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An Overview of the Risk Assessment Information System

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OAK RIDGE
National Laboratory

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Environmental Sciences Division

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LIST OF ACRONYMS AND ABBREVIATIONS

%	percent
ALM	Adult Lead Model
ARAR	Applicable or Relevant and Appropriate Requirement
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act 1980
cm^2	square centimeters
COC	Contaminants of Concern
COPC	Chemical of Potential Concern
DI	Daily Intake
DoD	Department of Defense
DOE	Department of Energy
ELCR	Excess Lifetime Cancer Risk
EPA	Environmental Protection Agency
FGR	Federal Guidance Report
GIABS	Fraction of Contaminant Absorbed in Gastro-Intestinal Tract
GSDi	Geometric Standard Deviation
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HQ	Hazard Quotient
ICRP	International Commission on Radiological Protection
IUR	Inhalation Unit Risk
LOC	Land Use Scenario of Concern
MCL	Maximum Contaminant Level
$\mu g/m^3$	micrograms per cubic meter
µg/dL	microliters per deciliter
mg/day	milligrams per day
mg/kg-day	milligrams per kilogram-day
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MOC	Media of Concern
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
ORR	Oak Ridge Reservation
OSF	Oral Slope Factor
OSRTI	Office of Superfund Remediation and Technology Innovation
OW	Office of Water
PbB	Blood Lead Concentration
pCi	picocurie
PEF	Particulate Emission Factor
PPRTV	Provisional Peer-Reviewed Toxicity Values
PRG	Preliminary Remediation Goal
RAGS	Risk Assessment Guidance for Superfund
RAIS	Risk Assessment Information System
RfC	Reference Concentration
RfD	Reference Dose
RML	Regional Removal Management Levels
ROC	Exposure Route of Concern
RVISL	Radon Vapor Intrusion Screening Level
SADA	Spatial Analysis and Decision Assistance
SDI	Subchronic Daily Intake

SF	Slope Factor
TBC	To-Be-Considered
TCE	Trichloroethylene
TDS	Total Dissolved Solids
TM	Technical Memorandum
TR	Radioactive Half-Life
TRW	Technical Review Workgroup
UCOR	United Cleanup Oak Ridge LLC
U.S.	United States
VF	Volatilization Factor
WQC	Water Quality Criteria

ABSTRACT

This technical memorandum (TM) presents an overview of the Risk Assessment Information System (RAIS), a collection of web-based tools designed to assist with the environmental risk assessment process. The objective of the RAIS is to be a single resource for the risk assessment process, providing guidance when planning and performing the steps: data assessment, exposure assessment, toxicity assessment, and risk characterization.

The RAIS evolved as a result of the initial remediation efforts at various United States (U.S.) Department of Energy (DOE) facilities. The goal was to increase the efficiency and transparency of the human health and ecological assessments being performed by DOE's Office of Environmental Management, Oak Ridge Operations (ORO) office by providing a repository for toxicity information, physicochemical data, risk assessment procedures, standardized risk calculation methods, and web-based tools. Since the initial launch in 1996, the RAIS has expanded its user base outside of the federal government and now has users from over 100 countries, universities, states, and local governments. What sets the RAIS apart from other risk assessment sites are the publicly available, searchable toxicity and physicochemical databases and the wide range of chemical and radionuclide risk calculation tools.

The purpose of this TM is to present the RAIS tools in order of the website menus and explain how they fit in the risk assessment process. In addition, this TM describes differences between the chemical and radionuclide tools of the RAIS. Screening level equations, chronic daily intake equations, and default exposure factors used in the chemical and radionuclide calculators are included in the appendices of this TM. This TM is not intended to be a detailed guide to risk assessment or the RAIS tools. The tools on the RAIS can be used to comply with procedures from multiple agencies, including but not limited to DOE, U.S. Environmental Protection Agency (EPA), U.S. Department of Defense (DoD), and many state governments. Further information on the RAIS tools can be found in the user guides and tutorials available on the webpage.

1. INTRODUCTION

The Risk Assessment Information System (RAIS) is a collection of web-based tools designed to assist with the steps of an environmental risk assessment. The RAIS was designed to streamline all risk assessment processes, from toxicity data curation to risk calculation, in a transparent format. Taking advantage of searchable and executable databases, menu-driven queries, data downloads, and dynamic calculators, the RAIS offers essential tools that are used in the risk assessment process from project scoping to implementation. The RAIS tools are available at https://rais.ornl.gov/. The RAIS is sponsored by the United States (U.S.) Department of Energy (DOE), Office of Environmental Management, Oak Ridge Operations (ORO) Office through a joint collaboration between United Cleanup Oak Ridge LLC (UCOR) and Oak Ridge National Laboratory (ORNL).

The main RAIS tools either calculate screening levels, called preliminary remediation goals (PRGs), or risk. Many of the other tools provide details on the inputs into these PRG and risk calculations. The term “risk” or “risk assessment” is used throughout this technical memorandum (TM) to describe both excess lifetime cancer risk (ELCR) probability and the noncancer hazard index calculations.

1.1 HISTORY

The RAIS was developed to assist with remediation efforts at various DOE sites involved with The Manhattan Project legacy waste by standardizing toxicity values, exposure equations, and essentially the entire risk assessment process. The goal was to increase the efficiency and transparency of the ecological and human health risk assessment projects being performed by DOE’s Office of Environmental Management, ORO Office by providing a repository for information, established procedures, and standardized risk calculation methods and tools. The RAIS website was activated in 1996.

Prior to the RAIS, there was a lot of duplication in terms of curating toxicity values, physicochemical parameters, toxicity profiles, exposure parameters, and risk models. It was also common for risk assessments performed by different entities to have inconsistencies. Risk assessments were often multiple volumes of paper, because no central repository of common parameters could be cited. In addition, without the benefits of a single integrated system, each risk assessor was responsible for the maintenance of all databases needed for the risk assessment process. DOE's implementation of the RAIS and its associated guidance has streamlined the risk assessment process and eliminated the need for costly duplication of effort and printing.

Over time, the RAIS user base has expanded outside of the federal government and now has users from over 100 countries, 45 state governments, and many university programs. The RAIS also expanded to contain tools (or links to tools) developed by the RAIS team for the U.S. Environmental Protection Agency (EPA), Alaska, and Delaware. Additions to the RAIS continue to benefit all risk information users (e.g., DOE, EPA, U.S. Department of Defense [DoD], etc.).

1.2 PURPOSE

1.2.1 Purpose of this technical memorandum

The purpose of this TM is to:

- Present the risk assessment process and how the RAIS tools assist in each step,
- Identify all tools currently available on the RAIS and at linked sites,
- Provide brief instructions on how to access specific data and tools on the RAIS, and
- Provide a reference for those citing the RAIS and its applicability for use on their sites.

This TM is not intended to be a comprehensive resource for risk assessment methods. The tools on the RAIS can be used to comply with procedures from multiple agencies, including but not limited to DOE, U.S. Environmental Protection Agency (EPA), U.S. Department of Defense (DoD), and many state governments.

1.2.2 Purpose of RAIS

The objective of the RAIS is to provide a service-oriented environmental risk assessment expert system that is under configuration control. The RAIS offers tools and guidance for performing risk assessments based on general procedures applicable to many agencies or methods. The purpose of this on-line menu-driven system is to provide risk tools and information to an unlimited audience in a timely and efficient manner, enable consistent and high-quality risk calculations, eliminate the tedious collection of up-to-date toxicity values and other parameters necessary for conducting risk activities, automate the exposure assessment, and provide the means for site comparisons. RAIS tool inputs can also be modified by the user to accommodate site-specific needs. These modifications include changing exposure parameters, toxicity values, physicochemical properties, mutagenic status, volatility status, and modeling parameters.

Use of the RAIS will reduce the cost of assessment activities and provide a platform for standardizing basic environmental cleanup decision processes for hazardous and radioactive waste sites. The RAIS provides links to other innovative risk assessment tools developed by the RAIS team in support of the EPA Superfund program to provide all the publicly available risk assessment tools in one place.

Drawing upon its history of assisting the DOE with the aftermath of the Manhattan Project, the RAIS webpage contains two high levels of organization: Chemical Tools and Radionuclide Tools. Chemical tools address over 2,400 chemicals, including common chemicals such as trichloroethylene (TCE), benzene, and formaldehyde as well as inorganic metals such as lead, arsenic, and chromium. The tools and information offered for chemicals are further discussed in **Section 3**. Radionuclide tools address metals that undergo nuclear decay and emit ionizing radiation. For example, the isotopes of uranium, U-235, U-236, and U-238, are three of the over 1,200 radionuclides on the RAIS. The tools and information offered for radionuclides are further discussed in **Section 4**.

1.3 CONFIGURATION CONTROL

The RAIS is reviewed on a consistent basis to ensure the information is current. Changes to the system are based on routine updates, sponsor/user request, and regulatory changes.

Updates to the RAIS are tracked and recorded in a project management system. When a change is deemed necessary to correct an error, comply with new guidance, update chemical or radiological parameters, or add new modules, the task is added to the project management system, and RAIS team members are assigned. The changes are first made on an internal (development) version of the RAIS, where they are subjected to a Quality Assurance (QA) process by the RAIS team that checks for function and accuracy. If the changes to the internal version are approved, the modified files are moved into production and are publicly visible to all RAIS users. The QA process is repeated on the production site to ensure function and accuracy.

Changes to toxicity values, physicochemical parameters, ecological screening benchmarks, and other screening values primarily occur during the semiannual updates in May and November. Users can view the What's New page to see a log of updates made each month as far back as February 1996 (https://rais.ornl.gov/home/whatnew.html). The information on the "What's New" page is also distributed via e-mail to users who sign up as members of the RAIS User's Group (https://rais.ornl.gov/cgi-bin/tools/rais_user_signup). A key benefit of this feature is to inform users of updates that may impact ongoing risk assessments (e.g., revised toxicity values). It is recommended that the "What's New" page be checked prior to finalizing risk results and again before remedial action decisions are finalized.

The RAIS chemical and radionuclide PRG calculator results are checked frequently for accuracy and stability. Every default land use and media combination in these calculators are programmed to run nightly. The results are compared against a standard set of verified results stored in the database. An email is generated with the results of these comparisons and sent to the RAIS Team. If the nightly run does not match the standard set for a calculator, the discrepancy is flagged for attention in the email.

In addition to QA checks for accuracy and function, the RAIS servers and file systems are monitored. Service disruption notices that may be due to power outages, hardware failures, or software maintenance issues are automatically sent to the RAIS team. Planned service disruptions are posted on the RAIS website in advance of any outage. Any unplanned event is addressed immediately to ensure a great customer experience.

1.4 USER SUPPORT

All questions and suggestions from RAIS users are welcomed. General questions may be submitted through the RAIS contact feature at the bottom of each page. The Contact/Staff Listing page presents the contact information for the RAIS team including the area of expertise for each staff member (https://rais.ornl.gov/tools/people.php). The tutorials, glossary, user guides, and frequently asked question pages often contain the answers users are looking for. They are described in detail in the following text.

1.4.1 Tutorials

The RAIS has two online training platforms: "RAIS Main Tutorial" and "What is Risk Assessment?". The "RAIS Main Tutorial" is a detailed guide that covers all RAIS tools in the order that they are currently found on the RAIS (https://rais.ornl.gov/tutorials/tutorial.html). The "What is Risk Assessment?" tutorial provides a basic introduction to risk assessment as a concept and goes through the four main steps of a typical risk assessment (https://rais.ornl.gov/tutorials/whatisra.html).

1.4.2 Document Search

The RAIS includes a Document Search tool that allows users to search for risk assessment guidance, chemical or radionuclide-specific information, results from previous investigations, and more (https://rais.ornl.gov/tools/doc_search.php). A list of documents that contain RAIS PRG and risk calculation equation and model sources is included in **Appendix I**.

1.4.3 Guidance

The RAIS includes 3 types of guidance:

- ORO Regulatory Guidance – TM: provides a repository for procedures and technical memoranda developed for risk assessments conducted on the Oak Ridge Reservation (ORR) (https://rais.ornl.gov/guidance/tm.html);

- EPA Regulatory Guidance:

  – EPA Human Health Risk Assessment Guidance: provides a comprehensive list of EPA guidance for human health risk assessment (https://rais.ornl.gov/guidance/epa_hh.html),

- – EPA Ecological Risk Assessment Guidance: provides a comprehensive list of EPA guidance for ecological risk assessment (https://rais.ornl.gov/guidance/epa_eco.html), and
- – EPA Regional Supplemental Risk Assessment Guidance: provides regional-specific documents or links to the individual EPA regions (https://rais.ornl.gov/guidance/epa_reg.html); and

- State Guidance: provides links to health and environmental agencies from different states and territories (https://rais.ornl.gov/guidance/state.html).

1.4.4 Glossary

The RAIS webpage includes a glossary of environmental restoration terms with definitions from DOE-ORO staff and affiliates and other sources (https://rais.ornl.gov/home/glossary.html).

1.4.5 Training

The RAIS team has developed one- to -five-day risk assessment courses that can be modified to fit client needs and performed at the client locale (https://rais.ornl.gov/home/training.html). Additionally, training courses are held biannually, if possible, at ORNL. These classes provide hands-on use of the RAIS with education and supervision by the RAIS developers. The purpose of the training is to educate users on every aspect of the RAIS. The course clarifies sources of the databases, identifies many ways to apply the tools, provides users with an opportunity to voice concerns, educates beginners on the methods of risk assessment, and clarifies RAIS methods for advanced risk professionals. EPA tools developed by the RAIS team are also covered in these classes.

2. OVERVIEW OF RISK ASSESSMENT PROCESS

2.1 RISK ASSESSMENT BACKGROUND

The methods outlined in this document are consistent with parts A through F of the EPA's Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual (EPA 1989, 1991a, 1991b, 2001, 2004, and 2009). Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), RAGS serves as the primary regulatory guidance document for all risk assessments and their application to risk management in the Superfund program. While the RAIS was built to support the RAGS process, the tools can also be used for other EPA programs, other federal agencies, and state agencies as-is or by altering values and parameters in site-specific mode.

Environmental risk assessments can be utilized to:

- Aid in making decisions, such as the need for and the extent of remediation necessary at a given site,
- Develop criteria for handling chemical and/or radionuclide-contaminated materials,
- Estimate the likelihood of adverse effects as a result of exposure to contaminants, and
- Evaluate the effectiveness of various treatment technologies for hazardous/radioactive waste.

In this document, risk assessment is defined as the process to evaluate potential adverse health effects resulting from exposure to chemicals and radionuclides under a given set of circumstances. The following sections describes the four steps of a typical environmental risk assessment.

2.2 DATA ASSESSMENT

The risk assessment process begins with data compilation and evaluation of health problems that may be caused by the potential contaminants; this is sometimes called the hazard assessment. The objective of the data assessment step is to verify that the data are appropriate for use and are considered to be representative of current conditions. During this step, all available data are compiled, sorted by environmental medium, and evaluated relative to established criteria.

In the data assessment step, screens are used to determine contaminants of potential concern (COPCs). Typically, the maximum detected concentration of each analyte reported by a laboratory is compared to various screening levels. If the analyte concentration is above the screening level(s) for the applicable media and land use, the analyte is determined to be a COPC, and it is carried through the next step of the risk assessment process. Screens can be performed against risk-based PRGs, applicable or relevant and appropriate requirements (ARARs), background values, etc.

- **Preliminary Remediation Goals (PRGs)**

  A PRG is the average concentration of a chemical and/or radionuclide in an exposure area that will yield the specified target risk or hazard quotient in an individual who is exposed at random within the exposure area (EPA, 2022). PRGs can be thought of as "backward risk calculations", as the process starts with a target risk to calculate an acceptable media concentration.

  The PRGs presented on the RAIS were developed following general EPA guidance on using toxicity values and exposure information to derive risk-based PRGs that are protective of human health. The toxicity values used in the PRG calculations are discussed in Section 3.1 for chemicals and in Section 4.1 for radionuclides. The risk-based PRGs are applicable to all sites and, if used to guide early clean-up decisions, will result in residual risks from direct contact with a contaminated medium that satisfy the general acceptable ELCR range of 1E-04 to 1E-06 (10^{-4} to 10^{-6}) and a hazard index (HI) of 1 or less.

  The Chemical PRG Calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem) and Radionuclide PRG Calculator (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=rad) are discussed in Sections 3.2 and 4.2, respectively.

- **Applicable or Relevant and Appropriate Requirements (ARARs)**

  Data should also be screened against promulgated standards such as ARARs (https://rais.ornl.gov/tools/arar_search.php). ARARs often include EPA's Office of Water (OW) maximum contaminant levels (MCLs) for drinking water as well as other water quality criteria (WQC). Many States also promulgate ARARs that should be considered if they are more stringent than federal requirements. The RAIS ARAR search tool includes those established regulatory limits for surface water and groundwater.

  The chemical (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem) and radionuclide (https://rais.ornl.gov/tools/arar_search.php) ARAR search tools are discussed in Sections 3.4 and 4.4, respectively.

- **Background Values**

  Along with risk-based PRG and ARAR screens, data is sometimes screened against appropriate background values in order to account for naturally occurring or anthropogenic levels of chemicals unrelated to the contamination.

  The chemical and radionuclide background search tools are discussed in Sections 3.8 and 4.7, respectively.

- **Ecological Benchmarks**

  Risk assessments of many contaminated areas require that data be screened to identify those chemicals and/or radionuclides that may pose an ecological hazard. This screening assessment involves a comparison of the reported contaminant with toxicological benchmarks derived from laboratory or field data for a particular species or group of organisms. If an analyte concentration or the estimated exposure level is lower than the lowest calculated benchmark, then the analyte is unlikely to present an ecological risk. However, if the analyte concentration or the reported detection limit exceeds a benchmark, then further analysis is needed to determine what, if any, hazard is posed by that analyte for ecological receptors. The more the analyte concentration exceeds the benchmark value, the more likely that the contaminant poses an ecological risk. Screening ecological benchmarks, therefore, provide a quick way to determine priority contaminants at a particular waste site.

  The RAIS offers two versions of the ecological benchmark tool: one for chemicals (https://rais.ornl.gov/tools/eco_search.php?select=chem) and one for radionuclides (https://rais.ornl.gov/tools/eco_search.php?select=rad). More information can be found in the RAIS Ecological Benchmark User Guide (https://rais.ornl.gov/tools/eco_guide.html).

  Ecological benchmarks for chemicals and radionuclides are further discussed in Sections 3.5 and 4.5, respectively.

2.3 EXPOSURE ASSESSMENT

The objective of the exposure assessment step is to estimate the type and magnitude of COPC exposures that are present at or migrating from a site/facility. This step starts with characterizing the exposure setting, which involves defining the physical environment and identifying potential land use scenarios and media that may be impacted. After the exposure setting has been characterized, the appropriate exposure pathways are identified, and exposure is quantified for each route (i.e., ingestion, inhalation, dermal, external exposure, and consumption of produce).

2.3.1 Land Use Scenarios

Prior to beginning risk calculations, the RAIS PRG and risk calculator user guides can be used to help identify which land use scenarios and exposure pathways would be appropriate for a project by considering the default exposure factors of each land use scenario (e.g., exposure frequency, duration, and time). Additionally, the default exposure factors can often be replaced with site-specific values when calculating PRGs or performing risk characterization.

The land use scenarios considered in the chemical and radionuclide RAIS calculators are presented in **Figures 1** and **2**, respectively. The land use and media combinations available in the PRG calculators are the same as those available in the risk calculators.

For sites with an unknown future use (unrestricted future use), acceptable residential land use concentrations are typically used. If residential concentrations cannot be met, land use restrictions are typically deeded.

2.3.1.1 Resident

This receptor spends most, if not all, of the day at home. The media assessed for this receptor are soil, tap water, and air. The activities for this receptor involve typical home making chores (cooking, cleaning, showering, and laundering) as well as outdoor activities like gardening. For the soil pathway, it is assumed that there is an unlimited potential for surface erosion and the production of airborne particulates and vapor emissions. Adults and children may exhibit different exposure rates for some parameters. For example, the child resident is assumed to ingest 200 milligrams of soil per day (mg/day) while the adult ingests 100 mg/day. To account for changes in soil intake as the receptor ages, PRG calculations and risk characterization based on carcinogenic risk due to incidental ingestion of soil are calculated using age-adjusted ingestion factors. Additionally, the PRGs and/or risk results based on systemic toxicity (i.e., hazard) are calculated separately for the child and the adult.

Because most radionuclides are not volatile, exposure to vapors emitted from tap water are only considered for tritium and radon. Tritium is considered because it may exist as either hydrogen gas in water or replace one of the hydrogens found in the water molecule. Radon is considered because groundwater that is in contact with rock or soil containing radium will pick up radon and release it to the atmosphere when the water is used in a residence.

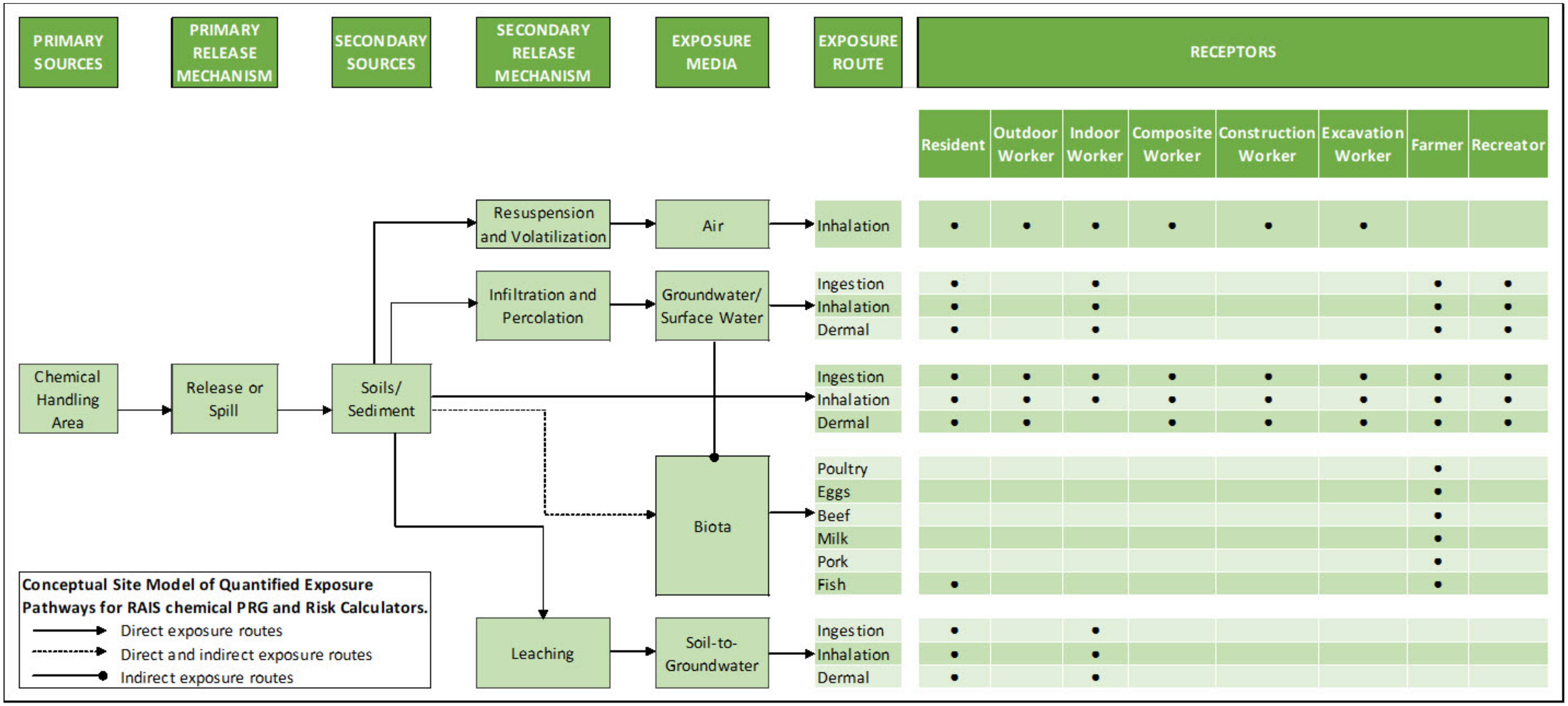
Refer to **Figures 1** and **2** for residential exposure pathways for chemicals and radionuclides, respectively.

2.3.1.2 Composite Worker

This is a long-term receptor exposed during the workday who is a full-time employee working on-site and spends most of the workday conducting maintenance activities outdoors. The media assessed for this receptor are soil and air. The activities for this receptor (e.g., moderate digging, landscaping) typically involve on-site exposure to surface soils. The composite worker is expected to have an elevated soil ingestion rate (100 mg/day). The composite worker combines the most protective exposure assumptions of the outdoor and indoor workers. The only difference between the outdoor worker and the composite worker is that the composite worker uses the more protective exposure frequency of 250 days/year from the indoor worker scenario. Refer to **Figures 1** and **2** for applicable exposure pathways for chemicals and radionuclides, respectively, for this land use.

2.3.1.3 Outdoor Worker

This is a long-term receptor exposed during the workday who is a full-time employee working on-site and spends most of the workday conducting maintenance activities outdoors. The media assessed for this receptor are soil and air. The activities for this receptor (e.g., moderate digging, landscaping) typically involve on-site exposure to surface soils. The outdoor worker is expected to have an elevated soil ingestion rate (100 mg/day). The outdoor worker receives more exposure than the indoor worker under commercial/industrial conditions. Refer to **Figures 1** and **2** for applicable exposure pathways for chemicals and radionuclides, respectively, for this land use.



Exposure Media	Exposure Route	Resident	Outdoor Worker	Indoor Worker	Composite Worker	Construction Worker	Excavation Worker	Farmer	Recreator
Air	Inhalation	•	•	•	•	•	•		
Groundwater/ Surface Water	Ingestion	•		•				•	•
	Inhalation	•		•				•	•
	Dermal	•		•				•	•
Soils/ Sediment	Ingestion	•	•	•	•	•	•	•	•
	Inhalation	•	•	•	•	•	•	•	•
	Dermal	•	•		•	•	•	•	•
Biota	Poultry							•	
	Eggs							•	
	Beef							•	
	Milk							•	
	Pork							•	
	Fish	•						•	
Soil-to-Groundwater	Ingestion	•		•					
	Inhalation	•		•					
	Dermal	•		•					

Figure 1. Conceptual site model of quantified exposure pathways for RAIS chemical PRG and risk calculators.

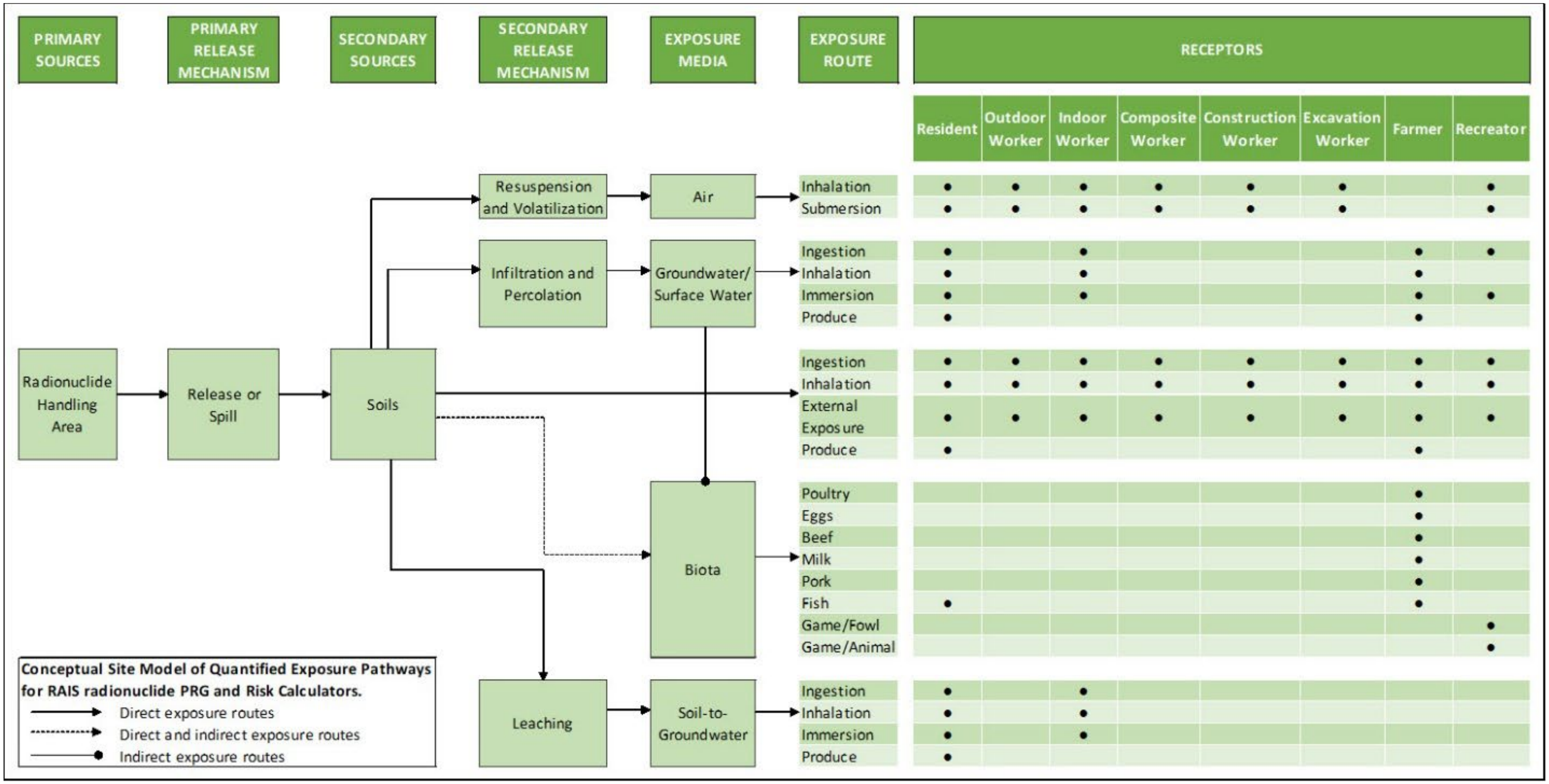


Figure 2. Conceptual site model of quantified exposure pathways for RAIS radionuclide PRG and Risk calculators.

2.3.1.4 Indoor Worker

This receptor spends most, if not all, of the workday indoors. Thus, an indoor worker has no direct dermal contact with outdoor soils. This worker may, however, be exposed to contaminants through ingestion of contaminated soils that have been incorporated into indoor dust and inhalation of volatiles and particulates from outside soils. PRGs calculated for this receptor are expected to be protective of both workers engaged in low intensity activities such as office work and those engaged in more strenuous activity (e.g., factory or warehouse workers). The indoor worker is expected to drink water at the facility, which could be sourced from contaminated groundwater or surface water. Refer to **Figures 1** and **2** for applicable exposure pathways for chemicals and radionuclides, respectively, for this land use.

2.3.1.5 Construction Worker

The construction worker land use scenario has two different options for soil: exposure to unpaved road traffic and exposure to other construction activities. These two scenarios differ in their calculations of particulate emission factor (PEF) and volatilization factor (VF) values. Both scenarios address two types of mechanical soil disruption: standard vehicle traffic and activities other than vehicle traffic (i.e., dozing, grading, tilling, dumping). Because the exposure durations are limited to one year, the PRGs and/or risk results are calculated using subchronic reference doses for all exposure routes. The construction worker is expected to have a soil ingestion rate of 330 mg/day, higher than the worker land use scenarios presented in **Sections 2.3.1.2 - 2.3.1.4**. Refer to **Figures 1** and **2** for applicable exposure pathways for chemicals and radionuclides, respectively, for this land use.

2.3.1.6 Excavation Worker

For the excavation worker land use scenario, individuals are assumed to be exposed to contaminated soil infrequently and for only a short period of time. The excavation worker is expected to have a soil ingestion rate of 330 mg/day, higher than the worker land use scenarios presented in **Sections 2.3.1.2 - 2.3.1.4**. Due to the nature of this scenario, exposure frequency is assumed to be only one month in length and, because excavation is assumed to be a rare occurrence, the exposure duration for any one worker is assumed to be for only one year. The calculations in the RAIS assume that there is an unlimited potential for soil erosion and production of particulate and vapor emissions. Because the exposure durations are limited, the PRGs and/or risk results are calculated using subchronic reference doses for all exposure routes. Refer to **Figures 1** and **2** for applicable exposure pathways for chemicals and radionuclides, respectively, for this land use.

2.3.1.7 Recreator

Under the recreator land use scenario, individuals are assumed to be exposed to contaminated media while playing, hiking, etc. This land use can also include what is often described as a "trespasser" or "site visitor" scenario in some risk assessments. For the soil and sediment pathways, it is assumed that there is an unlimited potential for surface erosion and the production of particulates and vapor emissions. Since the rate of incidental ingestion of soil and sediment in relation to body weight varies significantly between children and adults, PRG calculations and risk characterization based on carcinogenic risk due to incidental ingestion of soil are calculated using an age-adjusted ingestion factor. For the same reason, the PRGs and/or risk results based on systemic toxicity (i.e., hazard) are calculated separately for the child and the adult. Refer to **Figures 1** and **2** for applicable exposure pathways for chemicals and radionuclides, respectively, for this land use.

2.3.1.8 Farmer

The farmer land use scenario considers a receptor that raises and consumes various farm products (produce, milk, and beef). PRGs for protective concentrations in soil and water can be back-calculated from farm product direct consumption PRGs. The calculators can generate separate PRGs or risk outputs for the pathways presented in **Figures 1** and **2**. Like the resident land use scenario, age-adjusted intake equations are factored into the consumption model, particularly because rate of milk consumption tends to vary with age and body weight.

Presently, the radionuclide PRG and risk calculators assess swine, poultry, egg, and fish in addition to the beef, milk, and produce assessed by the chemical PRG and risk calculators.

2.3.2 Chronic Daily Intake (CDI)

The chronic daily intake (CDI) represents the amount of an individual contaminant taken in by the receptor on a chronic, daily basis via a specific exposure pathway (e.g., ingestion of groundwater from a well down-gradient of a spill). The CDI, combined with a toxicity value, can give the ELCR or the HI of COPC exposure. The RAIS offers the ability to calculate PRGs, HI, and ELCR based on subchronic daily (SDI) intakes as well.

2.4 TOXICITY ASSESSMENT

The toxicity assessment portion of the risk assessment consists of two steps: hazard identification and dose-response assessment. Hazard identification determines whether exposure to a chemical can increase the incidence of a particular adverse health effect and the likelihood of occurrence in humans. Dose-response assessment presents the relationship between the magnitude of exposure and adverse effects. For example, the length of time (magnitude of exposure) a person stays in the sun without protection is directly related to the severity of sunburn (adverse health effect) that person will receive. These two steps are used to produce toxicity values. The toxicity values are compiled from multiple sources.

During the toxicity assessment, toxicity values for each COPC are identified for the risk and hazard equations. The most common types of toxicity values are discussed below. Chemical toxicity and parameter tools are further discussed in **Section 3.1**, and radionuclide toxicity and parameter tools are further discussed in **Section 4.1**.

2.4.1 Cancer/Carcinogenic Toxicity Values

Slope factors and unit risks are the toxicity data most commonly used to evaluate potential human carcinogenic risks. They are 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. Both are accompanied by a weight-of-evidence classification to indicate the strength of the evidence that the agent is a human carcinogen.

An oral slope factor (OSF) represents an upper bound, approximating a 95 percent (%) confidence limit, on the increased cancer risk from a lifetime oral exposure to an agent. The use of the “upper bound” means that the “true risk” is likely to be lower than the risk estimate derived through the slope factor model (EPA, 1989). The inhalation unit risk (IUR) is defined as the upper-bound ELCR estimated to result from continuous exposure to an agent at a concentration of 1 microgram per cubic meter ($\mu g/m^3$) in air.

2.4.2 Noncancer/Noncarcinogenic Toxicity Values

An oral reference dose (RfD) is defined as "an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime" (EPA, 1989). Similary, an inhalation reference concentration (RfC) is an estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Various types of RfDs and RfCs are available depending on the length of exposure being evaluated (acute, chronic, or subchronic).

2.5 RISK CHARACTERIZATION

Risk characterization is the last step of the risk assessment process. Risk characterization incorporates the outcomes of the previous risk assessment steps and calculates the ELCR and HI resulting from potential exposure to chemicals and/or radionuclides via the applicable pathways and routes of exposure for a site.

All the COPCs have their ELCR and HI calculated using the CDIs from the exposure assessment and appropriate toxicity values from the toxicity assessment. Any ELCR that exceeds 1E-06 or HI exceeding 1 is of concern. Land use scenarios exceeding either of these benchmarks are land use scenarios of concern (LOCs). Risk characterization results for routes exceeding these criteria over all chemicals within a LOC are exposure routes of concern (ROCs). COPCs within a land use scenario of concern exceeding either of these benchmarks are contaminants of concern (COCs) for the LOC. ROCs are reviewed to determine media of concern (MOCs).

Risk characterization consists of the following steps:

- Quantify ELCR and HI for each COPC by exposure route for each land use/media combination;
- Quantify Total ELCR and HI for each COPC across all exposure routes;
- Quantify Total ELCR and HI for each exposure route across all COPCs;
- Quantify Total ELCR and HI across all exposure routes for each COPC for each land use/media combination;
- Identify LOCs, MOCs, ROCs, and COCs;
- Assess and present uncertainties;
- Consider site-specific human studies, if available; and
- Summarize and present baseline risk assessment characterization results.

All steps can be done using the RAIS risk calculators after selecting the appropriate land use and media combination and inputting the contaminant concentrations. Risk characterization can be understood as "forward risk calculations", since the risk or hazard resulting from potential exposure to chemicals and/or radionuclides will be calculated from known concentrations and the applicable pathways and exposure routes. PRG determinations are backwards-calculated (extrapolated from a set risk or hazard standard back to a "safe" or "acceptable" residual concentration level for a specific medium).

The risk calculator determines the individual risk from each of the contaminants within each pathway and sums the risks from the different contaminants within each pathway and across all pathways in order to determine total risk and hazard values for each pathway and each scenario.

The Chemical Risk Calculator (https://rais.ornl.gov/cgi-bin/prg/RISK_search?select=chem) and Radionuclide Risk Calculator (https://rais.ornl.gov/cgi-bin/prg/RISK_search?select=rad) are discussed in **Sections 3.2** and **4.2**, respectively.

2.5.1 Cancer

Risk for carcinogens is "estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen" or ELCR (EPA, 1989). **Figure 3** presents the linearity of increasing ELCR as concentration and CDI increases.

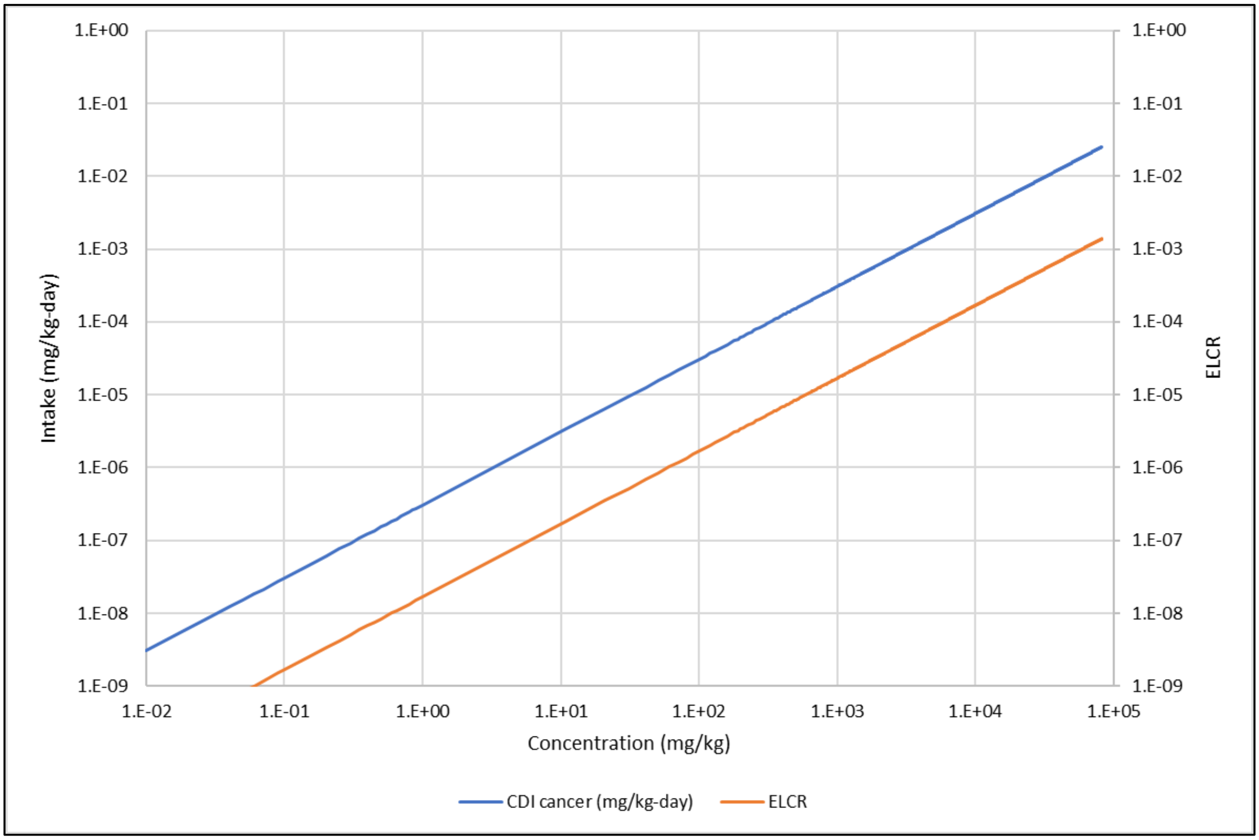


Figure 3. Low concentration vs. intake and ELCR for benzene, composite worker.

ELCR is calculated using the linear cancer risk equation shown below (EPA, 1989):

Linear Low Dose Cancer Risk Equation

$$Oral\ Risk = Intake\ \times SF\ \ [1a]$$

$$Inhlation\ Risk = Intake\ \times IUR\ [1b]$$

$$Dermal\ Risk = Intake\ \times \frac{SF}{GIABS}\ [1c]$$

$$External\ Risk = Intake\ \times SF\ [1d]$$

Where:

- Risk = a unitless probability of an individual developing cancer;

- Intake = daily intake (DI) (units vary per exposure route, see **Appendices C** and **H**);
- SF = slope factor (units vary per exposure route, see **Appendices C** and **H**);
- IUR = inhalation unit risk expressed as $(\mu g/m^3)^{-1}$; and
- GIABS = Fraction of contaminant absorbed in gastrointestinal tract, which is chemical-specific and unitless.

2.5.1.1 One-Hit Rule

The one-hit rule is an alternate calculation method that is utilized in instances of high exposure to chemicals and/or radionuclides (resulting in estimated risks that exceed 0.01) (EPA, 2020a and 2023). **Figure 4** shows the impact of the one-hit rule on the ELCR, as concentrations and CDI increase. The net effect of the one-hit rule is that the probability of getting cancer cannot exceed 100%.

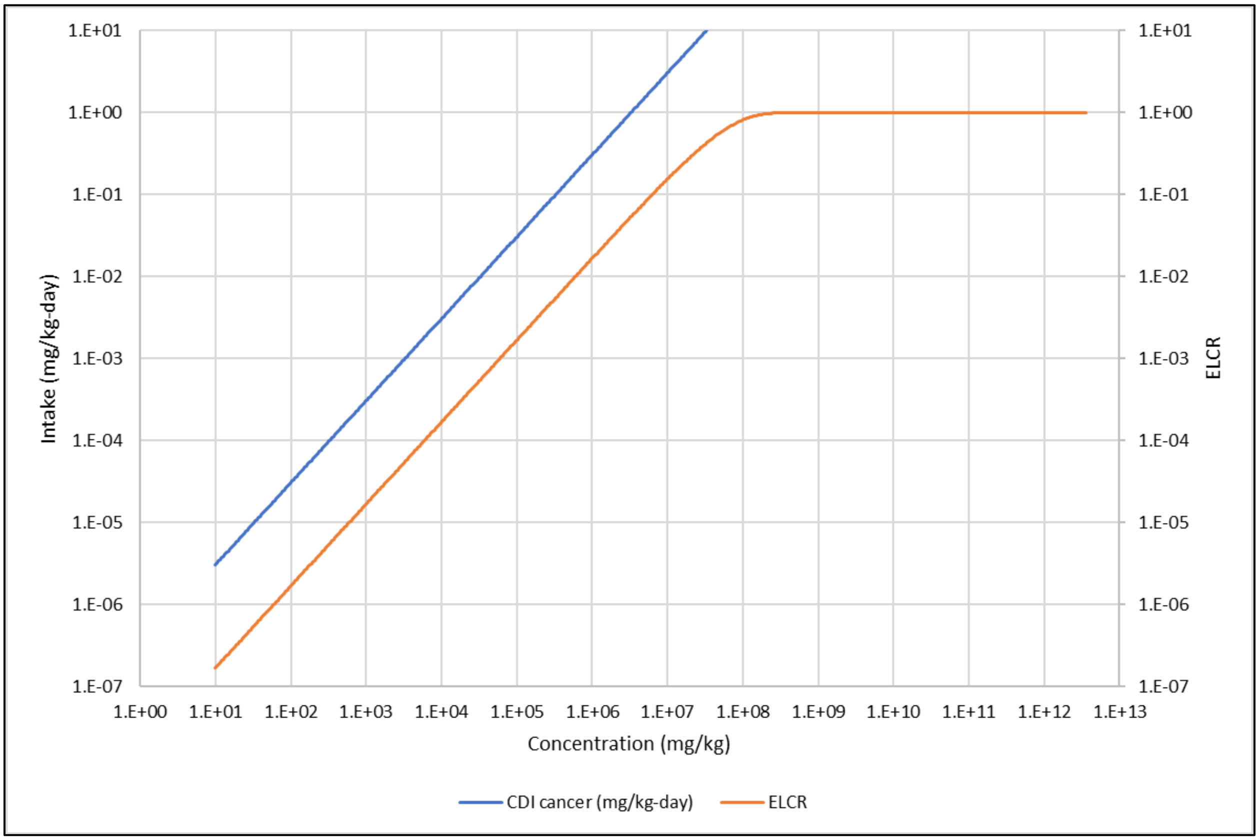


Figure 4. One-hit rule concentration vs. intake and ELCR composite worker, benzene.

The one-hit equation (shown in equation [2]) is consistent with the linear low-dose model for cancer risk (shown in equations [1a, 1b, and 1c]) (EPA, 1989):

One-Hit Equation for High Carcinogenic Risk Levels

$$Risk = 1 - \exp(-Intake \times TV) \; [2],$$

Where:

- Risk = a unitless probability of an individual developing cancer;
- exp = the exponential;
- Intake = DI as described in **Section 2.5.1**; and
- TV = toxicity value as described in **Section 2.5.1**.

2.5.2 Noncancer

The potential for non-carcinogenic effects to occur is evaluated by comparing an exposure level over a specific time period against an RfD derived for a similar exposure period.

Figure 5 presents a graph of a noncancer CDI and hazard quotient (HQ) calculation by increasing concentration. Also presented is the RfD, showing that any CDI below the RfD is not expected to show an adverse effect, and any CDI above the RfD is likely to show an adverse effect.

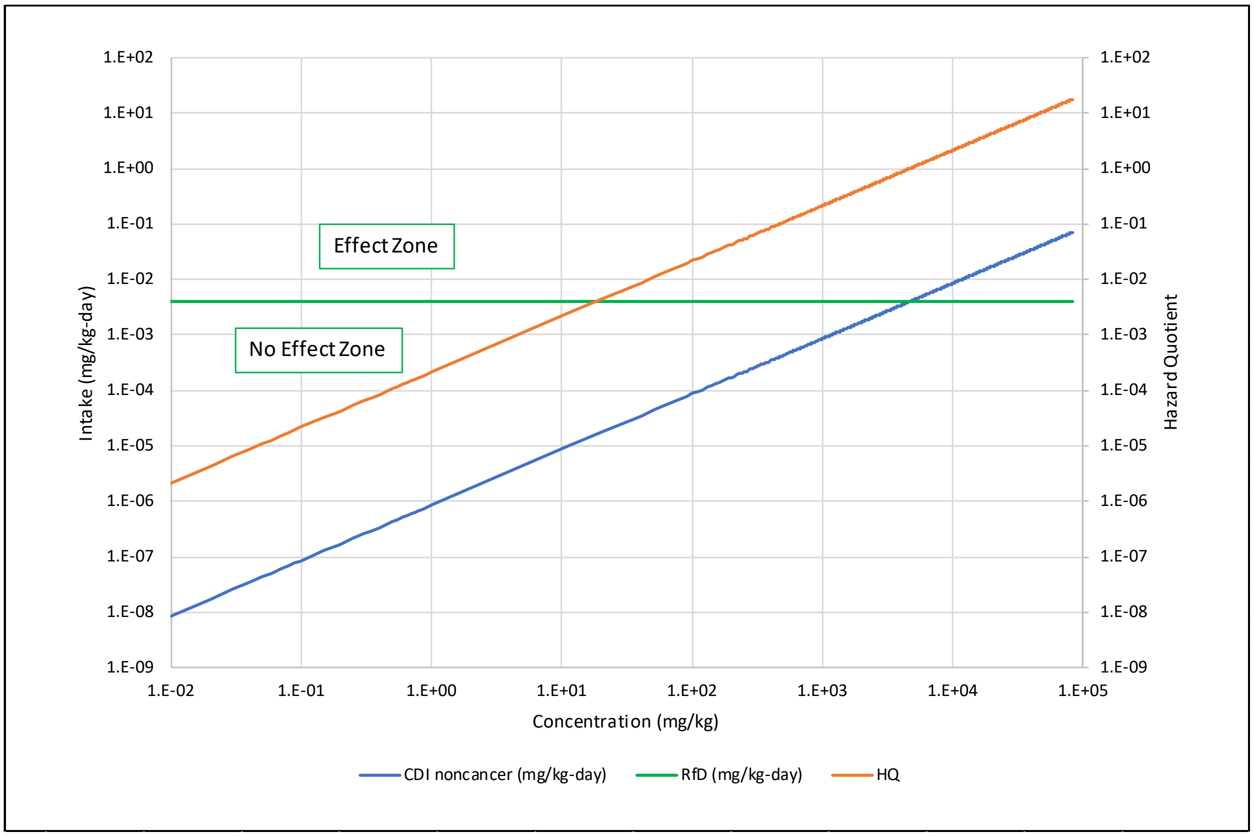


Figure 5. Concentration vs. intake and HQ for benzene, composite worker, noncancer.

The noncancer HQ is calculated using the equations shown below (EPA, 1989):

$$Oral\ Hazard\ Quotient = \frac{Intake}{RfD}\ [3a]$$

$$Inhalation\ Hazard\ Quotient = \frac{Intake}{RfC}\ [3b]$$

$$Dermal\ Hazard\ Quotient = \frac{Intake}{RfD\ x\ GIABS}\ [3c]$$

Where:

- Intake = can be CDI or SDI for the toxicant, expressed in milligrams per kilogram-day (mg/kg-day) for oral exposure or milligrams per cubic meter (mg/m^3) for inhalation;
- RfD = oral reference dose for the toxicant, expressed in mg/kg-day;
- RfC = inhalation reference concentration for the toxicant, expressed in mg/m^3; and
- GIABS = fraction of contaminant absorbed in gastrointestinal tract, which is chemical-specific and unitless.

3. CHEMICAL TOOLS

The RAIS chemical tools provide information that can be used in all the steps of a risk assessment. Tools include screening level and risk calculators, database look up tools, and transport models. The sections below are presented in the order that they are currently found on the RAIS.

Note that when searching by chemical name, organic compounds and some inorganic chemicals often have synonyms. For example, 2-butanone is also called methyl ethyl ketone, methyl acetone, 2-oxybutane, or simply MEK, depending on the chemical application. If the chemical of interest is not seen in the pick list, an internet search for synonyms should be conducted.

3.1 CHEMICAL TOXICITY AND PARAMETERS

The RAIS has four tools for obtaining chemical toxicity information:

- Chemical Toxicity Values
- Chemical Toxicity Metadata
- Chemical-Specific Parameters
- Chemical Data Profiles

The tools listed above are described in further detail below.

3.1.1 Chemical Toxicity Values

The Chemical Toxicity Values tool (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chemtox) searches for human health toxicological values for multiple chemicals simultaneously. After selecting chemicals of interest and the desired toxicity values, the RAIS will generate table(s) of toxicity values, chosen according to slight modifications of the EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9285.7-53 recommended hierarchy of toxicity values, as shown in **Table 1** (EPA, 2003b). The slight modifications include archived, draft, and addendum values from various sources.

Results can be downloaded in .xlsx format. Chronic, subchronic, and acute toxicity values are available.

Table 1. EPA Recommended Human Health Toxicity Value Hierarchy

Hierarchy Level	Toxicity Value
Tier 1	EPA's Integrated Risk Information System (IRIS)
Tier 2	EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs)
Tier 3	Other Toxicity Values: • EPA's Office of Pesticide Programs (OPP) Human Health Benchmarks for Pesticides (HHBPs), • Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs), • EPA Office of Water (OW), • PPRTV Appendix Screening Values, and • EPA's Health Effects Assessment Summary Tables (HEAST).

3.1.2 Chemical Toxicity Metadata

The Chemical Toxicity Metadata tool (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chemmeta) displays toxicity values as well as supporting information, such as target organs, cancer classification, tumor types, confidence levels, uncertainty factors, and other study details. Similar to the Chemical Toxicity Values tool, select chemicals of interest and the desired information. Results can be downloaded in .xlsx format. Chronic and subchronic toxicity metadata are available.

3.1.3 Chemical Data Profiles

The Chemical Data Profiles tool (https://rais.ornl.gov/tools/profile.php) is used to obtain a wide range of information on a specific chemical. The display includes a brief summary of the chemical, all toxicity values available in the database, and all chemical-specific parameters (ex., VF). The unique aspect of the RAIS Chemical Data Profiles tool is that data is displayed from a variety of federal, state, and other sources. While the Chemical Toxicity Values and Chemical Toxicity Metadata tools provide toxicity values based on the EPA OSWER Directive 9285.7-53 hierarchy only (EPA, 2003b), the Chemical Data Profiles tool shows all available toxicity values and parameters. The toxicity values and physicochemical properties that are used in the PRG and risk calculations are highlighted. Toxicity metadata is also available in this tool.

3.1.4 Chemical Parameters

The Chemical-Specific Parameters tool (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chemspef) searches for chemical-specific parameters for multiple chemicals simultaneously. After selecting chemicals of interest and the desired parameters, the RAIS will generate a table containing the values, chosen according to the EPA hierarchy (see Section 2.4.2 of the RAIS Chemical PRG Calculator User Guide for more information here: https://rais.ornl.gov/tools/rais_chemical_prg_guide.html). Results can be downloaded in .xlsx format. Over 40 parameters are available, including melting point, density, vapor pressure, water solubility, and Henry's Law constants. The major sources used to populate the database of chemical-specific parameters are listed below:

1. The Physical Properties Database (PHYSPROP) developed by Syracuse Research Corporation (SRC). https://www.srcinc.com/services/engineering-operational-and-environmental-services/scientific-databases.html.

2. The Estimation Programs Interface (EPI Suite™) developed by the U.S. Environmental Protection Agency's Office of Pollution Prevention and Toxics and SRC. https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface.

3. CRC Handbook of Chemistry and PhysicsExit. (Various Editions). https://hbcp.chemnetbase.com/.

4. Perry's Chemical Engineers' Handbook (Various Editions). McGraw-Hill. Online version available here: https://www.accessengineeringlibrary.com/browse/perrys-chemical-engineers-handbook-eighth-edition. Green, Don W.; Perry, Robert H. (2008).

5. Lange's Handbook of Chemistry (Various Editions). Speight, James G. (2005). McGraw-Hill. https://www.accessengineeringlibrary.com/content/book/9781259586095.

6. Yaws' Handbook of Thermodynamic and Physical Properties of Chemical Compounds. Knovel, 2003.

7. EPA Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (SSL) and Appendix A-C. https://rais.ornl.gov/documents/SSG_nonrad_supplemental.pdf.

8. Summary of Physical/Chemical and Environmental Parameters for PFAS: Subject to Interim Special Order by Consent No. 20-086-CWP/AP/GW/HW/DW/SW, paragraph 37(J)(3). Environmental Studies Report E21-0037. 3M, 2021. https://rais.ornl.gov/documents/3M.pdf.

9. 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. https://rais.ornl.gov/node/118631.

10. U.S. EPA 2015 Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air. OSWER Publication 9200.2-154. https://www.epa.gov/vaporintrusion/technical-guide-assessing-and-mitigating-vapor-intrusion-pathway-subsurface-vapor.

11. IAEA TRS 472 (IAEA). Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Terrestrial and Freshwater Environments. Technical Reports Series No. 472. International Atomic Energy Agency, Vienna. 2010. http://www-pub.iaea.org/MTCD/publications/PDF/trs472_web.pdf.

12. NCRP 123 (NCRP). NCRP Report No. 123, Screening Models for Releases of Radionuclides to the Atmosphere, Surface Water, and Ground. National Council on Radiation Protection and Measurements. January 22, 1996. http://ncrponline.org/publications/reports/ncrp-reports-123/.

13. BAES. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. C. F. Baes III, R. D. Sharp, A. L. Sjoreen, R.W. Shor. Oak Ridge National Laboratory 1984. https://www.nrc.gov/docs/ML1015/ML101590306.pdf.

3.2 CHEMICAL PRG CALCULATOR

Chemical preliminary remediation goals (PRGs) (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=chem) are calculated by selecting the applicable chemical(s) together with the applicable media, land use, and exposure route combination. If "site-specific" is selected as the PRG type, the following page will show the equations and exposure parameters used for deriving the PRGs, and some of the parameter values may be changed as necessary. If "default" is selected as the PRG type, the RAIS will proceed directly to the results page. Multiple chemicals can be selected. Results can be downloaded in .xlsx or .pdf formats. Additionally, the session inputs for the PRG calculator can be saved for future use and recalled by the PRG calculator.

The derivation of the selected PRG and the applicable equations and exposure parameters can be reviewed in more detail using the RAIS Chemical PRG Calculator User Guide (https://rais.ornl.gov/tools/rais_chemical_prg_guide.html). Tables of recommended default exposure parameters for the RAIS Chemical PRG Calculator can be found in **Appendix A**. Equations specific to the Chemical PRG Calculator are listed in **Appendix B**, while supporting equations applicable to multiple scenarios are listed in **Appendix J**.

3.3 CHEMICAL RISK CALCULATOR

Chemical risks (https://rais.ornl.gov/cgi-bin/prg/RISK_search?select=chem) are calculated by selecting COPCs from the chemical list together with the applicable media, land use, and exposure route combination.

On the following page, enter the known COPC concentrations for each media. This page also shows the equations and exposure parameters used for deriving the PRGs, and some of the parameter values may be changed as necessary. Results can be downloaded in .xlsx or .pdf formats. Additionally, the session inputs for the risk calculator can be saved for future use and recalled by the risk calculator.

The equations and exposure parameters used for the calculations are explained in greater detail in the RAIS Chemical Risk Calculator User Guide, available here: https://rais.ornl.gov/tools/rais_chemical_risk_guide.html. Tables of recommended default exposure parameters for the RAIS Chemical Risk Calculator can be found in **Appendix C**. Equations specific to the Chemical Risk Calculator are listed in **Appendix D**, while supporting equations applicable to multiple scenarios are listed in **Appendix J**.

3.4 CHEMICAL REGULATORY LIMITS (ARAR SEARCH)

The regulatory limits for groundwater and surface water contained in the RAIS database comprise chemical-specific values based on potential applicable or relevant and appropriate requirements (ARARs). These values should be used in conjunction with risk-based PRGs to ensure that the PRGs for a site meet the residual risk requirements for protection of human health and the environment in the National Oil and Hazardous Substance Pollution Contingency Plan (NCP). In some cases, the ARAR values presented in the RAIS may be To-Be-Considered (TBC) Guidance, because these values are superseded by site-specific State requirements.

To use the Chemical ARAR Search tool (https://rais.ornl.gov/tools/arar_search.php), first select a regulatory limit source (currently the options are "Federal" or 13 different states). On the following page, select the chemicals of interest and applicable regulatory limits for the selected source. Results can be downloaded in .xlsx format.

The Federal ARAR options are listed in **Table 2**.

Table 2. Established Regulatory Limits for Surface Water and Groundwater – Federal Source

Primary Drinking Water Standards	Federal Water Quality Criteria
Primary Drinking Water MCLs	Human Health WQC for Aquatic Organisms and Drinking Water
Primary Drinking Water MCLGs	Human Health WQC for Aquatic Organisms Only
Maximum Residual Detergent Levels	Federal Freshwater WQC – Maximum
Proposed Primary Drinking Water MCLs	Federal Freshwater WQC – Continuous
Proposed Drinking Water MCLGs	Federal Saltwater WQC – Maximum
Secondary Drinking Water SMCLs	Federal Saltwater WQC – Continuous Organoleptic Effect Criteria Federal WQC Source

Notes: MCL = maximum contaminant level; MCLG = maximum contaminant level goal; SMCL = secondary maximum contaminant level; WQC = water quality criteria

The state-specific ARARs available on the RAIS are listed in **Table 3**.

Table 3. Established Regulatory Limits for Surface Water and Groundwater – U.S. States

State	Available Criteria
California	Primary Drinking Water Standards Water Quality Control Standards
Georgia	Primary Drinking Water Standards Water Quality Control Standards Hazardous Site Response Type 1 Standards
Illinois	Primary Drinking Water Standards State Groundwater Standards Water Quality Standards Lake Michigan Basin Water Quality Standard General Use Derived Water Quality Criteria Lake Michigan Basin Derived Water Quality Criteria
Kentucky	Primary Drinking Water Standards Secondary Drinking Water Standards State Water Quality Criteria
New Jersey	Primary Drinking Water Standards Secondary Drinking Water Standards
New Mexico	Primary Drinking Water Standards Standards for Interstate and Intrastate Waters Standards for Groundwater of 10,000 mg/L TDS Concentration or Less
Nevada	Primary Drinking Water Standards Water Quality Standards
New York	State WQ Standards – Aquatic (Acute) State WQ Standards – Aquatic (Chronic) State WQ Standards – Aesthetics State WQ Standards – Health (Fish Consumption) State WQ Standards – Health (Water Source) State WQ Standards – Wildlife
Ohio	Primary Drinking Water Standards Secondary Drinking Water Standards Ohio Statewide Water Quality Criteria Lake Erie Standards Ohio River Water Quality Criteria Lake Erie Drainage Basin Water Quality Criteria Ohio River Drainage Basin Water Quality Criteria
South Carolina	Primary Drinking Water Standards State Groundwater Standards Water Quality Standards
Tennessee	Primary Drinking Water Standards Water Quality Criteria (WQC)
Washington	Primary Drinking Water Standards State Groundwater Standards Water Quality Standards
Wisconsin	Primary Drinking Water Standards Water Quality Standards State Groundwater Standards

Notes: mg/L = milligrams per liter; TDS = total dissolved solids; WQ = water quality

3.5 CHEMICAL ECOLOGICAL BENCHMARKS

The Ecological Benchmark Tool for Chemicals (https://rais.ornl.gov/tools/eco_search.php?select=chem) presents benchmarks for air, surface water, sediment, surface soil, and biota applicable to a range of aquatic organisms, soil invertebrates, mammals, and terrestrial plants. Benchmarks are from 29 sources including national, state, and international agencies. Many of the benchmarks were originally derived from the Environmental Sciences Division of ORNL or compiled as part of the Spatial Analysis and Decision Assistance (SADA) Project (https://www.sadaproject.net/). To find ecological benchmarks, select the benchmark source(s), media, and chemical(s) of interest. The RAIS displays separate tables for each selected media with a list of all available ecological benchmark values for the selected chemical(s) of interest plus references and footnotes. Results can be downloaded in .xlsx format.

3.6 ADULT LEAD MODEL

The RAIS includes two methods to assess risks associated with industrial worker exposures to lead in soil: the Adult Lead Model (ALM) PRG Calculator and the ALM Risk Calculator. For both, the methodology focuses on estimating fetal blood lead concentrations in women exposed to lead-contaminated soils. This approach also provides tools for evaluating risks of elevated blood lead concentrations among exposed adults.

Based on the Technical Review Workgroup's (TRW) analysis of the data collected in the completed NHANES III survey (1999-2004), updated ranges for the baseline adult blood lead concentration (PbB) and geometric standard deviation PbB (GSDi) adult parameters in the ALM have been included in the spreadsheets (EPA, 2003a). However, recent scientific evidence has demonstrated adverse health effects at blood lead concentrations below 10 microliters per deciliter (µg/dL) (down to 5 µg/dL and possibly below). The EPA Office of Superfund Remediation and Technology Innovation (OSRTI) is developing a new soil lead policy to address this new information. Until that soil lead policy is finalized, regional risk assessors and managers should consult with the TRW's Lead Committee before applying these updated values for risk assessment.

3.6.1 Lead Industrial Worker Soil PRG Calculator

Use this tool (https://rais.ornl.gov/cgi-bin/lead_model/prg_model) to calculate a PRG for an industrial worker exposed to lead-contaminated soils. The ALM PRG calculator displays the default exposure parameters used in the calculations, which can be changed if evaluating a site-specific scenario. The Lead Industrial Worker Soil PRG Equation is shown below (equation [4a]) along with the associated parameters in **Table 4**.

Lead Industrial Worker Soil PRG Equation

$$PRG_{soil} = \left[\left(\frac{PbB_{fetal,0.95}}{(GSD_i^{1.645}) \times R_{\frac{fetal}{maternal}}}\right) - PbB_0\right] \times \left[\frac{AT_{S,D}}{BKSF \times IR_S \times AF_{S,D} \times EF_{S,D}}\right] \text{ [4a]}$$

Table 4. Parameters for Lead Industrial Worker Soil PRG Equation

Parameter	Description	Value	Units
PRG_{soil}	Industrial Worker PRG in Soil for no more than 5% probability that fetal PbB exceeds target PbB	1050	mg/kg, µg/g, or ppm
$AT_{S, D}$	Averaging time (same for soil and dust))	365	days/year
$EF_{S, D}$	Exposure frequency (same for soil and dust)	219	days/year
IR_S	Soil ingestion rate (including soil-derived indoor dust)	0.05	g/day
$AF_{S, D}$	Absorption fraction (same for soil and dust)	0.12	unitless
BKSF	Biokinetic Slope Factor	0.4	µg/dL per µg/day
GSD_i	Geometric Standard Deviation PbB	1.8	unitless
PbB_0	Baseline PbB	0.6	µg/dL
$R_{fetal/maternal}$	Fetal/Maternal PbB ratio	0.9	unitless
$PbB_{fetal, 0.95}$	Target PbB in fetus; value of 5 is used because it is the midpoint of the recommended range of 2 to 8 µg/dL	5	µg/dL

Notes: g/day = grams per day; µg/day = microliters per day; µg/dL = microliters per deciliter; µg/g = micrograms per gram; mg/kg = milligrams per kilogram; ppm = parts per million

3.6.2 Lead Industrial Worker Soil Risk Calculator

The ALM Risk Calculator (https://rais.ornl.gov/cgi-bin/lead_model/risk_model) calculates the probability (risk) of the fetal blood lead concentration exceeding target blood levels by determining the fetal blood lead level concentration from the user-provided soil lead concentration. The ALM Risk Calculator displays the default exposure parameters used in the calculations, which can be changed if evaluating a site-specific scenario. Results can be downloaded in .xlsx or .pdf formats. The two equations (equations [4b] and [4c]) used for the risk calculations are shown below along with their associated parameters in **Table 5**.

Probability (Risk) of Fetal Blood Lead Level Exceeding Lead Blood Target Level Equation

$$Probability\ of\ PbB_{fetal} > PbB_t(\%) = 1 - \ CDF_{log-normal-dist}(x, \mu, \sigma)\ [4b]$$

Where:

- $x = PbB_t\left[\frac{(2:8\ \mu g)}{dl}\right]$;
- $\mu = \ln\left(PbB_{adult} \times R_{\frac{fetal}{maternal}}\right)$;
- $\sigma = \ln(GSD_i)$; and
- $PbB_{adult} = \left[\frac{PbS \times BKSF \times IR_S \times AF_{S,D} \times EF_{S,D}}{AT_{S,D}}\right] + PbB_0$.

Fetal Blood Lead Level Concentration Equation

$$PbB_{fetal,0.95} = \left[\left(\frac{PbS \times BKSF \times IR_S \times AF_{S,D} \times EF_{S,D}}{AT_{S,D}}\right) + PbB_0\right] \times \left[({GSD_i}^{1.645}) \times R_{\frac{fetal}{maternal}}\right][4c]$$

Table 5. Parameters for Lead Industrial Worker Soil Risk Equations

Parameter	Description	Value	Units
PbS	Soil Lead Concentration	Site-Specific	µg/g, or ppm
$AT_{S, D}$	Averaging time (same for soil and dust))	365	days/year
$EF_{S, D}$	Exposure frequency (same for soil and dust)	219	days/year
IR_S	Soil ingestion rate (including soil-derived indoor dust)	0.05	g/day
$AF_{S, D}$	Absorption fraction (same for soil and dust)	0.12	unitless
BKSF	Biokinetic Slope Factor	0.4	µg/dL per µg/day
GSD_i	Geometric Standard Deviation PbB	1.8	unitless
$R_{fetal/maternal}$	Fetal/Maternal PbB ratio	0.9	unitless
PbB_0	Baseline PbB	0.6	µg/dL
PbB_{adult}	PbB of adult worker, geometric mean	2.1	µg/dL
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	5	µg/dL
PbB_t	Target PbB level of concern; value of 5 is used because it is the midpoint of the recommended range of 2 to 8 µg/dL	5	µg/dL

Notes: g/day = grams per day; µg/day = microliters per day; µg/dL = microliters per deciliter; µg/g = micrograms per gram

3.7 MEDIA TRANSPORT TOOLS

The RAIS offers tools that model the migration of chemicals from soil to groundwater, resuspension of particulates into air, and volatilization of chemicals from soil into air.

3.7.1 Chemical Groundwater Transport Calculator

The Chemical Groundwater Transport Calculator (https://rais.ornl.gov/cgi-bin/prg/groundwater_transport?select=chem) recreates the migration pathway of contaminants from soil to groundwater by calculating the expected groundwater concentration from user-provided soil concentrations. The user can adjust parameters prior to exporting the results.

3.7.2 Chemical PEF Transport Calculator

There are multiple PEFs that can be calculated based on the exposure scenario at hand. The PEF Transport Calculator (https://rais.ornl.gov/cgi-bin/prg/air_transport_pef) guides the user through the calculation of the following PEFs:

- PEF Wind-Driven (PEF)
- Subchronic PEF Mechanically Driven – Unpaved Road Traffic (PEF_{sc})
- Subchronic PEF Mechanically Driven – Other Construction Activities (PEF'_{sc})
- Mechanical Particulate Emission Factor for Off-site Receptors (Standard Vehicle Traffic) (PEF_{off})
- Mechanical Particulate Emission Factor for Off-site Receptors (Other Construction Activities) (PEF'_{off})

3.7.3 VF Transport Calculator

VF is an inhalation variable that has different methods of calculation. VFs are chemical-specific unlike the PEFs that are scenario-specific. The VF Transport Calculator (https://rais.ornl.gov/cgi-bin/prg/air_transport_vf) guides the user through the calculation of the following:

- Infinite Source Chronic Volatilization Factor (VF_{ulim})
- Mass-limit Chronic Volatilization Factor (VF_{mlim})
- Unlimited Source Subchronic Volatilization Factor for Construction Worker ($VF_{ulim\text{-}sc}$)
- Mass-limit Subchronic Volatilization Factor for Construction Worker ($VF_{mlim\text{-}sc}$)

This calculator is only available for non-radionuclides.

3.8 CHEMICAL BACKGROUND VALUES

The RAIS offers two approaches to background screening: generic and site-specific.

The Generic Background Values tool (https://rais.ornl.gov/tools/bg_search.php) contains generic soil background values for selected non-radionuclide chemicals. These values can be applied to any area across the U.S. Users can compare these values against local background data or supplement an existing background value dataset. Results can be downloaded in .xlsx format.

The RAIS offers three site-specific background options: Oak Ridge, Portsmouth, and Paducah.

- The Oak Ridge Background Values (https://rais.ornl.gov/tools/orr_background.html)are from a Background Soil Characterization Project done at ORR in 1993 (DOE, 1993a, 1993b, 1993c, 2003). The purpose of the project was to evaluate the potential human health concerns from naturally occurring background constituents.

- The Portsmouth Background Values (https://rais.ornl.gov/tools/ports_background.html) are from a Soil Background Report for the Portsmouth Gaseous Diffusion Plant, which sought to develop a comprehensive soil dataset using surface and subsurface soil samples (DOE, 2015). The Portsmouth background dataset on the RAIS also includes background concentrations for groundwater.

- The Paducah Background Values (https://rais.ornl.gov/documents/DOE_Paducah-June-2023.pdf) are from Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Volume 1, Human Health, which sought to establish provisional background values for groundwater and soil (DOE, 2023). These values were developed by considering agreements reached between the DOE and the regulatory agencies during comment resolution meetings, in the Federal Facility Agreement, and at technical meetings. The Paducah background concentrations are available for soil (surface and subsurface) and groundwater (filtered and unfiltered).

4. RADIONUCLIDE TOOLS

In many cases, the radionuclide tools mirror and function just as the chemical tools on the RAIS. This design promotes consistency and ease of use. The sections below are presented in the order that they are currently found on the RAIS.

Some of the radionuclide tool picklists contain isotopes with designations of +D, +E, m, and n. The +D and +E designations mean that the first 100 and 1000 years of progeny ingrowth are included in the slope factors, respectively (e.g., U-238, U-238+D, and U-238+E). The +D and +E radionuclide use is now discouraged, as the parent half-life, biota uptake factors, and soil-to-water partition coefficients are de facto used for the progeny, which is not accurate. Metastable forms of the isotopes are designated by the letters “m”, “n”, etc. After decay, a nucleus may be in an excited state (metastable state) and emit a specific decay. When the half-life is long enough, unique toxicity values are derived for the metastable state, as is the case with Tc-99 and Tc-99m.

4.1 RADIONUCLIDE TOXICITY AND PARAMETERS

The radionuclide toxicity value and parameter tools contain isotopes capable of carcinogenesis (i.e., SFs). If it is necessary to consider the noncancer effects (e.g., RfD) of the radionuclide metals, as is often the case with uranium, the Chemical Toxicity Value search tool should also be used. For example, the radionuclide tools contain ingestion, inhalation, and external exposure SFs for each uranium isotope (e.g., U-234, U-235, and U-238); however, the chemical tools would contain the RfD for "Uranium (Soluble Salts)".

The RAIS maintains separate tables of the historic dose conversion factors (dose coefficients), whereas the SFs (risk coefficients) are always replaced with the latest values. Historic dose conversion factors are provided, as many regulatory values were promulgated based on their values.

RAIS radionuclide toxicity and parameter tools include:

- Radionuclide Risk Slope Factors
- Radionuclide Dose Conversion Factors for:
    - International Commission on Radiological Protection (ICRP) 107
    - ICRP 30
    - ICRP 60
- Radionuclide Parameters

The tools listed above are described in further detail below.

4.1.1 Radionuclide Risk Slope Factors

For a given radionuclide, Slope Factors (SFs) represent the ELCR equivalent per unit intake (i.e., ingestion or inhalation) or external exposure of that radionuclide (EPA, 2020b). These SFs are used to convert a radionuclide concentration in soil, air, water, or foodstuffs to a radiation ELCR. The primary use of SFs, also called risk coefficients, is to compute the ELCR resulting from site-related exposures. This is accomplished by multiplying the route-specific SF by the CDI of each radionuclide of potential concern for each route of exposure.

Ingestion and inhalation slope factors are central estimates in a linear model of the age-averaged, lifetime attributable radiation cancer incidence (fatal and nonfatal cancer) risk per unit of activity inhaled or ingested, expressed as risk/picocurie (pCi) (EPA, 2020a). External exposure SFs are central estimates of lifetime attributable radiation cancer incidence risk for each year of exposure to external radiation from photon-emitting radionuclides distributed uniformly in a thick layer of soil, expressed as risk/year per pCi/gram soil. External exposure SF units can also be risk/year per pCi/square centimeters (cm^2) of soil. When combined with site-specific media concentration data and appropriate exposure assumptions, SFs can be used to estimate lifetime cancer risks to members of the general population due to radionuclide exposures.

It should be noted that a SF for dermal contact is not included in the radionuclide SF tool; they are not available, and EPA has concluded that dermal exposure is generally not an important route of exposure for radionuclides (EPA, 1989). The only additional chemical-specific parameter for radionuclides is radioactive half-life (TR). This value assists in determining the importance of radioactive decay and daughter(s) in the risk evaluation.

The SFs presented on the RAIS (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=radslopes) are updated values from Federal Guidance Report (FGR) 13 supplement (EPA, 1999) using the International Commission on Radiological Protection (ICRP) 107 decay data (ICRP, 2008). The derivation and values are found in “Calculations of Slope Factors and Dose Coefficients” (ORNL, 2014). Results can be downloaded in .xlsx format.

4.1.2 Radionuclide Dose Conversion Factors

Radionuclide dose conversion factors, also known as dose coefficients, are used alongside SFs for radionuclide calculations. The dose conversion factors from the ICRP 107 (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=rad107) are updated values from FGR 13 supplement (EPA, 1999) using ICRP 107 decay data (ICRP, 2008). The derivation and values are in “Calculations of Slope Factors and Dose Coefficients” (ORNL, 2014). The dose conversion factors from ICRP 30 (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=rad30) can be found in FGR 11 (EPA, 1988), and the dose conversion factors from ICRP 60 (https://rais.ornl.gov/cgi-bin/tools/TOX_search?select=rad60) can be found in FGR 12 (EPA, 1993). Results from all three tools can be downloaded in .xlsx format.

4.1.3 Radionuclide Parameters

The Radionuclide Parameters tool searches for radionuclide-specific parameters for multiple radionuclides. After selecting radionuclides of interest and the desired parameters, the RAIS will generate a table containing the values, chosen according to the hierarchy explained in Section 2.3.2 of the RAIS Radionuclide PRG Calculator User Guide (https://rais.ornl.gov/tools/rais_rad_prg_guide.html). Results can be downloaded in .xlsx format.

4.2 RADIONUCLIDE PRG CALCULATOR

Radionuclide PRGs (https://rais.ornl.gov/cgi-bin/prg/PRG_search?select=rad) are calculated by selecting the applicable radionuclide(s) together with the applicable media, land use, and exposure route combination. If “site-specific” is selected as the PRG type, the following page will show the equations and exposure parameters used for deriving the PRGs, and some of the parameter values may be changed as necessary. If “default” is selected as the PRG type, the RAIS will proceed directly to the results page. Multiple radionuclides can be selected with this tool. Results can be downloaded in .xlsx or .pdf formats. Additionally, the session inputs for the PRG calculator can be saved for future use and recalled by the PRG calculator.

The derivation of the selected PRG(s) and the applicable equations and exposure parameters can be reviewed in more detail using the RAIS Radionuclide PRG Calculator User Guide available here: https://rais.ornl.gov/tools/rais_rad_prg_guide.html.

Tables of recommended default exposure parameters for the RAIS Radionuclide PRG Calculator can be found in **Appendix E**. Equations specific to the Radionuclide PRG Calculator are listed in **Appendix F**, while supporting equations applicable to multiple scenarios are listed in **Appendix J**.

4.3 RADIONUCLIDE RISK CALCULATOR

Radionuclide risks (https://rais.ornl.gov/cgi-bin/prg/RISK_search?select=rad) are calculated by selecting the COPCs from the radionuclide list together with the applicable media, land use, and exposure route combination.

On the following page, enter the known COPC concentrations for each media. The page also shows the equations and exposure parameters used for deriving the PRGs, and some of the parameter values may be changed as necessary. Results can be downloaded in .xlsx or .pdf formats. Additionally, the session inputs for the risk calculator can be saved for future use and recalled by the risk calculator.

The user can explore the equations and exposure parameters used for the calculations in the RAIS Radionuclide Risk Calculator User Guide available here: https://rais.ornl.gov/tools/rais_rad_risk_guide.html.

Tables of recommended default exposure parameters for the RAIS Radionuclide Risk Calculator can be found in **Appendix G**. Equations specific to the Radionuclide Risk Calculator are listed in **Appendix H**, while supporting equations applicable to multiple scenarios are listed in **Appendix J**.

4.4 RADIONUCLIDE REGULATORY LIMITS (ARAR SEARCH)

Refer to **Section 3.4** for a detailed discussion on the RAIS Chemical ARAR search tool, since the radionuclide tool works similarly. Few radionuclides are listed in ARARs, with the notable exceptions being tritium, radium, and uranium.

4.5 RADIONUCLIDE ECOLOGICAL BENCHMARKS

The Ecological Benchmark Tool for Radionuclides (https://rais.ornl.gov/tools/eco_search.php?select=rad) presents benchmarks from two sources: Los Alamos National Laboratory ECORISK Database – Release 4.1 and the Texas Commission on Environmental Quality (TCEQ) (recommended for use by U.S. EPA Region 6). Select a source(s), one or more of the three media options (sediment, soil, and surface water), and the radionuclide(s) of interest. The RAIS displays separate tables for each selected media with a list of all available ecological benchmark values for the selected radionuclide(s) of interest plus references and footnotes. Results can be downloaded in .xlsx format.

4.6 RADIONUCLIDE MEDIA TRANSPORT TOOLS

Refer to **Sections 3.7.1 and 3.7.2** for a detailed discussion of the Chemical Groundwater Transport Calculator and PEF Transport Calculator, since the radionuclide tools work similarly. There is no VF transport calculator for radionuclides, as most radionuclides are metals. The RAIS team has developed a separate radon vapor intrusion screening level (RVISL) calculator for the EPA (https://epa-visl.ornl.gov/radionuclides/).

4.7 RADIONUCLIDE BACKGROUND VALUES

The radionuclide background value search tool takes the user to the same pages as the chemical tools. Refer to **Section 3.8** for a detailed discussion on the background value search tools.

5. OTHER TOOLS AVAILABLE ON THE RAIS

The RAIS Team has produced a suite of calculators for the EPA, Alaska, and Delaware using the RAIS platform.

5.1 EPA TOOLS

The EPA tools consist of chemical and radionuclide calculators, toxicity value databases, and a radionuclide decay calculator. Below is a table that summarizes the existing EPA online calculators for assessing risks from chemicals and radionuclides at Superfund sites, with a link provided for each tool.

Table 6. EPA Calculators for the Protection of Human Health Used in the Superfund Program

Media Addressed	Chemical Risk	Radiological Risk	Radiological Dose
Soil, Water, Air, Biota, Soil to Groundwater	RSL	PRG	DCC
Inside Buildings (Dust, Air, Fixed Contamination)	WTC*	BPRG	BDCC
Outside Buildings (Dust, Air, Fixed Contamination)		SPRG	SDCC
Vapor Intrusion (Air, Soil Gas, Groundwater	VISL	RVISL	RVISL

Notes: *The WTC item is a document available at: https://epa-visl.ornl.gov/radionuclides/copc_benchmark.pdf ; BPRG = building preliminary remediation goal; DCC = dose compliance concentrations; PRG = preliminary remediation goal; RSL = regional screening level; RVISL = radon vapor intrusion screening level; SDCC = dose compliance concentrations for radionuclides on outdoor surfaces; SPRG = preliminary remediation goals for radionuclides on outdoor surfaces; WTC = World Trade Center

Other EPA tools hosted on the RAIS include:

- The Office of Emergency Management Regional Removal Management Level (RML) Calculator (http://www.epa.gov/risk/regional-removal-management-levels-chemicals-rmls);
- The EPA's Health Effects Assessment Summary Table (HEAST) (https://epa-heast.ornl.gov/);
- A duplicate of the Provisional Peer-reviewed Toxicity Values (PPRTVs) (https://hhpprtv.ornl.gov/); and
- A radionuclide decay chain (https://epa-prgs.ornl.gov/cgi-bin/radionuclides/chain.pl) tool that can predict the state of a radionuclide decay chain at any time in the future using a novel Bateman equation solver.

5.2 ALASKA TOOLS

The RAIS Team produces two tools for the state of Alaska. The Cleanup Levels Calculator (https://csites.ornl.gov/cgi-bin/cl_search) is similar to the RAIS Chemical PRG calculator described in **Section 3.2**, with the following notable exceptions: three precipitation zones are available for soil media and chemicals can be selected based on categories (e.g., metals, VOCs, PFAS, etc.). The Cumulative Risk Calculator (https://csites.ornl.gov/cgi-bin/risk_search) is similar to the RAIS Chemical Risk calculator described in **Section 3.3**. This calculator also provides the three precipitation zones.

5.3 DELAWARE TOOLS

The RAIS Team produces the Delaware Risk Assessment Calculator (DERAC) (https://derac.ornl.gov/cgi-bin/derac_search) for the state of Delaware Department of Natural Resources and Environmental Control. The DERAC is similar to the RAIS Chemical Risk calculator described in **Section 3.3** with the addition of a trespasser land use scenario.

6. CONCLUSION

The overall objective of the RAIS is to be a single source for environmental risk assessment, with assistance and guidance for planning and completing all steps of the risk assessment process through a variety of tools, searchable databases that cover a wide range of sources, and detailed user guides. While originally developed for the DOE ORR, the tools can be tailored for site-specific needs to benefit a broader scope of national and international users.

The RAIS provides essential tools for performing basic risk assessment activities, such as calculating preliminary remediation goals, locating toxicity values and profiles, accessing Federal and State guidelines, calculating human health risk models, and locating ecological benchmarks. The RAIS also provides the latest EPA risk guidance and directs the user to specific EPA and State guidance necessary for performing risk assessment activities within the CERCLA process that benefit all risk information users.

Implementation of the RAIS and its associated guidance streamlines the risk assessment process, avoids costly duplication of effort, provides risk tools and information in a timely and efficient manner, and enables consistent and high-quality risk analyses.

7. REFERENCES

DOE, 1993a. Final Report on the Background Soil Characterization Project at the Oak Ridge Reservation, Oak Ridge, Tennessee, Volume 1 - Results of Field Sampling Program, October 1993, DOE/OR/01-1175/V1.

DOE, 1993b. Final Report on the Background Soil Characterization Project at the Oak Ridge Reservation, Oak Ridge, Tennessee, Volume 2 - Data, October 1993, DOE/OR/01-1175/V2.

DOE, 1993c. Final Report on the Background Soil Characterization Project at the Oak Ridge Reservation, Oak Ridge, Tennessee, Volume 3 - Project Plan, October 1993, DOE/OR/01-1175/V3.

DOE, 2003. Soil Background Supplemental Data Set for the East Tennessee Technology Park, Oak Ridge, Tennessee, September 2003, DOE/OR/01-2105&D1. https://rais.ornl.gov/documents/BKGRDStudyfinalcopy.pdf.

DOE, 2023. Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky. Volume 1. Human Health, DOE/LX/07-0107&D2/R14/V1. Portsmouth/Paducah Project Office, U.S. Department of Energy, Lexington, Kentucky. June. https://rais.ornl.gov/documents/DOE_Paducah-June-2023.pdf. .

DOE, 2015. Final Soil Background Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE/PPO/03-0667&D1). Portsmouth/Paducah Project Office, U.S. Department of Energy, Lexington, Kentucky. May. https://rais.ornl.gov/documents/Final_Soil_Background_Report_for_PORTS_DOE_PPPO_03_0667_D1.pdf.

EPA, 1988. Federal Guidance Report No. 11: Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, And Ingestion. EPA 520-1-88-020. Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C., September.

EPA, 1989. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual. (Part A) EPA/540/1-89/002. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., December.

EPA, 1991a. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) OSWER Directive 9285.7-01B. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., December.

EPA, 1991b. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part C, Risk Evaluation of Remedial Alternatives). OSWER Directive 9285.7-01C. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., December.

EPA, 1993. Federal Guidance Report No. 12: External Exposure to Radionuclides in Air, Water, and Soil. EPA 402-R-93-081. Office of Radiation and Indoor Air, U.S. Environmental Protection Agency, Washington, D.C., September.

EPA, 1999. Federal Guidance Report No. 13: Cancer Risk Coefficients for Environmental Exposure to Radionuclides. EPA 402-R-99-001. Office of Air and Radiation, U.S. Environmental Protection Agency, Washington, D.C., September.

EPA, 2001. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) (Final). Publication 9285.7-47. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., December.

EPA, 2003a. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. Office of Solid Waste and Emergency Response (OSWER) Directive 9285.7-54 [EPA-540-R-03-001]. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., December 1996 (January 2003). https://www.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals#recommend.

EPA, 2003b. Human health toxicity values in Superfund risk assessments. OSWER Directive 9285.7-53. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., December 5.

EPA, 2020a. Preliminary Remediation Goals for Radionuclides at Superfund Sites User's Guide. Last updated July 24, 2020. https://epa-prgs.ornl.gov/radionuclides/users_guide.html.

EPA, 2020b. PRG Frequently Asked Questions (FAQ). Last updated July 24, 2020. https://epa-prgs.ornl.gov/radionuclides/faq.html.

EPA, 2022. Calculating Preliminary Remediation Goals (PRGs). Last updated June 28, 2022. https://www.epa.gov/risk/calculating-preliminary-remediation-goals-prgs.

EPA, 2023. Regional Screening Levels (RSLs) - User's Guide. Last updated May 4, 2023. https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide.

ICRP, 2008. Nuclear Decay Data for Dosimetric Calculations. ICRP Publication 107. Ann. ICRP 38 (3). https://www.icrp.org/publication.asp?id=ICRP%20Publication%20107.

