



## Risk Assessment & Prioritisation

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Twinning Project IL/11; M77  
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## Outline

- Contaminated Sites
- Overall investigation scheme (tiered approach)
- Preliminary assesement
- Risk Assessment
  - Historical investigations
  - Site investigations
  - Principles of Risk Assessment
- Remediation – recent examples

## Legal Framework in Austria

- Water Act (WRG 1959)
- Contaminated Sites Remediation Act (ALSAG 1989)
- Waste Management Act (AWG 2002)
- Austrian Standard ÖNORM S 2088
  - part 1: Groundwater (2<sup>nd</sup> edition 2004; under revision)
  - part 2: Soil (2014; 2<sup>nd</sup> edition)
  - part 3: Air (2003; 1<sup>st</sup> edition)

### Not existing in Austria (federal level):

- Soil Protection Act

## **Legal Framework (2)**

### **Financing/Funding**

#### **→Law on remediation of contaminated sites (ALSAG; 1989)**

**waste taxation system to finance/fund investigation and remediation of contaminated sites**

→Environmental support Act (UFG; 1993)

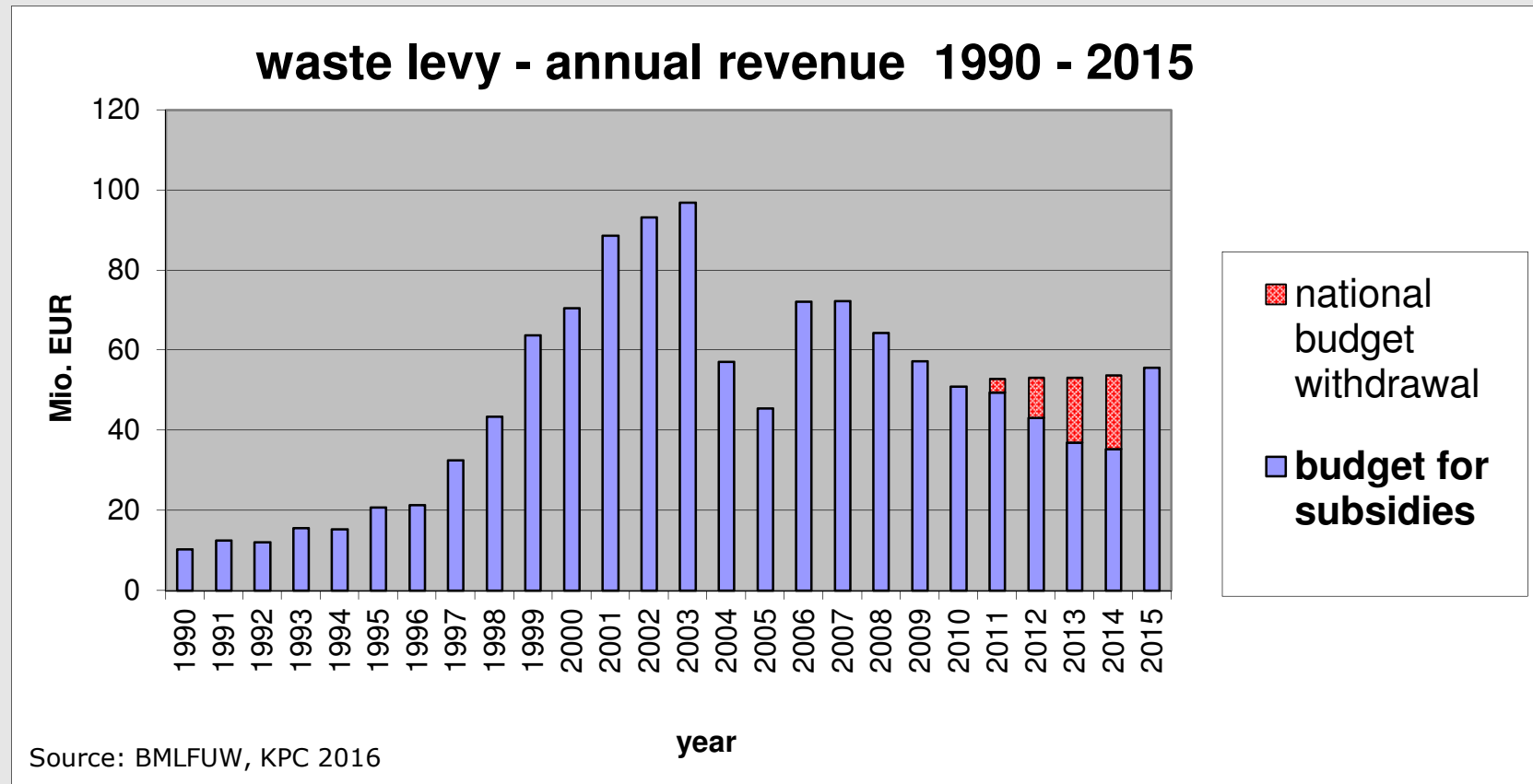
→EC-Guideline on Environmental State Aid  
(Competition Protection Regulations)

→AT: Guideline on financial support to remediate  
contaminated sites (FRL; 2002 – rev. continuous)

