

Sustainable management of contaminated sites

Presentation 3.3

Phase 3 – Basics of remediation techniques

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Content

Techniques to mitigate / remediate contaminated site components

- Hazardous wastes
- Contaminated building
- Buried waste / hotspots
- Soil and groundwater



Hazardous waste Dispose

Pack, store, transport, handing over, pre-treatment and destruct (co-incineration)



Hazardous waste

Excavation, packing and dispose



Removal litter layer formed on DDT



Handpicking bags with DDT



Excavating soil mixed with DDT

Pit with hazardous waste

Contain and restrict site-use



Figure 2 Closing of open pits and levelling of the terrain



Fencing



Figure 3 Application of HDPE plastic as topcover for the hot-spots

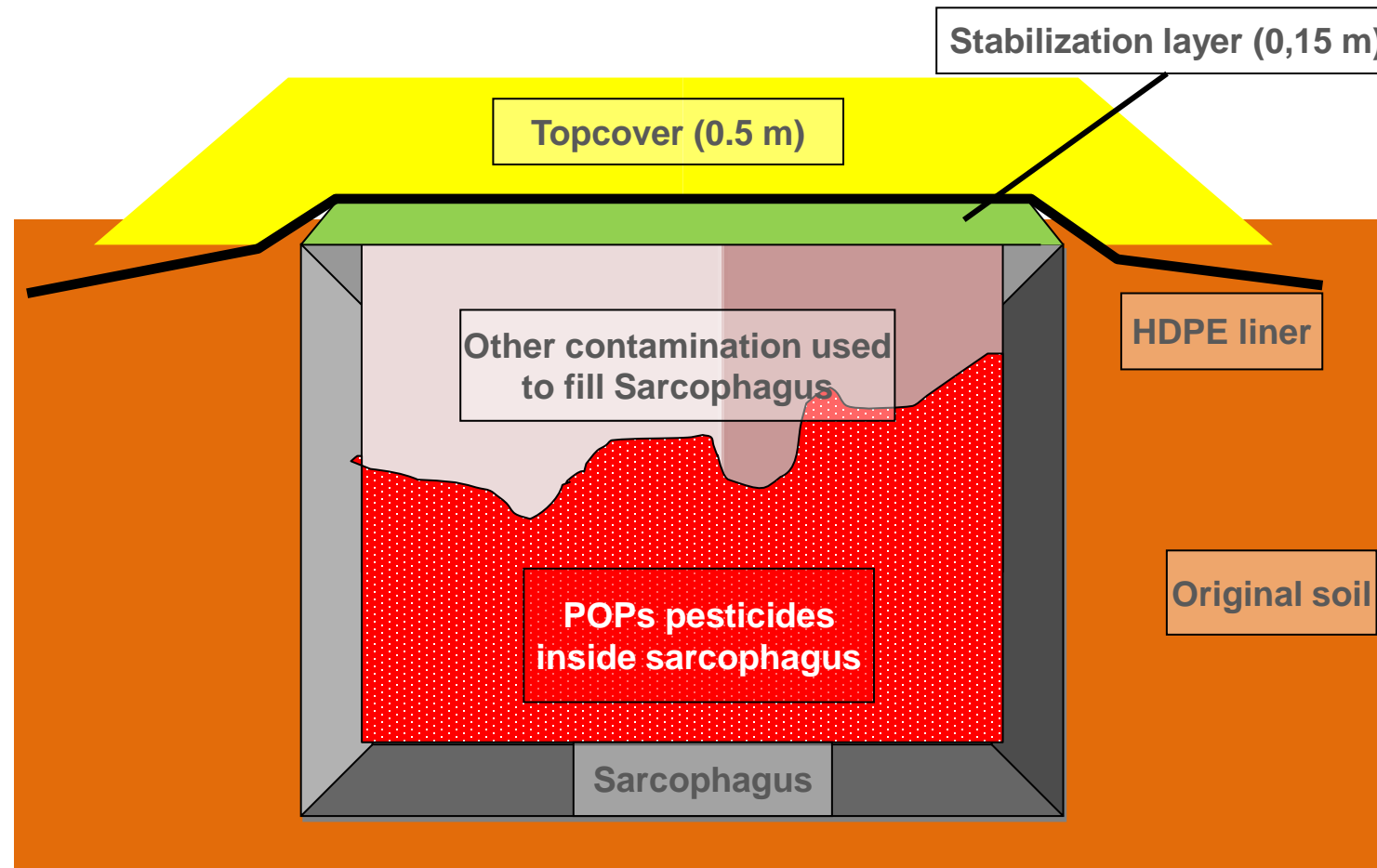


Permanent site guard



Pit with hazardous waste Contain

Containment in Sarcophagi Kyrgyzstan



Pit with hazardous waste

Excavate



Excavation



Sampling



Obtaining clean back fill material



Back filling

Excavated top cover

- Visibly contaminated with hazardous waste treat as hazardous waste
- Not visibly contaminated sample and analyze
 - Clean store for re-use
 - Not clean remediate as contaminated soil

Excavate buried hazardous waste

- If necessary, lower the groundwater table by drainage
- Pre-treat and/or repack excavated hazardous waste
- If pit bottom and walls are visibly contaminated with hazardous waste excavate and treat as hazardous waste
- Not visibly contaminated sample and analyze
 - If clean backfill excavation with clean soil
 - If soil contaminated remediate



Contaminated building Clean

Clean and maintain building

- Clean but dry as possible
- Collect sweepings
- Remove impregnated parts
- Treat sweeping and removed parts as hazardous waste
- Restrict use of building

Clean and demolish

- Decontamination
- Demolition
- Dispose decontaminated rubble to controlled landfill



Contaminated soil & groundwater

Ex-situ / In-situ remediation

EX-SITU TREATMENT TECHNOLOGIES

THERMAL



WASHING



LANDFARMING



OPERATIONAL IN-SITU TECHNOLOGIES

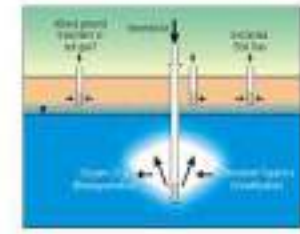
PHYSICAL



BIOLOGICAL



CHEMICAL



Excavate and treat

- Thermal treatment - all soil types
- Washing - preferably coarse textured-sandy soils
- Land-farming - only degradable organic components
- Immobilization - preferably coarse textured-sandy soils
- Containment – need monitoring and aftercare

Install and treat

- Preferably coarse textured - sandy soils
- Biological - only degradable organic components
- Physical and chemical - difficult to control
- In-situ immobilization - need monitoring and aftercare