ORNL, 2014. Calculation of Slope Factors and Dose Coefficients. ORNL/TM-2013/00. Center for Radiation Protection Knowledge, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

APPENDIX A. TABLES OF VARIABLES USED IN CHEMICAL PRG EQUATIONS

APPENDIX A. TABLES OF VARIABLES USED IN CHEMICAL PRG EQUATIONS

Table A-1: Toxicity Values

Symbol	Definition (units)	Default	Reference
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
IUR	Chronic Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Contaminant-specific	EPA Superfund hierarchy

Table A-2. Miscellaneous Variables

Symbol	Definition (units)	Default	Reference
TR	Target risk (unitless)	1×10^{-6}	Determined in this calculator
THQ	Target hazard quotient (unitless)	1	Determined in this calculator
LT	Lifetime (years)	70	U.S. EPA 2014 (Attachment 1)
K	Andelman Volatilization Factor (L/m^3)	0.5	U.S. EPA 1991b (pg. 20)
K_p	Permeability constant (cm/hr)	Chemical-specific	
t*	Time to reach steady-state (hours)	Chemical-specific	U.S. EPA 2004 (Page 3-4)
τ_{event}	Lag time per event (hours/event)	Chemical-specific	U.S. EPA 2004 (Page 3-4)
B	Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (unitless)	Chemical-specific	U.S. EPA 2004 (Page 3-4)
FA	Fraction absorbed water (unitless)	Chemical-specific	U.S. EPA 2004 (Page 3-4)
ABS_d	Fraction of contaminant absorbed dermally from soil (unitless)	Chemical-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.	Chemical-specific	U.S. EPA 2004 (Exhibit 4-1)
H'	Dimensionless Henry's Law Constant	Contaminant-specific	Hierarchy selection in Section 2.4.2
$\Delta H_{v,b}$	Enthalpy of vaporization at the normal boiling point (cal/mol)	Contaminant-specific	Hierarchy selection in Section 2.4.2
$\Delta H_{v,gw}$	Enthalpy of vaporization at temperature of groundwater (cal/mol)	Contaminant-specific	Determined in this calculator
T_w	Groundwater Temperatures (Kelvin)	Site-specific	Site-specific

Table A-2. Miscellaneous Variables

Symbol	Definition (units)	Default	Reference
T_c	Critical Temperatures (Kelvin)	Contaminant-specific	Hierarchy selection in Section 2.4.2
T_b	Normal Boiling Point (Kelvin)	Contaminant-specific	Hierarchy selection in Section 2.4.2

n	If ($T_b/T_c < 0.57$)
	If ($T_b/T_c > 0.71$)
	If ($0.57 < T_b/T_c \leq 0.71$)
		n = 0.3
		n = 0.41
		n = (0.74 x T_b/T_c - 0.116)
			U.S. EPA VISL 2014

Table A-3. Resident Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{res\text{-}sol\text{-}ingnc}$	Resident Child Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}dernc}$	Resident Child Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}inhn}$	Resident Child Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}totnc}$	Resident Child Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}ingna}$	Resident Adult Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}derna}$	Resident Adult Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}inhna}$	Resident Adult Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}totna}$	Resident Adult Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}ingnadj}$	Resident Age-adjusted Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}dernadj}$	Resident Age-adjusted Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}inhnadj}$	Resident Age-adjusted Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}totnadj}$	Resident Age-adjusted Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator

Table A-3. Resident Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{res\text{-}sol\text{-}ingc}$	Resident Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}derc}$	Resident Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}inhc}$	Resident Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}totc}$	Resident Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}ingmu}$	Resident Soil Mutagenic Ingestion (mg/kg)	Mutagen-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}dermu}$	Resident Soil Mutagenic Dermal (mg/kg)	Mutagen-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}inhmu}$	Resident Soil Mutagenic Inhalation (mg/kg)	Mutagen-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}totmu}$	Resident Soil Mutagenic Total (mg/kg)	Mutagen-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}ingvc}$	Resident Soil Carcinogenic Vinyl Chloride Ingestion (mg/kg)	Vinyl Chloride -specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}dervc}$	Resident Soil Carcinogenic Vinyl Chloride Dermal (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}inhvc}$	Resident Soil Carcinogenic Vinyl Chloride Inhalation (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}totvc}$	Resident Soil Carcinogenic Vinyl Chloride Total (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}ingtce}$	Resident Soil Carcinogenic and Mutagenic Trichloroethylene Ingestion (mg/kg)	Trichloroethylene - specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}dertce}$	Resident Soil Carcinogenic Trichloroethylene Dermal (mg/kg)	Trichloroethylene - specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}inhtce}$	Resident Soil Carcinogenic Trichloroethylene Inhalation (mg/kg)	Trichloroethylene - specific	Determined in this calculator
$PRG_{res\text{-}sol\text{-}tottce}$	Resident Soil Carcinogenic Trichloroethylene Total	Trichloroethylene - specific	Determined in this calculator
$BW_{res\text{-}a}$	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{res\text{-}c}$	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{0\text{-}2}$	Body Weight - 0-2 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{2\text{-}6}$	Body Weight - 2-6 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{6\text{-}16}$	Body Weight - 6-16 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{16\text{-}26}$	Body Weight - 16-26 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{res}	Exposure Duration - adult + child (years)	26	U.S. EPA 2014 (Attachment 1)
$ED_{res\text{-}a}$	Exposure Duration - adult (years)	20	U.S. EPA 2014 (Attachment 1)
$ED_{res\text{-}c}$	Exposure Duration - child (years)	6	U.S. EPA 2014 (Attachment 1)
$ED_{0\text{-}2}$	Exposure Duration - 0-2 Years (years)	2	U.S. EPA 2014 (Attachment 1)
$ED_{2\text{-}6}$	Exposure Duration - 2-6 Years (years)	4	U.S. EPA 2014 (Attachment 1)
$ED_{6\text{-}16}$	Exposure Duration - 6-16 Years (years)	10	U.S. EPA 2014 (Attachment 1)
$ED_{16\text{-}26}$	Exposure Duration - 16-26 Years (years)	10	U.S. EPA 2014 (Attachment 1)
EF_{res}	Exposure Frequency - adult + child (days/year)	350	U.S. EPA 2014 (Attachment 1)

Table A-3. Resident Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$EF_{res\text{-}a}$	Exposure Frequency - adult (days/year)	350	U.S. EPA 2014 (Attachment 1)
$EF_{res\text{-}c}$	Exposure Frequency - child (days/year)	350	U.S. EPA 2014 (Attachment 1)
$EF_{0\text{-}2}$	Exposure Frequency - 0-2 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
$EF_{2\text{-}6}$	Exposure Frequency - 2-6 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
$EF_{6\text{-}16}$	Exposure Frequency - 6-16 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
$EF_{16\text{-}26}$	Exposure Frequency - 16-26 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
$ET_{res\text{-}a}$	Resident Exposure Time - adult (hours/day)	24	The whole day
$ET_{res\text{-}c}$	Resident Exposure Time - child (hours/day)	24	The whole day
ET_{res}	Resident Exposure Time (hours/day)	24	The whole day
$ET_{0\text{-}2}$	Exposure Time - age segment 0-2 (hours/day)	24	The whole day
$ET_{2\text{-}6}$	Exposure Time - age segment 2-6 (hours/day)	24	The whole day
$ET_{6\text{-}16}$	Exposure Time - age segment 6-16 (hours/day)	24	The whole day
$ET_{16\text{-}26}$	Exposure Time - age segment 16-26 (hours/day)	24	The whole day
$IRS_{res\text{-}c}$	Ingestion Rate - Child (mg/day)	200	U.S. EPA 2014 (Attachment 1)
$IRS_{res\text{-}a}$	Ingestion Rate - Adult (mg/day)	100	U.S. EPA 2014 (Attachment 1)
$IRS_{0\text{-}2}$	Ingestion Rate - 0-2 years (mg/day)	200	U.S. EPA 2014 (Attachment 1)
$IRS_{2\text{-}6}$	Ingestion Rate - 2-6 years (mg/day)	200	U.S. EPA 2014 (Attachment 1)
$IRS_{6\text{-}16}$	Ingestion Rate - 6-16 years (mg/day)	100	U.S. EPA 2014 (Attachment 1)
$IRS_{16\text{-}26}$	Ingestion Rate - 16-26 years (mg/day)	100	U.S. EPA 2014 (Attachment 1)
$IFS_{res\text{-}adj}$	Ingestion Rate - Age-adjusted (mg/kg)	36,750	Calculated using the age-adjusted intake factors equation
$IFSM_{res\text{-}adj}$	Mutagenic Ingestion Rate - Age-adjusted (mg/kg)	166,833	Calculated using the mutagenic age-adjusted intake factors equation
$AF_{res\text{-}c}$	Adherence factor-child (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
$AF_{res\text{-}a}$	Adherence factor-adult (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
$AF_{0\text{-}2}$	Adherence factor 0-2 years (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
$AF_{2\text{-}6}$	Adherence factor 2-6 years (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
$AF_{6\text{-}16}$	Adherence factor 6-16 years (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
$AF_{16\text{-}26}$	Adherence factor 16-26 years (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
$DFS_{res\text{-}adj}$	Dermal contact factor- age-adjusted (mg/kg)	103,390	Calculated using the age-adjusted intake factors equation
$DFSM_{res\text{-}adj}$	Mutagenic dermal contact factor- age-adjusted (mg/kg)	428,260	Calculated using the mutagenic age-adjusted intake factors equation
$SA_{res\text{-}c}$	Surface area - child (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
$SA_{res\text{-}a}$	Surface area - adult (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
$SA_{0\text{-}2}$	Surface area 0-2 years (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
$SA_{2\text{-}6}$	Surface area 2-6 years (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
$SA_{6\text{-}16}$	Surface area 6-16 years (cm^2)	6032	U.S. EPA 2014 (Attachment 1)

Table A-3. Resident Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
SA_{16-26}	Surface area 16-26 (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
AT_{res}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{res-c}	Averaging time – child (days/year)	365 x ED_{res-c}	U.S. EPA 2014 (Attachment 1)
AT_{res-a}	Averaging time - adult (days/year)	365 x ED_{res}	U.S. EPA 2014 (Attachment 1)

Table A-4. Composite Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{com-sol-ingn}$	Composite Worker Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{com-sol-dern}$	Composite Worker Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{com-sol-inhn}$	Composite Worker Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{com-sol-totn}$	Composite Worker Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{com-sol-ingc}$	Composite Worker Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{com-sol-derc}$	Composite Worker Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{com-sol-inhc}$	Composite Worker Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{com-sol-totc}$	Composite Worker Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
BW_{com}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{com}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{com}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{com}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{com}	Ingestion Rate (mg/day)	100	U.S. EPA 2014 (Attachment 1)
AF_{com}	Adherence factor (mg/cm^2)	0.12	U.S. EPA 2014 (Attachment 1)
SA_{com}	Surface area (cm^2)	3527	U.S. EPA 2014 (Attachment 1)
AT_{com}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{com-a}	Averaging time (days/year)	365 x ED_{com}	U.S. EPA 2014 (Attachment 1)

Table A-5. Outdoor Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{out\text{-}sol\text{-}ingn}$	Outdoor Worker Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{out\text{-}sol\text{-}dern}$	Outdoor Worker Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{out\text{-}sol\text{-}inhn}$	Outdoor Worker Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{out\text{-}sol\text{-}totn}$	Outdoor Worker Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{out\text{-}sol\text{-}ingc}$	Outdoor Worker Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{out\text{-}sol\text{-}derc}$	Outdoor Worker Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{out\text{-}sol\text{-}inhc}$	Outdoor Worker Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{out\text{-}sol\text{-}totc}$	Outdoor Worker Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
BW_{out}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{out}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{out}	Exposure Frequency (days/year)	225	U.S. EPA 2014 (Attachment 1)
ET_{out}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{out}	Ingestion Rate (mg/day)	100	U.S. EPA 2014 (Attachment 1)
AF_{out}	Adherence factor (mg/cm^2)	0.12	U.S. EPA 2014 (Attachment 1)
SA_{out}	Surface area (cm^2)	3527	U.S. EPA 2014 (Attachment 1)
AT_{out}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{out\text{-}a}$	Averaging time (days/year)	365 x ED_{out}	U.S. EPA 2014 (Attachment 1)

Table A-6. Indoor Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{ind\text{-}sol\text{-}ingn}$	Indoor Worker Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}sol\text{-}inhn}$	Indoor Worker Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}sol\text{-}totn}$	Indoor Worker Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}sol\text{-}ingc}$	Indoor Worker Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}sol\text{-}inhc}$	Indoor Worker Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}sol\text{-}totc}$	Indoor Worker Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
BW_{ind}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{ind}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{ind}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{ind}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{ind}	Soil Ingestion Rate (mg/day)	50	U.S. EPA 2014 (Attachment 1)
$AT_{ind\text{-}a}$	Averaging time (days/year)	365 x ED_{ind}	U.S. EPA 2014 (Attachment 1)
AT_{ind}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)

Table A-7. Construction Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{con\text{-}sol\text{-}ingn}$	Construction Worker Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{con\text{-}sol\text{-}dern}$	Construction Worker Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{con\text{-}sol\text{-}inhn}$	Construction Worker Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{con\text{-}sol\text{-}totn}$	Construction Worker Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{con\text{-}sol\text{-}ingc}$	Construction Worker Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{con\text{-}sol\text{-}derc}$	Construction Worker Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{con\text{-}sol\text{-}inhc}$	Construction Worker Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{con\text{-}sol\text{-}totc}$	Construction Worker Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
BW_{con}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{con}	Exposure Duration (years)	1	U.S. EPA 2014 (Attachment 1)
EW_{con}	Exposure (weeks/year)	50	Based on 50 weeks per year (reasonable work season)
DW_{con}	Exposure (days/week)	5	Based on 5 days per week for 50 weeks
EF_{con}	Exposure Frequency (days/year)	EW x DW	Based on 5 days per week for 50 weeks
ET_{con}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{con}	Ingestion Rate (mg/day)	330	U.S. EPA 2002 (Exhibit 1-2)
AF_{con}	Adherence factor (mg/cm^2)	0.3	U.S. EPA 2002 (Exhibit 1-2)
SA_{con}	Surface area (cm^2)	3527	U.S. EPA 2014 (Attachment 1)
AT_{con}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{con\text{-}a}$	Averaging time (days/year)	365 x ED_{con}	U.S. EPA 2014 (Attachment 1)

Table A-8. Excavation Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{exc\text{-}sol\text{-}ingn}$	Excavation Worker Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{exc\text{-}sol\text{-}dern}$	Excavation Worker Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{exc\text{-}sol\text{-}inhn}$	Excavation Worker Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{exc\text{-}sol\text{-}totn}$	Excavation Worker Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{exc\text{-}sol\text{-}ingc}$	Excavation Worker Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{exc\text{-}sol\text{-}derc}$	Excavation Worker Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{exc\text{-}sol\text{-}inhc}$	Excavation Worker Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{exc\text{-}sol\text{-}totc}$	Excavation Worker Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
BW_{exc}	Body Weight (kg)	80	U.S. EPA 2011, Table 8-1
ED_{exc}	Exposure Duration (years)	1	U.S. EPA 1991a (pg. 15)
EF_{exc}	Exposure Frequency (days/year)	20	Based on 5 days per week for 4 weeks
ET_{exc}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{exc}	Ingestion Rate (mg/day)	330	U.S. EPA 2002 (Exhibit 1-2)
AF_{exc}	Adherence factor (mg/cm^2)	0.3	U.S. EPA 2002 (Exhibit 1-2)
SA_{exc}	Surface area (cm^2)	3527	U.S. EPA 2014 (Attachment 1)
AT_{exc}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{exc\text{-}a}$	Averaging time (days/year)	365 x ED_{exc}	U.S. EPA 2014 (Attachment 1)

Table A-9. Recreator Soil/Sediment Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{rec\text{-}sol\text{-}ingnc}$	Recreator Child Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec\text{-}sol\text{-}dernc}$	Recreator Child Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec\text{-}sol\text{-}inhn}$	Recreator Child Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec\text{-}sol\text{-}totnc}$	Recreator Child Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator

Table A-9. Recreator Soil/Sediment Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{rec-sol-ingna}$	Recreator Adult Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-sol-derna}$	Recreator Adult Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-sol-inhna}$	Recreator Adult Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-sol-totna}$	Recreator Adult Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-sol-ingnadj}$	Recreator Age-adjusted Soil Noncarcinogenic Ingestion (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-sol-dernadj}$	Recreator Age-adjusted Soil Noncarcinogenic Dermal (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-sol-inhnadj}$	Recreator Age-adjusted Soil Noncarcinogenic Inhalation (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-sol-totnadj}$	Recreator Age-adjusted Soil Noncarcinogenic Total (mg/kg)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-sol-ingc}$	Recreator Soil Carcinogenic Ingestion (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{rec-sol-derc}$	Recreator Soil Carcinogenic Dermal (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{rec-sol-inhc}$	Recreator Soil Carcinogenic Inhalation (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{rec-sol-totc}$	Recreator Soil Carcinogenic Total (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{rec-sol-ingmu}$	Recreator Soil Mutagenic Ingestion (mg/kg)	Mutagen-specific	Determined in this calculator
$PRG_{rec-sol-dermu}$	Recreator Soil Mutagenic Dermal (mg/kg)	Mutagen-specific	Determined in this calculator
$PRG_{rec-sol-inhmu}$	Recreator Soil Mutagenic Inhalation (mg/kg)	Mutagen-specific	Determined in this calculator
$PRG_{rec-sol-totmu}$	Recreator Soil Mutagenic Total (mg/kg)	Mutagen-specific	Determined in this calculator
$PRG_{rec-sol-ingvc}$	Recreator Soil Carcinogenic Vinyl Chloride Ingestion (mg/kg)	Vinyl Chloride -specific	Determined in this calculator
$PRG_{rec-sol-dervc}$	Recreator Soil Carcinogenic Vinyl Chloride Dermal (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{rec-sol-inhvc}$	Recreator Soil Carcinogenic Vinyl Chloride Inhalation (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{rec-sol-totvc}$	Recreator Soil Carcinogenic Vinyl Chloride Total (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{rec-sol-ingtce}$	Recreator Soil Carcinogenic and Mutagenic Trichloroethylene Ingestion (mg/kg)	Trichloroethylene-specific	Determined in this calculator

Table A-9. Recreator Soil/Sediment Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{rec\text{-}sol\text{-}dertce}$	Recreator Soil Carcinogenic and Mutagenic Trichloroethylene Dermal (mg/kg)	Trichloroethylene-specific	Determined in this calculator
$PRG_{rec\text{-}sol\text{-}inhtce}$	Recreator Soil Carcinogenic and Mutagenic Trichloroethylene Inhalation (mg/kg)	Trichloroethylene-specific	Determined in this calculator
$PRG_{rec\text{-}sol\text{-}tottce}$	Recreator Soil Carcinogenic and Mutagenic Trichloroethylene Total (mg/kg)	Trichloroethylene-specific	Determined in this calculator
$BW_{rec\text{-}a}$	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{rec\text{-}c}$	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{0\text{-}2}$	Body Weight - 0-2 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{2\text{-}6}$	Body Weight - 2-6 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{6\text{-}16}$	Body Weight - 6-16 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{16\text{-}26}$	Body Weight - 16-26 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{rec}	Exposure Duration - adult + child (years)	26	U.S. EPA 2014 (Attachment 1)
$ED_{rec\text{-}a}$	Exposure Duration - adult (years)	20	U.S. EPA 2014 (Attachment 1)
$ED_{rec\text{-}c}$	Exposure Duration - child (years)	6	U.S. EPA 2014 (Attachment 1)
$ED_{0\text{-}2}$	Exposure Duration - 0-2 Years (years)	2	U.S. EPA 2014 (Attachment 1)
$ED_{2\text{-}6}$	Exposure Duration - 2-6 Years (years)	4	U.S. EPA 2014 (Attachment 1)
$ED_{6\text{-}16}$	Exposure Duration - 6-16 Years (years)	10	U.S. EPA 2014 (Attachment 1)
$ED_{16\text{-}26}$	Exposure Duration - 16-26 Years (years)	10	U.S. EPA 2014 (Attachment 1)
EF_{rec}	Exposure Frequency - adult + child (days/year)	75	Reasonable Estimate
$EF_{rec\text{-}a}$	Exposure Frequency - adult (days/year)	75	Reasonable Estimate
$EF_{rec\text{-}c}$	Exposure Frequency - child (days/year)	75	Reasonable Estimate
$EF_{0\text{-}2}$	Exposure Frequency - 0-2 Years (days/year)	75	Reasonable Estimate
$EF_{2\text{-}6}$	Exposure Frequency - 2-6 Years (days/year)	75	Reasonable Estimate
$EF_{6\text{-}16}$	Exposure Frequency - 6-16 Years (days/year)	75	Reasonable Estimate
$EF_{16\text{-}26}$	Exposure Frequency - 16-26 Years (days/year)	75	Reasonable Estimate
ET_{rec}	Exposure Time (hours/day)	1	Reasonable Estimate
$ET_{rec\text{-}c}$	Exposure time - child (hours/day)	1	Reasonable Estimate
$ET_{rec\text{-}a}$	Exposure time - adult (hours/day)	1	Reasonable Estimate

Table A-9. Recreator Soil/Sediment Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
ET_{0-2}	Exposure time 0-2 years (hours/day)	1	Reasonable Estimate
ET_{2-6}	Exposure time 2-6 years (hours/day)	1	Reasonable Estimate
ET_{6-16}	Exposure time 6-16 years (hours/day)	1	Reasonable Estimate
ET_{16-26}	Exposure time 16-26 years (hours/day)	1	Reasonable Estimate
IRS_{rec-c}	Ingestion Rate - Child (mg/day)	200	U.S. EPA 2014 (Attachment 1)
IRS_{rec-a}	Ingestion Rate - Adult (mg/day)	100	U.S. EPA 2014 (Attachment 1)
IRS_{0-2}	Ingestion Rate - 0-2 years (mg/day)	200	U.S. EPA 2014 (Attachment 1)
IRS_{2-6}	Ingestion Rate - 2-6 years (mg/day)	200	U.S. EPA 2014 (Attachment 1)
IRS_{6-16}	Ingestion Rate - 6-16 years (mg/day)	100	U.S. EPA 2014 (Attachment 1)
IRS_{16-26}	Ingestion Rate - 16-26 years (mg/day)	100	U.S. EPA 2014 (Attachment 1)
$IFS_{rec-adj}$	Ingestion Rate - Age-adjusted (mg/kg)	7,875	Calculated using the age-adjusted intake factors equation
$IFSM_{rec-adj}$	Mutagenic Ingestion Rate - Age-adjusted (mg/kg)	35,750	Calculated using the mutagenic age-adjusted intake factors equation
AF_{rec-c}	Adherence factor-child (mg/cm^2)	0.2	U.S. EPA 2002 (Exhibit 1-2)
AF_{rec-a}	Adherence factor-adult (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
AF_{0-2}	Adherence factor 0-2 years (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
AF_{2-6}	Adherence factor 2-6 years (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
AF_{6-16}	Adherence factor 6-16 years (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
AF_{16-26}	Adherence factor 16-26 years (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
$DFS_{rec-adj}$	Dermal contact factor- age-adjusted (mg/kg)	22,155	Calculated using the age-adjusted intake factors equation
$DFSM_{rec-adj}$	Mutagenic dermal contact factor-age-adjusted (mg/kg)	91,770	Calculated using the age-adjusted intake factors equation
SA_{rec-c}	Surface area - child (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
SA_{rec-a}	Surface area - adult (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
SA_{0-2}	Surface area 0-2 years (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
SA_{2-6}	Surface area 2-6 years (cm^2)	2373	U.S. EPA 2014 (Attachment 1)

Table A-9. Recreator Soil/Sediment Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
SA_{6-16}	Surface area 6-16 years (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
SA_{16-26}	Surface area 16-26 (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
AT_{rec}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{rec-c}	Averaging time - child (days/year)	365 x ED_{rec-c}	U.S. EPA 2014 (Attachment 1)
AT_{rec-a}	Averaging time - adult (days/year)	365 x ED_{rec-a}	U.S. EPA 2014 (Attachment 1)

Table A-10. Recreator Surface Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{rec-wat-ingnc}$	Recreator Child Surface Water Noncarcinogenic Ingestion (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-wat-dernc}$	Recreator Child Surface Water Noncarcinogenic Dermal (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-wat-totnc}$	Recreator Child Surface Water Noncarcinogenic Total (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-wat-ingna}$	Recreator Adult Surface Water Noncarcinogenic Ingestion (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-wat-derna}$	Recreator Adult Surface Water Noncarcinogenic Dermal (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-wat-totna}$	Recreator Adult Surface Water Noncarcinogenic Total (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-wat-ingnadj}$	Recreator Age-adjusted Surface Water Noncarcinogenic Ingestion (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-wat-dernadj}$	Recreator Age-adjusted Surface Water Noncarcinogenic Dermal (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-wat-totnadj}$	Recreator Age-adjusted Surface Water Noncarcinogenic Total (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{rec-wat-ingc}$	Recreator Surface Water Carcinogenic Ingestion (µg/L)	Contaminant-specific	Determined in this calculator
$PRG_{rec-wat-derc}$	Recreator Surface Water Carcinogenic Dermal (µg/L)	Contaminant-specific	Determined in this calculator
$PRG_{rec-wat-totc}$	Recreator Surface Water Carcinogenic Total (µg/L)	Contaminant-specific	Determined in this calculator

Table A-10. Recreator Surface Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{rec\text{-}wat\text{-}ingmu}$	Recreator Surface Water Mutagenic Ingestion (µg/L)	Mutagen-specific	Determined in this calculator
$PRG_{rec\text{-}wat\text{-}dermu}$	Recreator Surface Water Mutagenic Dermal (µg/L)	Mutagen-specific	Determined in this calculator
$PRG_{rec\text{-}wat\text{-}totmu}$	Recreator Surface Water Mutagenic Total (µg/L)	Mutagen-specific	Determined in this calculator
$PRG_{rec\text{-}wat\text{-}ingvc}$	Recreator Surface Water Carcinogenic Vinyl Chloride Ingestion (µg/L)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{rec\text{-}wat\text{-}dervc}$	Recreator Surface Water Carcinogenic Vinyl Chloride Dermal (µg/L)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{rec\text{-}wat\text{-}totvc}$	Recreator Surface Water Carcinogenic Vinyl Chloride Total (µg/L)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{rec\text{-}wat\text{-}ingtce}$	Recreator Surface Water Carcinogenic and Mutagenic Trichloroethylene Ingestion (µg/L)	Trichloroethylene-specific	Determined in this calculator
$PRG_{rec\text{-}wat\text{-}dertce}$	Recreator Surface Water Carcinogenic and Mutagenic Trichloroethylene Dermal (µg/L)	Trichloroethylene-specific	Determined in this calculator
$PRG_{rec\text{-}wat\text{-}tottce}$	Recreator Surface Water Carcinogenic and Mutagenic Trichloroethylene Total (µg/L)	Trichloroethylene-specific	Determined in this calculator
$BW_{rec\text{-}a}$	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{rec\text{-}c}$	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{0\text{-}2}$	Body Weight - 0-2 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{2\text{-}6}$	Body Weight - 2-6 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{6\text{-}16}$	Body Weight - 6-16 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{16\text{-}26}$	Body Weight - 16-26 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
$ED_{rec\text{-}a}$	Exposure Duration - adult (years)	20	U.S. EPA 2014 (Attachment 1)
$ED_{rec\text{-}c}$	Exposure Duration - child (years)	6	U.S. EPA 2014 (Attachment 1)
$ED_{0\text{-}2}$	Exposure Duration - 0-2 Years (years)	2	U.S. EPA 2014 (Attachment 1)
$ED_{2\text{-}6}$	Exposure Duration - 2-6 Years (years)	4	U.S. EPA 2014 (Attachment 1)
$ED_{6\text{-}16}$	Exposure Duration - 6-16 Years (years)	10	U.S. EPA 2014 (Attachment 1)
$ED_{16\text{-}26}$	Exposure Duration - 16-26 Years (years)	10	U.S. EPA 2014 (Attachment 1)
$EF_{rec\text{-}a}$	Exposure Frequency - adult (days/year)	45	Region 4 Bulletin
$EF_{rec\text{-}c}$	Exposure Frequency - child (days/year)	45	Region 4 Bulletin
$EF_{0\text{-}2}$	Exposure Frequency - 0-2 Years (days/year)	45	Region 4 Bulletin

Table A-10. Recreator Surface Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$EF_{2\text{-}6}$	Exposure Frequency - 2-6 Years (days/year)	45	Region 4 Bulletin
$EF_{6\text{-}16}$	Exposure Frequency - 6-16 Years (days/year)	45	Region 4 Bulletin
$EF_{16\text{-}26}$	Exposure Frequency - 16-26 Years (days/year)	45	Region 4 Bulletin
$ET_{event\text{-}rec\text{-}c}$	Exposure Time - child (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec\text{-}a}$	Exposure Time - adult (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec(0\text{-}2)}$	Exposure Time (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec(2\text{-}6)}$	Exposure Time (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec(6\text{-}16)}$	Exposure Time (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec(16\text{-}26)}$	Exposure Time (hours/event)	1	Reasonable Estimate
$EV_{rec\text{-}c}$	Events - child (events/day)	1	Reasonable Estimate
$EV_{rec\text{-}a}$	Events - adult (events/day)	1	Reasonable Estimate
$EV_{0\text{-}2}$	Events (events/day)	1	Reasonable Estimate
$EV_{2\text{-}6}$	Events (events/day)	1	Reasonable Estimate
$EV_{6\text{-}16}$	Events (events/day)	1	Reasonable Estimate
$EV_{16\text{-}26}$	Events (events/day)	1	Reasonable Estimate
$IRW_{rec\text{-}c}$	Ingestion Rate - Child (L/hour)	0.12	Table 3.5 in EFH 2011
$IRW_{rec\text{-}a}$	Ingestion Rate - Adult (L/hour)	0.11	Time weighted average was calculated based on the upper percentile from Table 3.7 of EFH 2019
$IRW_{0\text{-}2}$	Ingestion Rate - 0-2 years (L/hour)	0.12	Table 3.5 in EFH 2011
$IRW_{2\text{-}6}$	Ingestion Rate - 2-6 years (L/hour)	0.12	Table 3.5 in EFH 2011
$IRW_{6\text{-}16}$	Ingestion Rate - 6-16 years (L/hour)	0.124	Time weighted average was calculated based on the upper percentile from Table 3.7 of EFH 2019
$IRW_{16\text{-}26}$	Ingestion Rate - 16-26 years (L/hour)	0.0985	Time weighted average was calculated based on the upper percentile from Table 3.7 of EFH 2019
$IFW_{rec\text{-}adj}$	Ingestion Rate - Age-adjusted (L/kg)	3.4	Calculated using the age-adjusted intake factors equation
$IFWM_{rec\text{-}adj}$	Mutagenic Ingestion Rate - Age-adjusted (L/kg)	14	Calculated using the mutagenic age-adjusted intake factors equation
$SA_{rec\text{-}c}$	Surface area - child (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{rec\text{-}a}$	Surface area - adult (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)

Table A-10. Recreator Surface Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$SA_{0\text{-}2}$	Surface area 0-2 years (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{2\text{-}6}$	Surface area 2-6 years (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{6\text{-}16}$	Surface area 6-16 years (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$SA_{16\text{-}26}$	Surface area 16-26 (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$DFW_{rec\text{-}adj}$	Dermal contact factor- age-adjusted (cm^2-event/kg)	335,655	Calculated using the age-adjusted intake factors equation
$DFWM_{rec\text{-}adj}$	Mutagenic dermal contact factor-age-adjusted (cm^2event/kg)	1,053,210	Calculated using the mutagenic age-adjusted intake factors equation
$AT_{rec\text{-}c}$	Averaging time (days/year)	365 x $ED_{rec\text{-}c}$	U.S. EPA 2014 (Attachment 1)
$AT_{rec\text{-}a}$	Averaging time (days/year)	365 x $ED_{rec\text{-}a}$	U.S. EPA 2014 (Attachment 1)

Table A-11. Resident Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{res\text{-}wat\text{-}ingnc}$	Resident Child Tap Water (Groundwater) Noncarcinogenic Ingestion (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}dernc}$	Resident Child Tap Water (Groundwater) Noncarcinogenic Dermal (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}inhn}$	Resident Child Tap Water (Groundwater) Noncarcinogenic Inhalation (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}totnc}$	Resident Child Tap Water (Groundwater) Noncarcinogenic Total (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}ingna}$	Resident Adult Tap Water (Groundwater) Noncarcinogenic Ingestion (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}derna}$	Resident Adult Tap Water (Groundwater) Noncarcinogenic Dermal (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}inhna}$	Resident Adult Tap Water (Groundwater) Noncarcinogenic Inhalation (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}totna}$	Resident Adult Tap Water (Groundwater) Noncarcinogenic Total (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}ingnadj}$	Resident Age-adjusted Tap Water (Groundwater) Noncarcinogenic Ingestion (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}dernadj}$	Resident Age-adjusted Tap Water (Groundwater) Noncarcinogenic Dermal (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}inhnadj}$	Resident Age-adjusted Tap Water (Groundwater) Noncarcinogenic Inhalation (µg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator

Table A-11. Resident Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{res\text{-}wat\text{-}totnadj}$	Resident Age-adjusted Tap Water (Groundwater) Noncarcinogenic Total (μg/L)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}ingc}$	Recreator Tap Water (Groundwater) Carcinogenic Ingestion (μg/L)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}derc}$	Resident Tap Water (Groundwater) Carcinogenic Dermal (μg/L)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}inhc}$	Resident Tap Water (Groundwater) Carcinogenic Inhalation (μg/L)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}totc}$	Resident Tap Water (Groundwater) Carcinogenic Total (μg/L)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}ingmu}$	Resident Tap Water (Groundwater) Mutagenic Ingestion (μg/L)	Mutagen-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}dermu}$	Resident Tap Water (Groundwater) Mutagenic Dermal (μg/L)	Mutagen-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}inhmu}$	Resident Tap Water (Groundwater) Mutagenic Inhalation (μg/L)	Mutagen-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}totmu}$	Resident Tap Water (Groundwater) Mutagenic Total (μg/L)	Mutagen-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}ingvc}$	Resident Tap Water (Groundwater) Carcinogenic Vinyl Chloride Ingestion (μg/L)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}dervc}$	Resident Tap Water (Groundwater) Carcinogenic Vinyl Chloride Dermal (μg/L)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}inhvc}$	Resident Tap Water (Groundwater) Carcinogenic Vinyl Chloride Inhalation (μg/L)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}totvc}$	Resident Tap Water (Groundwater) Carcinogenic Vinyl Chloride Total (μg/L)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}ingtce}$	Resident Tap Water (Groundwater) Carcinogenic and Mutagenic Trichloroethylene Ingestion (μg/L)	Trichloroethylene-specific	Determined in this calculator
$PRG_{res\text{-}wat\text{-}dertce}$	Resident Tap Water (Groundwater) Carcinogenic and Mutagenic Trichloroethylene Dermal (μg/L)	Trichloroethylene-specific	Determined in this calculator
$BW_{res\text{-}a}$	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{res\text{-}c}$	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{0\text{-}2}$	Body Weight - 0-2 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{2\text{-}6}$	Body Weight - 2-6 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{6\text{-}16}$	Body Weight - 6-16 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{16\text{-}26}$	Body Weight - 16-26 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{res}	Exposure Duration - adult + child (years)	26	U.S. EPA 2014 (Attachment 1)

Table A-11. Resident Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
ED_{res-a}	Exposure Duration - adult (years)	20	U.S. EPA 2014 (Attachment 1)
ED_{res-c}	Exposure Duration - child (years)	6	U.S. EPA 2014 (Attachment 1)
ED_{0-2}	Exposure Duration - 0-2 Years (years)	2	U.S. EPA 2014 (Attachment 1)
ED_{2-6}	Exposure Duration - 2-6 Years (years)	4	U.S. EPA 2014 (Attachment 1)
ED_{6-16}	Exposure Duration - 6-16 Years (years)	10	U.S. EPA 2014 (Attachment 1)
ED_{16-26}	Exposure Duration - 16-26 Years (years)	10	U.S. EPA 2014 (Attachment 1)
EF_{res}	Exposure Frequency - adult + child (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{res-a}	Exposure Frequency - adult (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{res-c}	Exposure Frequency - child (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{0-2}	Exposure Frequency - 0-2 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{2-6}	Exposure Frequency - 2-6 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{6-16}	Exposure Frequency - 6-16 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{16-26}	Exposure Frequency - 16-26 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
ET_{res}	Exposure Time (hours/day)	24	The whole day
$ET_{event-res-c}$	Exposure Time - child (hours/event)	0.54	U.S. EPA 2014 (Attachment 1)
$ET_{event-res-a}$	Exposure Time - adult (hours/event)	0.71	U.S. EPA 2014 (Attachment 1)
$ET_{event-res\ (0-2)}$	Exposure Time (hours/event)	0.54	U.S. EPA 2014 (Attachment 1)
$ET_{event-res\ (2-6)}$	Exposure Time (hours/event)	0.54	U.S. EPA 2014 (Attachment 1)
$ET_{event-res\ (6-16)}$	Exposure Time (hours/event)	0.71	U.S. EPA 2014 (Attachment 1)
$ET_{event-res\ (16-26)}$	Exposure Time (hours/event)	0.71	U.S. EPA 2014 (Attachment 1)
EV_{res-c}	Events - child (events/day)	1	U.S. EPA 2004 Exhibit 3-2
EV_{res-a}	Events - adult (events/day)	1	U.S. EPA 2004 Exhibit 3-2
EV_{0-2}	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2
EV_{2-6}	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2
EV_{6-16}	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2

Table A-11. Resident Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$EV_{16\text{-}26}$	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2
$IRW_{res\text{-}c}$	Ingestion Rate - Child (L/day)	0.78	U.S. EPA 2014 (Attachment 1)
$IRW_{res\text{-}a}$	Ingestion Rate - Adult (L/day)	2.5	U.S. EPA 2014 (Attachment 1)
$IRW_{0\text{-}2}$	Ingestion Rate - 0-2 years (L/day)	0.78	U.S. EPA 2014 (Attachment 1)
$IRW_{2\text{-}6}$	Ingestion Rate - 2-6 years (L/day)	0.78	U.S. EPA 2014 (Attachment 1)
$IRW_{6\text{-}16}$	Ingestion Rate - 6-16 years (L/day)	2.5	U.S. EPA 2014 (Attachment 1)
$IRW_{16\text{-}26}$	Ingestion Rate - 16-26 years (L/day)	2.5	U.S. EPA 2014 (Attachment 1)
$IFW_{res\text{-}adj}$	Ingestion Rate - Age-adjusted (L/kg)	327.95	Calculated using the age-adjusted intake factors equation
$IFWM_{res\text{-}adj}$	Mutagenic Ingestion Rate - Age-adjusted (L/kg)	1019.9	Calculated using the mutagenic age-adjusted intake factors equation
$SA_{res\text{-}c}$	Surface area - child (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{res\text{-}a}$	Surface area - adult (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$SA_{0\text{-}2}$	Surface area 0-2 years (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{2\text{-}6}$	Surface area 2-6 years (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{6\text{-}16}$	Surface area 6-16 years (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$SA_{16\text{-}26}$	Surface area 16-26 (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$DFW_{res\text{-}adj}$	Dermal contact factor- age-adjusted (L/kg)	2,610,650	Calculated using the age-adjusted intake factors equation
$DFWM_{res\text{-}adj}$	Mutagenic dermal contact factor- age-adjusted (L/kg)	8,191,633	Calculated using the mutagenic age-adjusted intake factors equation
AT_{res}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{res\text{-}c}$	Averaging time (days/year)	365 x $ED_{res\text{-}c}$	U.S. EPA 2014 (Attachment 1)
$AT_{res\text{-}a}$	Averaging time (days/year)	365 x $ED_{res\text{-}a}$	U.S. EPA 2014 (Attachment 1)

Table A-12. Indoor Worker Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{ind\text{-}wat\text{-}ingn}$	Indoor Worker Tap Water Air Noncarcinogenic Ingestion ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}wat\text{-}dern}$	Indoor Worker Tap Water Noncarcinogenic Dermal ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}wat\text{-}inhn}$	Indoor Worker Tap Water Noncarcinogenic Inhalation ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}wat\text{-}totn}$	Indoor Worker Tap Water Noncarcinogenic Total ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}wat\text{-}ingc}$	Indoor Worker Tap Water Air Carcinogenic Ingestion ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}wat\text{-}derc}$	Indoor Worker Tap Water Carcinogenic Dermal ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}wat\text{-}inhc}$	Indoor Worker Tap Water Carcinogenic Inhalation ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}wat\text{-}totc}$	Indoor Worker Tap Water Carcinogenic Total ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
BW_{ind}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{ind}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{ind}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{ind}	Exposure Time (hours/event)	8	U.S. EPA 2014 (Attachment 1)
$ET_{event\text{-}iw}$	Exposure Time Shower (hours/event)	0.71	U.S. EPA 2014 (Attachment 1)
EV_{ind}	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2
IRW_{ind}	Ingestion Rate (L/day)	1.25	U.S. EPA 2014 (FAQ 13)
SA_{ind}	Surface area (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
AT_{ind}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{ind\text{-}a}$	Averaging time (days/year)	365 x ED_{ind}	U.S. EPA 2014 (Attachment 1)

Table A-13. Resident Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{res\text{-}air\text{-}inhn}$	Resident Air Noncarcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}air\text{-}inhc}$	Resident Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}air\text{-}inhmu}$	Resident Air Mutagenic ($\mu g/m^3$)	Mutagen-specific	Determined in this calculator
$PRG_{res\text{-}air\text{-}inhvc}$	Resident Air Carcinogenic Vinyl Chloride ($\mu g/m^3$)	Vinyl Chloride-specific	Determined in this calculator
$PRG_{res\text{-}air\text{-}inhtce}$	Resident Air Carcinogenic and Mutagenic Trichloroethylene ($\mu g/m^3$)	Trichloroethylene-specific	Determined in this calculator
ED_{res}	Exposure Duration (years)	26	U.S. EPA 2014 (Attachment 1)
$ED_{0\text{-}2}$	Exposure Duration 0-2 years (years)	2	U.S. EPA 2014 (Attachment 1)
$ED_{2\text{-}6}$	Exposure Duration 2-6 years (years)	4	U.S. EPA 2014 (Attachment 1)
$ED_{6\text{-}16}$	Exposure Duration 6-16 years (years)	10	U.S. EPA 2014 (Attachment 1)
$ED_{16\text{-}26}$	Exposure Duration 16-26 years (years)	10	U.S. EPA 2014 (Attachment 1)
EF_{res}	Exposure Frequency (days/year)	350	U.S. EPA 2014 (Attachment 1)
ET_{res}	Exposure Time (hours/day)	24	The whole day
AT_{res}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{res\text{-}a}$	Averaging time (days/year)	365 x ED_{res}	U.S. EPA 2014 (Attachment 1)

Table A-14. Composite Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{com-air-inhn}$	Composite Worker Air Noncarcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{com-air-inhc}$	Composite Worker Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
ED_{com}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{com}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{com}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{com}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{com-a}	Averaging time (days/year)	365 x ED_{com}	U.S. EPA 2014 (Attachment 1)

Table A-15. Outdoor Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{out-air-inhn}$	Outdoor Worker Air Noncarcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{out-air-inhc}$	Outdoor Worker Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
ED_{out}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{out}	Exposure Frequency (days/year)	225	U.S. EPA 2014 (Attachment 1)
ET_{out}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{out}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{out-a}	Averaging time (days/year)	365 x ED_{out}	U.S. EPA 2014 (Attachment 1)

Table A-16. Indoor Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{ind\text{-}air\text{-}inhn}$	Indoor Worker Air Noncarcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{ind\text{-}air\text{-}inhc}$	Indoor Worker Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
ED_{ind}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{ind}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{ind}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{ind}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{ind\text{-}a}$	Averaging time (days/year)	365 x ED_{ind}	U.S. EPA 2014 (Attachment 1)

Table A-17. Construction Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{con\text{-}air\text{-}inhn}$	Construction Worker Air Noncarcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$PRG_{con\text{-}air\text{-}inhc}$	Construction Worker Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
ED_{con}	Exposure Duration (years)	1	U.S. EPA 2014 (Attachment 1)
EW_{con}	Exposure (weeks/year)	50	Based on 50 weeks per year (reasonable work season)
DW_{con}	Exposure (days/week)	5	Based on 5 days per week for 50 weeks
EF_{con}	Exposure Frequency (days/year)	EW x DW	Based on 5 days per week for 50 weeks
ET_{con}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{con}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{con\text{-}a}$	Averaging time (days/year)	365 x ED_{con}	U.S. EPA 2014 (Attachment 1)

Table A-18. Excavation Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{exc\text{-}air\text{-}inhn}$	Excavation Worker Air Noncarcinogenic (μg/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{exc\text{-}air\text{-}inhc}$	Excavation Worker Air Carcinogenic (μg/m^3)	Contaminant-specific	Determined in this calculator
ED_{exc}	Exposure Duration (years)	1	U.S. EPA 2014 (Attachment 1)
EF_{exc}	Exposure Frequency (days/year)	20	Based on 5 days per week for 4 weeks
ET_{exc}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{exc}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{exc\text{-}a}$	Averaging time (days/year)	365 x ED_{exc}	U.S. EPA 2014 (Attachment 1)

Table A-19. Resident Fish Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{res\text{-}fsh\text{-}ingn}$	Resident Fish Noncarcinogenic (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}fsh\text{-}ingc}$	Resident Fish Carcinogenic (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}fshw\text{-}ingn}$	Resident Surface Water Fish Noncarcinogenic (mg/kg)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}fshw\text{-}ingc}$	Resident Surface Water Fish Carcinogenic (mg/kg)	Contaminant-specific	Determined in this calculator
$BW_{res\text{-}a}$	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{res}	Exposure Duration (years)	26	U.S. EPA 2014 (Attachment 1)
EF_{res}	Exposure Frequency (days/year)	350	U.S. EPA 2014 (Attachment 1)
$IRF_{res\text{-}a}$	Fish Ingestion Rate (g/day)	54	U.S. EPA 2014 (Attachment 1)
AT_{res}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{res\text{-}a}$	Averaging time (days/year)	365 x ED_{res}	U.S. EPA 2014 (Attachment 1)

Table A-20. Farmer Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{far\text{-}prod\text{-}ingn}$	Farmer Produce Noncarcinogenic Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}prod\text{-}ingc}$	Farmer Produce Carcinogenic Ingestion	Contaminant-specific	Determined in this calculator

Table A-20. Farmer Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{far\text{-}wat\text{-}ingpn}$	Farmer Produce Noncarcinogenic Back-calculated Concentration in Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}wat\text{-}ingpc}$	Farmer Produce Carcinogenic Back-calculated Concentration in Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sol\text{-}ingpn}$	Farmer Produce Noncarcinogenic Back-calculated Concentration in Soil Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sol\text{-}ingpc}$	Farmer Produce Carcinogenic Back-calculated Concentration in Soil Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sw\text{-}ingpn}$	Farmer Produce Noncarcinogenic Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sw\text{-}ingpc}$	Farmer Produce Carcinogenic Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}dairy\text{-}ingn}$	Farmer Dairy Noncarcinogenic Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}dairy\text{-}ingc}$	Farmer Dairy Carcinogenic Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}wat\text{-}ingdn}$	Farmer Dairy Noncarcinogenic Back-calculated Concentration in Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}wat\text{-}ingdc}$	Farmer Dairy Carcinogenic Back-calculated Concentration in Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sol\text{-}ingdn}$	Farmer Dairy Noncarcinogenic Back-calculated Concentration in Soil Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sol\text{-}ingdc}$	Farmer Dairy Carcinogenic Back-calculated Concentration in Soil Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sw\text{-}ingdn}$	Farmer Dairy Noncarcinogenic Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sw\text{-}ingdc}$	Farmer Dairy Carcinogenic Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}beef\text{-}ingn}$	Farmer Beef Noncarcinogenic Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}beef\text{-}ingc}$	Farmer Beef Carcinogenic Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}wat\text{-}ingbn}$	Farmer Beef Noncarcinogenic Back-calculated Concentration in Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}wat\text{-}ingbc}$	Farmer Beef Carcinogenic Back-calculated Concentration in Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sol\text{-}ingbn}$	Farmer Beef Noncarcinogenic Back-calculated Concentration in Soil Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sol\text{-}ingbc}$	Farmer Beef Carcinogenic Back-calculated Concentration in Soil Ingestion	Contaminant-specific	Determined in this calculator

Table A-20. Farmer Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$PRG_{far\text{-}sw\text{-}ingbn}$	Farmer Beef Noncarcinogenic Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}sw\text{-}ingbc}$	Farmer Beef Carcinogenic Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$BW_{far\text{-}a}$	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{far\text{-}c}$	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
ED_{far}	Exposure Duration - adult (years)	40	U.S. EPA 1991a (pg. 15)
$ED_{far\text{-}c}$	Exposure Duration - adult (years)	6	U.S. EPA 1991a (pg. 15)
$ED_{far\text{-}a}$	Exposure Duration - adult (years)	34	U.S. EPA 1991a (pg. 15)
EF_{far}	Exposure Frequency (days/year)	350	U.S. EPA 2014 (Attachment 1)
AT_{far}	Averaging Time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{far\text{-}c}$	Averaging Time (days/year)	365 x $ED_{far\text{-}c}$	U.S. EPA 2014 (Attachment 1)
$IRF_{far\text{-}c}$	Fruit Ingestion Rate - Child (mg/day)	68.1×103	U.S. EPA 1997a (Table 13-61). U.S. EPA 1998 (Table C-1-2)
$IRF_{far\text{-}a}$	Fruit Ingestion Rate - Adult (mg/day)	176.8×103	U.S. EPA 1997a (Table 13-61). U.S. EPA 1998 (Table C-1-2)
$IFF_{far\text{-}adj}$	Fruit Ingestion Fraction - Age-adjusted (mg-year/kg-day)	35,833,000	Calculated using the age adjusted intake factors equation
$IRV_{far\text{-}c}$	Produce Ingestion Rate - Vegetables - Child (mg/day)	41.7×103	U.S. EPA 1997a (Table 13-61). U.S. EPA 1998 (Table C-1-2)
$IRV_{far\text{-}a}$	Produce Ingestion Rate - Vegetables - Adult (mg/day)	125.7×103	U.S. EPA 1997a (Table 13-61). U.S. EPA 1998 (Table C-1-2)
$IFV_{far\text{-}adj}$	Produce Ingestion Fraction - Vegetables - Age-adjusted (mg-year/kg-day)	24,535,875	Calculated using the age adjusted intake factors equation
$IRD_{far\text{-}c}$	Dairy Ingestion Rate - Child (mg/day)	349.5×103	U.S. EPA 1997a (Table 13-28). U.S. EPA 1998 (Table C-1-3)
$IRD_{far\text{-}a}$	Dairy Ingestion Rate - Adult (mg/day)	445.6×103	U.S. EPA 1997a (Table 13-28). U.S. EPA 1998 (Table C-1-3)

Table A-20. Farmer Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$IFD_{far-adj}$	Dairy Ingestion Fraction - Age-adjusted (mg-year/kg-day)	115,213,000	Calculated using the age adjusted intake factors equation
IRB_{far-c}	Beef Ingestion Rate - Child (mg/day)	40.1×103	U.S. EPA 1997a (Table 13-28). U.S. EPA 1998 (Table C-1-3)
IRB_{far-a}	Beef Ingestion Rate - Adult (mg/day)	178×103	U.S. EPA 1997a (Table 13-28). U.S. EPA 1998 (Table C-1-3)
$IFB_{far-adj}$	Beef Ingestion Fraction - Age-adjusted (mg-year/kg-day)	32,091,500	Calculated using the age adjusted intake factors equation
Irr_{rup}	Root uptake from irrigation multiplier (L/kg)	Contaminant-specific	Calculated
Irr_{res}	Resuspension from irrigation multiplier (L/kg)	Contaminant-specific	Calculated
Irr_{dep}	Aerial deposition from irrigation multiplier (L/kg)	Contaminant-specific	Calculated
R_{upp}	Dry root uptake for pasture multiplier (unitless)	$=BV_{dry}$	
R_{upv}	Wet root uptake for vegetables multiplier (unitless)	$=BV_{wet}$	
Q_{p-beef}	Beef Fodder Intake Rate (kg/day)	11.77	U.S. EPA 2005 (pg. B-138)
$Q_{p-dairy}$	Dairy Fodder Intake Rate (kg/day)	20.3	U.S. EPA 2005 (pg. B-145)
$Q_{w-dairy}$	Dairy Water Intake Rate (kg/day)	92	U.S. EPA 1999a (pg. 10-23). U.S. EPA 1997b.
Q_{w-beef}	Beef Water Intake Rate (kg/day)	53	U.S. EPA 1999a (pg. 10-23). U.S. EPA 1997b.
$Q_{s-dairy}$	Dairy Soil Intake Rate (kg/day)	0.4	U.S. EPA 2005 (pg. B-146)
Q_{s-beef}	Beef Soil Intake Rate (kg/day)	0.5	U.S. EPA 2005 (pg. B-139)
f_{p-beef}	Fraction of Time Animal is On-Site (unitless)	1	Maximum value used (100%)
$f_{p-dairy}$	Fraction of Time Animal is On-Site (unitless)	1	Maximum value used (100%)
f_{s-beef}	Fraction of Animal's Food from Site when On-Site (unitless)	1	Maximum value used (100%)
$f_{s-dairy}$	Fraction of Animal's Food from Site when On-Site (unitless)	1	Maximum value used (100%)
TF_{dairy}	Dairy Transfer Factor (day/kg)	Contaminant-specific	Hierarchy selection in Section 2.4.2
TF_{beef}	Beef Transfer Factor (day/kg)	Contaminant-specific	Hierarchy selection in Section 2.4.2
BCF	Fish Bioconcentration Factor (L/kg)	Contaminant-specific	Hierarchy selection in Section 2.4.2

Table A-20. Farmer Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CF_{far\text{-}produce}$	Fraction of Produce Consumed that is Contaminated	1	U.S. EPA 1998
$CF_{far\text{-}dairy}$	Fraction of Dairy Consumed that is Contaminated	1	U.S. EPA 1998
$CF_{far\text{-}beef}$	Fraction of Beef Consumed that is Contaminated	1	U.S. EPA 1998
I_r	Irrigation rate (L/m^2-day)	3.62	Personal communication with agricultural extension agent
F	Irrigation period (unitless)	0.25 (based on 3 months per year)	Personal communication with agricultural extension agent
λ_B	Effective rate for removal (1/day)	$\lambda_i + \lambda_{HL}$	NCRP 1996
λ_E	Decay for removal on produce (1/day)	$\lambda_i + (0.693/t_w)$	NCRP 1996
λ_{HL}	Soil leaching rate (1/day)	0.000027	NCRP 1996
λ_i	Decay (1/day)	$0.693/T_R$- radionuclides, 0 - non-radionuclides	NCRP 1996
t_w	Weathering half -life (day)	14	NCRP 1996
T_R	Half-life (days)	Contaminant-specific	
$MLF_{pasture}$	Pasture plant mass loading factor (unitless)	0.25	Hinton, T. G. 1992
$MLF_{produce}$	Produce plant mass loading factor (unitless)	0.26 x 0.052 = 0.0135	Hinton, 1992. U.S. EPA SSG 1996 table G-1. Dry weight to wet weight conversion equation from section 4.10.9
t_b	Long term deposition and buildup (day)	10,950	NCRP 1996
t_v	Above ground exposure time (day)	60	NCRP 1996
I_f	Interception fraction (unitless)	0.42	Miller, C. W. 1980
Y_v	Plant yield (wet) (kg/m^2)	2	NCRP 1996
P	Area density for root zone (kg/m^2)	240	Hoffman, F. O., R. H. Gardner, and K. F. Eckerman. 1982; Peterson, H. T., Jr. 1983; McKone, T. E. 1994
T	Translocation factor (unitless)	1	NCRP 1996
R_{es}	Soil resuspension multiplier)	= MLF (produce or pasture)	Hinton, T.G. 1992

Table A-21. Soil to Groundwater SSL Factor Variables

Symbol	Definition (units)	Default	Reference
C_w	Target soil leachate concentration (pCi/L)	Nonzero MCL or RSL × DAF	U.S. EPA. 2002 Equation 4-14
DAF	Dilution attenuation factor (unitless)	20 (or site-specific)	U.S. EPA. 2002 Equation 4-11
ED_{gw}	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
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.3	U.S. EPA. 2002 Equation 4-10
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	$= n- \theta_w$	U.S. EPA. 2002 Equation 4-10
n	Total soil porosity (L_{pore}/L_{soil})	$= 1-(\rho_b/\rho_s)$	U.S. EPA. 2002 Equation 4-10
ρ_s	Soil particle density (kg/L)	2.65	U.S. EPA. 2002 Equation 4-10
ρ_b	Dry soil bulk density (kg/L)	1.5	U.S. EPA. 2002 Equation 4-10
K_d	Soil-water partition coefficient (L/kg)	$= K_{oc}*f_{oc}$ for organics	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

Table A-22. Wind Particulate Emission Factor Equation Variables

Symbol	Definition (units)	Default	Reference
PEF_{wind}	Particulate Emission Factor - Minneapolis (m^3/kg)	1.36 × 109(region-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 (pg. D-2)
A_s	Areal extent of the site or contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA 2002 (pg. D-2)
B	Dispersion constant unitless	PEF and region-specific	U.S. EPA 2002 (pg. D-2)
C	Dispersion constant unitless	PEF and region-specific	U.S. EPA 2002 (pg. D-2)

Table A-23. Mechanical Particulate Emission Factor Variables from Vehicle Traffic

Symbol	Definition (units)	Default	Reference
PEF_{sc}	Particulate Emission Factor - subchronic (m^3/kg)	Contaminant-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)	7,200,000	U.S. EPA 2002 Equation 5-5
A_R	Surface area of contaminated road segment (m^2)	$A_R = L_R$ x W_R x 0.092903 m^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 Equation 5-5
∑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
t_c	Total time over which construction occurs (hrs)	8400	U.S. EPA. 2002 Equation 5-5

Table A-24. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
PEF'_{sc}	Particulate Emission Factor - subchronic (m^3/kg)	Contaminant-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	Site-specific	U.S. EPA 2002 Equation E-15

Table A-24. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
	square emission source (g/m^2-s per kg/m^3)		
F_D	Dispersion correction factor (unitless)	0.185	U.S. EPA 2002 Equation 5-5
T	Total time over which construction occurs (s)	7,200,000	U.S. EPA 2002 Equation 5-5
A_c	Areal extent of site surface soil contamination (acres)	(range 0.5 to 500)	U.S. EPA. 2002 Equation E-15
J'_T	Total time-averaged PM10 unit emission flux for construction activities other than traffic on unpaved roads (g/m^2-s)	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	PM10 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
$M_{m\text{-}excav}$	Gravimetric soil moisture content (%)	12 (mean value for municipal landfill cover)	U.S. EPA 2002 Equation E-21
ρ_{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_{excav}	Average depth of excavation (m)	Site-specific	U.S. EPA 2002 Equation E-21
$N_{A\text{-}dump}$	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	PM10 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

Table A-24. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
$M_{m\text{-}doz}$	Gravimetric soil moisture content (%)	7.9 (mean value for overburden)	U.S. EPA 2002 Equation E-22
$\sum VKT_{doz}$	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	PM10 scaling factor (unitless)	0.60	U.S. EPA 2002 Equation E-23
$\sum VKT_{grade}$	Sum of grading kilometers traveled (km)	Site-specific	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 $\sum VKT_{grade}$ in U.S. EPA 2002 Equation E-23
$A_{c\text{-}doz}$	Areal extent of dozing (acres)	Site-specific	Necessary to solve $\sum VKT_{doz}$ 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
A	Dispersion constant unitless	2.4538	U.S. EPA 2002 Equation E-15
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	17.5660	U.S. EPA 2002 Equation E-15
C	Dispersion constant unitless	189.0426	U.S. EPA 2002 Equation E-15
t_c	Total time over which construction occurs (hrs)	8400	U.S. EPA. 2002 Equation 5-5

Table A-25. Volatilization Factor Equation Variables

Symbol	Definition (units)	Default	Reference
VF_{ulim}	Unlimited Source Volatilization Factor - Minneapolis (m^3/kg)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
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)	68.81	U.S. EPA. 2002 Equation 4-8
D_A	Apparent Diffusivity (cm^2/s)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
T	Exposure interval (s)	819,936,000	U.S. EPA. 2002 Equation 4-8
ρ_b	Dry soil bulk density (g/cm^3)	1.5	U.S. EPA. 2002 Equation 4-8
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	0.28	U.S. EPA. 2002 Equation 4-8
n	Total soil porosity (L_{pore}/L_{soil})	0.43	U.S. EPA. 2002 Equation 4-8
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.15	U.S. EPA. 2002 Equation 4-8
ρ_s	Soil particle density (g/c m^3)	2.65	U.S. EPA. 2002 Equation 4-8
D_{ia}	Diffusivity in air (cm^2/s)	Contaminant-specific	U.S. EPA. 2001
D_w	Diffusivity in water (cm^2/s)	Contaminant-specific	U.S. EPA. 2001
K_d	Soil-water partition coefficient (K_{oc}×f_{oc})	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
K_{oc}	Soil organic carbon-water partition coefficient	Contaminant-specific	EPI Suite
f_{oc}	Organic carbon content of soil (g/g)	0.006	U.S. EPA. 2002 Equation 4-8
A_s	Areal extent of the site contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA. 2002 Equation 4-8
A	Dispersion Constant	11.911	U.S. EPA 2002 Exhibit D-3
B	Dispersion Constant	18.4385	U.S. EPA 2002 Exhibit D-3
C	Dispersion Constant	209.7845	U.S. EPA 2002 Exhibit D-3

Table A-26. Mass Limit Volatilization Factor Equation Variables

Symbol	Definition (units)	Default	Reference
VF_{mlim}	Mass Limit Volatilization Factor - Minneapolis (m^3/kg)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
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)	68.81	U.S. EPA. 2002 Equation 4-8
D_s	Average Source Depth (m)	Site-specific	U.S. EPA. 2002 Equation 4-13
T	Exposure interval (years)	26	U.S. EPA. 2002 Equation 4-8
ρ_b	Dry soil bulk density (g/cm^3)	1.5	U.S. EPA. 2002 Equation 4-8
A_s	Areal extent of the site contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA. 2002 Equation 4-8
A	Dispersion Constant	11.911	U.S. EPA 2002 Exhibit D-3
B	Dispersion Constant	18.4385	U.S. EPA 2002 Exhibit D-3
C	Dispersion Constant	209.7845	U.S. EPA 2002 Exhibit D-3

Table A-27. Subchronic Volatilization Factor Equation Variables

Symbol	Definition (units)	Default	Reference
$VF_{ulim\text{-}sc}$	Volatilization Factor - Minneapolis (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
D_A	Apparent Diffusivity (cm^2/s)	Contaminant-specific	U.S. EPA. 2002 Equation 5-15
T	Exposure interval (s)	30,240,000	U.S. EPA. 2002 Equation 5-17
ρ_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
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	0.28	U.S. EPA. 2002 Equation 5-14
n	Total soil porosity (L_{pore}/L_{soil})	0.43	U.S. EPA. 2002 Equation 5-14
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.15	U.S. EPA. 2002 Equation 5-14
ρ_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
D_{iw}	Diffusivity in water (cm^2/s)	Contaminant-specific	U.S. EPA. 2001
K_d	Soil-water partition coefficient ($K_{oc} \times f_{oc}$)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
K_{oc}	Soil organic carbon-water partition coefficient	Contaminant-specific	EPI Suite
f_{oc}	Organic carbon content of soil (g/g)	0.006	U.S. EPA. 2002 Equation 4-8
A_c	Areal extent of the site contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA. 2002 Equation 4-8
A	Dispersion Constant	2.4538	U.S. EPA 2002 Exhibit 5-15
B	Dispersion Constant	17.5560	U.S. EPA 2002 Exhibit 5-15
C	Dispersion Constant	189.0426	U.S. EPA 2002 Exhibit 5-15
t_c	Total time over which construction occurs (hrs)	8400	U.S. EPA. 2002 Equation 5-5

Table A-28. Subchronic Mass Limit Volatilization Factor Equation Variables

Symbol	Definition (units)	Default	Reference
$VF_{mlim-sc}$	Volatilization Factor - Minneapolis (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
d_s	Average source depth (m)	Site-specific	U.S. EPA. 2002 Equation 5-17
F_D	Dispersion correction factor (unitless)	0.185	U.S. EPA. 2002 Equation 5-14
T	Exposure interval (s)	30,240,000	U.S. EPA. 2002 Equation 5-17
ρ_b	Dry soil bulk density (g/cm^3)	1.5	U.S. EPA. 2002 Equation 5-14
A_c	Areal extent of the site contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA. 2002 Equation 4-8
A	Dispersion Constant	2.4538	U.S. EPA 2002 Exhibit 5-15
B	Dispersion Constant	17.5560	U.S. EPA 2002 Exhibit 5-15
C	Dispersion Constant	189.0426	U.S. EPA 2002 Exhibit 5-15
t_c	Total time over which construction occurs (hrs)	8400	U.S. EPA. 2002 Equation 5-5

APPENDIX B. CHEMICAL PRG EQUATIONS

APPENDIX B. CHEMICAL PRG EQUATIONS

Resident Soil PRG Equations

Noncarcinogenic Child Soil Ingestion

$$PRG_{res-sol-ingnc}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right) \times BW_{res-c}(15\ kg)}{\left(\frac{RBA}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRS_{res-c}\left(\frac{200\ mg}{day}\right)}$$

Noncarcinogenic Child Soil Inhalation

$$PRG_{res-sol-inhnc}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times ET_{res-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Noncarcinogenic Child Soil Dermal

$$PRG_{res-sol-dernc}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right) \times BW_{res-c}(15\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right) \times GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times SA_{res-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right) \times ABS_d}$$

Noncarcinogenic Child Soil Total

$$PRG_{res-sol-totnc}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{res-sol-ingnc}} + \frac{1}{PRG_{res-sol-inhnc}} + \frac{1}{PRG_{res-sol-dernc}}}$$

Noncarcinogenic Adult Soil Ingestion

$$PRG_{res-sol-ingna}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right) \times BW_{res-a}(80\ kg)}{\left(\frac{RBA}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times IRS_{res-a}\left(\frac{100\ mg}{day}\right)}$$

Noncarcinogenic Adult Soil Inhalation

$$\mathrm{PRG}_{\mathrm{res\text{-}sol\text{-}inhna}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{THQ}\times \mathrm{AT}_{\mathrm{res\text{-}a}}\left(\frac{365\ \mathrm{days}}{\mathrm{yr}}\times \mathrm{ED}_{\mathrm{res}}(26\ \mathrm{yr})\right)}{\left(\frac{1}{\mathrm{RfC}\left(\frac{\mathrm{mg}}{\mathrm{m}^3}\right)}\right)\times \mathrm{EF}_{\mathrm{res\text{-}a}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED}_{\mathrm{res}}(26\ \mathrm{yr})\times \mathrm{ET}_{\mathrm{res\text{-}a}}\left(\frac{24\ \mathrm{hrs}}{\mathrm{day}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)\times\left(\frac{1}{\mathrm{VF_s}\left(\frac{\mathrm{m}^3}{\mathrm{kg}}\right)}+\frac{1}{\mathrm{PEF}\left(\frac{\mathrm{m}^3}{\mathrm{kg}}\right)}\right)}$$

Noncarcinogenic Adult Soil Dermal

$$\mathrm{PRG}_{\mathrm{res\text{-}sol\text{-}derna}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{THQ}\times \mathrm{AT}_{\mathrm{res\text{-}a}}\left(\frac{365\ \mathrm{days}}{\mathrm{yr}}\times \mathrm{ED}_{\mathrm{res}}(26\ \mathrm{yr})\right)\times \mathrm{BW}_{\mathrm{res\text{-}a}}(80\ \mathrm{kg})}{\left(\frac{1}{\mathrm{RfD_o}\left(\frac{\mathrm{mg}}{\mathrm{kg-day}}\right)\times \mathrm{GIABS}}\right)\times\left(\frac{10^{-6}\ \mathrm{kg}}{\mathrm{mg}}\right)\times \mathrm{EF}_{\mathrm{res\text{-}a}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED}_{\mathrm{res}}(26\ \mathrm{yr})\times \mathrm{SA}_{\mathrm{res\text{-}a}}\left(\frac{6{,}032\ \mathrm{cm}^2}{\mathrm{day}}\right)\times \mathrm{AF}_{\mathrm{res\text{-}a}}\left(\frac{0.07\ \mathrm{mg}}{\mathrm{cm}^2}\right)\times \mathrm{ABS_d}}$$

Noncarcinogenic Adult Soil Total

$$\mathrm{PRG}_{\mathrm{res\text{-}sol\text{-}totna}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{1}{\frac{1}{\mathrm{PRG}_{\mathrm{res\text{-}sol\text{-}ingna}}}+\frac{1}{\mathrm{PRG}_{\mathrm{res\text{-}sol\text{-}inhna}}}+\frac{1}{\mathrm{PRG}_{\mathrm{res\text{-}sol\text{-}derna}}}}$$

Noncarcinogenic Age-adjusted Soil Ingestion

$$\mathrm{PRG}_{\mathrm{res\text{-}sol\text{-}ingnadj}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{THQ}\times \mathrm{AT}_{\mathrm{res\text{-}a}}\left(\frac{365\ \mathrm{days}}{\mathrm{yr}}\times \mathrm{ED}_{\mathrm{res}}(26\ \mathrm{yr})\right)}{\left(\frac{\mathrm{RBA}}{\mathrm{RfD_o}\left(\frac{\mathrm{mg}}{\mathrm{kg-day}}\right)}\right)\times\left(\frac{10^{-6}\ \mathrm{kg}}{\mathrm{mg}}\right)\times \mathrm{IFS}_{\mathrm{res\text{-}adj}}\left(\frac{36{,}750\ \mathrm{mg}}{\mathrm{kg}}\right)}$$

where:

$$\mathrm{IFS}_{\mathrm{res\text{-}adj}}\left(\frac{36{,}750\ \mathrm{mg}}{\mathrm{kg}}\right)=\left[\frac{\mathrm{EF}_{\mathrm{res\text{-}c}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED}_{\mathrm{res\text{-}c}}(6\ \mathrm{yr})\times \mathrm{IRS}_{\mathrm{res\text{-}c}}\left(\frac{200\ \mathrm{mg}}{\mathrm{day}}\right)}{\mathrm{BW}_{\mathrm{res\text{-}c}}(15\ \mathrm{kg})}+\frac{\mathrm{EF}_{\mathrm{res\text{-}a}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED}_{\mathrm{res\text{-}a}}(20\ \mathrm{yr})\times \mathrm{IRS}_{\mathrm{res\text{-}a}}\left(\frac{100\ \mathrm{mg}}{\mathrm{day}}\right)}{\mathrm{BW}_{\mathrm{res\text{-}a}}(80\ \mathrm{kg})}\right]$$

Noncarcinogenic Age-adjusted Soil Inhalation

$$\mathrm{PRG}_{\mathrm{res\text{-}sol\text{-}inhnadj}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{THQ}\times \mathrm{AT}_{\mathrm{res\text{-}a}}\left(\frac{365\ \mathrm{days}}{\mathrm{yr}}\times \mathrm{ED}_{\mathrm{res}}(26\ \mathrm{yr})\right)}{\left(\frac{1}{\mathrm{RfC}\left(\frac{\mathrm{mg}}{\mathrm{m}^3}\right)}\right)\times \mathrm{EF}_{\mathrm{res}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED}_{\mathrm{res}}(26\ \mathrm{yr})\times \mathrm{ET}_{\mathrm{res}}\left(\frac{24\ \mathrm{hrs}}{\mathrm{day}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)\times\left(\frac{1}{\mathrm{VF_s}\left(\frac{\mathrm{m}^3}{\mathrm{kg}}\right)}+\frac{1}{\mathrm{PEF}\left(\frac{\mathrm{m}^3}{\mathrm{kg}}\right)}\right)}$$

Noncarcinogenic Age-adjusted Soil Dermal

$$PRG_{res\text{-}sol\text{-}dernadj}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{res\text{-}a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right) \times GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFS_{res\text{-}adj}\left(\frac{103{,}390\ mg}{kg}\right) \times ABS_d}$$

where:

$$DFS_{res\text{-}adj}\left(\frac{103{,}390\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times SA_{res\text{-}c}\left(\frac{2{,}373\ cm^2}{day}\right) \times AF_{res\text{-}c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{res\text{-}c}(15\ kg)} + \\ \frac{EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times SA_{res\text{-}a}\left(\frac{6{,}032\ cm^2}{day}\right) \times AF_{res\text{-}a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{res\text{-}a}(80\ kg)}\end{array}\right]$$

Noncarcinogenic Age-adjusted Soil Total

$$PRG_{res\text{-}sol\text{-}totnadj}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{res\text{-}sol\text{-}ingnadj}} + \frac{1}{PRG_{res\text{-}sol\text{-}inhnadj}} + \frac{1}{PRG_{res\text{-}sol\text{-}dernadj}}}$$

Carcinogenic Soil Ingestion

$$PRG_{res\text{-}sol\text{-}ingc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times IFS_{res\text{-}adj}\left(\frac{36{,}750\ mg}{kg}\right)}$$

where:

$$IFS_{res\text{-}adj}\left(\frac{36{,}750\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times IRS_{res\text{-}c}\left(\frac{200\ mg}{day}\right)}{BW_{res\text{-}c}(15\ kg)} + \\ \frac{EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times IRS_{res\text{-}a}\left(\frac{100\ mg}{day}\right)}{BW_{res\text{-}a}(80\ kg)}\end{array}\right]$$

Carcinogenic Soil Inhalation

$$PRG_{res\text{-}sol\text{-}inhc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Carcinogenic Soil Dermal

$$PRG_{res-sol-derc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right) \times ABS_d}$$

where:

$$DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right) = \left[\begin{array}{c}\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times SA_{res-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{res-c}(15\ kg)} + \\ \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times SA_{res-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{res-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{res-a}(80\ kg)}\end{array}\right]$$

Carcinogenic Soil Total

$$PRG_{res-sol-totc}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{res-sol-ingc}} + \frac{1}{PRG_{res-sol-inhc}} + \frac{1}{PRG_{res-sol-derc}}}$$

Mutagenic Soil Ingestion

$$PRG_{res-sol-ingmu}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times IFSM_{res-adj}\left(\frac{166,833.3\ mg}{kg}\right)}$$

where:

$$IFSM_{res-adj}\left(\frac{166,833.3\ mg}{kg}\right) = \left[\begin{array}{c}\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times IRS_{0-2}\left(\frac{200\ mg}{day}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times IRS_{2-6}\left(\frac{200\ mg}{day}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times IRS_{6-16}\left(\frac{100\ mg}{day}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times IRS_{16-26}\left(\frac{100\ mg}{day}\right) \times 1}{BW_{16-26}(80\ kg)}\end{array}\right]$$

Mutagenic Soil Inhalation

$$PRG_{res-sol-inhmu}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right) \times \left[\begin{array}{l}\left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 1\right)\end{array}\right]}$$

Mutagenic Soil Dermal

$$PRG_{res-sol-dermu}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFSM_{res-adj}\left(\frac{428,260\ mg}{kg}\right) \times ABS_d}$$

where:

$$DFSM_{res-adj}\left(\frac{428,260\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times SA_{0-2}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{0-2}\left(\frac{0.2\ mg}{cm^2}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times SA_{2-6}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{2-6}\left(\frac{0.2\ mg}{cm^2}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times SA_{6-16}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{6-16}\left(\frac{0.07\ mg}{cm^2}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times SA_{16-26}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{16-26}\left(\frac{0.07\ mg}{cm^2}\right) \times 1}{BW_{16-26}(80\ kg)}\end{array}\right]$$

Mutagenic Soil Total

$$PRG_{res-sol-totmu}\left(\frac{mg}{kg}\right) = \frac{1}{\dfrac{1}{PRG_{res-sol-ingmu}} + \dfrac{1}{PRG_{res-sol-inhmu}} + \dfrac{1}{PRG_{res-sol-dermu}}}$$

Vinyl Chloride Soil Ingestion

$$PRG_{res-sol-ingvc}\left(\frac{mg}{kg}\right) = \frac{TR}{\left(\left(\dfrac{CSF_o\left(\dfrac{mg}{kg-day}\right)^{-1} \times \left(\dfrac{10^{-6}\ kg}{mg}\right) \times RBA \times IFS_{res-adj}\left(\dfrac{36,750\ mg}{kg}\right)}{AT_{res}\left(\dfrac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + \left(\dfrac{CSF_o\left(\dfrac{mg}{kg-day}\right)^{-1} \times \left(\dfrac{10^{-6}\ kg}{mg}\right) \times RBA \times IRS_{res-c}\left(\dfrac{200\ mg}{day}\right)}{BW_{res-c}(15\ kg)}\right)\right)}$$

where:

$$IFS_{res-adj}\left(\frac{36,750\ mg}{kg}\right) = \left[\frac{EF_{res-c}\left(\dfrac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRS_{res-c}\left(\dfrac{200\ mg}{day}\right)}{BW_{res-c}(15\ kg)} + \frac{EF_{res-a}\left(\dfrac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRS_{res-a}\left(\dfrac{100\ mg}{day}\right)}{BW_{res-a}(80\ kg)}\right]$$

Vinyl Chloride Soil Inhalation

$$PRG_{res-sol-inhvc}\left(\frac{mg}{kg}\right) = \frac{TR}{\left(\left(\dfrac{IUR\left(\dfrac{\mu g}{m^3}\right)^{-1} \times \left(\dfrac{1000\ \mu g}{mg}\right) \times EF_{res}\left(\dfrac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\dfrac{24\ hrs}{day}\right) \times \left(\dfrac{1\ day}{24\ hrs}\right)}{AT_{res}\left(\dfrac{365\ days}{yr} \times LT(70\ yrs)\right) \times VF_s\left(\dfrac{m^3}{kg}\right)}\right) + \left(\dfrac{IUR\left(\dfrac{\mu g}{m^3}\right)^{-1}}{VF_s\left(\dfrac{m^3}{kg}\right)} \times \left(\dfrac{1000\ \mu g}{mg}\right)\right)\right)}$$

Vinyl Chloride Soil Dermal

$$PRG_{res\text{-}sol\text{-}dervc}\left(\frac{mg}{kg}\right)=\frac{TR}{\left(\left(\frac{\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\times\left(\frac{10^{-6}\ kg}{mg}\right)\times DFS_{res\text{-}adj}\left(\frac{103,390\ mg}{kg}\right)\times ABS_d}{AT_{res}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}\right)+\left(\frac{\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\times\left(\frac{10^{-6}\ kg}{mg}\right)\times SA_{res\text{-}c}\left(\frac{2,373\ cm^2}{day}\right)\times AF_{res\text{-}c}\left(\frac{0.2\ mg}{cm^2}\right)\times ABS_d}{BW_{res\text{-}c}\,(15\ kg)}\right)\right)}$$

where:

$$DFS_{res\text{-}adj}\left(\frac{103,390\ mg}{kg}\right)=\left[\frac{EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right)\times ED_{res\text{-}c}(6\ yr)\times SA_{res\text{-}c}\left(\frac{2,373\ cm^2}{day}\right)\times AF_{res\text{-}c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{res\text{-}c}\,(15\ kg)}+\frac{EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right)\times ED_{res\text{-}a}(20\ yr)\times SA_{res\text{-}a}\left(\frac{6,032\ cm^2}{day}\right)\times AF_{res\text{-}a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{res\text{-}a}\,(80\ kg)}\right]$$

Vinyl Chloride Soil Total

$$PRG_{res\text{-}sol\text{-}totvc}\left(\frac{mg}{kg}\right)=\frac{1}{\frac{1}{PRG_{res\text{-}sol\text{-}ingvc}}+\frac{1}{PRG_{res\text{-}sol\text{-}inhvc}}+\frac{1}{PRG_{res\text{-}sol\text{-}dervc}}}$$

Trichloroethylene Soil Ingestion

$$PRG_{res-sol-ingtce}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times \left(\begin{array}{l}\left(CAF_o(0.804) \times IFS_{res-adj}\left(\frac{36,750\ mg}{kg}\right)\right) + \\ \left(MAF_o(0.202) \times IFSM_{res-adj}\left(\frac{166,833.3\ mg}{kg}\right)\right)\end{array}\right)}$$

where:

$$IFS_{res-adj}\left(\frac{36,750\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRS_{res-c}\left(\frac{200\ mg}{day}\right)}{BW_{res-c}(15\ kg)} + \\ \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRS_{res-a}\left(\frac{100\ mg}{day}\right)}{BW_{res-a}(80\ kg)}\end{array}\right]$$

and:

$$IFSM_{res-adj}\left(\frac{166,833.3\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times IRS_{0-2}\left(\frac{200\ mg}{day}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times IRS_{2-6}\left(\frac{200\ mg}{day}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times IRS_{6-16}\left(\frac{100\ mg}{day}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times IRS_{16-26}\left(\frac{100\ mg}{day}\right) \times 1}{BW_{16-26}(80\ kg)}\end{array}\right]$$

Trichloroethylene Soil Inhalation

$$PRG_{res-sol-inhtce}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{\begin{array}{l}IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right) \times \\ \left[\begin{array}{l}\left(EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times CAF_i(0.756)\right) + \\ \left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 1\right)\end{array}\right]\end{array}}$$

Trichloroethylene Soil Dermal

$$PRG_{res-sol-dertce}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times \left(\begin{array}{l}\left(CAF_o(0.804) \times DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right) \times ABS_d\right) + \\ \left(MAF_o(0.202) \times DFSM_{res-adj}\left(\frac{428,260\ mg}{kg}\right) \times ABS_d\right)\end{array}\right)}$$

where:

$$DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times SA_{res-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{res-c}(15\ kg)} + \\ \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times SA_{res-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{res-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{res-a}(80\ kg)}\end{array}\right]$$

and:

$$DFSM_{res-adj}\left(\frac{428,260\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times SA_{0-2}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{0-2}\left(\frac{0.2\ mg}{cm^2}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times SA_{2-6}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{2-6}\left(\frac{0.2\ mg}{cm^2}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times SA_{6-16}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{6-16}\left(\frac{0.07\ mg}{cm^2}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times SA_{16-26}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{16-26}\left(\frac{0.07\ mg}{cm^2}\right) \times 1}{BW_{16-26}(80\ kg)}\end{array}\right]$$

Trichloroethylene Soil Total

$$PRG_{res-sol-tottce}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{res-sol-ingtce}} + \frac{1}{PRG_{res-sol-inhtce}} + \frac{1}{PRG_{res-sol-dertce}}}$$

Supporting Child Soil

$$ED_{res-c}(6\text{ yr}) = ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr})$$

$$BW_{res-c}(15\text{ kg}) = \frac{ED_{0-2}(2\text{ yr}) \times BW_{0-2}(15\text{ kg}) + ED_{2-6}(4\text{ yr}) \times BW_{2-6}(15\text{ kg})}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr})}$$

$$EF_{res-c}\left(\frac{350\text{ days}}{\text{yr}}\right) = \frac{ED_{0-2}(2\text{ yr}) \times EF_{0-2}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{2-6}(4\text{ yr}) \times EF_{2-6}\left(\frac{350\text{ days}}{\text{yr}}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr})}$$

$$ET_{res-c}\left(\frac{24\text{ hrs}}{\text{day}}\right) = \frac{ED_{0-2}(2\text{ yr}) \times ET_{0-2}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{2-6}(4\text{ yr}) \times ET_{2-6}\left(\frac{24\text{ hrs}}{\text{day}}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr})}$$

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

$$SA_{res-c}\left(\frac{2{,}373\text{ cm}^2}{\text{day}}\right) = \frac{ED_{0-2}(2\text{ yr}) \times SA_{0-2}\left(\frac{2{,}373\text{ cm}^2}{\text{day}}\right) + ED_{2-6}(4\text{ yr}) \times SA_{2-6}\left(\frac{2{,}373\text{ cm}^2}{\text{day}}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr})}$$

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

Supporting Adult Soil

$$ED_{res-a}(20\ yr) = ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)$$

$$BW_{res-a}(80\ kg) = \frac{ED_{6-16}(10\ yr) \times BW_{6-16}(80\ kg) + ED_{16-26}(10\ yr) \times BW_{16-26}(80\ kg)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$EF_{res-a}\left(\frac{350\ days}{yr}\right) = \frac{ED_{6-16}(10\ yr) \times EF_{6-16}\left(\frac{350\ days}{yr}\right) + ED_{16-26}(10\ yr) \times EF_{16-26}\left(\frac{350\ days}{yr}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$ET_{res-a}\left(\frac{24\ hrs}{day}\right) = \frac{ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) + ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

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

$$SA_{res-a}\left(\frac{6,032\ cm^2}{day}\right) = \frac{ED_{6-16}(10\ yr) \times SA_{6-16}\left(\frac{6,032\ cm^2}{day}\right) + ED_{16-26}(10\ yr) \times SA_{16-26}\left(\frac{6,032\ cm^2}{day}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$IRS_{res-a}\left(\frac{100\ mg}{day}\right) = \frac{ED_{6-16}(10\ yr) \times IRS_{6-16}\left(\frac{100\ mg}{day}\right) + ED_{16-26}(10\ yr) \times IRS_{16-26}\left(\frac{100\ mg}{day}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

Supporting Age-adjusted Soil

$$ED_{res}(26\text{ yr}) = ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})$$

$$EF_{res}\left(\frac{350\text{ days}}{\text{yr}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}(2\text{ yr}) \times EF_{0-2}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{2-6}(4\text{ yr}) \times EF_{2-6}\left(\frac{350\text{ days}}{\text{yr}}\right) + \\ ED_{6-16}(10\text{ yr}) \times EF_{6-16}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{16-26}(10\text{ yr}) \times EF_{16-26}\left(\frac{350\text{ days}}{\text{yr}}\right) \end{array}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$ET_{res}\left(\frac{24\text{ hrs}}{\text{day}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}(2\text{ yr}) \times ET_{0-2}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{2-6}(4\text{ yr}) \times ET_{2-6}\left(\frac{24\text{ hrs}}{\text{day}}\right) + \\ ED_{6-16}(10\text{ yr}) \times ET_{6-16}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times ET_{16-26}\left(\frac{24\text{ hrs}}{\text{day}}\right) \end{array}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

Resident Air PRG Equations

Noncarcinogenic Air Inhalation

$$PRG_{res-air-inhn}\left(\frac{\mu g}{m^3}\right) = \frac{THQ \times AT_{res-a}\left(\frac{365\text{ days}}{\text{yr}} \times ED_{res}(26\text{ yr})\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res}\left(\frac{350\text{ days}}{\text{yr}}\right) \times ED_{res}(26\text{ yr}) \times ET_{res}\left(\frac{24\text{ hrs}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right)}$$

Carcinogenic Air Inhalation

$$PRG_{res-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{TR \times AT_{res}\left(\frac{365\text{ days}}{\text{yr}} \times LT(70\text{ yrs})\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times EF_{res}\left(\frac{350\text{ days}}{\text{yr}}\right) \times ED_{res}(26\text{ yr}) \times ET_{res}\left(\frac{24\text{ hrs}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right)}$$

Mutagenic Air Inhalation

$$\mathrm{PRG}_{\text{res-air-inhmu}}\left(\frac{\mu g}{m^3}\right)=\frac{TR\times AT_{res}\left(\frac{365\text{ days}}{yr}\times LT(70\text{ yrs})\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left[\begin{array}{l}\left(EF_{0-2}\left(\frac{350\text{ days}}{yr}\right)\times ED_{0-2}(2\text{ yr})\times ET_{0-2}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times 10\right)+\\ \left(EF_{2-6}\left(\frac{350\text{ days}}{yr}\right)\times ED_{2-6}(4\text{ yr})\times ET_{2-6}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times 3\right)+\\ \left(EF_{6-16}\left(\frac{350\text{ days}}{yr}\right)\times ED_{6-16}(10\text{ yr})\times ET_{6-16}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times 3\right)+\\ \left(EF_{16-26}\left(\frac{350\text{ days}}{yr}\right)\times ED_{16-26}(10\text{ yr})\times ET_{16-26}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times 1\right)\end{array}\right]}$$

Vinyl Chloride Air Inhalation

$$\mathrm{PRG}_{\text{res-air-inhvc}}\left(\frac{\mu g}{m^3}\right)=\frac{TR}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}+\left(\frac{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times EF_{res}\left(\frac{350\text{ days}}{yr}\right)\times ED_{res}(26\text{ yr})\times ET_{res}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)}{AT_{res}\left(\frac{365\text{ days}}{yr}\times LT(70\text{ yrs})\right)}\right)}$$

Trichloroethylene Air Inhalation

$$\mathrm{PRG}_{\text{res-air-inhtce}}\left(\frac{\mu g}{m^3}\right)=\frac{TR\times AT_{res}\left(\frac{365\text{ days}}{yr}\times LT(70\text{ yrs})\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left[\begin{array}{l}\left(EF_{res}\left(\frac{350\text{ days}}{yr}\right)\times ED_{res}(26\text{ yr})\times ET_{res}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times CAF_i(0.756)\right)+\\ \left(EF_{0-2}\left(\frac{350\text{ days}}{yr}\right)\times ED_{0-2}(2\text{ yr})\times ET_{0-2}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times MAF_i(0.244)\times 10\right)+\\ \left(EF_{2-6}\left(\frac{350\text{ days}}{yr}\right)\times ED_{2-6}(4\text{ yr})\times ET_{2-6}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times MAF_i(0.244)\times 3\right)+\\ \left(EF_{6-16}\left(\frac{350\text{ days}}{yr}\right)\times ED_{6-16}(10\text{ yr})\times ET_{6-16}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times MAF_i(0.244)\times 3\right)+\\ \left(EF_{16-26}\left(\frac{350\text{ days}}{yr}\right)\times ED_{16-26}(10\text{ yr})\times ET_{16-26}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times MAF_i(0.244)\times 1\right)\end{array}\right]}$$

Refractory Ceramic Fibers Air Inhalation

$$\mathrm{PRG}_{\text{res-air-inhrcf}}\left(\frac{f}{m^3}\right)=\frac{THQ\times AT_{res-a}\left(\frac{365\text{ days}}{yr}\times ED_{res}(26\text{ yr})\right)}{\left(\frac{1}{RfC\left(\frac{f}{m^3}\right)}\right)\times EF_{res}\left(\frac{350\text{ days}}{yr}\right)\times ED_{res}(26\text{ yr})\times ET_{res}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)}$$

Asbestos Air Inhalation

$$\mathrm{PRG}_{\text{res-air-inhasb}}\left(\frac{f}{m^3}\right)=\frac{TR\times AT_{res}\left(\frac{365\text{ days}}{yr}\times LT(70\text{ yrs})\right)}{IUR\left(\frac{f}{m^3}\right)^{-1}\times EF_{res}\left(\frac{350\text{ days}}{yr}\right)\times ED_{res}(26\text{ yr})\times ET_{res}\left(\frac{24\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)}$$

Resident Tap Water PRG Equations

Noncarcinogenic Child Tap Water Ingestion

$$PRG_{res-wat-ingnc}\left(\frac{\mu g}{L}\right) = \frac{THQ \times AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right) \times BW_{res-c}(15\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRW_{res-c}\left(\frac{0.78\ L}{day}\right)}$$

Noncarcinogenic Child Tap Water Inhalation

$$PRG_{res-wat-inhnc}\left(\frac{\mu g}{L}\right) = \frac{THQ \times AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times ET_{res-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times K\left(\frac{0.5\ L}{m^3}\right)}$$

Noncarcinogenic Child Tap Water Dermal

For Inorganics:

$$PRG_{res-wat-dernc}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)}$$

For Organics:

IF $ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right) \leq t^*\ (hrs)$, then:

$$PRG_{res-wat-dernc}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right) > t^*\ (hrs)$, then:

$$PRG_{res-wat-dernc}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = \frac{THQ \times AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right) \times BW_{res-c}(15\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right) \times GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times EV_{res-c}\left(\frac{1\ event}{day}\right) \times SA_{res-c}\left(6{,}365\ cm^2\right)}$$

Noncarcinogenic Child Tap Water Total

$$PRG_{res-wat-totnc}\left(\frac{\mu g}{L}\right) = \frac{1}{\frac{1}{PRG_{res-wat-ingnc}} + \frac{1}{PRG_{res-wat-inhnc}} + \frac{1}{PRG_{res-wat-dernc}}}$$

Noncarcinogenic Adult Tap Water Ingestion

$$\mathrm{PRG}_{\text{res-wat-ingna}}\left(\frac{\mu g}{L}\right)=\frac{\mathrm{THQ}\times \mathrm{AT}_{\text{res-a}}\left(\frac{365\ \text{days}}{\text{yr}}\times \mathrm{ED}_{\text{res}}\,(26\ \text{yr})\right)\times \mathrm{BW}_{\text{res-a}}\,(80\ \text{kg})}{\left(\frac{1}{\mathrm{RfD_o}\left(\frac{mg}{kg-day}\right)}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times \mathrm{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right)\times \mathrm{ED}_{\text{res}}\,(26\ \text{yr})\times \mathrm{IRW}_{\text{res-a}}\left(\frac{2.5\ L}{day}\right)}$$

Noncarcinogenic Adult Tap Water Inhalation

$$\mathrm{PRG}_{\text{res-wat-inhna}}\left(\frac{\mu g}{L}\right)=\frac{\mathrm{THQ}\times \mathrm{AT}_{\text{res-a}}\left(\frac{365\ \text{days}}{\text{yr}}\times \mathrm{ED}_{\text{res}}\,(26\ \text{yr})\right)}{\left(\frac{1}{\mathrm{RfC}\left(\frac{mg}{m^3}\right)}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times \mathrm{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right)\times \mathrm{ED}_{\text{res}}\,(26\ \text{yr})\times \mathrm{ET}_{\text{res-a}}\left(\frac{24\ \text{hrs}}{\text{day}}\right)\times\left(\frac{1\ \text{day}}{24\ \text{hrs}}\right)\times K\left(\frac{0.5\ L}{m^3}\right)}$$

Noncarcinogenic Adult Tap Water Dermal

For Inorganics:

$$\mathrm{PRG}_{\text{res-wat-derna}}\left(\frac{\mu g}{L}\right)=\frac{\mathrm{DA}_{\text{event}}\left(\frac{\mu g}{cm^2-\text{event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times \mathrm{ET}_{\text{event-res-a}}\left(\frac{0.71\ \text{hrs}}{\text{event}}\right)}$$

For Organics:

IF $\mathrm{ET}_{\text{event-res-a}}\left(\frac{0.71\ \text{hrs}}{\text{event}}\right)\le t^*\,(\text{hrs})$, then:

$$\mathrm{PRG}_{\text{res-wat-derna}}\left(\frac{\mu g}{L}\right)=\frac{\mathrm{DA}_{\text{event}}\left(\frac{\mu g}{cm^2-\text{event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times \mathrm{FA}\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{\text{event}}\left(\frac{hrs}{event}\right)\times \mathrm{ET}_{\text{event-res-a}}\left(\frac{0.71\ \text{hrs}}{\text{event}}\right)}{\pi}}}$$

or:

IF $\mathrm{ET}_{\text{event-res-a}}\left(\frac{0.71\ \text{hrs}}{\text{event}}\right)> t^*\,(\text{hrs})$, then:

$$\mathrm{PRG}_{\text{res-wat-derna}}\left(\frac{\mu g}{L}\right)=\frac{\mathrm{DA}_{\text{event}}\left(\frac{\mu g}{cm^2-\text{event}}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{\mathrm{FA}\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{\mathrm{ET}_{\text{event-res-a}}\left(\frac{0.71\ \text{hrs}}{\text{event}}\right)}{1+B}+2\times\tau_{\text{event}}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$\mathrm{DA}_{\text{event}}\left(\frac{\mu g}{cm^2-\text{event}}\right)=\frac{\mathrm{THQ}\times \mathrm{AT}_{\text{res-a}}\left(\frac{365\ \text{days}}{\text{yr}}\times \mathrm{ED}_{\text{res}}\,(26\ \text{yr})\right)\times \mathrm{BW}_{\text{res-a}}\,(80\ \text{kg})}{\left(\frac{1}{\mathrm{RfD_o}\left(\frac{mg}{kg-day}\right)\times \mathrm{GIABS}}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times \mathrm{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right)\times \mathrm{ED}_{\text{res}}\,(26\ \text{yr})\times \mathrm{EV}_{\text{res-a}}\left(\frac{1\ \text{event}}{\text{day}}\right)\times \mathrm{SA}_{\text{res-a}}\left(19{,}652\ cm^2\right)}$$

Noncarcinogenic Adult Tap Water Total

$$\mathrm{PRG}_{\text{res-wat-totna}}\left(\frac{\mu g}{L}\right)=\frac{1}{\frac{1}{\mathrm{PRG}_{\text{res-wat-ingna}}}+\frac{1}{\mathrm{PRG}_{\text{res-wat-inhna}}}+\frac{1}{\mathrm{PRG}_{\text{res-wat-derna}}}}$$

Noncarcinogenic Age-adjusted Tap Water Ingestion

$$PRG_{res-wat-ingnadj}\left(\frac{\mu g}{L}\right) = \frac{THQ \times AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}\,(26\ yr)\right)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times IFW_{res-adj}\left(\frac{327.95\ L}{kg}\right)}$$

where:

$$IFW_{res-adj}\left(\frac{327.95\ L}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}\,(6\ yr) \times IRW_{res-c}\left(\frac{0.78\ L}{day}\right)}{BW_{res-c}\,(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}\,(20\ yr) \times IRW_{res-a}\left(\frac{2.5\ L}{day}\right)}{BW_{res-a}\,(80\ kg)}\right]$$

Noncarcinogenic Age-adjusted Tap Water Inhalation

$$PRG_{res-wat-inhnadj}\left(\frac{\mu g}{L}\right) = \frac{THQ \times AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}\,(26\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res}\,(26\ yr) \times ET_{res-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times K\left(\frac{0.5\ L}{m^3}\right)}$$

Noncarcinogenic Age-adjusted Tap Water Dermal

For Inorganics:

$$PRG_{res-wat-dernadj}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}$$

For Organics:

IF $ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) \leq t^*\ (hrs)$, then:

$$PRG_{res-wat-dernadj}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) > t^*\ (hrs)$, then:

$$PRG_{res-wat-dernadj}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) = \left(\frac{\left(ED_{res-c}\ (6\ yr) \times ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)\right) + \left(ED_{res-a}\ (20\ yr) \times ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right)\right)}{ED_{res}\ (26\ yr)}\right)$$

and:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = \frac{THQ \times AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}\ (26\ yr)\right)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right) \times GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times DFW_{res-adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right)}$$

where:

$$DFW_{res-adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right) = \left(\begin{array}{c}\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}\ (6\ yr) \times EV_{res-c}\left(\frac{1\ event}{day}\right) \times SA_{res-c}\left(6,365\ cm^2\right)}{BW_{res-c}\ (15\ kg)} + \\ \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}\ (20\ yr) \times EV_{res-a}\left(\frac{1\ event}{day}\right) \times SA_{res-a}\left(19,652\ cm^2\right)}{BW_{res-a}\ (80\ kg)}\end{array}\right)$$

Noncarcinogenic Age-adjusted Tap Water Total

$$PRG_{res-wat-totnadj}\left(\frac{\mu g}{L}\right) = \frac{1}{\frac{1}{PRG_{res-wat-ingnadj}} + \frac{1}{PRG_{res-wat-inhnadj}} + \frac{1}{PRG_{res-wat-dernadj}}}$$

Carcinogenic Tap Water Ingestion

$$\text{PRG}_{\text{res-wat-ingc}}\left(\frac{\mu g}{L}\right) = \frac{\text{TR} \times \text{AT}_{\text{res}}\left(\frac{365\ \text{days}}{\text{yr}} \times \text{LT}(70\ \text{yrs})\right)}{\text{CSF}_{\text{o}}\left(\frac{\text{mg}}{\text{kg}-\text{day}}\right)^{-1} \times \left(\frac{\text{mg}}{1000\ \mu g}\right) \times \text{IFW}_{\text{res-adj}}\left(\frac{327.95\ \text{L}}{\text{kg}}\right)}$$

where:

$$\text{IFW}_{\text{res-adj}}\left(\frac{327.95\ \text{L}}{\text{kg}}\right) = \left[\frac{\text{EF}_{\text{res-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-c}}(6\ \text{yr}) \times \text{IRW}_{\text{res-c}}\left(\frac{0.78\ \text{L}}{\text{day}}\right)}{\text{BW}_{\text{res-c}}(15\ \text{kg})} + \frac{\text{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-a}}(20\ \text{yr}) \times \text{IRW}_{\text{res-a}}\left(\frac{2.5\ \text{L}}{\text{day}}\right)}{\text{BW}_{\text{res-a}}(80\ \text{kg})}\right]$$

Carcinogenic Tap Water Inhalation

$$\text{PRG}_{\text{res-wat-inhc}}\left(\frac{\mu g}{L}\right) = \frac{\text{TR} \times \text{AT}_{\text{res}}\left(\frac{365\ \text{days}}{\text{yr}} \times \text{LT}(70\ \text{yrs})\right)}{\text{IUR}\left(\frac{\mu g}{m^3}\right)^{-1} \times \text{EF}_{\text{res}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res}}(26\ \text{yr}) \times \text{ET}_{\text{res}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{K}\left(\frac{0.5\ \text{L}}{m^3}\right)}$$

Carcinogenic Tap Water Dermal

For Inorganics:

$$PRG_{res-wat-derc}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2 - event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}$$

For Organics:

IF $ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) \le t^*\ (hrs)$, then:

$$PRG_{res-wat-derc}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2 - event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) > t^*\ (hrs)$, then:

$$PRG_{res-wat-derc}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2 - event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}{1 + B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1 + 3B + 3B^2}{(1 + B)^2}\right)\right]}$$

where:

$$ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) = \left(\frac{\left(ED_{res-c}(6\ yr) \times ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)\right) + \left(ED_{res-a}(20\ yr) \times ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right)\right)}{ED_{res}(26\ yr)}\right)$$

and:

$$DA_{event}\left(\frac{\mu g}{cm^2 - event}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg - day}\right)^{-1}}{GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times DFW_{res-adj}\left(\frac{2,610,650\ cm^2 - event}{kg}\right)}$$

where:

$$DFW_{res-adj}\left(\frac{2,610,650\ cm^2 - event}{kg}\right) = \left(\begin{array}{c}\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times EV_{res-c}\left(\frac{1\ event}{day}\right) \times SA_{res-c}\left(6,365\ cm^2\right)}{BW_{res-c}(15\ kg)} + \\ \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times EV_{res-a}\left(\frac{1\ event}{day}\right) \times SA_{res-a}\left(19,652\ cm^2\right)}{BW_{res-a}(80\ kg)}\end{array}\right)$$

Carcinogenic Tap Water Total

$$PRG_{res-wat-totc}\left(\frac{\mu g}{L}\right) = \frac{1}{\frac{1}{PRG_{res-wat-ingc}} + \frac{1}{PRG_{res-wat-inhc}} + \frac{1}{PRG_{res-wat-derc}}}$$

Mutagenic Tap Water Ingestion

$$\text{PRG}_{\text{res-wat-ingmu}}\left(\frac{\mu g}{L}\right) = \frac{\text{TR} \times \text{AT}_{\text{res}}\left(\frac{365\text{ days}}{\text{yr}} \times \text{LT}(70\text{ yrs})\right)}{\text{CSF}_o\left(\frac{\text{mg}}{\text{kg-day}}\right)^{-1} \times \left(\frac{\text{mg}}{1000\ \mu\text{g}}\right) \times \text{IFWM}_{\text{res-adj}}\left(\frac{1{,}019.9\text{ L}}{\text{kg}}\right)}$$

where:

$$\text{IFWM}_{\text{res-adj}}\left(\frac{1{,}019.9\text{ L}}{\text{kg}}\right) = \left[\begin{array}{c} \frac{\text{EF}_{0-2}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{0-2}(2\text{ yr}) \times \text{IRW}_{0-2}\left(\frac{0.78\text{ L}}{\text{day}}\right) \times 10}{\text{BW}_{0-2}(15\text{ kg})} + \\ \frac{\text{EF}_{2-6}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{2-6}(4\text{ yr}) \times \text{IRW}_{2-6}\left(\frac{0.78\text{ L}}{\text{day}}\right) \times 3}{\text{BW}_{2-6}(15\text{ kg})} + \\ \frac{\text{EF}_{6-16}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{6-16}(10\text{ yr}) \times \text{IRW}_{6-16}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times 3}{\text{BW}_{6-16}(80\text{ kg})} + \\ \frac{\text{EF}_{16-26}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{16-26}(10\text{ yr}) \times \text{IRW}_{16-26}\left(\frac{2.5\text{ L}}{\text{day}}\right) \times 1}{\text{BW}_{16-26}(80\text{ kg})} \end{array}\right]$$

Mutagenic Tap Water Inhalation

$$\text{PRG}_{\text{res-wat-inhmu}}\left(\frac{\mu g}{L}\right) = \frac{\text{TR} \times \text{AT}_{\text{res}}\left(\frac{365\text{ days}}{\text{yr}} \times \text{LT}(70\text{ yrs})\right)}{\begin{array}{l} \text{IUR}\left(\frac{\mu g}{m^3}\right)^{-1} \times \text{K}\left(\frac{0.5\text{ L}}{m^3}\right) \times \\ \left[\begin{array}{c} \left(\text{EF}_{0-2}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{0-2}(2\text{ yr}) \times \text{ET}_{0-2}\left(\frac{24\text{ hrs}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right) \times 10\right) + \\ \left(\text{EF}_{2-6}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{2-6}(4\text{ yr}) \times \text{ET}_{2-6}\left(\frac{24\text{ hrs}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right) \times 3\right) + \\ \left(\text{EF}_{6-16}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{6-16}(10\text{ yr}) \times \text{ET}_{6-16}\left(\frac{24\text{ hrs}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right) \times 3\right) + \\ \left(\text{EF}_{16-26}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{16-26}(10\text{ yr}) \times \text{ET}_{16-26}\left(\frac{24\text{ hrs}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right) \times 1\right) \end{array}\right] \end{array}}$$

Mutagenic Tap Water Dermal

For Inorganics:

$$PRG_{res-wat-dermu}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right)}$$

For Organics:

IF $ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right)\leq t^*(hrs)$, then:

$$PRG_{res-wat-dermu}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right)>t^*(hrs)$, then:

$$PRG_{res-wat-dermu}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right)=\frac{\left(\begin{array}{c}\left(ED_{0-2}(2\ yr)\times ET_{event-(0-2)}\left(\frac{0.54\ hrs}{event}\right)\right)+\left(ED_{2-6}(4\ yr)\times ET_{event-(2-6)}\left(\frac{0.54\ hrs}{event}\right)\right)+\\\left(\left(ED_{6-16}(10\ yr)\times ET_{event-(6-16)}\left(\frac{0.71\ hrs}{event}\right)\right)+\left(ED_{16-26}(10\ yr)\times ET_{event-(16-26)}\left(\frac{0.71\ hrs}{event}\right)\right)\right)\end{array}\right)}{ED_{0-2}(2\ yr)+ED_{2-6}(4\ yr)+ED_{6-16}(10\ yr)+ED_{16-26}(10\ yr)}$$

and:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=\frac{TR\times AT_{res}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times DFWM_{res-adj}\left(\frac{8,191,633\ cm^2-event}{kg}\right)}$$

where:

$$DFWM_{res-adj}\left(\frac{8,191,633\ cm^2-event}{kg}\right)=\left(\begin{array}{c}\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right)\times ED_{0-2}(2\ yr)\times EV_{0-2}\left(\frac{1\ event}{day}\right)\times SA_{0-2}\left(6,365\ cm^2\right)\times 10}{BW_{0-2}(15\ kg)}+\\\frac{EF_{2-6}\left(\frac{350\ days}{yr}\right)\times ED_{2-6}(4\ yr)\times EV_{2-6}\left(\frac{1\ event}{day}\right)\times SA_{2-6}\left(6,365\ cm^2\right)\times 3}{BW_{2-6}(15\ kg)}+\\\frac{EF_{6-16}\left(\frac{350\ days}{yr}\right)\times ED_{6-16}(10\ yr)\times EV_{6-16}\left(\frac{1\ event}{day}\right)\times SA_{6-16}\left(19,652\ cm^2\right)\times 3}{BW_{6-16}(80\ kg)}+\\\frac{EF_{16-26}\left(\frac{350\ days}{yr}\right)\times ED_{16-26}(10\ yr)\times EV_{16-26}\left(\frac{1\ event}{day}\right)\times SA_{16-26}\left(19,652\ cm^2\right)\times 1}{BW_{16-26}(80\ kg)}\end{array}\right)$$

Mutagenic Tap Water Total

$$\mathrm{PRG}_{\text{res-wat-totmu}}\left(\frac{\mu g}{L}\right)=\frac{1}{\dfrac{1}{\mathrm{PRG}_{\text{res-wat-ingmu}}}+\dfrac{1}{\mathrm{PRG}_{\text{res-wat-inhmu}}}+\dfrac{1}{\mathrm{PRG}_{\text{res-wat-dermu}}}}$$

Vinyl Chloride Tap Water Ingestion

$$\mathrm{PRG}_{\text{res-wat-ingvc}}\left(\frac{\mu g}{L}\right)=\frac{\mathrm{TR}}{\left(\left(\dfrac{\mathrm{CSF_o}\left(\frac{mg}{kg-day}\right)^{-1}\times\left(\frac{mg}{1000\ \mu g}\right)\times\mathrm{IFW}_{\text{res-adj}}\left(\frac{327.95\ L}{kg}\right)}{\mathrm{AT}_{\text{res}}\left(\frac{365\ days}{yr}\times\mathrm{LT}(70\ yrs)\right)}\right)+\left(\dfrac{\mathrm{CSF_o}\left(\frac{mg}{kg-day}\right)^{-1}\times\left(\frac{mg}{1000\ \mu g}\right)\times\mathrm{IRW}_{\text{res-c}}\left(\frac{0.78\ L}{day}\right)}{\mathrm{BW}_{\text{res-c}}(15\ kg)}\right)\right)}$$

where:

$$\mathrm{IFW}_{\text{res-adj}}\left(\frac{327.95\ L}{kg}\right)=\left[\frac{\mathrm{EF}_{\text{res-c}}\left(\frac{350\ days}{yr}\right)\times\mathrm{ED}_{\text{res-c}}(6\ yr)\times\mathrm{IRW}_{\text{res-c}}\left(\frac{0.78\ L}{day}\right)}{\mathrm{BW}_{\text{res-c}}(15\ kg)}+\frac{\mathrm{EF}_{\text{res-a}}\left(\frac{350\ days}{yr}\right)\times\mathrm{ED}_{\text{res-a}}(20\ yr)\times\mathrm{IRW}_{\text{res-a}}\left(\frac{2.5\ L}{day}\right)}{\mathrm{BW}_{\text{res-a}}(80\ kg)}\right]$$

Vinyl Chloride Tap Water Inhalation

$$\mathrm{PRG}_{\text{res-wat-inhvc}}\left(\frac{\mu g}{L}\right)=\frac{\mathrm{TR}}{\left(\left(\dfrac{\mathrm{IUR}\left(\frac{\mu g}{m^3}\right)^{-1}\times\mathrm{EF}_{\text{res}}\left(\frac{350\ days}{yr}\right)\times\mathrm{ED}_{\text{res}}(26\ yr)\times\mathrm{ET}_{\text{res}}\left(\frac{24\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times K\left(\frac{0.5\ L}{m^3}\right)}{\mathrm{AT}_{\text{res}}\left(\frac{365\ days}{yr}\times\mathrm{LT}(70\ yrs)\right)}\right)+\left(\mathrm{IUR}\left(\frac{\mu g}{m^3}\right)^{-1}\times K\left(\frac{0.5\ L}{m^3}\right)\right)\right)}$$

Vinyl Chloride Tap Water Dermal

IF $ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) \le t^{*}\ (hrs)$, then:

$$PRG_{res-wat-dervc}\left(\frac{\mu g}{L}\right) = \frac{DA_{vc-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}{\pi}}}$$

or,

IF $ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) > t^{*}\ (hrs)$, then:

$$PRG_{res-wat-dervc}\left(\frac{\mu g}{L}\right) = \frac{DA_{vc-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) = \left(\frac{\left(ED_{res-c}(6\ yr) \times ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)\right) + \left(ED_{res-a}(20\ yr) \times ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right)\right)}{ED_{res}(26\ yr)}\right)$$

and:

$$DA_{vc-event}\left(\frac{\mu g}{cm^2-event}\right) = \frac{TR}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left[\left(\frac{DFW_{res-adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + \left(\frac{EV_{res-c}\left(\frac{1\ event}{day}\right) \times SA_{res-c}\left(6,365\ cm^2\right)}{BW_{res-c}(15\ kg)}\right)\right]}$$

where:

$$DFW_{res-adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right) = \left(\begin{array}{c}\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times EV_{res-c}\left(\frac{1\ event}{day}\right) \times SA_{res-c}\left(6,365\ cm^2\right)}{BW_{res-c}(15\ kg)} + \\ \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times EV_{res-a}\left(\frac{1\ event}{day}\right) \times SA_{res-a}\left(19,652\ cm^2\right)}{BW_{res-a}(80\ kg)}\end{array}\right)$$

Vinyl Chloride Tap Water Total

$$PRG_{res-wat-totvc}\left(\frac{\mu g}{L}\right) = \frac{1}{\frac{1}{PRG_{res-wat-ingvc}} + \frac{1}{PRG_{res-wat-inhvc}} + \frac{1}{PRG_{res-wat-dervc}}}$$

