62-777 Update "Lite"

- CTL equations in current version of Ch. 62-777 were used
- Updates were made to physicochemical properties, toxicity values, and exposure assumptions
- Physicochemical values
  - Hierarchy of sources changed to match EPA RSL tables
  - Numerous small changes
- Toxicity values
  - Used hierarchy of sources in Ch. 62-780
  - Largest effect on CTLs for chemicals that are now, or no longer, carcinogens
- Exposure assumptions
  - Updated to match current EPA recommendations

GCTL Update

GCTLs for carcinogens in groundwater

$$GCTL(\mu g/L) = \frac{1 \times 10^{-6} \times BW \times CF}{CSF_o \times WC}$$

Parameter	Definition	Default Value
GCTL	groundwater cleanup target level (µg/L)	-
TR	target cancer risk (unitless)	1×10^{-6}
BW	average body weight (kg)	70.0
CF	conversion factor (µg/mg)	1000
CSF_o	oral cancer slope factor $(mg/kg\text{-}day)^{-1}$	chemical-specific [a]
WC	average water consumption rate (L/day)	2

GCTL Update

GCTLs for non-carcinogens in groundwater

$$GCTL(\mu g/L) = \frac{RfD_o \times BW \times RSC \times CF}{WC}$$

Parameter	Definition (units)	Default Value
GCTL	groundwater cleanup target level (µg/L)	-
BW	average body weight (kg)	70
RfD_o	oral reference dose (mg/kg-day)	chemical-specific [a]
RSC	relative source contribution (%)	20
CF	conversion factor (µg/mg)	1000
WC	average water consumption rate (L/day)	2

Yellow = updated tox or phys/chem value Red = updated exposure value

SCTL Update

SCTLs for carcinogens in soil - resident

$$SCTL = \frac{TR \times BW \times AT \times RBA}{EF \times ED \times FC \times \left[\left(CSF_o \times IR_o \times 10^{-6}\, kg/mg \right) + \left(CSF_d \times SA \times AF \times DA \times 10^{-6}\, kg/mg \right) + \left(CSF_i \times IR_i \times \left(\frac{1}{VF} + \frac{1}{PEF} \right) \right) \right]}$$

SCTL = Soil Cleanup Target Level
TR = target cancer risk (unitless)
BW = body weight (kg)
AT = averaging time (days)
EF = exposure frequency (days/yr)
ED = exposure duration (years)
RBA = relative bioavailability factor (unitless)

FC = fraction from contaminated source (unitless)
IR_O = ingestion rate, oral (mg/day)
SA = surface area of skin exposed (cm^2/day)
AF = adherence factor (mg/cm^2)
DA = dermal absorption (unitless)
IR_i = inhalation rate (m^3/day)
VF = volatilization factor (m^3/kg)

PEF = particulate emission factor (m^3/kg)
CSF = cancer slope factor (mg/kg-day)$^{-1}$
CSF_O = oral
CSF_d = dermal
CSF_i = inhalation

Yellow = updated tox or phys/chem value Red = updated exposure value

SCTL Update

SCTLs for carcinogens in soil - worker

$$SCTL = \frac{TR \times BW \times AT \times RBA}{EF \times ED \times FC \times \left[\left(CSF_o \times IR_o \times 10^{-6} kg/mg \right) + \left(CSF_d \times SA \times AF \times DA \times 10^{-6} kg/mg \right) + \left(CSF_i \times IR_i \times \left(\frac{1}{VF} + \frac{1}{PEF} \right) \right) \right]}$$

SCTL = Soil Cleanup Target Level
TR = target cancer risk (unitless)
BW = body weight (kg)
AT = averaging time (days)
EF = exposure frequency (days/yr)
ED = exposure duration (years)
RBA = relative bioavailability factor (unitless)

FC = fraction from contaminated source (unitless)
IR_O = ingestion rate, oral (mg/day)
SA = surface area of skin exposed (cm^2/day)
AF = adherence factor (mg/cm^2)
DA = dermal absorption (unitless)
IR_i = inhalation rate (m^3/day)
VF = volatilization factor (m^3/kg)

PEF = particulate emission factor (m^3/kg)
CSF = cancer slope factor (mg/kg-day)$^{-1}$
CSF_O = oral
CSF_d = dermal
CSF_i = inhalation

Yellow = updated tox or phys/chem value Red = updated exposure value

SCTL Update

SCTLs for non-carcinogens in soil - resident

$$SCTL = \frac{THI \times BW \times AT \times RBA}{EF \times ED \times FC \times \left[\left(\frac{1}{RfD_o} \times IR_o \times 10^{-6}\,kg/mg\right) + \left(\frac{1}{RfD_d} \times SA \times AF \times DA \times 10^{-6}\,kg/mg\right) + \left(\frac{1}{RfD_i} \times IR_i \times \left(\frac{1}{VF} + \frac{1}{PEF}\right)\right)\right]}$$