Contaminated soil & groundwater

Ex-situ land farming

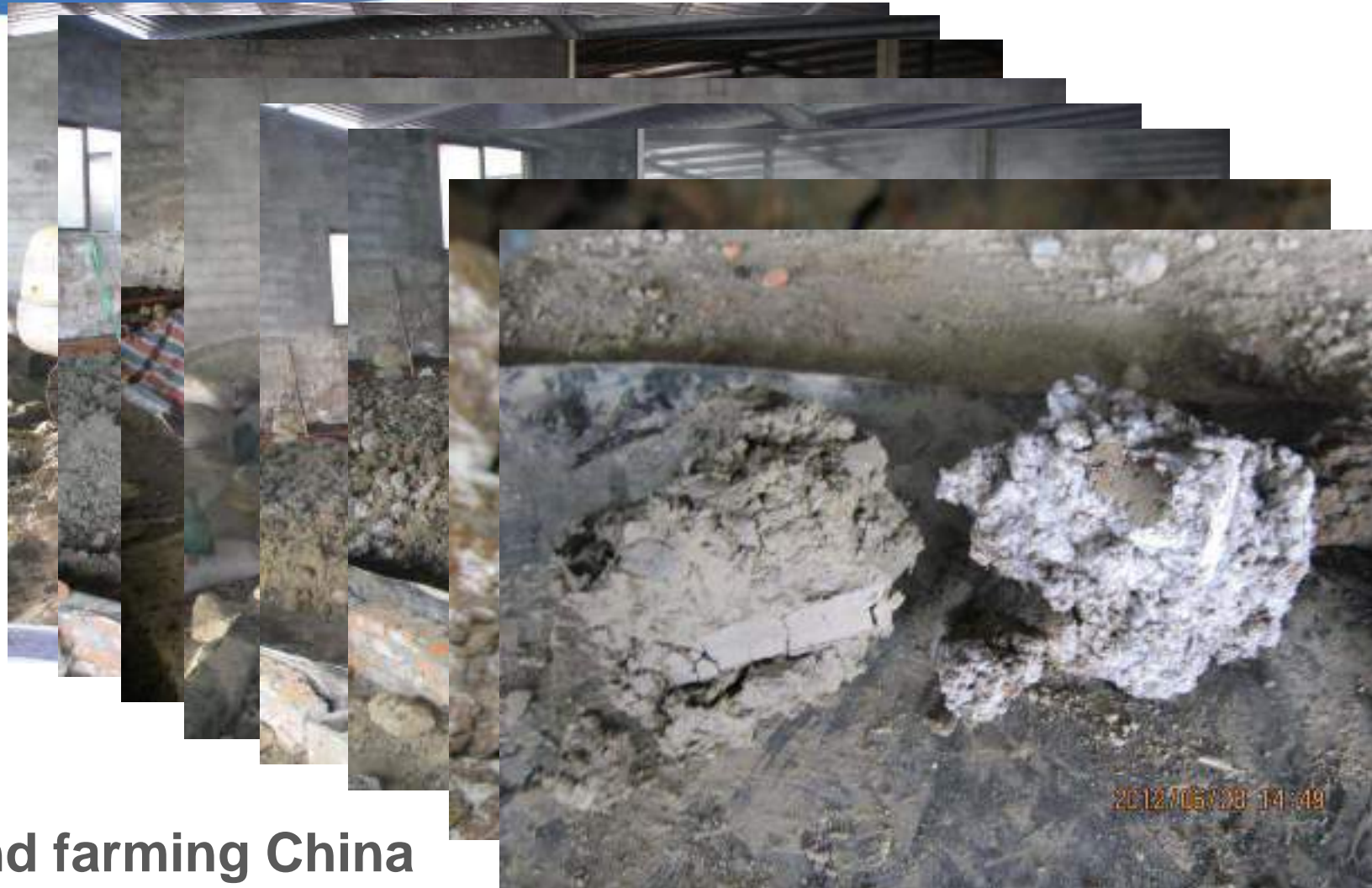
Example of Land farming China

- Five cycles, each 7~10 days
 - ✓ Application of DARAMEND[®]
 - ✓ Irrigation
 - ✓ Measurement parameters
 - ✓ Anaerobic cycle with cover
 - ✓ Aerobic cycle after tilling
- Three composite soil samples were taken before and after each cycle
- Fungus observed on surface and inside



Contaminated soil & groundwater

Ex-situ land farming



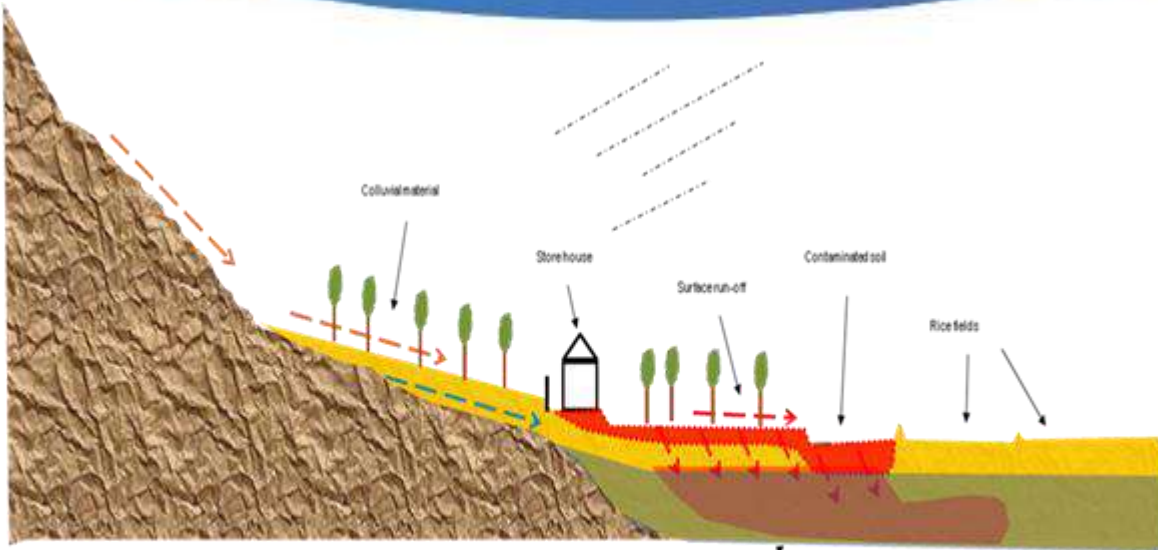
Example of Land farming China



Contaminated soil & groundwater

Example remediation strategy

- Repack waste from store and co-incinerate
- Excavate hotspot and co-incinerate
- Ex-situ land farming > contaminated soil
- Fence site and restrict sites use
- Phyto contain remaining DDT contaminated
- Reduce infiltration of run-off by site drainage
- Install peat barrier contain and enhance bio-degradation DDT contaminated groundwater



