2\text{-}6}\left(\frac{0.54\ \text{hours}}{\text{event}}\right)\times ED_{2\text{-}6}(4\ \text{years})+\\ ET_{6\text{-}16}\left(\frac{0.71\ \text{hours}}{\text{event}}\right)\times ED_{6\text{-}16}(10\ \text{years})+ET_{16\text{-}26}\left(\frac{0.71\ \text{hours}}{\text{event}}\right)\times ED_{16\text{-}26}(1\ \text{years})\end{array}\right)}{ED_{0\text{-}2}(2\ \text{years})+ED_{2\text{-}6}(4\ \text{years})+ED_{6\text{-}16}(10\ \text{years})+ED_{16\text{-}26}(10\ \text{years})}$$

- inhalation of volatiles,

$$PRG_{water\text{-}tce\text{-}inh}(\mu g/L)=\frac{TR\times AT_{resw}\left(\frac{365\ \text{days}}{\text{year}}\times LT(70\ \text{years})\right)}{\begin{array}{l}ET_{resw}\left(\frac{24\ \text{hours}}{\text{day}}\right)\times\left(\frac{1\ \text{day}}{24\ \text{hours}}\right)\times K\left(\frac{0.5\ \text{L}}{\text{m}^3}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times\\ \left(\left(EF_{resw}\left(\frac{350\ \text{days}}{\text{year}}\right)\times ED_{resw}(26\ \text{years})\times CAF_i(0.756)\right)+\right.\\ \left(\left(ED_{0\text{-}2}(2\ \text{years})\times EF_{0\text{-}2}\left(\frac{350\ \text{days}}{\text{year}}\right)\times MAF_i(0.244)\times 10\right)+\left(ED_{2\text{-}6}(4\ \text{years})\times EF_{2\text{-}6}\left(\frac{350\ \text{days}}{\text{year}}\right)\times MAF_i(0.244)\times 3\right)+\right.\\ \left.\left.\left(ED_{6\text{-}16}(10\ \text{years})\times EF_{6\text{-}16}\left(\frac{350\ \text{days}}{\text{year}}\right)\times MAF_i(0.244)\times 3\right)+\left(ED_{16\text{-}26}(10\ \text{years})\times EF_{16\text{-}26}\left(\frac{350\ \text{days}}{\text{year}}\right)\times MAF_i(0.244)\times 1\right)\right)\right)\end{array}}$$

- Total.

$$PRG_{water\text{-}tce\text{-}tot}(\mu g/L)=\frac{1}{\frac{1}{PRG_{water\text{-}tce\text{-}ing}}+\frac{1}{PRG_{water\text{-}tce\text{-}der}}+\frac{1}{PRG_{water\text{-}tce\text{-}inh}}}$$

4.8.7 Supporting Equations

- Child

$$ED_c\left(6\text{ years}\right)=ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)$$

$$BW_c\left(15\text{ kg}\right)=\frac{BW_{0\text{-}2}\left(15\text{ kg}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+BW_{2\text{-}6}\left(15\text{ kg}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$EF_c\left(\frac{350\text{ days}}{\text{year}}\right)=\frac{EF_{0\text{-}2}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+EF_{2\text{-}6}\left(\frac{350\text{ days}}{\text{year}}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$EV_c\left(\frac{1\text{ event}}{\text{day}}\right)=\frac{EV_{0\text{-}2}\left(\frac{1\text{ event}}{\text{day}}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+EV_{2\text{-}6}\left(\frac{1\text{ event}}{\text{day}}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$ET_c\left(\frac{0.54\text{ hour}}{\text{event}}\right)=\frac{ET_{0\text{-}2}\left(\frac{0.54\text{ hour}}{\text{event}}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+ET_{2\text{-}6}\left(\frac{0.54\text{ hour}}{\text{event}}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$SA_c\left(6378\text{ cm}^2\right)=\frac{SA_{0\text{-}2}\left(6378\text{ cm}^2\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+SA_{2\text{-}6}\left(6378\text{ cm}^2\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$IRW_c\left(\frac{0.78\text{ L}}{\text{day}}\right)=\frac{IRW_{0\text{-}2}\left(\frac{0.78\text{ L}}{\text{day}}\right)\times ED_{0\text{-}2}\left(2\text{ years}\right)+IRW_{2\text{-}6}\left(\frac{0.78\text{ L}}{\text{day}}\right)\times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right)+ED_{2\text{-}6}\left(4\text{ years}\right)}$$

- Adult

$$ED_a\,(20\text{ years}) = ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})$$

$$BW_a\,(80\text{ kg}) = \frac{BW_{6-16}\,(80\text{ kg}) \times ED_{6-16}\,(10\text{ years}) + BW_{16-26}\,(80\text{ kg}) \times ED_{16-26}\,(10\text{ years})}{ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})}$$

$$EF_a\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{EF_{6-16}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{6-16}\,(10\text{ years}) + EF_{16-26}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{16-26}\,(10\text{ years})}{ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})}$$

$$EV_a\left(\frac{1\text{ event}}{\text{day}}\right) = \frac{EV_{6-16}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{6-16}\,(10\text{ years}) + EV_{16-26}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{16-26}\,(10\text{ years})}{ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})}$$

$$ET_a\left(\frac{0.71\text{ hour}}{\text{event}}\right) = \frac{ET_{6-16}\left(\frac{0.71\text{ hour}}{\text{event}}\right) \times ED_{6-16}\,(10\text{ years}) + ET_{16-26}\left(\frac{0.71\text{ hour}}{\text{event}}\right) \times ED_{16-26}\,(10\text{ years})}{ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})}$$

$$SA_a\left(20900\text{ cm}^2\right) = \frac{SA_{6-16}\left(20900\text{ cm}^2\right) \times ED_{6-16}\,(10\text{ years}) + SA_{16-26}\left(20900\text{ cm}^2\right) \times ED_{16-26}\,(10\text{ years})}{ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})}$$

$$IRW_a\left(\frac{2.5\text{ L}}{\text{day}}\right) = \frac{IRW_{6-16}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times ED_{6-16}\,(10\text{ years}) + IRW_{16-26}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times ED_{16-26}\,(10\text{ years})}{ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})}$$

- Age-adjusted

$$ED_r\,(26\text{ years}) = ED_{0-2}\,(2\text{ years}) + ED_{2-6}\,(4\text{ years}) + ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})$$

$$EF_r\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{EF_{0-2}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{0-2}\,(2\text{ years}) + EF_{2-6}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{2-6}\,(4\text{ years}) + EF_{6-16}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{6-16}\,(10\text{ years}) + EF_{16-26}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{16-26}\,(10\text{ years})}{ED_{0-2}\,(2\text{ years}) + ED_{2-6}\,(4\text{ years}) + ED_{6-16}\,(10\text{ years}) + ED_{16-26}\,(10\text{ years})}$$

$$ET_r\left(\frac{24\text{ hours}}{\text{day}}\right)$$

4.9 Resident air

4.9.1 Noncarcinogenic

The air land use equation, presented here, contains the following exposure routes:

- inhalation

$$SL_{res-air-nc}\left(\mu g/m^3\right) = \frac{THQ \times AT_r\left(\frac{365\text{ days}}{\text{year}} \times ED_r\,(26\text{ years})\right) \times \left(\frac{1000\,\mu g}{mg}\right)}{EF_r\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_r\,(26\text{ years}) \times ET_{ra}\left(\frac{24\text{ hours}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hours}}\right) \times \frac{1}{RfC\left(\frac{mg}{m^3}\right)}}$$

4.9.2 Carcinogenic

The air land use equation, presented here, contains the following exposure routes:

- inhalation

$$SL_{res\text{-}air\text{-}ca}\left(\mu g/m^3\right)=\frac{TR\times AT_r\left(\frac{365\ \text{days}}{\text{year}}\times LT\ (70\ \text{years})\right)}{EF_r\left(\frac{350\ \text{days}}{\text{year}}\right)\times ED_r\ (26\ \text{years})\times ET_{ra}\left(\frac{24\ \text{hours}}{\text{day}}\right)\times\left(\frac{1\ \text{day}}{24\ \text{hours}}\right)\times IUR\left(\mu g/m^3\right)^{-1}}$$

4.9.3 Mutagenic

The air land use equation, presented here, contains the following exposure routes:

- inhalation

$$SL_{res\text{-}air\text{-}mu}\left(\mu g/m^3\right)=\frac{TR\times AT_r\left(\frac{365\ \text{days}}{\text{year}}\times LT\ (70\ \text{years})\right)}{\left(\frac{1\ \text{day}}{24\ \text{hours}}\right)\times\left(\begin{array}{l}\left(ED_{0-2}\ (yrs)\times EF_{0-2}\left(\frac{350\ \text{days}}{\text{year}}\right)\times ET_{0-2}\left(\frac{24\ \text{hours}}{\text{day}}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times 10\right)+\\ \left(ED_{2-6}\ (yrs)\times EF_{2-6}\left(\frac{350\ \text{days}}{\text{year}}\right)\times ET_{2-6}\left(\frac{24\ \text{hours}}{\text{day}}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times 3\right)+\\ \left(ED_{6-16}\ (yrs)\times EF_{6-16}\left(\frac{350\ \text{days}}{\text{year}}\right)\times ET_{6-16}\left(\frac{24\ \text{hours}}{\text{day}}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times 3\right)+\\ \left(ED_{16-26}\ (yrs)\times EF_{16-26}\left(\frac{350\ \text{days}}{\text{year}}\right)\times ET_{16-26}\left(\frac{24\ \text{hours}}{\text{day}}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times 1\right)\end{array}\right)}$$

4.9.4 Vinyl Chloride - Carcinogenic

The air land use equation, presented here, contains the following exposure routes:

- inhalation

$$SL_{res\text{-}air\text{-}ca\text{-}vinyl\ chloride}\left(\mu g/m^3\right)=\frac{TR}{IUR\left(\mu g/m^3\right)^{-1}+\left(\frac{IUR\left(\mu g/m^3\right)^{-1}\times EF_r\left(\frac{350\ \text{days}}{\text{year}}\right)\times ED_r\ (26\ \text{years})\times ET_{ra}\left(\frac{24\ \text{hours}}{\text{day}}\right)\times\left(\frac{1\ \text{day}}{24\ \text{hours}}\right)}{AT_r\left(\frac{365\ \text{days}}{\text{year}}\times LT\ (70\ \text{years})\right)}\right)}$$

4.9.5 Trichloroethylene - Carcinogenic and Mutagenic

The air land use equation, presented here, contains the following exposure routes:

- inhalation

$$PRG_{res\text{-}air\text{-}tce}\left(\mu g/m^3\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\begin{array}{l}\left(ED_r\ (26\ years)\times EF_r\left(\frac{350\ days}{year}\right)\times ET_{ra}\left(\frac{24\ hours}{day}\right)\times CAF_i\ (0.756)\right)+\\ \left(\begin{array}{l}\left(ED_{0\text{-}2}\ (yrs)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ET_{0\text{-}2}\left(\frac{24\ hours}{day}\right)\times MAF_i\ (0.244)\times 10\right)+\\ \left(ED_{2\text{-}6}\ (yrs)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ET_{2\text{-}6}\left(\frac{24\ hours}{day}\right)\times MAF_i\ (0.244)\times 3\right)+\\ \left(ED_{6\text{-}16}\ (yrs)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times ET_{6\text{-}16}\left(\frac{24\ hours}{day}\right)\times MAF_i\ (0.244)\times 3\right)+\\ \left(ED_{16\text{-}26}\ (yrs)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times ET_{16\text{-}26}\left(\frac{24\ hours}{day}\right)\times MAF_i\ (0.244)\times 1\right)\end{array}\right)\end{array}\right)}$$

4.10 Worker air

4.10.1 Noncarcinogenic

The air land use equation, presented here, contains the following exposure routes:

- Inhalation

$$SL_{w\text{-}air\text{-}nc}\left(\mu g/m^3\right)=\frac{THQ\times AT_w\left(\frac{365\ days}{year}\times ED_w\ (25\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_w\left(\frac{250\ days}{year}\right)\times ED_w\ (25\ years)\times ET_w\left(\frac{8\ hr}{24\ hr}\right)\times\frac{1}{RfC\left(\frac{mg}{m^3}\right)}}$$

4.10.2 Carcinogenic

The air land use equation, presented here, contains the following exposure routes:

- Inhalation

$$SL_{w\text{-}air\text{-}ca}\left(\mu g/m^3\right)=\frac{TR\times AT_w\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{EF_w\left(\frac{250\ days}{year}\right)\times ED_w\ (25\ years)\times ET_w\left(\frac{8\ hr}{24\ hr}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}}$$

4.11 Ingestion of Fish

The ingestion of fish exposure route is not provided in the Generic Tables but SLs can be created by using the Calculator and the equations that follow:

4.11.1 Noncarcinogenic

The ingestion of fish equation, presented here, contains the following exposure route:

- consumption of fish.

$$SL_{res\text{-}fsh\text{-}nc\text{-}ing}\,(mg/kg)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\right)\times ED_r\,(26\ years)\times BW_a\,(80\ Kg)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\,(26\ year)\times\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)}\times IRF_a\left(\frac{5.4\times10^4\ mg}{day}\right)\times\frac{10^{-6}Kg}{1mg}}$$

4.11.2 Carcinogenic

The ingestion of fish equation, presented here, contains the following exposure route:

- consumption of fish.

$$SL_{res\text{-}fsh\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\right)\times LT\,(70\ years)\times BW_a\,(80\ Kg)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\,(26\ year)\times CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IRF_a\left(\frac{5.4\times10^4\ mg}{day}\right)\times\frac{10^{-6}Kg}{1\ mg}}$$

Note: the consumption rate for fish is not age adjusted for this land use. Also the SL calculated for fish is not for soil but is for fish tissue.

4.12 Soil to Groundwater

These equations are used to calculate screening levels in soil (SSLs) that are protective of groundwater. SSLs are either back-calculated from protective risk-based ground water concentrations or based on MCLs. The SSLs were designed for use during the early stages of a site evaluation when information about subsurface conditions may be limited. Because of this constraint, the equations used are based on conservative, simplifying assumptions about the release and transport of contaminants in the subsurface. Migration of contaminants from soil to groundwater can be envisioned as a two-stage process: (1) release of contaminant in soil leachate and (2) transport of the contaminant through the underlying soil and aquifer to a receptor well. The SSL methodology considers both of these fate and transport mechanisms.

The SSLs protective of groundwater, provided in the generic tables and the calculator, are all risk-based concentrations based on three phases (vapor, soil and water). No substitution for C_{sat} is performed. If the risk-based concentration exceeds C_{sat}, the resulting SSL concentration may be overly protective. This is because the dissolved, absorbed and vapor concentrations cease to rise linearly as soil concentration increases above the C_{sat} level (pure product or nonaqueous phase liquid (NAPL) is present). The SSL model used in the RSL calculator is not a four phase model. If a NAPL is present at your site more sophisticated models may be necessary.

SSLs are provided for metals in the Generic Tables based on Kds from the Soil Screening Guidance Exhibit C-4 . According to Appendix C,

> "Exhibit C-4 provides pH-specific soil-water partition coefficients (Kd) for metals. Site-specific soil pH measurements can be used to select appropriate Kd values for these metals. Where site-specific soil pH values are not available, values corresponding to a pH of 6.8 should be used."

If a metal is not listed in Exhibit C-4, Kds were taken from Baes, C. F. 1984. Kds for organic coumponds are calculated from K_{oc} and the fraction of organic carbon in the soil (f_{oc}). Kds for metals are listed below.

Chemical	CAS	Kd	Reference
Aluminum	7429-90-5	1.50E+03	Baes, C.F. 1984
Antimony (metallic)	7440-36-0	4.50E+01	SSG 9355.4-23 July 1996
Arsenic, Inorganic	7440-38-2	2.90E+01	SSG 9355.4-23 July 1996
Barium	7440-39-3	4.10E+01	SSG 9355.4-23 July 1996
Beryllium and compounds	7440-41-7	7.90E+02	SSG 9355.4-23 July 1996
Boron And Borates Only	7440-42-8	3.00E+00	Baes, C.F. 1984
Bromate	15541-45-4	7.50E+00	Baes, C.F. 1984
Cadmium (Diet)	7440-43-9	7.50E+01	SSG 9355.4-23 July 1996
Cadmium (Water)	7440-43-9	7.50E+01	SSG 9355.4-23 July 1996

Chlorine	7782-50-5	2.50E-01	Baes, C.F. 1984
Chromium (III) (Insoluble Salts)	16065-83-1	1.80E+06	SSG 9355.4-23 July 1996
Chromium Salts	0-00-3	8.50E+02	Baes, C.F. 1984
Chromium VI (chromic acid mists)	18540-29-9	1.90E+01	SSG 9355.4-23 July 1996
Chromium VI (particulates)	18540-29-9	1.90E+01	SSG 9355.4-23 July 1996
Chromium, Total (1:6 ratio Cr VI : Cr III)	7440-47-3	1.80E+06	SSG 9355.4-23 July 1996
Cobalt	7440-48-4	4.50E+01	Baes, C.F. 1984
Copper	7440-50-8	3.50E+01	Baes, C.F. 1984
Cyanide (CN-)	57-12-5	9.90E+00	SSG 9355.4-23 July 1996
Fluorine (Soluble Fluoride)	7782-41-4	1.50E+02	Baes, C.F. 1984
Hydrogen Cyanide (HCN)	74-90-8	9.90E+00	Surrogate value from Cyanide
Iron	7439-89-6	2.50E+01	Baes, C.F. 1984
Lead and Compounds	7439-92-1	9.00E+02	Baes, C.F. 1984
Lithium	7439-93-2	3.00E+02	Baes, C.F. 1984
Magnesium	7439-95-4	4.50E+00	Baes, C.F. 1984
Manganese (Diet)	7439-96-5	6.50E+01	Baes, C.F. 1984
Manganese (Water)	7439-96-5	6.50E+01	Baes, C.F. 1984
Mercury (elemental)	7439-97-6	5.20E+01	SSG 9355.4-23 July 1996
Mercury, Inorganic Salts	0-01-7	5.20E+01	SSG 9355.4-23 July 1996
Molybdenum	7439-98-7	2.00E+01	Baes, C.F. 1984
Nickel Soluble Salts	7440-02-0	6.50E+01	SSG 9355.4-23 July 1996
Phosphorus, White	7723-14-0	3.50E+00	Baes, C.F. 1984
Selenium	7782-49-2	5.00E+00	SSG 9355.4-23 July 1996
Silver	7440-22-4	8.30E+00	SSG 9355.4-23 July 1996
Sodium	7440-23-5	1.00E+02	Baes, C.F. 1984
Strontium, Stable	7440-24-6	3.50E+01	Baes, C.F. 1984
Thallium (Soluble Salts)	7440-28-0	7.10E+01	SSG 9355.4-23 July 1996
Thorium	0-23-2	1.50E+05	Baes, C.F. 1984
Tin	7440-31-5	2.50E+02	Baes, C.F. 1984
Titanium	7440-32-6	1.00E+03	Baes, C.F. 1984
Uranium (Soluble Salts)	0-23-8	4.50E+02	Baes, C.F. 1984
Vanadium and Compounds	0-06-6	1.00E+03	SSG 9355.4-23 July 1996
Vanadium, Metallic	7440-62-2	1.00E+03	SSG 9355.4-23 July 1996
Zinc (Metallic)	7440-66-6	6.20E+01	SSG 9355.4-23 July 1996
Zirconium	7440-67-7	3.00E+03	Baes, C.F. 1984

Because Kds vary greatly by soil type, it is highly recommended that site-specific Kds be determined and used to develop SSLs.

The more protective of the carcinogenic and noncarcinogenic SLs is selected to calculate the SSL.

4.12.1 Noncarcinogenic Tapwater Equations for SSLs

The tapwater equations, presented in Section 4.7.1, are used to calculate the noncarcinogenic SSLs for volatiles and nonvolatiles. If the contaminant is a volatile, ingestion, dermal and inhalation exposure routes are considered. If the contaminant is not a volatile, only ingestion and dermal are considered.

4.12.2 Carcinogenic Tapwater Equations for SSLs

The tapwater equations, presented in Section 4.7.2, are used to calculate the carcinogenic SSLs for volatiles and nonvolatiles. Sections 4.7.3 and 4.7.4 present the mutagenic and vinyl chloride equations, respectively. If the contaminant is a volatile, ingestion, dermal and inhalation exposure routes are considered. If the contaminant is not a volatile, only ingestion and dermal are considered.

4.12.3 Method 1 for SSL Determination

Method 1 employs a partitioning equation for migration to groundwater and defaults are provided. This method is used to generate the download default tables.

- method 1.

$$SSL(mg/kg) = C_w\left(\frac{mg}{L}\right) \times DAF \times \left[K_d\left(\frac{L}{kg}\right) + \left(\frac{\left(\theta_w\left(\frac{L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{L_{air}}{L_{soil}}\right) \times H'\right)}{\rho_b\left(\frac{1.5\ kg}{L}\right)}\right)\right]$$

where:

$$\theta_a\left(\frac{L_{air}}{L_{soil}}\right) = n\left(\frac{L_{water}}{L_{soil}}\right) - \theta_w\left(\frac{0.3\ L_{water}}{L_{soil}}\right);$$

$$n\left(\frac{L_{pore}}{L_{soil}}\right) = 1 - \left(\frac{\rho_b\left(\frac{1.5\ kg}{L}\right)}{\rho_s\left(\frac{2.65\ kg}{L}\right)}\right) \text{ and}$$

$$K_d\left(\frac{L}{kg}\right) = K_{oc}\left(\frac{L}{kg}\right) \times f_{oc}\ (0.002 \text{ unitless})$$

4.12.4 Method 2 for SSL Determination

Method 2 employs a mass-limit equation for migration to groundwater and site-specific information is required. This method can be used in the calculator portion of this website.

- method 2.

$$SSL(mg/kg) = \frac{C_w\left(\frac{mg}{L}\right) \times DAF \times I\left(\frac{0.18\ m}{year}\right) \times ED\ (70\ years)}{\rho_b\left(\frac{1.5\ kg}{L}\right) \times d_s\ (m)}$$

4.12.5 Determination of the Dilution Factor

The SSL values in the download tables are based on a dilution factor of 1. If one wishes to use the calculator to calculate screening levels using the SSL guidance for a source up to 0.5 acres, then a dilution factor of 20 can be used. If all of the parameters needed to calculate a site-specific dilution factor are known, they may be entered.

- dilution factor.

$$\text{Dilution Attenuation Factor (DAF)} = 1 + \frac{K\left(\frac{m}{year}\right)\times i\left(\frac{m}{m}\right)\times d(m)}{I\left(\frac{0.18\ m}{year}\right)\times L(m)}$$

where:

$$d(m) = \left(0.0112\times L^2(m)\right)^{0.5} + d_a \times \left[1-\exp\left(\frac{-L(m)\times I\left(\frac{m}{year}\right)}{K\left(\frac{m}{year}\right)\times i\left(\frac{m}{m}\right)\times d_a(m)}\right)\right]$$

4.13 Supporting Equations and Parameter Discussion

There are two parts of the above land use equations that require further explanation. They are the inhalation variables: the particulate emission factor (PEF) and the volatilization factor (VF).

4.13.1 Wind-driven Particulate Emission Factor (PEF)

Inhalation of contaminants adsorbed to respirable particles (PM10) was assessed using a default PEF equal to 1.36 x 10^9 m^3/kg. This equation relates the contaminant concentration in soil with the concentration of respirable particles in the air due to fugitive dust emissions from contaminated soils. The generic PEF was derived using default values that correspond to a receptor point concentration of approximately 0.76 µg/m^3. The relationship is derived by Cowherd (1985) for a rapid assessment procedure applicable to a typical hazardous waste site, where the surface contamination provides a relatively continuous and constant potential for emission over an extended period of time (e.g., years). This represents an annual average emission rate based on wind erosion that should be compared with chronic health criteria; it is not appropriate for evaluating the potential for more acute exposures. Definitions of the input variables are in Table 1.

With the exception of specific heavy metals, the PEF does not appear to significantly affect most soil screening levels. The equation forms the basis for deriving a generic PEF for the inhalation pathway. For more details regarding specific parameters used in the PEF model, refer to Soil Screening Guidance: Technical Background Document. The use of alternate values on a specific site should be justified and presented in an Administrative Record if considered in CERCLA remedy selection.

$$PEF_w\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{Q}{C_{wind}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\frac{3{,}600\left(\frac{s}{hour}\right)}{0.036\times(1\text{-}V)\times\left(\frac{U_m\left(\frac{m}{s}\right)}{U_t\left(\frac{m}{s}\right)}\right)^3\times F(x)}$$

$$\text{and: } \frac{Q}{C_{wind}} = A\times\exp\left[\frac{\left(\ln A_s\,(acre)-B\right)^2}{C}\right]$$

Note: the generic PEF evaluates wind-borne emissions and does not consider dust emissions from traffic or other forms of mechanical disturbance that could lead to greater emissions than assumed here.

4.13.2 Vehicle traffic-driven Particulate Emission Factor (PEF_{sc})

The equation to calculate the subchronic particulate emission factor (PEF_{sc}) is significantly different from the residential and non-residential PEF equations. The PEF_{sc} focuses exclusively on emissions from truck traffic on unpaved roads, which typically contribute the majority of dust emissions during construction. This equation requires estimates of parameters such as the number of days with at least 0.01 inches of rainfall, the mean vehicle weight, and the sum of fleet vehicle distance traveled during construction.

The number of days with at least 0.01 inches of rainfall can be estimated using Exhibit 5-2 in the supplemental soil screening guidance. . Mean vehicle weight (W) can be estimated by assuming the numbers and weights of different types of vehicles. For example, assuming that the daily unpaved road traffic consists of 20 two-ton cars and 10 twenty-ton trucks, the mean vehicle weight would be:

W = [(20 cars x 2 tons/car) + (10 trucks x 20 tons/truck)]/30 vehicles = 8 tons

The sum of the fleet vehicle kilometers traveled during construction (? VKT) can be estimated based on the size of the area of surface soil contamination, assuming the configuration of the unpaved road, and the amount of vehicle traffic on the road. For example, if the area of surface soil contamination is 0.5 acres (or 2,024 m^2), and one assumes that this area is configured as a square with the unpaved road segment dividing the square evenly, the road length would be equal to the square root of 2,024 m^2, 45 m (or 0.045 km). Assuming that each vehicle travels the length of the road once per day, 5 days per week for a total of 6 months, the total fleet vehicle kilometers traveled would be:

? VKT = 30 vehicles x 0.045 km/day x (52 wks/yr ÷ 2) x 5 days/wk = 175.5 km

$$PEF_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right)=\frac{Q}{C_{sr}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\frac{1}{F_D}\times\left[\frac{T(s)\times A_R\left(m^2\right)}{\frac{2.6\times\left(\frac{s}{12}\right)^{0.8}\times\left(\frac{W(tons)}{3}\right)^{0.4}}{\left(\frac{M_{dry}}{0.2}\right)^{0.3}}\times\frac{365\left(\frac{days}{year}\right)-p\left(\frac{days}{year}\right)}{365\left(\frac{days}{year}\right)}\times 281.9\times\sum VKT(km)}\right]$$

$$\frac{Q}{C_{sr}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)=A\times\exp\left[\frac{\left(\ln A_s(acre)-B\right)^2}{C}\right]$$

$$A_R\left(m^2\right)=L_R(ft)\times W_R(20\ ft)\times 0.092903\left(\frac{m^2}{ft^2}\right)$$

$$W(tons)=\frac{\left(\text{number of cars}\times\frac{tons}{car}+\text{number of trucks}\times\frac{tons}{truck}\right)}{\text{total vehicles}}$$

$$\sum VKT(km)=\text{total vehichles}\times\text{distance}\left(\frac{km}{day}\right)\times EW_{cw}\left(\frac{weeks}{year}\right)\times DW_{cw}\left(\frac{days}{week}\right)$$

$$T\ (7200000\ s)=ED_{cw}(1\ yr)\times EF_{cw}\left(\frac{250\ days}{year}\right)\times ET_{cw}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{3600\ s}{hr}\right)$$

$$F_D(0.18584)=0.1852+\left(5.3537/t_c\right)+\left(-9.6318/t_c^{\,2}\right)$$

$$t_c\ (8400\ hr)=ED_{cw}(1\ yr)\times EW_{cw}\left(\frac{50\ wks}{year}\right)\times\left(\frac{7\ days}{week}\right)\times\left(\frac{24\ hrs}{day}\right)$$

4.13.3 Other than vehicle traffic-driven Particulate Emission Factor (PEF'_{sc})

Other than emissions from unpaved road traffic, the construction worker may also be exposed to particulate matter emissions from wind erosion, excavation soil dumping, dozing, grading, and tilling or similar operations PEF'_{sc}. These operations may occur separately or concurrently and the duration of each operation may be different. For these reasons, the total unit mass emitted from each operation is calculated separately and the sum is normalized over the entire area of contamination and over the entire time during which construction activities take place. Equation E-26 in the supplemental soil screening guidance was used.

$$PEF_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right)=\frac{Q}{C_{sr}}\left(\frac{\left(\frac{g}{m^2\text{- s}}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\frac{1}{F_D}\times\left[\frac{T\,(s)\times A_R\left(m^2\right)}{\frac{2.6\text{ x }\left(\frac{s}{12}\right)^{0.8}\times\left(\frac{W(tons)}{3}\right)^{0.4}}{\left(\frac{M_{dry}}{0.2}\right)^{0.3}}\times\frac{\left(365\left(\frac{days}{year}\right)\text{- p}\left(\frac{days}{year}\right)\right)}{365\left(\frac{days}{year}\right)}\times 281.9\times\Sigma\,VKT(km)}\right]$$

$$\frac{Q}{C_{sr}}\left(\frac{\left(\frac{g}{m^2\text{- s}}\right)}{\left(\frac{kg}{m^3}\right)}\right)=A\times\exp\left[\frac{\left(\ln A_s\,(acre)\text{-}B\right)^2}{C}\right]$$

$$A_R\left(m^2\right)=L_R\,(ft)\times W_R\,(20\text{ ft})\times 0.092903\left(\frac{m^2}{ft^2}\right)$$

$$W\,(tons)=\frac{\left(\text{number of cars}\times\frac{tons}{car}+\text{number of trucks}\times\frac{tons}{truck}\right)}{\text{total vehicles}}$$

$$\Sigma\,VKT\,(km)=\text{total vehichles}\times\text{distance}\left(\frac{km}{day}\right)\times EW_{cw}\left(\frac{weeks}{year}\right)\times DW_{cw}\left(\frac{days}{week}\right)$$

$$T\ (7200000\text{ s})=ED_{cw}\,(1\text{ yr})\times EF_{cw}\left(\frac{250\text{ days}}{year}\right)\times ET_{cw}\left(\frac{8\text{ hrs}}{day}\right)\times\left(\frac{3600\text{ s}}{hr}\right)$$

$$F_D\,(0.18584)=0.1852+\left(5.3537\,/\,t_c\right)+\left(\text{-}9.6318\,/\,t_c{}^2\right)$$

$$t_c\,(8400\text{ hr})=ED_{cw}\,(1\text{ yr})\times EW_{cw}\left(\frac{50\text{ wks}}{year}\right)\times\left(\frac{7\text{ days}}{week}\right)\times\left(\frac{24\text{ hrs}}{day}\right)$$

4.13.4 Infinite Source Chronic Volatilization Factor (VF)

The soil-to-air VF is used to define the relationship between the concentration of the contaminant in soil and the flux of the volatilized contaminant to air. VF is calculated from the equation below using chemical-specific properties and either site-measured or default values for soil moisture, dry bulk density, and fraction of organic carbon in soil. The Soil Screening Guidance: User's Guide describes how to develop site measured values for these parameters.

VF is only calculated for volatile organic compounds (VOCs). VOCs, for the purpose of this guidance, generally are chemicals with a Henry's Law constant greater than or equal to 1 x 10^{-5} atm-m^3/mole and a molecular weight of less than 200 g/mole. Exceptions are: Mercury (elemental), Pyrene, Dibromochloromethane and Dibromo-3-chloropropane, 1,2-. The VOC status of a chemical is important for some exposure routes. According to RAGS Part E, default dermal absorption values are not provided for VOCs. Without dermal absorption values, the dermal exposure to soil route cannot be quantified. For the purposes of this guidance, dermal exposure to soil is only quantified if RAGS Part E provides a dermal absorption value in Exhibit 3-4 or the website, regardless of VOC status. The rationale for this is that in the considered soil exposure scenarios, volatile organic compounds would tend to be volatilized from the soil on skin and should be accounted for via inhalation routes in the combined exposure pathway analysis. Further, a chemical must be a VOC in order to be included in the calculation of tapwater inhalation.

unlimited source model for chronic exposure

$$VF_s\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{\frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2\text{-} s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \left(3.14 \times D_A\left(\frac{cm^2}{s}\right) \times T(s)\right)^{1/2} \times 10^{-4}\left(\frac{m^2}{cm^2}\right)}{2 \times \rho_b\left(\frac{g}{cm^3}\right) \times D_A\left(\frac{cm^2}{s}\right)}$$

$$\text{where: } \frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2\text{-} s}\right)}{\left(\frac{kg}{m^3}\right)}\right) = A \times \exp\left[\frac{\left(\ln A_s(acre) - B\right)^2}{C}\right]$$

$$\text{where: } D_A\left(\frac{cm^2}{s}\right) = \frac{\left(\theta_a\left(\frac{L_{air}}{L_{soil}}\right)^{10/3} \times D_{ia}\left(\frac{cm^2}{s}\right) \times H' + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right)^{10/3} \times D_{iw}\left(\frac{cm^2}{s}\right)\right) \Big/ n^2\left(\frac{L_{pore}}{L_{soil}}\right)}{\rho_b\left(\frac{1.5g}{cm^3}\right) \times K_d\left(\frac{cm^3}{g}\right) + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{L_{air}}{L_{soil}}\right) \times H'}$$

$$\text{where: } \theta_a\left(\frac{L_{air}}{L_{soil}}\right) = n\left(\frac{L_{pore}}{L_{soil}}\right)\theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) \text{and } n\left(\frac{L_{pore}}{L_{soil}}\right) = 1 - \left(\rho_b\left(\frac{1.5g}{cm^3}\right) \Big/ \rho_s\left(\frac{2.65\ g}{cm^3}\right)\right)$$

$$\text{where: } K_d\left(\frac{cm^3}{g}\right) = f_{oc}\left(\frac{g}{g}\right) \times K_{oc}\left(\frac{cm^3}{g}\right) \text{ only for organics.}$$

Diffusivity in Water (cm^2/s)

Diffusivity in water can be calculated from the chemical's molecular weight and density, using the following correlation equation based on WATER9 (U.S. EPA, 2001):

$$D_{iw}\left(\frac{cm^2}{s}\right) = 0.0001518 \times \left(\frac{T\,^oC + 273.16}{298.16}\right) \times \left(\frac{MW\left(\frac{g}{mol}\right)}{\rho\left(\frac{g}{cm^3}\right)}\right)^{-0.6}$$

where

T typically = 25 ^{o}C

If density is not available,

$$D_{iw}\left(\frac{cm^2}{s}\right) = 0.000222 \times (MW)^{-\left(\frac{2}{3}\right)}$$

If density is not available, diffusivity in water can be calculated using the correlation equation based on U.S. EPA (1987). The value for diffusivity in water must be greater than zero. No maximum limit is enforced.

Diffusivity in Air (cm^2/s).

Diffusivity in air can be calculated from the chemical's molecular weight and density, using the following correlation equation based on WATER9 (U.S. EPA, 2001):

$$D_{ia}\left(\frac{cm^2}{s}\right)=\frac{0.00229\times\left(T\,^{o}C+273.16\right)^{1.5}\times\sqrt{0.034+\left(\frac{1}{MW\left(\frac{g}{mol}\right)}\right)}\times MW_{cor}}{\left(\left(\frac{MW\left(\frac{g}{mol}\right)}{2.5\times\rho\left(\frac{g}{cm^3}\right)}\right)^{0.333}+1.8\right)^2}$$

where

T typically $= 25\,^{o}C$

$MW_{cor} = \left(1\text{-}0.000015\times MW^2\right)$ If MW_{cor} is less than 0.4, then MW_{cor} is set to 0.4.

If density is not available,

$$D_{ia}\left(\frac{cm^2}{s}\right)=1.9\times\left(MW\left(\frac{g}{mol}\right)^{-\left(\frac{2}{3}\right)}\right)$$ except for dioxins use, $$D_{ia}\left(\frac{cm^2}{s}\right)=\left(\frac{154}{MW\left(\frac{g}{mol}\right)}\right)^{0.5}\times 0.068$$

If density is not available, diffusivity in air can be calculated using the correlation equation based on U.S. EPA (1987). For dioxins, diffusivity in air can be calculated from the molecular weight using the correlation equation based on EPA's Dioxin Reassessment (U.S. EPA, 2000).

4.13.5 Mass-limit Chronic Volatilization Factor (VF)

This Equation presents a model for calculating mass-limit SSLs for the outdoor inhalation of volatiles. This model can be used only if the depth and area of contamination are known or can be estimated with confidence. This equation is presented in the Soil Screening Guidance: User's Guide and the Supplemental Soil Screening Guidance.

Use of infinite source models to estimate volatilization can violate mass balance considerations, especially for small sources. To address this concern, the Soil Screening Guidance includes a model for calculating a mass-limit SSL that provides a lower limit to the SSL **when the area and depth (i.e., volume) of the source are known or can be estimated reliably.**

A mass-limit SSL represents the level of contaminant in the subsurface that is still protective when the entire volume of contamination volatilizes over the 30-year exposure duration and the level of contaminant at the receptor does not exceed the health-based limit.

To use mass-limit SSLs, determine the area and depth of the source, calculate both standard and mass-limit SSLs, compare them for each chemical of concern and select the higher of the two values.

