



European Union Network for the Implementation  
and Enforcement of Environmental Law

# IMPEL Water and Land Remediation



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Katarína Paluchová, Jaroslav Schwarz (SEA)**



Federal Ministry  
Republic of Austria  
Agriculture, Regions  
and Tourism



МИНИСТЕРСТВО НА  
ОКОЛНАТА СРЕДА И ВОДИТЕ



REPUBLIKA HRVATSKA  
Državni inspektorat



MINISTRY OF AGRICULTURE  
RURAL DEVELOPMENT  
AND THE ENVIRONMENT



REPUBLIC OF ESTONIA  
MINISTRY OF THE ENVIRONMENT



Roinn Cumarsáide, Gnómhaithe  
ar son na hAeráide & Comhshaoil  
Department of Communications,  
Climate Action & Environment



National IMPEL Coordinators





Główny Inspektorat  
Ochrony Środowiska

igamaot



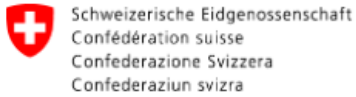
GARDA NAȚIONALĂ DE MEDIU



SLOVENSKÁ  
INŠPEKCIA  
ŽIVOTNÉHO  
PROSTREDIA



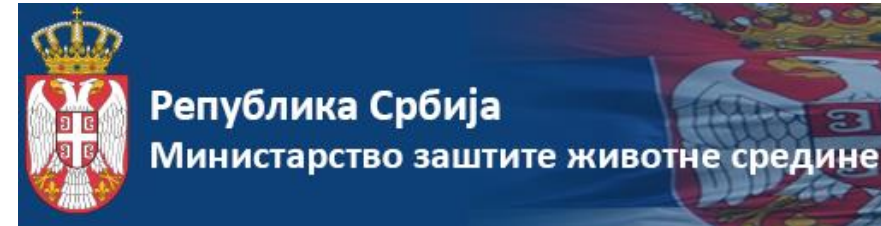
Departamento de  
Planificación Territorial,  
Vivienda y Transportes



Bundesamt für Umwelt BAFU



TÜRKİYE CUMHURİYETİ  
ÇEVRE VE ŞEHİRCİLİK  
BAKANLIĞI



Omgevingsdienst NL



Inspectie Leefomgeving en Transport  
Ministerie van Infrastructuur en Waterstaat

HUIS VAN DE NEDERLANDSE  
PROVINCIES



Rijkswaterstaat  
Ministerie van Infrastructuur en Waterstaat

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Cyfoeth Naturiol Cymru  
Natural Resources Wales



Department of the  
Environment

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Scottish Environment  
Protection Agency  
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Swedish Agency  
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Water Management

NATUR  
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VERKET

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ENVIRONMENTAL  
PROTECTION  
AGENCY



ČESKÁ INSPEKCE  
ŽIVOTNÍHO PROSTŘEDÍ



<https://www.impel.eu>



## What is IMPEL

The European Union Network for the **Implementation and Enforcement of Environmental Law** (IMPEL) is an international non-profit association of the environmental authorities of the European Union Member States, acceding and candidate countries, as well as potential candidates to join the European Community.

The association is registered in Belgium and its legal seat is in Brussels. Currently, IMPEL has 56 members from 36 countries including all EU Member States, North Macedonia, Serbia, Turkey, Iceland, Kosovo, Albania, Switzerland and Norway.

IMPEL was set up in 1992 as an informal Network of European environmental regulators and authorities. In 2008, IMPEL was transformed into an international non-profit association under Belgian law.

## Thematic Areas – Expert Teams

- Water and land
- Cross-cutting tools and approaches
- Nature protection
- Waste and TFS (Transfrontier Shipment of Waste)
- Industry and air



# WLR: WATER AND LAND REMEDIATION



## Why it is needed?

This project aims to speed up the process, focusing on the remediation phase that is often the bottleneck, promoting In Situ and Ex Situ technologies.

