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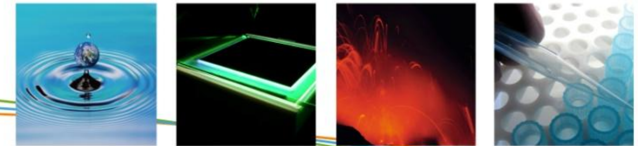


Remediation technologies and integration of their impact in water management: goals & major outcomes – FP7 AQUAREHAB

Leen Bastiaens, VITO, Belgium

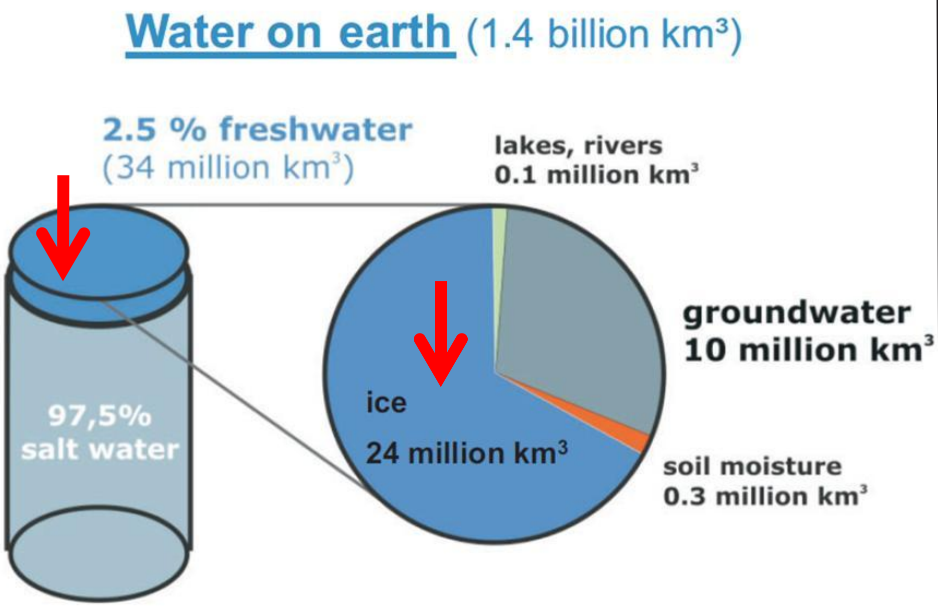
WT&M 2013, Leuven

November 20-21st, 2013

AQUA REHAB

SEVENTH FRAMEWORK PROGRAMME

Water Quantity



BGR, 2008

Water Quality

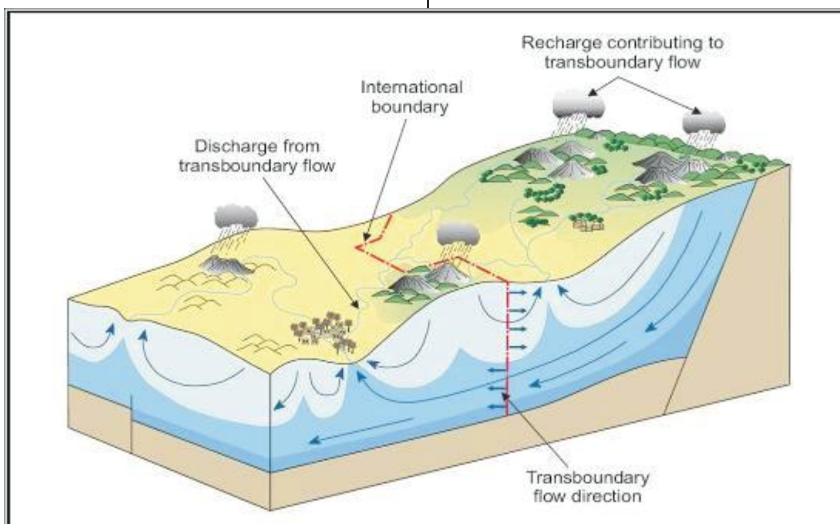
= status of specific water type (for a specific application)

» Priority pollutants

» Local legislations

‘ You can only find what you are looking for’

= crucial for industry, agriculture & daily life



Water is a precious and a finite resource

FP7 AQUAREHAB

Collaborative FP7 Project, Large-scale integrating project (ENV 2008 3.1.1.1.)

19 partners – 12 countries – 8,5 Meuro project

Duration: 5/2009 – 12/2013 (56 months)

Coordination: VITO, L. Bastiaens

'Development of rehabilitation technologies and approaches for multipressured degraded waters

and

the integration of their impact in river basin management'

Project title

Remediation technology development

&

Numerical models

'1 + 1 = 3' - effect

Groundwater

&

Surface water

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Multidisciplinary team – 19 partners

Technology development

Flemisch Institute for Technological Research - Belgium
Catholic University of Leuven - Belgium
Geological Survey of Denmark and Greenland - Denmark
Helmholtz Zentrum München (HMGU) - Germany
CTM Centre Tecnologic - Spain
University of Stuttgart - Germany
Politecnico di Torino – Italy
Ben Gurion University of the NEGEV - Israel
Sapion Bodemadvies – Belgium **SME**
Hoganas AB – Sweden

Modellers

Flemisch Institute for Technological Research - Belgium
Technical University of Delft - The Netherlands
Ben Gurion University of the NEGEV - Israel
UNESCO-IHE Institute for Water education - The Netherlands
University of Sheffield - UK
University of Copenhagen – Denmark
Politecnico di Torino – Italy

Analyses & data

Chemical Analyses
ISODETECT – Germany **SME**

Molecular biology
Wageningen University
The Netherlands

Toxicology
Masarykova University/recetox
Czech Republic

Ecology
Environmental Institute **SME**
Slovak Republic

Socio-economical aspects
INERIS - France

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Aim of AQUAREHAB

To develop/improve :

» 5 innovative (groundwater) rehabilitation technologies

» methods (feasibility tests), tools (numerical models) and guidelines

→ to assist potential end-users

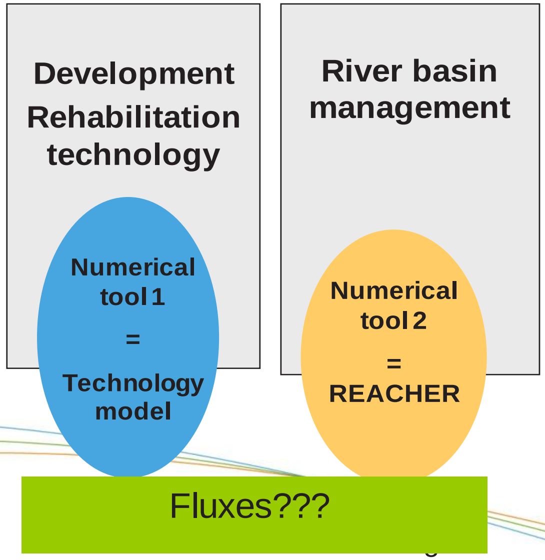
→ to determine longterm impact on local fluxes of pollutants