Note that the equation requires a site-specific determination of the average depth of contamination in the source. Step 3, in the SSG, provides guidance for conducting subsurface sampling to determine source depth. Where the actual average depth of contamination is uncertain, a conservative estimate should be used (e.g., the maximum possible depth in the unsaturated zone). At many sites, the average water table depth may be used unless there is reason to believe that contamination extends below the water table. In this case SSLs do not apply and further investigation of the source in question is needed.

mass limit model for chronic exposure

$$VF_s\left(\frac{m^3_{air}}{kg_{soil}}\right)=\frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\frac{\left[T\,(year)\times\left(3.15\times10^7\left(\frac{s}{year}\right)\right)\right]}{\rho_b\left(\frac{Mg}{m^3}\right)\times d_s\,(m)\times10^6\left(\frac{g}{Mg}\right)}$$

$$\text{where: }\frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)=A\times\exp\left[\frac{\left(\ln A_s\,(acre)-B\right)^2}{C}\right]$$

4.13.6 Unlimited Source Subchronic Volatilization Factor for Construction Worker (VF_{sc})

Equation 5-14 of the supplemental soil screening guidance is appropriate for calculating the soil-to-air volatilization factor (VF_{sc}) that relates the concentration of a contaminant in soil to the concentration in air resulting from volatilization. The equation for the subchronic dispersion factor for volatiles, Q/C_{sa}, is presented in Equation 5-15 of the supplemental soil screening guidance. Q/C_{sa} was derived using EPA's SCREEN3 dispersion model for a hypothetical site under a wide range of meteorological conditions. Unlike the Q/C values for the other scenarios, the Q/C_{sa} for the construction scenario's simple site-specific approach can be modified only to reflect different site sizes between 0.5 and 500 acres; it cannot be modified for climatic zone. Site managers conducting a detailed site-specific analysis for the construction scenario can develop a site-specific Q/C value by running the SCREEN3 model. Further details on the derivation of Q/C_{sa} can be found in Appendix E of the supplemental soil screening guidance.

unlimited source model for subchronic exposure

$$VF_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \frac{1}{F_D} \times \left[\frac{\left(3.14 \times D_A\left(\frac{cm^2}{s}\right) \times T(s)\right)^{1/2}}{2 \times \rho_b\left(\frac{1.5g}{cm^3}\right) \times D_A\left(\frac{cm^2}{s}\right)}\right] \times 10^{-4}\left(\frac{m^2}{cm^2}\right)$$

$$\text{where: } \frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right) = A \times \exp\left[\frac{\left(\ln A_s(acre) - B\right)^2}{C}\right]$$

$$D_A\left(\frac{cm^2}{s}\right) = \frac{\left(\theta_a\left(\frac{L_{air}}{L_{soil}}\right)^{10/3} \times D_{ia}\left(\frac{cm^2}{s}\right) \times H' + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right)^{10/3} \times D_{iw}\left(\frac{cm^2}{s}\right)\right) \Big/ n^2\left(\frac{L_{pore}}{L_{soil}}\right)}{\rho_b\left(\frac{1.5g}{cm^3}\right) \times K_d\left(\frac{cm^3}{g}\right) + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{L_{air}}{L_{soil}}\right) \times H'}$$

$$\theta_a\left(\frac{L_{air}}{L_{soil}}\right) = n\left(\frac{L_{pore}}{L_{soil}}\right) - \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) \text{and } n\left(\frac{L_{pore}}{L_{soil}}\right) = 1 - \left(\rho_b\left(\frac{1.5\ g}{cm^3}\right) \Big/ \rho_s\left(\frac{2.65\ g}{cm^3}\right)\right)$$

$$K_d\left(\frac{cm^3}{g}\right) = f_{oc}\left(\frac{g}{g}\right) \times K_{oc}\left(\frac{cm^3}{g}\right) \text{ only for organics.}$$

$$T\ (30240000\ s) = ED_{cw}(1\ yr) \times EW_{cw}\left(\frac{50\ wks}{year}\right) \times \left(\frac{7\ days}{week}\right) \times \left(\frac{24\ hrs}{day}\right) \times \left(\frac{3600\ s}{hr}\right)$$

$$F_D\ (0.18584) = 0.1852 + \left(5.3537 / t_c\right) + \left(-9.6318 / t_c^2\right)$$

$$t_c\ (8400\ hr) = ED_{cw}(1\ yr) \times EW_{cw}\left(\frac{50\ wks}{year}\right) \times \left(\frac{7\ days}{week}\right) \times \left(\frac{24\ hrs}{day}\right)$$

4.13.7 Mass-limit Subchronic Volatilization Factor for Construction Worker (VF_{sc})

Because the equations developed to calculate SSLs for the inhalation of volatiles outdoors assume an infinite source, they can violate mass-balance considerations, especially for small sources. To address this concern, a mass-limit SSL equation for this pathway may be used (Equation 5-17 of the supplemental soils screening guidance). This equation can be used only when the volume (i.e., area and depth) of the contaminated soil source is known or can be estimated with confidence. As discussed above, the simple site-specific approach for calculating construction scenario SSLs uses the same emission model for volatiles as that used in the residential and non-residential scenarios. However, the conservative nature of this model (i.e., it assumes all contamination is at the surface) makes it sufficiently protective of construction worker exposures to volatiles.

mass limit model for subchronic exposure

$$VF_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right)=\frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\frac{1}{F_D}\times\frac{T\,(s)}{\rho_b\left(\frac{1.5\ Mg}{m^3}\right)\times d_s\,(m)\times 10^6\left(\frac{g}{Mg}\right)}$$

$$\text{where: }\frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)=A\times\exp\left[\frac{\left(\ln A_s\,(acre)-B\right)^2}{C}\right]$$

$$T\ (30240000\ s)=ED_{cw}\,(1\ yr)\times EW_{cw}\left(\frac{50\ wks}{year}\right)\times\left(\frac{7\ days}{week}\right)\times\left(\frac{24\ hrs}{day}\right)\times\left(\frac{3600\ s}{hr}\right)$$

$$F_D\,(0.18584)=0.1852+\left(5.3537/t_c\right)+\left(-9.6318/t_c^{\,2}\right)$$

$$t_c\,(8400\ hr)=ED_{cw}\,(1\ yr)\times EW_{cw}\left(\frac{50\ wks}{year}\right)\times\left(\frac{7\ days}{week}\right)\times\left(\frac{24\ hrs}{day}\right)$$

4.13.8 Dermal Contact with Water Supporting Equations

- B = Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (ve)

$$B=\frac{K_p\left(\frac{cm}{hr}\right)}{K_{p,ve}\left(\frac{cm}{hr}\right)}=K_p\left(\frac{cm}{hr}\right)\times\frac{\sqrt{MW}\left(\frac{g}{mole}\right)}{2.6}$$

where :

$$K_{p,ve}\left(\frac{cm}{hr}\right)=\frac{K_{ew}\times D_e\left(\frac{cm^2}{hr}\right)}{L_e\,(cm)}$$

- t^* = Time to reach steady-state (hr) = 2.4 t_{event}

$$\tau_{event}\left(\frac{hours}{event}\right)=\frac{l_{sc}^2\,(cm)}{6\times D_{sc}\left(\frac{cm^2}{hr}\right)}$$

where:

$$\log\frac{D_{sc}\left(\frac{cm^2}{hr}\right)}{l_{sc}\,(cm)}=-2.80-0.0056\times MW\left(\frac{g}{mole}\right)\ \text{ or }\ \frac{D_{sc}\left(\frac{cm^2}{hr}\right)}{l_{sc}\,(cm)}=10^{\left(-2.80-0.0056\times MW\left(\frac{g}{mole}\right)\right)}$$

thus:

$$l_{sc}\,(cm)=\frac{10^{\left(-2.80-0.0056\times MW\left(\frac{g}{mole}\right)\right)}}{D_{sc}\left(\frac{cm^2}{hr}\right)}\ \text{ and }\ D_{sc}\left(\frac{cm^2}{hr}\right)=l_{sc}\,(cm)\times 10^{\left(-2.80-0.0056\times MW\left(\frac{g}{mole}\right)\right)}$$

- t_{event} = Lag time per event (hr/event)

$$\text{If } B \leq 0.6, \text{ then } t^*(hr) = 2.4 \times \tau_{event}\left(\frac{hour}{event}\right)$$

or,

$$\text{If } B > 0.6, \text{ then } t^*(hr) = 6 \times \tau_{event}\left(\frac{hour}{event}\right) \times \left(b - \sqrt{b^2 - c^2}\right)$$

where:

$$b = \frac{2 \times (1+B)^2}{\pi} - c \quad \text{and} \quad c = \frac{1 + 3 \times B + 3 \times B^2}{3 \times (1+B)}$$

5. Special Considerations

Most of the SLs are readily derived by referring to the above equations. However, there are some cases for which the standard equations do not apply and/or external adjustments to the SLs are recommended. These special case chemicals are discussed below.

5.1 Cadmium

IRIS presents an oral "water" RfD for cadmium for use in assessment of risks to water of 0.0005 mg/kg-day. IRIS also presents an oral "food" RfD for cadmium for use in assessment of risks to soil and biota of 0.001 mg/kg-day. The SLs for Cadmium are based on the appropriate oral RfD based on the media. The "water" RfD is slightly more conservative (by a factor of 2) than the RfD for "food" and it could be argued that the more conservative RfD should be used to develop screening levels. RAGS Part E, in Exhibit 4-1, presents a GIABS for soil of 2.5% and for water of 5%.

5.2 Lead

EPA has no consensus RfD or CSF for inorganic lead, so it is not possible to calculate SLs as we have done for other chemicals. EPA considers lead to be a special case because of the difficulty in identifying the classic "threshold" needed to develop an RfD.

EPA therefore evaluates lead exposure by using blood-lead modeling, such as the Integrated Exposure-Uptake Biokinetic Model (IEUBK). The EPA Office of Solid Waste has also released a detailed directive on risk assessment and cleanup of residential soil lead. The directive recommends that soil lead levels less than 400 mg/kg are generally safe for residential use. Above that level, the document suggests collecting data and modeling blood-lead levels with the IEUBK model. For the purposes of screening, therefore, 400 mg/kg is recommended for residential soils. For water, we suggest 15 µg/L (the EPA Action Level in water), and for air, the National Ambient Air Quality Standard of 0.15 $\mu g/m^3$.

However, caution should be used when both water and soil are being assessed. The IEUBK model shows that if the average soil concentration is 400 mg/kg, an average tap water concentration above 5 µg/L would yield more than 5% of the population above a 10 µg/dL blood-lead level. If the average tap water concentration is 15 µg/L, an average soil concentration greater than 250 mg/kg would yield more than 5% of the population above a 10 µg/dL blood-lead level.

EPA uses a second Adult Lead Model to estimate SLs for an industrial setting. This SL is intended to protect a fetus that may be carried by a pregnant female worker. It is assumed that a cleanup goal that is protective of a fetus will also afford protection for male or female adult workers. The model equations were developed to calculate cleanup goals such that the fetus of a pregnant female worker would not likely have an unsafe concentration of lead in blood.

For more information on EPA's lead models and other lead-related topics, please go to Addressing Lead at Superfund Sites.

5.3 Manganese

The IRIS RfD (0.14 mg/kg-day) includes manganese from all sources, including diet. The author of the IRIS assessment for manganese recommended that the dietary contribution from the normal U.S. diet (an upper limit of 5 mg/day) be subtracted when evaluating non-food (e.g., drinking water or soil) exposures to manganese, leading to a RfD of 0.071 mg/kg-day for non-food items. The explanatory text in IRIS further recommends using a modifying factor of 3 when calculating risks associated with non-food sources due to a number of uncertainties that are discussed in the IRIS file for manganese, leading to a RfD of 0.024 mg/kg-day. This modified RfD has been used in the derivation of some manganese screening levels for soil and water. For more information regarding the Manganese RfD, users are advised to contact the author of the IRIS assessment on Manganese.

5.4 Vanadium Compounds

The oral RfD toxicity value for Vanadium, used in this website, is derived from the IRIS oral RfD for Vanadium Pentoxide by factoring out the molecular weight (MW) of the oxide ion. Vanadium Pentoxide (V_20_5) has a molecular weight of 181.88. The two atoms of Vanadium contribute 56% of the MW. Vanadium Pentoxide's oral RfD of 9E-03 mg/kg-day multiplied by 56% gives a Vanadium oral RfD of 5.04E-03 mg/kg-day.

5.5 Uranium

"Uranium Soluble Salts" uses the IRIS oral RfD of 3E-03 mg/kg-day. For the insoluble salts of Uranium, the oral RfD of 6E-04 mg/kg-day may be used from the Federal Register, Thursday December 7, 2000. Part II, Environmental Protection Agency. 40 CFR Parts 9, 141, and 142 - National Primary Drinking Water Regulations; Radionuclides; Final Rule. p 76713.

5.6 Chromium (VI)

It is recommended that valence-specific data for chromium be collected when chromium is likely to be an important contaminant at a site, and when hexavalent chromium (Cr (VI)) may exist. For Cr(VI), IRIS shows an air unit risk of 1.2E-2 per (µg/m^3). While the exact ratio of Cr(VI) to Cr(III) in the data used to derive the IRIS air unit risk value is not known, it is likely that both Cr(VI) and Cr(III) were present. The RSLs calculated using the IRIS air unit risk assume that the Cr(VI) to Cr(III) ratio is 1:6. Because of various sources of uncertainty, this assumption may overestimate or underestimate the risk calculated. Users are invited to review the document "Toxicological Review of Hexavalent Chromium" in support of the summary information on Cr(VI) on IRIS to determine whether they believe this ratio applies to their projects and to consider consulting with an EPA regional risk assessor.

In the RSL Table, the Cr(VI) specific value (assuming 100% Cr(VI)) is derived by multiplying the IRIS Cr(VI) value by 7. This is considered to be a health-protective assumption, and is also consistent with the State of California's interpretation of the Mancuso study that forms the basis of Cr(VI)'s estimated cancer potency.

If you are working on a chromium site, you may want to contact the appropriate regulatory officials in your region to determine what their position is on this issue.

The Maximum Contaminant Level (MCL) of 100 µg/L for "Chromium (total)", from the EPA's MCL listing is applied to the "Chromium, Total" analyte on this website.

Tier 3 sources were used to derive the screening levels for Cr(VI).

The New Jersey Department of Environmental Protection (NJDEP) determined that Cr(VI) by ingestion is likely to be carcinogenic in humans. NJDEP derived an oral cancer slope factor, based on cancer bioassays conducted by the National Toxicology Program (http://www.state.nj.us/dep/dsr/chromium/soil-cleanup-derivation.pdf). The New Jersey assessment did not make a determination that Cr(VI) was mutagenic by mode of action for carcinogenesis.

EPA's Office of Pesticide Programs (OPP) made a determination that Cr(VI) has a mutagenic mode of action for carcinogenesis in all cells regardless of type, following administration via drinking water. OPP recommended that Age-Dependent Adjustment Factors (ADAFs) be applied when assessing cancer risks from early-life exposure (< 16 years of age). This determination was reviewed by OPP's Cancer Assessment Review Committee and published in a peer review journal).

Therefore, in 2009 the RSL workgroup adopted the Tier III NJDEP values and the OPP recommendation with respect to mutagenicity. More recently, in 2011, external peer reviewers provided input on the EPA's Office of Research and Development Integrated Risk Information System draft Toxicological Review of Hexavalent Chromium (http://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=221433). The majority of reviewers questioned the evidence used to support a mutagenic mode of action for carcinogenesis for Cr(VI). Furthermore, in 2011 California Environmental Protection Agency finalized its drinking water Public Health Goal for Cr(VI). CalEPA's Technical Support Document concluded in numerous studies that Cr(VI) is both genotoxic and mutagenic. (http://www.oehha.ca.gov/water/phg/072911Cr6PHG.html)

Therefore, the RSL workgroup acknowledges that there is uncertainty associated with the assessment of hexavalent chromium. However, no updated consensus IRIS assessment (Tier I) has yet appeared, and chromium is still under review by the IRIS program. With respect to RSLs, the more health-protective approach of applying ADAFs for early life exposure via ingestion, dermal and inhalation was used to calculate screening levels for all exposure pathways. Application of ADAFs for all exposure pathways results in more health-protective screening levels.

As always, consult EPA toxicologists in the Superfund program of the regional office when developing site specific screening levels.

5.7 Aminodinitrotoluenes

The IRIS oral RfD of 2E-03 mg/kg-day for 2,4-Dinitrotoluene is used as a surrogate for 2-Amino-4,6-Dinitrotoluene and 4-Amino-2,6-Dinitrotoluene.

5.8 PCBs

Aroclor 1016 is considered "lowest risk" and assigned appropriate toxicity values. All other Aroclors are assigned the high risk toxicity values.

5.9 Xylenes

The IRIS oral RfD of 2E-01 mg/kg-day for xylene, mixture is used as a surrogate for the 3 xylene congeners. The earlier RfD values for some xylene isomers were withdrawn from our electronic version of HEAST. Also, the IRIS inhalation RfC of 1E-01 mg/m^3 for xylene, mixture is used as a surrogate for the 3 xylene congeners.

5.10 Arsenic

Arsenic screening levels for ingestion of soil are now calculated with the relative bioavailability factor (RBA) of 0.6. The RBA can be adjusted using the calculator in site-specific/user-provided mode the same way toxicity values can be changed. The RBA for soil ingestion is shown in the calculator output. The 2012 document, Compilation and Review of Data on Relative Bioavailability of Arsenic in Soil provides supporting information.

Absolute bioavailability can be thought of as the absorption fraction. Relative bioavailability accounts for differences in the bioavailability of a contaminant between the medium of exposure (e.g., soil) and the media associated with the toxicity value (e.g., the arsenic RfD and CSF are derived from drinking water studies). The 60% oral RBA for arsenic in soil is empirically-based. It represents an upper-bound estimate from numerous studies where the oral RBA of soil-borne arsenic in samples collected from across the U.S. was experimentally determined against the water-soluble form. This RBA does not apply to dermal exposures to arsenic in soil for which the absorbed dose is calculated using a dermal absorption fraction (ABSd) of 0.03 (Exhibit 3-4 of USEPA, 2004).

5.11 Total Petroleum Hydrocarbons (TPHs)

The six TPH fractions were assigned representative compounds for determination of toxicity values and chemical-specific parameters to calculate RSLs. The PPRTV paper was the principal source for the derivation of these values.

The carbon ranges and representative compounds are listed in the table below. An average of the chemical-specific parameters for 2-methylnaphthalene and naphthalene was calculated for the medium aromatic fraction.

TPH Fractions	Number of Carbons	Equivalent Carbon Number Index	Representative Compound (RfD/RfC)
Low aliphatic	C5-C8	EC5-EC8	n-hexane
Medium aliphatic	C9-C18	EC>8-EC16	hydrocarbon streams*
High aliphatic	C19-C32	EC>16-EC35	white mineral oil
Low aromatic	C6-C8	EC6-EC<9	benzene
Medium aromatic	C9-C16	EC9-EC<22	2-methylnaphthalene/naphthalene
High aromatic	C17-C32	EC>22-EC35	fluoranthene

*Medium aliphatic representative compound was not listed in PPRTV paper so n-nonane was selected.

5.12 Soil Saturation Limit (C_{sat})

The soil saturation concentration, C_{sat}, corresponds to the contaminant concentration in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and saturation of soil pore air have been reached. Above this concentration, the soil contaminant may be present in free phase (i.e., nonaqueous phase liquids (NAPLs) for contaminants that are liquid at ambient soil temperatures and pure solid phases for compounds that are solid at ambient soil temperatures). C_{sat} is not calculated for chemicals that are solid at ambient soil temperatures. The following decision criteria was established from SSL guidance, Table C-3: if melting point is less than 20 °C, chemical is a liquid; if melting point is above 20 °C, chemical is solid.

Equation 4-10 is used to calculate C_{sat} for each volatile contaminant. As an update to RAGS HHEM, Part B (USEPA 1991a), this equation takes into account the amount of contaminant that is in the vapor phase in soil in addition to the amount dissolved in the soil's pore water and sorbed to soil particles.

Chemical-specific C_{sat} concentrations must be compared with each VF-based SL because a basic principle of the SL volatilization model is not applicable when free-phase contaminants are present. How these cases are handled depends on whether the contaminant is liquid or solid at ambient temperatures. Liquid contaminants that have a VF-based SL that exceeds the C_{sat} concentration are set equal to C_{sat} whereas for solids (e.g., PAHs), soil screening decisions are based on the appropriate SLs for other pathways of concern at the site (e.g., ingestion).

The RSL tables and the default calculator settings do not substitute C_{sat} for risk-based calculations. If the risk-based concentration exceeds C_{sat}, the resulting SSL concentration may be overly protective. This is because the dissolved, absorbed and vapor concentrations cease to rise linearly as soil concentration increases above the C_{sat} level (pure product or nonaqueous phase liquid (NAPL) is present). The SSL model used in the RSL calculator is not a four phase model. If a NAPL is present at your site more sophisticated models may be necessary. The calculator, if operated in site-specific mode, will give the option to apply the C_{sat} substitution rule.

$$C_{sat} = \frac{S\left(\frac{mg}{L}\right)}{\rho_b\left(\frac{Kg}{L}\right)} \times \left(K_d\left(\frac{L}{Kg}\right) \times \rho_b\left(\frac{Kg}{L}\right) + \theta_w\left(\frac{L_{water}}{L_{soil}}\right) + H' \times \theta_a\left(\frac{L_{air}}{L_{soil}}\right)\right)$$

where

$$Kd = K_{oc}\left(\frac{L}{Kg}\right) \times f_{oc}\left(\frac{g}{g}\right),$$

$$\theta_a\left(\frac{L_{air}}{L_{soil}}\right) = n\left(\frac{L_{pore}}{L_{soil}}\right) - \theta_w\left(\frac{L_{water}}{L_{soil}}\right) \text{ and}$$

$$n = 1 - \left(\frac{\rho_b\left(\frac{Kg}{L}\right)}{\rho_s\left(\frac{Kg}{L}\right)}\right)$$

5.13 SL Theoretical Ceiling Limit

The ceiling limit of 10^{+5} mg/kg is equivalent to a chemical representing 10% by weight of the soil sample. At this contaminant concentration (and higher), the assumptions for soil contact may be violated (for example, soil adherence and wind-borne dispersion assumptions) due to the presence of the foreign substance itself.

The RSL tables and the default calculator settings do not substitute the theoretical ceiling limit for risk-based calculations but they do indicate if the resulting RSL has exceeded the theoretical ceiling limit in the key. The calculator, if operated in site-specific mode, will give the option to apply the theoretical ceiling limit.

5.14 Target Risk

With the exceptions described previously, SLs are chemical concentrations that correspond to fixed levels of risk (i.e., either a one-in-one million [10^{-6}] cancer risk or a noncarcinogenic hazard quotient of 1) in soil, air, and water. In most cases, where a substance causes both cancer and noncancer (systemic) effects, the 10^{-6} cancer risk will result in a more stringent criteria and consequently this value is presented in the printed copy of the Table. SL concentrations that equate to a 10^{-6} cancer risk are indicated by 'ca' in the calculator and 'c' in the generic tables. SL concentrations that equate to a hazard quotient of 1 for noncarcinogenic concerns are indicated by 'nc' in the calculator and 'n' in the generic tables.

If the SLs are to be used for site screening, it is recommended that both cancer and noncancer-based SLs be used. Both carcinogenic and noncarcinogenic values may be obtained in the Supporting Tables.

Some users of this SL Table may plan to multiply the cancer SL concentrations by 10 or 100 to set 'action levels' for triggering remediation or to set less stringent cleanup levels for a specific site after considering non-risk-based factors such as ambient levels, detection limits, or technological feasibility. This risk management practice recognizes that there may be a range of values that may be 'acceptable' for carcinogenic risk (EPA's risk management range is one-in-a-million [10^{-6}] to one-in-ten thousand [10^{-4}]). However, this practice could lead one to overlook serious noncancer health threats and it is strongly recommended that the user consult with a toxicologist or regional risk assessor before doing this. Carcinogens are indicated by an asterisk ('*') in the SL Table where the noncancer SLs would be exceeded if the cancer value that is displayed is multiplied by 100. ('**') indicate that the noncancer values would be exceeded if the cancer SL were multiplied by 10. There is no range of 'acceptable' noncarcinogenic 'risk' for CERCLA sites. Therefore, the noncancer SLs should not be multiplied by 10 or 100 when setting final cleanup criteria. In the rare case where noncancer SLs are more stringent than cancer SLs set at one-in-one-million risk, a similar approach has been applied (e.g. 'max').

SL concentrations in the printed Table are risk-based, but for soil there are two important exceptions: (1) for several volatile chemicals, SLs may exceed the soil saturation level ('sat') and (2) SLs may exceed a non-risk based 'ceiling limit' concentration of 10^{+5} mg/kg ('max') for relatively less toxic inorganic and semivolatile contaminants. For more information on the 'sat' value in the SL Table, please see the discussion in Section 5.11. For more information on the 'max' value in the SL Table, please see the discussion in Section 5.13.

With respect to applying a 'ceiling limit' for chemicals other than volatiles, it is recognized that this is not a universally accepted approach. Some within the agency argue that all values should be risk-based to allow for scaling (for example, if the risk-based SL is set at a hazard quotient = 1.0, and the user would like to set the hazard quotient to 0.1 to take into account multiple chemicals, then this is as simple as multiplying the risk-based SL by 1/10th). If scaling is necessary, SL users can do this simply by referring to the Supporting Tables at this website where risk-based soil concentrations are presented for all chemicals.

In spite of the fact that applying a ceiling limit is not a universally accepted approach, this table applies a 'max' soil concentration to the SL Table for the following reasons:

- Risk-based SLs for some chemicals in soil exceed unity (>1,000,000 mg/kg), which is not possible.
- The ceiling limit of 10^{+5} mg/kg is equivalent to a chemical representing 10% by weight of the soil sample. At this contaminant concentration (and higher), the assumptions for soil contact may be violated (for example, soil adherence and wind-borne dispersion assumptions) due to the presence of the foreign substance itself.

- SLs currently do not address short-term exposures (e.g., pica children and construction workers). Although extremely high soil SLs are likely to represent relatively non-toxic chemicals, such high values may not be justified if in fact more toxicological data were available for evaluating short-term and/or acute exposures.

5.15 Screening Sites with Multiple Contaminants

The screening levels in the tables are calculated under the assumption that only one contaminant is present. Users needing to screen sites with multiple contaminants should consult with their regional risk assessors. The following sections describe how target risks can be changed to screen against multiple contaminants and how the ratio of concentration to RSL can be used to estimate total risk.

5.15.1 Adjusting Target Risk and Target Hazard Quotient

When multiple contaminants are present at a site the target hazard quotient (THQ) may be modified. The following options are among the commonly used methods to modify the THQ:

1. The calculator on this website can be used to generate SLs based on any THQ or target cancer risk (TR) deemed appropriate by the user. The THQ input to the calculator can be modified from the default of 1. How much it should be modified is a user decision, but it could be based upon the number of contaminants being screened together. For example, if one is screening two contaminants together, then the THQ could be modified to 0.5. If ten contaminants are being screened together, then the THQ could be modified to 0.1. The above example weights each chemical equally; it is also possible to weight the chemicals unequally, as long as the total risk meets the desired goal. The decision of how to weight the chemicals is likely to be site-specific, and it is recommended that this decision be made in consultation with the regional risk assessor.

   Note that when the TR or THQ is altered, the relationship between cancer-based and noncancer-based SLs may change. At certain risk levels, the cancer-based number may be more conservative; at different risk levels, the noncancer-based number may be more conservative. The data user needs to consider both cancer and noncancer endpoints.

2. Similar to the above approach of using the calculator to recalculate SLs based on non-default target levels, the values in the screening tables themselves can be addressed directly. Consistent with the above logic, although the EPA Superfund Program has not developed guidance on this, it is not uncommon that Superfund sites are screened at a THQ of 0.1. (The cancer-based SLs are already at a target risk of 1E-6 and are usually not adjusted further in this scenario.) SLs based on a THQ of 0.1 can be derived by dividing a default SL by 10. Again, note that altering the target HQ can change the relationship between cancer-based and noncancer-based screening levels; the data user needs to consider both endpoints. Additional approaches or alternatives may exist. When screening actual or potential Superfund sites, users are encouraged to consult with risk assessors in that EPA Regional Office when evaluating or screening contamination at a site with multiple contaminants to see if they may know of another approach or if they have a preference.

5.15.2 Using RSLs to Sum Risk from Multiple Contaminants

RSLs can be used to estimate the total risk from multiple contaminants at a site as part of a screening procedure used by some regions. This methodology, which does not substitute for a baseline risk assessment, is often called the "sum of the ratios" approach. A step-wise approach follows:

1. Perform an extensive records search and compile existing data.

2. Identify site contaminants in the SL Table. Record the SL concentrations for various media and note whether SL is based on cancer risk (indicated by 'c') or noncancer hazard (indicated by 'n'). Segregate cancer SLs from non-cancer SLs and exclude (but don't eliminate) non-risk based SLs 's' or 'm'.

3. For cancer risk estimates, take the site-specific concentration (maximum or 95th percent of the upper confidence limit on the mean (UCL)) and divide by the SL concentrations that are designated for cancer evaluation 'c'. Multiply this ratio by 10^{-6} to estimate chemical-specific risk for a reasonable maximum exposure (RME). For multiple pollutants, simply add the risk for each chemical. See equation below.

$$\text{Risk} = \left[\left(\frac{\text{conc}_x}{\text{SL}_x}\right) + \left(\frac{\text{conc}_y}{\text{SL}_y}\right) + \left(\frac{\text{conc}_z}{\text{SL}_z}\right)\right] \times 10^{-6}$$

4. For non-cancer hazard estimates, divide the concentration term by its respective non-cancer SL designated as 'n' and sum the ratios for multiple contaminants. The cumulative ratio represents a non-carcinogenic hazard index (HI). A hazard index of 1 or less is generally considered 'safe'. A ratio greater than 1 suggests further evaluation. Note that carcinogens may also have an associated non-cancer SL that is not listed in the SL Table. To obtain these values, the user should view the Supporting Tables. See equation below.

$$\text{Hazard Index} = \left[\left(\frac{\text{conc}_x}{\text{SL}_x}\right) + \left(\frac{\text{conc}_y}{\text{SL}_y}\right) + \left(\frac{\text{conc}_z}{\text{SL}_z}\right)\right]$$

5.16 Deriving Soil Gas SLs

The air SLs could apply to indoor air from, e.g., a vapor intrusion scenario. To model indoor air concentrations from other media (e.g., soil gas, groundwater), consult with regional experts in vapor intrusion.

For more information on EPA's current understanding of this emerging exposure pathway, please refer to EPA's recent draft guidance Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) (USEPA 2002) available on the web at: http://www.epa.gov/osw/hazard/correctiveaction/eis/vapor.htm.

5.17 Mutagens

Some of the cancer causing analytes in this tool operate by a mutagenic mode of action for carcinogenesis. There is reason to surmise that some chemicals with a mutagenic mode of action, which would be expected to cause irreversible changes to DNA, would exhibit a greater effect in early-life versus later-life exposure. Cancer risk to children in the context of the U.S. Environmental Protection Agency's cancer guidelines (U.S. EPA, 2005) includes both early-life exposures that may result in the occurrence of cancer during childhood and early-life exposures that may contribute to cancers later in life. In keeping with this guidance, separate cancer risk equations are presented for mutagens. The mutagen vinyl chloride has a unique set of equations. Consult Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, EPA/630/R-03/003F, March 2005 for further information.

http://www.epa.gov/oswer/riskassessment/sghandbook/chemicals.htm provides more detailed information about which contaminants are considered carcinogenic by a mutagenic mode of action. In addition to the previous document's list of these contaminants, Chromium VI, 7,12-Dimethylbenz(a)anthracene, Benz(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene and Indeno(1,2,3-c,d)pyrene are also considered carcinogenic by a mutagenic mode of action.

5.18 Trichloroethylene (TCE)

In order to make the calculator display the correct results for TCE, the standard cancer and mutagen equations needed to be combined. Since TCE requires the use of different toxicity values for cancer and mutagen equations, it was decided to make a toxicity value adjustment factor for cancer (CAF) and mutagens (MAF). The adjustments were done for oral (o) and inhalation (i). These adjustment factors are used in the TCE equation images presented in section 4. The equations used are presented below. The adjustment factors are based on the adult-based toxicity values and these are the cancer toxicity

$$CAF_o\,(0.804) = \frac{CSF_o\left(\frac{3.7\times10^{-2}\,mg}{Kg-day}\right)^{-1}\ \text{NHL+Liver oral slope factor}}{CSF_o\left(\frac{4.6\times10^{-2}\,mg}{Kg-day}\right)^{-1}\ \text{Adult}-\text{based oral slope factor}} \qquad MAF_o\,(0.202) = \frac{CSF_o\left(\frac{9.3\times10^{-3}\,mg}{Kg-day}\right)^{-1}\ \text{Kidney oral slope factor}}{CSF_o\left(\frac{4.6\times10^{-2}\,mg}{Kg-day}\right)^{-1}\ \text{Adult}-\text{based oral slope factor}}$$

$$CAF_i\,(0.756) = \frac{IUR\left(3.1\times10^{-6}\,\mu g/m^3\right)^{-1}\ \text{NHL+Liver unit risk estimate}}{IUR\left(4.1\times10^{-6}\,\mu g/m^3\right)^{-1}\ \text{Adult}-\text{based unit risk estimate}} \qquad MAF_i\,(0.244) = \frac{IUR\left(1\times10^{-6}\,\mu g/m^3\right)^{-1}\ \text{Kidney unit risk estimate}}{IUR\left(4.1\times10^{-6}\,\mu g/m^3\right)^{-1}\ \text{Adult}-\text{based unit risk estimate}}$$

values presented in the Generic Tables.

5.19 Mercuric Chloride (and other Mercury salts)

The IRIS RfC for "Mercury (elemental)" is used as a surrogate for "Mercuric Chloride (and other Mercury salts)". Note, that the VF for "Mercury (elemental)" is not used as a surrogate for "Mercuric Chloride (and other Mercury salts)". The use of the surrogate RfC would appear to be a violation of the RSL toxicity hierarchy because Cal EPA offers a RfC for Mercuric Chloride. However, the actual form of mercury evaluated for the Cal EPA RfC was elemental mercury. Since IRIS already had a RfC for "Mercury (elemental)", it was decided to use the tier 1 source over a tier 3 source.

5.20 Cyanide (CN-)

The IRIS RfC for "Hydrogen Cyanide" is used as a surrogate for "Cyanide (CN-)".

6. Using the Calculator

The

Calculator can be used to generate site-specific SLs or PRGs. The calculator requires the user to make some simple selections. To use the calculator Select a land use. Next, select whether you want Default or Site-specific SLs. Selecting default screening levels will reproduce the results in the generic Generic Tables. Selecting Site-Specific will allow you to change exposure parameters. Now pick your analytes. To pick several in a row, depress the left mouse button and drag, then release. Or hold the Ctrl key down and select multiple analytes that are not in a row. Select the output option. Hit the retrieve button. If you selected Site-Specific, the next page allows you to change exposure parameters. Hit the retrieve button. SLs are being calculated. The first table presents the input parameters that were selected. The next table contains the screening levels. This table can be too big to print. The easiest way to manage this table is to move it to a spreadsheet or a database. To copy this table, hold the left mouse key down and drag across the entire table. when done, press Ctrl c to copy. Switch to a spreadsheet and press Ctrl v to paste.

Table 1. Standard Default Factors

Symbol	Definition (units)	Default	Reference
SLs			
$SL_{res\text{-}air\text{-}ca}$	Resident Air Carcinogenic (µg/m^3)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}air\text{-}ca\text{-}vinyl\ chloride}$	Resident Air Carcinogenic Vinyl Chloride (µg/m^3)	Vinyl Chloride-specific	Determined in this calculator
$SL_{res\text{-}air\text{-}mu}$	Resident Air Mutagenic (µg/m^3)	Mutagen-specific	Determined in this calculator
$SL_{res\text{-}air\text{-}nc}$	Resident Air Noncarcinogenic (µg/m^3)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}fsh\text{-}ca\text{-}ing}$	Resident Fish Carcinogenic (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}fsh\text{-}nc\text{-}ing}$	Resident Fish Noncarcinogenic (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}ca\text{-}ing}$	Resident Tapwater Groundwater Carcinogenic Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}ca\text{-}der}$	Resident Tapwater Groundwater Carcinogenic Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}ca\text{-}inh}$	Resident Tapwater Groundwater Carcinogenic Inhalation (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}ca\text{-}tot}$	Resident Tapwater Groundwater Carcinogenic Total (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}water\text{-}ca\text{-}vc\text{-}ing}$	Resident Tapwater Groundwater Carcinogenic Vinyl Chloride Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}water\text{-}ca\text{-}vc\text{-}der}$	Resident Tapwater Groundwater Carcinogenic Vinyl Chloride Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}water\text{-}ca\text{-}vc\text{-}inh}$	Resident Tapwater Groundwater Carcinogenic Vinyl Chloride Inhalation (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}water\text{-}ca\text{-}vc\text{-}tot}$	Resident Tapwater Groundwater Carcinogenic Vinyl Chloride Total (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}mu\text{-}ing}$	Resident Tapwater Groundwater Mutagenic Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}mu\text{-}der}$	Resident Tapwater Groundwater Mutagenic Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}mu\text{-}inh}$	Resident Tapwater Groundwater Mutagenic Inhalation (µg/L)	Mutagen-specific	Determined in this calculator
$SL_{water\text{-}mu\text{-}tot}$	Resident Tapwater Groundwater Mutagenic Total (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}nc\text{-}ing}$	Resident Tapwater Groundwater Noncarcinogenic Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}nc\text{-}der}$	Resident Tapwater Groundwater Noncarcinogenic Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{water\text{-}nc\text{-}inh}$	Resident Tapwater Groundwater Noncarcinogenic Inhalation (µg/L)	Mutagen-specific	Determined in this calculator

$SL_{water\text{-}nc\text{-}tot}$	Resident Tapwater Groundwater Noncarcinogenic Total (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}ca\text{-}ing}$	Resident Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}ca\text{-}der}$	Resident Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}ca\text{-}inh}$	Resident Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}ca\text{-}tot}$	Resident Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}ca\text{-}vc\text{-}ing}$	Resident Soil Carcinogenic Vinyl Chloride Ingestion (mg/kg)	Vinyl Chloride - specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}ca\text{-}vc\text{-}der}$	Resident Soil Carcinogenic Vinyl Chloride Dermal (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}ca\text{-}vc\text{-}inh}$	Resident Soil Carcinogenic Vinyl Chloride Inhalation (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}ca\text{-}vc\text{-}tot}$	Resident Soil Carcinogenic Vinyl Chloride Total (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}mu\text{-}ing}$	Resident Soil Mutagenic Ingestion (mg/kg)	Mutagen-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}mu\text{-}der}$	Resident Soil Mutagenic Dermal (mg/kg)	Mutagen-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}mu\text{-}inh}$	Resident Soil Mutagenic Inhalation (mg/kg)	Mutagen-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}mu\text{-}tot}$	Resident Soil Mutagenic Total (mg/kg)	Mutagen-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}nc\text{-}ing}$	Resident Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}nc\text{-}der}$	Resident Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}nc\text{-}inh}$	Resident Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{res\text{-}sol\text{-}nc\text{-}tot}$	Resident Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{w\text{-}sol\text{-}ca\text{-}ing}$	Composite Worker Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{w\text{-}sol\text{-}ca\text{-}der}$	Composite Worker Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{w\text{-}sol\text{-}ca\text{-}inh}$	Composite Worker Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{w\text{-}sol\text{-}ca\text{-}tot}$	Composite Worker Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{w\text{-}sol\text{-}nc\text{-}ing}$	Composite Worker Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{w\text{-}sol\text{-}nc\text{-}der}$	Composite Worker Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{w\text{-}sol\text{-}nc\text{-}inh}$	Composite Worker Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator

$SL_{w\text{-}sol\text{-}nc\text{-}tot}$	Composite Worker Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{iw\text{-}sol\text{-}ca\text{-}ing}$	Indoor Worker Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{iw\text{-}sol\text{-}ca\text{-}der}$	Indoor Worker Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{iw\text{-}sol\text{-}ca\text{-}inh}$	Indoor Worker Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{iw\text{-}sol\text{-}ca\text{-}tot}$	Indoor Worker Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{iw\text{-}sol\text{-}nc\text{-}ing}$	Indoor Worker Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{iw\text{-}sol\text{-}nc\text{-}der}$	Indoor Worker Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{iw\text{-}sol\text{-}nc\text{-}inh}$	Indoor Worker Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{iw\text{-}sol\text{-}nc\text{-}tot}$	Indoor Worker Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{ow\text{-}sol\text{-}ca\text{-}ing}$	Outdoor Worker Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{ow\text{-}sol\text{-}ca\text{-}der}$	Outdoor Worker Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{ow\text{-}sol\text{-}ca\text{-}inh}$	Outdoor Worker Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{ow\text{-}sol\text{-}ca\text{-}tot}$	Outdoor Worker Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{ow\text{-}sol\text{-}nc\text{-}ing}$	Outdoor Worker Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{ow\text{-}sol\text{-}nc\text{-}der}$	Outdoor Worker Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{ow\text{-}sol\text{-}nc\text{-}inh}$	Outdoor Worker Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{ow\text{-}sol\text{-}nc\text{-}tot}$	Outdoor Worker Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{cw\text{-}sol\text{-}ca\text{-}ing}$	Construction Worker Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{cw\text{-}sol\text{-}ca\text{-}der}$	Construction Worker Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{cw\text{-}sol\text{-}ca\text{-}inh}$	Construction Worker Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{cw\text{-}sol\text{-}ca\text{-}tot}$	Construction Worker Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{cw\text{-}sol\text{-}nc\text{-}ing}$	Construction Worker Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
SL	Construction Worker Soil Noncarcinogenic	Contaminant-specific	Determined in this calculator

cw-sol-nc-der	Dermal (mg/kg)		
$SL_{cw-sol-nc-inh}$	Construction Worker Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{cw-sol-nc-tot}$	Construction Worker Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{rec-sol-ca-ing}$	Recreator Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{rec-sol-ca-der}$	Recreator Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{rec-sol-ca-inh}$	Recreator Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{rec-sol-ca-tot}$	Recreator Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{rec-sol-nc-ing}$	Recreator Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{rec-sol-nc-der}$	Recreator Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{rec-sol-nc-inh}$	Recreator Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{rec-sol-nc-tot}$	Recreator Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$SL_{rec-water-ca-der}$	Recreator Surface Water Carcinogenic Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{rec-water-ca-ing}$	Recreator Surface Water Carcinogenic Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{rec-water-ca-tot}$	Recreator Surface Water Carcinogenic Total (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{rec-water-vc-der}$	Recreator Surface Water Carcinogenic Vinyl Chloride Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{rec-water-vc-ing}$	Recreator Surface Water Carcinogenic Vinyl Chloride Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{rec-water-vc-tot}$	Recreator Surface Water Carcinogenic Vinyl Chloride Total (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{rec-water-nc-der}$	Recreator Surface Water Non-Carcinogenic Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{rec-water-nc-ing}$	Recreator Surface Water Non-Carcinogenic Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$SL_{rec-water-nc-tot}$	Recreator Surface Water Non-Carcinogenic Total (µg/L)	Contaminant-specific	Determined in this calculator
Toxicity Values			
RfD_o	Chronic Oral Reference Dose (mg/kg-day)	Contaminant-specific	EPA Superfund hierarchy
RfC	Chronic Inhalation Reference Concentration (mg/m^3)	Contaminant-specific	EPA Superfund hierarchy
CSF_o	Chronic oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Contaminant-specific	EPA Superfund hierarchy
	3 -1		