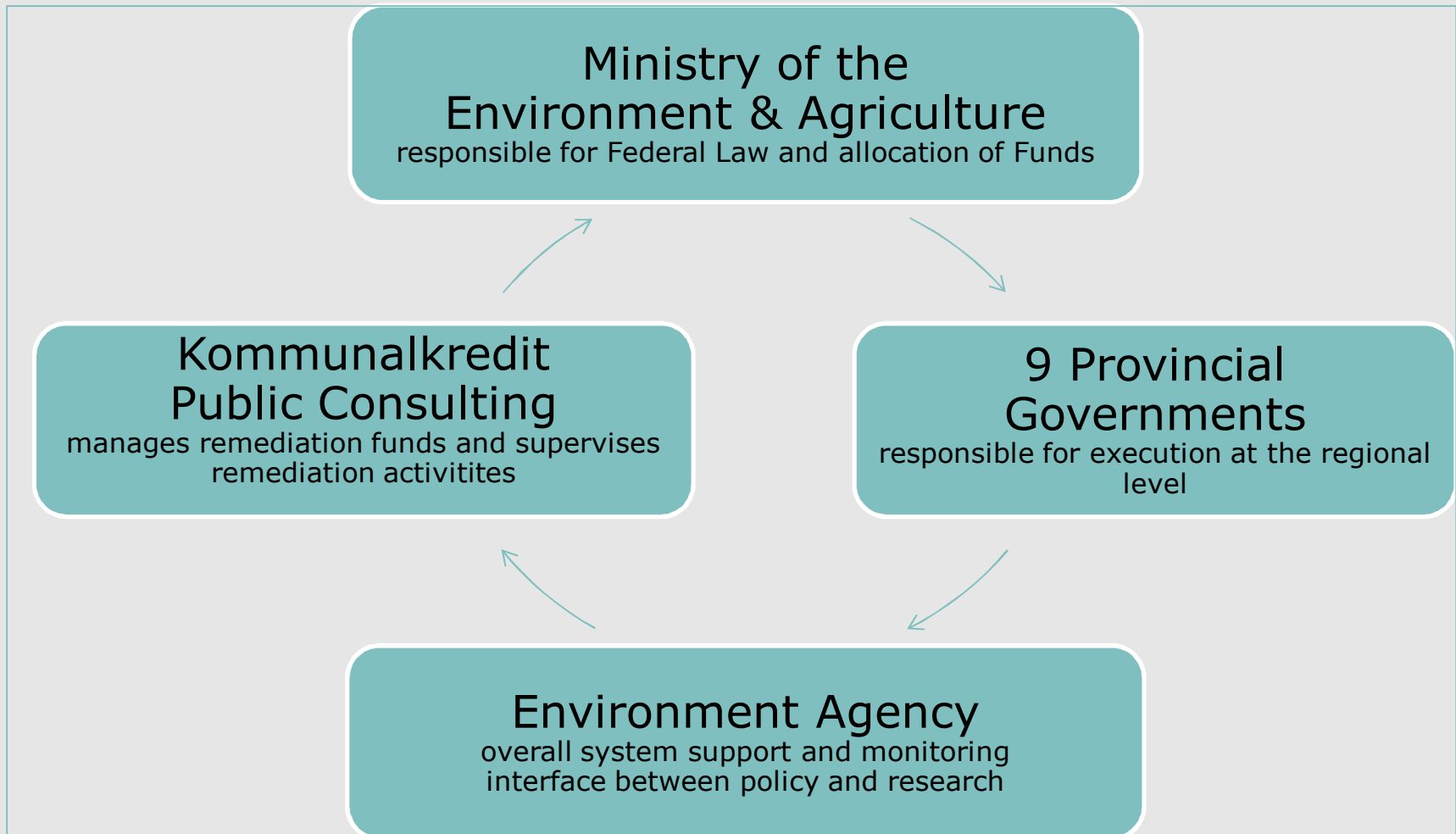
→Public Procurement Law (BVergG; 2002)

