ATSDR CV Supplemental Guidance

Health Guidelines and Cancer Risk

When media-specific screening levels are met or exceeded during the initial screening phase of the Agency for Toxic Substances and Disease Registry's (ATSDR) public health assessment process, health assessors typically conduct further evaluation. This involves calculating site-specific exposure estimates (oral exposure doses, adjusted air concentrations, and cancer risks), and incorporating noncancer health guidelines and cancer risk estimates into their site-specific assessments to evaluate the potential for health effects. For noncancer, oral health guidelines include ATSDR minimal risk levels (MRLs) and EPA reference doses (RfDs). Inhalation health guidelines include ATSDR MRLs and Environmental Protection Agency (EPA) reference concentrations (RfCs). For cancer, health assessors use EPA's oral cancer slope factors (CSFs) and inhalation unit risks (IURs). The **Health Guidelines and Cancer Risk** tables in the Public Health Assessment Site Tool (PHAST) present ATSDR's oral and inhalation MRLs and EPA's RfDs, RfCs, CSFs, and IURs. PHAST also presents cancer classifications for EPA, the National Toxicological Program (NTP), the International Agency for Research on Cancer (IARC), and the National Institute for Occupational Safety and Health (NIOSH). Provided below are the conversion formulas for inhalation MRLs, definitions, and cancer classifications for the table.

<u>**Conversion Formulas for Inhalation MRLs:**</u>

Concentration in $\mu g/m^3$ = Concentration in parts per billion (ppb) x contaminant molecular weight (grams/mole) / 24.45

Concentration in ppb = Concentration in micrograms per cubic meter ($\mu g/m^3$) x 24.45 / contaminant molecular weight (grams/mole)

<u>**Abbreviation, Acronym, and Unit Definitions**</u>

CASRN	Chemical Abstracts Services Registry Number	$\mu g/m^3$	micrograms per cubic meter	NTP	National Toxicology Program
CSF	oral cancer slope factor (EPA)	mg/kg/day	milligrams per kilogram per day	ppb	parts per billion
EPA	Environmental Protection Agency	MRL	minimal risk level (ATSDR)	RfC	reference concentration (EPA)
IARC	International Agency for Research on Cancer	Mut	mutagen	RfD	reference dose (EPA)
IUR	inhalation unit risk (EPA)	NIOSH	National Institute for Occupational Safety and Health		

Health Guidelines and Cancer Risk (continued)

Cancer Classifications (Note: Per ATSDR guidance, contaminants that are considered probable, likely, or reasonably anticipated to cause cancer in humans should be evaluated as if they are known human carcinogens.)

EPA (Based on 1986 cancer assessment guidelines; EPA/630/R-00/004)

A	Human carcinogen
B1	Probable human carcinogen (limited human, sufficient animal studies)
B2	Probable human carcinogen (inadequate human, sufficient animal studies)
C	Possible human carcinogen (no human, limited animal studies)
D	Not classified as to human carcinogenicity
E	Evidence of non-carcinogenicity for humans

EPA (Based on 1996 cancer assessment guidelines; EPA/600/P-92/003C)

KL	Known/Likely human carcinogen
CN	Carcinogenic potential cannot be determined
NO	Not likely to be carcinogenic to humans

EPA (Based on 1999 cancer assessment guidelines; Review Draft NCEA-F-0644)

CA	Carcinogenic to humans
LI	Likely to be carcinogenic to humans
NS	Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential
DI	Data are inadequate for assessment of human carcinogenic potential
NL	Not likely to be carcinogenic to humans

EPA (Based on 2005 cancer assessment guidelines; EPA/630/P-03/001F; EPA/630/R-03/003F)

CH	Carcinogenic to humans
LC	Likely to be carcinogenic to humans
SU	Suggestive evidence of carcinogenic potential
IN	Inadequate information to assess carcinogenic potential
NC	Not likely to be carcinogenic to humans

NTP

1	Known human carcinogen
2	Reasonably anticipated to be a carcinogen

IARC

1	Carcinogenic to humans (sufficient human evidence)
2A	Probably carcinogenic to humans (limited human evidence; sufficient evidence in animals)
2B	Possibly carcinogenic to humans (limited human evidence; less than sufficient evidence in animals)
3	Not classifiable
4	Probably not carcinogenic to humans