IUR	Chronic Inhalation Unit Risk (µg/m)	Contaminant-specific	EPA Superfund hierarchy
Miscellaneous Variables			
TR	target risk	1×10^{-6}	Determined in this calculator
THQ	target hazard quotient	1	Determined in this calculator
K	Andelman Volatilization Factor (L/m^3)	0.5	U.S. EPA 1991b (pg. 20)
K_p	Dermal Permeability Constant (cm/hr)	Contaminant-specific	U.S. EPA 2004
AT_r	Averaging time - resident (days/year)	365	U.S. EPA 1989 (pg. 6-23)
AT_w	Averaging time - composite worker (days/year)	365	U.S. EPA 1989 (pg. 6-23)
AT_{iw}	Averaging time - indoor worker (days/year)	365	U.S. EPA 1989 (pg. 6-23)
AT_{ow}	Averaging time - outdoor worker (days/year)	365	U.S. EPA 1989 (pg. 6-23)
AT_{cw}	Averaging time - construction worker (days/year)	365	U.S. EPA 1989 (pg. 6-23)
AT_{rec}	Averaging time - recreator (days/year)	365	U.S. EPA 1989 (pg. 6-23)
LT	Lifetime (years)	70	U.S. EPA 1989 (pg. 6-22)
Ingestion, and Dermal Contact Rates			
IRW_c	Resident Drinking Water Ingestion Rate - Child (L/day)	0.78	U.S. EPA 2011, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years)
IRW_a	Resident Drinking Water Ingestion Rate - Adult (L/day)	2.5	U.S. EPA 2011, Table 3-33; 90th percentile of consumer-only ingestion of drinking water (>= 21 years)
IFW_{adj}	Resident Drinking Water Ingestion Rate - Age-adjusted (L/kg)	327.95	Calculated using the age adjusted intake factors equation
$IFWM_{adj}$	Resident Mutagenic Drinking Water Ingestion Rate - Age-adjusted (L/kg)	1019.9	Calculated using the age adjusted intake factors equation
IRS_c	Resident Soil Ingestion Rate - Child (mg/day)	200	U.S. EPA 1991a (pg. 15)
IRS_a	Resident Soil Ingestion Rate - Adult (mg/day)	100	U.S. EPA 1991a (pg. 15)
IFS_{adj}	Resident Soil Ingestion Rate - Age-adjusted (mg/kg)	36750	Calculated using the age adjusted intake factors equation
$IFSM_{adj}$	Resident Mutagenic Soil Ingestion Rate - Age-adjusted (mg/kg)	166833.33	Calculated using the age adjusted intake factors equation
IR	Indoor Worker Soil Ingestion Rate		

iw	(mg/day)	50	U.S. EPA 1991a (pg. 15)
IR_{ow}	Outdoor Worker Soil Ingestion Rate (mg/day)	100	U.S. EPA 1991a (pg. 15)
IR_{cw}	Construction Worker Soil Ingestion Rate (mg/day)	330	U.S. EPA 2002 Exhibit 5-1
IRW_{recwc}	Recreator Surface Water Ingestion Rate - Child (L/hr)	0.05	U.S. EPA Region 4
IRW_{recwa}	Recreator Surface Water Ingestion Rate - Adult (L/hr)	0.05	U.S. EPA Region 4
$IFW_{rec-adj}$	Recreator Surface Water Ingestion Rate - Age-adjusted (L/kg)	Site-specific	Calculated using the age adjusted intake factors equation
IRW_{0-2}	Surface Water Ingestion Rate - Age Segment 0-2 (L/hr)	0.05	U.S. EPA Region 4
IRW_{2-6}	Surface Water Ingestion Rate - Age Segment 2-6 (L/hr)	0.05	U.S. EPA Region 4
IRW_{6-16}	Surface Water Ingestion Rate - Age Segment 6-16 (L/hr)	0.05	U.S. EPA Region 4
IRW_{16-26}	Surface Water Ingestion Rate - Age Segment 16-26 (L/hr)	0.05	U.S. EPA Region 4
$IFWM_{rec-adj}$	Recreator Mutagenic Surface Water Ingestion Rate - Age-adjusted (L/kg)	Site-specific	Calculated using the age adjusted intake factors equation
IRS_{recsc}	Recreator Soil Ingestion Rate - Child (mg/day)	200	U.S. EPA 1991a (pg. 15)
IRS_{recsa}	Recreator Soil Ingestion Rate - Adult (mg/day)	100	U.S. EPA 1991a (pg. 15)
$IFS_{rec-adj}$	Recreator Soil Ingestion Rate - Age-adjusted (mg/kg)	Site-specific	Calculated using the age adjusted intake factors equation
IRS_{0-2}	Soil Ingestion Rate - Age-segment 0-2 (mg/day)	200	U.S. EPA 1991a (pg. 15)
IRS_{2-6}	Soil Ingestion Rate - Age-segment 2-6 (mg/day)	200	U.S. EPA 1991a (pg. 15)
IRS_{6-16}	Soil Ingestion Rate - Age-segment 6-16 (mg/day)	100	U.S. EPA 1991a (pg. 15)
IRS_{16-26}	Soil Ingestion Rate - Age-segment 16-26 (mg/day)	100	U.S. EPA 1991a (pg. 15)
$IFSM_{rec-adj}$	Recreator Mutagenic Soil Ingestion Rate - Age-adjusted (mg/kg)	Site-specific	Calculated using the age adjusted intake factors equation
DFS_{adj}	Resident soil dermal contact factor- age-adjusted (mg/kg)	112266	Calculated using the age adjusted intake factors equation
	Resident Mutagenic soil dermal contact		Calculated using the age

$DFSM_{adj}$	factor- age-adjusted (mg/kg)	475598.66	adjusted intake factors equation
$DFS_{rec-adj}$	Recreator soil dermal contact factor- age-adjusted (mg/kg)	Site-specific	Calculated using the age adjusted intake factors equation
$DFSM_{rec-adj}$	Recreator Mutagenic soil dermal contact factor- age-adjusted (mg/kg)	Site-specific	Calculated using the age adjusted intake factors equation
DFW_{adj}	Resident water dermal contact factor- age-adjusted (cm^2 - event/kg)	2721670	Calculated using the age adjusted intake factors equation
$DFWM_{adj}$	Resident Mutagenic water dermal contact factor- age-adjusted (cm^2 - event/kg)	Site-specific	Calculated using the age adjusted intake factors equation
$DFW_{rec-adj}$	Recreator water dermal contact factor- age-adjusted (cm^2 - event/kg)	Site-specific	Calculated using the age adjusted intake factors equation
$DFWM_{rec-adj}$	Recreator Mutagenic water dermal contact factor- age-adjusted (cm^2 - event/kg)	Site-specific	Calculated using the age adjusted intake factors equation
IRF_a	Fish Ingestion Rate (mg/day)	Site-specific	Recommend using site-specific values
SA_c	Resident soil surface area - child (cm^2)	2690	U.S. EPA 2011, Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years)(forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere.
SA_a	Resident soil surface area - adult (cm^2)	6032	U.S. EPA 2011, Tables 7-2 and 7-12; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, 21+ years)(forearm and lower leg-specific data used for males and female lower leg; ratio of male forearm to arm applied to female arm data.
SA_c	Resident water surface area - child (cm^2)	6378	U.S. EPA 2011, Table 7.10; weighted average of mean values for children <6 years.
SA_a	Resident water surface area - adult (cm^2)	20900	U.S. EPA 2011, Table 7.10; weighted average of mean values for adults, male and

			female 21+.
SA_{ow}	Worker soil surface area - adult (cm^2)	3470	US EPA 2011, Table 7-2; weighted avergae of mean values for head, hands, and forearms (male and female), 21+years)
SA_{cw}	Worker soil surface area - adult (cm^2)	3470	US EPA 2011, Table 7-2; weighted avergae of mean values for head, hands, and forearms (male and female), 21+years)
SA_{recsc}	Recreator surface area - child soil (cm^2)	Site-specific	Calculated using the age adjusted intake factors equation
SA_{recsa}	Recreator surface area - adult soil (cm^2)	Site-specific	Calculated using the age adjusted intake factors equation
SA_{recwc}	Recreator surface area - child water (cm^2)	Site-specific	Calculated using the age adjusted intake factors equation
SA_{recwa}	Recreator surface area - adult water (cm^2)	Site-specific	Calculated using the age adjusted intake factors equation
SA_{0-2}	Recreator soil surface area - age segment 0-2 (cm^2)	Site-specific	Site-specific
SA_{2-6}	Recreator soil surface area - age segment 2-6 (cm^2)	Site-specific	Site-specific
SA_{6-16}	Recreator soil surface area - age segment 6-16 (cm^2)	Site-specific	Site-specific
SA_{16-26}	Recreator soil surface area - age segment 16-26 (cm^2)	Site-specific	Site-specific
AF_c	Resident soil adherence factor - child (mg/cm^2)	0.2	U.S. EPA 2002 (Exhibit 1-2)
AF_a	Resident soil adherence factor - adult (mg/cm^2)	0.07	U.S. EPA 2002 (Exhibit 1-2)
AF_{ow}	Worker soil adherence factor(mg/cm^2)	0.12	U.S. EPA 2011, Table 7-20 and Section 7.2.2; arithmetic mean of weighted average of body part- specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities
AF_{cw}	Construction Worker soil adherence factor(mg/cm^2)	0.3	U.S. EPA 2002 (Exhibit 5-1)
AF_{recsc}	Recreator soil adherence factor - child (mg/cm^2)	Site-specific	Site-specific

AF_{recsa}	Recreator soil adherence factor - adult (mg/cm^2)	Site-specific	Site-specific
AF_{0-2}	Recreator soil adherence factor - age segment 0-2 (mg/cm^2)	Site-specific	Site-specific
AF_{2-6}	Recreator soil adherence factor - age segment 2-6 (mg/cm^2)	Site-specific	Site-specific
AF_{6-16}	Recreator soil adherence factor - age segment 6-16 (mg/cm^2)	Site-specific	Site-specific
AF_{16-26}	Recreator soil adherence factor - age segment 16-26 (mg/cm^2)	Site-specific	Site-specific
BW_c	Resident Body Weight - child (kg)	15	U.S. EPA 1991a (pg. 15)
BW_a	Resident Body Weight - adult (kg)	80	U.S. EPA 2011, Table 8-3; weighted mean values for adults 21 - 78
BW_{recsc}	Recreator Body Weight - child soil (kg)	Site-specific	Site-specific
BW_{recsa}	Recreator Body Weight - adult soil (kg)	Site-specific	Site-specific
BW_{recwc}	Recreator Body Weight - child water (kg)	Site-specific	Site-specific
BW_{recwa}	Recreator Body Weight - adult water (kg)	Site-specific	Site-specific
BW_{0-2}	Recreator Body Weight - age segment 0-2 (kg)	Site-specific	Site-specific
BW_{2-6}	Recreator Body Weight - age segment 2-6 (kg)	Site-specific	Site-specific
BW_{6-16}	Recreator Body Weight - age segment 6-16 (kg)	Site-specific	Site-specific
BW_{16-26}	Recreator Body Weight - age segment 16-26 (kg)	Site-specific	Site-specific
BW_{ow}	Outdoor Worker Body Weight (kg)	80	U.S. EPA 1991a (pg. 15)
BW_{cw}	Construction Worker Body Weight (kg)	80	U.S. EPA 2011, Table 8-3; weighted mean values for adults 21 - 78
BW_{iw}	Outdoor Worker Body Weight (kg)	80	U.S. EPA 2011, Table 8-3; weighted mean values for adults 21 - 78
BW_w	Worker Body Weight (kg)	80	U.S. EPA 2011, Table 8-3; weighted mean values for adults 21 - 78
ABS_d	Fraction of contaminant absorbed dermally from soil (unitless)	Contaminant-specific	U.S. EPA 2004 (Exhibit 3-4)
GIABS	Fraction of contaminant absorbed in gastrointestinal tract (unitless) Note: if the GIABS is >50% then it is set to 100% for the calculation of dermal toxicity values.	Contaminant-specific	U.S. EPA 2004 (Exhibit 4-1)
DA			U.S. EPA 2004 (Equation 3.2

event	Absorbed dose per event (µg/cm - event)	Contaminant-specific	and 3.3)
Exposure Frequency, Exposure Duration, and Exposure Time Variables			
EF_r	Resident Exposure Frequency (days/yr)	350	U.S. EPA 1991a (pg. 15)
EF_w	Worker Exposure Frequency (days/yr)	250	U.S. EPA 1991a (pg. 15)
EF_{iw}	Indoor Worker Exposure Frequency (days/yr)	250	U.S. EPA 1991a (pg. 15)
EF_{ow}	Outdoor Worker Exposure Frequency (days/yr)	225	U.S. EPA 1991a (pg. 15)
EF_{cw}	Construction Worker Exposure Frequency (days/yr)	250	U.S. EPA 2002 Exhibit 5-1
EF_{rec}	Recreator Exposure Frequency (days/yr)	Site-specific	Site-specific
EF_{recs}	Recreator Soil Exposure Frequency (days/yr)	Site-specific	Site-specific
EF_{recsc}	Recreator Soil Exposure Frequency - child (days/yr)	Site-specific	Site-specific
EF_{recsa}	Recreator Soil Exposure Frequency - adult (days/yr)	Site-specific	Site-specific
EF_{recwc}	Recreator Water Exposure Frequency - child (days/yr)	Site-specific	Site-specific
EF_{recwa}	Recreator Water Exposure Frequency - adult (days/yr)	Site-specific	Site-specific
EF_{0-2}	Exposure Frequency - age segment 0-2 (days/yr)	Site-specific	Site-specific
EF_{2-6}	Exposure Frequency - age segment 2-6 (days/yr)	Site-specific	Site-specific
EF_{6-16}	Exposure Frequency - age segment 6-16 (days/yr)	Site-specific	Site-specific
EF_{16-26}	Exposure Frequency - age segment 16-26 (days/yr)	Site-specific	Site-specific
ED_r	Resident Exposure Duration (yr)	26	EPA 2011, Table 16-108; 90th percentile for current residence time.
ED_c	Resident Exposure Duration - child (yr)	6	U.S. EPA 1991a (pg. 15)
ED_a	Resident Exposure Duration - adult (yr)	20	ED_r (26 years) - ED_c (6 years)
ED_w	Worker Exposure Duration - (yr)	25	U.S. EPA 1991a (pg. 15)
ED_{iw}	Indoor Worker Exposure Duration - (yr)	25	U.S. EPA 1991a (pg. 15)
ED_{ow}	Outdoor Worker Exposure Duration (yr)	25	U.S. EPA 1991a (pg. 15)
ED_{cw}	Construction Worker Exposure Duration (yr)	1	U.S. EPA 2002 Exhibit 5-1
ED_{rec}	Recreator Exposure Duration (yr)	Site-specific	Site-specific
ED_{recsc}	Recreator Exposure Duration - child soil (yr)	Site-specific	Site-specific

ED_{recsa}	Recreator Exposure Duration - adult soil (yr)	Site-specific	Site-specific
ED_{recwc}	Recreator Exposure Duration - child water (yr)	Site-specific	Site-specific
ED_{recwa}	Recreator Exposure Duration - adult water (yr)	Site-specific	Site-specific
ED_{0-2}	Exposure Duration - age segment 0-2 (yr)	Site-specific	Site-specific
ED_{2-6}	Exposure Duration - age segment 2-6 (yr)	Site-specific	Site-specific
ED_{6-16}	Exposure Duration - age segment 6-16 (yr)	Site-specific	Site-specific
ED_{16-26}	Exposure Duration - age segment 16-26 (yr)	Site-specific	Site-specific
ET_{ra}	Resident Air Exposure Time (hours/day)	24	The whole day
ET_{rs}	Resident Soil Exposure Time (hours/day)	24	The whole day
ET_{w}	Worker Air Exposure Time (hr/hr)	8	The work day
ET_{ws}	Worker Soil Exposure Time (hours/day)	8	The work day
ET_{recs}	Recreator Soil Exposure Time (hours/day)	Site-specific	Site-specific
ET_{recsc}	Recreator Soil Exposure Time - child (hours/day)	Site-specific	Site-specific
ET_{recsa}	Recreator Soil Exposure Time - adult (hours/day)	Site-specific	Site-specific
ET_{recw}	Recreator Surface Water Exposure Time (hours/event)	Site-specific	Site-specific
ET_{rw}	Resident Water Exposure Time (hours/day)	24	The whole day
ET_{rwc}	Resident Water Exposure Time - child (hours/event)	0.54	U.S. EPA 2011, Table 16-28; weighted average of 90th percentile time spent bathing (birth to <6 years)
ET_{rwa}	Resident Water Exposure Time - adult (hours/event)	0.71	U.S. EPA 2011, Tables 16-30 and 16-31; weighted average of adult (21 to 78) 90th percentile of time spent bathing/ showering in a day, divided by mean number of baths/showers taken in a day.
ET_{recwc}	Recreator Surface Water Exposure Time - child (hours/event)	Site-specific	Site-specific
ET_{recwa}	Recreator Surface Water Exposure Time - adult (hours/event)	Site-specific	Site-specific
ET_{0-2}	Exposure Time - age segment 0-2 (hours/event)	Site-specific	Site-specific
ET_{2-6}	Exposure Time - age segment 2-6 (hours/event)	Site-specific	Site-specific

ET_{6-16}	Exposure Time - age segment 6-16 (hours/event)	Site-specific	Site-specific
ET_{16-26}	Exposure Time - age segment 16-26 (hours/event)	Site-specific	Site-specific
$ET_{recw-adj}$	Recreator Exposure Time - age-adjusted (hr/hr)	Site-specific	Calculated using the age adjusted intake factors equation
EV_{recwc}	Recreator Events - child (events/day)	Site-specific	Site-specific
EV_{recwa}	Recreator Events - adult (events/day)	Site-specific	Site-specific
EV_{0-2}	Events - age segment 0-2 (events/day)	Site-specific	Site-specific
EV_{2-6}	Events - age segment 2-6 (events/day)	Site-specific	Site-specific
EV_{6-16}	Events - age segment 6-16 (events/day)	Site-specific	Site-specific
EV_{16-26}	Events - age segment 16-26 (events/day)	Site-specific	Site-specific
Soil to Groundwater SSL Factor Variables			
C_w	Target soil leachate concentration (mg/L)	nonzero MCL or RSL × DAF	U.S. EPA. 2002 Equation 4-14
DAF	Dilution attenuation factor (unitless)	1 (or site-specific)	U.S. EPA. 2002 Equation 4-11
ED	Exposure duration	70	U.S. EPA. 2002 Equation 4-14
I	Infiltration Rate (m/year)	0.18	U.S. EPA. 2002 Equation 4-11
L	source length parallel to ground water flow (m)	site-specific	U.S. EPA. 2002 Equation 4-11
i	hydraulic gradient (m/m)	site-specific	U.S. EPA. 2002 Equation 4-11
K	aquifer hydraulic conductivity (m/year)	site-specific	U.S. EPA. 2002 Equation 4-11
$?_w$	water-filled soil porosity (L_{water}/L_{soil})	0.3	U.S. EPA. 2002 Equation 4-10
$?_a$	air-filled soil porosity (L_{air}/L_{soil})	$= n-?_w$	U.S. EPA. 2002 Equation 4-10
n	total soil porosity(L_{pore}/L_{soil})	$= 1-(?_b/?_s)$	U.S. EPA. 2002 Equation 4-10
$?_s$	soil particle density (Kg/L)	2.65	U.S. EPA. 2002 Equation 4-10
$?_b$	dry soil bulk density (kg/L)	1.5	U.S. EPA. 2002 Equation 4-10
H'	Dimensionless Henry Law Constant (unitless)	analyte-specific	EPI Suite
K_d	soil-water partition coefficient (L/kg)	$= K_{oc}*f_{oc}$ for organics	U.S. EPA. 2002 Equation 4-10
K_{oc}	soil organic carbon/water partition coefficient (L/kg)	analyte-specific	EPI Suite
f_{oc}	fraction organic carbon in soil (g/g)	0.002 (2%)	U.S. EPA. 2002 Equation 4-10
d_a	aquifer thickness (m)	site-specific	U.S. EPA. 2002 Equation 4-10
d_s	depth of source (m)	site-specific	U.S. EPA. 2002 Equation 4-10
d	mixing zone depth (m)	site-specific	U.S. EPA. 2002 Equation 4-12
Wind Particulate Emission Factor Variables			
	Particulate Emission Factor - Minneapolis	1.36×10^9(region-	

PEF_w	(m^3/kg)	specific)	U.S. EPA 2002 Exhibit D-2
Q/C_{wind}	Inverse of the Mean Concentration at the Center of a 0.5-Acre-Square Source (g/m^2-s per kg/m^3)	93.77 (region-specific)	U.S. EPA 2002 Exhibit D-2
V	Fraction of Vegetative Cover (unitless)	0.5	U.S. EPA. 2002 Equation 4-5
U_m	Mean Annual Wind Speed (m/s)	4.69	U.S. EPA. 2002 Equation 4-5
U_t	Equivalent Threshold Value of Wind Speed at 7m (m/s)	11.32	U.S. EPA. 2002 Equation 4-5
F(x)	Function Dependent on U_m /U_t (unitless)	0.194	U.S. EPA. 2002 Equation 4-5
A	Dispersion constant unitless	PEF and region-specific	U.S. EPA 2002 Exhibit D-2
A_s	Areal extent of the site or contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA 2002 Exhibit D-2
B	Dispersion constant unitless	PEF and region-specific	U.S. EPA 2002 Exhibit D-2
C	Dispersion constant unitless	PEF and region-specific	U.S. EPA 2002 Exhibit D-2
Mechanical Particulate Emission Factor Variables from Vehicle Traffic			
PEF_{sc}	Particulate Emission Factor - subchronic (m^3/kg)	(site-specific)	U.S. EPA 2002 Equation 5-5
Q/C_{sr}	Inverse of the ratio of the 1-h geometric mean concentration to the emission flux along a straight road segment bisecting a square site (g/m^2-s per kg/m^3)	23.02 (for 0.5 acre site)	U.S. EPA 2002 Equation 5-5
F_D	Dispersion correction factor (unitless)	0.185	U.S. EPA 2002 Equation 5-5
T	Total time over which construction occurs (s)	site-specific	U.S. EPA 2002 Equation 5-5
A_R	Surface area of contaminated road segment (m^2)	(A_R = L_R * W_R * 0.092903m^2 /ft^2)	U.S. EPA 2002 Equation 5-5
L_R	Length of road segment (ft)	Site-specific	U.S. EPA 2002 Equation 5-5
W_R	Width of road segment (ft)	20	U.S. EPA 2002 Equation E-18
W	Mean vehicle weight (tons)	(number of cars x tons/car + number of trucks x tons/truck) / total vehicles)	U.S. EPA 2002 Equation 5-5
p	Number of days with at least 0.01 inches of precipitation (days/year)	Site-specific	U.S. EPA 2002 Exhibit 5-2
?VKT	Sum of fleet vehicle kilometers traveled during the exposure duration (km)	?VKT = total vehicles x distance (km/day) x frequency (weeks/year) x (days/year)	U.S. EPA 2002 Equation 5-5

A	Dispersion constant unitless	12.9351	U.S. EPA 2002 Equation 5-6
A_s	Areal extent of site surface soil contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA 2002 Equation 5-6
B	Dispersion constant unitless	5.7383	U.S. EPA 2002 Equation 5-6
C	Dispersion constant unitless	71.7711	U.S. EPA 2002 Equation 5-6
Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic			
PEF'_{sc}	Particulate Emission Factor - subchronic (m^3/kg)	(site-specific)	U.S. EPA 2002 Equation E-26
Q/C_{sa}	Inverse of the ratio of the 1-h. geometric mean air concentration and the emission flux at the center of the square emission source (g/m^2-s per kg/m^3)	Site-specific	U.S. EPA 2002 Equation E-15
F_D	Dispersion correction factor (unitless)	Site-specific	U.S. EPA 2002 Equation E-16
A	Dispersion constant unitless	2.4538	U.S. EPA 2002 Equation E-15
B	Dispersion constant unitless	17.5660	U.S. EPA 2002 Equation E-15
C	Dispersion constant unitless	189.0426	U.S. EPA 2002 Equation E-15
A_s	Areal extent of site surface soil contamination (acres)	(range 0.5 to 500)	U.S. EPA 2002 Equation E-15
J'_T (g/m^2-s)	Total time-averaged PM_{10} unit emission flux for construction activities other than traffic on unpaved roads	Site-specific	U.S. EPA 2002 Equation E-25
M^{PC}_{wind}	Unit mass emitted from wind erosion (g)	site-specific	U.S. EPA 2002 Equation E-20
V	Fraction of Vegetative Cover (unitless)	0	U.S. EPA 2002 Equation E-20
U_m	Mean Annual Wind Speed (m/s)	4.69	U.S. EPA 2002 Equation E-20
U_t	Equivalent Threshold Value of Wind Speed at 7m (m/s)	11.32	U.S. EPA 2002 Equation E-20
F(x)	Function Dependent on U_m /U_t (unitless)	0.194	U.S. EPA 2002 Equation E-20
A_{surf}	Areal extent of site surface soil contamination (m^2)	(range 0.5 to 500)	U.S. EPA 2002 Equation E-20
ED	Exposure duration (years)	Site-specific	U.S. EPA 2002 Equation E-20
M_{excav}	Unit mass emitted from excavation soil dumping (g)	site-specific	U.S. EPA 2002 Equation E-21
0.35	PM_{10} particle size multiplier (unitless)	0.35	U.S. EPA 2002 Equation E-21
U_m	Mean annual wind speed during construction (m/s)	4.69	U.S. EPA 2002 Equation E-21
$M_{m-excav}$	Gravimetric soil moisture content (%)	12 (mean value for municipal landfill cover)	U.S. EPA 2002 Equation E-21
$?_{soil}$	In situ soil density (includes water) (Mg/m^3)	1.68	U.S. EPA 2002 Equation E-21
A_{excav}	Areal extent of excavation (m^2)	(range 0.5 to 500)	U.S. EPA 2002 Equation E-21
d	Average depth of excavation (m)	Site-specific	U.S. EPA 2002 Equation E-21

excav			
$N_{A\text{-}dump}$	Number of times soil is dumped (unitless)	2	U.S. EPA 2002 Equation E-21
M_{doz}	Unit mass emitted from dozing operations (g)	site-specific	U.S. EPA 2002 Equation E-22
0.75	PM_{10} scaling factor (unitless)	0.75	U.S. EPA 2002 Equation E-22
s_{doz}	Soil silt content (%)	6.9	U.S. EPA 2002 Equation E-22
$M_{m\text{-}doz}$	Gravimetric soil moisture content (%)	7.9 (mean value for overburden)	U.S. EPA 2002 Equation E-22
$?VKT_{doz}$	Sum of dozing kilometers traveled (km)	Site-specific	U.S. EPA 2002 Equation E-22
S_{doz}	Average dozing speed (kph)	11.4 (mean value for graders)	U.S. EPA 2002 Equation E-22
$N_{A\text{-}doz}$	Number of times site is dozed (unitless)	Site-specific	U.S. EPA 2002 Equation E-22
B_d	Dozer blade length (m)	Site-specific	U.S. EPA 2002 Page E-28
M_{grade}	Unit mass emitted from grading operations (g)	site-specific	U.S. EPA 2002 Equation E-23
0.60	PM_{10} scaling factor (unitless)	0.60	U.S. EPA 2002 Equation E-23
$?VKT_{grade}$	Sum of grading kilometers traveled (km)		U.S. EPA 2002 Equation E-23
S_{grade}	Average grading speed (kph)	11.4 (mean value for graders)	U.S. EPA 2002 Equation E-23
$N_{A\text{-}grade}$	Number of times site is graded (unitless)	Site-specific	U.S. EPA 2002 Equation E-23
B_g	Grader blade length (m)	Site-specific	U.S. EPA 2002 Page E-28
M_{till}	Unit mass emitted from tilling operations (g)	site-specific	U.S. EPA 2002 Equation E-24
s_{till}	Soil silt content (%)	18	U.S. EPA 2002 Equation E-24
$A_{c\text{-}till}$	Areal extent of tilling (acres)	Site-specific	U.S. EPA 2002 Equation E-24
$A_{c\text{-}grade}$	Areal extent of grading (acres)	Site-specific	Necessary to solve $?VKT_{grade}$ in U.S. EPA 2002 Equation E-23
$A_{c\text{-}doz}$	Areal extent of dozinging (acres)	Site-specific	Necessary to solve $?VKT_{grade}$ in U.S. EPA 2002 Equation E-22
$N_{A\text{-}till}$	Number of times soil is tilled (unitless)	2	U.S. EPA 2002 Equation E-24
Chronic Volatilization Factor and Soil Saturation Limit Variables			
VF_s	Volatilization Factor - Los Angeles (m^3/kg)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
C_{sat}	Soil saturation concentration (mg/kg)	Contaminant-specific	U.S. EPA. 2002 Equation 4-9
Q/C_{vol}	Inverse of the Mean Concentration at the Center of a 0.5-Acre-Square Source (g/m^2-s per kg/m^3)	68.18	U.S. EPA. 2002 Equation 4-8
A	Dispersion constant unitless	11.9110 (region-	U.S. EPA 2002 Exhibit D-3

		specific)	
A_s	Areal extent of the site contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA 2002 Equation 4-8
B	Dispersion constant unitless	18.4385 (region-specific)	U.S. EPA 2002 Exhibit D-3
C	Dispersion constant unitless	209.7845 (region-specific)	U.S. EPA 2002 Exhibit D-3
D_A	Apparent Diffusivity (cm^2/s)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
T	Exposure interval (s)	8.2×10^8 (used for unlimited source model)	U.S. EPA. 2002 Equation 4-8
T	Exposure interval (years)	26 (used for mass-limit model)	U.S. EPA. 2002 Equation 4-13
$?_b$	Dry soil bulk density (g/cm^3)	1.5	U.S. EPA. 2002 Equation 4-8
$?_a$	Air-filled soil porosity (L_{air}/L_{soil}) ($n-?_w$)	0.28	U.S. EPA. 2002 Equation 4-8
n	Total soil porosity (L_{pore}/L_{soil}) ($1-(?_b/?_s)$	0.43	U.S. EPA. 2002 Equation 4-8
$?_w$	Water-filled soil porosity (L_{water}/L_{soil})	0.15	U.S. EPA. 2002 Equation 4-8
$?_s$	Soil particle density (g/cm^3)	2.65	U.S. EPA. 2002 Equation 4-8
S	Water Solubility Limit (mg/L)	Contaminant-specific	EPI Suite
D_{ia}	Diffusivity in air (cm^2/s)	Contaminant-specific	U.S. EPA. 2001
H'	Dimensionless Henry's Law Constant	Contaminant-specific	EPI Suite
D_{iw}	Diffusivity in water (cm^2/s)	Contaminant-specific	U.S. EPA. 2001
K_d	Soil-water partition coefficient (L/Kg) ($K_{oc} \times f_{oc}$)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
K_{oc}	Soil organic carbon-water partition coefficient (L/Kg)	Contaminant-specific	EPI Suite
f_{oc}	Organic carbon content of soil (g/g)	0.006	U.S. EPA. 2002 Equation 4-8
d_s	Average source depth (m)	Site-specific	U.S. EPA 2002 Equation 4-13
Subchronic Volatilization Factor for Unlimited Source and Mass-limit Equations			
VF_{sc}	Subchronic Volatilization Factor (m^3/kg)	Contaminant-specific	U.S. EPA 2002 Equation 5-14
Q/C_{sa}	Inverse of the ratio of the 1-h geometric mean air concentration to the volatilization flux at the center of a square source (g/m^2-s per kg/m^3)	14.31 (for 0.5 acre site)	U.S. EPA 2002 Equation 5-14
A	Dispersion constant unitless	2.4538	U.S. EPA 2002 Equation 5-15
A_c	Areal extent of the site soil contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA 2002 Equation 5-15
B	Dispersion constant unitless	17.5660	U.S. EPA 2002 Equation 5-15
C	Dispersion constant unitless	189.0426	U.S. EPA 2002 Equation 5-15
D_A	Apparent Diffusivity (cm^2/s)	Contaminant-specific	U.S. EPA 2002 Equation 5-14

T	Total time over which construction occurs (s)	site-specific	U.S. EPA 2002 Equation 5-14
$?_b$	Dry soil bulk density (g/cm^3)	1.5	U.S. EPA 2002 Equation 5-14
F_D	Dispersion correction factor (unitless)	0.185	U.S. EPA 2002 Equation 5-14
$?_a$	Air-filled soil porosity (L_{air}/L_{soil}) (n-$?_w$)	0.28	U.S. EPA 2002 Equation 5-14
n	Total soil porosity (L_{pore}/L_{soil}) (1-($?_b/?_s$)	0.43	U.S. EPA 2002 Equation 5-14
$?_w$	Water-filled soil porosity (L_{water}/L_{soil})	0.15	U.S. EPA 2002 Equation 5-14
$?_s$	Soil particle density (g/cm^3)	2.65	U.S. EPA 2002 Equation 5-14
D_{ia}	Diffusivity in air (cm^2/s)	Contaminant-specific	U.S. EPA 2001
H'	Dimensionless Henry's Law Constant	Contaminant-specific	EPI Suite
D_{iw}	Diffusivity in water (cm^2/s)	Contaminant-specific	U.S. EPA 2001
K_d	Soil-water partition coefficient (L/Kg) ($K_{oc} \times f_{oc}$)	Contaminant-specific	U.S. EPA 2002 Equation 5-14
K_{oc}	Soil organic carbon-water partition coefficient (L/Kg)	Contaminant-specific	EPI Suite
f_{oc}	Organic carbon content of soil (g/g)	0.006 (0.6%)	U.S. EPA 2002 Equation 5-14
T	Total time over which construction occurs (year)	site-specific (T=ED)	U.S. EPA 2002 Equation 5-17
d_s	Average source depth (m)	Site-specific	U.S. EPA 2002 Equation 5-17

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For assistance/questions please use the rsl table contact us page

Mid-Atlantic Hazardous Site Cleanup

Risk Assessment

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What's New

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Table of Contents

The What's New section keeps users informed of changes to: toxicity values, exposure parameters, chemical-specific parameters, equation formats and any other SL changes. Please check this site frequently to be advised of any recent changes.

January, 2015

- New Regional Screening Levels Tables were generated to correct the error of omitting the soil ingestion pathway for 17 chemicals. The correction resulted in a lowering of the residential and industrial soil screening levels for these chemicals. Sulfur Trioxide was corrected for an incorrect CAS Number provided by the source and new chemical-specific parameters were added accordingly. Please download this spreadsheet file (or this pdf file) that compares the previous summary table to the current summary table for TR=1E-06 and THQ=1.0. Please download this spreadsheet file (or this pdf file) that compares the previous summary table to the current summary table for TR=1E-06 and THQ=0.1.

  Changes are the following:

  1. Chemicals with new soil ingestion values are:
     Added in November 2014
     - barium chromate,
     - calcium chromate,
     - lead chromate,
     - lead phosphate,
     - nickel acetate,
     - nickel carbonate,
     - nickel hydroxide,
     - nickelocene,
     - perfluorobutane sulfonate,
     - Potassium Perfluorobutane Sulfonate,
     - sodium dichromate,
     - strontium chromate,
     - styrene-acrylonitrile (SAN) trimer and
     - triethylene glycol.

     Added in May 2014
     - aroclor 5460.

     Added in November 2013
     - Tricresyl Phosphate (TCP) and
     - Thiocyanic Acid.
  2. Sulfur Trioxide CAS number has been corrected.

November, 2014

- New Tables were generated that reflect changes in the toxicity and chemical-specific parameters as per the RSL hierarchies. This spreadsheet file (or this pdf file) is a comparison of the previous toxicity database to the current. This spreadsheet file (or this pdf file) is a comparison of the previous summary table to the current for TR=1E-06 and THQ=1.0. This spreadsheet file (or this pdf file) is a comparison of the previous summary table to the current for TR=1E-06 and THQ=0.1.

  Changes are the following:

1. Chemicals with new toxicity values due to PPRTV updates are:
    - ethyl acrylate,
    - triethylene glycol,
    - isopropanol,
    - styrene-acrylonitrile (SAN) trimer,
    - 1,3-dibromobenzene,
    - perfluorobutane sulfonate and
    - Potassium Perfluorobutane Sulfonate.
2. Chemicals with new toxicity values due to new Cal EPA updates are:
    - nickelocene,
    - nickel oxide,
    - nickel acetate,
    - lead subacetate,
    - direct black 38,
    - direct blue 6,
    - direct brown 95,
    - nickel carbonate,
    - lead phosphate,
    - sulfur trioxide,
    - lead chromate,
    - strontium chromate,
    - barium chromate,
    - sodium dichromate,
    - nickel hydroxide,
    - nickel carbonyl,
    - calcium chromate and
    - HCDD, 1,2,3,4,6,7,8- (Calculator Only).
3. naptha, high flash aromatic (HFAN) CAS number has been corrected.

- Section 5.20 was added to the user guide to explain the RfC source for cyanide.
- A new FAQ was added to explain the removal of the trans 1,2 dichloroethylene PPRTV.
- The default intake rate was removed from the fish RSL equations. The fish scenario now requires the Calculator to use Site-Specific mode.
- The MCL of 15 µg/Lhas been added to the tapwater column for lead.
- Section 5.10 of the user guide was updated to clarify the use of the arsenic RBA in oral exposure to soil calculations.
- Additional parameters were added to the Generic Tables in the Chemical Specific Parameters supporting table.
- FAQ 6 was updated now that the calculator results can be downloaded in a spreadsheet.

May, 2014

- New Tables were generated that reflect changes in the toxicity and chemical-specific parameters as per the RSL hierarchies. This spreadsheet file (or this pdf file) is a comparison of the previous toxicity database to the current. There are no files comparing the old and new summary tables because nearly every value has changed due to implementation of Exposure Factor Handbook parameter values.

Changes are the following:

1. Chemicals with new toxicity values due to PPRTV updates are:
    - guanidine chloride,
    - guanidine,
    - azodicarbonamide,
    - dicyclopentadiene,
    - 1,2-trans dichloroethylene (See this memo for an explanation) and
    - aroclor 5460.
2. 1,2-dichloroethylene (mixed isomers) was removed from the table and calculator because the RSLs were higher than the individual isomers.

- An OSWER Directive was released instructing the use of exposure parameters from the Exposure Factors Handbook. All of the RSL equations have been updated accordingly.
- The cancer toxicity values have been removed for the total petroleum hydrocarbons. See the FAQ page for updates on screening TPHs in risk assessments.

The new construction worker landuse equations were modified to more clearly define averaging time and time of exposure for exposures less than one year. For scenarios lasting less than one year, please contact your regional risk assessor for guidance.

- For the residential landuse, the exposure frequency was moved into the age-adjusted intake portion of the equation. Now each age segment can have a unique exposure frequency.
- Trichloroethylene SL calculation has changed from a three step process to a seamless calculation. See the TCE FAQ. The User Guide now contains separate equations for TCE similar to those presented for vinyl chloride. User Guide Section 5.18 presents how toxicity adjustment factors were used to combine the cancer and mutagen equations.
- All Furans were assigned an ABS of 0.03 for this version of the RSLs. RAGS Part E assigned an ABS of 0.03 to all dioxins in exhibit 3-4 but furans were not mentioned. However, the reference provided in RAGS Part E suggests that furans should also be included.
- A new key column was added to the summary table after the Risk-based SSL column.
- FAQs were updated or added to explain:
  - how the RSL tables and calculator handle rounding,
  - three and four phase equilibrium modeling,
  - TCE equation changes,
  - TPH screening and
  - use of PPRTV appendix screening levels.

November, 2013

- New Tables were generated that reflect changes in the toxicity and chemical-specific parameters as per the RSL hierarchies. This spreadsheet file (or this pdf file) is a comparison of the previous toxicity database to the current. This spreadsheet file (or this pdf file) is a comparison of the previous summary table to the current for TR=1E-06 and THQ=1.0. This spreadsheet file (or this pdf file) is a comparison of the previous summary table to the current for TR=1E-06 and THQ=0.1.

Changes are the following:

1. Chemicals with new toxicity values due to PPRTV updates are:
   - dinitrotoluene, technical grade,
   - nonane, n-,
   - ethyl acetate,
   - tert-amyl-alcohol,
   - ethoxyethanol, 2-,
   - dimethoxybenzidine, 3,3'-,
   - butylated hydroxytoluene,
   - nitromethane
   - dibenzothiophene
   - dichlorobenzotrifluoride, 3,4- (subchronic only)
   - trinitrophenylmethylnitramine (Tertyl) and
   - endosulfan sulfate (subchronic only).
2. Chemicals with new toxicity values due to IRIS updates are:
   - Methanol
   - Biphenyl and
   - 1,4-Dioxane.
3. Chemicals with new toxicity values due to Cal EPA updates are:
   - Butadine, 1,3- and
   - Caprolactam.

- The calculator page now has an option for the user to enter site concentrations and calculate risk based on the RSL target risk and the RSL concentration. This is a simple calculation where the risk based on the entered media concentration is equal to the RSL target risk multiplied by the user concentration is then divided by the RSL concentration.

RISK=(RSL_TR x User_C)/RSL_C or
HQ=(RSL_THQ x User_C)/RSL_C

The RSL and risk results are presented in the output and available for download. No daily intakes are calculated.

Whether this calculation will suit the needs of a given project depends upon site-specific decisions, the conceptual site model, the purpose of the risk assessment and the authority under which it is being conducted, etc. Please consult your regional risk assessor for further guidance in site-specific situations.

- The calculator offers the user to populate the pick list based on CAS number search as well as chemical name.
- The total petroleum hydrocarbons, previously added to the calculator, have been added to the RSL tables. For the low aliphatic fraction, n-hexane was selected as the representative compound for the toxicity values as well as the chemical-specific parameters. For the medium aliphatic fraction, hydrocarbon streams was selected as the representative compound for the toxicity values and n-nonane was selected to represent the chemical-specific parameters. For the high aliphatic fraction, white mineral oil was selected as the representative compound for the toxicity values as well as the chemical-specific parameters. For the low aromatic fraction, benzene was selected as the representative compound for the toxicity values as well as the chemical-specific parameters. For the medium aromatic fraction, 2-methylnaphthalene was selected as the representative compound for the RfD and naphthalene was selected for the RfC. An average of the chemical-specific parameters for 2-methylnaphthalene and naphthalene was calculated. For the high aromatic fraction, fluoranthene was selected as the representative compound for the toxicity values as well as the chemical-specific parameters.
- A new construction worker landuse was added to the calculator only. The construction landuse is described in the supplemental soil screening guidance. This landuse is limited to an exposure duration of 1 year and is thus, subchronic. Other unique aspects of this scenario are that the PEF is based on mechanical disturbance of the soil and a special VF equation is used. In general, the intakes and contact rates are all greater than the outdoor worker. Exhibit 5-1 presents the exposure parameters.
- For the residential landuse, adult and child noncancer results for soil, tapwater and soil to groundwater exposure are now provided in calculator output. This gives the user the ability to calculate RSLs for scenarios where only adults are exposed such as prisons, military bases and retirement communities.
- The phthalates are now added to their own chemical group and will all appear together in the table like the dioxins and cyanides, etc. do. FAQ 9 is updated accordingly
- "ethyl chloride" is now listed as "ethyl chloride (chloroethane)".
- FAQs were added to explain:
  - why IRIS air concentrations and drinking water unit risk values differ from the RSLs,
  - the process of printing the color tables in black and white,
  - how the various EPA regions use the screening tables with different THQs,
  - the Chlordane CAS number selection,
  - how to apply the tapwater RSLs to dissolved vs total data and
  - how the TCDD (Dioxin) oral slope factor was chosen.

- FAQs 9 and 34 were updated.

