

# Sustainable management of contaminated sites

Presentation 2.6

Phase 2 – Environmental Risk Assessment

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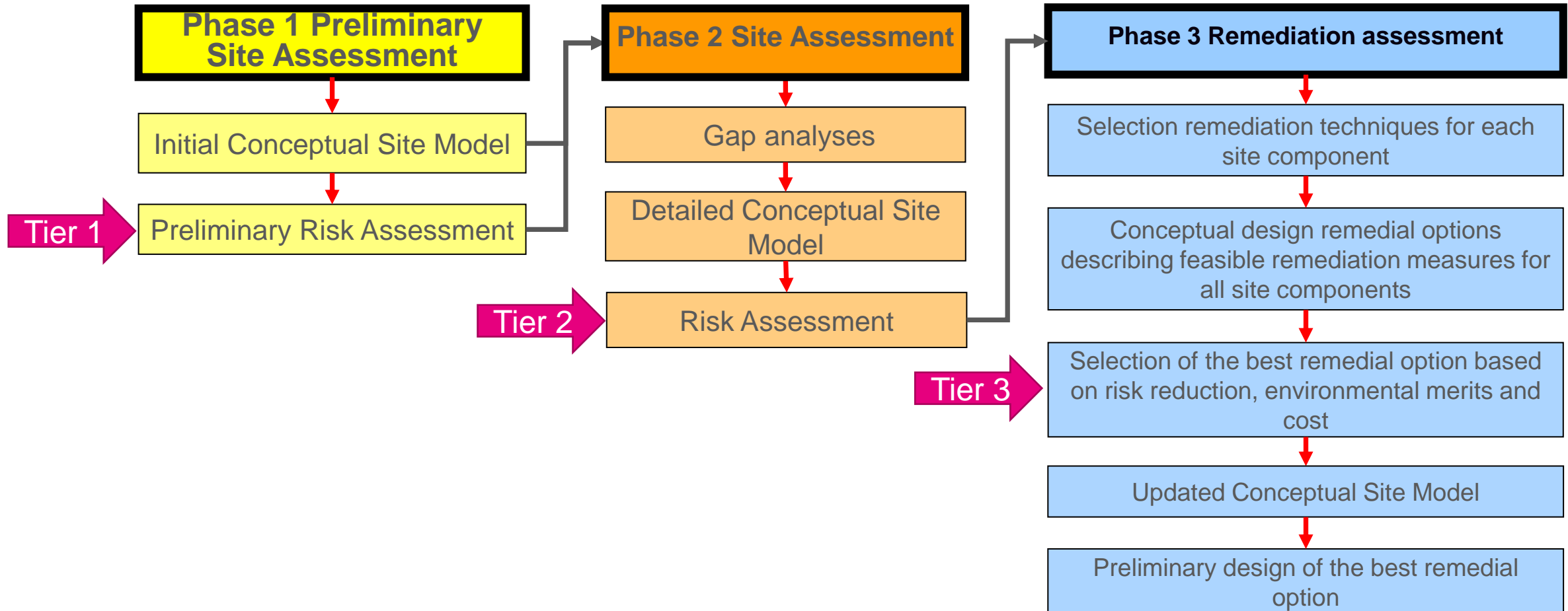
# Content

- **Tier 1**
  - Preliminary risk assessment
  - Qualitative
- **Tier 2**
  - Risk assessment
  - Semi-quantitative
- **Tier 3**
  - Advanced risk assessment
  - Quantitative

