Managed aquifer recharge in line with European groundwater legislation

FP7 project DEMEAU on impact evaluation and approaches for authorization

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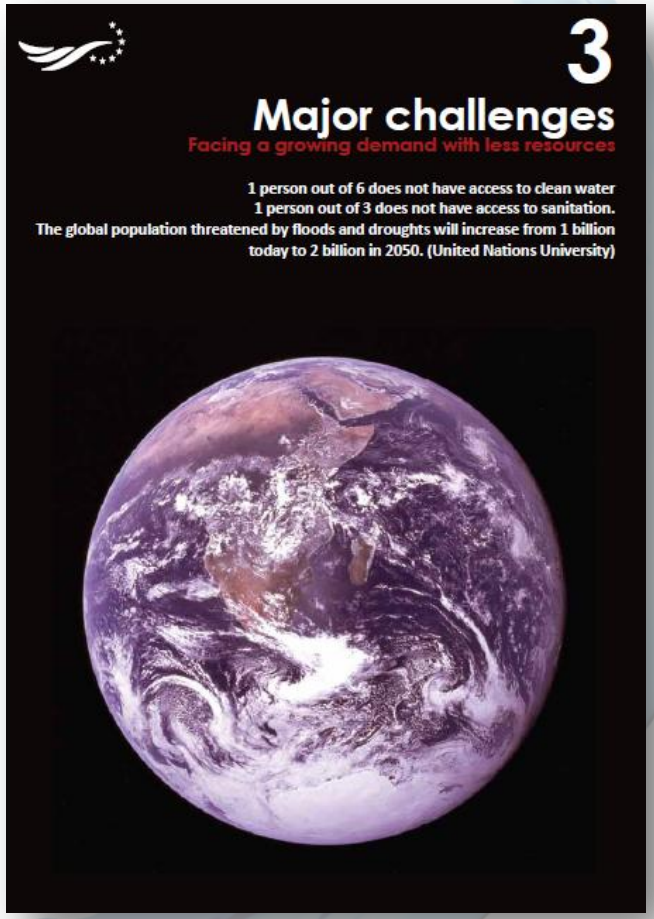
Outline

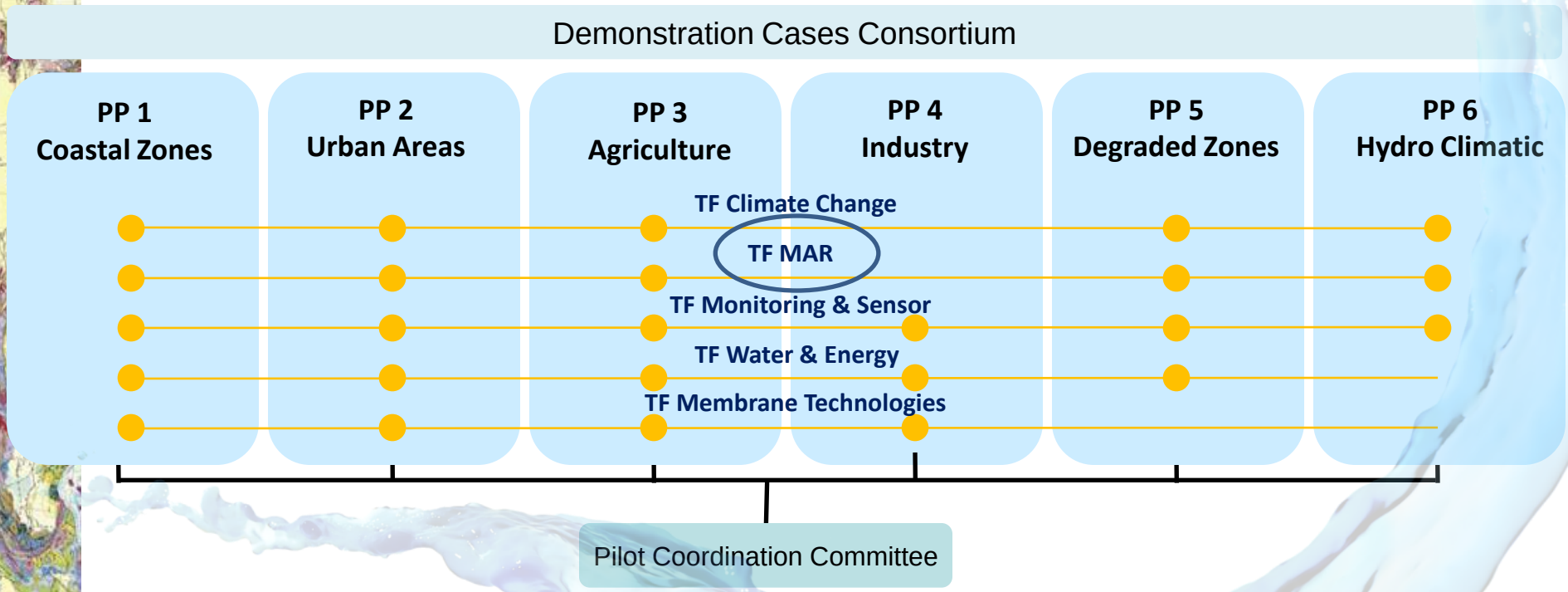
- The European Water Supply and Sanitation Technology Plattform (WssTP)
- The FP7 project DEMEAU
- Recent results on Managed Aquifer Recharge in Europe