Contaminated soil & groundwater

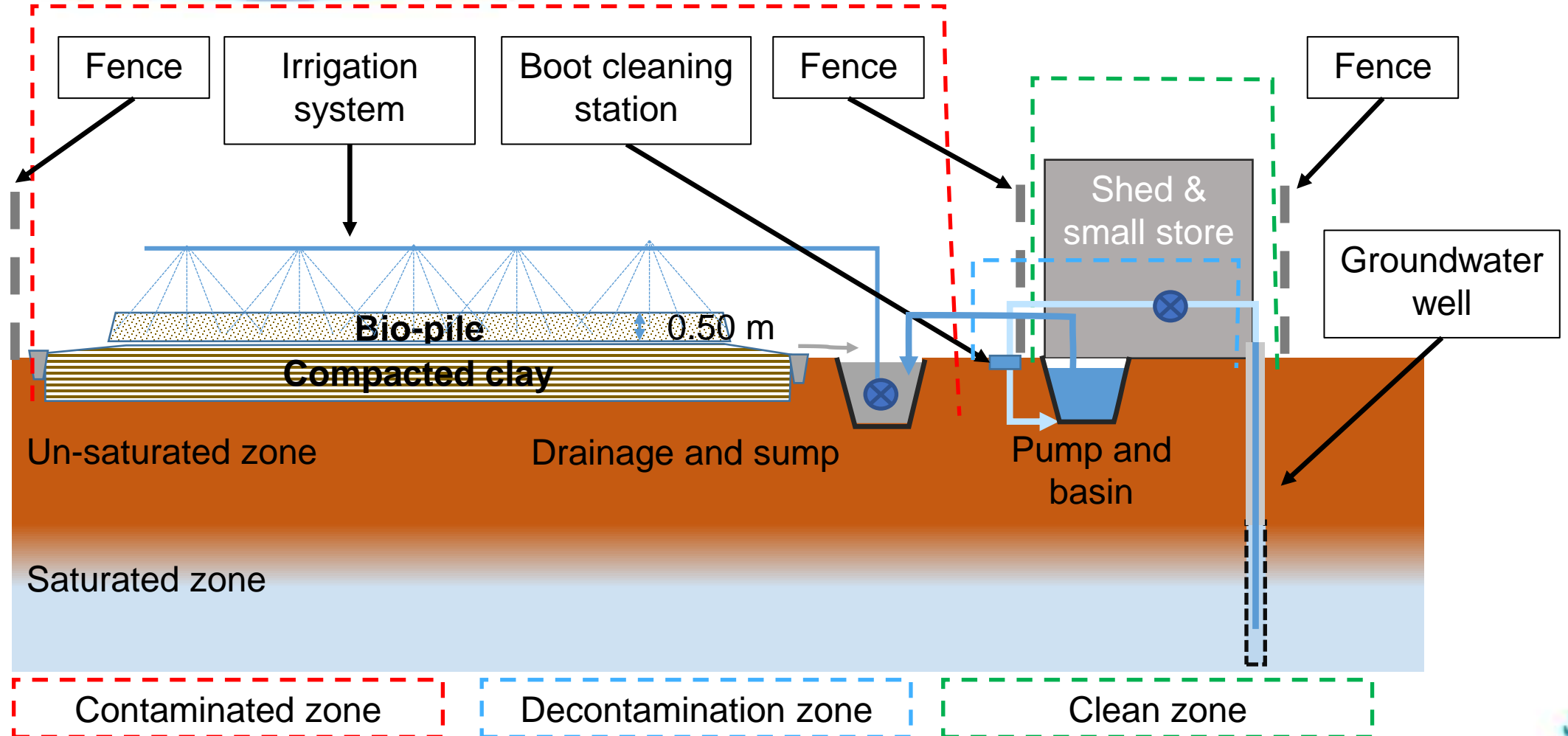
Ex-situ land farming

Example Viet Nam



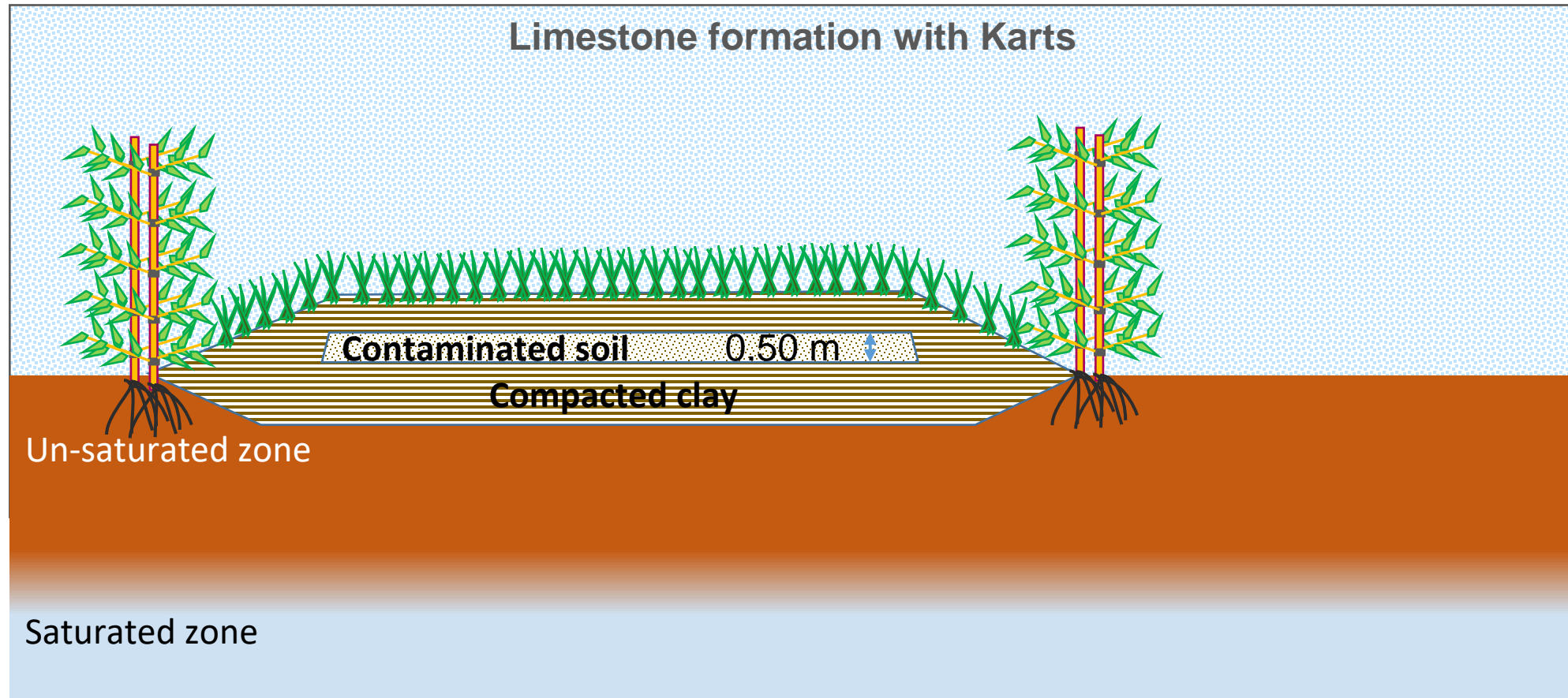
Contaminated soil & groundwater

Ex-situ land farming



Contaminated soil & groundwater

Ex-situ containment



Contaminated soil & groundwater

Ex-situ land Immobilization & Stabilization

- Acid Tar
- Sandy soil
- Within established performance criteria of end-product
 - Leaching heavy metals < National standards
 - Porosity
 - Stability
 - Organic contaminants < reuse standards
 - Strength compression & shear

