



LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

**MARSol Workshop: Monitoring and Investigation
Technologies, March 16th-17th 2015, Athens**

DEMO SITE 2: ALGARVE AND ALENTEJO, SOUTH PORTUGAL

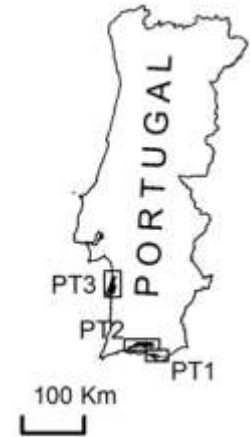
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DEMO Site 2: Algarve and Alentejo, South Portugal

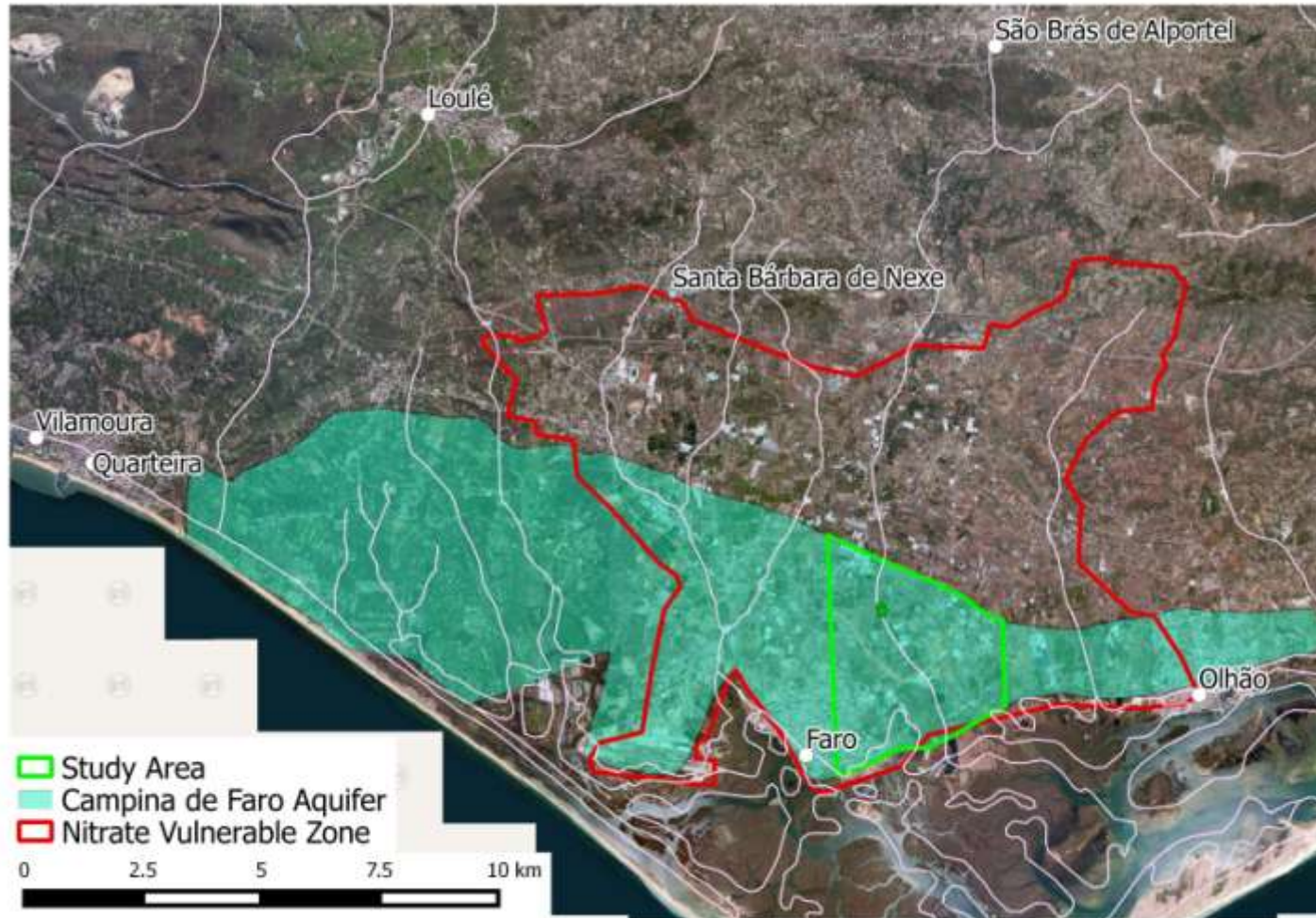


PT1 Algarve, Rio Seco

- Recharge goal: Improvement of water quality in a nitrate vulnerable zone;
- Recharge concept: Infiltration basins in river bed and infiltration dug wells “Noras”;
- Monitoring concept:
 - 4 “short” piezometers in the basins (manual measurements)
 - 4 piezometers in the upper aquifer unit (Upper Miocene) next to the basins
 - 1 piezometer located upstream of the basins (control)
 - 1 water well (not in operation) for monitoring the lower aquifer subunit (Lower Miocene)
 - Dug wells scattered across territory for Water quality