Major Challenges in SRA 2010

- Coping with increasing water stress (quantity & quality)
- Reducing impact of extreme events (droughts and floods)
- Managing aging or lacking infrastructure
- Facilitating technology transfer
- Establishing an “Enabling Framework”
- The MDGs for Sustainable Water Supply and Sanitation Services in Developing Countries



Task Forces for Cross-Cutting Issues

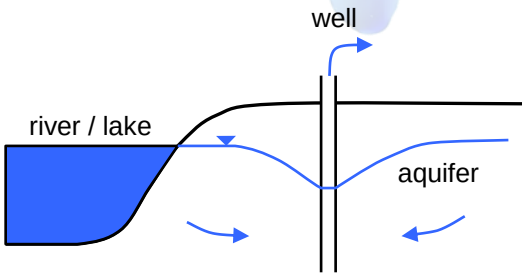


WssTP
The European Water Platform

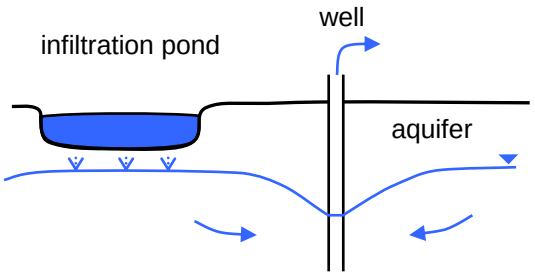
European Federation of Geologists

Managed Aquifer Recharge in Europe

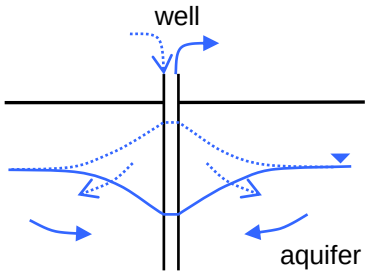
Bank filtration (BF)



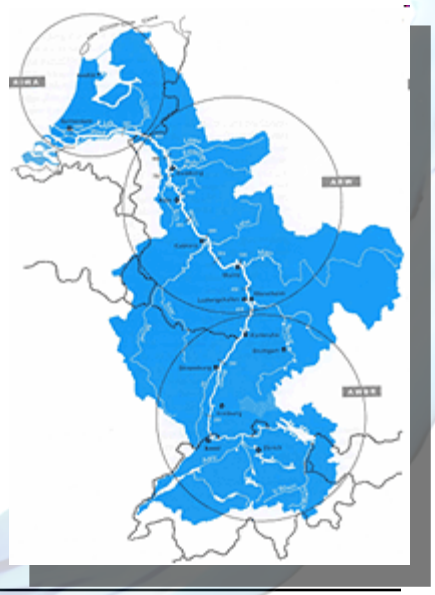
Aquifer recharge via infiltration ponds (AR)



Aquifer storage and recovery (ASR)



- 60 % of Berlin's drinking water (120 Mio m³/year)
- along the river Rhine bank filtrate serves 15 Mio. people (e.g. Düsseldorf, Cologne)
- Budapest and Belgrade rely on BF from the Danube
- drinking water in France: up to 50 % BF
- dune filtration supplying 16 % of NL's drinking water

