Demo site Llobregat, Barcelona (WP 6)

Albert Folch

Athens, March 16st 2016

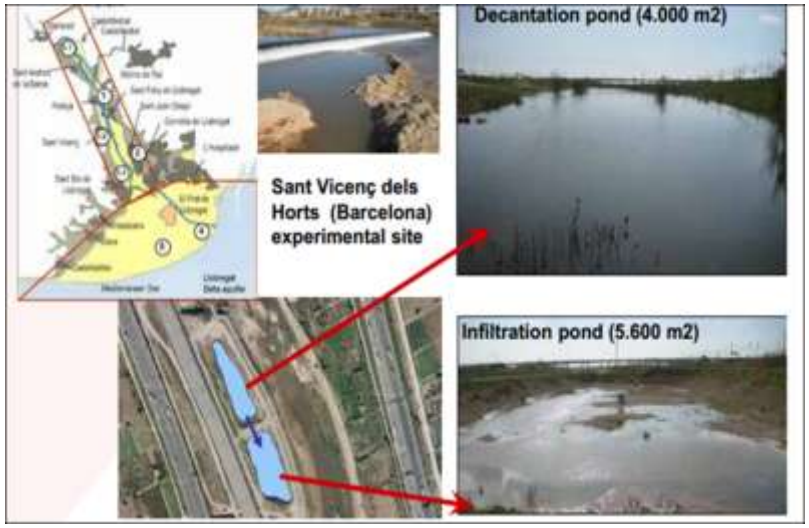
UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

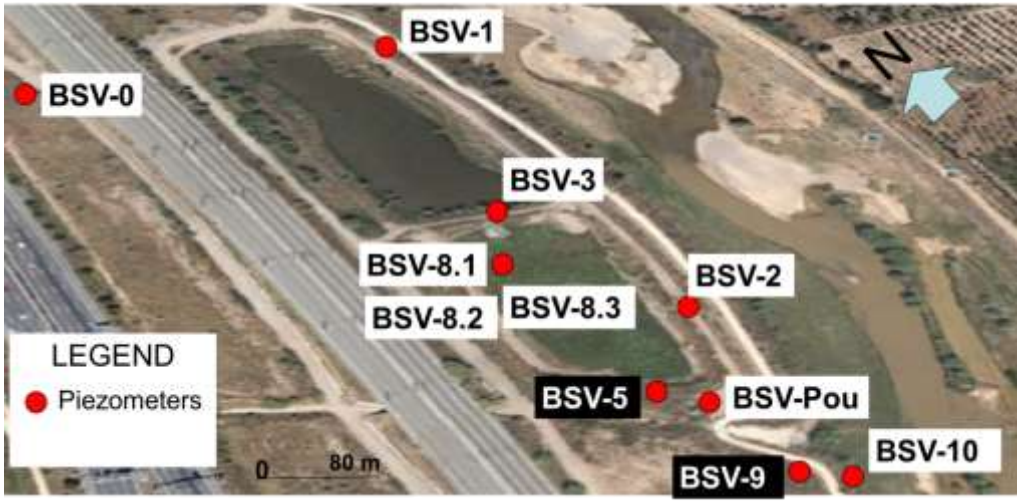
THE SITE

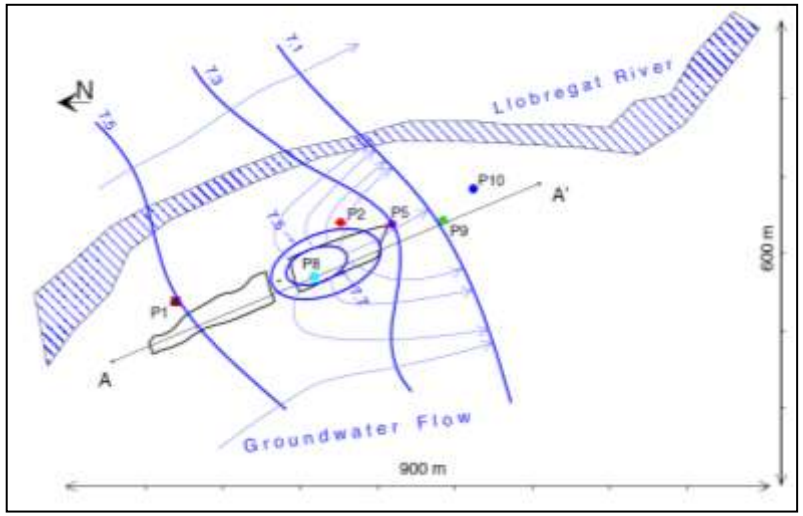
Barcelona

Sedimentation pond
Recharge pond
El Llobregat
El Llobregat

THE SITE







Hydraulic Parameters:

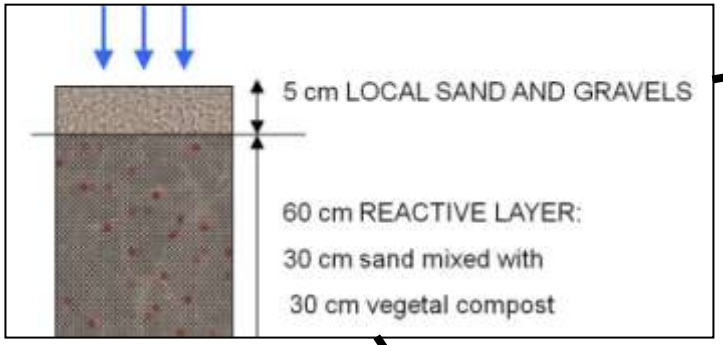
- Hydraulic Conductivity: 1000 m/day
- Local aquifer thickness: 10-15m
- Hydraulic gradient: 2.3 ‰

