

# Natural Systems for Treatment



WP3.2 – WP3.3 – WP5.3 colleagues  
Diederik Rousseau and Gary Amy

SWITCH ScM – Belo Horizonte, Brazil – December 1, 2008

UNESCO-IHE  
Institute for Water Education



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INTRODUCTION:  
WHAT, WHICH and WHY?

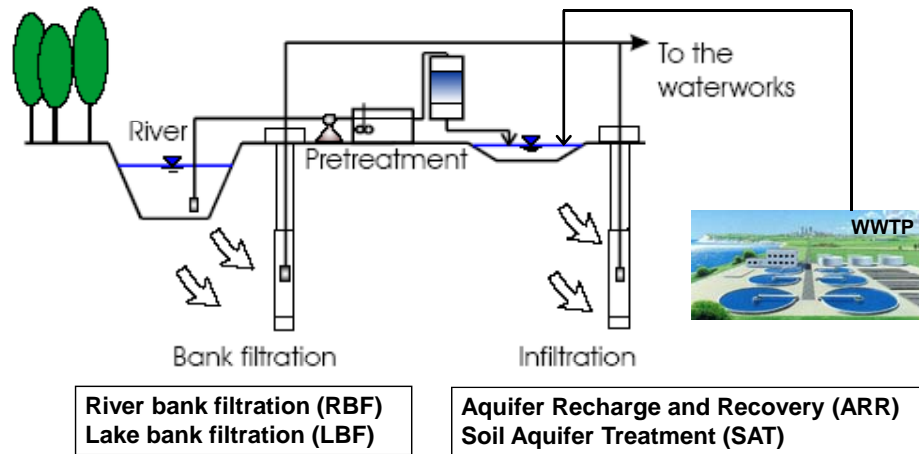
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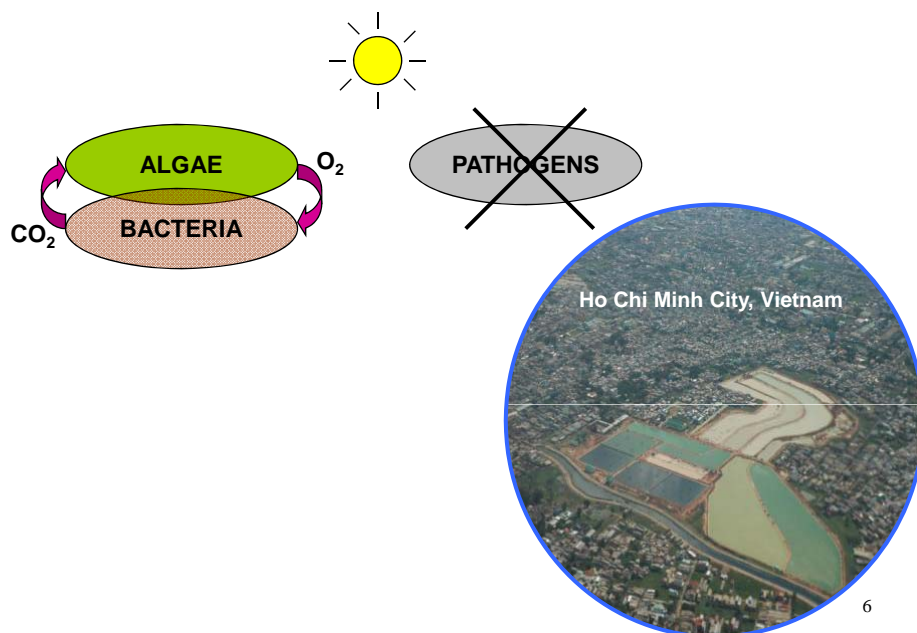
## Bank Filtration (BF), Infiltration (ARR) and Soil Aquifer Treatment (SAT)



(Source: Kuehn, 2003)

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## Waste Stabilization Ponds (WSP)



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## Constructed Wetlands (CW)