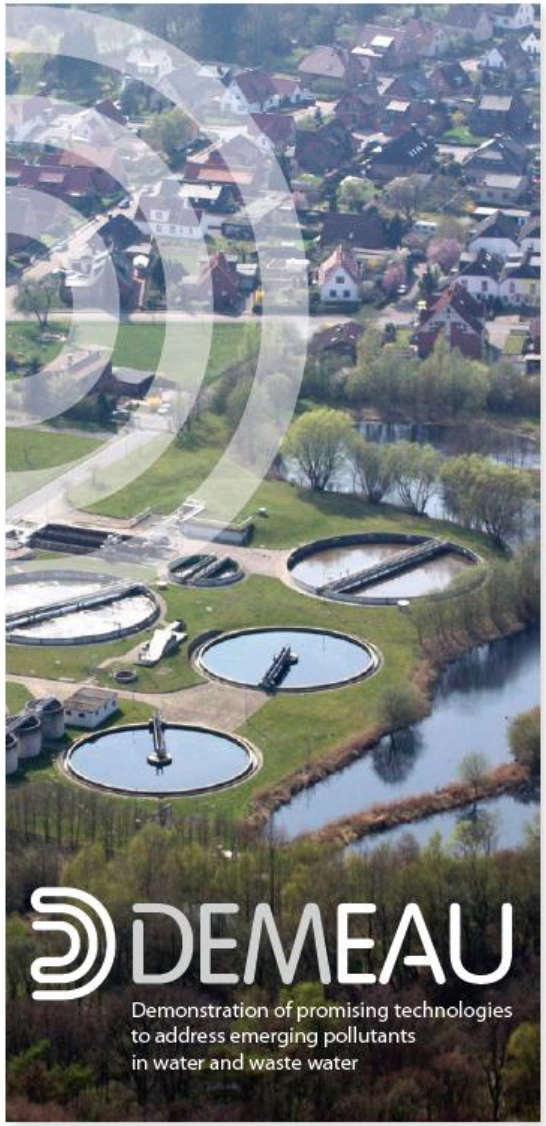


MAR Task Force Outcomes: Challenges and Research Needs

- Legislation
  - different authorizational approaches in EU member states
  ➔ supportive frame (especially within re-use schemes) necessary
- Health related risks
  - pathogens, persistent trace organics & transformation products
  ➔ development of “best management practices”
- Sustainability
  quality of infiltrated water to avoid irreversible impact on subsurface systems
  long-term stability
  ➔ life cycle assessment
- Technical and financial risks
  limited predictability, high investment costs
  ➔ definition of limiting conditions

FP7 Project DEMEAU

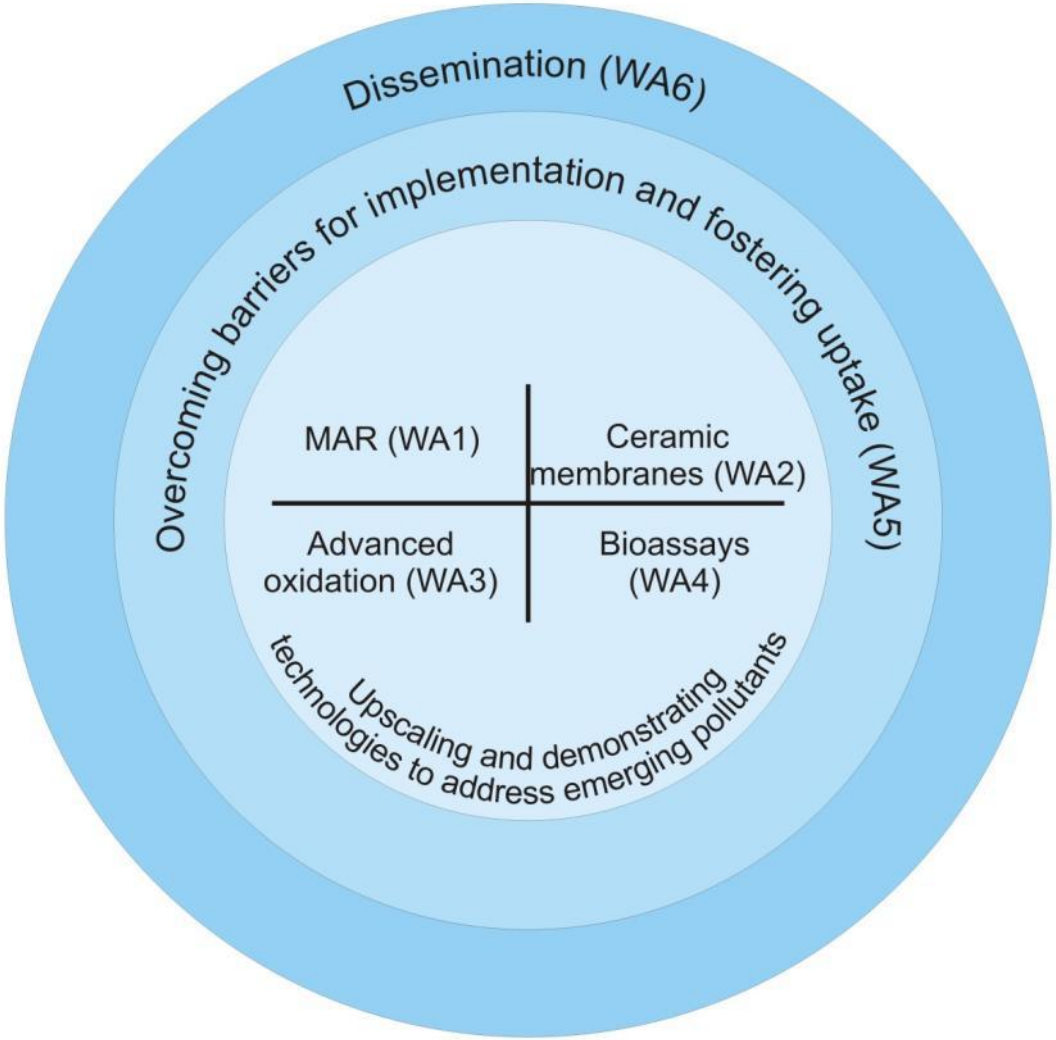
- DEMEAU: GA 308339
- EU Call: ENV.2012.6.5-2
- Total costs: 4.6 M€
- EC contribution: 3.0 M€
- Duration: 36 months
- Coordinator: KWR, dr. Theo van den Hoven
- Consortium: 17 partners from 5 countries
- (NL, DE, CH, FR, ES)
- Website: www.demeau-fp7.eu