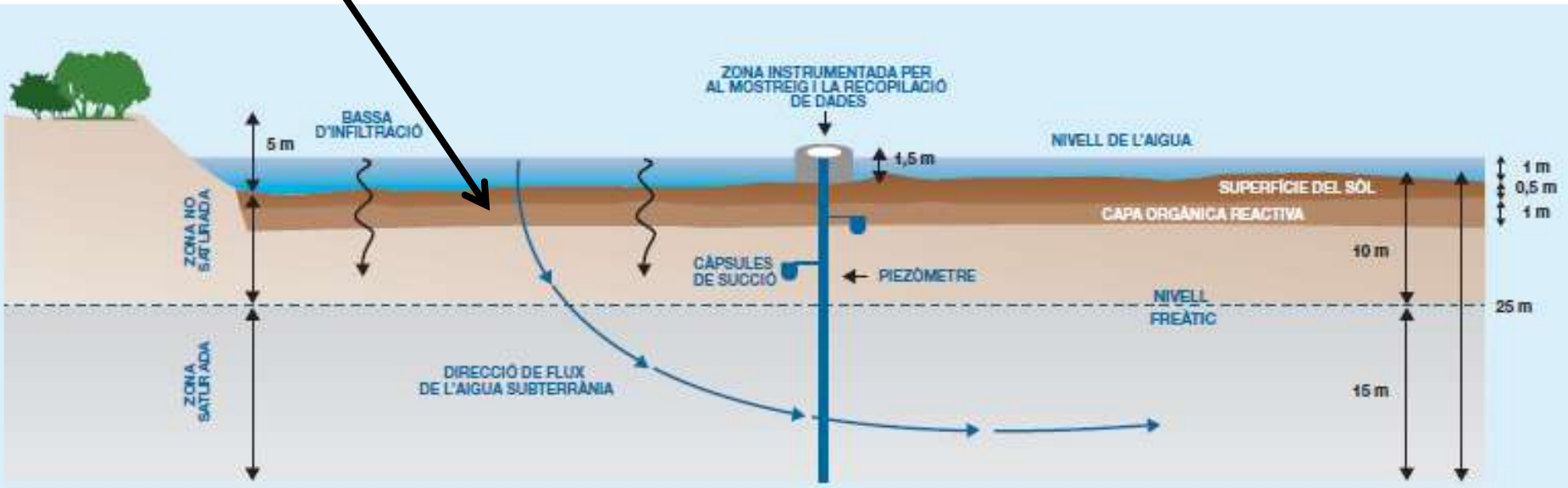
Operational parameters:

- Infiltration surface: ≈5600 m²
- Infiltration rate (average): 1m³/m²/day

WHAT IS THE FUNNY THING?

An active layer located at the bottom of an infiltration pond to enhance the degradation of certain contaminants.





WHAT IS THE FUNNY THING?

Degradation produced by microorganisms

Biodegradation

(Bio)clogging

What kind of bacteria we find and where?

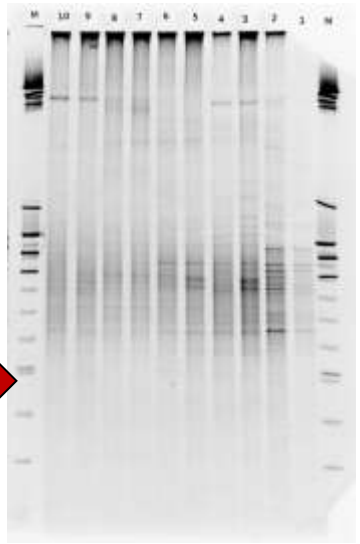
How are they affected by environmental conditions (T, sal, …)?

Sampling
(with Microbiologists)

Soil

Water

July 2014



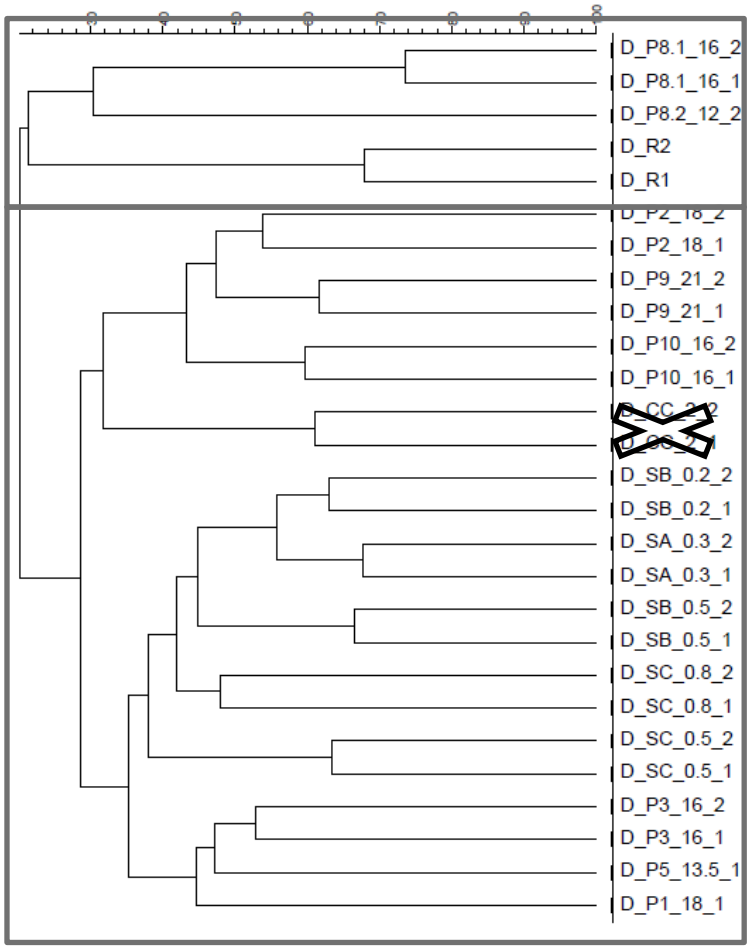
MICROBIOLOGY

What microbiological changes produce MAR with a reactive layer?

Dry period
(March 2015)

MICROBIOLOGY: Dendogram dry conditions

Generated by Cluster analysis using UPGMA algorithm representing the similarities between samples.



