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Green Economy in Eastern Partner Countries

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Assessment of environmental damage to land

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Preliminary Conceptual Site Model (CSM)

- What are the primary sources of contamination
- What are the active transport processes (eg. Atmospheric dispersion, leaching into the groundwater, dispersion in groundwater etc ...)
- What are the targets of contamination

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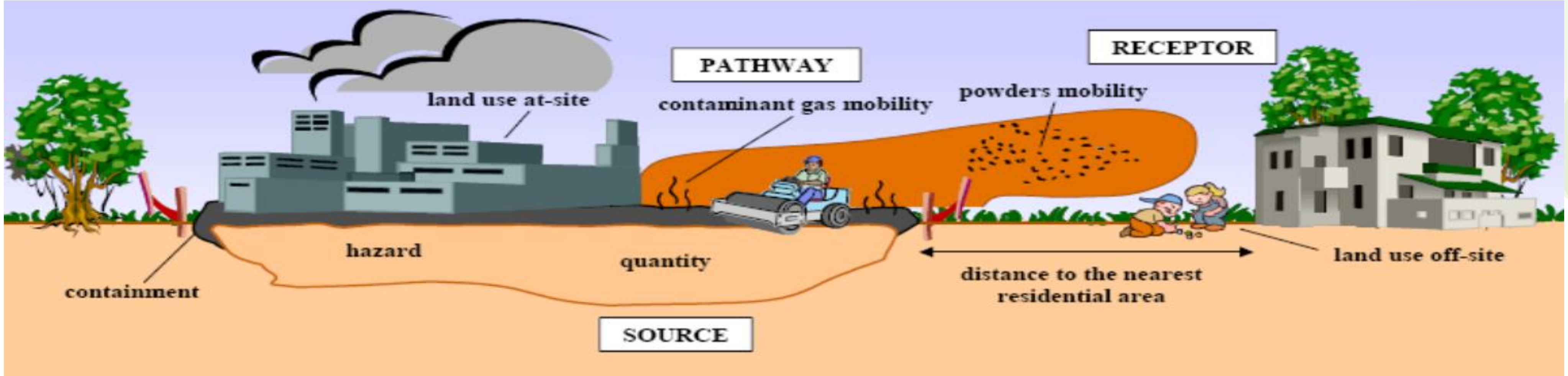
What and where to look: what parameters, matrices to be investigated, sampling strategy

Conceptual Site Model



Source: Towards an EEA Europe-wide assessment of areas under risk for soil contamination - Volume III - PRA.MS: scoring model and algorithm, EEA Report, April 2005

Detailed reconstruction of the subsurface geologic setting and groundwater circulation (geologic and hydrogeologic model) is essential for a proper **understanding of contamination dynamics, risk assessment, and remediation design**. The conformation of the subsurface (in terms of stratigraphy, i.e., sediment composition and ratio geometry) determines the patterns of subsurface water flow and, more generally, the patterns of migration of contaminants, both in the soil and water matrix