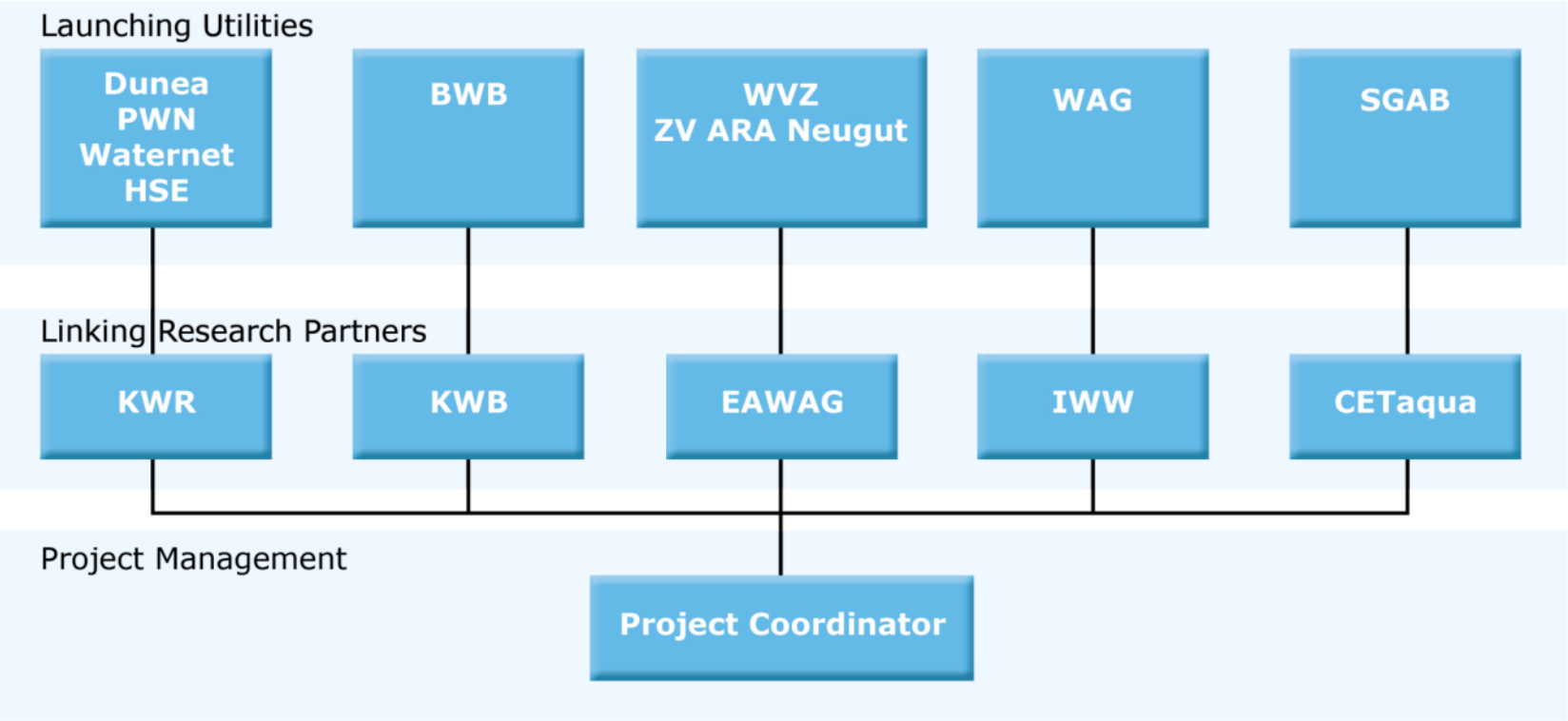
DEMEAU: Overall objective

To promote the uptake of knowledge, prototypes and practices from previous EU research enabling the water and wastewater sector to face emerging pollutants

