Generation of Contaminant Standards

Soil ingestion rate

Inhalation rate

Body Weight

Exposure duration

Exposure Frequency

Exposure duration


WARNING

What is a soil contaminant standard?

They are a concentration threshold (mg/kg dry weight soil) at which certain actions are recommended or enforced. They are usually at a concentration where there is a potential calculated risk to human health or the environment.

Target Value

Screening Value

Soil Guideline Value

Cleanup Value

Intervention Value

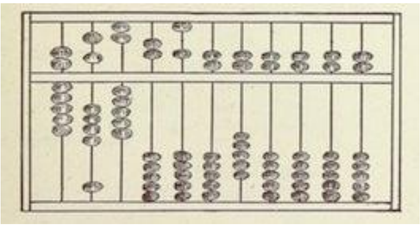
Trigger Value

Reference Value

Basis Equation for SCS

$$Intake\ rate\ (bw.day) = \frac{soil\ concentration\ x\ contact\ rate\ x\ exposure\ frequency\ x\ exposure\ duration}{body\ weight\ x\ averaging\ time}$$

Contact rate = values for pathway (ingestion rate, inhalation rate etc)
Exposure frequency = days/year
Exposure duration = years
Body weight = kg
Averaging time = exposure duration x 365 (threshold substance)
= life time (75 yrs) x 365 = 27,375 days (non-threshold substance)



Basis Equation for SCS

Intake rate is compared to an acceptable intake rate for the substance.

Acceptable intake rate

- Tolerable daily intake (TDI) for threshold compounds
- Dose that yields a specified increased cancer risk (in NZ = one additional cancer in 1,000,000 people (10^{-5}))

Basis Equation for SCS

$$SCS = \frac{acceptable\ intake\ x\ body\ weight\ x\ averaging\ time}{contact\ rate\ x\ exposure\ frequency\ x\ exposure\ duration}$$

Acceptable intake = varies for pathway and substance (mg/kg)
Exposure frequency = days/year
Exposure duration = years
Body weight = kg
Averaging time = exposure duration x 365 (threshold substance)
= life time (75 yrs) x 365 = 27,375 days (non-threshold substance)

Pathway Specific Equations (Threshold)

DERMAL ABSORPTION

ABSORBING CONTAMINANTS THROUGH SKIN

- Body weight *BW*
- Skin area *AR*
- **Soil loading on skin *AH***
- Contaminant's ability to pass from soil through skin *AF*
- How frequently people are exposed to contaminated soil *EF*

$$SGV_d = \frac{RHS \times BW \times 365{,}000{,}000}{AD \times AF \times EF}$$

ACCEPTABLE INTAKE OF CONTAMINANT RHS

- Contaminant dose that is unlikely to have significant effect on health TIV
- Intake from sources other than soil *BI*

$$RHS = TIV - BI$$

SOIL INGESTION

SWALLOWING DIRT AND DUST

- Body weight *BW*
- Proportion of contaminant taken up by the body when soil is ingested (bioavailability) *BA*
- Daily amount of soil ingested *IR*
- How frequently people are exposed to contaminated soil *EF*

$$SGV_{(ing)} = \frac{RHS \times BW \times 365{,}000{,}000 \times BA}{IR \times EF}$$

ACCEPTABLE INTAKE OF CONTAMINANT RHS

- Contaminant dose that is unlikely to have significant effect on health TIV
- Intake from sources other than soil *BI*

$$RHS = TIV - BI$$

DUST INHALATION

INHALING DUST INTO THE LUNGS

- Body weight BW
- Proportion of soil fine enough to become dust *PEF*
- Daily amount of air inhaled *IH*
- How frequently people are exposed to contaminated soil *EF*
- Proportion of dust retained in lungs *R*