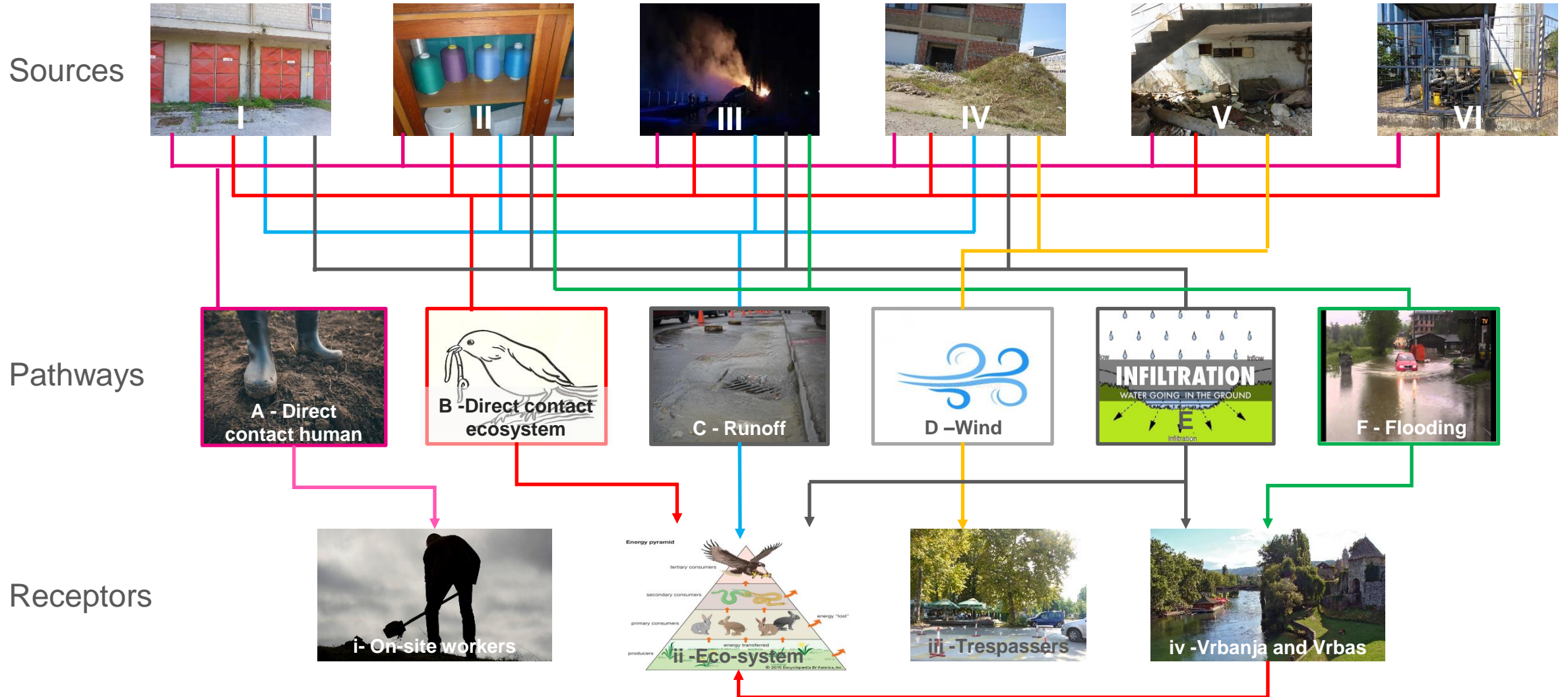


# Risk Assessment

## Phase 1, 2 and 3



# ICSM of a PCB contaminated site input of Tier 1 RA



# Risk Assessment

## Tier 1

- **Qualitative assessment of direct, potential & latent risks for**
  - ✓ Human health
  - ✓ Ecosystem
  - ✓ Migration into the surrounding environment
- **The levels of contaminants in soil & groundwater**
  - ✓ Are assessed based on expert judgment
  - ✓ Assumptions are made
  - ✓ Gives the direction of the site assessment