Project scope and structure



Launching Utilities



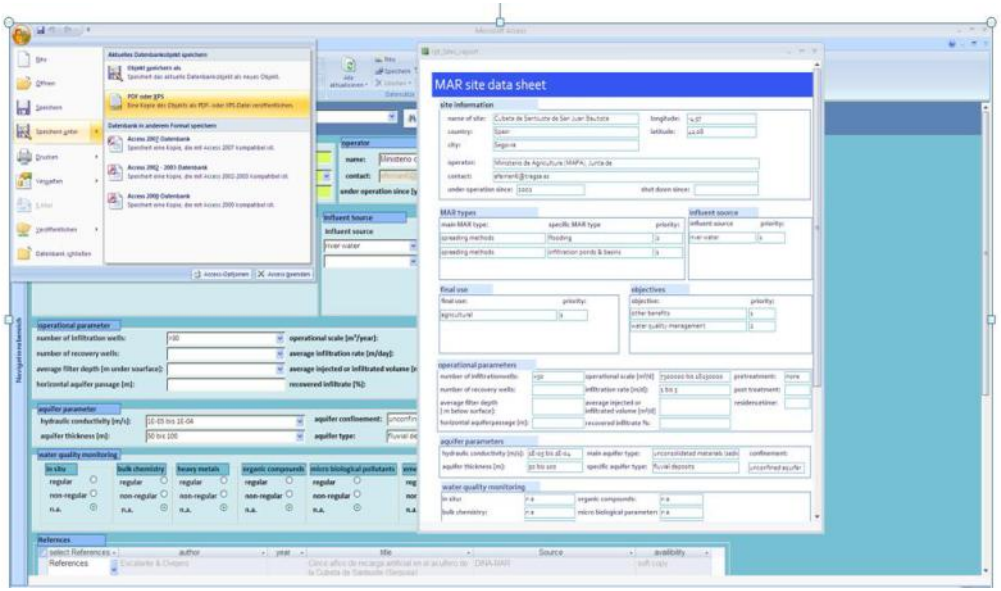
WA 1 Managed Aquifer Recharge

- Why do we address MAR in DEMEAU?
- the water framework directive stipulates MAR as a measure to restore the quantitative and qualitative good status of aquifers,
- within drinking water production and water re-use offer great benefits due to
  - high storage capacity,
  - low environmental foot-print,
  - additional purification (TSS, pathogens, BDOC).
- Drawback: some emerging pollutants may break through
- Barriers for widespread uptake:
  - high uncertainties regarding performance (➔ lack of transferable operational guidelines and design criteria)
  - EU groundwater directive prohibits deterioration of groundwater quality ➔ authorization procedure inconsistent (➔ lack of criteria for authorization of new sites)

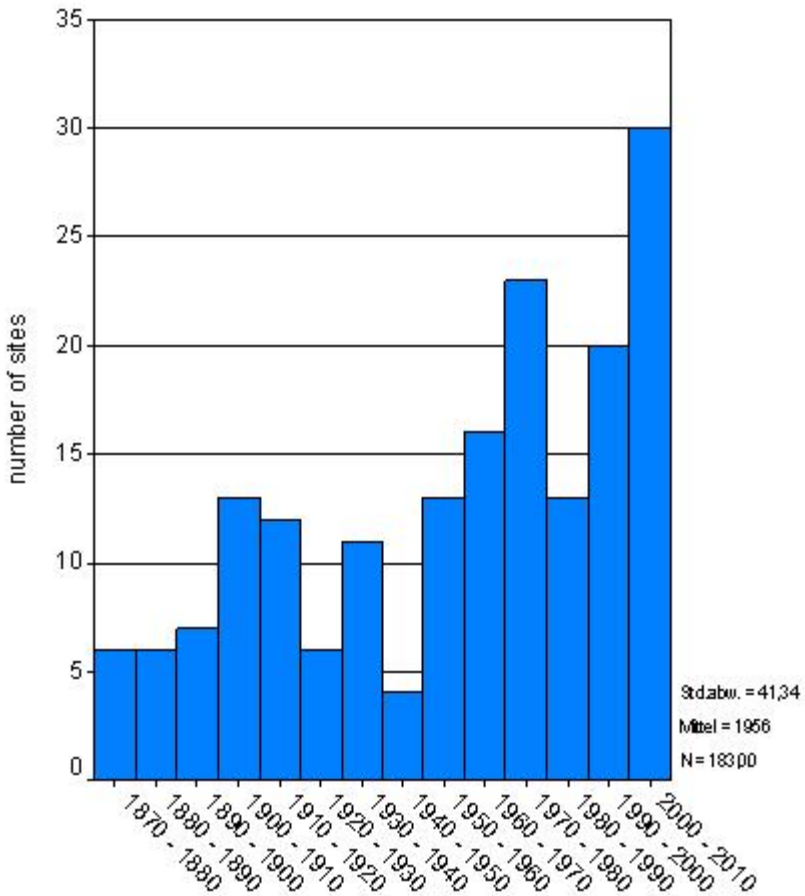
Results of EU projects like Techneau, Reclaim Water, Aquarec, Gabardine

Results so far

- Development of an MAR catalogue
- Approach for long-term impact evaluation
- Decision matrix for emerging pollutants' removal