Band pattern 1
River
P8

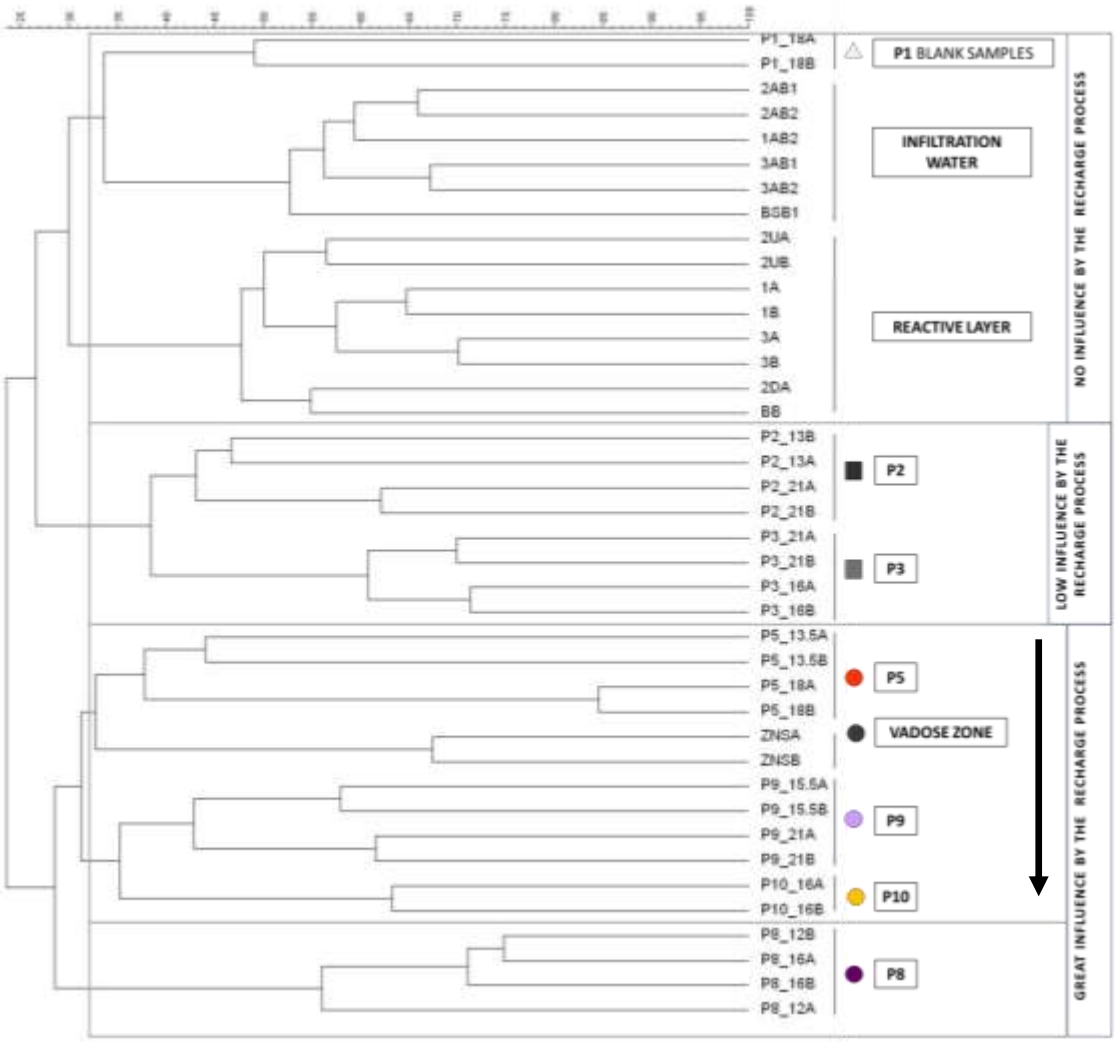
Band pattern 2

P2, P9,P10

Sediment

P3, P5, P1

MICROBIOLOGY: Dendogram under recharge conditions



MAR SOL MANAGED AQUIFER RECHARGE SOLUTIONS

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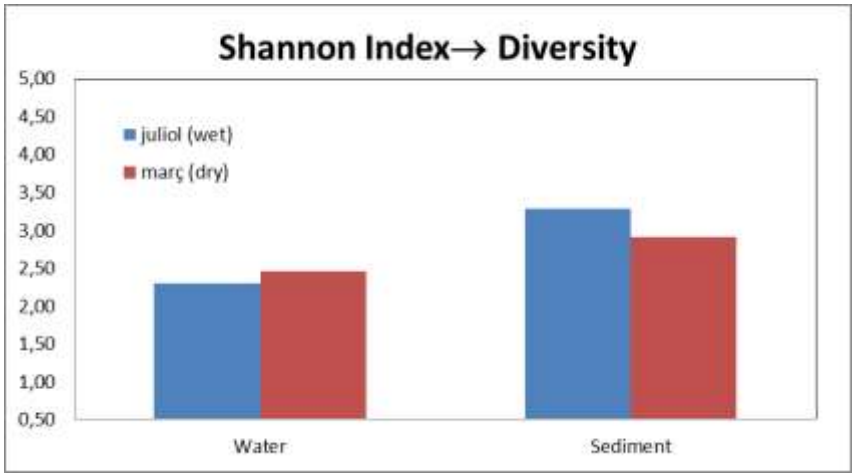
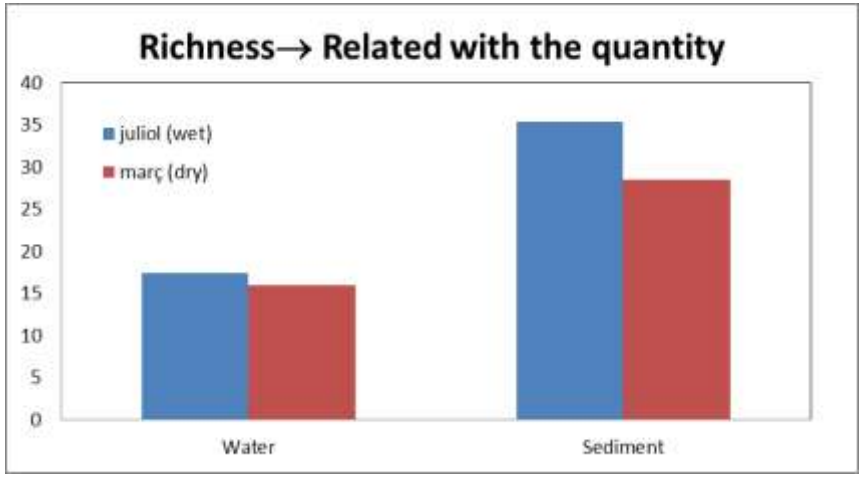
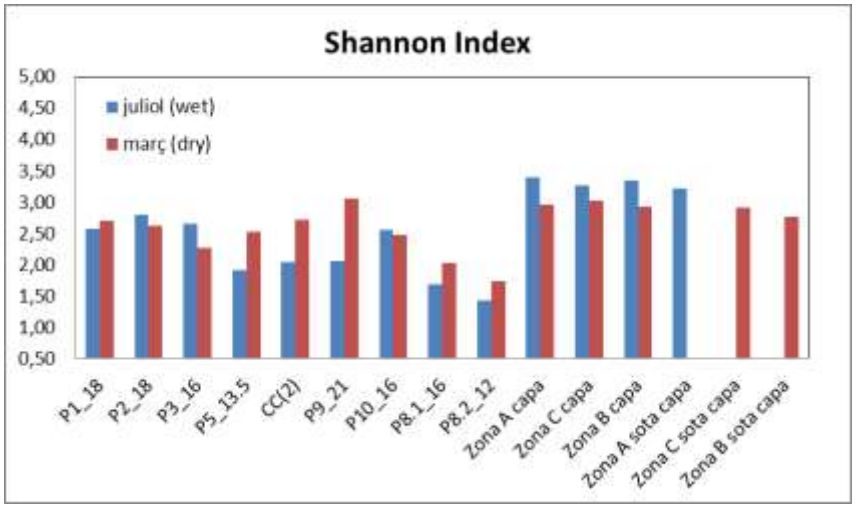
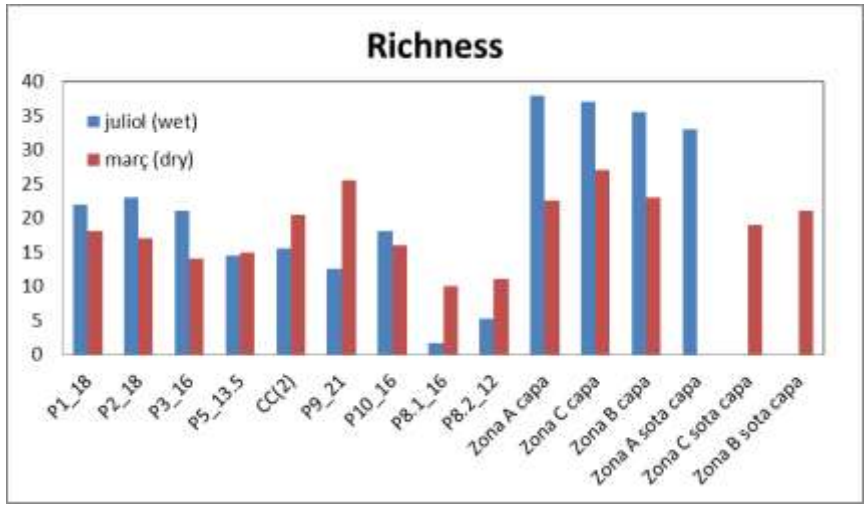
MICROBIOLOGY