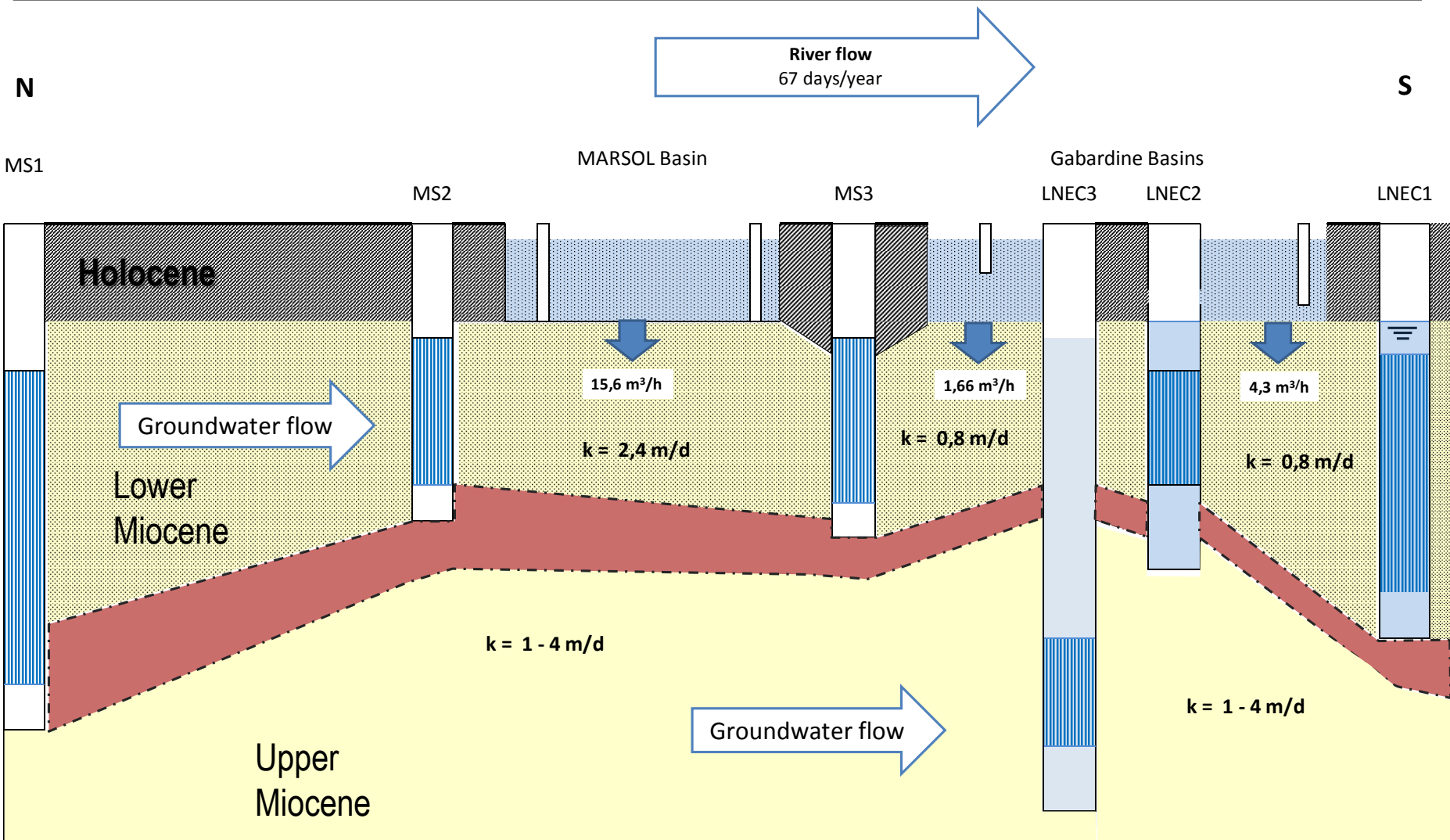
DEMO Site 2: Algarve and Alentejo, South Portugal