## Outcomes

- Support/exchange technical experience required to make progress with the Remediation phase in Europe
- Two technologies and two reports per year, until 2024
- 2021 **IN SITU CHEMICAL OXIDATION AND SOIL VAPOR EXTRACTION**
- 2022 **MULTI PHASE EXTRACTION AND SOIL WASHING**
- 2023 To be agreed – We will discuss



**Project Leader:**  
Marco Falconi, ISPRA, Italy



# WLR: WATER AND LAND REMEDIATION



## Results for 2021

- Final documents on ISCO has been approved by IMPEL General Assembly on 7-8 December 2021 and are now published in IMPEL website, available in many languages
- <https://www.impel.eu/projects/water-and-land-remediation/>

In Situ Chemical Oxidation (ISCO) report (EN)



Έκθεση για την επιτόπια χημική οξείδωση (ETΧΟ), Τελική έκθεση (GR)



Ossidazione chimica in situ (ISCO) report (IT)



In situ chemische oxidatie (ISCO) (NL)



Utlenianie Chemiczne In Situ - raport (PL)



Raport privind Oxidarea Chimică in-situ (ISCO). (RO)



In Situ Kemična Oksidacija (In Situ Chemical Oxidation - ISCO) poročilo (SI)



In situ chemická oxidácia (ISCO), Záverečná správa (SK)



Yerinde Kimyasal Oksidasyon Raporu (TR)



Rapport sur l'oxydation chimique in situ (OCIS) (FR)





# WLR: WATER AND LAND REMEDIATION



## Results for 2021

- Final documents on SVE has been approved by IMPEL General Assembly on 7-8 December 2021 and are now published in IMPEL website, available in many languages
- <https://www.impel.eu/projects/water-and-land-remediation/>


Soil Vapour Extraction (SVE) report (EN) 

Έκθεση για την εξαγωγή ατμών εδάφους. (GR) 

Rapport sur l'extraction des vapeurs du sol (EVS). (FR) 

Estrazione vapori da suolo (SVE) (IT) 

Bodemlucht-Extractie -report (NL) 

Ekstrakcja Par z Gruntu (SVE) - raport (PL) 

Raport privind extracția vaporilor din sol (SVE). (RO) 

Ekstrakcija talnih hlapov (Soil Vapour Extraction - SVE) poročilo (SI) 

Extrakcia pôdneho vzduchu (SVE) (SK) 

Toprak Gazı Ekstraksiyonu (SVE) Raporu (TR) 



# WLR: WATER AND LAND REMEDIATION



New technologies 2022-2023?

<b>Biopile</b>	★
<b>Landfarming</b>	★
<b>Phytoremediation</b>	★ ★
<b>Bioremediation</b>	★ ★ ★
<b>Thermal desorption</b>	★ ★ ★

<b>Air Sparging</b>	★ ★
<b>In situ chemical reduction</b>	★ ★ ★
<b>Bioremediation</b>	★ ★ ★
<b>Permeable Reactive Barriers</b>	★ ★
<b>Groundwater Circulation Wells</b>	★



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## What is the target group?

- Competent authorities for remediation technology approval/application/monitoring, industrial operators, environmental protection agencies, nature protection bodies, environmental inspectorates, environmental monitoring, and research institutions, technical universities, environmental associations, NGOs, insurance companies and associations, environmental consultants.

## Who is the project manager and the authors?

**Marco Falconi** is working as a Technologist at ISPRA (Italian Institute for Environmental Protection and Research) and is the **IMPEL Water and Land expert team leader**. He holds two masters – one in Environmental Science and a second one in Geology.

Marco has international experience with projects with the United Nations in the Balkan countries and in GEO6 assessment. He is one of the EIONET National Reference Center for Soil. In ISPRA he is the coordinator of the “Soil and Land” chapter of the annual Urban Areas Report. He is also the scientific coordinator of Remtech Europe, an annual conference on contaminated sites. He teaches Environmental Assessment at the Polytechnical University of Marche and at the University of Camerino.





