Applicability of managed aquifer recharge to achieve the goals of sustainable development facing climate change in semi-arid regions (Southern Spain)

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Centre of Hydrogeology of the University of Malaga

International Conference "Groundwater, key to the Sustainable Development Goals".

Paris, May 18-20th, 2022

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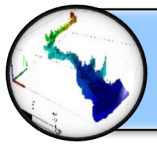
Objectives, SDGs and Water management

Applicability of Managed Aquifer Recharge to achieve the goals of sustainable development facing climate change in semi-arid regions (Southern Spain)

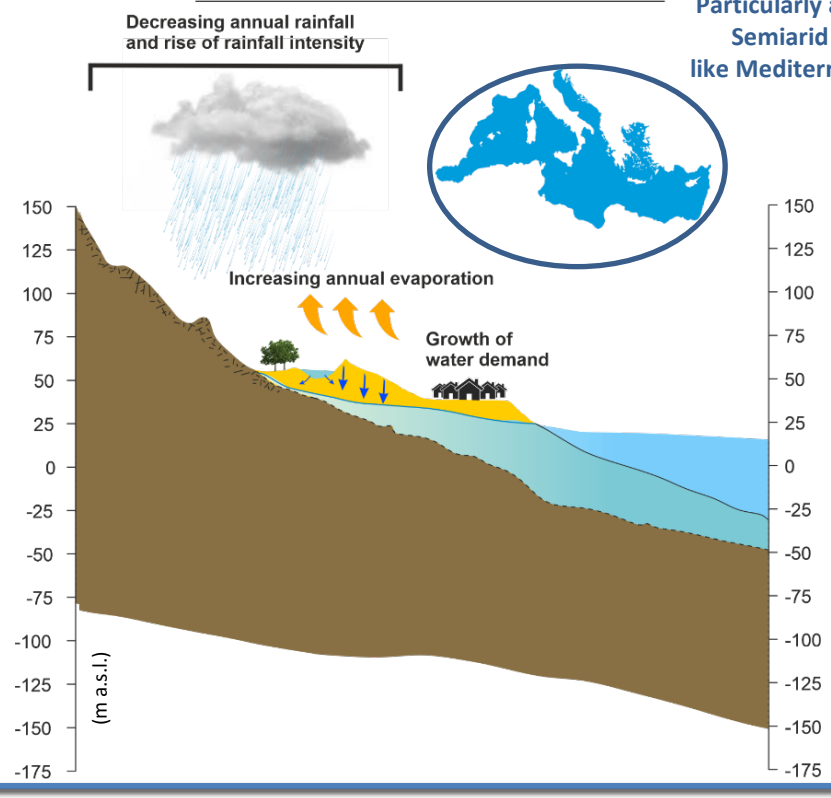
OBJECTIVES



To define the prior research needed for better selection of MAR techniques and effectiveness in the design

Synthesizes a series of previous experiences carried out in South Spain involving the Centre of Hydrogeology of the University of Malaga (CEHIUMA)

WATER MANAGEMENT PROBLEMS

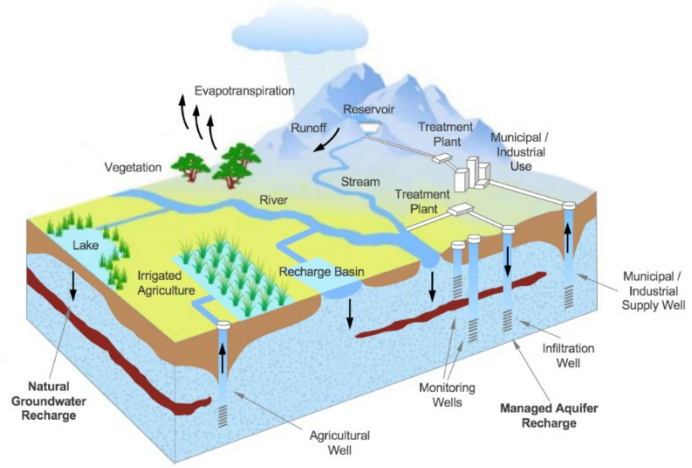


Particularly alarming in Semiarid regions like Mediterranean area

Improving security of supply and achieving the Sustainable Development Goals (SDGs).