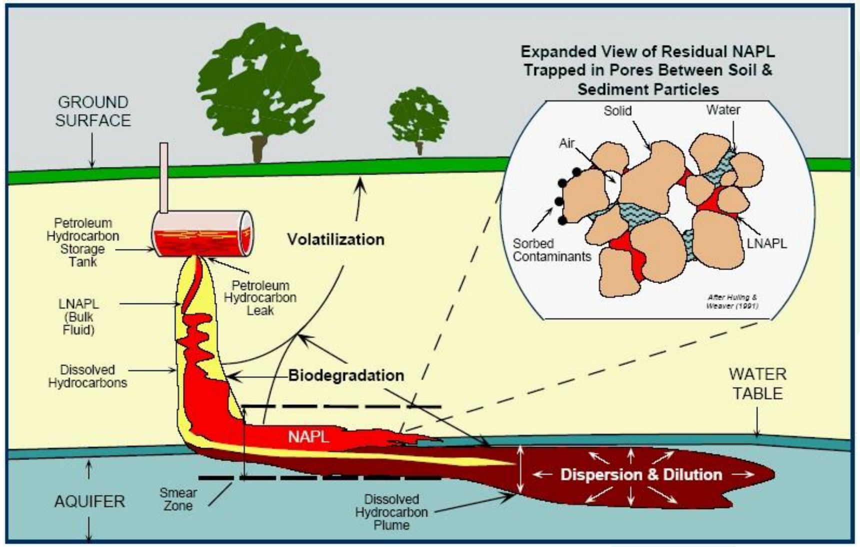
Non Acqueous Phase Liquid

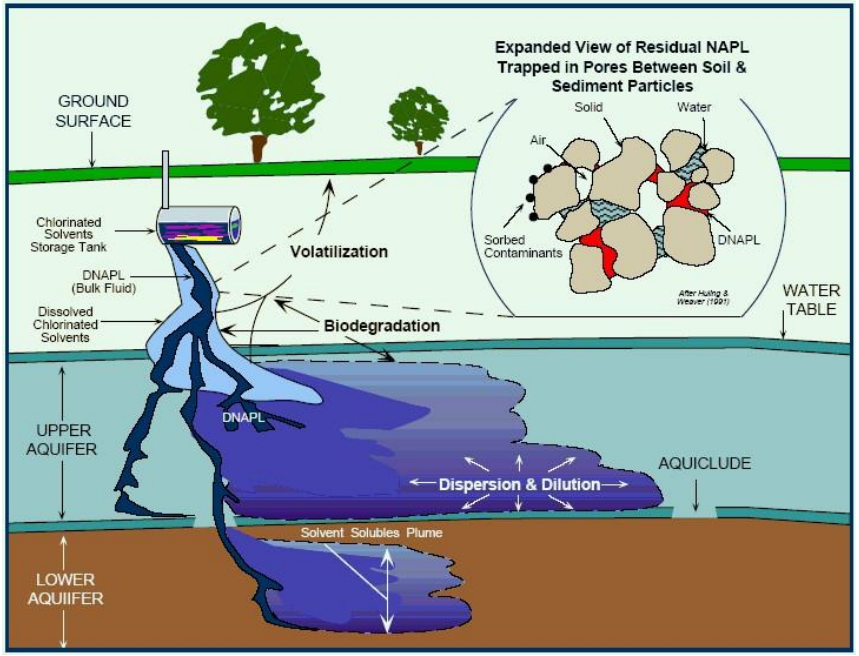
LNAPL = NAPL with density lower than that of water.

- Gasoline, diesel, aviation fuels, lubricants, petroleum, etc.
- Multicomponent Mixtures

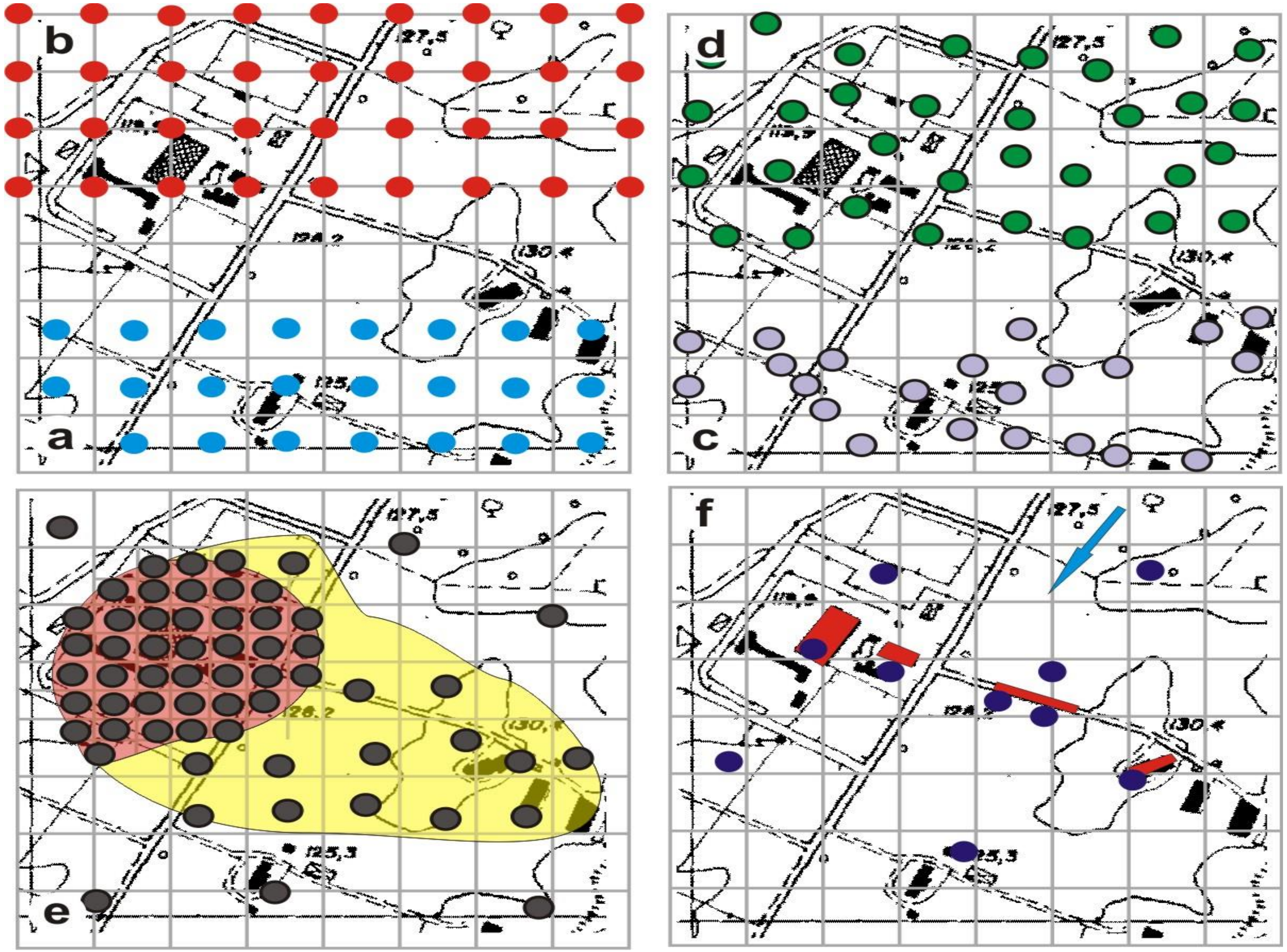
DNAPL = NAPL with a density greater than that water