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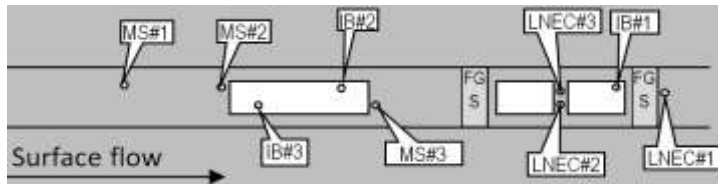
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PT1 Algarve, rio Seco

- Infiltration tests (Set/Out 2014 and Jun 2015)
- Tracer tests with NaCl (Out 2014)
- Continuous monitoring of infiltration basins (on-going)



Saturated zone monitoring equipment



Groundwater sampling and *in situ* measurement equipment

CTD-Diver



- Robust, durable, corrosion proof housing
- Conductivity range 0 to 120 mS/cm

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Corrosion Proof Multi-parameter Groundwater Datalogger

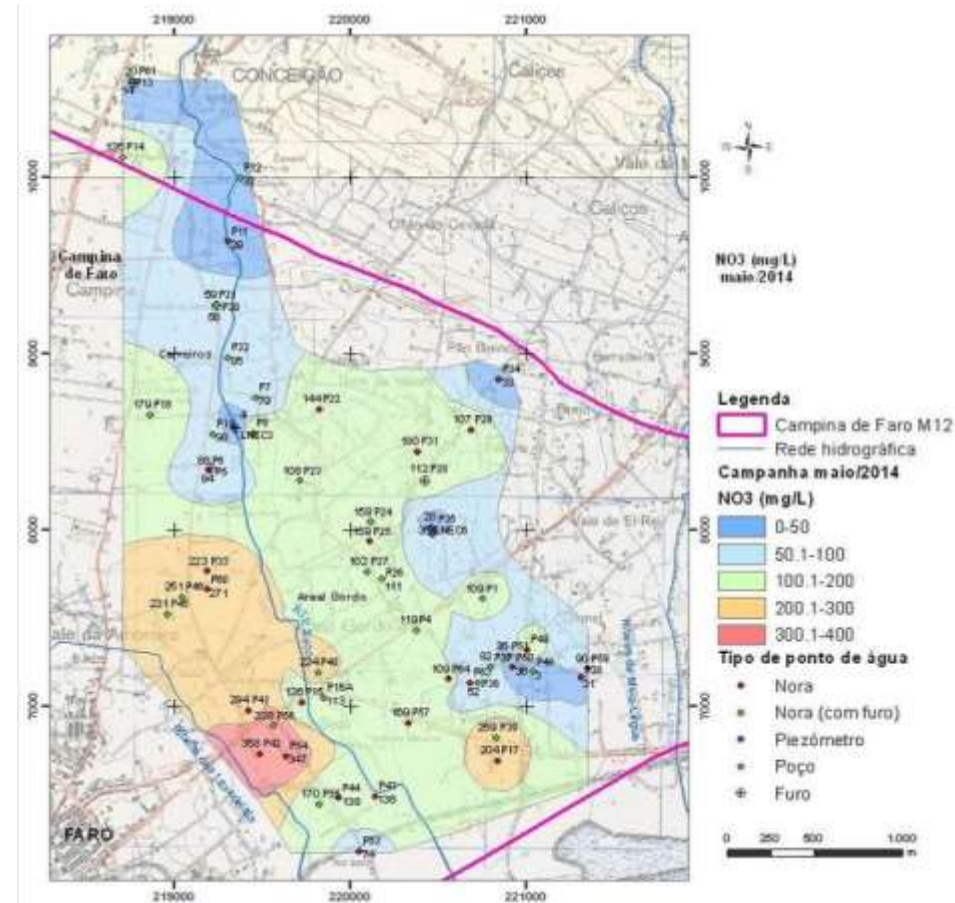
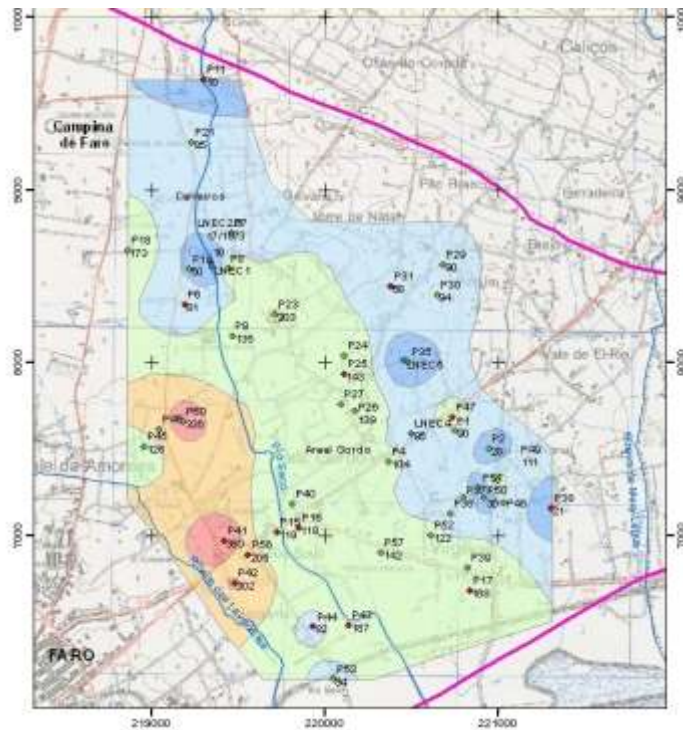
Features