NIOSH

OC	Occupational carcinogen

Soil CVs (ppm)

Comparison values (CVs) are ATSDR-derived contaminant- and media-specific concentrations used by health assessors during the initial screening phase of ATSDR's public health assessment process to identify environmental contaminants that require further evaluation. When several CVs are available for a contaminant, the lowest of the available CVs (the most health-protective) is ATSDR's recommended CV, which should be used for screening to identify contaminants of potential concern (with the exception of arsenic in soil[1]). ATSDR derives CVs using epidemiological and toxicological data and applying uncertainty or safety factors to ensure they adequately protect public health. Therefore, contaminants detected in concentrations less than CVs are unlikely to pose a health threat. Media-specific CVs incorporate standard default exposure assumptions and are not site-specific. ATSDR has developed CVs based on cancer health effects, called cancer risk evaluation guides (CREGs), and on noncancer health effects, which are environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs). The **Soil CVs (ppm)** table in PHAST presents ATSDR's CREGs, EMEGs, and RMEGs. Provided below are the definitions and ATSDR CV exposure assumptions for the table.

NOTE: Contaminant concentrations that meet or exceed their respective CVs do not necessarily pose a health threat. Contaminants detected at or above CVs require additional evaluation as part of ATSDR's public health assessment process to determine their potential health impact.

Acronym and Unit Definitions

CASRN   Chemical Abstracts Services Registry Number
CREG   cancer risk evaluation guide (ATSDR)
EMEG   environmental media evaluation guide (ATSDR)
kg   kilogram

mg   milligram
ppm   parts per million
RMEG   reference dose media evaluation guide (ATSDR)

EMEG/RMEG Formula Exposure Assumptions

Adult

Body weight = 80 kg
Water intake rate = 100 mg/day

Child

Body weight = 7.8 kg (birth to < 1 year)
Soil intake rate = 150 mg/day
Pica soil intake rate = 5,000 mg; 3 days/week

CREG Age-Group Specific Formula Exposure Assumptions

Birth to 1 year: Body weight = 7.8 kg, soil intake rate = 150 milligrams/day

1 to < 2 years: Body weight = 11.4 kg, soil intake rate: 200 milligrams/day

2 to < 6 years: Body weight = 17.4 kg, soil intake rate: 200 milligrams/day

6 to < 11 years: Body weight = 31.8 kg, soil intake rate: 200 milligrams/day

11 to < 16 years: Body weight = 56.8 kg, soil intake rate: 100 milligrams/day

16 to < 21 years: Body weight = 71.6 kg, soil intake rate: 100 milligrams/day

Adult: Body weight = 80 kg, soil intake rate = 100 milligrams/day

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[1] Note: In the case of arsenic, the cancer risk evaluation guide (the lowest CV) is below background levels, so it is not the recommended ATSDR CV. In this case, ATSDR chooses the next lowest value to screen arsenic.

Formulas for ATSDR's Soil CVs

ATSDR has derived noncancer comparison values (CVs) in soil, called environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs), and cancer CVs referred to as cancer risk evaluation guides (CREGs). As detailed below, for CREGs, ATSDR uses formulas that sum information for each age group for non-mutagenic contaminants and mutagenic contaminants. The CREG equations for mutagens incorporate age-dependent adjustment factors (ADAFs) for each age group: 10 for exposures occurring from birth to < 2 years, and 3 for exposures occurring from 2 to < 16 years (1 is applied in the formula for older age groups). For trichloroethylene (TCE), refer to the "TCE cancer risk equations" file on the PHAST Resources page. See the "Soil CVs" tab in this file for the exposure assumptions ATSDR uses in these formulas.