# Public remediation budget

total (1990 – 2015): ~ 1,24 bio. EURO



# Key Players



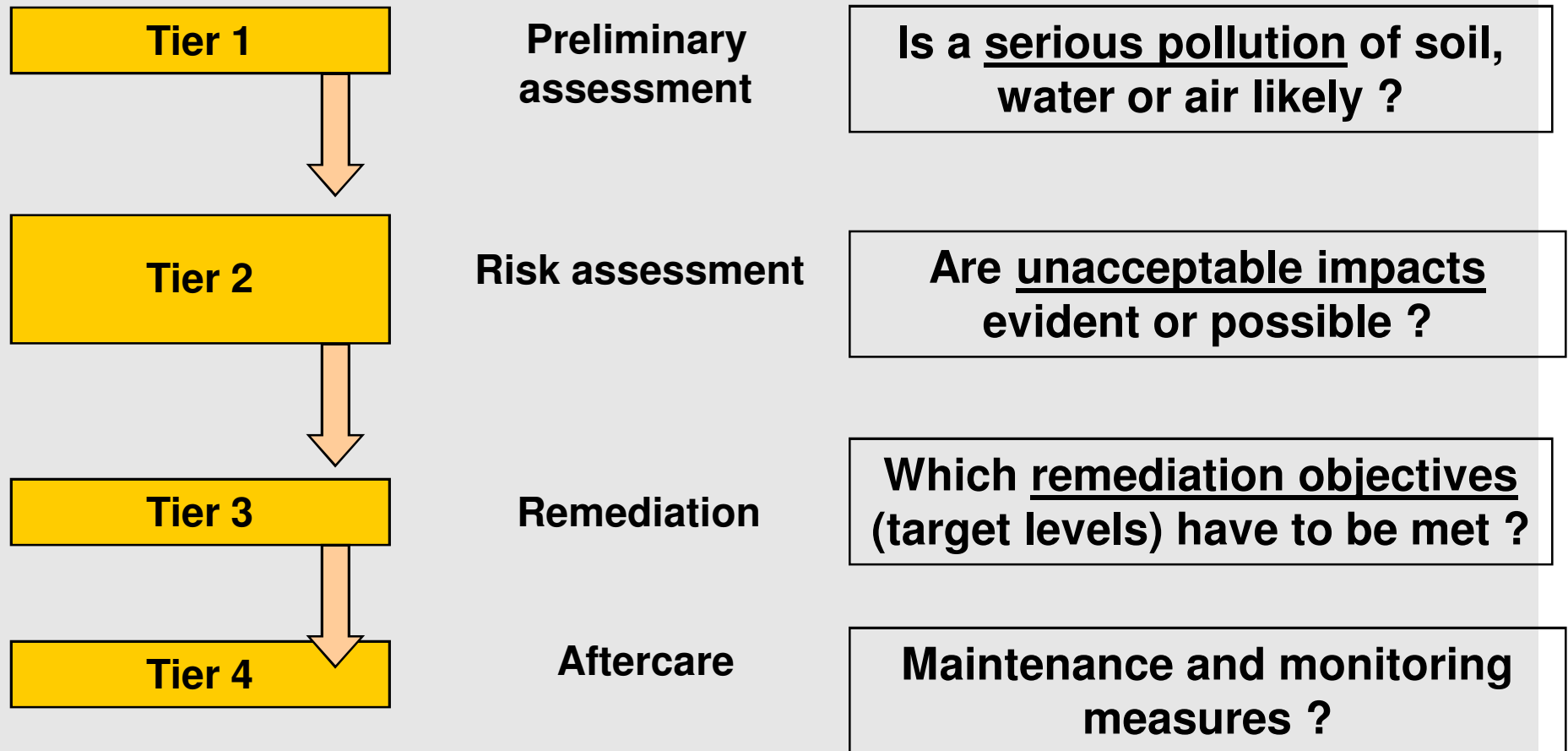


## Remediation 1990 - 2005



**Landfill "Fischer"**  
remediation costs:  
**140 mio. €**

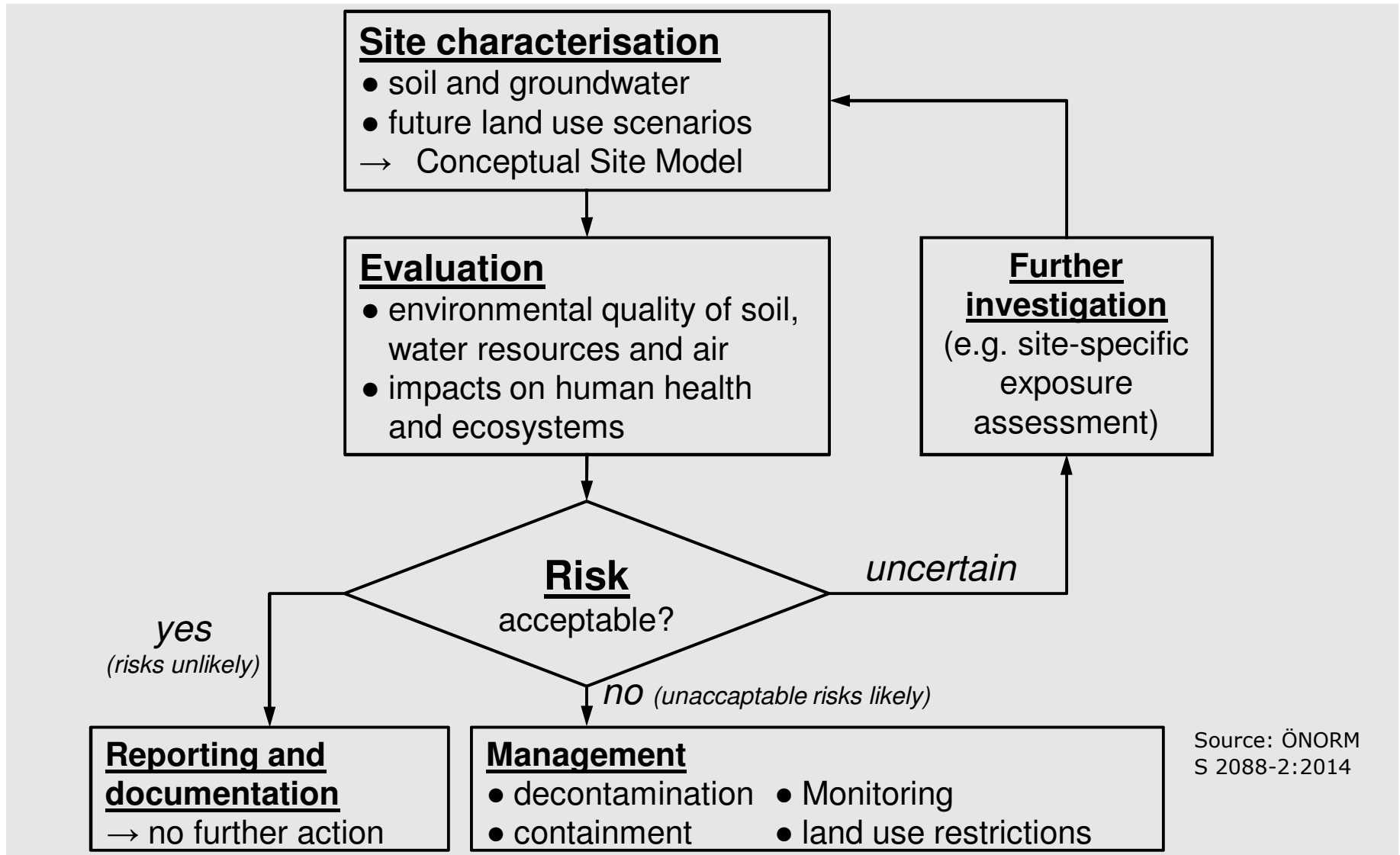
## Overall Procedure – Tiered Approach



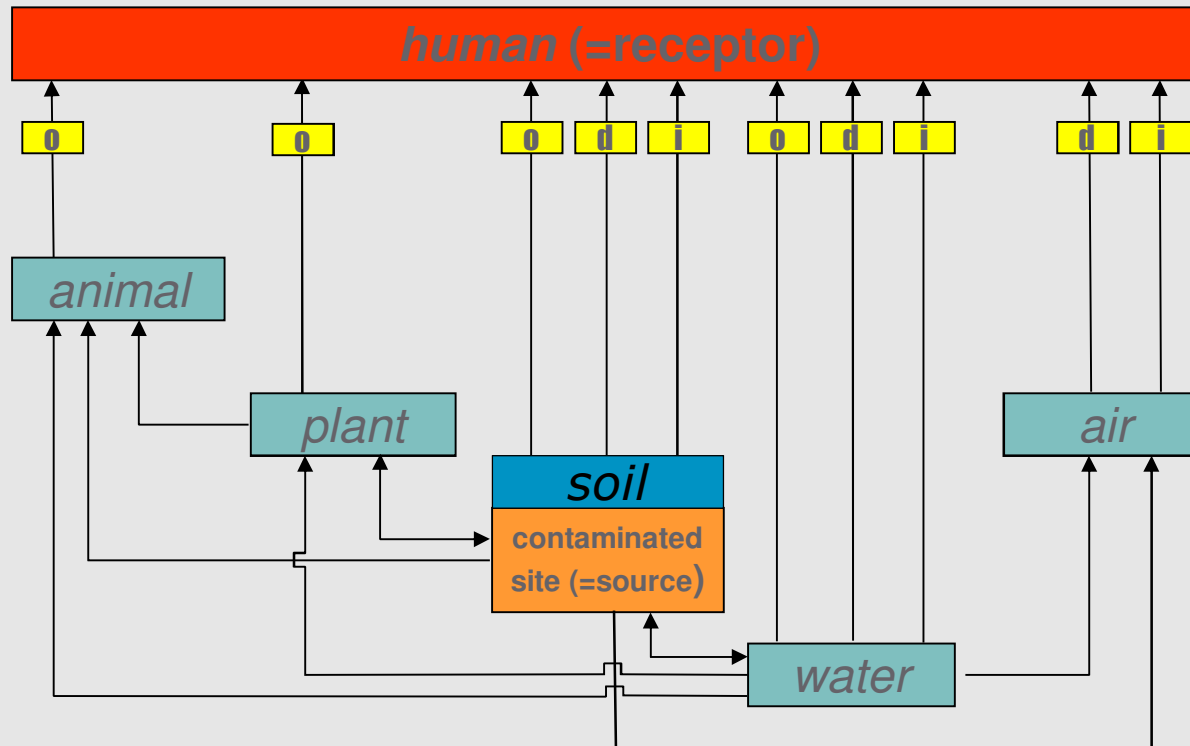