Trichloroethylene Tap Water Ingestion

$$PRG_{res-wat-ingtce}\left(\frac{\mu g}{L}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{mg}{1000\ \mu g}\right) \times \left(\left(CAF_o(0.804) \times IFW_{res-adj}\left(\frac{327.95\ L}{kg}\right)\right) + \left(MAF_o(0.202) \times IFWM_{res-adj}\left(\frac{1{,}019.9\ L}{kg}\right)\right)\right)}$$

where:

$$IFW_{res-adj}\left(\frac{327.95\ L}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRW_{res-c}\left(\frac{0.78\ L}{day}\right)}{BW_{res-c}(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRW_{res-a}\left(\frac{2.5\ L}{day}\right)}{BW_{res-a}(80\ kg)}\right]$$

and:

$$IFWM_{res-adj}\left(\frac{1{,}019.9\ L}{kg}\right) = \left[\begin{array}{l}\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times IRW_{0-2}\left(\frac{0.78\ L}{day}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times IRW_{2-6}\left(\frac{0.78\ L}{day}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times IRW_{6-16}\left(\frac{2.5\ L}{day}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times IRW_{16-26}\left(\frac{2.5\ L}{day}\right) \times 1}{BW_{16-26}(80\ kg)}\end{array}\right]$$

Trichloroethylene Tap Water Inhalation

$$PRG_{res-wat-inhtce}\left(\frac{\mu g}{L}\right) = \frac{TR \times AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times K\left(\frac{0.5\ L}{m^3}\right) \times \left[\begin{array}{l}\left(EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times CAF_i(0.756)\right) + \\ \left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 1\right)\end{array}\right]}$$

Trichloroethylene Tap Water Dermal

IF $ET_{event-res-madj}\left(\frac{0.671\text{ hrs}}{\text{event}}\right) \leq t^{*}(\text{hrs})$, then:

$$PRG_{res-wat-dertce}\left(\frac{\mu g}{L}\right) = \frac{DA_{tce-event}\left(\frac{\mu g}{cm^2-\text{event}}\right) \times \left(\frac{1000\text{ cm}^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-res-madj}\left(\frac{0.671\text{ hrs}}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-res-madj}\left(\frac{0.671\text{ hrs}}{\text{event}}\right) > t^{*}(\text{hrs})$, then:

$$PRG_{res-wat-dertce}\left(\frac{\mu g}{L}\right) = \frac{DA_{tce-event}\left(\frac{\mu g}{cm^2-\text{event}}\right) \times \left(\frac{1000\text{ cm}^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-res-madj}\left(\frac{0.671\text{ hrs}}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$ET_{event-res-madj}\left(\frac{0.671\text{ hrs}}{event}\right) = \frac{\left(\begin{array}{c}\left(ED_{0-2}(2\text{ yr}) \times ET_{event-(0-2)}\left(\frac{0.54\text{ hrs}}{event}\right)\right) + \left(ED_{2-6}(4\text{ yr}) \times ET_{event-(2-6)}\left(\frac{0.54\text{ hrs}}{event}\right)\right) + \\ \left(ED_{6-16}(10\text{ yr}) \times ET_{event-(6-16)}\left(\frac{0.71\text{ hrs}}{event}\right)\right) + \left(ED_{16-26}(10\text{ yr}) \times ET_{event-(16-26)}\left(\frac{0.71\text{ hrs}}{event}\right)\right)\end{array}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

and:

$$DA_{tce-event}\left(\frac{\mu g}{cm^2-\text{event}}\right) = \frac{TR \times AT_{res}\left(\frac{365\text{ days}}{yr} \times LT(70\text{ yrs})\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left[\begin{array}{c}\left(CAF_o(0.804) \times DFW_{res-adj}\left(\frac{2,610,650\text{ cm}^2-\text{event}}{kg}\right)\right) + \\ \left(MAF_o(0.202) \times DFWM_{res-adj}\left(\frac{8,191,633\text{ cm}^2-\text{event}}{kg}\right)\right)\end{array}\right]}$$

where:

$$DFW_{res-adj}\left(\frac{2,610,650\text{ cm}^2-\text{event}}{kg}\right) = \left(\begin{array}{c}\frac{EF_{res-c}\left(\frac{350\text{ days}}{yr}\right) \times ED_{res-c}(6\text{ yr}) \times EV_{res-c}\left(\frac{1\text{ event}}{day}\right) \times SA_{res-c}\left(6,365\text{ cm}^2\right)}{BW_{res-c}(15\text{ kg})} + \\ \frac{EF_{res-a}\left(\frac{350\text{ days}}{yr}\right) \times ED_{res-a}(20\text{ yr}) \times EV_{res-a}\left(\frac{1\text{ event}}{day}\right) \times SA_{res-a}\left(19,652\text{ cm}^2\right)}{BW_{res-a}(80\text{ kg})}\end{array}\right)$$

and:

$$DFWM_{res-adj}\left(\frac{8,191,633\text{ cm}^2-\text{event}}{kg}\right) = \left(\begin{array}{c}\frac{EF_{0-2}\left(\frac{350\text{ days}}{yr}\right) \times ED_{0-2}(2\text{ yr}) \times EV_{0-2}\left(\frac{1\text{ event}}{day}\right) \times SA_{0-2}\left(6,365\text{ cm}^2\right) \times 10}{BW_{0-2}(15\text{ kg})} + \\ \frac{EF_{2-6}\left(\frac{350\text{ days}}{yr}\right) \times ED_{2-6}(4\text{ yr}) \times EV_{2-6}\left(\frac{1\text{ event}}{day}\right) \times SA_{2-6}\left(6,365\text{ cm}^2\right) \times 3}{BW_{2-6}(15\text{ kg})} + \\ \frac{EF_{6-16}\left(\frac{350\text{ days}}{yr}\right) \times ED_{6-16}(10\text{ yr}) \times EV_{6-16}\left(\frac{1\text{ event}}{day}\right) \times SA_{6-16}\left(19,652\text{ cm}^2\right) \times 3}{BW_{6-16}(80\text{ kg})} + \\ \frac{EF_{16-26}\left(\frac{350\text{ days}}{yr}\right) \times ED_{16-26}(10\text{ yr}) \times EV_{16-26}\left(\frac{1\text{ event}}{day}\right) \times SA_{16-26}\left(19,652\text{ cm}^2\right) \times 1}{BW_{16-26}(80\text{ kg})}\end{array}\right)$$

Trichloroethylene Tap Water Total

$$\text{PRG}_{\text{res-wat-tottce}}\left(\frac{\mu g}{L}\right) = \frac{1}{\dfrac{1}{\text{PRG}_{\text{res-wat-ingtce}}} + \dfrac{1}{\text{PRG}_{\text{res-wat-inhtce}}} + \dfrac{1}{\text{PRG}_{\text{res-wat-dertce}}}}$$

Supporting Child Tap Water

$$\text{ED}_{\text{res-c}}(6\text{ yr}) = \text{ED}_{0-2}(2\text{ yr}) + \text{ED}_{2-6}(4\text{ yr})$$

$$\text{BW}_{\text{res-c}}(15\text{ kg}) = \frac{\text{ED}_{0-2}(2\text{ yr}) \times \text{BW}_{0-2}(15\text{ kg}) + \text{ED}_{2-6}(4\text{ yr}) \times \text{BW}_{2-6}(15\text{ kg})}{\text{ED}_{0-2}(2\text{ yr}) + \text{ED}_{2-6}(4\text{ yr})}$$

$$\text{EF}_{\text{res-c}}\left(\frac{350\text{ days}}{\text{yr}}\right) = \frac{\text{ED}_{0-2}(2\text{ yr}) \times \text{EF}_{0-2}\left(\frac{350\text{ days}}{\text{yr}}\right) + \text{ED}_{2-6}(4\text{ yr}) \times \text{EF}_{2-6}\left(\frac{350\text{ days}}{\text{yr}}\right)}{\text{ED}_{0-2}(2\text{ yr}) + \text{ED}_{2-6}(4\text{ yr})}$$

$$\text{ET}_{\text{res-c}}\left(\frac{24\text{ hrs}}{\text{day}}\right) = \frac{\text{ED}_{0-2}(2\text{ yr}) \times \text{ET}_{0-2}\left(\frac{24\text{ hrs}}{\text{day}}\right) + \text{ED}_{2-6}(4\text{ yr}) \times \text{ET}_{2-6}\left(\frac{24\text{ hrs}}{\text{day}}\right)}{\text{ED}_{0-2}(2\text{ yr}) + \text{ED}_{2-6}(4\text{ yr})}$$

$$\text{ET}_{\text{event-res-c}}\left(\frac{0.54\text{ hrs}}{\text{event}}\right) = \frac{\text{ED}_{0-2}(2\text{ yr}) \times \text{ET}_{\text{event-(0-2)}}\left(\frac{0.54\text{ hrs}}{\text{event}}\right) + \text{ED}_{2-6}(4\text{ yr}) \times \text{ET}_{\text{event-(2-6)}}\left(\frac{0.54\text{ hrs}}{\text{event}}\right)}{\text{ED}_{0-2}(2\text{ yr}) + \text{ED}_{2-6}(4\text{ yr})}$$

$$\text{EV}_{\text{res-c}}\left(\frac{1\text{ event}}{\text{day}}\right) = \frac{\text{ED}_{0-2}(2\text{ yr}) \times \text{EV}_{0-2}\left(\frac{1\text{ event}}{\text{day}}\right) + \text{ED}_{2-6}(4\text{ yr}) \times \text{EV}_{2-6}\left(\frac{1\text{ event}}{\text{day}}\right)}{\text{ED}_{0-2}(2\text{ yr}) + \text{ED}_{2-6}(4\text{ yr})}$$

$$\text{SA}_{\text{res-c}}\left(6{,}365\text{ cm}^2\right) = \frac{\text{ED}_{0-2}(2\text{ yr}) \times \text{SA}_{0-2}\left(6{,}365\text{ cm}^2\right) + \text{ED}_{2-6}(4\text{ yr}) \times \text{SA}_{2-6}\left(6{,}365\text{ cm}^2\right)}{\text{ED}_{0-2}(2\text{ yr}) + \text{ED}_{2-6}(4\text{ yr})}$$

$$\text{IRW}_{\text{res-c}}\left(\frac{0.78\text{ L}}{\text{day}}\right) = \frac{\text{ED}_{0-2}(2\text{ yr}) \times \text{IRW}_{0-2}\left(\frac{0.78\text{ L}}{\text{day}}\right) + \text{ED}_{2-6}(4\text{ yr}) \times \text{IRW}_{2-6}\left(\frac{0.78\text{ L}}{\text{day}}\right)}{\text{ED}_{0-2}(2\text{ yr}) + \text{ED}_{2-6}(4\text{ yr})}$$

Supporting Adult Tap Water

$$ED_{res-a}(20\ yr) = ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)$$

$$BW_{res-a}(80\ kg) = \frac{ED_{6-16}(10\ yr) \times BW_{6-16}(80\ kg) + ED_{16-26}(10\ yr) \times BW_{16-26}(80\ kg)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$EF_{res-a}\left(\frac{350\ days}{yr}\right) = \frac{ED_{6-16}(10\ yr) \times EF_{6-16}\left(\frac{350\ days}{yr}\right) + ED_{16-26}(10\ yr) \times EF_{16-26}\left(\frac{350\ days}{yr}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$ET_{res-a}\left(\frac{24\ hrs}{day}\right) = \frac{ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) + ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right) = \frac{ED_{6-16}(10\ yr) \times ET_{event-(6-16)}\left(\frac{0.71\ hrs}{event}\right) + ED_{16-26}(10\ yr) \times ET_{event-(16-26)}\left(\frac{0.71\ hrs}{event}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$EV_{res-a}\left(\frac{1\ event}{day}\right) = \frac{ED_{6-16}(10\ yr) \times EV_{6-16}\left(\frac{1\ event}{day}\right) + ED_{16-26}(10\ yr) \times EV_{16-26}\left(\frac{1\ event}{day}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$SA_{res-a}\left(19,652\ cm^2\right) = \frac{ED_{6-16}(10\ yr) \times SA_{6-16}\left(19,652\ cm^2\right) + ED_{16-26}(10\ yr) \times SA_{16-26}\left(19,652\ cm^2\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$IRW_{res-a}\left(\frac{2.5\ L}{day}\right) = \frac{ED_{6-16}(10\ yr) \times IRW_{6-16}\left(\frac{2.5\ L}{day}\right) + ED_{16-26}(10\ yr) \times IRW_{16-26}\left(\frac{2.5\ L}{day}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

Supporting Age-adjusted Tap Water

$$ED_{res}(26\text{ yr}) = ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})$$

$$EF_{res}\left(\frac{350\text{ days}}{\text{yr}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}(2\text{ yr}) \times EF_{0-2}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{2-6}(4\text{ yr}) \times EF_{2-6}\left(\frac{350\text{ days}}{\text{yr}}\right) + \\ ED_{6-16}(10\text{ yr}) \times EF_{6-16}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{16-26}(10\text{ yr}) \times EF_{16-26}\left(\frac{350\text{ days}}{\text{yr}}\right) \end{array}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$ET_{res}\left(\frac{24\text{ hrs}}{\text{day}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}(2\text{ yr}) \times ET_{0-2}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{2-6}(4\text{ yr}) \times ET_{2-6}\left(\frac{24\text{ hrs}}{\text{day}}\right) + \\ ED_{6-16}(10\text{ yr}) \times ET_{6-16}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times ET_{16-26}\left(\frac{24\text{ hrs}}{\text{day}}\right) \end{array}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

<u>Resident Fish PRG Equations</u>

Noncarcinogenic Fish Ingestion

$$PRG_{res-fsh-ingn}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{res-a}\left(\frac{365\text{ days}}{\text{yr}} \times ED_{res}(26\text{ yr})\right) \times BW_{res-a}(80\text{ kg})}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{10^{-6}\text{ kg}}{\text{mg}}\right) \times EF_{res}\left(\frac{350\text{ days}}{\text{yr}}\right) \times ED_{res}(26\text{ yr}) \times IRFI_{res-a}\left(\frac{54{,}000\text{ mg}}{\text{day}}\right)}$$

Carcinogenic Fish Ingestion

$$PRG_{res-fsh-ingc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{res}\left(\frac{365\text{ days}}{\text{yr}} \times LT(70\text{ yrs})\right) \times BW_{res-a}(80\text{ kg})}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\text{ kg}}{\text{mg}}\right) \times EF_{res}\left(\frac{350\text{ days}}{\text{yr}}\right) \times ED_{res}(26\text{ yr}) \times IRFI_{res-a}\left(\frac{54{,}000\text{ mg}}{\text{day}}\right)}$$

Noncarcinogenic Fish Ingestion Back-calculated to Water

$$PRG_{res-fsh-ingnw}\left(\frac{mg}{L}\right) = \frac{PRG_{res-fsh-ingnw}\left(\frac{mg}{kg}\right)}{BCF\left(\frac{L}{kg}\right)}$$

Carcinogenic Fish Ingestion Back-calculated to Water

$$PRG_{res-fsh-ingcw}\left(\frac{mg}{L}\right) = \frac{PRG_{res-fsh-ingcw}\left(\frac{mg}{kg}\right)}{BCF\left(\frac{L}{kg}\right)}$$

Composite Worker Soil PRG Equations

Noncarcinogenic Soil Ingestion

$$PRG_{com-sol-ingn}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{com-a}\left(\frac{365\ days}{yr} \times ED_{com}\,(25\ yr)\right) \times BW_{com}\,(80\ kg)}{\left(\frac{RBA}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}\,(25\ yr) \times IRS_{com}\left(\frac{100\ mg}{day}\right)}$$

Noncarcinogenic Soil Inhalation

$$PRG_{com-sol-inhn}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{com-a}\left(\frac{365\ days}{yr} \times ED_{com}\,(25\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}\,(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Noncarcinogenic Soil Dermal

$$PRG_{com-sol-dern}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{com-a}\left(\frac{365\ days}{yr} \times ED_{com}\,(25\ yr)\right) \times BW_{com}\,(80\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right) \times GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}\,(25\ yr) \times SA_{com}\left(\frac{3{,}527\ cm^2}{day}\right) \times AF_{com}\left(\frac{0.12\ mg}{cm^2}\right) \times ABS_d}$$

Noncarcinogenic Soil Total

$$PRG_{com-sol-totn}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{com-sol-ingn}} + \frac{1}{PRG_{com-sol-inhn}} + \frac{1}{PRG_{com-sol-dern}}}$$

Carcinogenic Soil Ingestion

$$PRG_{com-sol-ingc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{com}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{com}\,(80\ kg)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}\,(25\ yr) \times IRS_{com}\left(\frac{100\ mg}{day}\right)}$$

Carcinogenic Soil Inhalation

$$PRG_{com-sol-inhc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{com}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}\,(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Carcinogenic Soil Dermal

$$PRG_{com-sol-derc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{com}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{com}(80\ kg)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times SA_{com}\left(\frac{3,527\ cm^2}{day}\right) \times AF_{com}\left(\frac{0.12\ mg}{cm^2}\right) \times ABS_d}$$

Carcinogenic Soil Total

$$PRG_{com-sol-totc}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{com-sol-ingc}} + \frac{1}{PRG_{com-sol-inhc}} + \frac{1}{PRG_{com-sol-derc}}}$$

Composite Worker Air PRG Equations

Noncarcinogenic Air Inhalation

$$PRG_{com-air-inhn}\left(\frac{\mu g}{m^3}\right) = \frac{THQ \times AT_{com-a}\left(\frac{365\ days}{yr} \times ED_{com}(25\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Carcinogenic Air Inhalation

$$PRG_{com-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{TR \times AT_{com}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Refractory Ceramic Fibers Air Inhalation

$$PRG_{com-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{THQ \times AT_{com-a}\left(\frac{365\ days}{yr} \times ED_{com}(25\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{f}{m^3}\right)}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Asbestos Air Inhalation

$$PRG_{com-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{TR \times AT_{com}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{f}{m^3}\right)^{-1} \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Outdoor Worker Soil PRG Equations

Noncarcinogenic Soil Ingestion

$$\mathrm{PRG_{out\text{-}sol\text{-}ingn}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{THQ}\times \mathrm{AT_{out\text{-}a}}\left(\frac{365\ \mathrm{days}}{\mathrm{yr}}\times \mathrm{ED_{out}}\,(25\ \mathrm{yr})\right)\times \mathrm{BW_{out}}\,(80\ \mathrm{kg})}{\left(\frac{\mathrm{RBA}}{\mathrm{RfD_o}\left(\frac{\mathrm{mg}}{\mathrm{kg-day}}\right)}\right)\times\left(\frac{10^{-6}\ \mathrm{kg}}{\mathrm{mg}}\right)\times \mathrm{EF_{out}}\left(\frac{225\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED_{out}}\,(25\ \mathrm{yr})\times \mathrm{IRS_{out}}\left(\frac{100\ \mathrm{mg}}{\mathrm{day}}\right)}$$

Noncarcinogenic Soil Inhalation

$$\mathrm{PRG_{out\text{-}sol\text{-}inhn}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{THQ}\times \mathrm{AT_{out\text{-}a}}\left(\frac{365\ \mathrm{days}}{\mathrm{yr}}\times \mathrm{ED_{out}}\,(25\ \mathrm{yr})\right)}{\left(\frac{1}{\mathrm{RfC}\left(\frac{\mathrm{mg}}{\mathrm{m^3}}\right)}\right)\times \mathrm{EF_{out}}\left(\frac{225\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED_{out}}\,(25\ \mathrm{yr})\times \mathrm{ET_{out}}\left(\frac{8\ \mathrm{hrs}}{\mathrm{day}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)\times\left(\frac{1}{\mathrm{VF_s}\left(\frac{\mathrm{m^3}}{\mathrm{kg}}\right)}+\frac{1}{\mathrm{PEF}\left(\frac{\mathrm{m^3}}{\mathrm{kg}}\right)}\right)}$$

Noncarcinogenic Soil Dermal

$$\mathrm{PRG_{out\text{-}sol\text{-}dern}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{THQ}\times \mathrm{AT_{out\text{-}a}}\left(\frac{365\ \mathrm{days}}{\mathrm{yr}}\times \mathrm{ED_{out}}\,(25\ \mathrm{yr})\right)\times \mathrm{BW_{out}}\,(80\ \mathrm{kg})}{\left(\frac{1}{\mathrm{RfD_o}\left(\frac{\mathrm{mg}}{\mathrm{kg-day}}\right)\times \mathrm{GIABS}}\right)\times\left(\frac{10^{-6}\ \mathrm{kg}}{\mathrm{mg}}\right)\times \mathrm{EF_{out}}\left(\frac{225\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED_{out}}\,(25\ \mathrm{yr})\times \mathrm{SA_{out}}\left(\frac{3{,}527\ \mathrm{cm^2}}{\mathrm{day}}\right)\times \mathrm{AF_{out}}\left(\frac{0.12\ \mathrm{mg}}{\mathrm{cm^2}}\right)\times \mathrm{ABS_d}}$$

Noncarcinogenic Soil Total

$$\mathrm{PRG_{out\text{-}sol\text{-}totn}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{1}{\frac{1}{\mathrm{PRG_{out\text{-}sol\text{-}ingn}}}+\frac{1}{\mathrm{PRG_{out\text{-}sol\text{-}inhn}}}+\frac{1}{\mathrm{PRG_{out\text{-}sol\text{-}dern}}}}$$

Carcinogenic Soil Ingestion

$$\mathrm{PRG_{out\text{-}sol\text{-}ingc}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{TR}\times \mathrm{AT_{out}}\left(\frac{365\ \mathrm{days}}{\mathrm{yr}}\times \mathrm{LT}\,(70\ \mathrm{yrs})\right)\times \mathrm{BW_{out}}\,(80\ \mathrm{kg})}{\mathrm{CSF_o}\left(\frac{\mathrm{mg}}{\mathrm{kg-day}}\right)^{-1}\times\left(\frac{10^{-6}\ \mathrm{kg}}{\mathrm{mg}}\right)\times \mathrm{RBA}\times \mathrm{EF_{out}}\left(\frac{225\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED_{out}}\,(25\ \mathrm{yr})\times \mathrm{IRS_{out}}\left(\frac{100\ \mathrm{mg}}{\mathrm{day}}\right)}$$

Carcinogenic Soil Inhalation

$$\mathrm{PRG_{out\text{-}sol\text{-}inhc}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{TR}\times \mathrm{AT_{out}}\left(\frac{365\ \mathrm{days}}{\mathrm{yr}}\times \mathrm{LT}\,(70\ \mathrm{yrs})\right)}{\mathrm{IUR}\left(\frac{\mu\mathrm{g}}{\mathrm{m^3}}\right)^{-1}\times\left(\frac{1000\ \mu\mathrm{g}}{\mathrm{mg}}\right)\times \mathrm{EF_{out}}\left(\frac{225\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED_{out}}\,(25\ \mathrm{yr})\times \mathrm{ET_{out}}\left(\frac{8\ \mathrm{hrs}}{\mathrm{day}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)\times\left(\frac{1}{\mathrm{VF_s}\left(\frac{\mathrm{m^3}}{\mathrm{kg}}\right)}+\frac{1}{\mathrm{PEF}\left(\frac{\mathrm{m^3}}{\mathrm{kg}}\right)}\right)}$$

Carcinogenic Soil Dermal

$$PRG_{rec-sol-derc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) \times ABS_d}$$

where:

$$DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times SA_{rec-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{rec-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Carcinogenic Soil Total

$$PRG_{out-sol-totc}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{out-sol-ingc}} + \frac{1}{PRG_{out-sol-inhc}} + \frac{1}{PRG_{out-sol-derc}}}$$

Outdoor Worker Air PRG Equations

Noncarcinogenic Air Inhalation

$$PRG_{out-air-inhn}\left(\frac{\mu g}{m^3}\right) = \frac{THQ \times AT_{out-a}\left(\frac{365\ days}{yr} \times ED_{out}(25\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Carcinogenic Air Inhalation

$$PRG_{out-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{TR \times AT_{out}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Refractory Ceramic Fibers Air Inhalation

$$PRG_{out-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{THQ \times AT_{out-a}\left(\frac{365\ days}{yr} \times ED_{out}(25\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{f}{m^3}\right)}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Asbestos Air Inhalation

$$PRG_{out-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{TR \times AT_{out}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{f}{m^3}\right)^{-1} \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Indoor Worker Soil PRG Equations

Noncarcinogenic Soil Ingestion

$$PRG_{ind-sol-ingn}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{ind-a}\left(\frac{365\ days}{yr} \times ED_{ind}(25\ yr)\right) \times BW_{ind}(80\ kg)}{\left(\frac{RBA}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times IRS_{ind}\left(\frac{50\ mg}{day}\right)}$$

Noncarcinogenic Soil Inhalation

$$PRG_{ind-sol-inhn}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{ind-a}\left(\frac{365\ days}{yr} \times ED_{ind}(25\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Noncarcinogenic Soil Total

$$PRG_{ind-sol-totn}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{ind-sol-ingn}} + \frac{1}{PRG_{ind-sol-inhn}}}$$

Carcinogenic Soil Ingestion

$$PRG_{ind-sol-ingc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{ind}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{ind}(80\ kg)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times IRS_{ind}\left(\frac{50\ mg}{day}\right)}$$

Carcinogenic Soil Inhalation

$$PRG_{ind-sol-inhc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{ind}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Carcinogenic Soil Total

$$PRG_{ind-sol-totc}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{ind-sol-ingc}} + \frac{1}{PRG_{ind-sol-inhc}}}$$

Indoor Worker Air PRG Equations

Noncarcinogenic Air Inhalation

$$PRG_{ind-air-inhn}\left(\frac{\mu g}{m^3}\right) = \frac{THQ \times AT_{ind-a}\left(\frac{365\ days}{yr} \times ED_{ind}\,(25\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}\,(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Carcinogenic Air Inhalation

$$PRG_{ind-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{TR \times AT_{ind}\left(\frac{365\ days}{yr} \times LT\,(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}\,(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Refractory Ceramic Fibers Air Inhalation

$$PRG_{ind-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{THQ \times AT_{ind-a}\left(\frac{365\ days}{yr} \times ED_{ind}\,(25\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{f}{m^3}\right)}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}\,(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Asbestos Air Inhalation

$$PRG_{ind-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{TR \times AT_{ind}\left(\frac{365\ days}{yr} \times LT\,(70\ yrs)\right)}{IUR\left(\frac{f}{m^3}\right)^{-1} \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}\,(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Indoor Worker Tap Water PRG Equations

Noncarcinogenic Tap Water Ingestion

$$\text{PRG}_{\text{ind-wat-ingn}}\left(\frac{\mu g}{L}\right) = \frac{\text{THQ} \times \text{AT}_{\text{ind-a}}\left(\frac{365\text{ days}}{\text{yr}} \times \text{ED}_{\text{ind}}(25\text{ yr})\right) \times \text{BW}_{\text{ind}}(80\text{ kg})}{\left(\frac{1}{\text{RfD}_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \text{EF}_{\text{ind}}\left(\frac{250\text{ days}}{\text{yr}}\right) \times \text{ED}_{\text{ind}}(25\text{ yr}) \times \text{IRW}_{\text{ind}}\left(\frac{1.25\text{ L}}{\text{day}}\right)}$$

Noncarcinogenic Tap Water Inhalation

$$\text{PRG}_{\text{ind-wat-inhn}}\left(\frac{\mu g}{L}\right) = \frac{\text{THQ} \times \text{AT}_{\text{ind-a}}\left(\frac{365\text{ days}}{\text{yr}} \times \text{ED}_{\text{ind}}(25\text{ yr})\right)}{\left(\frac{1}{\text{RfC}\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \text{EF}_{\text{ind}}\left(\frac{250\text{ days}}{\text{yr}}\right) \times \text{ED}_{\text{ind}}(25\text{ yr}) \times \text{ET}_{\text{ind-a}}\left(\frac{8\text{ hrs}}{\text{day}}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right) \times K\left(\frac{0.5\text{ L}}{m^3}\right)}$$

Noncarcinogenic Tap Water Dermal

For Inorganics:

$$\text{PRG}_{\text{ind-wat-dern}}\left(\frac{\mu g}{L}\right) = \frac{\text{DA}_{\text{event}}\left(\frac{\mu g}{cm^2-\text{event}}\right) \times \left(\frac{1000\text{ cm}^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times \text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right)}$$

For Organics:

IF $\text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right) \leq t^*\text{ (hrs)}$, then

$$\text{PRG}_{\text{ind-wat-dern}}\left(\frac{\mu g}{L}\right) = \frac{\text{DA}_{\text{event}}\left(\frac{\mu g}{cm^2-\text{event}}\right) \times \left(\frac{1000\text{ cm}^3}{L}\right)}{2 \times \text{FA} \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{\text{event}}\left(\frac{hrs}{\text{event}}\right) \times \text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right)}{\pi}}}$$

or,

IF $\text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right) > t^*\text{ (hrs)}$, then

$$\text{PRG}_{\text{ind-wat-dern}}\left(\frac{\mu g}{L}\right) = \frac{\text{DA}_{\text{event}}\left(\frac{\mu g}{cm^2-\text{event}}\right) \times \left(\frac{1000\text{ cm}^3}{L}\right)}{\text{FA} \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{\text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right)}{1 + B} + 2 \times \tau_{\text{event}}\left(\frac{hrs}{\text{event}}\right) \times \left(\frac{1 + 3B + 3B^2}{(1 + B)^2}\right)\right]}$$

where:

$$\text{DA}_{\text{event}}\left(\frac{\mu g}{cm^2-\text{event}}\right) = \frac{\text{THQ} \times \text{AT}_{\text{ind-a}}\left(\frac{365\text{ days}}{\text{yr}} \times \text{ED}_{\text{ind}}(25\text{ yr})\right) \times \left(\frac{1000\ \mu g}{mg}\right) \times \text{BW}_{\text{ind}}(80\text{ kg})}{\left(\frac{1}{\text{RfD}_o\left(\frac{mg}{kg-day}\right) \times \text{GIABS}}\right) \times \text{EF}_{\text{ind}}\left(\frac{250\text{ days}}{\text{yr}}\right) \times \text{ED}_{\text{ind}}(25\text{ yr}) \times \text{EV}_{\text{ind-a}}\left(\frac{1\text{ event}}{\text{day}}\right) \times \text{SA}_{\text{ind}}(19{,}652\text{ cm}^2)}$$

Noncarcinogenic Tap Water Total

$$\text{PRG}_{\text{ind-wat-totn}}\left(\frac{\mu g}{L}\right)=\frac{1}{\dfrac{1}{\text{PRG}_{\text{ind-wat-ingn}}}+\dfrac{1}{\text{PRG}_{\text{ind-wat-inhn}}}+\dfrac{1}{\text{PRG}_{\text{ind-wat-dern}}}}$$

Carcinogenic Tap Water Ingestion

$$\text{PRG}_{\text{ind-wat-ingc}}\left(\frac{\mu g}{L}\right)=\frac{\text{TR}\times\text{AT}_{\text{ind}}\left(\frac{365\text{ days}}{\text{yr}}\times\text{LT}(70\text{ yrs})\right)\times\text{BW}_{\text{ind}}(80\text{ kg})}{\text{CSF}_{\text{o}}\left(\frac{\text{mg}}{\text{kg}-\text{day}}\right)^{-1}\times\left(\frac{\text{mg}}{1000\ \mu g}\right)\times\text{EF}_{\text{ind}}\left(\frac{250\text{ days}}{\text{yr}}\right)\times\text{ED}_{\text{ind}}(25\text{ yr})\times\text{IRW}_{\text{ind}}\left(\frac{1.25\text{ L}}{\text{day}}\right)}$$

Carcinogenic Tap Water Inhalation

$$\text{PRG}_{\text{ind-wat-inhc}}\left(\frac{\mu g}{L}\right)=\frac{\text{TR}\times\text{AT}_{\text{ind}}\left(\frac{365\text{ days}}{\text{yr}}\times\text{LT}(70\text{ yrs})\right)}{\text{IUR}\left(\frac{\mu g}{m^3}\right)^{-1}\times\text{EF}_{\text{ind}}\left(\frac{250\text{ days}}{\text{yr}}\right)\times\text{ED}_{\text{ind}}(25\text{ yr})\times\text{ET}_{\text{ind-a}}\left(\frac{8\text{ hrs}}{\text{day}}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times\text{K}\left(\frac{0.5\text{ L}}{m^3}\right)}$$

Carcinogenic Tap Water Dermal

For Inorganics:

$$\text{PRG}_{\text{ind-wat-derc}}\left(\frac{\mu g}{L}\right)=\frac{\text{DA}_{\text{event}}\left(\frac{\mu g}{\text{cm}^2-\text{event}}\right)\times\left(\frac{1000\text{ cm}^3}{L}\right)}{\text{K}_{\text{p}}\left(\frac{\text{cm}}{\text{hr}}\right)\times\text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right)}$$

For Organics:

IF $\text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right)\leq t^*(\text{hrs})$, then

$$\text{PRG}_{\text{ind-wat-derc}}\left(\frac{\mu g}{L}\right)=\frac{\text{DA}_{\text{event}}\left(\frac{\mu g}{\text{cm}^2-\text{event}}\right)\times\left(\frac{1000\text{ cm}^3}{L}\right)}{2\times\text{FA}\times\text{K}_{\text{p}}\left(\frac{\text{cm}}{\text{hr}}\right)\times\sqrt{\dfrac{6\times\tau_{\text{event}}\left(\frac{\text{hrs}}{\text{event}}\right)\times\text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right)}{\pi}}}$$

or,

IF $\text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right)>t^*(\text{hrs})$, then

$$\text{PRG}_{\text{ind-wat-derc}}\left(\frac{\mu g}{L}\right)=\frac{\text{DA}_{\text{event}}\left(\frac{\mu g}{\text{cm}^2-\text{event}}\right)\times\left(\frac{1000\text{ cm}^3}{L}\right)}{\text{FA}\times\text{K}_{\text{p}}\left(\frac{\text{cm}}{\text{hr}}\right)\times\left[\dfrac{\text{ET}_{\text{event-ind-a}}\left(\frac{0.71\text{ hrs}}{\text{event}}\right)}{1+\text{B}}+2\times\tau_{\text{event}}\left(\frac{\text{hrs}}{\text{event}}\right)\times\left(\frac{1+3\text{B}+3\text{B}^2}{(1+\text{B})^2}\right)\right]}$$

where:

$$\text{DA}_{\text{event}}\left(\frac{\mu g}{\text{cm}^2-\text{event}}\right)=\frac{\text{TR}\times\text{AT}_{\text{ind}}\left(\frac{365\text{ days}}{\text{yr}}\times\text{LT}(70\text{ yrs})\right)\times\left(\frac{1000\ \mu g}{\text{mg}}\right)}{\left(\dfrac{\text{CSF}_{\text{o}}\left(\frac{\text{mg}}{\text{kg-day}}\right)^{-1}}{\text{GIABS}}\right)\times\text{EF}_{\text{ind}}\left(\frac{250\text{ days}}{\text{yr}}\right)\times\text{ED}_{\text{ind}}(25\text{ yr})\times\text{EV}_{\text{ind-a}}\left(\frac{1\text{ event}}{\text{day}}\right)\times\text{SA}_{\text{ind}}(19{,}652\text{ cm}^2)}$$

Carcinogenic Tap Water Total

$$PRG_{ind-wat-totc}\left(\frac{\mu g}{L}\right)=\frac{1}{\frac{1}{PRG_{ind-wat-ingc}}+\frac{1}{PRG_{ind-wat-inhc}}+\frac{1}{PRG_{ind-wat-derc}}}$$

Construction Worker Soil Exposure to Unpaved Road Traffic PRG Equations

Noncarcinogenic Soil Ingestion Unpaved Road Traffic

$$PRG_{con-sol-ingn}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)\times BW_{con}(80\ kg)}{\left(\frac{RBA}{RfD_o\left(\frac{mg}{kg-day}\right)}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times IRS_{con}\left(\frac{330\ mg}{day}\right)}$$

Noncarcinogenic Soil Inhalation Unpaved Road Traffic

$$PRG_{con-sol-inhn}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

Noncarcinogenic Soil Dermal Unpaved Road Traffic

$$PRG_{con-sol-dern}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)\times BW_{con}(80\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)\times GIABS}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times SA_{con}\left(\frac{3{,}527\ cm^2}{day}\right)\times AF_{con}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d}$$

Noncarcinogenic Soil Total Unpaved Road Traffic

$$PRG_{con-sol-totn}\left(\frac{mg}{kg}\right)=\frac{1}{\frac{1}{PRG_{con-sol-ingn}}+\frac{1}{PRG_{con-sol-inhn}}+\frac{1}{PRG_{con-sol-dern}}}$$

Carcinogenic Soil Ingestion Unpaved Road Traffic

$$PRG_{con-sol-ingc}\left(\frac{mg}{kg}\right)=\frac{TR\times AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{con}(80\ kg)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times IRS_{con}\left(\frac{330\ mg}{day}\right)}$$

Carcinogenic Soil Inhalation Unpaved Road Traffic

$$PRG_{con-sol-inhc}\left(\frac{mg}{kg}\right)=\frac{TR\times AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

Carcinogenic Soil Dermal Unpaved Road Traffic

$$PRG_{con-sol-derc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{con}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{con}(80\ kg)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times SA_{con}\left(\frac{3{,}527\ cm^2}{day}\right) \times AF_{con}\left(\frac{0.3\ mg}{cm^2}\right) \times ABS_d}$$

Carcinogenic Soil Total Unpaved Road Traffic

$$PRG_{con-sol-totc}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{con-sol-ingc}} + \frac{1}{PRG_{con-sol-inhc}} + \frac{1}{PRG_{con-sol-derc}}}$$

<u>Construction Worker Soil Exposure to Other Construction Activities PRG Equations</u>

Noncarcinogenic Soil Ingestion Other Construction Activities

$$PRG_{con-sol-ingnsa}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times \left(\frac{7\ days}{wk}\right) \times ED_{con}(1\ yr)\right) \times BW_{con}(80\ kg)}{\left(\frac{RBA}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times IRS_{con}\left(\frac{330\ mg}{day}\right)}$$

Noncarcinogenic Soil Inhalation Other Construction Activities

$$PRG_{con-sol-inhnsa}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times \left(\frac{7\ days}{wk}\right) \times ED_{con}(1\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF'_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

Noncarcinogenic Soil Dermal Other Construction Activities

$$PRG_{con-sol-dernsa}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times \left(\frac{7\ days}{wk}\right) \times ED_{con}(1\ yr)\right) \times BW_{con}(80\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right) \times GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times SA_{con}\left(\frac{3{,}527\ cm^2}{day}\right) \times AF_{con}\left(\frac{0.3\ mg}{cm^2}\right) \times ABS_d}$$

Noncarcinogenic Soil Total Other Construction Activities

$$PRG_{con-sol-totnsa}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{con-sol-ingnsa}} + \frac{1}{PRG_{con-sol-inhnsa}} + \frac{1}{PRG_{con-sol-dernsa}}}$$

Carcinogenic Soil Ingestion Other Construction Activities

$$PRG_{con-sol-ingcsa}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{con}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{con}(80\ kg)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times IRS_{con}\left(\frac{330\ mg}{day}\right)}$$

Carcinogenic Soil Inhalation Other Construction Activities

$$PRG_{con-sol-inhcsa}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{con}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF'_{sc}\left(\frac{m^3}{kg}\right)}\right)}$$

Carcinogenic Soil Dermal Other Construction Activities

$$PRG_{con-sol-dercsa}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{con}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{con}(80\ kg)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times SA_{con}\left(\frac{3,527\ cm^2}{day}\right) \times AF_{con}\left(\frac{0.3\ mg}{cm^2}\right) \times ABS_d}$$

Carcinogenic Soil Total Other Construction Activities

$$PRG_{con-sol-totcsa}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{con-sol-ingcsa}} + \frac{1}{PRG_{con-sol-inhcsa}} + \frac{1}{PRG_{con-sol-dercsa}}}$$

<u>**Construction Worker Air PRG Equations**</u>

Noncarcinogenic Air Inhalation

$$PRG_{con-air-inhn}\left(\frac{\mu g}{m^3}\right) = \frac{THQ \times AT_{con-a}\left(\frac{365\ days}{yr} \times ED_{con}(1\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Carcinogenic Air Inhalation

$$PRG_{con-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{TR \times AT_{con}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Refractory Ceramic Fibers Air Inhalation

$$PRG_{con-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{THQ \times AT_{con-a}\left(\frac{365\ days}{yr} \times ED_{con}(1\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{f}{m^3}\right)}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Asbestos Air Inhalation

$$PRG_{con-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{TR \times AT_{con}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{f}{m^3}\right)^{-1} \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Excavation Worker Soil PRG Equations

Noncarcinogenic Soil Ingestion

$$PRG_{exc-sol-ingn}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{exc-a}\left(\frac{365\ days}{yr}\times ED_{exc}(1\ yr)\right)\times BW_{exc}(80\ kg)}{\left(\frac{RBA}{RfD_o\left(\frac{mg}{kg-day}\right)}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times IRS_{exc}\left(\frac{330\ mg}{day}\right)}$$

Noncarcinogenic Soil Inhalation

$$PRG_{exc-sol-inhn}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{exc-a}\left(\frac{365\ days}{yr}\times ED_{exc}(1\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Noncarcinogenic Soil Dermal

$$PRG_{exc-sol-dern}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{exc-a}\left(\frac{365\ days}{yr}\times ED_{exc}(1\ yr)\right)\times BW_{exc}(80\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)\times GIABS}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times SA_{exc}\left(\frac{3{,}527\ cm^2}{day}\right)\times AF_{exc}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d}$$

Noncarcinogenic Soil Total

$$PRG_{exc-sol-totn}\left(\frac{mg}{kg}\right)=\frac{1}{\frac{1}{PRG_{exc-sol-ingn}}+\frac{1}{PRG_{exc-sol-inhn}}+\frac{1}{PRG_{exc-sol-dern}}}$$

Carcinogenic Soil Ingestion

$$PRG_{exc-sol-ingc}\left(\frac{mg}{kg}\right)=\frac{TR\times AT_{exc}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{exc}(80\ kg)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times IRS_{exc}\left(\frac{330\ mg}{day}\right)}$$

Carcinogenic Soil Inhalation

$$PRG_{exc-sol-inhc}\left(\frac{mg}{kg}\right)=\frac{TR\times AT_{exc}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1}\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Carcinogenic Soil Dermal

$$PRG_{exc-sol-derc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{exc}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{exc}(80\ kg)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times SA_{exc}\left(\frac{3,527\ cm^2}{day}\right) \times AF_{exc}\left(\frac{0.3\ mg}{cm^2}\right) \times ABS_d}$$

Carcinogenic Soil Total

$$PRG_{exc-sol-totc}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{exc-sol-ingc}} + \frac{1}{PRG_{exc-sol-inhc}} + \frac{1}{PRG_{exc-sol-derc}}}$$

Excavation Worker Air PRG Equations

Noncarcinogenic Air Inhalation

$$PRG_{exc-air-inhn}\left(\frac{\mu g}{m^3}\right) = \frac{THQ \times AT_{exc-a}\left(\frac{365\ days}{yr} \times ED_{exc}(1\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Carcinogenic Air Inhalation

$$PRG_{exc-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{TR \times AT_{exc}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Refractory Ceramic Fibers Air Inhalation

$$PRG_{exc-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{THQ \times AT_{exc-a}\left(\frac{365\ days}{yr} \times ED_{exc}(1\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{f}{m^3}\right)}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Asbestos Air Inhalation

$$PRG_{exc-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{TR \times AT_{exc}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{f}{m^3}\right)^{-1} \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}$$

Recreator Soil/Sediment PRG Equations

Noncarcinogenic Child Soil Ingestion

$$PRG_{rec-sol-ingnc}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{rec-c}\left(\frac{365\ days}{yr}\times ED_{rec-c}(6\ yr)\right)\times BW_{rec-c}(15\ kg)}{\left(\frac{RBA}{RfD_o\left(\frac{mg}{kg-day}\right)}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{rec-c}\left(\frac{75\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times IRS_{rec-c}\left(\frac{200\ mg}{day}\right)}$$

Noncarcinogenic Child Soil Inhalation

$$PRG_{rec-sol-inhnc}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{rec-c}\left(\frac{365\ days}{yr}\times ED_{rec-c}(6\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right)\times EF_{rec-c}\left(\frac{75\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times ET_{rec-c}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Noncarcinogenic Child Soil Dermal

$$PRG_{rec-sol-dernc}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{rec-c}\left(\frac{365\ days}{yr}\times ED_{rec-c}(6\ yr)\right)\times BW_{rec-c}(15\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)\times GIABS}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{rec-c}\left(\frac{75\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right)\times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right)\times ABS_d}$$

Noncarcinogenic Child Soil Total

$$PRG_{rec-sol-totnc}\left(\frac{mg}{kg}\right)=\frac{1}{\frac{1}{PRG_{rec-sol-ingnc}}+\frac{1}{PRG_{rec-sol-inhnc}}+\frac{1}{PRG_{rec-sol-dernc}}}$$

Noncarcinogenic Adult Soil Ingestion

$$PRG_{rec-sol-ingna}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{rec-a}\left(\frac{365\ days}{yr}\times ED_{rec}(26\ yr)\right)\times BW_{rec-a}(80\ kg)}{\left(\frac{RBA}{RfD_o\left(\frac{mg}{kg-day}\right)}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{rec-a}\left(\frac{75\ days}{yr}\right)\times ED_{rec}(26\ yr)\times IRS_{rec-a}\left(\frac{100\ mg}{day}\right)}$$

Noncarcinogenic Adult Soil Inhalation

$$PRG_{rec-sol-inhna}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{rec-a}\left(\frac{365\ days}{yr}\times ED_{rec}(26\ yr)\right)}{\left(\frac{1}{RfC\left(\frac{mg}{m^3}\right)}\right)\times EF_{rec-a}\left(\frac{75\ days}{yr}\right)\times ED_{rec}(26\ yr)\times ET_{rec-a}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Noncarcinogenic Adult Soil Dermal

$$PRG_{rec-sol-derna}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{rec-a}\left(\frac{365\ days}{yr}\times ED_{rec}(26\ yr)\right)\times BW_{rec-a}(80\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)\times GIABS}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{rec-a}\left(\frac{75\ days}{yr}\right)\times ED_{rec}(26\ yr)\times SA_{rec-a}\left(\frac{6,032\ cm^2}{day}\right)\times AF_{rec-a}\left(\frac{0.07\ mg}{cm^2}\right)\times ABS_d}$$

Noncarcinogenic Adult Soil Total

$$\text{PRG}_{\text{rec-sol-totna}}\left(\frac{\text{mg}}{\text{kg}}\right) = \frac{1}{\frac{1}{\text{PRG}_{\text{rec-sol-ingna}}} + \frac{1}{\text{PRG}_{\text{rec-sol-inhna}}} + \frac{1}{\text{PRG}_{\text{rec-sol-derna}}}}$$

Noncarcinogenic Age-adjusted Soil Ingestion

$$\text{PRG}_{\text{rec-sol-ingnadj}}\left(\frac{\text{mg}}{\text{kg}}\right) = \frac{\text{THQ} \times \text{AT}_{\text{rec-a}}\left(\frac{365\ \text{days}}{\text{yr}} \times \text{ED}_{\text{rec}}\,(26\ \text{yr})\right)}{\left(\frac{\text{RBA}}{\text{RfD}_{\text{o}}\left(\frac{\text{mg}}{\text{kg}-\text{day}}\right)}\right) \times \left(\frac{10^{-6}\ \text{kg}}{\text{mg}}\right) \times \text{IFS}_{\text{rec-adj}}\left(\frac{7{,}875\ \text{mg}}{\text{kg}}\right)}$$

where:

$$\text{IFS}_{\text{rec-adj}}\left(\frac{7{,}875\ \text{mg}}{\text{kg}}\right) = \left[\begin{array}{l}\frac{\text{EF}_{\text{rec-c}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-c}}\,(6\ \text{yr}) \times \text{IRS}_{\text{rec-c}}\left(\frac{200\ \text{mg}}{\text{day}}\right)}{\text{BW}_{\text{rec-c}}\,(15\ \text{kg})} + \\ \frac{\text{EF}_{\text{rec-a}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-a}}\,(20\ \text{yr}) \times \text{IRS}_{\text{rec-a}}\left(\frac{100\ \text{mg}}{\text{day}}\right)}{\text{BW}_{\text{rec-a}}\,(80\ \text{kg})}\end{array}\right]$$

Noncarcinogenic Age-adjusted Soil Inhalation

$$\text{PRG}_{\text{rec-sol-inhnadj}}\left(\frac{\text{mg}}{\text{kg}}\right) = \frac{\text{THQ} \times \text{AT}_{\text{rec-a}}\left(\frac{365\ \text{days}}{\text{yr}} \times \text{ED}_{\text{rec}}\,(26\ \text{yr})\right)}{\left(\frac{1}{\text{RfC}\left(\frac{\text{mg}}{\text{m}^3}\right)}\right) \times \text{EF}_{\text{rec}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec}}\,(26\ \text{yr}) \times \text{ET}_{\text{rec}}\left(\frac{1\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \left(\frac{1}{\text{VF}_{\text{s}}\left(\frac{\text{m}^3}{\text{kg}}\right)} + \frac{1}{\text{PEF}\left(\frac{\text{m}^3}{\text{kg}}\right)}\right)}$$

Noncarcinogenic Age-adjusted Soil Dermal

$$\text{PRG}_{\text{rec-sol-dernadj}}\left(\frac{\text{mg}}{\text{kg}}\right) = \frac{\text{THQ} \times \text{AT}_{\text{rec-a}}\left(\frac{365\ \text{days}}{\text{yr}} \times \text{ED}_{\text{rec}}\,(26\ \text{yr})\right)}{\left(\frac{1}{\text{RfD}_{\text{o}}\left(\frac{\text{mg}}{\text{kg}-\text{day}}\right) \times \text{GIABS}}\right) \times \left(\frac{10^{-6}\ \text{kg}}{\text{mg}}\right) \times \text{DFS}_{\text{rec-adj}}\left(\frac{22{,}155\ \text{mg}}{\text{kg}}\right) \times \text{ABS}_{\text{d}}}$$

where:

$$\text{DFS}_{\text{rec-adj}}\left(\frac{22{,}155\ \text{mg}}{\text{kg}}\right) = \left[\begin{array}{l}\frac{\text{EF}_{\text{rec-c}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-c}}\,(6\ \text{yr}) \times \text{SA}_{\text{rec-c}}\left(\frac{2{,}373\ \text{cm}^2}{\text{day}}\right) \times \text{AF}_{\text{rec-c}}\left(\frac{0.2\ \text{mg}}{\text{cm}^2}\right)}{\text{BW}_{\text{rec-c}}\,(15\ \text{kg})} + \\ \frac{\text{EF}_{\text{rec-a}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-a}}\,(20\ \text{yr}) \times \text{SA}_{\text{rec-a}}\left(\frac{6{,}032\ \text{cm}^2}{\text{day}}\right) \times \text{AF}_{\text{rec-a}}\left(\frac{0.07\ \text{mg}}{\text{cm}^2}\right)}{\text{BW}_{\text{rec-a}}\,(80\ \text{kg})}\end{array}\right]$$

Noncarcinogenic Age-adjusted Soil Total

$$PRG_{rec-sol-totnadj}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{rec-sol-ingnadj}} + \frac{1}{PRG_{rec-sol-inhnadj}} + \frac{1}{PRG_{rec-sol-dernadj}}}$$

Carcinogenic Soil Ingestion

$$PRG_{rec-sol-ingc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times IFS_{rec-adj}\left(\frac{7,875\ mg}{kg}\right)}$$

where:

$$IFS_{rec-adj}\left(\frac{7,875\ mg}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times IRS_{rec-c}\left(\frac{200\ mg}{day}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times IRS_{rec-a}\left(\frac{100\ mg}{day}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Carcinogenic Soil Inhalation

$$PRG_{rec-sol-inhc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times ED_{rec}(26\ yr) \times ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}$$

Carcinogenic Soil Dermal

$$PRG_{rec-sol-derc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) \times ABS_d}$$

where:

$$DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times SA_{rec-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{rec-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Carcinogenic Soil Total

$$PRG_{rec-sol-totc}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{rec-sol-ingc}} + \frac{1}{PRG_{rec-sol-inhc}} + \frac{1}{PRG_{rec-sol-derc}}}$$

Mutagenic Soil Ingestion

$$PRG_{rec-sol-ingmu}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{rec}\left(\frac{365\text{ days}}{yr} \times LT(70\text{ yrs})\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\text{ kg}}{mg}\right) \times RBA \times IFSM_{rec-adj}\left(\frac{35,750\text{ mg}}{kg}\right)}$$

where:

$$IFSM_{rec-adj}\left(\frac{35,750\text{ mg}}{kg}\right) = \left[\begin{array}{l} \frac{EF_{0-2}\left(\frac{75\text{ days}}{yr}\right) \times ED_{0-2}(2\text{ yr}) \times IRS_{0-2}\left(\frac{200\text{ mg}}{day}\right) \times 10}{BW_{0-2}(15\text{ kg})} + \\ \frac{EF_{2-6}\left(\frac{75\text{ days}}{yr}\right) \times ED_{2-6}(4\text{ yr}) \times IRS_{2-6}\left(\frac{200\text{ mg}}{day}\right) \times 3}{BW_{2-6}(15\text{ kg})} + \\ \frac{EF_{6-16}\left(\frac{75\text{ days}}{yr}\right) \times ED_{6-16}(10\text{ yr}) \times IRS_{6-16}\left(\frac{100\text{ mg}}{day}\right) \times 3}{BW_{6-16}(80\text{ kg})} + \\ \frac{EF_{16-26}\left(\frac{75\text{ days}}{yr}\right) \times ED_{16-26}(10\text{ yr}) \times IRS_{16-26}\left(\frac{100\text{ mg}}{day}\right) \times 1}{BW_{16-26}(80\text{ kg})} \end{array}\right]$$

Mutagenic Soil Inhalation

$$PRG_{rec-sol-inhmu}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{rec}\left(\frac{365\text{ days}}{yr} \times LT(70\text{ yrs})\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right) \times \left[\begin{array}{l} \left(EF_{0-2}\left(\frac{75\text{ days}}{yr}\right) \times ED_{0-2}(2\text{ yr}) \times ET_{0-2}\left(\frac{1\text{ hrs}}{day}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{75\text{ days}}{yr}\right) \times ED_{2-6}(4\text{ yr}) \times ET_{2-6}\left(\frac{1\text{ hrs}}{day}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{75\text{ days}}{yr}\right) \times ED_{6-16}(10\text{ yr}) \times ET_{6-16}\left(\frac{1\text{ hrs}}{day}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{75\text{ days}}{yr}\right) \times ED_{16-26}(10\text{ yr}) \times ET_{16-26}\left(\frac{1\text{ hrs}}{day}\right) \times \left(\frac{1\text{ day}}{24\text{ hrs}}\right) \times 1\right) \end{array}\right]}$$

Mutagenic Soil Dermal

$$\mathrm{PRG}_{\text{rec-sol-dermu}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{\mathrm{TR}\times\mathrm{AT}_{\text{rec}}\left(\frac{365\ \text{days}}{\text{yr}}\times\mathrm{LT}(70\ \text{yrs})\right)}{\left(\frac{\mathrm{CSF}_{\mathrm{o}}\left(\frac{\mathrm{mg}}{\mathrm{kg-day}}\right)^{-1}}{\mathrm{GIABS}}\right)\times\left(\frac{10^{-6}\ \mathrm{kg}}{\mathrm{mg}}\right)\times\mathrm{DFSM}_{\text{rec-adj}}\left(\frac{91{,}770\ \mathrm{mg}}{\mathrm{kg}}\right)\times\mathrm{ABS}_{\mathrm{d}}}$$

where:

$$\mathrm{DFSM}_{\text{rec-adj}}\left(\frac{91{,}770\ \mathrm{mg}}{\mathrm{kg}}\right)=\left[\begin{array}{c}\frac{\mathrm{EF}_{0-2}\left(\frac{75\ \text{days}}{\text{yr}}\right)\times\mathrm{ED}_{0-2}(2\ \text{yr})\times\mathrm{SA}_{0-2}\left(\frac{2{,}373\ \mathrm{cm}^2}{\text{day}}\right)\times\mathrm{AF}_{0-2}\left(\frac{0.2\ \mathrm{mg}}{\mathrm{cm}^2}\right)\times10}{\mathrm{BW}_{0-2}(15\ \mathrm{kg})}+\\ \frac{\mathrm{EF}_{2-6}\left(\frac{75\ \text{days}}{\text{yr}}\right)\times\mathrm{ED}_{2-6}(4\ \text{yr})\times\mathrm{SA}_{2-6}\left(\frac{2{,}373\ \mathrm{cm}^2}{\text{day}}\right)\times\mathrm{AF}_{2-6}\left(\frac{0.2\ \mathrm{mg}}{\mathrm{cm}^2}\right)\times3}{\mathrm{BW}_{2-6}(15\ \mathrm{kg})}+\\ \frac{\mathrm{EF}_{6-16}\left(\frac{75\ \text{days}}{\text{yr}}\right)\times\mathrm{ED}_{6-16}(10\ \text{yr})\times\mathrm{SA}_{6-16}\left(\frac{6{,}032\ \mathrm{cm}^2}{\text{day}}\right)\times\mathrm{AF}_{6-16}\left(\frac{0.07\ \mathrm{mg}}{\mathrm{cm}^2}\right)\times3}{\mathrm{BW}_{6-16}(80\ \mathrm{kg})}+\\ \frac{\mathrm{EF}_{16-26}\left(\frac{75\ \text{days}}{\text{yr}}\right)\times\mathrm{ED}_{16-26}(10\ \text{yr})\times\mathrm{SA}_{16-26}\left(\frac{6{,}032\ \mathrm{cm}^2}{\text{day}}\right)\times\mathrm{AF}_{16-26}\left(\frac{0.07\ \mathrm{mg}}{\mathrm{cm}^2}\right)\times1}{\mathrm{BW}_{16-26}(80\ \mathrm{kg})}\end{array}\right]$$

Mutagenic Soil Total

$$\mathrm{PRG}_{\text{rec-sol-totmu}}\left(\frac{\mathrm{mg}}{\mathrm{kg}}\right)=\frac{1}{\frac{1}{\mathrm{PRG}_{\text{rec-sol-ingmu}}}+\frac{1}{\mathrm{PRG}_{\text{rec-sol-inhmu}}}+\frac{1}{\mathrm{PRG}_{\text{rec-sol-dermu}}}}$$

Vinyl Chloride Soil Ingestion

$$\text{PRG}_{\text{rec-sol-ingvc}}\left(\frac{\text{mg}}{\text{kg}}\right)=\frac{\text{TR}}{\left(\left(\frac{\text{CSF}_o\left(\frac{\text{mg}}{\text{kg-day}}\right)^{-1}\times\left(\frac{10^{-6}\ \text{kg}}{\text{mg}}\right)\times\text{RBA}\times\text{IFS}_{\text{rec-adj}}\left(\frac{7{,}875\ \text{mg}}{\text{kg}}\right)}{\text{AT}_{\text{rec}}\left(\frac{365\ \text{days}}{\text{yr}}\times\text{LT}(70\ \text{yrs})\right)}\right)+\left(\frac{\text{CSF}_o\left(\frac{\text{mg}}{\text{kg-day}}\right)^{-1}\times\left(\frac{10^{-6}\ \text{kg}}{\text{mg}}\right)\times\text{RBA}\times\text{IRS}_{\text{rec-c}}\left(\frac{200\ \text{mg}}{\text{day}}\right)}{\text{BW}_{\text{rec-c}}(15\ \text{kg})}\right)\right)}$$

where:

$$\text{IFS}_{\text{rec-adj}}\left(\frac{7{,}875\ \text{mg}}{\text{kg}}\right)=\left[\frac{\text{EF}_{\text{rec-c}}\left(\frac{75\ \text{days}}{\text{yr}}\right)\times\text{ED}_{\text{rec-c}}(6\ \text{yr})\times\text{IRS}_{\text{rec-c}}\left(\frac{200\ \text{mg}}{\text{day}}\right)}{\text{BW}_{\text{rec-c}}(15\ \text{kg})}+\frac{\text{EF}_{\text{rec-a}}\left(\frac{75\ \text{days}}{\text{yr}}\right)\times\text{ED}_{\text{rec-a}}(20\ \text{yr})\times\text{IRS}_{\text{rec-a}}\left(\frac{100\ \text{mg}}{\text{day}}\right)}{\text{BW}_{\text{rec-a}}(80\ \text{kg})}\right]$$

Vinyl Chloride Soil Inhalation

$$\text{PRG}_{\text{rec-sol-inhvc}}\left(\frac{\text{mg}}{\text{kg}}\right)=\frac{\text{TR}}{\left(\left(\frac{\text{IUR}\left(\frac{\mu\text{g}}{\text{m}^3}\right)^{-1}\times\left(\frac{1000\ \mu\text{g}}{\text{mg}}\right)\times\text{EF}_{\text{rec}}\left(\frac{75\ \text{days}}{\text{yr}}\right)\times\text{ED}_{\text{rec}}(26\ \text{yr})\times\text{ET}_{\text{rec}}\left(\frac{1\ \text{hrs}}{\text{day}}\right)\times\left(\frac{1\ \text{day}}{24\ \text{hrs}}\right)}{\text{AT}_{\text{rec}}\left(\frac{365\ \text{days}}{\text{yr}}\times\text{LT}(70\ \text{yrs})\right)\times\text{VF}_s\left(\frac{\text{m}^3}{\text{kg}}\right)}\right)+\left(\frac{\text{IUR}\left(\frac{\mu\text{g}}{\text{m}^3}\right)^{-1}}{\text{VF}_s\left(\frac{\text{m}^3}{\text{kg}}\right)}\times\left(\frac{1000\ \mu\text{g}}{\text{mg}}\right)\right)\right)}$$

Vinyl Chloride Soil Dermal

$$PRG_{rec-sol-dervc}\left(\frac{mg}{kg}\right) = \frac{TR}{\left(\left(\frac{\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) \times ABS_d}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + \left(\frac{\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right) \times ABS_d}{BW_{rec-c}(15\ kg)}\right)\right)}$$

where:

$$DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times SA_{rec-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{rec-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Vinyl Chloride Soil Total

$$PRG_{rec-sol-totvc}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{rec-sol-ingvc}} + \frac{1}{PRG_{rec-sol-inhvc}} + \frac{1}{PRG_{rec-sol-dervc}}}$$

Trichloroethylene Soil Ingestion

$$PRG_{rec-sol-ingtce}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times \left(\left(CAF_o(0.804) \times IFS_{rec-adj}\left(\frac{7,875\ mg}{kg}\right)\right) + \left(MAF_o(0.202) \times IFSM_{rec-adj}\left(\frac{35,750\ mg}{kg}\right)\right)\right)}$$

where:

$$IFS_{rec-adj}\left(\frac{7,875\ mg}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times IRS_{rec-c}\left(\frac{200\ mg}{day}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times IRS_{rec-a}\left(\frac{100\ mg}{day}\right)}{BW_{rec-a}(80\ kg)}\right]$$

and:

$$IFSM_{rec-adj}\left(\frac{35,750\ mg}{kg}\right) = \left[\begin{array}{l} \frac{EF_{0-2}\left(\frac{75\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times IRS_{0-2}\left(\frac{200\ mg}{day}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{75\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times IRS_{2-6}\left(\frac{200\ mg}{day}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{75\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times IRS_{6-16}\left(\frac{100\ mg}{day}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{75\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times IRS_{16-26}\left(\frac{100\ mg}{day}\right) \times 1}{BW_{16-26}(80\ kg)} \end{array}\right]$$

Trichloroethylene Soil Inhalation

$$PRG_{rec-sol-inhtce}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{IUR\left(\frac{\mu g}{m^3}\right)^{-1} \times \left(\frac{1000\ \mu g}{mg}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right) \times \left[\begin{array}{l} \left(EF_{rec}\left(\frac{75\ days}{yr}\right) \times ED_{rec}(26\ yr) \times ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times CAF_i(0.756)\right) + \\ \left(EF_{0-2}\left(\frac{75\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{75\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{75\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{75\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 1\right) \end{array}\right]}$$

Trichloroethylene Soil Dermal

IF $ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right) \le t^*\ (hrs)$, then:

$$PRG_{rec-wat-dertce}\left(\frac{\mu g}{L}\right) = \frac{DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right) > t^*\ (hrs)$, then:

$$PRG_{rec-wat-dertce}\left(\frac{\mu g}{L}\right) = \frac{DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right)}{1 + B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1 + 3B + 3B^2}{(1 + B)^2}\right)\right]}$$

where:

$$ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right) = \frac{\left(\begin{array}{c}\left(ED_{0-2}(2\ yr) \times ET_{event-(0-2)}\left(\frac{1\ hrs}{event}\right)\right) + \left(ED_{2-6}(4\ yr) \times ET_{event-(2-6)}\left(\frac{1\ hrs}{event}\right)\right) + \\ \left(\left(ED_{6-16}(10\ yr) \times ET_{event-(6-16)}\left(\frac{1\ hrs}{event}\right)\right) + \left(ED_{16-26}(10\ yr) \times ET_{event-(16-26)}\left(\frac{1\ hrs}{event}\right)\right)\right)\end{array}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr) + ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

and:

$$DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left[\begin{array}{c}\left(CAF_o(0.804) \times DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right)\right) + \\ \left(MAF_o(0.202) \times DFWM_{rec-adj}\left(\frac{1,053,210\ cm^2-event}{kg}\right)\right)\end{array}\right]}$$

where:

$$DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right) = \left(\begin{array}{c}\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}(15\ kg)} + \\ \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times SA_{rec-a}\left(19,652\ cm^2\right)}{BW_{rec-a}(80\ kg)}\end{array}\right)$$

and:

$$DFWM_{rec-adj}\left(\frac{1,053,210\ cm^2-event}{kg}\right) = \left(\begin{array}{c}\frac{EF_{0-2}\left(\frac{45\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times EV_{0-2}\left(\frac{1\ event}{day}\right) \times SA_{0-2}\left(6,365\ cm^2\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{45\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times EV_{2-6}\left(\frac{1\ event}{day}\right) \times SA_{2-6}\left(6,365\ cm^2\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{45\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times EV_{6-16}\left(\frac{1\ event}{day}\right) \times SA_{6-16}\left(19,652\ cm^2\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{45\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times EV_{16-26}\left(\frac{1\ event}{day}\right) \times SA_{16-26}\left(19,652\ cm^2\right) \times 1}{BW_{16-26}(80\ kg)}\end{array}\right)$$

Trichloroethylene Soil Total

$$PRG_{rec-sol-tottce}\left(\frac{mg}{kg}\right) = \frac{1}{\frac{1}{PRG_{rec-sol-ingtce}} + \frac{1}{PRG_{rec-sol-inhtce}} + \frac{1}{PRG_{rec-sol-dertce}}}$$

Supporting Child Soil

$$ED_{rec-c}(6\ yr) = ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)$$

$$BW_{rec-c}(15\ kg) = \frac{ED_{0-2}(2\ yr)\times BW_{0-2}(15\ kg) + ED_{2-6}(4\ yr)\times BW_{2-6}(15\ kg)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$EF_{rec-c}\left(\frac{75\ days}{yr}\right) = \frac{ED_{0-2}(2\ yr)\times EF_{0-2}\left(\frac{75\ days}{yr}\right) + ED_{2-6}(4\ yr)\times EF_{2-6}\left(\frac{75\ days}{yr}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$ET_{rec-c}\left(\frac{1\ hrs}{day}\right) = \frac{ED_{0-2}(2\ yr)\times ET_{0-2}\left(\frac{1\ hrs}{day}\right) + ED_{2-6}(4\ yr)\times ET_{2-6}\left(\frac{1\ hrs}{day}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right) = \frac{ED_{0-2}(2\ yr)\times AF_{0-2}\left(\frac{0.2\ mg}{cm^2}\right) + ED_{2-6}(4\ yr)\times AF_{2-6}\left(\frac{0.2\ mg}{cm^2}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right) = \frac{ED_{0-2}(2\ yr)\times SA_{0-2}\left(\frac{2,373\ cm^2}{day}\right) + ED_{2-6}(4\ yr)\times SA_{2-6}\left(\frac{2,373\ cm^2}{day}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$IRS_{rec-c}\left(\frac{200\ mg}{day}\right) = \frac{ED_{0-2}(2\ yr)\times IRS_{0-2}\left(\frac{200\ mg}{day}\right) + ED_{2-6}(4\ yr)\times IRS_{2-6}\left(\frac{200\ mg}{day}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

Supporting Adult Soil

$$ED_{rec-a}(20\text{ yr}) = ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})$$

$$BW_{rec-a}(80\text{ kg}) = \frac{ED_{6-16}(10\text{ yr}) \times BW_{6-16}(80\text{ kg}) + ED_{16-26}(10\text{ yr}) \times BW_{16-26}(80\text{ kg})}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$EF_{rec-a}\left(\frac{75\text{ days}}{\text{yr}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times EF_{6-16}\left(\frac{75\text{ days}}{\text{yr}}\right) + ED_{16-26}(10\text{ yr}) \times EF_{16-26}\left(\frac{75\text{ days}}{\text{yr}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$ET_{rec-a}\left(\frac{1\text{ hrs}}{\text{day}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times ET_{6-16}\left(\frac{1\text{ hrs}}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times ET_{16-26}\left(\frac{1\text{ hrs}}{\text{day}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

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

$$SA_{rec-a}\left(\frac{6,032\text{ cm}^2}{\text{day}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times SA_{6-16}\left(\frac{6,032\text{ cm}^2}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times SA_{16-26}\left(\frac{6,032\text{ cm}^2}{\text{day}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

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

Supporting Age-adjusted Soil

$$\mathrm{ED}_{rec}\,(26\text{ yr}) = \mathrm{ED}_{0-2}\,(2\text{ yr}) + \mathrm{ED}_{2-6}\,(4\text{ yr}) + \mathrm{ED}_{6-16}\,(10\text{ yr}) + \mathrm{ED}_{16-26}\,(10\text{ yr})$$

$$\mathrm{EF}_{rec}\left(\frac{75\text{ days}}{\text{yr}}\right) = \frac{\left(\begin{array}{c}\mathrm{ED}_{0-2}\,(2\text{ yr}) \times \mathrm{EF}_{0-2}\left(\frac{75\text{ days}}{\text{yr}}\right) + \mathrm{ED}_{2-6}\,(4\text{ yr}) \times \mathrm{EF}_{2-6}\left(\frac{75\text{ days}}{\text{yr}}\right) + \\ \mathrm{ED}_{6-16}\,(10\text{ yr}) \times \mathrm{EF}_{6-16}\left(\frac{75\text{ days}}{\text{yr}}\right) + \mathrm{ED}_{16-26}\,(10\text{ yr}) \times \mathrm{EF}_{16-26}\left(\frac{75\text{ days}}{\text{yr}}\right)\end{array}\right)}{\mathrm{ED}_{0-2}\,(2\text{ yr}) + \mathrm{ED}_{2-6}\,(4\text{ yr}) + \mathrm{ED}_{6-16}\,(10\text{ yr}) + \mathrm{ED}_{16-26}\,(10\text{ yr})}$$

$$\mathrm{ET}_{rec}\left(\frac{1\text{ hrs}}{\text{day}}\right) = \frac{\left(\begin{array}{c}\mathrm{ED}_{0-2}\,(2\text{ yr}) \times \mathrm{ET}_{0-2}\left(\frac{1\text{ hrs}}{\text{day}}\right) + \mathrm{ED}_{2-6}\,(4\text{ yr}) \times \mathrm{ET}_{2-6}\left(\frac{1\text{ hrs}}{\text{day}}\right) + \\ \mathrm{ED}_{6-16}\,(10\text{ yr}) \times \mathrm{ET}_{6-16}\left(\frac{1\text{ hrs}}{\text{day}}\right) + \mathrm{ED}_{16-26}\,(10\text{ yr}) \times \mathrm{ET}_{16-26}\left(\frac{1\text{ hrs}}{\text{day}}\right)\end{array}\right)}{\mathrm{ED}_{0-2}\,(2\text{ yr}) + \mathrm{ED}_{2-6}\,(4\text{ yr}) + \mathrm{ED}_{6-16}\,(10\text{ yr}) + \mathrm{ED}_{16-26}\,(10\text{ yr})}$$

<u>Recreator Surface Water PRG Equations</u>

Noncarcinogenic Child Surface Water Ingestion

$$\mathrm{PRG}_{rec-wat-ingnc}\left(\frac{\mu\text{g}}{\text{L}}\right) = \frac{\mathrm{THQ} \times \mathrm{AT}_{rec-c}\left(\frac{365\text{ days}}{\text{yr}} \times \mathrm{ED}_{rec-c}\,(6\text{ yr})\right) \times \mathrm{BW}_{rec-c}\,(15\text{ kg})}{\left(\frac{1}{\mathrm{RfD_o}\left(\frac{\text{mg}}{\text{kg}-\text{day}}\right)}\right) \times \left(\frac{\text{mg}}{1000\ \mu\text{g}}\right) \times \mathrm{EF}_{rec-c}\left(\frac{45\text{ days}}{\text{yr}}\right) \times \mathrm{ED}_{rec-c}\,(6\text{ yr}) \times \mathrm{EV}_{rec-c}\left(\frac{1\text{ event}}{\text{day}}\right) \times \mathrm{ET}_{event-rec-c}\left(\frac{1\text{ hrs}}{\text{event}}\right) \times \mathrm{IRW}_{rec-c}\left(\frac{0.12\text{ L}}{\text{hr}}\right)}$$

Noncarcinogenic Child Surface Water Dermal

For Inorganics:

$$PRG_{rec-wat-dernc}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)}$$

For Organics:

IF $ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\leq t^*\ (hrs)$, then:

$$PRG_{rec-wat-dernc}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)>t^*\ (hrs)$, then:

$$PRG_{rec-wat-dernc}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=\frac{THQ\times AT_{rec-c}\left(\frac{365\ days}{yr}\times ED_{rec-c}(6\ yr)\right)\times BW_{rec-c}(15\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)\times GIABS}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{rec-c}\left(\frac{45\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times EV_{rec-c}\left(\frac{1\ event}{day}\right)\times SA_{rec-c}\left(6{,}365\ cm^2\right)}$$

Noncarcinogenic Child Surface Water Total

$$PRG_{rec-wat-totnc}\left(\frac{\mu g}{L}\right)=\frac{1}{\frac{1}{PRG_{rec-wat-ingnc}}+\frac{1}{PRG_{rec-wat-dernc}}}$$

Noncarcinogenic Adult Surface Water Ingestion

$$PRG_{rec-wat-ingna}\left(\frac{\mu g}{L}\right)=\frac{THQ\times AT_{rec-a}\left(\frac{365\ days}{yr}\times ED_{rec}(26\ yr)\right)\times BW_{rec-a}(80\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{rec-a}\left(\frac{45\ days}{yr}\right)\times ED_{rec}(26\ yr)\times EV_{rec-a}\left(\frac{1\ event}{day}\right)\times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)\times IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right)}$$

Noncarcinogenic Adult Surface Water Dermal

For Inorganics:

$$PRG_{rec-wat-derna}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)}$$

For Organics:

IF $ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) \leq t^*\ (hrs)$, then:

$$PRG_{rec-wat-derna}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) > t^*\ (hrs)$, then:

$$PRG_{rec-wat-derna}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = \frac{THQ \times AT_{rec-a}\left(\frac{365\ days}{yr} \times ED_{rec}(26\ yr)\right) \times BW_{rec-a}(80\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right) \times GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec}(26\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times SA_{rec-a}\left(19{,}652\ cm^2\right)}$$

Noncarcinogenic Adult Surface Water Total

$$PRG_{rec-wat-totna}\left(\frac{\mu g}{L}\right) = \frac{1}{\frac{1}{PRG_{rec-wat-ingna}} + \frac{1}{PRG_{rec-wat-derna}}}$$

Noncarcinogenic Age-adjusted Surface Water Ingestion

$$PRG_{rec-wat-ingnadj}\left(\frac{\mu g}{L}\right) = \frac{THQ \times AT_{rec-a}\left(\frac{365\ days}{yr} \times ED_{rec}(26\ yr)\right)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right)}$$

where:

$$IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right) = \left[\begin{array}{l}\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{BW_{rec-c}(15\ kg)} + \\ \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right)}{BW_{rec-a}(80\ kg)}\end{array}\right]$$

Noncarcinogenic Age-adjusted Surface Water Dermal

For Inorganics:

$$PRG_{rec-wat-dernadj}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2 - event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right) \times ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}$$

For Organics:

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) \leq t^*\ (hrs)$, then:

$$PRG_{rec-wat-dernadj}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2 - event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) > t^*\ (hrs)$, then:

$$PRG_{rec-wat-dernadj}\left(\frac{\mu g}{L}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2 - event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{1 + B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1 + 3B + 3B^2}{(1 + B)^2}\right)\right]}$$

where:

$$ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) = \left(\frac{\left(ED_{rec-c}\,(6\ yr) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\right) + \left(ED_{rec-a}\,(20\ yr) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)\right)}{ED_{rec}\,(26\ yr)}\right)$$

and:

$$DA_{event}\left(\frac{\mu g}{cm^2 - event}\right) = \frac{THQ \times AT_{rec-a}\left(\frac{365\ days}{yr} \times ED_{rec}\,(26\ yr)\right)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg - day}\right) \times GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times DFW_{rec-adj}\left(\frac{335,655\ cm^2 - event}{kg}\right)}$$

where:

$$DFW_{rec-adj}\left(\frac{335,655\ cm^2 - event}{kg}\right) = \left(\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}\,(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}\,(15\ kg)} + \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}\,(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times SA_{rec-a}\left(19,652\ cm^2\right)}{BW_{rec-a}\,(80\ kg)}\right)$$

Noncarcinogenic Age-adjusted Surface Water Total

$$\text{PRG}_{\text{rec-wat-totnadj}}\left(\frac{\mu\text{g}}{\text{L}}\right) = \frac{1}{\dfrac{1}{\text{PRG}_{\text{rec-wat-ingnadj}}} + \dfrac{1}{\text{PRG}_{\text{rec-wat-dernadj}}}}$$

Carcinogenic Surface Water Ingestion

$$\text{PRG}_{\text{rec-wat-ingc}}\left(\frac{\mu\text{g}}{\text{L}}\right) = \frac{\text{TR} \times \text{AT}_{\text{rec}}\left(\frac{365\ \text{days}}{\text{yr}} \times \text{LT}(70\ \text{yrs})\right)}{\text{CSF}_{\text{o}}\left(\frac{\text{mg}}{\text{kg-day}}\right)^{-1} \times \left(\frac{\text{mg}}{1000\ \mu\text{g}}\right) \times \text{IFW}_{\text{rec-adj}}\left(\frac{3.4\ \text{L}}{\text{kg}}\right)}$$

where:

$$\text{IFW}_{\text{rec-adj}}\left(\frac{3.4\ \text{L}}{\text{kg}}\right) = \left[\begin{array}{l} \dfrac{\text{EF}_{\text{rec-c}}\left(\frac{45\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-c}}(6\ \text{yr}) \times \text{EV}_{\text{rec-c}}\left(\frac{1\ \text{event}}{\text{day}}\right) \times \text{ET}_{\text{event-rec-c}}\left(\frac{1\ \text{hrs}}{\text{event}}\right) \times \text{IRW}_{\text{rec-c}}\left(\frac{0.12\ \text{L}}{\text{hr}}\right)}{\text{BW}_{\text{rec-c}}(15\ \text{kg})} + \\ \dfrac{\text{EF}_{\text{rec-a}}\left(\frac{45\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-a}}(20\ \text{yr}) \times \text{EV}_{\text{rec-a}}\left(\frac{1\ \text{event}}{\text{day}}\right) \times \text{ET}_{\text{event-rec-a}}\left(\frac{1\ \text{hrs}}{\text{event}}\right) \times \text{IRW}_{\text{rec-a}}\left(\frac{0.11\ \text{L}}{\text{hr}}\right)}{\text{BW}_{\text{rec-a}}(80\ \text{kg})} \end{array}\right]$$

Carcinogenic Surface Water Dermal

For Inorganics:

$$PRG_{rec\text{-}wat\text{-}derc}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{event\text{-}rec\text{-}adj}\left(\frac{1\ hrs}{event}\right)}$$

For Organics:

IF $ET_{event\text{-}rec\text{-}adj}\left(\frac{1\ hrs}{event}\right)\le t^*\ (hrs)$, then:

$$PRG_{rec\text{-}wat\text{-}derc}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event\text{-}rec\text{-}adj}\left(\frac{1\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event\text{-}rec\text{-}adj}\left(\frac{1\ hrs}{event}\right)>t^*\ (hrs)$, then:

$$PRG_{rec\text{-}wat\text{-}derc}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event\text{-}rec\text{-}adj}\left(\frac{1\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$ET_{event\text{-}rec\text{-}adj}\left(\frac{1\ hrs}{event}\right)=\left(\frac{\left(ED_{rec\text{-}c}(6\ yr)\times ET_{event\text{-}rec\text{-}c}\left(\frac{1\ hrs}{event}\right)\right)+\left(ED_{rec\text{-}a}(20\ yr)\times ET_{event\text{-}rec\text{-}a}\left(\frac{1\ hrs}{event}\right)\right)}{ED_{rec}(26\ yr)}\right)$$

and:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=\frac{TR\times AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times DFW_{rec\text{-}adj}\left(\frac{335,655\ cm^2-event}{kg}\right)}$$

where:

$$DFW_{rec\text{-}adj}\left(\frac{335,655\ cm^2-event}{kg}\right)=\left(\begin{array}{c}\frac{EF_{rec\text{-}c}\left(\frac{45\ days}{yr}\right)\times ED_{rec\text{-}c}(6\ yr)\times EV_{rec\text{-}c}\left(\frac{1\ event}{day}\right)\times SA_{rec\text{-}c}\left(6,365\ cm^2\right)}{BW_{rec\text{-}c}(15\ kg)}+\\ \frac{EF_{rec\text{-}a}\left(\frac{45\ days}{yr}\right)\times ED_{rec\text{-}a}(20\ yr)\times EV_{rec\text{-}a}\left(\frac{1\ event}{day}\right)\times SA_{rec\text{-}a}\left(19,652\ cm^2\right)}{BW_{rec\text{-}a}(80\ kg)}\end{array}\right)$$

Carcinogenic Surface Water Total

$$\mathrm{PRG}_{\mathrm{rec-wat-totc}}\left(\frac{\mu g}{L}\right) = \frac{1}{\dfrac{1}{\mathrm{PRG}_{\mathrm{rec-wat-ingc}}} + \dfrac{1}{\mathrm{PRG}_{\mathrm{rec-wat-derc}}}}$$

Mutagenic Surface Water Ingestion

$$\mathrm{PRG}_{\mathrm{rec-wat-ingmu}}\left(\frac{\mu g}{L}\right) = \frac{\mathrm{TR} \times \mathrm{AT}_{\mathrm{rec}}\left(\dfrac{365\ \mathrm{days}}{\mathrm{yr}} \times \mathrm{LT}(70\ \mathrm{yrs})\right)}{\mathrm{CSF}_{\mathrm{o}}\left(\dfrac{\mathrm{mg}}{\mathrm{kg-day}}\right)^{-1} \times \left(\dfrac{\mathrm{mg}}{1000\ \mu g}\right) \times \mathrm{IFWM}_{\mathrm{rec-adj}}\left(\dfrac{14\ \mathrm{L}}{\mathrm{kg}}\right)}$$

where:

$$\mathrm{IFWM}_{\mathrm{rec-adj}}\left(\frac{14\ \mathrm{L}}{\mathrm{kg}}\right) = \left[\begin{array}{c} \dfrac{\mathrm{EF}_{0-2}\left(\dfrac{45\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{0-2}(2\ \mathrm{yr}) \times \mathrm{EV}_{0-2}\left(\dfrac{1\ \mathrm{event}}{\mathrm{day}}\right) \times \mathrm{ET}_{\mathrm{event-(0-2)}}\left(\dfrac{1\ \mathrm{hrs}}{\mathrm{event}}\right) \times \mathrm{IRW}_{0-2}\left(\dfrac{0.12\ \mathrm{L}}{\mathrm{hr}}\right) \times 10}{\mathrm{BW}_{0-2}(15\ \mathrm{kg})} + \\ \dfrac{\mathrm{EF}_{2-6}\left(\dfrac{45\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{2-6}(4\ \mathrm{yr}) \times \mathrm{EV}_{2-6}\left(\dfrac{1\ \mathrm{event}}{\mathrm{day}}\right) \times \mathrm{ET}_{\mathrm{event-(2-6)}}\left(\dfrac{1\ \mathrm{hrs}}{\mathrm{event}}\right) \times \mathrm{IRW}_{2-6}\left(\dfrac{0.12\ \mathrm{L}}{\mathrm{hr}}\right) \times 3}{\mathrm{BW}_{2-6}(15\ \mathrm{kg})} + \\ \dfrac{\mathrm{EF}_{6-16}\left(\dfrac{45\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{6-16}(10\ \mathrm{yr}) \times \mathrm{EV}_{6-16}\left(\dfrac{1\ \mathrm{event}}{\mathrm{day}}\right) \times \mathrm{ET}_{\mathrm{event-(6-16)}}\left(\dfrac{1\ \mathrm{hrs}}{\mathrm{event}}\right) \times \mathrm{IRW}_{6-16}\left(\dfrac{0.124\ \mathrm{L}}{\mathrm{hr}}\right) \times 3}{\mathrm{BW}_{6-16}(80\ \mathrm{kg})} + \\ \dfrac{\mathrm{EF}_{16-26}\left(\dfrac{45\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{16-26}(10\ \mathrm{yr}) \times \mathrm{EV}_{16-26}\left(\dfrac{1\ \mathrm{event}}{\mathrm{day}}\right) \times \mathrm{ET}_{\mathrm{event-(16-26)}}\left(\dfrac{1\ \mathrm{hrs}}{\mathrm{event}}\right) \times \mathrm{IRW}_{16-26}\left(\dfrac{0.098\ \mathrm{L}}{\mathrm{hr}}\right) \times 1}{\mathrm{BW}_{16-26}(80\ \mathrm{kg})} \end{array}\right]$$

Mutagenic Surface Water Dermal

For Inorganics:

$$PRG_{rec\text{-}wat\text{-}dermu}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{K_p\left(\frac{cm}{hr}\right)\times ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)}$$

For Organics:

IF $ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)\leq t^*(hrs)$, then:

$$PRG_{rec\text{-}wat\text{-}dermu}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)>t^*(hrs)$, then:

$$PRG_{rec\text{-}wat\text{-}dermu}\left(\frac{\mu g}{L}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{1000\ cm^3}{L}\right)}{FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)=\frac{\left(\begin{array}{c}\left(ED_{0-2}(2\ yr)\times ET_{event\text{-}(0-2)}\left(\frac{1\ hrs}{event}\right)\right)+\left(ED_{2-6}(4\ yr)\times ET_{event\text{-}(2-6)}\left(\frac{1\ hrs}{event}\right)\right)+\\\left(ED_{6-16}(10\ yr)\times ET_{event\text{-}(6-16)}\left(\frac{1\ hrs}{event}\right)\right)+\left(ED_{16-26}(10\ yr)\times ET_{event\text{-}(16-26)}\left(\frac{1\ hrs}{event}\right)\right)\end{array}\right)}{ED_{0-2}(2\ yr)+ED_{2-6}(4\ yr)+ED_{6-16}(10\ yr)+ED_{16-26}(10\ yr)}$$

and:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=\frac{TR\times AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times DFWM_{rec\text{-}adj}\left(\frac{1{,}053{,}210\ cm^2-event}{kg}\right)}$$

where:

$$DFWM_{rec\text{-}adj}\left(\frac{1{,}053{,}210\ cm^2-event}{kg}\right)=\left(\begin{array}{c}\frac{EF_{0-2}\left(\frac{45\ days}{yr}\right)\times ED_{0-2}(2\ yr)\times EV_{0-2}\left(\frac{1\ event}{day}\right)\times SA_{0-2}\left(6{,}365\ cm^2\right)\times 10}{BW_{0-2}(15\ kg)}+\\\frac{EF_{2-6}\left(\frac{45\ days}{yr}\right)\times ED_{2-6}(4\ yr)\times EV_{2-6}\left(\frac{1\ event}{day}\right)\times SA_{2-6}\left(6{,}365\ cm^2\right)\times 3}{BW_{2-6}(15\ kg)}+\\\frac{EF_{6-16}\left(\frac{45\ days}{yr}\right)\times ED_{6-16}(10\ yr)\times EV_{6-16}\left(\frac{1\ event}{day}\right)\times SA_{6-16}\left(19{,}652\ cm^2\right)\times 3}{BW_{6-16}(80\ kg)}+\\\frac{EF_{16-26}\left(\frac{45\ days}{yr}\right)\times ED_{16-26}(10\ yr)\times EV_{16-26}\left(\frac{1\ event}{day}\right)\times SA_{16-26}\left(19{,}652\ cm^2\right)\times 1}{BW_{16-26}(80\ kg)}\end{array}\right)$$

Mutagenic Surface Water Total

$$PRG_{rec-wat-totmu}\left(\frac{\mu g}{L}\right) = \frac{1}{\frac{1}{PRG_{rec-wat-ingmu}} + \frac{1}{PRG_{rec-wat-dermu}}}$$

Vinyl Chloride Surface Water Ingestion

$$PRG_{rec-wat-ingvc}\left(\frac{\mu g}{L}\right) = \frac{TR}{\left(\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{mg}{1000\ \mu g}\right) \times IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + \left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{mg}{1000\ \mu g}\right) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{BW_{rec-c}(15\ kg)}\right)\right)}$$

where:

$$IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Vinyl Chloride Surface Water Dermal

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) \le t^{*}\ (hrs)$, then:

$$PRG_{rec-wat-dervc}\left(\frac{\mu g}{L}\right) = \frac{DA_{vc-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) > t^{*}\ (hrs)$, then:

$$PRG_{rec-wat-dervc}\left(\frac{\mu g}{L}\right) = \frac{DA_{vc-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{1 + B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1 + 3B + 3B^2}{(1 + B)^2}\right)\right]}$$

where:

$$ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) = \left(\frac{\left(ED_{rec-c}(6\ yr) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\right) + \left(ED_{rec-a}(20\ yr) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)\right)}{ED_{rec}(26\ yr)}\right)$$

and:

$$DA_{vc-event}\left(\frac{\mu g}{cm^2-event}\right) = \frac{TR}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left[\left(\frac{DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + \left(\frac{EV_{rec-c}\left(\frac{1\ event}{day}\right) \times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}(15\ kg)}\right)\right]}$$

where:

$$DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right) = \left(\begin{array}{c}\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}(15\ kg)} + \\ \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times SA_{rec-a}\left(19,652\ cm^2\right)}{BW_{rec-a}(80\ kg)}\end{array}\right)$$

Vinyl Chloride Surface Water Total

$$PRG_{rec-wat-totvc}\left(\frac{\mu g}{L}\right) = \frac{1}{\frac{1}{PRG_{rec-wat-ingvc}} + \frac{1}{PRG_{rec-wat-dervc}}}$$

Trichloroethylene Surface Water Ingestion

$$PRG_{rec-wat-ingtce}\left(\frac{\mu g}{L}\right) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{mg}{1000\ \mu g}\right) \times \left(\left(CAF_o(0.804) \times IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right)\right) + \left(MAF_o(0.202) \times IFWM_{rec-adj}\left(\frac{14\ L}{kg}\right)\right)\right)}$$

where:

$$IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right)}{BW_{rec-a}(80\ kg)}\right]$$

and:

$$IFWM_{rec-adj}\left(\frac{14\ L}{kg}\right) = \left[\frac{EF_{0-2}\left(\frac{45\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times EV_{0-2}\left(\frac{1\ event}{day}\right) \times ET_{event-(0-2)}\left(\frac{1\ hrs}{event}\right) \times IRW_{0-2}\left(\frac{0.12\ L}{hr}\right) \times 10}{BW_{0-2}(15\ kg)} + \frac{EF_{2-6}\left(\frac{45\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times EV_{2-6}\left(\frac{1\ event}{day}\right) \times ET_{event-(2-6)}\left(\frac{1\ hrs}{event}\right) \times IRW_{2-6}\left(\frac{0.12\ L}{hr}\right) \times 3}{BW_{2-6}(15\ kg)} + \frac{EF_{6-16}\left(\frac{45\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times EV_{6-16}\left(\frac{1\ event}{day}\right) \times ET_{event-(6-16)}\left(\frac{1\ hrs}{event}\right) \times IRW_{6-16}\left(\frac{0.124\ L}{hr}\right) \times 3}{BW_{6-16}(80\ kg)} + \frac{EF_{16-26}\left(\frac{45\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times EV_{16-26}\left(\frac{1\ event}{day}\right) \times ET_{event-(16-26)}\left(\frac{1\ hrs}{event}\right) \times IRW_{16-26}\left(\frac{0.098\ L}{hr}\right) \times 1}{BW_{16-26}(80\ kg)}\right]$$

Trichloroethylene Surface Water Dermal

IF $ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right) \le t^{*}\ (hrs)$, then:

$$PRG_{rec-wat-dertce}\left(\frac{\mu g}{L}\right) = \frac{DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right)}{\pi}}}$$

or:

IF $ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right) > t^{*}\ (hrs)$, then:

$$PRG_{rec-wat-dertce}\left(\frac{\mu g}{L}\right) = \frac{DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{1000\ cm^3}{L}\right)}{FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]}$$

where:

$$ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right) = \frac{\left(\begin{array}{c}\left(ED_{0-2}(2\ yr) \times ET_{event-(0-2)}\left(\frac{1\ hrs}{event}\right)\right) + \left(ED_{2-6}(4\ yr) \times ET_{event-(2-6)}\left(\frac{1\ hrs}{event}\right)\right) + \\ \left(\left(ED_{6-16}(10\ yr) \times ET_{event-(6-16)}\left(\frac{1\ hrs}{event}\right)\right) + \left(ED_{16-26}(10\ yr) \times ET_{event-(16-26)}\left(\frac{1\ hrs}{event}\right)\right)\right)\end{array}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr) + ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

and:

$$DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) = \frac{TR \times AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{\left(\frac{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}}{GIABS}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left[\begin{array}{c}\left(CAF_o(0.804) \times DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right)\right) + \\ \left(MAF_o(0.202) \times DFWM_{rec-adj}\left(\frac{1,053,210\ cm^2-event}{kg}\right)\right)\end{array}\right]}$$

where:

$$DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right) = \left(\begin{array}{c}\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}(15\ kg)} + \\ \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times SA_{rec-a}\left(19,652\ cm^2\right)}{BW_{rec-a}(80\ kg)}\end{array}\right)$$

and:

$$DFWM_{rec-adj}\left(\frac{1,053,210\ cm^2-event}{kg}\right) = \left(\begin{array}{c}\frac{EF_{0-2}\left(\frac{45\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times EV_{0-2}\left(\frac{1\ event}{day}\right) \times SA_{0-2}\left(6,365\ cm^2\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{45\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times EV_{2-6}\left(\frac{1\ event}{day}\right) \times SA_{2-6}\left(6,365\ cm^2\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{45\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times EV_{6-16}\left(\frac{1\ event}{day}\right) \times SA_{6-16}\left(19,652\ cm^2\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{45\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times EV_{16-26}\left(\frac{1\ event}{day}\right) \times SA_{16-26}\left(19,652\ cm^2\right) \times 1}{BW_{16-26}(80\ kg)}\end{array}\right)$$

Trichloroethylene Surface Water Total

$$PRG_{rec-wat-tottce}\left(\frac{\mu g}{L}\right) = \frac{1}{\frac{1}{PRG_{rec-wat-ingtce}} + \frac{1}{PRG_{rec-wat-dertce}}}$$

Supporting Child Surface Water

$$ED_{rec-c}(6\ yr) = ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)$$

$$BW_{rec-c}\left(15\ kg\right) = \frac{ED_{0-2}(2\ yr) \times BW_{0-2}\left(15\ kg\right) + ED_{2-6}(4\ yr) \times BW_{2-6}\left(15\ kg\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$EF_{rec-c}\left(\frac{45\ days}{yr}\right) = \frac{ED_{0-2}(2\ yr) \times EF_{0-2}\left(\frac{45\ days}{yr}\right) + ED_{2-6}(4\ yr) \times EF_{2-6}\left(\frac{45\ days}{yr}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right) = \frac{ED_{0-2}(2\ yr) \times ET_{event-rec}\left(\frac{1\ hrs}{event}\right) + ED_{2-6}(4\ yr) \times ET_{event-(2-6)}\left(\frac{1\ hrs}{event}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$EV_{rec-c}\left(\frac{1\ event}{day}\right) = \frac{ED_{0-2}(2\ yr) \times EV_{0-2}\left(\frac{1\ event}{day}\right) + ED_{2-6}(4\ yr) \times EV_{2-6}\left(\frac{1\ event}{day}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$SA_{rec-c}\left(6,365\ cm^2\right) = \frac{ED_{0-2}(2\ yr) \times SA_{0-2}\left(6,365\ cm^2\right) + ED_{2-6}(4\ yr) \times SA_{2-6}\left(6,365\ cm^2\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right) = \frac{ED_{0-2}(2\ yr) \times IRW_{0-2}\left(\frac{0.12\ L}{hr}\right) + ED_{2-6}(4\ yr) \times IRW_{2-6}\left(\frac{0.12\ L}{hr}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

Supporting Adult Surface Water

$$ED_{rec-a}\,(20\ yr) = ED_{6-16}\,(10\ yr) + ED_{16-26}\,(10\ yr)$$

$$BW_{rec-a}\left(80\ kg\right) = \frac{ED_{6-16}\,(10\ yr) \times BW_{6-16}\left(80\ kg\right) + ED_{16-26}\,(10\ yr) \times BW_{16-26}\left(80\ kg\right)}{ED_{6-16}\,(10\ yr) + ED_{16-26}\,(10\ yr)}$$

$$EF_{rec-a}\left(\frac{45\ days}{yr}\right) = \frac{ED_{6-16}\,(10\ yr) \times EF_{6-16}\left(\frac{45\ days}{yr}\right) + ED_{16-26}\,(10\ yr) \times EF_{16-26}\left(\frac{45\ days}{yr}\right)}{ED_{6-16}\,(10\ yr) + ED_{16-26}\,(10\ yr)}$$

$$ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) = \frac{ED_{6-16}\,(10\ yr) \times ET_{event-(6-16)}\left(\frac{1\ hrs}{event}\right) + ED_{16-26}\,(10\ yr) \times ET_{event-(16-26)}\left(\frac{1\ hrs}{event}\right)}{ED_{6-16}\,(10\ yr) + ED_{16-26}\,(10\ yr)}$$

$$EV_{rec-a}\left(\frac{1\ event}{day}\right) = \frac{ED_{6-16}\,(10\ yr) \times EV_{6-16}\left(\frac{1\ event}{day}\right) + ED_{16-26}\,(10\ yr) \times EV_{16-26}\left(\frac{1\ event}{day}\right)}{ED_{6-16}\,(10\ yr) + ED_{16-26}\,(10\ yr)}$$

$$SA_{rec-a}\left(19{,}652\ cm^2\right) = \frac{ED_{6-16}\,(10\ yr) \times SA_{6-16}\left(19{,}652\ cm^2\right) + ED_{16-26}\,(10\ yr) \times SA_{16-26}\left(19{,}652\ cm^2\right)}{ED_{6-16}\,(10\ yr) + ED_{16-26}\,(10\ yr)}$$

$$IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right) = \frac{ED_{6-16}\,(10\ yr) \times IRW_{6-16}\left(\frac{0.124\ L}{hr}\right) + ED_{16-26}\,(10\ yr) \times IRW_{16-26}\left(\frac{0.098\ L}{hr}\right)}{ED_{6-16}\,(10\ yr) + ED_{16-26}\,(10\ yr)}$$

Supporting Age-adjusted Surface Water

$$ED_{rec}\,(26\ yr) = ED_{0-2}\,(2\ yr) + ED_{2-6}\,(4\ yr) + ED_{6-16}\,(10\ yr) + ED_{16-26}\,(10\ yr)$$

$$EF_{rec}\left(\frac{45\ days}{yr}\right) = \frac{\left(\begin{array}{c} ED_{0-2}\,(2\ yr) \times EF_{0-2}\left(\frac{45\ days}{yr}\right) + ED_{2-6}\,(4\ yr) \times EF_{2-6}\left(\frac{45\ days}{yr}\right) + \\ ED_{6-16}\,(10\ yr) \times EF_{6-16}\left(\frac{45\ days}{yr}\right) + ED_{16-26}\,(10\ yr) \times EF_{16-26}\left(\frac{45\ days}{yr}\right) \end{array}\right)}{ED_{0-2}\,(2\ yr) + ED_{2-6}\,(4\ yr) + ED_{6-16}\,(10\ yr) + ED_{16-26}\,(10\ yr)}$$

Farmer Direct Consumption of Agricultural Products PRG Equations

Noncarcinogenic Produce Ingestion

$$PRG_{far\text{-}prod\text{-}ingn}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{far-c}\left(\frac{365\ days}{yr} \times ED_{far-c}(6\ yr)\right) \times BW_{far-c}(15\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times CF_{produce}(1) \times \left(IRF_{far-c}\left(\frac{68,100\ mg}{day}\right) + IRV_{far-c}\left(\frac{41,700\ mg}{day}\right)\right)}$$

Carcinogenic Produce Ingestion

$$PRG_{far\text{-}prod\text{-}ingc}\left(\frac{mg}{kg}\right) = \frac{TR \times AT_{far}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1} \times \left(\frac{10^{-6}\ kg}{mg}\right) \times CF_{produce}(1) \times \left(IFF_{far-adj}\left(\frac{35,833,000\ mg}{kg}\right) + IFV_{far-adj}\left(\frac{24,535,875\ mg}{kg}\right)\right)}$$

where:

$$IFF_{far-adj}\left(\frac{35,833,000\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68,100\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176,800\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

and:

$$IFV_{far-adj}\left(\frac{24,535,875\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41,700\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125,700\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

Noncarcinogenic Dairy Ingestion

$$PRG_{far\text{-}dairy\text{-}ingn}\left(\frac{mg}{kg}\right) = \frac{THQ \times AT_{far-c}\left(\frac{365\ days}{yr} \times ED_{far-c}(6\ yr)\right) \times BW_{far-c}(15\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times CF_{dairy}(1) \times IRD_{far-c}\left(\frac{349,500\ mg}{day}\right)}$$

Carcinogenic Dairy Ingestion

$$PRG_{far\text{-}dairy\text{-}ingc}\left(\frac{mg}{kg}\right)=\frac{TR\times AT_{far}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}\times\left(\frac{10^{-6}\ kg}{mg}\right)\times CF_{dairy}(1)\times IFD_{far-adj}\left(\frac{115,213,000\ mg}{kg}\right)}$$

where:

$$IFD_{far-adj}\left(\frac{115,213,000\ mg}{kg}\right)=\left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times IRD_{far-c}\left(\frac{349,500\ mg}{day}\right)}{BW_{far-c}(15\ kg)}+\frac{EF_{far-a}\left(\frac{350\ days}{yr}\right)\times ED_{far-a}(34\ yr)\times IRD_{far-a}\left(\frac{445,600\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

Noncarcinogenic Beef Ingestion

$$PRG_{far\text{-}beef\text{-}ingn}\left(\frac{mg}{kg}\right)=\frac{THQ\times AT_{far-c}\left(\frac{365\ days}{yr}\times ED_{far-c}(6\ yr)\right)\times BW_{far-c}(15\ kg)}{\left(\frac{1}{RfD_o\left(\frac{mg}{kg-day}\right)}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times CF_{beef}(1)\times IRB_{far-c}\left(\frac{40,100\ mg}{day}\right)}$$

Carcinogenic Beef Ingestion

$$PRG_{far\text{-}beef\text{-}ingc}\left(\frac{mg}{kg}\right)=\frac{TR\times AT_{far}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}{CSF_o\left(\frac{mg}{kg-day}\right)^{-1}\times\left(\frac{10^{-6}\ kg}{mg}\right)\times CF_{beef}(1)\times IFB_{far-adj}\left(\frac{32,091,500\ mg}{kg}\right)}$$

where:

$$IFB_{far-adj}\left(\frac{32,091,500\ mg}{kg}\right)=\left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times IRB_{far-c}\left(\frac{40,100\ mg}{day}\right)}{BW_{far-c}(15\ kg)}+\frac{EF_{far-a}\left(\frac{350\ days}{yr}\right)\times ED_{far-a}(34\ yr)\times IRB_{far-a}\left(\frac{178,000\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

Farmer Direct Consumption of Agricultural Products - Back-calculated to Water PRG Equations

Noncarcinogenic Produce Ingestion Water

$$PRG_{far-wat-ingpn}\left(\frac{mg}{kg}\right) = \frac{PRG_{far-prod-ingn}\left(\frac{mg}{kg}\right)}{\left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right)}$$

where:

$$Irr_{rup}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times BV_{wet} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{res}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times MLF_{produce} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{dep}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times I_f \times T \times \left[1 - \exp\left(\left(\frac{\lambda_E}{day}\right) \times t_v\ (days)\right)\right]}{Y_v\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_E}{day}\right)}$$

Carcinogenic Produce Ingestion Water

$$PRG_{far-wat-ingpc}\left(\frac{mg}{kg}\right) = \frac{PRG_{far-prod-ingc}\left(\frac{mg}{kg}\right)}{\left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right)}$$

where:

$$Irr_{rup}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times BV_{wet} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{res}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times MLF_{produce} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{dep}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times I_f \times T \times \left[1 - \exp\left(\left(\frac{\lambda_E}{day}\right) \times t_v\ (days)\right)\right]}{Y_v\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_E}{day}\right)}$$

Noncarcinogenic Dairy Ingestion Water

$$PRG_{far-wat-ingdn}\left(\frac{mg}{L}\right) = \frac{PRG_{far-dairy-ingn}\left(\frac{mg}{kg}\right)}{TF_{dairy}\left(\frac{day}{kg}\right) \times Q_{w-dairy}\left(\frac{92\ L}{day}\right)}$$

Carcinogenic Dairy Ingestion Water

$$PRG_{far-wat-ingdc}\left(\frac{mg}{L}\right) = \frac{PRG_{far-dairy-ingc}\left(\frac{mg}{kg}\right)}{TF_{dairy}\left(\frac{day}{kg}\right) \times Q_{w-dairy}\left(\frac{92\ L}{day}\right)}$$

Noncarcinogenic Beef Ingestion Water

$$PRG_{far-wat-ingbn}\left(\frac{mg}{L}\right) = \frac{PRG_{far-beef-ingn}\left(\frac{mg}{kg}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times Q_{w-beef}\left(\frac{53\ L}{day}\right)}$$

Carcinogenic Beef Ingestion Water

$$PRG_{far-wat-ingbc}\left(\frac{mg}{L}\right) = \frac{PRG_{far-beef-ingc}\left(\frac{mg}{kg}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times Q_{w-beef}\left(\frac{53\ L}{day}\right)}$$

Farmer Direct Consumption of Agricultural Products - Back-calculated to Soil PRG Equations

Noncarcinogenic Produce Ingestion Soil

$$PRG_{far-sol-ingpn}\left(\frac{mg}{kg}\right) = \frac{PRG_{far-prod-ingn}\left(\frac{mg}{kg}\right)}{\left(R_{upv} + R_{es}\right)}$$

where:

$$R_{upv} = BV_{wet}\ ;\ R_{es} = MLF_{produce}(0.0135)$$

Carcinogenic Produce Ingestion Soil

$$PRG_{far-sol-ingpc}\left(\frac{mg}{kg}\right) = \frac{PRG_{far-prod-ingc}\left(\frac{mg}{kg}\right)}{\left(R_{upv} + R_{es}\right)}$$

where:

$$R_{upv} = BV_{wet}\ ;\ R_{es} = MLF_{produce}(0.0135)$$

Noncarcinogenic Dairy Ingestion Soil

$$PRG_{far-sol-ingdn}\left(\frac{mg}{kg}\right) = \frac{PRG_{far-dairy-ingn}\left(\frac{mg}{kg}\right)}{TF_{dairy}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)\end{array}\right]}$$

where:

$R_{upp} = BV_{dry}$; $R_{es} = MLF_{pasture}(0.25)$

Carcinogenic Dairy Ingestion Soil

$$PRG_{far-sol-ingdc}\left(\frac{mg}{kg}\right) = \frac{PRG_{far-dairy-ingc}\left(\frac{mg}{kg}\right)}{TF_{dairy}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)\end{array}\right]}$$

where:

$R_{upp} = BV_{dry}$; $R_{es} = MLF_{pasture}(0.25)$

Noncarcinogenic Beef Ingestion Soil

$$PRG_{far-sol-ingbn}\left(\frac{mg}{kg}\right) = \frac{PRG_{far-beef-ingn}\left(\frac{mg}{kg}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\end{array}\right]}$$

where:

$R_{upp} = BV_{dry}$; $R_{es} = MLF_{pasture}(0.25)$

Carcinogenic Beef Ingestion Soil

$$PRG_{far-sol-ingbc}\left(\frac{mg}{kg}\right) = \frac{PRG_{far-beef-ingc}\left(\frac{mg}{kg}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\end{array}\right]}$$

where:

$R_{upp} = BV_{dry}$; $R_{es} = MLF_{pasture}(0.25)$

Farmer Direct Consumption of Agricultural Products - Back-calculated to Soil and Water PRG Equations

Noncarcinogenic Produce Ingestion Combined Soil and Water

$PRG_{far-sw-ingpn}$ =

$$\text{INTERCEPT} = \frac{PRG_{far-prod-ingn}\left(\frac{mg}{kg}\right)}{\left(R_{upv} + R_{es}\right)}$$

and:

$$\text{SLOPE} = \frac{\left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right)}{\left(R_{upv} + R_{es}\right)}$$

where:

$$R_{upv} = BV_{wet}\ ;\ R_{es} = MLF_{produce}(0.0135)$$

and:

$$Irr_{rup}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times BV_{wet} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{res}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times MLF_{produce} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{dep}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times I_f \times T \times \left[1 - \exp\left(\left(\frac{\lambda_E}{day}\right) \times t_v\ (days)\right)\right]}{Y_v\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_E}{day}\right)}$$

Carcinogenic Produce Ingestion Combined Soil and Water

$$PRG_{far-sw-ingpc} =$$

$$INTERCEPT = \frac{PRG_{far-prod-ingc}\left(\frac{mg}{kg}\right)}{\left(R_{upv} + R_{es}\right)}$$

and:

$$SLOPE = \frac{\left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right)}{\left(R_{upv} + R_{es}\right)}$$

where:

$$R_{upv} = BV_{wet}\ ;\ R_{es} = MLF_{produce}(0.0135)$$

and:

$$Irr_{rup}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times BV_{wet} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{res}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times MLF_{produce} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{dep}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times I_f \times T \times \left[1 - \exp\left(\left(\frac{\lambda_E}{day}\right) \times t_v\ (days)\right)\right]}{Y_v\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_E}{day}\right)}$$

Noncarcinogenic Dairy Ingestion Combined Soil and Water

$$PRG_{far-sw-ingdn} =$$

$$\text{INTERCEPT} = \frac{PRG_{far-dairy-ingn}\left(\frac{mg}{kg}\right)}{TF_{dairy}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)\end{array}\right]}$$

and:

$$\text{SLOPE} = \frac{Q_{w-dairy}\left(\frac{92\ L}{day}\right)}{\left[\begin{array}{c}\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)\end{array}\right]}$$

where:

$$R_{upp} = BV_{dry}\ ;\ R_{es} = MLF_{pasture}(0.25)$$

Carcinogenic Dairy Ingestion Combined Soil and Water

$$PRG_{far-sw-ingdc} =$$

$$\text{INTERCEPT} = \frac{PRG_{far-dairy-ingc}\left(\frac{mg}{kg}\right)}{TF_{dairy}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)\end{array}\right]}$$

and:

$$\text{SLOPE} = \frac{Q_{w-dairy}\left(\frac{92\ L}{day}\right)}{\left[\begin{array}{c}\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)\end{array}\right]}$$

where:

$$R_{upp} = BV_{dry}\ ;\ R_{es} = MLF_{pasture}(0.25)$$

Noncarcinogenic Beef Ingestion Combined Soil and Water

$PRG_{far-sw-ingbn}$ =

$$INTERCEPT = \frac{PRG_{far-beef-ingn}\left(\frac{mg}{kg}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\end{array}\right]}$$

and:

$$SLOPE = \frac{Q_{w-beef}\left(\frac{53\ L}{day}\right)}{\left[\begin{array}{c}\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\end{array}\right]}$$

where:

$R_{upp} = BV_{dry}$; $R_{es} = MLF_{pasture}(0.25)$

Carcinogenic Beef Ingestion Combined Soil and Water

$PRG_{far-sw-ingbc}$ =

$$INTERCEPT = \frac{PRG_{far-beef-ingc}\left(\frac{mg}{kg}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\end{array}\right]}$$

and:

$$SLOPE = \frac{Q_{w-beef}\left(\frac{53\ L}{day}\right)}{\left[\begin{array}{c}\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\end{array}\right]}$$

where:

$R_{upp} = BV_{dry}$; $R_{es} = MLF_{pasture}(0.25)$

Soil to Groundwater PRG Equations

Method 1 for SSL Determination

$$SSL\left(\frac{mg}{kg}\right) = C_{water}\left(\frac{mg}{L}\right) \times \left[K_d\left(\frac{L}{kg}\right) + \left(\frac{\theta_w\left(\frac{0.3\ L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{0.13\ L_{air}}{L_{soil}}\right) \times H'}{\rho_b\left(\frac{1.5\ kg}{L}\right)}\right)\right]$$

where:

$$C_{water}\left(\frac{mg}{L}\right) = SL\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1,000\ \mu g}\right) \times DAF$$

where:

$$SL\left(\frac{\mu g}{L}\right) = MCL\left(\frac{\mu g}{L}\right);\ RSL\left(\frac{\mu g}{L}\right);\ RML\left(\frac{\mu g}{L}\right);\ \text{or}\ PRG\left(\frac{\mu g}{L}\right)$$

$$\theta_a\left(\frac{0.13\ L_{air}}{L_{soil}}\right) = n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) - \theta_w\left(\frac{0.3\ L_{water}}{L_{soil}}\right);\ n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) = 1 - \frac{\rho_b\left(\frac{1.5\ kg}{L}\right)}{\rho_s\left(\frac{2.65\ kg}{L}\right)}$$

and:

$$K_d\left(\frac{L}{kg}\right) = f_{oc}\left(\frac{0.002\ g-carbon}{g-soil}\right) \times K_{oc}\left(\frac{L}{kg}\right)$$, for organic compounds;

$K_d\left(\frac{L}{kg}\right)$ values for inorganic compounds are listed in the user guide.