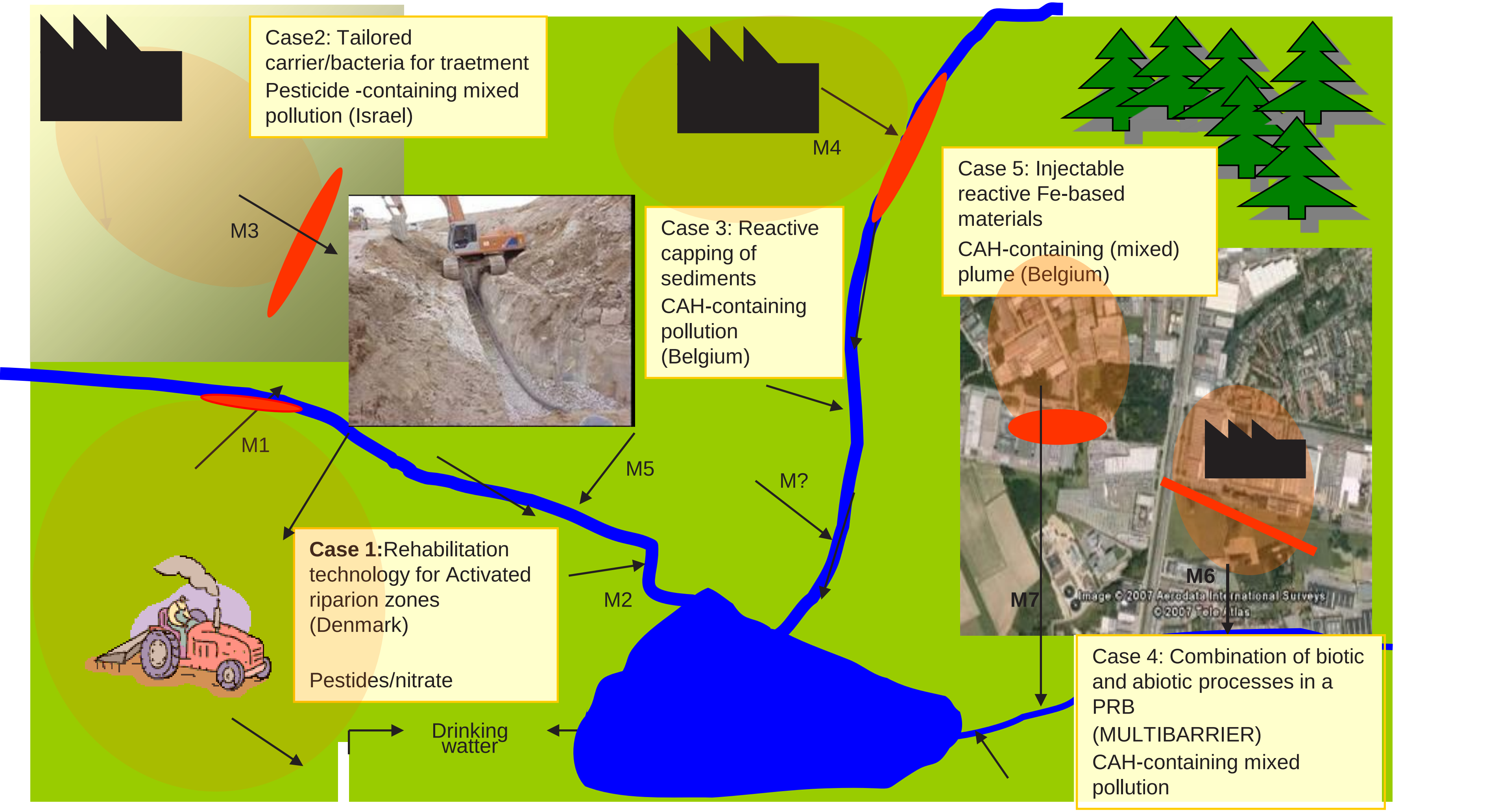
» a collaborative management tool 'REACHER' to evaluate ecological and economical effects of different remedial actions on river basins

» An approach to link effects of rehabilitation technologies with the river basin management tool

→ Removing barriers for application of in-situ remediation technologies

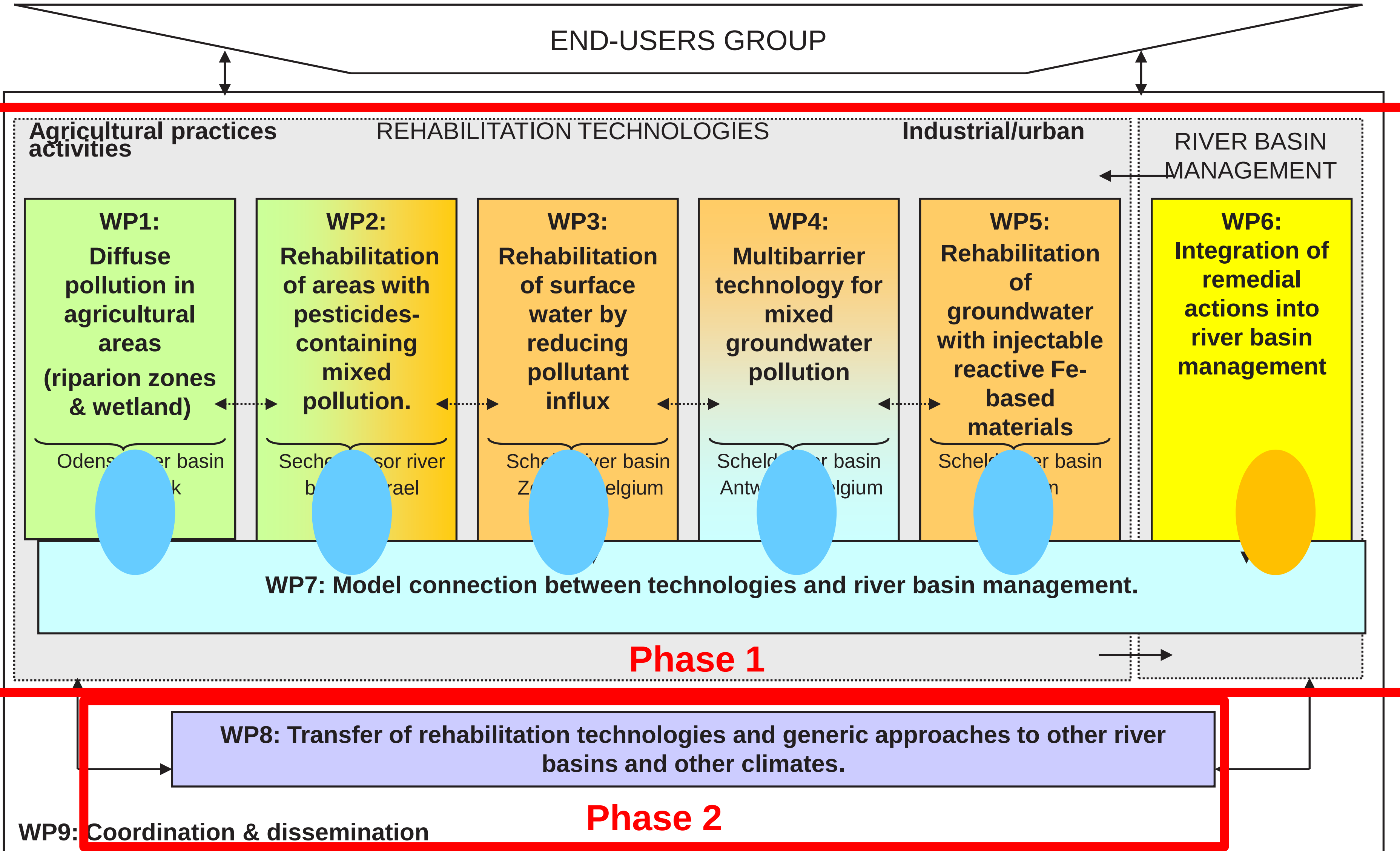
→ Basis for future river basin management





Case2: Tailored carrier/bacteria for traetment
Pesticide -containing mixed pollution (Israel)
M3
M4
Case 3: Reactive capping of sediments
CAH-containing pollution (Belgium)
Case 5: Injectable reactive Fe-based materials
CAH-containing (mixed) plume (Belgium)
M1
M5
M?
M6
M7
Case 1:Rehabilitation technology for Activated riparion zones (Denmark)
Pestides/nitrate
M2
Drinking watter
Case 4: Combination of biotic and abiotic processes in a PRB (MULTIBARRIER)
CAH-containing mixed pollution