Soil EMEG in ppm (mg/kg) = $\dfrac{[MRL * BW]}{[IR * CF]}$

Where,

MRL = ATSDR minimal risk level (mg/kg/day)

BW = body weight (kg)

IR = soil intake rate (mg/day)

CF = conversion factor of 10^{-6} (kg/mg)

Pica Soil EMEG in ppm (mg/kg) = $\dfrac{[MRL * BW]}{[IR * EF * CF]}$

Where,

MRL = ATSDR minimal risk level (mg/kg/day)

BW = body weight (kg)

IR = pica soil intake rate (mg/day)

EF = pica default exposure frequency (3 days/7 days)

CF = conversion factor of 10^{-6} (kg/mg)

Soil RMEG in ppm (mg/kg) = $\dfrac{[RfD * BW]}{[IR * CF]}$

Where,

RfD = EPA reference dose (mg/kg/day)

BW = body weight (kg)

IR = soil intake rate (mg/day)

CF = conversion factor of 10^{-6} (kg/mg)

Soil CREG Formulas (shown below)

Where,

Target risk = 0.000001 (or 1 x 10^{-6})

Oral CSF = contaminant-specific oral cancer slope factor$(mg/kg/day)^{-1}$

IR = soil intake rate (mg/day)

CF = conversion factor of 10^{-6} (kg/mg)

ED = age-specific exposure duration (yrs)

BW = age-specific body weight (kg)

ADAF = age-dependent adjustment factor (mutagens only)

Soil CREG Formula for Non-Mutagens $\dfrac{Target\ Risk*78\ years}{Oral\ CSF} * \left[\sum \dfrac{IR*Conversion\ factor* ED}{BW} \right]^{-1}$

Soil CREG (non-ADAF) in ppm (mg/kg) = (0.000001 * 78) / oral CSF * ((birth to 1 year RME intake rate * 0.000001 * 1 / birth to < 1 year body weight) + (1 to < 2 years RME intake rate * 0.000001 * 1 / 1 to < 2 years body weight) + (2 to < 6 years RME intake rate * 0.000001 * 4 / 2 to < 6 years body weight) + (6 to < 11 years RME intake rate * 0.000001 * 5 / 6 to < 11 years body weight) + (11 to < 16 years RME intake rate * 0.000001 * 5 / 11 to < 16 years body weight) + (16 to < 21 years RME intake rate * 0.000001 * 5 / 16 to < 21 years body weight) + (adult RME intake rate * 0.000001 * 57 / adult body weight))$^{-1}$

Soil CREG Formula for Mutagens $\dfrac{Target\ Risk*78\ years}{Oral\ CSF} * \left[\sum \dfrac{IR*Conversion\ factor* ED*ADAF}{BW} \right]^{-1}$

Soil CREG (ADAF) in ppm (mg/kg) = (0.000001 * 78)/ oral CSF * ((birth to 1 year RME intake rate * 0.000001 * 1 * birth to < 1 year ADAF / birth to < 1 year body weight) + (1 to < 2 years RME intake rate * 0.000001 * 1 * 1 to < 2 years ADAF / 1 to < 2 years body weight) + (2 to < 6 years RME intake rate * 0.000001 * 4 * 2 to < 6 years ADAF / 2 to < 6 years body weight) + (6 to < 11 years RME intake rate * 0.000001 * 5 * 6 to < 11 years ADAF / 6 to < 11 years body weight) + (11 to < 16 years RME intake rate * 0.000001 * 5 * 11 to < 16 years ADAF / 11 to < 16 years body weight) + (16 to < 21 years RME intake rate * 0.000001 * 5 * 16 to < 21 years ADAF / 16 to < 21 years body weight) + (adult RME intake rate * 0.000001 * 57 * adult ADAF / adult body weight))$^{-1}$

Drinking Water CVs (ppb)

Comparison values (CVs) are ATSDR-derived contaminant- and media-specific concentrations used by health assessors during the initial screening phase of ATSDR's public health assessment process to identify environmental contaminants that require further evaluation. When several CVs are available for a contaminant, the lowest of the available CVs (the most health-protective) is ATSDR's recommended CV, which should be used for screening to identify contaminants of potential concern. ATSDR derives CVs using epidemiological and toxicological data and applying uncertainty or safety factors to ensure they adequately protect public health. Therefore, contaminants detected in concentrations less than CVs are unlikely to pose a health threat. Media-specific CVs incorporate standard default exposure assumptions and are not site-specific. ATSDR has developed CVs based on cancer health effects, called cancer risk evaluation guides (CREGs), and on noncancer health effects, which are environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs). Health assessors might also compare contaminant concentrations to additional screening levels for water, including EPA's maximum contaminant levels (MCLs), maximum contaminant level goals (MCLGs), and lifetime health advisories (LTHAs). The **Drinking Water CVs (ppb)** table in PHAST presents ATSDR's CREGs, EMEGs, and RMEGs, as well as EPA's MCLs, MCLGs, and LTHAs. Provided below are the definitions and ATSDR CV exposure assumptions for the table.