Saxby, UK, domestic wastewater



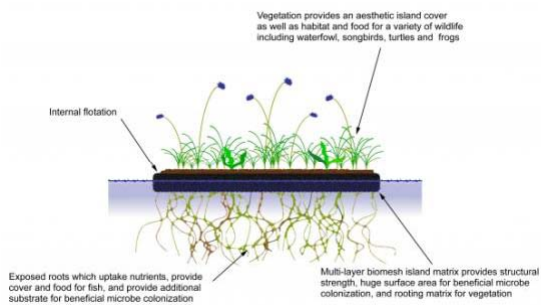
Tielt-Winge, Belgium, domestic WW



Analândia, SP, Brazil, potable water

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## Ecohydrological techniques



Floating islands

Controlled flooding area



## Specific Advantages of Natural Systems

- ◆ ***Natural and Sustainable Treatment***
- ◆ A Multi-Objective (≈Contaminant) Process
- ◆ Removal of Turbidity and Suspended Solids
- ◆ Removal of Biodegradable Organics
  - ◆ Bulk Organic Matter
  - ◆ Trace Organic Compounds
- ◆ Removal of Microorganisms
- ◆ Removal of Nutrients (to varying degrees)
- ◆ Low Investment and Operation Cost
- ◆ Ancillary benefits

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SWITCH CONTRIBUTIONS



## Work packages involved

- ◆ WP 3.2 – Safe water reuse

Soil Aquifer Treatment (SAT), Engineered Artificial Reservoir (EAR),  
Aquifer Storage and Recovery (ASR)

- ◆ WP 3.3 – Urban water supply and use – other productive uses

Constructed Wetland (CW) with Electroflocculation (EF); SAT pre- and post-treatment (from secondary effluent)

- ◆ WP 5.3 – Natural systems and the urban water cycle

Bank filtration (BF), Artificial Recharge and Recovery (ARR),  
Constructed Wetlands (CW), High-rate stabilization ponds (WSP),  
Hyporheic zone treatment (HZT), Ecohydrology measures (EH)

## What Should be done to Promote Natural Treatment Systems?

- ◆ Development of Design Guidelines, Nomographs, Software, Decision Support Systems for Application

- ◆ Including, and Officially Recognizing Natural-System Technologies for Water and Wastewater Treatment

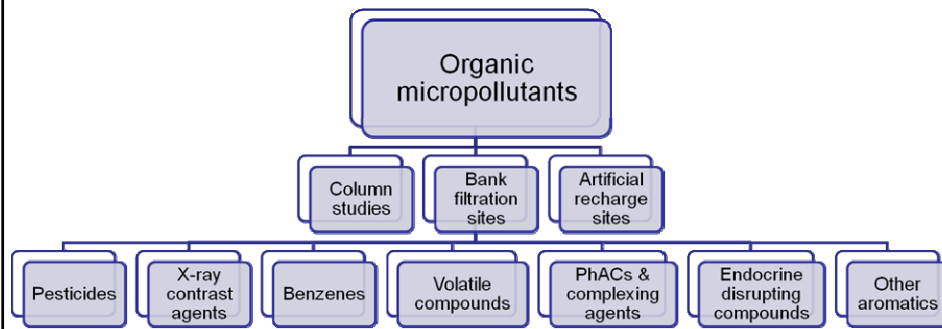
- ◆ **Information Dissemination:** Making Design Engineers, Planners and Educators aware of the Potentials of Natural-System Technologies (training and capacity building; demonstration projects)

- ◆ Networking among professionals involved in Natural-system Technologies (at regional and national level) for information sharing and collaborative research

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## Development of Design Guidelines, Decision Support Systems etc. for Application

### ◆ PhD Andrew Maeng – guidelines for BF



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## Development of Design Guidelines, Decision Support Systems etc. for Application

The screenshot shows a Microsoft Excel spreadsheet titled 'Trace organic guideline tool1'. The spreadsheet is divided into two main sections: 'Pharmaceutically Active Compounds' and 'Instructions'.

**Pharmaceutically Active Compounds**

Influent Concentration	10	µg/l
Please enter the Residence time or Distance of well from surface water in cells below		
Residence Time	50	Days
Distance of Well from Surface Water	50	Metres
Residence Time Output Based - Removal Efficiency Range	58-72	%
Distance Output - Removal Efficiency Range	58-75	%

**Instructions**

**Input Required**

**Output/Result**

**Instruction**

Input either distance of well from surface water or residence time but NOT BOTH.