# ÖNORM S 2088-2

- Austrian Standard adopted by 1. September 2014
- land-use-specific evaluation of soil contamination
- Risk Characterisation
  - 5 different types of land uses
  - Oral, inhalative and dermal scenarios
  - Toxicologically derived trigger values



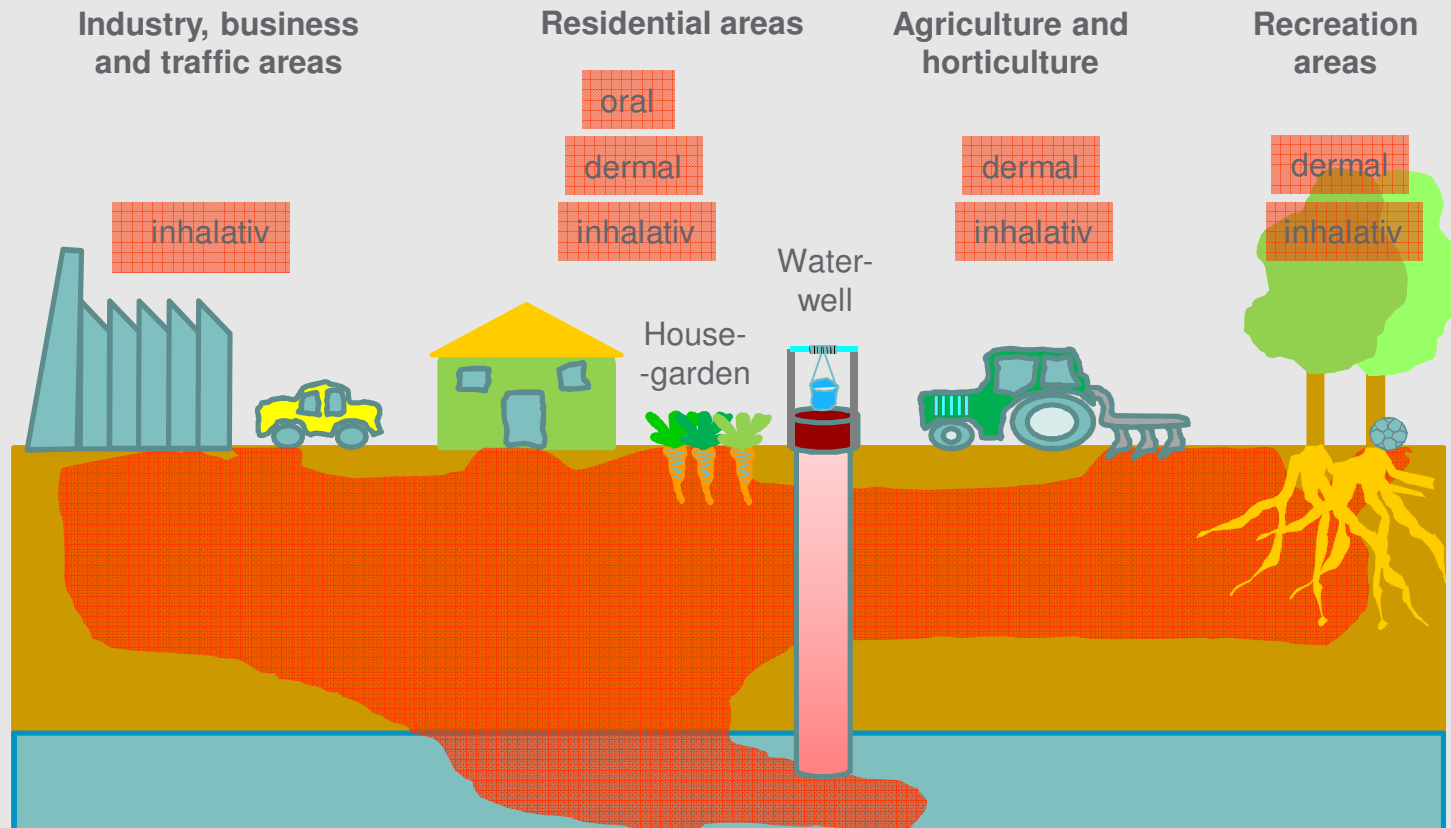
# Potential pathways of exposure...