SUSTAINABLE DEVELOPMENT GOALS

6 CLEAN WATER AND SANITATION

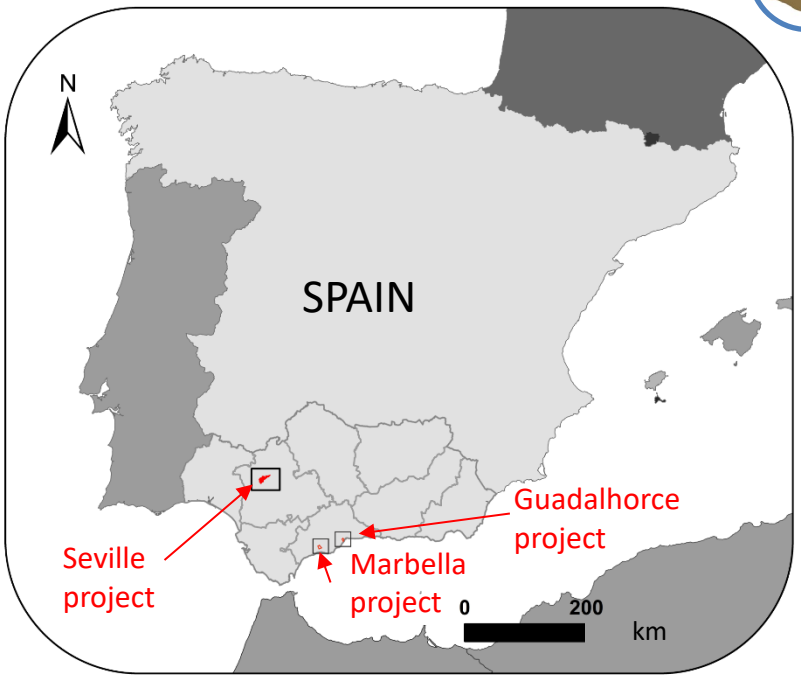


The role of managed aquifer recharge in water resources management (adapted from California Department of Water Resources)

Hydrogeological characterization and MAR

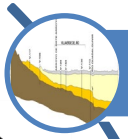
Applicability of Managed Aquifer Recharge to achieve the goals of sustainable development facing climate change in semi-arid regions (Southern Spain)

Managed Aquifer Recharge (MAR) is considered an increasingly important water management strategy to enhance the quantity and quality of groundwater as a key step towards achieving the SDGs.



Location of previous experiences carried out in Southern Spain involving the Centre of Hydrogeology of the University of Malaga (CEHIUMA)

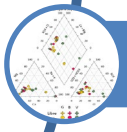
Hydrogeological characterization


Definition of aquifer geometry and limits to estimate storage capacity


Assessment of hydraulic properties


Quantification of the groundwater budget


Hydrogeological conceptual and numerical model


Groundwater quality monitoring


Availability of water to be recharged

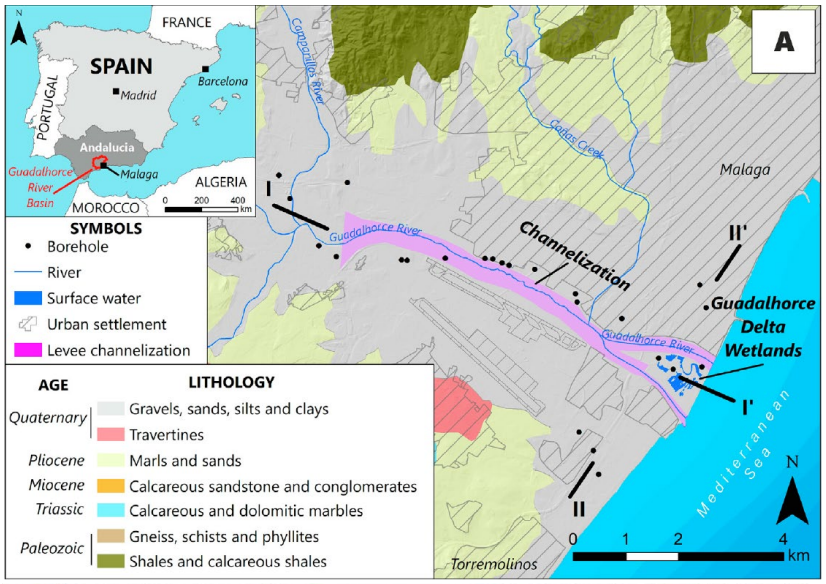

Social and economic drivers

Guadalhorce project

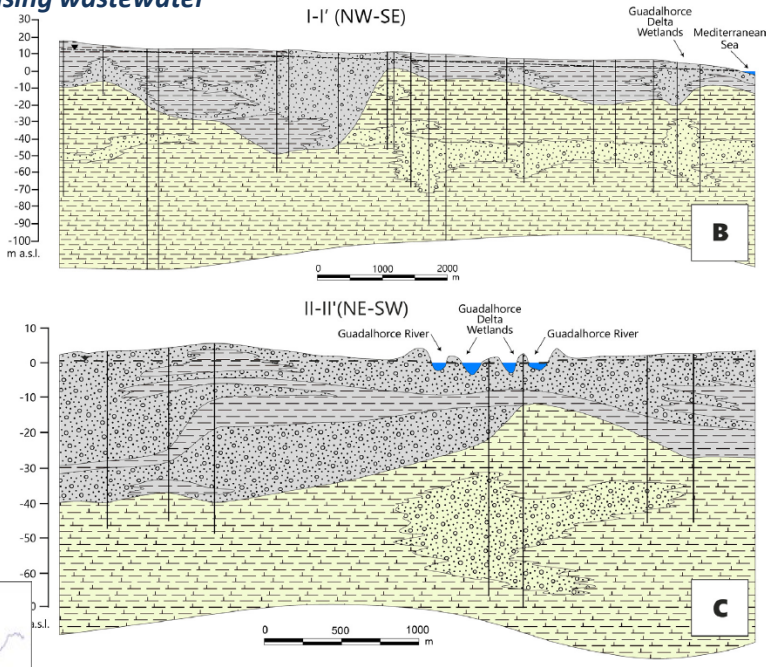
Applicability of Managed Aquifer Recharge to achieve the goals of sustainable development facing climate change in semi-arid regions (Southern Spain)