What microbiological changes produce MAR with a reactive layer?





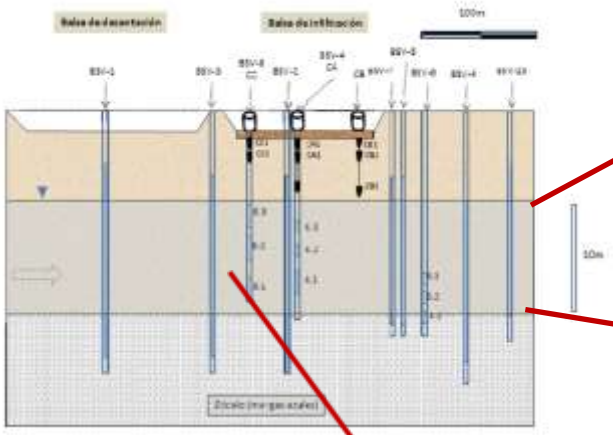


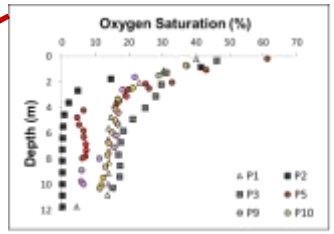


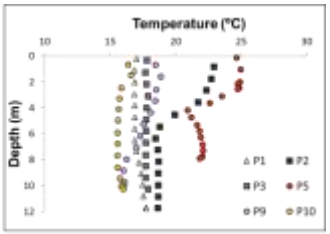
OTHER IMPORTANT PARAMETERS

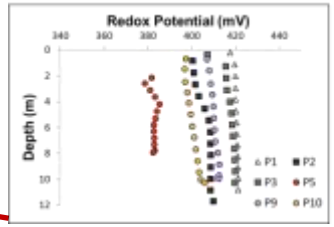
Measuring physicochemical parameters involved in microbiological activity

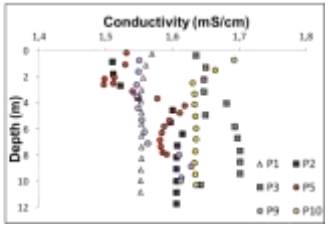
In Groundwater (Cond, T, DO, Eh)