- Chlorinated solvents (PCE, TCE, TCA, etc.), creosote-based wood preservative oils, coal tar (tars), etc.
- Single-component mixtures or otherwise less complex than LNAPLs





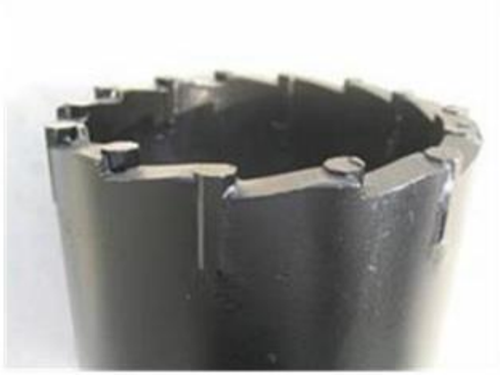
Soil - Sampling strategy



a & b) Systematic grid
c) Random
d) Systematic- Random
e) Layered (mixed)
f) Judgmental

Core sampler

Drilling is performed by means of a rotary drill, with diameters normally between 60 and 150 mm, so as to minimise disturbance of the materials being drilled and to allow **representative samples (cores)** to be taken. The walls of the borehole will be supported, as required, by circulating fluids (water, mud), by linings, or by cementing the borehole itself; the choice of the type of support depends on the soil characteristics.



Core sampler

The samples extracted are then placed in special **sampling boxes** for their preservation, where the borehole number and reference depths will be indelibly marked. During the survey the **stratigraphy** of the ground will be recorded; this will include all the elements relative to the sampling and in situ tests and a **description of the individual layers**, as well as any notes by the operator relative to circulation losses, column reflow, the percentage of core obtained, etc.