NOTE: Contaminant concentrations that meet or exceed their respective CVs do not necessarily pose a health threat. Contaminants detected at or above CVs require additional evaluation as part of ATSDR's public health assessment process to determine their potential health impact.

Acronym and Unit Definitions

CASRN   Chemical Abstracts Services Registry Number
MCL   maximum contaminant level (EPA)
CREG   cancer risk evaluation guide (ATSDR)
EMEG   environmental media evaluation guide (ATSDR)
kg   kilogram

LTHA   lifetime health advisory (EPA)
L   liter
MCLG   maximum contaminant level goal (EPA)
ppb   parts per billion
RMEG   reference dose media evaluation guide (ATSDR)

EMEG/RMEG Formula Exposure Assumptions

Adult

Body weight = 80 kg

Water intake rate = 3.229 L/day

Child

Body weight = 7.8 kg (birth to 1 year)

Water intake rate = 1.106 L/day

CREG Age-Group Specific Formula Exposure Assumptions

Birth to 1 year: Body weight = 7.8 kg, water intake rate = 1.106 L/day

1 to < 2 years: Body weight = 11.4 kg, water intake rate: 0.658 L/day

2 to < 6 years: Body weight = 17.4 kg, water intake rate: 0.852 L/day

6 to < 11 years: Body weight = 31.8 kg, water intake rate: 1.258 L/day

11 to < 16 years: Body weight = 56.8 kg, water intake rate: 1.761 L/day

16 to < 21 years: Body weight = 71.6 kg, water intake rate: 2.214 L/day

Adult: Body weight = 80 kg, water intake rate = 3.229 L/day

Formulas for ATSDR's Drinking Water CVs

ATSDR has derived noncancer comparison values (CVs) in water, called environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs), and cancer CVs referred to as cancer risk evaluation guides (CREGs). As detailed below, for CREGs, ATSDR uses formulas that sum information for each age group for non-mutagenic contaminants and mutagenic contaminants. The CREG equations for mutagens incorporate age-dependent adjustment factors (ADAFs) for each age group: 10 for exposures occurring from birth to < 2 years, and 3 for exposures occurring from 2 to < 16 years (1 is applied in the formula for older age groups). For trichloroethylene (TCE), refer to the "TCE cancer risk equations" file on the PHAST Resources page. See the "Drinking Water CVs" tab in this file for the exposure assumptions ATSDR uses in these formulas.

Drinking Water EMEG in ppb (µg/L) = $\dfrac{[MRL * BW]}{[IR * CF]}$

Where,

MRL = ATSDR minimal risk level (mg/kg/day)

BW = body weight (kg)

IR = water intake rate (L/day)

CF = conversion factor of 0.001 (mg/µg)

Drinking Water RMEG in ppb (µg/L) = $\dfrac{[RfD * BW]}{[IR * CF]}$

Where,

RfD = EPA reference dose (mg/kg/day)

BW = body weight (kg)

IR = water intake rate (L/day)

CF = conversion factor of 0.001 (unitless)

Drinking Water CREG Formulas (as shown at the end of the formulas, the sum is multiplied by 1,000 to go from ppm to ppb)

Where,

Target risk = 0.000001 (or 1 x 10^{-6})

Oral CSF = contaminant-specific oral cancer slope factor (mg/kg/day)$^{-1}$

IR = water intake rate (L/day)

ED = age-specific exposure duration (yrs)

BW = age-specific body weight (kg)

ADAF = age-dependent adjustment factor (mutagens only)