June, 2013

- The THQ = 0.1 Tables were corrected for TCE residential land use screening values found in the Summary Table, Soil to Groundwater supporting Table and the Composite Table.

- If you are unclear about which set of tables (THQ=1.0 or THQ=0.1) to use at your site, contact your EPA regional risk assessment website. The rationale for using THQ of 0.1 for screening is that if 10 chemicals were at a site and all narrowly passed a screening at THQ=1.0, the resulting total HI could actually be 10.

May, 2013

- New Tables were generated that reflect changes in the toxicity and chemical-specific parameters as per the RSL hierarchies. This spreadsheet file (or this pdf file) is a comparison of the previous toxicity database to the current.

  All tables are presented with target cancer risk (TR) of 1E-06, however, tables are presented with target hazard quotients (THQ) of 1.0 and 0.1. Use the tables appropriate for your region.

  Changes are the following:

  1. Chemicals with new toxicity values due to PPRTV updates are:
     - Toluene-2,5-diamine,

- Butylbenzene, tert-,
- Octyl Phthalate, di-N-,
- Butylbenzene, sec-,
- Thiocyanic Acid,
- Dinitrotoluene, 2,6-,
- Methyl-1,4-benzenediamine dihydrochloride, 2-,
- Methylbenzene-1,4-diamine sulfate, 2-,
- Benzenediamine-2-methyl sulfate, 1,4-,
- Zirconium and
- Dinitrotoluene, Technical grade.

2. Chemicals with new toxicity values due to ATSDR updates are:
    - Uranium (Soluble Salts),
    - 1,4-Dioxane,
    - Tricresyl Phosphate (TCP),
    - Cadmium,
    - Vanadium and Compounds and
    - Tris(1,3-Dichloro-2-propyl) Phosphate.
3. Chemicals with new toxicity values due to Cal EPA updates are:
    - Nickel Refinery Dust,
    - Nickel Carbonyl,
    - Nickel Oxide and
    - Nickel Subsulfide.

- New Tables are now provided with target hazard quotients (THQ) of 1.0 and 0.1. Use the tables appropriate for your region.
- The RfDs for the numbered, dioxin-like PCBs are now based on the TCDD (Dioxin) RfD from IRIS and the TEFs presented in User Guide.
- The high aliphatic and high aromatic TPHs were classified as SVOCs and all the TPHs were given chemical-specific parameters. Chemical-specific parameter assignments were based on the representative compounds identified in the PPRTV paper when available. The medium aliphatic TPH did not have a surrogate listed in the PPRTV paper so n-nonane was assigned. The TPHs are currently available in the calculator only.
- Glyphosate Koc was updated.
- Thiocyanic Acid was given the CAS number 463-56-9. This number was previously assigned to Thiocyanate.
- Vanadium and Compounds was given the CAS number 7440-62-2. Previously it did not have a CAS number. This results in the database matching a RfC from ATSDR.
- The calculator, if operated in site-specific mode, now gives the option to substitute the Csat for the inhalation route screening level as well as giving the opportunity to substitute the theoretical concentration limit of 1E+05 mg/kg for the total screening level. These two options, combined with the ability change the target risk and the target hazard quotient should provide users with enough flexibility to generate screening levels applicable to many site-specific situations.
- Arsenic screening levels for ingestion of soil are now calculated with the relative bioavailability factor (RBA) of 0.6. The RBA can be adjusted using the calculator in site-specific/user-provided mode the same way toxicity values can be changed. The RBA for soil ingestion is shown in the calculator output. See Section 5.10 of the User Guide for more information.

January, 2013

In the November 2012 Update, the third to the last bullet that identifies the updates to the recreator landuse scenario, the following additional information may be useful.

> The calculator-based recreator landuse scenario shares the following identical default exposure parameters with the residential landuse scenario: body surface area, ingestion rates, body weight and soil adherence factors. Default recreational exposure parameters are not provided for exposure frequency, exposure time and events per day because recreational activities vary greatly and should be derived on a site-specific basis. Please see the User's Guide for the exposure equations and a conceptual model of quantified pathways.

November, 2012

- New Tables were generated that reflect changes in the toxicity and chemical-specific parameters as per the RSL hierarchies. This spreadsheet file (or this pdf file) is a comparison of the previous toxicity database to the current. Changes are the following:

1. The hydrogen cyanide RfC was also assigned to cyanide. Further, the cyanide Kd was also assigned to hydrogen cyanide. This will allow for calculation of a Csat and protection of groundwater SSLs.
2. Chemicals with new toxicity values due to PPRTV updates are:
    - acetone cyanohydrin,
    - boron trichloride
    - chloroethanol, 2-,
    - cyclohexene,
    - diethanolamine,
    - ethylene cyanohydrin,
    - methacrylonitrile,
    - methyl acrylate,
    - octyl phthalate, di-N-,
    - thallium acetate,
    - thallium carbonate,
    - thallium chloride,
    - thallium (I) nitrate,
    - thallium sulfate,
    - thiocyanate,
    - toluene-2,5-diamine,
    - toluidine, p-,
    - triacetin,
    - tris(1-chloro-2-propyl)phosphate and
    - zirconium.
3. The RfC for mercuric chloride was replaced with the IRIS RfC for elemental mercury.

- Changes in chemical-specific parameters were also made. The most significant change was updating the hierarchy of sources for water solubility as it was discovered that some sources were more qualitative than assumed. This spreadsheet file (or this pdf file) is a comparison of the previous database to the current for parameters not associated with the dermal to tapwater route.
- Thiocyanate was reclassified as an inorganic compound to be equivalent to all the other cyanide compounds.
- Changes were also made to the parameters involved in dermal exposure to water. Our previous hierarchy used RAGS Part E before using EPI for EPD (effective predictive domain) determination and Kp (dermal permeability) values. Recently released logKows (logp) for some chemicals conflicted with those in RAGS Part E. Specifically for the RSL project, the most recent logKow were used to determine EPD status. To complete the transition the RSLs now also calculate our own FA (fraction absorbed) values. This spreadsheet file (or this pdf file) is a comparison of the previous database to the current for parameters associated with the dermal to tapwater route.
- To calculate a Csat, the ambient state of the VOC in soil must be known. As indicated in the SSL Guidance, Csat is not calculated for a chemical that is solid at soil temperatures. To make sure this rule was being followed, the melting point database was updated and this rule was established from the SSL guidance: if melting point is less than 20 °C, chemical is a liquid; if melting point is above 20 °C, chemical is solid.
- The FAQ has been updated in response to user questions.
- The individual TPHs (total petroleum hydrocarbons) are now available in the RSL calculator.
- MCLs were added for the following:
    - aldicarb,
    - aldicarb sulfone and
    - aldicarb sulfoxide.
- The recreator scenario includes additional default exposure parameters that are the same as exposure parameters for the residential scenario.
- The RSL calculator was updated for the residential scenario site-specific option. The RSL calculator requires separate entries for each age cohort.
- The RSL calculator output for the "Soil to Groundwater" scenario has been updated to include the SSLs for both cancer and noncancer rather than just the most protective value. The recommended SSL will still be presented. This change is because many chemicals have significant noncancer effects in addition to their cancer risk and should be considered.

May, 2012

- New Tables generated that reflect changes from all the toxicity and chemical-specific parameter sources used in the hierarchies. This spreadsheet file (or this pdf file (PDF) (2 pp, 46.3K, About PDF)) is a comparison of the previous toxicity database to the current. Changes are:
    1. Uranium (Soluble Salts) lost its ATSDR RfC because it was DRAFT.
    2. Cyanides, Sodium Cyanide, Potassium Cyanide, Potassium Silver Cyanide, Calcium Cyanide have new IRIS RfDs.
    3. Cresol, p-chloro-m- and Cresol, -p now have the ATSDR RfD for Cresols.
    4. Eleven chemicals had their VOC status changed due to updates in Henry's Law constants. Chemicals that were once classified as SVOCS and are now VOCs are: Dihydrosafrole, 2-Chloroacetaldehyde, Propylene, Ethyleneimine, 1,4-Dithiane, Methyl Isocyanate, Mineral Oils and Dimethylvinylchloride. Chemicals that were once VOCs and are now SVOCs are:Isobutyl Alcohol, Cresols and Propylene Glycol Dinitrate.
    5. Tetrahydrofuran (IRIS), Hexamethylphosphoramide (PPRTV) and Sulfalone (PPRTV) are new chemicals.
    6. Tetrachloroethylene, Methylene Chloride and TCDD have new IRIS values.
    7. Methylene Chloride is now classified as a mutagen.
    8. ABS values were assigned for 1 and 2-Methylnaphthalene.
    9. The EPD status for Chlordane was changed.
- The Recreator landuse was updated to include output for adult as well as child for noncancer. The Equations Page and User's Guide have been updated to reflect this addition.
- The inputs into the PEF and VF are now included in the calculator output.
- The NAAQS value for lead was added to Resident Air.
- The User's Guide has been updated.
- The FAQ has been updated in response to user questions.

November, 2011

- New Tables generated that reflect changes from all the toxicity sources used in the toxicity hierarchy. This spreadsheet file (or this pdf file) is a comparison of the previous toxicity database to the current. Changes are:
    1. Hexachloroethane has a new RFD and SFO from IRIS. IRIS dropped the IUR.
    2. Trichloroacetic Acid is a new chemical with IRIS RFDOC and SFO.
    3. TCE has new IRIS RfD, RfC, SFO and IUR. TCE is now classified as a mutagen. See the new FAQ.
    4. Chlorpyrifos has the IRIS RFDOC dropped.
    5. Vanadium Sulfate RfD was dropped from HEAST.
    6. Acrylamide is now treated as a mutagen.
- TCE has a new IRIS assessment and the RSLs reflect the new toxicity values presented. For land uses that include children's exposure, special calculations are required. Users will be required to run the calculator in site-specific/user-provided mode to generate accurate TCE RSLs. See the new FAQ.
- This release introduces dermal exposure to tapwater equations following RAGS Part E.
- This release switches from the adult to the child for noncancer tapwater RSL equations. Soil and Tapwater now follow the same protocol of using the child as the noncancer receptor.
- Change RSL, PPRTV and HEAST contact information from Dave Crawford/Rich Kapuscinski to Michele Burgess.
- The User's Guide has been updated.
- The FAQ has been updated in response to user questions.
- The Equations Page has been updated to present new tapwater equations. Changes include addressing dermal exposures when we have the data from RAGS Part E, and basing the noncancer tapwater RSLs upon children's exposures.

June, 2011

New Tables generated that:

- Remove the inhalation unit risk value for the analyte "lead and compounds" (which will delete the residential and industrial air SLs that were inadvertently calculated for this analyte).
- Update soil to groundwater screening levels for the following mutagens: Benzidine, Chromium(VI), Acrylamide, Trichloropropane, 1,2,3-, Nitrosodimethylamine, N-,

Methylene-bis(2-chloroaniline), 4,4'-, Nitrosodiethylamine, N-, Benz[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Chrysene, Dibenz[a,h]anthracene and Indeno[1,2,3-cd]pyrene.
- Added GIABS and ABS values to newly added analytes.
- Updated the status of those contaminants determined by EPA to be carcinogenic by a mutagenic mode of action for Acrylamide, Anthraquinone, 9,10-, Benzenediamine-2-methyl sulfate, 1,4-, Methyl-1,4-benzenediamine dihydrochloride, 2-, Methylbenzene,1-4-diamine, monohydrochloride, 2-, Methylbenzene-1,4-diamine sulfate, 2-, Phenothiazine, Trimethylbenzene, 1,2,3-, Dimethylbenz(a)anthracene, 7,12-, Nitroso-N-ethylurea, N-, Methylcholanthrene, 3-, Nitroso-N-methylurea, N-, Safrole and Urethane to reflect the list of contaminants presented in the EPA Office of Solid Waste and Emergency Responses's Handbook for Implementing the Supplemental Cancer Guidance at Waste and Cleanup Sites described in Section 5.15 of the RSLs' User's Guide.

May, 2011

- New Tables generated that reflect changes from all the toxicity sources used in the toxicity hierarchy. This spreadsheet file (or this pdf file) is a comparison of the previous toxicity database to the current.
- Subchronic toxicity values are now available for assessment of less than chronic scenarios. This option is only available in the calculator. None of the RSLs in the download tables are calculated with subchronic toxicity values because all of those scenarios are assumed to be chronic for screening purposes. Scenarios less than seven years exposure duration may or may not be judged as chronic in the risk assessment. Consult your regional risk assessor for further guidance on this matter.
- A recreational scenario is now available in the RSL calculator. Surface water and sediment/soil can be evaluated. The EPA provides very few default exposure parameters so users are encouraged to have a strong understanding of their receptor prior to use and are required to use the "site-specific" option. The landuse equations are presented in the User Guide and the Equations page. The recreational scenario assess dermal exposure to water following RAGS Part E guidance. This feature required many new supporting equations to be developed.
- The User's Guide has been updated.
- FAQs 9, 16, 18, 33, 36 and 38 have been updated in response to user questions.
- All the perchlorates are grouped together in the tables.
- The database of the RSL sources for chemical-specific parameters was updated. EPI, CRC, Perry's, Lange's and Yaw's were updated.
- All the phosphates are grouped together in the tables.

February, 2011

- The restriction on acess to the PPRTV website has been lifted. PPRTVs can be accessed from links in section 2.3 of the user guide and FAQ#27.

November 11, 2010

- New Tables generated that reflect changes from all the toxicity sources used in the toxicity hierarchy. This spreadsheet file (or this pdf file) is a comparison of the previous toxicity database to the current.
- The User's Guide has been updated.
- The FAQ has been updated in response to user questions. The FAQ has also been reorganized into 5 topics to facilitate searching.
- TEFs have been applied to noncarcinogenic toxicity values for the dioxin like PCBs.
- "Mercuric Sulfide" and "Mercury, Inorganic Salts" were removed from the table and "Mercuric Chloride" was renamed "Mercuric Chloride (and other Mercury salts)".
- "Manganese water" wasrenamed "Manganese non-diet".

May 17, 2010

- New Tables generated that reflect changes from all the toxicity sources used in the toxicity hierarchy. This spreadsheet file (or this pdf file) is a comparison of the previous toxicity database to the current.
- The User's Guide has been updated.
- The FAQ has been updated in response to user questions.

- The contaminant names and CAS numbers have been moved to the center of the tables. This change was implemented so that the contaminant name would nearly always be visible on your screen.

December 7, 2009

- New Tables generated that reflect changes from all the toxicity sources used in the toxicity hierarchy. This spreadsheet file (or this pdf file (PDF) (4 pp, 56.9K, About PDF)) is a comparison of the previous toxicity database to the current.
- The User's Guide has been updated.
  - A new source of toxicity values used was added: screening toxicity values in an appendix to certain PPRTV assessments. While we have less confidence in a screening toxicity value than in a PPRTV, we put these ahead of HEAST toxicity values because these appendix screening toxicity values are more recent and use current EPA methodologies in the derivation, and because the PPRTV appendix screening toxicity values also receive external peer review.
- The FAQ has been updated in response to user questions.
- The database of chemical-specific parameters was updated. In particular, EPI had significant improvements to its Koc program. Changes in Koc effect calculations of the Volatilization Factor, Soil Screening Levels and Soil Saturation Concentrations.

April 15, 2009

- New Tables generated that reflect changes from all the toxicity sources used in the toxicity hierarchy. This spreadsheet file (or this pdf file (PDF) (23 pp, 84.4k) is a comparison of the previous toxicity database to the current.
- The User's Guide has been updated.
  - The generic tables no longer provide individual SLs for dioxin-like congeners. The User's Guide provides instructions on how to apply the TEFs.
  - RAGS Part F guidance has been incorporated into the FAQ and User's Guide.
  - The OSWER Cancer Handbook guidelines have been incorporated into a new section in the user guide addressing mutagens (Section 5.14).
  - A detailed discussion of the sources of Kd values has been added to Section 4.9 of the User's Guide.
  - Section 5.12 was added to the User's Guide to address potential methods of screening sites with multiple contaminants.
- The FAQ has been updated in response to user questions.

October 16, 2008: Summary of Changes Posted

- Spreadsheet of changes (XLS)
- Notes about the Spreadsheet of changes
  1) purple row = chemical no longer in table due to no values
  2) green row = chemical added
  3) yellow boxes = differences
- For the yellow differences, prior (June) value is on top and current (September) value is below. Letter differences are due to change in tox source and possible tox value. Note the "C" iur values which were in wrong units from CALEPA but are correct now.
- Most metals differ in soil to groundwater calculations. All PCBs/Dioxins that have "W" have been modified with newer TEF."

September 12, 2008

- New Tables generated that reflect the addition of several PPRTVs. Beta designation is removed.

July 7, 2008

- New Tables generated that reflect the addition of the Cal EPA IUR for Naphthalene.

July 3, 2008

- New Tables generated that reflect the correction of the IUR for Ethylene oxide.

July 2, 2008

- New Tables generated that reflect the removal of the CalEPA RfC for Trichloroethylene (TCE). After careful consideration, it was determined that the resulting noncancer screening level may not be protective of non-carcinogenic effects.

June 20, 2008

- New Tables generated that corrected the usage of the "nc" and "ca**" designation in the Summary Table for Tapwater.

June 17, 2008

- New Tables generated that corrected the usage of the "ca**" designation in the Summary Table.

June 13, 2008

- Some duplicate rows were removed from the residential tapwater supporting table.

May 2008

- Website open as a Beta release.
- The lead action level presented in the Generic Tables was changed from 0.015 to 15 ug/L.
- The copper action level presented in the Generic Tables was changed from 1.3 to 1300 ug/L.
- The labels for adult and child body weight in the Calculator output were corrected.
- The target risk labels in the Resident Air Supporting Table were corrected.
- The Inhalation Unit Risk for TCDD was changed to 38 and the Generic Tables were updated.

Top of page

For assistance/questions please use the rsl table contact us page

Frequently Asked Questions (November 2014)

For assistance/questions please use the rsl table contact us page

This page presents many questions asked by site users and the applicable responses. Please search this page for answers to your questions prior to contacting technical support staff. Researching the questions and answers posted here will greatly reduce the time it takes for you to solve many problems that arise from calculating and using this SL site.

To simplify the process of finding a relevant FAQ, the following categories are provided. Simply click the category and you will be taken to list of relevant questions.

Table of Contents

You will need the free Adobe Reader to view some of the files on this page. See EPA's PDF page to learn more.

Background/history of RSLs

- What are SLs?
- Why are SLs used?
- How do SLs differ from cleanup standards?
- How often do you update the SL Table?
- Can I get a copy of a previous SL table?
- Does my region recommend the use of the tables where THQ=1.0 or THQ=0.1? What table do I use and when do I use it?

General Use Questions

- How can I get the calculator results or the other web pages to print on one page?
- Where can I find out about WATER9, CHEMDAT8, and CHEM9?
- Do the fish tissue and/or soil SLs apply to wet-weight or dry-weight data?
- Why do some of the numbers on the SL Table exceed a million parts per million (1E+06 mg/kg)? That's not possible!
- What is the preferred citation for information taken from this website?
- How do I freeze the header row with the column names so it always is visible when I view the tables in a spreadsheet?
- How do I print the tables in black and white so the gray scale doesn't show up?
- Why do the contaminant names no longer appear in the first column in the tables?
- Are the tapwater RSLs based on total (unfiltered) or dissolved (filtered) concentrations?
- Why is rounding in the RSL tables and calculator different from SSSG Appendix A?
- If I have NAPL present in my soil is the soil screening level (SSL) protective of groundwater model used in the RSLs still valid?

Exposure Questions

- The exposure variables table in the SL background document lists the averaging time for non-carcinogens as "ED*365." What does that mean?
- What populations and what exposures are considered in each type of RSL?
- Do the RSLs factor inhalation from vapor intrusion?

General Toxicity Value Issues

- Where else can I go for toxicity studies (values) not on this site?
- I can't find the chemical that I am interested in. Why isn't it in your database? Are there other places where I should look to find the information that I need?

Chemical-specific Issues (sorted alphabetically by chemical)

The list of questions presented below is not in the same order as the questions listed in the five above categories.

1. **What are SLs?**

   The screening levels (SLs) presented on this site are developed using risk assessment guidance from the EPA Superfund program and can be used for Superfund sites. They are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data. SLs are considered by the Agency to be protective for humans (including sensitive groups) over a lifetime; however, SLs are not always applicable to a particular site and do not address non-human health endpoints, such as ecological impacts. The SLs contained in the SL table are generic; they are calculated without site-specific information. They may be re-calculated using site-specific data.

2. **Why are SLs used?**

   They are used for site "screening" and as initial cleanup goals, if applicable. SLs are not de facto cleanup standards and should not be applied as such. The SL's role in site "screening" is to help identify areas, contaminants, and conditions that require further federal attention at a particular site. Generally, at sites where contaminant concentrations fall below SLs, no further action or study is warranted under the Superfund program, so long as the exposure assumptions at a site match those taken into account by the SL calculations. Chemical concentrations above the SL would not automatically designate a site as "dirty" or trigger a response action; however, exceeding a SL suggests that further evaluation of the potential risks by site contaminants is appropriate. SLs are also useful tools for identifying initial cleanup goals at a site. In this role, SLs provide long-term targets to use during the analysis of different remedial alternatives. By developing SLs early in the decision-making process, design staff may be able to streamline the consideration of remedial alternatives.

3. **How do SLs differ from cleanup standards?**

SLs are generic screening values, not de facto cleanup standards. Once the Baseline Risk Assessment (BLRA) is completed, site-specific risk-based remediation goals can be derived using the BLRA results. The selection of final cleanup goals may also include (Applicable or Relevant and Appropriate Requirements (ARARs) and to be considered guidance (TBCs), as well as site-specific risk-based goals.

In the Superfund program, this evaluation is carried out as part of the nine criteria for remedy selection outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Once the nine-criteria analysis is completed, the SL may be retained as is or modified (based on site-specific information) prior to becoming established as a cleanup standard. This site-specific cleanup level is then documented in the Record of Decision.

4. **How often do you update the SL Table?**

   It is anticipated that the SLs will be updated approximately semiannually in the Fall and Spring. Please take note of the "What's New" page to identify when toxicity values are updated.

5. **Can I get a copy of a previous SL table?**

   We do not distribute outdated copies of the SL table. Each new version of the table supersedes all previous versions. If you wish to maintain previous versions of the SLs for a long-term project, you can download the entire table and save multiple versions with a time-stamp.

6. **How can I get the calculator results or the other web pages to print on one page?**

   Historically this was an issue for the RSL calculator. Now calculator results can be accessed in PDF or Spreadsheet files. At the top of the RSL calculator results page, output links can be found.

7. **Where else can I go for toxicity studies (values) not on this site?**

   The EPA toxicity value hierarchy is explained in the User's Guide of this website. For chemicals not listed in the hierarchy, toxicity information may be obtained by contacting the U.S. EPA Superfund Health Risk Technical Support Center at (513) 569-7300 or the Agency for Toxic Substances and Disease Registry (ATSDR) Information Center at 1-888-422-8737. Consult with your regional risk assessor when considering toxicity values not listed on these tables. For occupational exposure standards, try NIOSH, WHO, or OSHA. For information on nerve agents, contact DENIX.

8. **Where can I find out about WATER9, CHEMDAT8, and CHEM9?**

   These programs help estimate various chemical-specific parameters such as diffusivity in air and water. WATER9 is an analytical model for estimating compound-specific air emissions from wastewater collection & treatment systems. CHEMDAT8 is a Lotus 1-2-3 spreadsheet that includes analytical models for estimating VOC emissions from treatment, storage and disposal facility (TSDF) processes. CHEM9 is a compound properties processor that is based upon an EPA compound database of over 1000 compounds. It provides the capability to estimate compound properties that are not available in the database, including the compound volatility and the theoretical recovery (fraction measured (Fm)) for EPA test methods 25D and 305.

9. **I can't find the chemical in which I am interested. Why isn't it in your database? Are there other places where I should look to find the information that I need?**

   The Generic Tables are not completely alphabetical. Some chemicals are listed together under a broader chemical group.

   If you are trying to locate various PAHs or PCBs, they are listed in the table under Polynuclear Aromatic Hydrocarbons and Polychlorinated Biphenyls, respectively. Also, dioxin congeners may be compared with the SL for congener 2,3,7,8-TCDD, once the appropriate Toxicity Equivalence Factors have been applied.

   Chemical groups are in bold type in the tables and chemicals in those groups are indented. Your chemical may be listed in one of the following chemical groups:

   - Cyanides
   - Dioxins
   - Furans
   - Lead Compounds
   - Mercury Compounds
   - Perchlorates
   - Phosphates, Inorganic
   - Phthalates
   - Polychlorinated Biphenyls (PCBs)
   -

Polynuclear Aromatic Hydrocarbons (PAHs)

If you still cannot find the chemical in the database, it means that we have no EPA toxicity value for it. The SL table only includes chemical species for which we have toxicity values or MCLs.

Consult with your regional risk assessor when searching for toxicity values not listed on these tables.

There are many other useful toxicological/risk assessment sites on the internet. In many cases, data may be available but will require a literature search.

The calculator allows the user to calculate SLs for a chemical not in our database. Select "Test Chemical" in the pick list and one can enter chemical-specific information for any chemical not already listed.

RSL Chemical Name	Synonym
Ethyl Chloride	Chloroethane
Picramic Acid	2-Amino-4,6-dinitrophenol
Stirofos	Tetrachlorovinphos
Tertyl	Trinitrophenylmethylnitramine
o-cresol	2-methylphenol
m-cresol	3-methylphenol
p-cresol	4-methylphenol
Methylene Chloride	Dichloromethane
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX
Hexachlorocyclohexane, Gamma	Lindane

10. **For manganese, IRIS shows an oral RfD of 0.14 mg/kg-day, but the SL Table uses 0.024 mg/kg-day. Why?**

    The IRIS RfD includes manganese from all sources, including diet. The explanatory text in IRIS recommends using a modifying factor of 3 when calculating risks associated with non-food sources, and the SL table follows this recommendation. IRIS also recommends subtracting dietary exposure (default assumption in this case is 5 mg). Thus, the IRIS RfD has been lowered by a factor of 2 x 3, or 6. The table now reflects manganese for "non-food" sources.

11. **Can the oral RfDs in the SL Table be applied to dermal exposure?**

    Not directly. Oral RfDs are usually based on administered dose and therefore tacitly include a GI absorption factor. Thus, any use of oral RfDs (or CSFs) in dermal risk calculations should involve removing this absorption factor. Consult the Risk Assessment Guidance for Superfund, Part A, Appendix A, for further details on how to do this. (See also RAGS Part E.)

    Note that the SL table displays the GIABS used in dermal SL calculations.

12. **The exposure variables table in the SL background document lists the averaging time for non-carcinogens as "ED*365." What does that mean?**

    ED is exposure duration, in years, and * is the computer-ese symbol for multiplication. Multiplying ED by 365 simply converts the duration to days. In fact, the ED term is included in both the numerator and denominator of the SL algorithms for non-cancer risk, canceling it altogether. See RAGS for more information.

13. **Where did the inorganic lead SL value in the Table come from?**

    EPA has no consensus RfD or CSF for inorganic lead, so it is not possible to calculate SLs as we have done for other chemicals. EPA considers lead to be a special case because of the difficulty in identifying the classic "threshold" needed to develop an RfD.

    EPA therefore evaluates lead exposure by using blood-lead modeling, such as the Integrated Exposure-Uptake Biokinetic Model (IEUBK). The EPA Office of Solid Waste has also released a detailed directive on risk assessment and cleanup of residential soil lead. The directive recommends that soil lead levels less than 400 mg/kg are generally safe for residential use. Above that level, the document suggests collecting data and modeling blood-lead levels with the IEUBK model. For the purposes of screening, therefore, 400 mg/kg is recommended for residential soils. For water, we suggest 15 µg/L (the EPA Action Level in water), and for air, the National Ambient Air Quality Standard of 0.15 $\mu g/m^3$.

However, caution should be used when both water and soil are being assessed. The IEUBK model shows that if the average soil concentration is 400 mg/kg, an average tap water concentration above 5 µg/L would yield more than than a 5% probability of exceeding a 10 µg/L/dL blood-lead level for a typical child. If the average tap water concentration is 15 µg/L, an average soil concentration greater than 250 mg/kg would yield more than a 5% probability of exceeding a 10 µg/L/dL blood-lead level for a typical child.

For more information see Addressing Lead At Superfund Sites.

14. **Where did the cancer toxicity values for carcinogenic PAHs come from?**

    The PAH SFOs are all calculated relative to benzo[a]pyrene, which has an IRIS slope factor. The relative factors for the other PAHs can be found in *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons*. The Toxicity Equivalency Factors (TEFs) are listed in Section 2.3.5 of the User's Guide. The PAH IURs are all from California EPA.

15. **Why is there no oral RfD for mercury? How should I handle mercury?**

    IRIS gives oral RfDs for mercuric chloride and for methylmercury, but not for elemental mercury. Therefore, the SL Table follows suit. Consult your toxicologist to determine which of the available mercury numbers is suitable for the conditions at your site (e.g., whether mercury is likely to be organic or inorganic.)

16. **The cadmium numbers are labeled "food" and "water." Which do I use if I have another medium, such as soil?**

    "Food" is for food and soil use; "water" is for water only. Further, the cadmium RfDs on IRIS are based on the same study. The food RfD incorporates a 2.5% absorption adjustment; the water RfD incorporates a 5% absorption adjustment. For another medium such as soil, the risk assessor should choose the number whose absorption factor most closely matches the expected conditions at the site. For example, if the expected absorption of cadmium from soil is 3%, the food-based number would be a good approximation. In most cases, the expected absorption is unknown and the RfD for food should be used for soil screening without making any changes to the value.

17. **The slope factors for benzene are actually ranges, yet the SL table shows only a single number. Which number was chosen and why?**

    The upper end of the slope factor range was chosen. This is because the SL Table is a screening tool, and the consequences of screening out a chemical that could pose a significant risk are more serious than the consequences of carrying the chemical through to the next step of the risk assessment. (At each step of the risk assessment, the risk is further refined using site-specific analysis. Chemicals can always be eliminated from the risk assessment at a later step than the initial screening, if appropriate.)

18. **What toxicity values are used for TCE?**

    IRIS has recently released a Toxicity Assessment for TCE. IRIS suggests that the kidney risk be assessed using the mutagenic equations and the liver and non-Hodgkin lymphoma (NHL) be addressed using the standard cancer equations. In order to make the calculator display the correct results for TCE, the standard cancer and mutagen equations needed to be combined. Since TCE requires the use of different toxicity values for cancer and mutagen equations, it was decided to make a toxicity value adjustment factor for cancer (CAF) and mutagens (MAF). The adjustments were done for oral (o) and inhalation (i). These adjustment factors are used in the TCE equation images presented in section 4 of the User Guide. The equations used to generate adjustment factors are presented below. The adjustment factors are based on the adult-based toxicity values and these are the cancer toxicity values presented in the Generic Tables.

$$CAF_o\left(0.804\right) = \frac{CSF_o\left(\frac{3.7\times10^{-2}mg}{Kg-day}\right)^{-1}\ \text{NHL+Liver oral slope factor}}{CSF_o\left(\frac{4.6\times10^{-2}mg}{Kg-day}\right)^{-1}\ \text{Adult}-\text{based oral slope factor}} \quad MAF_o\left(0.202\right) = \frac{CSF_o\left(\frac{9.3\times10^{-3}mg}{Kg-day}\right)^{-1}\ \text{Kidney oral slope factor}}{CSF_o\left(\frac{4.6\times10^{-2}mg}{Kg-day}\right)^{-1}\ \text{Adult}-\text{based oral slope factor}}$$

$$CAF_i\left(0.756\right) = \frac{IUR\left(3.1\times10^{-6}\ \mu g/m^3\right)^{-1}\ \text{NHL+Liver unit risk estimate}}{IUR\left(4.1\times10^{-6}\ \mu g/m^3\right)^{-1}\ \text{Adult}-\text{based unit risk estimate}} \quad MAF_i\left(0.244\right) = \frac{IUR\left(1\times10^{-6}\ \mu g/m^3\right)^{-1}\ \text{Kidney unit risk estimate}}{IUR\left(4.1\times10^{-6}\ \mu g/m^3\right)^{-1}\ \text{Adult}-\text{based unit risk estimate}}$$

The calculator, if run in default mode, will now produce accurate TCE RSLs for all land uses. The old three step process is no longer necessary.

19. **IRIS presents 2 types of toxicity values for vinyl chloride yet the SL table shows only a single number. Which number was chosen and why?**

The vinyl chloride calculations were based on the examples given in the Toxicological Review for vinyl chloride, which appears on IRIS. IRIS presents "continuous lifetime exposure during adulthood" and "continuous lifetime exposure from birth" slope factors and inhalation unit risks. Because the equations used on this website show the individual lifetime segments, the "continuous lifetime exposure during adulthood" toxicity values are chosen.

The examples in the Toxicological Review indicate that, during childhood, both pro-rated and non-pro-rated risks should be generated using the lower slope factor or IUR. When estimating the risk using this method and considering the lifetime segments during childhood and adulthood, it is clear that the cancer risks early in life are higher than those that would be generated if the typical pro-rated risks were simply generated using the lifetime CSF or IUR. This finding is consistent with the IRIS assessment's statements that cancer risk is increased during early life.

Over the course of a 70-year lifetime, the risk generated using the pro-rated and non-pro-rated segments, along with the lower CSF or IUR, generally exceeds the risk generated using only pro-rated exposure and the lifetime CSF or IUR. However, the former risk estimates trend closer and closer to the latter as life advances, and converge at about the 70-year mark.

20. **2,4/2,6-dinitrotoluene mixture has a cancer slope factor, why don't the individual isomers use the same slope factor?**

It was determined for this website that the IRIS toxicological profile did not adequately address this issue.

21. **Do the fish tissue and/or soil SLs apply to wet-weight or dry-weight data?**

The fish SLs represent the concentration that can be consumed at the rate indicated in the Technical Background Document. Therefore, wet or dry weight is not an inherent assumption of the SL numbers. Rather, users of the Table should consider whether their population of interest is more likely to consume the fish using a preparation method that is better simulated by a wet or dry weight. (For example, consumption of raw or fried fish would be more likely represented by wet weight, whereas consumption of smoked or dried fish might be better represented by dry weight.) In other words, the use of a site-specific sample as wet or dry weight should be governed by its representativeness for the population of interest.

When applying the RSL for soil to a soil sample, consult the Quality Assurance Project Plan for the sampling regime and analysis. For example, inorganic compounds in soils are dried prior to the extraction process for analysis while VOCs are not. As always, please consult your Regional risk assessor when applying the RSLs to site - specific data.

22. **Why do some of the numbers on the SL Table exceed a million parts per million (1E+06 mg/kg)? That's not possible!**

For certain low-toxicity chemicals, the SLs exceed possible concentrations at the target risks. Many years ago, these SLs were rounded to the highest possible concentration, or 1.0E+06 ppm. This type of truncation has been discontinued so that Table users can adjust the SLs to a different target risk whenever necessary. For example, when screening chemicals at a target HQ of 0.1, noncarcinogenic SLs may simply be divided by 10. Such scaling is not possible when SLs are rounded. Users who are interested in truncation can also consult the Soil Screening Guidance for a discussion of "Csat," the saturation concentration, which reflects physical limits on soil concentrations.

SLs may also exceed a non-risk based 'ceiling limit' concentration of 1.0E+05 mg/kg ('max') for relatively less toxic inorganic and semivolatile contaminants. The ceiling limit of 1.0E+05 mg/kg is equivalent to a chemical representing 10% by weight of the soil sample. At this contaminant concentration (and higher), the assumptions for soil contact may be violated (for example, soil adherence and wind-borne dispersion assumptions) due to the presence of the foreign substance itself.

The calculator, if operated in site-specific mode, will give the option to apply the C_{sat} substitution rule as well as the option to apply the theoretical ceiling limit.

23. **Why isn't oral/inhalation route-to-route extrapolation used to generate toxicity factors on the Screening Table?**

Previous versions of regional screening tables did contain some route-to-route extrapolation, because of the scarcity of inhalation toxicity factors. However, this was not optimal due to the uncertainty associated with making such adjustments (e.g., point-of-entry, first-pass, and route-specific effects may not be adequately considered by simple extrapolations). With the increasing availability of Tier III toxicity values, generic route-to-route extrapolation has been discontinued. Chemical-specific route-to-route extrapolation may be used by Tier I, II, or III sources after thorough consideration of the chemical-specific issues.

24. **Previous Regional Tables used Inhalation Reference Doses (RfDi) and Slope Factors (SFI). Why does the new table use RfCs and IURs?**

In the past, some regional tables converted RfCs to RfDs and IURs to SFIs for inhalation. This was initially done because risk equations once relied upon RfDs and SFIs in units of mg/kg/day and 1/mg/kg/day, respectively. However, as the inhalation guidance has evolved, RfCs and IURs, in units of mg/m^3 and $m^3/\mu g/L$ respectively, have become the recommended toxicity factors. Please see Methods for Derivation of Inhalation Reference Concentrations (RfCs) and Application of Inhalation Dosimetry or (PDF) for more information. Also please see the FAQ concerning route-to-route extrapolation.

25. **How were the toxicity values provided in IRIS on chromium used to calculate chromium screening levels?**

Beginning in the Fall 2009, we are more strongly encouraging the collection of valent-specific data when chromium is likely to be a COC at the site, and we are no longer calculating default screening levels for total chromium. We are instead calculating screening levels for Cr(III) using toxicity values derived for Cr(III) and using toxicity values derived for Cr(VI) for Cr(VI) screening levels. IRIS Provides two RfC values (8E-6 mg/m^3 for chromic acid mists and Cr(VI) aerosols and 1E-4 mg/m^3 for Cr(VI) particulates). Our default screening levels use the RfC of 1E-4 mg/m^3 for particulates. Review of site specific information may warrant the use of the RfC of 8E-6 mg/m^3 when chromic acid mists or dissolved Cr(VI) aerosols are being assessed. All of the toxicity values used for Cr(III) and Cr(VI) come from IRIS, except (as noted in the following FAQ) the oral slope factor for Cr(VI) which was originally derived by New Jersey Department of Environmental Protection scientists.

In the RSL Table, the Cr(VI) specific value (assuming 100% Cr(VI)) is derived by multiplying the IRIS Cr(VI) Inhalation Unit Risk value by 7. This is considered to be a health-protective assumption, and is also consistent with the State of California's interpretation of the Mancuso study that forms the basis of Cr(VI)'s estimated cancer potency.

If you are working on a chromium site, you may want to contact the appropriate regulatory officials in your region to determine what their position is on this issue.

The Maximum Contaminant Level (MCL) of 100 µg/L for "Chromium (total)", from the EPA's MCL listing is shown on the total chromium line in the tables.

For more information see User Guide Section on Chromium.

26. **Why are the screening levels for Cr(VI) significantly lower than previous values?**

The New Jersey Department of Environmental Protection (NJDEP) recently determined that Cr(VI) by ingestion is likely to be carcinogenic in humans. NJDEP and derived a new oral cancer slope factor, based on cancer bioassays conducted by the National Toxicology Program (http://www.state.nj.us/dep/dsr/chromium/soil-cleanup-derivation.pdf). In addition, EPA?s Office of Pesticide Programs (OPP) has concluded that the weight-of-evidence supports that Cr(VI) may act through a mutagenic mode of action following administration via drinking water and has also recommended that Age-Dependent Adjustment Factors (ADAFs) be applied when assessing cancer risks from early-life exposure (< 16 years of age).

Both of these assessments are considered Tier 3 sources and were used to derive the screening levels for Cr(VI). We applied ADAFs for early life exposure via ingestion and inhalation because OPP?s proposed mutagenic mode of action for Cr(VI) occurs in all cells, regardless of type. Application of ADAFs for all exposure pathways results in more health-protective screening levels.

For more information see User Guide Section on Chromium.

27. **What are the sources of toxicity values used on this site?**

In 2003, EPA's Superfund program revised its hierarchy of human health toxicity values, providing three tiers of toxicity values (http://www.epa.gov/oswer/riskassessment/pdf/hhmemo.pdf). Three tier 3 sources were identified in that guidance, but it was acknowledged that additional tier 3 sources may exist. The 2003 guidance did not attempt to rank or put the identified tier 3 sources into a hierarchy of their own. However, when developing the screening tables and calculator presented on this website, EPA needed to establish a hierarchy among the tier 3 sources. The toxicity values used as "defaults" in these tables and calculator are consistent with the 2003 guidance. Toxicity values from the following sources in the order in which they are presented below are used as the defaults in these tables and calculator.

1. EPA's Integrated Risk Information System (IRIS)
2. The Provisional Peer Reviewed Toxicity Values (PPRTVs) derived by EPA's Superfund Health Risk Technical Support Center (STSC) for the EPA Superfund program.
3. The Agency for Toxic Substances and Disease Registry (ATSDR) minimal risk levels (MRLs)
4. The California Environmental Protection Agency (OEHHA) Office of Environmental Health Hazard Assessment's Chronic Reference Exposure Levels (RELS) from October 2013 and the Cancer Potency Values from July 21, 2009 with updates in 2011 for dioxin/furans and dioxinlike PCBs. In July 2014 additional cancer and noncancer toxicity values were provided in, "Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values".
5. In the Fall 2009, this new source of toxicity values used was added: screening toxicity values in an appendix to certain PPRTV assessments. While we have less confidence in a screening toxicity value than in a PPRTV, we put these ahead of HEAST toxicity values because these appendix screening toxicity values are more recent and use current EPA methodologies in the derivation, and because the PPRTV appendix screening toxicity values also receive external peer review.
6. The EPA Superfund program's Health Effects Assessment Summary Table.

   Users of these screening tables and calculator wishing to consider using other toxicity values, including toxicity values from additional sources, may find the discussions and seven preferences on selecting toxicity values in the attached Environmental Council of States paper useful for this purpose (ECOS website), (ECOS paper).