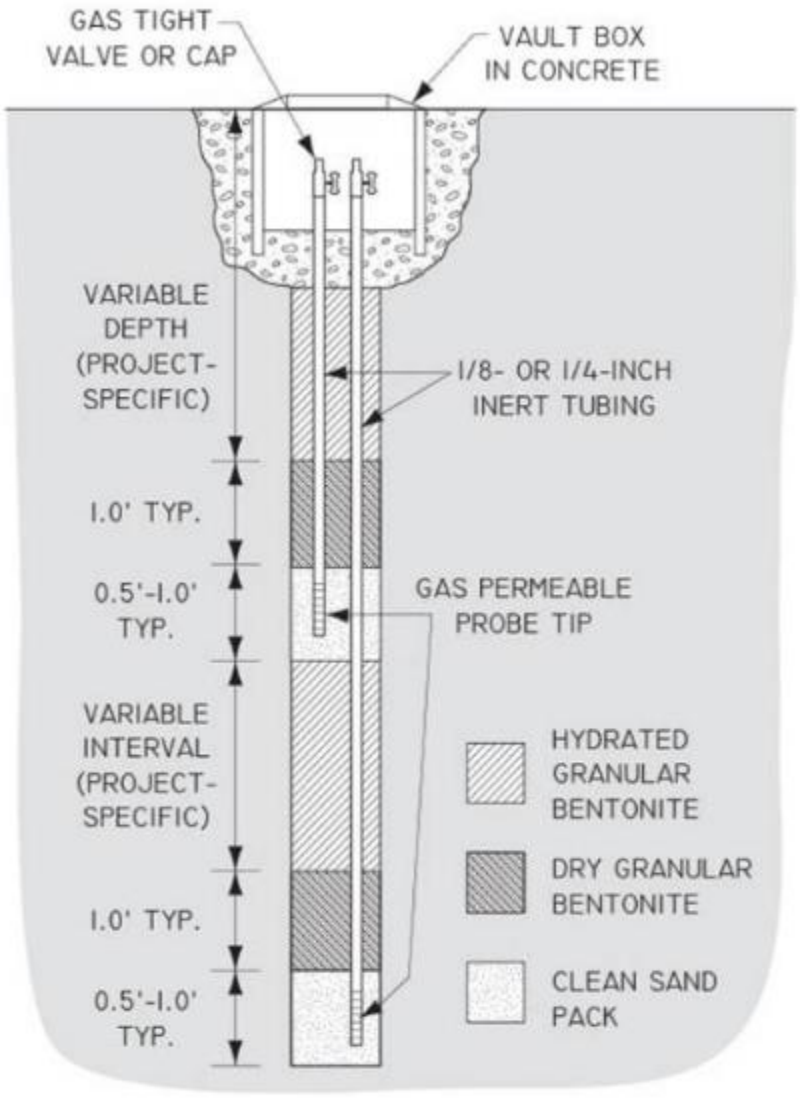
Lines of evidence (1) – Soil Gas Survey

Strengths

- There is already a good technical expertise;
- It determines the concentration of VOCs;
- It may allow a mapping of the vertical profiles of VOCs in the soil (assesses C gradients and possible biodegradation);
- It quantifies the possible accumulation of VOCs in the presence of impermeable horizons.

Weaknesses

- Not suitable for surface and groundwater sampling;
- It requires the implementation of transport models and mixing to quantify ambient air;
- SGS are local measurements that require the location of several probes to assess the spatial variability of the emission phenomenon



Lines of evidence (2) – Flux Chamber

Strengths

- They allow the monitoring of the VOC source migration
- usable for surface contamination sources;
- the accumulation chamber identifies significant flow points.

Weaknesses

- A technique that is not well established in land reclamation;
- Sometimes insufficiently tested chambers are used;
- It does not distinguish the contribution of different contaminated matrices;
- Unrepresentative, to date, for monitoring on paved surfaces due to the difficulty of determining areas of real emission flux;

Lines of evidence (3) – Ambient air

Strengths

- Less difficult to operate than other techniques;
- The results can be used directly without the aid of models;
- Sampling can be of long duration (days, weeks).

Weaknesses

- Influenced by the presence of <u>environmental background</u> and sources
- punctual (e.g. active industrial areas);
- the contribution of the various matrices cannot be distinguished;

Secondary sources of contamination

Surface soil (≤ 1m below ground surface)

Reported materials

Deep Soil (> 1m below ground surface)

Groundwater

Migration pathways

The migration pathways are represented by the mechanisms through which the contaminant is transferred from source to the environmental compartment where the exposure takes place, Point Of Exposure (POE). In general, the main migration routes are:

- Emission of particulates from contaminated surface soil (outdoor)
- Volatilization from contaminated surface soil (outdoor)
- Volatilization from contaminated deep soil (outdoor)
- Volatilization from contaminated deep soil (indoor)
- Volatilization from contaminated GW (outdoor)
- Volatilization from contaminated GW (indoor)
- Leaching from soil and transport in groundwater

Receptors

Industrial

Workers

Residential

Recreational

Children + Adults

Calculation of RISK and Site Specific Target Levels (CSR)