# CSM of a PCB contaminated site input of Tier 2 RA

North

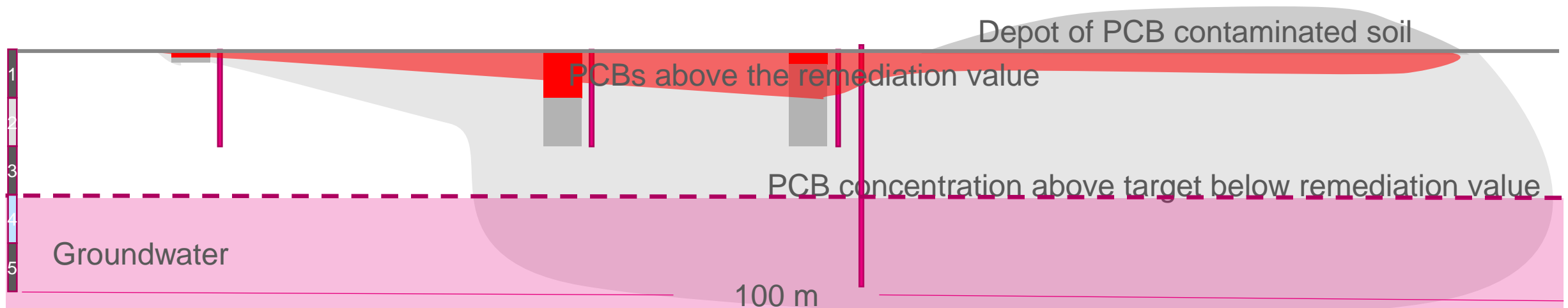
South

ZR 27

ZR 26

ZR 25

ZR 02



Location	Contaminants	M <sup>3</sup>	Tons*
Depot with sand behind bunkers	Solid Waste and PCB	100	1.7
Soil under and around the depot with sand behind bunkers	Solid Waste and PCB	100	1.7
Strip of land West of platform and South of depot with sand behind bunkers	Solid Waste and PCB	200	3.4

Volumes of the contaminated soil in concentrations above the remediation values at the part of the Radiator site surveyed

\*Specific weight 1 m<sup>3</sup> = 1.7 tons



# Risk Assessment

## Tier 2

- **Quantification assessment of direct, potential & latent risks for**
  - Human health
  - Ecosystem
  - Migration into the surrounding environment
- **The levels of contaminants in soil & groundwater**
  - Are analyzed
  - Analytical results are tested against national reference levels
- **Reference levels**
  - Preferably national reference levels should be used
  - If no national reference levels are present, use international accepted reference frame works

# Risk Assessment

## Dutch Reference Values

- The **TARGET VALUE** is the baseline concentration value below which compounds and/or elements are known or assumed not to affect the natural properties of the soil
- The **INTERVENTION VALUE** is the maximum tolerable concentration above which remediation is required. This occurs if one or more compounds in concentrations equal to or higher than the intervention value is found in more than 25 m<sup>3</sup> of soil or 1000 m<sup>3</sup> of ground water
- **INDICATIVE LEVELS FOR SERIOUS CONTAMINATION** are also given for some contaminants.
- **Values for soil/sediment** are expressed as the concentration in a standard soil (10% organic matter and 25% clay). Target and Intervention values vary according to the clay and organic matter content of the soil



# Some examples

## Dutch Reference Values

Parameter	Soil (mg/kg dry matter)*		Groundwater (µg/l)**		
	Values	Target	Intervention	Target	Intervention
Polychlorinated biphenyl (sum 7)	-	-	1	0.01	0.01
DDT/DDE/DDD (sum)	-	-	-	0.004 <u>ng</u> /L	0.01
HCH-compound (sum)	-	-	-	0.05	-
Benzene	-	-	1.1	0.2	30

\*For soil sample analyses the unit is milligram per kilogram (mg/kg dry weight) = PPM

\*\*For groundwater analysed the unit is microgram per litre (µg/l) = PPB



# Example Servian

## Land-use value for PCB contaminated soil

- **Agricultural land-use**

- $< 0.01$  ppm\*      Clean no restriction for agricultural use
- $\geq 0.01 - < 1.10$  ppm      Restricted to annual crops
- $\geq 1.10 - < 16.50$  ppm      Restricted to forestry
- $\geq 16.50$  ppm      No agricultural land-use & Risk reduction measures to be taken

- **Industrial land-use**

- $< 50$  ppm      No restriction on industrial use
- $\geq 50$  ppm      Restriction on industrial use & Risk reduction measures to be taken