   When using toxicity values, users are encouraged to carefully review the basis for the value and to document the basis of toxicity values used on a CERCLA site.

   Please contact a Superfund risk assessor in your Region for help with chemicals that lack toxicity values in the sources outlined above.

28. **Why is the tapwater screening level for Perchlorate of 11 µg/L different from the preliminary remedial goal (PRG) of 15 µg/L calculated by the Office of Solid Waste and Emergency Response in its January 8, 2009, guidance (perchlorate_memo_01_08_09.pdf)?**

As described in the OSWER memorandum, the Agency has now issued an Interim Drinking Water Health Advisory (Interim Health Advisory) for exposure to perchlorate of 15 µg/L in water. A health advisory provides technical guidance to federal, state, and other public health officials on health effects, analytical methods and treatment technologies associated with drinking water contamination. The Interim Health Advisory for perchlorate was developed using EPA's RfD of of 7E-04 mg/kg-day and representative body weight, as well as 90th percentile drinking water and national food exposure data for pregnant women in order to protect the most sensitive population identified by the National Research Council (NRC) (i.e., the fetuses of pregnant women who might have hypothyroidism or iodide deficiency).

The NCP (40 CFR 300.430(e)(2)(A)(1)) provides that when establishing acceptable exposure levels for use as remediation goals (for a Superfund site), consideration must be given to concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effects over a lifetime or part of a lifetime, incorporating an adequate margin of safety. As a result of the publication of the Interim Health Advisory for perchlorate, OSWER recommends that where no federal or state applicable or relevant and appropriate (ARAR) requirements exist under federal or state laws, 15 µg/L (or 15 ppb) is recommended as the PRG for perchlorate when making CERCLA site-specific cleanup decisions where there is an actual or potential drinking water exposure pathway. However, where State regulations qualify as ARARs for perchlorate, the remediation goals established shall be developed considering the State regulations that qualify as ARARs, as well as other factors cited in the NCP (see 40 CFR 300.430(e)(2)(i)(ff)). Final remediation goals and remedy decisions are made in accordance with 40 CFR300.430 (e) and (f) and associated provisions.

Preliminary remediation goals are the starting points in the development of final cleanup levels at sites. As at all sites addressed under the NCP, these goals may be modified, depending on physical characteristics of a site, State laws and guidance, and other site specific factors, such as additional exposure routes.

One can derive a Drinking Water Equivalent Level of 11 μg/L using EPA's reference dose (RfD) of 7E-04 mg/kg-day and an assumption that all exposure to perchlorate comes from groundwater.

29. **What is the preferred citation for information taken from this website?**

    United States Environmental Protection Agency Regions 3, 6, and 9. (Insert date accessed). Regional Screening Levels for Chemical Contaminants at Superfund Sites. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

30. **How was the copper RfD derived?**

    Currently the RfD is 0.04 mg/kg-day with a reference of HEAST. Actually, HEAST presents a concentration in drinking water screening level of 1.3 mg/L. In order to use the value to assess oral exposures to other media, we "back out" the adult exposure assumptions (e.g. body weight of 70 kg, ingestion rate of 2 L/day) that go into the calculation of a drinking water screening level.

31. **Where do the RfDs and RfCs for the xylene congeners come from?**

    The IRIS RfD and RfC values for "xylene, mixture" are used as surrogate values for the individual congeners. The earlier RfD values for some xylene isomers were withdrawn from our electronic version of HEAST. The IRIS RfC value replaces values from Cal EPA.

32. **How do I freeze the header row with the column names so it always is visible when I view the tables in a spreadsheet?**

    There are times when you have many rows of data in a spreadsheet program. On the top of the page are labels but when you scroll down for more data, the labels go away. One way to prevent this from happening is to freeze panes, so when you scroll down, the labels won't move. Click your cursor into the row BELOW the column headers. In the Main Menu of Excel go to "Window" and select "Freeze Pane". For newer versions of Excel, click on the "View" tab and click the Freeze Panes" icon. Columns can also be frozen in a similar manner.

33. **Why do the contaminant names no longer appear in the first column in the tables?**

    There is a lot of information provided in the lines in the table which causes the print to be quite small. Many users make the print larger on their screen, but when they do this and scroll over to the columns on the right it is hard to determine which line pertains to your contaminant of interest, because the contaminant name no longer appears on the screen. The contaminant names and their CASRNs were moved to the middle of the lines so that the contaminant name would nearly always be visible on your screen.

34. **What populations and what exposures are considered in each type of RSL?**

    The following table lists the land uses addressed, media addressed and the age of the receptor utilized in the RSL table.

		Exposure Routes (Cancer)			Exposure Routes (Noncancer)		
Land use	Media	Oral	Dermal	Inhalation	Oral	Dermal	Inhalation
Resident	Soil	Adult + Child	Adult + Child	Both	Child	Child	Both
	Tapwater	Adult + Child	Adult + Child	Both	Child	Child	Both
	Air	NA	NA	Both	NA	NA	Both
Composite Worker	Soil	Adult	Adult	Adult	Adult	Adult	Adult
	Air	NA	NA	Adult	NA	NA	Adult
Soil to Groundwater	Soil	Adult + Child	Adult + Child	Both	Both	Child	Child

NA = Not Applicable

The following table lists the land uses addressed, media addressed and the age of the receptor utilized in the RSL calculator.

		Exposure Routes (Cancer)			Exposure Routes (Noncancer)		
Land use	Media	Oral	Dermal	Inhalation	Oral	Dermal	Inhalation
Resident	Soil	Adult + Child	Adult + Child	Both	Both	Both	Both
	Tapwater	Adult + Child	Adult + Child	Both	Both	Both	Both
	Air	NA	NA	Both	NA	NA	Both

Recreator	Soil/Sediment	Adult + Child	Adult + Child	Both	Both	Both	Both
	Surface Water	Adult + Child	Adult + Child	NA	Both	Both	NA
Outdoor Worker	Soil	Adult	Adult	Adult	Adult	Adult	Adult
	Air	NA	NA	Adult	NA	NA	Adult
Indoor Worker	Soil	Adult	NA	Adult	Adult	NA	Adult
	Air	NA	NA	Adult	NA	NA	Adult
Composite Worker	Soil	Adult	Adult	Adult	Adult	Adult	Adult
	Air	NA	NA	Adult	NA	NA	Adult
Construction Worker	Soil	Adult	Adult	Adult	Adult	Adult	Adult
	Air	NA	NA	NA	NA	NA	NA
Fish	Fish	Adult	NA	NA	Adult	NA	NA
Soil to Groundwater	Soil	Adult + Child	Adult + Child	Both	Both	Both	Both

NA = Not Applicable

35. **Do the RSLs factor inhalation from vapor intrusion?**

Air RSLs represent screening levels for indoor or outdoor air. There are no RSLs specific to the vapor intrusion pathway, i.e., for subsurface sources that may contribute to indoor air contamination. To estimate indoor air concentrations from subsurface or other sources, consult with regional experts in vapor intrusion.

For links to guidance on vapor intrusion, see http://www.epa.gov/oswer/vaporintrusion/. The EPA 2002 interim draft Vapor Intrusion Guidance can be found there.

The residential and industrial air regional screening values can be used to screen chemicals that are detected in the air (e.g., indoor and outdoor) from a variety of sources.

36. **How do I apply the trihalomethane MCLs?**

The individual trihalomethanes (bromodichloromethane; bromoform; dibromochloromethane, chloroform) all have the MCL of 80 µg/L listed in the RSL table. However, 80 µg/L is the MCL for Total Trihalomethanes.

37. **Since an earlier FAQ said that route to route extrapolations were not used by the RSLs to develop toxicity values, how were the inhalation unit risks derived for Polychlorinated biphenyls (PCBs)?**

Although it is true that route to route extrapolations (oral to inhalation or inhalation to oral) of toxicity values are not used by the RSLs, support for these inhalation unit risk values for PCBs is found in the IRIS assessment on PCBs. IRIS presents the oral slope factors for high, low and lowest risk in section II.B.3. of the IRIS Assessment . The IRIS high risk oral slope factor (SFO) is 2; low risk is 0.4; and lowest is 0.07 (mg/kg-d)$^{-1}$. IRIS states, *"For inhalation of evaporated congeners, the middle-tier slope factor can be converted to a unit risk estimate and ambient air concentrations associated with specified risk levels."* and *"For inhalation of an aerosol or dust contaminated with PCBs, the slope factor for "high risk and persistence" should be used instead."* So, take the "middle tier" SFO of 0.4 and divide by body weight over inhalation rate (70 kg/20 m^3) and divide by 1000 µg/mg and you get 1.E-04 (µg/m^3)$^{-1}$ IUR for low risk IUR. For the high risk take the SFO of 2 and divide by body weight over inhalation rate (70 kg/20 m^3) and divide by 1000 µg/mg and you get 5.7E-04 (µg/m^3)$^{-1}$ for high risk IUR. For the lowest risk take the SFO of 0.07 and divide by body weight over inhalation rate (70 kg/20 m^3) and divide by 1000 µg/mg and you get 2E-05 (µg/m^3)$^{-1}$ for lowest risk IUR.

Aroclor 1016 is considered to be in the lowest risk tier and the other Aroclors on the RSL table are considered to be in the high risk tier.

38. **How do I convert (mg/m^3)$^{-1}$ to (µg/m^3)$^{-1}$?**

Vanadium Pentoxide has an inhalation unit risk (IUR) of 8.3 (mg/m^3)$^{-1}$ presented in a PPRTV however, the RSL equations and database require IURs to be in (µg/m^3)$^{-1}$. For the conversion to be correct, the superscript of -1 must be addressed. The IUR could be presented as 8.3 (m^3/mg) without the superscript. From this point, multiply by 1mg/1000µg and the mg will cancel leaving 8.3E-03 (m^3/µg). Now flip the units to give 8.3E-03 (µg/m^3)$^{-1}$.

39. **How do I convert ATSDR inhalation MRLs in parts per million (ppm) to mg/m^3?**

ATSDR lists the chronic inhalation MRL for acetone as 13 ppm. To convert to mg/m^3, multiply the ppm value by the molecular weight in grams/mole then divide by 24.45. For example: (13ppm * 58.08 g/mole)/24.45 = 30.88 mg/m^3 which is rounded to 3.1E+01 mg/m^3 in the RSL tables. The number 24.45 in the equation above is the volume (liters) of a mole (gram molecular weight) of a gas or vapor when the pressure is at 1 atmosphere (760 torr or 760 mm Hg) and at 25°C.

40. **How do I print the tables in black and white so the gray scale doesn't show up?**

If you need the tables printed in black and white you can quickly remove the color in Excel by clicking the select all button and then checking the "No Fill" box in the Font Group. After these two steps you can print in black and white. In Adobe one can print in gray scale but not in pure black and white.

41. **Why do Tapwater RSLs differ from IRIS drinking water concentrations when both are based on a target cancer risk of 1E-06?**

There are three reasons: 1) IRIS calculations include only exposure to tap water due to ingestion, while the RSLs also include dermal and inhalation exposures. 2) For ingestion and dermal exposure routes the RSL cancer equations age-adjust the intake rates between the child and the adult based on body weight and exposure duration while IRIS only considers the adult intake. 3) The RSL equations also time-adjusts the lifetime intake of 70 years over a 30 year exposure period at 350/365 days a year while IRIS does not time adjust for exposure duration or days per year.

To see an example calculation click here.

42. **Why do air RSLs differ from IRIS air concentrations derived from the same inhalation unit risk values when both are based on a target cancer risk of 1E-06?**

The RSL equation time-adjusts the lifetime of 70 years over a 30 year exposure period at 350/365 days a year while IRIS does not time adjust for exposure duration or days per year.

To see an example calculation click here.

43. **Does my region recommend the use of the tables where THQ=1.0 or THQ=0.1? What table do I use and when do I use it?**

Generally, if you are screening only one contaminant, the THQ=1.0 table can be used. Generally, if you are screening multiple chemicals it is preferred, to use the THQ=0.1 tables.

The rationale for using THQ=0.1 for screening is that when multiple contaminants of concern are present at a site or one or more are present in multiple exposure media, the total hazard index could exceed 1.0 if each were screened at the HQ of 1.0. If you are unclear as to which set of tables (THQ=1.0 or THQ=0.1) to use at a site, consult an EPA risk assessor in your region.

44. **[TCDD] Why was the TCDD (Dioxin) oral slope factor of 130,000 (mg/kg-day)$^{-1}$ (or 1.3E-04 (pg/kg-day)$^{-1}$) chosen?**

Several Tier 3 sources were available that contained oral slope factors for TCDD. In the RSL hierarchy, the CalEPA is the first Tier 3 source to have an oral slope factor, so it was selected. Below are tier 3 oral slope factor sources that can be considered:

- EPA?s Office of Health and Environmental Assessment (EPA 1985) developed an oral cancer slope factor of 1.56E-04 (pg/kg-day)$^{-1}$. This was based on the combined incidence of lung, palate, and nasal carcinomas, and liver hyperplastic nodules or carcinomas in female rats in the study by Kociba et al. (1978).
- EPA (1997a) (EPA?s Health Effects Assessment Summary Table, or HEAST) included an oral CSF of 1.5E-04 (pg/kg-day)$^{-1}$. The citation for the CSF in HEAST lists EPA (1985) as one of the sources for the HEAST value.
- California (CalEPA) (1986, 2002) developed an oral cancer slope factor of 1.3E-04 (pg/kg-day)$^{-1}$. This is based on the occurrence of hepatocellular adenomas and carcinomas in male mice in a study by the National Toxicology Program (NTP 1982).
- Michigan (MDEQ 1998) utilizes an oral cancer slope factor of 7.5E-05 (pg/kg-day)$^{-1}$, which is based on a re-analysis of the histological slides of livers from female rats from the Kociba et al. (1978) study using the liver tumor classification scheme proposed by NTP in 1986 (Maronpot et al. 1986, EPA 1990).
- Minnesota (MNDOH 2003) uses an oral cancer slope factor of 1.4E-03 (pg/kg-day)$^{-1}$, which is based on the draft re-evaluation of the exposure-response data for liver cancer in female rats reported in the draft EPA (2003b) dioxin reassessment.

45. **[Chlordane] Is the CAS number for Chlordane really for Technical Chlordane and what should I use for screening?**

The CAS number provided for Chlordane in the RSL table is the CAS number provided in IRIS for Technical Chlordane. The RSLs strive to use IRIS chemical names and CAS numbers however, in this case our other databases (ATSDR, CalEPA, EPI, etc) have previously used the 57-74-9 CAS number as a catchall for all types of Chlordane.

For screening, the RSL values should be suitable for Chlordane and Technical Chlordane as they are both mixtures of 100s of chemicals and Technical Chlordane production methods can produce different percent mixtures of components. See below for a discussion from IRIS:

> The U.S. EPA (1979) considers technical chlordane (CAS No. 12789-03-6) to be composed of 60% octachloro-4,7-methanotetrahydroindane (the cis and trans isomers) and 40% related compounds.
>
> The term chlordane in association with CAS No.57-74-9 refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components. For example, the mixture used by the National Cancer Institute (NCI) in its 1977 bioassay was described as 94.8% chlordane (cis [or alpha]-chlordane, 71.7%; trans [or gamma]-chlordane, 23.1%) with heptachlor, 0.3%; trans-nonachlor, 1.1%; cis-nonachlor, 0.6%; chlordene isomers, 0.25%; 3% other compounds, and hexachlorocyclopentadiene, 0.25% (NCI, 1977).
>
> Technical chlordane, CAS No. 12789-03-6, is a mixture of chlordane and chlordane related compounds having a lower percentage of the cis and trans isomers and a larger percentage of other compounds relative to mixtures with the above CAS number. Dearth and Hites (1991) identified 147 different compounds in a preparation of technical chlordane. The identity and percent of total for the 12 most abundant compounds were: cis-chlordane, 15%; trans-chlordane, 15%; trans-nonachlor, 9.7%; octachlordane, 3.9%; heptachlor, 3.8%; cis-nonachlor, 2.7%; ?compound K,? 2.6%; dihydrochlordene, 2.2%; nonachlor III, 2%; and three stereoisomeric dihydroheptachlors totaling 10.2%. These 12 compounds comprise 67% of the mixture, and the remaining 33% of the mixture consists of 135 other compounds. Infante et al. (1978) reported another production sample of technical chlordane to have a composition of 38 to 48% cis- and trans-chlordane, 3 to 7 or 7 to 13% heptachlor, 5 to 11% nonachlor, 17 to 25% other chlordane isomers, and a small amount of other compounds. Unless otherwise indicated all studies described in this document were carried out with technical grade chlordane.

If the RSLs were to hold strictly to the CAS numbers and provide separate screening values for Chlordane and Technical Chlordane, the Chlordane toxicity values would come from ATSDR and the Technical Chlordane values would come from IRIS, However, identical chemical-specific parameters would be used from EPI Suite. In fact, the ATSDR switches between both CAS numbers for Chlordane.

46. **Are the tapwater RSLs based on total (unfiltered) or dissolved (filtered) concentrations?**

The tapwater RSLs do not address total vs dissolved components in the drinking water; this is a sampling issue. The tapwater RSLs are for the concentration in the water at the tap regardless of how the water gets there or is sampled. The decision about whether to use total or dissolved data in a risk assessment is a site-specific one; consult your regional risk assessor.

47. **Why is rounding in the RSL tables and calculator different from SSSG Appendix A?**

The Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites in Appendix A presents SSLs above 10 rounded to 2 digits, and below 10 rounded to 1 digit. The RSL tables round to 2 digits for results above and below 10, and the calculator results display 3 digits. The rationale for providing "extra" digits is to assist users in checking the math. When individual exposure route results are rounded, many times it is impossible reproduce the total across multiple routes. Enough digits are provided in RSL tables and calculator results for the user to apply their own rounding protocol.

48. **If I have NAPL present in my soil is the soil screening level (SSL) protective of groundwater model used in the RSLs still valid?**

The RSL tables and the default calculator settings do not substitute C_{sat} for risk-based calculations. If the risk-based concentration exceeds C_{sat}, the resulting SSL concentration may be overly protective. This is because the dissolved, absorbed and vapor concentrations cease to rise linearly as soil concentration increases above the C_{sat} level (pure product or nonaqueous phase liquid (NAPL) is present). The SSL model used in the RSL calculator is not a four phase model. If a NAPL is present at your site more sophisticated models may be necessary. The calculator, if operated in site-specific mode, will give the option to apply the C_{sat} substitution rule.

49. **How are appendix 'toxicity screening values' used in RSL calculation and designated in the RSL tables?**

The Superfund Health Risk Technical Support Center (NCEA-Cincinnati) has derived 'toxicity screening values' in circumstances where data are "insufficient to support derivation" of a Provisional Peer-Reviewed Toxicity Value (PPRTV) under current guidelines, yet it is determined that "information is available for this chemical, which may be of limited use to risk assessors." In such cases, NCEA-Cincinnati summarizes available information in an appendix to a 'PPRTV Derivation Support Document.'

The RSLs for some chemicals are based upon appendix toxicity screening values. To alert users when these toxicity values are used, the key presents an "X" (for Appendix) rather than a "P" (for PPRTV). The reason for this distinction is because appendix toxicity screening values are distinct from PPRTVs and do not carry the same "weight" as PPRTVs.

PPRTVs are developed according to a Standard Operating Procedure and are derived after a review of the relevant scientific literature and generally using the same methods, sources of data, and Agency guidance for value derivation by the U.S. EPA IRIS Program. PPRTVs comprise the second tier of the OSWER-recommended sources of human health toxicity values.

'Toxicity screening values ' are not generally derived using the same methods, sources of data, and Agency guidance for value derivation used by the U.S. EPA IRIS Program. The RSL work-group regards 'toxicity screening values' as a type of Tier 3 toxicity value.

All derivation support documents prepared by the Superfund Health Risk Technical Support Center receive internal and external scientific peer review to ensure their appropriateness within the limitations detailed in the respective document. Neither PPRTVs nor appendix toxicity screening values typically receive the multi-program review provided for IRIS values.

Given these considerations, users of the RSL tables should understand and recognize that medium-specific screening levels based upon appendix toxicity screening values generally have more uncertainty. Questions or concerns about the appropriate use of appendix toxicity screening values or RSLs based upon such toxicity values should be directed to the Superfund Health Risk Technical Support Center.

50. **How are total petroleum hydrocarbon (TPHs) considered in calculating RSLs?**

Traditionally, hydrocarbon-impacted soils at sites contaminated by releases of petroleum fuels have been managed based on their total petroleum hydrocarbon (TPH) content. TPH is a term intended to refer to the total mass of hydrocarbons present without identifying individual compounds. In practice, TPH is defined by the analytical method that is used to measure the hydrocarbon content in contaminated media. To the extent that the hydrocarbon extraction efficiency is not identical for each method, the same sample analyzed by different TPH methods will produce different TPH concentrations.

The hazard and health risk assessments that are typically conducted to support risk management decisions at contaminated sites generally require some level of understanding of the chemical composition of the hydrocarbons that are present in the contaminated media. However, traditional TPH measurement techniques provide no specific information about the hydrocarbons that are detected. Because TPH is not a consistent entity, the assessment of health effects and development of toxicity values for mixtures of hydrocarbons are problematic. In fact, many risk assessors prefer to analyze and assess the individual chemical constituents rather than rely on TPH data; consult with your regional risk assessor for site-specific recommendations. In cases where TPH data are used, more details about the provisional TPH toxicity values are provided below.

In 2009, the Superfund Health Risk Technical Support Center (NCEA-Cincinnati) published a document that provides the data, methods, assumptions for deriving Provisional Peer-Reviewed Toxicity Values (PPRTVs) for each of six fractions of petroleum hydrocarbons. The carbon ranges and representative compounds are listed in the table below. The six TPH fractions were assigned representative compounds for determination of toxicity values and chemical-specific parameters to calculate RSLs. (An average of the chemical-specific parameters for 2-methylnaphthalene and naphthalene was calculated for the medium aromatic fraction.) In addition, there are nine accompanying derivation support documents for n-hexane, benzene, toluene, ethylbenzene, xylenes, commercial or practical grade hexane, midrange aliphatic hydrocarbon streams, white mineral oil, and high-flash aromatic naphtha.

The carbon ranges presented from your analytical laboratory may not exactly match the carbon ranges from the PPRTV assessment. The carbon ranges used in the RSLs are not intended to screen against DRO, ORO and RRO analysis.

TPH Fractions	Number of Carbons	Equivalent Carbon Number Index	Representative Compound (RfD/RfC)
Low aliphatic	C5-C8	EC5-EC8	n-hexane
Medium aliphatic	C9-C18	EC>8-EC16	hydrocarbon streams*
High aliphatic	C19-C32	EC>16-EC35	white mineral oil
Low aromatic	C6-C8	EC6-EC<9	benzene
Medium aromatic	C9-C16	EC9-EC<22	2-methylnaphthalene/naphthalene
High aromatic	C17-C32	EC>22-EC35	fluoranthene

*Medium aliphatic representative compound was not listed in PPRTV paper so n-nonane was selected by the RSL work-group.

Within the Superfund program, when TPHs are considered in the site characterization, they are assessed in supplemental health risk assessments only for potential noncancer health effects. Therefore, starting with the May 2014 update the RSLs are no longer calculated using cancer toxicity values. Most of the carcinogens in the TPH carbon range are individually listed on the RSL table. Combining TPH and individual constituent cancer risks would be overly protective.

51. **Why was the RfC for trans 1,2 dichloroethylene from the PPRTV removed from the RSLs?**

The 1,2-trans dichloroethylene PPRTV was archived due to inconsistencies in the conclusions regarding RfC derivation. (See this memo for further explanation.)

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Resident Soil Equations

- **Noncarcinogenic-child**
  - Ingestion

$$SL_{res\text{-}soil\text{-}nc\text{-}ing\text{-}c}\,(mg/kg) = \frac{THQ \times AT_r\left(\frac{365\ days}{year} \times ED_c\ (6\ years)\right) \times BW_c\ (15\ Kg)}{EF_r\left(\frac{350\ days}{year}\right) \times ED_c\ (6\ year) \times \frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)} \times IRS_c\left(\frac{200\ mg}{day}\right) \times \frac{10^{-6}Kg}{1mg}}$$

  - Dermal

$$SL_{res\text{-}soil\text{-}nc\text{-}der\text{-}c}\,(mg/kg) = \frac{THQ \times AT_r\left(\frac{365\ days}{year} \times ED_c\ (6\ years)\right) \times BW_c\ (15\ Kg)}{EF_r\left(\frac{350\ days}{year}\right) \times ED_c\ (6\ year) \times \frac{1}{\left(RfD_o\left(\frac{mg}{Kg\text{-}day}\right) \times GIABS\right)} \times SA_c\left(\frac{2690\ cm^2}{day}\right) \times AF_c\left(\frac{0.2\ mg}{cm^2}\right) \times ABS_d \times \frac{10^{-6}Kg}{1mg}}$$

  - Inhalation

$$SL_{res\text{-}soil\text{-}nc\text{-}inh\text{-}c}\,(mg/kg) = \frac{THQ \times AT_r\left(\frac{365\ days}{year} \times ED_c\ (6\ years)\right)}{EF_r\left(\frac{350\ days}{year}\right) \times ED_c\ (6\ year) \times ET_{rs}\left(\frac{24\ hours}{day}\right) \times \left(\frac{1\ day}{24\ hours}\right) \times \frac{1}{RfC\left(mg/m^3\right)} \times \left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)} + \frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)}$$

  - Total

$$SL_{res\text{-}soil\text{-}nc\text{-}tot\text{-}c}\,(mg/kg) = \frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}ing\text{-}c}} + \frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}der\text{-}c}} + \frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}inh\text{-}c}}}$$

- **Noncarcinogenic-adult**
  - Ingestion

$$SL_{res\text{-}soil\text{-}nc\text{-}ing\text{-}a}\,(mg/kg) = \frac{THQ \times AT_r\left(\frac{365\ days}{year} \times ED_r\ (26\ years)\right) \times BW_a\ (80\ Kg)}{EF_r\left(\frac{350\ days}{year}\right) \times ED_r\ (26\ year) \times \frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)} \times IRS_a\left(\frac{100\ mg}{day}\right) \times \frac{10^{-6}Kg}{1mg}}$$

- Dermal

$$SL_{res\text{-}soil\text{-}nc\text{-}der\text{-}a}\,(mg/kg)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)\times BW_a\,(80\ Kg)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\,(26\ year)\times\frac{1}{\left(RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS\right)}\times SA_a\left(\frac{6032\ cm^2}{day}\right)\times AF_a\left(\frac{0.07\ mg}{cm^2}\right)\times ABS_d\times\frac{10^{-6}Kg}{1mg}}$$

- Inhalation

$$SL_{res\text{-}soil\text{-}nc\text{-}inh\text{-}a}\,(mg/kg)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\,(26\ year)\times ET_{rs}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^3\right)}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)}$$

- Total

$$SL_{res\text{-}soil\text{-}nc\text{-}tot\text{-}a}\,(mg/kg)=\frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}ing\text{-}a}}+\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}der\text{-}a}}+\frac{1}{SL_{res\text{-}soil\text{-}nc\text{-}inh\text{-}a}}}$$

- **Carcinogenic**
  - Ingestion

$$SL_{res\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFS_{adj}\left(\frac{36750\ mg}{Kg}\right)\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$IFS_{adj}\left(\frac{36750\ mg}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_c\,(6\ years)\times IRS_c\left(\frac{200\ mg}{day}\right)}{BW_c\,(15\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_r\text{-}ED_c\,(20\ years)\times IRS_a\left(\frac{100\ mg}{day}\right)}{BW_a\,(80\ Kg)}$$

  - Dermal

$$SL_{res\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFS_{adj}\left(\frac{112266\ mg}{Kg}\right)\times ABS_d\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$DFS_{adj}\left(\frac{112266\ mg}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_c\,(6\ years)\times SA_c\left(\frac{2690\ cm^2}{day}\right)\times AF_c\left(\frac{0.2\ mg}{cm^2}\right)}{BW_c\,(15\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_r\text{-}ED_c\,(20\ years)\times SA_a\left(\frac{6032\ cm^2}{day}\right)\times AF_a\left(\frac{0.07\ mg}{cm^2}\right)}{BW_a\,(80\ Kg)}$$

  - Inhalation

$$SL_{res\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{IUR\left(\mu g/m^3\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_r\left(\frac{350\ days}{year}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)\times ED_r\,(26\ years)\times ET_{rs}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)}$$

- Total

$$SL_{res\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}inh}}}$$

- **Mutagenic**
  - Ingestion

$$SL_{res\text{-}soil\text{-}mu\text{-}ing}\,(mg/kg)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFSM_{adj}\left(\frac{166833.33\ mg}{Kg}\right)\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$IFSM_{adj\text{-}}\left(\frac{166833.33\ mg}{Kg}\right)=\frac{EF_{ressc\ 0\text{-}2}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\,(yr)\times IRS_c\left(\frac{200\ mg}{day}\right)\times 10}{BW_c\,(15\ Kg)}+\frac{EF_{ressc\ 2\text{-}6}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\,(yr)\times IRS_c\left(\frac{200\ mg}{day}\right)\times 3}{BW_c\,(15\ Kg)}+\frac{EF_{ressa\ 6\text{-}16}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\,(yr)\times IRS_a\left(\frac{100\ mg}{day}\right)\times 3}{BW_a\,(80\ Kg)}+\frac{EF_{ressa\ 16\text{-}26}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\,(yr)\times IRS_a\left(\frac{100\ mg}{day}\right)\times 1}{BW_a\,(80\ Kg)}$$

  - Dermal

$$SL_{res\text{-}soil\text{-}mu\text{-}der}\,(mg/kg)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFSM_{adj}\left(\frac{475598.67\ mg}{Kg}\right)\times ABS_d\times\left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$DFSM_{adj}\left(\frac{475598.67\ mg}{Kg}\right)=\frac{EF_{ressc\ 0\text{-}2}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\,(yr)\times AF_c\left(\frac{0.2\ mg}{cm^2}\right)\times SA_c\left(\frac{2690\ cm^2}{day}\right)\times 10}{BW_c\,(15\ Kg)}+\frac{EF_{ressc\ 2\text{-}6}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\,(yr)\times AF_c\left(\frac{0.2\ mg}{cm^2}\right)\times SA_c\left(\frac{2690\ cm^2}{day}\right)\times 3}{BW_c\,(15\ Kg)}+\frac{EF_{ressa\ 6\text{-}16}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\,(yr)\times AF_a\left(\frac{0.07\ mg}{cm^2}\right)\times SA_a\left(\frac{6032\ cm^2}{day}\right)\times 3}{BW_a\,(80\ Kg)}+\frac{EF_{ressa\ 16\text{-}26}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\,(yr)\times AF_a\left(\frac{0.07\ mg}{cm^2}\right)\times SA_a\left(\frac{6032\ cm^2}{day}\right)\times 1}{BW_a\,(80\ Kg)}$$

  - Inhalation

$$SL_{res\text{-}soil\text{-}mu\text{-}inh}\left(mg/kg\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}{ET_{rs}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\begin{array}{l}\left(EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\left(yrs\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 10\right)+\\\left(EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\left(yrs\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 3\right)+\\\left(EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\left(yrs\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 3\right)+\\\left(EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\left(yrs\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 1\right)\end{array}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)}$$

- Total

$$SL_{res\text{-}soil\text{-}mu\text{-}tot}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}mu\text{-}ing}}+\frac{1}{SL_{res\text{-}soil\text{-}mu\text{-}der}}+\frac{1}{SL_{res\text{-}soil\text{-}mu\text{-}inh}}}$$

- **Vinyl Chloride**
  - Ingestion

$$SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}ing}\left(mg/kg\right)=\frac{TR}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFS_{adj}\left(\frac{36750\ mg}{kg}\right)\times\frac{10^{-6}Kg}{1\ mg}}{AT_r\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}\right)+\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IRS_c\left(\frac{200\ mg}{day}\right)\times\frac{10^{-6}Kg}{1\ mg}}{BW_c\left(15\ kg\right)}\right)}$$

where:

$$IFS_{adj}\left(\frac{36750\ mg}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_c\left(6\ years\right)\times IRS_c\left(\frac{200\ mg}{day}\right)}{BW_c\left(15\ Kg\right)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_r\text{-}ED_c\left(20\ years\right)\times IRS_a\left(\frac{100\ mg}{day}\right)}{BW_a\left(80\ Kg\right)}$$

  - Dermal

$$SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}der}\,(mg/kg)=\frac{TR}{\left(\frac{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times DFS_{adj}\left(\frac{112266\ mg}{kg}\right)\times ABS_d\times\frac{10^{-6}Kg}{1\ mg}}{AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}\right)+\left(\frac{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times SA_c\left(\frac{2690\ cm^2}{day}\right)\times AF_c\left(\frac{0.2\ mg}{cm^2}\right)\times ABS\times\frac{10^{-6}Kg}{1\ mg}}{BW_c\,(15\ kg)}\right)}$$

where:

$$DFS_{adj}\left(\frac{112266\ mg}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_c\,(6\ years)\times SA_c\left(\frac{2690\ cm^2}{day}\right)\times AF_c\left(\frac{0.2\ mg}{cm^2}\right)}{BW_c\,(15\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_r\text{-}ED_c\,(20\ years)\times SA_a\left(\frac{6032\ cm^2}{day}\right)\times AF_a\left(\frac{0.07\ mg}{cm^2}\right)}{BW_a\,(80\ Kg)}$$

- Inhalation

$$SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}inh}\,(mg/kg)=\frac{TR}{\left(\frac{IUR\left(\mu g/m^3\right)^{-1}\times EF_r\left(\frac{350\ days}{year}\right)\times ED\,(26\ years)\times ET_{rs}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times VF_s\left(\frac{m^3}{kg}\right)}\right)+\left(\frac{IUR\left(\mu g/m^3\right)^{-1}}{VF_s\left(\frac{m^3}{kg}\right)}\times\left(\frac{1000\ \mu g}{mg}\right)\right)}$$

- Total

$$SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}ing}}+\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}der}}+\frac{1}{SL_{res\text{-}soil\text{-}ca\text{-}vc\text{-}inh}}}$$

- **Trichloroethylene**
  - Ingestion

$$PRG_{res\text{-}soil\text{-}tce\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{ress}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times\left(\frac{10^{-6}Kg}{mg}\right)\times\left(\left(CAF_o\,(0.804)\times IFS_{res\text{-}adj}\left(\frac{37650\ mg}{Kg}\right)\right)+\left(MAF_o\,(0.202)\times IFSM_{res\text{-}adj}\left(\frac{166833.33\ mg}{Kg}\right)\right)\right)}$$

where:

$$IFS_{res\text{-}adj}\left(\frac{36750\ mg}{Kg}\right)=\frac{ED_{ressc}\,(6\ years)\times EF_{ressc}\left(\frac{350\ days}{year}\right)\times IRS_{ressc}\left(\frac{200\ mg}{day}\right)}{BW_{ressc}\,(15\ Kg)}+\frac{ED_{ress}\,(26\ years)-ED_{ressc}\,(6\ years)\times EF_{ressa}\left(\frac{350\ days}{year}\right)\times IRS_{ressa}\left(\frac{100\ mg}{day}\right)}{BW_{ressa}\,(80\ Kg)}$$

where:

$$IFSM_{res\text{-}adj\text{-}}\left(\frac{166833.33\ mg}{Kg}\right)=\frac{ED_{0\text{-}2}\,(2years)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times IRS_{0\text{-}2}\left(\frac{200\ mg}{day}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+\frac{ED_{2\text{-}6}\,(4years)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times IRS_{2\text{-}6}\left(\frac{200\ mg}{day}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+\frac{ED_{6\text{-}16}\,(10years)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times IRS_{6\text{-}16}\left(\frac{100\ mg}{day}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+\frac{ED_{16\text{-}26}\,(10\ years)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times IRS_{16\text{-}26}\left(\frac{100\ mg}{day}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- Dermal

$$PRG_{res\text{-}soil\text{-}tce\text{-}der}\,(mg/kg) = \frac{TR \times AT_{ress}\left(\frac{365\ days}{year}\right) \times LT\,(70\ years)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}Kg}{mg}\right) \times \left(\left(CAF_o\,(0.804) \times DFS_{res\text{-}adj}\left(\frac{112266\ mg}{Kg}\right) \times ABS_d\right) + \left(MAF_o\,(0.202) \times DFSM_{res\text{-}adj}\left(\frac{475598.67\ mg}{Kg}\right) \times ABS_d\right)\right)}$$

where:

$$DFS_{res\text{-}adj}\left(\frac{112266\ mg}{Kg}\right) = \frac{ED_{ressc}\,(6\ years) \times EF_{ressc}\left(\frac{350\ days}{year}\right) \times SA_{ressc}\left(\frac{2690\ cm^2}{day}\right) \times AF_{ressc}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{ressc}\,(15\ Kg)} + \frac{ED_{ress}\,(26\ years) - ED_{ressc}\,(6\ years) \times EF_{ressa}\left(\frac{350\ days}{year}\right) \times SA_{ressa}\left(\frac{6032\ cm^2}{day}\right) \times AF_{ressa}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{ressa}\,(80\ Kg)}$$

where:

$$DFSM_{res\text{-}adj}\left(\frac{475598.67\ mg}{Kg}\right) = \frac{ED_{0\text{-}2}\,(2\ years) \times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right) \times AF_{0\text{-}2}\left(\frac{0.2\ mg}{cm^2}\right) \times SA_{0\text{-}2}\left(\frac{2690\ cm^2}{day}\right) \times 10}{BW_{0\text{-}2}\,(15\ Kg)} + \frac{ED_{2\text{-}6}\,(4\ years) \times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right) \times AF_{2\text{-}6}\left(\frac{0.2\ mg}{cm^2}\right) \times SA_{2\text{-}6}\left(\frac{2690\ cm^2}{day}\right) \times 3}{BW_{2\text{-}6}\,(15\ Kg)} + \frac{ED_{6\text{-}16}\,(10\ years) \times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right) \times AF_{6\text{-}16}\left(\frac{0.07\ mg}{cm^2}\right) \times SA_{6\text{-}16}\left(\frac{6032\ cm^2}{day}\right) \times 3}{BW_{6\text{-}16}\,(80\ Kg)} + \frac{ED_{16\text{-}26}\,(10\ years) \times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right) \times AF_{16\text{-}26}\left(\frac{0.07\ mg}{cm^2}\right) \times SA_{16\text{-}26}\left(\frac{6032\ cm^2}{day}\right) \times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- Inhalation

$$PRG_{res\text{-}soil\text{-}tce\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{ress}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{IUR\left(\mu g/m^3\right)^{-1}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\left(\begin{array}{l}CAF_i\,(0.756)\times EF_{ress}\left(\frac{350\ days}{year}\right)\times\\ ED_{ress}\,(26\ years)\times ET_{ress}\left(\frac{24\ hours}{day}\right)\end{array}\right)+\left(\begin{array}{l}\left(ED_{0\text{-}2}\,(2\ years)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ET_{0\text{-}2}\left(\frac{24\ hours}{day}\right)\times MAF_i\,(0.244)\times 10\right)+\\ \left(ED_{2\text{-}6}\,(4\ years)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ET_{2\text{-}6}\left(\frac{24\ hours}{day}\right)\times MAF_i\,(0.244)\times 3\right)+\\ \left(ED_{6\text{-}16}\,(10\ years)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times ET_{6\text{-}16}\left(\frac{24\ hours}{day}\right)\times MAF_i\,(0.244)\times 3\right)+\\ \left(ED_{16\text{-}26}\,(10\ years)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times ET_{16\text{-}26}\left(\frac{24\ hours}{day}\right)\times MAF_i\,(0.244)\times 1\right)\end{array}\right)\right)}$$

- Total

$$PRG_{res\text{-}soil\text{-}tce\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{PRG_{res\text{-}soil\text{-}tce\text{-}ing}}+\frac{1}{PRG_{res\text{-}soil\text{-}tce\text{-}der}}+\frac{1}{PRG_{res\text{-}soil\text{-}tce\text{-}inh}}}$$

- **Supporting Equations**
  - Child

$$ED_c\,(6\ years)=ED_{0\text{-}2}\,(2\ years)+ED_{2\text{-}6}\,(4\ years)$$

$$BW_c\,(15\ kg)=\frac{BW_{0\text{-}2}\,(15\ kg)\times ED_{0\text{-}2}\,(2\ years)+BW_{2\text{-}6}\,(15\ kg)\times ED_{2\text{-}6}\,(4\ years)}{ED_{0\text{-}2}\,(2\ years)+ED_{2\text{-}6}\,(4\ years)}$$

$$EF_c\left(\frac{350\ days}{year}\right)=\frac{EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\,(2\ years)+EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\,(4\ years)}{ED_{0\text{-}2}\,(2\ years)+ED_{2\text{-}6}\,(4\ years)}$$

$$AF_c\left(\frac{0.2\ mg}{cm^2}\right)=\frac{AF_{0\text{-}2}\left(\frac{0.2\ mg}{cm^2}\right)\times ED_{0\text{-}2}\,(2\ years)+AF_{2\text{-}6}\left(\frac{0.2\ mg}{cm^2}\right)\times ED_{2\text{-}6}\,(4\ years)}{ED_{0\text{-}2}\,(2\ years)+ED_{2\text{-}6}\,(4\ years)}$$

$$SA_c\left(\frac{2690\ cm^2}{day}\right)=\frac{SA_{0\text{-}2}\left(\frac{2690\ cm^2}{day}\right)\times ED_{0\text{-}2}\,(2\ years)+SA_{2\text{-}6}\left(\frac{2690\ cm^2}{day}\right)\times ED_{2\text{-}6}\,(4\ years)}{ED_{0\text{-}2}\,(2\ years)+ED_{2\text{-}6}\,(4\ years)}$$

$$IRS_c\left(\frac{200\ mg}{day}\right)=\frac{IRS_{0\text{-}2}\left(\frac{200\ mg}{day}\right)\times ED_{0\text{-}2}\,(2\ years)+IRS_{2\text{-}6}\left(\frac{200\ mg}{day}\right)\times ED_{2\text{-}6}\,(4\ years)}{ED_{0\text{-}2}\,(2\ years)+ED_{2\text{-}6}\,(4\ years)}$$

  - Adult

$$ED_a\,(20\text{ years}) = ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})$$

$$BW_a\,(80\text{ kg}) = \frac{BW_{6\text{-}16}\,(80\text{ kg}) \times ED_{6\text{-}16}\,(10\text{ years}) + BW_{16\text{-}26}\,(80\text{ kg}) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$

$$EF_a\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{EF_{6\text{-}16}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + EF_{16\text{-}26}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$

$$AF_a\left(\frac{0.07\text{ mg}}{\text{cm}^2}\right) = \frac{AF_{6\text{-}16}\left(\frac{0.07\text{ mg}}{\text{cm}^2}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + AF_{16\text{-}26}\left(\frac{0.07\text{ mg}}{\text{cm}^2}\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$

$$SA_a\left(\frac{6032\text{ cm}^2}{\text{day}}\right) = \frac{SA_{6\text{-}16}\left(\frac{6032\text{ cm}^2}{\text{day}}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + SA_{16\text{-}26}\left(\frac{6032\text{ cm}^2}{\text{day}}\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$

$$IRS_a\left(\frac{100\text{ mg}}{\text{day}}\right) = \frac{IRS_{6\text{-}16}\left(\frac{100\text{ mg}}{\text{day}}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + IRS_{16\text{-}26}\left(\frac{100\text{ mg}}{\text{day}}\right) \times ED_{16\text{-}26}\,(10\text{ years})}{ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$

- Age-adjusted

$$ED_r\,(26\text{ years}) = ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years}) + ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})$$

$$EF_r\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{\begin{gathered}EF_{0\text{-}2}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{0\text{-}2}\,(2\text{ years}) + EF_{2\text{-}6}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{2\text{-}6}\,(4\text{ years}) \\ + EF_{6\text{-}16}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{6\text{-}16}\,(10\text{ years}) + EF_{16\text{-}26}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{16\text{-}26}\,(10\text{ years})\end{gathered}}{ED_{0\text{-}2}\,(2\text{ years}) + ED_{2\text{-}6}\,(4\text{ years}) + ED_{6\text{-}16}\,(10\text{ years}) + ED_{16\text{-}26}\,(10\text{ years})}$$

$$ET_{ress}\left(\frac{24\text{ hour}}{\text{day}}\right)$$

Composite Worker Soil Equations

This land use is for developing industrial default screening levels that are presented in the Generic Tables.