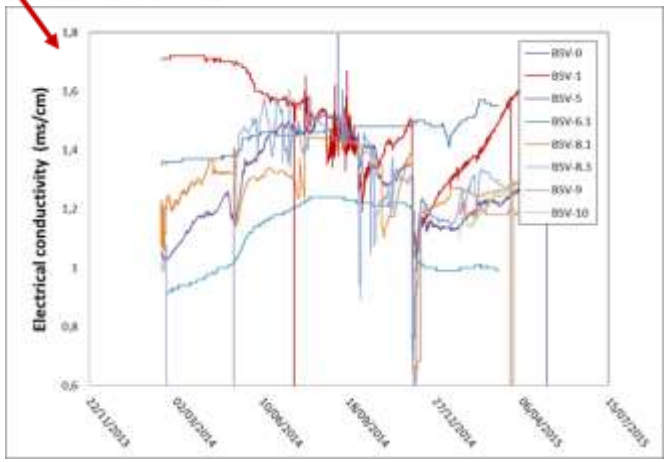


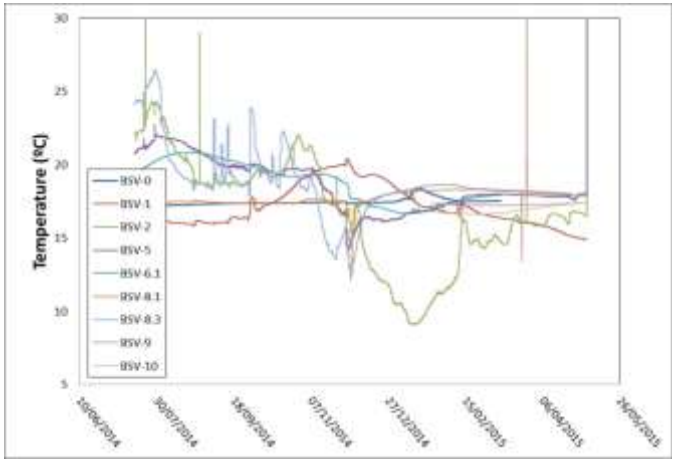




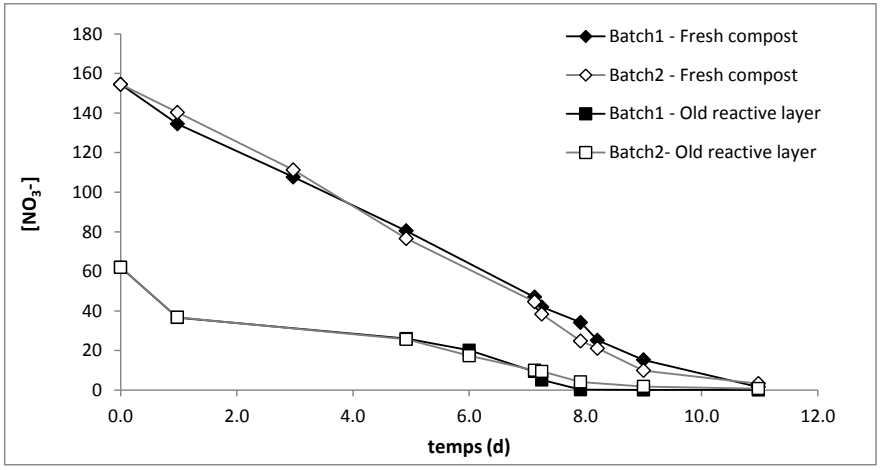






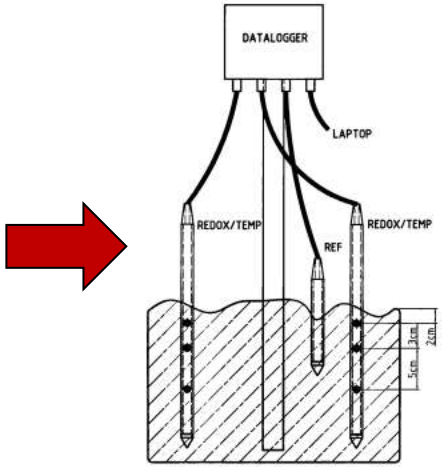


WHATS THE CICLE OF THE ORGANIC CARBON?



Batch experiments indicate that the reactive layer can induce denitrification even three years after installation

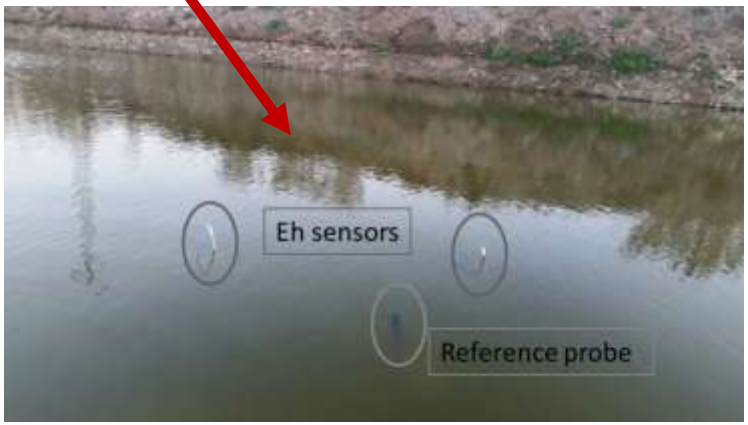
Continuous measurement of Eh and T



http://www.mvhconsult.nl/

WHATS THE CICLE OF THE ORGANIC CARBON?

Continuous measurement of Eh and T in Castebisbal ponds ⇒ Same water with no organic layer (17/02/2016)

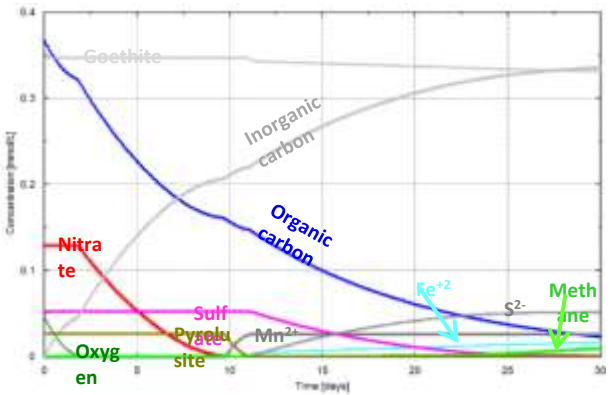


FUTURE WORKS (Mentioned in 2014)

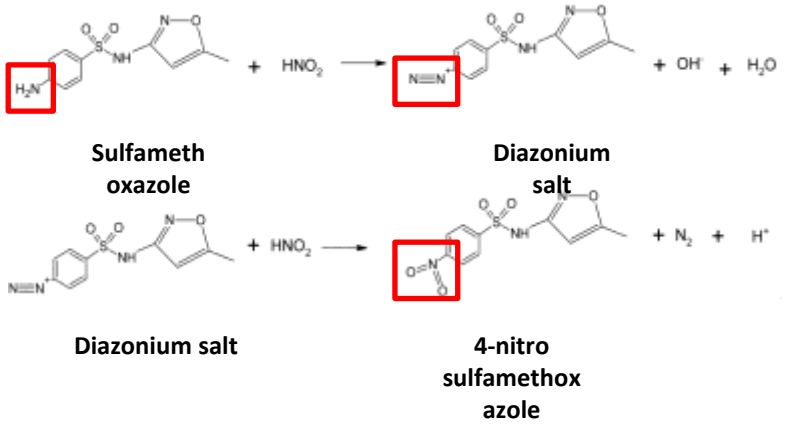
- **How to enhance natural attenuation of emerging pollutants in MAR applying engineering injection-extraction**

- Evaluating the degradation capabilities of different materials for reactive layers in MAR (Univ. Barcelona, WADISMAR).

- Understanding degradation mechanism of antibiotics: inside sulfamethoxazole and diclofenac.



Modeling organic matter degradation of reactive layer during MAR



Mechanism degradation of SMX under denitrifying conditions

HOW CAN CHAOTIC ADVECTION IMPROVE THE EMERGING POLLUTANTS DEGRADATION DURING MANAGED AQUIFER RECHARGE?

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CSIC
Consejo Superior de Investigaciones Científicas

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GOALS

To demonstrate if chaotic advection **increases the mixing** between recharged solution and groundwater in an infiltration recharge pond.