Wetland restoration in the alluvial formation of the Guadalhorce River Mouth (Malaga) using wastewater

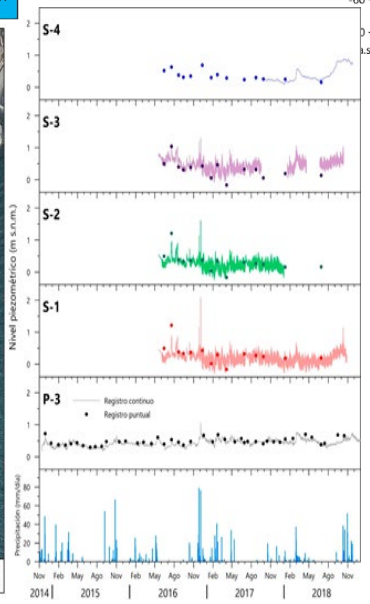
(Nieto et al., 2020)



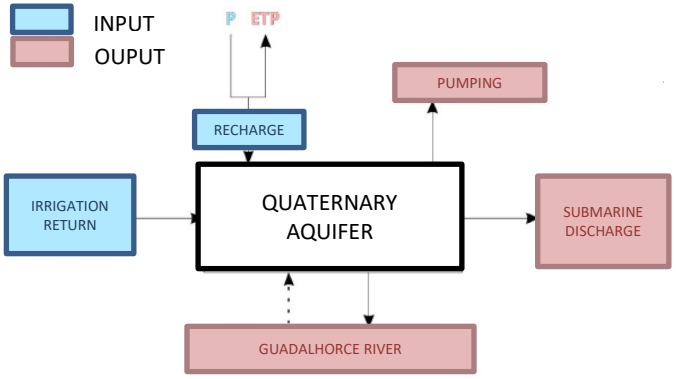
Definition of aquifer geometry and limits to estimate storage capacity



Piezometric level control



Quantification of the groundwater budget



Guadalhorce project

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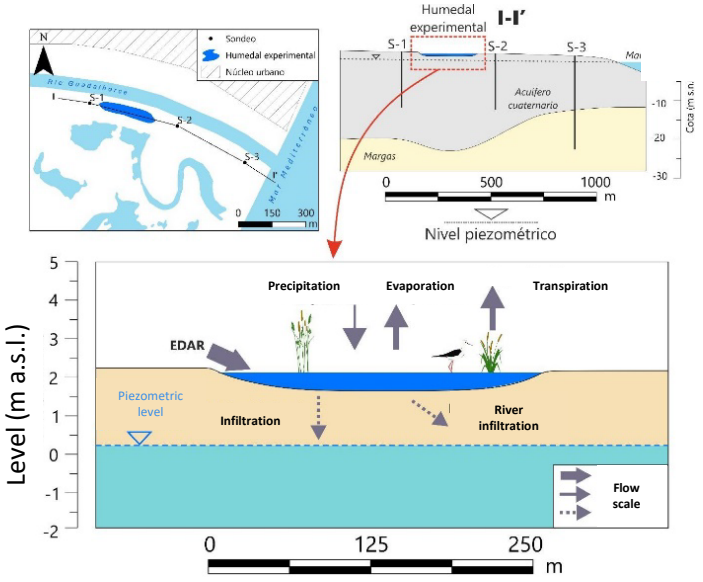
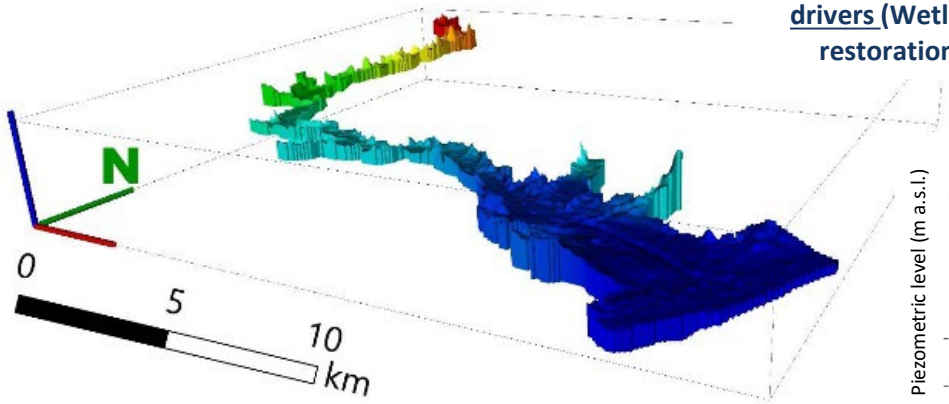
Wetland restoration in the alluvial formation of the Guadalhorce River Mouth (Malaga) using wastewater