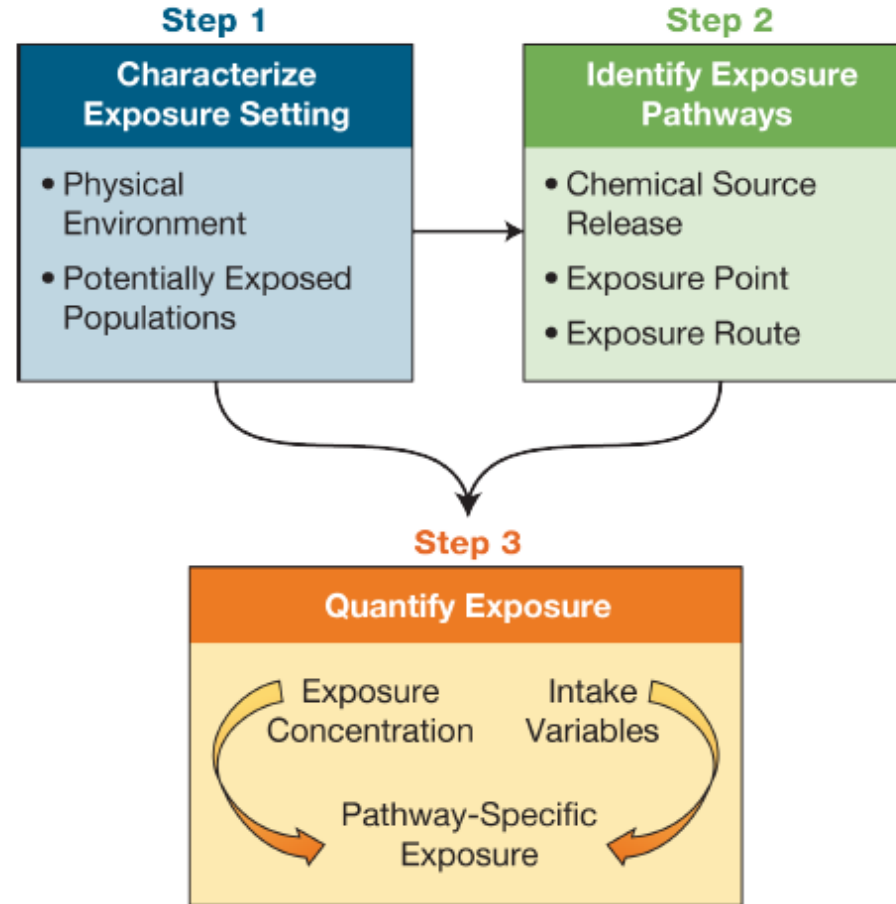
- **Residential land-use**

- $< 4.7$  ppm      No restrictions for residential use
- $\geq 4.7$  ppm      Restriction on residential use & Risk reduction measures to be taken



# Risk Assessment

## Detailed CSM input of Tier 3 RA



Assessment of Perceptions and Cancer Risks of Workers at a Polychlorinated Biphenyl-Contaminated Hotspot in Ethiopia

Figure 1-3. The exposure assessment process.

Source: USEPA 1989a.



# Risk assessment

## Tier 3

- **Quantification of direct, potential & latent risks for**
  - Human health
  - Ecosystem
  - Migration into the surrounding environment
- **The levels of contaminants in soil & groundwater**
  - Are analyzed
  - Analytical results are tested against national reference levels
- **Risk assessment models are used such as**
  - Risk Based Corrective Actions (RBCA) toolkit for Chemical Releases
  - Sanscrit
  - Csoil
  - VOLASOIL-model



# RBCA Toolkit for Chemical Releases

**RBCA Tool Kit for Chemical Releases**  
Version 2.6 © 2011 GSI Environmental Inc.

### Main Screen

**1. Project Information**

Site Name:   
Location:   
Completed By:   
Date:  Job ID:

**2. Which Type of RBCA Analysis?**

**Tier 1**  
Risk-Based Screening Levels

**Tier 2/3**  
Site-Specific Target Levels

**3. Calculation Options**  
*Affects which input data are required*

**Baseline Risks (Forward mode)**

**RBCA Cleanup Levels (Backward mode)**

Individual Constituent Risk Goals Only

Individual and Cumulative Risk Goals

Apply Source Depletion Algorithm  
Time to Future Exposure:  (yr)

### 4. RBCA Evaluation Process

**Prepare Input Data**  
Data Complete? (  = yes,  = no)

Exposure Pathways

↓

Constituents of Concern (COCs)

↓

Transport Models

↓

Soil Parameters

↓

GW Parameters

↓

Air Parameters

**Review Output**

Exposure Flowchart

COC Chem. Parameters

Input Data Summary

User-Spec. COC Data...