**Limits of Application**

These guidelines also apply to complexing agents. The limits of application of the guidelines proposed are:-

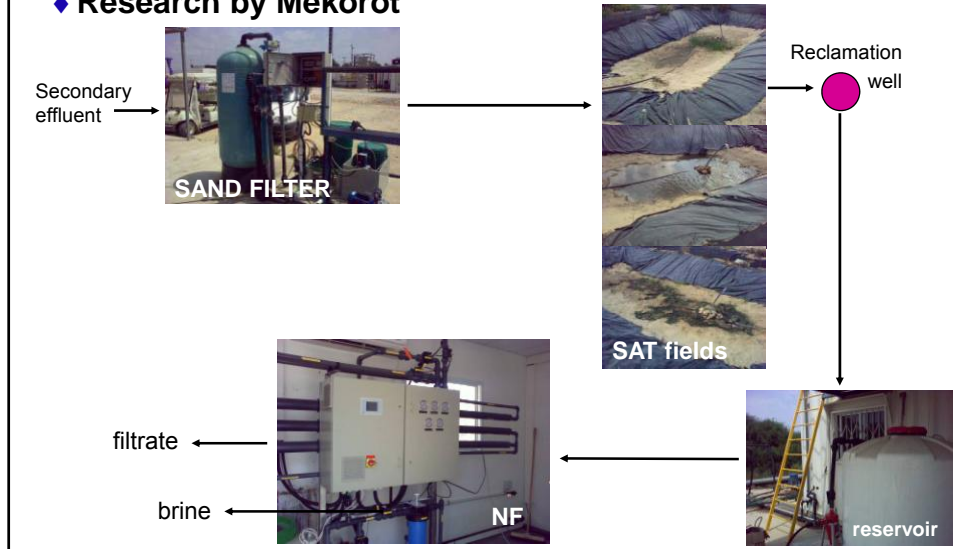
Influent range: 0.015 - 520 (µg/l) ; Effluent range: 0.0 - 290 (µg/l)

Distance : 0 - 125 m ; Residence Time: 0 - 140 Days

To view full guidelines developed click link : [Guidelines](#)

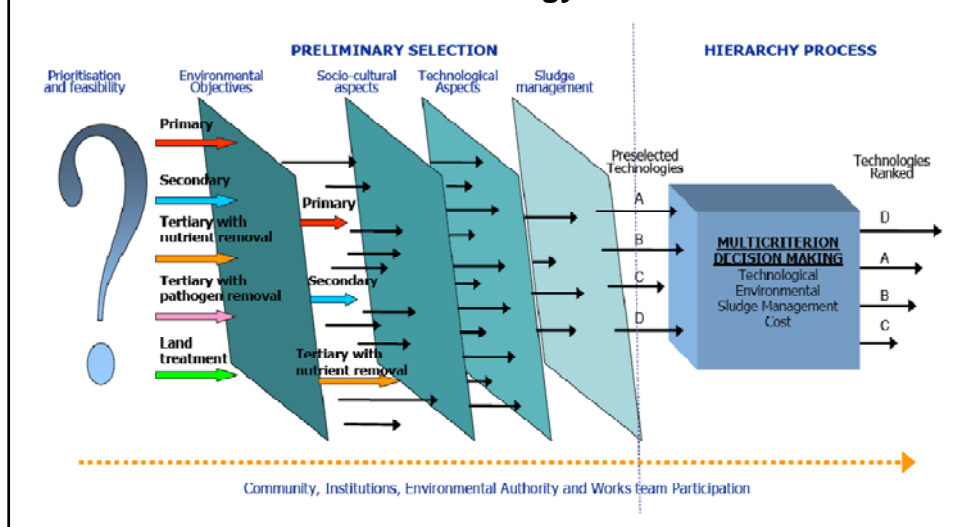
## Development of Design Guidelines, Decision Support Systems etc. for Application