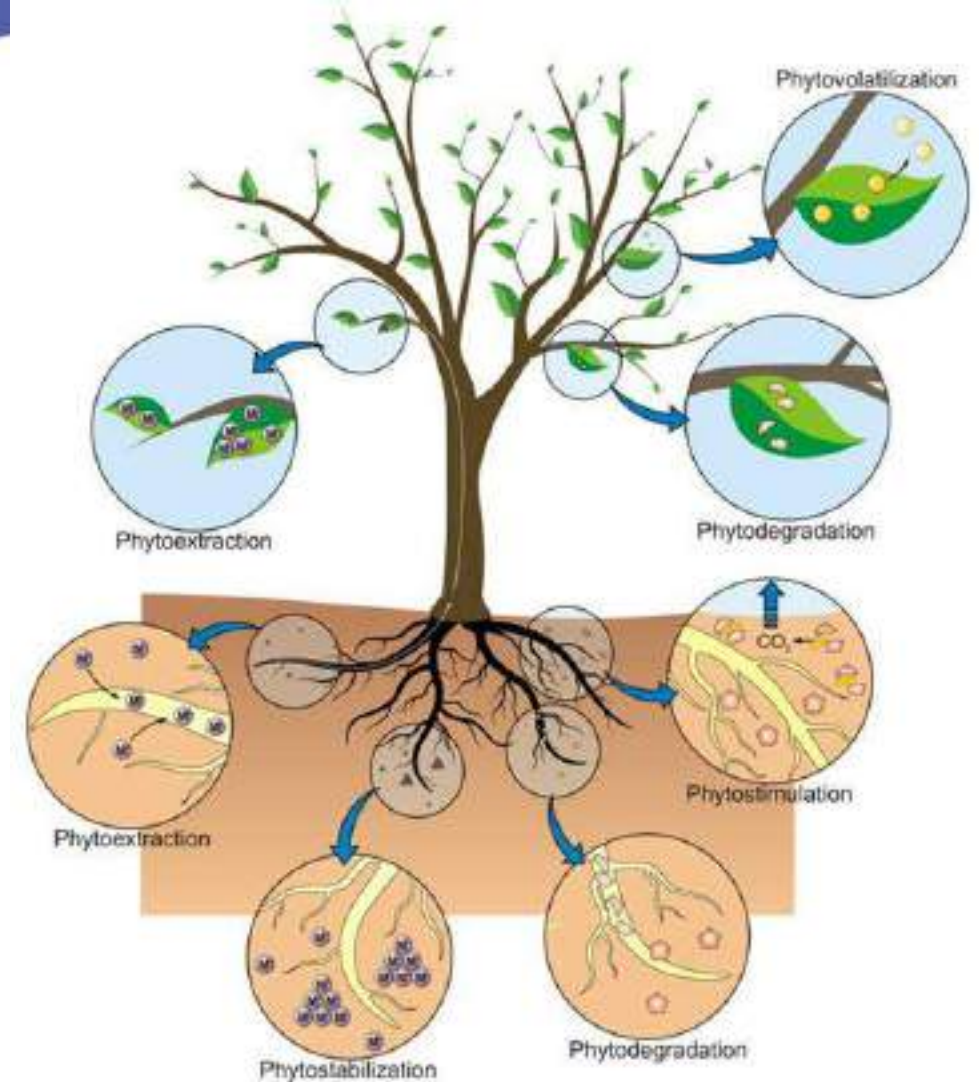


Contaminated soil & groundwater

In-situ phytoremediation

Principles

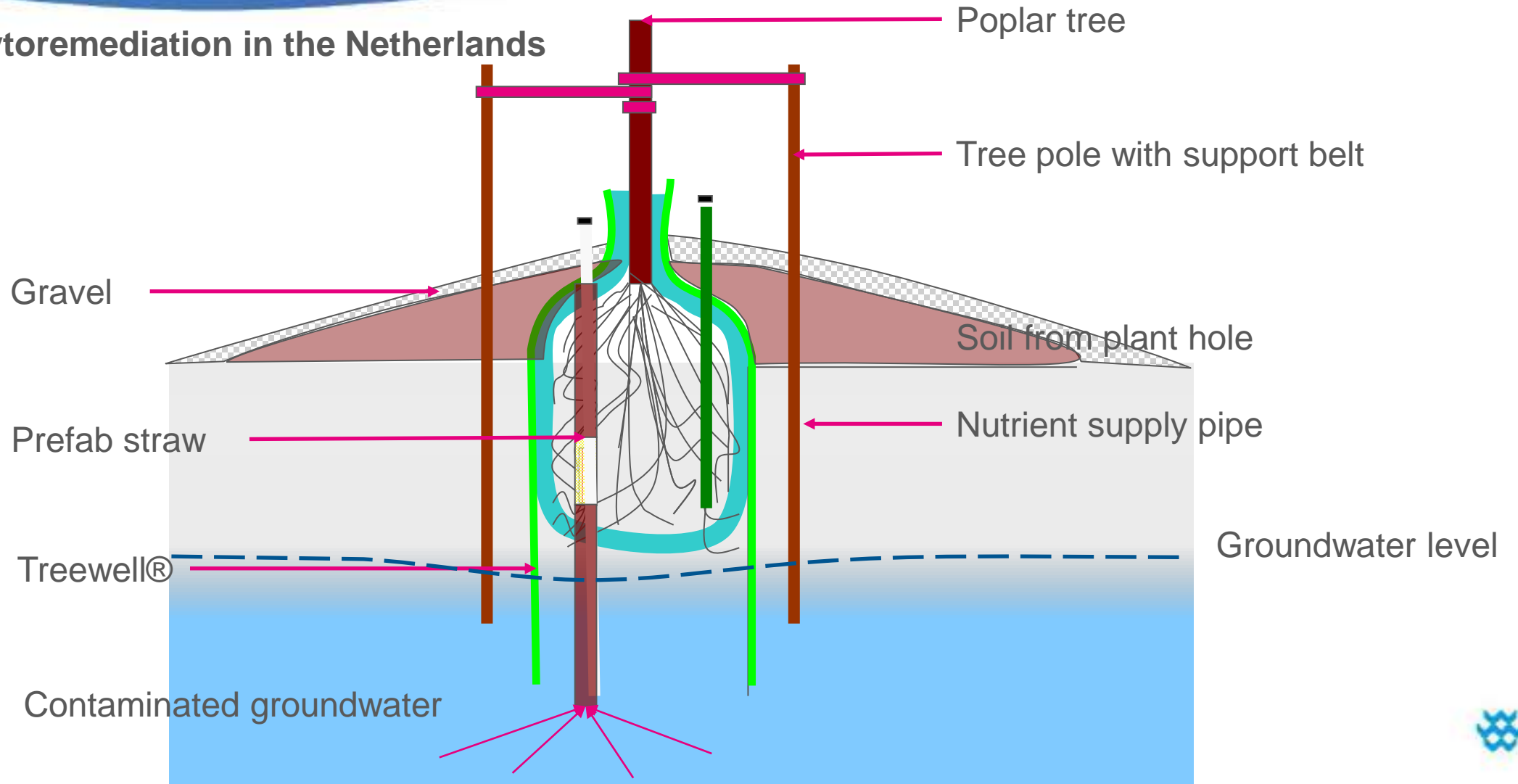
- Hydrological containment
- Erosion control
- Phytodegradation
- Phytoextraction and storage
- Uptake and degradation
- Uptake, emission and Uv degradation