- Innovative ceramic housing technology
- Three sensors in one sealed housing
- Conductivity range up to 120 mS/cm
- Compact size: Ø 22 mm - length 135 mm
- Various measurement methods
- 48,000 records of time stamp, pressure, temperature and conductivity
- 30-Point pressure factory calibration



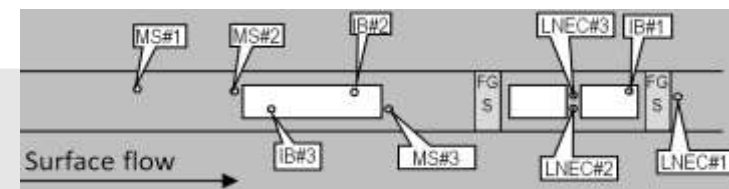
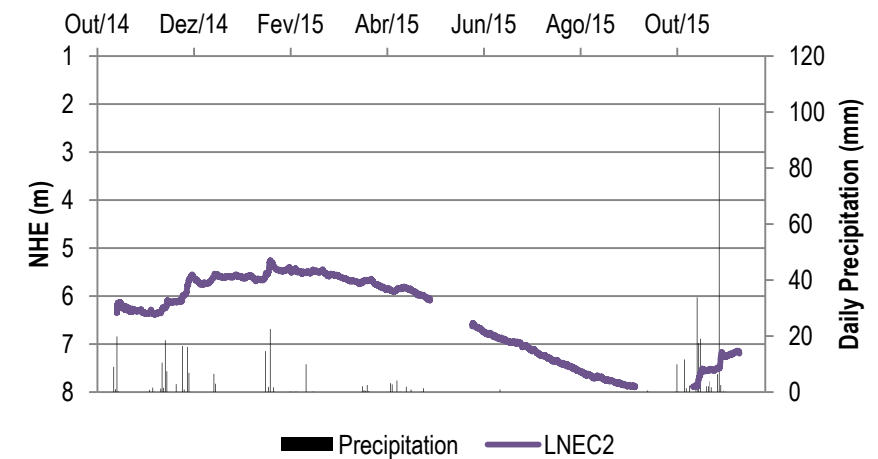
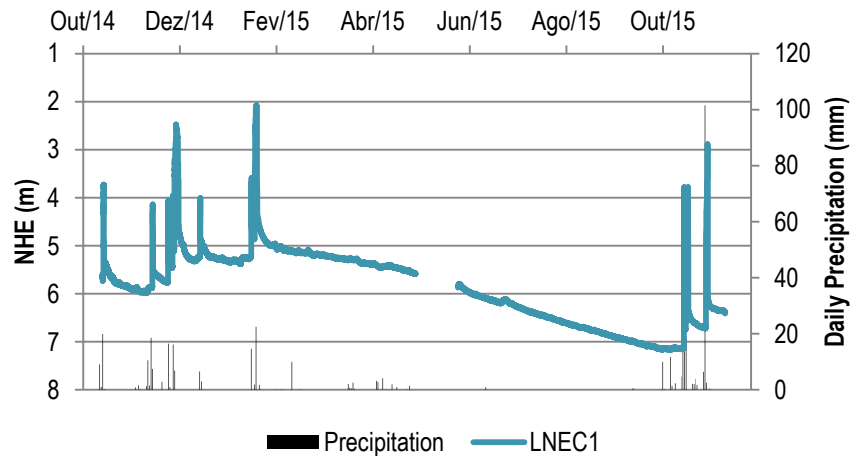
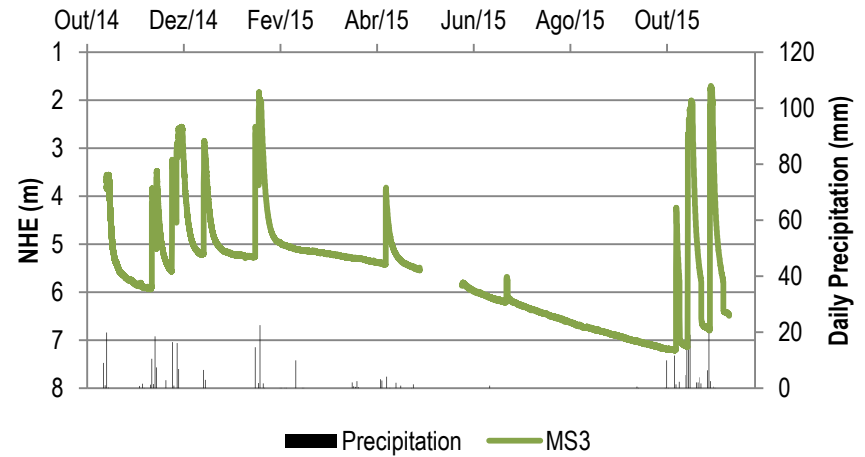
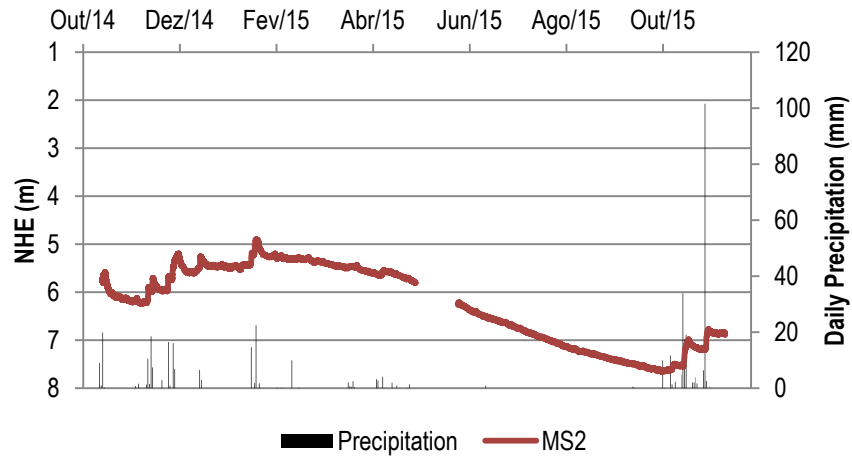
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- Yearly monitoring campaign (May)
- Manual sampling (bailer)
- UV-Molecular Absorption spectrometry