Drinking Water CREG Formula for Non-Mutagens $\quad \dfrac{Target\ Risk * 78\ years}{Oral\ CSF} * \left[\sum \dfrac{IR * ED}{BW} \right]^{-1}$

Drinking Water CREG (non-ADAF) in ppb (µg/L) = (0.000001 * 78 / oral CSF) * ((birth to < 1 year RME water intake rate * 1 / birth to < 1 year body weight) + (1 to < 2 years RME water intake rate * 1 / 1 to < 2 years body weight) + (2 to < 6 years RME water intake rate * 4 / 2 to < 6 years body weight) + (6 to < 11 years RME water intake rate * 5 / 6 to < 11 years body weight) + (11 to < 16 years RME water intake rate * 5 / 11 to < 16 years body weight) + (16 to < 21 years RME water intake rate * 5 / 16 to < 21 years body weight) + (adult RME water intake rate * 57 / adult body weight))$^{-1}$ * 1,000

Drinking Water CREG Formula for Mutagen $\quad \dfrac{Target\ Risk * 78\ years}{Oral\ CSF} * \left[\sum \dfrac{IR * ED * ADAF}{BW} \right]^{-1}$

Drinking Water CREG (ADAF) in ppb (µg/L) = (0.000001 * 78 / oral CSF) * ((birth to < 1 year RME water intake rate * 1 * birth to < 1 year ADAF / birth to < 1 year body weight) + (1 to < 2 years RME water intake rate * 1 * 1 to < 2 years ADAF / 1 to < 2 years body weight) + (2 to < 6 years RME water intake rate * 4 * 2 to < 6 years ADAF / 2 to < 6 years body weight) + (6 to < 11 years RME water intake rate * 5 * 6 to < 11 years ADAF / 6 to < 11 years body weight) + (11 to < 16 years RME water intake rate * 5 * 11 to < 16 years ADAF / 11 to < 16 years body weight) + (16 to < 21 years RME water intake rate * 5 * 16 to < 21 years ADAF / 16 to < 21 years body weight) + (adult RME water intake rate * 57 * adult ADAF / adult body weight))$^{-1}$ * 1,000

Air CVs (µg/m³) and Air CVs for VOCs (ppb)

Comparison values (CVs) are ATSDR-derived contaminant- and media-specific concentrations used by health assessors during the initial screening phase of ATSDR's public health assessment process to identify environmental contaminants that require further evaluation. When several CVs are available for a contaminant, the lowest of the available CVs (the most health-protective) is ATSDR's recommended CV, which should be used for screening to identify contaminants of potential concern. ATSDR derives CVs using epidemiological and toxicological data and applying uncertainty or safety factors to ensure they adequately protect public health. Therefore, contaminants detected in concentrations less than CVs are unlikely to pose a health threat. Media-specific CVs incorporate standard default exposure assumptions and are not site-specific. ATSDR has developed CVs based on cancer health effects, called cancer risk evaluation guides (CREGs), and noncancer health effects, which are environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs). The **Air CVs (µg/m³)** and **Air CVs for VOCs [Volatile Organic Compounds] (ppb)** tables in PHAST present ATSDR's CREGs, EMEGs, and RMEGs. Provided below are the conversion formulas for air CVs and definitions for the tables.

NOTE: Contaminant concentrations that meet or exceed their respective CVs do not necessarily pose a health threat. Contaminants detected at or above CVs require additional evaluation as part of ATSDR's public health assessment process to determine their potential health impact.

Conversion Formulas for Air CVs:

Concentration in µg/m³ = Concentration in parts per billion (ppb) x contaminant molecular weight (grams/mole) / 24.45

Concentration in ppb = Concentration in micrograms per cubic meter (µg/m³) x 24.45 / contaminant molecular weight (grams/mole)

Acronym and Unit Definitions

CASRN	Chemical Abstracts Services Registry Number
CREG	cancer risk evaluation guide (ATSDR)
EMEG	environmental media evaluation guide (ATSDR)
µg/m³	micrograms per cubic meter
ppb	parts per billion
RMEG	reference dose media evaluation guide (ATSDR)
VOC	volatile organic compound