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<b>Title of the report:</b> In Situ Chemical Oxidation (ISCO) report	<b>Number report:</b> 2020/09 ISCO
<b>Report adopted at IMPEL General Assembly Meeting:</b> 7-8 December 2021, Ljubljana (Slovenia)	<b>Total number of pages: 277</b>  <b>Report: 54 pages</b> <b>Annexes: 223 pages</b>
<b>Project Managers:</b>	
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Report + 16 CASE STUDIES

<b>Title of the report:</b> Soil Vapor Extraction (SVE) report	<b>Number report:</b> 2020/09 SVE
<b>Report adopted at IMPEL General Assembly Meeting:</b> 7-8 December 2021, Ljubljana (Slovenia)	<b>Total number of pages: 299</b>  <b>Report: 47 pages</b> <b>Annex: 252 pages</b>
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Report + 18 CASE STUDIES



# WLR: WATER AND LAND REMEDIATION



## Dissemination

- IMPEL documents **are not mandatory/legally binding** but nevertheless important references
- Final products will be disseminated by a number of national and regional authorities
- Presentation in conferences is welcomed by all collaborating networks (IT WILL NOT BE EXCLUSIVELY A PRODUCT OF IMPEL). **All authors** from IMPEL, Nicole, CommonForum, EIONET will be entitled to publish it in their website and present the main content of the document at national/international conferences