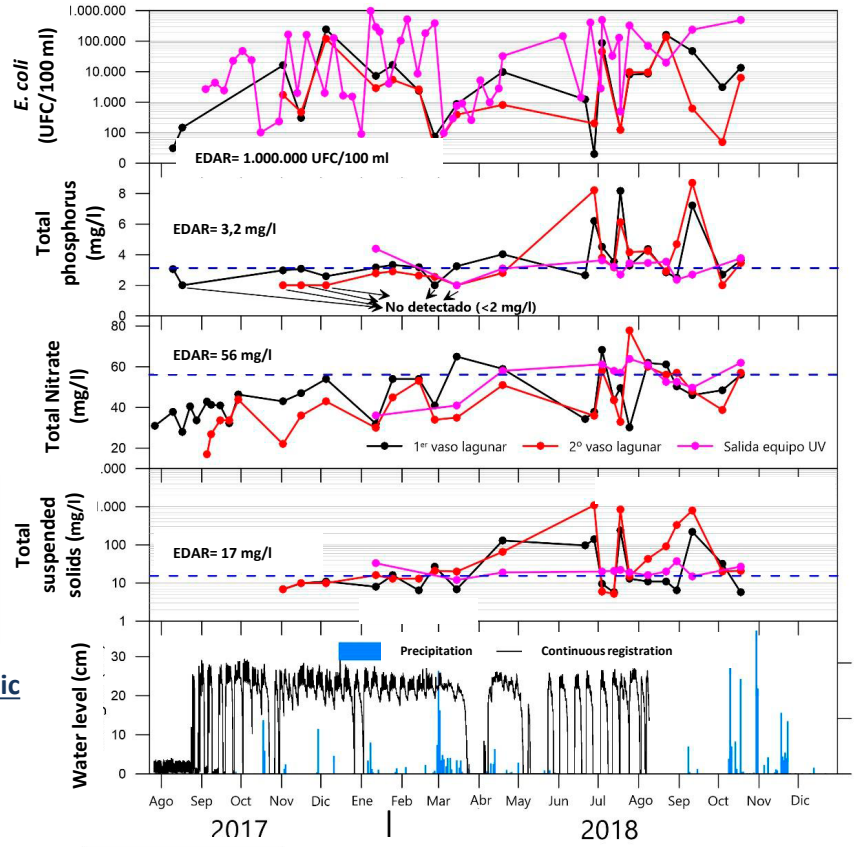
Hydrogeological conceptual and numerical model (Modflow)



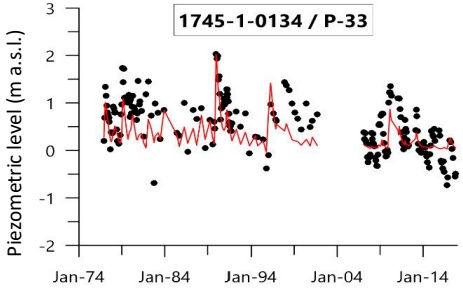
(Nieto, 2020)



Groundwater quality monitoring



Social and economic drivers (Wetland restoration)



Availability of water to be recharged (wastewater)

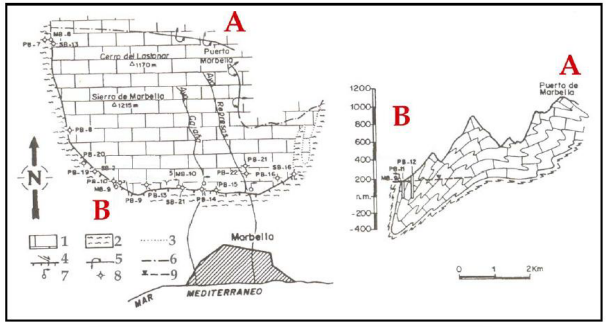
Marbella project I

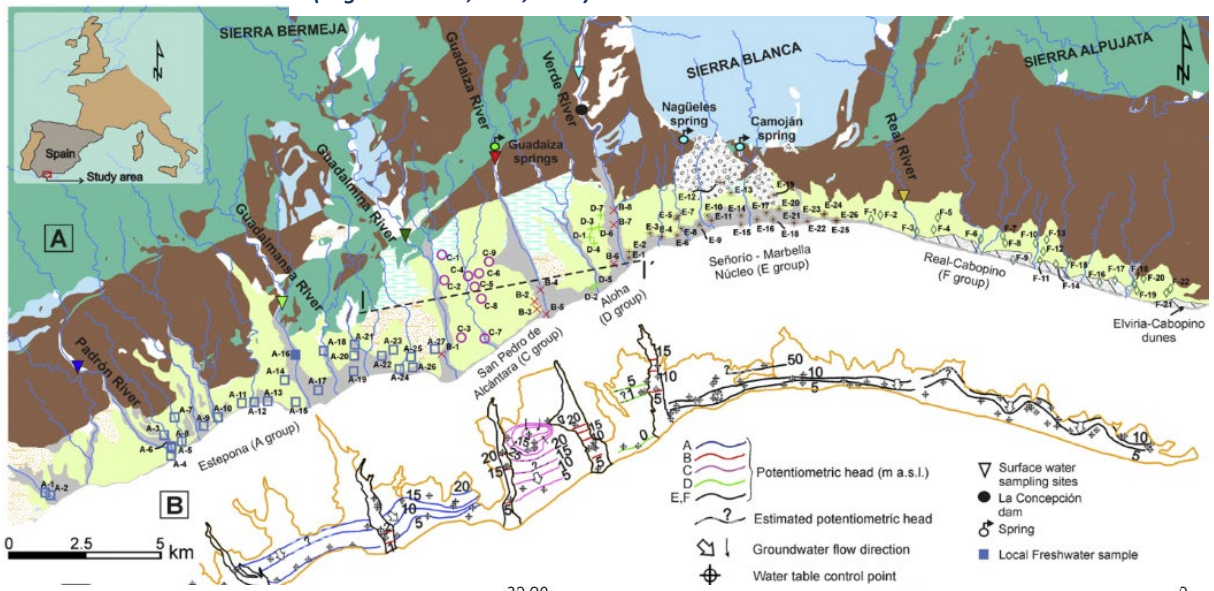
Applicability of Managed Aquifer Recharge to achieve the goals of sustainable development facing climate change in semi-arid regions (Southern Spain)