Source: Environment Agency Austria, 2011

...but which are relevant for my site?

# Land use, activities & exposure pathways



Source: Environment Agency Austria, 2011

# Discussions on exposure scenarios

- It was decided not to use modelling approaches and complex scenarios combining different exposure pathways, but to derive land-use-specific trigger values according to a sensitivity test for identifying a most relevant activity and exposure pathway.
- To recognize exposure by multiple contaminant sources the additional contaminant exposure by soil contamination is limited by 20 % of the acceptable daily intake (ADI).
- The process of deriving trigger values needs to be transparent and reproducible by a documentation of any algorithm or exposure parameter
  - ➔ see Annexes of ÖNORM S 2088-2:2014
- Accordingly referring to new scientific data any knowledge based amendment for the generic reference scenarios is feasible in using the standard on the mid-term.



## 5 different classes of land use

... and simplifying exposure scenarios:

- Playground – oral ingestion (and conservative approach due its to social sensitivity)
- Residential use – inhalative ingestion
- Agricultural and horticultural– inhalative ingestion
- Recreational use (generic characterisation or trigger values not possible)
- Industry, commerce and infrastructure (generic characterisation or trigger values not meaningful)

# Defining and selecting exposure parameters

- Biometric parameters
- ingestion rates
- Soil-plant transfer rates

&

- Toxicological reference values

## Plausibility testing

- control and comparison against background values (national data on agricultural and urban soils),
- trigger values from other European countries (Carlon C., (ed.); 2007),
- complementary national legislative documents (e.g. BAWP; “Federal waste management plan”, 2011),
- bioavailability data, and
- data on carcinogenic potentials for different metals species.

Parameter	Dimension	Trigger value		
		playground	residential*	agriculture**
Antimony	mg/kg	5	60	2
Arsenic	mg/kg	20	50	20
Lead	mg/kg	100	500	100
Cadmium	mg/kg	2	2	0,5
Chromium	mg/kg	100	75	100
Cobalt	mg/kg	-	-	50
Copper	mg/kg	100	500	100
Molybdenum	mg/kg	-	-	2,5
Nickel	mg/kg	70	-	100
Mercury	mg/kg	1	10	0,5
Selenium	mg/kg	-	-	1
Thallium	mg/kg	-	-	1
Vanadium	mg/kg	-	-	100
Zinc	mg/kg	-	-	300
Fluoride	mg/kg	-	-	200
Cyanide	mg/kg	5	-	5
TPH	mg/kg	50	-	200
PCDD/F	ng TE/kg	50	600	10
PCB	mg/kg	0,2	2	0,1
PAH	mg/kg	4	10	2
Benz(a)pyren	mg/kg	0,1	0,5	-

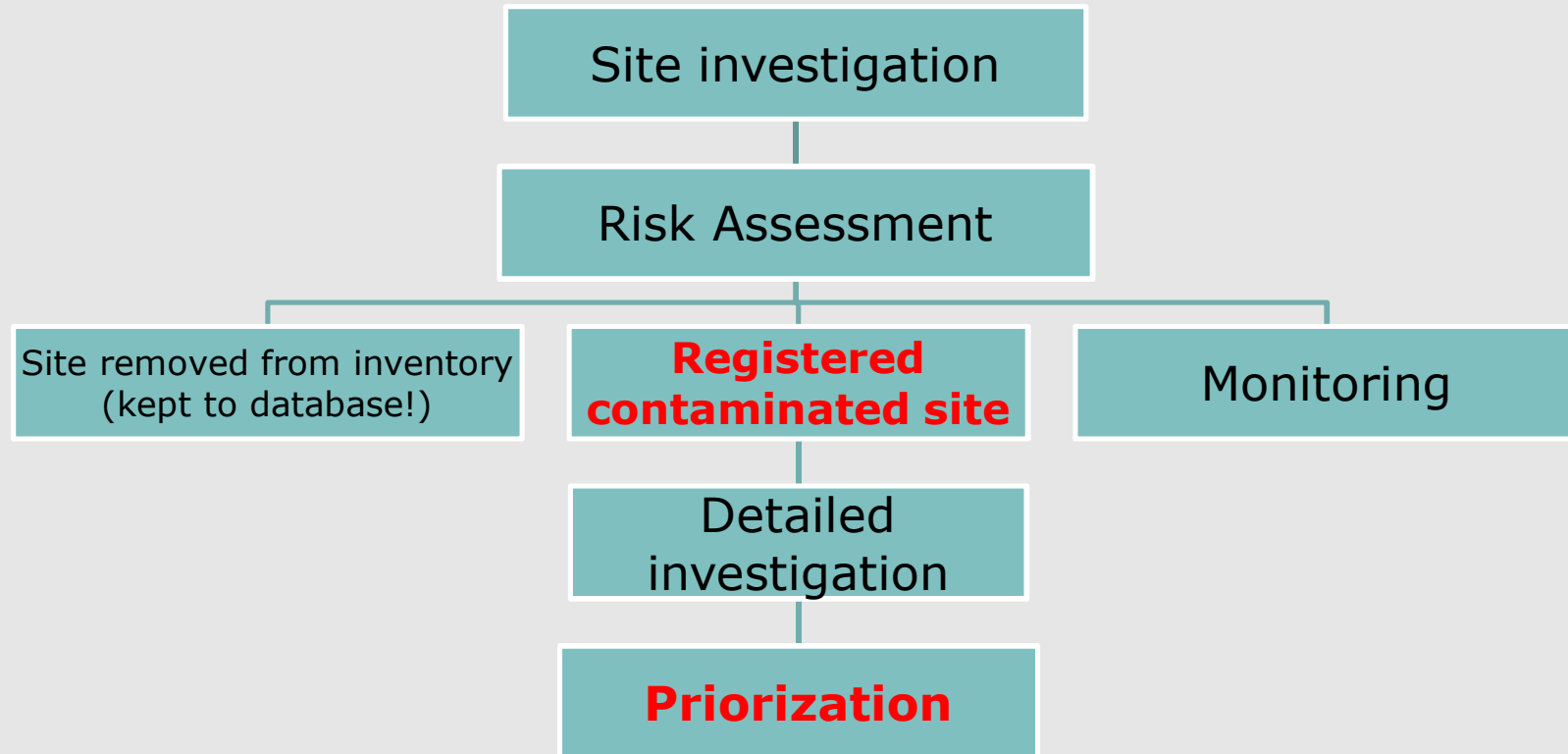
## Trigger values according to ÖNORM S 2088-2 (2014 ) – comparative summary (tables 1, 2 and 3)