Method 2 for SSL Determination

$$SSL\left(\frac{mg}{kg}\right) = \frac{C_{water}\left(\frac{mg}{L}\right) \times I\left(\frac{0.18\ m}{yr}\right) \times ED\,(70\ yr)}{\rho_b\left(\frac{1.5\ kg}{L}\right) \times d_s\left(\frac{mg}{kg}\right)}$$

where:

$$C_{water}\left(\frac{mg}{L}\right) = SL\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times DAF$$

where:

$$SL\left(\frac{\mu g}{L}\right) = MCL\left(\frac{\mu g}{L}\right);\ RSL\left(\frac{\mu g}{L}\right);\ RML\left(\frac{\mu g}{L}\right);\ \text{or } PRG\left(\frac{\mu g}{L}\right)$$

APPENDIX C. TABLES OF VARIABLES USED IN CHEMICAL CDI AND RISK EQUATIONS

APPENDIX C. TABLES OF VARIABLES USED IN CHEMICAL AND RISK EQUATIONS

Table C-1. Toxicity Values

Symbol	Definition (units)	Default	Reference
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
IUR	Chronic Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Contaminant-specific	EPA Superfund hierarchy

Table C-2. Miscellaneous Variables

Symbol	Definition (units)	Default	Reference
C_{soil}	Concentration of contaminant in soil (mg/kg)	User-input	Entered by user
$C_{g\text{-}water}$	Concentration of contaminant in groundwater (µg/L)	User-input	Entered by user
$C_{s\text{-}water}$	Concentration of contaminant in surface water (µg/L)	User-input	Entered by user
C_{air}	Concentration of contaminant in air ($\mu g/m^3$)	User-input	Entered by user
C_{fish}	Concentration of contaminant in fish (mg/kg)	User-input	Entered by user
$C_{produce}$	Concentration of contaminant in produce (mg/kg)	User-input	Entered by user
C_{dairy}	Concentration of contaminant in dairy (mg/kg)	User-input	Entered by user
C_{beef}	Concentration of contaminant in beef (mg/kg)	User-input	Entered by user
LT	Lifetime (years)	70	U.S. EPA 2014 (Attachment 1)
K	Andelman Volatilization Factor (L/m^3)	0.5	U.S. EPA 1991b (pg. 20)
K_p	permeability constant (cm/hr)	Chemical-specific	
t*	Time to reach steady-state (hours)	Chemical-specific	U.S. EPA 2004 (Page 3-4)
τ_{event}	Lag time per event (hours/event)	Chemical-specific	U.S. EPA 2004 (Page 3-4)
B	Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis (unitless)	Chemical-specific	U.S. EPA 2004 (Page 3-4)
FA	Fraction absorbed water (unitless)	Chemical-specific	U.S. EPA 2004 (Page 3-4)
ABS_d	Fraction of contaminant absorbed dermally from soil (unitless)	Chemical-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.	Chemical-specific	U.S. EPA 2004 (Exhibit 4-1)
H'	Dimensionless Henry's Law Constant	Contaminant-specific	Hierarchy selection in Section 2.4.2
$\Delta H_{v,b}$	Enthalpy of vaporization at the normal boiling point (cal/mol)	Contaminant-specific	Hierarchy selection in Section 2.4.2

Table C-2. Miscellaneous Variables

Symbol	Definition (units)	Default	Reference
$\Delta H_{v,gw}$	Enthalpy of vaporization at temperature of groundwater (cal/mol)	Contaminant-specific	Determined in this calculator
T_w	Groundwater Temperatures (Kelvin)	Site-specific	Site-specific
T_c	Critical Temperatures (Kelvin)	Contaminant-specific	Hierarchy selection in Section 2.4.2
T_b	Normal Boiling Point (Kelvin)	Contaminant-specific	Hierarchy selection in Section 2.4.2

n	If ($T_b/T_c < 0.57$)
	If ($T_b/T_c > 0.71$)
	If ($0.57 < T_b/T_c \leq 0.71$)
		n = 0.3
		n = 0.41
		n = (0.74 x T_b/T_c - 0.116)
			U.S. EPA VISL 2014

Table C-3. Resident Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{res\text{-}sol\text{-}ingnc}$	Resident Child Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}dernc}$	Resident Child Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}inhnc}$	Resident Child Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}ingna}$	Resident Adult Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}derna}$	Resident Adult Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}inhna}$	Resident Adult Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}ingnadj}$	Resident Age-adjusted Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}dernadj}$	Resident Age-adjusted Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}inhnadj}$	Resident Age-adjusted Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}ingc}$	Resident Soil Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}derc}$	Resident Soil Carcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator

Table C-3. Resident Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{res\text{-}sol\text{-}inhc}$	Resident Soil Carcinogenic Inhalation (μg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}ingmu}$	Resident Soil Mutagenic Ingestion (mg/kg-day)	Mutagen-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}dermu}$	Resident Soil Mutagenic Dermal (mg/kg-day)	Mutagen-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}inhmu}$	Resident Soil Mutagenic Inhalation (μg/m^3)	Mutagen-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}ingvc}$	Resident Soil Carcinogenic Vinyl Chloride Ingestion (mg/kg-day)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}dervc}$	Resident Soil Carcinogenic Vinyl Chloride Dermal (mg/kg-day)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}inhvc}$	Resident Soil Carcinogenic Vinyl Chloride Inhalation (μg/m^3)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}ingtce}$	Resident Soil Carcinogenic and Mutagenic Trichloroethylene Ingestion (mg/kg-day)	Trichloroethylene-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}dertce}$	Resident Soil Carcinogenic and Mutagenic Trichloroethylene Dermal (mg/kg-day)	Trichloroethylene-specific	Determined in this calculator
$CDI_{res\text{-}sol\text{-}inhtce}$	Resident Soil Carcinogenic and Mutagenic Trichloroethylene Inhalation (μg/m^3)	Trichloroethylene-specific	Determined in this calculator
$BW_{res\text{-}a}$	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{res\text{-}c}$	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{0\text{-}2}$	Body Weight - 0-2 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{2\text{-}6}$	Body Weight - 2-6 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{6\text{-}16}$	Body Weight - 6-16 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{16\text{-}26}$	Body Weight - 16-26 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{res}	Exposure Duration - adult + child (years)	26	U.S. EPA 2014 (Attachment 1)
$ED_{res\text{-}a}$	Exposure Duration - adult (years)	20	U.S. EPA 2014 (Attachment 1)
$ED_{res\text{-}c}$	Exposure Duration - child (years)	6	U.S. EPA 2014 (Attachment 1)
$ED_{0\text{-}2}$	Exposure Duration - 0-2 Years (years)	2	U.S. EPA 2014 (Attachment 1)

Table C-3. Resident Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
ED_{2-6}	Exposure Duration - 2-6 Years (years)	4	U.S. EPA 2014 (Attachment 1)
ED_{6-16}	Exposure Duration - 6-16 Years (years)	10	U.S. EPA 2014 (Attachment 1)
ED_{16-26}	Exposure Duration - 16-26 Years (years)	10	U.S. EPA 2014 (Attachment 1)
EF_{res}	Exposure Frequency - adult + child (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{res-a}	Exposure Frequency - adult (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{res-c}	Exposure Frequency - child (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{0-2}	Exposure Frequency - 0-2 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{2-6}	Exposure Frequency - 2-6 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{6-16}	Exposure Frequency - 6-16 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{16-26}	Exposure Frequency - 16-26 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
ET_{res-a}	Resident Exposure Time - adult (hours/day)	24	The whole day
ET_{res-c}	Resident Exposure Time - child (hours/day)	24	The whole day
ET_{res}	Resident Exposure Time (hours/day)	24	The whole day
ET_{0-2}	Exposure Time - age segment 0-2 (hours/day)	24	The whole day
ET_{2-6}	Exposure Time - age segment 2-6 (hours/day)	24	The whole day
ET_{6-16}	Exposure Time - age segment 6-16 (hours/day)	24	The whole day
ET_{16-26}	Exposure Time - age segment 16-26 (hours/day)	24	The whole day
IRS_{res-c}	Ingestion Rate - Child (mg/day)	200	U.S. EPA 2014 (Attachment 1)
IRS_{res-a}	Ingestion Rate - Adult (mg/day)	100	U.S. EPA 2014 (Attachment 1)
IRS_{0-2}	Ingestion Rate - 0-2 years (mg/day)	200	U.S. EPA 2014 (Attachment 1)

Table C-3. Resident Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
IRS_{2-6}	Ingestion Rate - 2-6 years (mg/day)	200	U.S. EPA 2014 (Attachment 1)
IRS_{6-16}	Ingestion Rate - 6-16 years (mg/day)	100	U.S. EPA 2014 (Attachment 1)
IRS_{16-26}	Ingestion Rate - 16-26 years (mg/day)	100	U.S. EPA 2014 (Attachment 1)
$IFS_{res-adj}$	Ingestion Rate - Age-adjusted (mg/kg)	36,750	Calculated using the age-adjusted intake factors equation
$IFSM_{res-adj}$	Mutagenic Ingestion Rate - Age-adjusted (mg/kg)	166,833	Calculated using the mutagenic age-adjusted intake factors equation
AF_{res-c}	Adherence factor-child (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
AF_{res-a}	Adherence factor-adult (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
AF_{0-2}	Adherence factor 0-2 years (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
AF_{2-6}	Adherence factor 2-6 years (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
AF_{6-16}	Adherence factor 6-16 years (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
AF_{16-26}	Adherence factor 16-26 years (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
$DFS_{res-adj}$	Dermal contact factor- age-adjusted (mg/kg)	103,390	Calculated using the age-adjusted intake factors equation
$DFSM_{res-adj}$	Mutagenic dermal contact factor-age-adjusted (mg/kg)	428,260	Calculated using the mutagenic age-adjusted intake factors equation
SA_{res-c}	Surface area - child (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
SA_{res-a}	Surface area - adult (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
SA_{0-2}	Surface area 0-2 years (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
SA_{2-6}	Surface area 2-6 years (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
SA_{6-16}	Surface area 6-16 years (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
SA_{16-26}	Surface area 16-26 (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
AT_{res}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)

Table C-3. Resident Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
AT_{res-c}	Averaging time – child (days/year)	365 x ED_{res-c}	U.S. EPA 2014 (Attachment 1)
AT_{res-a}	Averaging time - adult (days/year)	365 x ED_{res}	U.S. EPA 2014 (Attachment 1)

Table C-4. Composite Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{com-sol-ingn}$	Composite Worker Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{com-sol-dern}$	Composite Worker Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{com-sol-inhn}$	Composite Worker Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{com-sol-totn}$	Composite Worker Soil Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{com-sol-ingc}$	Composite Worker Soil Carcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{com-sol-derc}$	Composite Worker Soil Carcinogenic Inhalation (μg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{com-sol-inhc}$	Composite Worker Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{com-sol-totc}$	Composite Worker Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
BW_{com}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{com}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{com}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{com}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{com}	Ingestion Rate (mg/day)	100	U.S. EPA 2014 (Attachment 1)
AF_{com}	Adherence factor (mg/cm^2)	0.12	U.S. EPA 2014 (Attachment 1)
SA_{com}	Surface area (cm^2)	3527	U.S. EPA 2014 (Attachment 1)
AT_{com}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{com-a}	Averaging time (days/year)	365 x ED_{com}	U.S. EPA 2014 (Attachment 1)

Table C-5. Outdoor Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{out\text{-}sol\text{-}ingn}$	Outdoor Worker Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{out\text{-}sol\text{-}dern}$	Outdoor Worker Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{out\text{-}sol\text{-}inhn}$	Outdoor Worker Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{out\text{-}sol\text{-}ingc}$	Outdoor Worker Soil Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{out\text{-}sol\text{-}derc}$	Outdoor Worker Soil Carcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
BW_{out}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{out}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{out}	Exposure Frequency (days/year)	225	U.S. EPA 2014 (Attachment 1)
ET_{out}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{out}	Ingestion Rate (mg/day)	100	U.S. EPA 2014 (Attachment 1)
AF_{out}	Adherence factor (mg/cm^2)	0.12	U.S. EPA 2014 (Attachment 1)
SA_{out}	Surface area (cm^2)	3527	U.S. EPA 2014 (Attachment 1)
AT_{out}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{out\text{-}a}$	Averaging time (days/year)	365 x ED_{out}	U.S. EPA 2014 (Attachment 1)

Table C-6. Indoor Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{ind\text{-}sol\text{-}ingn}$	Indoor Worker Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{ind\text{-}sol\text{-}inhn}$	Indoor Worker Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{ind\text{-}sol\text{-}ingc}$	Indoor Worker Soil Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{ind\text{-}sol\text{-}inhc}$	Indoor Worker Soil Carcinogenic Inhalation (μg/m^3)	Contaminant-specific	Determined in this calculator
BW_{ind}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{ind}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{ind}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{ind}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{ind}	Soil Ingestion Rate (mg/day)	50	U.S. EPA 2014 (Attachment 1)
AT_{ind}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{ind\text{-}a}$	Averaging time (days/year)	365 x ED_{ind}	U.S. EPA 2014 (Attachment 1)

Table C-7. Construction Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{con\text{-}sol\text{-}ingn}$	Construction Worker Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{con\text{-}sol\text{-}dern}$	Construction Worker Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{con\text{-}sol\text{-}inhn}$	Construction Worker Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{con\text{-}sol\text{-}ingc}$	Construction Worker Soil Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{con\text{-}sol\text{-}derc}$	Construction Worker Soil Carcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{con\text{-}sol\text{-}inhc}$	Construction Worker Soil Carcinogenic Inhalation ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
BW_{con}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{con}	Exposure Duration (years)	1	U.S. EPA 2014 (Attachment 1)
EW_{con}	Exposure (weeks/year)	50	Based on 50 weeks per year (reasonable work season)
DW_{con}	Exposure (days/week)	5	Based on 5 days per week for 50 weeks
EF_{con}	Exposure Frequency (days/year)	EW x DW	Based on 5 days per week for 50 weeks
ET_{con}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{con}	Ingestion Rate (mg/day)	330	U.S. EPA 2002 (Exhibit 1-2)
AF_{con}	Adherence factor (mg/cm^2)	0.3	U.S. EPA 2002 (Exhibit 1-2)
SA_{con}	Surface area (cm^2)	3527	U.S. EPA 2014 (Attachment 1)
AT_{con}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{con\text{-}a}$	Averaging time (days/year)	365 x ED_{con}	U.S. EPA 2014 (Attachment 1)

Table C-8. Excavation Worker Soil Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{exc\text{-}sol\text{-}ingn}$	Excavation Worker Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{exc\text{-}sol\text{-}dern}$	Excavation Worker Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{exc\text{-}sol\text{-}inhn}$	Excavation Worker Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{exc\text{-}sol\text{-}ingc}$	Excavation Worker Soil Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{exc\text{-}sol\text{-}derc}$	Excavation Worker Soil Carcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{exc\text{-}sol\text{-}inhc}$	Excavation Worker Soil Carcinogenic Inhalation ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
BW_{ew}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{ew}	Exposure Duration (years)	1	U.S. EPA 2014 (Attachment 1)
EF_{ew}	Exposure Frequency (days/year)	20	Based on 5 days per week for 4 weeks
ET_{ew}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
IRS_{ew}	Ingestion Rate (mg/day)	330	U.S. EPA 2002 (Exhibit 1-2)
AF_{ew}	Adherence factor (mg/cm^2)	0.3	U.S. EPA 2002 (Exhibit 1-2)
SA_{ew}	Surface area (cm^2)	3527	U.S. EPA 2014 (Attachment 1)
AT_{ew}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{ew\text{-}a}$	Averaging time (days/year)	365 x ED_{exc}	U.S. EPA 2014 (Attachment 1)

Table C-9. Recreator Soil/Sediment Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{rec\text{-}sol\text{-}ingnc}$	Recreator Child Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}dernc}$	Recreator Child Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}inhn}$	Recreator Child Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}ingna}$	Recreator Adult Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator

Table C-9. Recreator Soil/Sediment Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{rec\text{-}sol\text{-}derna}$	Recreator Adult Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}inhna}$	Recreator Adult Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}ingnadj}$	Recreator Age-adjusted Soil Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}dernadj}$	Recreator Age-adjusted Soil Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}inhnadj}$	Recreator Age-adjusted Soil Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific Child, Adult and Age-adjusted	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}ingc}$	Recreator Soil Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}derc}$	Recreator Soil Carcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}inhc}$	Recreator Soil Carcinogenic Inhalation ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}ingmu}$	Recreator Soil Mutagenic Ingestion (mg/kg-day)	Mutagen-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}dermu}$	Recreator Soil Mutagenic Dermal (mg/kg-day)	Mutagen-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}inhmu}$	Recreator Soil Mutagenic Inhalation ($\mu g/m^3$)	Mutagen-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}ingvc}$	Recreator Soil Carcinogenic Vinyl Chloride Ingestion (mg/kg)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}dervc}$	Recreator Soil Carcinogenic Vinyl Chloride Dermal (mg/kg-day)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}inhvc}$	Recreator Soil Carcinogenic Vinyl Chloride Inhalation ($\mu g/m^3$)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}ingtce}$	Recreator Soil Carcinogenic and Mutagenic Trichloroethylene Ingestion (mg/kg-day)	Trichloroethylene-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}dertce}$	Recreator Soil Carcinogenic and Mutagenic Trichloroethylene Dermal (mg/kg-day)	Trichloroethylene-specific	Determined in this calculator
$CDI_{rec\text{-}sol\text{-}inhtce}$	Recreator Soil Carcinogenic and Mutagenic Trichloroethylene Inhalation ($\mu g/m^3$)	Trichloroethylene-specific	Determined in this calculator
$BW_{rec\text{-}a}$	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{rec\text{-}c}$	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{0\text{-}2}$	Body Weight - 0-2 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{2\text{-}6}$	Body Weight - 2-6 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
$BW_{6\text{-}16}$	Body Weight - 6-16 Years (kg)	80	U.S. EPA 2014 (Attachment 1)

Table C-9. Recreator Soil/Sediment Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
BW_{16-26}	Body Weight - 16-26 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{rec}	Exposure Duration - adult + child (years)	26	U.S. EPA 2014 (Attachment 1)
ED_{rec-a}	Exposure Duration - adult (years)	20	U.S. EPA 2014 (Attachment 1)
ED_{rec-c}	Exposure Duration - child (years)	6	U.S. EPA 2014 (Attachment 1)
ED_{0-2}	Exposure Duration - 0-2 Years (years)	2	U.S. EPA 2014 (Attachment 1)
ED_{2-6}	Exposure Duration - 2-6 Years (years)	4	U.S. EPA 2014 (Attachment 1)
ED_{6-16}	Exposure Duration - 6-16 Years (years)	10	U.S. EPA 2014 (Attachment 1)
ED_{16-26}	Exposure Duration - 16-26 Years (years)	10	U.S. EPA 2014 (Attachment 1)
EF_{rec}	Exposure Frequency - adult + child (days/year)	75	Reasonable Estimate
EF_{rec-a}	Exposure Frequency - adult (days/year)	75	Reasonable Estimate
EF_{rec-c}	Exposure Frequency - child (days/year)	75	Reasonable Estimate
EF_{0-2}	Exposure Frequency - 0-2 Years (days/year)	75	Reasonable Estimate
EF_{2-6}	Exposure Frequency - 2-6 Years (days/year)	75	Reasonable Estimate
EF_{6-16}	Exposure Frequency - 6-16 Years (days/year)	75	Reasonable Estimate
EF_{16-26}	Exposure Frequency - 16-26 Years (days/year)	75	Reasonable Estimate
ET_{rec}	Exposure Time (hours/day)	1	Reasonable Estimate
ET_{rec-c}	Exposure time - child (hours/day)	1	Reasonable Estimate
ET_{rec-a}	Exposure time - adult (hours/day)	1	Reasonable Estimate
ET_{0-2}	Exposure time 0-2 years (hours/day)	1	Reasonable Estimate
ET_{2-6}	Exposure time 2-6 years (hours/day)	1	Reasonable Estimate
ET_{6-16}	Exposure time 6-16 years (hours/day)	1	Reasonable Estimate
ET_{16-26}	Exposure time 16-26 years (hours/day)	1	Reasonable Estimate
IRS_{rec-c}	Ingestion Rate - Child (mg/day)	200	U.S. EPA 2014 (Attachment 1)
IRS_{rec-a}	Ingestion Rate - Adult (mg/day)	100	U.S. EPA 2014 (Attachment 1)
IRS_{0-2}	Ingestion Rate - 0-2 years (mg/day)	200	U.S. EPA 2014 (Attachment 1)
IRS_{2-6}	Ingestion Rate - 2-6 years (mg/day)	200	U.S. EPA 2014 (Attachment 1)
IRS_{6-16}	Ingestion Rate - 6-16 years (mg/day)	100	U.S. EPA 2014 (Attachment 1)
IRS_{16-26}	Ingestion Rate - 16-26 years (mg/day)	100	U.S. EPA 2014 (Attachment 1)

Table C-9. Recreator Soil/Sediment Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$IFS_{rec\text{-}adj}$	Ingestion Rate - Age-adjusted (mg/kg)	7,875	Calculated using the age-adjusted intake factors equation
$IFSM_{rec\text{-}adj}$	Mutagenic Ingestion Rate - Age-adjusted (mg/kg)	35,750	Calculated using the mutagenic age-adjusted intake factors equation
$AF_{rec\text{-}c}$	Adherence factor-child (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
$AF_{rec\text{-}a}$	Adherence factor-adult (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
$AF_{0\text{-}2}$	Adherence factor 0-2 years (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
$AF_{2\text{-}6}$	Adherence factor 2-6 years (mg/cm^2)	0.2	U.S. EPA 2014 (Attachment 1)
$AF_{6\text{-}16}$	Adherence factor 6-16 years (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
$AF_{16\text{-}26}$	Adherence factor 16-26 years (mg/cm^2)	0.07	U.S. EPA 2014 (Attachment 1)
$DFS_{rec\text{-}adj}$	Dermal contact factor- age-adjusted (mg/kg)	22,155	Calculated using the age-adjusted intake factors equation
$DFSM_{rec\text{-}adj}$	Mutagenic dermal contact factor-age-adjusted (mg/kg)	91,770	Calculated using the mutagenic age-adjusted intake factors equation
$SA_{rec\text{-}c}$	Surface area - child (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
$SA_{rec\text{-}a}$	Surface area - adult (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
$SA_{0\text{-}2}$	Surface area 0-2 years (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
$SA_{2\text{-}6}$	Surface area 2-6 years (cm^2)	2373	U.S. EPA 2014 (Attachment 1)
$SA_{6\text{-}16}$	Surface area 6-16 years (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
$SA_{16\text{-}26}$	Surface area 16-26 (cm^2)	6032	U.S. EPA 2014 (Attachment 1)
AT_{rec}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{rec\text{-}c}$	Averaging time - child (days/year)	365 x $ED_{rec\text{-}c}$	U.S. EPA 2014 (Attachment 1)
$AT_{rec\text{-}a}$	Averaging time - adult (days/year)	365 x ED_{rec}	U.S. EPA 2014 (Attachment 1)

Table C-10. Recreator Surface Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{rec\text{-}wat\text{-}ingnc}$	Recreator Child Surface Water Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator

Table C-10. Recreator Surface Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{rec-wat-dernc}$	Recreator Child Surface Water Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec-wat-ingna}$	Recreator Adult Surface Water Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec-wat-derna}$	Recreator Adult Surface Water Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec-wat-ingnadj}$	Recreator Age-adjusted Surface Water Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{rec-wat-dernadj}$	Recreator Age-adjusted Surface Water Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
CDIrec-wat-ingc	Recreator Surface Water Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
CDIrec-wat-derc	Recreator Surface Water Carcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
CDIrec-wat-ingmu	Recreator Surface Water Mutagenic Ingestion (mg/kg-day)	Mutagen-specific	Determined in this calculator
CDIrec-wat-dermu	Recreator Surface Water Mutagenic Dermal (mg/kg-day)	Mutagen-specific	Determined in this calculator
CDIrec-wat-ingvc	Recreator Surface Water Carcinogenic Vinyl Chloride Ingestion (mg/kg-day)	Vinyl Chloride-specific	Determined in this calculator
CDIrec-wat-dervc	Recreator Surface Water Carcinogenic Vinyl Chloride Dermal (mg/kg-day)	Vinyl Chloride-specific	Determined in this calculator
CDIrec-wat-ingtce	Recreator Surface Water Carcinogenic and Mutagenic Trichloroethylene Ingestion (mg/kg-day)	Trichloroethylene-specific	Determined in this calculator
CDIrec-wat-dertce	Recreator Surface Water Carcinogenic and Mutagenic Trichloroethylene Dermal (mg/kg-day)	Trichloroethylene-specific	Determined in this calculator
BW_{rec-a}	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
BW_{rec-c}	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
BW_{0-2}	Body Weight - 0-2 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
BW_{2-6}	Body Weight - 2-6 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
BW_{6-16}	Body Weight - 6-16 Years (kg)	80	U.S. EPA 2014 (Attachment 1)

Table C-10. Recreator Surface Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$BW_{16\text{-}26}$	Body Weight - 16-26 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
$ED_{rec\text{-}a}$	Exposure Duration - adult (years)	20	U.S. EPA 2014 (Attachment 1)
$ED_{rec\text{-}c}$	Exposure Duration - child (years)	6	U.S. EPA 2014 (Attachment 1)
$ED_{0\text{-}2}$	Exposure Duration - 0-2 Years (years)	2	U.S. EPA 2014 (Attachment 1)
$ED_{2\text{-}6}$	Exposure Duration - 2-6 Years (years)	4	U.S. EPA 2014 (Attachment 1)
$ED_{6\text{-}16}$	Exposure Duration - 6-16 Years (years)	10	U.S. EPA 2014 (Attachment 1)
$ED_{16\text{-}26}$	Exposure Duration - 16-26 Years (years)	10	U.S. EPA 2014 (Attachment 1)
$EF_{rec\text{-}a}$	Exposure Frequency - adult (days/year)	45	Region 4 Bulletin
$EF_{rec\text{-}c}$	Exposure Frequency - child (days/year)	45	Region 4 Bulletin
$EF_{0\text{-}2}$	Exposure Frequency - 0-2 Years (days/year)	45	Region 4 Bulletin
$EF_{2\text{-}6}$	Exposure Frequency - 2-6 Years (days/year)	45	Region 4 Bulletin
$EF_{6\text{-}16}$	Exposure Frequency - 6-16 Years (days/year)	45	Region 4 Bulletin
$EF_{16\text{-}26}$	Exposure Frequency - 16-26 Years (days/year)	45	Region 4 Bulletin
$ET_{event\text{-}rec\text{-}c}$	Exposure Time - child (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec\text{-}a}$	Exposure Time - adult (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec\ (0\text{-}2)}$	Exposure Time (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec\ (2\text{-}6)}$	Exposure Time (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec\ (6\text{-}16)}$	Exposure Time (hours/event)	1	Reasonable Estimate
$ET_{event\text{-}rec\ (16\text{-}26)}$	Exposure Time (hours/event)	1	Reasonable Estimate
$EV_{rec\text{-}c}$	Events - child (events/day)	1	Reasonable Estimate
$EV_{rec\text{-}a}$	Events - adult (events/day)	1	Reasonable Estimate
$EV_{0\text{-}2}$	Events (events/day)	1	Reasonable Estimate
$EV_{2\text{-}6}$	Events (events/day)	1	Reasonable Estimate
$EV_{6\text{-}16}$	Events (events/day)	1	Reasonable Estimate
$EV_{16\text{-}26}$	Events (events/day)	1	Reasonable Estimate
$IRW_{rec\text{-}c}$	Ingestion Rate - Child (L/hour)	0.12	Table 3.5 in EFH 2011
$IRW_{rec\text{-}a}$	Ingestion Rate - Adult (L/hour)	0.11	Time weighted average was calculated based on the upper percentile from Table 3.7 of EFH 2019
$IRW_{0\text{-}2}$	Ingestion Rate - 0-2 years (L/hour)	0.12	Table 3.5 in EFH 2011

Table C-10. Recreator Surface Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$IRW_{2\text{-}6}$	Ingestion Rate - 2-6 years (L/hour)	0.12	Table 3.5 in EFH 2011
$IRW_{6\text{-}16}$	Ingestion Rate - 6-16 years (L/hour)	0.124	Time weighted average was calculated based on the upper percentile from Table 3.7 of EFH 2019
$IRW_{16\text{-}26}$	Ingestion Rate - 16-26 years (L/hour)	0.0985	Time weighted average was calculated based on the upper percentile from Table 3.7 of EFH 2019
$IFW_{rec\text{-}adj}$	Ingestion Rate - Age-adjusted (L/kg)	3.4	Calculated using the age-adjusted intake factors equation
$IFWM_{rec\text{-}adj}$	Mutagenic Ingestion Rate - Age-adjusted (L/kg)	14	Calculated using the mutagenic age-adjusted intake factors equation
$SA_{rec\text{-}c}$	Surface area - child (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{rec\text{-}a}$	Surface area - adult (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$SA_{0\text{-}2}$	Surface area 0-2 years (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{2\text{-}6}$	Surface area 2-6 years (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{6\text{-}16}$	Surface area 6-16 years (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$SA_{16\text{-}26}$	Surface area 16-26 (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$DFW_{rec\text{-}adj}$	Dermal contact factor- age-adjusted (cm^2-event/kg)	335,655	Calculated using the age-adjusted intake factors equation
$DFWM_{rec\text{-}adj}$	Mutagenic dermal contact factor- age-adjusted (cm^2-event/kg)	1,053,210	Calculated using the mutagenic age-adjusted intake factors equation
AT_{rec}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{rec\text{-}c}$	Averaging time (days/year)	365 x $ED_{rec\text{-}c}$	U.S. EPA 2014 (Attachment 1)
$AT_{rec\text{-}a}$	Averaging time (days/year)	365 x $ED_{rec\text{-}a}$	U.S. EPA 2014 (Attachment 1)

Table C-11. Resident Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{res\text{-}wat\text{-}ingnc}$	Resident Child Tap Water (Groundwater) Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}dernc}$	Resident Child Tap Water (Groundwater) Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}inhn}$	Resident Child Tap Water (Groundwater) Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}ingna}$	Resident Adult Tap Water (Groundwater) Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}derna}$	Resident Adult Tap Water (Groundwater) Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}inhna}$	Resident Adult Tap Water (Groundwater) Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}ingnadj}$	Resident Age-adjusted Tap Water (Groundwater) Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}dernadj}$	Resident Age-adjusted Tap Water (Groundwater) Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}inhnadj}$	Resident Age-adjusted Tap Water (Groundwater) Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific Child, Adult and Age-adjusted Specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}ingc}$	Recreator Tap Water (Groundwater) Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}derc}$	Resident Tap Water (Groundwater) Carcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}inhc}$	Resident Tap Water (Groundwater) Carcinogenic Inhalation (μg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}ingmu}$	Resident Tap Water (Groundwater) Mutagenic Ingestion (mg/kg-day)	Mutagen-specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}dermu}$	Resident Tap Water (Groundwater) Mutagenic Dermal (mg/kg-day)	Mutagen-specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}inhmu}$	Resident Tap Water (Groundwater) Mutagenic Inhalation (μg/m^3)	Mutagen-specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}ingvc}$	Resident Tap Water (Groundwater) Carcinogenic Vinyl Chloride Ingestion (mg/kg-day)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}dervc}$	Resident Tap Water (Groundwater) Carcinogenic Vinyl Chloride Dermal (mg/kg-day)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}inhvc}$	Resident Tap Water (Groundwater) Carcinogenic Vinyl Chloride Inhalation (μg/m^3)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{res\text{-}wat\text{-}ingtce}$	Resident Tap Water (Groundwater) Carcinogenic and Mutagenic Trichloroethylene Ingestion (mg/kg-day)	Trichloroethylene-specific	Determined in this calculator

Table C-11. Resident Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{res-wat-dertce}$	Resident Tap Water (Groundwater) Carcinogenic and Mutagenic Trichloroethylene Dermal (mg/kg-day)	Trichloroethylene-specific	Determined in this calculator
BW_{res-a}	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
BW_{res-c}	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
BW_{0-2}	Body Weight - 0-2 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
BW_{2-6}	Body Weight - 2-6 Years (kg)	15	U.S. EPA 2014 (Attachment 1)
BW_{6-16}	Body Weight - 6-16 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
BW_{16-26}	Body Weight - 16-26 Years (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{res}	Exposure Duration - adult + child (years)	26	U.S. EPA 2014 (Attachment 1)
ED_{res-a}	Exposure Duration - adult (years)	20	U.S. EPA 2014 (Attachment 1)
ED_{res-c}	Exposure Duration - child (years)	6	U.S. EPA 2014 (Attachment 1)
ED_{0-2}	Exposure Duration - 0-2 Years (years)	2	U.S. EPA 2014 (Attachment 1)
ED_{2-6}	Exposure Duration - 2-6 Years (years)	4	U.S. EPA 2014 (Attachment 1)
ED_{6-16}	Exposure Duration - 6-16 Years (years)	10	U.S. EPA 2014 (Attachment 1)
ED_{16-26}	Exposure Duration - 16-26 Years (years)	10	U.S. EPA 2014 (Attachment 1)
EF_{res}	Exposure Frequency - adult + child (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{res-a}	Exposure Frequency - adult (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{res-c}	Exposure Frequency - child (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{0-2}	Exposure Frequency - 0-2 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{2-6}	Exposure Frequency - 2-6 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{6-16}	Exposure Frequency - 6-16 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
EF_{16-26}	Exposure Frequency - 16-26 Years (days/year)	350	U.S. EPA 2014 (Attachment 1)
ET_{res}	Exposure Time (hours/day)	24	The whole day
$ET_{event-res-c}$	Exposure Time - child (hours/event)	0.54	U.S. EPA 2014 (Attachment 1)
$ET_{event-res-a}$	Exposure Time - adult (hours/event)	0.71	U.S. EPA 2014 (Attachment 1)

Table C-11. Resident Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$ET_{event\text{-}res\ (0\text{-}2)}$	Exposure Time (hours/event)	0.54	U.S. EPA 2014 (Attachment 1)
$ET_{event\text{-}res\ (2\text{-}6)}$	Exposure Time (hours/event)	0.54	U.S. EPA 2014 (Attachment 1)
$ET_{event\text{-}res\ (6\text{-}16)}$	Exposure Time (hours/event)	0.71	U.S. EPA 2014 (Attachment 1)
$ET_{event\text{-}res\ (16\text{-}26)}$	Exposure Time (hours/event)	0.71	U.S. EPA 2014 (Attachment 1)
$EV_{res\text{-}c}$	Events - child (events/day)	1	U.S. EPA 2004 Exhibit 3-2
$EV_{res\text{-}a}$	Events - adult (events/day)	1	U.S. EPA 2004 Exhibit 3-2
$EV_{0\text{-}2}$	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2
$EV_{2\text{-}6}$	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2
$EV_{6\text{-}16}$	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2
$EV_{16\text{-}26}$	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2
$IRW_{res\text{-}c}$	Ingestion Rate - Child (L/day)	0.78	U.S. EPA 2014 (Attachment 1)
$IRW_{res\text{-}a}$	Ingestion Rate - Adult (L/day)	2.5	U.S. EPA 2014 (Attachment 1)
$IRW_{0\text{-}2}$	Ingestion Rate - 0-2 years (L/day)	0.78	U.S. EPA 2014 (Attachment 1)
$IRW_{2\text{-}6}$	Ingestion Rate - 2-6 years (L/day)	0.78	U.S. EPA 2014 (Attachment 1)
$IRW_{6\text{-}16}$	Ingestion Rate - 6-16 years (L/day)	2.5	U.S. EPA 2014 (Attachment 1)
$IRW_{16\text{-}26}$	Ingestion Rate - 16-26 years (L/day)	2.5	U.S. EPA 2014 (Attachment 1)
$IFW_{res\text{-}adj}$	Ingestion Rate - Age-adjusted (L/kg)	327.95	Calculated using the age-adjusted intake factors equation
$IFWM_{res\text{-}adj}$	Mutagenic Ingestion Rate - Age-adjusted (L/kg)	1019.9	Calculated using the mutagenic age-adjusted intake factors equation
$SA_{res\text{-}c}$	Surface area - child (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{res\text{-}a}$	Surface area - adult (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$SA_{0\text{-}2}$	Surface area 0-2 years (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{2\text{-}6}$	Surface area 2-6 years (cm^2)	6365	U.S. EPA 2014 (Attachment 1)
$SA_{6\text{-}16}$	Surface area 6-16 years (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)

Table C-11. Resident Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
SA_{16-26}	Surface area 16-26 (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
$DFW_{res-adj}$	Dermal contact factor- age-adjusted (L/kg)	2,610,650	Calculated using the age-adjusted intake factors equation
$DFWM_{res-adj}$	Mutagenic dermal contact factor- age-adjusted (L/kg)	8,191,633	Calculated using the mutagenic age-adjusted intake factors equation
AT_{res}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{res-c}	Averaging time - child (days/year)	365 x ED_{res-c}	U.S. EPA 2014 (Attachment 1)
AT_{res-a}	Averaging time - adult (days/year)	365 x ED_{res}	U.S. EPA 2014 (Attachment 1)

Table C-12. Indoor Worker Tap Water Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{ind\text{-}wat\text{-}ingn}$	Indoor Worker Tap Water Air Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{ind\text{-}wat\text{-}dern}$	Indoor Worker Tap Water Noncarcinogenic Dermal (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{ind\text{-}wat\text{-}inhn}$	Indoor Worker Tap Water Noncarcinogenic Inhalation (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{ind\text{-}wat\text{-}ingc}$	Indoor Worker Tap Water Air Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{ind\text{-}wat\text{-}derc}$	Indoor Worker Tap Water Carcinogenic Dermal ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$CDI_{ind\text{-}wat\text{-}inhc}$	Indoor Worker Tap Water Carcinogenic Inhalation ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
BW_{ind}	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{ind}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{ind}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{ind}	Exposure Time (hours/event)	8	U.S. EPA 2014 (Attachment 1)
$ET_{event\text{-}iw}$	Exposure Time Shower (hours/event)	0.71	U.S. EPA 2014 (Attachment 1)
EV_{ind}	Events (events/day)	1	U.S. EPA 2004 Exhibit 3-2
IRW_{ind}	Ingestion Rate (L/day)	1.25	U.S. EPA 2014 (FAQ 13)
SA_{ind}	Surface area (cm^2)	19,652	U.S. EPA 2014 (Attachment 1)
AT_{ind}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{ind\text{-}a}$	Averaging time (days/year)	365 x ED_{ind}	U.S. EPA 2014 (Attachment 1)

Table C-13. Resident Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{res\text{-}air\text{-}inhn}$	Resident Air Noncarcinogenic (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}air\text{-}inhc}$	Resident Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}air\text{-}inhmu}$	Resident Air Mutagenic ($\mu g/m^3$)	Mutagen-specific	Determined in this calculator
$CDI_{res\text{-}air\text{-}inhvc}$	Resident Air Carcinogenic Vinyl Chloride ($\mu g/m^3$)	Vinyl Chloride-specific	Determined in this calculator
$CDI_{res\text{-}air\text{-}inhtce}$	Resident Air Carcinogenic and Mutagenic Trichloroethylene ($\mu g/m^3$)	Trichloroethylene-specific	Determined in this calculator
ED_{res}	Exposure Duration (years)	26	U.S. EPA 2014 (Attachment 1)
$ED_{0\text{-}2}$	Exposure Duration 0-2 years (years)	2	U.S. EPA 2014 (Attachment 1)
$ED_{2\text{-}6}$	Exposure Duration 2-6 years (years)	4	U.S. EPA 2014 (Attachment 1)
$ED_{6\text{-}16}$	Exposure Duration 6-16 years (years)	10	U.S. EPA 2014 (Attachment 1)
$ED_{16\text{-}26}$	Exposure Duration 16-26 years (years)	10	U.S. EPA 2014 (Attachment 1)
EF_{res}	Exposure Frequency (days/year)	350	U.S. EPA 2014 (Attachment 1)
ET_{res}	Exposure Time (hours/day)	24	The whole day
AT_{res}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{res\text{-}a}$	Averaging time (days/year)	365 x ED_{res}	U.S. EPA 2014 (Attachment 1)

Table C-14. Composite Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{com-air-inhn}$	Composite Worker Air Noncarcinogenic (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{com-air-inhc}$	Composite Worker Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
ED_{com}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{com}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{com}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{com}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{com-a}	Averaging time (days/year)	365 x ED_{com}	U.S. EPA 2014 (Attachment 1)

Table C-15. Outdoor Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{out-air-inhn}$	Outdoor Worker Air Noncarcinogenic (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{out-air-inhc}$	Outdoor Worker Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
ED_{out}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{out}	Exposure Frequency (days/year)	225	U.S. EPA 2014 (Attachment 1)
ET_{out}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{out}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{out-a}	Averaging time (days/year)	365 x ED_{out}	U.S. EPA 2014 (Attachment 1)

Table C-16. Indoor Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{ind\text{-}air\text{-}inhn}$	Indoor Worker Air Noncarcinogenic (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{ind\text{-}air\text{-}inhc}$	Indoor Worker Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
ED_{ind}	Exposure Duration (years)	25	U.S. EPA 2014 (Attachment 1)
EF_{ind}	Exposure Frequency (days/year)	250	U.S. EPA 2014 (Attachment 1)
ET_{ind}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{ind}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{ind\text{-}a}$	Averaging time (days/year)	365 x ED_{ind}	U.S. EPA 2014 (Attachment 1)

Table C-17. Construction Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{con\text{-}air\text{-}inhn}$	Construction Worker Air Noncarcinogenic (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{con\text{-}air\text{-}inhc}$	Construction Worker Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
ED_{con}	Exposure Duration (years)	1	U.S. EPA 2014 (Attachment 1)
EW_{con}	Exposure (weeks/year)	50	Based on 50 weeks per year (reasonable work season)
DW_{con}	Exposure (days/week)	5	Based on 5 days per week for 50 weeks
EF_{con}	Exposure Frequency (days/year)	EW x DW	Based on 5 days per week for 50 weeks
ET_{con}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{con}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{con\text{-}a}$	Averaging time (days/year)	365 x ED_{con}	U.S. EPA 2014 (Attachment 1)

Table C-18. Excavation Worker Air Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{con-air-inhn}$	Excavation Worker Air Noncarcinogenic (mg/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{con-air-inhc}$	Excavation Worker Air Carcinogenic ($\mu g/m^3$)	Contaminant-specific	Determined in this calculator
ED_{ew}	Exposure Duration (years)	1	U.S. EPA 2014 (Attachment 1)
EF_{ew}	Exposure Frequency (days/year)	20	Based on 5 days per week for 4 weeks
ET_{ew}	Exposure Time (hours/day)	8	U.S. EPA 2014 (Attachment 1)
AT_{ew}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{exc-a}	Averaging time (days/year)	365 x ED_{ew}	U.S. EPA 2014 (Attachment 1)

Table C-19. Resident Fish Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{res-fsh-ingn}$	Resident Fish Noncarcinogenic (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{res-fsh-ingc}$	Resident Fish Carcinogenic (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{res-fshw-ingn}$	Resident Surface Water Fish Noncarcinogenic (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{res-fshw-ingc}$	Resident Surface Water Fish Carcinogenic (mg/kg-day)	Contaminant-specific	Determined in this calculator
BW_a	Body Weight (kg)	80	U.S. EPA 2014 (Attachment 1)
ED_{fish}	Exposure Duration (years)	26	U.S. EPA 2014 (Attachment 1)
EF_{fish}	Exposure Frequency (days/year)	350	U.S. EPA 2014 (Attachment 1)
IRF_a	Fish Ingestion Rate (g/day)	54	U.S. EPA 2014 (Attachment 1)
AT_{res}	Averaging time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
AT_{res-a}	Averaging time (days/year)	365 x ED_{res}	U.S. EPA 2014 (Attachment 1)

Table C-20. Farmer Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{far\text{-}prod\text{-}ingn}$	Agriculture Produce Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}prod\text{-}ingc}$	Agriculture Produce Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}wat\text{-}ingpn}$	Agriculture Produce Noncarcinogenic Back-calculated Concentration in Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}wat\text{-}ingpc}$	Agriculture Produce Carcinogenic Back-calculated Concentration in Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sol\text{-}ingpn}$	Agriculture Produce Noncarcinogenic Back-calculated Concentration in Soil Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sol\text{-}ingpc}$	Agriculture Produce Carcinogenic Back-calculated Concentration in Soil Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sw\text{-}ingpn}$	Agriculture Produce Noncarcinogenic Back-calculated Concentration in Soil and Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sw\text{-}ingpc}$	Agriculture Produce Carcinogenic Back-calculated Concentration in Soil and Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}dairy\text{-}ingn}$	Agriculture Dairy Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}dairy\text{-}ingc}$	Agriculture Dairy Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}wat\text{-}ingdn}$	Agriculture Dairy Noncarcinogenic Back-calculated Concentration in Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}wat\text{-}ingdc}$	Agriculture Dairy Carcinogenic Back-calculated Concentration in Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sol\text{-}ingdn}$	Agriculture Dairy Noncarcinogenic Back-calculated Concentration in Soil Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sol\text{-}ingdc}$	Agriculture Dairy Carcinogenic Back-calculated Concentration in Soil Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sw\text{-}ingdn}$	Agriculture Dairy Noncarcinogenic Back-calculated Concentration in Soil and Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sw\text{-}ingdc}$	Agriculture Dairy Carcinogenic Back-calculated Concentration in Soil and Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}beef\text{-}ingn}$	Agriculture Beef Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}beef\text{-}ingc}$	Agriculture Beef Carcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}wat\text{-}ingbn}$	Agriculture Beef Noncarcinogenic Back-calculated Concentration in Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator

Table C-20. Farmer Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$CDI_{far\text{-}wat\text{-}ingbc}$	Agriculture Beef Carcinogenic Back-calculated Concentration in Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sol\text{-}ingbn}$	Agriculture Beef Noncarcinogenic Back-calculated Concentration in Soil Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sol\text{-}ingbc}$	Agriculture Beef Carcinogenic Back-calculated Concentration in Soil Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sw\text{-}ingbn}$	Agriculture Beef Noncarcinogenic Back-calculated Concentration in Soil and Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}sw\text{-}ingbc}$	Agriculture Beef Carcinogenic Back-calculated Concentration in Soil and Water Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}prod\text{-}ingn}$	Agriculture Produce Noncarcinogenic Ingestion (mg/kg-day)	Contaminant-specific	Determined in this calculator
$BW_{far\text{-}a}$	Body Weight - adult (kg)	80	U.S. EPA 2014 (Attachment 1)
$BW_{far\text{-}c}$	Body Weight - child (kg)	15	U.S. EPA 2014 (Attachment 1)
ED_{far}	Exposure Duration - adult (years)	40	U.S. EPA 1991a (pg. 15)
$ED_{far\text{-}c}$	Exposure Duration - adult (years)	6	U.S. EPA 1991a (pg. 15)
$ED_{far\text{-}a}$	Exposure Duration - adult (years)	34	U.S. EPA 1991a (pg. 15)
EF_{far}	Exposure Frequency (days/year)	350	U.S. EPA 2014 (Attachment 1)
AT_{far}	Averaging Time (days/year)	365 x LT	U.S. EPA 2014 (Attachment 1)
$AT_{far\text{-}c}$	Averaging Time (days/year)	365 x $ED_{far\text{-}c}$	U.S. EPA 2014 (Attachment 1)
$IRF_{far\text{-}c}$	Produce Ingestion Rate - Fruit - Child (mg/day)	68.1×10^3	U.S. EPA 2011 (Table 13-5). U.S. EPA 1998 (Table C-1-2)
$IRF_{far\text{-}a}$	Produce Ingestion Rate - Fruit - Adult (mg/day)	176.8×10^3	U.S. EPA 2011 (Table 13-5). U.S. EPA 1998 (Table C-1-2)
$IFF_{far\text{-}adj}$	Produce Ingestion Rate - Fruit - Age-adjusted (mg/kg)	35,833,000	Calculated using the age adjusted intake factors equation
$IRV_{far\text{-}c}$	Produce Ingestion Rate - Vegetables - Child (mg/day)	41.7×10^3	U.S. EPA 2011 (Table 13-10). U.S. EPA 1998 (Table C-1-2)
$IRV_{far\text{-}a}$	Produce Ingestion Rate - Vegetables - Adult (mg/day)	125.7×10^3	U.S. EPA 2011 (Table 13-10). U.S. EPA 1998 (Table C-1-2)
$IFV_{far\text{-}adj}$	Produce Ingestion Rate - Vegetables - Age-adjusted (mg/kg)	24,535,875	Calculated using the age adjusted intake factors equation

Table C-20. Farmer Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
$IRD_{far\text{-}c}$	Dairy Ingestion Rate - Child (mg/day)	349.5×10^3	U.S. EPA 2011 (Table 13-25). U.S. EPA 1998 (Table C-1-3)
$IRD_{far\text{-}a}$	Dairy Ingestion Rate - Adult (mg/day)	445.6×10^3	U.S. EPA 2011 (Table 13-25). U.S. EPA 1998 (Table C-1-3)
$IFD_{far\text{-}adj}$	Dairy Ingestion Rate - Age-adjusted (mg/kg)	115,213,000	Calculated using the age adjusted intake factors equation
$IRB_{far\text{-}c}$	Beef Ingestion Rate - Child (mg/day)	40.1×10^3	U.S. EPA 2011 (Table 13-33). U.S. EPA 1998 (Table C-1-3)
$IRB_{far\text{-}a}$	Beef Ingestion Rate - Adult (mg/day)	178×10^3	U.S. EPA 2011 (Table 13-33). U.S. EPA 1998 (Table C-1-3)
$IFB_{far\text{-}adj}$	Beef Ingestion Rate - Age-adjusted (mg/kg)	30,091,500	Calculated using the age adjusted intake factors equation
Irr_{rup}	Root uptake from irrigation multiplier (L/kg)	Contaminant-specific	Calculated
Irr_{res}	Resuspension from irrigation multiplier (L/kg)	Contaminant-specific	Calculated
Irr_{dep}	Aerial deposition from irrigation multiplier (L/kg)	Contaminant-specific	Calculated
R_{upp}	Dry root uptake for pasture multiplier (unitless)	$=BV_{dry}$	
R_{upv}	Wet root uptake for vegetables multiplier (unitless)	$=BV_{wet}$	
$Q_{p\text{-}beef}$	Beef Fodder Intake Rate (kg/day)	11.77	U.S. EPA 2005 (pg. B-138), U.S. EPA 1997b.
$Q_{p\text{-}dairy}$	Dairy Fodder Intake Rate (kg/day)	20.3	U.S. EPA 2005 (pg. B-145), U.S. EPA 1997b.
$Q_{w\text{-}dairy}$	Dairy Water Intake Rate (kg/day)	92	U.S. EPA 1999a (pg. 10-23).
$Q_{w\text{-}beef}$	Beef Water Intake Rate (kg/day)	53	U.S. EPA 1999a (pg. 10-23).
$Q_{s\text{-}dairy}$	Dairy Soil Intake Rate (kg/day)	0.4	U.S. EPA 2005 (pg. B-146), U.S. EPA 1997b.
$Q_{s\text{-}beef}$	Beef Soil Intake Rate (kg/day)	0.5	U.S. EPA 2005 (pg. B-139), U.S. EPA 1997b.
$f_{p\text{-}beef}$	Fraction of Time Animal is On-Site (unitless)	1	Maximum value used (100%)
$f_{p\text{-}dairy}$	Fraction of Time Animal is On-Site (unitless)	1	Maximum value used (100%)
$f_{s\text{-}beef}$	Fraction of Animal's Food from Site when On-Site (unitless)	1	Maximum value used (100%)
$f_{s\text{-}dairy}$	Fraction of Animal's Food from Site when On-Site (unitless)	1	Maximum value used (100%)
TF_{dairy}	Dairy Transfer Factor (day/kg)	Contaminant-specific	Hierarchy selection in Section 2.4.2
TF_{beef}	Beef Transfer Factor (day/kg)	Contaminant-specific	Hierarchy selection in Section 2.4.2

Table C-20. Farmer Land Use Equation Variables

Symbol	Definition (units)	Default	Reference
BCF	Fish Bioconcentration Factor (L/kg)	Contaminant-specific	
$CF_{far\text{-}produce}$	Fraction of Produce Consumed that is Contaminated	1	U.S. EPA 1998
$CF_{far\text{-}dairy}$	Fraction of Dairy Consumed that is Contaminated	1	U.S. EPA 1998
$CF_{far\text{-}beef}$	Fraction of Beef Consumed that is Contaminated	1	U.S. EPA 1998
I_r	Irrigation rate (L/m^2-day)	3.62	Personal communication with agricultural extension agent
F	Irrigation period (unitless)	0.25 (based on 3 months per year)	Personal communication with agricultural extension agent
λ_B	Effective rate for removal (1/day)	$\lambda_i + \lambda_{HL}$	NCRP 1996
λ_E	Decay for removal on produce (1/day)	$\lambda_i + (0.693/t_w)$	NCRP 1996
λ_{HL}	Soil leaching rate (1/day)	0.000027	NCRP 1996
λ_i	Decay (1/day)	$0.693/T_R$- radionuclides, 0 - non-radionuclides	NCRP 1996
t_w	Weathering half -life (day)	14	NCRP 1996
T_R	Half-life (days)	Contaminant-specific	
$MLF_{pasture}$	Pasture plant mass loading factor (unitless)	0.25	Hinton, T. G. 1992
$MLF_{produce}$	Produce plant mass loading factor (unitless)	0.26 x 0.052 = 0.0135	Hinton, 1992. U.S. EPA SSG 1996 table G-1. Dry weight to wet weight conversion equation from section 4.10.9
t_b	Long term deposition and buildup (day)	10,950	NCRP 1996
t_v	Above ground exposure time (day)	60	NCRP 1996
I_f	Interception fraction (unitless)	0.42	Miller, C. W. 1980
Y_v	Plant yield (wet) (kg/m^2)	2	NCRP 1996
P	Area density for root zone (kg/m^2)	240	Hoffman, F. O., R. H. Gardner, and K. F. Eckerman. 1982; Peterson, H. T., Jr. 1983; McKone, T. E. 1994
T	Translocation factor (unitless)	1	NCRP 1996
R_{es}	Soil resuspension multiplier	= MLF (produce or pasture)	Hinton, T.G. 1992

Table C-21. Soil to Groundwater SSL Factor Variables

Symbol	Definition (units)	Default	Reference
C_w	Target soil leachate concentration (pCi/L)	Nonzero MCL or RSL × DAF	U.S. EPA. 2002 Equation 4-14
DAF	Dilution attenuation factor (unitless)	20 (or site-specific)	U.S. EPA. 2002 Equation 4-11
ED_{gw}	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
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.3	U.S. EPA. 2002 Equation 4-10
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	$= n- \theta_w$	U.S. EPA. 2002 Equation 4-10
n	Total soil porosity (L_{pore}/L_{soil})	$= 1-(\rho_b/\rho_s)$	U.S. EPA. 2002 Equation 4-10
ρ_s	Soil particle density (kg/L)	2.65	U.S. EPA. 2002 Equation 4-10
ρ_b	Dry soil bulk density (kg/L)	1.5	U.S. EPA. 2002 Equation 4-10
K_d	Soil-water partition coefficient (L/kg)	$= K_{oc}*f_{oc}$ for organics	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

Table C-22. Wind Particulate Emission Factor Equation Variables

Symbol	Definition (units)	Default	Reference
PEF_{wind}	Particulate Emission Factor - Minneapolis (m^3/kg)	1.36 × 109 (region-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 (pg. D-2)
A_s	Areal extent of the site or contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA 2002 (pg. D-2)
B	Dispersion constant unitless	PEF and region-specific	U.S. EPA 2002 (pg. D-2)
C	Dispersion constant unitless	PEF and region-specific	U.S. EPA 2002 (pg. D-2)

Table C-23. Mechanical Particulate Emission Factor Variables from Vehicle Traffic

Symbol	Definition (units)	Default	Reference
PEF_{sc}	Particulate Emission Factor - subchronic (m^3/kg)	Contaminant-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)	7,200,000	U.S. EPA 2002 Equation 5-5
A_R	Surface area of contaminated road segment (m^2)	$A_R = L_R$ x W_R x 0.092903 m^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 Equation 5-5
∑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
t_c	Total time over which construction occurs (hrs)	8400	U.S. EPA. 2002 Equation 5-5

Table C-24. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
PEF'_{sc}	Particulate Emission Factor - subchronic (m^3/kg)	Contaminant-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	Site-specific	U.S. EPA 2002 Equation E-15

Table C-24. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
	square emission source (g/m^2-s per kg/m^3)		
F_D	Dispersion correction factor (unitless)	0.185	U.S. EPA 2002 Equation 5-5
T	Total time over which construction occurs (s)	7,200,000	U.S. EPA 2002 Equation 5-5
A_c	Areal extent of site surface soil contamination (acres)	(range 0.5 to 500)	U.S. EPA. 2002 Equation E-15
J'_T	Total time-averaged PM10 unit emission flux for construction activities other than traffic on unpaved roads (g/m^2-s)	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	PM10 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
$M_{m\text{-}excav}$	Gravimetric soil moisture content (%)	12 (mean value for municipal landfill cover)	U.S. EPA 2002 Equation E-21
ρ_{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_{excav}	Average depth of excavation (m)	Site-specific	U.S. EPA 2002 Equation E-21
$N_{A\text{-}dump}$	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	PM10 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

Table C-24. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
$M_{m\text{-}doz}$	Gravimetric soil moisture content (%)	7.9 (mean value for overburden)	U.S. EPA 2002 Equation E-22
$\sum VKT_{doz}$	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	PM10 scaling factor (unitless)	0.60	U.S. EPA 2002 Equation E-23
$\sum VKT_{grade}$	Sum of grading kilometers traveled (km)	Site-specific	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 $\sum VKT_{grade}$ in U.S. EPA 2002 Equation E-23
$A_{c\text{-}doz}$	Areal extent of dozing (acres)	Site-specific	Necessary to solve $\sum VKT_{doz}$ 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
A	Dispersion constant unitless	2.4538	U.S. EPA 2002 Equation E-15
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	17.5660	U.S. EPA 2002 Equation E-15
C	Dispersion constant unitless	189.0426	U.S. EPA 2002 Equation E-15
t_c	Total time over which construction occurs (hrs)	8400	U.S. EPA. 2002 Equation 5-5

Table C-25. Volatilization Factor Equation Variables

Symbol	Definition (units)	Default	Reference
VF_{ulim}	Unlimited Source Volatilization Factor - Minneapolis (m^3/kg)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
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)	68.81	U.S. EPA. 2002 Equation 4-8
D_A	Apparent Diffusivity (cm^2/s)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
T	Exposure interval (s)	819,936,000	U.S. EPA. 2002 Equation 4-8
ρ_b	Dry soil bulk density (g/cm^3)	1.5	U.S. EPA. 2002 Equation 4-8
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	0.28	U.S. EPA. 2002 Equation 4-8
n	Total soil porosity (L_{pore}/L_{soil})	0.43	U.S. EPA. 2002 Equation 4-8
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.15	U.S. EPA. 2002 Equation 4-8
ρ_s	Soil particle density (g/c m^3)	2.65	U.S. EPA. 2002 Equation 4-8
D_{ia}	Diffusivity in air (cm^2/s)	Contaminant-specific	U.S. EPA. 2001
D_w	Diffusivity in water (cm^2/s)	Contaminant-specific	U.S. EPA. 2001
K_d	Soil-water partition coefficient ($K_{oc} \times f_{oc}$)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
K_{oc}	Soil organic carbon-water partition coefficient	Contaminant-specific	EPI Suite
f_{oc}	Organic carbon content of soil (g/g)	0.006	U.S. EPA. 2002 Equation 4-8
A_s	Areal extent of the site contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA. 2002 Equation 4-8
A	Dispersion Constant	11.911	U.S. EPA 2002 Exhibit D-3
B	Dispersion Constant	18.4385	U.S. EPA 2002 Exhibit D-3
C	Dispersion Constant	209.7845	U.S. EPA 2002 Exhibit D-3

Table C-26. Mass Limit Volatilization Factor Equation Variables

Symbol	Definition (units)	Default	Reference
VF_{mlim}	Mass Limit Volatilization Factor - Minneapolis (m^3/kg)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
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)	68.81	U.S. EPA. 2002 Equation 4-8
D_s	Average Source Depth (m)	Site-specific	U.S. EPA. 2002 Equation 4-13
T	Exposure interval (years)	26	U.S. EPA. 2002 Equation 4-8
ρ_b	Dry soil bulk density (g/cm^3)	1.5	U.S. EPA. 2002 Equation 4-8
A_s	Areal extent of the site contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA. 2002 Equation 4-8
A	Dispersion Constant	11.911	U.S. EPA 2002 Exhibit D-3
B	Dispersion Constant	18.4385	U.S. EPA 2002 Exhibit D-3
C	Dispersion Constant	209.7845	U.S. EPA 2002 Exhibit D-3

Table C-27. Subchronic Volatilization Factor Equation Variables

Symbol	Definition (units)	Default	Reference
$VF_{ulim-sc}$	Volatilization Factor - Minneapolis (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
D_A	Apparent Diffusivity (cm^2/s)	Contaminant-specific	U.S. EPA. 2002 Equation 5-15
T	Exposure interval (s)	30,240,000	U.S. EPA. 2002 Equation 5-17
ρ_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
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	0.28	U.S. EPA. 2002 Equation 5-14
n	Total soil porosity (L_{pore}/L_{soil})	0.43	U.S. EPA. 2002 Equation 5-14
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.15	U.S. EPA. 2002 Equation 5-14
ρ_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
D_{iw}	Diffusivity in water (cm^2/s)	Contaminant-specific	U.S. EPA. 2001
K_d	Soil-water partition coefficient ($K_{oc} \times f_{oc}$)	Contaminant-specific	U.S. EPA. 2002 Equation 4-8
K_{oc}	Soil organic carbon-water partition coefficient	Contaminant-specific	EPI Suite
f_{oc}	Organic carbon content of soil (g/g)	0.006	U.S. EPA. 2002 Equation 4-8
A_c	Areal extent of the site contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA. 2002 Equation 4-8
A	Dispersion Constant	2.4538	U.S. EPA 2002 Exhibit 5-15
B	Dispersion Constant	17.5560	U.S. EPA 2002 Exhibit 5-15
C	Dispersion Constant	189.0426	U.S. EPA 2002 Exhibit 5-15
t_c	Total time over which construction occurs (hrs)	8400	U.S. EPA. 2002 Equation 5-5

Table C-28. Subchronic Mass Limit Volatilization Factor Equation Variables

Symbol	Definition (units)	Default	Reference
$VF_{mlim\text{-}sc}$	Volatilization Factor - Minneapolis (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
d_s	Average source depth (m)	Site-specific	U.S. EPA. 2002 Equation 5-17
F_D	Dispersion correction factor (unitless)	0.185	U.S. EPA. 2002 Equation 5-14
T	Exposure interval (s)	30,240,000	U.S. EPA. 2002 Equation 5-17
ρ_b	Dry soil bulk density (g/cm^3)	1.5	U.S. EPA. 2002 Equation 5-14
A_c	Areal extent of the site contamination (acres)	0.5 (range 0.5 to 500)	U.S. EPA. 2002 Equation 4-8
A	Dispersion Constant	2.4538	U.S. EPA 2002 Exhibit 5-15
B	Dispersion Constant	17.5560	U.S. EPA 2002 Exhibit 5-15
C	Dispersion Constant	189.0426	U.S. EPA 2002 Exhibit 5-15
t_c	Total time over which construction occurs (hours)	8400	U.S. EPA. 2002 Equation 5-5

APPENDIX D. CHEMICAL CDI AND RISK EQUATIONS

APPENDIX D. CHEMICAL AND RISK CDI EQUATIONS

Resident Soil CDI Equations

Noncarcinogenic Child Soil Ingestion (CDI)

$$CDI_{res-sol-ingnc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRS_{res-c}\left(\frac{200\ mg}{day}\right)}{AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right) \times BW_{res-c}(15\ kg)}$$

Noncarcinogenic Child Soil Inhalation (CDI)

$$CDI_{res-sol-inhnc}\left(\frac{mg}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times ET_{res-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right)}$$

Noncarcinogenic Child Soil Dermal (CDI)

$$CDI_{res-sol-dernc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times SA_{res-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right) \times ABS_d}{AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right) \times BW_{res-c}(15\ kg)}$$

Noncarcinogenic Adult Soil Ingestion (CDI)

$$CDI_{res-sol-ingna}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times IRS_{res-a}\left(\frac{100\ mg}{day}\right)}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right) \times BW_{res-a}(80\ kg)}$$

Noncarcinogenic Adult Soil Inhalation (CDI)

$$CDI_{res-sol-inhna}\left(\frac{mg}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}$$

Noncarcinogenic Adult Soil Dermal (CDI)

$$CDI_{res-sol-derna}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times SA_{res-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{res-a}\left(\frac{0.07\ mg}{cm^2}\right) \times ABS_d}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right) \times BW_{res-a}(80\ kg)}$$

Noncarcinogenic Age-adjusted Soil Ingestion (CDI)

$$CDI_{res-sol-ingnadj}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times IFS_{res-adj}\left(\frac{36{,}750\ mg}{kg}\right)}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}$$

where:

$$IFS_{res-adj}\left(\frac{36{,}750\ mg}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRS_{res-c}\left(\frac{200\ mg}{day}\right)}{BW_{res-c}(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRS_{res-a}\left(\frac{100\ mg}{day}\right)}{BW_{res-a}(80\ kg)}\right]$$

Noncarcinogenic Age-adjusted Soil Inhalation (CDI)

$$CDI_{res-sol-inhnadj}\left(\frac{mg}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}$$

Noncarcinogenic Age-adjusted Soil Dermal (CDI)

$$CDI_{res-sol-dernadj}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFS_{res-adj}\left(\frac{103{,}390\ mg}{kg}\right) \times ABS_d}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}$$

where:

$$DFS_{res-adj}\left(\frac{103{,}390\ mg}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times SA_{res-c}\left(\frac{2{,}373\ cm^2}{day}\right) \times AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{res-c}(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times SA_{res-a}\left(\frac{6{,}032\ cm^2}{day}\right) \times AF_{res-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{res-a}(80\ kg)}\right]$$

Carcinogenic Soil Ingestion (CDI)

$$CDI_{res-sol-ingc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times IFS_{res-adj}\left(\frac{36,750\ mg}{kg}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFS_{res-adj}\left(\frac{36,750\ mg}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRS_{res-c}\left(\frac{200\ mg}{day}\right)}{BW_{res-c}\,(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRS_{res-a}\left(\frac{100\ mg}{day}\right)}{BW_{res-a}\,(80\ kg)}\right]$$

Carcinogenic Soil Inhalation (CDI)

$$CDI_{res-sol-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Carcinogenic Soil Dermal (CDI)

$$CDI_{res-sol-derc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right) \times ABS_d}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times SA_{res-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{res-c}\,(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times SA_{res-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{res-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{res-a}\,(80\ kg)}\right]$$

Mutagenic Soil Ingestion (CDI)

$$CDI_{res-sol-ingmu}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times RBA \times \left(\frac{10^{-6}\ kg}{mg}\right) \times IFSM_{res-adj}\left(\frac{166,833.3\ mg}{kg}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFSM_{res-adj}\left(\frac{166,833.3\ mg}{kg}\right) = \left[\begin{array}{c} \frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times IRS_{0-2}\left(\frac{200\ mg}{day}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times IRS_{2-6}\left(\frac{200\ mg}{day}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times IRS_{6-16}\left(\frac{100\ mg}{day}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times IRS_{16-26}\left(\frac{100\ mg}{day}\right) \times 1}{BW_{16-26}(80\ kg)} \end{array}\right]$$

Mutagenic Soil Inhalation (CDI)

$$CDI_{res-sol-inhmu}\left(\frac{\mu g}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{1000\ \mu g}{mg}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right) \times \left[\begin{array}{c} \left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 1\right) \end{array}\right]}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Mutagenic Soil Dermal (CDI)

$$CDI_{res-sol-dermu}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFSM_{res-adj}\left(\frac{428,260\ mg}{kg}\right) \times ABS_d}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$DFSM_{res-adj}\left(\frac{428,260\ mg}{kg}\right) = \left[\begin{array}{c} \frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times SA_{0-2}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{0-2}\left(\frac{0.2\ mg}{cm^2}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times SA_{2-6}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{2-6}\left(\frac{0.2\ mg}{cm^2}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times SA_{6-16}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{6-16}\left(\frac{0.07\ mg}{cm^2}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times SA_{16-26}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{16-26}\left(\frac{0.07\ mg}{cm^2}\right) \times 1}{BW_{16-26}(80\ kg)} \end{array}\right]$$

Vinyl Chloride Soil Ingestion (CDI)

$$CDI_{res-sol-ingvc}\left(\frac{mg}{kg-day}\right) = C_{soil}\left(\frac{mg}{kg}\right) \times \left(\begin{array}{c} \left(\frac{IFS_{res-adj}\left(\frac{36,750\ mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + \\ \left(\frac{IRS_{res-c}\left(\frac{200\ mg}{day}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA}{BW_{res-c}(15\ kg)}\right) \end{array}\right)$$

where:

$$IFS_{res-adj}\left(\frac{36,750\ mg}{kg}\right) = \left[\begin{array}{c} \frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRS_{res-c}\left(\frac{200\ mg}{day}\right)}{BW_{res-c}(15\ kg)} + \\ \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRS_{res-a}\left(\frac{100\ mg}{day}\right)}{BW_{res-a}(80\ kg)} \end{array}\right]$$

Vinyl Chloride Soil Inhalation (CDI)

$$CDI_{res-sol-inhmu}\left(\frac{\mu g}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)\times\left[\begin{array}{l}\left(EF_{0-2}\left(\frac{350\ days}{yr}\right)\times ED_{0-2}(2\ yr)\times ET_{0-2}\left(\frac{24\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times 10\right)+\\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right)\times ED_{2-6}(4\ yr)\times ET_{2-6}\left(\frac{24\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times 3\right)+\\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right)\times ED_{6-16}(10\ yr)\times ET_{6-16}\left(\frac{24\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times 3\right)+\\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right)\times ED_{16-26}(10\ yr)\times ET_{16-26}\left(\frac{24\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times 1\right)\end{array}\right]}{AT_{res}\left(\frac{365\ days}{yr}\ \times LT(70\ yrs)\right)}$$

Vinyl Chloride Soil Dermal (CDI)

$$CDI_{res-sol-dervc}\left(\frac{mg}{kg-day}\right) = C_{soil}\left(\frac{mg}{kg}\right)\times\left(\left(\frac{DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times ABS_d}{AT_{res}\left(\frac{365\ days}{yr}\ \times LT(70\ yrs)\right)}\right)+\left(\frac{SA_{res-c}\left(\frac{2,373\ cm^2}{day}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right)\times ABS_d}{BW_{res-c}(15\ kg)}\right)\right)$$

where:

$$DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right)\times ED_{res-c}(6\ yr)\times SA_{res-c}\left(\frac{2,373\ cm^2}{day}\right)\times AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{res-c}(15\ kg)}+\frac{EF_{res-a}\left(\frac{350\ days}{yr}\right)\times ED_{res-a}(20\ yr)\times SA_{res-a}\left(\frac{6,032\ cm^2}{day}\right)\times AF_{res-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{res-a}(80\ kg)}\right]$$

Trichloroethylene Soil Ingestion (CDI)

$$CDI_{res-sol-ingtce}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times \left(\left(CAF_o(0.804) \times IFS_{res-adj}\left(\frac{36,750\ mg}{kg}\right)\right) + \left(MAF_o(0.202) \times IFSM_{res-adj}\left(\frac{166,833.3\ mg}{kg}\right)\right)\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFS_{res-adj}\left(\frac{36,750\ mg}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRS_{res-c}\left(\frac{200\ mg}{day}\right)}{BW_{res-c}(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRS_{res-a}\left(\frac{100\ mg}{day}\right)}{BW_{res-a}(80\ kg)}\right]$$

and:

$$IFSM_{res-adj}\left(\frac{166,833.3\ mg}{kg}\right) = \left[\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times IRS_{0-2}\left(\frac{200\ mg}{day}\right) \times 10}{BW_{0-2}(15\ kg)} + \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times IRS_{2-6}\left(\frac{200\ mg}{day}\right) \times 3}{BW_{2-6}(15\ kg)} + \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times IRS_{6-16}\left(\frac{100\ mg}{day}\right) \times 3}{BW_{6-16}(80\ kg)} + \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times IRS_{16-26}\left(\frac{100\ mg}{day}\right) \times 1}{BW_{16-26}(80\ kg)}\right]$$

Trichloroethylene Soil Inhalation (CDI)

$$CDI_{res-sol-inhtce}\left(\frac{\mu g}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{1000\ \mu g}{mg}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right) \times \left[\begin{array}{l}\left(EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times CAF_i(0.756)\right) + \\ \left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 1\right)\end{array}\right]}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Trichloroethylene Soil Dermal (CDI)

$$CDI_{res-sol-dertce}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times \left(\left(CAF_o(0.804) \times DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right) \times ABS_d\right) + \left(MAF_o(0.202) \times DFSM_{res-adj}\left(\frac{428,260\ mg}{kg}\right) \times ABS_d\right)\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$DFS_{res-adj}\left(\frac{103,390\ mg}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times SA_{res-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{res-c}(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times SA_{res-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{res-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{res-a}(80\ kg)}\right]$$

and:

$$DFSM_{res-adj}\left(\frac{428,260\ mg}{kg}\right) = \left[\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times SA_{0-2}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{0-2}\left(\frac{0.2\ mg}{cm^2}\right) \times 10}{BW_{0-2}(15\ kg)} + \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times SA_{2-6}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{2-6}\left(\frac{0.2\ mg}{cm^2}\right) \times 3}{BW_{2-6}(15\ kg)} + \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times SA_{6-16}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{6-16}\left(\frac{0.07\ mg}{cm^2}\right) \times 3}{BW_{6-16}(80\ kg)} + \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times SA_{16-26}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{16-26}\left(\frac{0.07\ mg}{cm^2}\right) \times 1}{BW_{16-26}(80\ kg)}\right]$$

Supporting Child Soil (CDI)

$$BW_{res-c}\left(15\ kg\right) = \frac{ED_{0-2}(2\ yr) \times BW_{0-2}\left(15\ kg\right) + ED_{2-6}(4\ yr) \times BW_{2-6}\left(15\ kg\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$EF_{res-c}\left(\frac{350\ days}{yr}\right) = \frac{ED_{0-2}(2\ yr) \times EF_{0-2}\left(\frac{350\ days}{yr}\right) + ED_{2-6}(4\ yr) \times EF_{2-6}\left(\frac{350\ days}{yr}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$ET_{res-c}\left(\frac{24\ hrs}{day}\right) = \frac{ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) + ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$AF_{res-c}\left(\frac{0.2\ mg}{cm^2}\right) = \frac{ED_{0-2}(2\ yr) \times AF_{0-2}\left(\frac{0.2\ mg}{cm^2}\right) + ED_{2-6}(4\ yr) \times AF_{2-6}\left(\frac{0.2\ mg}{cm^2}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$SA_{res-c}\left(\frac{2,373\ cm^2}{day}\right) = \frac{ED_{0-2}(2\ yr) \times SA_{0-2}\left(\frac{2,373\ cm^2}{day}\right) + ED_{2-6}(4\ yr) \times SA_{2-6}\left(\frac{2,373\ cm^2}{day}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

$$IRS_{res-c}\left(\frac{200\ mg}{day}\right) = \frac{ED_{0-2}(2\ yr) \times IRS_{0-2}\left(\frac{200\ mg}{day}\right) + ED_{2-6}(4\ yr) \times IRS_{2-6}\left(\frac{200\ mg}{day}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr)}$$

Supporting Adult Soil (CDI)

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

$$EF_{res-a}\left(\frac{350\text{ days}}{\text{yr}}\right) = \frac{ED_{6-16}\,(10\text{ yr}) \times EF_{6-16}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{16-26}\,(10\text{ yr}) \times EF_{16-26}\left(\frac{350\text{ days}}{\text{yr}}\right)}{ED_{6-16}\,(10\text{ yr}) + ED_{16-26}\,(10\text{ yr})}$$

$$ET_{res-a}\left(\frac{24\text{ hrs}}{\text{day}}\right) = \frac{ED_{6-16}\,(10\text{ yr}) \times ET_{6-16}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{16-26}\,(10\text{ yr}) \times ET_{16-26}\left(\frac{24\text{ hrs}}{\text{day}}\right)}{ED_{6-16}\,(10\text{ yr}) + ED_{16-26}\,(10\text{ yr})}$$

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

$$SA_{res-a}\left(\frac{6,032\text{ cm}^2}{\text{day}}\right) = \frac{ED_{6-16}\,(10\text{ yr}) \times SA_{6-16}\left(\frac{6,032\text{ cm}^2}{\text{day}}\right) + ED_{16-26}\,(10\text{ yr}) \times SA_{16-26}\left(\frac{6,032\text{ cm}^2}{\text{day}}\right)}{ED_{6-16}\,(10\text{ yr}) + ED_{16-26}\,(10\text{ yr})}$$

$$IRS_{res-a}\left(\frac{100\text{ mg}}{\text{day}}\right) = \frac{ED_{6-16}\,(10\text{ yr}) \times IRS_{6-16}\left(\frac{100\text{ mg}}{\text{day}}\right) + ED_{16-26}\,(10\text{ yr}) \times IRS_{16-26}\left(\frac{100\text{ mg}}{\text{day}}\right)}{ED_{6-16}\,(10\text{ yr}) + ED_{16-26}\,(10\text{ yr})}$$

Supporting Age-adjusted Soil (CDI)

$$EF_{res}\left(\frac{350\text{ days}}{\text{yr}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}\,(2\text{ yr}) \times EF_{0-2}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{2-6}\,(4\text{ yr}) \times EF_{2-6}\left(\frac{350\text{ days}}{\text{yr}}\right) + \\ ED_{6-16}\,(10\text{ yr}) \times EF_{6-16}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{16-26}\,(10\text{ yr}) \times EF_{16-26}\left(\frac{350\text{ days}}{\text{yr}}\right) \end{array}\right)}{ED_{0-2}\,(2\text{ yr}) + ED_{2-6}\,(4\text{ yr}) + ED_{6-16}\,(10\text{ yr}) + ED_{16-26}\,(10\text{ yr})}$$

$$ET_{res}\left(\frac{24\text{ hrs}}{\text{day}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}\,(2\text{ yr}) \times ET_{0-2}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{2-6}\,(4\text{ yr}) \times ET_{2-6}\left(\frac{24\text{ hrs}}{\text{day}}\right) + \\ ED_{6-16}\,(10\text{ yr}) \times ET_{6-16}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{16-26}\,(10\text{ yr}) \times ET_{16-26}\left(\frac{24\text{ hrs}}{\text{day}}\right) \end{array}\right)}{ED_{0-2}\,(2\text{ yr}) + ED_{2-6}\,(4\text{ yr}) + ED_{6-16}\,(10\text{ yr}) + ED_{16-26}\,(10\text{ yr})}$$

Resident Air CDI Equations

Noncarcinogenic Air Inhalation (CDI)

$$CDI_{res-air-inhn}\left(\frac{mg}{m^3}\right) = \frac{C_{air}\left(\frac{\mu g}{m^3}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}$$

Carcinogenic Air Inhalation (CDI)

$$CDI_{res-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{C_{air}\left(\frac{\mu g}{m^3}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Mutagenic Air Inhalation (CDI)

$$CDI_{res-air-inhmu}\left(\frac{\mu g}{m^3}\right) = \frac{C_{air}\left(\frac{\mu g}{m^3}\right) \times \left[\begin{array}{c} \left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 1\right) \end{array}\right]}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Vinyl Chloride Air Inhalation (CDI)

$$CDI_{res-air-inhvc}\left(\frac{\mu g}{m^3}\right) = C_{air}\left(\frac{\mu g}{m^3}\right) \times \left(1 + \left(\frac{EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right)\right)$$

Trichloroethylene Air Inhalation (CDI)

$$CDI_{res-air-inhtce}\left(\frac{\mu g}{m^3}\right) = \frac{C_{air}\left(\frac{\mu g}{m^3}\right) \times \left[\begin{array}{c} \left(EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times CAF_i(0.756)\right) + \\ \left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 1\right) \end{array}\right]}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Refractory Ceramic Fibers Air Inhalation (CDI)

$$CDI_{res-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}$$

Asbestos Air Inhalation (CDI)

$$CDI_{res-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

<u>Resident Tap Water CDI Equations</u>

Noncarcinogenic Child Tap Water Ingestion (CDI)

$$CDI_{res-wat-ingnc}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRW_{res-c}\left(\frac{0.78\ L}{day}\right)}{AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right) \times BW_{res-c}(15\ kg)}$$

Noncarcinogenic Child Tap Water Inhalation (CDI)

$$CDI_{res-wat-inhnc}\left(\frac{\mu g}{m^3}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times ET_{res-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times K\left(\frac{0.5\ L}{m^3}\right)}{AT_{res-c}\left(\frac{365\ days}{yr} \times ED_{res-c}(6\ yr)\right)}$$

Noncarcinogenic Child Tap Water Dermal (CDI)

$$CDI_{res-wat-dernc}\left(\frac{mg}{kg-day}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{res-c}\left(\frac{350\ days}{yr}\right)\times ED_{res-c}(6\ yr)\times EV_{res-c}\left(\frac{1\ event}{day}\right)\times SA_{res-c}\left(6,365\ cm^2\right)}{AT_{res-c}\left(\frac{365\ days}{yr}\times ED_{res-c}(6\ yr)\right)\times BW_{res-c}(15\ kg)}$$

where:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right)\times K_p\left(\frac{cm}{hr}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)$$

For Organics:

IF $ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)\leq t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times 2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)}{\pi}}$$

or:

IF $ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)>t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Noncarcinogenic Adult Tap Water Ingestion (CDI)

$$CDI_{res-wat-ingna}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{res-a}\left(\frac{350\ days}{yr}\right)\times ED_{res}(26\ yr)\times IRW_{res-a}\left(\frac{2.5\ L}{day}\right)}{AT_{res-a}\left(\frac{365\ days}{yr}\times ED_{res}(26\ yr)\right)\times BW_{res-a}(80\ kg)}$$

Noncarcinogenic Adult Tap Water Inhalation (CDI)

$$CDI_{res-wat-inhna}\left(\frac{mg}{m^3}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{res-a}\left(\frac{350\ days}{yr}\right)\times ED_{res}(26\ yr)\times ET_{res-a}\left(\frac{24\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times K\left(\frac{0.5\ L}{m^3}\right)}{AT_{res-a}\left(\frac{365\ days}{yr}\times ED_{res}(26\ yr)\right)}$$

Noncarcinogenic Adult Tap Water Dermal (CDI)

$$CDI_{res-wat-derna}\left(\frac{mg}{kg-day}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times EV_{res-a}\left(\frac{1\ event}{day}\right) \times SA_{res-a}\left(19{,}652\ cm^2\right)}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right) \times BW_{res-a}(80\ kg)}$$

where:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times K_p\left(\frac{cm}{hr}\right) \times ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right)$$

For Organics:

IF $ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right) \leq t^*\ (hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times 2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right)}{\pi}}$$

or:

IF $ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right) > t^*\ (hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Noncarcinogenic Age-adjusted Tap Water Ingestion (CDI)

$$CDI_{res-wat-ingnadj}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times IFW_{res-adj}\left(\frac{327.95\ L}{kg}\right)}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}$$

where:

$$IFW_{res-adj}\left(\frac{327.95\ L}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRW_{res-c}\left(\frac{0.78\ L}{day}\right)}{BW_{res-c}(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRW_{res-a}\left(\frac{2.5\ L}{day}\right)}{BW_{res-a}(80\ kg)}\right]$$

Noncarcinogenic Age-adjusted Tap Water Inhalation (CDI)

$$CDI_{res-wat-inhnadj}\left(\frac{mg}{m^3}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times K\left(\frac{0.5\ L}{m^3}\right)}{AT_{res-a}\left(\frac{365\ days}{yr} \times ED_{res}(26\ yr)\right)}$$

Noncarcinogenic Age-adjusted Tap Water Dermal (CDI)

$$CDI_{res\text{-}wat\text{-}dernadj}\left(\frac{mg}{kg-day}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times DFW_{res\text{-}adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right)}{AT_{res\text{-}a}\left(\frac{365\ days}{yr}\times ED_{res}(26\ yr)\right)}$$

where:

$$DFW_{res\text{-}adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right)=\left(\begin{array}{c}\frac{EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right)\times ED_{res\text{-}c}(6\ yr)\times EV_{res\text{-}c}\left(\frac{1\ event}{day}\right)\times SA_{res\text{-}c}\left(6,365\ cm^2\right)}{BW_{res\text{-}c}(15\ kg)}+\\ \frac{EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right)\times ED_{res\text{-}a}(20\ yr)\times EV_{res\text{-}a}\left(\frac{1\ event}{day}\right)\times SA_{res\text{-}a}\left(19,652\ cm^2\right)}{BW_{res\text{-}a}(80\ kg)}\end{array}\right)$$

and:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times K_p\left(\frac{cm}{hr}\right)\times ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right)$$

For Organics:

$$\text{IF } ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right)\le t^*(hrs),\text{ then:}$$

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times 2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right)}{\pi}}$$

or:

$$\text{IF } ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right)>t^*(hrs),\text{ then:}$$

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

$$ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right)=\left(\frac{\left(ED_{res\text{-}c}(6\ yr)\times ET_{event\text{-}res\text{-}c}\left(\frac{0.54\ hrs}{event}\right)\right)+\left(ED_{res\text{-}a}(20\ yr)\times ET_{event\text{-}res\text{-}a}\left(\frac{0.71\ hrs}{event}\right)\right)}{ED_{res}(26\ yr)}\right)$$

Carcinogenic Tap Water Ingestion (CDI)

$$CDI_{res\text{-}wat\text{-}ingc}\left(\frac{mg}{kg-day}\right)=\frac{C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right)}{AT_{res}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

where:

$$IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right)=\left[\begin{array}{c}\frac{EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right)\times ED_{res\text{-}c}(6\ yr)\times IRW_{res\text{-}c}\left(\frac{0.78\ L}{day}\right)}{BW_{res\text{-}c}(15\ kg)}+\\ \frac{EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right)\times ED_{res\text{-}a}(20\ yr)\times IRW_{res\text{-}a}\left(\frac{2.5\ L}{day}\right)}{BW_{res\text{-}a}(80\ kg)}\end{array}\right]$$

Carcinogenic Tap Water Inhalation (CDI)

$$CDI_{res-wat-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times K\left(\frac{0.5\ L}{m^3}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Carcinogenic Tap Water Dermal (CDI)

$$CDI_{res-wat-derc}\left(\frac{mg}{kg-day}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times DFW_{res-adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$DFW_{res-adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right) = \left(\begin{array}{c}\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times EV_{res-c}\left(\frac{1\ event}{day}\right) \times SA_{res-c}\left(6,365\ cm^2\right)}{BW_{res-c}(15\ kg)} + \\ \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times EV_{res-a}\left(\frac{1\ event}{day}\right) \times SA_{res-a}\left(19,652\ cm^2\right)}{BW_{res-a}(80\ kg)}\end{array}\right)$$

and:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times K_p\left(\frac{cm}{hr}\right) \times ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)$$

For Organics:

$$\text{IF } ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) \le t^*(hrs),\text{ then:}$$

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times 2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}{\pi}}$$

or:

$$\text{IF } ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) > t^*(hrs),\text{ then:}$$

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

$$ET_{event-res-adj}\left(\frac{0.671\ hrs}{event}\right) = \left(\frac{\left(ED_{res-c}(6\ yr) \times ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)\right) + \left(ED_{res-a}(20\ yr) \times ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right)\right)}{ED_{res}(26\ yr)}\right)$$

Mutagenic Tap Water Ingestion (CDI)

$$CDI_{res-wat-ingmu}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times IFWM_{res-adj}\left(\frac{1,019.9\ L}{kg}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFWM_{res-adj}\left(\frac{1,019.9\ L}{kg}\right) = \left[\begin{array}{l} \dfrac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times IRW_{0-2}\left(\frac{0.78\ L}{day}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \dfrac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times IRW_{2-6}\left(\frac{0.78\ L}{day}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \dfrac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times IRW_{6-16}\left(\frac{2.5\ L}{day}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \dfrac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times IRW_{16-26}\left(\frac{2.5\ L}{day}\right) \times 1}{BW_{16-26}(80\ kg)} \end{array}\right]$$