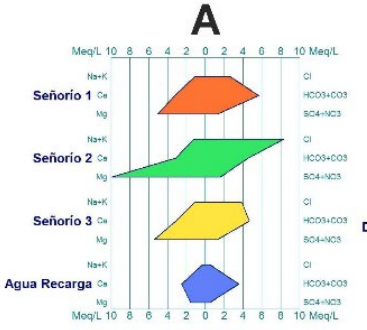
Experiences in the overexploited coastal detrital aquifers of Marbella (Malaga) using surface water from an overflow karst spring

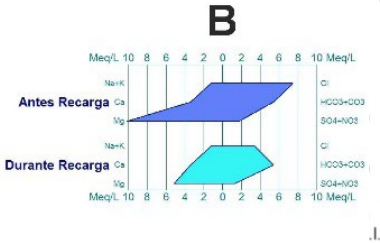
Definition of aquifer geometry and limits to estimate storage capacity

(Argamasilla M; et al, 2016)

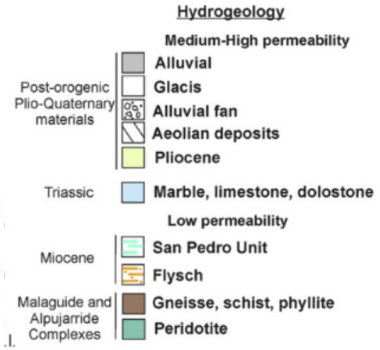


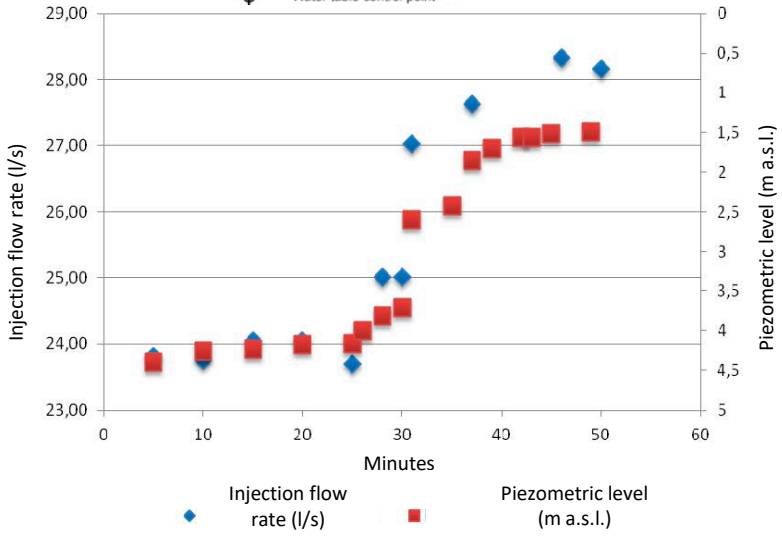






Groundwater quality monitoring (importance of mixing water)





Evolution of the piezometric level and injection flow in one of the injection boreholes (data provided by Aquagest)