- \* residential (e.g. gardening) or agricultural use: site-specific risk analysis
- \*\* further investigation of contaminant uptake by plant
- TPH ... Total Petroleum Hydrocarbons
- PCDD/F ... dioxins and furans
- PAH ... polycyclic aromatic hydrocarbons (16 reference substances)
- PCB ... polychlorinated biphenyls (7 reference substances)

Source: ÖNORM S 2088-2:2014

## Tier 2 – Risk Assessment (1)

*... assessing "potentially" contaminated sites*



Step 2 is either financed by the Ministry of Environment or a site owner:  
investigation costs may range between 50.000 – 2.000.000 € per site



## Tier 2 – Site Investigation (2)

- Preparing Risk Assessment by characterizing of sources, (potential) pathways and receptors
- Investigation Programmes (if the ME finances)
  - Design: Environment Agency
  - call for tender: Provincial Governments
  - Implementation: engineering companies  
(tendering: e.g. boreholes, sampling, lab-analyses)
  - Control: Provincial Governments
  - Supervision: Environment Agency
- Focus: Field investigations (accompanying: further historical investigation)

## Tier 2 – Site Investigation (3)

### Methodology

- Design of investigation programme based on historical investigations
- hydrological and (hydro-)geological investigations
- Sampling and analysis of air/gas, soil and (ground)water at the site and its surroundings

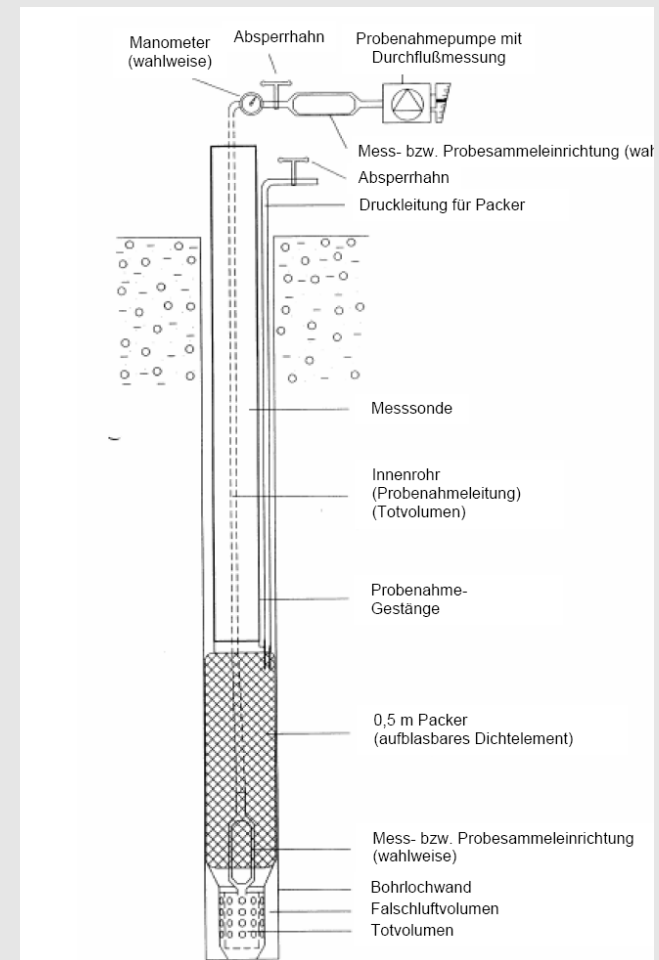
### Result: *"Conceptual Site Model"*

- detailed documentation, analysis and mapping of investigation results, description of uncertainties
- evidence based interpretation regarding contaminant distribution (sources & pathways), given ( & future) impacts on human health and the environment