- **Noncarcinogenic**
  - Ingestion

$$SL_{w\text{-soil-nc-ing}}\,(\text{mg/kg}) = \frac{THQ \times AT_{ow}\left(\frac{365\text{ days}}{\text{year}} \times ED_{ow}\,(25\text{ years})\right) \times BW_{ow}\,(80\text{ Kg})}{EF_{iw}\left(250\ \frac{\text{days}}{\text{year}}\right) \times ED_{ow}\,(25\text{ years}) \times \frac{1}{RfD_o\left(\frac{\text{mg}}{\text{kg-day}}\right)} \times IR_{ow}\left(100\,\frac{\text{mg}}{\text{day}}\right) \times \left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

  - Dermal

$$SL_{w\text{-}soil\text{-}nc\text{-}der}\,(mg/kg)=\frac{THQ\times AT_{ow}\left(\frac{365\ days}{year}\times ED_{ow}\,(25\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times\left(\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}day}\right)\times GIABS}\right)\times SA_{ow}\left(\frac{3470\ cm^2}{day}\right)\times AF_{ow}\left(\frac{0.12\ mg}{cm^2}\right)\times ABS_d\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Inhalation

$$SL_{w\text{-}soil\text{-}nc\text{-}inh}\,(mg/kg)=\frac{THQ\times AT_{ow}\left(\frac{365\ days}{year}\times ED_{ow}\,(25\ years)\right)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^3\right)}\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{kg}\right)}\right)}$$

- Total

$$SL_{w\text{-}soil\text{-}nc\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{w\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{w\text{-}soil\text{-}nc\text{-}der}}+\frac{1}{SL_{w\text{-}soil\text{-}nc\text{-}inh}}}$$

- **Carcinogenic**
  - Ingestion

$$SL_{w\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{ow}\left(100\ \frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

  - Dermal

$$SL_{w\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times\left(\frac{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times SA_{ow}\left(\frac{3470\ cm^2}{day}\right)\times AF_{ow}\left(\frac{0.12\ mg}{cm^2}\right)\times ABS_d\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

  - Inhalation

$$SL_{w\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{kg}\right)}\right)}$$

  - Total

$$SL_{w\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{w\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{w\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{w\text{-}soil\text{-}ca\text{-}inh}}}$$

Outdoor Worker Soil Equations

This land use is only presented in the calculator portion of this tool and is not part of the Generic Tables.

- **Noncarcinogenic**
  - Ingestion

$$SL_{ow\text{-}soil\text{-}nc\text{-}ing}\,(mg/kg)=\frac{THQ\times AT_{ow}\left(\frac{365\ days}{year}\times ED_{ow}\,(25\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times\frac{1}{RfD_{o}\left(\frac{mg}{kg\text{-}day}\right)}\times IR_{ow}\left(100\,\frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

  - Dermal

$$SL_{ow\text{-}soil\text{-}nc\text{-}der}\,(mg/kg)=\frac{THQ\times AT_{ow}\left(\frac{365\ days}{year}\times ED_{ow}\,(25\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times\left(\frac{1}{RfD_{o}\left(\frac{mg}{kg\text{-}day}\right)\times GIABS}\right)\times SA_{ow}\left(\frac{3470\ cm^{2}}{day}\right)\times AF_{ow}\left(\frac{0.12\ mg}{cm^{2}}\right)\times ABS_{d}\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

  - Inhalation

$$SL_{ow\text{-}soil\text{-}nc\text{-}inh}\,(mg/kg)=\frac{THQ\times AT_{ow}\left(\frac{365\ days}{year}\times ED_{ow}\,(25\ years)\right)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^{3}\right)}\times\left(\frac{1}{VF_{s}\left(\frac{m^{3}}{kg}\right)}+\frac{1}{PEF_{w}\left(\frac{m^{3}}{kg}\right)}\right)}$$

  - Total

$$SL_{ow\text{-}soil\text{-}nc\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{ow\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{ow\text{-}soil\text{-}nc\text{-}der}}+\frac{1}{SL_{ow\text{-}soil\text{-}nc\text{-}inh}}}$$

- **Carcinogenic**
  - Ingestion

$$SL_{ow\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{ow}\left(100\,\frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

  - Dermal

$$SL_{ow\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times BW_{ow}\,(80\ Kg)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times\left(\frac{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times SA_{ow}\left(\frac{3470\ cm^2}{day}\right)\times AF_{ow}\left(\frac{0.12\ mg}{cm^2}\right)\times ABS_d\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Inhalation

$$SL_{ow\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{ow}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{EF_{ow}\left(225\ \frac{days}{year}\right)\times ED_{ow}\,(25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{kg}\right)}\right)}$$

- Total

$$SL_{ow\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{ow\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{ow\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{ow\text{-}soil\text{-}ca\text{-}inh}}}$$

Indoor Worker Soil Equations

This land use is only presented in the calculator portion of this tool and is not part of the Generic Tables.

- **Noncarcinogenic**
  - Ingestion

$$SL_{iw\text{-}soil\text{-}nc\text{-}ing}\,(mg/kg)=\frac{THQ\times AT_{iw}\left(\frac{365\ days}{year}\times ED_{iw}\,(25\ years)\right)\times BW_{iw}\,(80\ Kg)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{iw}\,(25\ years)\times\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}day}\right)}\times IR_{iw}\left(50\ \frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

  - Inhalation

$$SL_{iw\text{-}soil\text{-}nc\text{-}inh}\,(mg/kg)=\frac{THQ\times AT_{iw}\left(\frac{365\ days}{year}\times ED_{iw}\,(25\ years)\right)}{EF_{iw}\left(250\ \frac{days}{year}\right)\times ED_{iw}\,(25\ years)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^3\right)}\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{kg}\right)}\right)}$$

  - Total

$$SL_{iw\text{-}soil\text{-}nc\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{iw\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{iw\text{-}soil\text{-}nc\text{-}inh}}}$$

- **Carcinogenic**
  -

- Ingestion

$$SL_{iw\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{iw}\left(\frac{365\text{ days}}{\text{year}}\times LT\,(70\text{ years})\right)\times BW_{iw}\,(80\text{ Kg})}{EF_{iw}\left(250\,\frac{\text{days}}{\text{year}}\right)\times ED_{iw}\,(25\text{ years})\times CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{iw}\left(50\,\frac{mg}{day}\right)\times\left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

- Inhalation

$$SL_{iw\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{iw}\left(\frac{365\text{ days}}{\text{year}}\times LT\,(70\text{ years})\right)}{EF_{iw}\left(250\,\frac{\text{days}}{\text{year}}\right)\times ED_{iw}\,(25\text{ years})\times ET_{ws}\left(\frac{8\text{ hours}}{\text{day}}\right)\times\left(\frac{1\text{ day}}{24\text{ hours}}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times\left(\frac{1000\,\mu g}{mg}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{kg}\right)}\right)}$$

- Total

$$SL_{iw\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{iw\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{iw\text{-}soil\text{-}ca\text{-}inh}}}$$

Construction Worker Soil Equations for Standard Vehicle Traffic

This land use is only presented in the calculator portion of this tool and is not part of the Generic Tables.

- **Noncarcinogenic**
  - Ingestion

$$SL_{cw\text{-}soil\text{-}nc\text{-}ing}\,(mg/kg)=\frac{THQ\times AT_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{\text{year}}\times\frac{7\text{ days}}{\text{week}}\times ED_{cw}\,(1\text{ year})\right)\times BW_{cw}\,(80\text{ Kg})}{EF_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{\text{year}}\times DW_{cw}\,\frac{5\text{ days}}{\text{week}}\right)\times ED_{cw}\,(1\text{ year})\times\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}day}\right)}\times IR_{cw}\left(330\,\frac{mg}{day}\right)\times\left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

  - Dermal

$$SL_{cw\text{-}soil\text{-}nc\text{-}der}\,(mg/kg)=\frac{THQ\times AT_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{\text{year}}\times\frac{7\text{ days}}{\text{week}}\times ED_{cw}\,(1\text{ year})\right)\times BW_{cw}\,(80\text{ Kg})}{EF_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{\text{year}}\times DW_{cw}\,\frac{5\text{ days}}{\text{week}}\right)\times ED_{cw}\,(1\text{ year})\times\left(\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}day}\right)\times GIABS}\right)\times SA_{cw}\left(\frac{3470\text{ cm}^2}{\text{day}}\right)\times AF_{cw}\left(\frac{0.3\text{ mg}}{\text{cm}^2}\right)\times ABS_d\times\left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

  - Inhalation

$$SL_{cw\text{-}soil\text{-}nc\text{-}inh}\,(mg/kg)=\frac{THQ\times AT_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{\text{year}}\times\frac{7\text{ days}}{\text{week}}\times ED_{cw}\,(1\text{ year})\right)}{EF_{cw}\left(EW_{cw}\,\frac{50\text{ weeks}}{\text{year}}\times DW_{cw}\,\frac{5\text{ days}}{\text{week}}\right)\times ED_{cw}\,(1\text{ year})\times ET_{ws}\left(\frac{8\text{ hours}}{\text{day}}\right)\times\left(\frac{1\text{ day}}{24\text{ hours}}\right)\times\frac{1}{RfC\left(mg/m^3\right)}\times\left(\frac{1}{VF_{sc}\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

  - Total

$$SL_{cw\text{-}soil\text{-}nc\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}der}}+\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}inh}}}$$

- **Carcinogenic**
  - Ingestion

$$SL_{cw\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\frac{50\text{ weeks}}{\text{year}}\times\frac{7\text{ days}}{\text{week}}\times LT\,(70\text{ years})\right)\times BW_{cw}\,(80\text{ Kg})}{EF_{cw}\left(EW_{cw}\frac{50\text{ weeks}}{\text{year}}\times DW_{cw}\frac{5\text{ days}}{\text{week}}\right)\times ED_{cw}\,(1\text{ year})\times CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{cw}\left(330\frac{mg}{day}\right)\times\left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

  - Dermal

$$SL_{cw\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\frac{50\text{ weeks}}{\text{year}}\times\frac{7\text{ days}}{\text{week}}\times LT\,(70\text{ years})\right)\times BW_{cw}\,(80\text{ Kg})}{EF_{cw}\left(EW_{cw}\frac{50\text{ weeks}}{\text{year}}\times DW_{cw}\frac{5\text{ days}}{\text{week}}\right)\times ED_{cw}\,(1\text{ year})\times\left(\frac{CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times SA_{cw}\left(\frac{3470\text{ cm}^2}{\text{day}}\right)\times AF_{cw}\left(\frac{0.3\text{ mg}}{\text{cm}^2}\right)\times ABS_{d}\times\left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

  - Inhalation

$$SL_{cw\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\frac{50\text{ weeks}}{\text{year}}\times\frac{7\text{ days}}{\text{week}}\times LT\,(70\text{ years})\right)}{EF_{cw}\left(EW_{cw}\frac{50\text{ weeks}}{\text{year}}\times DW_{cw}\frac{5\text{ days}}{\text{week}}\right)\times ED_{cw}\,(1\text{ year})\times ET_{ws}\left(\frac{8\text{ hours}}{\text{day}}\right)\times\left(\frac{1\text{ day}}{24\text{ hours}}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times\left(\frac{1}{VF_{sc}\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

  - Total

$$SL_{cw\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}inh}}}$$

Construction Worker Soil Equations for Other than Standard Vehicle Traffic (e.g. grading, tilling, excavating, dozing and wind)

This land use is only presented in the calculator portion of this tool and is not part of the Generic Tables.

- **Noncarcinogenic**
  - Ingestion

$$SL_{cw\text{-}soil\text{-}nc\text{-}ing}\,(mg/kg)=\frac{THQ\times AT_{cw}\left(EW_{cw}\frac{50\text{ weeks}}{\text{year}}\times\frac{7\text{ days}}{\text{week}}\times ED_{cw}\,(1\text{ year})\right)\times BW_{cw}\,(80\text{ Kg})}{EF_{cw}\left(EW_{cw}\frac{50\text{ weeks}}{\text{year}}\times DW_{cw}\frac{5\text{ days}}{\text{week}}\right)\times ED_{cw}\,(1\text{ year})\times\frac{1}{RfD_{o}\left(\frac{mg}{kg\text{-}day}\right)}\times IR_{cw}\left(330\frac{mg}{day}\right)\times\left(\frac{10^{-6}\text{ Kg}}{1\text{ mg}}\right)}$$

  - Dermal

$$SL_{cw\text{-}soil\text{-}nc\text{-}der}\,(mg/kg)=\frac{THQ\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times ED_{cw}\,(1\ year)\right)\times BW_{cw}\,(80\ Kg)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\ \frac{5\ days}{week}\right)\times ED_{cw}\,(1\ year)\times\left(\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}day}\right)\times GIABS}\right)\times SA_{cw}\left(\frac{3470\ cm^2}{day}\right)\times AF_{cw}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Inhalation

$$SL_{cw\text{-}soil\text{-}nc\text{-}inh}\,(mg/kg)=\frac{THQ\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times ED_{cw}\,(1\ year)\right)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\ \frac{5\ days}{week}\right)\times ED_{cw}\,(1\ year)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^3\right)}\times\left(\frac{1}{VF_{sc}\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF'_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

- Total

$$SL_{cw\text{-}soil\text{-}nc\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}der}}+\frac{1}{SL_{cw\text{-}soil\text{-}nc\text{-}inh}}}$$

- **Carcinogenic**
  - Ingestion

$$SL_{cw\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times LT\,(70\ years)\right)\times BW_{cw}\,(80\ Kg)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\ \frac{5\ days}{week}\right)\times ED_{cw}\,(1\ year)\times CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IR_{cw}\left(330\frac{mg}{day}\right)\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Dermal

$$SL_{cw\text{-}soil\text{-}ca\text{-}der}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times LT\,(70\ years)\right)\times BW_{cw}\,(80\ Kg)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\ \frac{5\ days}{week}\right)\times ED_{cw}\,(1\ year)\times\left(\frac{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}}{GIABS}\right)\times SA_{cw}\left(\frac{3470\ cm^2}{day}\right)\times AF_{cw}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d\times\left(\frac{10^{-6}\ Kg}{1\ mg}\right)}$$

- Inhalation

$$SL_{cw\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times\frac{7\ days}{week}\times LT\,(70\ years)\right)}{EF_{cw}\left(EW_{cw}\frac{50\ weeks}{year}\times DW_{cw}\ \frac{5\ days}{week}\right)\times ED_{cw}\,(1\ year)\times ET_{ws}\left(\frac{8\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_{sc}\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF'_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

- Total

$$SL_{cw\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}ing}}+\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}der}}+\frac{1}{SL_{cw\text{-}soil\text{-}ca\text{-}inh}}}$$

Recreational Soil / Sediment Equations

This land use is only presented in the calculator portion of this tool and is not part of the Generic Tables.

- **Noncarcinogenic - Child**
  - Ingestion

$$SL_{rec\text{-}soil\text{-}nc\text{-}ing\text{-}c}\left(mg/kg\right)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recsc}\left(years\right)\right)\times BW_{recsc}\left(15\ Kg\right)}{EF_{recsc}\left(\frac{days}{year}\right)\times ED_{recsc}\left(years\right)\times\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)}\times IRS_{recsc}\left(\frac{200\ mg}{day}\right)\times\frac{10^{-6}Kg}{1mg}}$$

  - Dermal

$$SL_{rec\text{-}soil\text{-}nc\text{-}der\text{-}c}\left(mg/kg\right)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recsc}\left(years\right)\right)\times BW_{recsc}\left(15\ Kg\right)}{EF_{recsc}\left(\frac{days}{year}\right)\times ED_{recsc}\left(year\right)\times\frac{1}{\left(RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS\right)}\times SA_{recsc}\left(\frac{2690\ cm^2}{day}\right)\times AF_{recsc}\left(\frac{0.2\ mg}{cm^2}\right)\times ABS_d\times\frac{10^{-6}Kg}{1mg}}$$

  - Inhalation

$$SL_{rec\text{-}soil\text{-}nc\text{-}inh\text{-}c}\left(mg/kg\right)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recsc}\left(years\right)\right)}{EF_{recsc}\left(\frac{days}{year}\right)\times ED_{recsc}\left(year\right)\times ET_{recsc}\left(\frac{hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)}$$

  - Total

$$SL_{rec\text{-}soil\text{-}nc\text{-}tot\text{-}c}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}ing}}+\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}der}}+\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}inh}}}$$

- **Noncarcinogenic - Adult**
  - Ingestion

$$SL_{rec\text{-}soil\text{-}nc\text{-}ing\text{-}a}\left(mg/kg\right)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recsa}\left(years\right)\right)\times BW_{recsa}\left(80\ Kg\right)}{EF_{recsa}\left(\frac{days}{year}\right)\times ED_{recsa}\left(years\right)\times\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)}\times IRS_{recsa}\left(\frac{100\ mg}{day}\right)\times\frac{10^{-6}Kg}{1mg}}$$

  - Dermal

$$SL_{rec\text{-}soil\text{-}nc\text{-}der\text{-}a}\left(mg/kg\right)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\times ED_{recsa}\left(years\right)\right)\times BW_{recsa}\left(80\ Kg\right)}{EF_{recsa}\left(\frac{days}{year}\right)\times ED_{recsa}\left(year\right)\times\frac{1}{\left(RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS\right)}\times SA_{recsa}\left(\frac{6032\ cm^2}{day}\right)\times AF_{recsa}\left(\frac{0.07\ mg}{cm^2}\right)\times ABS_d\times\frac{10^{-6}Kg}{1mg}}$$

  - Inhalation

$$SL_{rec\text{-}soil\text{-}nc\text{-}inh\text{-}a}\,(mg/kg) = \frac{THQ \times AT_{rec}\left(\frac{365\ days}{year}\right) \times ED_{recsa}\,(years)}{EF_{recsa}\left(\frac{days}{year}\right) \times ED_{recsa}\,(year) \times ET_{recsa}\left(\frac{hours}{day}\right) \times \left(\frac{1\ day}{24\ hours}\right) \times \frac{1}{RfC\left(\frac{mg}{m^3}\right)} \times \left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)} + \frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)}$$

- Total

$$SL_{rec\text{-}soil\text{-}nc\text{-}tot\text{-}a}\,(mg/kg) = \frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}ing\text{-}a}} + \frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}der\text{-}a}} + \frac{1}{SL_{rec\text{-}soil\text{-}nc\text{-}inh\text{-}a}}}$$

- **Carcinogenic**
  - Ingestion

$$SL_{rec\text{-}soil\text{-}ca\text{-}ing}\,(mg/kg) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{year} \times LT\,(70\ years)\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1} \times IFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) \times \left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$IFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) = \frac{ED_{recsc}\,(years) \times EF_{recsc}\left(\frac{days}{year}\right) \times IRS_{recsc}\left(\frac{200\ mg}{day}\right)}{BW_{recsc}\,(15\ Kg)} + \frac{ED_{recsa}\,(years) \times EF_{recsa}\left(\frac{days}{year}\right) \times IRS_{recsa}\left(\frac{100\ mg}{day}\right)}{BW_{recsa}\,(80\ Kg)}$$

  - Dermal

$$SL_{rec\text{-}soil\text{-}ca\text{-}der}\,(mg/kg) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{year} \times LT\,(70\ years)\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right) \times DFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) \times ABS_d \times \left(\frac{10^{-6}Kg}{mg}\right)}$$

where:

$$DFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) = \frac{ED_{recsc}\,(years) \times EF_{recsc}\left(\frac{days}{year}\right) \times SA_{recsc}\left(\frac{2690\ cm^2}{day}\right) \times AF_{recsc}\left(\frac{0.2 mg}{cm^2}\right)}{BW_{recsc}\,(15\ Kg)} + \frac{ED_{recsa}\,(years) \times EF_{recsa}\left(\frac{days}{year}\right) \times SA_{recsa}\left(\frac{6032\ cm^2}{day}\right) \times AF_{recsa}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{recsa}\,(80\ Kg)}$$

  - Inhalation

$$SL_{rec\text{-}soil\text{-}ca\text{-}inh}\,(mg/kg) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{year} \times LT\ (70\ years)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times EF_{recs}\left(\frac{days}{year}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)} + \frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right) \times ED_{recs}\,(years) \times ET_{recs}\left(\frac{hours}{day}\right) \times \left(\frac{1\ day}{24\ hours}\right)}$$

- Total

$$SL_{rec\text{-}soil\text{-}ca\text{-}tot}\,(mg/kg) = \frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}ing}} + \frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}der}} + \frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}inh}}}$$

- **Mutagenic**
  - Ingestion

$$SL_{rec\text{-}soil\text{-}mu\text{-}ing}\,(mg/kg) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{year} \times LT\ (70\ years)\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1} \times IFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) \times \left(\frac{10^{-6} Kg}{mg}\right)}$$

where:

$$IFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) = \frac{ED_{0\text{-}2}\,(yr) \times EF_{0\text{-}2}\left(\frac{days}{year}\right) \times IRS_{0\text{-}2}\left(\frac{200\ mg}{day}\right) \times 10}{BW_{0\text{-}2}\,(15\ Kg)} + \frac{ED_{2\text{-}6}\,(yr) \times EF_{2\text{-}6}\left(\frac{days}{year}\right) \times IRS_{2\text{-}6}\left(\frac{200\ mg}{day}\right) \times 3}{BW_{2\text{-}6}\,(15\ Kg)} + \frac{ED_{6\text{-}16}\,(yr) \times EF_{6\text{-}16}\left(\frac{days}{year}\right) \times IRS_{6\text{-}16}\left(\frac{100\ mg}{day}\right) \times 3}{BW_{6\text{-}16}\,(80\ Kg)} + \frac{ED_{16\text{-}26}\,(yr) \times EF_{16\text{-}26}\left(\frac{days}{year}\right) \times IRS_{16\text{-}26}\left(\frac{100\ mg}{day}\right) \times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

  - Dermal

$$SL_{rec\text{-}soil\text{-}mu\text{-}der}\,(mg/kg) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{year} \times LT\ (70\ years)\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right) \times DFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) \times ABS_d \times \left(\frac{10^{-6} Kg}{mg}\right)}$$

where:

$$DFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) = \frac{ED_{0\text{-}2}\,(yr) \times EF_{0\text{-}2}\left(\frac{days}{year}\right) \times AF_{0\text{-}2}\left(\frac{0.2\ mg}{cm^2}\right) \times SA_{0\text{-}2}\left(\frac{2690\ cm^2}{day}\right) \times 10}{BW_{0\text{-}2}\,(15\ Kg)} + \frac{ED_{2\text{-}6}\,(yr) \times EF_{2\text{-}6}\left(\frac{days}{year}\right) \times AF_{2\text{-}6}\left(\frac{0.2\ mg}{cm^2}\right) \times SA_{2\text{-}6}\left(\frac{2690\ cm^2}{day}\right) \times 3}{BW_{2\text{-}6}\,(15\ Kg)} + \frac{ED_{6\text{-}16}\,(yr) \times EF_{6\text{-}16}\left(\frac{days}{year}\right) \times AF_{6\text{-}16}\left(\frac{0.07\ mg}{cm^2}\right) \times SA_{6\text{-}16}\left(\frac{6032\ cm^2}{day}\right) \times 3}{BW_{6\text{-}16}\,(80\ Kg)} + \frac{ED_{16\text{-}26}\,(yr) \times EF_{16\text{-}26}\left(\frac{days}{year}\right) \times AF_{16\text{-}26}\left(\frac{0.07\ mg}{cm^2}\right) \times SA_{16\text{-}26}\left(\frac{6032\ cm^2}{day}\right) \times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

  - Inhalation

$$SL_{rec\text{-}soil\text{-}mu\text{-}inh}\,(mg/kg)=\frac{TR\times AT_{rec}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)}{\left(\frac{1\ day}{24\ hours}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)\times\left(\begin{array}{l}\left(ED_{0\text{-}2}\,(yrs)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times ET_{0\text{-}2}\left(\frac{hours}{day}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times 10\right)+\left(ED_{2\text{-}6}\,(yrs)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times ET_{2\text{-}6}\left(\frac{hours}{day}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times 3\right)+\\\left(ED_{6\text{-}16}\,(yrs)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times ET_{6\text{-}16}\left(\frac{hours}{day}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times 3\right)+\left(ED_{16\text{-}26}\,(yrs)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times ET_{16\text{-}26}\left(\frac{hours}{day}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times 1\right)\end{array}\right)}$$

- Total

$$SL_{rec\text{-}soil\text{-}mu\text{-}tot}\,(mg/kg)=\frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}mu\text{-}ing}}+\frac{1}{SL_{rec\text{-}soil\text{-}mu\text{-}der}}+\frac{1}{SL_{rec\text{-}soil\text{-}mu\text{-}inh}}}$$

- **Vinyl Chloride**
  - Ingestion

$$SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}ing}\,(mg/kg)=\frac{TR}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFS_{rec\text{-}adj}\left(\frac{mg}{kg}\right)\times\frac{10^{-6}Kg}{1\ mg}}{AT_{recs}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}\right)+\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IRS_{recsc}\left(\frac{200\ mg}{day}\right)\times\frac{10^{-6}Kg}{1\ mg}}{BW_{recsc}\,(15\ kg)}\right)}$$

  - Dermal

$$SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}der}\left(mg/kg\right)=\frac{TR}{\left(\frac{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times DFS_{rec\text{-}adj}\left(\frac{mg}{kg}\right)\times ABS_d\times\frac{10^{-6}Kg}{1\ mg}}{AT_{recs}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}\right)+\left(\frac{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times SA_{recsc}\left(\frac{2690\ cm^2}{day}\right)\times AF_{recsc}\left(\frac{0.2\ mg}{cm^2}\right)\times ABS\times\frac{10^{-6}Kg}{1\ mg}}{BW_{recsc}\left(15\ kg\right)}\right)}$$

- Inhalation

$$SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}inh}\left(mg/kg\right)=\frac{TR}{\left(\frac{IUR\left(\mu g/m^3\right)^{-1}\times EF_{recs}\left(\frac{days}{year}\right)\times ED_{recs}\left(years\right)\times ET_{recs}\left(\frac{hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{AT_{rec}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)\times VF_s\left(\frac{m^3}{kg}\right)}\right)+\left(\frac{IUR\left(\mu g/m^3\right)^{-1}}{VF_s\left(\frac{m^3}{kg}\right)}\times\left(\frac{1000\ \mu g}{mg}\right)\right)}$$

- Total

$$SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}tot}\left(mg/kg\right)=\frac{1}{\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}ing}}+\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}der}}+\frac{1}{SL_{rec\text{-}soil\text{-}ca\text{-}vc\text{-}inh}}}$$

- **Trichloroethylene**
  - Ingestion

$$PRG_{rec\text{-}soil\text{-}tce\text{-}ing}\,(mg/kg) = \frac{TR \times AT_{recs}\left(\frac{365\ days}{year}\right) \times LT\,(70\ years)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1} \times \left(\frac{10^{-6}\ Kg}{mg}\right) \times \left(\left(CAF_o\,(0.804) \times IFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)\right) + \left(MAF_o\,(0.202) \times IFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right)\right)\right)}$$

where:

$$IFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) = \frac{ED_{recsc}\,(years) \times EF_{recsc}\left(\frac{days}{year}\right) \times IRS_{recsc}\left(\frac{200\ mg}{day}\right)}{BW_{recsc}\,(15\ Kg)} + \frac{ED_{recs}\,(years) - ED_{recsc}\,(years) \times EF_{recsa}\left(\frac{days}{year}\right) \times IRS_{recsa}\left(\frac{100\ mg}{day}\right)}{BW_{recsa}\,(80\ Kg)}$$

where:

$$IFSM_{rec\text{-}adj\text{-}}\left(\frac{mg}{Kg}\right) = \frac{ED_{0\text{-}2}\,(years) \times EF_{0\text{-}2}\left(\frac{days}{year}\right) \times IRS_{0\text{-}2}\left(\frac{200\ mg}{day}\right) \times 10}{BW_{0\text{-}2}\,(15\ Kg)} + \frac{ED_{2\text{-}6}\,(years) \times EF_{2\text{-}6}\left(\frac{days}{year}\right) \times IRS_{2\text{-}6}\left(\frac{200\ mg}{day}\right) \times 3}{BW_{2\text{-}6}\,(15\ Kg)} + \frac{ED_{6\text{-}16}\,(years) \times EF_{6\text{-}16}\left(\frac{days}{year}\right) \times IRS_{6\text{-}16}\left(\frac{100\ mg}{day}\right) \times 3}{BW_{6\text{-}16}\,(80\ Kg)} + \frac{ED_{16\text{-}26}\,(years) \times EF_{16\text{-}26}\left(\frac{days}{year}\right) \times IRS_{16\text{-}26}\left(\frac{100\ mg}{day}\right) \times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- Dermal

$$PRG_{rec\text{-}soil\text{-}tce\text{-}der}\,(mg/kg) = \frac{TR \times AT_{recs}\left(\frac{365\ days}{year} \times LT\,(70\ years)\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}Kg}{mg}\right) \times \left(\left(CAF_o\,(0.804) \times DFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) \times ABS_d\right) + \left(MAF_o\,(0.202) \times DFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) \times ABS_d\right)\right)}$$

where:

$$DFS_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) = \frac{ED_{recsc}\,(years) \times EF_{recsc}\left(\frac{days}{year}\right) \times SA_{recsc}\left(\frac{2690\ cm^2}{day}\right) \times AF_{recsc}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{recsc}\,(15\ Kg)} + \frac{ED_{recs}\,(years) - ED_{recsc}\,(years) \times EF_{recsa}\left(\frac{days}{year}\right) \times SA_{recsa}\left(\frac{6032\ cm^2}{day}\right) \times AF_{recsa}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{recsa}\,(80\ Kg)}$$

where:

$$DFSM_{rec\text{-}adj}\left(\frac{mg}{Kg}\right) = \frac{ED_{0\text{-}2}\,(years) \times EF_{0\text{-}2}\left(\frac{days}{year}\right) \times AF_{0\text{-}2}\left(\frac{0.2\ mg}{cm^2}\right) \times SA_{0\text{-}2}\left(\frac{2690\ cm^2}{day}\right) \times 10}{BW_{0\text{-}2}\,(15\ Kg)} + \frac{ED_{2\text{-}6}\,(years) \times EF_{2\text{-}6}\left(\frac{days}{year}\right) \times AF_{2\text{-}6}\left(\frac{0.2\ mg}{cm^2}\right) \times SA_{2\text{-}6}\left(\frac{2690\ cm^2}{day}\right) \times 3}{BW_{2\text{-}6}\,(15\ Kg)} + \frac{ED_{6\text{-}16}\,(years) \times EF_{6\text{-}16}\left(\frac{days}{year}\right) \times AF_{6\text{-}16}\left(\frac{0.07\ mg}{cm^2}\right) \times SA_{6\text{-}16}\left(\frac{6032\ cm^2}{day}\right) \times 3}{BW_{6\text{-}16}\,(70\ Kg)} + \frac{ED_{16\text{-}26}\,(years) \times EF_{16\text{-}26}\left(\frac{days}{year}\right) \times AF_{16\text{-}26}\left(\frac{0.07\ mg}{cm^2}\right) \times SA_{16\text{-}26}\left(\frac{6032\ cm^2}{day}\right) \times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- Inhalation

$$PRG_{rec\text{-}soil\text{-}tce\text{-}inh}(mg/kg)=\frac{TR\times AT_{recs}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left(\frac{1}{VF_s\left(\frac{m^3}{Kg}\right)}+\frac{1}{PEF_w\left(\frac{m^3}{Kg}\right)}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\left(\begin{array}{l}CAF_i\,(0.756)\times EF_{recs}\left(\frac{days}{year}\right)\times\\ ED_{recs}\,(years)\times ET_{recs}\left(\frac{hours}{day}\right)\end{array}\right)+\left(\begin{array}{l}\left(ED_{0-2}\,(years)\times EF_{0-2}\left(\frac{days}{year}\right)\times ET_{0-2}\left(\frac{hours}{day}\right)\times MAF_i\,(0.244)\times 10\right)+\\ \left(ED_{2-6}\,(years)\times EF_{2-6}\left(\frac{days}{year}\right)\times ET_{2-6}\left(\frac{hours}{day}\right)\times MAF_i\,(0.244)\times 3\right)+\\ \left(ED_{6-16}\,(years)\times EF_{6-16}\left(\frac{days}{year}\right)\times ET_{6-16}\left(\frac{hours}{day}\right)\times MAF_i\,(0.244)\times 3\right)+\\ \left(ED_{16-26}\,(years)\times EF_{16-26}\left(\frac{days}{year}\right)\times ET_{16-26}\left(\frac{hours}{day}\right)\times MAF_i\,(0.244)\times 1\right)\end{array}\right)\right)}$$

- Total

$$PRG_{rec\text{-}soil\text{-}tce\text{-}tot}(mg/kg)=\frac{1}{\frac{1}{PRG_{rec\text{-}soil\text{-}tce\text{-}ing}}+\frac{1}{PRG_{rec\text{-}soil\text{-}tce\text{-}der}}+\frac{1}{PRG_{rec\text{-}soil\text{-}tce\text{-}inh}}}$$

- **Supporting Equations**
  - Child

$$ED_{recsc}\,(yr)=ED_{0-2}\,(yr)+ED_{2-6}\,(yr)$$

$$BW_{recsc}\,(kg)=\frac{BW_{0-2}\,(kg)\times ED_{0-2}\,(yr)+BW_{2-6}\,(kg)\times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr)+ED_{2-6}\,(yr)}$$

$$EF_{recsc}\left(\frac{days}{year}\right)=\frac{EF_{0-2}\left(\frac{days}{year}\right)\times ED_{0-2}\,(yr)+EF_{2-6}\left(\frac{days}{year}\right)\times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr)+ED_{2-6}\,(yr)}$$

$$AF_{recsc}\left(\frac{events}{day}\right)=\frac{AF_{0-2}\left(\frac{events}{day}\right)\times ED_{0-2}\,(yr)+AF_{2-6}\left(\frac{events}{day}\right)\times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr)+ED_{2-6}\,(yr)}$$

$$ET_{recsc}\left(\frac{hr}{day}\right)=\frac{ET_{0-2}\left(\frac{hr}{day}\right)\times ED_{0-2}\,(yr)+ET_{2-6}\left(\frac{hr}{day}\right)\times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr)+ED_{2-6}\,(yr)}$$

$$SA_{recsc}\left(\frac{cm^2}{day}\right)=\frac{SA_{0-2}\left(\frac{cm^2}{day}\right)\times ED_{0-2}\,(yr)+SA_{2-6}\left(\frac{cm^2}{day}\right)\times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr)+ED_{2-6}\,(yr)}$$

$$IRS_{recsc}\left(\frac{mg}{day}\right)=\frac{IRS_{0-2}\left(\frac{mg}{day}\right)\times ED_{0-2}\,(yr)+IRS_{2-6}\left(\frac{mg}{day}\right)\times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr)+ED_{2-6}\,(yr)}$$

  - Adult

$$ED_{recsa}\,(yr) = ED_{6-16}\,(yr) + ED_{16-26}\,(yr)$$

$$BW_{recsa}\,(kg) = \frac{BW_{6-16}\,(kg) \times ED_{6-16}\,(yr) + BW_{16-26}\,(kg) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$EF_{recsa}\left(\frac{days}{year}\right) = \frac{EF_{6-16}\left(\frac{days}{year}\right) \times ED_{6-16}\,(yr) + EF_{16-26}\left(\frac{days}{year}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$AF_{recsa}\left(\frac{events}{day}\right) = \frac{AF_{6-16}\left(\frac{events}{day}\right) \times ED_{6-16}\,(yr) + AF_{16-26}\left(\frac{events}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$ET_{recsa}\left(\frac{hr}{day}\right) = \frac{ET_{6-16}\left(\frac{hr}{day}\right) \times ED_{6-16}\,(yr) + ET_{16-26}\left(\frac{hr}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$SA_{recsa}\left(\frac{cm^2}{day}\right) = \frac{SA_{6-16}\left(\frac{cm^2}{day}\right) \times ED_{6-16}\,(yr) + SA_{16-26}\left(\frac{cm^2}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$IRS_{recsa}\left(\frac{mg}{day}\right) = \frac{IRS_{6-16}\left(\frac{mg}{day}\right) \times ED_{6-16}\,(yr) + IRS_{16-26}\left(\frac{mg}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

- Age-adjusted

$$ED_{recs}\,(yr) = ED_{0-2}\,(yr) + ED_{2-6}\,(yr) + ED_{6-16}\,(yr) + ED_{16-26}\,(yr)$$

$$EF_{recs}\left(\frac{days}{year}\right) = \frac{EF_{0-2}\left(\frac{days}{year}\right) \times ED_{0-2}\,(yr) + EF_{2-6}\left(\frac{days}{year}\right) \times ED_{2-6}\,(yr) + EF_{6-16}\left(\frac{days}{year}\right) \times ED_{6-16}\,(yr) + EF_{16-26}\left(\frac{days}{year}\right) \times ED_{16-26}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr) + ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$ET_{recs}\left(\frac{hr}{day}\right) = \frac{ET_{0-2}\left(\frac{hr}{day}\right) \times ED_{0-2}\,(yr) + ET_{2-6}\left(\frac{hr}{day}\right) \times ED_{2-6}\,(yr) + ET_{6-16}\left(\frac{hr}{day}\right) \times ED_{6-16}\,(yr) + ET_{16-26}\left(\frac{hr}{day}\right) \times ED_{16-26}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr) + ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

Recreator Surface Water Equations

This land use is only presented in the calculator portion of this tool and is not part of the Generic Tables.