### ◆ Research by Mekorot



## Development of Design Guidelines, Decision Support Systems etc. for Application

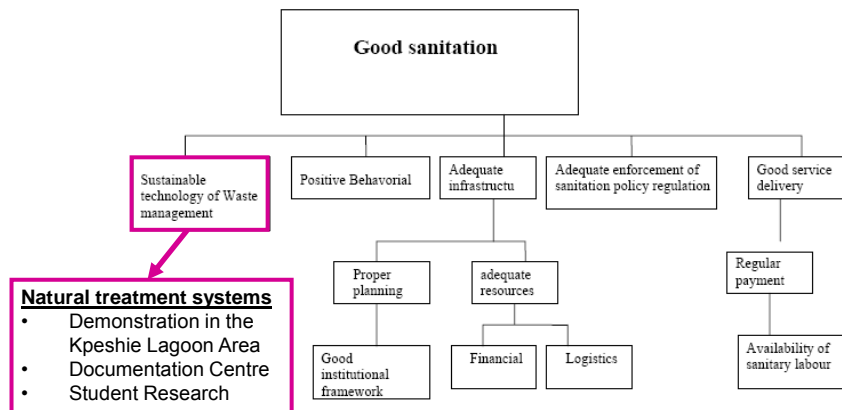
### ◆ PhD Alberto Galvis – Technology selection model





## Including and Recognizing Natural-System Technologies for (Waste)Water Treatment

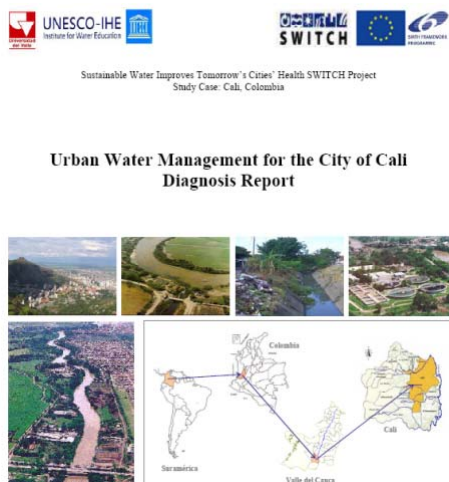
### ◆ Accra workshop (April 2007) ← literature reviews!



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## Including and Recognizing Natural-System Technologies for (Waste)Water Treatment

### ◆ Cali activities: study on wastewater management options



- CALI MUNICIPALITY
- WATER RESOURCES
- DRINKING WATER SUPPLY
- SEWERAGE SYSTEM
- WASTEWATER TREATMENT
- SOLID WASTE MANAGEMENT
- FUTURE URBAN EXPANSION AREAS
- INSTITUTIONAL FRAMEWORK

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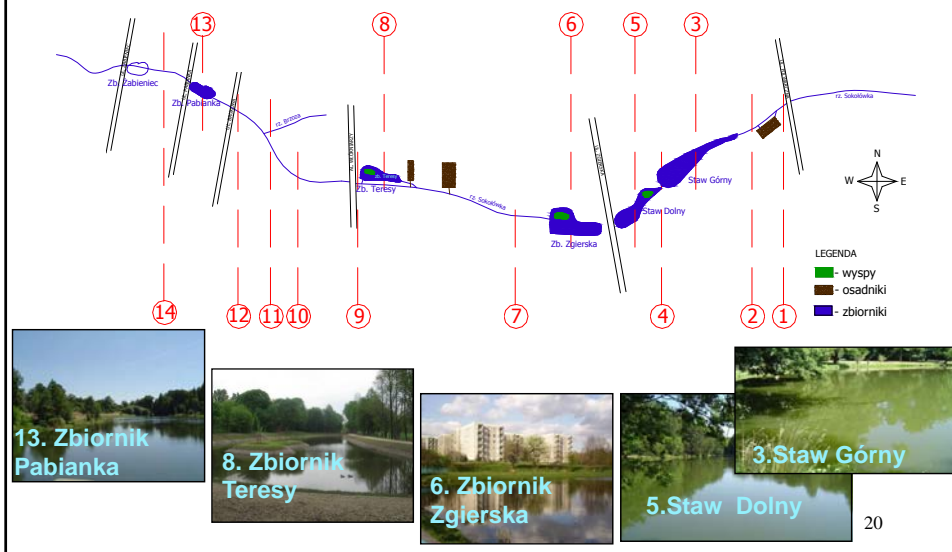
## Information Dissemination