Transient Domenico Analysis...

Baseline Risks...

Cleanup Levels...

### 5. Commands and Options

New Site Load Data... Save Data As... User Chemical Database

Set Units Print Sheet Print Report

Help Quit

<https://www.gsi-net.com/en/software/rbca-software-tool-kit-for-chemical-releases-version-2-6.html>



# Info Csoil

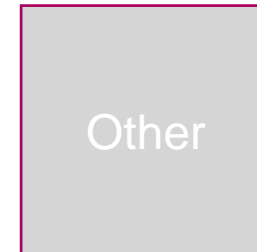
## Human health risk assessment for contaminated soil

- Calculates
  - ✓ The risks that humans are exposed to if they are in contact with soil contamination
  - ✓ Humans can be exposed to contaminated soil via different exposure routes
    - Soil
    - Air
    - Water
    - Crops
- The soil use, such as a vegetable garden, determines the degree of exposure.
- Physical-chemical properties of the contaminant in soil air, soil particles and groundwater also have an influence on the exposure

# Csoil

## 7 default land uses

1. Residential with garden
2. Places where children play
3. Residential with kitchen, -vegetable garden
4. Agriculture use
5. Nature areas
6. Urban green areas with nature values
7. Other green areas, infrastructure, buildings and industry



For each land-use an exposure scenario is defined which comprehend

- Soil ingestion rates
- Contact time
- Consumption rates





**If default land uses are not acceptable, describe land-use by changing the input of the following parameters**

- Daily intake soil (year average)
- Fraction consumption root crops or potato from own garden (from total)
- Fraction consumption leafy crops or vegetables from own garden (from total)
- Consumption amount root crops or potato
- Consumption amount vegetables of leafy crops
- Time spend indoors (year average)
- Time spend outdoors (year average)
- Exposure time soil contact indoor
- Exposure time soil contact outdoor
- Exposure via drinking water