- **Noncarcinogenic - Child**
  - Ingestion

$$SL_{rec\text{-}water\text{-}nc\text{-}ing\text{-}c}\,(\mu g/L) = \frac{THQ \times AT_{rec}\left(\frac{365\ days}{year} \times ED_{recwc}\,(years)\right) \times BW_{recwc}\,(15\ Kg) \times \left(\frac{1000\ \mu g}{mg}\right)}{EF_{recwc}\left(\frac{days}{year}\right) \times ED_{recwc}\,(years) \times \frac{1}{RfD_o\left(\frac{mg}{kg\text{-}d}\right)} \times IRW_{recwc}\left(\frac{0.05\ L}{hr}\right) \times EV_{recwc}\left(\frac{events}{day}\right) \times ET_{recwc}\left(\frac{hours}{event}\right)}$$

  - Dermal

FOR INORGANICS:

$$SL_{rec\text{-}water\text{-}nc\text{-}der\text{-}c}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{recwc}\left(\frac{hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{recwc}\left(\frac{hours}{event}\right)\le t^*\ (hr)\text{, then } SL_{rec\text{-}water\text{-}nc\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{recwc}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recwc}\left(\frac{hours}{event}\right)>t^*\ (hr)\text{, then } SL_{rec\text{-}water\text{-}nc\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{recwc}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)=\frac{THQ\times AT_{recw}\left(\frac{365\ days}{year}\right)\times ED_{recwc}\,(years)\times\left(\frac{1000\ \mu g}{mg}\right)\times BW_{recwc}\,(15\ Kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS}\right)\times EV_{recwc}\left(\frac{events}{day}\right)\times ED_{recwc}\,(years)\times EF_{recwc}\left(\frac{days}{year}\right)\times SA_{recwc}\left(6378\ cm^2\right)}$$

- Total

$$SL_{rec\text{-}water\text{-}nc\text{-}tot\text{-}c}\,(\mu g/L)=\frac{1}{\frac{1}{SL_{rec\text{-}water\text{-}nc\text{-}ing\text{-}c}}+\frac{1}{SL_{rec\text{-}water\text{-}nc\text{-}der\text{-}c}}}$$

- **Noncarcinogenic - Adult**
  - Ingestion

$$SL_{rec\text{-}water\text{-}nc\text{-}ing\text{-}a}\,(\mu g/L)=\frac{THQ\times AT_{rec}\left(\frac{365\ days}{year}\right)\times ED_{recwa}\,(years)\times BW_{recwa}\,(80\ Kg)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_{recwa}\left(\frac{days}{year}\right)\times ED_{recwa}\,(years)\times\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}d}\right)}\times IRW_{recwa}\left(\frac{0.05\ L}{hr}\right)\times EV_{recwa}\left(\frac{events}{day}\right)\times ET_{recwa}\left(\frac{hours}{event}\right)}$$

  - Dermal

FOR INORGANICS:

$$SL_{rec\text{-}water\text{-}nc\text{-}der\text{-}a}\ (\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{recwc}\left(\frac{hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{recwc}\left(\frac{hours}{event}\right)\le t^*\ (hr)\text{, then } SL_{rec\text{-}water\text{-}nc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{recwa}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recwc}\left(\frac{hours}{event}\right)> t^*\ (hr)\text{, then } SL_{rec\text{-}water\text{-}nc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{recwa}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right) = \frac{THQ\times AT_{recw}\left(\frac{365\ days}{year}\times ED_{recwa}\ (years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times BW_{recwa}\ (70\ Kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS}\right)\times EV_{recwa}\left(\frac{events}{day}\right)\times ED_{recwa}\ (years)\times EF_{recwa}\left(\frac{days}{year}\right)\times SA_{recwa}\left(20900\ cm^2\right)}$$

- Total

$$SL_{rec\text{-}water\text{-}nc\text{-}tot\text{-}a}\ (\mu g/L) = \frac{1}{\frac{1}{SL_{rec\text{-}water\text{-}nc\text{-}ing\text{-}a}}+\frac{1}{SL_{rec\text{-}water\text{-}nc\text{-}der\text{-}a}}}$$

- **Carcinogenic**
  - Ingestion

$$SL_{rec\text{-}water\text{-}ca\text{-}ing}\ (\mu g/L) = \frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)}$$

where:

$$IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right) = \frac{EV_{recwc}\left(\frac{events}{day}\right)\times ED_{recwc}\ (years)\times EF_{recwc}\left(\frac{days}{year}\right)\times ET_{recwc}\left(\frac{hours}{event}\right)\times IRW_{recwc}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwc}\ (15\ Kg)} + \frac{EV_{recwa}\left(\frac{events}{day}\right)\times ED_{recwa}\ (years)\times EF_{recwa}\left(\frac{days}{year}\right)\times ET_{recwa}\left(\frac{hours}{event}\right)\times IRW_{recwa}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwa}\ (80\ Kg)}$$

  - Dermal

FOR INORGANICS:

$$SL_{rec\text{-}water\text{-}ca\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) \le t^*\,(hr)\text{, then } SL_{rec\text{-}water\text{-}ca\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6 \times \tau_{event}\left(\frac{hours}{event}\right) \times ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) > t^*\,(hr)\text{, then } SL_{rec\text{-}water\text{-}ca\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hours}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right) = \frac{TR \times AT_{recw}\left(\frac{365\ days}{year} \times LT\,(70\ years)\right) \times \left(\frac{1000\ \mu g}{mg}\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right) \times DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right)}$$

where:

$$DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right) = \frac{EV_{recwc}\left(\frac{events}{day}\right) \times ED_{recwc}\,(years) \times EF_{recwc}\left(\frac{days}{year}\right) \times SA_{recwc}\left(6378\ cm^2\right)}{BW_{recwc}\,(15\ Kg)} + \frac{EV_{recwa}\left(\frac{events}{day}\right) \times ED_{recwa}\,(years) \times EF_{recwa}\left(\frac{days}{year}\right) \times SA_{recwa}\left(20900\ cm^2\right)}{BW_{recwa}\,(80\ Kg)}$$

and:

$$ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) = \frac{\left(ET_{recwc}\left(\frac{hours}{event}\right) \times ED_{recwc}\,(years) + ET_{recwa}\left(\frac{hours}{event}\right) \times ED_{recwa}\,(years)\right)}{ED_{recwc}\,(years) + ED_{recwa}\,(years)}$$

- Total

$$SL_{rec\text{-}water\text{-}ca\text{-}tot}\,(\mu g/L) = \frac{1}{\frac{1}{SL_{rec\text{-}water\text{-}ca\text{-}ing}} + \frac{1}{SL_{rec\text{-}water\text{-}ca\text{-}der}}}$$

- **Mutagenic**
  - Ingestion

$$SL_{rec\text{-}water\text{-}mu\text{-}ing}\,(\mu g/L)=\frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFWM_{rec\text{-}adj}\left(\frac{L}{Kg}\right)}$$

where:

$$IFWM_{rec\text{-}adj}\left(\frac{L}{Kg}\right)=\frac{ED_{0\text{-}2}\,(yr)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times IRW_{0\text{-}2}\left(\frac{0.05\ L}{hr}\right)\times EV_{0\text{-}2}\left(\frac{events}{day}\right)\times ET_{0\text{-}2}\left(\frac{hours}{event}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+$$

$$\frac{ED_{2\text{-}6}\,(yr)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times IRW_{2\text{-}6}\left(\frac{0.05\ L}{hr}\right)\times EV_{2\text{-}6}\left(\frac{events}{day}\right)\times ET_{2\text{-}6}\left(\frac{hours}{event}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+$$

$$\frac{ED_{6\text{-}16}\,(yr)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times IRW_{6\text{-}16}\left(\frac{0.05\ L}{hr}\right)\times EV_{6\text{-}16}\left(\frac{events}{day}\right)\times ET_{6\text{-}16}\left(\frac{hours}{event}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+$$

$$\frac{ED_{16\text{-}26}\,(yr)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times IRW_{16\text{-}26}\left(\frac{0.05\ L}{hr}\right)\times EV_{16\text{-}26}\left(\frac{events}{day}\right)\times ET_{16\text{-}26}\left(\frac{hours}{event}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- Dermal

FOR INORGANICS:

$$SL_{rec\text{-}water\text{-}mu\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)\le t^*\ (hr),\text{then } SL_{rec\text{-}water\text{-}mu\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)>t^*\ (hr),\text{then } SL_{rec\text{-}water\text{-}mu\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)=\frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFWM_{rec\text{-}adj}\left(\frac{events\text{-}\ cm^2}{kg}\right)}$$

$$\text{where: } DFWM_{rec\text{-}adj}\left(\frac{\text{events - cm}^2}{\text{kg}}\right)=\left[\begin{array}{l}\left(\dfrac{EV_{recw\ 0\text{-}2}\left(\frac{\text{events}}{\text{day}}\right)\times ED_{0\text{-}2}\ (\text{years})\times EF_{recw\ 0\text{-}2}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{0\text{-}2}\left(6378\ \text{cm}^2\right)\times 10}{BW_{0\text{-}2}\ (15\ \text{Kg})}\right)+\\ \left(\dfrac{EV_{recw\ 2\text{-}6}\left(\frac{\text{events}}{\text{day}}\right)\times ED_{2\text{-}6}\ (\text{years})\times EF_{recw\ 2\text{-}6}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{2\text{-}6}\left(6378\ \text{cm}^2\right)\times 3}{BW_{2\text{-}6}\ (15\ \text{Kg})}\right)+\\ \left(\dfrac{EV_{recw\ 6\text{-}16}\left(\frac{\text{events}}{\text{day}}\right)\times ED_{6\text{-}16}\ (\text{years})\times EF_{recw\ 6\text{-}16}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{6\text{-}16}\left(20900\ \text{cm}^2\right)\times 3}{BW_{6\text{-}16}\ (80\ \text{Kg})}\right)+\\ \left(\dfrac{EV_{recw\ 16\text{-}26}\left(\frac{\text{events}}{\text{day}}\right)\times ED_{16\text{-}26}\ (\text{years})\times EF_{recw\ 16\text{-}26}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{16\text{-}26}\left(20900\ \text{cm}^2\right)\times 1}{BW_{16\text{-}26}\ (80\ \text{Kg})}\right)\end{array}\right]$$

and:

$$ET_{recw\text{-}madj}\left(\frac{\text{hours}}{\text{event}}\right)=\frac{\left(\begin{array}{l}ET_{recw\ 0\text{-}2}\left(\frac{\text{hours}}{\text{event}}\right)\times ED_{0\text{-}2}\ (\text{years})+ET_{recw\ 2\text{-}6}\left(\frac{\text{hours}}{\text{event}}\right)\times ED_{2\text{-}6}\ (\text{years})+\\ ET_{recw\ 6\text{-}16}\left(\frac{\text{hours}}{\text{event}}\right)\times ED_{6\text{-}16}\ (\text{years})+ET_{recw\ 16\text{-}26}\left(\frac{\text{hours}}{\text{event}}\right)\times ED_{16\text{-}26}\ (\text{years})\end{array}\right)}{ED_{0\text{-}2}\ (\text{years})+ED_{2\text{-}6}\ (\text{years})+ED_{6\text{-}16}\ (\text{years})+ED_{16\text{-}26}\ (\text{years})}$$

- Total

$$SL_{rec\text{-}water\text{-}mu\text{-}tot}\ (\mu g/L)=\frac{1}{\dfrac{1}{SL_{rec\text{-}water\text{-}mu\text{-}ing}}+\dfrac{1}{SL_{rec\text{-}water\text{-}mu\text{-}der}}}$$

- **Vinyl Chloride**
  - Ingestion

$$SL_{rec\text{-}water\text{-}ca\text{-}vc\text{-}ing}\left(\mu g/L\right)=\frac{TR}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)\times\left(\frac{mg}{1000\ \mu g}\right)}{AT_{rec}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}\right)+\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times ET_{recwc}\left(\frac{hr}{day}\right)\times IRW_{recwc}\frac{0.05\ L}{hr}\times\left(\frac{mg}{1000\ \mu g}\right)}{BW_{recwc}\left(15\ kg\right)}\right)+}$$

where:

$$IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)=\frac{EV_{recwc}\left(\frac{events}{day}\right)\times ED_{recwc}\left(years\right)\times EF_{recwc}\left(\frac{days}{year}\right)\times ET_{recwc}\left(\frac{hours}{event}\right)\times IRW_{recwc}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwc}\left(15\ Kg\right)}+\frac{EV_{recwa}\left(\frac{events}{day}\right)\times ED_{recwa}\left(years\right)\times EF_{recwa}\left(\frac{days}{year}\right)\times ET_{recwa}\left(\frac{hours}{event}\right)\times IRW_{recwa}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwa}\left(80\ Kg\right)}$$

- Dermal

$$\text{IF } ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) \le t^{*}\ (hr), \text{then } SL_{rec\text{-}water\text{-}vc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) > t^{*}\ (hr), \text{then } SL_{rec\text{-}water\text{-}vc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{recw\text{-}adj}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}event}\right) = \frac{TR}{\left(\frac{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right)}{AT_{recw}\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}\right)+\left(\frac{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times EV_{recwa}\left(\frac{events}{day}\right)\times SA_c\left(6600\ cm^2\right)}{BW_c\ (15\ Kg)\times\left(\frac{1000\ \mu g}{mg}\right)}\right)}$$

where:

$$DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right) = \frac{EV_{recwc}\left(\frac{events}{day}\right)\times ED_{recwc}\ (years)\times EF_{recwc}\left(\frac{days}{year}\right)\times SA_c\left(6378\ cm^2\right)}{BW_c\ (15\ Kg)} + \frac{EV_{recwa}\left(\frac{events}{day}\right)\times ED_{recwa}\ (years)\times EF_{recwa}\left(\frac{days}{year}\right)\times SA_a\left(20900\ cm^2\right)}{BW_a\ (80\ Kg)}$$

and:

$$ET_{recw\text{-}adj}\left(\frac{hours}{event}\right) = \frac{\left(ET_{recwc}\left(\frac{hours}{event}\right)\times ED_{recwc}\ (years)\right)+\left(ET_{recwa}\left(\frac{hours}{event}\right)\times ED_{recwa}\ (years)\right)}{ED_{recwc}\ (years)+ED_{recwa}\ (years)}$$

- Total

$$SL_{rec\text{-}water\text{-}ca\text{-}vc\text{-}tot}\ (\mu g/L) = \frac{1}{\frac{1}{SL_{rec\text{-}water\text{-}ca\text{-}vc\text{-}ing}}+\frac{1}{SL_{rec\text{-}water\text{-}ca\text{-}vc\text{-}der}}}$$

- **Trichloroethylene**
  - Ingestion

$$PRG_{rec\text{-}water\text{-}tce\text{-}ing}\,(\mu g/L)=\frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times\left(\left(CAF_o\,(0.804)\times IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)\right)\right)+\left(MAF_o\,(0.202)\times IFWM_{rec\text{-}adj}\left(\frac{L}{Kg}\right)\right)}$$

where:

$$IFW_{rec\text{-}adj}\left(\frac{L}{Kg}\right)=\frac{EV_{recwc}\left(\frac{event}{day}\right)\times ED_{recwc}\,(years)\times EF_{recwc}\left(\frac{days}{year}\right)\times ET_{recwc}\left(\frac{hour}{event}\right)\times IRW_{recwc}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwc}\,(15\ Kg)}+\frac{EV_{recwa}\left(\frac{event}{day}\right)\times ED_{recwa}\,(years)\times EF_{recwa}\left(\frac{days}{year}\right)\times ET_{recwa}\left(\frac{hour}{event}\right)\times IRW_{recwa}\left(\frac{0.05\ L}{hr}\right)}{BW_{recwa}\,(80\ Kg)}$$

where:

$$IFWM_{rec\text{-}adj}\left(\frac{L}{Kg}\right)=\frac{ED_{0\text{-}2}\,(years)\times EF_{0\text{-}2}\left(\frac{days}{year}\right)\times IRW_{0\text{-}2}\left(\frac{0.05\ L}{hr}\right)\times EV_{0\text{-}2}\left(\frac{event}{day}\right)\times ET_{0\text{-}2}\left(\frac{hour}{event}\right)\times 10}{BW_{0\text{-}2}\,(15\ Kg)}+\frac{ED_{2\text{-}6}\,(years)\times EF_{2\text{-}6}\left(\frac{days}{year}\right)\times IRW_{2\text{-}6}\left(\frac{0.05\ L}{hr}\right)\times EV_{2\text{-}6}\left(\frac{event}{day}\right)\times ET_{2\text{-}6}\left(\frac{hour}{event}\right)\times 3}{BW_{2\text{-}6}\,(15\ Kg)}+\frac{ED_{6\text{-}16}\,(years)\times EF_{6\text{-}16}\left(\frac{days}{year}\right)\times IRW_{6\text{-}16}\left(\frac{0.05\ L}{hr}\right)\times EV_{6\text{-}16}\left(\frac{event}{day}\right)\times ET_{6\text{-}16}\left(\frac{hours}{event}\right)\times 3}{BW_{6\text{-}16}\,(80\ Kg)}+\frac{ED_{16\text{-}26}\,(years)\times EF_{16\text{-}26}\left(\frac{days}{year}\right)\times IRW_{16\text{-}26}\left(\frac{0.05\ L}{hr}\right)\times EV_{16\text{-}26}\left(\frac{event}{day}\right)\times ET_{16\text{-}26}\left(\frac{hour}{event}\right)\times 1}{BW_{16\text{-}26}\,(80\ Kg)}$$

- Dermal

FOR ORGANICS:

$$\text{IF } ET_{recw\text{-}madj}\left(\frac{1\ hour}{event}\right)\leq t^*\,(hr),\text{then } PRG_{rec\text{-}water\text{-}tce\text{-}der}\,(\mu g/L)=\frac{DA_{tce\text{-}event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{recw\text{-}madj}\left(\frac{hour}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{recw\text{-}madj}\left(\frac{hour}{event}\right)>t^*\,(hr),\text{then } PRG_{rec\text{-}water\text{-}tce\text{-}der}\,(\mu g/L)=\frac{DA_{tce\text{-}event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{recw\text{-}madj}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{tce\text{-}event}\left(\frac{ug}{cm^2\text{-}\ event}\right)=\frac{TR\times AT_{recw}\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times\left(\left(AF_o\,(0.804)\times DFW_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right)\right)\right)+\left(MAF_o\,(0.202)\times DFWM_{rec\text{-}adj}\left(\frac{events\text{-}cm^2}{kg}\right)\right)}$$

where:

$$DFW_{rec\text{-}adj}\left(\frac{\text{events - cm}^2}{\text{kg}}\right)=\frac{EV_{recwc}\left(\frac{\text{event}}{\text{day}}\right)\times ED_{recwc}\,(\text{years})\times EF_{recwc}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{recwc}\left(6378\text{ cm}^2\right)}{BW_{recwc}\,(15\text{ Kg})}+\frac{EV_{recwa}\left(\frac{\text{event}}{\text{day}}\right)\times ED_{recwa}\,(\text{years})\times EF_{recwa}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{recwa}\left(20900\text{ cm}^2\right)}{BW_{recwa}\,(80\text{ Kg})}$$

where:

$$DFWM_{rec\text{-}adj}\left(\frac{\text{events - cm}^2}{\text{kg}}\right)=\left[\left(\frac{EV_{recw\ 0\text{-}2}\left(\frac{\text{event}}{\text{day}}\right)\times ED_{0\text{-}2}\,(\text{years})\times EF_{recw\ 0\text{-}2}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{0\text{-}2}\left(6378\text{ cm}^2\right)\times 10}{BW_{0\text{-}2}\,(15\text{ Kg})}\right)+\left(\frac{EV_{recw\ 2\text{-}6}\left(\frac{\text{event}}{\text{day}}\right)\times ED_{2\text{-}6}\,(\text{years})\times EF_{recw\ 2\text{-}6}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{2\text{-}6}\left(6378\text{ cm}^2\right)\times 3}{BW_{2\text{-}6}\,(15\text{ Kg})}\right)+\left(\frac{EV_{recw\ 6\text{-}16}\left(\frac{\text{event}}{\text{day}}\right)\times ED_{6\text{-}16}\,(\text{years})\times EF_{recw\ 6\text{-}16}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{6\text{-}16}\left(20900\text{ cm}^2\right)\times 3}{BW_{6\text{-}16}\,(70\text{ Kg})}\right)+\left(\frac{EV_{recw\ 16\text{-}26}\left(\frac{\text{event}}{\text{day}}\right)\times ED_{16\text{-}26}\,(\text{years})\times EF_{recw\ 16\text{-}26}\left(\frac{\text{days}}{\text{year}}\right)\times SA_{16\text{-}26}\left(20900\text{ cm}^2\right)\times 1}{BW_{16\text{-}26}\,(80\text{ Kg})}\right)\right]$$

and:

$$ET_{recw\text{-}madj}\left(\frac{\text{hour}}{\text{event}}\right)=\frac{\left(\begin{array}{l}ET_{recw\ 0\text{-}2}\left(\frac{\text{hour}}{\text{event}}\right)\times ED_{0\text{-}2}\,(\text{years})+ET_{recw\ 2\text{-}6}\left(\frac{\text{hour}}{\text{event}}\right)\times ED_{2\text{-}6}\,(\text{years})+\\ ET_{recw\ 6\text{-}16}\left(\frac{\text{hour}}{\text{event}}\right)\times ED_{6\text{-}16}\,(\text{years})+ET_{recw\ 16\text{-}26}\left(\frac{1\text{ hour}}{\text{event}}\right)\times ED_{16\text{-}26}\,(\text{years})\end{array}\right)}{ED_{0\text{-}2}\,(\text{years})+ED_{2\text{-}6}\,(\text{years})+ED_{6\text{-}16}\,(\text{years})+ED_{16\text{-}26}\,(\text{years})}$$

- Total

$$PRG_{rec\text{-}water\text{-}tce\text{-}tot}\,(\mu g/L)=\frac{1}{\frac{1}{PRG_{rec\text{-}water\text{-}tce\text{-}ing}}+\frac{1}{PRG_{rec\text{-}water\text{-}tce\text{-}der}}}$$

- **Supporting Equations**
  - Child

$$ED_{recwc}\,(yr) = ED_{0-2}\,(yr) + ED_{2-6}\,(yr)$$

$$BW_{recwc}\,(kg) = \frac{BW_{0-2}\,(kg) \times ED_{0-2}\,(yr) + BW_{2-6}\,(kg) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$EF_{recwc}\left(\frac{days}{year}\right) = \frac{EF_{0-2}\left(\frac{days}{year}\right) \times ED_{0-2}\,(yr) + EF_{2-6}\left(\frac{days}{year}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$EV_{recwc}\left(\frac{events}{day}\right) = \frac{EV_{0-2}\left(\frac{events}{day}\right) \times ED_{0-2}\,(yr) + EV_{2-6}\left(\frac{events}{day}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$ET_{recwc}\left(\frac{hr}{event}\right) = \frac{ET_{0-2}\left(\frac{hr}{event}\right) \times ED_{0-2}\,(yr) + ET_{2-6}\left(\frac{hr}{event}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$SA_{recwc}\left(cm^2\right) = \frac{SA_{0-2}\left(cm^2\right) \times ED_{0-2}\,(yr) + SA_{2-6}\left(cm^2\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

$$IRW_{recwc}\left(\frac{L}{hr}\right) = \frac{IRW_{0-2}\left(\frac{L}{hr}\right) \times ED_{0-2}\,(yr) + IRW_{2-6}\left(\frac{L}{hr}\right) \times ED_{2-6}\,(yr)}{ED_{0-2}\,(yr) + ED_{2-6}\,(yr)}$$

- Adult

$$ED_{recwa}\,(yr) = ED_{6-16}\,(yr) + ED_{16-26}\,(yr)$$

$$BW_{recwa}\,(kg) = \frac{BW_{6-16}\,(kg) \times ED_{6-16}\,(yr) + BW_{16-26}\,(kg) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$EF_{recwa}\left(\frac{days}{year}\right) = \frac{EF_{6-16}\left(\frac{days}{year}\right) \times ED_{6-16}\,(yr) + EF_{16-26}\left(\frac{days}{year}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$EV_{recwa}\left(\frac{events}{day}\right) = \frac{EV_{6-16}\left(\frac{events}{day}\right) \times ED_{6-16}\,(yr) + EV_{16-26}\left(\frac{events}{day}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$ET_{recwa}\left(\frac{hr}{event}\right) = \frac{ET_{6-16}\left(\frac{hr}{event}\right) \times ED_{6-16}\,(yr) + ET_{16-26}\left(\frac{hr}{event}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$SSA_{recwa}\left(cm^2\right) = \frac{SA_{6-16}\left(cm^2\right) \times ED_{6-16}\,(yr) + SA_{16-26}\left(cm^2\right) \times ED_{16-30}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

$$IRW_{recwa}\left(\frac{L}{hr}\right) = \frac{IRW_{6-16}\left(\frac{L}{hr}\right) \times ED_{6-16}\,(yr) + IRW_{16-26}\left(\frac{L}{hr}\right) \times ED_{16-26}\,(yr)}{ED_{6-16}\,(yr) + ED_{16-26}\,(yr)}$$

- **Dermal Exposure to Water Supporting Equations**
  - B

$$B = \frac{K_p\left(\frac{cm}{hr}\right)}{K_{p,ve}\left(\frac{cm}{hr}\right)} = K_p\left(\frac{cm}{hr}\right) \times \frac{\sqrt{MW}\left(\frac{g}{mole}\right)}{2.6}$$

where :

$$K_{p,ve}\left(\frac{cm}{hr}\right) = \frac{K_{ew} \times D_e\left(\frac{cm^2}{hr}\right)}{L_e\,(cm)}$$

- t*

$$\text{If } B \le 0.6, \text{ then } t^*(hr) = 2.4 \times \tau_{event}\left(\frac{hour}{event}\right)$$

or,

$$\text{If } B > 0.6, \text{ then } t^*(hr) = 6 \times \tau_{event}\left(\frac{hour}{event}\right) \times \left(b - \sqrt{b^2 - c^2}\right)$$

where:

$$b = \frac{2 \times (1+B)^2}{\pi} - c \quad \text{and} \quad c = \frac{1+3 \times B + 3 \times B^2}{3 \times (1+B)}$$

- t

$$\tau_{event}\left(\frac{hours}{event}\right) = \frac{l_{sc}^2\,(cm)}{6 \times D_{sc}\left(\frac{cm^2}{hr}\right)}$$

where:

$$\log \frac{D_{sc}\left(\frac{cm^2}{hr}\right)}{l_{sc}\,(cm)} = -2.80 - 0.0056 \times MW\left(\frac{g}{mole}\right) \text{ or } \frac{D_{sc}\left(\frac{cm^2}{hr}\right)}{l_{sc}\,(cm)} = 10^{\left(-2.80 - 0.0056 \times MW\left(\frac{g}{mole}\right)\right)}$$

thus:

$$l_{sc}\,(cm) = \frac{10^{\left(-2.80 - 0.0056 \times MW\left(\frac{g}{mole}\right)\right)}}{D_{sc}\left(\frac{cm^2}{hr}\right)} \text{ and } D_{sc}\left(\frac{cm^2}{hr}\right) = l_{sc}\,(cm) \times 10^{\left(-2.80 - 0.0056 \times MW\left(\frac{g}{mole}\right)\right)}$$

Tap Water Equations

- **Noncarcinogenic-child**
  - Ingestion

$$SL_{water\text{-}nc\text{-}ing\text{-}c}\,(\mu g/L) = \frac{THQ \times AT_r\left(\frac{365\ days}{year} \times ED_c\,(6\ years)\right) \times BW_c\,(15\ Kg) \times \left(\frac{1000\ \mu g}{mg}\right)}{EF_r\left(350\ \frac{days}{year}\right) \times ED_c\,(6\ years) \times \frac{1}{RfD_o\left(\frac{mg}{kg\text{-}d}\right)} \times IRW_c\left(\frac{0.78\ L}{day}\right)}$$

  - Dermal

FOR INORGANICS:

$$SL_{water\text{-}nc\text{-}der\text{-}c}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\,event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{rwc}\left(\frac{0.54\ hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{rwc}\left(\frac{0.54\ hours}{event}\right)\le t^*\ (hr)\text{, then } SL_{water\text{-}nc\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\,event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{rwc}\left(\frac{0.54\ hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{rwc}\left(\frac{0.54\ hours}{event}\right)> t^*\ (hr)\text{, then } SL_{water\text{-}nc\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\,event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{rwc}\left(\frac{0.54\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}\,event}\right)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_c\ (6\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times BW_c\ (15\ Kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS}\right)\times EV_c\left(\frac{1\ events}{day}\right)\times ED_c\ (6\ years)\times EF\left(\frac{350\ days}{year}\right)\times SA_c\ (6378\ cm^2)}$$

- Inhalation

$$SL_{water\text{-}nc\text{-}inh\text{-}c}\,(\mu g/L)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_c\ (6\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_r\left(350\ \frac{days}{year}\right)\times ED_c\ (6\ years)\times ET_{rw}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(mg/m^3\right)}\times K\left(\frac{0.5\ L}{m^3}\right)}$$

- Total

$$SL_{res\text{-}water\text{-}nc\text{-}tot\text{-}c}\,(\mu g/L)=\frac{1}{\frac{1}{SL_{water\text{-}nc\text{-}ing\text{-}c}}+\frac{1}{SL_{water\text{-}nc\text{-}der\text{-}c}}+\frac{1}{SL_{water\text{-}nc\text{-}inh\text{-}c}}}$$

- **Noncarcinogenic-adult**
  - Ingestion

$$SL_{water\text{-}nc\text{-}ing\text{-}a}\,(\mu g/L)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\ (26\ years)\right)\times BW_a\ (80\ Kg)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_r\left(350\ \frac{days}{year}\right)\times ED_r\ (26\ years)\times\frac{1}{RfD_o\left(\frac{mg}{kg\text{-}d}\right)}\times IRW_a\left(\frac{2.5\ L}{day}\right)}$$

  - Dermal

FOR INORGANICS:

$$SL_{water\text{-}nc\text{-}der\text{-}a}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{rwa}\left(\frac{0.71\ hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{rwa}\left(\frac{0.71\ hours}{event}\right) \le t^*\ (hr), \text{then } SL_{water\text{-}nc\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{rwa}\left(\frac{0.71\ hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{rwa}\left(\frac{0.71\ hours}{event}\right) > t^*\ (hr), \text{then } SL_{water\text{-}nc\text{-}der}\,(\mu g/L) = \frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{rwa}\left(\frac{0.71\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right) = \frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times BW_a\,(80\ Kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)\times GIABS}\right)\times EV_a\left(\frac{1\ events}{day}\right)\times ED_r\,(26\ years)\times EF\left(\frac{350\ days}{year}\right)\times SA_a\left(20900\ cm^2\right)}$$

- Inhalation

$$SL_{water\text{-}nc\text{-}inh\text{-}a}\,(\mu g/L) = \frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\,(26\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_r\left(350\ \frac{days}{year}\right)\times ED_r\,(26\ years)\times ET_{rw}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\times K\left(\frac{0.5\ L}{m^3}\right)}$$

- Total

$$SL_{res\text{-}water\text{-}nc\text{-}tot\text{-}a}\,(\mu g/L) = \frac{1}{\frac{1}{SL_{water\text{-}nc\text{-}ing\text{-}a}}+\frac{1}{SL_{water\text{-}nc\text{-}der\text{-}a}}+\frac{1}{SL_{water\text{-}nc\text{-}inh\text{-}a}}}$$

- **Carcinogenic**
  - Ingestion

$$SL_{water\text{-}ca\text{-}ing}\,(\mu g/L)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times\left(IFW_{adj}\left(\frac{327.95\ L}{Kg}\right)\right)}$$

where:

$$IFW_{adj}\left(\frac{327.95\ L}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_c\,(6\ years)\times IRW_c\left(\frac{0.78\ L}{day}\right)}{BW_c\,(15\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_r\text{-}ED_c\,(20\ years)\times IRW_a\left(\frac{2.5\ L}{day}\right)}{BW_a\,(80\ Kg)}$$

- Dermal

FOR INORGANICS:

$$SL_{water\text{-}ca\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{rw\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{rw\text{-}adj}\left(\frac{hours}{event}\right)\le t^*\,(hr)\text{, then } SL_{water\text{-}ca\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{rw\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{rw\text{-}adj}\left(\frac{hours}{event}\right)>t^*\,(hr)\text{, then } SL_{water\text{-}ca\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{rw\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{-}\ event}\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFW_{adj}\left(\frac{2721670\ events\text{-}cm^2}{kg}\right)}$$

where:

$$DFW_{adj}\left(\frac{2721670\ events\text{-}cm^2}{kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times EV_c\left(\frac{1\ events}{day}\right)\times ED_c\,(6\ years)\times SA_c\,(6378\ cm^2)}{BW_c\,(15\ Kg)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times EV_a\left(\frac{1\ events}{day}\right)\times ED_a\,(20\ years)\times SA_a\,(20900\ cm^2)}{BW_a\,(80\ Kg)}$$

and:

$$ET_{rw\text{-}adj}\left(\frac{0.6708\ hours}{event}\right)=\frac{\left(ET_{rwc}\left(\frac{0.54\ hours}{event}\right)\times ED_c\,(6\ years)+ET_{rwa}\left(\frac{0.71\ hours}{event}\right)\times ED_r\text{-}ED_c\,(20\ years)\right)}{ED_r\,(26\ years)}$$

- Inhalation

$$SL_{water\text{-}ca\text{-}inh}\left(\mu g/L\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\left(26\ years\right)\times ET_{rw}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times K\left(\frac{0.5\ L}{m^3}\right)}$$

- Total

$$SL_{water\text{-}ca\text{-}tot}\left(\mu g/L\right)=\frac{1}{\frac{1}{SL_{water\text{-}ca\text{-}ing}}+\frac{1}{SL_{water\text{-}ca\text{-}der}}+\frac{1}{SL_{water\text{-}ca\text{-}inh}}}$$

- **Mutagenic**
  - Ingestion

$$SL_{water\text{-}mu\text{-}ing}\left(\mu g/L\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IFWM_{adj}\left(\frac{1019.9\ L}{Kg}\right)}$$

where:

$$IFWM_{adj}\left(\frac{1019.9\ L}{Kg}\right)=\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\left(yr\right)\times IRW_c\left(\frac{0.78\ L}{day}\right)\times 10}{BW_c\left(15\ Kg\right)}+\frac{EF_{ressc}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\left(yr\right)\times IRW_c\left(\frac{0.78\ L}{day}\right)\times 3}{BW_c\left(15\ Kg\right)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\left(yr\right)\times IRW_a\left(\frac{2.5\ L}{day}\right)\times 3}{BW_a\left(80\ Kg\right)}+\frac{EF_{ressa}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\left(yr\right)\times IRW_a\left(\frac{2.5\ L}{day}\right)\times 1}{BW_a\left(80\ Kg\right)}$$

  - Dermal

FOR INORGANICS:

$$SL_{water\text{-}mu\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{rw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right)}$$

FOR ORGANICS:

$$\text{IF } ET_{rw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right)\le t^*\ (hr),\text{then } SL_{water\text{-}mu\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{rw\text{-}madj}\left(\frac{hours}{event}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{rw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right)> t^*\ (hr),\text{then } SL_{water\text{-}mu\text{-}der}\,(\mu g/L)=\frac{DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{rdw\text{-}madj}\left(\frac{hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{ug}{cm^2\text{- event}}\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\,(70\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\right)\times DFWM_{adj}\left(\frac{8419740\ events\ -\ cm^2}{kg}\right)}$$

where:

$$DFWM_{adj}\left(\frac{8419740\ events\ -\ cm^2}{kg}\right)=\left[\begin{array}{l}\left(\frac{EV_{0\text{-}2}\left(\frac{1\ events}{day}\right)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ED_{0\text{-}2}\,(years)\times SA_c\left(6378\ cm^2\right)\times 10}{BW_c\,(15\ Kg)}\right)+\left(\frac{EV_{2\text{-}6}\left(\frac{1\ events}{day}\right)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ED_{2\text{-}6}\,(years)\times SA_c\left(6378\ cm^2\right)\times 3}{BW_c\,(15\ Kg)}\right)+\\ \left(\frac{EV_{6\text{-}16}\left(\frac{1\ events}{day}\right)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times ED_{6\text{-}16}\,(years)\times SA_a\left(20900\ cm^2\right)\times 3}{BW_a\,(80\ Kg)}\right)+\left(\frac{EV_{16\text{-}26}\left(\frac{1\ events}{day}\right)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times ED_{16\text{-}26}\,(years)\times SA_a\left(20900\ cm^2\right)\times 1}{BW_a\,(80\ Kg)}\right)\end{array}\right]$$

and:

$$ET_{rw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right)=\frac{\left(\begin{array}{l}ET_{0\text{-}2}\left(\frac{0.54\ hours}{event}\right)\times ED_{0\text{-}2}\,(years)+ET_{2\text{-}6}\left(\frac{0.54\ hours}{event}\right)\times ED_{2\text{-}6}\,(years)+\\ ET_{6\text{-}16}\left(\frac{0.71\ hours}{event}\right)\times ED_{6\text{-}16}\,(years)+ET_{16\text{-}26}\left(\frac{0.71\ hours}{event}\right)\times ED_{16-26}\,(years)\end{array}\right)}{ED_{0\text{-}2}\,(years)+ED_{2\text{-}6}\,(years)+ED_{6\text{-}16}\,(years)+ED_{16\text{-}26}\,(years)}$$

- Inhalation

$$SL_{water\text{-}mu\text{-}inh}\,(\mu g/L) = \frac{TR \times AT_r\left(\frac{365\ days}{year}\right) \times LT\,(70\ years)}{EF_r\left(\frac{350\ days}{year}\right) \times K\left(\frac{0.5\ L}{m^3}\right) \times ET_{rw}\left(\frac{24\ hours}{day}\right) \times \left(\frac{1\ day}{24\ hours}\right) \times \left(\begin{array}{l}\left(ED_{0\text{-}2}\,(yrs) \times IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times 10\right) + \left(ED_{2\text{-}6}\,(yrs) \times IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times 3\right) + \\ \left(ED_{6\text{-}16}\,(yrs) \times IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times 3\right) + \left(ED_{16\text{-}26}\,(yrs) \times IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times 1\right)\end{array}\right)}$$

- Total

$$SL_{water\text{-}mu\text{-}tot}\,(\mu g/L) = \frac{1}{\frac{1}{SL_{water\text{-}mu\text{-}ing}} + \frac{1}{SL_{water\text{-}mu\text{-}der}} + \frac{1}{SL_{water\text{-}mu\text{-}inh}}}$$

- **Vinyl Chloride**
  - Ingestion

$$SL_{water\text{-}ca\text{-}vc\text{-}ing}\,(\mu g/L) = \frac{TR}{\left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1} \times FW_{adj}\left(\frac{327.95\ L}{kg}\right) \times \left(\frac{mg}{1000\ \mu g}\right)}{AT\left(\frac{365\ days}{year} \times LT\,(70\ years)\right)}\right) + \left(\frac{CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1} \times IRW_c\left(\frac{0.78\ L}{day}\right) \times \left(\frac{mg}{1000\ \mu g}\right)}{BW_c\,(15\ kg)}\right)}$$

where:

$$IFW_{adj}\left(\frac{327.95\ L}{Kg}\right) = \frac{EF_{ressc}\left(\frac{350\ days}{year}\right) \times IED_c\,(6\ years) \times IRW_c\left(\frac{0.78\ L}{day}\right)}{BW_c\,(15\ Kg)} + \frac{EF_{ressa}\left(\frac{350\ days}{year}\right) \times IED_r\text{-}ED_c\,(20\ years) \times IRW_a\left(\frac{2.5\ L}{day}\right)}{BW_a\,(80\ Kg)}$$

  - Dermal

$$\text{IF } ET_{rw\text{-}adj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right) \le t^{*}\ (\text{hr}), \text{then } SL_{water\text{-}vc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{\text{ug}}{\text{cm}^2\text{-event}}\right) \times \left(\frac{1000\ \text{cm}^3}{\text{L}}\right)}{2 \times FA \times K_p\left(\frac{\text{cm}}{\text{hr}}\right) \sqrt{\frac{6 \times \tau_{event}\left(\frac{\text{hours}}{\text{event}}\right) \times ET_{rw\text{-}adj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right)}{\pi}}}$$

or,

$$\text{IF } ET_{rw\text{-}adj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right) > t^{*}\ (\text{hr}), \text{then } SL_{water\text{-}vc\text{-}der}\ (\mu g/L) = \frac{DA_{event}\left(\frac{\text{ug}}{\text{cm}^2\text{-event}}\right) \times \left(\frac{1000\ \text{cm}^3}{\text{L}}\right)}{FA \times K_p\left(\frac{\text{cm}}{\text{hr}}\right) \times \left[\frac{ET_{rw\text{-}adj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{\text{hours}}{\text{event}}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{\text{ug}}{\text{cm}^2\text{-event}}\right) = \frac{TR}{\left(\frac{\left(\frac{CSF_o\left(\frac{\text{mg}}{\text{Kg-day}}\right)}{GIABS}\right)^{-1} \times DFW_{adj}\left(\frac{2721670\ \text{events-cm}^2}{\text{kg}}\right)}{AT_r\left(\frac{365\ \text{days}}{\text{year}} \times LT\ (70\ \text{years})\right) \times \left(\frac{1000\ \mu g}{\text{mg}}\right)}\right) + \left(\frac{\left(\frac{CSF_o\left(\frac{\text{mg}}{\text{Kg-day}}\right)}{GIABS}\right)^{-1} \times EV_{rdwc}\left(\frac{1\text{events}}{\text{day}}\right) \times SA_c\ (6378\ \text{cm}^2)}{BW_c\ (15\ \text{Kg}) \times \left(\frac{1000\ \mu g}{\text{mg}}\right)}\right)}$$

where:

$$DFW_{adj}\left(\frac{2721670\ \text{events-cm}^2}{\text{kg}}\right) = \frac{EF_{ressc}\left(\frac{350\ \text{days}}{\text{year}}\right) \times EV_c\left(\frac{1\ \text{events}}{\text{day}}\right) \times ED_c\ (6\ \text{years}) \times SA_c\ (6378\ \text{cm}^2)}{BW_c\ (15\ \text{Kg})} + \frac{EF_{ressa}\left(\frac{350\ \text{days}}{\text{year}}\right) \times EV_a\left(\frac{1\ \text{events}}{\text{day}}\right) \times ED_a\ (20\ \text{years}) \times SA_a\ (20900\ \text{cm}^2)}{BW_a\ (80\ \text{Kg})}$$

and:

$$ET_{rw\text{-}adj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right) = \frac{\left(ET_{rwc}\left(\frac{0.54\ \text{hours}}{\text{event}}\right) \times ED_c\ (6\ \text{years})\right) + \left(ET_{rwa}\left(\frac{0.71\ \text{hours}}{\text{event}}\right) \times ED_r - ED_c\ (20\ \text{years})\right)}{ED_r\ (26\ \text{years})}$$