Formulas for ATSDR's Air CVs

ATSDR has derived noncancer comparison values (CVs) in air, called environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs), and cancer CVs, referred to as cancer risk evaluation guides (CREGs). There is no formula to calculate inhalation EMEGs and RMEGs, as inhalation EMEG = ATSDR minimal risk level (MRL) and inhalation RMEG = Environmental Protection Agency (EPA) reference concentration (RfC) and are considered protective of all age groups. ATSDR's formulas to calculate air CREGs are detailed below. The air CREG equation for mutagens sums information by age group and incorporate age-dependent adjustment factors (ADAFs) for each group: 10 for exposures occurring from birth to < 2 years, and 3 for exposures occurring from 2 to < 16 years (1 is applied in the formula for older age groups). For trichloroethylene (TCE), refer to the "TCE cancer risk equations" file on the PHAST Resources page.

Conversion Formulas for Air CVs:

Concentration in $\mu g/m^3$ = Concentration in parts per billion (ppb) x contaminant molecular weight (grams/mole) / 24.45

Concentration in ppb = Concentration in micrograms per cubic meter ($\mu g/m^3$) x 24.45 / contaminant molecular weight (grams/mole)

Air CREG Formulas (shown below)

Where,
TR = target risk (0.000001 or 1×10^{-6})
IUR = contaminant-specific inhalation unit risk $(\mu g/m^3)^{-1}$
ED = age-specific exposure duration (mutagens only)
ADAF = age-dependent adjustment factor (mutagens only)

Air CREG Formula for Non-Mutagens $\left[\frac{Target\ Risk * 78\ years}{IUR}\right] * [\sum ED]^{-1}$

Air CREG (non-ADAF) $(\mu g/m^3)^{-1}$ = (0.000001 * 78 / EPA IUR $((\mu g/m^3)^{-1})))$ * (78)

Air CREG Formula for Mutagens $\left[\frac{Target\ Risk * 78\ years}{IUR}\right] * [\sum ED * ADAF]^{-1}$

Air CREG (ADAF) $(\mu g/m^3)^{-1}$ = (0.000001 * 78 / EPA IUR $((\mu g/m^3)^{-1})))$ * ((1 * birth to < 1 year ADAF) + (1 * 1 to < 2 years ADAF) + (4 * 2 to < 6 years ADAF) + (5 * 6 to < 11 years ADAF) + (5 * 11 to < 16 years ADAF) + (5 * 16 to < 21 years ADAF) + (57 * adult ADAF))

Soil Vapor Intrusion-Soil Gas CVs ($\mu g/m^3$) and Soil Vapor Intrusion-Soil Gas CVs (ppb)

Comparison values (CVs) are ATSDR-derived contaminant- and media-specific concentrations used by health assessors during the initial screening phase of ATSDR's public health assessment process to identify environmental contaminants that require further evaluation. When several CVs are available for a contaminant, the lowest of the available CVs (the most health-protective) is ATSDR's recommended CV, which should be used for screening to identify contaminants of potential concern. ATSDR derives soil vapor intrusion-soil gas CVs for contaminants that have an air CV and a Henry's Law constant. Contaminants detected in concentrations less than CVs are unlikely to pose a health threat. Soil vapor intrusion-soil gas CVs are based on air CVs, which incorporate standard default exposure assumptions and are not site-specific. ATSDR has developed CVs based on cancer health effects, called cancer risk evaluation guides (CREGs), and on noncancer health effects, which are environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs). The **Soil Vapor Intrusion-Soil Gas CVs ($\mu g/m^3$)** and the **Soil Vapor Intrusion-Soil Gas CVs (ppb)** tables in PHAST present ATSDR's CREGs, EMEGs, and RMEGs. Provided below are the conversion formulas for the soil vapor intrusion-soil gas CVs and definitions for the tables.

NOTE: Contaminant concentrations that meet or exceed their respective CVs do not necessarily pose a health threat. Contaminants detected at or above CVs require additional evaluation as part of ATSDR's public health assessment process to determine their potential health impact.