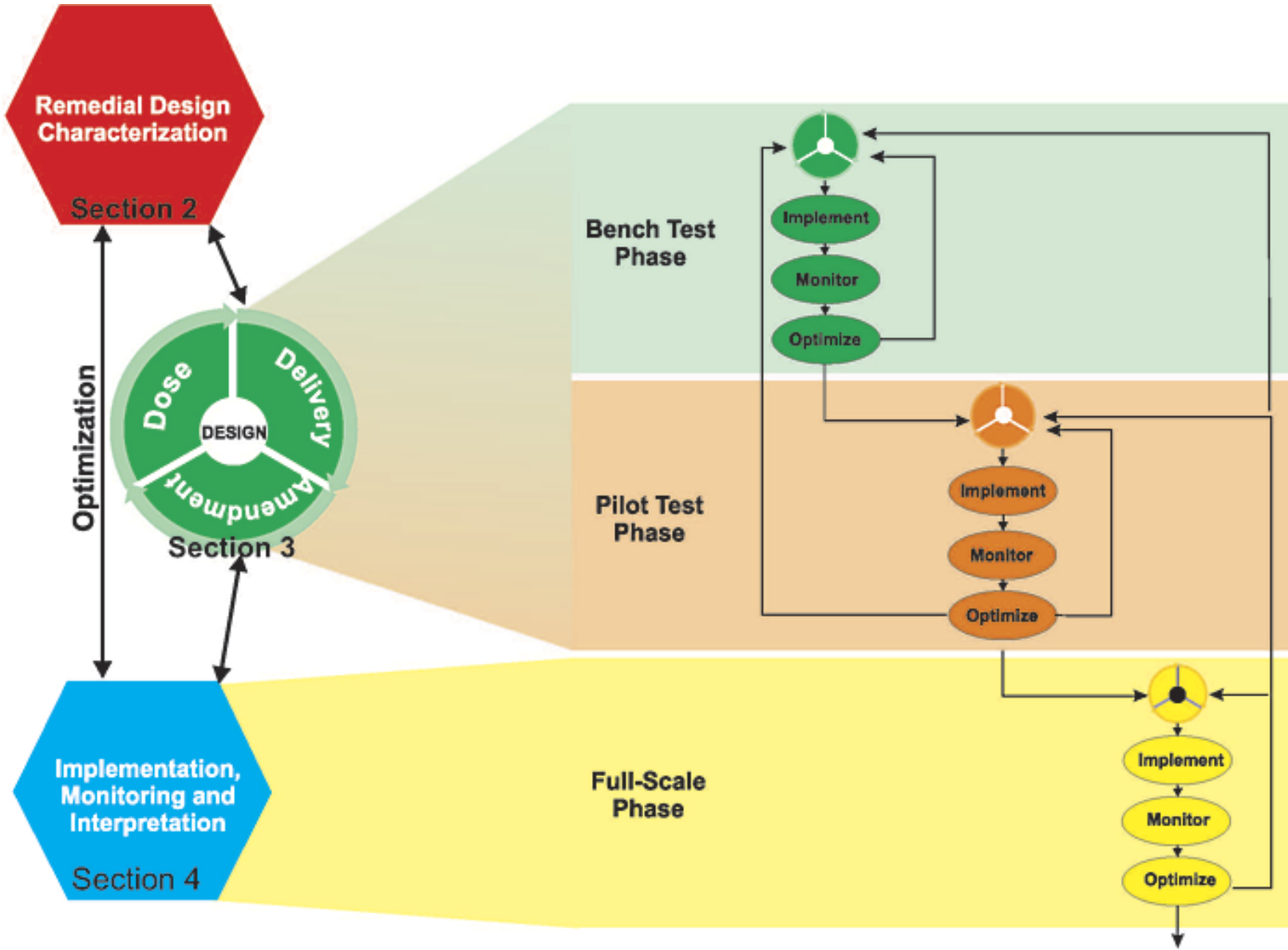
# WLR: WATER AND LAND REMEDIATION



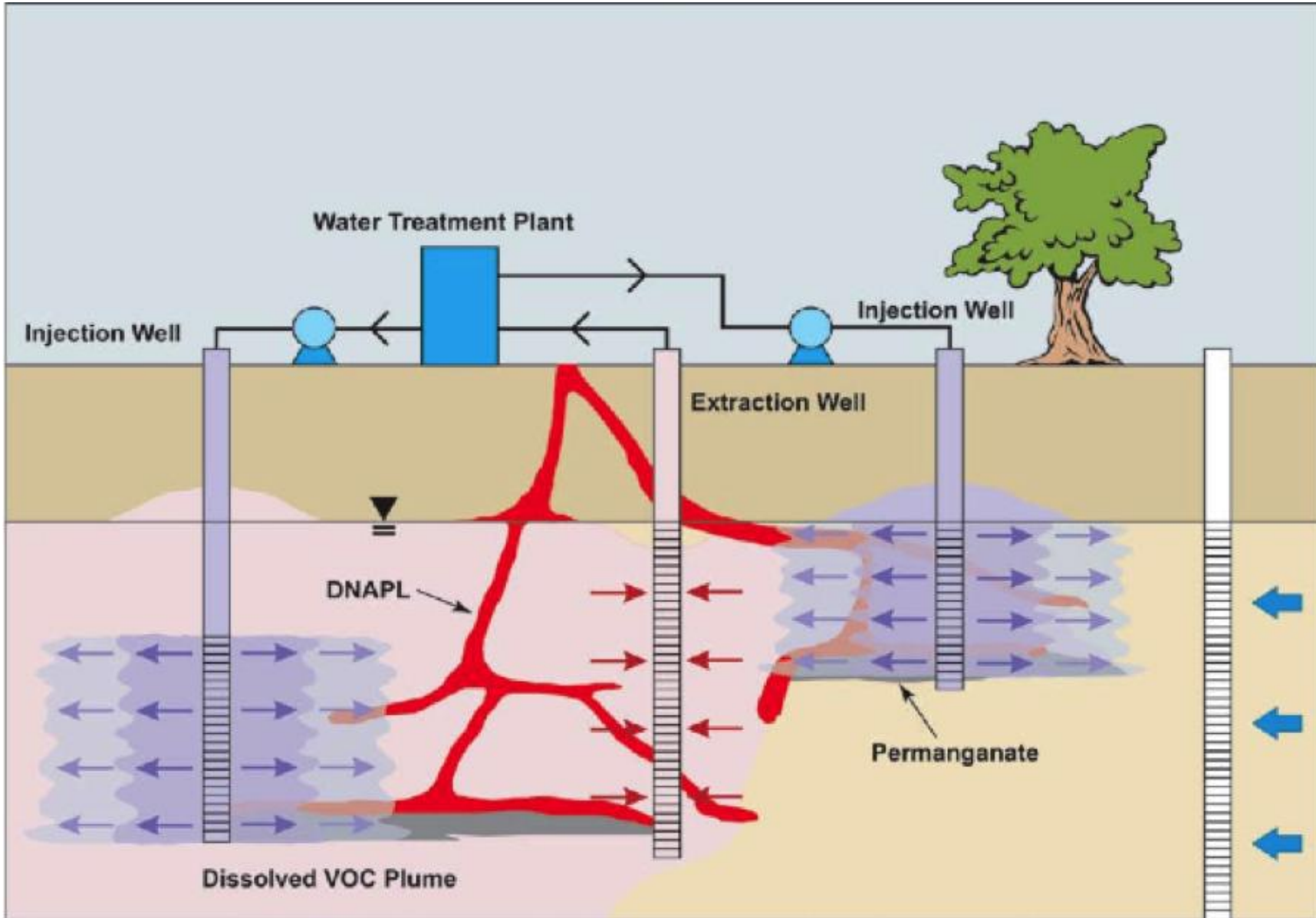
## Dissemination

- IMPEL meeting
- CF/Nicole meeting
- ICCS 2022 (Slovak)
- REMEDy (Poland)
- Other conferences .....
- YES WE MAY GO THERE, but **we need also to go deep in Europe, to Local authorities** (LANGUAGE!!!). NEED for list of local control/decisional authorities

# ISCO – WHAT IS IT



# ISCO – DESCRIPTION





# ISCO – FEASIBILITY STUDY



<b>Nature of contaminant</b>	<b>ISCO Applicable?</b>	<b>Considerations</b>
Mobile NAPL: Continuous NAPL pools	Possible, but challenging	Co-solvent/surfactant or very high oxidant dose required
Residual NAPL: Discontinuous NAPL globules	Yes, but challenging	Co-solvent/surfactant or high oxidant dose
High groundwater concentrations: >10 mg/L	Yes, a good fit	Standard
Low groundwater concentrations: <1 mg/L	Yes, but may not be cost effective	Cost driven by matrix oxidant demand and size of plume