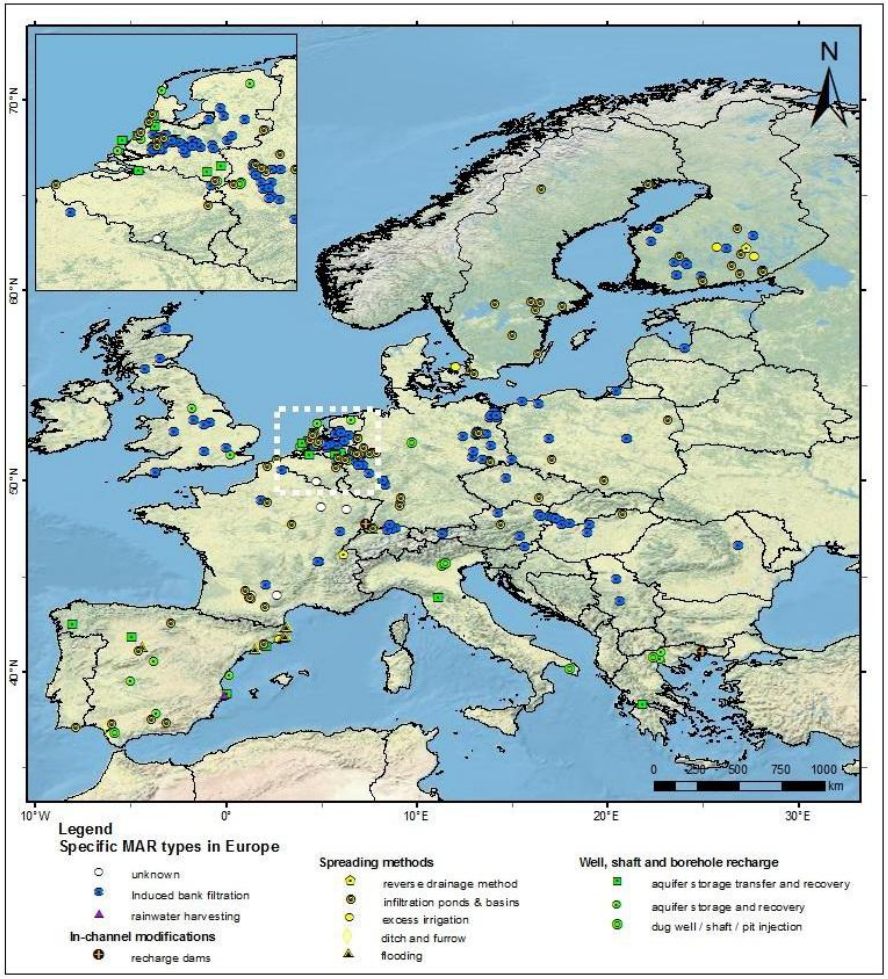


Historical development of MAR in Europe



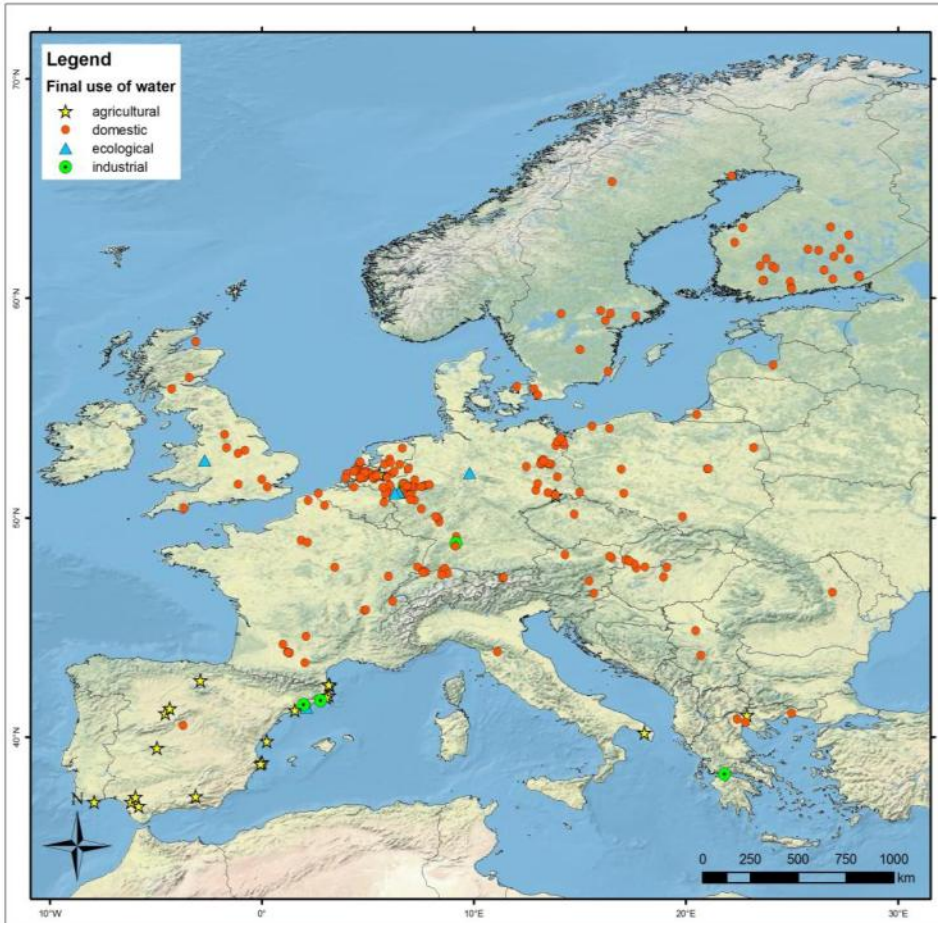
- First water works using BF and IP in 1870´s (Germany, Netherlands…)
- Increasing number of new sites in last decades (~230 sites catalogued in 2013)

MAR types in Europe



- Induced BF (51%), Infiltration Ponds (23%)
- BF at Rivers and Lakes in central, east and north Europe
- Infiltrations ponds and injection in south Europe (Spain)