Concentration Representative to the Source

CRS

FT

Source Dimensions

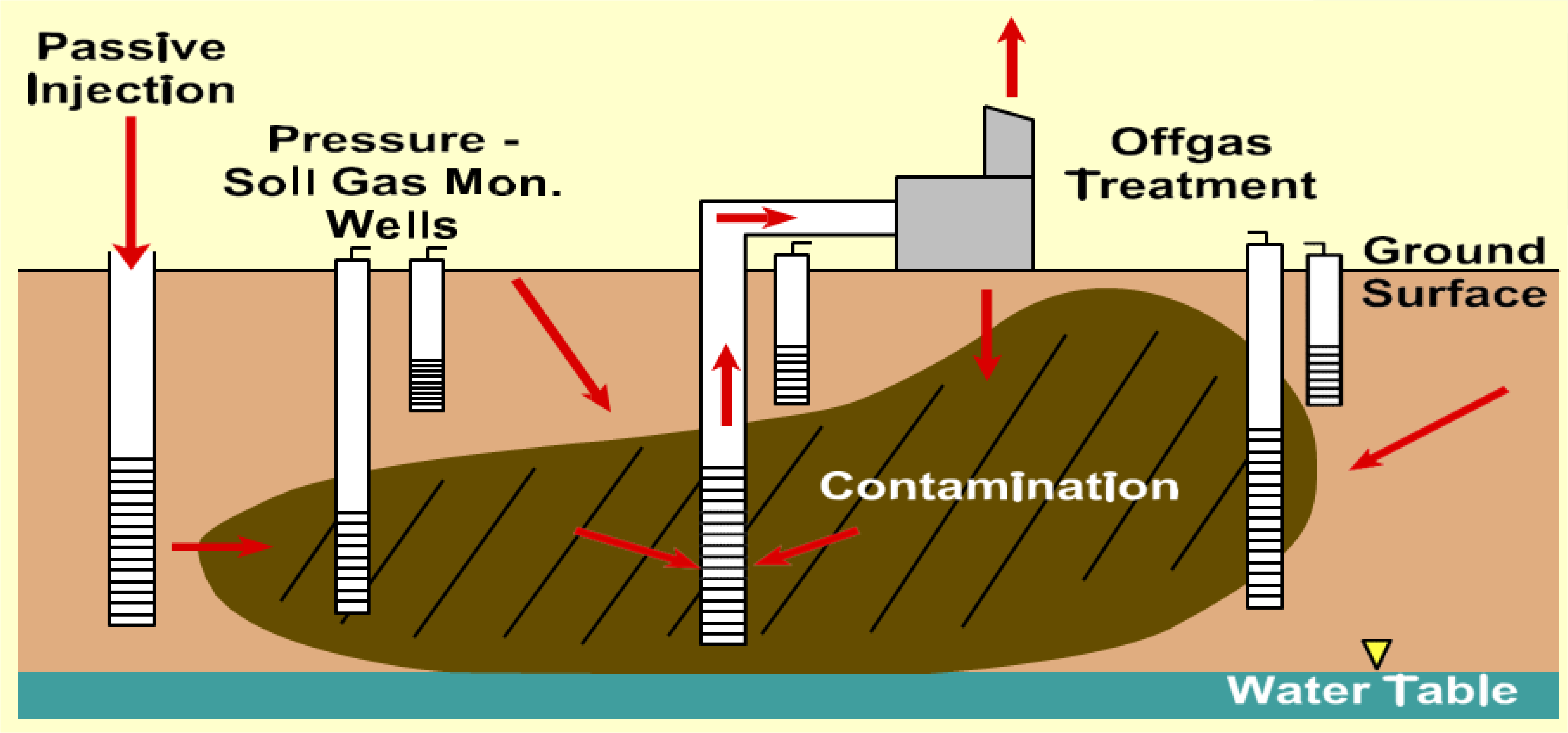
Forward mode - *Risk Calculation R*

$$R = CRS \times FT \times EM \times T$$

Backward mode - *Calculation of Siste specific Target Levels*

$$CSR = \frac{C_{POE-acc}}{FT}$$

Soil Vapor Extraction – Scheme



ISCO

STRONG OXIDIZING

- Hydrogen peroxide
- Fenton Reagent

FEATURES

- Wide range of applicability (considerable number of treatable contaminants compounds);
- High reactivity;
- Poor penetration in the aquifer;
- Safety problems;
- Very low compatibility with a Later stage of biotreatment

SLOW OXIDIZING

- Permanganate
- Persulphates

FEATURES

- Limited applicability range (small number of treatable contaminants compounds);
- Low reactivity;
- Good penetration;
- Ease of management;
- Low compatibility with a later stage of biotreatment

Thanks for your attention!