- ◆ Literature reviews
- ◆ Training
  - ◆ SAT workshop in Israel
  - ◆ Natural treatment systems workshop in Ghana
  - ◆ Workshop NTS planned in Cali (2009)
  - ◆ Workshop SAT planned in Accra (2009)
  - ◆ Development of online course

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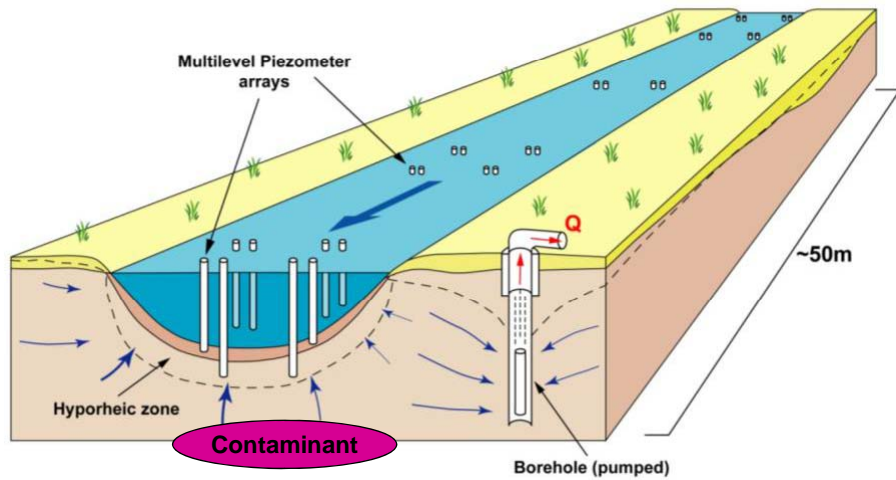
## Information Dissemination

- ◆ Demo activities in Lodz – Sokolowska river



## Information Dissemination

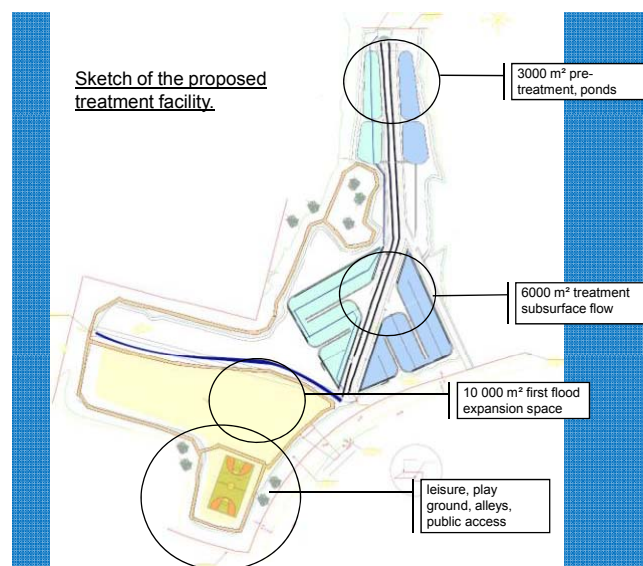
### ◆ Demo activities in Birmingham – HZ treatment



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## Information Dissemination

### ◆ Demo activities in Belo Horizonte – Creek revitalization



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## Tomorrow's presentations

**09:30** *Diederik Rousseau (UNESCO-IHE):* How Can Natural Systems Contribute to Achieving the Required Paradigm Shifts in IUWM?

**09:45** *Marcos von Sperling (UFMG):* Setup of an In-stream Treatment Facility for Urban Creek Revitalization - Belo Horizonte, Brazil

**10:05** *Fernanda Aller (University of Birmingham):* Mobility of Viruses in an Urban Sandstone Aquifer

**10:20** *Mike Rivett (University of Birmingham):* The SWITCH Hyporheic Zone Test Site, Birmingham: Overview of Baseline and Extraction Test 1 data

**11:00** *Avi Aharoni (Mekorot Water):* Alternative Hybrid UF-SAT or SAT-NF Treatments to Upgrade Effluent Quality

**11:20** *Andrew Maeng (UNESCO-IHE):* Bank Filtration as a Robust and Effective Barrier for Bulk Organic Matter and Organic Micropollutant Elimination

# THANK YOU !



**d.rousseau@unesco-ihe.org**  
**g.amy@unesco-ihe.org**

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