Mutagenic Tap Water Inhalation (CDI)

$$CDI_{res-wat-inhmu}\left(\frac{\mu g}{m^3}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times K\left(\frac{0.5\ L}{m^3}\right) \times \left[\begin{array}{l} \left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times 1\right) \end{array}\right]}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Mutagenic Tap Water Dermal (CDI)

$$\mathrm{CDI}_{\text{res-wat-dermu}}\left(\frac{\text{mg}}{\text{kg-day}}\right) = \frac{\mathrm{DA}_{\text{event}}\left(\frac{\mu\text{g}}{\text{cm}^2\text{-event}}\right) \times \left(\frac{\text{mg}}{1000\ \mu\text{g}}\right) \times \mathrm{DFWM}_{\text{res-adj}}\left(\frac{8{,}191{,}633\ \text{cm}^2\text{-event}}{\text{kg}}\right)}{\mathrm{AT}_{\text{res}}\left(\frac{365\ \text{days}}{\text{yr}} \times \mathrm{LT}(70\ \text{yrs})\right)}$$

where:

$$\mathrm{DFWM}_{\text{res-adj}}\left(\frac{8{,}191{,}633\ \text{cm}^2\text{-event}}{\text{kg}}\right) = \left(\begin{array}{c} \frac{\mathrm{EF}_{0-2}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{0-2}(2\ \text{yr}) \times \mathrm{EV}_{0-2}\left(\frac{1\ \text{event}}{\text{day}}\right) \times \mathrm{SA}_{0-2}\left(6{,}365\ \text{cm}^2\right) \times 10}{\mathrm{BW}_{0-2}(15\ \text{kg})} + \\ \frac{\mathrm{EF}_{2-6}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{2-6}(4\ \text{yr}) \times \mathrm{EV}_{2-6}\left(\frac{1\ \text{event}}{\text{day}}\right) \times \mathrm{SA}_{2-6}\left(6{,}365\ \text{cm}^2\right) \times 3}{\mathrm{BW}_{2-6}(15\ \text{kg})} + \\ \frac{\mathrm{EF}_{6-16}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{6-16}(10\ \text{yr}) \times \mathrm{EV}_{6-16}\left(\frac{1\ \text{event}}{\text{day}}\right) \times \mathrm{SA}_{6-16}\left(19{,}652\ \text{cm}^2\right) \times 3}{\mathrm{BW}_{6-16}(80\ \text{kg})} + \\ \frac{\mathrm{EF}_{16-26}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{16-26}(10\ \text{yr}) \times \mathrm{EV}_{16-26}\left(\frac{1\ \text{event}}{\text{day}}\right) \times \mathrm{SA}_{16-26}\left(19{,}652\ \text{cm}^2\right) \times 1}{\mathrm{BW}_{16-26}(80\ \text{kg})} \end{array}\right)$$

and:

For Inorganics:

$$\mathrm{DA}_{\text{event}}\left(\frac{\mu\text{g}}{\text{cm}^2\text{-event}}\right) = \mathrm{C}_{\text{water}}\left(\frac{\mu\text{g}}{\text{L}}\right) \times \left(\frac{\text{L}}{1000\ \text{cm}^3}\right) \times \mathrm{K}_{\text{p}}\left(\frac{\text{cm}}{\text{hr}}\right) \times \mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.671\ \text{hrs}}{\text{event}}\right)$$

For Organics:

IF $\mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.671\ \text{hrs}}{\text{event}}\right) \leq t^*(\text{hrs})$, then:

$$\mathrm{DA}_{\text{event}}\left(\frac{\mu\text{g}}{\text{cm}^2\text{-event}}\right) = \mathrm{C}_{\text{water}}\left(\frac{\mu\text{g}}{\text{L}}\right) \times \left(\frac{\text{L}}{1000\ \text{cm}^3}\right) \times 2 \times \mathrm{FA} \times \mathrm{K}_{\text{p}}\left(\frac{\text{cm}}{\text{hr}}\right) \times \sqrt{\frac{6 \times \tau_{\text{event}}\left(\frac{\text{hrs}}{\text{event}}\right) \times \mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.671\ \text{hrs}}{\text{event}}\right)}{\pi}}$$

or:

IF $\mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.671\ \text{hrs}}{\text{event}}\right) > t^*(\text{hrs})$, then:

$$\mathrm{DA}_{\text{event}}\left(\frac{\mu\text{g}}{\text{cm}^2\text{-event}}\right) = \mathrm{C}_{\text{water}}\left(\frac{\mu\text{g}}{\text{L}}\right) \times \left(\frac{\text{L}}{1000\ \text{cm}^3}\right) \times \mathrm{FA} \times \mathrm{K}_{\text{p}}\left(\frac{\text{cm}}{\text{hr}}\right) \times \left[\frac{\mathrm{ET}_{\text{event-res-adj}}\left(\frac{0.671\ \text{hrs}}{\text{event}}\right)}{1 + \mathrm{B}} + 2 \times \tau_{\text{event}}\left(\frac{\text{hrs}}{\text{event}}\right) \times \left(\frac{1 + 3\mathrm{B} + 3\mathrm{B}^2}{(1 + \mathrm{B})^2}\right)\right]$$

where:

$$\mathrm{ET}_{\text{event-res-madj}}\left(\frac{0.671\ \text{hrs}}{\text{event}}\right) = \frac{\left(\begin{array}{c} \left(\mathrm{ED}_{0-2}(2\ \text{yr}) \times \mathrm{ET}_{\text{event-(0-2)}}\left(\frac{0.54\ \text{hrs}}{\text{event}}\right)\right) + \left(\mathrm{ED}_{2-6}(4\ \text{yr}) \times \mathrm{ET}_{\text{event-(2-6)}}\left(\frac{0.54\ \text{hrs}}{\text{event}}\right)\right) + \\ \left(\left(\mathrm{ED}_{6-16}(10\ \text{yr}) \times \mathrm{ET}_{\text{event-(6-16)}}\left(\frac{0.71\ \text{hrs}}{\text{event}}\right)\right) + \left(\mathrm{ED}_{16-26}(10\ \text{yr}) \times \mathrm{ET}_{\text{event-(16-26)}}\left(\frac{0.71\ \text{hrs}}{\text{event}}\right)\right)\right) \end{array}\right)}{\mathrm{ED}_{0-2}(2\ \text{yr}) + \mathrm{ED}_{2-6}(4\ \text{yr}) + \mathrm{ED}_{6-16}(10\ \text{yr}) + \mathrm{ED}_{16-26}(10\ \text{yr})}$$

Vinyl Chloride Tap Water Ingestion (CDI)

$$CDI_{res\text{-}wat\text{-}ingvc}\left(\frac{mg}{kg-day}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right)\left(\left(\frac{IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + \left(\frac{IRW_{res\text{-}c}\left(\frac{0.78\ L}{day}\right)}{BW_{res\text{-}c}(15\ kg)}\right)\right)$$

where:

$$IFW_{res\text{-}adj}\left(\frac{327.95\ L}{kg}\right) = \left[\frac{EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times IRW_{res\text{-}c}\left(\frac{0.78\ L}{day}\right)}{BW_{res\text{-}c}(15\ kg)} + \frac{EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times IRW_{res\text{-}a}\left(\frac{2.5\ L}{day}\right)}{BW_{res\text{-}a}(80\ kg)}\right]$$

Vinyl Chloride Tap Water Inhalation (CDI)

$$CDI_{res\text{-}wat\text{-}inhvc}\left(\frac{\mu g}{m^3}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\left(\frac{EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times K\left(\frac{0.5\ L}{m^3}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + K\left(\frac{0.5\ L}{m^3}\right)\right)$$

Vinyl Chloride Tap Water Dermal (CDI)

$$CDI_{res\text{-}wat\text{-}dervc}\left(\frac{mg}{kg-day}\right) = DA_{vc\text{-}event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left(\left(\frac{DFW_{res\text{-}adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + \left(\frac{EV_{res\text{-}c}\left(\frac{1\ event}{day}\right) \times SA_{res\text{-}c}\left(6,365\ cm^2\right)}{BW_{res\text{-}c}(15\ kg)}\right)\right)$$

where:

$$DFW_{res\text{-}adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right) = \left(\frac{EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times EV_{res\text{-}c}\left(\frac{1\ event}{day}\right) \times SA_{res\text{-}c}\left(6,365\ cm^2\right)}{BW_{res\text{-}c}(15\ kg)} + \frac{EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times EV_{res\text{-}a}\left(\frac{1\ event}{day}\right) \times SA_{res\text{-}a}\left(19,652\ cm^2\right)}{BW_{res\text{-}a}(80\ kg)}\right)$$

and:

$$\text{IF } ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right) \le t^*(hrs), \text{ then:}$$

$$DA_{vc\text{-}event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times 2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right)}{\pi}}$$

or:

$$\text{IF } ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right) > t^*(hrs), \text{ then:}$$

$$DA_{vc\text{-}event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right)}{1 + B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1 + 3B + 3B^2}{(1 + B)^2}\right)\right]$$

where:

$$ET_{event\text{-}res\text{-}adj}\left(\frac{0.671\ hrs}{event}\right) = \left(\frac{\left(ED_{res\text{-}c}(6\ yr) \times ET_{event\text{-}res\text{-}c}\left(\frac{0.54\ hrs}{event}\right)\right) + \left(ED_{res\text{-}a}(20\ yr) \times ET_{event\text{-}res\text{-}a}\left(\frac{0.71\ hrs}{event}\right)\right)}{ED_{res}(26\ yr)}\right)$$

Trichloroethylene Tap Water Ingestion (CDI)

$$CDI_{res-wat-ingtce}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left(\left(CAF_o(0.804) \times IFW_{res-adj}\left(\frac{327.95\ L}{kg}\right)\right) + \left(MAF_o(0.202) \times IFWM_{res-adj}\left(\frac{1,019.9\ L}{kg}\right)\right)\right)}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFW_{res-adj}\left(\frac{327.95\ L}{kg}\right) = \left[\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRW_{res-c}\left(\frac{0.78\ L}{day}\right)}{BW_{res-c}(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRW_{res-a}\left(\frac{2.5\ L}{day}\right)}{BW_{res-a}(80\ kg)}\right]$$

and:

$$IFWM_{res-adj}\left(\frac{1,019.9\ L}{kg}\right) = \left[\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times IRW_{0-2}\left(\frac{0.78\ L}{day}\right) \times 10}{BW_{0-2}(15\ kg)} + \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times IRW_{2-6}\left(\frac{0.78\ L}{day}\right) \times 3}{BW_{2-6}(15\ kg)} + \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times IRW_{6-16}\left(\frac{2.5\ L}{day}\right) \times 3}{BW_{6-16}(80\ kg)} + \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times IRW_{16-26}\left(\frac{2.5\ L}{day}\right) \times 1}{BW_{16-26}(80\ kg)}\right]$$

Trichloroethylene Tap Water Inhalation (CDI)

$$CDI_{res-wat-inhtce}\left(\frac{\mu g}{m^3}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times K\left(\frac{0.5\ L}{m^3}\right) \times \left[\begin{array}{l} \left(EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times CAF_i(0.756)\right) + \\ \left(EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 10\right) + \\ \left(EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times ET_{6-16}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 3\right) + \\ \left(EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times ET_{16-26}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times MAF_i(0.244) \times 1\right) \end{array}\right]}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Trichloroethylene Tap Water Dermal (CDI)

$$CDI_{res-wat-dertce}\left(\frac{mg}{kg-day}\right) = \frac{DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left[\left(CAF_o(0.804) \times DFW_{res-adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right)\right) + \left(MAF_o(0.202) \times DFWM_{res-adj}\left(\frac{8,191,633\ cm^2-event}{kg}\right)\right)\right]}{AT_{res}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$DFW_{res-adj}\left(\frac{2,610,650\ cm^2-event}{kg}\right) = \left(\frac{EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times EV_{res-c}\left(\frac{1\ event}{day}\right) \times SA_{res-c}\left(6,365\ cm^2\right)}{BW_{res-c}(15\ kg)} + \frac{EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times EV_{res-a}\left(\frac{1\ event}{day}\right) \times SA_{res-a}\left(19,652\ cm^2\right)}{BW_{res-a}(80\ kg)}\right)$$

and:

$$DFWM_{res-adj}\left(\frac{8,191,633\ cm^2-event}{kg}\right) = \left(\frac{EF_{0-2}\left(\frac{350\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times EV_{0-2}\left(\frac{1\ event}{day}\right) \times SA_{0-2}\left(6,365\ cm^2\right) \times 10}{BW_{0-2}(15\ kg)} + \frac{EF_{2-6}\left(\frac{350\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times EV_{2-6}\left(\frac{1\ event}{day}\right) \times SA_{2-6}\left(6,365\ cm^2\right) \times 3}{BW_{2-6}(15\ kg)} + \frac{EF_{6-16}\left(\frac{350\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times EV_{6-16}\left(\frac{1\ event}{day}\right) \times SA_{6-16}\left(19,652\ cm^2\right) \times 3}{BW_{6-16}(80\ kg)} + \frac{EF_{16-26}\left(\frac{350\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times EV_{16-26}\left(\frac{1\ event}{day}\right) \times SA_{16-26}\left(19,652\ cm^2\right) \times 1}{BW_{16-26}(80\ kg)}\right)$$

and:

IF $ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right) \leq t^*(hrs)$, then:

$$DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times 2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right)}{\pi}}$$

or:

IF $ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right) > t^*(hrs)$, then:

$$DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right)}{1 + B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1 + 3B + 3B^2}{(1 + B)^2}\right)\right]$$

where:

$$ET_{event-res-madj}\left(\frac{0.671\ hrs}{event}\right) = \frac{\left(ED_{0-2}(2\ yr) \times ET_{event-(0-2)}\left(\frac{0.54\ hrs}{event}\right)\right) + \left(ED_{2-6}(4\ yr) \times ET_{event-(2-6)}\left(\frac{0.54\ hrs}{event}\right)\right) + \left(\left(ED_{6-16}(10\ yr) \times ET_{event-(6-16)}\left(\frac{0.71\ hrs}{event}\right)\right) + \left(ED_{16-26}(10\ yr) \times ET_{event-(16-26)}\left(\frac{0.71\ hrs}{event}\right)\right)\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr) + ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

Supporting Child Tap Water (CDI)

$$BW_{res-c}\left(15\ kg\right) = \frac{ED_{0-2}\left(2\ yr\right) \times BW_{0-2}\left(15\ kg\right) + ED_{2-6}\left(4\ yr\right) \times BW_{2-6}\left(15\ kg\right)}{ED_{0-2}\left(2\ yr\right) + ED_{2-6}\left(4\ yr\right)}$$

$$EF_{res-c}\left(\frac{350\ days}{yr}\right) = \frac{ED_{0-2}\left(2\ yr\right) \times EF_{0-2}\left(\frac{350\ days}{yr}\right) + ED_{2-6}\left(4\ yr\right) \times EF_{2-6}\left(\frac{350\ days}{yr}\right)}{ED_{0-2}\left(2\ yr\right) + ED_{2-6}\left(4\ yr\right)}$$

$$ET_{res-c}\left(\frac{24\ hrs}{day}\right) = \frac{ED_{0-2}\left(2\ yr\right) \times ET_{0-2}\left(\frac{24\ hrs}{day}\right) + ED_{2-6}\left(4\ yr\right) \times ET_{2-6}\left(\frac{24\ hrs}{day}\right)}{ED_{0-2}\left(2\ yr\right) + ED_{2-6}\left(4\ yr\right)}$$

$$ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right) = \frac{ED_{0-2}\left(2\ yr\right) \times ET_{event-(0-2)}\left(\frac{0.54\ hrs}{event}\right) + ED_{2-6}\left(4\ yr\right) \times ET_{event-(2-6)}\left(\frac{0.54\ hrs}{event}\right)}{ED_{0-2}\left(2\ yr\right) + ED_{2-6}\left(4\ yr\right)}$$

$$EV_{res-c}\left(\frac{1\ event}{day}\right) = \frac{ED_{0-2}\left(2\ yr\right) \times EV_{0-2}\left(\frac{1\ event}{day}\right) + ED_{2-6}\left(4\ yr\right) \times EV_{2-6}\left(\frac{1\ event}{day}\right)}{ED_{0-2}\left(2\ yr\right) + ED_{2-6}\left(4\ yr\right)}$$

$$SA_{res-c}\left(6,365\ cm^2\right) = \frac{ED_{0-2}\left(2\ yr\right) \times SA_{0-2}\left(6,365\ cm^2\right) + ED_{2-6}\left(4\ yr\right) \times SA_{2-6}\left(6,365\ cm^2\right)}{ED_{0-2}\left(2\ yr\right) + ED_{2-6}\left(4\ yr\right)}$$

$$IRW_{res-c}\left(\frac{0.78\ L}{day}\right) = \frac{ED_{0-2}\left(2\ yr\right) \times IRW_{0-2}\left(\frac{0.78\ L}{day}\right) + ED_{2-6}\left(4\ yr\right) \times IRW_{2-6}\left(\frac{0.78\ L}{day}\right)}{ED_{0-2}\left(2\ yr\right) + ED_{2-6}\left(4\ yr\right)}$$

Supporting Adult Tap Water (CDI)

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

$$EF_{res-a}\left(\frac{350\text{ days}}{\text{yr}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times EF_{6-16}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{16-26}(10\text{ yr}) \times EF_{16-26}\left(\frac{350\text{ days}}{\text{yr}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$ET_{res-a}\left(\frac{24\text{ hrs}}{\text{day}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times ET_{6-16}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times ET_{16-26}\left(\frac{24\text{ hrs}}{\text{day}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$ET_{event-res-a}\left(\frac{0.71\text{ hrs}}{\text{event}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times ET_{event-(6-16)}\left(\frac{0.71\text{ hrs}}{\text{event}}\right) + ED_{16-26}(10\text{ yr}) \times ET_{event-(16-26)}\left(\frac{0.71\text{ hrs}}{\text{event}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$EV_{res-a}\left(\frac{1\text{ event}}{\text{day}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times EV_{6-16}\left(\frac{1\text{ event}}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times EV_{16-26}\left(\frac{1\text{ event}}{\text{day}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$SA_{res-a}\left(19{,}652\text{ cm}^2\right) = \frac{ED_{6-16}(10\text{ yr}) \times SA_{6-16}\left(19{,}652\text{ cm}^2\right) + ED_{16-26}(10\text{ yr}) \times SA_{16-26}\left(19{,}652\text{ cm}^2\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$IRW_{res-a}\left(\frac{2.5\text{ L}}{\text{day}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times IRW_{6-16}\left(\frac{2.5\text{ L}}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times IRW_{16-26}\left(\frac{2.5\text{ L}}{\text{day}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

Supporting Age-adjusted Tap Water (CDI)

$$EF_{res}\left(\frac{350\text{ days}}{\text{yr}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}(2\text{ yr}) \times EF_{0-2}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{2-6}(4\text{ yr}) \times EF_{2-6}\left(\frac{350\text{ days}}{\text{yr}}\right) + \\ ED_{6-16}(10\text{ yr}) \times EF_{6-16}\left(\frac{350\text{ days}}{\text{yr}}\right) + ED_{16-26}(10\text{ yr}) \times EF_{16-26}\left(\frac{350\text{ days}}{\text{yr}}\right) \end{array}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$ET_{res}\left(\frac{24\text{ hrs}}{\text{day}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}(2\text{ yr}) \times ET_{0-2}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{2-6}(4\text{ yr}) \times ET_{2-6}\left(\frac{24\text{ hrs}}{\text{day}}\right) + \\ ED_{6-16}(10\text{ yr}) \times ET_{6-16}\left(\frac{24\text{ hrs}}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times ET_{16-26}\left(\frac{24\text{ hrs}}{\text{day}}\right) \end{array}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

Resident Fish CDI Equations

Noncarcinogenic Fish Ingestion (CDI)

$$CDI_{res-fsh-ingn}\left(\frac{mg}{kg-day}\right)=\frac{C_{fish}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{res}\left(\frac{350\ days}{yr}\right)\times ED_{res}(26\ yr)\times IRFI_{res-a}\left(\frac{54,000\ mg}{day}\right)}{AT_{res-a}\left(\frac{365\ days}{yr}\times ED_{res}(26\ yr)\right)\times BW_{res-a}(80\ kg)}$$

Carcinogenic Fish Ingestion (CDI)

$$CDI_{res-fsh-ingc}\left(\frac{mg}{kg-day}\right)=\frac{C_{fish}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{res}\left(\frac{350\ days}{yr}\right)\times ED_{res}(26\ yr)\times IRFI_{res-a}\left(\frac{54,000\ mg}{day}\right)}{AT_{res}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{res-a}(80\ kg)}$$

Noncarcinogenic Fish Ingestion Back-calculated to Water (CDI)

$$CDI_{res-fsh-ingnw}\left(\frac{mg}{kg-day}\right)=\frac{C_{water}\left(\frac{mg}{L}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times BCF\left(\frac{L}{kg}\right)\times EF_{res}\left(\frac{350\ days}{yr}\right)\times ED_{res}(26\ yr)\times IRFI_{res-a}\left(\frac{54,000\ mg}{day}\right)}{AT_{res-a}\left(\frac{365\ days}{yr}\times ED_{res}(26\ yr)\right)\times BW_{res-a}(80\ kg)}$$

Carcinogenic Fish Ingestion Back-calculated to Water (CDI)

$$CDI_{res-fsh-ingcw}\left(\frac{mg}{kg-day}\right)=\frac{C_{water}\left(\frac{mg}{L}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times BCF\left(\frac{L}{kg}\right)\times EF_{res}\left(\frac{350\ days}{yr}\right)\times ED_{res}(26\ yr)\times IRFI_{res-a}\left(\frac{54,000\ mg}{day}\right)}{AT_{res}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{res-a}(80\ kg)}$$

Composite Worker Soil CDI Equations

Noncarcinogenic Soil Ingestion (CDI)

$$CDI_{com-sol-ingn}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{com}\left(\frac{250\ days}{yr}\right)\times ED_{com}(25\ yr)\times IRS_{com}\left(\frac{100\ mg}{day}\right)}{AT_{com-a}\left(\frac{365\ days}{yr}\times ED_{com}(25\ yr)\right)\times BW_{com}(80\ kg)}$$

Noncarcinogenic Soil Inhalation (CDI)

$$CDI_{com-sol-inhn}\left(\frac{mg}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times EF_{com}\left(\frac{250\ days}{yr}\right)\times ED_{com}(25\ yr)\times ET_{com}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{com-a}\left(\frac{365\ days}{yr}\times ED_{com}(25\ yr)\right)}$$

Noncarcinogenic Soil Dermal (CDI)

$$CDI_{com\text{-}sol\text{-}dern}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{com}\left(\frac{250\ days}{yr}\right)\times ED_{com}(25\ yr)\times SA_{com}\left(\frac{3{,}527\ cm^2}{day}\right)\times AF_{com}\left(\frac{0.12\ mg}{cm^2}\right)\times ABS_d}{AT_{com-a}\left(\frac{365\ days}{yr}\times ED_{com}(25\ yr)\right)\times BW_{com}(80\ kg)}$$

Carcinogenic Soil Ingestion (CDI)

$$CDI_{com\text{-}sol\text{-}ingc}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{com}\left(\frac{250\ days}{yr}\right)\times ED_{com}(25\ yr)\times IRS_{com}\left(\frac{100\ mg}{day}\right)}{AT_{com}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{com}(80\ kg)}$$

Carcinogenic Soil Inhalation (CDI)

$$CDI_{com\text{-}sol\text{-}inhc}\left(\frac{\mu g}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_{com}\left(\frac{250\ days}{yr}\right)\times ED_{com}(25\ yr)\times ET_{com}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{com}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Carcinogenic Soil Dermal (CDI)

$$CDI_{com\text{-}sol\text{-}derc}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{com}\left(\frac{250\ days}{yr}\right)\times ED_{com}(25\ yr)\times SA_{com}\left(\frac{3{,}527\ cm^2}{day}\right)\times AF_{com}\left(\frac{0.12\ mg}{cm^2}\right)\times ABS_d}{AT_{com}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{com}(80\ kg)}$$

Composite Worker Air CDI Equations

Noncarcinogenic Air Inhalation (CDI)

$$CDI_{com\text{-}air\text{-}inhn}\left(\frac{mg}{m^3}\right)=\frac{C_{air}\left(\frac{\mu g}{m^3}\right)\times\left(\frac{mg}{1000\ \mu g}\right)EF_{com}\left(\frac{250\ days}{yr}\right)\times ED_{com}(25\ yr)\times ET_{com}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)}{AT_{com-a}\left(\frac{365\ days}{yr}\times ED_{com}(25\ yr)\right)}$$

Carcinogenic Air Inhalation (CDI)

$$CDI_{com\text{-}air\text{-}inhc}\left(\frac{\mu g}{m^3}\right)=\frac{C_{air}\left(\frac{\mu g}{m^3}\right)\times EF_{com}\left(\frac{250\ days}{yr}\right)\times ED_{com}(25\ yr)\times ET_{com}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)}{AT_{com}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Refractory Ceramic Fibers Air Inhalation (CDI)

$$CDI_{com-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{com-a}\left(\frac{365\ days}{yr} \times ED_{com}(25\ yr)\right)}$$

Asbestos Air Inhalation (CDI)

$$CDI_{com-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{com}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

<u>Outdoor Worker Soil CDI Equations</u>

Noncarcinogenic Soil Ingestion (CDI)

$$CDI_{out-sol-ingn}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times IRS_{out}\left(\frac{100\ mg}{day}\right)}{AT_{out-a}\left(\frac{365\ days}{yr} \times ED_{out}(25\ yr)\right) \times BW_{out}(80\ kg)}$$

Noncarcinogenic Soil Inhalation (CDI)

$$CDI_{out-sol-inhn}\left(\frac{mg}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{out-a}\left(\frac{365\ days}{yr} \times ED_{out}(25\ yr)\right)}$$

Noncarcinogenic Soil Dermal (CDI)

$$CDI_{out-sol-dern}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times SA_{out}\left(\frac{3,527\ cm^2}{day}\right) \times AF_{out}\left(\frac{0.12\ mg}{cm^2}\right) \times ABS_d}{AT_{out-a}\left(\frac{365\ days}{yr} \times ED_{out}(25\ yr)\right) \times BW_{out}(80\ kg)}$$

Carcinogenic Soil Ingestion (CDI)

$$CDI_{out-sol-ingc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times IRS_{out}\left(\frac{100\ mg}{day}\right)}{AT_{out}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{out}(80\ kg)}$$

Carcinogenic Soil Inhalation (CDI)

$$CDI_{out-sol-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{1000\ \mu g}{mg}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{out}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Carcinogenic Soil Dermal (CDI)

$$CDI_{out-sol-derc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times SA_{out}\left(\frac{3,527\ cm^2}{day}\right) \times AF_{out}\left(\frac{0.12\ mg}{cm^2}\right) \times ABS_d}{AT_{out}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times BW_{out}(80\ kg)}$$

Outdoor Worker Air CDI Equations

Noncarcinogenic Air Inhalation (CDI)

$$CDI_{out-air-inhn}\left(\frac{mg}{m^3}\right) = \frac{C_{air}\left(\frac{\mu g}{m^3}\right) \times \left(\frac{mg}{1000\ \mu g}\right) EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{out-a}\left(\frac{365\ days}{yr} \times ED_{out}(25\ yr)\right)}$$

Carcinogenic Air Inhalation (CDI)

$$CDI_{out-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{C_{air}\left(\frac{\mu g}{m^3}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{out}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Refractory Ceramic Fibers Air Inhalation (CDI)

$$CDI_{out-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{out-a}\left(\frac{365\ days}{yr} \times ED_{out}(25\ yr)\right)}$$

Asbestos Air Inhalation (CDI)

$$CDI_{out-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{out}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Indoor Worker Soil CDI Equations

Noncarcinogenic Soil Ingestion (CDI)

$$CDI_{ind-sol-ingn}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times IRS_{ind}\left(\frac{50\ mg}{day}\right)}{AT_{ind-a}\left(\frac{365\ days}{yr}\times ED_{ind}(25\ yr)\right)\times BW_{ind}(80\ kg)}$$

Noncarcinogenic Soil Inhalation (CDI)

$$CDI_{ind-sol-inhn}\left(\frac{mg}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times ET_{ind}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{ind-a}\left(\frac{365\ days}{yr}\times ED_{ind}(25\ yr)\right)}$$

Carcinogenic Soil Ingestion (CDI)

$$CDI_{ind-sol-ingc}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times IRS_{ind}\left(\frac{50\ mg}{day}\right)}{AT_{ind}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{ind}(80\ kg)}$$

Carcinogenic Soil Inhalation (CDI)

$$CDI_{ind-sol-inhc}\left(\frac{\mu g}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times ET_{ind}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{ind}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Indoor Worker Air CDI Equations

Noncarcinogenic Air Inhalation (CDI)

$$CDI_{ind-air-inhn}\left(\frac{mg}{m^3}\right)=\frac{C_{air}\left(\frac{\mu g}{m^3}\right)\times\left(\frac{mg}{1000\ \mu g}\right)EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times ET_{ind}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)}{AT_{ind-a}\left(\frac{365\ days}{yr}\times ED_{ind}(25\ yr)\right)}$$

Carcinogenic Air Inhalation (CDI)

$$CDI_{ind-air-inhc}\left(\frac{\mu g}{m^3}\right)=\frac{C_{air}\left(\frac{\mu g}{m^3}\right)\times EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times ET_{ind}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)}{AT_{ind}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Refractory Ceramic Fibers Air Inhalation (CDI)

$$CDI_{ind-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{ind-a}\left(\frac{365\ days}{yr} \times ED_{ind}(25\ yr)\right)}$$

Asbestos Air Inhalation (CDI)

$$CDI_{ind-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{ind}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Indoor Worker Tap Water CDI Equations

Noncarcinogenic Tap Water Ingestion (CDI)

$$CDI_{ind-wat-ingn}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times IRW_{ind}\left(\frac{1.25\ L}{day}\right)}{AT_{ind-a}\left(\frac{365\ days}{yr} \times ED_{ind}(25\ yr)\right) \times BW_{ind}\ (80\ kg)}$$

Noncarcinogenic Tap Water Inhalation (CDI)

$$CDI_{ind-wat-inhn}\left(\frac{mg}{m^3}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind-a}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times K\left(\frac{0.5\ L}{m^3}\right)}{AT_{ind-a}\left(\frac{365\ days}{yr} \times ED_{ind}(25\ yr)\right) \times}$$

Noncarcinogenic Tap Water Dermal (CDI)

$$CDI_{ind\text{-}wat\text{-}derm}\left(\frac{mg}{kg-day}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times EV_{ind}\left(\frac{1\ event}{day}\right)\times SA_{ind}\left(19{,}652\ cm^2\right)}{AT_{ind\text{-}a}\left(\frac{365\ days}{yr}\times ED_{ind}(25\ yr)\right)\times BW_{ind}(80\ kg)}$$

where:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times K_p\left(\frac{cm}{hr}\right)\times ET_{event\text{-}ind\text{-}a}\left(\frac{0.71\ hrs}{event}\right)$$

For Organics:

IF $ET_{event\text{-}ind}\left(\frac{0.71\ hrs}{event}\right)\leq t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times 2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event\text{-}ind}\left(\frac{0.71\ hrs}{event}\right)}{\pi}}$$

or,

IF $ET_{event\text{-}ind}\left(\frac{0.71\ hrs}{event}\right)>t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event\text{-}ind}\left(\frac{0.71\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Carcinogenic Tap Water Ingestion (CDI)

$$CDI_{ind\text{-}wat\text{-}ingc}\left(\frac{mg}{kg-day}\right)=\frac{C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times IRW_{ind}\left(\frac{1.25\ L}{day}\right)}{AT_{ind}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{ind}(80\ kg)}$$

Carcinogenic Tap Water Inhalation (CDI)

$$CDI_{ind\text{-}wat\text{-}inhc}\left(\frac{\mu g}{m^3}\right)=\frac{C_{water}\left(\frac{\mu g}{L}\right)\times EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times ET_{ind\text{-}a}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times K\left(\frac{0.5\ L}{m^3}\right)}{AT_{ind}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Carcinogenic Tap Water Dermal (CDI)

$$CDI_{ind-wat-derc}\left(\frac{mg}{kg-day}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{ind}\left(\frac{250\ days}{yr}\right)\times ED_{ind}(25\ yr)\times EV_{ind}\left(\frac{1\ event}{day}\right)\times SA_{ind}\left(19{,}652\ cm^2\right)}{AT_{ind}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{ind}(80\ kg)}$$

where:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times K_p\left(\frac{cm}{hr}\right)\times ET_{event-ind-a}\left(\frac{0.71\ hrs}{event}\right)$$

For Organics:

IF $ET_{event-ind}\left(\frac{0.71\ hrs}{event}\right)\leq t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times 2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event-ind}\left(\frac{0.71\ hrs}{event}\right)}{\pi}}$$

or,

IF $ET_{event-ind}\left(\frac{0.71\ hrs}{event}\right)>t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event-ind}\left(\frac{0.71\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Construction Worker Soil Exposure to Unpaved Road Traffic CDI Equations

Noncarcinogenic Soil Ingestion (CDI) Unpaved Road Traffic

$$CDI_{con-sol-ingn}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times IRS_{con}\left(\frac{330\ mg}{day}\right)}{AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)\times BW_{con}(80\ kg)}$$

Noncarcinogenic Soil Inhalation (CDI) Unpaved Road Traffic

$$CDI_{con-sol-inhn}\left(\frac{mg}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_{sc}\left(\frac{m^3}{kg}\right)}\right)}{AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)}$$

Noncarcinogenic Soil Dermal (CDI) Unpaved Road Traffic

$$CDI_{con-sol-dern}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times SA_{con}\left(\frac{3{,}527\ cm^2}{day}\right)\times AF_{con}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d}{AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)\times BW_{con}(80\ kg)}$$

Carcinogenic Soil Ingestion (CDI) Unpaved Road Traffic

$$CDI_{con-sol-ingc}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times IRS_{con}\left(\frac{330\ mg}{day}\right)}{AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{con}(80\ kg)}$$

Carcinogenic Soil Inhalation (CDI) Unpaved Road Traffic

$$CDI_{con-sol-inhc}\left(\frac{\mu g}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF_{sc}\left(\frac{m^3}{kg}\right)}\right)}{AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Carcinogenic Soil Dermal (CDI) Unpaved Road Traffic

$$CDI_{con-sol-derc}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times SA_{con}\left(\frac{3,527\ cm^2}{day}\right)\times AF_{con}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d}{AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{con}(80\ kg)}$$

<u>Construction Worker Soil Exposure to Other Construction Activities CDI Equations</u>

Noncarcinogenic Soil Ingestion (CDI) Other Construction Activities

$$CDI_{con-sol-ingnsa}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times IRS_{con}\left(\frac{330\ mg}{day}\right)}{AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)\times BW_{con}(80\ kg)}$$

Noncarcinogenic Soil Inhalation (CDI) Other Construction Activities

$$CDI_{con-sol-inhnsa}\left(\frac{mg}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF'_{sc}\left(\frac{m^3}{kg}\right)}\right)}{AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)}$$

Noncarcinogenic Soil Dermal (CDI) Other Construction Activities

$$CDI_{con-sol-dernsa}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times SA_{con}\left(\frac{3,527\ cm^2}{day}\right)\times AF_{con}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d}{AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)\times BW_{con}(80\ kg)}$$

Carcinogenic Soil Ingestion (CDI) Other Construction Activities

$$CDI_{con-sol-ingcsa}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times IRS_{con}\left(\frac{330\ mg}{day}\right)}{AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{con}(80\ kg)}$$

Carcinogenic Soil Inhalation (CDI) Other Construction Activities

$$CDI_{con-sol-inhcsa}\left(\frac{\mu g}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF'_{sc}\left(\frac{m^3}{kg}\right)}\right)}{AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Carcinogenic Soil Dermal (CDI) Other Construction Activities

$$CDI_{con-sol-dercsa}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times SA_{con}\left(\frac{3{,}527\ cm^2}{day}\right)\times AF_{con}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d}{AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{con}(80\ kg)}$$

Construction Worker Air CDI Equations

Noncarcinogenic Air Inhalation (CDI)

$$CDI_{con-air-inhn}\left(\frac{mg}{m^3}\right)=\frac{C_{air}\left(\frac{\mu g}{m^3}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)}{AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)}$$

Carcinogenic Air Inhalation (CDI)

$$CDI_{con-air-inhc}\left(\frac{\mu g}{m^3}\right)=\frac{C_{air}\left(\frac{\mu g}{m^3}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)}{AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Refractory Ceramic Fibers Air Inhalation (CDI)

$$CDI_{con-air-inhrcf}\left(\frac{f}{m^3}\right)=\frac{C_{air}\left(\frac{f}{m^3}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)}{AT_{con-a}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times\left(\frac{7\ days}{wk}\right)\times ED_{con}(1\ yr)\right)}$$

Asbestos Air Inhalation (CDI)

$$CDI_{con-air-inhasb}\left(\frac{f}{m^3}\right)=\frac{C_{air}\left(\frac{f}{m^3}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)}{AT_{con}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Excavation Worker Soil CDI Equations

Noncarcinogenic Soil Ingestion (CDI)

$$CDI_{exc-sol-ingn}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times IRS_{exc}\left(\frac{330\ mg}{day}\right)}{AT_{exc-a}\left(\frac{365\ days}{yr}\times ED_{exc}(1\ yr)\right)\times BW_{exc}(80\ kg)}$$

Noncarcinogenic Soil Inhalation (CDI)

$$CDI_{exc-sol-inhn}\left(\frac{mg}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{exc-a}\left(\frac{365\ days}{yr}\times ED_{exc}(1\ yr)\right)}$$

Noncarcinogenic Soil Dermal (CDI)

$$CDI_{exc-sol-dern}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times SA_{exc}\left(\frac{3,527\ cm^2}{day}\right)\times AF_{exc}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d}{AT_{exc-a}\left(\frac{365\ days}{yr}\times ED_{exc}(1\ yr)\right)\times BW_{exc}(80\ kg)}$$

Carcinogenic Soil Ingestion (CDI)

$$CDI_{exc-sol-ingc}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times IRS_{exc}\left(\frac{330\ mg}{day}\right)}{AT_{exc}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)\times BW_{exc}(80\ kg)}$$

Carcinogenic Soil Inhalation (CDI)

$$CDI_{exc-sol-inhc}\left(\frac{\mu g}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{exc}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Carcinogenic Soil Dermal (CDI)

$$CDI_{exc-sol-dern}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times SA_{exc}\left(\frac{3,527\ cm^2}{day}\right)\times AF_{exc}\left(\frac{0.3\ mg}{cm^2}\right)\times ABS_d}{AT_{exc-a}\left(\frac{365\ days}{yr}\times ED_{exc}(1\ yr)\right)\times BW_{exc}(80\ kg)}$$

Excavation Worker Air CDI Equations

Noncarcinogenic Air Inhalation (CDI)

$$CDI_{exc-air-inhn}\left(\frac{mg}{m^3}\right) = \frac{C_{air}\left(\frac{\mu g}{m^3}\right) \times \left(\frac{mg}{1000\ \mu g}\right) EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{exc-a}\left(\frac{365\ days}{yr} \times ED_{exc}(1\ yr)\right)}$$

Carcinogenic Air Inhalation (CDI)

$$CDI_{exc-air-inhc}\left(\frac{\mu g}{m^3}\right) = \frac{C_{air}\left(\frac{\mu g}{m^3}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{exc}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Refractory Ceramic Fibers Air Inhalation (CDI)

$$CDI_{exc-air-inhrcf}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{exc-a}\left(\frac{365\ days}{yr} \times ED_{exc}(1\ yr)\right)}$$

Asbestos Air Inhalation (CDI)

$$CDI_{exc-air-inhasb}\left(\frac{f}{m^3}\right) = \frac{C_{air}\left(\frac{f}{m^3}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{exc}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

Recreator Soil/Sediment CDI Equations

Noncarcinogenic Child Soil Ingestion (CDI)

$$CDI_{rec-sol-ingnc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times IRS_{rec-c}\left(\frac{200\ mg}{day}\right)}{AT_{rec-c}\left(\frac{365\ days}{yr} \times ED_{rec-c}(6\ yr)\right) \times BW_{rec-c}(15\ kg)}$$

Noncarcinogenic Child Soil Inhalation (CDI)

$$CDI_{rec-sol-inhnc}\left(\frac{mg}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times ET_{rec-c}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{rec-c}\left(\frac{365\ days}{yr} \times ED_{rec-c}(6\ yr)\right)}$$

Noncarcinogenic Child Soil Dermal (CDI)

$$CDI_{rec-sol-dernc}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)EF_{rec-c}\left(\frac{75\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right)\times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right)\times ABS_d}{AT_{rec-c}\left(\frac{365\ days}{yr}\times ED_{rec-c}(6\ yr)\right)\times BW_{rec-c}(15\ kg)}$$

Noncarcinogenic Adult Soil Ingestion (CDI)

$$CDI_{rec-sol-ingna}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times EF_{rec-a}\left(\frac{75\ days}{yr}\right)\times ED_{rec}(26\ yr)\times IRS_{rec-a}\left(\frac{100\ mg}{day}\right)}{AT_{rec-a}\left(\frac{365\ days}{yr}\times ED_{rec}(26\ yr)\right)\times BW_{rec-a}(80\ kg)}$$

Noncarcinogenic Adult Soil Inhalation (CDI)

$$CDI_{rec-sol-inhna}\left(\frac{mg}{m^3}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times EF_{rec-a}\left(\frac{75\ days}{yr}\right)\times ED_{rec}(26\ yr)\times ET_{rec-a}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{rec-a}\left(\frac{365\ days}{yr}\times ED_{rec}(26\ yr)\right)}$$

Noncarcinogenic Adult Soil Dermal (CDI)

$$CDI_{rec-sol-derna}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{rec-a}\left(\frac{75\ days}{yr}\right)\times ED_{rec}(26\ yr)\times SA_{rec-a}\left(\frac{6,032\ cm^2}{day}\right)\times AF_{rec-a}\left(\frac{0.07\ mg}{cm^2}\right)\times ABS_d}{AT_{rec-a}\left(\frac{365\ days}{yr}\times ED_{rec}(26\ yr)\right)\times BW_{rec-a}(80\ kg)}$$

Noncarcinogenic Age-adjusted Soil Ingestion (CDI)

$$CDI_{rec-sol-ingnadj}\left(\frac{mg}{kg-day}\right)=\frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times IFS_{rec-adj}\left(\frac{7,875\ mg}{kg}\right)}{AT_{rec-a}\left(\frac{365\ days}{yr}\times ED_{rec}(26\ yr)\right)}$$

where:

$$IFS_{rec-adj}\left(\frac{7,875\ mg}{kg}\right)=\left[\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times IRS_{rec-c}\left(\frac{200\ mg}{day}\right)}{BW_{rec-c}(15\ kg)}+\frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right)\times ED_{rec-a}(20\ yr)\times IRS_{rec-a}\left(\frac{100\ mg}{day}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Noncarcinogenic Age-adjusted Soil Inhalation (CDI)

$$CDI_{rec\text{-}sol\text{-}inhnadj}\left(\frac{mg}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times ED_{rec}(26\ yr) \times ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{rec\text{-}a}\left(\frac{365\ days}{yr} \times ED_{rec}(26\ yr)\right)}$$

Noncarcinogenic Age-adjusted Soil Dermal (CDI)

$$CDI_{rec\text{-}sol\text{-}dernadj}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFS_{rec\text{-}adj}\left(\frac{22,155\ mg}{kg}\right) \times ABS_d}{AT_{rec\text{-}a}\left(\frac{365\ days}{yr} \times ED_{rec}(26\ yr)\right)}$$

where:

$$DFS_{rec\text{-}adj}\left(\frac{22,155\ mg}{kg}\right) = \left[\frac{EF_{rec\text{-}c}\left(\frac{75\ days}{yr}\right) \times ED_{rec\text{-}c}(6\ yr) \times SA_{rec\text{-}c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{rec\text{-}c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{rec\text{-}c}(15\ kg)} + \frac{EF_{rec\text{-}a}\left(\frac{75\ days}{yr}\right) \times ED_{rec\text{-}a}(20\ yr) \times SA_{rec\text{-}a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{rec\text{-}a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{rec\text{-}a}(80\ kg)}\right]$$

Carcinogenic Soil Ingestion (CDI)

$$CDI_{rec\text{-}sol\text{-}ingc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA \times IFS_{rec\text{-}adj}\left(\frac{7,875\ mg}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFS_{rec\text{-}adj}\left(\frac{7,875\ mg}{kg}\right) = \left[\frac{EF_{rec\text{-}c}\left(\frac{75\ days}{yr}\right) \times ED_{rec\text{-}c}(6\ yr) \times IRS_{rec\text{-}c}\left(\frac{200\ mg}{day}\right)}{BW_{rec\text{-}c}(15\ kg)} + \frac{EF_{rec\text{-}a}\left(\frac{75\ days}{yr}\right) \times ED_{rec\text{-}a}(20\ yr) \times IRS_{rec\text{-}a}\left(\frac{100\ mg}{day}\right)}{BW_{rec\text{-}a}(80\ kg)}\right]$$

Carcinogenic Soil Inhalation (CDI)

$$CDI_{rec\text{-}sol\text{-}inhnc}\left(\frac{mg}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times EF_{rec\text{-}c}\left(\frac{75\ days}{yr}\right) \times ED_{rec\text{-}c}(6\ yr) \times ET_{rec\text{-}c}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)} + \frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)}{AT_{rec\text{-}c}\left(\frac{365\ days}{yr} \times ED_{rec\text{-}c}(6\ yr)\right)}$$

Carcinogenic Soil Dermal (CDI)

$$CDI_{rec-sol-derc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) \times ABS_d}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times SA_{rec-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{rec-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Mutagenic Soil Ingestion (CDI)

$$CDI_{rec-sol-ingmu}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times RBA \times \left(\frac{10^{-6}\ kg}{mg}\right) \times IFSM_{rec-adj}\left(\frac{35,750\ mg}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFSM_{rec-adj}\left(\frac{35,750\ mg}{kg}\right) = \left[\frac{EF_{0-2}\left(\frac{75\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times IRS_{0-2}\left(\frac{200\ mg}{day}\right) \times 10}{BW_{0-2}(15\ kg)} + \frac{EF_{2-6}\left(\frac{75\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times IRS_{2-6}\left(\frac{200\ mg}{day}\right) \times 3}{BW_{2-6}(15\ kg)} + \frac{EF_{6-16}\left(\frac{75\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times IRS_{6-16}\left(\frac{100\ mg}{day}\right) \times 3}{BW_{6-16}(80\ kg)} + \frac{EF_{16-26}\left(\frac{75\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times IRS_{16-26}\left(\frac{100\ mg}{day}\right) \times 1}{BW_{16-26}(80\ kg)}\right]$$

Mutagenic Soil Inhalation (CDI)

$$\mathrm{CDI}_{\text{rec-sol-inhmu}}\left(\frac{\mu g}{m^3}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)\times\left[\begin{array}{c}\left(EF_{0-2}\left(\frac{75\ days}{yr}\right)\times ED_{0-2}(2\ yr)\times ET_{0-2}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times 10\right)+\\ \left(EF_{2-6}\left(\frac{75\ days}{yr}\right)\times ED_{2-6}(4\ yr)\times ET_{2-6}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times 3\right)+\\ \left(EF_{6-16}\left(\frac{75\ days}{yr}\right)\times ED_{6-16}(10\ yr)\times ET_{6-16}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times 3\right)+\\ \left(EF_{16-26}\left(\frac{75\ days}{yr}\right)\times ED_{16-26}(10\ yr)\times ET_{16-26}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times 1\right)\end{array}\right]}{AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Mutagenic Soil Dermal (CDI)

$$\mathrm{CDI}_{\text{rec-sol-dermu}}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times DFSM_{rec-adj}\left(\frac{91,770\ mg}{kg}\right)\times ABS_d}{AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

where:

$$DFSM_{rec-adj}\left(\frac{91,770\ mg}{kg}\right) = \left[\begin{array}{c}\frac{EF_{0-2}\left(\frac{75\ days}{yr}\right)\times ED_{0-2}(2\ yr)\times SA_{0-2}\left(\frac{2,373\ cm^2}{day}\right)\times AF_{0-2}\left(\frac{0.2\ mg}{cm^2}\right)\times 10}{BW_{0-2}(15\ kg)}+\\ \frac{EF_{2-6}\left(\frac{75\ days}{yr}\right)\times ED_{2-6}(4\ yr)\times SA_{2-6}\left(\frac{2,373\ cm^2}{day}\right)\times AF_{2-6}\left(\frac{0.2\ mg}{cm^2}\right)\times 3}{BW_{2-6}(15\ kg)}+\\ \frac{EF_{6-16}\left(\frac{75\ days}{yr}\right)\times ED_{6-16}(10\ yr)\times SA_{6-16}\left(\frac{6,032\ cm^2}{day}\right)\times AF_{6-16}\left(\frac{0.07\ mg}{cm^2}\right)\times 3}{BW_{6-16}(80\ kg)}+\\ \frac{EF_{16-26}\left(\frac{75\ days}{yr}\right)\times ED_{16-26}(10\ yr)\times SA_{16-26}\left(\frac{6,032\ cm^2}{day}\right)\times AF_{16-26}\left(\frac{0.07\ mg}{cm^2}\right)\times 1}{BW_{16-26}(80\ kg)}\end{array}\right]$$

Vinyl Chloride Soil Ingestion (CDI)

$$CDI_{rec-sol-ingvc}\left(\frac{mg}{kg-day}\right) = C_{soil}\left(\frac{mg}{kg}\right) \times \left(\left(\frac{IFS_{rec-adj}\left(\frac{7{,}875\ mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}\right) + \left(\frac{IRS_{rec-c}\left(\frac{200\ mg}{day}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times RBA}{BW_{rec-c}\,(15\ kg)}\right)\right)$$

where:

$$IFS_{rec-adj}\left(\frac{7{,}875\ mg}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times IRS_{rec-c}\left(\frac{200\ mg}{day}\right)}{BW_{rec-c}\,(15\ kg)} + \frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times IRS_{rec-a}\left(\frac{100\ mg}{day}\right)}{BW_{rec-a}\,(80\ kg)}\right]$$

Vinyl Chloride Soil Inhalation (CDI)

$$CDI_{rec-sol-inhvc}\left(\frac{\mu g}{m^3}\right) = C_{soil}\left(\frac{mg}{kg}\right) \times \left(\left(\frac{EF_{rec}\left(\frac{75\ days}{yr}\right) \times ED_{rec}(26\ yr) \times ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right)}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right) \times VF_s\left(\frac{m^3}{kg}\right) \times \left(\frac{mg}{1000\ \mu g}\right)}\right) + \left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right) \times \left(\frac{mg}{1000\ \mu g}\right)}\right)\right)$$

Vinyl Chloride Soil Dermal (CDI)

$$CDI_{rec-sol-dervc}\left(\frac{mg}{kg-day}\right) = C_{soil}\left(\frac{mg}{kg}\right) \times \left(\left(\frac{DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times ABS_d}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)} \right) + \left(\frac{SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right) \times ABS_d}{BW_{rec-c}\ (15\ kg)} \right) \right)$$

where:

$$DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{rec-c}\ (15\ kg)} + \frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times SA_{rec-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{rec-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{rec-a}\ (80\ kg)} \right]$$

Trichloroethylene Soil Ingestion (CDI)

$$CDI_{rec-sol-ingtce}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times RBA\times\left(\begin{array}{l}\left(CAF_o(0.804)\times IFS_{rec-adj}\left(\frac{7,875\ mg}{kg}\right)\right)+\\\left(MAF_o(0.202)\times IFSM_{rec-adj}\left(\frac{35,750\ mg}{kg}\right)\right)\end{array}\right)}{AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

where:

$$IFS_{rec-adj}\left(\frac{7,875\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times IRS_{rec-c}\left(\frac{200\ mg}{day}\right)}{BW_{rec-c}(15\ kg)}+\\\frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right)\times ED_{rec-a}(20\ yr)\times IRS_{rec-a}\left(\frac{100\ mg}{day}\right)}{BW_{rec-a}(80\ kg)}\end{array}\right]$$

and:

$$IFSM_{rec-adj}\left(\frac{35,750\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{0-2}\left(\frac{75\ days}{yr}\right)\times ED_{0-2}(2\ yr)\times IRS_{0-2}\left(\frac{200\ mg}{day}\right)\times 10}{BW_{0-2}(15\ kg)}+\\\frac{EF_{2-6}\left(\frac{75\ days}{yr}\right)\times ED_{2-6}(4\ yr)\times IRS_{2-6}\left(\frac{200\ mg}{day}\right)\times 3}{BW_{2-6}(15\ kg)}+\\\frac{EF_{6-16}\left(\frac{75\ days}{yr}\right)\times ED_{6-16}(10\ yr)\times IRS_{6-16}\left(\frac{100\ mg}{day}\right)\times 3}{BW_{6-16}(80\ kg)}+\\\frac{EF_{16-26}\left(\frac{75\ days}{yr}\right)\times ED_{16-26}(10\ yr)\times IRS_{16-26}\left(\frac{100\ mg}{day}\right)\times 1}{BW_{16-26}(80\ kg)}\end{array}\right]$$

Trichloroethylene Soil Inhalation (CDI)

$$CDI_{rec-sol-inhtce}\left(\frac{\mu g}{m^3}\right) = \frac{\begin{array}{l}C_{soil}\left(\frac{mg}{kg}\right)\times\left(\frac{1000\ \mu g}{mg}\right)\times\left(\frac{1}{VF_s\left(\frac{m^3}{kg}\right)}+\frac{1}{PEF\left(\frac{m^3}{kg}\right)}\right)\times\\\left[\begin{array}{l}\left(EF_{rec}\left(\frac{75\ days}{yr}\right)\times ED_{rec}(26\ yr)\times ET_{rec}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times CAF_i(0.756)\right)+\\\left(EF_{0-2}\left(\frac{75\ days}{yr}\right)\times ED_{0-2}(2\ yr)\times ET_{0-2}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times MAF_i(0.244)\times 10\right)+\\\left(EF_{2-6}\left(\frac{75\ days}{yr}\right)\times ED_{2-6}(4\ yr)\times ET_{2-6}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times MAF_i(0.244)\times 3\right)+\\\left(EF_{6-16}\left(\frac{75\ days}{yr}\right)\times ED_{6-16}(10\ yr)\times ET_{6-16}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times MAF_i(0.244)\times 3\right)+\\\left(EF_{16-26}\left(\frac{75\ days}{yr}\right)\times ED_{16-26}(10\ yr)\times ET_{16-26}\left(\frac{1\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times MAF_i(0.244)\times 1\right)\end{array}\right]\end{array}}{AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

Trichloroethylene Soil Dermal (CDI)

$$CDI_{rec-sol-dertce}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times \left(\begin{array}{l}\left(CAF_o\,(0.804) \times DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) \times ABS_d\right)\ + \\ \left(MAF_o\,(0.202) \times DFSM_{rec-adj}\left(\frac{91,770\ mg}{kg}\right) \times ABS_d\right)\end{array}\right)}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$DFS_{rec-adj}\left(\frac{22,155\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times SA_{rec-c}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{rec-c}\left(\frac{0.2\ mg}{cm^2}\right)}{BW_{rec-c}\,(15\ kg)} + \\ \frac{EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times SA_{rec-a}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{rec-a}\left(\frac{0.07\ mg}{cm^2}\right)}{BW_{rec-a}\,(80\ kg)}\end{array}\right]$$

and:

$$DFSM_{rec-adj}\left(\frac{91,770\ mg}{kg}\right) = \left[\begin{array}{l}\frac{EF_{0-2}\left(\frac{75\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times SA_{0-2}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{0-2}\left(\frac{0.2\ mg}{cm^2}\right) \times 10}{BW_{0-2}\,(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{75\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times SA_{2-6}\left(\frac{2,373\ cm^2}{day}\right) \times AF_{2-6}\left(\frac{0.2\ mg}{cm^2}\right) \times 3}{BW_{2-6}\,(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{75\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times SA_{6-16}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{6-16}\left(\frac{0.07\ mg}{cm^2}\right) \times 3}{BW_{6-16}\,(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{75\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times SA_{16-26}\left(\frac{6,032\ cm^2}{day}\right) \times AF_{16-26}\left(\frac{0.07\ mg}{cm^2}\right) \times 1}{BW_{16-26}\,(80\ kg)}\end{array}\right]$$

Supporting Child Soil (CDI)

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

$$EF_{rec-c}\left(\frac{75\ \text{days}}{\text{yr}}\right) = \frac{ED_{0-2}(2\ \text{yr}) \times EF_{0-2}\left(\frac{75\ \text{days}}{\text{yr}}\right) + ED_{2-6}(4\ \text{yr}) \times EF_{2-6}\left(\frac{75\ \text{days}}{\text{yr}}\right)}{ED_{0-2}(2\ \text{yr}) + ED_{2-6}(4\ \text{yr})}$$

$$ET_{rec-c}\left(\frac{1\ \text{hrs}}{\text{day}}\right) = \frac{ED_{0-2}(2\ \text{yr}) \times ET_{0-2}\left(\frac{1\ \text{hrs}}{\text{day}}\right) + ED_{2-6}(4\ \text{yr}) \times ET_{2-6}\left(\frac{1\ \text{hrs}}{\text{day}}\right)}{ED_{0-2}(2\ \text{yr}) + ED_{2-6}(4\ \text{yr})}$$

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

$$SA_{rec-c}\left(\frac{2,373\ \text{cm}^2}{\text{day}}\right) = \frac{ED_{0-2}(2\ \text{yr}) \times SA_{0-2}\left(\frac{2,373\ \text{cm}^2}{\text{day}}\right) + ED_{2-6}(4\ \text{yr}) \times SA_{2-6}\left(\frac{2,373\ \text{cm}^2}{\text{day}}\right)}{ED_{0-2}(2\ \text{yr}) + ED_{2-6}(4\ \text{yr})}$$

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

Supporting Adult Soil (CDI)

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

$$EF_{rec-a}\left(\frac{75\text{ days}}{\text{yr}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times EF_{6-16}\left(\frac{75\text{ days}}{\text{yr}}\right) + ED_{16-26}(10\text{ yr}) \times EF_{16-26}\left(\frac{75\text{ days}}{\text{yr}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$ET_{rec-a}\left(\frac{1\text{ hrs}}{\text{day}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times ET_{6-16}\left(\frac{1\text{ hrs}}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times ET_{16-26}\left(\frac{1\text{ hrs}}{\text{day}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

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

$$SA_{rec-a}\left(\frac{6,032\text{ cm}^2}{\text{day}}\right) = \frac{ED_{6-16}(10\text{ yr}) \times SA_{6-16}\left(\frac{6,032\text{ cm}^2}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times SA_{16-26}\left(\frac{6,032\text{ cm}^2}{\text{day}}\right)}{ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

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

Supporting Age-adjusted Soil (CDI)

$$EF_{rec}\left(\frac{75\text{ days}}{\text{yr}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}(2\text{ yr}) \times EF_{0-2}\left(\frac{75\text{ days}}{\text{yr}}\right) + ED_{2-6}(4\text{ yr}) \times EF_{2-6}\left(\frac{75\text{ days}}{\text{yr}}\right) + \\ ED_{6-16}(10\text{ yr}) \times EF_{6-16}\left(\frac{75\text{ days}}{\text{yr}}\right) + ED_{16-26}(10\text{ yr}) \times EF_{16-26}\left(\frac{75\text{ days}}{\text{yr}}\right) \end{array}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

$$ET_{rec}\left(\frac{1\text{ hrs}}{\text{day}}\right) = \frac{\left(\begin{array}{c} ED_{0-2}(2\text{ yr}) \times ET_{0-2}\left(\frac{1\text{ hrs}}{\text{day}}\right) + ED_{2-6}(4\text{ yr}) \times ET_{2-6}\left(\frac{1\text{ hrs}}{\text{day}}\right) + \\ ED_{6-16}(10\text{ yr}) \times ET_{6-16}\left(\frac{1\text{ hrs}}{\text{day}}\right) + ED_{16-26}(10\text{ yr}) \times ET_{16-26}\left(\frac{1\text{ hrs}}{\text{day}}\right) \end{array}\right)}{ED_{0-2}(2\text{ yr}) + ED_{2-6}(4\text{ yr}) + ED_{6-16}(10\text{ yr}) + ED_{16-26}(10\text{ yr})}$$

Recreator Surface Water CDI Equations

Noncarcinogenic Child Surface Water Ingestion (CDI)

$$CDI_{rec-wat-ingnc}\left(\frac{mg}{kg-day}\right)=\frac{C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{rec-c}\left(\frac{45\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times ET_{rec-c}\left(\frac{1\ hrs}{day}\right)\times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{AT_{rec-c}\left(\frac{365\ days}{yr}\times ED_{rec-c}(6\ yr)\right)\times BW_{rec-c}(15\ kg)}$$

Noncarcinogenic Child Surface Water Dermal (CDI)

$$CDI_{rec-wat-dernc}\left(\frac{mg}{kg-day}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{rec-c}\left(\frac{45\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times EV_{rec-c}\left(\frac{1\ event}{day}\right)\times SA_{rec-c}\left(6,365\ cm^2\right)}{AT_{rec-c}\left(\frac{365\ days}{yr}\times ED_{rec-c}(6\ yr)\right)\times BW_{rec-c}(15\ kg)}$$

where:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times K_p\left(\frac{cm}{hr}\right)\times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)$$

For Organics:

IF $ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\leq t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times 2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)}{\pi}}$$

or:

IF $ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)>t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

Noncarcinogenic Adult Surface Water Ingestion (CDI)

$$CDI_{rec-wat-ingna}\left(\frac{mg}{kg-day}\right)=\frac{C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{rec-a}\left(\frac{45\ days}{yr}\right)\times ED_{rec}(26\ yr)\times ET_{rec-a}\left(\frac{1\ hrs}{day}\right)\times IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right)}{AT_{rec-a}\left(\frac{365\ days}{yr}\times ED_{rec}(26\ yr)\right)\times BW_{rec-a}(80\ kg)}$$

Noncarcinogenic Adult Surface Water Dermal (CDI)

$$CDI_{rec-wat-derna}\left(\frac{mg}{kg-day}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times EF_{rec-a}\left(\frac{.\ days}{yr}\right) \times ED_{rec}(26\ yr) \times EV_{rec-a}\left(\frac{.\ event}{day}\right) \times SA_{rec-a}\left(19,652\ cm^2\right)}{AT_{rec-a}\left(\frac{365\ days}{yr} \times ED_{rec}(26\ yr)\right) \times BW_{rec-a}(80\ kg)}$$

where:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times K_p\left(\frac{cm}{hr}\right) \times ET_{event-rec-a}\left(\frac{.\ hrs}{event}\right)$$

For Organics:

IF $ET_{event-rec-a}\left(\frac{.\ hrs}{event}\right) \leq t^*\,(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times 2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-rec-a}\left(\frac{.\ hrs}{event}\right)}{\pi}}$$

or:

IF $ET_{event-rec-a}\left(\frac{.\ hrs}{event}\right) > t^*\,(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-rec-a}\left(\frac{.\ hrs}{event}\right)}{1 + B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1 + 3B + 3B^2}{(1 + B)^2}\right)\right]$$

Noncarcinogenic Age-adjusted Surface Water Ingestion (CDI)

$$CDI_{rec-wat-ingnadj}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right)}{AT_{rec-a}\left(\frac{365\ days}{yr} \times ED_{rec}(26\ yr)\right)}$$

where:

$$IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Noncarcinogenic Age-adjusted Surface Water Dermal (CDI)

$$CDI_{rec-wat-dernadj}\left(\frac{mg}{kg-day}\right) = \frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right)}{AT_{rec-a}\left(\frac{365\ days}{yr} \times ED_{rec}(26\ yr)\right)}$$

where:

$$DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right) = \left(\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times SA_{rec-a}\left(19,652\ cm^2\right)}{BW_{rec-a}(80\ kg)}\right)$$

and:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times K_p\left(\frac{cm}{hr}\right) \times ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)$$

For Organics:

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) \le t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times 2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{\pi}}$$

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) > t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

$$ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) = \left(\frac{\left(ED_{rec-c}(6\ yr) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\right) + \left(ED_{rec-a}(20\ yr) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)\right)}{ED_{rec}(26\ yr)}\right)$$

Carcinogenic Surface Water Ingestion (CDI)

$$CDI_{rec-wat-ingc}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{BW_{rec-c}(15\ kg)} + \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Carcinogenic Surface Water Dermal (CDI)

$$CDI_{rec-wat-derc}\left(\frac{mg}{kg-day}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

where:

$$DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right)=\left(\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times EV_{rec-c}\left(\frac{1\ event}{day}\right)\times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}(15\ kg)}+\frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right)\times ED_{rec-a}(20\ yr)\times EV_{rec-a}\left(\frac{1\ event}{day}\right)\times SA_{rec-a}\left(19,652\ cm^2\right)}{BW_{rec-a}(80\ kg)}\right)$$

and:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times K_p\left(\frac{cm}{hr}\right)\times ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)$$

For Organics:

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)\leq t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times 2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{\pi}}$$

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)>t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

$$ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)=\left(\frac{\left(ED_{rec-c}(6\ yr)\times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\right)+\left(ED_{rec-a}(20\ yr)\times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)\right)}{ED_{rec}(26\ yr)}\right)$$

Mutagenic Surface Water Ingestion (CDI)

$$CDI_{rec-wat-ingmu}\left(\frac{mg}{kg-day}\right)=\frac{C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times IFWM_{rec-adj}\left(\frac{14\ L}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

where:

$$IFWM_{rec-adj}\left(\frac{14\ L}{kg}\right)=\left[\begin{array}{c}\frac{EF_{0-2}\left(\frac{45\ days}{yr}\right)\times ED_{0-2}(2\ yr)\times EV_{0-2}\left(\frac{1\ event}{day}\right)\times ET_{event-(0-2)}\left(\frac{1\ hrs}{event}\right)\times IRW_{0-2}\left(\frac{0.12\ L}{hr}\right)\times 10}{BW_{0-2}(15\ kg)}+\\ \frac{EF_{2-6}\left(\frac{45\ days}{yr}\right)\times ED_{2-6}(4\ yr)\times EV_{2-6}\left(\frac{1\ event}{day}\right)\times ET_{event-(2-6)}\left(\frac{1\ hrs}{event}\right)\times IRW_{2-6}\left(\frac{0.12\ L}{hr}\right)\times 3}{BW_{2-6}(15\ kg)}+\\ \frac{EF_{6-16}\left(\frac{45\ days}{yr}\right)\times ED_{6-16}(10\ yr)\times EV_{6-16}\left(\frac{1\ event}{day}\right)\times ET_{event-(6-16)}\left(\frac{1\ hrs}{event}\right)\times IRW_{6-16}\left(\frac{0.124\ L}{hr}\right)\times 3}{BW_{6-16}(80\ kg)}+\\ \frac{EF_{16-26}\left(\frac{45\ days}{yr}\right)\times ED_{16-26}(10\ yr)\times EV_{16-26}\left(\frac{1\ event}{day}\right)\times ET_{event-(16-26)}\left(\frac{1\ hrs}{event}\right)\times IRW_{16-26}\left(\frac{0.098\ L}{hr}\right)\times 1}{BW_{16-26}(80\ kg)}\end{array}\right]$$

Mutagenic Surface Water Dermal (CDI)

$$CDI_{rec\text{-}wat\text{-}dermu}\left(\frac{mg}{kg-day}\right)=\frac{DA_{event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times DFWM_{rec\text{-}adj}\left(\frac{1,053,210\ cm^2-event}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

where:

$$DFWM_{rec\text{-}adj}\left(\frac{1,053,210\ cm^2-event}{kg}\right)=\left(\begin{array}{c}\frac{EF_{0-2}\left(\frac{45\ days}{yr}\right)\times ED_{0-2}(2\ yr)\times EV_{0-2}\left(\frac{1\ event}{day}\right)\times SA_{0-2}\left(6,365\ cm^2\right)\times 10}{BW_{0-2}(15\ kg)}+\\ \frac{EF_{2-6}\left(\frac{45\ days}{yr}\right)\times ED_{2-6}(4\ yr)\times EV_{2-6}\left(\frac{1\ event}{day}\right)\times SA_{2-6}\left(6,365\ cm^2\right)\times 3}{BW_{2-6}(15\ kg)}+\\ \frac{EF_{6-16}\left(\frac{45\ days}{yr}\right)\times ED_{6-16}(10\ yr)\times EV_{6-16}\left(\frac{1\ event}{day}\right)\times SA_{6-16}\left(19,652\ cm^2\right)\times 3}{BW_{6-16}(80\ kg)}+\\ \frac{EF_{16-26}\left(\frac{45\ days}{yr}\right)\times ED_{16-26}(10\ yr)\times EV_{16-26}\left(\frac{1\ event}{day}\right)\times SA_{16-26}\left(19,652\ cm^2\right)\times 1}{BW_{16-26}(80\ kg)}\end{array}\right)$$

and:

For Inorganics:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times K_p\left(\frac{cm}{hr}\right)\times ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)$$

For Organics:

IF $ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)\leq t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times 2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)}{\pi}}$$

or:

IF $ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)>t^*(hrs)$, then:

$$DA_{event}\left(\frac{\mu g}{cm^2-event}\right)=C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

$$ET_{event\text{-}rec\text{-}madj}\left(\frac{1\ hrs}{event}\right)=\frac{\left(\begin{array}{c}\left(ED_{0-2}(2\ yr)\times ET_{event\text{-}(0-2)}\left(\frac{1\ hrs}{event}\right)\right)+\left(ED_{2-6}(4\ yr)\times ET_{event\text{-}(2-6)}\left(\frac{1\ hrs}{event}\right)\right)+\\ \left(ED_{6-16}(10\ yr)\times ET_{event\text{-}(6-16)}\left(\frac{1\ hrs}{event}\right)\right)+\left(ED_{16-26}(10\ yr)\times ET_{event\text{-}(16-26)}\left(\frac{1\ hrs}{event}\right)\right)\end{array}\right)}{ED_{0-2}(2\ yr)+ED_{2-6}(4\ yr)+ED_{6-16}(10\ yr)+ED_{16-26}(10\ yr)}$$

Vinyl Chloride Surface Water Ingestion (CDI)

$$CDI_{rec-wat-ingvc}\left(\frac{mg}{kg-day}\right) = C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\left(\left(\frac{IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}\right)+\left(\frac{EV_{rec-c}\left(\frac{1\ event}{day}\right)\times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{BW_{rec-c}(15\ kg)}\right)\right)$$

where:

$$IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right) = \left[\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times EV_{rec-c}\left(\frac{1\ event}{day}\right)\times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{BW_{rec-c}(15\ kg)}+\frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right)\times ED_{rec-a}(20\ yr)\times EV_{rec-a}\left(\frac{1\ event}{day}\right)\times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)\times IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right)}{BW_{rec-a}(80\ kg)}\right]$$

Vinyl Chloride Surface Water Dermal (CDI)

$$CDI_{rec-wat-dervc}\left(\frac{mg}{kg-day}\right) = DA_{vc-event}\left(\frac{\mu g}{cm^2-event}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times\left(\left(\frac{DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right)}{AT_{rec}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}\right)+\left(\frac{EV_{rec-c}\left(\frac{1\ event}{day}\right)\times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}(15\ kg)}\right)\right)$$

where:

$$DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right) = \left(\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right)\times ED_{rec-c}(6\ yr)\times EV_{rec-c}\left(\frac{1\ event}{day}\right)\times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}(15\ kg)}+\frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right)\times ED_{rec-a}(20\ yr)\times EV_{rec-a}\left(\frac{1\ event}{day}\right)\times SA_{rec-a}\left(19,652\ cm^2\right)}{BW_{rec-a}(80\ kg)}\right)$$

and:

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)\leq t^*(hrs)$, then:

$$DA_{vc-event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times 2\times FA\times K_p\left(\frac{cm}{hr}\right)\times\sqrt{\frac{6\times\tau_{event}\left(\frac{hrs}{event}\right)\times ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{\pi}}$$

or:

IF $ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) > t^*(hrs)$, then:

$$DA_{vc-event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{L}{1000\ cm^3}\right)\times FA\times K_p\left(\frac{cm}{hr}\right)\times\left[\frac{ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right)}{1+B}+2\times\tau_{event}\left(\frac{hrs}{event}\right)\times\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

$$ET_{event-rec-adj}\left(\frac{1\ hrs}{event}\right) = \left(\frac{\left(ED_{rec-c}(6\ yr)\times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\right)+\left(ED_{rec-a}(20\ yr)\times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)\right)}{ED_{rec}(26\ yr)}\right)$$

Trichloroethylene Surface Water Ingestion (CDI)

$$CDI_{rec-wat-ingtce}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left(\begin{array}{l}\left(CAF_o(0.804) \times IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right)\right) + \\ \left(MAF_o(0.202) \times IFWM_{rec-adj}\left(\frac{14\ L}{kg}\right)\right)\end{array}\right)}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFW_{rec-adj}\left(\frac{3.4\ L}{kg}\right) = \left[\begin{array}{l}\dfrac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-c}\left(\frac{0.12\ L}{hr}\right)}{BW_{rec-c}(15\ kg)} + \\ \dfrac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right)}{BW_{rec-a}(80\ kg)}\end{array}\right]$$

and:

$$IFWM_{rec-adj}\left(\frac{14\ L}{kg}\right) = \left[\begin{array}{l}\dfrac{EF_{0-2}\left(\frac{45\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times EV_{0-2}\left(\frac{1\ event}{day}\right) \times ET_{event-(0-2)}\left(\frac{1\ hrs}{event}\right) \times IRW_{0-2}\left(\frac{0.12\ L}{hr}\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \dfrac{EF_{2-6}\left(\frac{45\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times EV_{2-6}\left(\frac{1\ event}{day}\right) \times ET_{event-(2-6)}\left(\frac{1\ hrs}{event}\right) \times IRW_{2-6}\left(\frac{0.12\ L}{hr}\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \dfrac{EF_{6-16}\left(\frac{45\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times EV_{6-16}\left(\frac{1\ event}{day}\right) \times ET_{event-(6-16)}\left(\frac{1\ hrs}{event}\right) \times IRW_{6-16}\left(\frac{0.124\ L}{hr}\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \dfrac{EF_{16-26}\left(\frac{45\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times EV_{16-26}\left(\frac{1\ event}{day}\right) \times ET_{event-(16-26)}\left(\frac{1\ hrs}{event}\right) \times IRW_{16-26}\left(\frac{0.098\ L}{hr}\right) \times 1}{BW_{16-26}(80\ kg)}\end{array}\right]$$

Trichloroethylene Surface Water Dermal (CDI)

$$CDI_{rec-wat-dertce}\left(\frac{mg}{kg-day}\right) = \frac{DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left[\begin{array}{l}\left(CAF_o(0.804) \times DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right)\right) + \\ \left(MAF_o(0.202) \times DFWM_{rec-adj}\left(\frac{1,053,210\ cm^2-event}{kg}\right)\right)\end{array}\right]}{AT_{rec}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$DFW_{rec-adj}\left(\frac{335,655\ cm^2-event}{kg}\right) = \left(\begin{array}{l}\frac{EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ event}{day}\right) \times SA_{rec-c}\left(6,365\ cm^2\right)}{BW_{rec-c}(15\ kg)} + \\ \frac{EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ event}{day}\right) \times SA_{rec-a}\left(19,652\ cm^2\right)}{BW_{rec-a}(80\ kg)}\end{array}\right)$$

and:

$$DFWM_{rec-adj}\left(\frac{1,053,210\ cm^2-event}{kg}\right) = \left(\begin{array}{l}\frac{EF_{0-2}\left(\frac{45\ days}{yr}\right) \times ED_{0-2}(2\ yr) \times EV_{0-2}\left(\frac{1\ event}{day}\right) \times SA_{0-2}\left(6,365\ cm^2\right) \times 10}{BW_{0-2}(15\ kg)} + \\ \frac{EF_{2-6}\left(\frac{45\ days}{yr}\right) \times ED_{2-6}(4\ yr) \times EV_{2-6}\left(\frac{1\ event}{day}\right) \times SA_{2-6}\left(6,365\ cm^2\right) \times 3}{BW_{2-6}(15\ kg)} + \\ \frac{EF_{6-16}\left(\frac{45\ days}{yr}\right) \times ED_{6-16}(10\ yr) \times EV_{6-16}\left(\frac{1\ event}{day}\right) \times SA_{6-16}\left(19,652\ cm^2\right) \times 3}{BW_{6-16}(80\ kg)} + \\ \frac{EF_{16-26}\left(\frac{45\ days}{yr}\right) \times ED_{16-26}(10\ yr) \times EV_{16-26}\left(\frac{1\ event}{day}\right) \times SA_{16-26}\left(19,652\ cm^2\right) \times 1}{BW_{16-26}(80\ kg)}\end{array}\right)$$

and:

IF $ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right) \leq t^*(hrs)$, then:

$$DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times 2 \times FA \times K_p\left(\frac{cm}{hr}\right) \times \sqrt{\frac{6 \times \tau_{event}\left(\frac{hrs}{event}\right) \times ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right)}{\pi}}$$

or:

IF $ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right) > t^*(hrs)$, then:

$$DA_{tce-event}\left(\frac{\mu g}{cm^2-event}\right) = C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{L}{1000\ cm^3}\right) \times FA \times K_p\left(\frac{cm}{hr}\right) \times \left[\frac{ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right)}{1+B} + 2 \times \tau_{event}\left(\frac{hrs}{event}\right) \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

$$ET_{event-rec-madj}\left(\frac{1\ hrs}{event}\right) = \frac{\left(\begin{array}{l}\left(ED_{0-2}(2\ yr) \times ET_{event-(0-2)}\left(\frac{1\ hrs}{event}\right)\right) + \left(ED_{2-6}(4\ yr) \times ET_{event-(2-6)}\left(\frac{1\ hrs}{event}\right)\right) + \\ \left(ED_{6-16}(10\ yr) \times ET_{event-(6-16)}\left(\frac{1\ hrs}{event}\right)\right) + \left(ED_{16-26}(10\ yr) \times ET_{event-(16-26)}\left(\frac{1\ hrs}{event}\right)\right)\end{array}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr) + ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

Supporting Child Surface Water (CDI)

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

$$EF_{rec-c}\left(\frac{45\ \text{days}}{\text{yr}}\right) = \frac{ED_{0-2}(2\ \text{yr}) \times EF_{0-2}\left(\frac{45\ \text{days}}{\text{yr}}\right) + ED_{2-6}(4\ \text{yr}) \times EF_{2-6}\left(\frac{45\ \text{days}}{\text{yr}}\right)}{ED_{0-2}(2\ \text{yr}) + ED_{2-6}(4\ \text{yr})}$$

$$ET_{event-rec-c}\left(\frac{1\ \text{hrs}}{\text{event}}\right) = \frac{ED_{0-2}(2\ \text{yr}) \times ET_{event-rec}\left(\frac{1\ \text{hrs}}{\text{event}}\right) + ED_{2-6}(4\ \text{yr}) \times ET_{event-(2-6)}\left(\frac{1\ \text{hrs}}{\text{event}}\right)}{ED_{0-2}(2\ \text{yr}) + ED_{2-6}(4\ \text{yr})}$$

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

$$SA_{rec-c}\left(6,365\ \text{cm}^2\right) = \frac{ED_{0-2}(2\ \text{yr}) \times SA_{0-2}\left(6,365\ \text{cm}^2\right) + ED_{2-6}(4\ \text{yr}) \times SA_{2-6}\left(6,365\ \text{cm}^2\right)}{ED_{0-2}(2\ \text{yr}) + ED_{2-6}(4\ \text{yr})}$$

$$IRW_{rec-c}\left(\frac{0.12\ \text{L}}{\text{hr}}\right) = \frac{ED_{0-2}(2\ \text{yr}) \times IRW_{0-2}\left(\frac{0.12\ \text{L}}{\text{hr}}\right) + ED_{2-6}(4\ \text{yr}) \times IRW_{2-6}\left(\frac{0.12\ \text{L}}{\text{hr}}\right)}{ED_{0-2}(2\ \text{yr}) + ED_{2-6}(4\ \text{yr})}$$

Supporting Adult Surface Water (CDI)

$$BW_{rec-a}\,(80\ kg) = \frac{ED_{6-16}(10\ yr) \times BW_{6-16}\,(80\ kg) + ED_{16-26}(10\ yr) \times BW_{16-26}\,(80\ kg)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$EF_{rec-a}\left(\frac{45\ days}{yr}\right) = \frac{ED_{6-16}(10\ yr) \times EF_{6-16}\left(\frac{45\ days}{yr}\right) + ED_{16-26}(10\ yr) \times EF_{16-26}\left(\frac{45\ days}{yr}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) = \frac{ED_{6-16}(10\ yr) \times ET_{event-(6-16)}\left(\frac{1\ hrs}{event}\right) + ED_{16-26}(10\ yr) \times ET_{event-(16-26)}\left(\frac{1\ hrs}{event}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$EV_{rec-a}\left(\frac{1\ event}{day}\right) = \frac{ED_{6-16}(10\ yr) \times EV_{6-16}\left(\frac{1\ event}{day}\right) + ED_{16-26}(10\ yr) \times EV_{16-26}\left(\frac{1\ event}{day}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$SA_{rec-a}\left(19,652\ cm^2\right) = \frac{ED_{6-16}(10\ yr) \times SA_{6-16}\left(19,652\ cm^2\right) + ED_{16-26}(10\ yr) \times SA_{16-26}\left(19,652\ cm^2\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

$$IRW_{rec-a}\left(\frac{0.11\ L}{hr}\right) = \frac{ED_{6-16}(10\ yr) \times IRW_{6-16}\left(\frac{0.124\ L}{hr}\right) + ED_{16-26}(10\ yr) \times IRW_{16-26}\left(\frac{0.098\ L}{hr}\right)}{ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

Supporting Age-adjusted Surface Water (CDI)

$$EF_{rec}\left(\frac{45\ days}{yr}\right) = \frac{\left(\begin{array}{c} ED_{0-2}(2\ yr) \times EF_{0-2}\left(\frac{45\ days}{yr}\right) + ED_{2-6}(4\ yr) \times EF_{2-6}\left(\frac{45\ days}{yr}\right) + \\ ED_{6-16}(10\ yr) \times EF_{6-16}\left(\frac{45\ days}{yr}\right) + ED_{16-26}(10\ yr) \times EF_{16-26}\left(\frac{45\ days}{yr}\right) \end{array}\right)}{ED_{0-2}(2\ yr) + ED_{2-6}(4\ yr) + ED_{6-16}(10\ yr) + ED_{16-26}(10\ yr)}$$

Farmer Direct Consumption of Agricultural Products CDI Equations

Noncarcinogenic Produce Ingestion (CDI)

$$CDI_{far-prod-ingn}\left(\frac{mg}{kg-day}\right)=\frac{C_{produce}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times CF_{produce}(1)\times\left(IRF_{far-c}\left(\frac{68,100\ mg}{day}\right)+IRV_{far-c}\left(\frac{41,700\ mg}{day}\right)\right)}{AT_{far-c}\left(\frac{365\ days}{yr}\times ED_{far-c}(6\ yr)\right)\times BW_{far-c}(15\ kg)}$$

Carcinogenic Produce Ingestion (CDI)

$$CDI_{far-prod-ingc}\left(\frac{mg}{kg-day}\right)=\frac{C_{produce}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times CF_{produce}(1)\times\left(IFF_{far-adj}\left(\frac{35,833,000\ mg}{kg}\right)+IFV_{far-adj}\left(\frac{24,535,875\ mg}{kg}\right)\right)}{AT_{far}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

where:

$$IFF_{far-adj}\left(\frac{35,833,000\ mg}{kg}\right)=\left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times IRF_{far-c}\left(\frac{68,100\ mg}{day}\right)}{BW_{far-c}(15\ kg)}+\frac{EF_{far-a}\left(\frac{350\ days}{yr}\right)\times ED_{far-a}(34\ yr)\times IRF_{far-a}\left(\frac{176,800\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

and:

$$IFV_{far-adj}\left(\frac{24,535,875\ mg}{kg}\right)=\left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times IRV_{far-c}\left(\frac{41,700\ mg}{day}\right)}{BW_{far-c}(15\ kg)}+\frac{EF_{far-a}\left(\frac{350\ days}{yr}\right)\times ED_{far-a}(34\ yr)\times IRV_{far-a}\left(\frac{125,700\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

Noncarcinogenic Dairy Ingestion (CDI)

$$CDI_{far-dairy-ingn}\left(\frac{mg}{kg-day}\right)=\frac{C_{dairy}\left(\frac{mg}{kg}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times CF_{dairy}(1)\times IRD_{far-c}\left(\frac{349,500\ mg}{day}\right)}{AT_{far-c}\left(\frac{365\ days}{yr}\times ED_{far-c}(6\ yr)\right)\times BW_{far-c}(15\ kg)}$$

Carcinogenic Dairy Ingestion (CDI)

$$CDI_{far-dairy-ingc}\left(\frac{mg}{kg-day}\right) = \frac{C_{dairy}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times CF_{dairy}(1) \times IFD_{far-adj}\left(\frac{115,213,000\ mg}{kg}\right)}{AT_{far}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFD_{far-adj}\left(\frac{115,213,000\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRD_{far-c}\left(\frac{349,500\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRD_{far-a}\left(\frac{445,600\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

Noncarcinogenic Beef Ingestion (CDI)

$$CDI_{far-beef-ingn}\left(\frac{mg}{kg-day}\right) = \frac{C_{beef}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times CF_{beef}(1) \times IRB_{far-c}\left(\frac{40,100\ mg}{day}\right)}{AT_{far-c}\left(\frac{365\ days}{yr} \times ED_{far-c}(6\ yr)\right) \times BW_{far-c}(15\ kg)}$$

Carcinogenic Beef Ingestion (CDI)

$$CDI_{far-beef-ingc}\left(\frac{mg}{kg-day}\right) = \frac{C_{beef}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times CF_{beef}(1) \times IFB_{far-adj}\left(\frac{32,091,500\ mg}{kg}\right)}{AT_{far}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFB_{far-adj}\left(\frac{32,091,500\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRB_{far-c}\left(\frac{40,100\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRB_{far-a}\left(\frac{178,000\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

Farmer Direct Consumption of Agricultural Products - Back-calculated to Water CDI Equations

Noncarcinogenic Produce Ingestion Water (CDI)

$$CDI_{far-wat-ing-prodn}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times CF_{produce}(1) \times \left(IRF_{far-c}\left(\frac{68,100\ mg}{day}\right) + IRV_{far-c}\left(\frac{41,700\ mg}{day}\right)\right)}{AT_{far-c}\left(\frac{365\ days}{yr} \times ED_{far-c}(6\ yr)\right) \times BW_{far-c}(15\ kg)}$$

where:

$$Irr_{rup}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times BV_{wet} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{res}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times MLF_{produce} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{dep}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times I_f \times T \times \left[1 - \exp\left(\left(\frac{\lambda_E}{day}\right) \times t_v\ (days)\right)\right]}{Y_v\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_E}{day}\right)}$$

Carcinogenic Produce Ingestion Water (CDI)

$$CDI_{far-wat-ing-prodc}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times \left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times CF_{produce}(1) \times \left(IFF_{far-adj}\left(\frac{35,833,000\ mg}{kg}\right) + IFV_{far-adj}\left(\frac{24,535,875\ mg}{kg}\right)\right)}{AT_{far}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFF_{far-adj}\left(\frac{35,833,000\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68,100\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176,800\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

and:

$$IFV_{far-adj}\left(\frac{24,535,875\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41,700\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125,700\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

and:

$$Irr_{rup}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times BV_{wet} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{res}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times MLF_{produce} \times \left[1 - \exp\left(\left(\frac{\lambda_B}{day}\right) \times t_b\ (days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{dep}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times I_f \times T \times \left[1 - \exp\left(\left(\frac{\lambda_E}{day}\right) \times t_v\ (days)\right)\right]}{Y_v\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_E}{day}\right)}$$

Noncarcinogenic Dairy Ingestion Water (CDI)

$$CDI_{far-wat-ing-dairyn}\left(\frac{mg}{kg-day}\right)=\frac{\begin{array}{r}C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times CF_{dairy}(1)\times\\ IRD_{far-c}\left(\frac{349{,}500\ mg}{day}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times TF_{dairy}\left(\frac{day}{kg}\right)\times Q_{w-dairy}\left(\frac{92\ L}{day}\right)\end{array}}{AT_{far-c}\left(\frac{365\ days}{yr}\times ED_{far-c}(6\ yr)\right)\times BW_{far-c}(15\ kg)}$$

Carcinogenic Dairy Ingestion Water (CDI)

$$CDI_{far-wat-ing-dairyc}\left(\frac{mg}{kg-day}\right)=\frac{\begin{array}{r}C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times CF_{dairy}(1)\times IFD_{far-adj}\left(\frac{115{,}213{,}000\ mg}{kg}\right)\times\\ \left(\frac{10^{-6}\ kg}{mg}\right)\times TF_{dairy}\left(\frac{day}{kg}\right)\times Q_{w-dairy}\left(\frac{92\ L}{day}\right)\end{array}}{AT_{far}\left(\frac{365\ days}{yr}\times LT(70\ yrs)\right)}$$

where:

$$IFD_{far-adj}\left(\frac{115{,}213{,}000\ mg}{kg}\right)=\left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times IRD_{far-c}\left(\frac{349{,}500\ mg}{day}\right)}{BW_{far-c}(15\ kg)}+\frac{EF_{far-a}\left(\frac{350\ days}{yr}\right)\times ED_{far-a}(34\ yr)\times IRD_{far-a}\left(\frac{445{,}600\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

Noncarcinogenic Beef Ingestion Water (CDI)

$$CDI_{far-wat-ing-beefn}\left(\frac{mg}{kg-day}\right)=\frac{\begin{array}{r}C_{water}\left(\frac{\mu g}{L}\right)\times\left(\frac{mg}{1000\ \mu g}\right)\times EF_{far-c}\left(\frac{350\ days}{yr}\right)\times ED_{far-c}(6\ yr)\times CF_{beef}(1)\times\\ IRB_{far-c}\left(\frac{40{,}100\ mg}{day}\right)\times\left(\frac{10^{-6}\ kg}{mg}\right)\times TF_{beef}\left(\frac{day}{kg}\right)\times Q_{w-beef}\left(\frac{53\ L}{day}\right)\end{array}}{AT_{far-c}\left(\frac{365\ days}{yr}\times ED_{far-c}(6\ yr)\right)\times BW_{far-c}(15\ kg)}$$

Carcinogenic Beef Ingestion Water (CDI)

$$CDI_{far-wat-ing-beefc}\left(\frac{mg}{kg-day}\right) = \frac{C_{water}\left(\frac{\mu g}{L}\right) \times \left(\frac{mg}{1000\ \mu g}\right) \times CF_{beef}(1) \times IFB_{far-adj}\left(\frac{32,091,500\ mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times TF_{beef}\left(\frac{day}{kg}\right) \times Q_{w-beef}\left(\frac{53\ L}{day}\right)}{AT_{far}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFB_{far-adj}\left(\frac{32,091,500\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRB_{far-c}\left(\frac{40,100\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRB_{far-a}\left(\frac{178,000\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

Farmer Direct Consumption of Agricultural Products - Back-calculated to Soil CDI Equations

Noncarcinogenic Produce Ingestion Soil (CDI)

$$CDI_{far-sol-ing-prodn}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times CF_{produce}(1) \times (R_{upv} + R_{es}) \times \left(IRF_{far-c}\left(\frac{68,100\ mg}{day}\right) + IRV_{far-c}\left(\frac{41,700\ mg}{day}\right)\right)}{AT_{far-c}\left(\frac{365\ days}{yr} \times ED_{far-c}(6\ yr)\right) \times BW_{far-c}(15\ kg)}$$

where:

$R_{upv} = BV_{wet}$; $R_{es} = MLF_{produce}(0.0135)$

Carcinogenic Produce Ingestion Soil (CDI)

$$CDI_{far\text{-}sol\text{-}ing\text{-}prodc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times CF_{produce}(1) \times \left(R_{upv} + R_{es}\right) \times \left(IFF_{far\text{-}adj}\left(\frac{35,833,000\ mg}{kg}\right) + IFV_{far\text{-}adj}\left(\frac{24,535,875\ mg}{kg}\right)\right)}{AT_{far}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFF_{far\text{-}adj}\left(\frac{35,833,000\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68,100\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176,800\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

and:

$$IFV_{far\text{-}adj}\left(\frac{24,535,875\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41,700\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125,700\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

and:

$$R_{upv} = BV_{wet}\ ;\ R_{es} = MLF_{produce}(0.0135)$$

Noncarcinogenic Dairy Ingestion Soil (CDI)

$$CDI_{far\text{-}sol\text{-}ing\text{-}dairyn}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times CF_{dairy}(1) \times IRD_{far-c}\left(\frac{349,500\ mg}{day}\right) \times \left\{TF_{dairy}\left(\frac{day}{kg}\right) \times \left[\left(Q_{p\text{-}dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p\text{-}dairy}(1) \times f_{s\text{-}dairy}(1) \times \left(R_{upp} + R_{es}\right)\right) + \left(Q_{s\text{-}dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p\text{-}dairy}(1)\right)\right]\right\}}{AT_{far-c}\left(\frac{365\ days}{yr} \times ED_{far-c}(6\ yr)\right) \times BW_{far-c}(15\ kg)}$$

where:

$$R_{upp} = BV_{dry}\ ;\ R_{es} = MLF_{pasture}(0.25)$$

Carcinogenic Dairy Ingestion Soil (CDI)

$$CDI_{far-sol-ing-dairyc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times CF_{dairy}(1) \times IFD_{far-adj}\left(\frac{115{,}213{,}000\ mg}{kg}\right) \times \left\{TF_{dairy}\left(\frac{day}{kg}\right) \times \left[\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times (R_{upp} + R_{es})\right) + \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)\right]\right\}}{AT_{far}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFD_{far-adj}\left(\frac{115{,}213{,}000\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRD_{far-c}\left(\frac{349{,}500\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRD_{far-a}\left(\frac{445{,}600\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

and:

$R_{upp} = BV_{dry}$; $R_{es} = MLF_{pasture}(0.25)$

Noncarcinogenic Beef Ingestion Soil (CDI)

$$CDI_{far-sol-ing-beefn}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times CF_{beef}(1) \times IRB_{far-c}\left(\frac{40{,}100\ mg}{day}\right) \times \left\{TF_{beef}\left(\frac{day}{kg}\right) \times \left[\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times (R_{upp} + R_{es})\right) + \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\right]\right\}}{AT_{far-c}\left(\frac{365\ days}{yr} \times ED_{far-c}(6\ yr)\right) \times BW_{far-c}(15\ kg)}$$

where:

$R_{upp} = BV_{dry}$; $R_{es} = MLF_{pasture}(0.25)$

Carcinogenic Beef Ingestion Soil (CDI)

$$CDI_{far-sol-ing-beefc}\left(\frac{mg}{kg-day}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{10^{-6}\ kg}{mg}\right) \times CF_{beef}(1) \times IFB_{far-adj}\left(\frac{32,091,500\ mg}{kg}\right) \times \left\{TF_{beef}\left(\frac{day}{kg}\right) \times \left[\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times (R_{upp} + R_{es})\right) + \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\right]\right\}}{AT_{far}\left(\frac{365\ days}{yr} \times LT(70\ yrs)\right)}$$

where:

$$IFB_{far-adj}\left(\frac{32,091,500\ mg}{kg}\right) = \left[\frac{EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRB_{far-c}\left(\frac{40,100\ mg}{day}\right)}{BW_{far-c}(15\ kg)} + \frac{EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRB_{far-a}\left(\frac{178,000\ mg}{day}\right)}{BW_{far-a}(80\ kg)}\right]$$

and:

$$R_{upp} = BV_{dry}\ ;\ R_{es} = MLF_{pasture}(0.25)$$

Soil to Groundwater CDI Equations

Method 1: Concentration in Groundwater from Concentration in Soil

$$C_{water}\left(\frac{\mu g}{L}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{1{,}000\ \mu g}{mg}\right)}{\left[K_d\left(\frac{L}{kg}\right) + \left(\frac{\theta_w\left(\frac{0.3\ L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{0.13\ L_{air}}{L_{soil}}\right) \times H'}{\rho_b\left(\frac{1.5\ kg}{L}\right)}\right)\right] \times DAF}$$

where:

$$\theta_a\left(\frac{0.13\ L_{air}}{L_{soil}}\right) = n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) - \theta_w\left(\frac{0.3\ L_{water}}{L_{soil}}\right);\ n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) = 1 - \frac{\rho_b\left(\frac{1.5\ kg}{L}\right)}{\rho_s\left(\frac{2.65\ kg}{L}\right)}$$

and:

$K_d\left(\frac{L}{kg}\right) = f_{oc}\left(\frac{0.002\ g-carbon}{g-soil}\right) \times K_{oc}\left(\frac{L}{kg}\right)$, for organic compounds;

$K_d\left(\frac{L}{kg}\right)$ values for inorganic compounds are listed in the user guide.