Conversion Formulas for SVI-Soil Gas CVs:

Concentration in $\mu g/m^3$ = Concentration in parts per billion (ppb) x contaminant molecular weight (grams/mole) / 24.45

Concentration in ppb = Concentration in micrograms per cubic meter ($\mu g/m^3$) x 24.45 / contaminant molecular weight (grams/mole)

Acronym and Unit Definitions

CASRN Chemical Abstracts Services Registry Number
CREG   cancer risk evaluation guide (ATSDR)
EMEG   environmental media evaluation guide (ATSDR)
$\mu g/m^3$ micrograms per cubic meter
ppb   parts per billion
RMEG   reference dose media evaluation guide (ATSDR)

Soil Vapor Intrusion-Groundwater CVs (ppb)

Comparison values (CVs) are ATSDR-derived contaminant- and media-specific concentrations used by health assessors during the initial screening phase of ATSDR's public health assessment process to identify environmental contaminants that require further evaluation. When several CVs are available for a contaminant, the lowest of the available CVs (the most health-protective) is ATSDR's recommended CV, which should be used for screening to identify contaminants of potential concern. ATSDR derives soil vapor intrusion-groundwater CVs for contaminants that have an air CV and a Henry's Law constant. Contaminants detected in concentrations less than CVs are unlikely to pose a health threat. Soil vapor intrusion-groundwater CVs are based on air CVs, which incorporate standard default exposure assumptions and are not site-specific. ATSDR has developed CVs based on cancer health effects, called cancer risk evaluation guides (CREGs), and noncancer health effects, which are environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs). The **Soil Vapor Intrusion-Groundwater CVs (ppb)** table in PHAST presents ATSDR's CREGs, EMEGs, and RMEGs. Provided below are the definitions for the table.

NOTE: Contaminant concentrations that meet or exceed their respective CVs do not necessarily pose a health threat. Contaminants detected at or above CVs require additional evaluation as part of ATSDR's public health assessment process to determine their potential health impact.

Acronym and Unit Definitions

CASRN   Chemical Abstracts Services Registry Number
CREG   cancer risk evaluation guide (ATSDR)
EMEG   environmental media evaluation guide (ATSDR)
ppb   parts per billion
RMEG   reference dose media evaluation guide (ATSDR)

Formulas for ATSDR's Soil Vapor Intrusion CVs

ATSDR has derived noncancer comparison values (CVs) for soil vapor intrusion (SVI), called environmental media evaluation guides (EMEGs) and reference dose media evaluation guides (RMEGs), and cancer CVs, referred to as cancer risk evaluation guides (CREGs). The formulas for these CVs are presented below.

EMEG, RMEG, and CREG Soil Vapor Intrusion Formulas

SVI-Groundwater CV in ppb $= \dfrac{CVair}{[H' * \alpha gw * CF]}$

Where,
CVair = ATSDR's air CV (EMEG, RMEG, or CREG) ($\mu g/m^3$)
H' = Henry's Law constant (unitless)
αgw = 0.001 (generic value for groundwater) (unitless)
CF = conversion factor of 1,000 (L/m^3) to convert $\mu g/L$ (water) to $\mu g/m^3$ (air)

SVI-Soil Gas CV in $\mu g/m^3$ $= \dfrac{CVair}{\alpha sg}$

Where,
CVair = ATSDR's air CV (EMEG, RMEG, or CREG) ($\mu g/m^3$)
αsg = 0.03 (generic value for subslab soil gas) (unitless)

SVI-Soil Gas CV in ppb $= \dfrac{[CVair * (24.45 / Molecular\ weight)]}{\alpha sg}$

Where,
CVair = ATSDR's air CV (EMEG, RMEG, or CREG) ($\mu g/m^3$)
αsg = 0.03 (generic value for subslab soil gas) (unitless)

Alternative Text for More Detailed Formulas

Soil CREG Formula for Non-Mutagens

The non-ADAF soil CREG in ppm or mg per kg equals (0.000001 times 78) divided by oral CSF) times ((birth to 1 year RME intake rate times 0.000001 times 1 divided by birth to less than 1 year body weight) plus (1 to less than 2 years RME intake rate times 0.000001 times 1 divided by 1 to less than 2 years body weight) plus (2 to less than 6 years RME intake rate times 0.000001 times 4 divided by 2 to less than 6 years body weight) plus (6 to less than 11 years RME intake rate times 0.000001 times 5 divided by 6 to less than 11 years body weight) plus (11 to less than 16 years RME intake rate times 0.000001 times 5 divided by 11 to less than 16 years body weight) plus (16 to less than 21 years RME intake rate times 0.000001 times 5 divided by 16 to less than 21 years body weight) plus (adult RME intake rate times 0.000001 times 57 divided by adult body weight))$^{-1}$