Marbella project I

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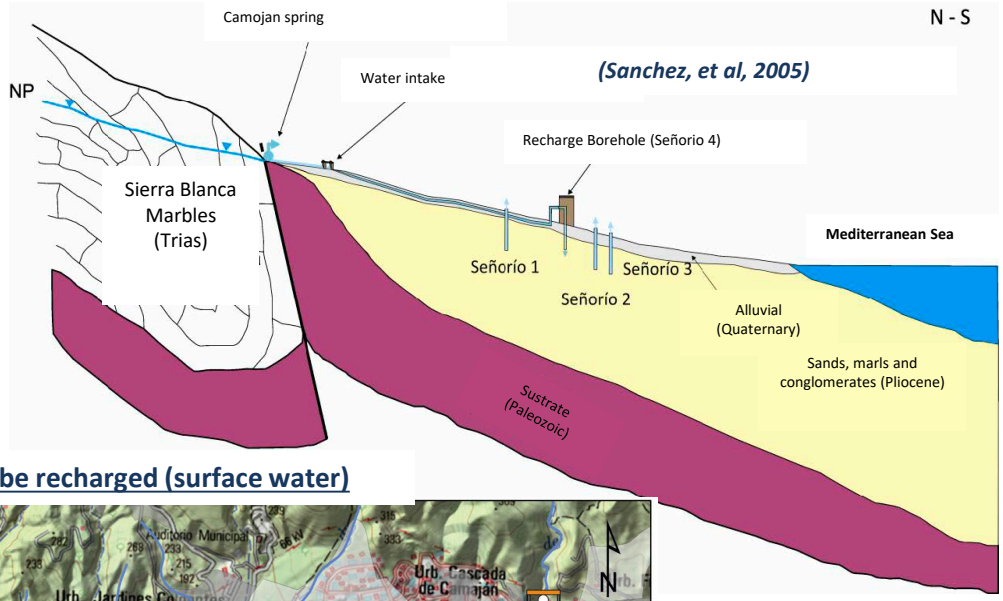
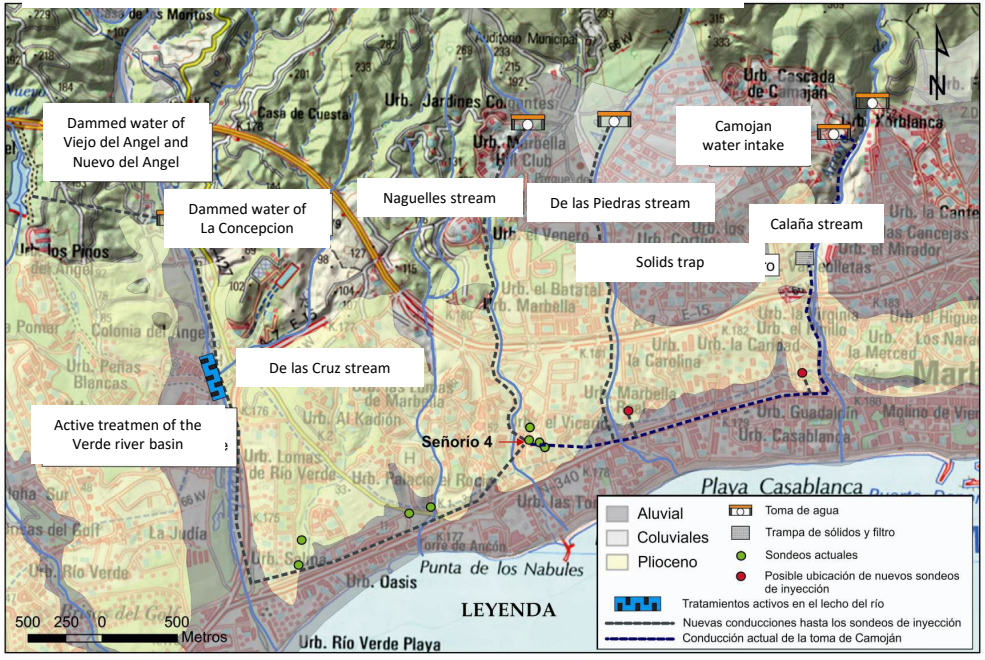
Experiences in the overexploited coastal detrital aquifers of Marbella (Malaga) using surface water from an overflow karst spring



Water intake and solids trap

Availability of water to be recharged (surface water)



Señorío 4 borehole in the Señorio aquifer

Marbella project II

Applicability of Managed Aquifer Recharge to achieve the goals of sustainable development facing climate change in semi-arid regions (Southern Spain)

Experiences in the overexploited coastal detrital aquifers of Marbella (Malaga) using recycled wastewater through wells and infiltration ponds

Definition of aquifer geometry and limits to estimate storage capacity (initial geological characterisation)

EDAR La Vibora
Stream
Mediterranean Highway
Contour lines 20 metres
Study Area
Buildings

Lithological units

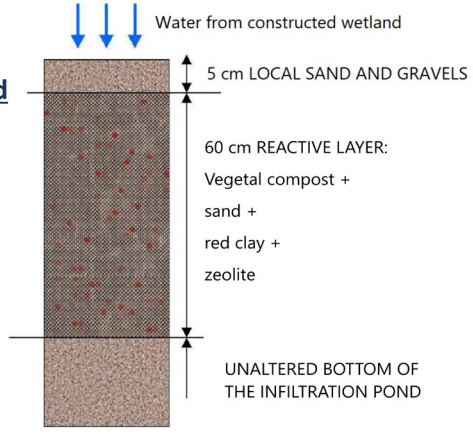
Sands, clay, silt, greywackes, pebbles
Limestones, greywackes (locally phyllitas)
Phyllites, metapelite, metabasite and greywackes
Micaschist, phyllite and sanstones

Availability of water to be recharged (wastewater)