## Tier 2 – Site Investigation (4)

### Example: air/soil sampling

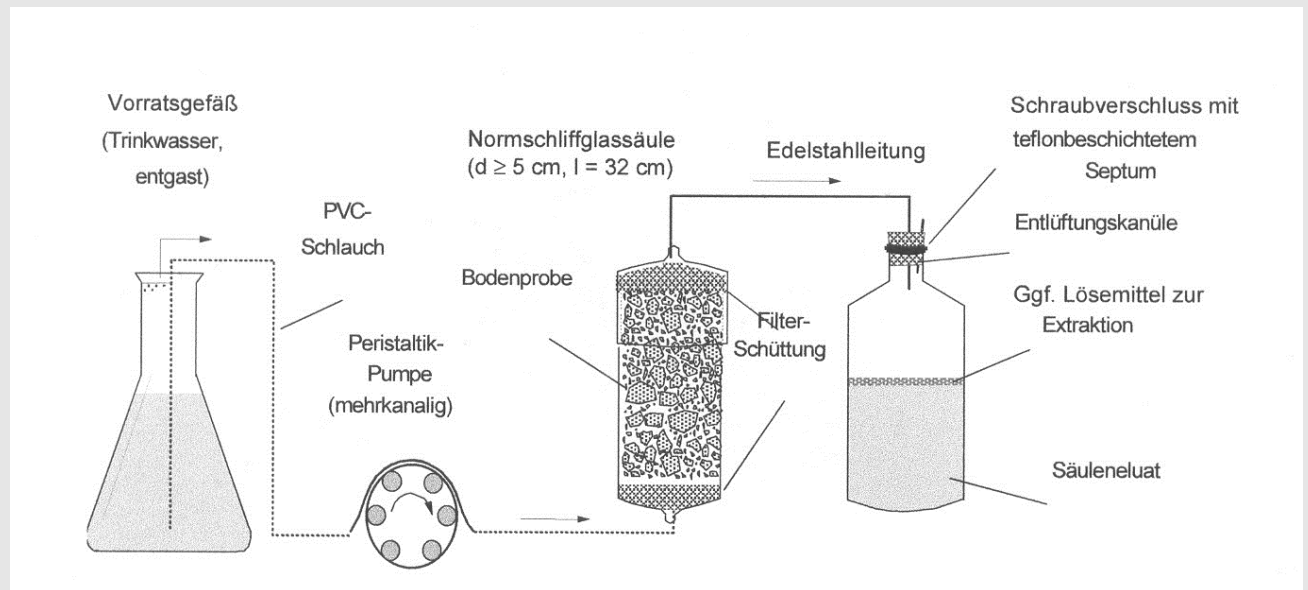
- Soil-gas sampling: TPH, BTEX, CHC, etc. (see **figure**)
- Landfill-gas sampling
- Indoor-air sampling: toxic or explosive substances



## Tier 2 – Site Investigation (5)

### Example: analysis of soil samples

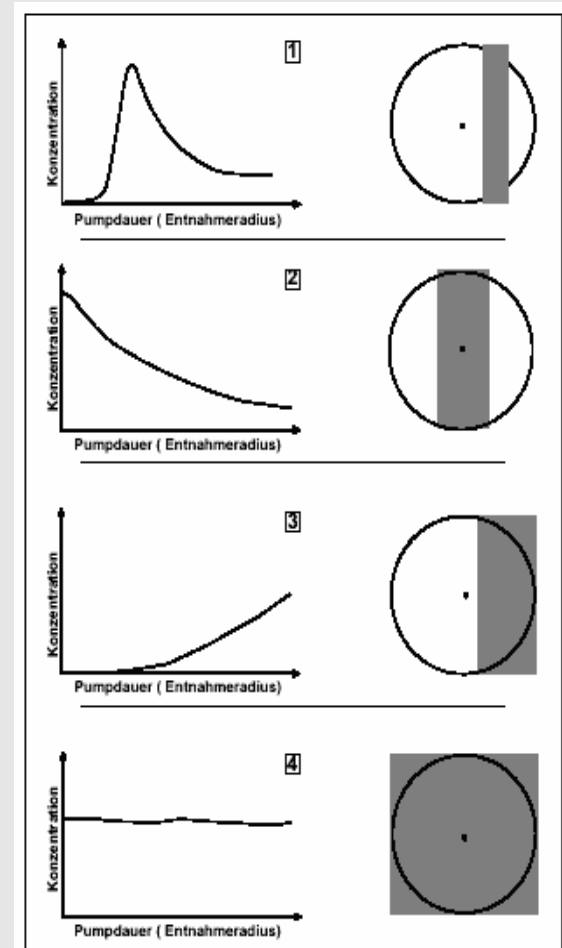
- Total concentrations
- Potential and recent mobilization (leaching tests, extractions): new guidelines in 2011 (e.g. column-tests; see **figure**)
- leachate quality



## Tier 2 – Site Investigation (6)

### Example: groundwater sampling

- Groundwater wells
- Sampling with groundwater pumps
- Sampling with bailers: mineral oil, BTEX, (PAH); or vertical profiles
- Pumping tests (4 h to 1 week):  
geometry of plume; determination of  
substance loads  
(see **figure**)





## Tier 2 – Risk Assessment (7)

### Field investigations – Quality Management

- Standards for
  - Design of investigations
  - Investigation methods (e.g. drilling, sampling, analyses)
- Contractor's SOP for non-standardized methods
- Control: Provincial Governments & Environment Agency
  - Site inspections
  - Control-analyses by lab of Umweltbundesamt
  - (Laboratory inspections)

## Tier 2 – Risk Assessment (8)

### Main objectives of risk assessment

- Assessment of the mid to long-term behavior of pollutants and possible impacts
- Toxicological assessment of chronic risks
  - exposure assessment for a defined receptor
  - toxicity assessment for the pollutant