$$SGV_{ih} = \frac{RHS \times BW \times PEF \times 365}{IH \times EF \times R}$$

ACCEPTABLE INTAKE OF CONTAMINANT RHS

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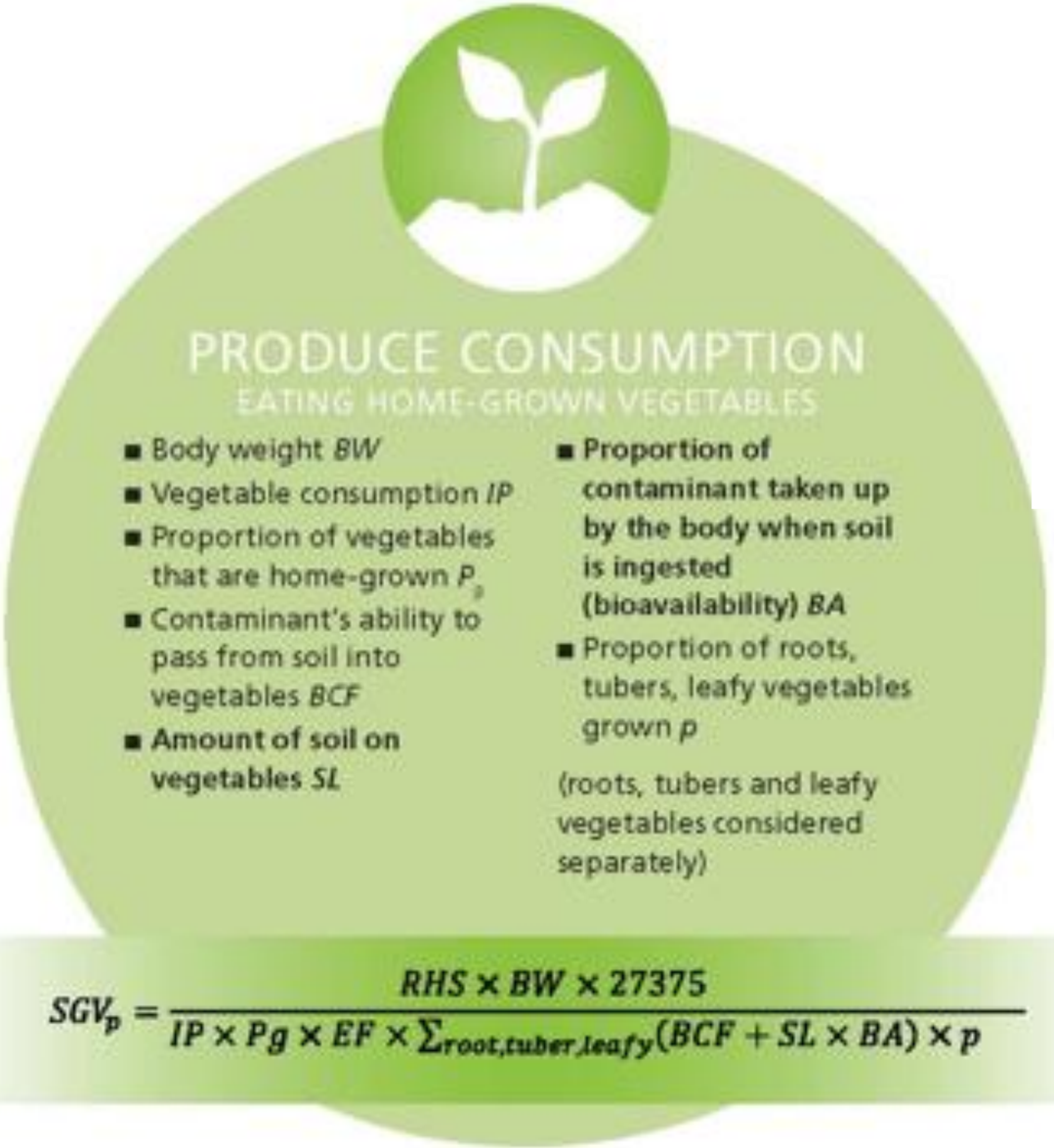
- Intake from sources other than soil *BI*