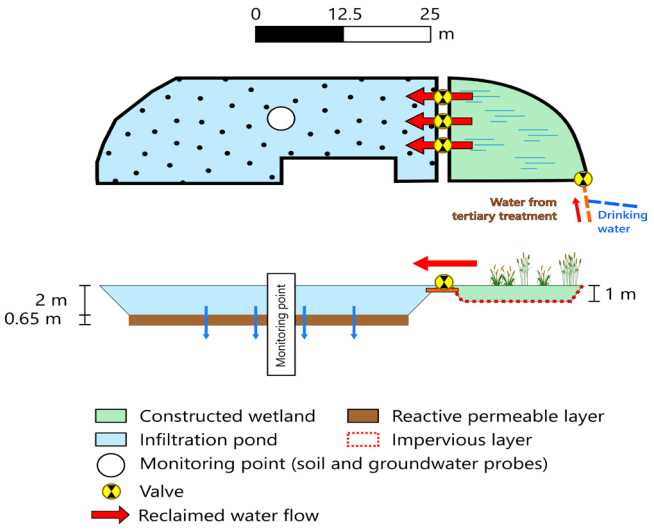
Assessment of hydraulic properties (construction of piezometers and pumping tests)

Groundwater quality and piezometric level monitoring

Reaction bed



MATRIX Managed Aquifer Recharge System

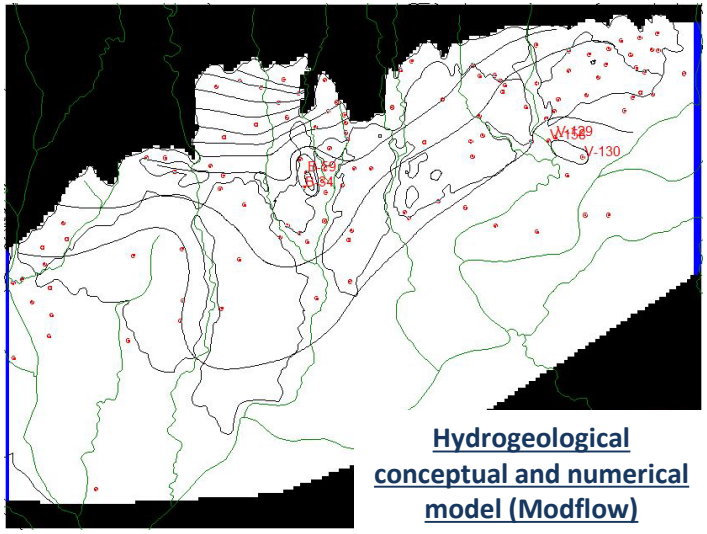


Seville project

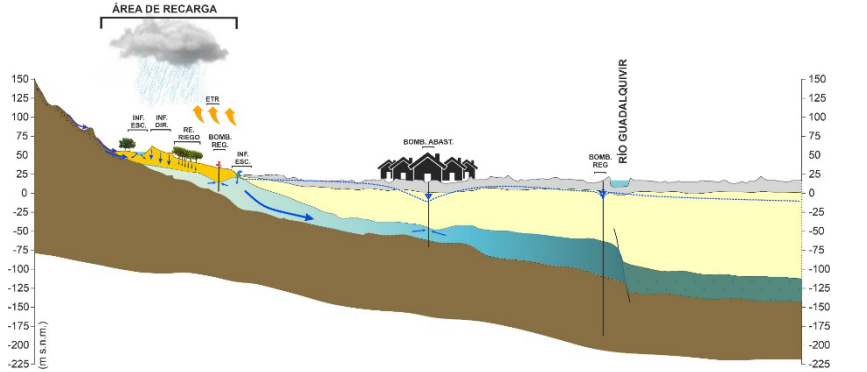
Applicability of Managed Aquifer Recharge to achieve the goals of sustainable development facing climate change in semi-arid regions (Southern Spain)

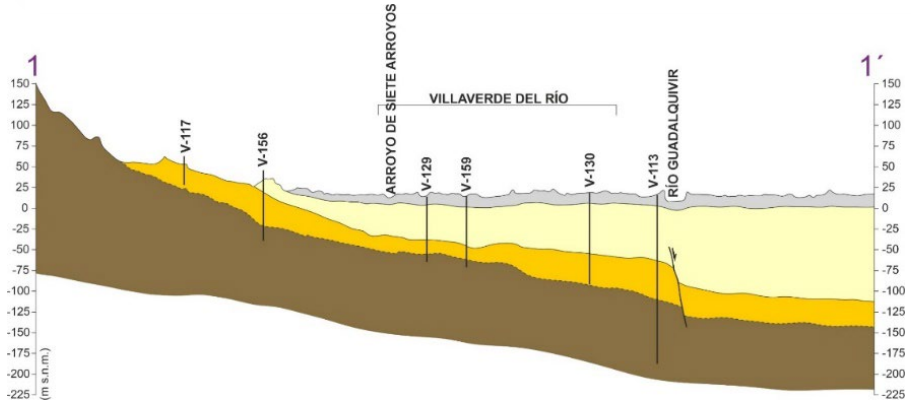
A pilot trial in the semi-confined aquifer of Niebla-Posadas (Guadalquivir basin) to recharge dammed water surplus and increase the resilience of the supply system of a large city (Seville)