SCTL = Soil Cleanup Target Level
THI = target hazard index (unitless)
BW = body weight (kg)
AT = averaging time (days)
EF = exposure frequency (days/yr)
ED = exposure duration (years)
RBA = relative bioavailability factor (unitless)

FC = fraction from contaminated source (unitless)
IR_o = ingestion rate, oral (mg/day)
SA = surface area of skin exposed (cm^2/day)
AF = adherence factor (mg/cm^2)
DA = dermal absorption (unitless)
IR_i = inhalation rate (m^3/day)
VF = volatilization factor (m^3/kg)

PEF = particulate emission factor (m^3/kg)
RfD = reference dose (mg/kg-day)
RfD_o = oral
RfD_d = dermal
RfD_i = inhalation

Yellow = updated tox or phys/chem value Red = updated exposure value

SCTL Update

SCTLs for non-carcinogens in soil - worker

$$SCTL = \frac{THI \times BW \times AT \times RBA}{EF \times ED \times FC \times \left[\left(\frac{1}{RfD_o} \times IR_o \times 10^{-6}\,kg/mg\right) + \left(\frac{1}{RfD_d} \times SA \times AF \times DA \times 10^{-6}\,kg/mg\right) + \left(\frac{1}{RfD_i} \times IR_i \times \left(\frac{1}{VF} + \frac{1}{PEF}\right)\right)\right]}$$

SCTL = Soil Cleanup Target Level
THI = target hazard index (unitless)
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VF = volatilization factor (m^3/kg)

PEF = particulate emission factor (m^3/kg)
RfD = reference dose (mg/kg-day)
RfD_o = oral
RfD_d = dermal
RfD_i = inhalation

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Leachability Update

SCTLs for leachability

$$SCTL\,(mg/kg) = GCTL(\mu g/L) \times CF(mg/\mu g) \times DF \times \left[K_{oc}\,(L/kg) \times f_{oc}\,(g/g) + \frac{\theta_w\,(L_{water}/L_{soil}) + \theta_a\,(L_{air}/L_{soil}) \times H'}{\rho_b\,(g/cm^3)} \right]$$

Parameter	Definition (units)	Variables and Default
GCTL	groundwater cleanup target level (µg/L)	table-specific value [1]
CF	conversion factor (mg/µg)	0.001
DAF	dilution attenuation factor (unitless)	20 [2]
K_{oc}	soil-organic carbon partition coefficient (L/kg)	chemical-specific value [3]
f_{oc}	fraction organic carbon in soil (g/g)	0.002 [4]
θ_w	water-filled soil porosity (L_{water}/L_{soil})	$\omega\rho_b$
θ_a	air-filled soil porosity (L_{air}/L_{soil})	$\eta - \theta_w$
H	Henry's Law constant (atm-m^3/mol)	chemical-specific value [3]
H'	Henry's Law constant (unitless)	H × 41
ρ_b	dry soil bulk density (g/cm^3)	1.5 [4]
ω	average soil moisture content (g_{water}/g_{soil})	0.2 (20%) [4]
η	total soil porosity (L_{pore}/L_{soil})	$1-(\rho_b/\rho_s)$
ρ_s	soil particle density (g/cm^3)	2.65

Yellow = updated tox or phys/chem value Red = updated exposure value

Csat Update

C_{sat}

$$C_{sat} = \frac{S}{\rho_b}\left(K_d \rho_b + \theta_w + H'\theta_a\right)$$

Parameter	Definition (Units)	Default Value
C_{sat}	soil saturation concentration (mg/kg)	-
S	solubility in water (mg/L)	chemical-specific [b]
ρ_s	soil particle density (g/cm^3)	2.65
ρ_b	dry soil bulk density(g/cm^3)	1.5 [c]
η	total soil porosity (L_{pore}/L_{soil})	$1 - (\rho_b/\rho_s)$
θ_a	air-filled soil porosity (L_{air}/L_{soil})	$\eta - \theta_w$
θ_w	water-filled soil porosity (L_{water}/L_{soil})	$\omega\rho_b$
K_d	soil-water partition coefficient (cm^3/g)	$K_{oc} \times f_{oc}$
ω	average soil moisture content (kg_{water}/kg_{soil})	0.1 (10%) [c]
H	Henry's Law constant ($atm\text{-}m^3/mol$)	chemical-specific [b]
H'	Henry's Law constant (unitless)	H × 41
K_{oc}	soil-organic carbon partition coefficient (L/kg)	chemical-specific [b]
f_{oc}	fraction organic carbon in soil (g/g)	0.006 (0.6%) [c]

Yellow = updated tox or phys/chem value Red = updated exposure value