Structure AQUAREHAB



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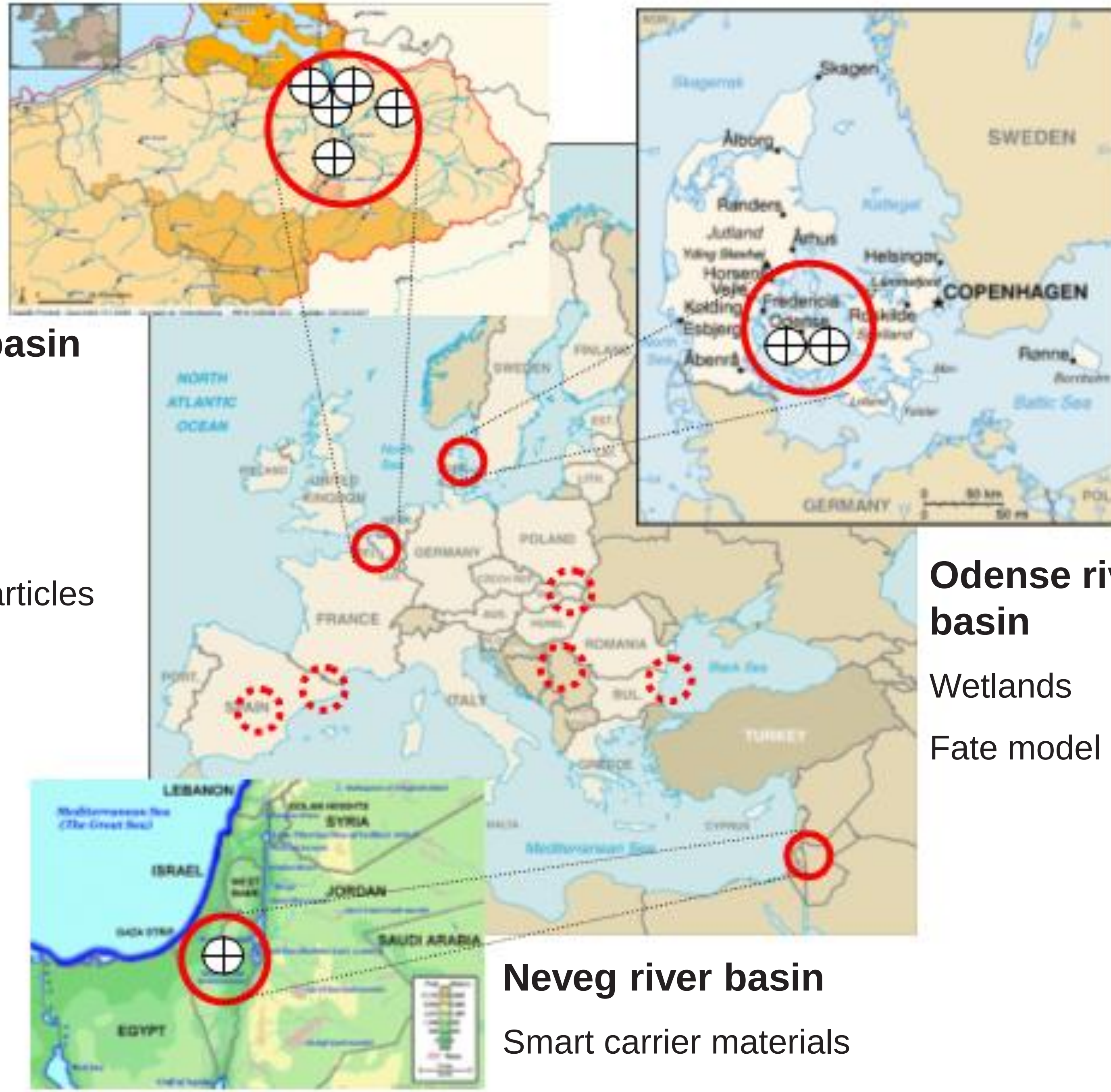
Schelt river basin

- Multibarrier
- Capping
- Wetlands
- Injectable Fe-particles
- Fate model



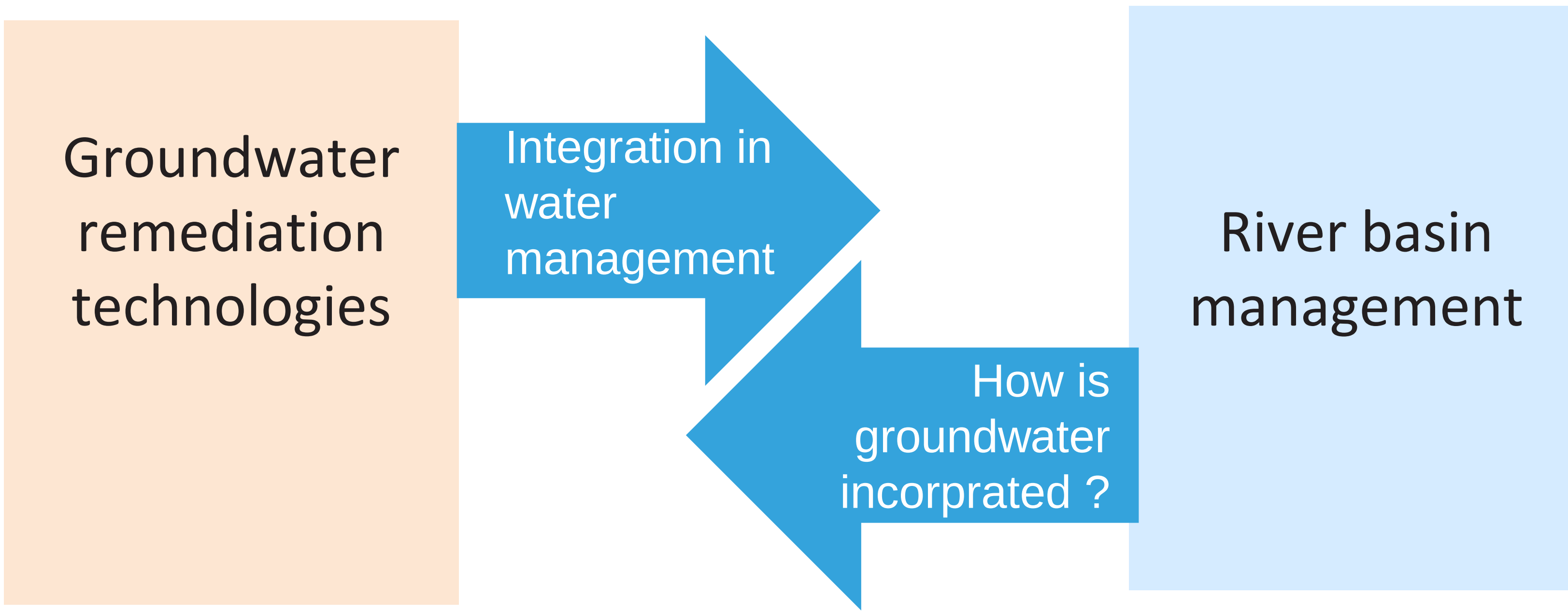
Odense river basin

- Wetlands
- Fate model

Neveg river basin

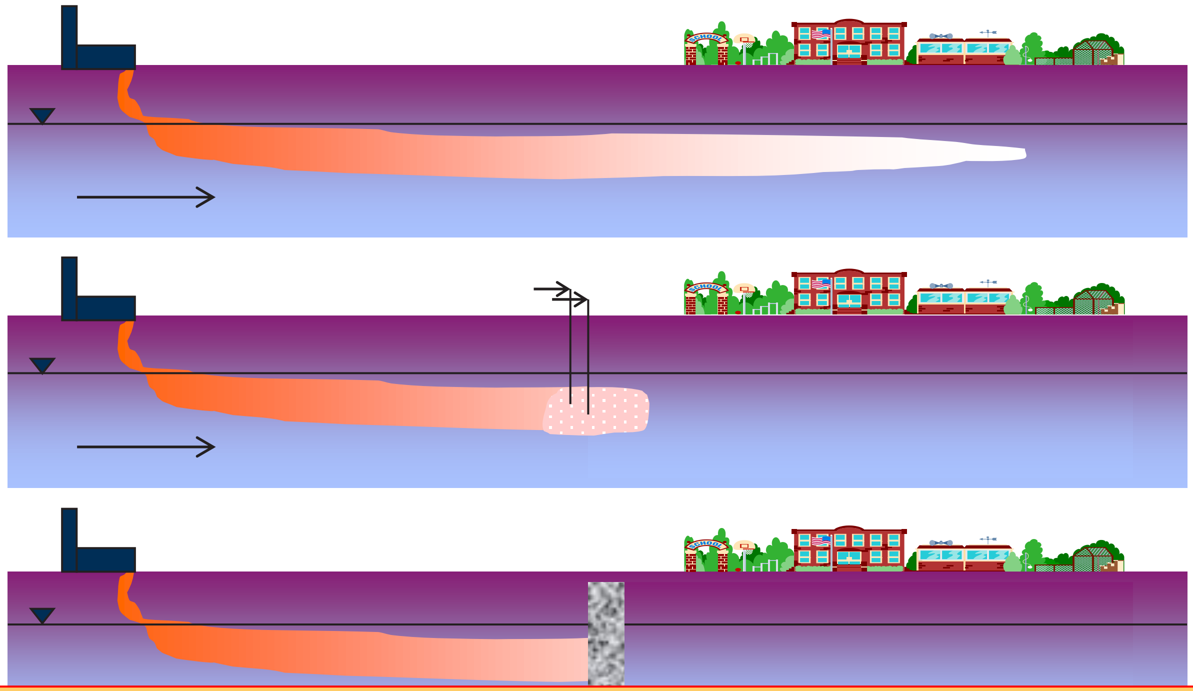
- Smart carrier materials

AQUAREHAB approach



1. General ideas behind the approaches
2. Summary of main outcomes

Groundwater pollution & remediation



Current aim:

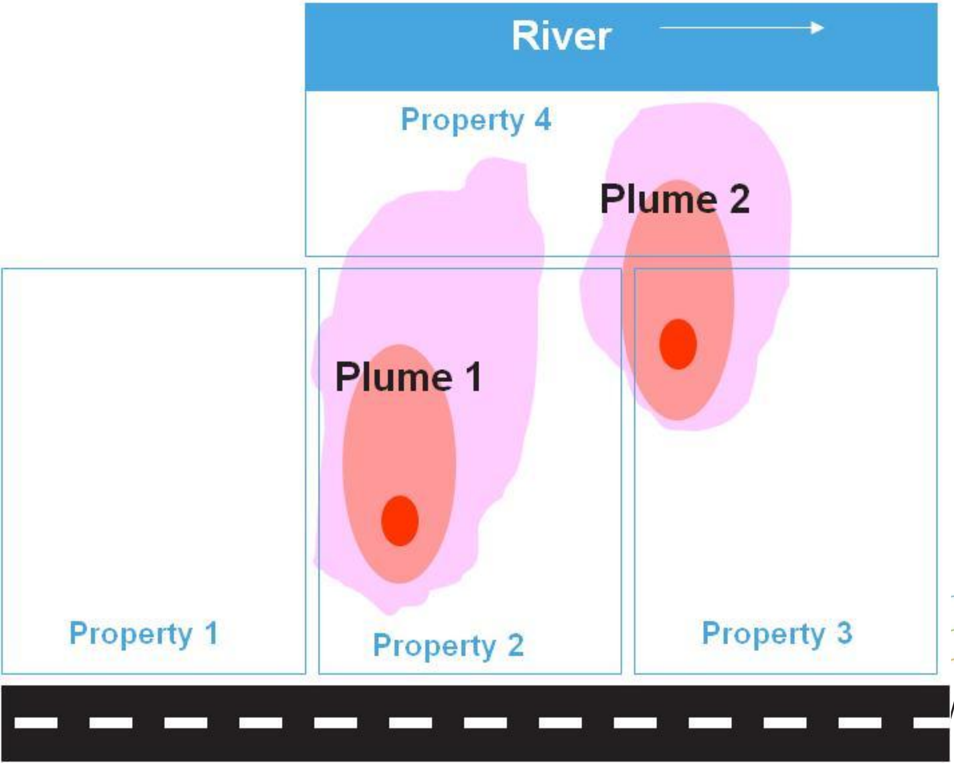
To remove or contain pollutants → to prevent spreading across the property boundary

To reduce concentration on 'own property'

‘own property/pollution’ approach

Classical approach:

- impact of ‘my’ pollution
- on direct vicinity



‘Clustered’ approach

More innovative approach:

- Several properties considered
- Risk-based remediation (source-path-receptor)
- Impact on m-km scale

EU Water Framework Directive (WFD)

Aim: protecting surface and groundwater using a common management approach

Objectives:

- to restore good ecological and chemical status for all water bodies (or good ecological potential for heavily modified water bodies) across the Community by 2015
  → Impact in time
- to integrate water management activities at the river basin level.
  → Impact on a much larger scale, crossboundary
  → Tools to assess, design and plan restoration actions

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Evolution of remediation technologies

- Dimension 1: Remediation concept
  - Ex-situ → in-situ
- Dimension 2: Type of pollutant
  - BTEX/oil/PAHs → … → mixed pollution → emerging pollutants
- Dimension 3: Pollutant removal processes
  - Biological → reduction, oxidation, flushing, …→ combinations
- Dimension 4: Impact of technology considered
  - In time
    - Weeks → years → decades
  - In space
    - ‘property’ (m) → clusters of properties (m-km)→ groundwater bodies (10 km^2) → river basin (> 100 km)

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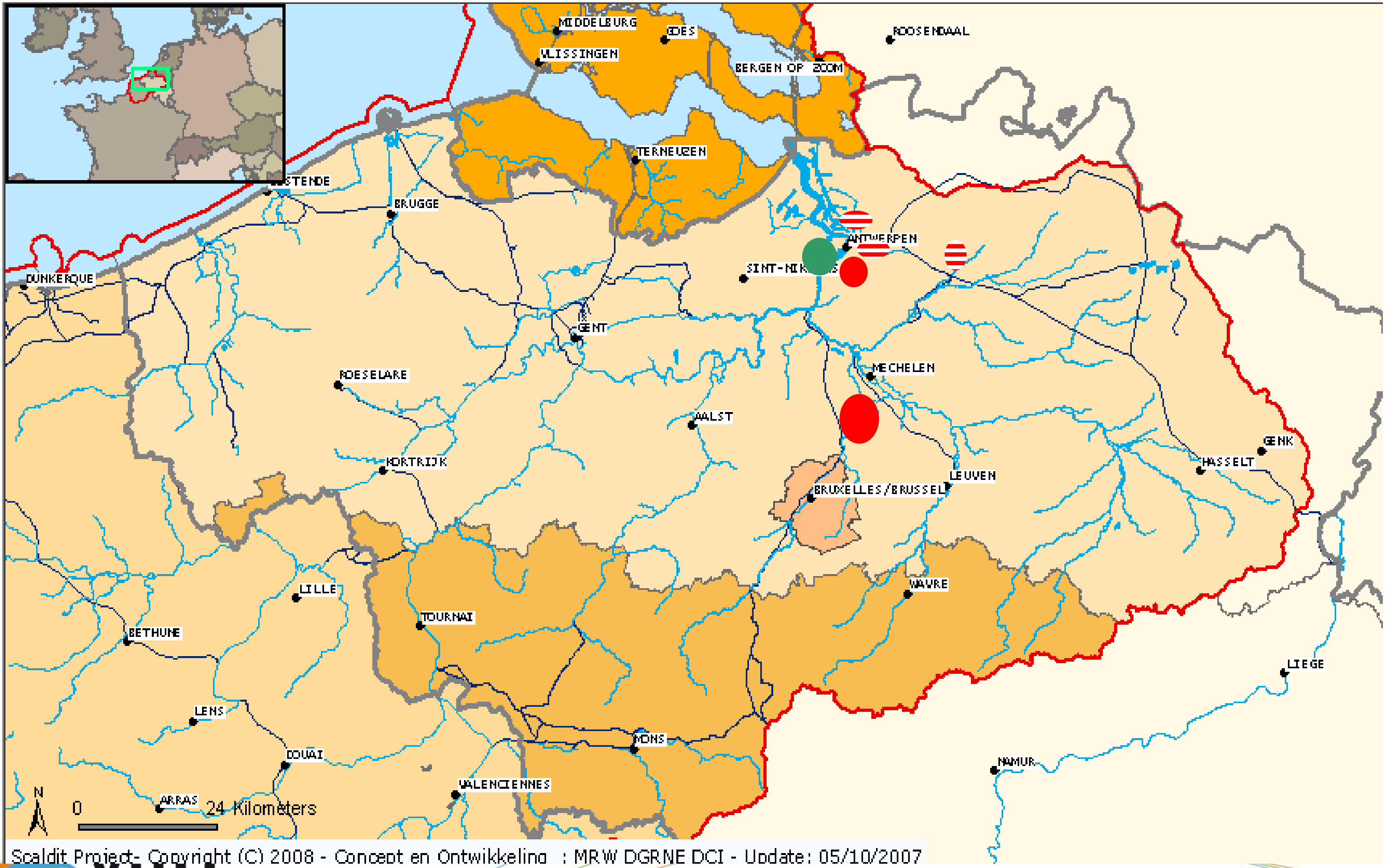
Schelde waterbody