Method 2: Concentration in Groundwater from Concentration in Soil

$$C_{water}\left(\frac{\mu g}{L}\right) = \frac{C_{soil}\left(\frac{mg}{kg}\right) \times \left(\frac{1000\ \mu g}{mg}\right) \times \rho_b\left(\frac{1.5\ kg}{L}\right) \times d_s\left(\frac{mg}{kg}\right)}{I\left(\frac{0.18\ m}{yr}\right) \times ED(70\ yr) \times DAF}$$

APPENDIX E. TABLES OF RECOMMENDED DEFAULT EXPOSURE PARAMETERS FOR RADIONUCLIDE PRG CALCULATOR

APPENDIX E. TABLES OF RECOMMENDED DEFAULT EXPOSURE PARAMETERS FOR RADIONUCLIDE PRG CALCULATOR

Table E-1. Slope Factors (SFs)

Symbol	Definition (units)	Default	Reference
SF_s	Soil Ingestion Slope Factor - population (risk/pCi)	Isotope-specific	ORNL 2014c
SF_{sa}	Soil Ingestion Slope Factor - adult only (risk/pCi)	Isotope-specific	ORNL 2014c
SF_f	Food Ingestion Slope Factor (risk/pCi)	Isotope-specific	ORNL 2014c
SF_w	Water Ingestion Slope Factor (risk/pCi)	Isotope-specific	ORNL 2014c
SF_i	Slope Factor - inhalation (risk/pCi)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}sv}$	Slope Factor - external exposure (risk/yr per pCi/g)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}1cm}$	Slope Factor - external exposure (risk/yr per pCi/g)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}5cm}$	Slope Factor - external exposure (risk/yr per pCi/g)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}15cm}$	Slope Factor - external exposure (risk/yr per pCi/g)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}gp}$	Slope Factor - external exposure (risk/yr per pCi/cm^2)	Isotope-specific	ORNL 2014c
SF_{sub}	Slope Factor - submersion (risk/yr per pCi/cm^3)	Isotope-specific	ORNL 2014c
SF_{imm}	Slope Factor - immersion (risk/yr per pCi/L)	Isotope-specific	ORNL 2014c

Table E-2. Miscellaneous Variables

Symbol	Definition (units)	Default	Reference
TR	Target Risk	1×10^{-6}	U.S. EPA 1991b
λ	Decay constant = 0.693/half-life (year^{-1}) where 0.693 = ln(2)	Isotope-specific	Developed for Radionuclide Soil Screening calculator
K	Andelman Volatilization Factor (L/m^3)	0.5	U.S. EPA 1991b (pg. 20)
$ACF_{ext\text{-}sv}$	Area Correction Factor - soil volume (unitless)	Isotope-specific	ORNL 2014a
$ACF_{ext\text{-}1cm}$	Area Correction Factor – 1 cm (unitless)	Isotope-specific	ORNL 2014a
$ACF_{ext\text{-}5cm}$	Area Correction Factor – 5 cm (unitless)	Isotope-specific	ORNL 2014a
$ACF_{ext\text{-}15cm}$	Area Correction Factor – 15 cm (unitless)	Isotope-specific	ORNL 2014a
$ACF_{ext\text{-}gp}$	Area Correction Factor - ground plane (unitless)	Isotope-specific	ORNL 2014a
GSF_i	Gamma Shielding Factor - Indoor (unitless)	0.4	U.S. EPA 2000a. (pg. 2-22). U.S. EPA 2000b. (pg. 2-18)
$GSF_{ext\text{-}sv}$	Gamma Shielding Factor - soil volume (unitless)	Isotope-specific	ORNL 2014a
$GSF_{ext\text{-}1cm}$	Gamma Shielding Factor – 1 cm (unitless)	Isotope-specific	ORNL 2014b
$GSF_{ext\text{-}5cm}$	Gamma Shielding Factor – 5 cm (unitless)	Isotope-specific	ORNL 2014b
$GSF_{ext\text{-}15cm}$	Gamma Shielding Factor – 15 cm (unitless)	Isotope-specific	ORNL 2014b
$GSF_{ext\text{-}gp}$	Gamma Shielding Factor - ground plane (unitless)	Isotope-specific	ORNL 2014b
GSF_a	Gamma Shielding Factor - Air (unitless)	1	Developed for Radionuclide Soil Screening calculator

Table E-3. Resident Soil

Symbol	Definition (units)	Default	Reference
$PRG_{res\text{-}soil\text{-}ing}$	Resident Soil Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}soil\text{-}inh}$	Resident Soil Radionuclide Inhalation (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}soil\text{-}ext}$	Resident Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}soil\text{-}produce\text{-}ing}$	Resident Soil Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}produce\text{-}ing}$	Resident Produce Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}soil\text{-}tot}$	Resident Soil Radionuclide Total (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}soil\text{-}sv}$	Resident Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}soil\text{-}1cm}$	Resident Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}soil\text{-}5cm}$	Resident Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}soil\text{-}15cm}$	Resident Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}soil\text{-}gp}$	Resident Soil Radionuclide External (pCi/cm^2)	Contaminant-specific	Determined in this calculator
t_{res}	Time - resident (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$CF_{res\text{-}produce}$	Produce Contaminated Fraction - resident (unitless)	0.25	U.S. EPA 1990. U.S. EPA. 1998. (pg. C-9)
Bv_{wet}	Soil to Plant Transfer Factor - wet (pCi/g-fresh plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
R_{upv}	Wet root uptake for produce multiplier (unitless)	Radionuclide-specific (=Bv_{wet})	Hierarchy selection in Section 2.3.2
R_{es}	Soil resuspension multiplier (dimensionless)	=MLF (pasture or produce)	Hinton 1992
$IFS_{res\text{-}adj}$	Resident Ingestion Fraction - age-adjusted (mg)	1,120,000	Calculated using the age-adjusted intake factors equation.
$IRS_{res\text{-}a}$	Resident Soil Ingestion Rate - adult (mg/day)	100	U.S. EPA 1991a (pg. 15)
$IRS_{res\text{-}c}$	Resident Soil Ingestion Rate - child (mg/day)	200	U.S. EPA 1991a (pg. 15)
$IFA_{res\text{-}adj}$	Resident Inhalation Rate - age-adjusted (m^3)	161,100	Calculated using the age-adjusted intake factors equation.
$IRA_{res\text{-}a}$	Resident Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
$IRA_{res\text{-}c}$	Resident Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
$IFV_{res\text{-}adj}$	Resident Vegetable Ingestion Fraction - age-adjusted (g)	989,870	Calculated using the age-adjusted intake factors equation
$IRV_{res\text{-}a}$	Resident Vegetable Ingestion Rate - adult (g/day)	128.9	U.S. EPA 2011 (Table 13-10)

Table E-3. Resident Soil

Symbol	Definition (units)	Default	Reference
IRV_{res-c}	Resident Vegetable Ingestion Rate - child (g/day)	41.7	U.S. EPA 2011 (Table 13-10)
$IFF_{res-adj}$	Resident Fruit Ingestion Fraction - age-adjusted (g)	1,462,510	Calculated using the age-adjusted intake factors equation
IRF_{res-a}	Resident Fruit Ingestion Rate - adult (g/day)	188.5	U.S. EPA 2011 (Table 13-5)
IRF_{res-c}	Resident Fruit Ingestion Rate - child (g/day)	68.1	U.S. EPA 2011 (Table 13-5)
EF_{res}	Resident Exposure Frequency - (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{res-a}	Resident Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{res-c}	Resident Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{res}	Resident Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
ED_{res-a}	Resident Exposure Duration - adult (years)	20	ED_{res} (26 years) - ED_{res-c} (6 years)
ED_{res-c}	Resident Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
ET_{res}	Resident Exposure Time (hours/day)	24	24 Hours per 24 hour Day
ET_{res-a}	Resident Exposure Time - adult (hours/day)	24	24 Hours per 24 hour Day
ET_{res-c}	Resident Exposure Time - child (hours/day)	24	24 Hours per 24 hour Day
ET_{res-i}	Resident Exposure Time - indoor (hours/day)	16.416	U.S. EPA 2011 (Table 16-16 50^{th}%)
ET_{res-o}	Resident Exposure Time - outdoor (hours/day)	1.752	U.S. EPA 2011 (Table 16-20 50^{th}%))

Table E-4. Indoor Worker Soil

Symbol	Definition (units)	Default	Reference
$PRG_{iw\text{-}soil\text{-}ing}$	Indoor Worker Soil Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}soil\text{-}inh}$	Indoor Worker Soil Radionuclide Inhalation (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}soil\text{-}ext}$	Indoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}soil\text{-}tot}$	Indoor Worker Soil Radionuclide Total (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}soil\text{-}sv}$	Indoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}soil\text{-}1cm}$	Indoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}soil\text{-}5cm}$	Indoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}soil\text{-}15cm}$	Indoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}soil\text{-}gp}$	Indoor Worker Soil Radionuclide External (pCi/cm^2)	Contaminant-specific	Determined in this calculator
t_{iw}	Time - indoor worker (years)	25	U.S. EPA 1991a (pg. 15)
IRS_{iw}	Indoor Worker Soil Ingestion Rate (mg/day)	50	U.S. EPA 2001 (pg. 4-3)
IRA_{iw}	Indoor Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{iw}	Indoor Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_{iw}	Indoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{iw}	Indoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-5. Outdoor Worker Soil

Symbol	Definition (units)	Default	Reference
$PRG_{ow\text{-}soil\text{-}ing}$	Outdoor Worker Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}soil\text{-}inh}$	Outdoor Worker Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}soil\text{-}ext}$	Outdoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}soil\text{-}tot}$	Outdoor Worker Soil Radionuclide Total (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}soil\text{-}sv}$	Outdoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}soil\text{-}1cm}$	Outdoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}soil\text{-}5cm}$	Outdoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}soil\text{-}15cm}$	Outdoor Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}soil\text{-}gp}$	Outdoor Worker Soil Radionuclide External (pCi/cm^2)	Contaminant-specific	Determined in this calculator
t_{ow}	Time - outdoor worker (years)	25	U.S. EPA 1991a (pg. 15)
IRS_{ow}	Outdoor Worker Soil Ingestion Rate (mg/day)	100	U.S. EPA 1991a (pg. 15)
IRA_{ow}	Outdoor Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{ow}	Outdoor Worker Exposure Frequency (days/year)	225	U.S. EPA 1991a (pg. 15)
ED_{ow}	Outdoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{ow}	Outdoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-6. Composite Worker Soil

Symbol	Definition (units)	Default	Reference
$PRG_{w\text{-}soil\text{-}ing}$	Composite Worker Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}soil\text{-}inh}$	Composite Worker Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}soil\text{-}ext}$	Composite Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}soil\text{-}tot}$	Composite Worker Soil Radionuclide Total (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}soil\text{-}sv}$	Composite Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}soil\text{-}1cm}$	Composite Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}soil\text{-}5cm}$	Composite Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}soil\text{-}15cm}$	Composite Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}soil\text{-}gp}$	Composite Worker Soil Radionuclide External (pCi/cm^2)	Contaminant-specific	Determined in this calculator
t_w	Time - worker (years)	25	U.S. EPA 1991a (pg. 15)
IRS_w	Composite Worker Soil Ingestion Rate (mg/day)	100	U.S. EPA 1991a (pg. 15)
IRA_w	Composite Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_w	Composite Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_w	Composite Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_w	Composite Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-7. Excavation Worker Soil

Symbol	Definition (units)	Default	Reference
$PRG_{ew\text{-}soil\text{-}ing}$	Excavation Worker Soil Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{ew\text{-}soil\text{-}inh}$	Excavation Worker Soil Radionuclide Inhalation (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{ew\text{-}soil\text{-}ext}$	Excavation Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{ew\text{-}soil\text{-}tot}$	Excavation Worker Soil Radionuclide Total (pCi/g)	Contaminant-specific	Determined in this calculator
t_{ew}	Time - excavation worker (years)	1	U.S. EPA 2002 Exhibit 5-1
IRS_{ew}	Excavation Worker Soil Ingestion Rate (mg/day)	330	
IRA_{ew}	Excavation Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{ew}	Excavation Worker Exposure Frequency (days/year)	20	
ED_{ew}	Excavation Worker Exposure Duration (years)	1	U.S. EPA 2002 Exhibit 5-1
$ET_{ew\text{-}o}$	Excavation Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-8. Construction Worker Soil

Symbol	Definition (units)	Default	Reference
$PRG_{cw\text{-}soil\text{-}ing}$	Construction Worker Soil Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}soil\text{-}inh}$	Construction Worker Soil Radionuclide Inhalation (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}soil\text{-}ext}$	Construction Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}soil\text{-}tot}$	Construction Worker Soil Radionuclide Total (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}soil\text{-}sv}$	Construction Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}soil\text{-}1cm}$	Construction Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}soil\text{-}5cm}$	Construction Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}soil\text{-}15cm}$	Construction Worker Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}soil\text{-}gp}$	Construction Worker Soil Radionuclide External (pCi/cm^2)	Contaminant-specific	Determined in this calculator
t_{cw}	Time - construction worker (years)	1	U.S. EPA 2002 Exhibit 5-1
IRS_{cw}	Construction Worker Soil Ingestion Rate (mg/day)	330	
IRA_{cw}	Construction Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{cw}	Construction Worker Exposure Frequency (days/year)	250	U.S. EPA 2002 Exhibit 5-1
EW_{cw}	Construction Worker Exposure Frequency (weeks/year)	50	U.S. EPA 2002 Exhibit 5-1
DW_{cw}	Construction Worker Exposure Frequency (days/week)	5	U.S. EPA 2002 Exhibit 5-1
ED_{cw}	Construction Worker Exposure Duration (years)	1	U.S. EPA 2002 Exhibit 5-1
ET_{cw}	Construction Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-9. Recreator Soil/Sediment

Symbol	Definition (units)	Default	Reference
$PRG_{rec\text{-}soil\text{-}ing}$	Recreator Soil Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}soil\text{-}inh}$	Recreator Soil Radionuclide Inhalation (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}soil\text{-}ext}$	Recreator Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}soil\text{-}tot}$	Recreator Soil Radionuclide Total (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}soil\text{-}sv}$	Recreator Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}soil\text{-}1cm}$	Recreator Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator

Table E-9. Recreator Soil/Sediment

Symbol	Definition (units)	Default	Reference
$PRG_{rec\text{-}soil\text{-}5cm}$	Recreator Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}soil\text{-}15cm}$	Recreator Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}soil\text{-}gp}$	Recreator Soil Radionuclide External (pCi/cm^2)	Contaminant-specific	Determined in this calculator
t_{rec}	Time - recreator (years)	Site-specific	Site-specific
$IFS_{rec\text{-}adj}$	Recreator Ingestion Fraction - age-adjusted (mg)	240,000	Calculated using the age-adjusted intake factors equation.
$IRS_{rec\text{-}a}$	Recreator Soil Ingestion Rate - adult (mg/day)	100	U.S. EPA 1991a (pg. 15)
$IRS_{rec\text{-}c}$	Recreator Soil Ingestion Rate - child (mg/day)	200	U.S. EPA 1991a (pg. 15)
$IFA_{rec\text{-}adj}$	Recreator Inhalation Fraction - age-adjusted (m^3)	1,437.50	Calculated using the age-adjusted intake factors equation.
$IRA_{rec\text{-}a}$	Recreator Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
$IRA_{rec\text{-}c}$	Recreator Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
EF_{rec}	Recreator Exposure Frequency - (days/year)	75	Reasonable estimate
$EF_{rec\text{-}a}$	Recreator Exposure Frequency - adult (days/year)	75	Reasonable estimate
$EF_{rec\text{-}c}$	Recreator Exposure Frequency - child (days/year)	75	Reasonable estimate
ED_{rec}	Recreator Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$ED_{rec\text{-}a}$	Recreator Exposure Duration - adult (years)	20	ED_{res} (26 years) - $ED_{res\text{-}c}$ (6 years)
$ED_{rec\text{-}c}$	Recreator Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
ET_{rec}	Recreator Exposure Time (hours/day)	1	Reasonable estimate
$ET_{rec\text{-}a}$	Recreator Exposure Time - adult (hours/day)	1	Reasonable estimate
$ET_{rec\text{-}c}$	Recreator Exposure Time - child (hours/day)	1	Reasonable estimate

Table E-10. Farmer Soil

Symbol	Definition (units)	Default	Reference
$PRG_{far\text{-}soil\text{-}ing}$	Farmer Soil Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}soil\text{-}inh}$	Farmer Soil Radionuclide Inhalation (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}soil\text{-}ext}$	Farmer Soil Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{soil\text{-}far\text{-}produce\text{-}ing}$	Farmer Produce Radionuclide Back-calculated Concentration in Soil Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{soil\text{-}far\text{-}poultry\text{-}ing}$	Farmer Poultry Radionuclide Back-calculated Concentration in Soil Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator

Table E-10. Farmer Soil

Symbol	Definition (units)	Default	Reference
$PRG_{soil\text{-}far\text{-}egg\text{-}ing}$	Farmer Egg Radionuclide Back-calculated Concentration in Soil Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{soil\text{-}far\text{-}beef\text{-}ing}$	Farmer Beef Radionuclide Back-calculated Concentration in Soil Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{soil\text{-}far\text{-}dairy\text{-}ing}$	Farmer Dairy Radionuclide Back-calculated Concentration in Soil Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{soil\text{-}far\text{-}swine\text{-}ing}$	Farmer Swine Radionuclide Back-calculated Concentration in Soil Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{soil\text{-}far\text{-}fish\text{-}ing}$	Farmer Fish Radionuclide Back-calculated Concentration in Soil Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{far\text{-}soil\text{-}tot}$	Farmer Soil Radionuclide Total (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}produce\text{-}ing}$	Farmer Produce Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}poultry\text{-}ing}$	Farmer Poultry Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}egg\text{-}ing}$	Farmer Egg Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}beef\text{-}ing}$	Farmer Beef Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}dairy\text{-}ing}$	Farmer Dairy Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}swine\text{-}ing}$	Farmer Swine Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}fish\text{-}ing}$	Farmer Fish Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
ρ_m	Density of milk (kg/L)	1.03	Milk Composition & Synthesis Resource Library
t_{far}	Time - farmer (years)	40	U.S. EPA 2005 (pg. C-24/C-26)
Bv_{wet}	Soil to Plant Transfer Factor - wet (pCi/g-fresh plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
Bv_{dry}	Soil to Plant Transfer Factor - dry (pCi/g-dry plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
R_{upv}	Wet root uptake for produce multiplier (unitless)	Radionuclide-specific (=Bv_{wet})	Hierarchy selection in Section 2.3.2
R_{upp}	Dry root uptake for pasture multiplier (dimensionless)	Radionuclide-specific (=Bv_{dry})	Hierarchy selection in Section 2.3.2
R_{es}	Soil resuspension multiplier (dimensionless)	=MLF (pasture or produce)	Hinton 1992
TF_{beef}	Beef Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{dairy}	Dairy Transfer Factor (day/L)	Radionuclide-specific	Hierarchy selection in Section 2.3.2

Table E-10. Farmer Soil

Symbol	Definition (units)	Default	Reference
TF_{swine}	Swine Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
$TF_{poultry}$	Poultry Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{egg}	Egg Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
$MLF_{produce}$	Produce Plant Mass Loading Factor (unitless)	0.26 x 0.052 = 0.0135	Hinton, 1992. U.S. EPA SSG 1996 table G-1. Dry weight to wet weight conversion equation from section 4.10.8.
$MLF_{pasture}$	Pasture Plant Mass Loading Factor (unitless)	0.25	Hinton, T. G. 1992
$Q_{p\text{-}beef}$	Beef Fodder Intake Rate (kg/day)	11.77	U.S. EPA 2005 (pg. B-138)
$Q_{p\text{-}dairy}$	Dairy Fodder Intake Rate (kg/day)	20.3	U.S. EPA 2005 (pg. B-145)
$Q_{p\text{-}swine}$	Swine Fodder Intake Rate (kg/day)	4.7	U.S. EPA 2005 (pg. B-152)
$Q_{p\text{-}poultry}$	Poultry Fodder Intake Rate (kg/day)	0.2	U.S. EPA 2005 (pg. B-158/164)
$Q_{s\text{-}beef}$	Beef Soil Intake Rate (kg/day)	0.5	U.S. EPA 2005 (pg. B-139)
$Q_{s\text{-}dairy}$	Dairy Soil Intake Rate (kg/day)	0.4	U.S. EPA 2005 (pg. B-146)
$Q_{s\text{-}swine}$	Swine Soil Intake Rate (kg/day)	0.37	U.S. EPA 2005 (pg. B-153)
$Q_{s\text{-}poultry}$	Poultry Soil Intake Rate (kg/day)	0.022	U.S. EPA 2005 (pg. B-159/165)
$f_{p\text{-}beef}$	Fraction of Time Animal is On-Site - beef (unitless)	1	Developed for this calculator
$f_{p\text{-}dairy}$	Fraction of Time Animal is On-Site - dairy (unitless)	1	Developed for this calculator
$f_{p\text{-}swine}$	Fraction of Time Animal is On-Site - swine (unitless)	1	Developed for this calculator
$f_{p\text{-}poultry}$	Fraction of Time Animal is On-Site - poultry (unitless)	1	Developed for this calculator
$f_{s\text{-}beef}$	Fraction of Animal's Food from Site when On-Site - beef (unitless)	1	Developed for this calculator
$f_{s\text{-}dairy}$	Fraction of Animal's Food from Site when On-Site - dairy (unitless)	1	Developed for this calculator
$f_{s\text{-}swine}$	Fraction of Animal's Food from Site when On-Site - swine (unitless)	1	Developed for this calculator
$f_{s\text{-}poultry}$	Fraction of Animal's Food from Site when On-Site - poultry (unitless)	1	Developed for this calculator
$IFS_{far\text{-}adj}$	Farmer Soil Ingestion Fraction - age-adjusted (mg)	1,610,000	Calculated using the age-adjusted intake factors equation.
$IRS_{far\text{-}a}$	Farmer Soil Ingestion Rate - adult (mg/day)	100	U.S. EPA 1991a (pg. 15)

Table E-10. Farmer Soil

Symbol	Definition (units)	Default	Reference
$IFA_{far-adj}$	Farmer Inhalation Rate - age-adjusted (m^3)	259,000	Calculated using the age-adjusted intake factors equation.
IRA_{far-a}	Farmer Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
IRA_{far-c}	Farmer Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
IRS_{far-c}	Farmer Soil Ingestion Rate - child (mg/day)	200	U.S. EPA 1991a (pg. 15)
EF_{far}	Farmer Exposure Frequency (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{far-a}	Farmer Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{far}	Farmer Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{far}	Farmer Exposure Duration (years)	40	U.S. EPA 2005 (Table 6-3)
ED_{far-a}	Farmer Exposure Duration - adult (years)	34	U.S. EPA 1994a
ED_{far-c}	Farmer Exposure Duration - child (years)	6	U.S. EPA 2005 (Table 6-3)
ET_{far}	Farmer Exposure Time - (hours/day)	24	24 Hours per 24 hour Day
ET_{far-a}	Farmer Exposure Time - Adult (hours/day)	24	24 Hours per 24 hour Day
ET_{far-c}	Farmer Exposure Time - Child (hours/day)	24	24 Hours per 24 hour Day
ET_{far-i}	Farmer Exposure Time - indoor (hours/day)	10.008	1440 hrs/day - (ET_{far-o} + ET_{far-a})
$ET_{far-away}$	Farmer Exposure Time - away (hours/day)	1.83	U.S. EPA 2011 (Tables 16-20 and 16-24 total of time in vehicles, near vehicles and outdoors other than near residence 25th%)
ET_{far-o}	Farmer Exposure Time - outdoor (hours/day)	12.168	U.S. EPA 2011 (Table 16-20 95th%))

Table E-11. Resident Tap Water

Symbol	Definition (units)	Default	Reference
$PRG_{water-ing}$	Resident Tap Water (Groundwater) Radionuclide Ingestion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water-inh}$	Resident Tap Water (Groundwater) Radionuclide Inhalation (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water-imm}$	Resident Tap Water (Groundwater) Radionuclide Immersion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water-tot}$	Resident Tap Water (Groundwater) Radionuclide Total (pCi/L)	Contaminant-specific	Determined in this calculator
Irr_{rup}	Root uptake from irrigation multiplier (L/kg)	Isotope-specific	Calculated

Table E-11. Resident Tap Water

Symbol	Definition (units)	Default	Reference
Irr_{res}	Resuspension from irrigation multiplier (L/kg)	Isotope-specific	Calculated
Irr_{dep}	Aerial deposition from irrigation multiplier (L/kg)	Isotope-specific	Calculated
Bv_{wet}	Soil to Plant Transfer Factor - wet (pCi/g-fresh plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
F	Irrigation Period (unitless)	0.25	Personal communication
I_f	Interception Fraction (unitless)	0.42	Miller, C. W. 1980
I_r	Irrigation Rate (L/m^2)	3.62	Personal communication
λ_{HL}	Soil Leaching Rate (1/day)	0.000027	NCRP 1996
λ_i	Decay (1/day)	0.693/TR - radionuclides	NCRP 1996
λ_E	Decay for Removal on Produce (1/day)	$\lambda_i + (0.693/t_w)$	NCRP 1996
λ_B	Effective Rate for Removal (1/day)	$\lambda_{HL} - \lambda_i$	NCRP 1996
T	Translocation Factor (unitless)	1	NCRP 1996
t_b	Long Term Deposition and Buildup (day)	10950	NCRP 1996
t_v	Above Ground Exposure Time (day)	60	NCRP 1996
t_w	Weathering Half-life (day)	14	NCRP 1996
Y_v	Plant Yield - wet (kg/m^2)	2	NCRP 1996
P	Area Density for Root Zone (kg/m^2)	240	Hoffman, F. O., R. H. Gardner, and K. F. Eckerman. 1982; Peterson, H. T., Jr. 1983; McKone, T. E. 1994
$MLF_{produce}$	Produce Plant Mass Loading Factor (unitless)	0.26 x 0.052 = 0.0135	Hinton, 1992. U.S. EPA SSG 1996 table G-1. Dry weight to wet weight conversion equation from section 4.10.8.
$IFW_{res-adj}$	Resident Tap Water Ingestion Rate - age-adjusted (L)	19,138	Calculated using the age-adjusted intake factors equation.
IRW_{res-a}	Resident Tap Water Ingestion - adult (L/day)	2.5	U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (21+)
IRW_{res-c}	Resident Tap Water Ingestion - child (L/day)	0.78	U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years)
$IFA_{res-adj}$	Resident Inhalation Rate - age-adjusted (m^3)	161,100	Calculated using the age-adjusted intake factors equation.
$DFA_{res-adj}$	Resident Immersion Factor - age-adjusted (hours)	6104	Calculated using the age-adjusted intake factors equation.
IRA_{res-a}	Resident Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)

Table E-11. Resident Tap Water

Symbol	Definition (units)	Default	Reference
IRA_{res-c}	Resident Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
$IFV_{res-adj}$	Resident Vegetable Ingestion Fraction - age-adjusted (g)	989,870	Calculated using the age-adjusted intake factors equation
IRV_{res-a}	Resident Vegetable Ingestion Rate - adult (g/day)	128.9	U.S. EPA 2011 (Table 13-10)
IRV_{res-c}	Resident Vegetable Ingestion Rate - child (g/day)	41.7	U.S. EPA 2011 (Table 13-10)
$IFF_{res-adj}$	Resident Fruit Ingestion Fraction - age-adjusted (g)	1,462,510	Calculated using the age-adjusted intake factors equation
IRF_{res-a}	Resident Fruit Ingestion Rate - adult (g/day)	188.5	U.S. EPA 2011 (Table 13-5)
IRF_{res-c}	Resident Fruit Ingestion Rate - child (g/day)	68.1	U.S. EPA 2011 (Table 13-5)
EF_{res}	Resident Exposure Frequency - (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{res-a}	Resident Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{res-c}	Resident Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{res}	Resident Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
ED_{res-a}	Resident Exposure Duration - adult (years)	20	ED_{res} (26 years) - ED_{res-c} (6 years)
ED_{res-c}	Resident Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
$ET_{event-res-a}$	Resident Tap Water Exposure Time - Adult (hours/event)	0.71	U.S. EPA 1997a
$ET_{event-res-c}$	Resident Tap Water Exposure Time - Child (hours/event)	0.54	U.S. EPA 1997a
EV_{res-a}	Number of bathing events per day - adult resident (events/day)	1	U.S. EPA 2004 Exhibit 3-2
EV_{res-c}	Number of bathing events per day - child resident (events/day)	1	U.S. EPA 2004 Exhibit 3-2

Table E-12. Indoor Worker Tap Water

Symbol	Definition (units)	Default	Reference
$PRG_{iw\text{-}water\text{-}ing}$	Indoor Worker Tap Water Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}water\text{-}inh}$	Indoor Worker Tap Water Radionuclide Inhalation (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}water\text{-}ext}$	Indoor Worker Tap Water Radionuclide External (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}water\text{-}tot}$	Indoor Worker Tap Water Radionuclide Total (pCi/g)	Contaminant-specific	Determined in this calculator
IRW_{iw}	Indoor Worker Tap Water Ingestion (L/day)	1.25	U.S. EPA 2014, FAQ 13
EF_{iw}	Indoor Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_{iw}	Indoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{iw}	Indoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day
$ET_{event\text{-}iw}$	Indoor Worker Tap Water Exposure Time - adult (hours/event)	0.71	U.S. EPA 1997a
EV_{iw}	Number of bathing events per day - Indoor Worker (events/day)	1	U.S. EPA 2004 Exhibit 3-2

Table E-13. Recreator Surface Water

Symbol	Definition (units)	Default	Reference
$PRG_{rec\text{-}water\text{-}ing}$	Recreator Surface Water Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}water\text{-}imm}$	Recreator Surface Water Radionuclide Immersion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}water\text{-}tot}$	Recreator Surface Water Radionuclide Total (pCi/L)	Contaminant-specific	Determined in this calculator
$IFW_{rec\text{-}adj}$	Recreator Surface Water Ingestion - age-adjusted (L)	131.4	Calculated using the age-adjusted intake factors equation.
$IRW_{rec\text{-}a}$	Recreator Surface water Ingestion - adult (L/hour)	0.11	Time weighted average was calculated based on the upper percentile from Table 3.7 of EFH 2019
$IRW_{rec\text{-}c}$	Recreator Surface water Ingestion - child (L/hour)	0.12	Table 3.5 in EFH 2011
$DFA_{rec\text{-}adj}$	Recreator Immersion Factor - age-adjusted (hours)	1170	Calculated using the age-adjusted intake factors equation.
EF_{rec}	Recreator Exposure Frequency - (days/year)	45	Region 4 Bulletin
$EF_{rec\text{-}c}$	Recreator Exposure Frequency - child (days/year)	45	Region 4 Bulletin
$EF_{rec\text{-}a}$	Recreator Exposure Frequency - adult (days/year)	45	Region 4 Bulletin
ED_{rec}	Recreator Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$ED_{rec\text{-}a}$	Recreator Exposure Duration - adult (years)	20	ED_{res} (26 years) - $ED_{res\text{-}c}$ (6 years)
$ED_{rec\text{-}c}$	Recreator Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
$ET_{event\text{-}rec\text{-}a}$	Number of bathing events per day - adult recreator (events/day)	1	Reasonable estimate
$ET_{event\text{-}rec\text{-}c}$	Number of hours per bathing event - child recreator (hours/event)	1	Reasonable estimate
$EV_{rec\text{-}a}$	Number of hours per bathing event - child recreator (hours/event)	1	Reasonable estimate
$EV_{rec\text{-}c}$	Number of bathing events per day - child recreator (events/day)	1	Reasonable estimate

Table E-14. Farmer Tap Water

Symbol	Definition (units)	Default	Reference
$PRG_{water\text{-}far\text{-}ing}$	Farmer Tap Water (Groundwater) Radionuclide Ingestion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}inh}$	Farmer Tap Water (Groundwater) Radionuclide Inhalation (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}imm}$	Farmer Tap Water (Groundwater) Radionuclide Immersion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}produce\text{-}ing}$	Farmer Produce Radionuclide Back-calculated Concentration in Water Ingestion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}poultry\text{-}ing}$	Farmer Poultry Radionuclide Back-calculated Concentration in Water Ingestion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}egg\text{-}ing}$	Farmer Egg Radionuclide Back-calculated Concentration in Water Ingestion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}beef\text{-}ing}$	Farmer Beef Radionuclide Back-calculated Concentration in Water Ingestion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}dairy\text{-}ing}$	Farmer Dairy Radionuclide Back-calculated Concentration in Water Ingestion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}swine\text{-}ing}$	Farmer Swine Radionuclide Back-calculated Concentration in Water Ingestion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}fish\text{-}ing}$	Farmer Fish Radionuclide Back-calculated Concentration in Water Ingestion (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{water\text{-}far\text{-}tot}$	Farmer Tap Water (Groundwater) Radionuclide Total (pCi/L)	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}produce\text{-}ing}$	Farmer Produce Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}poultry\text{-}ing}$	Farmer Poultry Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}egg\text{-}ing}$	Farmer Egg Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}beef\text{-}ing}$	Farmer Beef Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}dairy\text{-}ing}$	Farmer Dairy Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}swine\text{-}ing}$	Farmer Swine Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
$PRG_{sw\text{-}far\text{-}fish\text{-}ing}$	Farmer Fish Radionuclide Back-calculated Concentration in Soil and Water Ingestion	Contaminant-specific	Determined in this calculator
ρ_m	Density of milk (kg/L)	1.03	Milk Composition & Synthesis Resource Library
BCF	Fish Transfer Factor (L/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2

Table E-14. Farmer Tap Water

Symbol	Definition (units)	Default	Reference
TF_{beef}	Beef Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{dairy}	Dairy Transfer Factor (day/L)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{swine}	Swine Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
$TF_{poultry}$	Poultry Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{egg}	Egg Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
Q_{w-beef}	Beef Water Intake Rate (L/day)	53	U.S. EPA 1999a (pg. 10-23). U.S. EPA 1997b.
$Q_{w-dairy}$	Dairy Water Intake Rate (L/day)	92	U.S. EPA 1999a (pg. 10-23). U.S. EPA 1997b.
$Q_{w-swine}$	Swine Water Intake Rate (L/day)	11.4	NEC, Swine Nutrition Guide (pg. 19). U.S. EPA 1998 (pg. B-180)
$Q_{w-poultry}$	Poultry Water Intake Rate (L/day)	0.4	U.S. EPA 2005 (pg. B-159/165), NRC 1994 pg. 15 ($Q_w = 2 \times Q_p$)
Irr_{rup}	Root uptake from irrigation multiplier	Isotope-specific	Calculated
Irr_{res}	Resuspension from irrigation multiplier	Isotope-specific	Calculated
Irr_{dep}	Aerial deposition from irrigation multiplier	Isotope-specific	Calculated
Bv_{wet}	Soil to Plant Transfer Factor - wet (pCi/g-fresh plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
F	Irrigation Period (unitless)	0.25	Personal communication
I_f	Interception Fraction (unitless)	0.42	Miller, C. W. 1980
I_r	Irrigation Rate (L/m^2)	3.62	Personal communication
λ_{HL}	Soil Leaching Rate (1/day)	0.000027	NCRP 1996
λ_i	Decay (1/day)	0.693/TR - radionuclides	NCRP 1996
λ_E	Decay for Removal on Produce (1/day)	$\lambda_i + (0.693/t_w)$	NCRP 1996
λ_B	Effective Rate for Removal (1/day)	λ_{HL} - λ_i	NCRP 1996
T	Translocation Factor (unitless)	1	NCRP 1996
t_b	Long Term Deposition and Buildup (day)	10950	NCRP 1996
t_v	Above Ground Exposure Time (day)	60	NCRP 1996
t_w	Weathering Half-life (day)	14	NCRP 1996
Y_v	Plant Yield - wet (kg/m^2)	2	NCRP 1996
P	Area Density for Root Zone (kg/m^2)	240	Hoffman, F. O., R. H. Gardner, and K. F. Eckerman. 1982; Peterson, H. T., Jr. 1983; McKone, T. E. 1994
$MLF_{produce}$	Produce Plant Mass Loading Factor (unitless)	0.26 x 0.052 = 0.0135	Hinton, 1992. U.S. EPA SSG 1996 table G-1. Dry weight to wet weight conversion equation from section 4.10.8.
$IFW_{far-adj}$	Farmer Water Ingestion Fraction - age-adjusted (L)	31,388	Calculated using the age-adjusted intake factors equation.

Table E-14. Farmer Tap Water

Symbol	Definition (units)	Default	Reference
IRW_{far-a}	Farmer Water Ingestion Rate - adult (L/day)	2.5	U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (21+)
IRW_{far-c}	Farmer Water Ingestion Rate - child (L/day)	0.78	U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years)
$IFA_{far-adj}$	Farmer Inhalation Rate - age-adjusted (m^3)	259,000	Calculated using the age-adjusted intake factors equation.
$DFA_{far-adj}$	Farmer Immersion Factor - age-adjusted (hours)	9583	Calculated using the age-adjusted intake factors equation.
IRA_{far-a}	Farmer Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
IRA_{far-c}	Farmer Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
EF_{far}	Farmer Exposure Frequency (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{far-a}	Farmer Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{far}	Farmer Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{far}	Farmer Exposure Duration (years)	40	U.S. EPA 2005 (Table 6-3)
ED_{far-a}	Farmer Exposure Duration - adult (years)	34	U.S. EPA 1994a
ED_{far-c}	Farmer Exposure Duration - child (years)	6	U.S. EPA 2005 (Table 6-3)
$ET_{event-far-c}$	Farmer Tap Water Exposure Time - Child (hours/day)	0.54	U.S. EPA 1997a
$ET_{event-far-a}$	Farmer Tap Water Exposure Time - Adult (hours/day)	0.71	U.S. EPA 1997a
EV_{far-a}	Number of bathing events per day - adult farmer (events/day)	1	U.S. EPA 2004 Exhibit 3-2
EV_{far-c}	Number of bathing events per day - child farmer (events/day)	1	U.S. EPA 2004 Exhibit 3-2

Table E-15. Resident Air

Symbol	Definition (units)	Default	Reference
$PRG_{res\text{-}air\text{-}inh\text{-}decay}$	Resident Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}air\text{-}sub\text{-}decay}$	Resident Air Radionuclide Submersion w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}air\text{-}tot\text{-}decay}$	Resident Air Radionuclide Total w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}air\text{-}inh\text{-}nodecay}$	Resident Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}air\text{-}sub\text{-}nodecay}$	Resident Air Radionuclide Submersion w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{res\text{-}air\text{-}tot\text{-}nodecay}$	Resident Air Radionuclide Total w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
t_{res}	Time - resident (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$IFA_{res\text{-}adj}$	Resident Inhalation Rate - age-adjusted (m^3)	161,100	Calculated using the age-adjusted intake factors equation.
$IRA_{res\text{-}a}$	Resident Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
$IRA_{res\text{-}c}$	Resident Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
EF_{res}	Resident Exposure Frequency - (days/year)	350	U.S. EPA 1991a (pg. 15)
$EF_{res\text{-}c}$	Resident Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
$EF_{res\text{-}a}$	Resident Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{res}	Resident Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$ED_{res\text{-}a}$	Resident Exposure Duration - adult (years)	20	ED_{res} (26 years) - $ED_{res\text{-}c}$ (6 years)
$ED_{res\text{-}c}$	Resident Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
ET_{res}	Resident Exposure Time (hours/day)	24	24 Hours per 24 hour Day
$ET_{res\text{-}a}$	Resident Exposure Time - adult (hours/day)	24	24 Hours per 24 hour Day
$ET_{res\text{-}c}$	Resident Exposure Time - child (hours/day)	24	24 Hours per 24 hour Day

Table E-16. Indoor Worker Air

Symbol	Definition (units)	Default	Reference
$PRG_{iw\text{-}air\text{-}inh\text{-}decay}$	Indoor Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}air\text{-}sub\text{-}decay}$	Indoor Worker Air Radionuclide Submersion w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}air\text{-}tot\text{-}decay}$	Indoor Worker Air Radionuclide Total w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}air\text{-}inh\text{-}nodecay}$	Indoor Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}air\text{-}sub\text{-}nodecay}$	Indoor Worker Air Radionuclide Submersion w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{iw\text{-}air\text{-}tot\text{-}nodecay}$	Indoor Worker Air Radionuclide Total w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
IRA_{iw}	Indoor Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{iw}	Indoor Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_{iw}	Indoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{iw}	Indoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-17. Outdoor Worker Air

Symbol	Definition (units)	Default	Reference
$PRG_{ow\text{-}air\text{-}inh\text{-}decay}$	Outdoor Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}air\text{-}sub\text{-}decay}$	Outdoor Worker Air Radionuclide Submersion w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}air\text{-}tot\text{-}decay}$	Outdoor Worker Air Radionuclide Total w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}air\text{-}inh\text{-}nodecay}$	Outdoor Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}air\text{-}sub\text{-}nodecay}$	Outdoor Worker Air Radionuclide Submersion w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ow\text{-}air\text{-}tot\text{-}nodecay}$	Outdoor Worker Air Radionuclide Total w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
t_{ow}	Time - outdoor worker (years)	25	U.S. EPA 1991a (pg. 15)
IRA_{ow}	Outdoor Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{ow}	Outdoor Worker Exposure Frequency (days/year)	225	U.S. EPA 1991a (pg. 15)
ED_{ow}	Outdoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{ow}	Outdoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-18. Composite Worker Air

Symbol	Definition (units)	Default	Reference
$PRG_{w\text{-}air\text{-}inh\text{-}decay}$	Composite Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}air\text{-}sub\text{-}decay}$	Composite Worker Air Radionuclide Submersion w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}air\text{-}tot\text{-}decay}$	Composite Worker Air Radionuclide Total w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}air\text{-}inh\text{-}nodecay}$	Composite Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}air\text{-}sub\text{-}nodecay}$	Composite Worker Air Radionuclide Submersion w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{w\text{-}air\text{-}tot\text{-}nodecay}$	Composite Worker Air Radionuclide Total w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
t_w	Time - worker (years)	25	U.S. EPA 1991a (pg. 15)
IRA_w	Composite Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_w	Composite Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_w	Composite Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_w	Composite Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-19. Excavation Worker Air

Symbol	Definition (units)	Default	Reference
$PRG_{ew\text{-}air\text{-}inh\text{-}decay}$	Excavation Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ew\text{-}air\text{-}sub\text{-}decay}$	Excavation Worker Air Radionuclide Submersion w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ew\text{-}air\text{-}tot\text{-}decay}$	Excavation Worker Air Radionuclide Total w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ew\text{-}air\text{-}inh\text{-}nodecay}$	Excavation Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ew\text{-}air\text{-}sub\text{-}nodecay}$	Excavation Worker Air Radionuclide Submersion w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{ew\text{-}air\text{-}tot\text{-}nodecay}$	Excavation Worker Air Radionuclide Total w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
t_{ew}	Time - excavation worker (years)	1	U.S. EPA 2002 Exhibit 5-1
IRA_{ew}	Excavation Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{ew}	Excavation Worker Exposure Frequency (days/year)	20	
ED_{ew}	Excavation Worker Exposure Duration (years)	1	U.S. EPA 2002 Exhibit 5-1
$ET_{ew\text{-}o}$	Excavation Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-20. Construction Worker Air

Symbol	Definition (units)	Default	Reference
$PRG_{cw\text{-}air\text{-}inh\text{-}decay}$	Construction Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}air\text{-}sub\text{-}decay}$	Construction Worker Air Radionuclide Submersion w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}air\text{-}tot\text{-}decay}$	Construction Worker Air Radionuclide Total w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}air\text{-}inh\text{-}nodecay}$	Construction Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}air\text{-}sub\text{-}nodecay}$	Construction Worker Air Radionuclide Submersion w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{cw\text{-}air\text{-}tot\text{-}nodecay}$	Construction Worker Air Radionuclide Total w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
t_{cw}	Time - construction worker (years)	1	U.S. EPA 2002 Exhibit 5-1
IRA_{cw}	Construction Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{cw}	Construction Worker Exposure Frequency (days/year)	250	U.S. EPA 2002 Exhibit 5-1
EW_{cw}	Construction Worker Exposure Frequency (weeks/year)	50	U.S. EPA 2002 Exhibit 5-1
DW_{cw}	Construction Worker Exposure Frequency (days/week)	5	U.S. EPA 2002 Exhibit 5-1
ED_{cw}	Construction Worker Exposure Duration (years)	1	U.S. EPA 2002 Exhibit 5-1
ET_{cw}	Construction Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table E-21. Recreator Air

Symbol	Definition (units)	Default	Reference
$PRG_{rec\text{-}air\text{-}inh\text{-}decay}$	Recreator Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}air\text{-}sub\text{-}decay}$	Recreator Worker Air Radionuclide Submersion w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}air\text{-}tot\text{-}decay}$	Recreator Worker Air Radionuclide Total w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}air\text{-}inh\text{-}nodecay}$	Recreator Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}air\text{-}sub\text{-}nodecay}$	Recreator Air Radionuclide Submersion w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$PRG_{rec\text{-}air\text{-}tot\text{-}nodecay}$	Recreator Air Radionuclide Total w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
t_{rec}	Time - recreator (years)	Site-specific	Site-specific
$IFA_{rec\text{-}adj}$	Recreator Inhalation Fraction - age-adjusted (m^3)	1,437.5	Calculated using the age-adjusted intake factors equation.
$IRA_{rec\text{-}a}$	Recreator Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
$IRA_{rec\text{-}c}$	Recreator Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
EF_{rec}	Recreator Exposure Frequency - (days/year)	75	Reasonable estimate
$EF_{rec\text{-}a}$	Recreator Exposure Frequency - adult (days/year)	75	Reasonable estimate
$EF_{rec\text{-}c}$	Recreator Exposure Frequency - child (days/year)	75	Reasonable estimate
ED_{rec}	Recreator Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$ED_{rec\text{-}a}$	Recreator Exposure Duration - adult (years)	20	ED_{res} (26 years) - $ED_{res\text{-}c}$ (6 years)
$ED_{rec\text{-}c}$	Recreator Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
ET_{rec}	Recreator Exposure Time (hours/day)	1	Reasonable estimate
$ET_{rec\text{-}a}$	Recreator Exposure Time - adult (hours/day)	1	Reasonable estimate
$ET_{rec\text{-}c}$	Recreator Exposure Time - child (hours/day)	1	Reasonable estimate

Table E-22. Resident Fish Consumption

Symbol	Definition (units)	Default	Reference
$PRG_{res-fsh-ing}$	Resident Fish Radionuclide (pCi)	Contaminant-specific	Determined in this calculator
$PRG_{res-fshw-ing}$	Resident Surface Water Fish Radionuclide (pCi)	Contaminant-specific	Determined in this calculator
$CF_{res-fish}$	Fish Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
BCF	Fish Transfer Factor (L/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
IRF_{res}	Resident Fish Ingestion Rate (g/day)	54	U.S. EPA 1991a (page 15)
EF_{res}	Resident Exposure Frequency - (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{res}	Resident Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.

Table E-23. Recreator Game and Fowl Consumption

Symbol	Definition (units)	Default	Reference
$CDI_{rec-fowl-rad-ing}$	Recreator Fowl Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil-rec-fowl-rad-ing}$	Recreator Fowl Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-rec-fowl-rad-ing}$	Recreator Fowl Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{rec-game-rad-ing}$	Recreator Game Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil-rec-game-rad-ing}$	Recreator Game Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-rec-game-rad-ing}$	Recreator Game Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CF_{rec-game}$	Game Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{rec-fowl}$	Fowl Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
Bv_{dry}	Soil to Plant Transfer Factor - dry (pCi/g-dry plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
R_{upp}	Dry root uptake for pasture multiplier (dimensionless)	Radionuclide-specific (=Bv_{dry})	Hierarchy selection in Section 2.3.2
TF_{beef}	Game Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2

Table E-23. Recreator Game and Fowl Consumption

Symbol	Definition (units)	Default	Reference
$TF_{poultry}$	Fowl Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
Q_{w-game}	Game Water Intake Rate (L/day)	Site-specific	-
Q_{w-fowl}	Fowl Water Intake Rate (L/day)	Site-specific	-
Q_{p-game}	Game Fodder Intake Rate (kg/day)	Site-specific	-
Q_{p-fowl}	Fowl Fodder Intake Rate (kg/day)	Site-specific	-
Q_{s-game}	Game Soil Intake Rate (kg/day)	Site-specific	-
Q_{s-fowl}	Fowl Soil Intake Rate (kg/day)	Site-specific	-
f_{p-game}	Fraction of Time Animal is On-Site - game (unitless)	Site-specific	-
f_{p-fowl}	Fraction of Time Animal is On-Site - fowl (unitless)	Site-specific	-
f_{s-game}	Fraction of Animal's Food from Site when On-Site - game (unitless)	Site-specific	-
f_{s-fowl}	Fraction of Animal's Food from Site when On-Site - fowl (unitless)	Site-specific	-
EF_{rec}	Recreator Exposure Frequency - (days/year)	75	Reasonable estimate
ED_{rec}	Recreator Exposure Duration (years)	26	Reasonable estimate

Table E-24. Farmer Direct Ingestion

Symbol	Definition (units)	Default	Reference
$PRG_{far-produce-ing}$	Farmer Produce Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{far-poultry-ing}$	Farmer Poultry Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{far-egg-ing}$	Farmer Egg Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{far-beef-ing}$	Farmer Beef Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{far-dairy-ing}$	Farmer Dairy Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{far-swine-ing}$	Farmer Swine Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$PRG_{far-fish-ing}$	Farmer Fish Radionuclide Ingestion (pCi/g)	Contaminant-specific	Determined in this calculator
$CF_{far-produce}$	Produce Contaminated Fraction - farmer (unitless)	1	U.S. EPA 1994c. U.S. EPA. 1998. (pg. C-9)
$CF_{far-poultry}$	Poultry Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{far-egg}$	Egg Contaminated Fraction - Farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{far-beef}$	Beef Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{far-dairy}$	Dairy Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator

Table E-24. Farmer Direct Ingestion

Symbol	Definition (units)	Default	Reference
$CF_{far\text{-}swine}$	Swine Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{far\text{-}fish}$	Fish Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$IFV_{far\text{-}adj}$	Farmer Vegetable Ingestion Fraction - age-adjusted (g)	1,583,400	Calculated using the age-adjusted intake factors equation
$IRV_{far\text{-}a}$	Farmer Vegetable Ingestion Rate - adult (g/day)	125.7	U.S. EPA 2011 (Table 13-10)
$IRV_{far\text{-}c}$	Farmer Vegetable Ingestion Rate - child (g/day)	41.7	U.S. EPA 2011 (Table 13-10)
$IFF_{far\text{-}adj}$	Farmer Fruit Ingestion Rate - age-adjusted (g)	2,246,930	Calculated using the age-adjusted intake factors equation
$IRF_{far\text{-}a}$	Farmer Fruit Ingestion Rate - adult (g/day)	176.8	U.S. EPA 2011 (Table 13-5)
$IRF_{far\text{-}c}$	Farmer Fruit Ingestion Rate - child (g/day)	68.1	U.S. EPA 2011 (Table 13-5)
$IFP_{far\text{-}adj}$	Farmer Poultry Ingestion Fraction - age-adjusted (g)	1,318,100	Calculated using the age-adjusted intake factors equation
$IRP_{far\text{-}a}$	Farmer Poultry Ingestion Rate - adult (g/day)	106.6	U.S. EPA 2011 (Table 13-52)
$IRP_{far\text{-}c}$	Farmer Poultry Ingestion Rate - child (g/day)	23.6	U.S. EPA 2011 (Table 13-52)
$IFE_{far\text{-}adj}$	Farmer Egg Ingestion Rate - age-adjusted (g)	658,455	Calculated using the age-adjusted intake factors equation
$IRE_{far\text{-}a}$	Farmer Egg Ingestion Rate - adult (g/day)	53.4	U.S. EPA 2011 (Table 13-40)
$IRE_{far\text{-}c}$	Farmer Egg Ingestion Rate - child (g/day)	10.95	U.S. EPA 2011 (Table 13-40)
$IFB_{far\text{-}adj}$	Farmer Beef Ingestion Fraction - age-adjusted (g)	2,202,410	Calculated using the age-adjusted intake factors equation
$IRB_{far\text{-}a}$	Farmer Beef Ingestion Rate - adult (g/day)	178.0	U.S. EPA 2011 (Table 13-33)
$IRB_{far\text{-}c}$	Farmer Beef Ingestion Rate - child (g/day)	40.1	U.S. EPA 2011 (Table 13-33)
$IFD_{far\text{-}adj}$	Farmer Dairy Ingestion Fraction - age-adjusted (g)	6,036,590	Calculated using the age-adjusted intake factors equation
$IRD_{far\text{-}a}$	Farmer Dairy Ingestion Rate - adult (g/day)	445.6	U.S. EPA 2011 (Table 11-4)
$IRD_{far\text{-}c}$	Farmer Dairy Ingestion Rate - child (g/day)	349.5	U.S. EPA 2011 (Table 11-4)
$IFSW_{far\text{-}adj}$	Farmer Swine Ingestion Fraction - age-adjusted (g)	1,203,860	Calculated using the age-adjusted intake factors equation

Table E-24. Farmer Direct Ingestion

Symbol	Definition (units)	Default	Reference
$IRSW_{far\text{-}a}$	Farmer Swine Ingestion Rate - adult (g/day)	97.9	U.S. EPA 2011 (Table 13-51)
$IRSW_{far\text{-}c}$	Farmer Swine Ingestion Rate - child (g/day)	18.5	U.S. EPA 2011 (Table 13-51)
$IFFI_{far\text{-}adj}$	Farmer Fish Ingestion Fraction - age-adjusted (g)	1,918,140	Calculated using the age-adjusted intake factors equation
$IRFI_{far\text{-}a}$	Farmer Fish Ingestion Rate - adult (g/day)	155.4	U.S. EPA 2011 (Table 13-20)
$IRFI_{far\text{-}c}$	Farmer Fish Ingestion Rate - child (g/day)	32.8	U.S. EPA 2011 (Table 13-20)
$CDI_{far\text{-}produce\text{-}rad\text{-}ing}$	Farmer Produce Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator

Table E-25. Soil to Groundwater SSL Factor Variables

Symbol	Definition (units)	Default	Reference
C_w	Target soil leachate concentration (pCi/L)	Nonzero MCL or RSL × DAF	U.S. EPA. 2002 Equation 4-14
DAF	Dilution attenuation factor (unitless)	20 (or site-specific)	U.S. EPA. 2002 Equation 4-11
ED_{gw}	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
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.3	U.S. EPA. 2002 Equation 4-10
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	$= n-\theta_w$	U.S. EPA. 2002 Equation 4-10
n	Total soil porosity (L_{pore}/L_{soil})	$= 1-(\rho_b/\rho_s)$	U.S. EPA. 2002 Equation 4-10
ρ_s	Soil particle density (kg/L)	2.65	U.S. EPA. 2002 Equation 4-10
ρ_b	Dry soil bulk density (kg/L)	1.5	U.S. EPA. 2002 Equation 4-10
K_d	Soil-water partition coefficient (L/kg)	$= K_{oc}*f_{oc}$ for organics	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

Table E-26. Wind Particulate Emission Factor Variables

Symbol	Definition (units)	Default	Reference
PEF_w	Particulate Emission Factor - Minneapolis (m^3/kg)	1.36 x 10^9 (region-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 7 m (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

Table E-27. Mechanical Particulate Emission Factor Variables from Vehicle Traffic

Symbol	Definition (units)	Default	Reference
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)	7,200,000	U.S. EPA 2002 Equation 5-5
A_R	Surface area of contaminated road segment (m^2)	($A_R = L_R$ x W_R x 0.092903 m^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
$\sum$VKT	Sum of fleet vehicle kilometers traveled during the exposure duration (km)	$\sum$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

Table E-28. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
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)	0.185	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

Table E-28. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
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 7 m (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
$M_{m\text{-}excav}$	Gravimetric soil moisture content (%)	12 (Mean value for municipal landfill cover)	U.S. EPA 2002 Equation E-21
ρ_{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_{excav}	Average depth of excavation (m)	Site-specific	U.S. EPA 2002 Equation E-21
$N_{A\text{-}dump}$	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
$\sum VKT_{doz}$	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

Table E-28. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
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
$\sum VKT_{grade}$	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 $\sum VKT_{grade}$ in U.S. EPA 2002 Equation E-23
$A_{c\text{-}doz}$	Areal extent of dozing (acres)	Site-specific	Necessary to solve $\sum VKT_{doz}$ 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

APPENDIX F. RADIONUCLIDE PRG EQUATIONS

APPENDIX F. RADIONUCLIDE PRG EQUATIONS

Resident Soil PRG Equations

Soil Ingestion

$$\text{PRG}_{\text{res-sol-ing}}\left(\frac{\text{pCi}}{\text{g}}\right) = \left(\frac{\text{TR}}{\text{SF}_{\text{o}}\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFS}_{\text{res-adj}}(1,120,000\ \text{mg}) \times \left(\frac{\text{g}}{1000\ \text{mg}}\right)}\right) \times \left(\frac{\text{t}(\text{yr}) \times \lambda\left(\frac{1}{\text{yr}}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{\text{yr}}\right) \times \text{t}(\text{yr})}\right)}\right)$$

where:

$$\text{IFS}_{\text{res-adj}}(1,120,000\ \text{mg}) = \left[\begin{array}{l}\left(\text{EF}_{\text{res-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-c}}(6\ \text{yr}) \times \text{IRS}_{\text{res-c}}\left(\frac{200\ \text{mg}}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-a}}(20\ \text{yr}) \times \text{IRS}_{\text{res-a}}\left(\frac{100\ \text{mg}}{\text{day}}\right)\right)\end{array}\right]$$

Soil Inhalation

$$\text{PRG}_{\text{res-sol-inh}}\left(\frac{\text{pCi}}{\text{g}}\right) = \left(\frac{\text{TR}}{\text{SF}_{\text{i}}\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFA}_{\text{res-adj}}\left(161,000\ \text{m}^3\right) \times \frac{1}{\text{PEF}\left(\frac{\text{m}^3}{\text{kg}}\right)} \times \left(\frac{1000\ \text{g}}{\text{kg}}\right)}\right) \times \left(\frac{\text{t}(\text{yr}) \times \lambda\left(\frac{1}{\text{yr}}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{\text{yr}}\right) \times \text{t}(\text{yr})}\right)}\right)$$

where:

$$\text{IFA}_{\text{res-adj}}\left(161,000\ \text{m}^3\right) = \left[\begin{array}{l}\left(\text{EF}_{\text{res-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-c}}(6\ \text{yr}) \times \text{ET}_{\text{res-c}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{res-c}}\left(\frac{10\ \text{m}^3}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-a}}(20\ \text{yr}) \times \text{ET}_{\text{res-a}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{res-a}}\left(\frac{20\ \text{m}^3}{\text{day}}\right)\right)\end{array}\right]$$

Soil External Exposure

$$\text{PRG}_{\text{res-sol-ext}}\left(\frac{\text{pCi}}{\text{g}}\right) = \left(\frac{\text{TR}}{\begin{array}{c}\text{SF}_{\text{ext-sv}}\left(\frac{\text{risk/yr}}{\text{pCi/g}}\right) \times \text{EF}_{\text{res}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \left(\frac{1\ \text{yr}}{365\ \text{days}}\right) \times \text{ED}_{\text{res}}(26\ \text{yr}) \times \text{ACF}_{\text{ext-sv}} \times \\ \left[\left(\text{ET}_{\text{res-o}}\left(\frac{1.752\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{GSF}_{\text{o-ext-sv}}\right) + \left(\text{ET}_{\text{res-i}}\left(\frac{16.416\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{GSF}_{\text{i-total}}\right)\right]\end{array}}\right) \times \left(\frac{\text{t}(\text{yr}) \times \lambda\left(\frac{1}{\text{yr}}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{\text{yr}}\right) \times \text{t}(\text{yr})}\right)}\right)$$

Soil Contribution to Produce Ingestion

$$PRG_{res-sol-produce-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{res-produce-ing}\left(\frac{pCi}{g}\right)}{\left(R_{upv} + R_{es}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$R_{upv} = BV_{wet}\left(\frac{pCi / g - fresh - plant}{pCi / g - dry - soil}\right) ; R_{es} = MLF_{produce}\left(\frac{0.0135\ g - dry - soil}{g - fresh - plant}\right)$$

Direct Produce Ingestion

$$PRG_{res-produce-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times \left(IFF_{res-adj}(1{,}462{,}510\ g) + IFV_{res-adj}(989{,}870\ g)\right) \times CF_{res-produce}(0.25)}\right)$$

where:

$$IFF_{res-adj}(1{,}462{,}510\ g) = \left[\left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRF_{res-c}\left(\frac{68.1\ g}{day}\right)\right) + \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRF_{res-a}\left(\frac{188.5\ g}{day}\right)\right)\right]$$

and:

$$IFV_{res-adj}(989{,}870\ g) = \left[\left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRV_{res-c}\left(\frac{41.7\ g}{day}\right)\right) + \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRV_{res-a}\left(\frac{128.9\ g}{day}\right)\right)\right]$$

Soil Total

$$PRG_{res-sol-tot}\left(\frac{pCi}{g}\right) = \left(\frac{1}{\frac{1}{PRG_{res-sol-ing}} + \frac{1}{PRG_{res-sol-inh}} + \frac{1}{PRG_{res-sol-ext}} + \frac{1}{PRG_{res-sol-produce-ing-tot}}}\right)$$

Resident Alternate External Sources PRG Equations

Direct External Exposure (sv)

$$PRG_{res-sol-sv}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c} SF_{ext-sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{res}(26\ yr) \times ACF_{ext-sv} \times \\ \left[\left(ET_{res-o}\left(\frac{1.752\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-sv}\right) + \left(ET_{res-i}\left(\frac{16.416\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right] \end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (1 cm)

$$PRG_{res-sol-1cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-1cm}\left(\frac{risk/yr}{pCi/g}\right)\times EF_{res}\left(\frac{350\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{res}(26\ yr)\times ACF_{ext-1cm}\times \left[\left(ET_{res-o}\left(\frac{1.752\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_{o-ext-1cm}\right)+\left(ET_{res-i}\left(\frac{16.416\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_{i-total}\right)\right]}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Direct External Exposure (5 cm)

$$PRG_{res-sol-5cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-5cm}\left(\frac{risk/yr}{pCi/g}\right)\times EF_{res}\left(\frac{350\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{res}(26\ yr)\times ACF_{ext-5cm}\times \left[\left(ET_{res-o}\left(\frac{1.752\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_{o-ext-5cm}\right)+\left(ET_{res-i}\left(\frac{16.416\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_{i-total}\right)\right]}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Direct External Exposure (15 cm)

$$PRG_{res-sol-15cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-15cm}\left(\frac{risk/yr}{pCi/g}\right)\times EF_{res}\left(\frac{350\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{res}(26\ yr)\times ACF_{ext-15cm}\times \left[\left(ET_{res-o}\left(\frac{1.752\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_{o-ext-15cm}\right)+\left(ET_{res-i}\left(\frac{16.416\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_{i-total}\right)\right]}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Direct External Exposure (ground plane)

$$PRG_{res-sol-gp}\left(\frac{pCi}{cm^2}\right) = \left(\frac{TR}{SF_{ext-gp}\left(\frac{risk/yr}{pCi/cm^2}\right)\times EF_{res}\left(\frac{350\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{res}(26\ yr)\times ACF_{ext-gp}\times \left[\left(ET_{res-o}\left(\frac{1.752\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_{o-ext-gp}\right)+\left(ET_{res-i}\left(\frac{16.416\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_{i-total}\right)\right]}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Resident Air PRG Equations

Air Inhalation

$$PRG_{res-air-inh}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right)\times IFA_{res-adj}\left(161{,}000\ m^3\right)}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

where:

$$IFA_{res-adj}\left(161{,}000\ m^3\right) = \left[\left(EF_{res-c}\left(\frac{350\ days}{yr}\right)\times ED_{res-c}(6\ yr)\times ET_{res-c}\left(\frac{24\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{res-c}\left(\frac{10\ m^3}{day}\right)\right)+\left(EF_{res-a}\left(\frac{350\ days}{yr}\right)\times ED_{res-a}(20\ yr)\times ET_{res-a}\left(\frac{24\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{res-a}\left(\frac{20\ m^3}{day}\right)\right)\right]$$

Air Submersion

$$PRG_{res-air-sub}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right)\times EF_{res}\left(\frac{350\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{res}(26\ yr)\times ET_{res}\left(\frac{24\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_a(1.0)}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Air Total

$$\text{PRG}_{\text{res-air-tot}}\left(\frac{\text{pCi}}{\text{m}^3}\right) = \left(\frac{1}{\frac{1}{\text{PRG}_{\text{res-air-inh}}} + \frac{1}{\text{PRG}_{\text{res-air-sub}}}}\right)$$

Air Inhalation (without decay)

$$\text{PRG}_{\text{res-air-inhnd}}\left(\frac{\text{pCi}}{\text{m}^3}\right) = \left(\frac{\text{TR}}{\text{SF}_{\text{i}}\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFA}_{\text{res-adj}}\left(161{,}000\ \text{m}^3\right)}\right)$$

where:

$$\text{IFA}_{\text{res-adj}}\left(161{,}000\ \text{m}^3\right) = \left[\begin{array}{l}\left(\text{EF}_{\text{res-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-c}}(6\ \text{yr}) \times \text{ET}_{\text{res-c}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{res-c}}\left(\frac{10\ \text{m}^3}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-a}}(20\ \text{yr}) \times \text{ET}_{\text{res-a}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{res-a}}\left(\frac{20\ \text{m}^3}{\text{day}}\right)\right)\end{array}\right]$$

Air Submersion (without decay)

$$\text{PRG}_{\text{res-air-subnd}}\left(\frac{\text{pCi}}{\text{m}^3}\right) = \left(\frac{\text{TR}}{\text{SF}_{\text{sub}}\left(\frac{\text{risk/yr}}{\text{pCi/m}^3}\right) \times \text{EF}_{\text{res}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \left(\frac{1\ \text{yr}}{365\ \text{days}}\right) \times \text{ED}_{\text{res}}(26\ \text{yr}) \times \text{ET}_{\text{res}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{GSF}_{\text{a}}(1.0)}\right)$$

Air Total (without decay)

$$\text{PRG}_{\text{res-air-totnd}}\left(\frac{\text{pCi}}{\text{m}^3}\right) = \left(\frac{1}{\frac{1}{\text{PRG}_{\text{res-air-inhnd}}} + \frac{1}{\text{PRG}_{\text{res-air-subnd}}}}\right)$$

<u>Resident Tap Water PRG Equations</u>

Tap Water Ingestion

$$\text{PRG}_{\text{res-wat-ing}}\left(\frac{\text{pCi}}{\text{L}}\right) = \left(\frac{\text{TR}}{\text{SF}_{\text{w}}\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFW}_{\text{res-adj}}(19{,}138\ \text{L})}\right)$$

where:

$$\text{IFW}_{\text{res-adj}}(19{,}138\ \text{L}) = \left[\begin{array}{l}\left(\text{EF}_{\text{res-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-c}}(6\ \text{yr}) \times \text{IRW}_{\text{res-c}}\left(\frac{0.78\ \text{L}}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-a}}(20\ \text{yr}) \times \text{IRW}_{\text{res-a}}\left(\frac{2.5\ \text{L}}{\text{day}}\right)\right)\end{array}\right]$$

Tap Water Inhalation

$$\text{PRG}_{\text{res-wat-inh}}\left(\frac{\text{pCi}}{\text{L}}\right) = \left(\frac{\text{TR}}{\text{SF}_i\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFA}_{\text{res-adj}}\left(161{,}000\ \text{m}^3\right) \times \text{K}\left(\frac{0.5\ \text{L}}{\text{m}^3}\right)}\right)$$

where:

$$\text{IFA}_{\text{res-adj}}\left(161{,}000\ \text{m}^3\right) = \left[\begin{array}{l}\left(\text{EF}_{\text{res-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-c}}(6\ \text{yr}) \times \text{ET}_{\text{res-c}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{res-c}}\left(\frac{10\ \text{m}^3}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-a}}(20\ \text{yr}) \times \text{ET}_{\text{res-a}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{res-a}}\left(\frac{20\ \text{m}^3}{\text{day}}\right)\right)\end{array}\right]$$

Tap Water Immersion

$$\text{PRG}_{\text{res-wat-imm}}\left(\frac{\text{pCi}}{\text{L}}\right) = \left(\frac{\text{TR}}{\text{SF}_{\text{imm}}\left(\frac{\text{risk/yr}}{\text{pCi/L}}\right) \times \left(\frac{1\ \text{yr}}{8{,}760\ \text{hrs}}\right) \times \text{DFA}_{\text{res-adj}}\left(6{,}104\ \text{hrs}\right)}\right)$$

where:

$$\text{DFA}_{\text{res-adj}}\left(6{,}104\ \text{hrs}\right) = \left[\begin{array}{l}\left(\text{EF}_{\text{res-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-c}}(6\ \text{yr}) \times \text{EV}_{\text{res-c}}\left(\frac{1\ \text{events}}{\text{day}}\right) \times \text{ET}_{\text{event-res-c}}\left(\frac{0.54\ \text{hrs}}{\text{event}}\right)\right) + \\ \left(\text{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{res-a}}(20\ \text{yr}) \times \text{EV}_{\text{res-a}}\left(\frac{1\ \text{events}}{\text{day}}\right) \times \text{ET}_{\text{event-res-a}}\left(\frac{0.71\ \text{hrs}}{\text{event}}\right)\right)\end{array}\right]$$

Tap Water Contribution to Produce Ingestion

$$\text{PRG}_{\text{res-wat-produce-ing}}\left(\frac{\text{pCi}}{\text{L}}\right) = \frac{\text{PRG}_{\text{res-produce-ing}}\left(\frac{\text{pCi}}{\text{g}}\right)}{\left(\frac{1\ \text{kg}}{1000\ \text{g}}\right) \times \left(\text{Irr}_{\text{rup}}\left(\frac{\text{L}}{\text{kg}}\right) + \text{Irr}_{\text{res}}\left(\frac{\text{L}}{\text{kg}}\right) + \text{Irr}_{\text{dep}}\left(\frac{\text{L}}{\text{kg}}\right)\right)}$$

where:

$$\text{Irr}_{\text{rup}}\left(\frac{\text{L}}{\text{kg}}\right) = \frac{\text{I}_r\left(\frac{\text{L}}{\text{m}^2-\text{day}}\right) \times \text{F} \times \text{MLF}_{\text{produce}}\left(\frac{0.0135\ \text{g}-\text{dry}-\text{soil}}{\text{g}-\text{fresh}-\text{plant}}\right) \times \left[1-\exp\left(-\left(\frac{\lambda_B}{\text{day}}\right) \times t_b\ (\text{days})\right)\right]}{\text{P}\left(\frac{\text{kg}}{\text{m}^2}\right) \times \left(\frac{\lambda_B}{\text{day}}\right)}$$

$$\text{Irr}_{\text{res}}\left(\frac{\text{L}}{\text{kg}}\right) = \frac{\text{I}_r\left(\frac{\text{L}}{\text{m}^2-\text{day}}\right) \times \text{F} \times \text{BV}_{\text{wet}}\left(\frac{\text{pCi / g}-\text{fresh}-\text{plant}}{\text{pCi / g}-\text{dry}-\text{soil}}\right) \times \left[1-\exp\left(-\left(\frac{\lambda_B}{\text{day}}\right) \times t_b\ (\text{days})\right)\right]}{\text{P}\left(\frac{\text{kg}}{\text{m}^2}\right) \times \left(\frac{\lambda_B}{\text{day}}\right)}$$

and:

$$\text{Irr}_{\text{dep}}\left(\frac{\text{L}}{\text{kg}}\right) = \frac{\text{I}_r\left(\frac{\text{L}}{\text{m}^2-\text{day}}\right) \times \text{F} \times \text{I}_f \times \text{T} \times \left[1-\exp\left(-\left(\frac{\lambda_E}{\text{day}}\right) \times t_v\ (\text{days})\right)\right]}{\text{Y}_v\left(\frac{\text{kg}}{\text{m}^2}\right) \times \left(\frac{\lambda_E}{\text{day}}\right)}$$

Direct Produce Ingestion

$$PRG_{res\text{-}produce\text{-}ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times \left(IFF_{res\text{-}adj}(1{,}462{,}510\ g) + IFV_{res\text{-}adj}(989{,}870\ g)\right) \times CF_{res\text{-}produce}(0.25)}\right)$$

where:

$$IFF_{res\text{-}adj}(1{,}462{,}510\ g) = \left[\begin{array}{l}\left(EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times IRF_{res\text{-}c}\left(\frac{68.1\ g}{day}\right)\right) + \\ \left(EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times IRF_{res\text{-}a}\left(\frac{188.5\ g}{day}\right)\right)\end{array}\right]$$

and:

$$IFV_{res\text{-}adj}(989{,}870\ g) = \left[\begin{array}{l}\left(EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times IRV_{res\text{-}c}\left(\frac{41.7\ g}{day}\right)\right) + \\ \left(EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times IRV_{res\text{-}a}\left(\frac{128.9\ g}{day}\right)\right)\end{array}\right]$$

Tap Water Total

$$PRG_{res\text{-}wat\text{-}tot}\left(\frac{pCi}{L}\right) = \left(\frac{1}{\frac{1}{PRG_{res\text{-}wat\text{-}ing}} + \frac{1}{PRG_{res\text{-}wat\text{-}inh}} + \frac{1}{PRG_{res\text{-}wat\text{-}imm}} + \frac{1}{PRG_{res\text{-}wat\text{-}produce\text{-}ing}}}\right)$$

Resident Fish PRG Equations

Direct Fish Ingestion

$$PRG_{res\text{-}fish\text{-}ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times ED_{res}(26\ yr) \times IRFI_{res\text{-}a}\left(\frac{54{,}000\ mg}{day}\right) \times \left(\frac{g}{1000\ mg}\right) \times CF_{res\text{-}fish}(1)}\right)$$

Surface Water Contribution to Fish Ingestion

$$PRG_{res\text{-}fish\text{-}ingw}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{res\text{-}fish\text{-}ing}\left(\frac{pCi}{g}\right)}{BCF\left(\frac{L}{kg}\right) \times \left(\frac{1\ kg}{1000\ g}\right)}\right)$$

Indoor Worker Soil PRG Equations

Soil Ingestion

$$PRG_{ind\text{-}sol\text{-}ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{sa}\left(\frac{risk}{pCi}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times IRS_{ind}\left(\frac{50\ mg}{day}\right) \times \left(\frac{g}{1000\ mg}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil Inhalation

$$PRG_{ind-sol-inh}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_i\left(\frac{risk}{pCi}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \\ \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{ind}\left(\frac{60\ m^3}{day}\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right)\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil External Exposure

$$PRG_{ind-sol-ext}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times \\ ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{i-total}\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil Total

$$PRG_{ind-sol-tot}\left(\frac{pCi}{g}\right) = \left(\frac{1}{\frac{1}{PRG_{ind-sol-ing}} + \frac{1}{PRG_{ind-sol-inh}} + \frac{1}{PRG_{ind-sol-ext}}}\right)$$

<u>Indoor Worker Alternate External Sources PRG Equations</u>

Direct External Exposure (sv)

$$PRG_{ind-sol-sv}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times \\ ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{i-total}\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (1 cm)

$$PRG_{ind-sol-1cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-1cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times \\ ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-1cm} \times GSF_{i-total}\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (5 cm)

$$PRG_{ind-sol-5cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-5cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times \\ ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-5cm} \times GSF_{i-total}\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (15 cm)

$$PRG_{ind-sol-15cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-15cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-15cm} \times GSF_{i-total}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (ground plane)

$$PRG_{ind-sol-gp}\left(\frac{pCi}{cm^2}\right) = \left(\frac{TR}{SF_{ext-gp}\left(\frac{risk/yr}{pCi/cm^2}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-gp} \times GSF_{i-total}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

<u>Indoor Worker Air PRG Equations</u>

Air Inhalation

$$PRG_{ind-air-inh}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{ind}\left(\frac{60\ m^3}{day}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Air Submersion

$$PRG_{ind-air-sub}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Air Total

$$PRG_{ind-air-tot}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{ind-air-inh}} + \frac{1}{PRG_{ind-air-sub}}}\right)$$

Air Inhalation (without decay)

$$PRG_{ind-air-inhnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{ind}\left(\frac{60\ m^3}{day}\right)}\right)$$

Air Submersion (without decay)

$$PRG_{ind-air-subnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)}\right)$$

Air Total (without decay)

$$\mathrm{PRG}_{\text{ind-air-totnd}}\left(\frac{\mathrm{pCi}}{\mathrm{m}^3}\right)=\left(\frac{1}{\frac{1}{\mathrm{PRG}_{\text{ind-air-inhnd}}}+\frac{1}{\mathrm{PRG}_{\text{ind-air-subnd}}}}\right)$$

Indoor Worker Tap Water PRG Equations

Tap Water Ingestion

$$\mathrm{PRG}_{\text{ind-wat-ing}}\left(\frac{\mathrm{pCi}}{\mathrm{L}}\right)=\left(\frac{\mathrm{TR}}{\mathrm{SF_w}\left(\frac{\mathrm{risk}}{\mathrm{pCi}}\right)\times \mathrm{EF_{ind}}\left(\frac{250\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED_{ind}}\,(25\ \mathrm{yr})\times \mathrm{IRW}_{\text{ind-a}}\left(\frac{1.25\ \mathrm{L}}{\mathrm{day}}\right)}\right)$$

Tap Water Inhalation

$$\mathrm{PRG}_{\text{ind-wat-inh}}\left(\frac{\mathrm{pCi}}{\mathrm{L}}\right)=\left(\frac{\mathrm{TR}}{\mathrm{SF_i}\left(\frac{\mathrm{risk}}{\mathrm{pCi}}\right)\times \mathrm{EF_{ind}}\left(\frac{250\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED_{ind}}\,(25\ \mathrm{yr})\times \mathrm{ET_{ind}}\left(\frac{8\ \mathrm{hrs}}{\mathrm{day}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)\times \mathrm{IRA}_{\text{ind-a}}\left(\frac{60\ \mathrm{m}^3}{\mathrm{day}}\right)\times \mathrm{K}\left(\frac{0.5\ \mathrm{L}}{\mathrm{m}^3}\right)}\right)$$

Tap Water Immersion

$$\mathrm{PRG}_{\text{ind-wat-imm}}\left(\frac{\mathrm{pCi}}{\mathrm{L}}\right)=\left(\frac{\mathrm{TR}}{\mathrm{SF_{imm}}\left(\frac{\mathrm{risk/yr}}{\mathrm{pCi/L}}\right)\times \mathrm{EF_{ind}}\left(\frac{250\ \mathrm{days}}{\mathrm{yr}}\right)\times\left(\frac{1\ \mathrm{yr}}{365\ \mathrm{days}}\right)\times \mathrm{ED_{ind}}\,(25\ \mathrm{yr})\times \mathrm{EV_{ind}}\left(\frac{1\ \mathrm{events}}{\mathrm{day}}\right)\times \mathrm{ET}_{\text{event-ind-a}}\left(\frac{0.71\ \mathrm{hrs}}{\mathrm{event}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)}\right)$$

Tap Water Total

$$\mathrm{PRG}_{\text{ind-wat-tot}}\left(\frac{\mathrm{pCi}}{\mathrm{L}}\right)=\left(\frac{1}{\frac{1}{\mathrm{PRG}_{\text{ind-wat-ing}}}+\frac{1}{\mathrm{PRG}_{\text{ind-wat-inh}}}+\frac{1}{\mathrm{PRG}_{\text{ind-wat-imm}}}}\right)$$

Outdoor Worker Soil PRG Equations

Soil Ingestion

$$\mathrm{PRG}_{\text{out-sol-ing}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right)=\left(\frac{\mathrm{TR}}{\mathrm{SF_{sa}}\left(\frac{\mathrm{risk}}{\mathrm{pCi}}\right)\times \mathrm{EF_{out}}\left(\frac{225\ \mathrm{days}}{\mathrm{yr}}\right)\times \mathrm{ED_{out}}\,(25\ \mathrm{yr})\times \mathrm{IRS_{out}}\left(\frac{100\ \mathrm{mg}}{\mathrm{day}}\right)\times\left(\frac{\mathrm{g}}{1000\ \mathrm{mg}}\right)}\right)\times\left(\frac{\mathrm{t(yr)}\times\lambda\left(\frac{1}{\mathrm{yr}}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right)\times \mathrm{t(yr)}}\right)}\right)$$

Soil Inhalation

$$PRG_{out-sol-inh}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c} SF_i\left(\frac{risk}{pCi}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \\ \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{out}\left(\frac{60\ m^3}{day}\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right) \end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil External Exposure

$$PRG_{out-sol-ext}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c} SF_{ext-sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv} \end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil Total

$$PRG_{out-sol-tot}\left(\frac{pCi}{g}\right) = \left(\frac{1}{\frac{1}{PRG_{out-sol-ing}} + \frac{1}{PRG_{out-sol-inh}} + \frac{1}{PRG_{out-sol-ext}}}\right)$$

<u>Outdoor Worker Alternate External Sources PRG Equations</u>

Direct External Exposure (sv)

$$PRG_{out-sol-sv}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c} SF_{ext-sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv} \end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (1 cm)

$$PRG_{out-sol-1cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c} SF_{ext-1cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-1cm} \times GSF_{o-ext-1cm} \end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (5 cm)

$$PRG_{out-sol-5cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c} SF_{ext-5cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-5cm} \times GSF_{o-ext-5cm} \end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (15 cm)

$$PRG_{out-sol-15cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{gathered}SF_{ext-15cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-15cm} \times GSF_{o-ext-15cm}\end{gathered}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (ground plane)

$$PRG_{out-sol-gp}\left(\frac{pCi}{cm^2}\right) = \left(\frac{TR}{\begin{gathered}SF_{ext-gp}\left(\frac{risk/yr}{pCi/cm^2}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-gp} \times GSF_{o-ext-gp}\end{gathered}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

<u>Outdoor Worker Air PRG Equations</u>

Air Inhalation

$$PRG_{out-air-inh}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{out}\left(\frac{60\ m^3}{day}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Air Submersion

$$PRG_{out-air-sub}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Air Total

$$PRG_{out-air-tot}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{out-air-inh}} + \frac{1}{PRG_{out-air-sub}}}\right)$$

Air Inhalation (without decay)

$$PRG_{out-air-inhnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{out}\left(\frac{60\ m^3}{day}\right)}\right)$$

Air Submersion (without decay)

$$PRG_{out-air-subnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)}\right)$$

Air Total (without decay)

$$PRG_{out\text{-}air\text{-}totnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{out\text{-}air\text{-}inhnd}} + \frac{1}{PRG_{out\text{-}air\text{-}subnd}}}\right)$$

Composite Worker Soil PRG Equations

Soil Ingestion

$$PRG_{com\text{-}sol\text{-}ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{sa}\left(\frac{risk}{pCi}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}\,(25\ yr) \times IRS_{com}\left(\frac{100\ mg}{day}\right) \times \left(\frac{g}{1000\ mg}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil Inhalation

$$PRG_{com\text{-}sol\text{-}inh}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{gathered}SF_i\left(\frac{risk}{pCi}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}\,(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \\ \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{com}\left(\frac{60\ m^3}{day}\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right)\end{gathered}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil External Exposure

$$PRG_{com\text{-}sol\text{-}ext}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{gathered}SF_{ext\text{-}sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}\,(25\ yr) \times ACF_{ext\text{-}sv} \times \\ \left[\left(ET_{com\text{-}o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o\text{-}ext\text{-}sv}\right) + \left(ET_{com\text{-}i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i\text{-}total}\right)\right]\end{gathered}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil Total

$$PRG_{com\text{-}sol\text{-}tot}\left(\frac{pCi}{g}\right) = \left(\frac{1}{\frac{1}{PRG_{com\text{-}sol\text{-}ing}} + \frac{1}{PRG_{com\text{-}sol\text{-}inh}} + \frac{1}{PRG_{com\text{-}sol\text{-}ext}}}\right)$$

Composite Worker Alternate External Sources PRG Equations

Direct External Exposure (sv)

$$PRG_{com\text{-}sol\text{-}sv}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{gathered}SF_{ext\text{-}sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}\,(25\ yr) \times ACF_{ext\text{-}sv} \times \\ \left[\left(ET_{com\text{-}o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o\text{-}ext\text{-}sv}\right) + \left(ET_{com\text{-}i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i\text{-}total}\right)\right]\end{gathered}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (1 cm)

$$PRG_{com-sol-1cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-1cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext-1cm} \times \left[\left(ET_{com-o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-1cm}\right) + \left(ET_{com-i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (5 cm)

$$PRG_{com-sol-5cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-5cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext-5cm} \times \left[\left(ET_{com-o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-5cm}\right) + \left(ET_{com-i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (15 cm)

$$PRG_{com-sol-15cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-15cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext-15cm} \times \left[\left(ET_{com-o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-15cm}\right) + \left(ET_{com-i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (ground plane)

$$PRG_{com-sol-gp}\left(\frac{pCi}{cm^2}\right) = \left(\frac{TR}{SF_{ext-gp}\left(\frac{risk/yr}{pCi/cm^2}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext-gp} \times \left[\left(ET_{com-o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-gp}\right) + \left(ET_{com-i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Composite Worker Air PRG Equations

Air Inhalation

$$PRG_{com-air-inh}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{com}\left(\frac{60\ m^3}{day}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Air Submersion

$$PRG_{com-air-sub}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Air Total

$$PRG_{com-air-tot}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{com-air-inh}} + \frac{1}{PRG_{com-air-sub}}}\right)$$

Air Inhalation (without decay)

$$PRG_{com-air-inhnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{com}\left(\frac{60\ m^3}{day}\right)}\right)$$

Air Submersion (without decay)

$$PRG_{com-air-subnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)}\right)$$

Air Total (without decay)

$$PRG_{com-air-totnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{com-air-inhnd}} + \frac{1}{PRG_{com-air-subnd}}}\right)$$

Excavation Worker Soil PRG Equations

Soil Ingestion

$$PRG_{exc-sol-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{sa}\left(\frac{risk}{pCi}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times IRS_{exc}\left(\frac{330\ mg}{day}\right) \times \left(\frac{g}{1000\ mg}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil Inhalation

$$PRG_{exc-sol-inh}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c} SF_i\left(\frac{risk}{pCi}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \\ \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{exc}\left(\frac{60\ m^3}{day}\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right) \end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil External Exposure

$$PRG_{exc-sol-ext}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c} SF_{ext-sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{exc}(1\ yr) \times \\ ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv} \end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil Total

$$PRG_{exc-sol-tot}\left(\frac{pCi}{g}\right) = \left(\frac{1}{\frac{1}{PRG_{exc-sol-ing}} + \frac{1}{PRG_{exc-sol-inh}} + \frac{1}{PRG_{exc-sol-ext}}}\right)$$

Excavation Worker Air PRG Equations

Air Inhalation

$$PRG_{exc-air-inh}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{exc}\left(\frac{60\ m^3}{day}\right)}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Air Submersion

$$PRG_{exc-air-sub}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_a(1.0)}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Air Total

$$PRG_{exc-air-tot}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{exc-air-inh}}+\frac{1}{PRG_{exc-air-sub}}}\right)$$

Air Inhalation (without decay)

$$PRG_{exc-air-inhnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{exc}\left(\frac{60\ m^3}{day}\right)}\right)$$

Air Submersion (without decay)

$$PRG_{exc-air-subnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_a(1.0)}\right)$$

Air Total (without decay)

$$PRG_{exc-air-totnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{exc-air-inhnd}}+\frac{1}{PRG_{exc-air-subnd}}}\right)$$

Construction Worker Soil Exposure to Unpaved Road Traffic PRG Equations

Soil Ingestion - Unpaved Road Traffic

$$PRG_{con-sol-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{sa}\left(\frac{risk}{pCi}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times IRS_{con}\left(\frac{330\ mg}{day}\right)\times\left(\frac{g}{1000\ mg}\right)}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Soil Inhalation - Unpaved Road Traffic

$$\mathrm{PRG}_{\mathrm{con-sol-inh}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right)=\left(\frac{\mathrm{TR}}{\begin{array}{c}\mathrm{SF_i}\left(\frac{\mathrm{risk}}{\mathrm{pCi}}\right)\times \mathrm{EF_{con}}\left(\mathrm{EW_{con}}\left(\frac{50\ \mathrm{wks}}{\mathrm{yr}}\right)\times \mathrm{DW_{con}}\left(\frac{5\ \mathrm{days}}{\mathrm{wk}}\right)\right)\times \mathrm{ED_{con}}\,(1\ \mathrm{yr})\times\\ \mathrm{ET_{con}}\left(\frac{8\ \mathrm{hrs}}{\mathrm{day}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)\times \mathrm{IRA_{con}}\left(\frac{60\ \mathrm{m}^3}{\mathrm{day}}\right)\times\frac{1}{\mathrm{PEF_{sc}}\left(\frac{\mathrm{m}^3}{\mathrm{kg}}\right)}\times\left(\frac{1000\ \mathrm{g}}{\mathrm{kg}}\right)\end{array}}\right)\times\left(\frac{t(\mathrm{yr})\times\lambda\left(\frac{1}{\mathrm{yr}}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right)\times t(\mathrm{yr})}\right)}\right)$$

Soil External Exposure - Unpaved Road Traffic

$$\mathrm{PRG}_{\mathrm{con-sol-ext}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right)=\left(\frac{\mathrm{TR}}{\begin{array}{c}\mathrm{SF_{ext-sv}}\left(\frac{\mathrm{risk/yr}}{\mathrm{pCi/g}}\right)\times \mathrm{EF_{con}}\left(\mathrm{EW_{con}}\left(\frac{50\ \mathrm{wks}}{\mathrm{yr}}\right)\times \mathrm{DW_{con}}\left(\frac{5\ \mathrm{days}}{\mathrm{wk}}\right)\right)\times\left(\frac{1\ \mathrm{yr}}{365\ \mathrm{days}}\right)\times\\ \mathrm{ED_{con}}\,(1\ \mathrm{yr})\times \mathrm{ET_{con}}\left(\frac{8\ \mathrm{hrs}}{\mathrm{day}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)\times \mathrm{ACF_{ext-sv}}\times \mathrm{GSF_{o-ext-sv}}\end{array}}\right)\times\left(\frac{t(\mathrm{yr})\times\lambda\left(\frac{1}{\mathrm{yr}}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right)\times t(\mathrm{yr})}\right)}\right)$$

Soil Total - Unpaved Road Traffic

$$\mathrm{PRG}_{\mathrm{con-sol-tot}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right)=\left(\frac{1}{\frac{1}{\mathrm{PRG_{con-sol-ing}}}+\frac{1}{\mathrm{PRG_{con-sol-inh}}}+\frac{1}{\mathrm{PRG_{con-sol-ext}}}}\right)$$

Construction Worker Soil Exposure to Other Construction Activities PRG Equations

Soil Ingestion - Other Construction Activities

$$\mathrm{PRG}_{\mathrm{con-sol-ingsa}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right)=\left(\frac{\mathrm{TR}}{\mathrm{SF_{sa}}\left(\frac{\mathrm{risk}}{\mathrm{pCi}}\right)\times \mathrm{EF_{con}}\left(\mathrm{EW_{con}}\left(\frac{50\ \mathrm{wks}}{\mathrm{yr}}\right)\times \mathrm{DW_{con}}\left(\frac{5\ \mathrm{days}}{\mathrm{wk}}\right)\right)\times \mathrm{ED_{con}}\,(1\ \mathrm{yr})\times \mathrm{IRS_{con}}\left(\frac{330\ \mathrm{mg}}{\mathrm{day}}\right)\times\left(\frac{\mathrm{g}}{1000\ \mathrm{mg}}\right)}\right)\times\left(\frac{t(\mathrm{yr})\times\lambda\left(\frac{1}{\mathrm{yr}}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right)\times t(\mathrm{yr})}\right)}\right)$$

Soil Inhalation - Other Construction Activities

$$\mathrm{PRG}_{\mathrm{con-sol-inhsa}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right)=\left(\frac{\mathrm{TR}}{\begin{array}{c}\mathrm{SF_i}\left(\frac{\mathrm{risk}}{\mathrm{pCi}}\right)\times \mathrm{EF_{con}}\left(\mathrm{EW_{con}}\left(\frac{50\ \mathrm{wks}}{\mathrm{yr}}\right)\times \mathrm{DW_{con}}\left(\frac{5\ \mathrm{days}}{\mathrm{wk}}\right)\right)\times \mathrm{ED_{con}}\,(1\ \mathrm{yr})\times\\ \mathrm{ET_{con}}\left(\frac{8\ \mathrm{hrs}}{\mathrm{day}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)\times \mathrm{IRA_{con}}\left(\frac{60\ \mathrm{m}^3}{\mathrm{day}}\right)\times\frac{1}{\mathrm{PEF'_{sc}}\left(\frac{\mathrm{m}^3}{\mathrm{kg}}\right)}\times\left(\frac{1000\ \mathrm{g}}{\mathrm{kg}}\right)\end{array}}\right)\times\left(\frac{t(\mathrm{yr})\times\lambda\left(\frac{1}{\mathrm{yr}}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right)\times t(\mathrm{yr})}\right)}\right)$$

Soil External Exposure - Other Construction Activities

$$\mathrm{PRG}_{\mathrm{con-sol-extsa}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right)=\left(\frac{\mathrm{TR}}{\begin{array}{c}\mathrm{SF_{ext-sv}}\left(\frac{\mathrm{risk/yr}}{\mathrm{pCi/g}}\right)\times \mathrm{EF_{con}}\left(\mathrm{EW_{con}}\left(\frac{50\ \mathrm{wks}}{\mathrm{yr}}\right)\times \mathrm{DW_{con}}\left(\frac{5\ \mathrm{days}}{\mathrm{wk}}\right)\right)\times\left(\frac{1\ \mathrm{yr}}{365\ \mathrm{days}}\right)\times\\ \mathrm{ED_{con}}\,(1\ \mathrm{yr})\times \mathrm{ET_{con}}\left(\frac{8\ \mathrm{hrs}}{\mathrm{day}}\right)\times\left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right)\times \mathrm{ACF_{ext-sv}}\times \mathrm{GSF_{o-ext-sv}}\end{array}}\right)\times\left(\frac{t(\mathrm{yr})\times\lambda\left(\frac{1}{\mathrm{yr}}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right)\times t(\mathrm{yr})}\right)}\right)$$

Soil Total - Other Construction Activities

$$PRG_{con-sol-totsa}\left(\frac{pCi}{g}\right) = \left(\frac{1}{\frac{1}{PRG_{con-sol-ingsa}} + \frac{1}{PRG_{con-sol-inhsa}} + \frac{1}{PRG_{con-sol-extsa}}}\right)$$

Construction Worker Soil Alternate External Sources PRG Equations

Direct External Exposure (sv)

$$PRG_{con-sol-sv}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (1 cm)

$$PRG_{con-sol-1cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-1cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-1cm} \times GSF_{o-ext-1cm}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (5 cm)

$$PRG_{con-sol-1cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-1cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-1cm} \times GSF_{o-ext-1cm}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (15 cm)

$$PRG_{con-sol-15cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_{ext-15cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-15cm} \times GSF_{o-ext-15cm}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (ground plane)

$$PRG_{con-sol-gp}\left(\frac{pCi}{cm^2}\right) = \left(\frac{TR}{SF_{ext-gp}\left(\frac{risk/yr}{pCi/cm^2}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-gp} \times GSF_{o-ext-gp}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Construction Worker Air PRG Equations

Air Inhalation

$$PRG_{con-air-inh}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{\begin{array}{c}SF_i\left(\frac{risk}{pCi}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times \\ ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{con}\left(\frac{60\ m^3}{day}\right)\end{array}}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Air Submersion

$$PRG_{con-air-sub}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{\begin{array}{c}SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times\left(\frac{1\ yr}{365\ days}\right)\times \\ ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_a(1.0)\end{array}}\right)\times\left(\frac{t(yr)\times\lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}\right)$$

Air Total

$$PRG_{con-air-tot}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{con-air-inh}}+\frac{1}{PRG_{con-air-sub}}}\right)$$

Air Inhalation (without decay)

$$PRG_{con-air-inhnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{\begin{array}{c}SF_i\left(\frac{risk}{pCi}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times \\ ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{con}\left(\frac{60\ m^3}{day}\right)\end{array}}\right)$$

Air Submersion (without decay)

$$PRG_{con-air-subnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{TR}{\begin{array}{c}SF_{sub}\left(\frac{risk/yr}{pCi/m^3}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times\left(\frac{1\ yr}{365\ days}\right)\times \\ ED_{con}(1\ yr)\times ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_a(1.0)\end{array}}\right)$$

Air Total (without decay)

$$PRG_{con-air-totnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{con-air-inhnd}}+\frac{1}{PRG_{con-air-subnd}}}\right)$$

Recreator Soil PRG Equations

Soil Ingestion

$$\mathrm{PRG}_{\text{rec-sol-ing}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) = \left(\frac{\mathrm{TR}}{\mathrm{SF_o}\left(\frac{\mathrm{risk}}{\mathrm{pCi}}\right) \times \mathrm{IFS}_{\text{rec-adj}}\,(240{,}000\ \mathrm{mg}) \times \left(\frac{\mathrm{g}}{1000\ \mathrm{mg}}\right)}\right) \times \left(\frac{t(\mathrm{yr}) \times \lambda\left(\frac{1}{\mathrm{yr}}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right)\times t(\mathrm{yr})}\right)}\right)$$

where:

$$\mathrm{IFS}_{\text{rec-adj}}\,(240{,}000\ \mathrm{mg}) = \left[\begin{array}{l}\left(\mathrm{EF}_{\text{rec-c}}\left(\frac{75\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\text{rec-c}}\,(6\ \mathrm{yr}) \times \mathrm{IRS}_{\text{rec-c}}\left(\frac{200\ \mathrm{mg}}{\mathrm{day}}\right)\right) + \\ \left(\mathrm{EF}_{\text{rec-a}}\left(\frac{75\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\text{rec-a}}\,(20\ \mathrm{yr}) \times \mathrm{IRS}_{\text{rec-a}}\left(\frac{100\ \mathrm{mg}}{\mathrm{day}}\right)\right)\end{array}\right]$$

Soil Inhalation

$$\mathrm{PRG}_{\text{rec-sol-inh}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) = \left(\frac{\mathrm{TR}}{\mathrm{SF_i}\left(\frac{\mathrm{risk}}{\mathrm{pCi}}\right) \times \mathrm{IFA}_{\text{rec-adj}}\left(1{,}437.5\ \mathrm{m^3}\right) \times \frac{1}{\mathrm{PEF}\left(\frac{\mathrm{m^3}}{\mathrm{kg}}\right)} \times \left(\frac{1000\ \mathrm{g}}{\mathrm{kg}}\right)}\right) \times \left(\frac{t(\mathrm{yr}) \times \lambda\left(\frac{1}{\mathrm{yr}}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right)\times t(\mathrm{yr})}\right)}\right)$$

where:

$$\mathrm{IFA}_{\text{rec-adj}}\left(1{,}437.5\ \mathrm{m^3}\right) = \left[\begin{array}{l}\left(\mathrm{EF}_{\text{rec-c}}\left(\frac{75\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\text{rec-c}}\,(6\ \mathrm{yr}) \times \mathrm{ET}_{\text{rec-c}}\left(\frac{1\ \mathrm{hrs}}{\mathrm{day}}\right) \times \left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right) \times \mathrm{IRA}_{\text{rec-c}}\left(\frac{10\ \mathrm{m^3}}{\mathrm{day}}\right)\right) + \\ \left(\mathrm{EF}_{\text{rec-a}}\left(\frac{75\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\text{rec-a}}\,(20\ \mathrm{yr}) \times \mathrm{ET}_{\text{rec-a}}\left(\frac{1\ \mathrm{hrs}}{\mathrm{day}}\right) \times \left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right) \times \mathrm{IRA}_{\text{rec-a}}\left(\frac{20\ \mathrm{m^3}}{\mathrm{day}}\right)\right)\end{array}\right]$$

Soil External Exposure

$$\mathrm{PRG}_{\text{rec-sol-ext}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) = \left(\frac{\mathrm{TR}}{\begin{array}{c}\mathrm{SF}_{\text{ext-sv}}\left(\frac{\mathrm{risk/yr}}{\mathrm{pCi/g}}\right) \times \mathrm{EF}_{\text{rec}}\left(\frac{75\ \mathrm{days}}{\mathrm{yr}}\right) \times \left(\frac{1\ \mathrm{yr}}{365\ \mathrm{days}}\right) \times \mathrm{ED}_{\text{rec}}\,(26\ \mathrm{yr}) \times \\ \mathrm{ET}_{\text{rec}}\left(\frac{1\ \mathrm{hrs}}{\mathrm{day}}\right) \times \left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right) \times \mathrm{ACF}_{\text{ext-sv}} \times \mathrm{GSF}_{\text{o-ext-sv}}\end{array}}\right) \times \left(\frac{t(\mathrm{yr}) \times \lambda\left(\frac{1}{\mathrm{yr}}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right)\times t(\mathrm{yr})}\right)}\right)$$

Soil Total

$$\mathrm{PRG}_{\text{rec-sol-tot}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) = \left(\frac{1}{\frac{1}{\mathrm{PRG}_{\text{rec-sol-ing}}} + \frac{1}{\mathrm{PRG}_{\text{rec-sol-inh}}} + \frac{1}{\mathrm{PRG}_{\text{rec-sol-ext}}}}\right)$$

Recreator Alternate External Sources PRG Equations

Direct External Exposure (sv)

$$PRG_{rec-sol-sv}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{rec}(26\ yr) \times \\ ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv}\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (1 cm)

$$PRG_{rec-sol-1cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-1cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{rec}(26\ yr) \times \\ ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-1cm} \times GSF_{o-ext-1cm}\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (5 cm)

$$PRG_{rec-sol-5cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-5cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{rec}(26\ yr) \times \\ ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-5cm} \times GSF_{o-ext-5cm}\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (15 cm)

$$PRG_{rec-sol-15cm}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-15cm}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{rec}(26\ yr) \times \\ ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-15cm} \times GSF_{o-ext-15cm}\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Direct External Exposure (ground plane)

$$PRG_{rec-sol-gp}\left(\frac{pCi}{cm^2}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-gp}\left(\frac{risk/yr}{pCi/cm^2}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{rec}(26\ yr) \times \\ ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-gp} \times GSF_{o-ext-gp}\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Recreator Air PRG Equations

Air Inhalation

$$\text{PRG}_{\text{rec-air-inh}}\left(\frac{\text{pCi}}{\text{m}^3}\right) = \left(\frac{\text{TR}}{\text{SF}_\text{i}\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFA}_{\text{rec-adj}}\left(1{,}437.5\ \text{m}^3\right)}\right) \times \left(\frac{\text{t(yr)} \times \lambda\left(\frac{1}{\text{yr}}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{\text{yr}}\right) \times \text{t(yr)}}\right)}\right)$$

where:

$$\text{IFA}_{\text{rec-adj}}\left(1{,}437.5\ \text{m}^3\right) = \left[\begin{array}{l}\left(\text{EF}_{\text{rec-c}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-c}}(6\ \text{yr}) \times \text{ET}_{\text{rec-c}}\left(\frac{1\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{rec-c}}\left(\frac{10\ \text{m}^3}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{rec-a}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-a}}(20\ \text{yr}) \times \text{ET}_{\text{rec-a}}\left(\frac{1\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{rec-a}}\left(\frac{20\ \text{m}^3}{\text{day}}\right)\right)\end{array}\right]$$

Air Submersion

$$\text{PRG}_{\text{rec-air-sub}}\left(\frac{\text{pCi}}{\text{m}^3}\right) = \left(\frac{\text{TR}}{\text{SF}_{\text{sub}}\left(\frac{\text{risk/yr}}{\text{pCi/m}^3}\right) \times \text{EF}_{\text{rec}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \left(\frac{1\ \text{yr}}{365\ \text{days}}\right) \times \text{ED}_{\text{rec}}(26\ \text{yr}) \times \text{ET}_{\text{rec}}\left(\frac{1\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{GSF}_\text{a}(1.0)}\right) \times \left(\frac{\text{t(yr)} \times \lambda\left(\frac{1}{\text{yr}}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{\text{yr}}\right) \times \text{t(yr)}}\right)}\right)$$

Air Total

$$\text{PRG}_{\text{rec-air-tot}}\left(\frac{\text{pCi}}{\text{m}^3}\right) = \left(\frac{1}{\frac{1}{\text{PRG}_{\text{rec-air-inh}}} + \frac{1}{\text{PRG}_{\text{rec-air-sub}}}}\right)$$

Air Inhalation (without decay)

$$\text{PRG}_{\text{rec-air-inhnd}}\left(\frac{\text{pCi}}{\text{m}^3}\right) = \left(\frac{\text{TR}}{\text{SF}_\text{i}\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFA}_{\text{rec-adj}}\left(1{,}437.5\ \text{m}^3\right)}\right)$$

where:

$$\text{IFA}_{\text{rec-adj}}\left(1{,}437.5\ \text{m}^3\right) = \left[\begin{array}{l}\left(\text{EF}_{\text{rec-c}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-c}}(6\ \text{yr}) \times \text{ET}_{\text{rec-c}}\left(\frac{1\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{rec-c}}\left(\frac{10\ \text{m}^3}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{rec-a}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \text{ED}_{\text{rec-a}}(20\ \text{yr}) \times \text{ET}_{\text{rec-a}}\left(\frac{1\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{IRA}_{\text{rec-a}}\left(\frac{20\ \text{m}^3}{\text{day}}\right)\right)\end{array}\right]$$

Air Submersion (without decay)

$$\text{PRG}_{\text{rec-air-subnd}}\left(\frac{\text{pCi}}{\text{m}^3}\right) = \left(\frac{\text{TR}}{\text{SF}_{\text{sub}}\left(\frac{\text{risk/yr}}{\text{pCi/m}^3}\right) \times \text{EF}_{\text{rec}}\left(\frac{75\ \text{days}}{\text{yr}}\right) \times \left(\frac{1\ \text{yr}}{365\ \text{days}}\right) \times \text{ED}_{\text{rec}}(26\ \text{yr}) \times \text{ET}_{\text{rec}}\left(\frac{1\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \text{GSF}_\text{a}(1.0)}\right)$$

Air Total (without decay)

$$PRG_{rec-air-totnd}\left(\frac{pCi}{m^3}\right) = \left(\frac{1}{\frac{1}{PRG_{rec-air-inhnd}} + \frac{1}{PRG_{rec-air-subnd}}}\right)$$

Recreator Consumption of Fowl and Game PRG Equations

Direct Fowl Ingestion

$$PRG_{rec-fowl-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times EF_{rec}\left(\frac{days}{yr}\right) \times ED_{rec}\,(26\ yr) \times IRGF_{rec}\left(\frac{g}{day}\right) \times CF_{rec-fowl}\,(1)}\right)$$

Soil Contribution to Fowl Ingestion

$$PRG_{rec-sol-fowl-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{rec-fowl-ing}\left(\frac{pCi}{g}\right)}{TF_{fowl}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-fowl}\left(\frac{kg}{day}\right) \times f_{p-fowl}\,(1) \times f_{s-fowl}\,(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-fowl}\left(\frac{kg}{day}\right) \times f_{p-fowl}\,(1)\right)\end{array}\right]}\right) \times \left(\frac{t\,(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t\,(yr)}\right)}\right)$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi\ /\ g-dry-plant}{pCi\ /\ g-dry-soil}\right);\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Surface Water Contribution to Fowl Ingestion

$$PRG_{rec-wat-fowl-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{rec-fowl-ing}\left(\frac{pCi}{g}\right)}{TF_{fowl}\left(\frac{day}{kg}\right) \times Q_{w-fowl}\left(\frac{L}{day}\right) \times f_{w-fowl}\,(1) \times \left(\frac{1\ kg}{1000\ g}\right)}\right)$$