Contaminated soil & groundwater

In-situ phytoremediation

Example of phytoremediation in the Netherlands

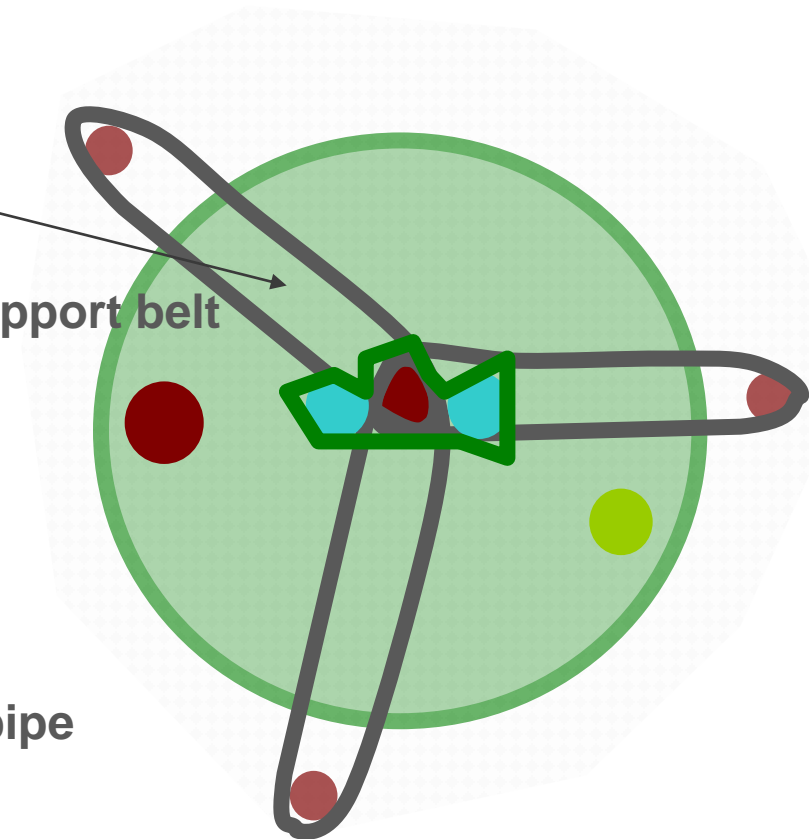


Contaminated soil & groundwater

In-situ phytoremediation

Example of phytoremediation in the Netherlands

- Containment by groundwater use of willows
- Uptake of groundwater with COC Dioxane
- Transport of water in tree to leaves
- Emission by evapotranspiration
- Uv degradation of Dioxane



Contaminated soil & groundwater

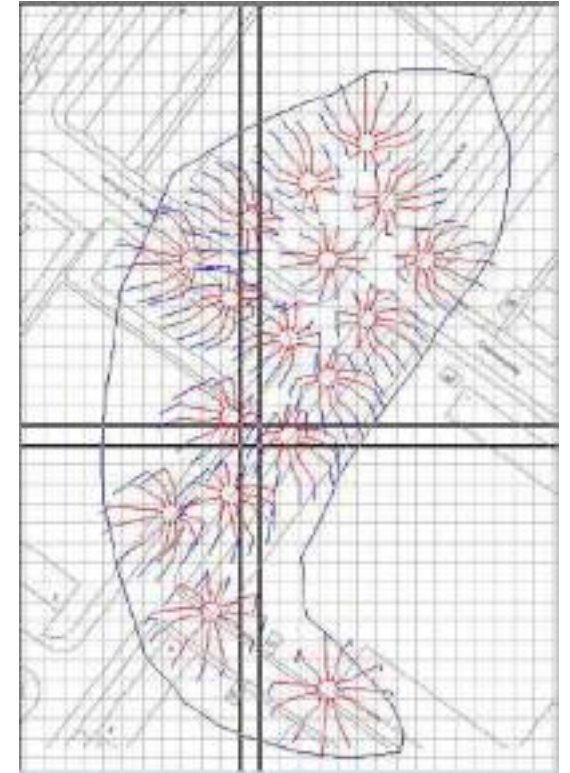
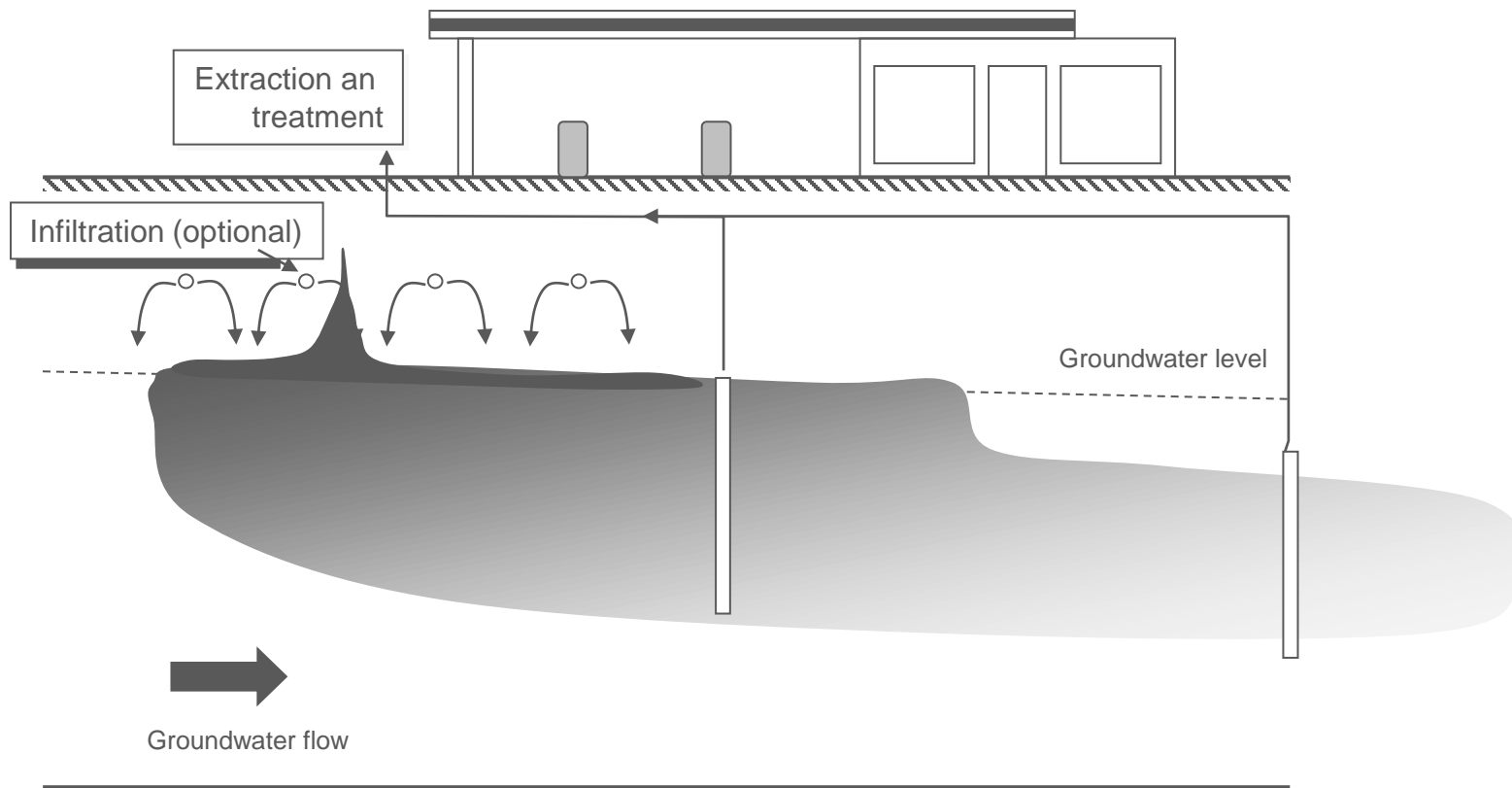
Ex-situ phytoremediation