To demonstrate if chaotic advection improves the **redox reaction processes.**

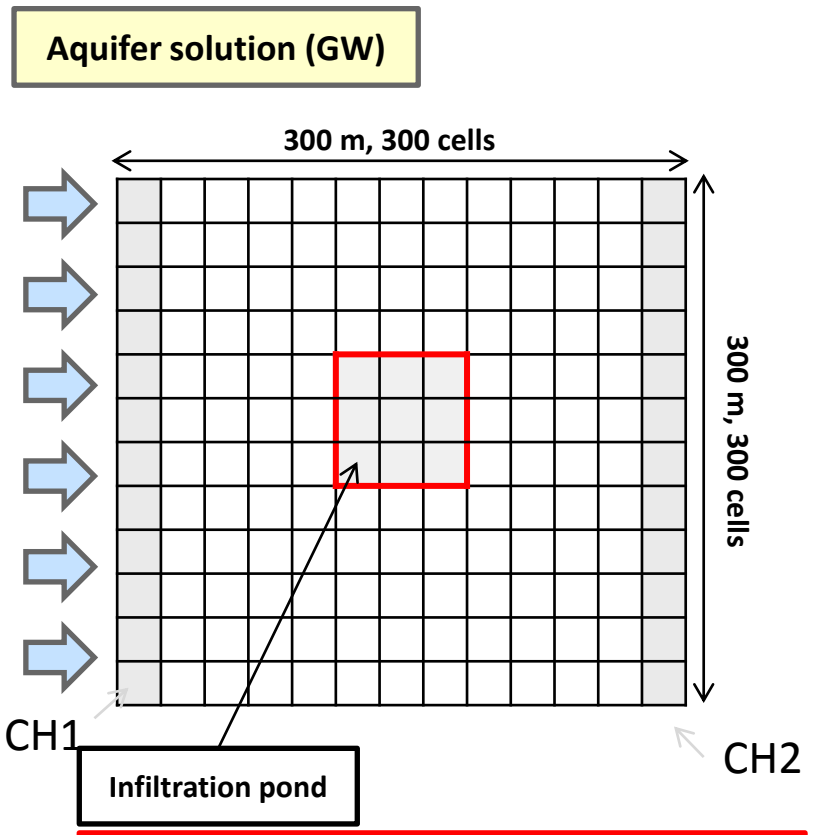
To evaluate if an **emerging compound degradation (3 benzotriazoles) is improved** by applying chaotic advection.

WHAT IS THE EFFECT OF HETEROGENITY?