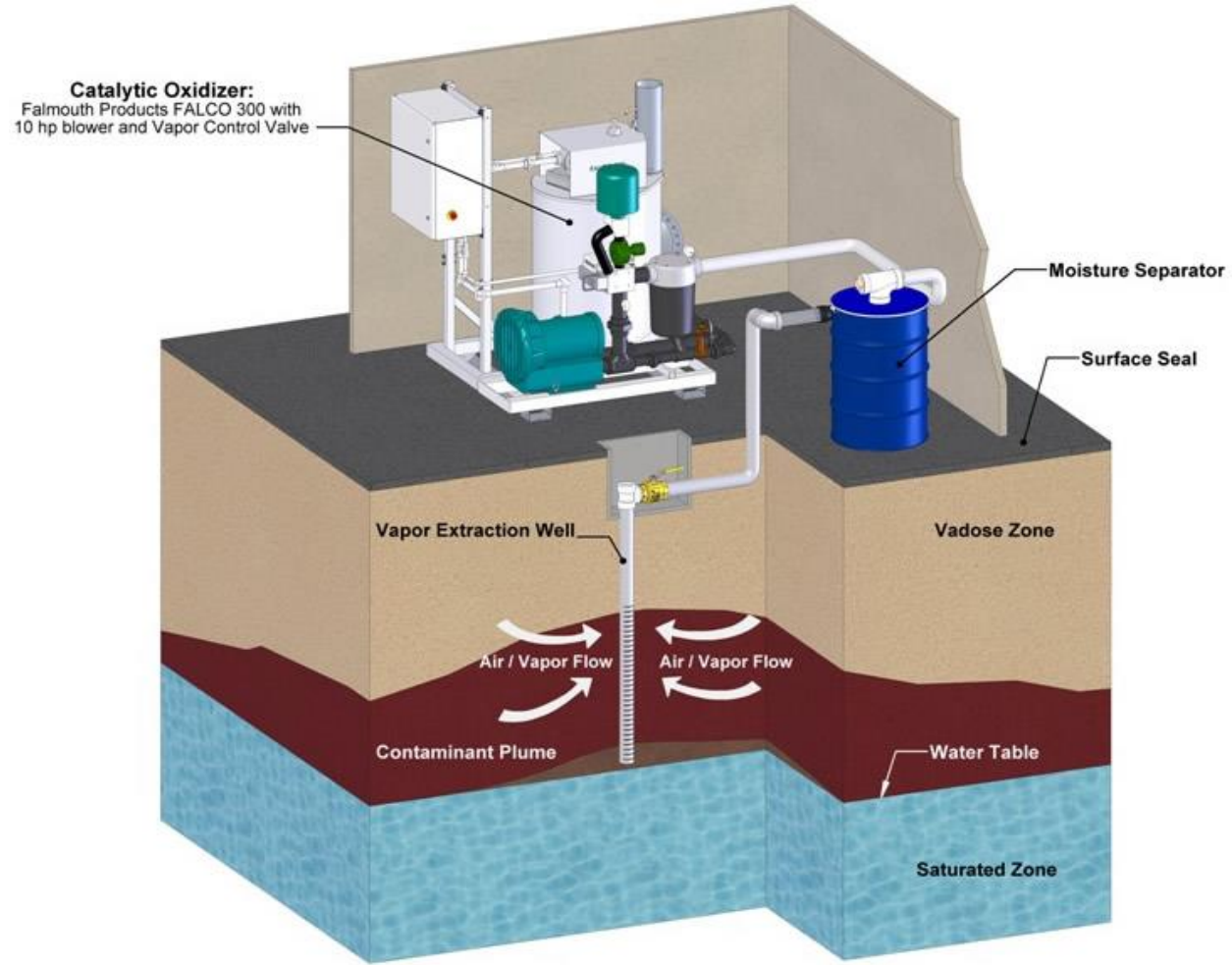
# ISCO – MONITORING



- **Laboratory tests.** The purpose of these tests is to evaluate the efficiency of specific type of reagent on a sample of soil material from the site and calculate its consumption.
- **Tracer tests.** The aim of these tests is to exclude an existence of undesirable preferential routes through which the reagent could drain.
- **Semi-operational on-site tests.** The purpose of these tests is to evaluate ISCO during operation. The tests are carried out on a selected borehole, in about 1 month time. As a result, the dosage of oxidizing agents, detergents and parameters such as the amount of oxidation agent, the method and frequency of dosing can be adapted.



# SVE – DESCRIPTION



**SOIL VAPOR EXTRACTION (SVE)**

REV 4-28-11



# SVE – FEASIBILITY STUDY



- type/condition of surface cover (e.g., asphalt, vegetation);
- presence and extent of buried structures or utilities
- topography
- soil type distribution and depth
- depth to water table and its seasonal fluctuation
- soil moisture content and variability
- thickness of the capillary fringe
- air permeability and how it varies within the domain of interest
- organic carbon content and variability.



# SVE – IN FIELD TEST



- define the target treatment zone
- propose a conceptual model for the air distribution in the treatment zone
- sustainable airflow rates
- total gas extraction rate
- anticipated contaminant vapor removal rates
- preferred orientation of subsurface airflow
- effective radius of influence and determine if the well spacings are cost-prohibitive
- propose the depth, location, and construction specifics of the wells
- number of vapor extraction wells required
- vapor treatment technology for system off-gas



# SVE – PERFORMANCE MONITORING



- soil gas chemical monitoring
- VOC and flow rate measurements in SVE system influent, and possibly in individual extraction wells, should be used to calculate the contaminant mass removal rates from the unsaturated soil.
- Contaminant concentrations are usually measured at off-gas treatment influent and effluent (before and after carbon canisters) to assess the effectiveness of the air emission control system.
- Groundwater chemical monitoring: remediation in the vadose zone should not be conducted independently of groundwater conditions. Unsaturated soil may be, in fact, recontaminated by capillary action and water table fluctuations.
- Physical monitoring: soil and vapor temperature, relative humidity, water levels, flow rate, vacuum/pressure measurement



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# Thank you for your attention

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