Definition of aquifer geometry and limits to estimate storage capacity



Hydrogeological conceptual and numerical model (Modflow)





Social and economic drivers (Water supply and irrigation)

Seville project

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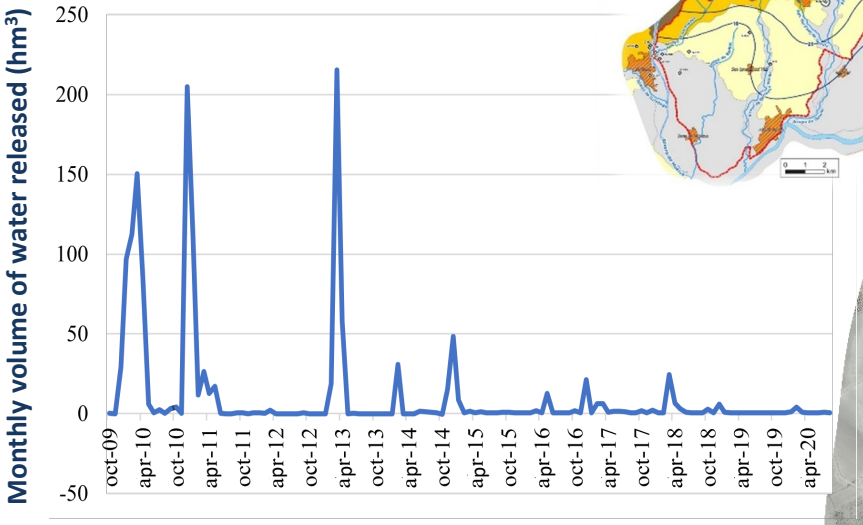
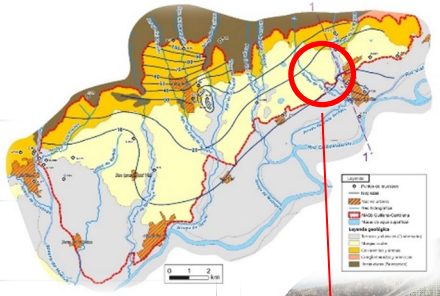
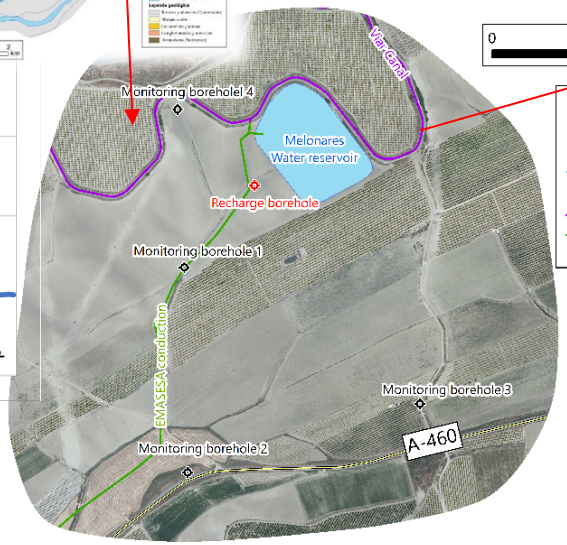
Quantification of the groundwater budget



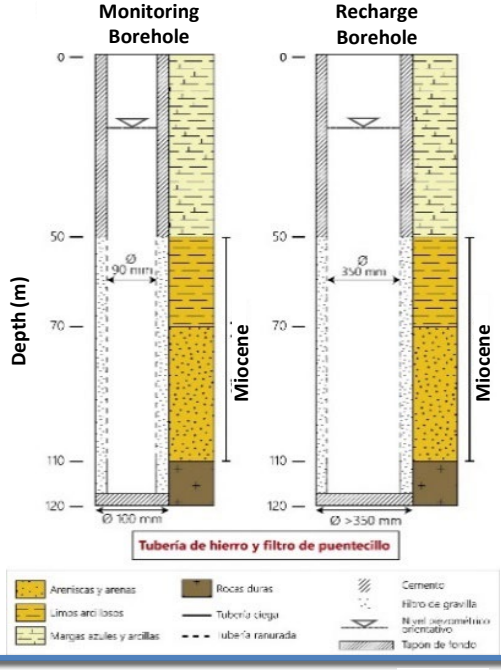


Availability of water to be recharged (dammed water)



Groundwater quality monitoring

Better possible selection of the water source for recharge and a site-specific design the most compliant MAR facilities



Final remarks

- **All these experiences demonstrate the feasibility of MAR applications in water-stressed areas as Southern Spain, but also its transferability to climatically similar areas to ensure water availability, improving sustainable water management and environmental restoration in line with the SDGs of the proposed 2030 horizon**

- **It is also necessary to emphasize the importance of combining correct site selection, a rigorous hydrogeology background knowledge, a good selection of the water source for recharge and a site-specific design the most compliant MAR facilities**

Thanks for your attention