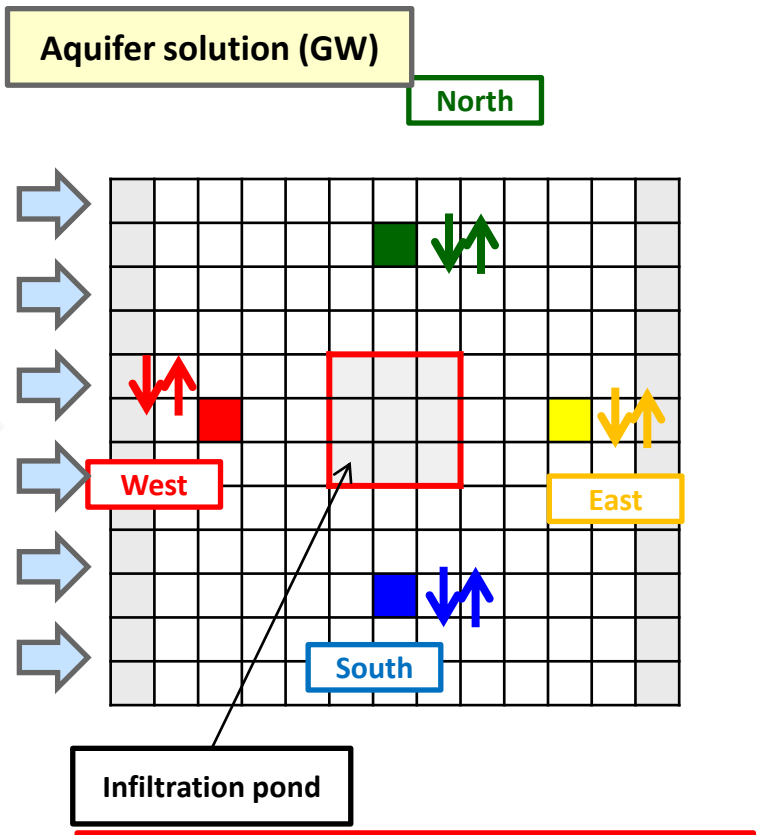
SET-UP

Model sketch

These models only reproduce the saturated zone.
2D MODEL



With chaotic advection



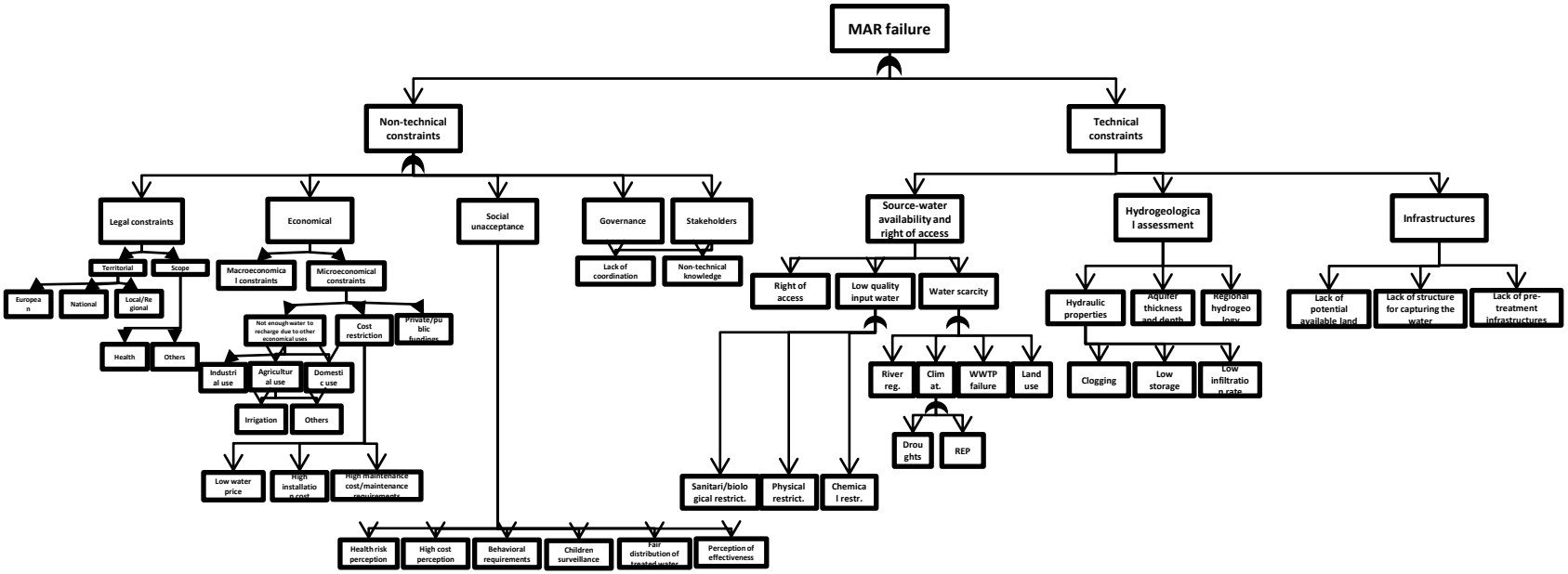
WE NEED YOUR HELP

FAULT TREE OF INFILTRATION POUNDS IN MANAGED AQUIFER RECHARGE

DESIGN + CONSTRUCTION v3

NC: Nitrogen cycle
EC: Emerging compound
OM: Organic matter
REP: Rainfall event periodicity
NU: Nutrients

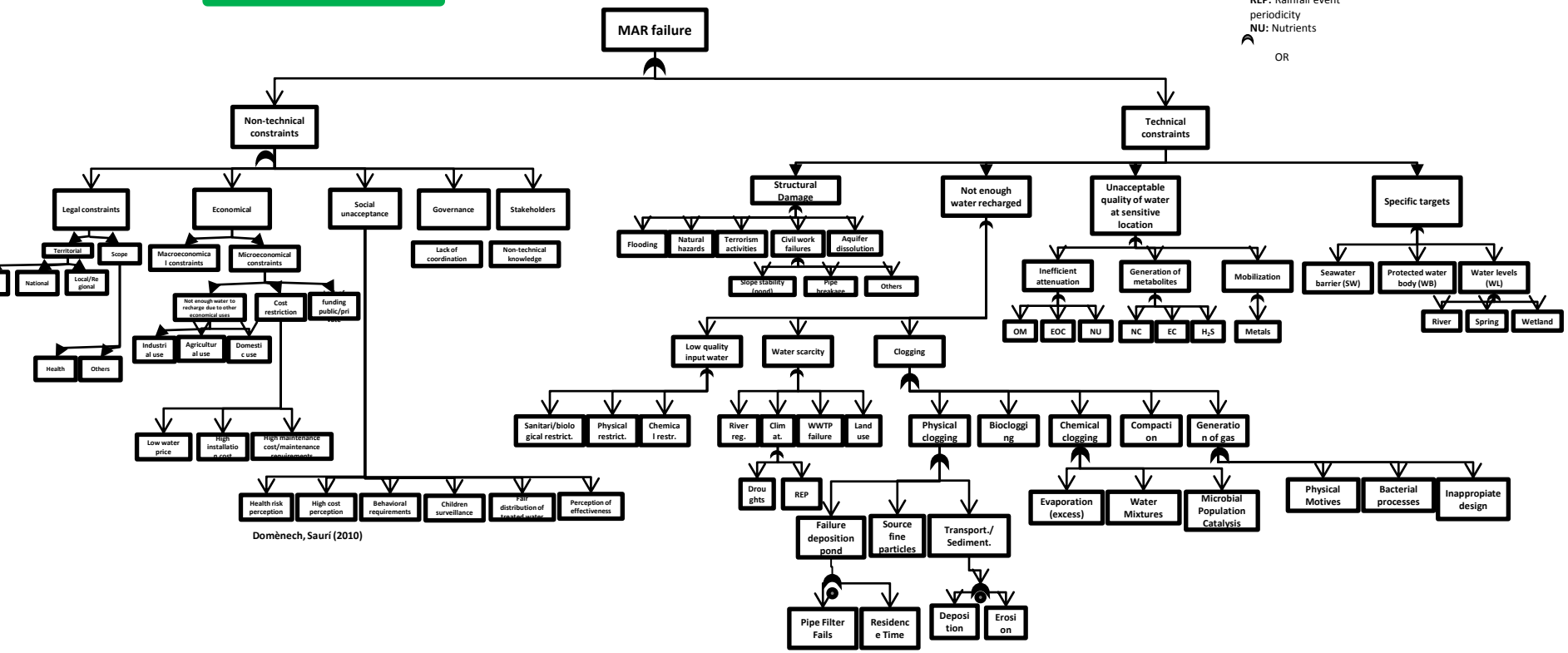
OR



Domènech, Saurí (2010)

Mankad et al. (2009) Journal of Cleaner Production

OPERATIONAL
v3



Domènech, Saurí (2010)