$$RHS = TIV - BI$$



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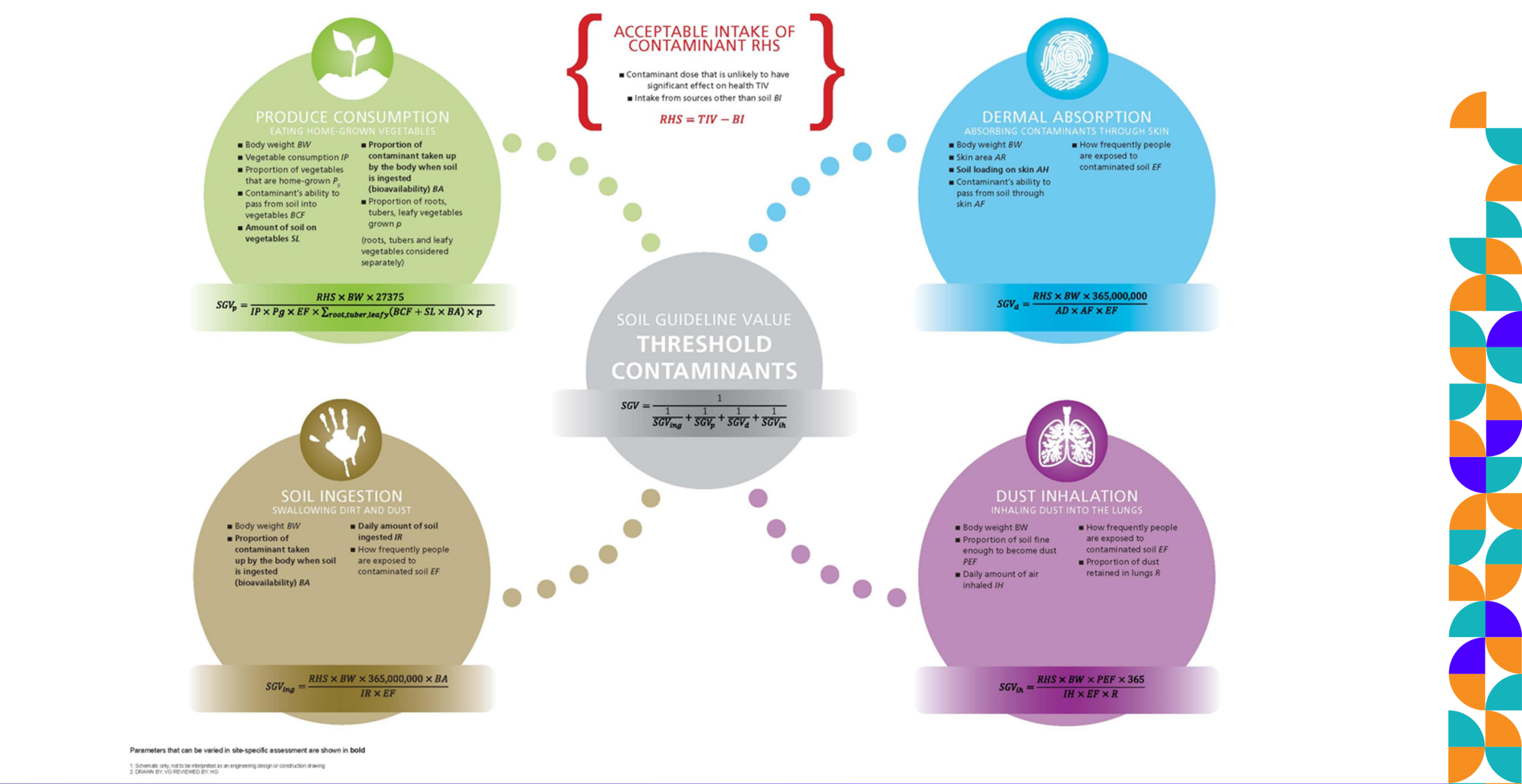
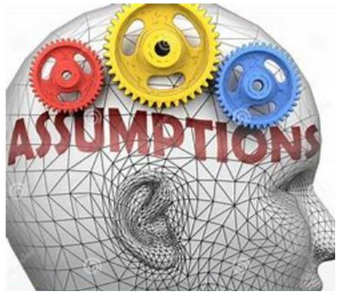


Parameters that can be varied in site-specific assessment are shown in bold

1. Schematic only, not to be interpreted as an engineering design or construction drawing.
2. DRAWN BY: VG REVIEWED BY: HG