- Inhalation

$$SL_{water\text{-}ca\text{-}vc\text{-}inh}\ (\mu g/L) = \frac{TR}{\left(\frac{IUR\left(\mu g/m^3\right)^{-1} \times EF\left(\frac{350\ \text{days}}{\text{year}}\right) \times ED\ (30\ \text{years}) \times ET_{rw}\left(\frac{24\ \text{hours}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hours}}\right) \times K\left(\frac{0.5\ \text{L}}{\text{m}^3}\right)}{AT\left(\frac{365\ \text{days}}{\text{year}} \times LT\ (70\ \text{years})\right)}\right) + \left(IUR\left(\mu g/m^3\right)^{-1} \times K\left(\frac{0.5\ \text{L}}{\text{m}^3}\right)\right)}$$

- Total

$$SL_{water\text{-}ca\text{-}vc\text{-}tot}\ (\mu g/L) = \frac{1}{\frac{1}{SL_{water\text{-}ca\text{-}vc\text{-}ing}} + \frac{1}{SL_{water\text{-}ca\text{-}vc\text{-}der}} + \frac{1}{SL_{water\text{-}ca\text{-}vc\text{-}inh}}}$$

- **Trichloroethylene**
  - Ingestion

$$PRG_{water\text{-}tce\text{-}ing}\left(\mu g/L\right)=\frac{TR\times AT_{resw}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{CSF_{o}\left(\frac{mg}{kg\text{-}day}\right)^{-1}\times\left(\left(CAF_{o}\left(0.804\right)\times IFW_{resw\text{-}adj}\left(\frac{327.95\ L}{Kg}\right)\right)\right)+\left(MAF_{o}\left(0.202\right)\times IFWM_{res\text{-}adj}\left(\frac{1019.9\ L}{Kg}\right)\right)}$$

where:

$$IFW_{resw\text{-}adj}\left(\frac{327.95\ L}{Kg}\right)=\frac{ED_{reswc}\left(6\ years\right)\times EF_{reswc}\left(\frac{350\ days}{year}\right)\times IRW_{reswc}\left(\frac{0.78\ L}{day}\right)}{BW_{c}\left(15\ Kg\right)}+\frac{ED_{resw}\left(26\ years\right)-ED_{reswc}\left(6\ years\right)\times EF_{reswa}\left(\frac{350\ days}{year}\right)\times IRW_{reswa}\left(\frac{2.5\ L}{day}\right)}{BW_{reswa}\left(80\ Kg\right)}$$

where:

$$IFWM_{res\text{-}adj\text{-}}\left(\frac{1019.9\ L}{Kg}\right)=\frac{ED_{0\text{-}2}\left(2\ years\right)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times IRW_{0\text{-}2}\left(\frac{0.78\ L}{day}\right)\times 10}{BW_{0\text{-}2}\left(15\ Kg\right)}+\frac{ED_{2\text{-}6}\left(4\ years\right)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times IRW_{2\text{-}6}\left(\frac{0.78\ L}{day}\right)\times 3}{BW_{2\text{-}6}\left(15\ Kg\right)}+\frac{ED_{6\text{-}16}\left(10\ years\right)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times IRW_{6\text{-}16}\left(\frac{2.5\ L}{day}\right)\times 3}{BW_{6\text{-}16}\left(80\ Kg\right)}+\frac{ED_{16\text{-}26}\left(10\ years\right)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times IRW_{16\text{-}26}\left(\frac{2.5\ L}{day}\right)\times 1}{BW_{16\text{-}26}\left(80\ Kg\right)}$$

  - Dermal

FOR ORGANICS:

$$IF\ ET_{resw\text{-}adj}\left(\frac{hours}{event}\right)\text{£}\ t^{*}\left(hr\right),then\ PRG_{water\text{-}tce\text{-}der}\left(\mu g/L\right)=\frac{DA_{tce\text{-}event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right)\times\left(\frac{1000\ cm^{3}}{L}\right)}{2\times FA\times K_{p}\left(\frac{cm}{hr}\right)\sqrt{\frac{6\times\tau_{event}\left(\frac{hours}{event}\right)\times ET_{resw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right)}{\pi}}}$$

or,

$$IF\ ET_{resw\text{-}adj}\left(\frac{hours}{event}\right)>t^{*}\left(hr\right),then\ PRG_{water\text{-}tce\text{-}der}\left(\mu g/L\right)=\frac{DA_{tce\text{-}event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right)\times\left(\frac{1000\ cm^{3}}{L}\right)}{FA\times K_{p}\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{resw\text{-}madj}\left(\frac{0.6708\ hours}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hours}{event}\right)\times\left(\frac{1+3B+3B^{2}}{\left(1+B\right)^{2}}\right)\right]}$$

where:

$$DA_{tce\text{-}event}\left(\frac{ug}{cm^{2}\text{-}\ event}\right)=\frac{TR\times AT_{resw}\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{\frac{CSF_{o}\left(\frac{mg}{Kg\text{-}day}\right)^{-1}}{GIABS}\times\left(\left(AF_{o}\left(0.804\right)\times DFW_{res\text{-}adj}\left(\frac{2721670\ events\ \text{-}\ cm^{2}}{kg}\right)\right)\right)+\left(MAF_{o}\left(0.202\right)\times DFWM_{res\text{-}adj}\left(\frac{8419740\ events\ \text{-}\ cm^{2}}{kg}\right)\right)\Bigg)}$$

where:

$$DFW_{res\text{-}adj}\left(\frac{2721670\ \text{events - cm}^2}{\text{kg}}\right)=\frac{EV_{reswc}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{reswc}\,(6\ \text{years})\times EF_{reswc}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{reswc}\left(6378\ \text{cm}^2\right)}{BW_{resw}\,(15\ \text{Kg})}+$$

$$\frac{EV_{reswa}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{reswa}\,(20\ \text{years})\times EF_{reswa}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{reswa}\left(20900\ \text{cm}^2\right)}{BW_{reswa}\,(80\ \text{Kg})}$$

where:

$$DFWM_{res\text{-}adj}\left(\frac{8419740\ \text{events - cm}^2}{\text{kg}}\right)=\left[\begin{array}{l}\left(\frac{EV_{0\text{-}2}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{0\text{-}2}\,(2\ \text{years})\times EF_{0\text{-}2}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{0\text{-}2}\left(6378\ \text{cm}^2\right)\times 10}{BW_{0\text{-}2}\,(15\ \text{Kg})}\right)+\\ \left(\frac{EV_{2\text{-}6}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{2\text{-}6}\,(4\ \text{years})\times EF_{2\text{-}6}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{2\text{-}6}\left(6378\ \text{cm}^2\right)\times 3}{BW_{2\text{-}6}\,(15\ \text{Kg})}\right)+\\ \left(\frac{EV_{6\text{-}16}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{6\text{-}16}\,(10\ \text{years})\times EF_{6\text{-}16}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{6\text{-}16}\left(20900\ \text{cm}^2\right)\times 3}{BW_{6\text{-}16}\,(80\ \text{Kg})}\right)+\\ \left(\frac{EV_{16\text{-}26}\left(\frac{1\ \text{events}}{\text{day}}\right)\times ED_{16\text{-}26}\,(10\ \text{years})\times EF_{16\text{-}26}\left(\frac{350\ \text{days}}{\text{year}}\right)\times SA_{16\text{-}26}\left(20900\ \text{cm}^2\right)\times 1}{BW_{16\text{-}26}\,(80\ \text{Kg})}\right)\end{array}\right]$$

and:

$$ET_{resw\text{-}madj}\left(\frac{0.6708\ \text{hours}}{\text{event}}\right)=\frac{\left(\begin{array}{l}ET_{0\text{-}2}\left(\frac{0.54\ \text{hours}}{\text{event}}\right)\times ED_{0\text{-}2}\,(2\ \text{years})+ET_{2\text{-}6}\left(\frac{0.54\ \text{hours}}{\text{event}}\right)\times ED_{2\text{-}6}\,(4\ \text{years})+\\ ET_{6\text{-}16}\left(\frac{0.71\ \text{hours}}{\text{event}}\right)\times ED_{6\text{-}16}\,(10\ \text{years})+ET_{16\text{-}26}\left(\frac{0.71\ \text{hours}}{\text{event}}\right)\times ED_{16\text{-}26}\,(1\ \text{years})\end{array}\right)}{ED_{0\text{-}2}\,(2\ \text{years})+ED_{2\text{-}6}\,(4\ \text{years})+ED_{6\text{-}16}\,(10\ \text{years})+ED_{16\text{-}26}\,(10\ \text{years})}$$

- Inhalation

$$PRG_{water\text{-}tce\text{-}inh}\,(\mu g/L)=\frac{TR\times AT_{resw}\left(\frac{365\ \text{days}}{\text{year}}\right)\times LT\,(70\ \text{years})}{\begin{array}{l}ET_{resw}\left(\frac{24\ \text{hours}}{\text{day}}\right)\times\left(\frac{1\ \text{day}}{24\ \text{hours}}\right)\times K\left(\frac{0.5\ \text{L}}{\text{m}^3}\right)\times IUR\left(\mu g/m^3\right)^{-1}\times\\ \left(\left(EF_{resw}\left(\frac{350\ \text{days}}{\text{year}}\right)\times ED_{resw}\,(26\ \text{years})\times CAF_i\,(0.756)\right)+\right.\\ \left(\left(\left(ED_{0\text{-}2}\,(2\ \text{years})\times EF_{0\text{-}2}\left(\frac{350\ \text{days}}{\text{year}}\right)\times MAF_i\,(0.244)\times 10\right)+\left(ED_{2\text{-}6}\,(4\ \text{years})\times EF_{2\text{-}6}\left(\frac{350\ \text{days}}{\text{year}}\right)\times MAF_i\,(0.244)\times 3\right)+\right.\right.\\ \left.\left.\left.\left(ED_{6\text{-}16}\,(10\ \text{years})\times EF_{6\text{-}16}\left(\frac{350\ \text{days}}{\text{year}}\right)\times MAF_i\,(0.244)\times 3\right)+\left(ED_{16\text{-}26}\,(10\ \text{years})\times EF_{16\text{-}26}\left(\frac{350\ \text{days}}{\text{year}}\right)\times MAF_i\,(0.244)\times 1\right)\right)\right)\right)\end{array}}$$

- Total

$$PRG_{water\text{-}tce\text{-}tot}\,(\mu g/L)=\frac{1}{\frac{1}{PRG_{water\text{-}tce\text{-}ing}}+\frac{1}{PRG_{water\text{-}tce\text{-}der}}+\frac{1}{PRG_{water\text{-}tce\text{-}inh}}}$$

- **Supporting Equations**
  - Child

$$ED_c\left(6\text{ years}\right) = ED_{0\text{-}2}\left(2\text{ years}\right) + ED_{2\text{-}6}\left(4\text{ years}\right)$$

$$BW_c\left(15\text{ kg}\right) = \frac{BW_{0\text{-}2}\left(15\text{ kg}\right) \times ED_{0\text{-}2}\left(2\text{ years}\right) + BW_{2\text{-}6}\left(15\text{ kg}\right) \times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right) + ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$EF_c\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{EF_{0\text{-}2}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{0\text{-}2}\left(2\text{ years}\right) + EF_{2\text{-}6}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right) + ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$EV_c\left(\frac{1\text{ event}}{\text{day}}\right) = \frac{EV_{0\text{-}2}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{0\text{-}2}\left(2\text{ years}\right) + EV_{2\text{-}6}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right) + ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$ET_c\left(\frac{0.54\text{ hour}}{\text{event}}\right) = \frac{ET_{0\text{-}2}\left(\frac{0.54\text{ hour}}{\text{event}}\right) \times ED_{0\text{-}2}\left(2\text{ years}\right) + ET_{2\text{-}6}\left(\frac{0.54\text{ hour}}{\text{event}}\right) \times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right) + ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$SA_c\left(6378\text{ cm}^2\right) = \frac{SA_{0\text{-}2}\left(6378\text{ cm}^2\right) \times ED_{0\text{-}2}\left(2\text{ years}\right) + SA_{2\text{-}6}\left(6378\text{ cm}^2\right) \times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right) + ED_{2\text{-}6}\left(4\text{ years}\right)}$$

$$IRW_c\left(\frac{0.78\text{ L}}{\text{day}}\right) = \frac{IRW_{0\text{-}2}\left(\frac{0.78\text{ L}}{\text{day}}\right) \times ED_{0\text{-}2}\left(2\text{ years}\right) + IRW_{2\text{-}6}\left(\frac{0.78\text{ L}}{\text{day}}\right) \times ED_{2\text{-}6}\left(4\text{ years}\right)}{ED_{0\text{-}2}\left(2\text{ years}\right) + ED_{2\text{-}6}\left(4\text{ years}\right)}$$

  - Adult

$$ED_a\ (20\text{ years}) = ED_{6\text{-}16}\ (10\text{ years}) + ED_{16\text{-}26}\ (10\text{ years})$$

$$BW_a\ (80\text{ kg}) = \frac{BW_{6\text{-}16}\ (80\text{ kg}) \times ED_{6\text{-}16}\ (10\text{ years}) + BW_{16\text{-}26}\ (80\text{ kg}) \times ED_{16\text{-}26}\ (10\text{ years})}{ED_{6\text{-}16}\ (10\text{ years}) + ED_{16\text{-}26}\ (10\text{ years})}$$

$$EF_a\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{EF_{6\text{-}16}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{6\text{-}16}\ (10\text{ years}) + EF_{16\text{-}26}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{16\text{-}26}\ (10\text{ years})}{ED_{6\text{-}16}\ (10\text{ years}) + ED_{16\text{-}26}\ (10\text{ years})}$$

$$EV_a\left(\frac{1\text{ event}}{\text{day}}\right) = \frac{EV_{6\text{-}16}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{6\text{-}16}\ (10\text{ years}) + EV_{16\text{-}26}\left(\frac{1\text{ event}}{\text{day}}\right) \times ED_{16\text{-}26}\ (10\text{ years})}{ED_{6\text{-}16}\ (10\text{ years}) + ED_{16\text{-}26}\ (10\text{ years})}$$

$$ET_a\left(\frac{0.71\text{ hour}}{\text{event}}\right) = \frac{ET_{6\text{-}16}\left(\frac{0.71\text{ hour}}{\text{event}}\right) \times ED_{6\text{-}16}\ (10\text{ years}) + ET_{16\text{-}26}\left(\frac{0.71\text{ hour}}{\text{event}}\right) \times ED_{16\text{-}26}\ (10\text{ years})}{ED_{6\text{-}16}\ (10\text{ years}) + ED_{16\text{-}26}\ (10\text{ years})}$$

$$SA_a\left(20900\text{ cm}^2\right) = \frac{SA_{6\text{-}16}\left(20900\text{ cm}^2\right) \times ED_{6\text{-}16}\ (10\text{ years}) + SA_{16\text{-}26}\left(20900\text{ cm}^2\right) \times ED_{16\text{-}26}\ (10\text{ years})}{ED_{6\text{-}16}\ (10\text{ years}) + ED_{16\text{-}26}\ (10\text{ years})}$$

$$IRW_a\left(\frac{2.5\text{ L}}{\text{day}}\right) = \frac{IRW_{6\text{-}16}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times ED_{6\text{-}16}\ (10\text{ years}) + IRW_{16\text{-}26}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times ED_{16\text{-}26}\ (10\text{ years})}{ED_{6\text{-}16}\ (10\text{ years}) + ED_{16\text{-}26}\ (10\text{ years})}$$

- Age-adjusted

$$ED_r\ (26\text{ years}) = ED_{0\text{-}2}\ (2\text{ years}) + ED_{2\text{-}6}\ (4\text{ years}) + ED_{6\text{-}16}\ (10\text{ years}) + ED_{16\text{-}26}\ (10\text{ years})$$

$$EF_r\left(\frac{350\text{ days}}{\text{year}}\right) = \frac{\begin{array}{c} EF_{0\text{-}2}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{0\text{-}2}\ (2\text{ years}) + EF_{2\text{-}6}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{2\text{-}6}\ (4\text{ years}) \\ + EF_{6\text{-}16}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{6\text{-}16}\ (10\text{ years}) + EF_{16\text{-}26}\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_{16\text{-}26}\ (10\text{ years}) \end{array}}{ED_{0\text{-}2}\ (2\text{ years}) + ED_{2\text{-}6}\ (4\text{ years}) + ED_{6\text{-}16}\ (10\text{ years}) + ED_{16\text{-}26}\ (10\text{ years})}$$

$$ET_r\left(\frac{24\text{ hours}}{\text{day}}\right)$$

Resident Air Equations

- **Noncarcinogenic**
  - Inhalation

$$SL_{res\text{-}air\text{-}nc}\left(\mu g/m^3\right) = \frac{THQ \times AT_r\left(\frac{365\text{ days}}{\text{year}} \times ED_r\ (26\text{ years})\right) \times \left(\frac{1000\ \mu g}{\text{mg}}\right)}{EF_r\left(\frac{350\text{ days}}{\text{year}}\right) \times ED_r\ (26\text{ years}) \times ET_{ra}\left(\frac{24\text{ hours}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hours}}\right) \times \frac{1}{RfC\left(\text{mg}/\text{m}^3\right)}}$$

- **Carcinogenic**
  - Inhalation

$$SL_{res\text{-}air\text{-}ca}\left(\mu g/m^3\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\ (26\ years)\times ET_{ra}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}}$$

- **Mutagenic**
  - Inhalation

$$SL_{res\text{-}air\text{-}mu}\left(\mu g/m^3\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{\left(\frac{1\ day}{24\ hours}\right)\times\left(\begin{array}{l}\left(ED_{0\text{-}2}\ (yrs)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ET_{0\text{-}2}\left(\frac{24\ hours}{day}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 10\right)+\\ \left(ED_{2\text{-}6}\ (yrs)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ET_{2\text{-}6}\left(\frac{24\ hours}{day}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 3\right)+\\ \left(ED_{6\text{-}16}\ (yrs)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times ET_{6\text{-}16}\left(\frac{24\ hours}{day}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 3\right)+\\ \left(ED_{16\text{-}26}\ (yrs)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times ET_{16\text{-}26}\left(\frac{24\ hours}{day}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times 1\right)\end{array}\right)}$$

- **Vinyl Chloride**
  - Inhalation

$$SL_{res\text{-}air\text{-}ca\text{-}vinyl\ chloride}\left(\mu g/m^3\right)=\frac{TR}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}+\left(\frac{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times EF_r\left(\frac{350\ days}{year}\right)\times ED_r\ (26\ years)\times ET_{ra}\left(\frac{24\ hours}{day}\right)\times\left(\frac{1\ day}{24\ hours}\right)}{AT_r\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}\right)}$$

- **Trichloroethylene**
  - Inhalation

$$PRG_{res\text{-}air\text{-}tce}\left(\mu g/m^3\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left(\frac{1\ day}{24\ hours}\right)\times\left(\begin{array}{l}\left(ED_r\ (26\ years)\times EF_r\left(\frac{350\ days}{year}\right)\times ET_{ra}\left(\frac{24\ hours}{day}\right)\times CAF_i\ (0.756)\right)+\\\left(\begin{array}{l}\left(ED_{0\text{-}2}\ (yrs)\times EF_{0\text{-}2}\left(\frac{350\ days}{year}\right)\times ET_{0\text{-}2}\left(\frac{24\ hours}{day}\right)\times MAF_i\ (0.244)\times 10\right)+\\\left(ED_{2\text{-}6}\ (yrs)\times EF_{2\text{-}6}\left(\frac{350\ days}{year}\right)\times ET_{2\text{-}6}\left(\frac{24\ hours}{day}\right)\times MAF_i\ (0.244)\times 3\right)+\\\left(ED_{6\text{-}16}\ (yrs)\times EF_{6\text{-}16}\left(\frac{350\ days}{year}\right)\times ET_{6\text{-}16}\left(\frac{24\ hours}{day}\right)\times MAF_i\ (0.244)\times 3\right)+\\\left(ED_{16\text{-}26}\ (yrs)\times EF_{16\text{-}26}\left(\frac{350\ days}{year}\right)\times ET_{16\text{-}26}\left(\frac{24\ hours}{day}\right)\times MAF_i\ (0.244)\times 1\right)\end{array}\right)\end{array}\right)}$$

Worker Air Equations

This land use is for developing industrial default screening levels that are presented in the Generic Tables.

- **Noncarcinogenic**
  - **Inhalation**

$$SL_{w\text{-}air\text{-}nc}\left(\mu g/m^3\right)=\frac{THQ\times AT_w\left(\frac{365\ days}{year}\times ED_w\ (25\ years)\right)\times\left(\frac{1000\ \mu g}{mg}\right)}{EF_w\left(\frac{250\ days}{year}\right)\times ED_w\ (25\ years)\times ET_w\left(\frac{8\ hr}{24\ hr}\right)\times\frac{1}{RfC\left(\frac{mg}{m^3}\right)}}$$

- **Carcinogenic**
  - **Inhalation**

$$SL_{w\text{-}air\text{-}ca}\left(\mu g/m^3\right)=\frac{TR\times AT_w\left(\frac{365\ days}{year}\times LT\ (70\ years)\right)}{EF_w\left(\frac{250\ days}{year}\right)\times ED_w\ (25\ years)\times ET_w\left(\frac{8\ hr}{24\ hr}\right)\times IUR\left(\frac{\mu g}{m^3}\right)^{-1}}$$

Fish Ingestion Equations

This land use is only presented in the calculator portion of this tool and is not part of the Generic Tables.

- **Noncarcinogenic**

$$SL_{res\text{-}fsh\text{-}nc\text{-}ing}\left(mg/kg\right)=\frac{THQ\times AT_r\left(\frac{365\ days}{year}\times ED_r\left(26\ years\right)\right)\times BW_a\left(80\ Kg\right)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\left(26\ year\right)\times\frac{1}{RfD_o\left(\frac{mg}{Kg\text{-}day}\right)}\times IRF_a\left(\frac{5.4\times10^4\ mg}{day}\right)\times\frac{10^{-6}Kg}{1\ mg}}$$

- **Carcinogenic**

$$SL_{res\text{-}fsh\text{-}ca\text{-}ing}\left(mg/kg\right)=\frac{TR\times AT_r\left(\frac{365\ days}{year}\times LT\left(70\ years\right)\right)\times BW_a\left(80\ Kg\right)}{EF_r\left(\frac{350\ days}{year}\right)\times ED_r\left(26\ year\right)\times CSF_o\left(\frac{mg}{Kg\text{-}day}\right)^{-1}\times IRF_a\left(\frac{5.4\times10^4\ mg}{day}\right)\times\frac{10^{-6}Kg}{1\ mg}}$$

Supporting Equations

- **Wind Particulate Emission Factor**

$$PEF_w\left(\frac{m^3_{air}}{kg_{soil}}\right)=\frac{Q}{C_{wind}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\frac{3{,}600\left(\frac{s}{hour}\right)}{0.036\times\left(1\text{-}V\right)\times\left(\frac{U_m\left(\frac{m}{s}\right)}{U_t\left(\frac{m}{s}\right)}\right)^3\times F\left(x\right)}$$

$$\text{and: }\frac{Q}{C_{wind}}=A\times\exp\left[\frac{\left(\ln A_s\left(acre\right)-B\right)^2}{C}\right]$$

- **Wind Volatilization Factors**

unlimited source model for chronic exposure

$$VF_s\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{\frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \left(3.14 \times D_A\left(\frac{cm^2}{s}\right) \times T(s)\right)^{1/2} \times 10^{-4}\left(\frac{m^2}{cm^2}\right)}{2 \times \rho_b\left(\frac{g}{cm^3}\right) \times D_A\left(\frac{cm^2}{s}\right)}$$

$$\text{where: } \frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right) = A \times \exp\left[\frac{\left(\ln A_s\,(acre) - B\right)^2}{C}\right]$$

$$\text{where: } D_A\left(\frac{cm^2}{s}\right) = \frac{\left(\theta_a\left(\frac{L_{air}}{L_{soil}}\right)^{10/3} \times D_{ia}\left(\frac{cm^2}{s}\right) \times H' + \theta_w\left(\frac{0.15\,L_{water}}{L_{soil}}\right)^{10/3} \times D_{iw}\left(\frac{cm^2}{s}\right)\right) / n^2\left(\frac{L_{pore}}{L_{soil}}\right)}{\rho_b\left(\frac{1.5g}{cm^3}\right) \times K_d\left(\frac{cm^3}{g}\right) + \theta_w\left(\frac{0.15\,L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{L_{air}}{L_{soil}}\right) \times H'}$$

$$\text{where: } \theta_a\left(\frac{L_{air}}{L_{soil}}\right) = n\left(\frac{L_{pore}}{L_{soil}}\right)\theta_w\left(\frac{0.15\,L_{water}}{L_{soil}}\right) \text{ and } n\left(\frac{L_{pore}}{L_{soil}}\right) = 1 - \left(\rho_b\left(\frac{1.5g}{cm^3}\right) \Big/ \rho_s\left(\frac{2.65\,g}{cm^3}\right)\right)$$

$$\text{where: } K_d\left(\frac{cm^3}{g}\right) = f_{oc}\left(\frac{g}{g}\right) \times K_{oc}\left(\frac{cm^3}{g}\right) \text{ only for organics.}$$

mass limit model for chronic exposure

$$VF_s\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \frac{\left[T(year) \times \left(3.15 \times 10^7\left(\frac{s}{year}\right)\right)\right]}{\rho_b\left(\frac{Mg}{m^3}\right) \times d_s(m) \times 10^6\left(\frac{g}{Mg}\right)}$$

$$\text{where: } \frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right) = A \times \exp\left[\frac{\left(\ln A_s\,(acre) - B\right)^2}{C}\right]$$

- **Mechanical Particulate Emission Factor for Construction Worker from Vehicle Traffic on Unpaved Roads**

$$PEF_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right)=\frac{Q}{C_{sr}}\left(\frac{\left(\frac{g}{m^2\text{- }s}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\frac{1}{F_D}\times\left[\frac{T\,(s)\ \times A_R\left(m^2\right)}{\frac{2.6\times\left(\frac{s}{12}\right)^{0.8}\times\left(\frac{W(tons)}{3}\right)^{0.4}}{\left(\frac{M_{dry}}{0.2}\right)^{0.3}}\times\frac{\left(365\left(\frac{days}{year}\right)-p\left(\frac{days}{year}\right)\right)}{365\left(\frac{days}{year}\right)}\times 281.9\times\Sigma\,VKT(km)}\right]$$

$$\frac{Q}{C_{sr}}\left(\frac{\left(\frac{g}{m^2\text{- }s}\right)}{\left(\frac{kg}{m^3}\right)}\right)=A\times\exp\left[\frac{\left(\ln A_s\,(acre)-B\right)^2}{C}\right]$$

$$A_R\left(m^2\right)=L_R\,(ft)\ \times W_R\,(20\ ft)\ \times 0.092903\left(\frac{m^2}{ft^2}\right)$$

$$W\,(tons)=\frac{\left(\text{number of cars}\times\frac{tons}{car}+\text{number of trucks}\times\frac{tons}{truck}\right)}{\text{total vehicles}}$$

$$\Sigma\,VKT\,(km)=\text{total vehichles}\times\text{distance}\left(\frac{km}{day}\right)\times EW_{cw}\left(\frac{weeks}{year}\right)\times DW_{cw}\left(\frac{days}{week}\right)$$

$$T\ (7200000\ s)=ED_{cw}\,(1\ yr)\times EF_{cw}\left(\frac{250\ days}{year}\right)\times ET_{cw}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{3600\ s}{hr}\right)$$

$$F_D\,(0.18584)=0.1852+\left(5.3537\,/\,t_c\right)+\left(-9.6318\,/\,t_c{}^2\right)$$

$$t_c\,(8400\ hr)=ED_{cw}\,(1\ yr)\ \times EW_{cw}\left(\frac{50\ wks}{year}\right)\times\left(\frac{7\ days}{week}\right)\times\left(\frac{24\ hrs}{day}\right)$$

- **Mechanical Particulate Emission Factor for Construction Worker from other than Vehicle Traffic on Unpaved Roads**

$$PEF'_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right)=\frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\frac{1}{F_D}\times\frac{1}{\langle J'_T\rangle\left(\frac{g}{m^2-s}\right)}$$

$$\text{where: }\frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)=A\times\exp\left[\frac{\left(\ln A_c\,(acre)-B\right)^2}{C}\right]$$

$$\langle J'_T\rangle\left(\frac{g}{m^2-s}\right)=\frac{M^{pc}_{wind}(g)+M_{excav}(g)+M_{doz}(g)+M_{grade}(g)+M_{till}(g)}{A_{surf}\left(m^2\right)\times T(s)}$$

$$M^{pc}_{wind}(g)=0.036\times(1\text{-}V)\times\left(\frac{U_m\left(\frac{m}{s}\right)}{U_t\left(\frac{m}{s}\right)}\right)^3\times F(x)\times A_{surf}\left(m^2\right)\times ED\;(yr)\times 8760\left(\frac{hr}{yr}\right)$$

$$M_{excav}(g)=0.35\times 0.0016\times\frac{\left(\frac{U_m\left(\frac{m}{s}\right)}{2.2}\right)^{1.3}}{\left(\frac{M_{m\text{-}excav}(\%)}{2}\right)^{1.4}}\times\rho_{soil}\left(\frac{Mg}{m^3}\right)\times A_{excav}\left(m^2\right)\times d_{excav}(m)\times N_{A\text{-}dump}\times 1000\left(\frac{g}{kg}\right)$$

$$M_{doz}(g)=0.75\times\frac{0.45\times s_{doz}(\%)^{1.5}}{\left(M_{m\text{-}doz}(\%)\right)^{1.4}}\times\frac{\Sigma\,VKT_{doz}(km)}{S_{doz}\left(\frac{km}{hr}\right)}\times 1000\left(\frac{g}{kg}\right)$$

$$M_{grade}(g)=0.60\times 0.0056\times S_{grade}\left(\frac{km}{hr}\right)^{2.0}\times\Sigma\,VKT_{grade}(km)\times 1000\left(\frac{g}{kg}\right)$$

and

$$M_{till}(g)=1.1\times s_{till}(\%)^{0.6}\times A_{c-till}(acres)\times 4047\left(\frac{m^2}{acre}\right)\times 10^{-4}\left(\frac{ha}{m^2}\right)\times 1000\left(\frac{g}{kg}\right)\times N_{A\text{-}till}$$

$$\text{where: }\Sigma\,VKT_{grade}(km)=A_{c-grade}(acres)\times 4047\left(\frac{m^2}{acre}\right)\times\frac{1}{B_g(m)}\times\frac{1}{1000\left(\frac{m}{km}\right)}\times N_{A\text{-}grade}$$

$$\text{where: }\Sigma\,VKT_{doz}(km)=A_{c-doz}(acres)\times 4047\left(\frac{m^2}{acre}\right)\times\frac{1}{B_g(m)}\times\frac{1}{1000\left(\frac{m}{km}\right)}\times N_{A\text{-}doz}$$

$$T\;(7200000\;s)=ED_{cw}\,(1\;yr)\times EF_{cw}\left(\frac{250\;days}{year}\right)\times ET_{cw}\left(\frac{8\;hrs}{day}\right)\times\left(\frac{3600\;s}{hr}\right)$$

$$F_D\,(0.18584)=0.1852+\left(5.3537\,/\,t_c\right)+\left(-9.6318\,/\,t_c^{\,2}\right)$$

$$t_c\,(8400\;hr)=ED_{cw}\,(1\;yr)\times EW_{cw}\left(\frac{50\;wks}{year}\right)\times\left(\frac{7\;days}{week}\right)\times\left(\frac{24\;hrs}{day}\right)$$

- **Unlimited Source Subchronic Volatilization Factor for Construction Worker**

unlimited source model for subchronic exposure

$$VF_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \frac{1}{F_D} \times \left[\frac{\left(3.14 \times D_A\left(\frac{cm^2}{s}\right) \times T(s)\right)^{1/2}}{2 \times \rho_b\left(\frac{1.5g}{cm^3}\right) \times D_A\left(\frac{cm^2}{s}\right)}\right] \times 10^{-4}\left(\frac{m^2}{cm^2}\right)$$

$$\text{where: } \frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right) = A \times \exp\left[\frac{\left(\ln A_s(acre) - B\right)^2}{C}\right]$$

$$D_A\left(\frac{cm^2}{s}\right) = \frac{\left[\theta_a\left(\frac{L_{air}}{L_{soil}}\right)^{10/3} \times D_{ia}\left(\frac{cm^2}{s}\right) \times H' + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right)^{10/3} \times D_{iw}\left(\frac{cm^2}{s}\right)\right] / n^2\left(\frac{L_{pore}}{L_{soil}}\right)}{\rho_b\left(\frac{1.5g}{cm^3}\right) \times K_d\left(\frac{cm^3}{g}\right) + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{L_{air}}{L_{soil}}\right) \times H'}$$

$$\theta_a\left(\frac{L_{air}}{L_{soil}}\right) = n\left(\frac{L_{pore}}{L_{soil}}\right) - \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) \text{ and } n\left(\frac{L_{pore}}{L_{soil}}\right) = 1 - \left(\rho_b\left(\frac{1.5\ g}{cm^3}\right) \Big/ \rho_s\left(\frac{2.65\ g}{cm^3}\right)\right)$$

$$K_d\left(\frac{cm^3}{g}\right) = f_{oc}\left(\frac{g}{g}\right) \times K_{oc}\left(\frac{cm^3}{g}\right) \text{ only for organics.}$$

$$T\ (30240000\ s) = ED_{cw}\ (1\ yr) \times EW_{cw}\left(\frac{50\ wks}{year}\right) \times \left(\frac{7\ days}{week}\right) \times \left(\frac{24\ hrs}{day}\right) \times \left(\frac{3600\ s}{hr}\right)$$

$$F_D\ (0.18584) = 0.1852 + \left(5.3537 / t_c\right) + \left(-9.6318 / t_c^{\ 2}\right)$$

$$t_c\ (8400\ hr) = ED_{cw}\ (1\ yr) \times EW_{cw}\left(\frac{50\ wks}{year}\right) \times \left(\frac{7\ days}{week}\right) \times \left(\frac{24\ hrs}{day}\right)$$

- **Mass Limit Subchronic Volatilization Factor for Construction Worker** mass limit model for subchronic exposure

$$VF_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right)=\frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)\times\frac{1}{F_D}\times\frac{T\,(s)}{\rho_b\left(\frac{1.5\ Mg}{m^3}\right)\times d_s\,(m)\times 10^6\left(\frac{g}{Mg}\right)}$$

$$\text{where: }\frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2\text{-}s}\right)}{\left(\frac{kg}{m^3}\right)}\right)=A\times\exp\left[\frac{(\ln A_s\,(acre)-B)^2}{C}\right]$$

$$T\ (30240000\ s)=ED_{cw}\,(1\ yr)\times EW_{cw}\left(\frac{50\ wks}{year}\right)\times\left(\frac{7\ days}{week}\right)\times\left(\frac{24\ hrs}{day}\right)\times\left(\frac{3600\ s}{hr}\right)$$

$$F_D\,(0.18584)=0.1852+(5.3537/t_c)+(-9.6318/t_c^{\,2})$$

$$t_c\,(8400\ hr)=ED_{cw}\,(1\ yr)\times EW_{cw}\left(\frac{50\ wks}{year}\right)\times\left(\frac{7\ days}{week}\right)\times\left(\frac{24\ hrs}{day}\right)$$

- **Soil Saturation Limit**

$$C_{sat}=\frac{S\left(\frac{mg}{L}\right)}{\rho_b\left(\frac{Kg}{L}\right)}\times\left(K_d\left(\frac{L}{Kg}\right)\times\rho_b\left(\frac{Kg}{L}\right)+\theta_w\left(\frac{L_{water}}{L_{soil}}\right)+H'\times\theta_a\left(\frac{L_{air}}{L_{soil}}\right)\right)$$

where

$$Kd=K_{oc}\left(\frac{L}{Kg}\right)\times f_{oc}\left(\frac{g}{g}\right),$$

$$\theta_a\left(\frac{L_{air}}{L_{soil}}\right)=n\left(\frac{L_{pore}}{L_{soil}}\right)-\theta_w\left(\frac{L_{water}}{L_{soil}}\right)\text{ and}$$

$$n=1-\left(\frac{\rho_b\left(\frac{Kg}{L}\right)}{\rho_s\left(\frac{Kg}{L}\right)}\right)$$

- **Diffusivity in Water**

$$D_{iw}\left(\frac{cm^2}{s}\right)=0.0001518\times\left(\frac{T\,^oC+273.16}{298.16}\right)\times\left(\frac{MW\left(\frac{g}{mol}\right)}{\rho\left(\frac{g}{cm^3}\right)}\right)^{-0.6}$$

where

T typically $= 25\,^oC$

If density is not available,

$$D_{iw}\left(\frac{cm^2}{s}\right)=0.000222\times(MW)^{-\left(\frac{2}{3}\right)}$$

- **Diffusivity in Air**

$$D_{ia}\left(\frac{cm^2}{s}\right)=\frac{0.00229\times\left(T\,^0C+273.16\right)^{1.5}\times\sqrt{0.034+\left(\frac{1}{MW\left(\frac{g}{mol}\right)}\right)}\times MW_{cor}}{\left(\left(\frac{MW\left(\frac{g}{mol}\right)}{2.5\times\rho\left(\frac{g}{cm^3}\right)}\right)^{0.333}+1.8\right)^2}$$

where

T typically $= 25\,^0C$

$MW_{cor} = \left(1\text{-}0.000015\times MW^2\right)$ If MW_{cor} is less than 0.4, then MW_{cor} is set to 0.4.

If density is not available,

$$D_{ia}\left(\frac{cm^2}{s}\right)=1.9\times\left(MW\left(\frac{g}{mol}\right)^{-\left(\frac{2}{3}\right)}\right)$$ except for dioxins use, $$D_{ia}\left(\frac{cm^2}{s}\right)=\left(\frac{154}{MW\left(\frac{g}{mol}\right)}\right)^{0.5}\times 0.068$$

- **TCE Toxicity Adjustment Factors**

$$CAF_o\,(0.804)=\frac{CSF_o\left(\frac{3.7\times10^{-2}\,mg}{Kg\text{-}day}\right)^{-1}\text{ NHL+Liver oral slope factor}}{CSF_o\left(\frac{4.6\times10^{-2}\,mg}{Kg\text{-}day}\right)^{-1}\text{ Adult – based oral slope factor}}$$

$$MAF_o\,(0.202)=\frac{CSF_o\left(\frac{9.3\times10^{-3}\,mg}{Kg\text{-}day}\right)^{-1}\text{ Kidney oral slope factor}}{CSF_o\left(\frac{4.6\times10^{-2}\,mg}{Kg\text{-}day}\right)^{-1}\text{ Adult – based oral slope factor}}$$

$$CAF_i\,(0.756)=\frac{IUR\left(3.1\times10^{-6}\,\mu g/m^3\right)^{-1}\text{ NHL+Liver unit risk estimate}}{IUR\left(4.1\times10^{-6}\,\mu g/m^3\right)^{-1}\text{ Adult – based unit risk estimate}}$$

$$MAF_i\,(0.244)=\frac{IUR\left(1\times10^{-6}\,\mu g/m^3\right)^{-1}\text{ Kidney unit risk estimate}}{IUR\left(4.1\times10^{-6}\,\mu g/m^3\right)^{-1}\text{ Adult – based unit risk estimate}}$$

For assistance/questions please use the rsl table contact us page

Screening Tools for Chemical and Radionuclide Contaminants

You will need Adobe Reader to view some of the files on this page. See EPA's PDF page to learn more.

Contents

RSL Calculator

Using the RSL Calculator

1. Select Scenario 2. Select Screening Level Type 3. Select Chemical Info Type 4. Select Risk Output 5. Select RfD/RfC Type 6. Select Individual Chemicals 7. Click Retrieve 8. Site-specific Parameters 9. View Results	1. Select Scenario Choose one of the 7 landuse scenarios and then select which media to assess under the "Select Media:" list that is displayed (except for "Fish" and "Soil to Groundwater").

Select Scenario

- (●) Resident
- ( ) Composite Worker (presented in Generic Tables)
- ( ) Construction Worker (RSL only)
- ( ) Indoor Worker (RSL only)
- ( ) Outdoor Worker RSL only)
- ( ) Fish (RSL only)

- ○ Soil to Groundwater (RSL only)
- ○ Recreator (Site Specific RSL only)

Select Media:
- ☐ Soil
- ☐ Air
- ☐ Tapwater

Select SL type

- ⦿ Defaults
- ○ Site Specific

Select Risk Output:

- ⦿ No
- ○ Yes

Select RfD/RfC Type:

- ⦿ Chronic
- ○ Subchronic

*Chronic selection will retrieve Chronic-only RfDs/RfCs; Subchronic selection will retrieve subchronic values where possible.

Select Individual Chemicals

ALAR (1596845)
Acenaphthene (83329)
Acenaphthylene (208968)
Acephate (30560191)
Acetaldehyde (75070)
Acetochlor (34256821)
Acetone (67641)
Acetone Cyanohydrin (75865)
Acetonitrile (75058)
Acetophenone (98862)
Acetylaminofluorene, 2- (53963)
Acifluorofen (50594666)

<< >> Selected

Acrylamide (79061)

Or Select Individual CAS Numbers

50293

Acetophenone (98862)
Acetylaminofluorene, 2- (53963)
Acifluorofen (50594666)
Acridine (260946)
Acrolein (107028)
Acrylamide (79061)

50293
50328
50000
50011
51285
51365
51752
51796
51365
55630

To add a chemical not in the list, select "Site Specific", "User-provided", then "Test Chemical".

<< >>

Or Select All

☐ ALL

Include Metadata

☐ Yes

Retrieve

Top of page

- Right-click and select "Save target as..." to download files.
- EquIS Format THQ=1.0 and TR=1E-06
- EquIS Format THQ=0.1 and TR=1E-06
- SADA Format THQ=1.0 and TR=1E-06
- SADA Format THQ=0.1 and TR=1E-06

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