NC: Nitrogen cycle
EC: Emerging compound
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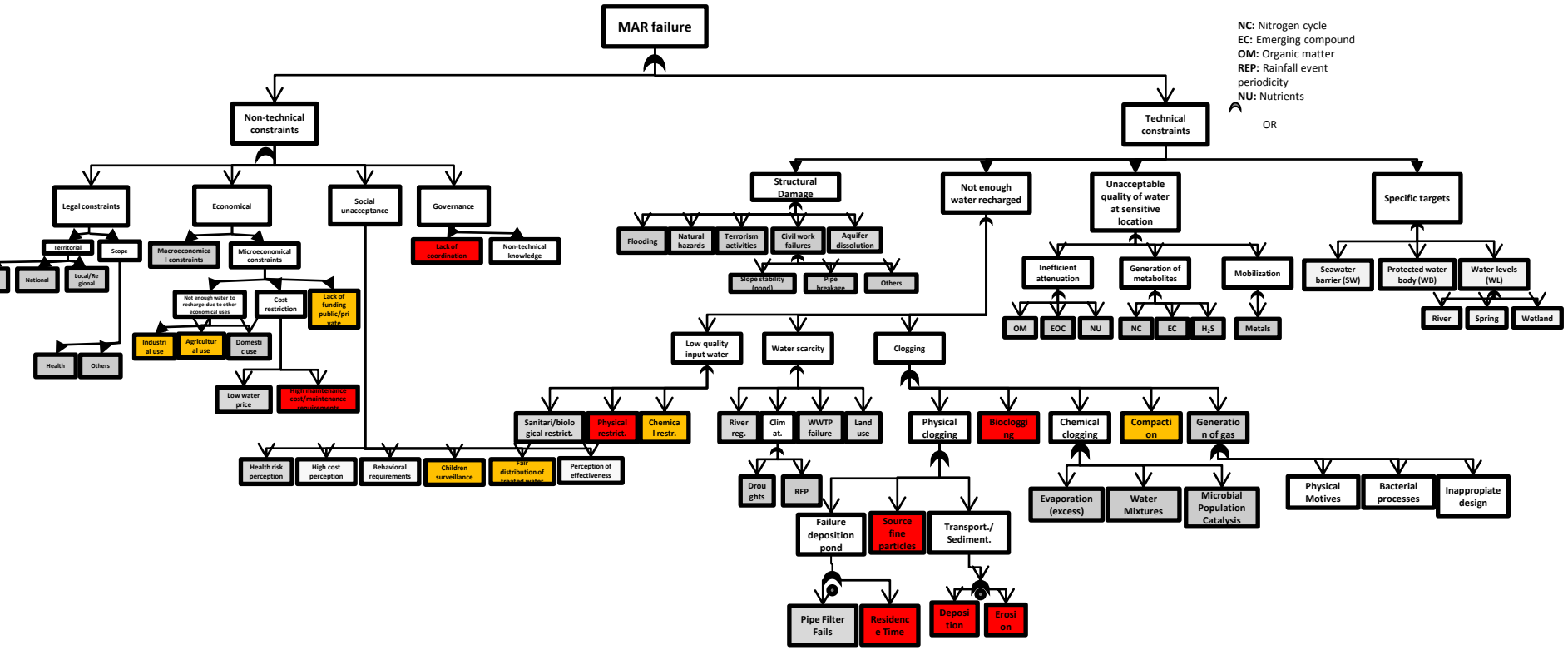
OR

LLOBREGAT SITE



ANSWER A CUESTIONARE

II. OPERATIONAL PROCESSES

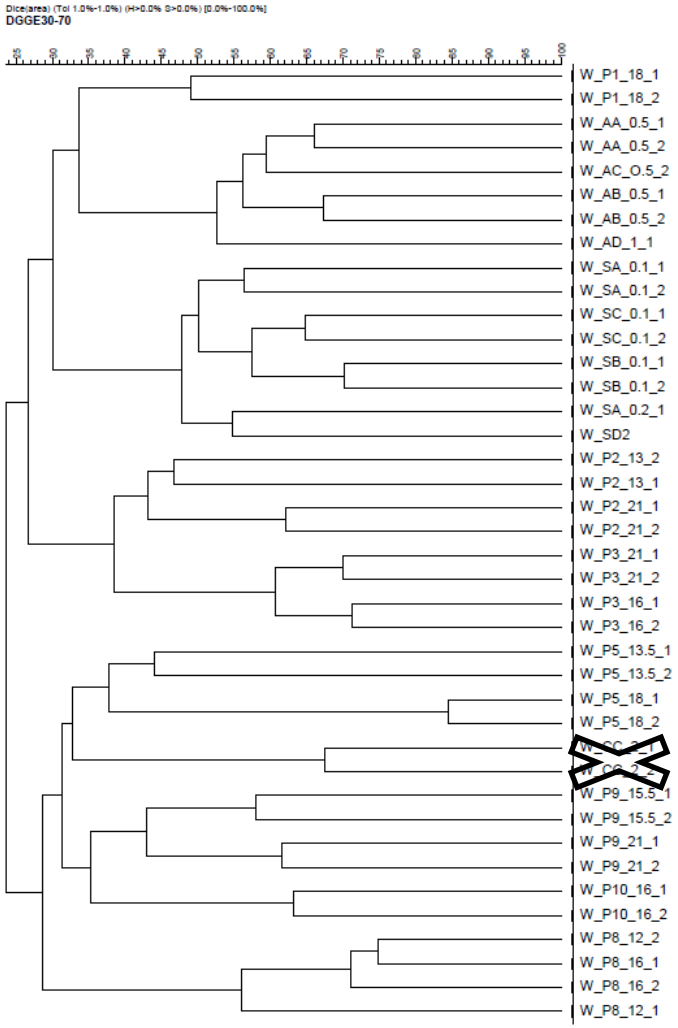
Please, answer the questions asking yourself if in your MAR facilities exists these types of risk. If YES, try to quantify as high, medium or low risk. If you do not know the risk, mark unknown.		HIGH	MEDIUM
1 NON-TECHNICAL CONSTRAINTS			
1.1 Legal constraints	Y / N		
1.1.1 Territorial constraints	Y / N		
1.1.1.1 European	Y / N		
1.1.1.2 National	Y / N		
1.1.1.3 Regional/Local	Y / N		
1.1.2 Scope of legislation	Y / N		
1.1.2.1 Health legislation	Y / N		
1.1.2.2 Others	Y / N		
1.2 Economic constraints	Y / N		
1.2.1 Macroeconomic constraints	Y / N		
1.2.2 Microeconomic constraints	Y / N		
1.2.2.1 Not enough water to recharge due to other economical uses	Y / N		
1.2.2.1.1 Industrial use	Y / N		
1.2.2.1.2 Agricultural use	Y / N		
1.2.2.1.3 Domestic use	Y / N		
1.2.2.2 Cost restriction	Y / N		
1.2.2.2.1 Low price of water	Y / N		
1.2.2.2.2 High installation cost	Y / N		
1.2.2.2.3 High maintenance cost/maintenance requirements	Y / N		
1.3 Social unacceptance	Y / N		
1.3.1 Health risk perception	Y / N		
1.3.2 High cost perception	Y / N		
1.3.3 Behavioral requirements	Y / N		
1.3.4 Children surveillance	Y / N		
1.3.5 Fair distribution of treated water	Y / N		
1.3.6 Perception of effectiveness	Y / N		
1.4 Governance	Y / N		
1.5 Lack of coordination among stakeholders involved in MAR	Y / N		
1.5.1 Lack of coordination	Y / N		
1.5.2 Non-technical knowledge	Y / N		
2 TECHNICAL CONSTRAINTS			
2.1 Structural Damages (if YES continue)	Y / N		
2.1.1 Flooding	Y / N		

THE END

Thank you

QUESTIONS?

DISCUSSION?

MICROBIOLOGY: Dendrogram under recharge conditions

Generated by Cluster analysis using UPGMA algorithm representing the similarities between samples.