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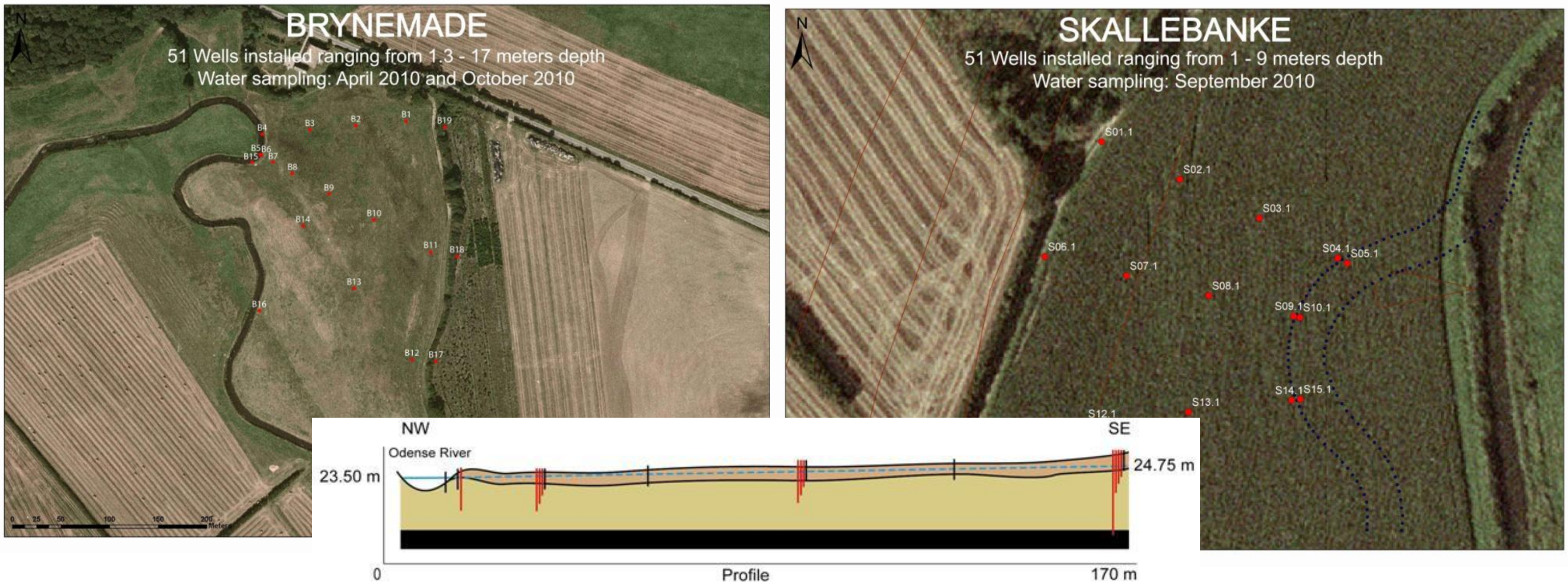
Technology 1. Wetlands (nitrate & pesticides)



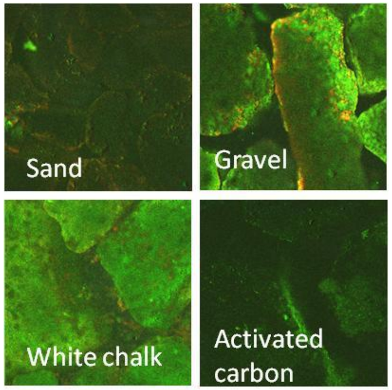
Lab

Field

2. Smart carrier-bacteria combinations

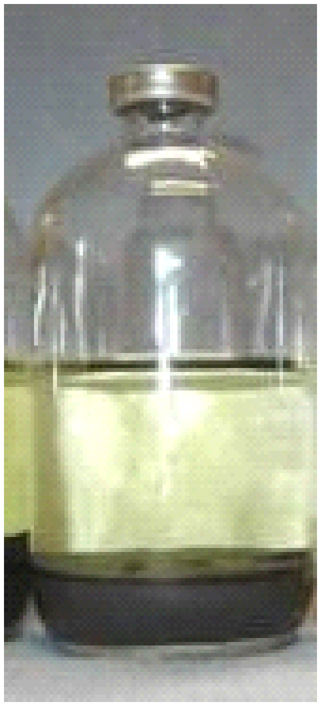
Lab tests → Pilot scale in the field → full scale

•Selection carriers
•Selection bacteria

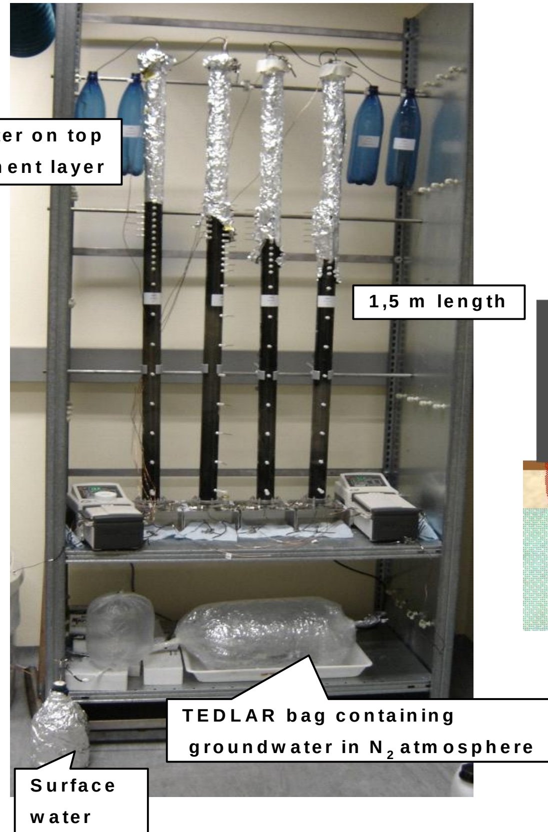


Focus

3. Activation of hyporeic zone - capping



Batch



Column

(In situ)

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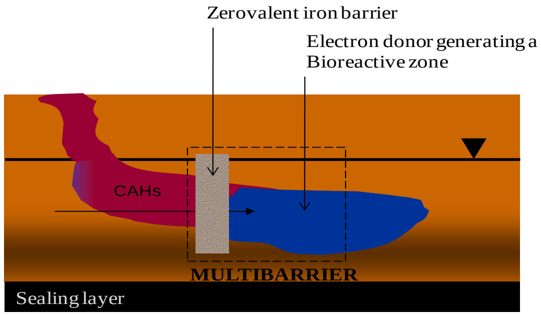
4. MULTIBARRIERS