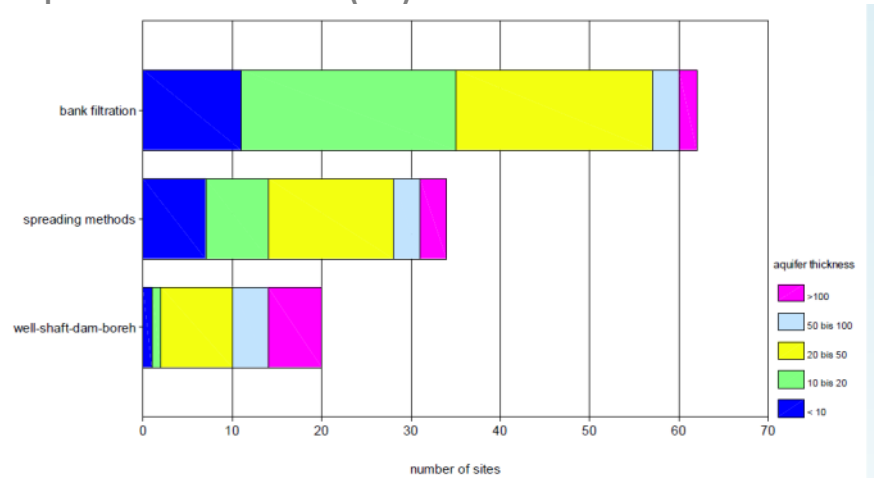
Final use of MAR water

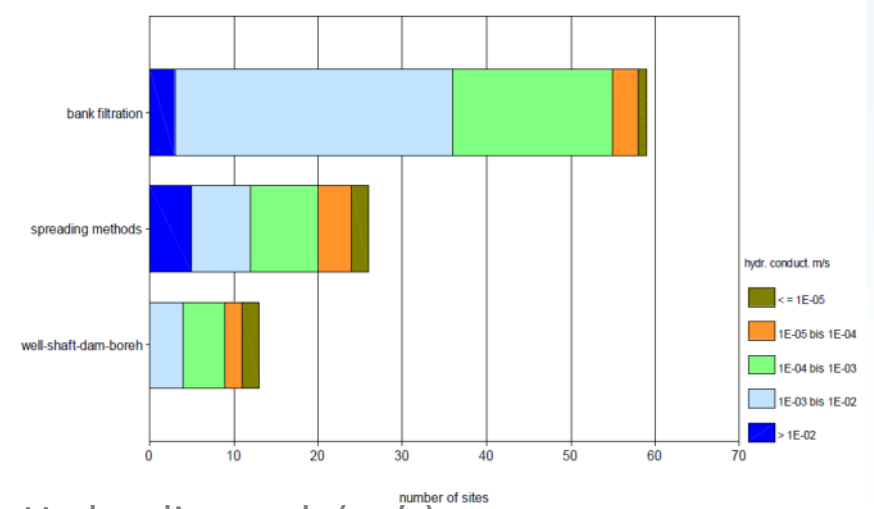


- Mostly agriculture in south Europe (Spain)
- Mostly drinking water in central and north Europe

Aquifer properties

Aquifer thickness (m)





Hydraulic cond. (m/s)

- MAR mostly in unconsolidated strata
- ASR/ASTR often in deep strata (>100 m)
- BF and IP often in shallow aquifer (10 – 50 m)
- BF and IP: $k = 10^{-4} – 10^{-2}$ m/s
- ASR/ASTR: $k = 10^{-5} – 10^{-3}$ m/s

Report and data base

- Report: „Catalogue of 286 Managed Aquifer Recharge Sites in Europe“
- Available under: http://demeau-fp7.eu/
- Data base completion ongoing, final version will be
  - To be integrated into IGRAC data-base
  - Available under http://demeau-fp7.eu/
- MAR catalogue is open for more input


DEMEAU

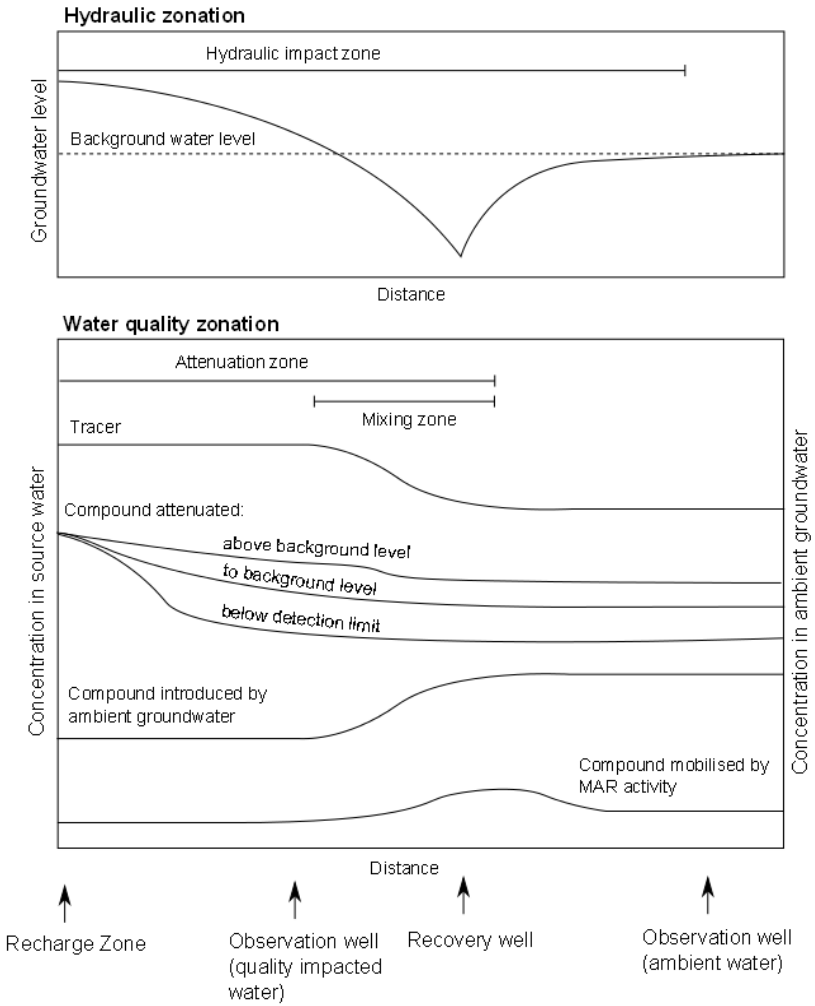
DEVELOPMENT OF A CATALOGUE ON EUROPEAN MAR SITES