Soil CREG Formula for Mutagens

The ADAF soil CREG in ppm or mg per kg equals (0.000001 times 78) divided by oral CSF) times ((birth to 1 year RME intake rate times 0.000001 times 1 times birth to less than 1 year ADAF divided by birth to less than 1 year body weight) plus (1 to less than 2 years RME intake rate times 0.000001 times 1 times 1 to less than 2 years ADAF divided by 1 to less than 2 years body weight) plus (2 to less than 6 years RME intake rate times 0.000001 times 4 times 2 to less than 6 years ADAF divided by 2 to less than 6 years body weight) plus (6 to less than 11 years RME intake rate times 0.000001 times 5 times 6 to less than 11 years ADAF divided by 6 to less than 11 years body weight) plus (11 to less than 16 years RME intake rate times 0.000001 times 5 times 11 to less than 16 years ADAF divided by 11 to less than 16 years body weight) plus (16 to less than 21 years RME intake rate times 0.000001 times 5 times 16 to less than 21 years ADAF divided by 16 to less than 21 years body weight) plus (adult RME intake rate times 0.000001 times 57 times adult ADAF divided by adult body weight))$^{-1}$

Drinking Water CREG Formula for Non-Mutagens

The non-ADAF drinking water CREG in ppb or micrograms per liter equals (0.000001 times 78 divided by oral CSF) times ((birth to less than 1 year RME water intake rate times 1 divided by birth to less than 1 year body weight) plus (1 to less than 2 years RME water intake rate times 1 divided by 1 to less than 2 years body weight) plus (2 to less than 6 years RME water intake rate times 4 divided by 2 to less than 6 years body weight) plus (6 to less than 11 years RME water intake rate times 5 divided by 6 to less than 11 years body weight) plus (11 to less than 16 years RME water intake rate times 5 divided by 11 to less than 16 years body weight) plus (16 to less than 21 years RME water intake rate times 5 divided by 16 to less than 21 years body weight) plus (adult RME water intake rate times 57 divided by adult body weight))$^{-1}$ times 1,000

Drinking Water CREG Formula for Mutagens

The ADAF drinking water CREG in ppb or micrograms per liter quals (0.000001 times 78 divided by oral CSF) times ((birth to less than 1 year RME water intake rate times 1 times birth to less than 1 year ADAF divided by birth to less than 1 year body weight) plus (1 to less than 2 years RME water intake rate times 1 times 1 to less than 2 years ADAF divided by 1 to less than 2 years body weight) plus (2 to less than 6 years RME water intake rate times 4 times 2 to less than 6 years ADAF divided by 2 to less than 6 years body weight) plus (6 to less than 11 years RME water intake rate times 5 times 6 to less than 11 years ADAF divided by 6 to less than 11 years body weight) plus (11 to less than 16 years RME water intake rate times 5 times 11 to less than 16 years ADAF divided by 11 to less than 16 years body weight) plus (16 to less than 21 years RME water intake rate times 5 times 16 to less than 21 years ADAF divided by 16 to less than 21 years body weight) plus (adult RME water intake rate times 57 times adult ADAF divided by adult body weight))$^{-1}$ times 1,000

Air CREG Formula for Mutagens

The ADAF air CREG is ((0.000001 times 78 divided by EPA IUR ((micrograms per cubic meter) to negative 1))) times ((1 times birth to less than 1 year ADAF) plus (1 times 1 to less than 2 years ADAF) plus (4 times 2 to less than 6 years ADAF) plus (5 times 6 to less than 11 years ADAF) plus (5 times 11 to less than 16 years ADAF) plus (5 times 16 to less than 21 years ADAF) plus (57 times adult ADAF))