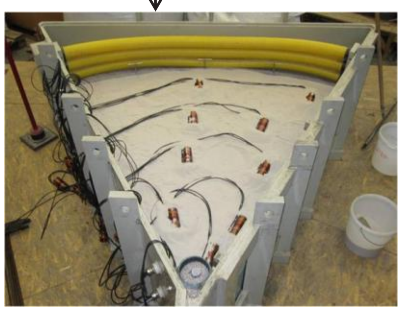


Lab

Field

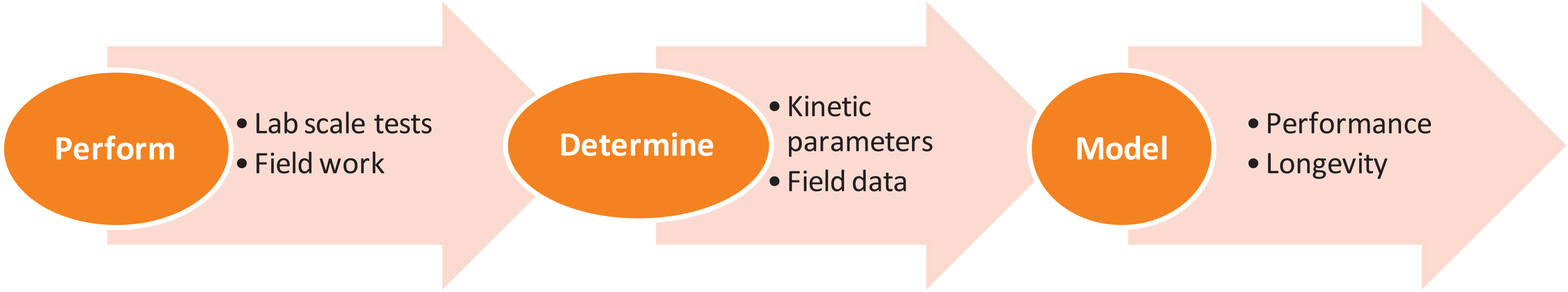
5. injectable iron particles AQUAREHAB

Reactivity & mobility

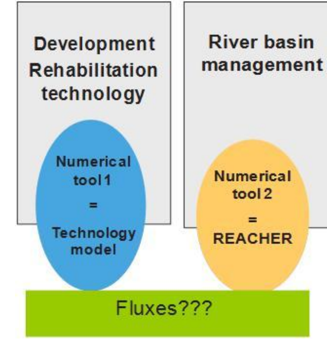


Microscale ZVI (in guar gum) – injection – Belgium

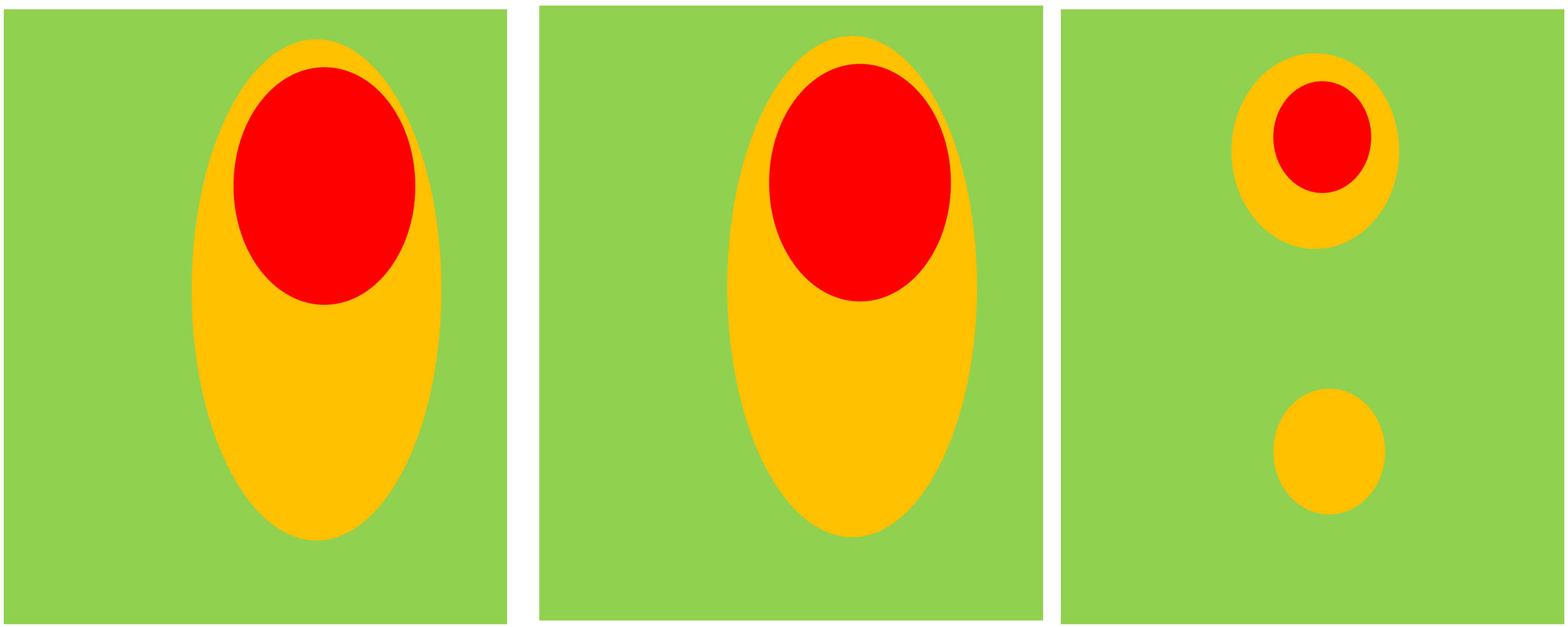
Impact of measures



Technology model output



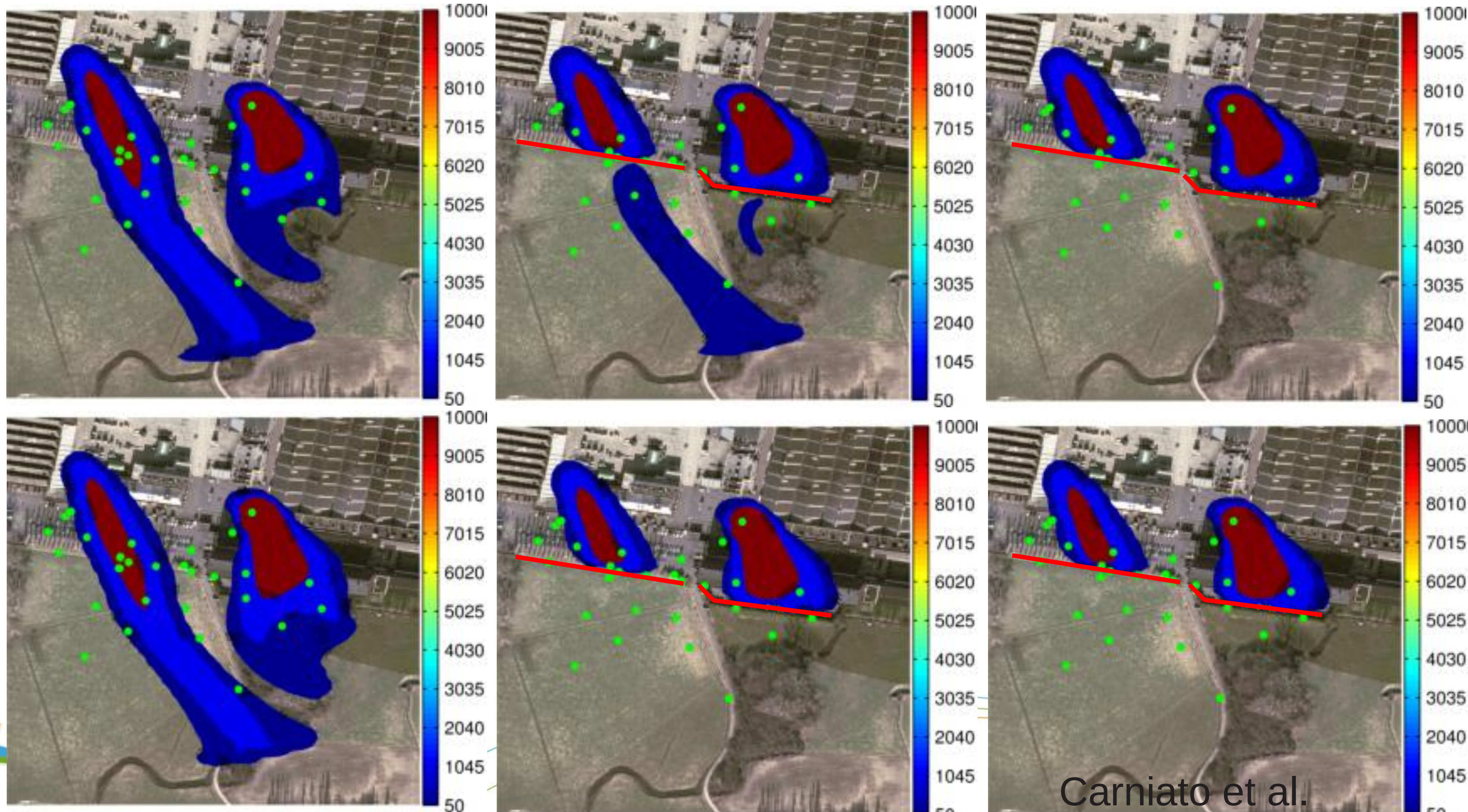
2010 | 2015 - NA | 2015 – measure



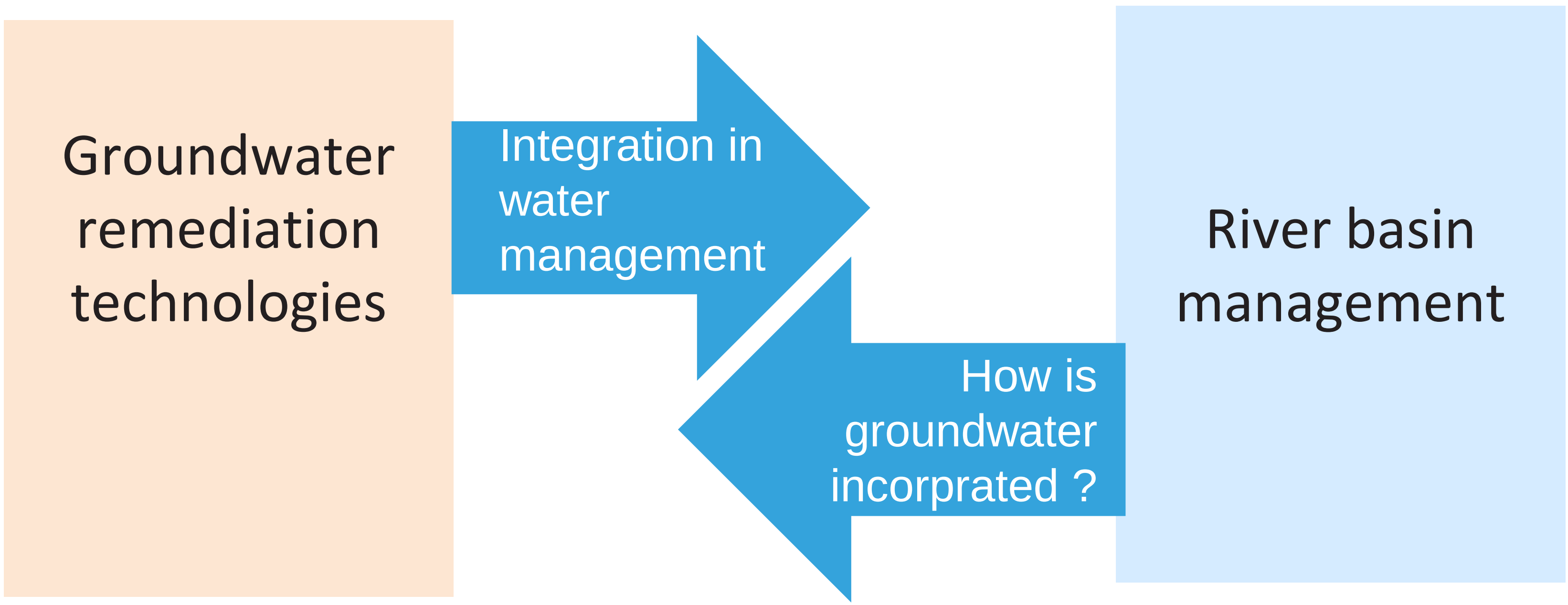
Plume scale

Example AQUAREHAB output technology model in the field

	No PRB, natural attenuation	PRB, natural attenuation	PRB, enhanced natural attenuation
2015			
2035			