Direct Land Game Ingestion

$$PRG_{rec-game-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times EF_{rec}\left(\frac{days}{yr}\right) \times ED_{rec}\,(26\ yr) \times IRGL_{rec}\left(\frac{g}{day}\right) \times CF_{rec-game}\,(1)}\right)$$

Soil Contribution to Land Game Ingestion

$$PRG_{rec\text{-}sol\text{-}game\text{-}ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{rec\text{-}game\text{-}ing}\left(\frac{pCi}{g}\right)}{TF_{game}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p\text{-}game}\left(\frac{kg}{day}\right) \times f_{p\text{-}game}(1) \times f_{s\text{-}game}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s\text{-}game}\left(\frac{kg}{day}\right) \times f_{p\text{-}game}(1)\right)\end{array}\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g - dry - plant}{pCi / g - dry - soil}\right);\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g - dry - soil}{g - dry - plant}\right)$$

Surface Water Contribution to Land Game Ingestion

$$PRG_{rec\text{-}wat\text{-}game\text{-}ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{rec\text{-}game\text{-}ing}\left(\frac{pCi}{g}\right)}{TF_{game}\left(\frac{day}{kg}\right) \times Q_{w\text{-}game}\left(\frac{L}{day}\right) \times f_{w\text{-}game}(1) \times \left(\frac{1\ kg}{1000\ g}\right)}\right)$$

Recreator Surface Water PRG Equations

Surface Water Ingestion

$$PRG_{rec\text{-}wat\text{-}ing}\left(\frac{pCi}{L}\right) = \left(\frac{TR}{SF_{w}\left(\frac{risk}{pCi}\right) \times IFW_{rec\text{-}adj}(131.4\ L)}\right)$$

where:

$$IFW_{rec\text{-}adj}(131.4\ L) = \left[\begin{array}{c}\left(EF_{rec\text{-}c}\left(\frac{45\ days}{yr}\right) \times ED_{rec\text{-}c}(6\ yr) \times EV_{rec\text{-}c}\left(\frac{1\ events}{day}\right) \times ET_{event\text{-}rec\text{-}c}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec\text{-}c}\left(\frac{0.12\ L}{day}\right)\right) + \\ \left(EF_{rec\text{-}a}\left(\frac{45\ days}{yr}\right) \times ED_{rec\text{-}a}(20\ yr) \times EV_{rec\text{-}a}\left(\frac{1\ events}{day}\right) \times ET_{event\text{-}rec\text{-}a}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec\text{-}a}\left(\frac{0.11\ L}{day}\right)\right)\end{array}\right]$$

Surface Water Immersion

$$PRG_{rec\text{-}wat\text{-}imm}\left(\frac{pCi}{L}\right) = \left(\frac{TR}{SF_{imm}\left(\frac{risk/yr}{pCi/L}\right) \times \left(\frac{1\ yr}{8,760\ hrs}\right) \times DFA_{rec\text{-}adj}(1,170\ hrs)}\right)$$

where:

$$DFA_{rec\text{-}adj}(1,170\ hrs) = \left[\begin{array}{c}\left(EF_{rec\text{-}c}\left(\frac{45\ days}{yr}\right) \times ED_{rec\text{-}c}(6\ yr) \times EV_{rec\text{-}c}\left(\frac{1\ events}{day}\right) \times ET_{event\text{-}rec\text{-}c}\left(\frac{1\ hrs}{event}\right)\right) + \\ \left(EF_{rec\text{-}a}\left(\frac{45\ days}{yr}\right) \times ED_{rec\text{-}a}(20\ yr) \times EV_{rec\text{-}a}\left(\frac{1\ events}{day}\right) \times ET_{event\text{-}rec\text{-}a}\left(\frac{1\ hrs}{event}\right)\right)\end{array}\right]$$

Surface Water Total

$$PRG_{rec-wat-tot}\left(\frac{pCi}{L}\right) = \left(\frac{1}{\frac{1}{PRG_{rec-wat-ing}} + \frac{1}{PRG_{rec-wat-imm}}}\right)$$

Farmer Direct Consumption of Agricultural Products PRG Equations

Direct Produce Ingestion

$$PRG_{far-produce-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times \left(IFF_{far-adj}(2,246,930\ g) + IFV_{far-adj}(1,583,400\ g)\right) \times CF_{far-produce}(1)}\right)$$

where:

$$IFF_{far-adj}(2,246,930\ g) = \begin{bmatrix} \left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68.1\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176.8\ g}{day}\right)\right) \end{bmatrix}$$

and:

$$IFV_{far-adj}(1,583,400\ g) = \begin{bmatrix} \left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41.7\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125.7\ g}{day}\right)\right) \end{bmatrix}$$

Direct Egg Ingestion

$$PRG_{far-egg-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times IFE_{far-adj}(658,455\ g) \times CF_{far-egg}(1)}\right)$$

where:

$$IFE_{far-adj}(658,455\ g) = \begin{bmatrix} \left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRE_{far-c}\left(\frac{10.95\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRE_{far-a}\left(\frac{53.4\ g}{day}\right)\right) \end{bmatrix}$$

Direct Poultry Ingestion

$$PRG_{far-poultry-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times IFP_{far-adj}(1{,}318{,}100\ g) \times CF_{far-poultry}(1)}\right)$$

where:

$$IFP_{far-adj}(1{,}318{,}100\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRP_{far-c}\left(\frac{23.6\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRP_{far-a}\left(\frac{106.6\ g}{day}\right)\right)\end{array}\right]$$

Direct Fish Ingestion

$$PRG_{far-fish-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times IFFI_{far-adj}(1{,}918{,}140\ g) \times CF_{far-fish}(1)}\right)$$

where:

$$IFFI_{far-adj}(1{,}918{,}140\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRFI_{far-c}\left(\frac{32.8\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRFI_{far-a}\left(\frac{155.4\ g}{day}\right)\right)\end{array}\right]$$

Direct Beef Ingestion

$$PRG_{far-beef-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times IFB_{far-adj}(2{,}202{,}410\ g) \times CF_{far-beef}(1)}\right)$$

where:

$$IFB_{far-adj}(2{,}202{,}410\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRB_{far-c}\left(\frac{40.1\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRB_{far-a}\left(\frac{178\ g}{day}\right)\right)\end{array}\right]$$

Direct Dairy Ingestion

$$\text{PRG}_{\text{far-dairy-ing}}\left(\frac{\text{pCi}}{\text{g}}\right) = \left(\frac{\text{TR}}{\text{SF}_\text{f}\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFD}_{\text{far-adj}}\,(6{,}036{,}590\text{ g}) \times \text{CF}_{\text{far-dairy}}\,(1)}\right)$$

where:

$$\text{IFD}_{\text{far-adj}}\,(6{,}036{,}590\text{ g}) = \left[\begin{array}{l}\left(\text{EF}_{\text{far-c}}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{\text{far-c}}\,(6\text{ yr}) \times \text{IRD}_{\text{far-c}}\left(\frac{349.5\text{ g}}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{far-a}}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{\text{far-a}}\,(34\text{ yr}) \times \text{IRD}_{\text{far-a}}\left(\frac{445.6\text{ g}}{\text{day}}\right)\right)\end{array}\right]$$

Direct Swine Ingestion

$$\text{PRG}_{\text{far-swine-ing}}\left(\frac{\text{pCi}}{\text{g}}\right) = \left(\frac{\text{TR}}{\text{SF}_\text{f}\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFSW}_{\text{far-adj}}\,(1{,}203{,}860\text{ g}) \times \text{CF}_{\text{far-swine}}\,(1)}\right)$$

where:

$$\text{IFSW}_{\text{far-adj}}\,(1{,}203{,}860\text{ g}) = \left[\begin{array}{l}\left(\text{EF}_{\text{far-c}}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{\text{far-c}}\,(6\text{ yr}) \times \text{IRSW}_{\text{far-c}}\left(\frac{18.5\text{ g}}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{far-a}}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{\text{far-a}}\,(34\text{ yr}) \times \text{IRSW}_{\text{far-a}}\left(\frac{97.9\text{ g}}{\text{day}}\right)\right)\end{array}\right]$$

Farmer Direct Consumption of Agricultural Products - Back-calculated to Soil PRG Equations

Soil Ingestion

$$\text{PRG}_{\text{far-sol-ing}}\left(\frac{\text{pCi}}{\text{g}}\right) = \left(\frac{\text{TR}}{\text{SF}_\text{o}\left(\frac{\text{risk}}{\text{pCi}}\right) \times \text{IFS}_{\text{far-adj}}\,(1{,}610{,}000\text{ mg}) \times \left(\frac{\text{g}}{1000\text{ mg}}\right)}\right) \times \left(\frac{\text{t(yr)} \times \lambda\left(\frac{1}{\text{yr}}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{\text{yr}}\right) \times \text{t(yr)}}\right)}\right)$$

where:

$$\text{IFS}_{\text{far-adj}}\,(1{,}610{,}000\text{ mg}) = \left[\begin{array}{l}\left(\text{EF}_{\text{far-c}}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{\text{far-c}}\,(6\text{ yr}) \times \text{IRS}_{\text{far-c}}\left(\frac{200\text{ mg}}{\text{day}}\right)\right) + \\ \left(\text{EF}_{\text{far-a}}\left(\frac{350\text{ days}}{\text{yr}}\right) \times \text{ED}_{\text{far-a}}\,(34\text{ yr}) \times \text{IRS}_{\text{far-a}}\left(\frac{100\text{ mg}}{\text{day}}\right)\right)\end{array}\right]$$

Soil Inhalation

$$PRG_{far-sol-inh}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right) \times IFA_{far-adj}\left(259{,}000\ m^3\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$IFA_{far-adj}\left(259{,}000\ m^3\right) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times ET_{far-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{far-c}\left(\frac{10\ m^3}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times ET_{far-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{far-a}\left(\frac{20\ m^3}{day}\right)\right)\end{array}\right]$$

Soil External Exposure

$$PRG_{far-sol-ext}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{\begin{array}{c}SF_{ext-sv}\left(\frac{risk/yr}{pCi/g}\right) \times EF_{far}\left(\frac{350\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{far}(40\ yr) \times ACF_{ext-sv} \times \\ \left[\left(ET_{far-o}\left(\frac{12.168\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-sv}\right) + \left(ET_{far-i}\left(\frac{10.008\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right]\end{array}}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

Soil Contribution to Produce Ingestion

$$PRG_{far-sol-produce-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-produce-ing}\left(\frac{pCi}{g}\right)}{\left(R_{upv} + R_{es}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$R_{upv} = BV_{wet}\left(\frac{pCi / g - fresh - plant}{pCi / g - dry - soil}\right) ;\ R_{es} = MLF_{produce}\left(\frac{0.0135\ g - dry - soil}{g - fresh - plant}\right)$$

Direct Produce Ingestion

$$PRG_{far-produce-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times \left(IFF_{far-adj}(2{,}246{,}930\ g) + IFV_{far-adj}(1{,}583{,}400\ g)\right) \times CF_{far-produce}(1)}\right)$$

where:

$$IFF_{far-adj}(2{,}246{,}930\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68.1\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176.8\ g}{day}\right)\right)\end{array}\right]$$

and:

$$IFV_{far-adj}(1{,}583{,}400\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41.7\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125.7\ g}{day}\right)\right)\end{array}\right]$$

Soil Contribution to Egg Ingestion

$$PRG_{far-sol-egg-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-egg-ing}\left(\frac{pCi}{g}\right)}{TF_{egg}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-poultry}\left(\frac{0.2\ kg}{day}\right) \times f_{p-poultry}(1) \times f_{s-poultry}(1) \times (R_{upp} + R_{es})\right) + \\ \left(Q_{s-poultry}\left(\frac{0.022\ kg}{day}\right) \times f_{p-poultry}(1)\right)\end{array}\right]}\right)$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right) ; R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Soil Contribution to Poultry Ingestion

$$PRG_{far-sol-poultry-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-poultry-ing}\left(\frac{pCi}{g}\right)}{TF_{poultry}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-poultry}\left(\frac{0.2\ kg}{day}\right) \times f_{p-poultry}(1) \times f_{s-poultry}(1) \times (R_{upp} + R_{es})\right) + \\ \left(Q_{s-poultry}\left(\frac{0.022\ kg}{day}\right) \times f_{p-poultry}(1)\right)\end{array}\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right) ; R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Soil Contribution to Fish Ingestion

$$PRG_{far-sol-fish-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-fish-ing}\left(\frac{pCi}{g}\right) \times K_d\left(\frac{L}{kg}\right)}{BCF\left(\frac{L}{kg}\right)}\right)$$

Soil Contribution to Beef Ingestion

$$PRG_{far-sol-beef-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-beef-ing}\left(\frac{pCi}{g}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times (R_{upp} + R_{es})\right) + \\ \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\end{array}\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right) ; R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Soil Contribution to Dairy Ingestion

$$PRG_{far-sol-dairy-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-dairy-ing}\left(\frac{pCi}{g}\right)}{TF_{dairy}\left(\frac{day}{L-milk}\right) \times \rho_m\left(\frac{1.03\ kg}{L-milk}\right)^{-1} \times \left[\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times (R_{upp} + R_{es})\right) + \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right) ; R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Soil Contribution to Swine Ingestion

$$PRG_{far-sol-swine-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-swine-ing}\left(\frac{pCi}{g}\right)}{TF_{swine}\left(\frac{day}{kg}\right) \times \left[\left(Q_{p-swine}\left(\frac{4.7\ kg}{day}\right) \times f_{p-swine}(1) \times f_{s-swine}(1) \times (R_{upp} + R_{es})\right) + \left(Q_{s-swine}\left(\frac{0.37\ kg}{day}\right) \times f_{p-swine}(1)\right)\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right) ; R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Soil Total

$$PRG_{far-sol-tot}\left(\frac{pCi}{g}\right) = \left(\frac{1}{\frac{1}{PRG_{far-sol-ing}} + \frac{1}{PRG_{far-sol-inh}} + \frac{1}{PRG_{far-sol-ext}} + \frac{1}{PRG_{far-sol-produce-ing-tot}} + \frac{1}{PRG_{far-sol-egg-ing}} + \frac{1}{PRG_{far-sol-poultry-ing}} + \frac{1}{PRG_{far-sol-finfish-ing}} + \frac{1}{PRG_{far-sol-beef-ing}} + \frac{1}{PRG_{far-sol-dairy-ing}} + \frac{1}{PRG_{far-sol-swine-ing}}}\right)$$

<u>Farmer Direct Consumption of Agricultural Products - Back-calculated to Water PRG Equations</u>

Tap Water Ingestion

$$PRG_{far-wat-ing}\left(\frac{pCi}{L}\right) = \left(\frac{TR}{SF_w\left(\frac{risk}{pCi}\right) \times IFW_{far-adj}(31{,}388\ L)}\right)$$

where:

$$IFW_{far-adj}(31{,}388\ L) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRW_{far-c}\left(\frac{0.78\ L}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRW_{far-a}\left(\frac{2.5\ L}{day}\right)\right)\right]$$

Tap Water Inhalation

$$PRG_{far-wat-inh}\left(\frac{pCi}{L}\right) = \left(\frac{TR}{SF_i\left(\frac{risk}{pCi}\right) \times IFA_{far-adj}\left(259{,}000\ m^3\right) \times K\left(\frac{0.5\ L}{m^3}\right)}\right)$$

where:

$$IFA_{far-adj}\left(259{,}000\ m^3\right) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times ET_{far-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{far-c}\left(\frac{10\ m^3}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times ET_{far-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{far-a}\left(\frac{20\ m^3}{day}\right)\right)\end{array}\right]$$

Tap Water Immersion

$$PRG_{far-wat-imm}\left(\frac{pCi}{L}\right) = \left(\frac{TR}{SF_{imm}\left(\frac{risk/yr}{pCi/L}\right) \times \left(\frac{1\ yr}{8{,}760\ hrs}\right) \times DFA_{far-adj}\left(9{,}583\ hrs\right)}\right)$$

where:

$$DFA_{far-adj}\left(9{,}583\ hrs\right) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times EV_{far-c}\left(\frac{1\ events}{day}\right) \times ET_{event-far-c}\left(\frac{0.54\ hrs}{event}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times EV_{far-a}\left(\frac{1\ events}{day}\right) \times ET_{event-far-a}\left(\frac{0.71\ hrs}{event}\right)\right)\end{array}\right]$$

Tap Water Contribution to Produce Ingestion

$$PRG_{far-wat-produce-ing}\left(\frac{pCi}{L}\right) = \frac{PRG_{far-produce-ing}\left(\frac{pCi}{g}\right)}{\left(\frac{1\ kg}{1000\ g}\right) \times \left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right)}$$

where:

$$Irr_{rup}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times MLF_{produce}\left(\frac{0.0135\ g-dry-soil}{g-fresh-plant}\right) \times \left[1-\exp\left(-\left(\frac{\lambda_B}{day}\right) \times t_b\,(days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

$$Irr_{res}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times BV_{wet}\left(\frac{pCi\ /\ g-fresh-plant}{pCi\ /\ g-dry-soil}\right) \times \left[1-\exp\left(-\left(\frac{\lambda_B}{day}\right) \times t_b\,(days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{dep}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times I_f \times T \times \left[1-\exp\left(-\left(\frac{\lambda_E}{day}\right) \times t_v\,(days)\right)\right]}{Y_v\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_E}{day}\right)}$$

Direct Produce Ingestion

$$PRG_{far-produce-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times \left(IFF_{far-adj}(2,246,930\text{ g}) + IFV_{far-adj}(1,583,400\text{ g})\right) \times CF_{far-produce}(1)}\right)$$

where:

$$IFF_{far-adj}(2,246,930\text{ g}) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\text{ days}}{yr}\right) \times ED_{far-c}(6\text{ yr}) \times IRF_{far-c}\left(\frac{68.1\text{ g}}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\text{ days}}{yr}\right) \times ED_{far-a}(34\text{ yr}) \times IRF_{far-a}\left(\frac{176.8\text{ g}}{day}\right)\right)\end{array}\right]$$

and:

$$IFV_{far-adj}(1,583,400\text{ g}) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\text{ days}}{yr}\right) \times ED_{far-c}(6\text{ yr}) \times IRV_{far-c}\left(\frac{41.7\text{ g}}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\text{ days}}{yr}\right) \times ED_{far-a}(34\text{ yr}) \times IRV_{far-a}\left(\frac{125.7\text{ g}}{day}\right)\right)\end{array}\right]$$

Tap Water Contribution to Egg Ingestion

$$PRG_{far-wat-egg-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-egg-ing}\left(\frac{pCi}{g}\right)}{TF_{egg}\left(\frac{day}{kg}\right) \times Q_{w-poultry}\left(\frac{0.4\text{ L}}{day}\right) \times f_{w-poultry}(1) \times \left(\frac{1\text{ kg}}{1000\text{ g}}\right)}\right)$$

Tap Water Contribution to Poultry Ingestion

$$PRG_{far-wat-poultry-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-poultry-ing}\left(\frac{pCi}{g}\right)}{TF_{poultry}\left(\frac{day}{kg}\right) \times Q_{w-poultry}\left(\frac{0.4\text{ L}}{day}\right) \times f_{w-poultry}(1) \times \left(\frac{1\text{ kg}}{1000\text{ g}}\right)}\right)$$

Tap Water Contribution to Fish Ingestion

$$PRG_{far-wat-fish-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-fish-ing}\left(\frac{pCi}{g}\right)}{BCF\left(\frac{L}{kg}\right) \times \left(\frac{1\text{ kg}}{1000\text{ g}}\right)}\right)$$

Tap Water Contribution to Beef Ingestion

$$PRG_{far-wat-beef-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-beef-ing}\left(\frac{pCi}{g}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times Q_{w-beef}\left(\frac{53\text{ L}}{day}\right) \times f_{w-beef}(1) \times \left(\frac{1\text{ kg}}{1000\text{ g}}\right)}\right)$$

Tap Water Contribution to Dairy Ingestion

$$PRG_{far-wat-dairy-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-dairy-ing}\left(\frac{pCi}{g}\right)}{TF_{dairy}\left(\frac{day}{L-milk}\right) \times \rho_m \left(\frac{1.03\ kg}{L-milk}\right)^{-1} \times Q_{w-dairy}\left(\frac{92\ L}{day}\right) \times f_{w-dairy}(1) \times \left(\frac{1\ kg}{1000\ g}\right)}\right)$$

Tap Water Contribution to Swine Ingestion

$$PRG_{far-wat-swine-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-swine-ing}\left(\frac{pCi}{g}\right)}{TF_{swine}\left(\frac{day}{kg}\right) \times Q_{w-swine}\left(\frac{11.4\ L}{day}\right) \times f_{w-swine}(1) \times \left(\frac{1\ kg}{1000\ g}\right)}\right)$$

Tap Water Total

$$PRG_{far-wat-tot}\left(\frac{pCi}{L}\right) = \left(\frac{1}{\frac{1}{PRG_{far-wat-ing}} + \frac{1}{PRG_{far-wat-inh}} + \frac{1}{PRG_{far-wat-imm}} + \frac{1}{PRG_{far-wat-produce-ing-tot}} + \frac{1}{PRG_{far-wat-egg-ing}} + \frac{1}{PRG_{far-wat-poultry-ing}} + \frac{1}{PRG_{far-wat-finfish-ing}} + \frac{1}{PRG_{far-wat-beef-ing}} + \frac{1}{PRG_{far-wat-dairy-ing}} + \frac{1}{PRG_{far-wat-swine-ing}}}\right)$$

Farmer Direct Consumption of Agricultural Products - Back-calculated to Soil and Water PRG Equations

Soil and Tap Water Contribution to Produce Ingestion

y – INTERCEPT =

$$PRG_{far-sw-produce-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-produce-ing}\left(\frac{pCi}{g}\right)}{(R_{upv} + R_{es})}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

and:

x – INTERCEPT =

$$PRG_{far-sw-produce-ing}\left(\frac{pCi}{L}\right) = \frac{PRG_{far-produce-ing}\left(\frac{pCi}{g}\right)}{\left(\frac{1\ kg}{1000\ g}\right) \times \left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right)}$$

Soil and Tap Water Contribution to Egg Ingestion

y-INTERCEPT =

$$PRG_{far-soil-egg-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-egg-ing}\left(\frac{pCi}{g}\right)}{TF_{egg}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-poultry}\left(\frac{0.2\ kg}{day}\right) \times f_{p-poultry}(1) \times f_{s-poultry}(1) \times (R_{upp} + R_{es})\right) + \\ \left(Q_{s-poultry}\left(\frac{0.022\ kg}{day}\right) \times f_{p-poultry}(1)\right)\end{array}\right]}\right)$$

and:

x-INTERCEPT =

$$PRG_{far-wat-egg-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-egg-ing}\left(\frac{pCi}{g}\right)}{TF_{egg}\left(\frac{day}{kg}\right) \times Q_{w-poultry}\left(\frac{0.4\ L}{day}\right) \times f_{w-poultry}(1) \times \left(\frac{1\ kg}{1000\ g}\right)}\right)$$

and:

$$SLOPE = \frac{Q_{w-poultry}\left(\frac{0.4\ L}{day}\right) \times f_{w-poultry}(1)}{\left(Q_{p-poultry}\left(\frac{0.2\ kg}{day}\right) \times f_{p-poultry}(1) \times f_{s-poultry}(1) \times (R_{upp} + R_{es})\right) + \left(Q_{s-poultry}\left(\frac{0.022\ kg}{day}\right) \times f_{p-poultry}(1)\right)}$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right);\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Soil and Tap Water Contribution to Poultry Ingestion

y-INTERCEPT =

$$PRG_{far-soil-poultry-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-poultry-ing}\left(\frac{pCi}{g}\right)}{TF_{poultry}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-poultry}\left(\frac{0.2\ kg}{day}\right) \times f_{p-poultry}(1) \times f_{s-poultry}(1) \times (R_{upp} + R_{es})\right) + \\ \left(Q_{s-poultry}\left(\frac{0.022\ kg}{day}\right) \times f_{p-poultry}(1)\right)\end{array}\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

and:

x-INTERCEPT =

$$PRG_{far-wat-poultry-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-poultry-ing}\left(\frac{pCi}{g}\right)}{TF_{poultry}\left(\frac{day}{kg}\right) \times Q_{w-poultry}\left(\frac{0.4\ L}{day}\right) \times f_{w-poultry}(1) \times \left(\frac{1\ kg}{1000\ g}\right)}\right)$$

and:

$$SLOPE = \frac{Q_{w-poultry}\left(\frac{0.4\ L}{day}\right) \times f_{w-poultry}(1)}{\left(Q_{p-poultry}\left(\frac{0.2\ kg}{day}\right) \times f_{p-poultry}(1) \times f_{s-poultry}(1) \times (R_{upp} + R_{es})\right) + \left(Q_{s-poultry}\left(\frac{0.022\ kg}{day}\right) \times f_{p-poultry}(1)\right)}$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right);\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Soil and Tap Water Contribution to Fish Ingestion

$$y-\text{INTERCEPT} =$$

$$\text{PRG}_{\text{far-soil-fish-ing}}\left(\frac{\text{pCi}}{\text{g}}\right) = \left(\frac{\text{PRG}_{\text{far-fish-ing}}\left(\frac{\text{pCi}}{\text{g}}\right) \times K_d\left(\frac{\text{L}}{\text{kg}}\right)}{\text{BCF}\left(\frac{\text{L}}{\text{kg}}\right)}\right)$$

and:

$$x-\text{INTERCEPT} =$$

$$\text{PRG}_{\text{far-wat-fish-ing}}\left(\frac{\text{pCi}}{\text{L}}\right) = \left(\frac{\text{PRG}_{\text{far-fish-ing}}\left(\frac{\text{pCi}}{\text{g}}\right)}{\text{BCF}\left(\frac{\text{L}}{\text{kg}}\right) \times \left(\frac{1\ \text{kg}}{1000\ \text{g}}\right)}\right)$$

and:

$$\text{SLOPE} = \frac{K_d\left(\frac{\text{L}}{\text{kg}}\right)}{1000}$$

Soil and Tap Water Contribution to Beef Ingestion

y - INTERCEPT =

$$PRG_{far-soil-beef-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-beef-ing}\left(\frac{pCi}{g}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c}\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)\end{array}\right]}\right)$$

and:

x - INTERCEPT =

$$PRG_{far-wat-beef-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-beef-ing}\left(\frac{pCi}{g}\right)}{TF_{beef}\left(\frac{day}{kg}\right) \times Q_{w-beef}\left(\frac{53\ L}{day}\right) \times f_{w-beef}(1) \times \left(\frac{1\ kg}{1000\ g}\right)}\right)$$

and:

$$SLOPE = \frac{Q_{w-beef}\left(\frac{53\ L}{day}\right) \times f_{w-beef}(1)}{\left(Q_{p-beef}\left(\frac{11.77\ kg}{day}\right) \times f_{p-beef}(1) \times f_{s-beef}(1) \times \left(R_{upp} + R_{es}\right)\right) + \left(Q_{s-beef}\left(\frac{0.5\ kg}{day}\right) \times f_{p-beef}(1)\right)}$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi\ /\ g-dry-plant}{pCi\ /\ g-dry-soil}\right)\ ;\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Soil and Tap Water Contribution to Dairy Ingestion

y - INTERCEPT =

$$PRG_{far-soil-dairy-ing}\left(\frac{pCi}{g}\right) = \left(\frac{PRG_{far-dairy-ing}\left(\frac{pCi}{g}\right)}{TF_{dairy}\left(\frac{day}{L-milk}\right) \times \rho_m\left(\frac{1.03\ kg}{L-milk}\right)^{-1} \times \left[\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times (R_{upp} + R_{es})\right) + \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)\right]}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

and:

x - INTERCEPT =

$$PRG_{far-wat-dairy-ing}\left(\frac{pCi}{L}\right) = \left(\frac{PRG_{far-dairy-ing}\left(\frac{pCi}{g}\right)}{TF_{dairy}\left(\frac{day}{L-milk}\right) \times \rho_m\left(\frac{1.03\ kg}{L-milk}\right)^{-1} \times Q_{w-dairy}\left(\frac{92\ L}{day}\right) \times f_{w-dairy}(1) \times \left(\frac{1\ kg}{1000\ g}\right)}\right)$$

and:

$$SLOPE = \frac{Q_{w-dairy}\left(\frac{92\ L}{day}\right) \times f_{w-dairy}(1)}{\left(Q_{p-dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p-dairy}(1) \times f_{s-dairy}(1) \times (R_{upp} + R_{es})\right) + \left(Q_{s-dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p-dairy}(1)\right)}$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right);\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Soil and Tap Water Contribution to Swine Ingestion

$$PRG_{far-swine-ing}\left(\frac{pCi}{g}\right) = \left(\frac{TR}{SF_f\left(\frac{risk}{pCi}\right) \times IFSW_{far-adj}(1,203,860\ g) \times CF_{far-swine}(1)}\right)$$

where:

$$IFSW_{far-adj}(1,203,860\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRSW_{far-c}\left(\frac{18.5\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRSW_{far-a}\left(\frac{97.9\ g}{day}\right)\right)\right]$$

Soil to Groundwater PRG Equations

Method 1 for SSL Determination

$$SSL\left(\frac{pCi}{g}\right) = C_{water}\left(\frac{pCi}{L}\right) \times \left(\frac{kg}{1{,}000\ g}\right) \times \left[K_d\left(\frac{L}{kg}\right) + \left(\frac{\theta_w\left(\frac{0.3\ L_{water}}{L_{soil}}\right)}{\rho_b\left(\frac{1.5\ kg}{L}\right)}\right)\right] \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$C_{water}\left(\frac{pCi}{L}\right) = MCL\left(\frac{pCi}{L}\right) \times DAF$$

or:

$$C_{water}\left(\frac{pCi}{L}\right) = PRG\left(\frac{pCi}{L}\right) \times DAF$$

Method 2 for SSL Determination

$$SSL\left(\frac{pCi}{g}\right) = \left(\frac{C_{water}\left(\frac{pCi}{L}\right) \times I\left(\frac{0.18\ m}{yr}\right) \times ED\,(70\ yr)}{\rho_b\left(\frac{1.5\ kg}{L}\right) \times d_s\left(\frac{mg}{kg}\right) \times \left(\frac{1{,}000\ g}{kg}\right)}\right) \times \left(\frac{t(yr) \times \lambda\left(\frac{1}{yr}\right)}{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}\right)$$

where:

$$C_{water}\left(\frac{pCi}{L}\right) = MCL\left(\frac{pCi}{L}\right) \times DAF$$

or:

$$C_{water}\left(\frac{pCi}{L}\right) = PRG\left(\frac{pCi}{L}\right) \times DAF$$

APPENDIX G. TABLES OF RECOMMENDED DEFAULT EXPOSURE PARAMETERS FOR RADIONUCLIDE RISK CALCULATOR

APPENDIX G. TABLES OF RECOMMENDED DEFAULT EXPOSURE PARAMETERS FOR RADIONUCLIDE RISK CALCULATOR

Table G-1. Slope Factors (SFs)

Symbol	Definition (units)	Default	Reference
SF_s	Soil Ingestion Slope Factor - population (risk/pCi)	Isotope-specific	ORNL 2014c
SF_{sa}	Soil Ingestion Slope Factor - adult only (risk/pCi)	Isotope-specific	ORNL 2014c
SF_f	Food Ingestion Slope Factor (risk/pCi)	Isotope-specific	ORNL 2014c
SF_w	Water Ingestion Slope Factor (risk/pCi)	Isotope-specific	ORNL 2014c
SF_i	Slope Factor - inhalation (risk/pCi)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}sv}$	Slope Factor - external exposure (risk/yr per pCi/g)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}1cm}$	Slope Factor - external exposure (risk/yr per pCi/g)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}5cm}$	Slope Factor - external exposure (risk/yr per pCi/g)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}15cm}$	Slope Factor - external exposure (risk/yr per pCi/g)	Isotope-specific	ORNL 2014c
$SF_{ext\text{-}gp}$	Slope Factor - external exposure (risk/yr per pCi/cm^2)	Isotope-specific	ORNL 2014c
SF_{sub}	Slope Factor - submersion (risk/yr per pCi/cm^3)	Isotope-specific	ORNL 2014c
SF_{imm}	Slope Factor - immersion (risk/yr per pCi/L)	Isotope-specific	ORNL 2014c

Table G-2. Miscellaneous Variables

Symbol	Definition (units)	Default	Reference
C_{soil}	Concentration of contaminant in soil (pCi/g)	User-input	
$C_{g\text{-}water}$	Concentration of contaminant in groundwater (pCi/L)	User-input	
$C_{s\text{-}water}$	Concentration of contaminant in surface water (pCi/L)	User-input	
C_{air}	Concentration of contaminant in air (pCi/m^3)	User-input	
C_{fish}	Concentration of contaminant in fish (pCi/g)	User-input	
$C_{produce}$	Concentration of contaminant in produce (pCi/g)	User-input	
C_{milk}	Concentration of contaminant in milk (pCi/g)	User-input	
C_{beef}	Concentration of contaminant in beef (pCi/g)	User-input	
$C_{poultry}$	Concentration of contaminant in poultry (pCi/g)	User-input	
C_{egg}	Concentration of contaminant in egg (pCi/g)	User-input	
C_{swine}	Concentration of contaminant in swine (pCi/g)	User-input	
λ	Decay constant = 0.693/half-life (year^{-1}) where 0.693 = ln(2)	Isotope-specific	Developed for Radionuclide Soil Screening calculator
K	Andelman Volatilization Factor (L/m^3)	0.5	U.S. EPA 1991b (pg. 20)
$ACF_{ext\text{-}sv}$	Area Correction Factor - soil volume (unitless)	Isotope-specific	ORNL 2014a
$ACF_{ext\text{-}1cm}$	Area Correction Factor – 1 cm (unitless)	Isotope-specific	ORNL 2014a
$ACF_{ext\text{-}5cm}$	Area Correction Factor – 5 cm (unitless)	Isotope-specific	ORNL 2014a
$ACF_{ext\text{-}15cm}$	Area Correction Factor – 15 cm (unitless)	Isotope-specific	ORNL 2014a
$ACF_{ext\text{-}gp}$	Area Correction Factor - ground plane (unitless)	Isotope-specific	ORNL 2014a
GSF_i	Gamma Shielding Factor - Indoor (unitless)	0.4	U.S. EPA 2000a. (pg. 2-22). U.S. EPA 2000b. (pg. 2-18)
$GSF_{ext\text{-}sv}$	Gamma Shielding Factor - soil volume (unitless)	Isotope-specific	ORNL 2014a
$GSF_{ext\text{-}1cm}$	Gamma Shielding Factor – 1 cm (unitless)	Isotope-specific	ORNL 2014b
$GSF_{ext\text{-}5cm}$	Gamma Shielding Factor – 5 cm (unitless)	Isotope-specific	ORNL 2014b
$GSF_{ext\text{-}15cm}$	Gamma Shielding Factor – 15 cm (unitless)	Isotope-specific	ORNL 2014b
$GSF_{ext\text{-}gp}$	Gamma Shielding Factor - ground plane (unitless)	Isotope-specific	ORNL 2014b
GSF_a	Gamma Shielding Factor - Air (unitless)	1	Developed for Radionuclide Soil Screening calculator

Table G-3. Resident Soil

Symbol	Definition (units)	Default	Reference
$CDI_{res\text{-}soil\text{-}rad\text{-}ing}$	Resident Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}soil\text{-}rad\text{-}inh}$	Resident Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}soil\text{-}rad\text{-}ext}$	Resident Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}soil\text{-}rad\text{-}sv}$	Resident Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator

Table G-3. Resident Soil

Symbol	Definition (units)	Default	Reference
$CDI_{res-soil-rad-1cm}$	Resident Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{res-soil-rad-5cm}$	Resident Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{res-soil-rad-15cm}$	Resident Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{res-soil-rad-gp}$	Resident Soil Radionuclide External (pCi-year/cm^2)	Contaminant-specific	Determined in this calculator
t_{res}	Time - resident (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$CF_{res-produce}$	Produce Contaminated Fraction - resident (unitless)	0.25	U.S. EPA 1990. U.S. EPA. 1998. (pg. C-9)
Bv_{wet}	Soil to Plant Transfer Factor - wet (pCi/g-fresh plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
R_{upv}	Wet root uptake for produce multiplier (unitless)	Radionuclide-specific (=Bv_{wet})	Hierarchy selection in Section 2.3.2
R_{es}	Soil resuspension multiplier (dimensionless)	=MLF (pasture or produce)	Hinton 1992
$IFS_{res-adj}$	Resident Ingestion Fraction - age-adjusted (mg)	1,120,000	Calculated using the age-adjusted intake factors equation.
IRS_{res-a}	Resident Soil Ingestion Rate - adult (mg/day)	100	U.S. EPA 1991a (pg. 15)
IRS_{res-c}	Resident Soil Ingestion Rate - child (mg/day)	200	U.S. EPA 1991a (pg. 15)
$IFA_{res-adj}$	Resident Inhalation Rate - age-adjusted (m^3)	161,100	Calculated using the age-adjusted intake factors equation.
IRA_{res-a}	Resident Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
IRA_{res-c}	Resident Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
$IFV_{res-adj}$	Resident Vegetable Ingestion Fraction - age-adjusted (g)	989,870	Calculated using the age-adjusted intake factors equation
IRV_{res-a}	Resident Vegetable Ingestion Rate - adult (g/day)	128.9	U.S. EPA 2011 (Table 13-10)
IRV_{res-c}	Resident Vegetable Ingestion Rate - child (g/day)	41.7	U.S. EPA 2011 (Table 13-10)
$IFF_{res-adj}$	Resident Fruit Ingestion Fraction - age-adjusted (g)	1,462,510	Calculated using the age-adjusted intake factors equation
IRF_{res-a}	Resident Fruit Ingestion Rate - adult (g/day)	188.5	U.S. EPA 2011 (Table 13-5)
IRF_{res-c}	Resident Fruit Ingestion Rate - child (g/day)	68.1	U.S. EPA 2011 (Table 13-5)
EF_{res}	Resident Exposure Frequency - (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{res-a}	Resident Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{res-c}	Resident Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{res}	Resident Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile

Table G-3. Resident Soil

Symbol	Definition (units)	Default	Reference
			or current residence time.
ED_{res-a}	Resident Exposure Duration - adult (years)	20	ED_{res} (26 years) - ED_{res-c} (6 years)
ED_{res-c}	Resident Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
ET_{res}	Resident Exposure Time (hours/day)	24	24 Hours per 24 hour Day
ET_{res-a}	Resident Exposure Time - adult (hours/day)	24	24 Hours per 24 hour Day
ET_{res-c}	Resident Exposure Time - child (hours/day)	24	24 Hours per 24 hour Day
ET_{res-i}	Resident Exposure Time - indoor (hours/day)	16.416	U.S. EPA 2011 (Table 16-16 50^{th}%)
ET_{res-o}	Resident Exposure Time - outdoor (hours/day)	1.752	U.S. EPA 2011 (Table 16-20 50^{th}%))
$CDI_{res-soil-rad-ing}$	Resident Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{res-soil-rad-inh}$	Resident Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{res-soil-rad-ext}$	Resident Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator

Table G-4. Indoor Worker Soil

Symbol	Definition (units)	Default	Reference
$CDI_{iw\text{-}rad\text{-}ing}$	Indoor Worker Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{iw\text{-}rad\text{-}inh}$	Indoor Worker Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{iw\text{-}sol\text{-}rad\text{-}ext}$	Indoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{iw\text{-}sol\text{-}rad\text{-}sv}$	Indoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{iw\text{-}sol\text{-}rad\text{-}1cm}$	Indoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{iw\text{-}sol\text{-}rad\text{-}5cm}$	Indoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{iw\text{-}sol\text{-}rad\text{-}15cm}$	Indoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{iw\text{-}sol\text{-}rad\text{-}gp}$	Indoor Worker Soil Radionuclide External (pCi-year/cm^2)	Contaminant-specific	Determined in this calculator
t_{iw}	Time - indoor worker (years)	25	U.S. EPA 1991a (pg. 15)
IRS_{iw}	Indoor Worker Soil Ingestion Rate (mg/day)	50	U.S. EPA 2001 (pg. 4-3)
IRA_{iw}	Indoor Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{iw}	Indoor Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_{iw}	Indoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{iw}	Indoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-5. Outdoor Worker Soil

Symbol	Definition (units)	Default	Reference
$CDI_{ow\text{-}soil\text{-}rad\text{-}ing}$	Outdoor Worker Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{ow\text{-}soil\text{-}rad\text{-}inh}$	Outdoor Worker Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{ow\text{-}soil\text{-}rad\text{-}ext}$	Outdoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{ow\text{-}soil\text{-}rad\text{-}sv}$	Outdoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{ow\text{-}soil\text{-}rad\text{-}1cm}$	Outdoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{ow\text{-}soil\text{-}rad\text{-}5cm}$	Outdoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{ow\text{-}soil\text{-}rad\text{-}15cm}$	Outdoor Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{ow\text{-}soil\text{-}rad\text{-}gp}$	Outdoor Worker Soil Radionuclide External (pCi-year/cm^2)	Contaminant-specific	Determined in this calculator
t_{ow}	Time - outdoor worker (years)	25	U.S. EPA 1991a (pg. 15)
IRS_{ow}	Outdoor Worker Soil Ingestion Rate (mg/day)	100	U.S. EPA 1991a (pg. 15)
IRA_{ow}	Outdoor Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{ow}	Outdoor Worker Exposure Frequency (days/year)	225	U.S. EPA 1991a (pg. 15)
ED_{ow}	Outdoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{ow}	Outdoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-6. Composite Worker Soil

Symbol	Definition (units)	Default	Reference
$CDI_{w\text{-}soil\text{-}rad\text{-}ing}$	Composite Worker Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}soil\text{-}rad\text{-}inh}$	Composite Worker Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}soil\text{-}rad\text{-}ext}$	Composite Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}soil\text{-}rad\text{-}sv}$	Composite Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}soil\text{-}rad\text{-}1cm}$	Composite Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}soil\text{-}rad\text{-}5cm}$	Composite Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}soil\text{-}rad\text{-}15cm}$	Composite Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}soil\text{-}rad\text{-}gp}$	Composite Worker Soil Radionuclide External (pCi-year/cm^2)	Contaminant-specific	Determined in this calculator
t_w	Time - worker (years)	25	U.S. EPA 1991a (pg. 15)
IRS_w	Composite Worker Soil Ingestion Rate (mg/day)	100	U.S. EPA 1991a (pg. 15)
IRA_w	Composite Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_w	Composite Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_w	Composite Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_w	Composite Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-7. Excavation Worker Soil

Symbol	Definition (units)	Default	Reference
$CDI_{ew\text{-}sol\text{-}rad\text{-}ing}$	Excavation Worker Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{ew\text{-}sol\text{-}rad\text{-}inh}$	Excavation Worker Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{ew\text{-}sol\text{-}rad\text{-}ext}$	Excavation Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
t_{ew}	Time - excavation worker (years)	1	U.S. EPA 2002 Exhibit 5-1
IRS_{ew}	Excavation Worker Soil Ingestion Rate (mg/day)	330	
IRA_{ew}	Excavation Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{ew}	Excavation Worker Exposure Frequency (days/year)	20	
ED_{ew}	Excavation Worker Exposure Duration (years)	1	U.S. EPA 2002 Exhibit 5-1
$ET_{ew\text{-}o}$	Excavation Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-8. Construction Worker Soil

Symbol	Definition (units)	Default	Reference
$CDI_{cw\text{-}sol\text{-}rad\text{-}ing}$	Construction Worker Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}sol\text{-}rad\text{-}inh}$	Construction Worker Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}sol\text{-}rad\text{-}ext}$	Construction Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}sol\text{-}rad\text{-}sv}$	Construction Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}sol\text{-}rad\text{-}1cm}$	Construction Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}sol\text{-}rad\text{-}5cm}$	Construction Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}sol\text{-}rad\text{-}15cm}$	Construction Worker Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}sol\text{-}rad\text{-}gp}$	Construction Worker Soil Radionuclide External (pCi-year/cm^2)	Contaminant-specific	Determined in this calculator
t_{cw}	Time - construction worker (years)	1	U.S. EPA 2002 Exhibit 5-1
IRS_{cw}	Construction Worker Soil Ingestion Rate (mg/day)	330	
IRA_{cw}	Construction Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{cw}	Construction Worker Exposure Frequency (days/year)	250	U.S. EPA 2002 Exhibit 5-1
EW_{cw}	Construction Worker Exposure Frequency (weeks/year)	50	U.S. EPA 2002 Exhibit 5-1
DW_{cw}	Construction Worker Exposure Frequency (days/week)	5	U.S. EPA 2002 Exhibit 5-1
ED_{cw}	Construction Worker Exposure Duration (years)	1	U.S. EPA 2002 Exhibit 5-1
ET_{cw}	Construction Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-9. Recreator Soil/Sediment

Symbol	Definition (units)	Default	Reference
$CDI_{rec\text{-}soil\text{-}rad\text{-}ing}$	Recreator Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}soil\text{-}rad\text{-}inh}$	Recreator Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}soil\text{-}rad\text{-}ext}$	Recreator Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}soil\text{-}rad\text{-}sv}$	Recreator Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}soil\text{-}rad\text{-}1cm}$	Recreator Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}soil\text{-}rad\text{-}5cm}$	Recreator Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}soil\text{-}rad\text{-}15cm}$	Recreator Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}soil\text{-}rad\text{-}gp}$	Recreator Soil Radionuclide External (pCi-year/cm^2)	Contaminant-specific	Determined in this calculator
t_{rec}	Time - recreator (years)	Site-specific	Site-specific
$IFS_{rec\text{-}adj}$	Recreator Ingestion Fraction - age-adjusted (mg)	240,000	Calculated using the age-adjusted intake factors equation.
$IRS_{rec\text{-}a}$	Recreator Soil Ingestion Rate - adult (mg/day)	100	U.S. EPA 1991a (pg. 15)
$IRS_{rec\text{-}c}$	Recreator Soil Ingestion Rate - child (mg/day)	200	U.S. EPA 1991a (pg. 15)
$IFA_{rec\text{-}adj}$	Recreator Inhalation Fraction - age-adjusted (m^3)	1,437.50	Calculated using the age-adjusted intake factors equation.
$IRA_{rec\text{-}a}$	Recreator Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
$IRA_{rec\text{-}c}$	Recreator Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
EF_{rec}	Recreator Exposure Frequency - (days/year)	75	Reasonable estimate
$EF_{rec\text{-}a}$	Recreator Exposure Frequency - adult (days/year)	75	Reasonable estimate
$EF_{rec\text{-}c}$	Recreator Exposure Frequency - child (days/year)	75	Reasonable estimate
ED_{rec}	Recreator Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$ED_{rec\text{-}a}$	Recreator Exposure Duration - adult (years)	20	ED_{res} (26 years) - $ED_{res\text{-}c}$ (6 years)
$ED_{rec\text{-}c}$	Recreator Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
ET_{rec}	Recreator Exposure Time (hours/day)	1	Reasonable estimate
$ET_{rec\text{-}a}$	Recreator Exposure Time - adult (hours/day)	1	Reasonable estimate
$ET_{rec\text{-}c}$	Recreator Exposure Time - child (hours/day)	1	Reasonable estimate

Table G-10. Farmer Soil

Symbol	Definition (units)	Default	Reference
$CDI_{far\text{-}soil\text{-}rad\text{-}ing}$	Farmer Soil Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}soil\text{-}rad\text{-}inh}$	Farmer Soil Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{far\text{-}soil\text{-}rad\text{-}ext}$	Farmer Soil Radionuclide External (pCi-year/g)	Contaminant-specific	Determined in this calculator
$CDI_{soil\text{-}far\text{-}produce\text{-}rad\text{-}ing}$	Farmer Produce Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil\text{-}far\text{-}poultry\text{-}rad\text{-}ing}$	Farmer Poultry Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil\text{-}far\text{-}egg\text{-}rad\text{-}ing}$	Farmer Egg Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil\text{-}far\text{-}beef\text{-}rad\text{-}ing}$	Farmer Beef Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil\text{-}far\text{-}dairy\text{-}rad\text{-}ing}$	Farmer Dairy Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil\text{-}far\text{-}swine\text{-}rad\text{-}ing}$	Farmer Swine Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil\text{-}far\text{-}fish\text{-}rad\text{-}ing}$	Farmer Fish Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
ρ_m	Density of milk (kg/L)	1.03	Milk Composition & Synthesis Resource Library
t_{far}	Time - farmer (years)	40	U.S. EPA 2005 (pg. C-24/C-26)
Bv_{wet}	Soil to Plant Transfer Factor - wet (pCi/g-fresh plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
Bv_{dry}	Soil to Plant Transfer Factor - dry (pCi/g-dry plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
R_{upv}	Wet root uptake for produce multiplier (unitless)	Radionuclide-specific (=Bv_{wet})	Hierarchy selection in Section 2.3.2
R_{upp}	Dry root uptake for pasture multiplier (dimensionless)	Radionuclide-specific (=Bv_{dry})	Hierarchy selection in Section 2.3.2
R_{es}	Soil resuspension multiplier (dimensionless)	=MLF (pasture or produce)	Hinton 1992
TF_{beef}	Beef Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{dairy}	Dairy Transfer Factor (day/L)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{swine}	Swine Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
$TF_{poultry}$	Poultry Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{egg}	Egg Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
$MLF_{produce}$	Produce Plant Mass Loading Factor (unitless)	0.26 x 0.052 = 0.0135	Hinton, 1992. U.S. EPA SSG 1996 table G-1. Dry weight to wet

Table G-10. Farmer Soil

Symbol	Definition (units)	Default	Reference
			weight conversion equation from section 4.10.7.
$MLF_{pasture}$	Pasture Plant Mass Loading Factor (unitless)	0.25	Hinton, T. G. 1992
$Q_{p\text{-}beef}$	Beef Fodder Intake Rate (kg/day)	11.77	U.S. EPA 2005 (pg. B-138)
$Q_{p\text{-}dairy}$	Dairy Fodder Intake Rate (kg/day)	20.3	U.S. EPA 2005 (pg. B-145)
$Q_{p\text{-}swine}$	Swine Fodder Intake Rate (kg/day)	4.7	U.S. EPA 2005 (pg. B-152)
$Q_{p\text{-}poultry}$	Poultry Fodder Intake Rate (kg/day)	0.2	U.S. EPA 2005 (pg. B-158/164)
$Q_{s\text{-}beef}$	Beef Soil Intake Rate (kg/day)	0.5	U.S. EPA 2005 (pg. B-139)
$Q_{s\text{-}dairy}$	Dairy Soil Intake Rate (kg/day)	0.4	U.S. EPA 2005 (pg. B-146)
$Q_{s\text{-}swine}$	Swine Soil Intake Rate (kg/day)	0.37	U.S. EPA 2005 (pg. B-153)
$Q_{s\text{-}poultry}$	Poultry Soil Intake Rate (kg/day)	0.022	U.S. EPA 2005 (pg. B-159/165)
$f_{p\text{-}beef}$	Fraction of Time Animal is On-Site - beef (unitless)	1	Developed for this calculator
$f_{p\text{-}dairy}$	Fraction of Time Animal is On-Site - dairy (unitless)	1	Developed for this calculator
$f_{p\text{-}swine}$	Fraction of Time Animal is On-Site - swine (unitless)	1	Developed for this calculator
$f_{p\text{-}poultry}$	Fraction of Time Animal is On-Site - poultry (unitless)	1	Developed for this calculator
$f_{s\text{-}beef}$	Fraction of Animal's Food from Site when On-Site - beef (unitless)	1	Developed for this calculator
$f_{s\text{-}dairy}$	Fraction of Animal's Food from Site when On-Site - dairy (unitless)	1	Developed for this calculator
$f_{s\text{-}swine}$	Fraction of Animal's Food from Site when On-Site - swine (unitless)	1	Developed for this calculator
$f_{s\text{-}poultry}$	Fraction of Animal's Food from Site when On-Site - poultry (unitless)	1	Developed for this calculator
$IFS_{far\text{-}adj}$	Farmer Soil Ingestion Fraction - age-adjusted (mg)	1,610,000	Calculated using the age-adjusted intake factors equation.
$IRS_{far\text{-}a}$	Farmer Soil Ingestion Rate - adult (mg/day)	100	U.S. EPA 1991a (pg. 15)
$IFA_{far\text{-}adj}$	Farmer Inhalation Rate - age-adjusted (m^3)	259,000	Calculated using the age-adjusted intake factors equation.
$IRA_{far\text{-}a}$	Farmer Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
$IRA_{far\text{-}c}$	Farmer Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
$IRS_{far\text{-}c}$	Farmer Soil Ingestion Rate - child (mg/day)	200	U.S. EPA 1991a (pg. 15)

Table G-10. Farmer Soil

Symbol	Definition (units)	Default	Reference
EF_{far}	Farmer Exposure Frequency (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{far-a}	Farmer Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{far}	Farmer Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{far}	Farmer Exposure Duration (years)	40	U.S. EPA 2005 (Table 6-3)
ED_{far-a}	Farmer Exposure Duration - adult (years)	34	U.S. EPA 1994a
ED_{far-c}	Farmer Exposure Duration - child (years)	6	U.S. EPA 2005 (Table 6-3)
ET_{far}	Farmer Exposure Time - (hours/day)	24	24 Hours per 24 hour Day
ET_{far-a}	Farmer Exposure Time - Adult (hours/day)	24	24 Hours per 24 hour Day
ET_{far-c}	Farmer Exposure Time - Child (hours/day)	24	24 Hours per 24 hour Day
ET_{far-i}	Farmer Exposure Time - indoor (hours/day)	10.008	1440 hrs/day - (ET_{far-o} + ET_{far-a})
$ET_{far-away}$	Farmer Exposure Time - away (hours/day)	1.83	U.S. EPA 2011 (Tables 16-20 and 16-24 total of time in vehicles, near vehicles and outdoors other than near residence 25^{th}%)
ET_{far-o}	Farmer Exposure Time - outdoor (hours/day)	12.168	U.S. EPA 2011 (Table 16-20 95^{th}%))

Table G-11. Resident Tap Water

Symbol	Definition (units)	Default	Reference
$CDI_{water-rad-ing}$	Resident Tap Water (Groundwater) Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-rad-inh}$	Resident Tap Water (Groundwater) Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-rad-imm}$	Resident Tap Water (Groundwater) Radionuclide Immersion (pCi-year/L)	Contaminant-specific	Determined in this calculator
Irr_{rup}	Root uptake from irrigation multiplier (L/kg)	Isotope-specific	Calculated
Irr_{res}	Resuspension from irrigation multiplier (L/kg)	Isotope-specific	Calculated
Irr_{dep}	Aerial deposition from irrigation multiplier (L/kg)	Isotope-specific	Calculated
Bv_{wet}	Soil to Plant Transfer Factor - wet (pCi/g-fresh plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
F	Irrigation Period (unitless)	0.25	Personal communication
I_f	Interception Fraction (unitless)	0.42	Miller, C. W. 1980
I_r	Irrigation Rate (L/m^2)	3.62	Personal communication

Table G-11. Resident Tap Water

Symbol	Definition (units)	Default	Reference
λ_{HL}	Soil Leaching Rate (1/day)	0.000027	NCRP 1996
λ_i	Decay (1/day)	0.693/TR - radionuclides	NCRP 1996
λ_E	Decay for Removal on Produce (1/day)	$\lambda_i + (0.693/t_w)$	NCRP 1996
λ_B	Effective Rate for Removal (1/day)	$\lambda_{HL} - \lambda_i$	NCRP 1996
T	Translocation Factor (unitless)	1	NCRP 1996
t_b	Long Term Deposition and Buildup (day)	10950	NCRP 1996
t_v	Above Ground Exposure Time (day)	60	NCRP 1996
t_w	Weathering Half-life (day)	14	NCRP 1996
Y_v	Plant Yield - wet (kg/m^2)	2	NCRP 1996
P	Area Density for Root Zone (kg/m^2)	240	Hoffman, F. O., R. H. Gardner, and K. F. Eckerman. 1982; Peterson, H. T., Jr. 1983; McKone, T. E. 1994
$MLF_{produce}$	Produce Plant Mass Loading Factor (unitless)	0.26 x 0.052 = 0.0135	Hinton, 1992. U.S. EPA SSG 1996 table G-1. Dry weight to wet weight conversion equation from section 4.10.7.
$IFW_{res\text{-}adj}$	Resident Tap Water Ingestion Rate - age-adjusted (L)	19,138	Calculated using the age-adjusted intake factors equation.
$IRW_{res\text{-}a}$	Resident Tap Water Ingestion - adult (L/day)	2.5	U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (21+)
$IRW_{res\text{-}c}$	Resident Tap Water Ingestion - child (L/day)	0.78	U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years)
$IFA_{res\text{-}adj}$	Resident Inhalation Rate - age-adjusted (m^3)	161,100	Calculated using the age-adjusted intake factors equation.
$DFA_{res\text{-}adj}$	Resident Immersion Factor - age-adjusted (hours)	6104	Calculated using the age-adjusted intake factors equation.
$IRA_{res\text{-}a}$	Resident Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
$IRA_{res\text{-}c}$	Resident Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)

Table G-11. Resident Tap Water

Symbol	Definition (units)	Default	Reference
$IFV_{res\text{-}adj}$	Resident Vegetable Ingestion Fraction - age-adjusted (g)	989,870	Calculated using the age-adjusted intake factors equation
$IRV_{res\text{-}a}$	Resident Vegetable Ingestion Rate - adult (g/day)	128.9	U.S. EPA 2011 (Table 13-10)
$IRV_{res\text{-}c}$	Resident Vegetable Ingestion Rate - child (g/day)	41.7	U.S. EPA 2011 (Table 13-10)
$IFF_{res\text{-}adj}$	Resident Fruit Ingestion Fraction - age-adjusted (g)	1,462,510	Calculated using the age-adjusted intake factors equation
$IRF_{res\text{-}a}$	Resident Fruit Ingestion Rate - adult (g/day)	188.5	U.S. EPA 2011 (Table 13-5)
$IRF_{res\text{-}c}$	Resident Fruit Ingestion Rate - child (g/day)	68.1	U.S. EPA 2011 (Table 13-5)
EF_{res}	Resident Exposure Frequency - (days/year)	350	U.S. EPA 1991a (pg. 15)
$EF_{res\text{-}a}$	Resident Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
$EF_{res\text{-}c}$	Resident Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{res}	Resident Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$ED_{res\text{-}a}$	Resident Exposure Duration - adult (years)	20	ED_{res} (26 years) - $ED_{res\text{-}c}$ (6 years)
$ED_{res\text{-}c}$	Resident Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
$ET_{event\text{-}res\text{-}a}$	Resident Tap Water Exposure Time - Adult (hours/event)	0.71	U.S. EPA 1997a
$ET_{event\text{-}res\text{-}c}$	Resident Tap Water Exposure Time - Child (hours/event)	0.54	U.S. EPA 1997a
$EV_{res\text{-}a}$	Number of bathing events per day - adult resident (events/day)	1	U.S. EPA 2004 Exhibit 3-2
$EV_{res\text{-}c}$	Number of bathing events per day - child resident (events/day)	1	U.S. EPA 2004 Exhibit 3-2

Table G-12. Indoor Worker Tap Water

Symbol	Definition (units)	Default	Reference
$CDI_{iw\text{-}water\text{-}ing}$	Indoor Worker Tap Water Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{iw\text{-}water\text{-}inh}$	Indoor Worker Tap Water Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{iw\text{-}water\text{-}imm}$	Indoor Worker Tap Water Radionuclide Immersion (pCi/L-year)	Contaminant-specific	Determined in this calculator
IRW_{iw}	Indoor Worker Tap Water Ingestion (L/day)	1.25	U.S. EPA 2014, FAQ 13
EF_{iw}	Indoor Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_{iw}	Indoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{iw}	Indoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day
$ET_{event\text{-}iw}$	Indoor Worker Tap Water Exposure Time - adult (hours/event)	0.71	U.S. EPA 1997a
EV_{iw}	Number of bathing events per day - Indoor Worker (events/day)	1	U.S. EPA 2004 Exhibit 3-2

Table G-13. Recreator Surface Water

Symbol	Definition (units)	Default	Reference
$CDI_{rec\text{-}water\text{-}rad\text{-}ing}$	Recreator Surface Water Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{rec\text{-}water\text{-}rad\text{-}imm}$	Recreator Surface Water Radionuclide Immersion (pCi-year/L)	Contaminant-specific	Determined in this calculator
$IFW_{rec\text{-}adj}$	Recreator Surface Water Ingestion - age-adjusted (L)	131.4	Calculated using the age-adjusted intake factors equation.
$IRW_{rec\text{-}a}$	Recreator Surface Water Ingestion - adult (L/hour)	0.11	Time weighted average was calculated based on the upper percentile from Table 3.7 of EFH 2019
$IRW_{rec\text{-}c}$	Recreator Surface Water Ingestion - child (L/hour)	0.12	Table 3.5 in EFH 2011
$DFA_{rec\text{-}adj}$	Recreator Immersion Factor - age-adjusted (hours)	1170	Calculated using the age-adjusted intake factors equation.
EF_{rec}	Recreator Exposure Frequency - (days/year)	45	Region 4 Bulletin
$EF_{rec\text{-}c}$	Recreator Exposure Frequency - child (days/year)	45	Region 4 Bulletin
$EF_{rec\text{-}a}$	Recreator Exposure Frequency - adult (days/year)	45	Region 4 Bulletin
ED_{rec}	Recreator Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$ED_{rec\text{-}a}$	Recreator Exposure Duration - adult (years)	20	ED_{res} (26 years) - $ED_{res\text{-}c}$ (6 years)
$ED_{rec\text{-}c}$	Recreator Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
$ET_{event\text{-}rec\text{-}a}$	Number of bathing events per day - adult recreator (events/day)	1	Reasonable estimate
$ET_{event\text{-}rec\text{-}c}$	Number of hours per bathing event - child recreator (hours/event)	1	Reasonable estimate
$EV_{rec\text{-}a}$	Number of hours per bathing event - child recreator (hours/event)	1	Reasonable estimate
$EV_{rec\text{-}c}$	Number of bathing events per day - child recreator (events/day)	1	Reasonable estimate

Table G-14. Farmer Tap Water

Symbol	Definition (units)	Default	Reference
$CDI_{water\text{-}rad\text{-}far\text{-}ing}$	Farmer Tap Water (Groundwater) Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water\text{-}rad\text{-}far\text{-}inh}$	Farmer Tap Water (Groundwater) Radionuclide Inhalation (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water\text{-}rad\text{-}far\text{-}imm}$	Farmer Tap Water (Groundwater) Radionuclide Immersion (pCi-year/L)	Contaminant-specific	Determined in this calculator
$CDI_{water\text{-}far\text{-}produce\text{-}rad\text{-}ing}$	Farmer Produce Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator

Table G-14. Farmer Tap Water

Symbol	Definition (units)	Default	Reference
$CDI_{water-far-poultry-rad-ing}$	Farmer Poultry Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-far-egg-rad-ing}$	Farmer Egg Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-far-beef-rad-ing}$	Farmer Beef Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-far-dairy-rad-ing}$	Farmer Dairy Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-far-swine-rad-ing}$	Farmer Swine Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-far-fish-rad-ing}$	Farmer Fish Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
ρ_m	Density of milk (kg/L)	1.03	Milk Composition & Synthesis Resource Library
BCF	Fish Transfer Factor (L/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{beef}	Beef Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{dairy}	Dairy Transfer Factor (day/L)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{swine}	Swine Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
$TF_{poultry}$	Poultry Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
TF_{egg}	Egg Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
Q_{w-beef}	Beef Water Intake Rate (L/day)	53	U.S. EPA 1999a (pg. 10-23). U.S. EPA 1997b.
$Q_{w-dairy}$	Dairy Water Intake Rate (L/day)	92	U.S. EPA 1999a (pg. 10-23). U.S. EPA 1997b.
$Q_{w-swine}$	Swine Water Intake Rate (L/day)	11.4	NEC, Swine Nutrition Guide (pg. 19). U.S. EPA 1998 (pg. B-180)
$Q_{w-poultry}$	Poultry Water Intake Rate (L/day)	0.4	U.S. EPA 2005 (pg. B-159/165), NRC 1994 pg. 15 ($Q_w = 2 \times Q_p$)
Irr_{rup}	root uptake from irrigation multiplier	Isotope-specific	Calculated
Irr_{res}	resuspension from irrigation multiplier	Isotope-specific	Calculated
Irr_{dep}	aerial deposition from irrigation multiplier	Isotope-specific	Calculated
Bv_{wet}	Soil to Plant Transfer Factor - wet (pCi/g-fresh plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
F	Irrigation Period (unitless)	0.25	Personal communication
I_f	Interception Fraction (unitless)	0.42	Miller, C. W. 1980

Table G-14. Farmer Tap Water

Symbol	Definition (units)	Default	Reference
I_r	Irrigation Rate (L/m^2)	3.62	Personal communication
λ_{HL}	Soil Leaching Rate (1/day)	0.000027	NCRP 1996
λ_i	decay (1/day)	0.693/TR - radionuclides	NCRP 1996
λ_E	Decay for Removal on Produce (1/day)	$\lambda_i + (0.693/t_w)$	NCRP 1996
λ_B	Effective Rate for Removal (1/day)	$\lambda_{HL} - \lambda_i$	NCRP 1996
T	Translocation Factor (unitless)	1	NCRP 1996
t_b	Long Term Deposition and Buildup (day)	10950	NCRP 1996
t_v	Above Ground Exposure Time (day)	60	NCRP 1996
t_w	Weathering Half-life (day)	14	NCRP 1996
Y_v	Plant Yield - wet (kg/m^2)	2	NCRP 1996
P	Area Density for Root Zone (kg/m^2)	240	Hoffman, F. O., R. H. Gardner, and K. F. Eckerman. 1982; Peterson, H. T., Jr. 1983; McKone, T. E. 1994
$MLF_{produce}$	Produce Plant Mass Loading Factor (unitless)	0.26 x 0.052 = 0.0135	Hinton, 1992. U.S. EPA SSG 1996 table G-1. Dry weight to wet weight conversion equation from section 4.10.7.
$IFW_{far-adj}$	Farmer Water Ingestion Fraction - age-adjusted (L)	31,388	Calculated using the age-adjusted intake factors equation.
IRW_{far-a}	Farmer Water Ingestion Rate - adult (L/day)	2.5	U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (21+)
IRW_{far-c}	Farmer Water Ingestion Rate - child (L/day)	0.78	U.S. EPA 2011a, Tables 3-15 and 3-33; weighted average of 90th percentile consumer-only ingestion of drinking water (birth to <6 years)
$IFA_{far-adj}$	Farmer Inhalation Rate - age-adjusted (m^3)	259,000	Calculated using the age-adjusted intake factors equation.
$DFA_{far-adj}$	Farmer Immersion Factor - age-adjusted (hours)	9583	Calculated using the age-adjusted intake factors equation.
IRA_{far-a}	Farmer Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
IRA_{far-c}	Farmer Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
EF_{far}	Farmer Exposure Frequency (days/year)	350	U.S. EPA 1991a (pg. 15)

Table G-14. Farmer Tap Water

Symbol	Definition (units)	Default	Reference
$EF_{far\text{-}a}$	Farmer Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
EF_{far}	Farmer Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{far}	Farmer Exposure Duration (years)	40	U.S. EPA 2005 (Table 6-3)
$ED_{far\text{-}a}$	Farmer Exposure Duration - adult (years)	34	U.S. EPA 1994a
$ED_{far\text{-}c}$	Farmer Exposure Duration - child (years)	6	U.S. EPA 2005 (Table 6-3)
$ET_{event\text{-}far\text{-}c}$	Farmer Tap Water Exposure Time - Child (hours/day)	0.54	U.S. EPA 1997a
$ET_{event\text{-}far\text{-}a}$	Farmer Tap Water Exposure Time - Adult (hours/day)	0.71	U.S. EPA 1997a
$EV_{far\text{-}a}$	Number of bathing events per day - adult farmer (events/day)	1	U.S. EPA 2004 Exhibit 3-2
$EV_{far\text{-}c}$	Number of bathing events per day - child farmer (events/day)	1	U.S. EPA 2004 Exhibit 3-2

Table G-15. Resident Air

Symbol	Definition (units)	Default	Reference
$CDI_{res\text{-}air\text{-}rad\text{-}inh\text{-}decay}$	Resident Air Radionuclide Inhalation w/ Decay (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}air\text{-}rad\text{-}sub\text{-}decay}$	Resident Air Radionuclide Submersion w/ Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}air\text{-}rad\text{-}inh\text{-}nodecay}$	Resident Air Radionuclide Inhalation w/out Decay (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}air\text{-}rad\text{-}sub\text{-}nodecay}$	Resident Air Radionuclide Submersion w/out Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
t_{res}	Time - resident (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$IFA_{res\text{-}adj}$	Resident Inhalation Rate - age-adjusted (m^3)	161,100	Calculated using the age-adjusted intake factors equation.
$IRA_{res\text{-}a}$	Resident Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
$IRA_{res\text{-}c}$	Resident Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
EF_{res}	Resident Exposure Frequency - (days/year)	350	U.S. EPA 1991a (pg. 15)
$EF_{res\text{-}c}$	Resident Exposure Frequency - child (days/year)	350	U.S. EPA 1991a (pg. 15)
$EF_{res\text{-}a}$	Resident Exposure Frequency - adult (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{res}	Resident Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
$ED_{res\text{-}a}$	Resident Exposure Duration - adult (years)	20	ED_{res} (26 years) - $ED_{res\text{-}c}$ (6 years)
$ED_{res\text{-}c}$	Resident Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
ET_{res}	Resident Exposure Time (hours/day)	24	24 Hours per 24 hour Day
$ET_{res\text{-}a}$	Resident Exposure Time - adult (hours/day)	24	24 Hours per 24 hour Day
$ET_{res\text{-}c}$	Resident Exposure Time - child (hours/day)	24	24 Hours per 24 hour Day

Table G-16. Indoor Worker Air

Symbol	Definition (units)	Default	Reference
$CDI_{iw-air-rad-inh-decay}$	Indoor Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{iw-air-rad-sub-decay}$	Indoor Worker Air Radionuclide Submersion w/ Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{iw-air-rad-inh-nodecay}$	Indoor Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{iw-air-rad-sub-nodecay}$	Indoor Worker Air Radionuclide Submersion w/out Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
IRA_{iw}	Indoor Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{iw}	Indoor Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_{iw}	Indoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{iw}	Indoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-17. Outdoor Worker Air

Symbol	Definition (units)	Default	Reference
$CDI_{ow-air-rad-inh-decay}$	Outdoor Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{ow-air-rad-sub-decay}$	Outdoor Worker Air Radionuclide Submersion w/ Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{ow-air-rad-inh-nodecay}$	Outdoor Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{ow-air-rad-sub-nodecay}$	Outdoor Worker Air Radionuclide Submersion w/out Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
t_{ow}	Time - outdoor worker (years)	25	U.S. EPA 1991a (pg. 15)
IRA_{ow}	Outdoor Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{ow}	Outdoor Worker Exposure Frequency (days/year)	225	U.S. EPA 1991a (pg. 15)
ED_{ow}	Outdoor Worker Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_{ow}	Outdoor Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-18. Composite Worker Air

Symbol	Definition (units)	Default	Reference
$CDI_{w\text{-}air\text{-}rad\text{-}inh\text{-}decay}$	Composite Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}air\text{-}rad\text{-}sub\text{-}decay}$	Composite Worker Air Radionuclide Submersion w/ Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}air\text{-}rad\text{-}inh\text{-}nodecay}$	Composite Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{w\text{-}air\text{-}rad\text{-}sub\text{-}nodecay}$	Composite Worker Air Radionuclide Submersion w/out Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
t_w	Time - worker (years)	25	U.S. EPA 1991a (pg. 15)
IRA_w	Composite Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_w	Composite Worker Exposure Frequency (days/year)	250	U.S. EPA 1991a (pg. 15)
ED_w	Composite Exposure Duration (years)	25	U.S. EPA 1991a (pg. 15)
ET_w	Composite Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-19. Excavation Worker Air

Symbol	Definition (units)	Default	Reference
$CDI_{ew\text{-}air\text{-}rad\text{-}inh\text{-}decay}$	Excavation Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{ew\text{-}air\text{-}rad\text{-}sub\text{-}decay}$	Excavation Worker Air Radionuclide Submersion w/ Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{ew\text{-}air\text{-}rad\text{-}inh\text{-}nodecay}$	Excavation Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{ew\text{-}air\text{-}rad\text{-}sub\text{-}nodecay}$	Excavation Worker Air Radionuclide Submersion w/out Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
t_{ew}	Time - excavation worker (years)	1	U.S. EPA 2002 Exhibit 5-1
IRA_{ew}	Excavation Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{ew}	Excavation Worker Exposure Frequency (days/year)	20	
ED_{ew}	Excavation Worker Exposure Duration (years)	1	U.S. EPA 2002 Exhibit 5-1
$ET_{ew\text{-}o}$	Excavation Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-20. Construction Worker Air

Symbol	Definition (units)	Default	Reference
$CDI_{cw\text{-}air\text{-}rad\text{-}inh\text{-}decay}$	Construction Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}air\text{-}rad\text{-}sub\text{-}decay}$	Construction Worker Air Radionuclide Submersion w/ Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}air\text{-}rad\text{-}inh\text{-}nodecay}$	Construction Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{cw\text{-}air\text{-}rad\text{-}sub\text{-}nodecay}$	Construction Worker Air Radionuclide Submersion w/out Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
t_{cw}	Time - construction worker (years)	1	U.S. EPA 2002 Exhibit 5-1
IRA_{cw}	Construction Worker Inhalation Rate (m^3/day; based on a rate of 2.5 m^3/hour for 24 hours)	60	U.S. EPA 1997a (pg. 5-11)
EF_{cw}	Construction Worker Exposure Frequency (days/year)	250	U.S. EPA 2002 Exhibit 5-1
EW_{cw}	Construction Worker Exposure Frequency (weeks/year)	50	U.S. EPA 2002 Exhibit 5-1
DW_{cw}	Construction Worker Exposure Frequency (days/week)	5	U.S. EPA 2002 Exhibit 5-1
ED_{cw}	Construction Worker Exposure Duration (years)	1	U.S. EPA 2002 Exhibit 5-1
ET_{cw}	Construction Worker Exposure Time (hours/day)	8	Eight Hours per 24 hour Day

Table G-21. Recreator Air

Symbol	Definition (units)	Default	Reference
$CDI_{rec-air-rad-inh-decay}$	Recreator Worker Air Radionuclide Inhalation w/ Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{rec-air-rad-sub-decay}$	Recreator Worker Air Radionuclide Submersion w/ Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{rec-air-rad-inh-nodecay}$	Recreator Worker Air Radionuclide Inhalation w/out Decay (pCi/m^3)	Contaminant-specific	Determined in this calculator
$CDI_{rec-air-rad-sub-nodecay}$	Recreator Air Radionuclide Submersion w/out Decay (pCi-year/m^3)	Contaminant-specific	Determined in this calculator
t_{rec}	Time - recreator (years)	Site-specific	Site-specific
$IFA_{rec-adj}$	Recreator Inhalation Fraction - age-adjusted (m^3)	1,437.5	Calculated using the age-adjusted intake factors equation.
IRA_{rec-a}	Recreator Inhalation Rate - adult (m^3/day)	20	U.S. EPA 1991a (pg. 15)
IRA_{rec-c}	Recreator Inhalation Rate - child (m^3/day)	10	U.S. EPA 1997a (pg. 5-11)
EF_{rec}	Recreator Exposure Frequency - (days/year)	75	Reasonable estimate
EF_{rec-a}	Recreator Exposure Frequency - adult (days/year)	75	Reasonable estimate
EF_{rec-c}	Recreator Exposure Frequency - child (days/year)	75	Reasonable estimate
ED_{rec}	Recreator Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.
ED_{rec-a}	Recreator Exposure Duration - adult (years)	20	ED_{res} (26 years) - ED_{res-c} (6 years)
ED_{rec-c}	Recreator Exposure Duration - child (years)	6	U.S. EPA 1991a, Pages 6 and 15
ET_{rec}	Recreator Exposure Time (hours/day)	1	Reasonable estimate
ET_{rec-a}	Recreator Exposure Time - adult (hours/day)	1	Reasonable estimate
ET_{rec-c}	Recreator Exposure Time - child (hours/day)	1	Reasonable estimate

Table G-22. Resident Fish Consumption

Symbol	Definition (units)	Default	Reference
$CDI_{res\text{-}fsh\text{-}rad\text{-}ing}$	Resident Fish Radionuclide (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{res\text{-}fshw\text{-}rad\text{-}ing}$	Resident Surface Water Fish Radionuclide (pCi)	Contaminant-specific	Determined in this calculator
BCF	Fish Transfer Factor (L/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
IRF_{res}	Resident Fish Ingestion Rate (g/day)	54	U.S. EPA 1991a (page 15)
EF_{res}	Resident Exposure Frequency - (days/year)	350	U.S. EPA 1991a (pg. 15)
ED_{res}	Resident Exposure Duration (years)	26	U.S. EPA 2011a, Table 16-108; 90th percentile or current residence time.

Table G-23. Recreator Game and Fowl Consumption

Symbol	Definition (units)	Default	Reference
$CDI_{rec-fowl-rad-ing}$	Recreator Fowl Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil-rec-fowl-rad-ing}$	Recreator Fowl Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-rec-fowl-rad-ing}$	Recreator Fowl Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{rec-game-rad-ing}$	Recreator Game Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{soil-rec-game-rad-ing}$	Recreator Game Radionuclide Back-calculated Concentration in Soil Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{water-rec-game-rad-ing}$	Recreator Game Radionuclide Back-calculated Concentration in Water Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CF_{rec-game}$	Game Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{rec-fowl}$	Fowl Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
Bv_{dry}	Soil to Plant Transfer Factor - dry (pCi/g-dry plant per pCi/g-dry soil)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
R_{upp}	Dry root uptake for pasture multiplier (dimensionless)	Radionuclide-specific (=Bv_{dry})	Hierarchy selection in Section 2.3.2
TF_{beef}	Game Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
$TF_{poultry}$	Fowl Transfer Factor (day/kg)	Radionuclide-specific	Hierarchy selection in Section 2.3.2
Q_{w-game}	Game Water Intake Rate (L/day)	Site-specific	-
Q_{w-fowl}	Fowl Water Intake Rate (L/day)	Site-specific	-
Q_{p-game}	Game Fodder Intake Rate (kg/day)	Site-specific	-
Q_{p-fowl}	Fowl Fodder Intake Rate (kg/day)	Site-specific	-
Q_{s-game}	Game Soil Intake Rate (kg/day)	Site-specific	-
Q_{s-fowl}	Fowl Soil Intake Rate (kg/day)	Site-specific	-
f_{p-game}	Fraction of Time Animal is On-Site - game (unitless)	Site-specific	-
f_{p-fowl}	Fraction of Time Animal is On-Site - fowl (unitless)	Site-specific	-
f_{s-game}	Fraction of Animal's Food from Site when On-Site - game (unitless)	Site-specific	-
f_{s-fowl}	Fraction of Animal's Food from Site when On-Site - fowl (unitless)	Site-specific	-
EF_{rec}	Recreator Exposure Frequency - (days/year)	75	Reasonable estimate
ED_{rec}	Recreator Exposure Duration (years)	26	Reasonable estimate

Table G-24. Farmer Direct Ingestion

Symbol	Definition (units)	Default	Reference
$CDI_{far-produce-rad-ing}$	Farmer Produce Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{far-poultry-rad-ing}$	Farmer Poultry Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{far-egg-rad-ing}$	Farmer Egg Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{far-beef-rad-ing}$	Farmer Beef Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{far-dairy-rad-ing}$	Farmer Dairy Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{far-swine-rad-ing}$	Farmer Swine Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CDI_{far-fish-rad-ing}$	Farmer Fish Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator
$CF_{far-produce}$	Produce Contaminated Fraction - farmer (unitless)	1	U.S. EPA 1994c. U.S. EPA. 1998. (pg. C-9)
$CF_{far-poultry}$	Poultry Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{far-egg}$	Egg Contaminated Fraction - Farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{far-beef}$	Beef Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{far-dairy}$	Dairy Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{far-swine}$	Swine Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$CF_{far-fish}$	Fish Contaminated Fraction - farmer (unitless)	1	Developed for Radionuclide Soil Screening calculator
$IFV_{far-adj}$	Farmer Vegetable Ingestion Fraction - age-adjusted (g)	1,583,400	Calculated using the age-adjusted intake factors equation
IRV_{far-a}	Farmer Vegetable Ingestion Rate - adult (g/day)	125.7	U.S. EPA 2011 (Table 13-10)
IRV_{far-c}	Farmer Vegetable Ingestion Rate - child (g/day)	41.7	U.S. EPA 2011 (Table 13-10)
$IFF_{far-adj}$	Farmer Fruit Ingestion Rate - age-adjusted (g)	2,246,930	Calculated using the age-adjusted intake factors equation
IRF_{far-a}	Farmer Fruit Ingestion Rate - adult (g/day)	176.8	U.S. EPA 2011 (Table 13-5)
IRF_{far-c}	Farmer Fruit Ingestion Rate - child (g/day)	68.1	U.S. EPA 2011 (Table 13-5)
$IFP_{far-adj}$	Farmer Poultry Ingestion Fraction - age-adjusted (g)	1,318,100	Calculated using the age-adjusted intake factors equation

Table G-24. Farmer Direct Ingestion

Symbol	Definition (units)	Default	Reference
IRP_{far-a}	Farmer Poultry Ingestion Rate - adult (g/day)	106.6	U.S. EPA 2011 (Table 13-52)
IRP_{far-c}	Farmer Poultry Ingestion Rate - child (g/day)	23.6	U.S. EPA 2011 (Table 13-52)
$IFE_{far-adj}$	Farmer Egg Ingestion Rate - age-adjusted (g)	658,455	Calculated using the age-adjusted intake factors equation
IRE_{far-a}	Farmer Egg Ingestion Rate - adult (g/day)	53.4	U.S. EPA 2011 (Table 13-40)
IRE_{far-c}	Farmer Egg Ingestion Rate - child (g/day)	10.95	U.S. EPA 2011 (Table 13-40)
$IFB_{far-adj}$	Farmer Beef Ingestion Fraction - age-adjusted (g)	2,202,410	Calculated using the age-adjusted intake factors equation
IRB_{far-a}	Farmer Beef Ingestion Rate - adult (g/day)	178.0	U.S. EPA 2011 (Table 13-33)
IRB_{far-c}	Farmer Beef Ingestion Rate - child (g/day)	40.1	U.S. EPA 2011 (Table 13-33)
$IFD_{far-adj}$	Farmer Dairy Ingestion Fraction - age-adjusted (g)	6,036,590	Calculated using the age-adjusted intake factors equation
IRD_{far-a}	Farmer Dairy Ingestion Rate - adult (g/day)	445.6	U.S. EPA 2011 (Table 11-4)
IRD_{far-c}	Farmer Dairy Ingestion Rate - child (g/day)	349.5	U.S. EPA 2011 (Table 11-4)
$IFSW_{far-adj}$	Farmer Swine Ingestion Fraction - age-adjusted (g)	1,203,860	Calculated using the age-adjusted intake factors equation
$IRSW_{far-a}$	Farmer Swine Ingestion Rate - adult (g/day)	97.9	U.S. EPA 2011 (Table 13-51)
$IRSW_{far-c}$	Farmer Swine Ingestion Rate - child (g/day)	18.5	U.S. EPA 2011 (Table 13-51)
$IFFI_{far-adj}$	Farmer Fish Ingestion Fraction - age-adjusted (g)	1,918,140	Calculated using the age-adjusted intake factors equation
$IRFI_{far-a}$	Farmer Fish Ingestion Rate - adult (g/day)	155.4	U.S. EPA 2011 (Table 13-20)
$IRFI_{far-c}$	Farmer Fish Ingestion Rate - child (g/day)	32.8	U.S. EPA 2011 (Table 13-20)
$CDI_{far-produce-rad-ing}$	Farmer Produce Radionuclide Ingestion (pCi)	Contaminant-specific	Determined in this calculator

Table G-25. Soil to Groundwater SSL Factor Variables

Symbol	Definition (units)	Default	Reference
C_w	Target soil leachate concentration (pCi/L)	Nonzero MCL or RSL × DAF	U.S. EPA. 2002 Equation 4-14
DAF	Dilution attenuation factor (unitless)	20 (or site-specific)	U.S. EPA. 2002 Equation 4-11
ED_{gw}	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
θ_w	Water-filled soil porosity (L_{water}/L_{soil})	0.3	U.S. EPA. 2002 Equation 4-10
θ_a	Air-filled soil porosity (L_{air}/L_{soil})	$= n-\theta_w$	U.S. EPA. 2002 Equation 4-10
n	Total soil porosity (L_{pore}/L_{soil})	$= 1-(\rho_b/\rho_s)$	U.S. EPA. 2002 Equation 4-10
ρ_s	Soil particle density (Kg/L)	2.65	U.S. EPA. 2002 Equation 4-10
ρ_b	Dry soil bulk density (kg/L)	1.5	U.S. EPA. 2002 Equation 4-10
K_d	Soil-water partition coefficient (L/kg)	$= K_{oc} * f_{oc}$ for organics	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

Table G-26. Wind Particulate Emission Factor Variables

Symbol	Definition (units)	Default	Reference
PEF_w	Particulate Emission Factor - Minneapolis (m^3/kg)	1.36 x 10^9 (region-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 7 m (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

Table G-27. Mechanical Particulate Emission Factor Variables from Vehicle Traffic

Symbol	Definition (units)	Default	Reference
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)	7,200,000	U.S. EPA 2002 Equation 5-5
A_R	Surface area of contaminated road segment (m^2)	($A_R = L_R$ x W_R x 0.092903 m^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

Table G-28. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
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)	0.185	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

Table G-28. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
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 7 m (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
$M_{m\text{-}excav}$	Gravimetric soil moisture content (%)	12 (Mean value for municipal landfill cover)	U.S. EPA 2002 Equation E-21
ρ_{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_{excav}	Average depth of excavation (m)	Site-specific	U.S. EPA 2002 Equation E-21
$N_{A\text{-}dump}$	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
$\sum VKT_{doz}$	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

Table G-28. Mechanical Particulate Emission Factor Variables from other than Vehicle Traffic

Symbol	Definition (units)	Default	Reference
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
$\sum VKT_{grade}$	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 $\sum VKT_{grade}$ in U.S. EPA 2002 Equation E-23
$A_{c\text{-}doz}$	Areal extent of dozing (acres)	Site-specific	Necessary to solve $\sum VKT_{doz}$ 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

APPENDIX H. RADIONUCLIDE CDI AND RISK EQUATIONS

APPENDIX H. RADIONUCLIDE CDI AND RISK EQUATIONS

Resident Soil CDI Equations

Soil Ingestion

$$CDI_{res-sol-ing}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times IFS_{res-adj}(1{,}120{,}000\ mg) \times \left(\frac{g}{1000\ mg}\right)\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

where:

$$IFS_{res-adj}(1{,}120{,}000\ mg) = \left[\begin{array}{l}\left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRS_{res-c}\left(\frac{200\ mg}{day}\right)\right) + \\ \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRS_{res-a}\left(\frac{100\ mg}{day}\right)\right)\end{array}\right]$$

Soil Inhalation

$$CDI_{res-sol-inh}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times IFA_{res-adj}\left(161{,}000\ m^3\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right)\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

where:

$$IFA_{res-adj}\left(161{,}000\ m^3\right) = \left[\begin{array}{l}\left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times ET_{res-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{res-c}\left(\frac{10\ m^3}{day}\right)\right) + \\ \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times ET_{res-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{res-a}\left(\frac{20\ m^3}{day}\right)\right)\end{array}\right]$$

Soil External Exposure

$$CDI_{res-sol-ext}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c}C_{soil}\left(\frac{pCi}{g}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{res}(26\ yr) \times ACF_{ext-sv} \times \\ \left[\left(ET_{res-o}\left(\frac{1.752\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-sv}\right) + \left(ET_{res-i}\left(\frac{16.416\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right]\end{array}\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Soil Contribution to Produce Ingestion

$$CDI_{res\text{-}sol\text{-}produce\text{-}ing}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times (R_{upv} + R_{es}) \times (IFF_{res\text{-}adj}(1,462,510\ g) + IFV_{res\text{-}adj}(989,870\ g)) \times CF_{res\text{-}produce}(0.25)\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

where:

$$R_{upv} = BV_{wet}\left(\frac{pCi\ /\ g\text{-}fresh\text{-}plant}{pCi\ /\ g\text{-}dry\text{-}soil}\right);\ R_{es} = MLF_{produce}\left(\frac{0.0135\ g\text{-}dry\text{-}soil}{g\text{-}fresh\text{-}plant}\right)$$

and:

$$IFF_{res\text{-}adj}(1,462,510\ g) = \left[\begin{array}{l}\left(EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times IRF_{res\text{-}c}\left(\frac{68.1\ g}{day}\right)\right) + \\ \left(EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times IRF_{res\text{-}a}\left(\frac{188.5\ g}{day}\right)\right)\end{array}\right]$$

and:

$$IFV_{res\text{-}adj}(989,870\ g) = \left[\begin{array}{l}\left(EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times IRV_{res\text{-}c}\left(\frac{41.7\ g}{day}\right)\right) + \\ \left(EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times IRV_{res\text{-}a}\left(\frac{128.9\ g}{day}\right)\right)\end{array}\right]$$

Direct Produce Ingestion

$$CDI_{res\text{-}produce\text{-}ing}(pCi) = \left(C_{produce}\left(\frac{pCi}{g}\right) \times (IFF_{res\text{-}adj}(1,462,510\ g) + IFV_{res\text{-}adj}(989,870\ g)) \times CF_{res\text{-}produce}(0.25)\right)$$

where:

$$IFF_{res\text{-}adj}(1,462,510\ g) = \left[\begin{array}{l}\left(EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times IRF_{res\text{-}c}\left(\frac{68.1\ g}{day}\right)\right) + \\ \left(EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times IRF_{res\text{-}a}\left(\frac{188.5\ g}{day}\right)\right)\end{array}\right]$$

and:

$$IFV_{res\text{-}adj}(989,870\ g) = \left[\begin{array}{l}\left(EF_{res\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}c}(6\ yr) \times IRV_{res\text{-}c}\left(\frac{41.7\ g}{day}\right)\right) + \\ \left(EF_{res\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{res\text{-}a}(20\ yr) \times IRV_{res\text{-}a}\left(\frac{128.9\ g}{day}\right)\right)\end{array}\right]$$

Resident Alternate External Sources CDI Equations

Direct External Exposure (sv)

$$CDI_{res\text{-}sol\text{-}sv}\left(\frac{pCi\text{-}yr}{g}\right) = \left(\begin{array}{c}C_{soil}\left(\frac{pCi}{g}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{res}(26\ yr) \times ACF_{ext\text{-}sv} \times \\ \left[\left(ET_{res\text{-}o}\left(\frac{1.752\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o\text{-}ext\text{-}sv}\right) + \left(ET_{res\text{-}i}\left(\frac{16.416\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i\text{-}total}\right)\right]\end{array}\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (1 cm)

$$\mathrm{CDI}_{\text{res-sol-1cm}}\left(\frac{\mathrm{pCi-yr}}{\mathrm{g}}\right) = \left(\begin{array}{c} \mathrm{C}_{\text{soil}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) \times \mathrm{EF}_{\text{res}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \left(\frac{1\ \text{yr}}{365\ \text{days}}\right) \times \mathrm{ED}_{\text{res}}(26\ \text{yr}) \times \mathrm{ACF}_{\text{ext-1cm}} \times \\ \left[\left(\mathrm{ET}_{\text{res-o}}\left(\frac{1.752\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{GSF}_{\text{o-ext-1cm}}\right) + \left(\mathrm{ET}_{\text{res-i}}\left(\frac{16.416\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{GSF}_{\text{i-total}}\right)\right] \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{\text{yr}}\right)\times t(\text{yr})}\right)}{t(\text{yr}) \times \lambda\left(\frac{1}{\text{yr}}\right)}\right)$$

Direct External Exposure (5 cm)

$$\mathrm{CDI}_{\text{res-sol-5cm}}\left(\frac{\mathrm{pCi-yr}}{\mathrm{g}}\right) = \left(\begin{array}{c} \mathrm{C}_{\text{soil}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) \times \mathrm{EF}_{\text{res}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \left(\frac{1\ \text{yr}}{365\ \text{days}}\right) \times \mathrm{ED}_{\text{res}}(26\ \text{yr}) \times \mathrm{ACF}_{\text{ext-5cm}} \times \\ \left[\left(\mathrm{ET}_{\text{res-o}}\left(\frac{1.752\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{GSF}_{\text{o-ext-5cm}}\right) + \left(\mathrm{ET}_{\text{res-i}}\left(\frac{16.416\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{GSF}_{\text{i-total}}\right)\right] \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{\text{yr}}\right)\times t(\text{yr})}\right)}{t(\text{yr}) \times \lambda\left(\frac{1}{\text{yr}}\right)}\right)$$

Direct External Exposure (15 cm)

$$\mathrm{CDI}_{\text{res-sol-15cm}}\left(\frac{\mathrm{pCi-yr}}{\mathrm{g}}\right) = \left(\begin{array}{c} \mathrm{C}_{\text{soil}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) \times \mathrm{EF}_{\text{res}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \left(\frac{1\ \text{yr}}{365\ \text{days}}\right) \times \mathrm{ED}_{\text{res}}(26\ \text{yr}) \times \mathrm{ACF}_{\text{ext-15cm}} \times \\ \left[\left(\mathrm{ET}_{\text{res-o}}\left(\frac{1.752\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{GSF}_{\text{o-ext-15cm}}\right) + \left(\mathrm{ET}_{\text{res-i}}\left(\frac{16.416\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{GSF}_{\text{i-total}}\right)\right] \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{\text{yr}}\right)\times t(\text{yr})}\right)}{t(\text{yr}) \times \lambda\left(\frac{1}{\text{yr}}\right)}\right)$$

Direct External Exposure (ground plane)

$$\mathrm{CDI}_{\text{res-sol-gp}}\left(\frac{\mathrm{pCi-yr}}{\mathrm{cm}^2}\right) = \left(\begin{array}{c} \mathrm{C}_{\text{soil}}\left(\frac{\mathrm{pCi}}{\mathrm{cm}^2}\right) \times \mathrm{EF}_{\text{res}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \left(\frac{1\ \text{yr}}{365\ \text{days}}\right) \times \mathrm{ED}_{\text{res}}(26\ \text{yr}) \times \mathrm{ACF}_{\text{ext-gp}} \times \\ \left[\left(\mathrm{ET}_{\text{res-o}}\left(\frac{1.752\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{GSF}_{\text{o-ext-gp}}\right) + \left(\mathrm{ET}_{\text{res-i}}\left(\frac{16.416\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{GSF}_{\text{i-total}}\right)\right] \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{\text{yr}}\right)\times t(\text{yr})}\right)}{t(\text{yr}) \times \lambda\left(\frac{1}{\text{yr}}\right)}\right)$$

Resident Air CDI Equations

Air Inhalation

$$\mathrm{CDI}_{\text{res-air-inh}}(\mathrm{pCi}) = \left(\mathrm{C}_{\text{air}}\left(\frac{\mathrm{pCi}}{\mathrm{m}^3}\right) \times \mathrm{IFA}_{\text{res-adj}}\left(161{,}000\ \mathrm{m}^3\right)\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{\text{yr}}\right)\times t(\text{yr})}\right)}{t(\text{yr}) \times \lambda\left(\frac{1}{\text{yr}}\right)}\right)$$

where:

$$\mathrm{IFA}_{\text{res-adj}}\left(161{,}000\ \mathrm{m}^3\right) = \left[\begin{array}{c} \left(\mathrm{EF}_{\text{res-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{\text{res-c}}(6\ \text{yr}) \times \mathrm{ET}_{\text{res-c}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{IRA}_{\text{res-c}}\left(\frac{10\ \mathrm{m}^3}{\text{day}}\right)\right) + \\ \left(\mathrm{EF}_{\text{res-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{\text{res-a}}(20\ \text{yr}) \times \mathrm{ET}_{\text{res-a}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{IRA}_{\text{res-a}}\left(\frac{20\ \mathrm{m}^3}{\text{day}}\right)\right) \end{array}\right]$$

Air Submersion

$$\mathrm{CDI}_{\text{res-air-sub}}\left(\frac{\mathrm{pCi-yr}}{\mathrm{m}^3}\right) = \left(\mathrm{C}_{\text{air}}\left(\frac{\mathrm{pCi}}{\mathrm{m}^3}\right) \times \mathrm{EF}_{\text{res}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \left(\frac{1\ \text{yr}}{365\ \text{days}}\right) \times \mathrm{ED}_{\text{res}}(26\ \text{yr}) \times \mathrm{ET}_{\text{res}}\left(\frac{24\ \text{hrs}}{\text{day}}\right) \times \left(\frac{1\ \text{day}}{24\ \text{hrs}}\right) \times \mathrm{GSF}_{\text{a}}(1.0)\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{\text{yr}}\right)\times t(\text{yr})}\right)}{t(\text{yr}) \times \lambda\left(\frac{1}{\text{yr}}\right)}\right)$$

Air Inhalation (without decay)

$$CDI_{res-air-inhnd}(pCi) = \left(C_{air} \times \left(\frac{pCi}{m^3}\right) \times IFA_{res-adj}\left(161{,}000\ m^3\right)\right)$$

where:

$$IFA_{res-adj}\left(161{,}000\ m^3\right) = \left[\begin{array}{l} \left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times ET_{res-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{res-c}\left(\frac{10\ m^3}{day}\right)\right) + \\ \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times ET_{res-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{res-a}\left(\frac{20\ m^3}{day}\right)\right) \end{array}\right]$$

Air Submersion (without decay)

$$CDI_{res-air-subnd}\left(\frac{pCi-yr}{m^3}\right) = \left(C_{air} \times \left(\frac{pCi}{m^3}\right) \times EF_{res}\left(\frac{350\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{res}(26\ yr) \times ET_{res}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)\right)$$

Resident Tap Water CDI Equations

Tap Water Ingestion

$$CDI_{res-wat-ing}(pCi) = \left(C_{water}\left(\frac{pCi}{L}\right) \times IFW_{res-adj}(19{,}138\ L)\right)$$

where:

$$IFW_{res-adj}(19{,}138\ L) = \left[\begin{array}{l} \left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRW_{res-c}\left(\frac{0.78\ L}{day}\right)\right) + \\ \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRW_{res-a}\left(\frac{2.5\ L}{day}\right)\right) \end{array}\right]$$

Tap Water Inhalation

$$CDI_{res-wat-inh}(pCi) = \left(C_{water}\left(\frac{pCi}{L}\right) \times IFA_{res-adj}\left(161{,}000\ m^3\right) \times K\left(\frac{0.5\ L}{m^3}\right)\right)$$

where:

$$IFA_{res-adj}\left(161{,}000\ m^3\right) = \left[\begin{array}{l} \left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times ET_{res-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{res-c}\left(\frac{10\ m^3}{day}\right)\right) + \\ \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times ET_{res-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{res-a}\left(\frac{20\ m^3}{day}\right)\right) \end{array}\right]$$

Tap Water Immersion

$$CDI_{res-wat-imm}\left(\frac{pCi-yr}{L}\right) = \left(C_{water}\left(\frac{pCi}{L}\right) \times \left(\frac{1\ yr}{8,760\ hrs}\right) \times DFA_{res-adj}\,(6,104\ hrs)\right)$$

where:

$$DFA_{res-adj}\,(6,104\ hrs) = \left[\begin{array}{l}\left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times EV_{res-c}\left(\frac{1\ events}{day}\right) \times ET_{event-res-c}\left(\frac{0.54\ hrs}{event}\right)\right) + \\ \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times EV_{res-a}\left(\frac{1\ events}{day}\right) \times ET_{event-res-a}\left(\frac{0.71\ hrs}{event}\right)\right)\end{array}\right]$$

Tap Water Contribution to Produce Ingestion

$$CDI_{res-wat-produce-ing}(pCi) = \left[\begin{array}{c}C_{water}\left(\frac{pCi}{L}\right) \times \left(IFF_{res-adj}(1,462,510\ g) + IFV_{res-adj}(989,870\ g)\right) \times CF_{res-produce}(0.25) \\ \left(\frac{1\ kg}{1000\ g}\right) \times \left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right)\end{array}\right]$$

where:

$$Irr_{rup}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times MLF_{produce}\left(\frac{0.0135\ g-dry-soil}{g-fresh-plant}\right) \times \left[1-\exp\left(-\left(\frac{\lambda_B}{day}\right) \times t_b\,(days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

$$Irr_{res}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times BV_{wet}\left(\frac{pCi\ /\ g-fresh-plant}{pCi\ /\ g-dry-soil}\right) \times \left[1-\exp\left(-\left(\frac{\lambda_B}{day}\right) \times t_b\,(days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{dep}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times I_f \times T \times \left[1-\exp\left(-\left(\frac{\lambda_E}{day}\right) \times t_v\,(days)\right)\right]}{Y_v\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_E}{day}\right)}$$

and:

$$IFF_{res-adj}(1,462,510\ g) = \left[\begin{array}{l}\left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRF_{res-c}\left(\frac{68.1\ g}{day}\right)\right) + \\ \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRF_{res-a}\left(\frac{188.5\ g}{day}\right)\right)\end{array}\right]$$

and:

$$IFV_{res-adj}(989,870\ g) = \left[\begin{array}{l}\left(EF_{res-c}\left(\frac{350\ days}{yr}\right) \times ED_{res-c}(6\ yr) \times IRV_{res-c}\left(\frac{41.7\ g}{day}\right)\right) + \\ \left(EF_{res-a}\left(\frac{350\ days}{yr}\right) \times ED_{res-a}(20\ yr) \times IRV_{res-a}\left(\frac{128.9\ g}{day}\right)\right)\end{array}\right]$$