Assumptions – Lots of them

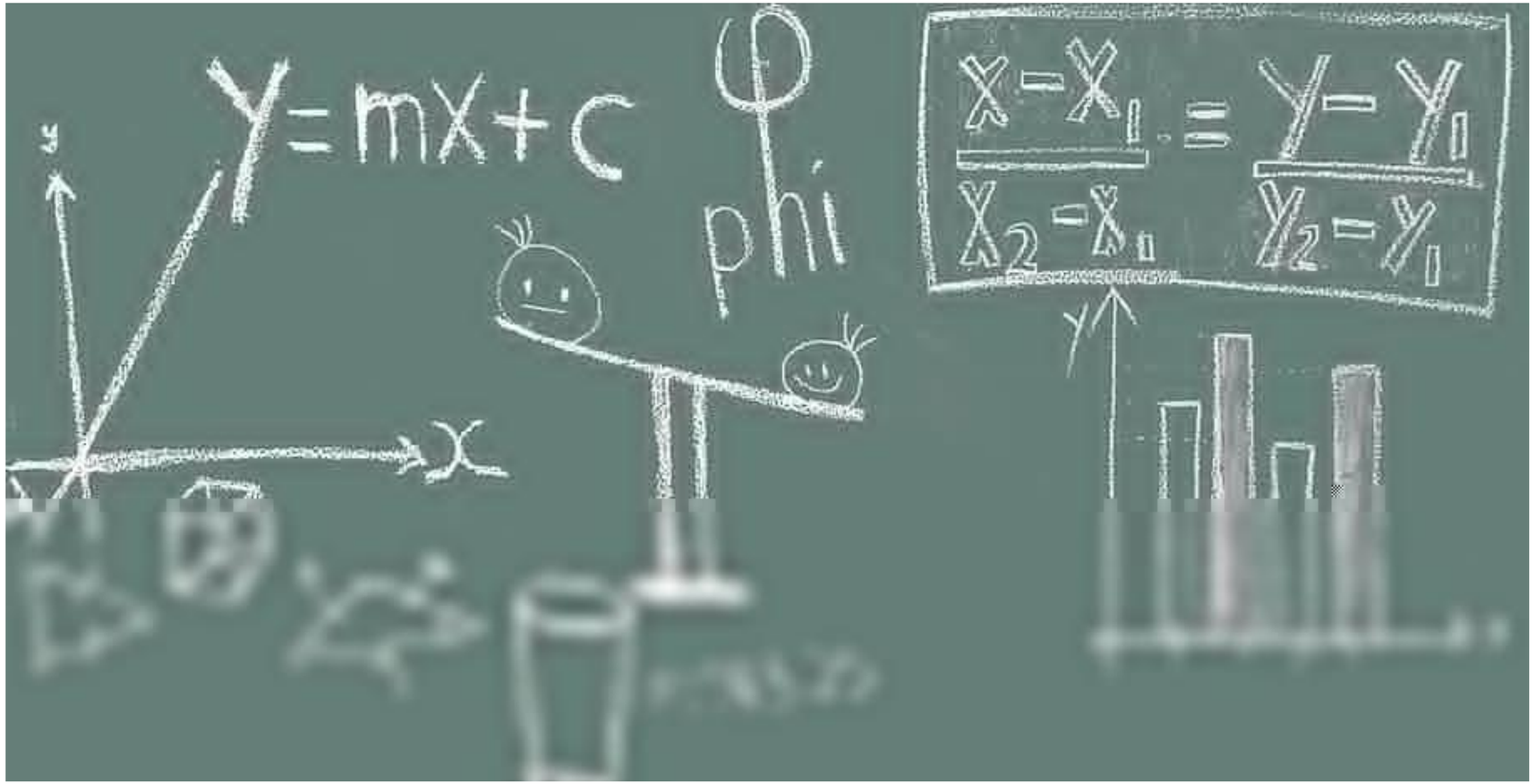
Body weight (kg) – 70kg adult, 15 kg child
Exposed skin area (cm2) – Can change with PPE requirements
Ingestion rate (mg/soil/day) – (25 to 100 mg/day)
Proportion of vegetables home grown – What is a good estimate
Exposure frequency and duration – days per year, hours per day
……



Assumptions

Essential educated guesses about future conditions that drive decision-making and forecasting.

Examples



Site Specific SCS for Arsenic

Exposure Factor	Units	Adopted Park User Specific Assumptions			
		Child Playing in Park	Parent Supervising Children	Jogger / Pedestrian	Park Groundsman
Body Weight	kg	15	70	70	70
Exposure duration	Years	6	12	24	24
Averaging Time CARCINOGENS	Years	70	70	70	70
Exposure frequency	days/year	104	104	240	52
Soil Ingestion Rate	mg/day	100	10	100	100
Area of Exposed Skin	m^2	2625	4700	4700	4700
Soil Adherence	mg/cm^2	0.5	0.5	0.5	1
Inhalation rate	m3/d	3.8	20	20	9.6
Proportion of particles retained in lungs		0.75	0.75	0.75	0.75
Acceptable Concentration	mg/kg	83.0	132.2	130.4	62.3

Scenario		Residential		Lifestyle	
Receptor		Child	Adult	Child	
Home-grown produce consump	P_g		10%	25%	
Combined soil guideline value	*SGV*	19	61	17	mg/kg
Eliminate produce		24		21	
AND Reduce ingestion by	*50%*	48		42	
	80%	119		104	

Takeaways

1. Tier 1 SGV are conservative
2. Assumptions are based on whole of population data
3. Challenge the status quo

Warning: get calculations peer reviewed