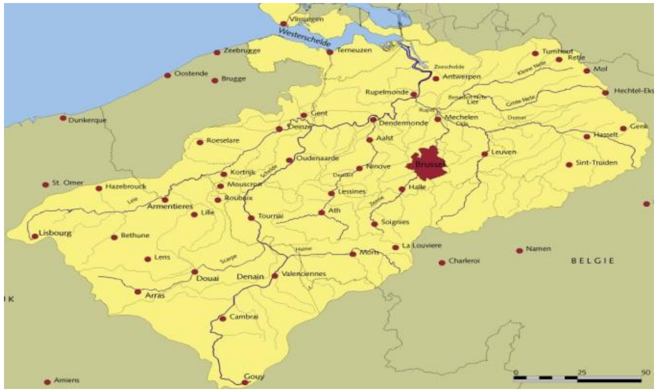


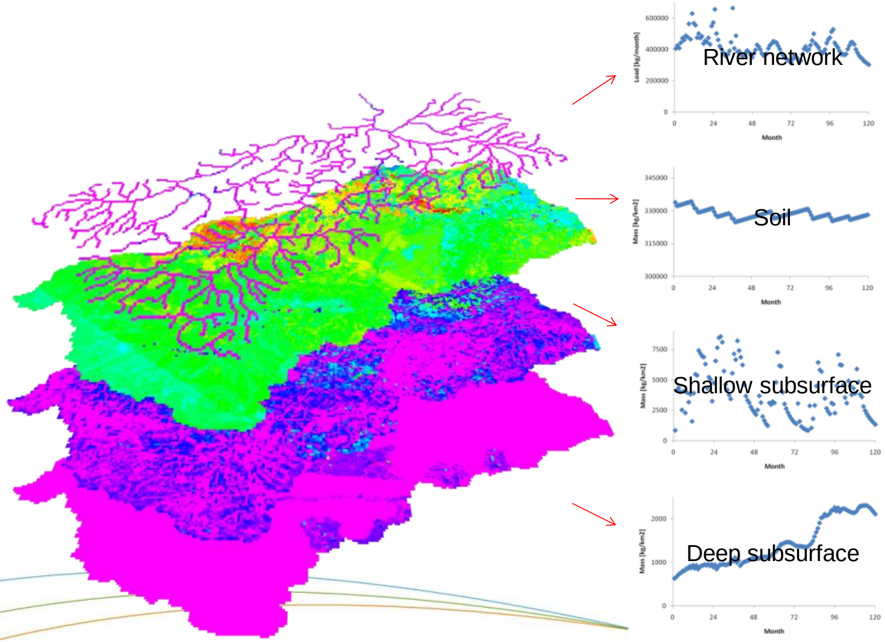
AQUAREHAB approach



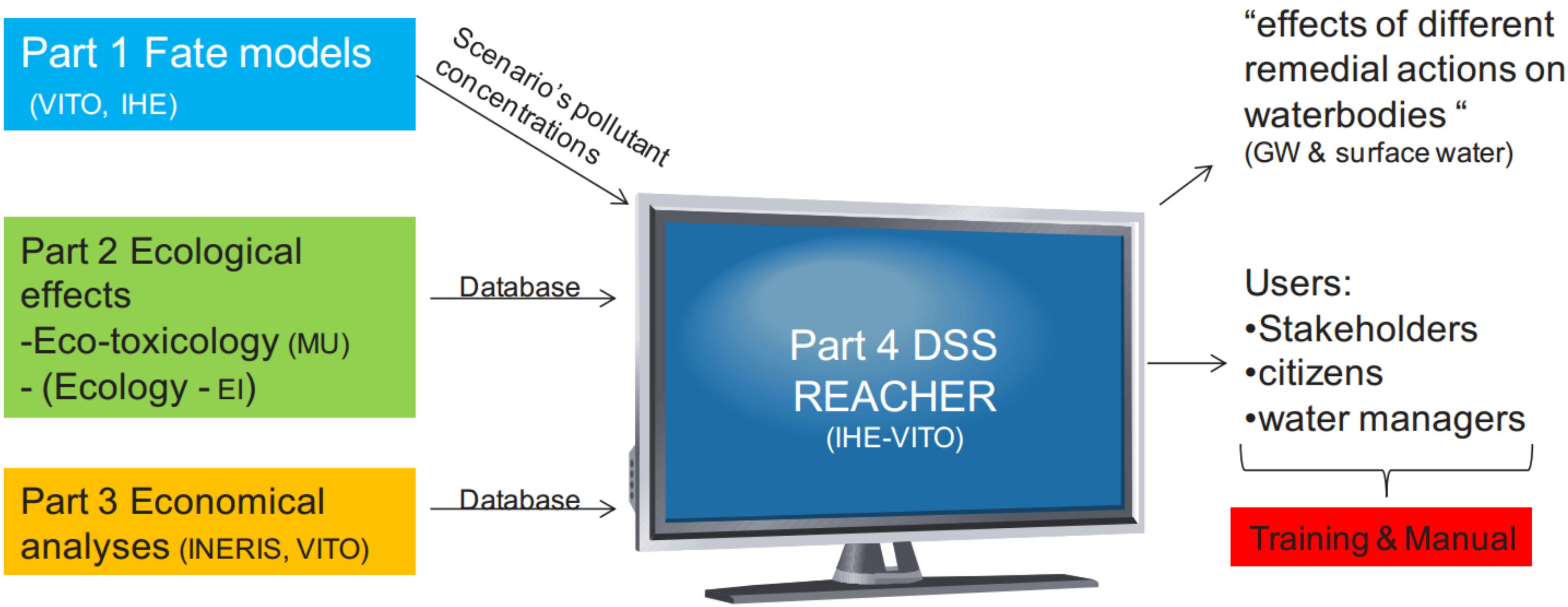
River basin mangement: chemical fate models

- SWAT model Odense (N, pesticides)
- SECOMSA framework Scheldt (N)



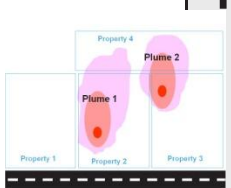


REACHER: integrates models + information and supports decision



Interaction groundwater & surface water

Development
Rehabilitation
technology



River basin management

Surface water & GW

Wetlands

Fluxes

Fluxes

Numerical tool 1

= technology model

→ Processes

→ Longevity

→ Hydrogeology

Numerical tool 2

= REACHER

→ Pollutants

→ Ecology

→ Economy

Pollutant type
Dynamics
Scale
…
Semi-confidential versus public character

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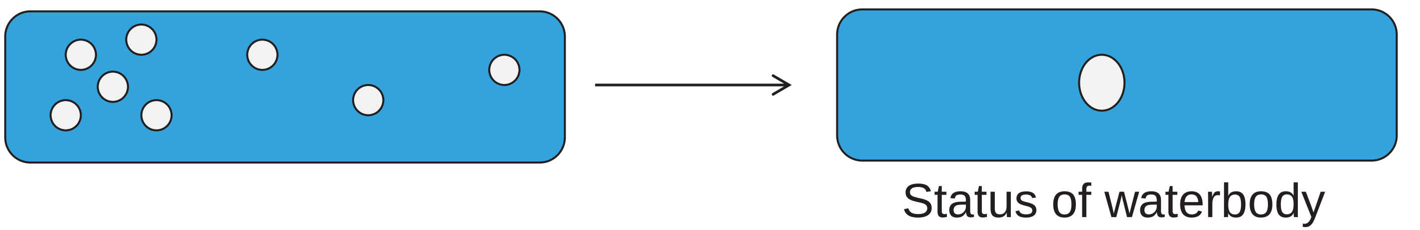
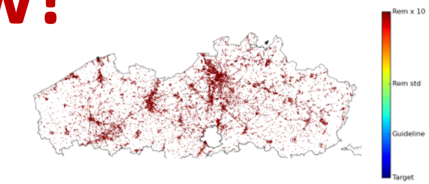
Groundwater at different scales

- River basin management:
  - focus on nitrates, pesticides = diffuse pollution linked to agricultural activities
  - Shallow & also deeper wells > 200 m included



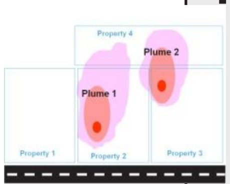
- Groundwater management:
  - Pollutants < spills, accidents → CAHs (PCE, TCE, .. VC), BTEX, … MTBE,
  - Data bases exist
  - More shallow wells (many – per case)

REACHER-local - new!



