

Calculation of GSAC via Dermal Exposure

From CLR10

$$\text{ADE} = \frac{\text{IR}_{\text{dermal}} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}} \quad \text{Equation 1}$$

Where:

- ADE - Average daily exposure (mg/kg.bw/day)
- $\text{IR}_{\text{dermal}}$ - Chemical exposure rate via dermal route (mg/day)
- EF - Exposure frequency (days/yr)
- ED - Exposure Duration (days)
- BW - Human bodyweight (kg)
- AT - Averaging time (day)

$$\text{IR}_{\text{dermal}} = (\text{AAD} \times \text{A}_{\text{skin}})_{\text{outdoor}} + (\text{AAD} \times \text{A}_{\text{skin}} \times \text{F}_{\text{dust}})_{\text{indoor}} \quad \text{Equation 2}$$

Where:

- AAD - Average absorbed contaminant dose per unit area of skin (mg/cm²/day)
- A_{skin} - Exposed skin area (cm²)
- F_{dust} - Fraction of locally derived soil in indoor dust

AAD is considered equivalent to average absorbed contaminant dose per event, assuming only a single event each day.

$$\text{DA}_{\text{event}} = \text{C}_{\text{soil}} \times \text{AF} \times \text{ABS} \times 10^{-6} \quad \text{Equation 3}$$

Where:

- DA_{event} - Dermal absorbed contaminant dose per contact event (mg/cm²/event)
- C_{soil} - Chemical concentration in soil (mg/kg)
- AF - Adherence factor of soil to skin (mg/cm²/event)
- ABS - Dermal absorption fraction

To calculate the soil concentration for an ADE equivalent to the HCV (Health Criteria Value) combine and rearrange Equations 1-3.

$$\text{C}_{\text{soil}} = \frac{\text{BW} \times \text{AT} \times \text{HCV}}{((\text{AF} \times \text{ABS} \times \text{A}_{\text{skin}})_{\text{outdoor}} + (\text{AF} \times \text{ABS} \times \text{A}_{\text{skin}} \times \text{F}_{\text{dust}})_{\text{indoor}}) \times \text{EF} \times \text{ED} \times 10^{-6}}$$

This can then be combined with the SNIFFER output for the other pathways, so that

$$1/\text{GSAC} = 1/\text{SNIFFER} + 1/\text{C}_{\text{soil}}$$

Where

- GSAC – Generic Site Assessment Criteria
- SNIFFER – Output from the SNIFFER model

Residential Land Use – Standard Inputs

$$C_{\text{soil}} = \frac{BW \times AT \times HCV}{((AF \times ABS \times A_{\text{skin}})_{\text{outdoor}} + (AF \times ABS \times A_{\text{skin}} \times F_{\text{dust}})_{\text{indoor}}) \times EF \times ED \times 10^{-6}}$$

BW – 11.15 (Time Averaged bodyweight from SNIFFER)

AT – 2190 days (0-6 yrs)

AF (outdoor) – 1 mg/cm² (CLEA Briefing Note 1)

AF (indoor) – 0.06 mg/cm² (CLEA Briefing Note 1)

ABS – 0.13 for BaP from SNIFFER adapted from USEPA 2001

0.1 for NG (SNIFFER 2003, based on USEPA 2001)

A_{skin} (outdoor) – 544 cm² (Time averaged mean exposed skin area 0-6 years, based on data from CLEA Briefing Note 1)

A_{skin} (indoor) – 685 cm² (Time averaged from CLEA Briefing Note 1)

F_{dust} – 0.75 (CLR 10 data)

EF – 120 days (Time averaged data from CLR10)

ED – 6 years

10⁻⁶ – Correction Factor, kg to mg

HCV – contaminant specific (TDSI or ID) mg/kg.bw/day

Residential

Benzo(a)pyrene

$$C_{\text{soil}} = 11.15 \times 2190 \times 0.00002 / ((1 \times 0.13 \times 544) + (0.06 \times 0.13 \times 685 \times 0.75)) \times 120 \times 6 \times 10^{-6}$$

$$= 9.1 \text{ mg/kg}$$

Nitroglycerine

$$C_{\text{soil}} = 11.15 \times 2190 \times 0.0009 / ((1 \times 0.1 \times 544) + (0.06 \times 0.1 \times 685 \times 0.75)) \times 120 \times 6 \times 10^{-6}$$

$$= 531 \text{ mg/kg}$$

The following table presents GSACs calculated by combining the SNIFFER output with the calculated dermal route assessment criteria using the equation:

$$1/\text{GSAC} = 1/\text{SNIFFER} + 1/C_{\text{soil}}(\text{dermal})$$

Contaminant	Sniffer Output		Calculated CLR10 Dermal Assessment Criteria	Combined GSAC	
	Residential with Plant Uptake	Residential without Plant Uptake		Residential with Plant Uptake	Residential without Plant Uptake
PAHs					
Benzo(a)pyrene	1.3	2.0	9.1	1.1	1.66
Nitroglycerine	5	91.3	531	5	78