Responsible: Environment Agency

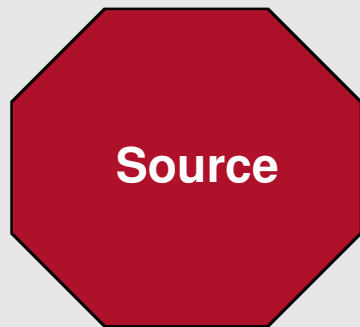
### **WATCH OUT!**

**ACUTE HAZARDS → EMERGENCY MEASURES!**

Responsible: Provincial Governments

## Tier 2 – Risk Assessment (9)

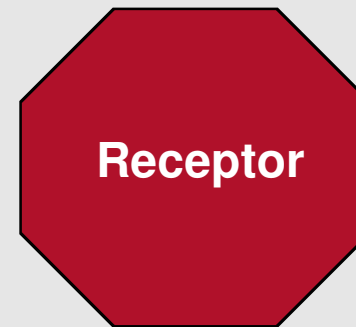
### Principles of Risk Assessment



**X**



**X**



- contamination type and extent

- unsaturated zone
- Groundwater (plume)

- water, soil, air
- plants, animals, humans
- ecosystem

## Tier 2 – Prioritisation (10)

### Source (Scoring procedure)

- ***Contaminant Properties***
  - Non-hazardous (e.g. D&C waste)
  - Less hazardous (e.g. MSW)
  - Hazardous (e.g. Heavy metals, volatile CHC)
  - Very hazardous (e.g. As, Pb, benzene, PCE)
- ***Extent of contaminated area*** [m<sup>3</sup>]  
(according to hazard)

## Tier 2 – Prioritisation (11)

### Pathway

- Length of plume (local < 10 m to very long > 500 m)
- Downstream mass-flow (load) of contaminant [g/d]

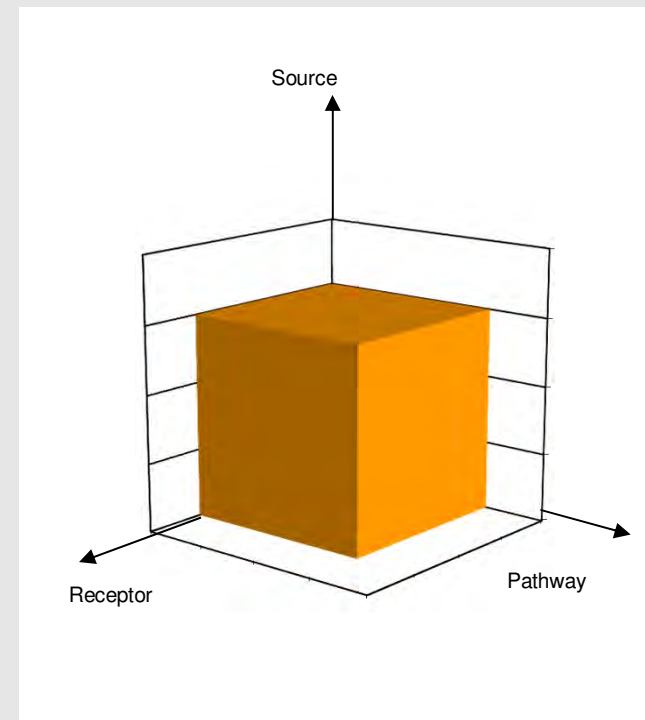
### Receptor – e.g. groundwater

- Groundwater use
  - drinking water supply > or < 50 people
  - e.g. irrigation
  - no use
- Resource management
  - Quantitative and qualitative groundwater conditions
- Ecological relevance (surface water interaction)

## Tier 2 – Prioritisation (12)

### ➔ Scoring regarding specific receptor

- i. Source: 1 to 4 points
- ii. Pathway: 1 to 4 points
- iii. Receptor: 1 to 4 points
- SUM: 3 to 12 points**



## Tier 2 – Prioritisation (13)

### → Any “seriously” contaminated site

- Relevant receptors (groundwater, surface water, soil and/or air) have to be determined
- Assessment regarding relevant receptor(s)
- highest rating (“most endangered” receptor)
  - **Priority classification**
- **Classification** → extent of public funding depends on the classification

## Tier 3 – Remediation (1) Funding

*Extent of the grants depending on*

- *assigned priority class (1, 2 or 3) of a site &*
- *the applicant:*

### **Competitive sector (private enterprises):**

- ⊗ 'non-liable' polluters: 65% - 95% of eligible costs
- ⊗ 'liable polluter': 55% - 65% but max. 100.000 EURO ("de-minimis")

### **Non competitive sector (municipalities etc):**

- ⊗ 'non-liable' polluters: 65% - 95% of eligible costs
- ⊗ 'liable polluter': 55% - 65%



## Tier 3 – Remediation (2)

### ***RESPONSIBILITIES***

Public Fund: Ministry of Environment

Finances: Kommunalkredit AG

Permits, Control, Decommissioning:  
Provincial Government

Supervision and Final “Declassification”:  
Environment Agency

## Tier 3 – Remediation (3)

### Remediation objectives (targets) and selection of technology

depend on:

Technical, environmental and economic feasibility

- Target is “environmentally sound”
- Technology to meet target is available
- Costs can be covered
- consensus/commitment by stakeholders (society) on targets and costs is necessary
- There is NO technology for every purpose

## Tier 3 – Remediation (4)

### **Remediation objectives (targets) and selection of technology**

Proposals: Site Owner

Responsibility (Permitting): Provincial government

Advice (Funding): Environment Agency

## Tier 4 - Aftercare

- Monitoring
- Maintenance:
  - either use-restrictions and/or
  - re-use of sites considering necessary measures to prevent uncontrolled contaminant releases

General Advice: Environment Agency

Responsibility: Provincial Government

## Contact & Information

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