Development

Rehabilitation technology



REACHER- local

River basin management

REACHER-watershed

River basin management

Fluxes

Local legislation

GD

WFD

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Experiences up to now

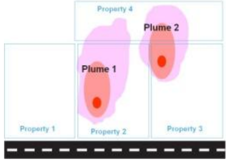
- WFD directive – initiated with focus on surface water
  - Selection of pollutants
  - Procedure worked out to evaluate ‘good quality’

- WFD less elaborated for groundwater →groundwater directive
  - Parameter list limited
  - Local problems with long-term impacts

- AQUAREHAB – REACHER (fate models & data bases &DSS):
  - Groundwater and surface water require a different approach
    - Fate model
    - Data

Advice to policy makers towards Challenges of integrating impact of groundwater remediation into water management

- For water management on river basin scale:
  - Groundwater is not only a ‘path’
  - Groundwater also to be considered as receptor
- Explore link between ‘river basin management’ & ‘groundwater management’



  - Connect data bases on pollutant concentrations
  - Type of pollutants to be reconsidered:
    - Nitrate in groundwater management?
    - Volatile compounds in river basin mangement?
- Groundwater management not possible at river basin scale

  → sub-groundwaterbodies, considering ‘real’ fluxes

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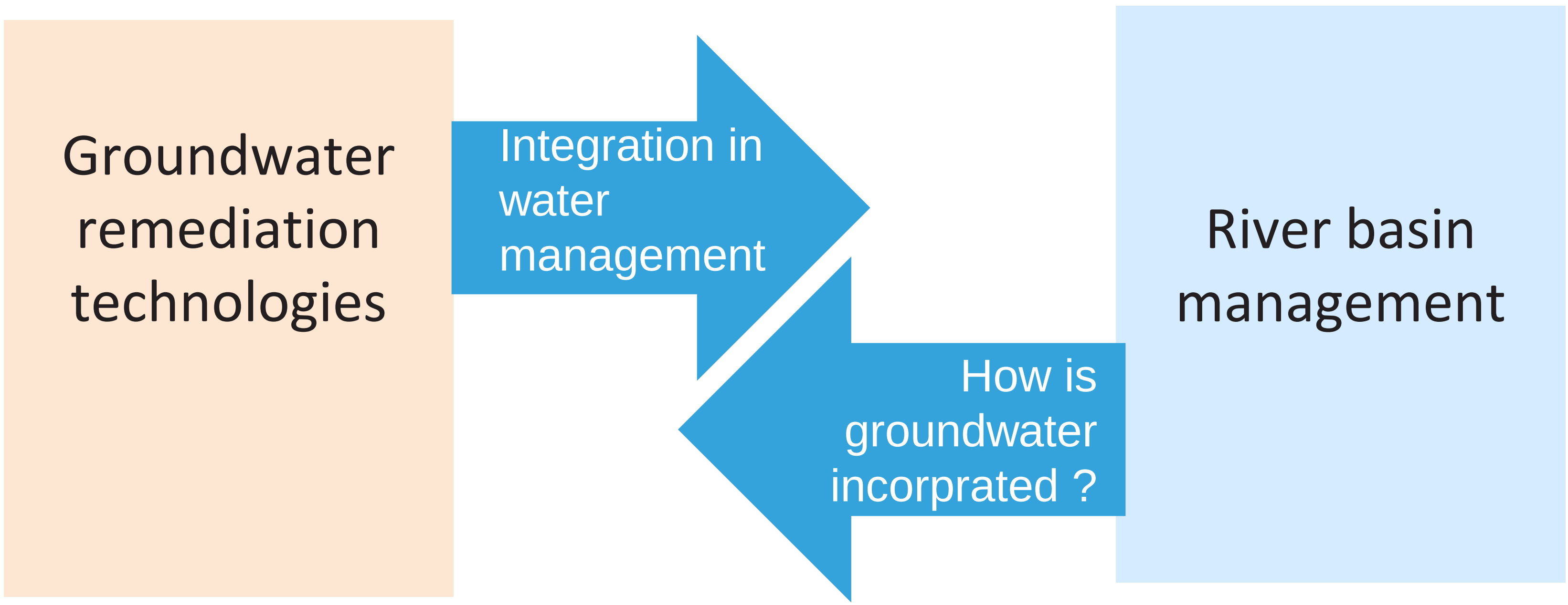
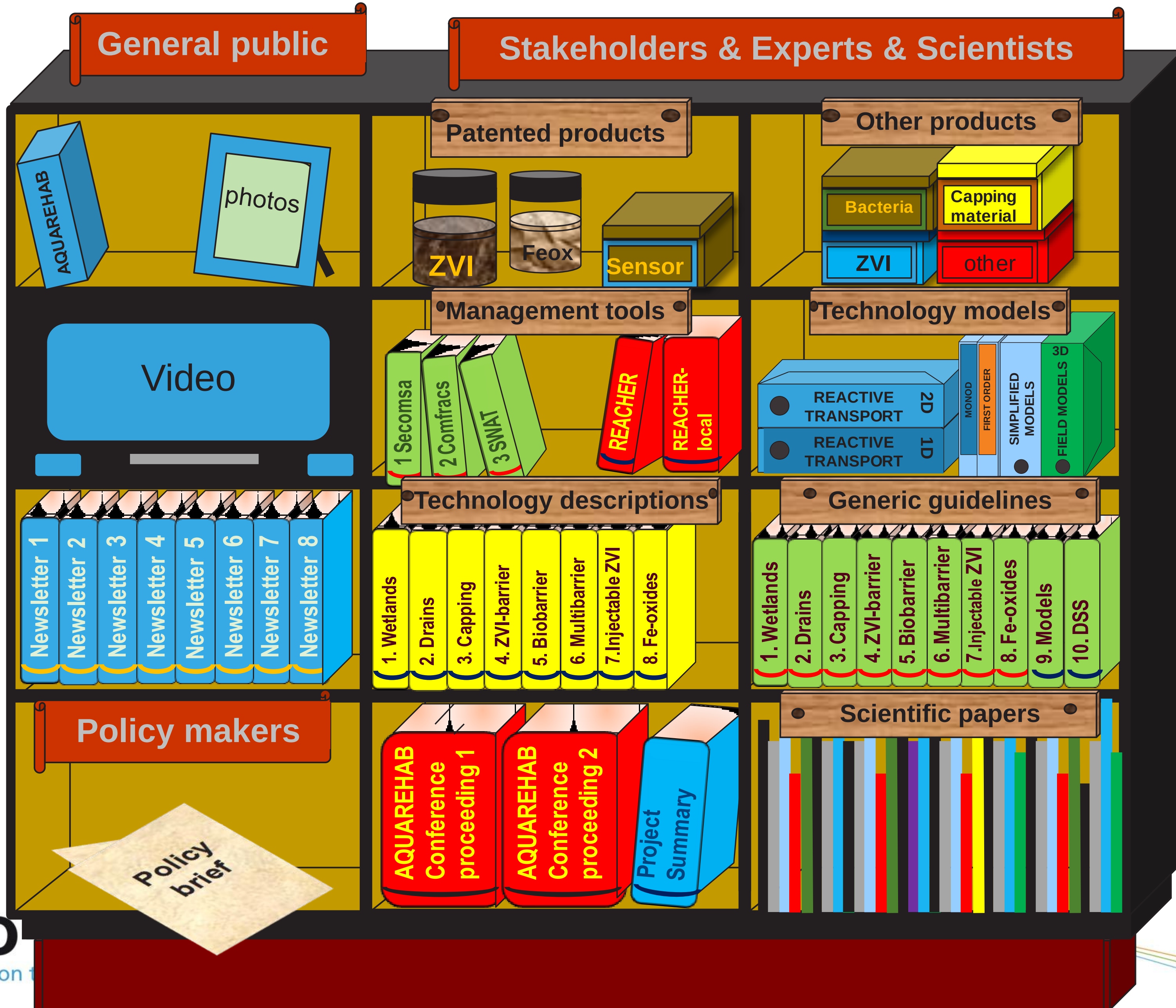
AQUAREHAB approach



AQUAREHAB output



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ACKNOWLEDGMENTS

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For more information: www.aquarehab.vito.be

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