DOCUMENTATION

SEVENTH FRAMEWORK PROGRAMME

The research leading to these results has received funding from the European Community's Seventh Framework Programme under Grant Agreement No.308339 (Project DEMEAU).

Long-term impact evaluation



Hydraulic impact zone:
recharge zone + pumping zone

Water quality impact zonation:
attenuation zone (incl. mixing)

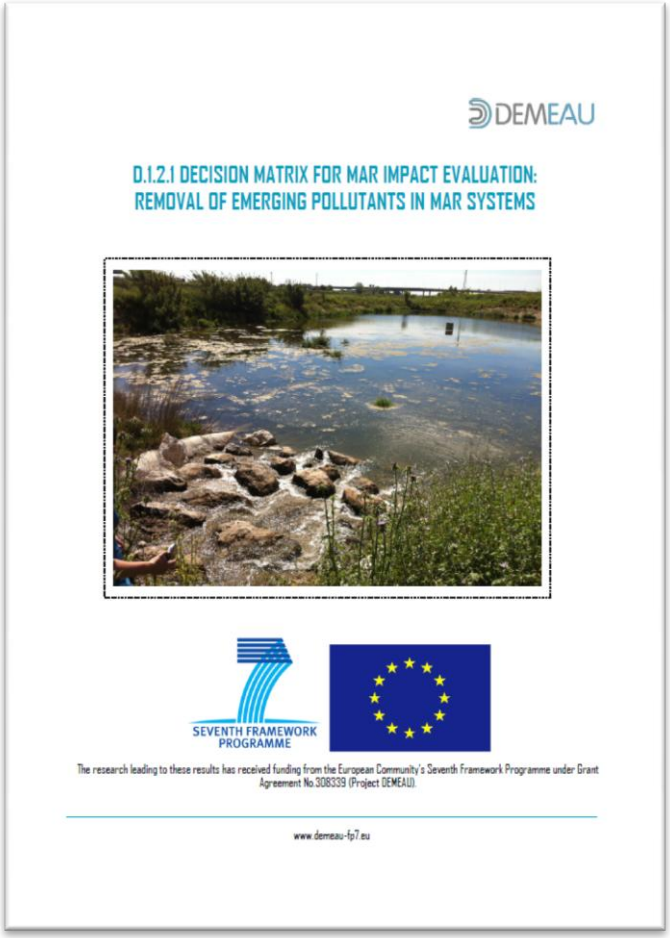
Different behavior and input paths of compounds:

- Tracer (used to calculate mixing proportions or travel times)
- Compounds attenuated to different levels
- Compound introduced by the ambient groundwater
- Compound mobilised by MAR activity

Sprenger et al. (in prep)

Decision matrix for emerging pollutants' removal

- Bibliographic review on trace organic removal rates in different Managed Aquifer Recharge (MAR) sites
- Identification of key parameters for removal
- Identification of optimum conditions for removal of 12 selected compounds



	Reduction zone			
	Oxic	NO3	Fe-Mn	SO4
< 7 days	Diclofenac			
< 1 month				
< 6 months				
< 1 year				
> 1 year				

	Reduction zone			
	Oxic	NO3	Fe-Mn	SO4
< 7 days				
< 1 month	Sulfamethoxazole			
< 6 months				
< 1 year				
> 1 year				

Vilanova et al. (in prep)

Summary and Outlook

- Managed Aquifer Recharge was identified as relevant, cross-cutting issue by the WssTP
- FP 7 project DEMEAU aims at developing recommendations for an environmental impact based approach for MAR authorization
- Catalogue of MAR sites in Europe completed
- Approach for long term impact evaluation developed and to be tested at different sites
- Decision matrix for emerging pollutants' removal developed
- Next steps:
  - Workshop for interested utilities 5th December in Berlin
  - Tool box for for deriving optimum design & operation
  - Definition of hydrogeological pre-requisites

Acknowledgements

WssTP Task Force MAR

For contributions to DEMEAU:

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