Direct Produce Ingestion

$$\mathrm{CDI}_{\mathrm{res-produce-ing}}(\mathrm{pCi}) = \left(\mathrm{C}_{\mathrm{produce}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) \times \left(\mathrm{IFF}_{\mathrm{res-adj}}(1{,}462{,}510\ \mathrm{g}) + \mathrm{IFV}_{\mathrm{res-adj}}(989{,}870\ \mathrm{g})\right) \times \mathrm{CF}_{\mathrm{res-produce}}(0.25)\right)$$

where:

$$\mathrm{IFF}_{\mathrm{res-adj}}(1{,}462{,}510\ \mathrm{g}) = \left[\begin{array}{l}\left(\mathrm{EF}_{\mathrm{res-c}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\mathrm{res-c}}(6\ \mathrm{yr}) \times \mathrm{IRF}_{\mathrm{res-c}}\left(\frac{68.1\ \mathrm{g}}{\mathrm{day}}\right)\right) + \\ \left(\mathrm{EF}_{\mathrm{res-a}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\mathrm{res-a}}(20\ \mathrm{yr}) \times \mathrm{IRF}_{\mathrm{res-a}}\left(\frac{188.5\ \mathrm{g}}{\mathrm{day}}\right)\right)\end{array}\right]$$

and:

$$\mathrm{IFV}_{\mathrm{res-adj}}(989{,}870\ \mathrm{g}) = \left[\begin{array}{l}\left(\mathrm{EF}_{\mathrm{res-c}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\mathrm{res-c}}(6\ \mathrm{yr}) \times \mathrm{IRV}_{\mathrm{res-c}}\left(\frac{41.7\ \mathrm{g}}{\mathrm{day}}\right)\right) + \\ \left(\mathrm{EF}_{\mathrm{res-a}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\mathrm{res-a}}(20\ \mathrm{yr}) \times \mathrm{IRV}_{\mathrm{res-a}}\left(\frac{128.9\ \mathrm{g}}{\mathrm{day}}\right)\right)\end{array}\right]$$

Resident Fish CDI Equations

Direct Fish Ingestion

$$\mathrm{CDI}_{\mathrm{res-fish-ing}}(\mathrm{pCi}) = \left(\mathrm{C}_{\mathrm{fish}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) \times \mathrm{EF}_{\mathrm{res}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\mathrm{res}}(26\ \mathrm{yr}) \times \mathrm{IRFI}_{\mathrm{res-a}}\left(\frac{54{,}000\ \mathrm{mg}}{\mathrm{day}}\right) \times \left(\frac{\mathrm{g}}{1000\ \mathrm{mg}}\right) \times \mathrm{CF}_{\mathrm{res-fish}}(1)\right)$$

Surface Water Contribution to Fish Ingestion

$$\mathrm{CDI}_{\mathrm{res-fish-ingw}}\left(\frac{\mathrm{pCi}}{\mathrm{L}}\right) = \left(\mathrm{C}_{\mathrm{water}} \times \left(\frac{\mathrm{pCi}}{\mathrm{L}}\right) \times \mathrm{EF}_{\mathrm{res}}\left(\frac{350\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\mathrm{res}}(26\ \mathrm{yr}) \times \mathrm{IRFI}_{\mathrm{res-a}}\left(\frac{54{,}000\ \mathrm{mg}}{\mathrm{day}}\right) \times \left(\frac{\mathrm{g}}{1000\ \mathrm{mg}}\right)\mathrm{BCF}\left(\frac{\mathrm{L}}{\mathrm{kg}}\right) \times \left(\frac{1\ \mathrm{kg}}{1000\ \mathrm{g}}\right) \times \mathrm{CF}_{\mathrm{res-fish}}(1)\right)$$

Indoor Worker Soil CDI Equations

Soil Ingestion

$$\mathrm{CDI}_{\mathrm{ind-sol-ing}}(\mathrm{pCi}) = \left(\mathrm{C}_{\mathrm{soil}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) \times \mathrm{EF}_{\mathrm{ind}}\left(\frac{250\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\mathrm{ind}}(25\ \mathrm{yr}) \times \mathrm{IRS}_{\mathrm{ind}}\left(\frac{50\ \mathrm{mg}}{\mathrm{day}}\right) \times \left(\frac{\mathrm{g}}{1000\ \mathrm{mg}}\right)\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right) \times \mathrm{t(yr)}}\right)}{\mathrm{t(yr)} \times \lambda\left(\frac{1}{\mathrm{yr}}\right)}\right)$$

Soil Inhalation

$$\mathrm{CDI}_{\mathrm{ind-sol-inh}}(\mathrm{pCi}) = \left(\begin{array}{l}\mathrm{C}_{\mathrm{soil}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right)\mathrm{EF}_{\mathrm{ind}}\left(\frac{250\ \mathrm{days}}{\mathrm{yr}}\right) \times \mathrm{ED}_{\mathrm{ind}}(25\ \mathrm{yr}) \times \mathrm{ET}_{\mathrm{ind}}\left(\frac{8\ \mathrm{hrs}}{\mathrm{day}}\right) \times \\ \left(\frac{1\ \mathrm{day}}{24\ \mathrm{hrs}}\right) \times \mathrm{IRA}_{\mathrm{ind}}\left(\frac{60\ \mathrm{m}^3}{\mathrm{day}}\right) \times \frac{1}{\mathrm{PEF}\left(\frac{\mathrm{m}^3}{\mathrm{kg}}\right)} \times \left(\frac{1000\ \mathrm{g}}{\mathrm{kg}}\right)\end{array}\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{\mathrm{yr}}\right) \times \mathrm{t(yr)}}\right)}{\mathrm{t(yr)} \times \lambda\left(\frac{1}{\mathrm{yr}}\right)}\right)$$

Soil External Exposure

$$CDI_{ind-sol-ext}\left(\frac{pCi-yr}{g}\right)=\begin{pmatrix} C_{soil}\left(\frac{pCi}{g}\right)\times EF_{ind}\left(\frac{250\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{ind}(25\text{ yr})\times \\ ET_{ind}\left(\frac{8\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext-sv}\times GSF_{i-total}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Indoor Worker Alternate External Sources CDI Equations

Direct External Exposure (sv)

$$CDI_{ind-sol-sv}\left(\frac{pCi-yr}{g}\right)=\begin{pmatrix} C_{soil}\left(\frac{pCi}{g}\right)\times EF_{ind}\left(\frac{250\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{ind}(25\text{ yr})\times \\ ET_{ind}\left(\frac{8\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext-sv}\times GSF_{i-total}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (1 cm)

$$CDI_{ind-sol-1cm}\left(\frac{pCi-yr}{g}\right)=\begin{pmatrix} C_{soil}\left(\frac{pCi}{g}\right)\times EF_{ind}\left(\frac{250\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{ind}(25\text{ yr})\times \\ ET_{ind}\left(\frac{8\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext-1cm}\times GSF_{i-total}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (5 cm)

$$CDI_{ind-sol-5cm}\left(\frac{pCi-yr}{g}\right)=\begin{pmatrix} C_{soil}\left(\frac{pCi}{g}\right)\times EF_{ind}\left(\frac{250\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{ind}(25\text{ yr})\times \\ ET_{ind}\left(\frac{8\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext-5cm}\times GSF_{i-total}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (15 cm)

$$CDI_{ind-sol-15cm}\left(\frac{pCi-yr}{g}\right)=\begin{pmatrix} C_{soil}\left(\frac{pCi}{g}\right)\times EF_{ind}\left(\frac{250\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{ind}(25\text{ yr})\times \\ ET_{ind}\left(\frac{8\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext-15cm}\times GSF_{i-total}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (ground plane)

$$CDI_{ind-sol-gp}\left(\frac{pCi-yr}{cm^2}\right)=\begin{pmatrix} C_{soil}\left(\frac{pCi}{cm^2}\right)\times EF_{ind}\left(\frac{250\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{ind}(25\text{ yr})\times \\ ET_{ind}\left(\frac{8\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext-gp}\times GSF_{i-total}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Indoor Worker Air CDI Equations

Air Inhalation

$$CDI_{ind\text{-}air\text{-}inh}(pCi) = \left(C_{air}\left(\frac{pCi}{m^3}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{ind}\left(\frac{60\ m^3}{day}\right)\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Air Submersion

$$CDI_{ind\text{-}air\text{-}sub}\left(\frac{pCi-yr}{m^3}\right) = \left(C_{air}\left(\frac{pCi}{m^3}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Air Inhalation (without decay)

$$CDI_{ind\text{-}air\text{-}inhnd}(pCi) = \left(C_{air} \times \left(\frac{pCi}{m^3}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{ind}\left(\frac{60\ m^3}{day}\right)\right)$$

Air Submersion (without decay)

$$CDI_{ind\text{-}air\text{-}subnd}\left(\frac{pCi-yr}{m^3}\right) = \left(C_{air} \times \left(\frac{pCi}{m^3}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)\right)$$

Indoor Worker Tap Water CDI Equations

Tap Water Ingestion

$$CDI_{ind\text{-}wat\text{-}ing}(pCi) = \left(C_{water}\left(\frac{pCi}{L}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times IRW_{ind\text{-}a}\left(\frac{1.25\ L}{day}\right)\right)$$

Tap Water Inhalation

$$CDI_{ind\text{-}wat\text{-}inh}(pCi) = \left(C_{water}\left(\frac{pCi}{L}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times ED_{ind}(25\ yr) \times ET_{ind}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{ind\text{-}a}\left(\frac{60\ m^3}{day}\right) \times K\left(\frac{0.5\ L}{m^3}\right)\right)$$

Tap Water Immersion

$$CDI_{ind\text{-}wat\text{-}imm}\left(\frac{pCi-yr}{L}\right) = \left(C_{water}\left(\frac{pCi}{L}\right) \times EF_{ind}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{ind}(25\ yr) \times EV_{ind}\left(\frac{1\ events}{day}\right) \times ET_{event\text{-}ind\text{-}a}\left(\frac{0.71\ hrs}{event}\right) \times \left(\frac{1\ day}{24\ hrs}\right)\right)$$

Outdoor Worker Soil CDI Equations

Soil Ingestion

$$CDI_{out\text{-}sol\text{-}ing}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times IRS_{out}\left(\frac{100\ mg}{day}\right) \times \left(\frac{g}{1000\ mg}\right)\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Soil Inhalation

$$CDI_{out\text{-}sol\text{-}inh}(pCi) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) EF_{out}\left(\frac{225\ days}{yr}\right) \times ED_{out}(25\ yr) \times ET_{out}\left(\frac{8\ hrs}{day}\right) \times \\ \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{out}\left(\frac{60\ m^3}{day}\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right) \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Soil External Exposure

$$CDI_{out\text{-}sol\text{-}ext}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv} \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Outdoor Worker Alternate External Sources CDI Equations

Direct External Exposure (sv)

$$CDI_{out\text{-}sol\text{-}sv}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv} \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (1 cm)

$$CDI_{out\text{-}sol\text{-}1cm}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-1cm} \times GSF_{o-ext-1cm} \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (5 cm)

$$CDI_{out\text{-}sol\text{-}5cm}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{out}\left(\frac{225\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{out}(25\ yr) \times \\ ET_{out}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-5cm} \times GSF_{o-ext-5cm} \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (15 cm)

$$CDI_{out-sol-15cm}\left(\frac{pCi-yr}{g}\right)=\left(\begin{array}{c}C_{soil}\left(\frac{pCi}{g}\right)\times EF_{out}\left(\frac{225\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{out}(25\ yr)\times \\ ET_{out}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times ACF_{ext-15cm}\times GSF_{o-ext-15cm}\end{array}\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (ground plane)

$$CDI_{out-sol-gp}\left(\frac{pCi-yr}{cm^2}\right)=\left(\begin{array}{c}C_{soil}\left(\frac{pCi}{cm^2}\right)\times EF_{out}\left(\frac{225\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{out}(25\ yr)\times \\ ET_{out}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times ACF_{ext-gp}\times GSF_{o-ext-gp}\end{array}\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Outdoor Worker Air CDI Equations

Air Inhalation

$$CDI_{out-air-inh}(pCi)=\left(C_{air}\left(\frac{pCi}{m^3}\right)\times EF_{out}\left(\frac{225\ days}{yr}\right)\times ED_{out}(25\ yr)\times ET_{out}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{out}\left(\frac{60\ m^3}{day}\right)\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Air Submersion

$$CDI_{out-air-sub}\left(\frac{pCi-yr}{m^3}\right)=\left(C_{air}\left(\frac{pCi}{m^3}\right)\times EF_{out}\left(\frac{225\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{out}(25\ yr)\times ET_{out}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_a(1.0)\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Air Inhalation (without decay)

$$CDI_{out-air-inhnd}(pCi)=\left(C_{air}\times\left(\frac{pCi}{m^3}\right)\times EF_{out}\left(\frac{225\ days}{yr}\right)\times ED_{out}(25\ yr)\times ET_{out}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{out}\left(\frac{60\ m^3}{day}\right)\right)$$

Air Submersion (without decay)

$$CDI_{out-air-subnd}\left(\frac{pCi-yr}{m^3}\right)=\left(C_{air}\times\left(\frac{pCi}{m^3}\right)\times EF_{out}\left(\frac{225\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{out}(25\ yr)\times ET_{out}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_a(1.0)\right)$$

Composite Worker Soil CDI Equations

Soil Ingestion

$$CDI_{com-sol-ing}(pCi)=\left(C_{soil}\left(\frac{pCi}{g}\right)\times EF_{com}\left(\frac{250\ days}{yr}\right)\times ED_{com}(25\ yr)\times IRS_{com}\left(\frac{100\ mg}{day}\right)\times\left(\frac{g}{1000\ mg}\right)\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Soil Inhalation

$$CDI_{com-sol-inh}(pCi) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \\ \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{com}\left(\frac{60\ m^3}{day}\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right) \end{array} \right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)} \right)$$

Soil External Exposure

$$CDI_{com-sol-ext}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext-sv} \times \\ \left[\left(ET_{com-o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-sv}\right) + \left(ET_{com-i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right] \end{array} \right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)} \right)$$

Composite Worker Alternate External Sources CDI Equations

Direct External Exposure (sv)

$$CDI_{com-sol-sv}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext-sv} \times \\ \left[\left(ET_{com-o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-sv}\right) + \left(ET_{com-i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right] \end{array} \right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)} \right)$$

Direct External Exposure (1 cm)

$$CDI_{com-sol-1cm}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext-1cm} \times \\ \left[\left(ET_{com-o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-1cm}\right) + \left(ET_{com-i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right] \end{array} \right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)} \right)$$

Direct External Exposure (5 cm)

$$CDI_{com-sol-5cm}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext-5cm} \times \\ \left[\left(ET_{com-o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-5cm}\right) + \left(ET_{com-i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right] \end{array} \right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)} \right)$$

Direct External Exposure (15 cm)

$$CDI_{com-sol-15cm}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext-15cm} \times \\ \left[\left(ET_{com-o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-15cm}\right) + \left(ET_{com-i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right] \end{array} \right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)} \right)$$

Direct External Exposure (ground plane)

$$CDI_{com\text{-}sol\text{-}gp}\left(\frac{pCi-yr}{cm^2}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{cm^2}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ACF_{ext\text{-}gp} \times \\ \left[\left(ET_{com\text{-}o}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o\text{-}ext\text{-}gp}\right) + \left(ET_{com\text{-}i}\left(\frac{0\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i\text{-}total}\right)\right] \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Composite Worker Air CDI Equations

Air Inhalation

$$CDI_{com\text{-}air\text{-}inh}(pCi) = \left(C_{air}\left(\frac{pCi}{m^3}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{com}\left(\frac{60\ m^3}{day}\right)\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Air Submersion

$$CDI_{com\text{-}air\text{-}sub}\left(\frac{pCi-yr}{m^3}\right) = \left(C_{air}\left(\frac{pCi}{m^3}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Air Inhalation (without decay)

$$CDI_{com\text{-}air\text{-}inhnd}(pCi) = \left(C_{air} \times \left(\frac{pCi}{m^3}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{com}\left(\frac{60\ m^3}{day}\right)\right)$$

Air Submersion (without decay)

$$CDI_{com\text{-}air\text{-}subnd}\left(\frac{pCi-yr}{m^3}\right) = \left(C_{air} \times \left(\frac{pCi}{m^3}\right) \times EF_{com}\left(\frac{250\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{com}(25\ yr) \times ET_{com}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)\right)$$

Excavation Worker Soil CDI Equations

Soil Ingestion

$$CDI_{exc\text{-}sol\text{-}ing}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times IRS_{exc}\left(\frac{330\ mg}{day}\right) \times \left(\frac{g}{1000\ mg}\right)\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Soil Inhalation

$$CDI_{exc\text{-}sol\text{-}inh}(pCi) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) EF_{exc}\left(\frac{20\ days}{yr}\right) \times ED_{exc}(1\ yr) \times ET_{exc}\left(\frac{8\ hrs}{day}\right) \times \\ \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{exc}\left(\frac{60\ m^3}{day}\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right) \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Soil External Exposure

$$CDI_{exc-sol-ext}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{exc}(1\ yr)\times \\ ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times ACF_{ext-sv}\times GSF_{o-ext-sv} \end{array}\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Excavation Worker Air CDI Equations

Air Inhalation

$$CDI_{exc-air-inh}(pCi) = \left(C_{air}\left(\frac{pCi}{m^3}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{exc}\left(\frac{60\ m^3}{day}\right)\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Air Submersion

$$CDI_{exc-air-sub}\left(\frac{pCi-yr}{m^3}\right) = \left(C_{air}\left(\frac{pCi}{m^3}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_a(1.0)\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Air Inhalation (without decay)

$$CDI_{exc-air-inhnd}(pCi) = \left(C_{air}\left(\frac{pCi}{m^3}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{exc}\left(\frac{60\ m^3}{day}\right)\right)$$

Air Submersion (without decay)

$$CDI_{exc-air-subnd}\left(\frac{pCi-yr}{m^3}\right) = \left(C_{air}\left(\frac{pCi}{m^3}\right)\times EF_{exc}\left(\frac{20\ days}{yr}\right)\times\left(\frac{1\ yr}{365\ days}\right)\times ED_{exc}(1\ yr)\times ET_{exc}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times GSF_a(1.0)\right)$$

Construction Worker Soil Exposure to Unpaved Road Traffic CDI Equations

Soil Ingestion - Unpaved Road Traffic

$$CDI_{con-sol-ing}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times IRS_{con}\left(\frac{330\ mg}{day}\right)\times\left(\frac{g}{1000\ mg}\right)\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Soil Inhalation - Unpaved Road Traffic

$$CDI_{con-sol-inh}(pCi) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right)\times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right)\times DW_{con}\left(\frac{5\ days}{wk}\right)\right)\times ED_{con}(1\ yr)\times \\ ET_{con}\left(\frac{8\ hrs}{day}\right)\times\left(\frac{1\ day}{24\ hrs}\right)\times IRA_{con}\left(\frac{60\ m^3}{day}\right)\times\frac{1}{PEF_{sc}\left(\frac{m^3}{kg}\right)}\times\left(\frac{1000\ g}{kg}\right) \end{array}\right)\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Soil External Exposure - Unpaved Road Traffic

$$CDI_{con-sol-ext}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times \\ ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv} \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Construction Worker Soil Exposure to Other Construction Activities CDI Equations

Soil Ingestion - Other Construction Activities

$$CDI_{con-sol-ingsa}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times IRS_{con}\left(\frac{330\ mg}{day}\right) \times \left(\frac{g}{1000\ mg}\right)\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Soil Inhalation - Other Construction Activities

$$CDI_{con-sol-inhsa}(pCi) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times ED_{con}(1\ yr) \times \\ ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{con}\left(\frac{60\ m^3}{day}\right) \times \frac{1}{PEF'_{sc}\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right) \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Soil External Exposure - Other Construction Activities

$$CDI_{con-sol-extsa}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times \\ ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv} \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Construction Worker Soil Alternate External Sources CDI Equations

Direct External Exposure (sv)

$$CDI_{con-sol-sv}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times \\ ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-sv} \times GSF_{o-ext-sv} \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (1 cm)

$$CDI_{con-sol-1cm}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times \\ ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-1cm} \times GSF_{o-ext-1cm} \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (5 cm)

$$CDI_{con-sol-1cm}\left(\frac{pCi-yr}{g}\right) = \left(\frac{C_{soil}\left(\frac{pCi}{g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times}{ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-1cm} \times GSF_{o-ext-1cm}}\right) \times \left(\frac{\left(1-exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (15 cm)

$$CDI_{con-sol-15cm}\left(\frac{pCi-yr}{g}\right) = \left(\frac{C_{soil}\left(\frac{pCi}{g}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times}{ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-15cm} \times GSF_{o-ext-15cm}}\right) \times \left(\frac{\left(1-exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (ground plane)

$$CDI_{con-sol-gp}\left(\frac{pCi-yr}{cm^2}\right) = \left(\frac{C_{soil}\left(\frac{pCi}{cm^2}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times}{ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext-gp} \times GSF_{o-ext-gp}}\right) \times \left(\frac{\left(1-exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Construction Worker Air CDI Equations

Air Inhalation

$$CDI_{con-air-inh}(pCi) = \left(\frac{C_{air}\left(\frac{pCi}{m^3}\right) EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times}{ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{con}\left(\frac{60\ m^3}{day}\right)}\right) \times \left(\frac{\left(1-exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Air Submersion

$$CDI_{con-air-sub}\left(\frac{pCi-yr}{m^3}\right) = \left(\frac{C_{air}\left(\frac{pCi}{m^3}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times}{ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)}\right) \times \left(\frac{\left(1-exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Air Inhalation (without decay)

$$CDI_{con-air-inhnd}(pCi) = \left(\frac{C_{air} \times \left(\frac{pCi}{m^3}\right) EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times}{ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{con}\left(\frac{60\ m^3}{day}\right)}\right)$$

Air Submersion (without decay)

$$CDI_{con\text{-}air\text{-}subnd}\left(\frac{pCi-yr}{m^3}\right) = \left(\begin{array}{c} C_{air} \times \left(\frac{pCi}{m^3}\right) \times EF_{con}\left(EW_{con}\left(\frac{50\ wks}{yr}\right) \times DW_{con}\left(\frac{5\ days}{wk}\right)\right) \times \left(\frac{1\ yr}{365\ days}\right) \times \\ ED_{con}(1\ yr) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0) \end{array}\right)$$

Recreator Soil CDI Equations

Soil Ingestion

$$CDI_{rec\text{-}sol\text{-}ing}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times IFS_{rec\text{-}adj}(240,000\ mg) \times \left(\frac{g}{1000\ mg}\right)\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

where:

$$IFS_{rec\text{-}adj}(240,000\ mg) = \left[\begin{array}{c} \left(EF_{rec\text{-}c}\left(\frac{75\ days}{yr}\right) \times ED_{rec\text{-}c}(6\ yr) \times IRS_{rec\text{-}c}\left(\frac{200\ mg}{day}\right)\right) + \\ \left(EF_{rec\text{-}a}\left(\frac{75\ days}{yr}\right) \times ED_{rec\text{-}a}(20\ yr) \times IRS_{rec\text{-}a}\left(\frac{100\ mg}{day}\right)\right) \end{array}\right]$$

Soil Inhalation

$$CDI_{rec\text{-}sol\text{-}inh}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times IFA_{rec\text{-}adj}\left(1,437.5\ m^3\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right)\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

where:

$$IFA_{rec\text{-}adj}\left(1,437.5\ m^3\right) = \left[\begin{array}{c} \left(EF_{rec\text{-}c}\left(\frac{75\ days}{yr}\right) \times ED_{rec\text{-}c}(6\ yr) \times ET_{rec\text{-}c}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{rec\text{-}c}\left(\frac{10\ m^3}{day}\right)\right) + \\ \left(EF_{rec\text{-}a}\left(\frac{75\ days}{yr}\right) \times ED_{rec\text{-}a}(20\ yr) \times ET_{rec\text{-}a}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{rec\text{-}a}\left(\frac{20\ m^3}{day}\right)\right) \end{array}\right]$$

Soil External Exposure

$$CDI_{rec\text{-}sol\text{-}ext}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{rec}(26\ yr) \times \\ ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times ACF_{ext\text{-}sv} \times GSF_{o\text{-}ext\text{-}sv} \end{array}\right) \times \left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Recreator Alternate External Sources CDI Equations

Direct External Exposure (sv)

$$CDI_{rec\text{-}sol\text{-}sv}\left(\frac{pCi-yr}{g}\right)=\begin{pmatrix}C_{soil}\left(\frac{pCi}{g}\right)\times EF_{rec}\left(\frac{75\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{rec}(26\text{ yr})\times\\ ET_{rec}\left(\frac{1\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext\text{-}sv}\times GSF_{o\text{-}ext\text{-}sv}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (1 cm)

$$CDI_{rec\text{-}sol\text{-}1cm}\left(\frac{pCi-yr}{g}\right)=\begin{pmatrix}C_{soil}\left(\frac{pCi}{g}\right)\times EF_{rec}\left(\frac{75\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{rec}(26\text{ yr})\times\\ ET_{rec}\left(\frac{1\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext\text{-}1cm}\times GSF_{o\text{-}ext\text{-}1cm}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (5 cm)

$$CDI_{rec\text{-}sol\text{-}5cm}\left(\frac{pCi-yr}{g}\right)=\begin{pmatrix}C_{soil}\left(\frac{pCi}{g}\right)\times EF_{rec}\left(\frac{75\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{rec}(26\text{ yr})\times\\ ET_{rec}\left(\frac{1\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext\text{-}5cm}\times GSF_{o\text{-}ext\text{-}5cm}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (15 cm)

$$CDI_{rec\text{-}sol\text{-}15cm}\left(\frac{pCi-yr}{g}\right)=\begin{pmatrix}C_{soil}\left(\frac{pCi}{g}\right)\times EF_{rec}\left(\frac{75\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{rec}(26\text{ yr})\times\\ ET_{rec}\left(\frac{1\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext\text{-}15cm}\times GSF_{o\text{-}ext\text{-}15cm}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Direct External Exposure (ground plane)

$$CDI_{rec\text{-}sol\text{-}gp}\left(\frac{pCi-yr}{cm^2}\right)=\begin{pmatrix}C_{soil}\left(\frac{pCi}{cm^2}\right)\times EF_{rec}\left(\frac{75\text{ days}}{yr}\right)\times\left(\frac{1\text{ yr}}{365\text{ days}}\right)\times ED_{rec}(26\text{ yr})\times\\ ET_{rec}\left(\frac{1\text{ hrs}}{day}\right)\times\left(\frac{1\text{ day}}{24\text{ hrs}}\right)\times ACF_{ext\text{-}gp}\times GSF_{o\text{-}ext\text{-}gp}\end{pmatrix}\times\left(\frac{\left(1-\exp^{-\lambda\left(\frac{1}{yr}\right)\times t(yr)}\right)}{t(yr)\times\lambda\left(\frac{1}{yr}\right)}\right)$$

Recreator Air CDI Equations

Air Inhalation

$$CDI_{rec-air-inh}(pCi) = \left(C_{air}\left(\frac{pCi}{m^3}\right) \times IFA_{rec-adj}\left(1{,}437.5\ m^3\right)\right) \times \left(\frac{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

where:

$$IFA_{rec-adj}\left(1{,}437.5\ m^3\right) = \left[\begin{array}{l}\left(EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times ET_{rec-c}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{rec-c}\left(\frac{10\ m^3}{day}\right)\right) + \\ \left(EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times ET_{rec-a}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{rec-a}\left(\frac{20\ m^3}{day}\right)\right)\end{array}\right]$$

Air Submersion

$$CDI_{rec-air-sub}\left(\frac{pCi-yr}{m^3}\right) = \left(C_{air}\left(\frac{pCi}{m^3}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{rec}(26\ yr) \times ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)\right) \times \left(\frac{\left(1 - exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Air Inhalation (without decay)

$$CDI_{rec-air-inhnd}(pCi) = \left(C_{air} \times \left(\frac{pCi}{m^3}\right) \times IFA_{rec-adj}\left(1{,}437.5\ m^3\right)\right)$$

where:

$$IFA_{rec-adj}\left(1{,}437.5\ m^3\right) = \left[\begin{array}{l}\left(EF_{rec-c}\left(\frac{75\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times ET_{rec-c}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{rec-c}\left(\frac{10\ m^3}{day}\right)\right) + \\ \left(EF_{rec-a}\left(\frac{75\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times ET_{rec-a}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{rec-a}\left(\frac{20\ m^3}{day}\right)\right)\end{array}\right]$$

Air Submersion (without decay)

$$CDI_{rec-air-subnd}\left(\frac{pCi-yr}{m^3}\right) = \left(C_{air} \times \left(\frac{pCi}{m^3}\right) \times EF_{rec}\left(\frac{75\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{rec}(26\ yr) \times ET_{rec}\left(\frac{1\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_a(1.0)\right)$$

Recreator Consumption of Fowl and Game CDI Equations

Direct Fowl Ingestion

$$CDI_{rec-fowl-ing}(pCi) = \left(C_{fowl} \times EF_{rec}\left(\frac{days}{yr}\right) \times ED_{rec}(26\ yr) \times IRGF_{rec}\left(\frac{g}{day}\right) \times CF_{rec-fowl}(1)\right)$$

Soil Contribution to Fowl Ingestion

$$CDI_{rec-sol-fowl-ing}(pCi) = \left[\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{rec}\left(\frac{days}{yr}\right) \times ED_{rec}(yr) \times IRGF_{rec}\left(\frac{g}{day}\right) \times CF_{rec-fowl}(1) \times \\ TF_{fowl}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c} \left(Q_{p-fowl}\left(\frac{kg}{day}\right) \times f_{p-fowl}(1) \times f_{s-fowl}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-fowl}\left(\frac{kg}{day}\right) \times f_{p-fowl}(1)\right) \end{array}\right] \end{array}\right]$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right); R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Surface Water Contribution to Fowl Ingestion

$$CDI_{rec-wat-fowl-ing}(pCi) = \left(\begin{array}{c} C_{water}\left(\frac{pCi}{L}\right) \times TF_{fowl}\left(\frac{day}{kg}\right) \times Q_{w-fowl}\left(\frac{L}{day}\right) \times f_{w-fowl}(1) \times \left(\frac{1\ kg}{1000\ g}\right) \times \\ EF_{rec}\left(\frac{days}{yr}\right) \times ED_{rec}(yr) \times IRGF_{rec}\left(\frac{g}{day}\right) \times CF_{rec-fowl}(1) \end{array}\right)$$

Direct Land Game Ingestion

$$CDI_{rec-game-ing}(pCi) = \left(C_{game} \times EF_{rec}\left(\frac{days}{yr}\right) \times ED_{rec}(26\ yr) \times IRGL_{rec}\left(\frac{g}{day}\right) \times CF_{rec-game}(1)\right)$$

Soil Contribution to Land Game Ingestion

$$CDI_{rec-sol-game-ing}(pCi) = \left[\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times EF_{rec}\left(\frac{days}{yr}\right) \times ED_{rec}(yr) \times IRGF_{rec}\left(\frac{g}{day}\right) \times CF_{rec-game}(1) \times \\ TF_{game}\left(\frac{day}{kg}\right) \times \left[\begin{array}{c} \left(Q_{p-game}\left(\frac{kg}{day}\right) \times f_{p-game}(1) \times f_{s-game}(1) \times \left(R_{upp} + R_{es}\right)\right) + \\ \left(Q_{s-game}\left(\frac{kg}{day}\right) \times f_{p-game}(1)\right) \end{array}\right] \end{array}\right]$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g-dry-plant}{pCi / g-dry-soil}\right); R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)$$

Surface Water Contribution to Land Game Ingestion

$$CDI_{rec-wat-game-ing}(pCi) = \left(\begin{array}{c} C_{water}\left(\frac{pCi}{L}\right) \times TF_{game}\left(\frac{day}{kg}\right) \times Q_{w-game}\left(\frac{L}{day}\right) \times \times f_{w-game}(1)\left(\frac{1\ kg}{1000\ g}\right) \times \\ EF_{rec}\left(\frac{days}{yr}\right) \times ED_{rec}(yr) \times IRGL_{rec}\left(\frac{g}{day}\right) \times CF_{rec-game}(1) \end{array}\right)$$

Recreator Surface Water CDI Equations

Surface Water Ingestion

$$CDI_{rec-wat-ing}(pCi) = \left(C_{water}\left(\frac{pCi}{L}\right) \times IFW_{rec-adj}(131.4\ L)\right)$$

where:

$$IFW_{rec-adj}(131.4\ L) = \left[\begin{array}{l}\left(EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ events}{day}\right) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-c}\left(\frac{0.12\ L}{day}\right)\right) + \\ \left(EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ events}{day}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right) \times IRW_{rec-a}\left(\frac{0.11\ L}{day}\right)\right)\end{array}\right]$$

Surface Water Immersion

$$CDI_{rec-wat-imm}\left(\frac{pCi-yr}{L}\right) = \left(C_{water}\left(\frac{pCi}{L}\right) \times \left(\frac{1\ yr}{8,760\ hrs}\right) \times DFA_{rec-adj}(1,170\ hrs)\right)$$

where:

$$DFA_{rec-adj}(1,170\ hrs) = \left[\begin{array}{l}\left(EF_{rec-c}\left(\frac{45\ days}{yr}\right) \times ED_{rec-c}(6\ yr) \times EV_{rec-c}\left(\frac{1\ events}{day}\right) \times ET_{event-rec-c}\left(\frac{1\ hrs}{event}\right)\right) + \\ \left(EF_{rec-a}\left(\frac{45\ days}{yr}\right) \times ED_{rec-a}(20\ yr) \times EV_{rec-a}\left(\frac{1\ events}{day}\right) \times ET_{event-rec-a}\left(\frac{1\ hrs}{event}\right)\right)\end{array}\right]$$

Farmer Direct Consumption of Agricultural Products CDI Equations

Direct Produce Ingestion

$$CDI_{far-produce-ing}(pCi) = \left(C_{produce}\left(\frac{pCi}{g}\right) \times (IFF_{far-adj}(2,246,930\ g) + IFV_{far-adj}(1,583,400\ g)) \times CF_{far-produce}(1)\right)$$

where:

$$IFF_{far-adj}(2,246,930\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68.1\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176.8\ g}{day}\right)\right)\end{array}\right]$$

and:

$$IFV_{far-adj}(1,583,400\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41.7\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125.7\ g}{day}\right)\right)\end{array}\right]$$

Direct Egg Ingestion

$$CDI_{far-egg-ing}(pCi) = \left(C_{egg}\left(\frac{pCi}{g}\right) \times IFE_{far-adj}(658,455\ g) \times CF_{far-egg}(1)\right)$$

where:

$$IFE_{far-adj}(658,455\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRE_{far-c}\left(\frac{10.95\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRE_{far-a}\left(\frac{53.4\ g}{day}\right)\right)\right]$$

Direct Poultry Ingestion

$$CDI_{far-poultry-ing}(pCi) = \left(C_{poultry}\left(\frac{pCi}{g}\right) \times IFP_{far-adj}(1,318,100\ g) \times CF_{far-poultry}(1)\right)$$

where:

$$IFP_{far-adj}(1,318,100\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRP_{far-c}\left(\frac{23.6\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRP_{far-a}\left(\frac{106.6\ g}{day}\right)\right)\right]$$

Direct Fish Ingestion

$$CDI_{far-fish-ing}(pCi) = \left(C_{fish}\left(\frac{pCi}{g}\right) \times IFFI_{far-adj}(1,918,140\ g) \times CF_{far-fish}(1)\right)$$

where:

$$IFFI_{far-adj}(1,918,140\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRFI_{far-c}\left(\frac{32.8\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRFI_{far-a}\left(\frac{155.4\ g}{day}\right)\right)\right]$$

Direct Beef Ingestion

$$CDI_{far-beef-ing}(pCi) = \left(C_{beef}\left(\frac{pCi}{g}\right) \times IFB_{far-adj}(2,202,410\ g) \times CF_{far-beef}(1)\right)$$

where:

$$IFB_{far-adj}(2,202,410\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRB_{far-c}\left(\frac{40.1\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRB_{far-a}\left(\frac{178\ g}{day}\right)\right)\end{array}\right]$$

Direct Dairy Ingestion

$$CDI_{far-dairy-ing}(pCi) = \left(C_{dairy}\left(\frac{pCi}{g}\right) \times IFD_{far-adj}(6,036,590\ g) \times CF_{far-dairy}(1)\right)$$

where:

$$IFD_{far-adj}(6,036,590\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRD_{far-c}\left(\frac{349.5\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRD_{far-a}\left(\frac{445.6\ g}{day}\right)\right)\end{array}\right]$$

Direct Swine Ingestion

$$CDI_{far-swine-ing}(pCi) = \left(C_{swine}\left(\frac{pCi}{g}\right) \times IFSW_{far-adj}(1,203,860\ g) \times CF_{far-swine}(1)\right)$$

where:

$$IFSW_{far-adj}(1,203,860\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRSW_{far-c}\left(\frac{18.5\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRSW_{far-a}\left(\frac{97.9\ g}{day}\right)\right)\end{array}\right]$$

<u>Farmer Direct Consumption of Agricultural Products - Back-calculated to Soil CDI Equations</u>

Soil Ingestion

$$CDI_{far-sol-ing}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times IFS_{far-adj}(1,610,000\ mg) \times \left(\frac{g}{1000\ mg}\right)\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

where:

$$IFS_{far-adj}(1,610,000\ mg) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRS_{far-c}\left(\frac{200\ mg}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRS_{far-a}\left(\frac{100\ mg}{day}\right)\right)\end{array}\right]$$

Soil Inhalation

$$CDI_{far-sol-inh}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times IFA_{far-adj}\left(259,000\ m^3\right) \times \frac{1}{PEF\left(\frac{m^3}{kg}\right)} \times \left(\frac{1000\ g}{kg}\right)\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

where:

$$IFA_{far-adj}\left(259,000\ m^3\right) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times ET_{far-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{far-c}\left(\frac{10\ m^3}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times ET_{far-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{far-a}\left(\frac{20\ m^3}{day}\right)\right)\end{array}\right]$$

Soil External Exposure

$$CDI_{far-sol-ext}\left(\frac{pCi-yr}{g}\right) = \left(\begin{array}{c}C_{soil}\left(\frac{pCi}{g}\right) \times EF_{far}\left(\frac{350\ days}{yr}\right) \times \left(\frac{1\ yr}{365\ days}\right) \times ED_{far}(40\ yr) \times ACF_{ext-sv} \times \\ \left[\left(ET_{far-o}\left(\frac{12.168\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{o-ext-sv}\right) + \left(ET_{far-i}\left(\frac{10.008\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times GSF_{i-total}\right)\right]\end{array}\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Soil Contribution to Produce Ingestion

$$CDI_{far-sol-produce-ing}(pCi) = \left(C_{soil}\left(\frac{pCi}{g}\right) \times (R_{upv} + R_{es}) \times (IFF_{far-adj}(2,246,930\ g) + IFV_{far-adj}(1,583,400\ g)) \times CF_{far-produce}(1)\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

where:

$$R_{upv} = BV_{wet}\left(\frac{pCi / g-fresh-plant}{pCi / g-dry-soil}\right);\ R_{es} = MLF_{produce}\left(\frac{0.0135\ g-dry-soil}{g-fresh-plant}\right)$$

and:

$$IFF_{far-adj}(2,246,930\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68.1\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176.8\ g}{day}\right)\right)\right]$$

and:

$$IFV_{far-adj}(1,583,400\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41.7\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125.7\ g}{day}\right)\right)\right]$$

Direct Produce Ingestion

$$CDI_{far-produce-ing}(pCi) = \left(C_{produce}\left(\frac{pCi}{g}\right) \times (IFF_{far-adj}(2,246,930\ g) + IFV_{far-adj}(1,583,400\ g)) \times CF_{far-produce}(1)\right)$$

where:

$$IFF_{far-adj}(2,246,930\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68.1\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176.8\ g}{day}\right)\right)\right]$$

and:

$$IFV_{far-adj}(1,583,400\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41.7\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125.7\ g}{day}\right)\right)\right]$$

Soil Contribution to Egg Ingestion

$$
CDI_{far-sol-egg-ing}(pCi) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times IFE_{far-adj}(658{,}455\ g) \times CF_{far-egg}(1) \times TF_{egg}\left(\frac{day}{kg}\right) \times \\ \left[\begin{array}{c} \left(Q_{p-poultry}\left(\frac{0.2\ kg}{day}\right) \times f_{p-poultry}(1) \times f_{s-poultry}(1) \times (R_{upp} + R_{es})\right) + \\ \left(Q_{s-poultry}\left(\frac{0.022\ kg}{day}\right) \times f_{p-poultry}(1)\right) \end{array} \right] \end{array} \right)
$$

where:

$$
R_{upp} = BV_{dry}\left(\frac{pCi\ /\ g-dry-plant}{pCi\ /\ g-dry-soil}\right);\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)
$$

and:

$$
IFE_{far-adj}(658{,}455\ g) = \left[\begin{array}{c} \left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRE_{far-c}\left(\frac{10.95\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRE_{far-a}\left(\frac{53.4\ g}{day}\right)\right) \end{array} \right]
$$

Soil Contribution to Poultry Ingestion

$$
CDI_{far-sol-poultry-ing}(pCi) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times IFP_{far-adj}(1{,}318{,}100\ g) \times CF_{far-poultry}(1) \times TF_{poultry}\left(\frac{day}{kg}\right) \times \\ \left[\begin{array}{c} \left(Q_{p-poultry}\left(\frac{0.2\ kg}{day}\right) \times f_{p-poultry}(1) \times f_{s-poultry}(1) \times (R_{upp} + R_{es})\right) + \\ \left(Q_{s-poultry}\left(\frac{0.022\ kg}{day}\right) \times f_{p-poultry}(1)\right) \end{array} \right] \end{array} \right)
$$

where:

$$
R_{upp} = BV_{dry}\left(\frac{pCi\ /\ g-dry-plant}{pCi\ /\ g-dry-soil}\right);\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g-dry-soil}{g-dry-plant}\right)
$$

and:

$$
IFP_{far-adj}(1{,}318{,}100\ g) = \left[\begin{array}{c} \left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRP_{far-c}\left(\frac{23.6\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRP_{far-a}\left(\frac{106.6\ g}{day}\right)\right) \end{array} \right]
$$

Soil Contribution to Fish Ingestion

$$\mathrm{CDI}_{\text{far-sol-fish-ing}}(\mathrm{pCi}) = \frac{C_{\text{soil}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) \times \mathrm{BCF}\left(\frac{\mathrm{L}}{\mathrm{kg}}\right)}{K_d\left(\frac{\mathrm{L}}{\mathrm{kg}}\right)} \times \mathrm{IFFI}_{\text{far-adj}}(1{,}918{,}140\ \mathrm{g}) \times \mathrm{CF}_{\text{far-fish}}(1)$$

where:

$$\mathrm{IFFI}_{\text{far-adj}}(1{,}918{,}140\ \mathrm{g}) = \left[\begin{array}{l}\left(\mathrm{EF}_{\text{far-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{\text{far-c}}(6\ \text{yr}) \times \mathrm{IRFI}_{\text{far-c}}\left(\frac{32.8\ \mathrm{g}}{\text{day}}\right)\right) + \\ \left(\mathrm{EF}_{\text{far-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{\text{far-a}}(34\ \text{yr}) \times \mathrm{IRFI}_{\text{far-a}}\left(\frac{155.4\ \mathrm{g}}{\text{day}}\right)\right)\end{array}\right]$$

Soil Contribution to Beef Ingestion

$$\mathrm{CDI}_{\text{far-sol-beef-ing}}(\mathrm{pCi}) = \left(\begin{array}{c}C_{\text{soil}}\left(\frac{\mathrm{pCi}}{\mathrm{g}}\right) \times \mathrm{IFB}_{\text{far-adj}}(2{,}202{,}410\ \mathrm{g}) \times \mathrm{CF}_{\text{far-beef}}(1) \times \mathrm{TF}_{\text{beef}}\left(\frac{\text{day}}{\text{kg}}\right) \times \\ \left[\begin{array}{c}\left(Q_{\text{p-beef}}\left(\frac{11.77\ \text{kg}}{\text{day}}\right) \times f_{\text{p-beef}}(1) \times f_{\text{s-beef}}(1) \times (R_{\text{upp}} + R_{\text{es}})\right) + \\ \left(Q_{\text{s-beef}}\left(\frac{0.5\ \text{kg}}{\text{day}}\right) \times f_{\text{p-beef}}(1)\right)\end{array}\right]\end{array}\right)$$

where:

$$R_{\text{upp}} = \mathrm{BV}_{\text{dry}}\left(\frac{\mathrm{pCi}\,/\,\mathrm{g-dry-plant}}{\mathrm{pCi}\,/\,\mathrm{g-dry-soil}}\right);\ R_{\text{es}} = \mathrm{MLF}_{\text{pasture}}\left(\frac{0.25\ \mathrm{g-dry-soil}}{\mathrm{g-dry-plant}}\right)$$

and:

$$\mathrm{IFB}_{\text{far-adj}}(2{,}202{,}410\ \mathrm{g}) = \left[\begin{array}{l}\left(\mathrm{EF}_{\text{far-c}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{\text{far-c}}(6\ \text{yr}) \times \mathrm{IRB}_{\text{far-c}}\left(\frac{40.1\ \mathrm{g}}{\text{day}}\right)\right) + \\ \left(\mathrm{EF}_{\text{far-a}}\left(\frac{350\ \text{days}}{\text{yr}}\right) \times \mathrm{ED}_{\text{far-a}}(34\ \text{yr}) \times \mathrm{IRB}_{\text{far-a}}\left(\frac{178\ \mathrm{g}}{\text{day}}\right)\right)\end{array}\right]$$

Soil Contribution to Dairy Ingestion

$$CDI_{far\text{-}sol\text{-}dairy\text{-}ing}(pCi) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times IFD_{far\text{-}adj}(6{,}036{,}590\ g) \times CF_{far\text{-}dairy}(1) \times TF_{dairy}\left(\frac{day}{L\text{-}milk}\right) \times \rho_m\left(\frac{1.03\ kg}{L\text{-}milk}\right)^{-1} \times \\ \left[\begin{array}{c} \left(Q_{p\text{-}dairy}\left(\frac{20.3\ kg}{day}\right) \times f_{p\text{-}dairy}(1) \times f_{s\text{-}dairy}(1) \times (R_{upp} + R_{es})\right) + \\ \left(Q_{s\text{-}dairy}\left(\frac{0.4\ kg}{day}\right) \times f_{p\text{-}dairy}(1)\right) \end{array} \right] \end{array} \right)$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g\text{-}dry\text{-}plant}{pCi / g\text{-}dry\text{-}soil}\right);\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g\text{-}dry\text{-}soil}{g\text{-}dry\text{-}plant}\right)$$

and:

$$IFD_{far\text{-}adj}(6{,}036{,}590\ g) = \left[\begin{array}{c} \left(EF_{far\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{far\text{-}c}(6\ yr) \times IRD_{far\text{-}c}\left(\frac{349.5\ g}{day}\right)\right) + \\ \left(EF_{far\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{far\text{-}a}(34\ yr) \times IRD_{far\text{-}a}\left(\frac{445.6\ g}{day}\right)\right) \end{array} \right]$$

Soil Contribution to Swine Ingestion

$$CDI_{far\text{-}sol\text{-}swine\text{-}ing}(pCi) = \left(\begin{array}{c} C_{soil}\left(\frac{pCi}{g}\right) \times IFSW_{far\text{-}adj}(1{,}203{,}860\ g) \times CF_{far\text{-}swine}(1) \times TF_{swine}\left(\frac{day}{kg}\right) \times \\ \left[\begin{array}{c} \left(Q_{p\text{-}swine}\left(\frac{4.7\ kg}{day}\right) \times f_{p\text{-}swine}(1) \times f_{s\text{-}swine}(1) \times (R_{upp} + R_{es})\right) + \\ \left(Q_{s\text{-}swine}\left(\frac{0.37\ kg}{day}\right) \times f_{p\text{-}swine}(1)\right) \end{array} \right] \end{array} \right)$$

where:

$$R_{upp} = BV_{dry}\left(\frac{pCi / g\text{-}dry\text{-}plant}{pCi / g\text{-}dry\text{-}soil}\right);\ R_{es} = MLF_{pasture}\left(\frac{0.25\ g\text{-}dry\text{-}soil}{g\text{-}dry\text{-}plant}\right)$$

and:

$$IFSW_{far\text{-}adj}(1{,}203{,}860\ g) = \left[\begin{array}{c} \left(EF_{far\text{-}c}\left(\frac{350\ days}{yr}\right) \times ED_{far\text{-}c}(6\ yr) \times IRSW_{far\text{-}c}\left(\frac{18.5\ g}{day}\right)\right) + \\ \left(EF_{far\text{-}a}\left(\frac{350\ days}{yr}\right) \times ED_{far\text{-}a}(34\ yr) \times IRSW_{far\text{-}a}\left(\frac{97.9\ g}{day}\right)\right) \end{array} \right]$$

Farmer Direct Consumption of Agricultural Products - Back-calculated to Water CDI Equations

Tap Water Ingestion

$$CDI_{far-wat-ing}(pCi) = \left(C_{water}\left(\frac{pCi}{L}\right) \times IFW_{far-adj}(31,388\ L)\right)$$

where:

$$IFW_{far-adj}(31,388\ L) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRW_{far-c}\left(\frac{0.78\ L}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRW_{far-a}\left(\frac{2.5\ L}{day}\right)\right)\right]$$

Tap Water Inhalation

$$CDI_{far-wat-inh}(pCi) = \left(C_{water}\left(\frac{pCi}{L}\right) \times IFA_{far-adj}\left(259,000\ m^3\right) \times K\left(\frac{0.5\ L}{m^3}\right)\right)$$

where:

$$IFA_{far-adj}\left(259,000\ m^3\right) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times ET_{far-c}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{far-c}\left(\frac{10\ m^3}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times ET_{far-a}\left(\frac{24\ hrs}{day}\right) \times \left(\frac{1\ day}{24\ hrs}\right) \times IRA_{far-a}\left(\frac{20\ m^3}{day}\right)\right)\right]$$

Tap Water Immersion

$$CDI_{far-wat-imm}\left(\frac{pCi-yr}{L}\right) = \left(C_{water}\left(\frac{pCi}{L}\right) \times \left(\frac{1\ yr}{8,760\ hrs}\right) \times DFA_{far-adj}(9,583\ hrs)\right)$$

where:

$$DFA_{far-adj}(9,583\ hrs) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times EV_{far-c}\left(\frac{1\ events}{day}\right) \times ET_{event-far-c}\left(\frac{0.54\ hrs}{event}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times EV_{far-a}\left(\frac{1\ events}{day}\right) \times ET_{event-far-a}\left(\frac{0.71\ hrs}{event}\right)\right)\right]$$

Tap Water Contribution to Produce Ingestion

$$CDI_{far-wat-produce-ing}(pCi) = \left[C_{water}\left(\frac{pCi}{L}\right) \times \left(IFF_{far-adj}(2,246,930\ g) + IFV_{far-adj}(1,583,400\ g)\right) \times CF_{far-produce}(1) \times \left(\frac{1\ kg}{1000\ g}\right) \times \left(Irr_{rup}\left(\frac{L}{kg}\right) + Irr_{res}\left(\frac{L}{kg}\right) + Irr_{dep}\left(\frac{L}{kg}\right)\right) \right]$$

where:

$$Irr_{rup}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times MLF_{produce}\left(\frac{0.0135\ g-dry-soil}{g-fresh-plant}\right) \times \left[1 - \exp\left(-\left(\frac{\lambda_B}{day}\right) \times t_b\,(days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

$$Irr_{res}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times BV_{wet}\left(\frac{pCi\,/\,g-fresh-plant}{pCi\,/\,g-dry-soil}\right) \times \left[1 - \exp\left(-\left(\frac{\lambda_B}{day}\right) \times t_b\,(days)\right)\right]}{P\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_B}{day}\right)}$$

and:

$$Irr_{dep}\left(\frac{L}{kg}\right) = \frac{I_r\left(\frac{L}{m^2-day}\right) \times F \times I_f \times T \times \left[1 - \exp\left(-\left(\frac{\lambda_E}{day}\right) \times t_v\,(days)\right)\right]}{Y_v\left(\frac{kg}{m^2}\right) \times \left(\frac{\lambda_E}{day}\right)}$$

and:

$$IFF_{far-adj}(2,246,930\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68.1\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176.8\ g}{day}\right)\right) \right]$$

and:

$$IFV_{far-adj}(1,583,400\ g) = \left[\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41.7\ g}{day}\right)\right) + \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125.7\ g}{day}\right)\right) \right]$$

Direct Produce Ingestion

$$CDI_{far-produce-ing}(pCi) = \left(C_{produce}\left(\frac{pCi}{g}\right) \times \left(IFF_{far-adj}(2,246,930\ g) + IFV_{far-adj}(1,583,400\ g)\right) \times CF_{far-produce}(1)\right)$$

where:

$$IFF_{far-adj}(2,246,930\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRF_{far-c}\left(\frac{68.1\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRF_{far-a}\left(\frac{176.8\ g}{day}\right)\right)\end{array}\right]$$

and:

$$IFV_{far-adj}(1,583,400\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRV_{far-c}\left(\frac{41.7\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRV_{far-a}\left(\frac{125.7\ g}{day}\right)\right)\end{array}\right]$$

Tap Water Contribution to Egg Ingestion

$$CDI_{far-wat-egg-ing}(pCi) = C_{water}\left(\frac{pCi}{L}\right) \times IFE_{far-adj}(658,455\ g) \times CF_{far-egg}(1) \times TF_{egg}\left(\frac{day}{kg}\right) \times Q_{w-poultry}\left(\frac{0.4\ L}{day}\right) \times f_{w-poultry}(1) \times \left(\frac{1\ kg}{1000\ g}\right)$$

where:

$$IFE_{far-adj}(658,455\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRE_{far-c}\left(\frac{10.95\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRE_{far-a}\left(\frac{53.4\ g}{day}\right)\right)\end{array}\right]$$

Tap Water Contribution to Poultry Ingestion

$$CDI_{far-wat-poultry-ing}(pCi) = C_{water}\left(\frac{pCi}{L}\right) \times IFP_{far-adj}(1,318,100\ g) \times CF_{far-poultry}(1) \times TF_{poultry}\left(\frac{day}{kg}\right) \times Q_{w-poultry}\left(\frac{0.4\ L}{day}\right) \times f_{w-poultry}(1) \times \left(\frac{1\ kg}{1000\ g}\right)$$

where:

$$IFP_{far-adj}(1,318,100\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRP_{far-c}\left(\frac{23.6\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRP_{far-a}\left(\frac{106.6\ g}{day}\right)\right)\end{array}\right]$$

Tap Water Contribution to Fish Ingestion

$$CDI_{far-wat-fish-ing}(pCi) = C_{water}\left(\frac{pCi}{L}\right) \times BCF\left(\frac{L}{kg}\right) \times \left(\frac{1\ kg}{1000\ g}\right) \times IFFI_{far-adj}(1,918,140\ g) \times CF_{far-fish}(1)$$

where:

$$IFFI_{far-adj}(1,918,140\ g) = \left[\begin{array}{l}\left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRFI_{far-c}\left(\frac{32.8\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRFI_{far-a}\left(\frac{155.4\ g}{day}\right)\right)\end{array}\right]$$

Tap Water Contribution to Beef Ingestion

$$CDI_{far-wat-beef-ing}(pCi) = C_{water}\left(\frac{pCi}{L}\right) \times IFB_{far-adj}(2,202,410\ g) \times CF_{far-beef}(1) \times TF_{beef}\left(\frac{day}{kg}\right) \times Q_{w-beef}\left(\frac{53\ L}{day}\right) \times f_{w-beef}(1) \times \left(\frac{1\ kg}{1000\ g}\right)$$

where:

$$IFB_{far-adj}(2,202,410\ g) = \begin{bmatrix} \left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRB_{far-c}\left(\frac{40.1\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRB_{far-a}\left(\frac{178\ g}{day}\right)\right) \end{bmatrix}$$

Tap Water Contribution to Dairy Ingestion

$$CDI_{far-wat-dairy-ing}(pCi) = \begin{array}{c} C_{water}\left(\frac{pCi}{L}\right) \times IFD_{far-adj}(6,036,590\ g) \times CF_{far-dairy}(1) \times \\ TF_{dairy}\left(\frac{day}{L-milk}\right) \times \rho_m \left(\frac{1.03\ kg}{L-milk}\right)^{-1} \times Q_{w-dairy}\left(\frac{92\ L}{day}\right) \times f_{w-dairy}(1) \times \left(\frac{1\ kg}{1000\ g}\right) \end{array}$$

where:

$$IFD_{far-adj}(6,036,590\ g) = \begin{bmatrix} \left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRD_{far-c}\left(\frac{349.5\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRD_{far-a}\left(\frac{445.6\ g}{day}\right)\right) \end{bmatrix}$$

Tap Water Contribution to Swine Ingestion

$$CDI_{far-wat-swine-ing}(pCi) = C_{water}\left(\frac{pCi}{L}\right) \times IFSW_{far-adj}(1,203,860\ g) \times CF_{far-swine}(1) \times TF_{swine}\left(\frac{day}{kg}\right) \times Q_{w-swine}\left(\frac{11.4\ L}{day}\right) \times f_{w-swine}(1) \times \left(\frac{1\ kg}{1000\ g}\right)$$

where:

$$IFSW_{far-adj}(1,203,860\ g) = \begin{bmatrix} \left(EF_{far-c}\left(\frac{350\ days}{yr}\right) \times ED_{far-c}(6\ yr) \times IRSW_{far-c}\left(\frac{18.5\ g}{day}\right)\right) + \\ \left(EF_{far-a}\left(\frac{350\ days}{yr}\right) \times ED_{far-a}(34\ yr) \times IRSW_{far-a}\left(\frac{97.9\ g}{day}\right)\right) \end{bmatrix}$$

Soil to Groundwater CDI Equations

Method 1: Concentration in Groundwater from Concentration in Soil

$$C_{water}\left(\frac{pCi}{L}\right) = \frac{C_{soil}\left(\frac{pCi}{g}\right)}{\left[DAF \times \left(\frac{kg}{1,000\ g}\right) \times \left(K_d\left(\frac{L}{kg}\right) + \frac{\theta_w\left(\frac{0.3\ L_{water}}{L_{soil}}\right)}{\rho_b\left(\frac{1.5\ kg}{L}\right)}\right)\right]} \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

Method 2: Concentration in Groundwater from Concentration in Soil

$$C_{water}\left(\frac{pCi}{L}\right) = \left(\frac{C_{soil}\left(\frac{pCi}{g}\right) \times \left(\frac{1{,}000\ g}{kg}\right) \times \rho_b\left(\frac{1.5\ kg}{L}\right) \times d_s\left(\frac{mg}{kg}\right)}{I\left(\frac{0.18\ m}{yr}\right) \times ED(70\ yr) \times DAF}\right) \times \left(\frac{\left(1 - \exp^{-\lambda\left(\frac{1}{yr}\right) \times t(yr)}\right)}{t(yr) \times \lambda\left(\frac{1}{yr}\right)}\right)$$

APPENDIX I. SUPPORTING EQUATIONS

APPENDIX I. SUPPORTING TABLES

General excess lifetime cancer risk (ELCR) equation

$$\text{ELCR} = \text{CDI}\left(\frac{\mu g}{m^3}\right) \times \text{IUR}\left(\frac{\mu g}{m^3}\right)$$

General hazard quotient (HQ) equation

$$\text{HQ} = \frac{\text{CDI}\left(\frac{mg}{m^3}\right)}{\text{RfC}\left(\frac{mg}{m^3}\right)}$$

Miscellaneous Equations

Determination of the Dilution Attenuation Factor (DAF)

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

where:

$$d(m) = \left(0.0112 \times L^2(m)\right)^{0.5} + d_a(m) \times \left[1 - \exp\left(\frac{-L(m) \times I\left(\frac{0.18\ m}{yr}\right)}{K\left(\frac{m}{yr}\right) \times i\left(\frac{m}{m}\right) \times d_a(m)}\right)\right]$$

Soil Saturation Limit (C_{sat}) Equation

$$C_{sat}\left(\frac{mg}{kg}\right) = \frac{S\left(\frac{mg}{L}\right)}{\rho_b\left(\frac{1.5\ g}{cm^3}\right)} \times \left(K_d\left(\frac{L}{kg}\right) \times \rho_b\left(\frac{1.5\ g}{cm^3}\right) + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) + H' \times \theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right)\right)$$

where:

$K_d\left(\frac{L}{kg}\right) = f_{oc}\left(\frac{0.006\ g-carbon}{g-soil}\right) \times K_{oc}\left(\frac{L}{kg}\right)$, for organic compounds;

$K_d\left(\frac{L}{kg}\right)$ values for inorganic compounds are listed in the user guide.

$\theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right) = n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) - \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right)$ and: $n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) = 1 - \frac{\rho_b\left(\frac{1.5\ g}{cm^3}\right)}{\rho_s\left(\frac{2.65\ g}{cm^3}\right)}$

Soil to plant transfer factor-wet (BV_{wet}) Equation

$$BV_{wet} = BV_{dry} \times \left(\frac{100 - MC}{100}\right)$$

where:

MC = percent moisture content (%)

Soil to plant transfer factor-dry (BV_{dry}) Equation

$$BV_{dry} = BV_{wet} \times \left(\frac{100}{100 - MC}\right)$$

where:

MC = percent moisture content (%)

Trichloroethylene Adjustment Factor Derivation Equations

$$CAF_o(0.804) = \frac{CSF_o\left(\frac{3.7\times10^{-2}\ mg}{kg-day}\right)^{-1}\ \text{NHL + Liver Oral Slope Factor}}{CSF_o\left(\frac{4.6\times10^{-2}\ mg}{kg-day}\right)^{-1}\ \text{Adult - Based Oral Slope Factor}}\ ;\ MAF_o(0.202) = \frac{CSF_o\left(\frac{9.3\times10^{-3}\ mg}{kg-day}\right)^{-1}\ \text{Kidney Oral Slope Factor}}{CSF_o\left(\frac{4.6\times10^{-2}\ mg}{kg-day}\right)^{-1}\ \text{Adult - Based Oral Slope Factor}}$$

$$CAF_i(0.756) = \frac{IUR\left(\frac{3.1\times10^{-6}\ \mu g}{kg-day}\right)^{-1}\ \text{NHL + Liver Unit Risk Estimate}}{IUR\left(\frac{4.1\times10^{-6}\ \mu g}{kg-day}\right)^{-1}\ \text{Adult - Based Unit Risk Estimate}}\ ;\ MAF_i(0.244) = \frac{IUR\left(\frac{1.0\times10^{-6}\ \mu g}{kg-day}\right)^{-1}\ \text{Kidney Unit Risk Estimate}}{IUR\left(\frac{4.1\times10^{-6}\ \mu g}{kg-day}\right)^{-1}\ \text{Adult - Based Unit Risk Estimate}}$$

Particulate Emission Factor (PEF)

Wind Particulate Emission Factor (PEF) Equation

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

where:

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

and:

$$\text{if } x < 2,\ F(x) = 1.91207 - 0.0278085 + 0.48113x^2 - 1.09871x^3 + 0.335341x^4$$

$$\text{if } x \geq 2,\ F(x) = 0.18\left(8x^3 + 12x\right)e^{(-x^2)}$$

where:

$$x\ =\ 0.886\times\left(\frac{U_t\left(\frac{m}{s}\right)}{U_m\left(\frac{m}{s}\right)}\right)$$

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

$$PEF_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right) = \left[\frac{\frac{Q}{C_{sr}}\left(\frac{\left(\frac{g}{m^2-s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \frac{1}{F_D\,(0.18584)} \times T_t\,(7,200,000\ s) \times A_R\left(m^2\right)}{\frac{2.6 \times \left(\frac{s}{12}\right)^{0.8} \times \left(\frac{W\,(tons)}{3}\right)^{0.4}}{\left(\frac{M_{dry}}{0.2}\right)^{0.3}} \times \frac{\left(\frac{365\ days}{yr}\right) - p\left(\frac{days}{yr}\right)}{\left(\frac{365\ days}{yr}\right)} \times 281.9 \times \sum VKT\,(km)}\right]$$

where:

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

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

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

$$\sum VKT\,(km) = \text{total vehicles} \times \text{distance}\left(\frac{km}{day}\right) \times EW_{con}\left(\frac{50\ wk}{yr}\right) \times DW_{con}\left(\frac{7\ days}{wk}\right)$$

$$T_t\,(7,200,000\ s) = ED_{con}\,(1\ year) \times EF_{con}\left(\frac{250\ days}{yr}\right) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{3,600\ s}{hr}\right)$$

$$F_D\,(0.18584) = 0.1852 + \left(\frac{5.3537}{t_c\,(8,400\ hrs)}\right) + \left(\frac{-9.6318}{t_c\,(8,400\ hrs)^2}\right)$$

$$t_c\,(8,400\ hrs) = ED_{con}\,(1\ year) \times EW_{con}\left(\frac{50\ wk}{yr}\right) \times \left(\frac{7\ days}{wk}\right) \times \left(\frac{24\ hr}{day}\right)$$

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

$$PEF'_{sc}\left(\frac{m^3}{kg}\right) = \frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2-s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \frac{1}{F_D\,(0.18584)} \times \frac{1}{<J'_T>\left(\frac{g}{m^2-s}\right)}$$

where:

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

$$<J'_T>\left(\frac{g}{m^2-s}\right) = \frac{M^{pc}_{wind}\,(g) + M_{excav}\,(g) + M_{doz}\,(g) + M_{grade}\,(g) + M_{till}\,(g)}{A_{surf}\left(m^2\right) \times T_t\,(7,200,000\ s)}$$

$$M^{pc}_{wind}\,(g) = 0.036 \times (1 - V) \times \left(\frac{U_m\left(\frac{m}{s}\right)}{U_t\left(\frac{m}{s}\right)}\right)^3 \times F(x) \times A_{surf}\left(m^2\right) \times ED_{con}\,(1\ year) \times \left(\frac{8,760\ hr}{yr}\right)$$

$$M_{excav}\,(g) = 0.35 \times 0.0016 \times \frac{\left(\frac{U_m\left(\frac{m}{s}\right)}{2.2}\right)^{1.3}}{\left(\frac{M_{m-excav}\,(\%)}{2}\right)^{1.4}} \times \rho_{soil}\left(\frac{mg}{m^3}\right) \times A_{excav}\left(m^2\right) \times d_{excav}\,(m) \times NA_{dump} \times \left(\frac{1,000\ g}{kg}\right)$$

$$M_{doz}\,(g) = 0.75 \times \frac{0.45 \times s_{doz}\,(\%)^{1.5}}{(M_{m-doz}\,(\%))^{1.4}} \times \frac{\sum VKT_{doz}\,(km)}{S_{doz}\left(\frac{km}{hr}\right)} \times \left(\frac{1,000\ g}{kg}\right)$$

$$M_{grade}\,(g) = 0.60 \times 0.0056 \times S_{grade}\left(\frac{km}{hr}\right)^2 \times \sum VKT_{grade}\,(km) \times \left(\frac{1,000\ g}{kg}\right)$$

and:

$$M_{till}\,(g) = 1.1 \times s_{till}\,(\%)^{0.6} \times A_{c-till}\,(acres) \times \left(\frac{4047\ m^2}{acre}\right) \times \left(\frac{10^{-4}\ ha}{m^2}\right)\left(\frac{1,000\ g}{kg}\right) \times NA_{till}$$

where: =

$$\sum VKT_{grade}\,(km) = A_{c-grade}\,(acres) \times \left(\frac{4047\ m^2}{acre}\right) \times \frac{1}{B_{l-grade}\,(m)} \times \frac{1}{\left(\frac{1,000\ m}{km}\right)} \times NA_{grade}$$

$$\sum VKT_{doz}\,(km) = A_{c-doz}\,(acres) \times \left(\frac{4047\ m^2}{acre}\right) \times \frac{1}{B_{l-doz}\,(m)} \times \frac{1}{\left(\frac{1,000\ m}{km}\right)} \times NA_{doz}$$

$$T_t\,(7,200,000\ s) = ED_{con}\,(1\ year) \times EF_{con}\left(\frac{250\ days}{yr}\right) \times ET_{con}\left(\frac{8\ hrs}{day}\right) \times \left(\frac{3,600\ s}{hr}\right)$$

$$F_D\,(0.18584) = 0.1852 + \left(\frac{5.3537}{t_c\,(8,400\ hrs)}\right) + \left(\frac{-9.6318}{t_c\,(8,400\ hrs)^2}\right)$$

$$t_c\,(8,400\ hrs) = ED_{con}\,(1\ year) \times EW_{con}\left(\frac{50\ wk}{yr}\right) \times \left(\frac{7\ days}{wk}\right) \times \left(\frac{24\ hr}{day}\right)$$

and:

$$\text{if } x < 2,\ F(x) = 1.91207 - 0.0278085 + 0.48113x^2 - 1.09871x^3 + 0.335341x^4$$

$$\text{if } x \geq 2,\ F(x) = 0.18\left(8x^3 + 12x\right)e^{(-x^2)}$$

where:

$$x = 0.886 \times \left(\frac{U_t\left(\frac{m}{s}\right)}{U_m\left(\frac{m}{s}\right)}\right)$$

Volatilization Factor (VF_{ulim})

Unlimited Source Volatilization Factor (VF_{ulim}) Equation

$$VF_s\left(\frac{m_{air}^3}{kg_{soil}}\right) = \frac{\frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2-s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \left(3.14 \times D_A\left(\frac{cm^2}{s}\right) \times T(s)\right)^{1/2} \times \left(\frac{10^{-4}\ m^2}{cm^2}\right)}{2 \times \rho_b\left(\frac{1.5\ g}{cm^3}\right) \times D_A\left(\frac{cm^2}{s}\right)}$$

where:

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

and:

$$D_A\left(\frac{cm^2}{s}\right) = \frac{\left(\theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right)^{10/3} \times D_{ia}\left(\frac{cm^2}{s}\right) \times H' + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) \times D_{iw}\left(\frac{cm^2}{s}\right)\right) \Big/ n^2\left(\frac{0.43\ L_{pore}}{L_{soil}}\right)}{\rho_b\left(\frac{1.5\ g}{cm^3}\right) \times K_d\left(\frac{cm^2}{g}\right) + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right) \times H'}$$

where:

$$\theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right) = n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) - \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) \text{ and: } n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) = 1 - \frac{\rho_b\left(\frac{1.5\ g}{cm^3}\right)}{\rho_s\left(\frac{2.65\ g}{cm^3}\right)}$$

and:

$$K_d\left(\frac{cm^2}{g}\right) = f_{oc}\left(\frac{0.006\ g-carbon}{g-soil}\right) \times K_{oc}\left(\frac{cm^3}{g}\right) \text{ only for organics.}$$

Diffusivity in Water (D_{iw})

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

where:

T typically = 25°C

If density is not available use,

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

Diffusivity in Air (D_{ia})

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

where:

T typically = 25°C

$$MW_{cor} = \left(1 - 0.000015 \times MW\left(\frac{g}{mole}\right)^2\right)$$

If MW_{cor} is less than 0.4, then MW_{cor} is set to 0.4.

If density is not available use,

$$D_{ia}\left(\frac{cm^2}{s}\right) = 1.9 \times \left(MW\left(\frac{g}{mole}\right)^{-(2/3)}\right)$$

For dioxins, furans, and dioxin-like PCBs always use,

$$D_{ia}\left(\frac{cm^2}{s}\right) = \left(\frac{154\left(\frac{g}{mole}\right)}{MW\left(\frac{g}{mole}\right)}\right)^{0.5} \times 0.068\left(\frac{cm^2}{s}\right)$$

Volatilization Factor (VF)

Mass-limit Chronic Volatilization Factor (VF_{mlim})

$$VF_s\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{\frac{Q}{C_{vol}}\left(\frac{\left(\frac{g}{m^2-s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \left(T(yr)\left(3.15 \times \left(\frac{10^7\ s}{yr}\right)\right)\right)}{\rho_b\left(\frac{mg}{m^3}\right) \times d_s(m) \times \left(\frac{10^6\ g}{Mg}\right)}$$

where:

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

Unlimited Source Subchronic Volatilization Factor for Construction Worker ($VF_{ulim\text{-}sc}$)

$$VF_{sc}\left(\frac{m^3_{air}}{kg_{soil}}\right) = \frac{\frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2-s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \frac{1}{F_D\,(0.18584)} \times \left(3.14 \times D_A\left(\frac{cm^2}{s}\right) \times T(s)\right)^{1/2} \times \left(\frac{10^{-4}\ m^2}{cm^2}\right)}{2 \times \rho_b\left(\frac{1.5\ g}{cm^3}\right) \times D_A\left(\frac{cm^2}{s}\right)}$$

where:

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

$$D_A\left(\frac{cm^2}{s}\right) = \frac{\left(\theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right)^{10/3} \times D_{ia}\left(\frac{cm^2}{s}\right) \times H' + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) \times D_{iw}\left(\frac{cm^2}{s}\right)\right) \Big/ n^2\left(\frac{0.43\ L_{pore}}{L_{soil}}\right)}{\rho_b\left(\frac{1.5\ g}{cm^3}\right) \times K_d\left(\frac{cm^2}{g}\right) + \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right) \times H'}$$

$$\theta_a\left(\frac{0.28\ L_{air}}{L_{soil}}\right) = n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) - \theta_w\left(\frac{0.15\ L_{water}}{L_{soil}}\right) \text{ and: } n\left(\frac{0.43\ L_{pore}}{L_{soil}}\right) = 1 - \frac{\rho_b\left(\frac{1.5\ g}{cm^3}\right)}{\rho_s\left(\frac{2.65\ g}{cm^3}\right)}$$

$$K_d\left(\frac{cm^2}{g}\right) = f_{oc}\left(\frac{0.006\ g-carbon}{g-soil}\right) \times K_{oc}\left(\frac{cm^3}{g}\right) \text{ only for organics.}$$

$$T(30,240,000\ s) = ED_{con}\,(1\ year) \times EW_{con}\left(\frac{50\ wk}{yr}\right) \times \left(\frac{7\ days}{wk}\right) \times \left(\frac{24\ hr}{day}\right) \times \left(\frac{3,600\ s}{hr}\right)$$

$$F_D\,(0.18584) = 0.1852 + \left(\frac{5.3537}{t_c\,(8,400\ hrs)}\right) + \left(\frac{-9.6318}{t_c\,(8,400\ hrs)^2}\right)$$

$$t_c\,(8,400\ hrs) = ED_{con}\,(1\ year) \times EW_{con}\left(\frac{50\ wk}{yr}\right) \times \left(\frac{7\ days}{wk}\right) \times \left(\frac{24\ hr}{day}\right)$$

Mass-limit Subchronic Volatilization Factor for Construction Worker ($VF_{mlim\text{-}sc}$)

$$VF_{sc}\left(\frac{m_{air}^3}{kg_{soil}}\right) = \frac{\frac{Q}{C_{sa}}\left(\frac{\left(\frac{g}{m^2-s}\right)}{\left(\frac{kg}{m^3}\right)}\right) \times \frac{1}{F_D\,(0.18584)} \times T\,(s)}{\rho_b\left(\frac{mg}{m^3}\right) \times d_s\,(m) \times \left(\frac{10^6\ g}{Mg}\right)}$$

where:

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

$$T\,(30,240,000\ s) = ED_{con}\,(1\ year) \times EW_{con}\left(\frac{50\ wk}{yr}\right) \times \left(\frac{7\ days}{wk}\right) \times \left(\frac{24\ hr}{day}\right) \times \left(\frac{3,600\ s}{hr}\right)$$

$$F_D\,(0.18584) = 0.1852\ +\ \left(\frac{5.3537}{t_c\,(8,400\ hrs)}\right)\ +\ \left(\frac{-9.6318}{t_c\,(8,400\ hrs)^2}\right)$$

$$t_c\,(8,400\ hrs) = ED_{con}\,(1\ year) \times EW_{con}\left(\frac{50\ wk}{yr}\right) \times \left(\frac{7\ days}{wk}\right) \times \left(\frac{24\ hr}{day}\right)$$

Dermal Contact with Water Supporting Equations

Effective Predictive Domain (EPD)

EPD boundaries of MW and log K_{ow} :

$$-0.06831 \le -5.103 \times 10^{-4} \times MW + 0.05616 \times \log K_{ow} \le 0.5577$$

and:

$$-0.06831 \le -5.103 \times 10^{-4} \times MW + 0.05616 \times \log K_{ow} \le 0.1758$$

where:

log K_{ow} = log octanol/water partition coefficient (dimensionless);

MW = Molecular Weight $\left(\frac{g}{mole}\right)$

Dermal permeability constant (K_p)

$$K_p = 10^{\log K_p}$$

where:

$$\log K_p = -2.805063 + r^2 \times \log K_{ow} - 0.0056118 \times MW$$

where:

log K_p = log dermal permeability coefficient of compound in water $\left(\frac{cm}{hr}\right)$;

$r^2 = 0.6645865$

Fraction absorbed water (FA)

If B ≤ 0.1,

$$FA = 0.9589849087 - (0.0163393790 \times \log B) - \left(0.1451565908 \times \log \tau_{event}\left(\frac{hrs}{event}\right)\right) - \left(0.0534664095 \times \log B \times \log \tau_{event}\left(\frac{hrs}{event}\right)\right);$$

If B > 0.1 and ≤ 1,

$$FA = 1.051232292 + (0.091016187 \times \log B) - \left(0.286735467 \times \log \tau_{event}\left(\frac{hrs}{event}\right)\right) - \left(0.180504367 \times \log B \times \log \tau_{event}\left(\frac{hrs}{event}\right)\right);$$

If B > 1,

$$FA = 0.992336792 + (0.479643809 \times \log B) - \left(0.114381522 \times \log \tau_{event}\left(\frac{hrs}{event}\right)\right) - \left(1.263647642 \times \log B \times \log \tau_{event}\left(\frac{hrs}{event}\right)\right);$$

where:

$$\tau_{event}\left(\frac{hrs}{event}\right) = 10^{\left(\frac{I_{sc}^2\,(cm)}{6 \times D_{sc}\left(\frac{cm^2}{hr}\right)}\right)}\ ; \quad \log B = 10^{\left(K_p\left(\frac{cm}{hr}\right) \times \frac{\sqrt{MW\left(\frac{g}{mole}\right)}}{2.6}\right)}$$

MW = Molecular Weight $\left(\frac{g}{mole}\right)$

and:

If FA $\geq$ 1, then FA = 1 ;

If FA $<$ 0, then FA = 0 ;

Else, FA is rounded to the nearest tenth.

The dimensionless value (B)

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

where:

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

where:

$K_{ew} = 1$ (assuming epidermis behaves essentially as water);

$L_e\,(cm) = 10^{-2}\,(cm)$

$$D_e\left(\frac{cm^2}{hr}\right) = \frac{7.1 \times 10^{-6}\left(\frac{cm^2}{s}\right)}{\sqrt{MW\left(\frac{g}{mole}\right)}} \quad \left(\text{assumes } D_e = 10^{-6}\left(\frac{cm^2}{s}\right) \text{ when } MW = 50\right)$$

t* = Time to reach steady-state

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

or:

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

where:

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

τ_{event} = Lag time per event

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

where:

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

thus:

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

Mass Loading Factor (MLF) Conversion Equations

MLFdry

$$MLF_{dry} = MLF_{wet} \times \left(\frac{100}{100 - MC} \right)$$

where:

MC = percent moisture content (%)

MLFwet

$$MLF_{wet} = MLF_{dry} \times \left(\frac{100 - MC}{100} \right)$$

where:

MC = percent moisture content (%)

Henry's Law Constant and Vapor Pressure Determination at Temperature Other Than 25°C Equations

Derivation of Henry's Law Constant (H')

$$H'T_{gw}\ (K) = \left(\frac{\exp\left[- \dfrac{\Delta H_{v,gw}\left(\dfrac{cal}{mol}\right)}{R_c\ \left(1.9872\ \left(\dfrac{cal}{mol-k}\right)\right)} \times \left(\dfrac{1}{T_{gw}\ (K)} - \dfrac{1}{T_R\ (298.15\ K)}\right)\right] \times HLC\ \left(\dfrac{atm-m^3}{mol-k}\right)}{R\ \left(8.205E-05\ \left(\dfrac{atm-m^3}{mol-k}\right)\right) \times T_{gw}\ (K)} \right)$$

where:

$$T_{gw}\ (K) = \ ^\circ C + 273.15$$

$$\Delta H_{v,gw}\left(\frac{cal}{mol}\right) = \Delta H_{v,b}\left(\frac{cal}{mol}\right) \times \left[\frac{1 - T_{gw}\ (K) \big/ T_c\ (K)}{1 - T_b\ (K) \big/ T_c\ (K)}\right]^n$$

where:

If $T_b\ (K) \big/ T_c\ (K) < 0.57$, $n = 0.3$,

If $T_b\ (K) \big/ T_c\ (K) > 0.71$, $n = 0.41$,

If $\left(0.57 < T_b\ (K) \big/ T_c\ (K) \leq 0.71\right)$, $n = \left(0.74 \times T_b\ (K) \big/ T_c\ (K) - 0.116\right)$

Derivation of Vapor Pressure ($VP'T_{gw}$)

$$VP'T_{gw}(mmHg) = VP(mmHg) \times \exp\left[- \frac{\Delta H_{v,gw}\left(\frac{cal}{mol}\right)}{R_c\left(1.9872\left(\frac{cal}{mol-k}\right)\right)} \times \left(\frac{1}{T_{gw}\ (K)} - \frac{1}{T_R\ (298.15\ K)}\right)\right]$$

where:

$$T_{gw}\ (K) = °C + 273.15$$

$$\Delta H_{v,gw}\left(\frac{cal}{mol}\right) = \Delta H_{v,b}\left(\frac{cal}{mol}\right) \times \left[\frac{1 - T_{gw}\ (K) / T_c\ (K)}{1 - T_b\ (K) / T_c\ (K)}\right]^n$$

where:

If $T_b\ (K) / T_c\ (K) < 0.57$, $n = 0.3$,

If $T_b\ (K) / T_c\ (K) > 0.71$, $n = 0.41$,

If $\left(0.57 < T_b\ (K) / T_c\ (K) \leq 0.71\right)$, $n = \left(0.74 \times T_b\ (K) / T_c\ (K) - 0.116\right)$

APPENDIX J. EQUATION AND MODEL REFERENCE DOCUMENTS

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This appendix consists of a list of documents that contain the source of the equations and models used in RAIS PRG and risk calculations.

Year	Reference Document
1985	Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water-Part I. EPA/600/6-85/002a. Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, GA 30613. Revised September 1985.
1986	Guidelines for Mutagenicity Risk Assessment. EPA/630/R-98/003. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. September 24 1986.
1986	Guidelines for the Health Risk Assessment of Chemical Mixtures. EPA/630/R-98/002. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. September 24 1986.
1988	Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (Interim Final). OSWER Directive 9355.3-01. EPA/540/G-89/004. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency, Washington, D.C. October 1988.
1988	Superfund Exposure Assessment Manual. EPA/540/1-88/001, OSWER directive 9285.5-1. Office of Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. 1988.
1989	Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A) (Interim Final). EPA/540/1-89/002. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. December 1989.
1991	Alpha 2u-Globulin: Association with Chemically Induced Renal Toxicity and Neoplasia in the Male Rat. EPA/625/3-91/019F. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. September 1991.
1991	Guidance for Data Useability in Risk Assessment (Part A). EPA/540/R-92/003. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. December 1991.
1991	Guidelines for Developmental Toxicity Risk Assessment. EPA/600/FR-91/001. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. December 5 1991.
1991	Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance Standard Default Exposure Factors (Interim Final). OSWER Directive 9285.6-03. Office of Emergency and Remedial Response, Toxics Integration Branch, U.S. Environmental Protection Agency, Washington D.C. March 25, 1991.
1991	Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) (Interim). OSWER Directive 9285.7-01B. EPA/540/R-92/003. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. December 1991.
1991	Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part C, Risk Evaluation of Remedial Alternatives) (Interim). OSWER Directive 9285.7-01C. EPA/540/R-92/003. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. December 1991.
1992	Dermal Exposure Assessment: Principles and Application (Interim Report). EPA/600/8-91/011B. Exposure Assessment Group, Office of Health and Environmental Assessment, U.S. Environmental Protection Agency, Washington, D.C. January 1992.

Year	Reference Document
1992	Guidance for Data Useability in Risk Assessment (Part B). Publication 9285.7-09B, PB92-963362. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. May 1992.
1992	Guidelines for Exposure Assessment. EPA/600/Z-92/001. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. May 29 1992.
1992	Supplemental Guidance to RAGS: Calculating the Concentration Term, Intermittent Bulletin, Volume 1, Number 1. Publication Number 9285.7-08I. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. May 1992.
1993	U.S. EPA. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH). U.S. Environmental Protection Agency, Office of Research and Development, Office of Health and Environmental Assessment, Washington, DC, EPA/600/R-93/089 (NTIS PB94116571).
1994	Guidance for Performing Screening Level Risk Analyses at Combustion Facilities Burning Hazardous Wastes Attachment C (Draft). PX #175. Office of Emergency and Remedial Response, Office of Solid Waste, U.S. Environmental Protection Agency, Washington, D.C. December 14, 1994.
1994	Radiation Site Cleanup Regulations: Technical Support Document For The Development Of Radionuclide Cleanup Levels For Soil (Review Draft). EPA 402-R-96-011A. Office of Radiation and Indoor Air, U.S. Environmental Protection Agency, Washington, DC. September 1994. View PDF here: https://epa-prgs.ornl.gov/radionuclides/RadiationRegulations.pdf; View Appendix C here: https://epa-prgs.ornl.gov/radionuclides/APPC.pdf.
1994	Region 8 Superfund Technical Guidance: Evaluating and Identifying Contaminants of Concern for Human Health. SOP# 8RA-03. Region 8, U.S. Environmental Protection Agency, Washington, D.C. September 1994.
1994	Region 8 Superfund Technical Guidance: Model Site Conceptual Model for RI/FS Baseline Risk Assessments of Human and Ecological Health. SOP# 8RA-05. Region 8, U.S. Environmental Protection Agency, Washington, D.C. December 1994.
1994	Region 8 Superfund Technical Guidance: Model Statement of Work for RI/FS Baseline Risk Assessments of Human Health. SOP# 8RA-01. Region 8, U.S. Environmental Protection Agency, Washington, D.C. September 1994.
1995	Region 8 Superfund Technical Guidance: Criteria for Evaluating Blood Lead Data Quality and Use. SOP# 8RA-07. Region 8, U.S. Environmental Protection Agency, Washington, D.C. September 1995.
1995	Region 8 Superfund Technical Guidance: Estimating Site-Specific Exposure to Contaminants in Indoor Dust. SOP# 8RA-06. Region 8, U.S. Environmental Protection Agency, Washington, D.C. September 1995.
1996	Guidelines for Reproductive Toxicity Risk Assessment. EPA/630/R-96/009. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. October 31, 1996.
1996	NCRP 1996. Screening Models for Releases of Radionuclides to Atmosphere, Surface Water, and Ground, Vols. 1 and 2, NCRP Report No. 123. National Council on Radiation Protection and Measurements.
1996	Sampling Manual for IEUBK Model (Draft). Prepared for US Environmental Protection Agency Region 8 by Roy F. Weston Inc. December 31, 1996.
1996	Soil Screening Guidance: Technical Background Document. Publication 9355.4-17A, EPA/540/R95/128. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. May 1996.

Year	Reference Document
1996	Soil Screening Guidance: User's Guide (Second Edition). Publication 9355.4-23. EPA/540/R-96/018. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. July 1996.
1996	U.S. EPA. PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures (1996). U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington Office, Washington, DC, EPA/600/P-96/001F, 1996.
1997	Guidance on Cumulative Risk Assessment: Part 1. Planning and Scoping. Science Policy Council, U.S. Environmental Protection Agency, Washington, D.C. July 3, 1997.
1997	Guiding Principles for Monte Carlo Analysis. EPA/630/R-97/001. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. March 1997.
1997	U.S. EPA (Environmental Protection Agency). 1997. The Parameter Guidance Document. A Companion Document to the Methodology for Assessing Health Risks Associated with Multiple Pathways Exposure to Combustion Emissions. Internal Draft. NCEA-0238. National Center for Environmental Assessment, Cincinnati, OH.
1997	U.S. EPA. Health Effects Assessment Summary Tables (Heast). U.S. Environmental Protection Agency, Washington, D.C., 1997.
1998	Framework for Assessing Non-occupational, Non-dietary (Residential) Exposure to Pesticides (Draft 12/22/98). U.S. Environmental Protection Agency, Washington, D.C.
1998	Guidelines for Neurotoxicity Risk Assessment. EPA/630/R-95/001F. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. April 1998.
1998	Research Plan for Endocrine Disruptors. EPA/600/R-98/087. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. February 1998
1998	Summary Report for the Workshop on the Relationship Between Exposure Duration and Toxicity. EPA/600/R-99/081. National Center for Environmental Assessment, U.S. Environmental Protection Agency, Washington, D.C. September 1998.
1998	U.S. EPA. Assessment of Thyroid Follicular Cell Tumors. U.S. Environmental Protection Agency, Washington, DC, EPA/630/R-97/002, 1998.
1999	Data Collection for the Hazardous Waste Identification Rule; Section 10: Farm Food Chain and Terrestrial Foodweb Data. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. October 1999.
1999	Guidance for identifying pesticide chemicals and other substances that have a common mechanism of toxicity. U.S. Environmental Protection Agency, Washington, D.C. January 29 1999.
1999	Report of the Workshop on Selecting Input Distributions for Probabilistic Assessments. EPA/630/R-98/004. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. January 1999.
2000	Available EPA Information on Assessing Exposure to Pesticides in Food--A User's Guide. EPA-HQ-OPP-2007-0780-0001. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. June 21 2000.
2000	Choosing a percentile of acute dietary exposure as a threshold of regulatory concern. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460. March 16 2000.
2000	Handbook for Non-Cancer Health Effects Valuation. EPA-100-20-002. EPA Science Council, U.S. Environmental Protection Agency, Washington, D.C. December 2000.
2000	Risk Characterization Handbook. EPA/100/B-00/002. Office of Science Policy, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. December 2000.

Year	Reference Document
2000	Soil Screening Guidance for Radionuclides: Technical Background Document. Publication 9355.4-16, EPA/540-R-00-006, PB2000 963306. Office of Radiation and Indoor Air, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. October 2000.
2000	Soil Screening Guidance for Radionuclides: User's Guide. Publication 9355.4-16A, EPA/540-R-00-007, PB2000 963307. Office of Radiation and Indoor Air, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. October 2000.
2000	Summary report for the workshop on issues associated with dermal exposure and uptake. EPA/630/R-00/003; PB2001108368. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. December 2000.
2000	Summary Report of the Technical Workshop on Issues Associated with Considering Developmental Changes in Behavior and Anatomy When Assessing Exposure to Children. EPA/630/R-00/005. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. December 2000.
2000	The use of data on cholinesterase inhibition for risk assessments of organophosphorus and carbamate pesticides. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460. August 18 2000.
2001	Exploration of Aging and Toxic Response. EPA/630/R-01/003. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. February 15 2001.
2001	Exploration of Perinatal Pharmacokinetic Issues. EPA/630/R-01/004. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. May 10 2001.
2001	General Principles for Performing Aggregate Exposure and Risk Assessments. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. November 28 2001.
2001	Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) (Final). Publication 9285.7-47. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. December 2001.
2002	Consideration of the FQPA Safety Factor and Other Uncertainty Factors in Cumulative Risk Assessment of Chemicals Sharing a Common Mechanism of Toxicity. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460. February 28 2002.
2002	Determination of the Appropriate FQPA Safety Factor(s) in Assessing Pesticide Tolerances. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460. February 28 2002.
2002	Guidance on Cumulative Risk Assessment of Pesticide Chemicals That Have a Common Mechanism of Toxicity. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. 20460. January 14 2002.
2002	Role of Background in the CERCLA Cleanup Program. OSWER 9285.6-07P. Office of Solid Waste and Emergency Response, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. April 26, 2002.
2002	Sample Analysis and Quality Assurance Plan for Urinary Arsenic and Blood Lead Among Residents of VBI70 Neighborhoods. Region 8, U.S. Environmental Protection Agency, Denver, CO. June 2002.
2002	Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER Directive 9355.4-24. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. December 2002.

Year	Reference Document
2002	U.S. EPA. A Review of the Reference Dose and Reference Concentration Processes. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC, EPA/630/P-02/002F, 2002.
2003	A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information. EPA 100/B-03/001. Science Policy Council, U.S. Environmental Protection Agency, Washington, D.C. June 2003.
2003	U.S. EPA. Framework for Cumulative Risk Assessment. U.S. Environmental Protection Agency, Office of Research and Development, Center for Public Health and Environmental Assessment (CPHEA), formerly known as the National Center for Environmental Assessment (NCEA), Washington Office, Washington, DC, EPA/600/P-02/001F, 2003.
2004	Potential Implications of Genomics for Regulatory and Risk Assessment Applications at EPA. EPA 100/B-04/002. Science Policy Council, U.S. Environmental Protection Agency, Washington, D.C. December 2004.
2004	Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (Final). OSWER Directive 9285.7-02EP. Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, D.C. July 2004.
2005	Guidance for Thyroid Assays in Pregnant Animals, Fetuses and Postnatal Animals, and Adult Animals. Office of Pesticide Programs, Health Effects Division, U.S. Environmental Protection Agency, Washington, D.C. October 24 2005.
2005	Guidelines for Carcinogen Risk Assessment. EPA/630/P-03/001F. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. March 2005.
2005	Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (Final). EPA530-R-05-006. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 2005.
2005	U.S. Environmental Protection Agency (EPA). (2005) Guidance on selecting age groups for monitoring and assessing childhood exposures to environmental contaminants. National Center for Environmental Assessment, Washington, DC; EPA/630/P-03/003F. Available from: National Technical Information Service, Springfield, VA, and online at http://epa.gov/ncea.
2005	U.S. EPA. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. U.S. Environmental Protection Agency, Washington, DC, EPA/630/R-03/003F, 2005.
2006	Guide to Considering Children's Health When Developing EPA Actions: Implementing Executive Order 13045 and EPA's Policy on Evaluating Health Risks to Children. U.S. Environmental Protection Agency, Washington, DC. October 2006.
2006	U.S. EPA. A Framework For Assessing Health Risk of Environmental Exposures To Children (2006, Final). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-05/093F, 2006.
2006	WATER9, Version 3.0. Office of Air Quality Planning and Standards, U.S Environmental Protection Agency, Research Triangle Park, NC. Released June 29 2006. View web site here: https://www.epa.gov/chief/water9-version-30; View Appendix B PDF here: https://rais.ornl.gov/documents/iwairuxb.pdf.
2007	Framework for Metals Risk Assessment. EPA 120/R-07/001. Office of the Science Advisor, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. March 2007.

Year	Reference Document
2007	Nanotechnology White Paper. EPA 100/B-07/001. Office of the Science Advisor, Science Policy Council, U.S. Environmental Protection Agency, Washington, D.C. February 2007.
2007	U.S. EPA. Concepts, Methods, and Data Sources For Cumulative Health Risk Assessment of Multiple Chemicals, Exposures and Effects: A Resource Document (Final Report, 2008). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-06/013F, 2007.
2007	U.S. EPA. Considerations For Developing A Dosimetry-Based Cumulative Risk Assessment Approach For Mixtures of Environmental Contaminants (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-07/064, 2007.
2008	FORTMANN, R. C. Scientific and Ethical Approaches for Observational Exposure Studies. U.S. Environmental Protection Agency, Washington, D.C., EPA/600/R-08/062 (NTIS PB2008-112239), 2008.
2009	Revised Risk Assessment Methods for Workers, Children of Workers in Agricultural Fields and Pesticides with No Food Uses. EPA-HQ-OPP-2009-0889-0002. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. December 7 2009.
2009	Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment (Final). OSWER Directive 9285.7-82. EPA-540-R-070-002. Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, D.C. January 2009.
2009	The U.S. Environmental Protection Agency's Strategic Plan for Evaluating the Toxicity of Chemicals. EPA 100/K-09/001. Office of the Science Advisor, Science Policy Council, U.S. Environmental Protection Agency, Washington, D.C. March 2009.
2010	Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds. EPA/100/R - 10/005. Office of the Science Advisor, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. December 2010.
2011	Expansion of the Traditional Local Lymph Node Assay for the Assessment of Dermal Sensitization Potential of End Use Pesticide Products; and Adoption of a “Reduced” Protocol for the Traditional LLNA (Limit Dose). Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. April 2011.
2011	Recommended Use of Body Weight 3/4 as the Default Method in Derivation of the Oral Reference Dose. EPA/100/R11/0001. Office of the Science Advisor, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. February 2011.
2011	U.S. Environmental Protection Agency (EPA). (2011) Exposure Factors Handbook: 2011 Edition. National Center for Environmental Assessment, Washington, DC; EPA/600/R-09/052F. Available from the National Technical Information Service, Springfield, VA, and online at http://www.epa.gov/ncea/efh.
2012	Benchmark Dose Technical Guidance. EPA/100/R-12/001. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. June 2012.
2012	Environmental Protection Agency (EPA) (2012). Microbial Risk Assessment Guideline: Pathogenic Microorganisms with Focus on Food and Water. EPA/100/J-12/001
2012	EPA's Scientific Integrity Policy. Publication Number: 601B17001. U.S. Environmental Protection Agency, Washington, D.C. 2012.

Year	Reference Document
2012	Guidance for Waiving or Bridging of Mammalian Acute Toxicity Tests for Pesticides and Pesticide Products. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. March 1 2012.
2012	Standard Operating Procedures for Residential Pesticide Exposure Assessment. Health Effects Division, Office of Pesticide Programs, Office of Chemical Safety and Pollution Prevention, U.S. Environmental Protection Agency, Washington, DC. October 2012.
2013	Conflicts of Interest Review Process for Contractor-Managed Peer Reviews of EPA Highly Influential Scientific Assessment (HISA) and Influential Scientific Information (ISI) Documents. U.S. Environmental Protection Agency, Washington, D.C. March 21 2013.
2013	Part 158 Toxicology Data Requirements: Guidance for Neurotoxicity Battery, Subchronic Inhalation, Subchronic Dermal and Immunotoxicity Studies. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. May 1 2013.
2014	EPA Positive Matrix Factorization (PMF) 5.0 Fundamentals and User Guide. EPA/600/R-14/108. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. April 2014.
2014	Framework for Human Health Risk Assessment to Inform Decision Making. EPA/100/R-14/001. Office of the Science Advisor, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. April 5 2014.
2014	Guidance for Applying Quantitative Data to Develop Data-Derived Extrapolation Factors for Interspecies and Intraspecies Extrapolation. EPA/R-14-002F. Office of the Science Advisor, Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. September 2014.
2014	Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. February 6 2014.
2014	U.S. Environmental Protection Agency (USEPA). 2014. Risk Assessment Forum White Paper: Probabilistic Risk Assessment Methods and Case Studies. EPA/100/R-09/001A. Washington, D.C.: Risk Assessment Forum, Office of the Science Advisor, USEPA.
2015	Frequently Asked Questions (FAQS) About Update of Standard Default Exposure Factors. OSWER Directive 9285.6-03. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. September 14 2015.
2015	Indirect Dietary Residential Exposure Assessment Model (IDREAM) Implementation. Office of Pesticide Programs, Antimicrobials Division, U.S. Environmental Protection Agency, Washington, D.C. (version: June 26, 2015).
2015	Sarah S. Gallagher, Glenn E. Rice, Louis J. Scarano, Linda K. Teuschler, George Bollweg, Lawrence Martin, Cumulative risk assessment lessons learned: A review of case studies and issue papers, Chemosphere, Volume 120, 2015, Pages 697-705, ISSN 0045-6535, https://doi.org/10.1016/j.chemosphere.2014.10.030. (https://www.sciencedirect.com/science/article/pii/S0045653514012144)
2015	Science and Technology Policy Council Peer Review Handbook - 4th Edition. EPA/100/B-15/001. Science and Technology Policy Council, U.S. Environmental Protection Agency, Washington, D.C. October 2015.
2015	Use of an Alternate Testing Framework for Classification of Eye Irritation Potential of EPA Pesticide Products. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. March 2 2015.
2016	Process for Establishing & Implementing Alternative Approaches to Traditional in Vivo Acute Toxicity Studies. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C. February 4 2016.

Year	Reference Document
2019	Guidelines for Human Exposure Assessment. EPA/100/B-19/001. Risk Assessment Forum, U.S. Environmental Protection Agency, Washington, D.C. October 2019.
2022	Advances in Genetic Toxicology and Integration of in vivo Testing into Standard Repeat Dose Studies. U.S. Environmental Protection Agency, Washington, D.C. Last updated August 31, 2022.
2023	Acute Oral Toxicity Up-And-Down Procedure. WeStat, U.S. Environmental Protection Agency, Washington, D.C. 2023
2023	Integrated Risk Information System (IRIS). Center for Public Health and Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 2023.
2023	Occupational Pesticide Handler Exposure Data. U.S. Environmental Protection Agency, Washington, D.C. Last updated June 14, 2023.
2023	Occupational Pesticide Post-application Exposure Data. U.S. Environmental Protection Agency, Washington, D.C. Last updated April 25, 2023.
2023	Proposed Approach to Efficiently Develop Physiologically Based Pharmacokinetic (PBPK) & Physiologically Based Pharmacokinetic-Pharmacodynamic (PBPK-PD) Models for Pesticides. U.S. Environmental Protection Agency, Washington, D.C. Webpage last updated April 10, 2023.
No date	Using Probabilistic Methods to Enhance the Role of Risk Analysis in Decision-Making With Case Study Examples (External Review Draft). EPA/100/R-09/001. Risk Assessment Forum, Office of the Science Advisor, U.S. Environmental Protection Agency, Washington, D.C.