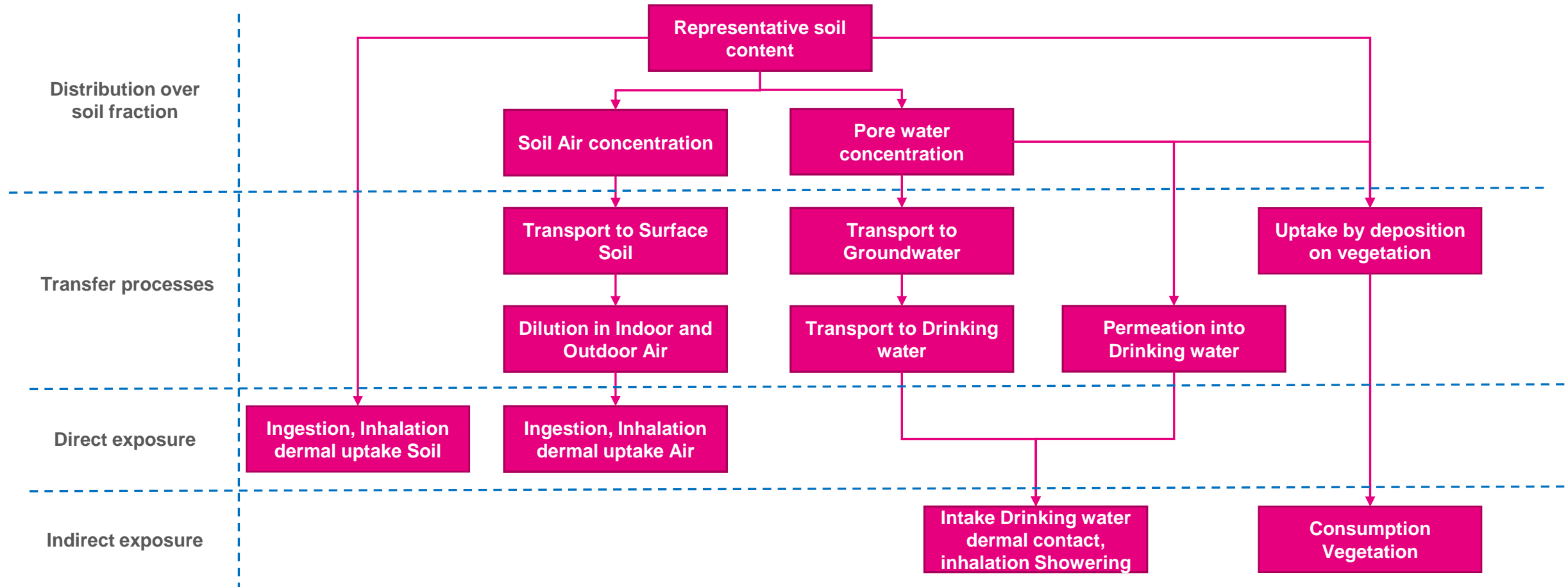
# Csoil EXPOSURE PATHWAYS

- All land-uses have default exposure pathways
  - ✓ Ingestion of soil
  - ✓ Inhalation of soil particles (indoors and outdoors)
  - ✓ Dermal contact with soil
  - ✓ Inhalation of vapours (indoors and outdoors)
  - ✓ Consumption of contaminated crops
  - ✓ Exposure via contaminated drinking water (via ingestion, inhalation of vapours and dermal contact)
- Additional exposure pathways are switched on/off based on the selected land-use
- Exposure and risks can be assessed for adults and children based on live-long exposure (default setting)
- When appropriate risk assessment can focus on children or adults separately



# Csoil

## Diagram showing the exposure routes of the model CSOIL 2000



# Thank you!

# Contact



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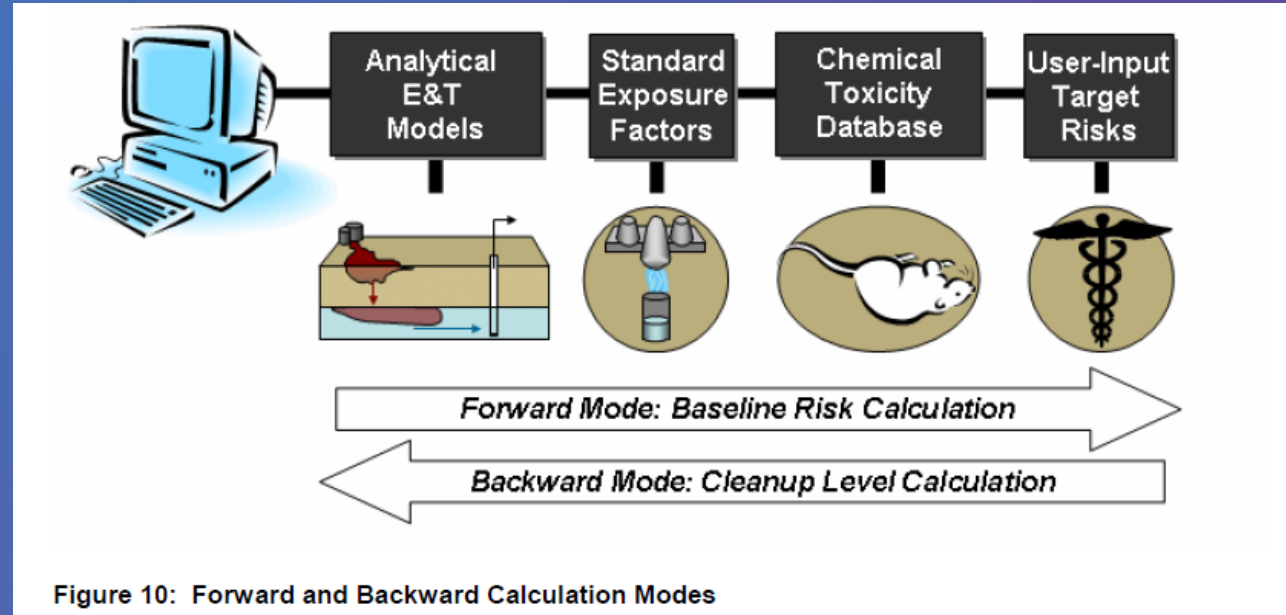


Figure 10: Forward and Backward Calculation Modes

# Questions?