- Contaminated soil is excavated transported to the remediation site
- Back filled
- Fenced installed – restrict site use
- Run-off drainage – prevent
- Trees and grass planted
- Monitoring and aftercare



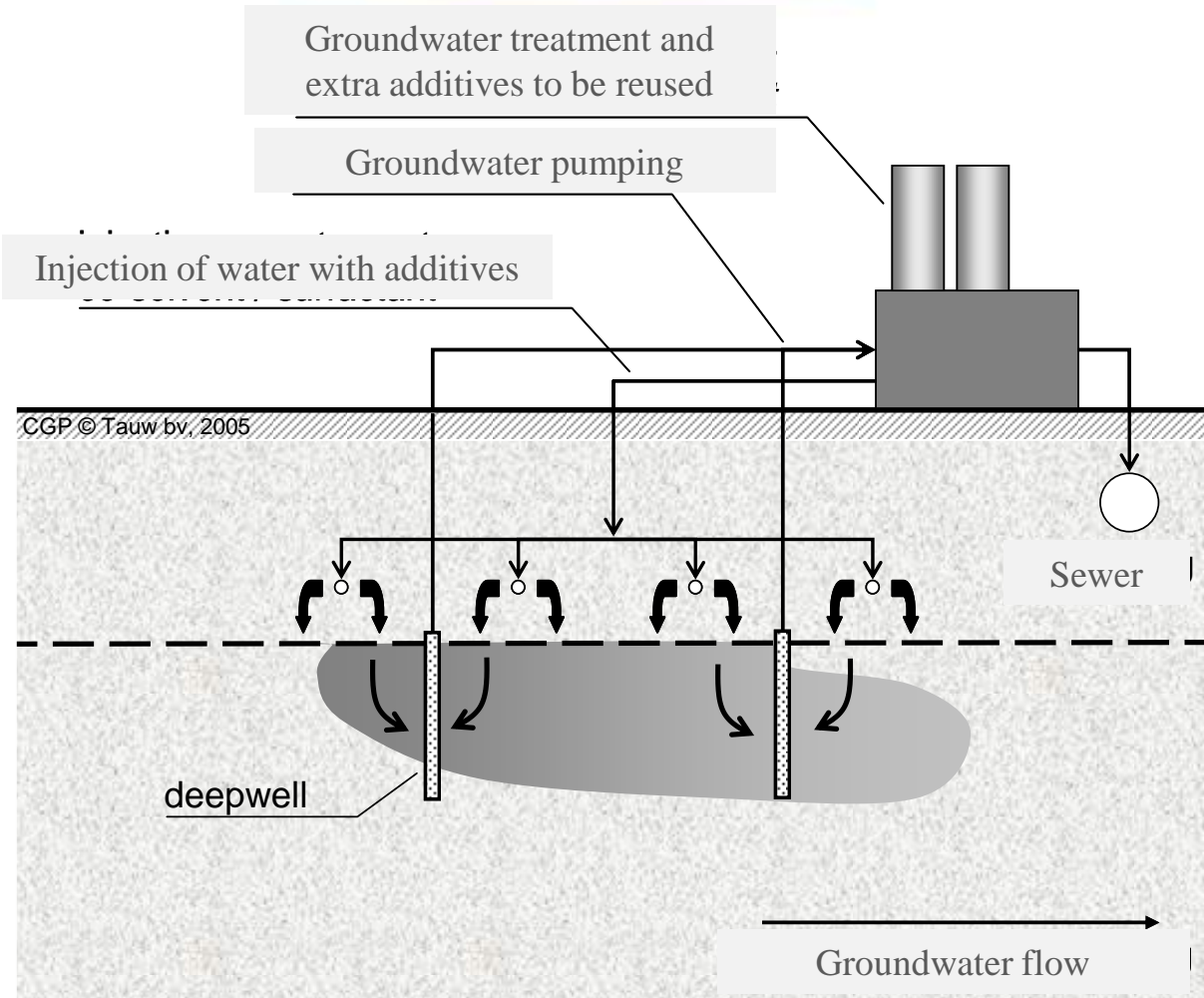
Contaminated groundwater

Pump & treat

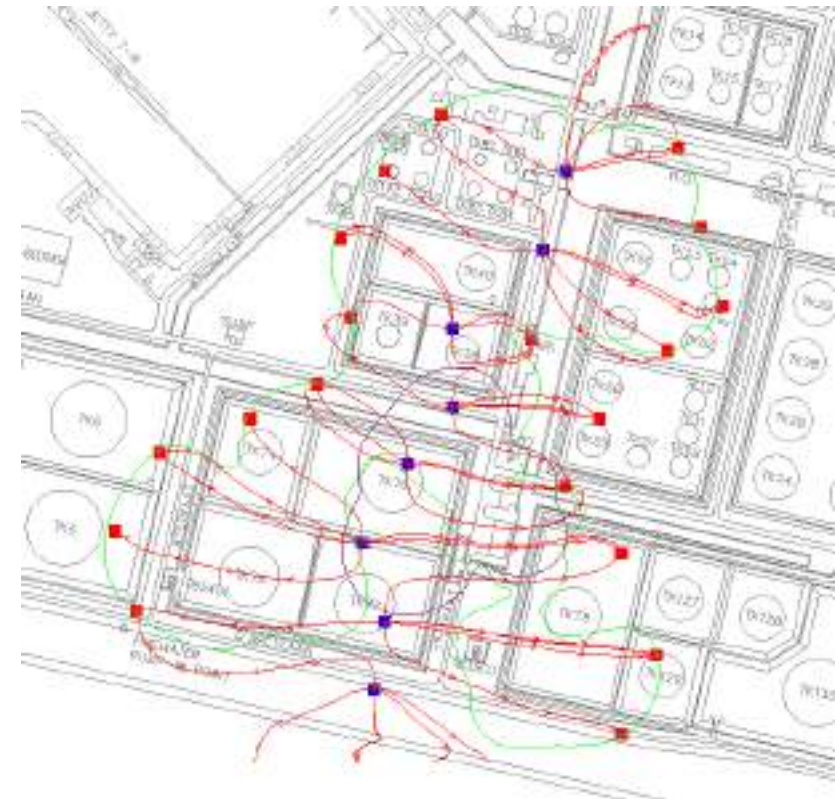


Contaminated soil & groundwater

In-situ rinsing

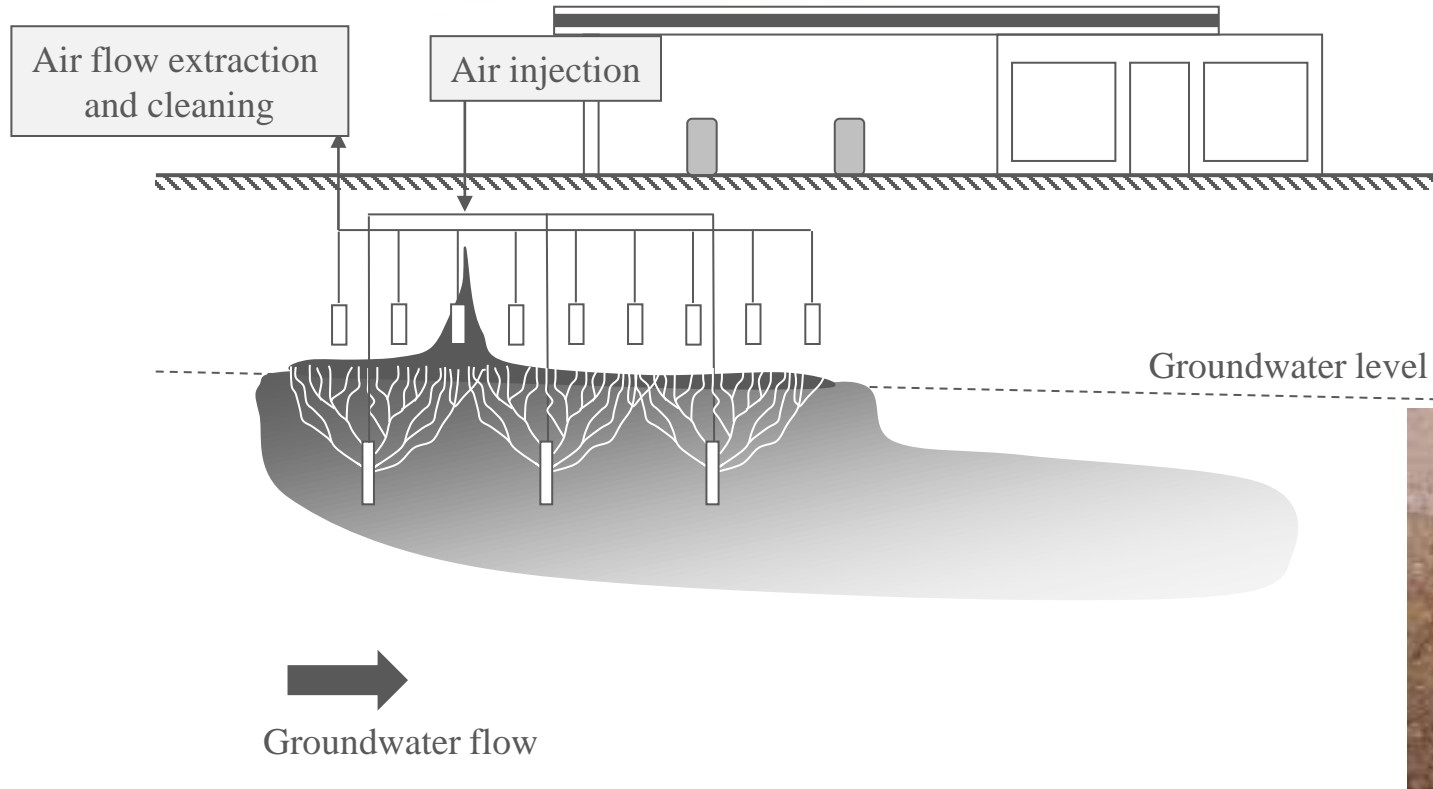


Model of groundwater flow



Contaminated soil & groundwater

Air sparging



Tube system



Operation system

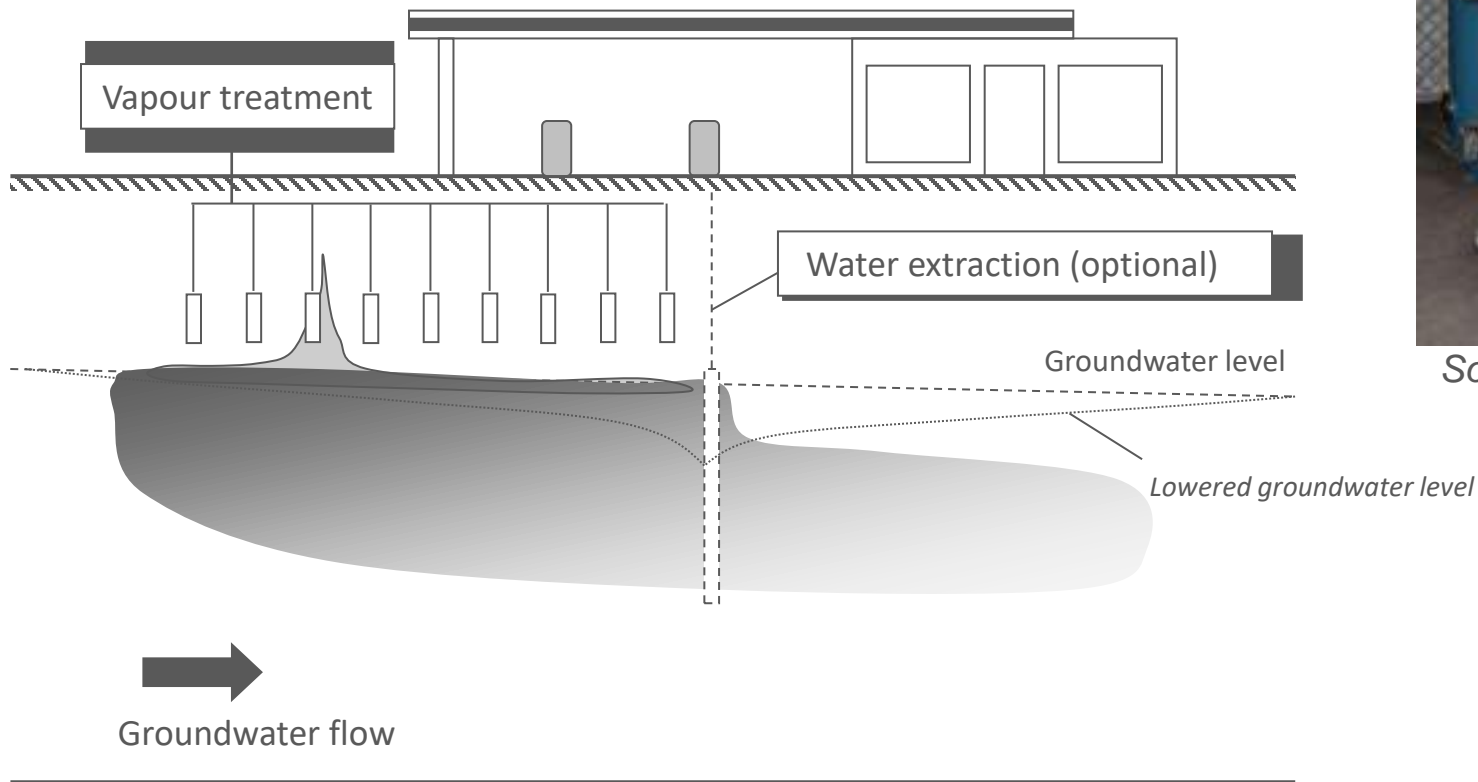


Injection filter



Contaminated soil & groundwater

Soil vapour extraction



Soil vapour extraction system

Catalytic oxidation



Contaminated soil & groundwater

In-situ chemical oxidation (ISCO)

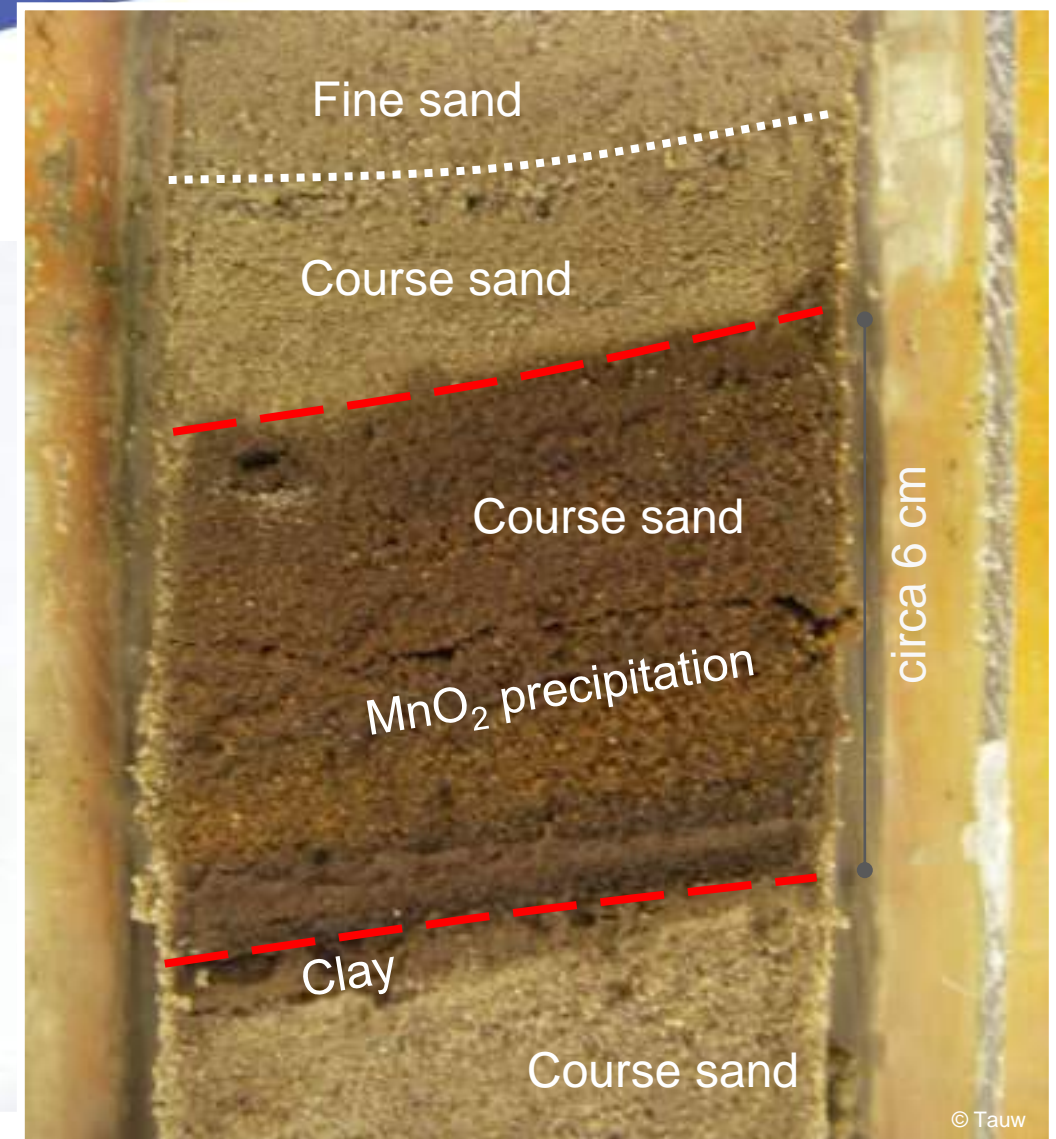
Permanganate application



In-situ chemical oxidation (ISCO)

Permanganate restrictions

To know the soil composition is essential for a successful in-situ remediation!!



Contact

Questions?



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