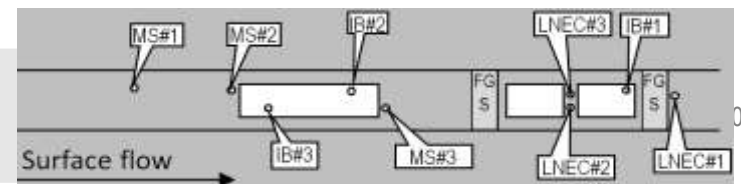
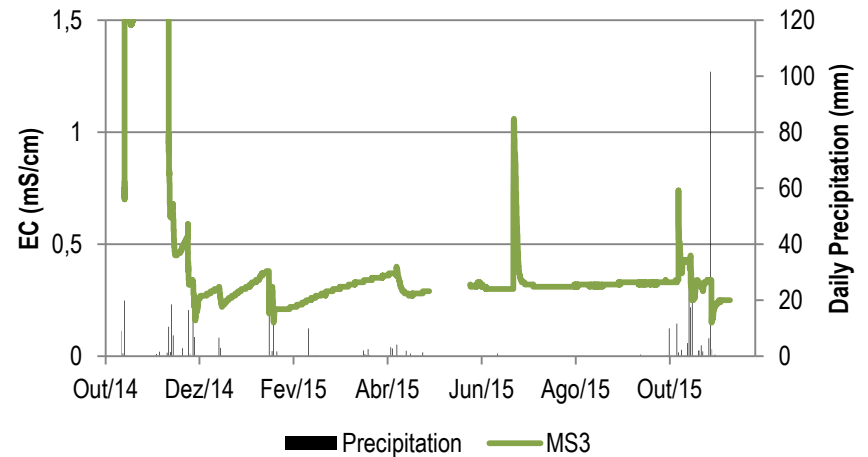
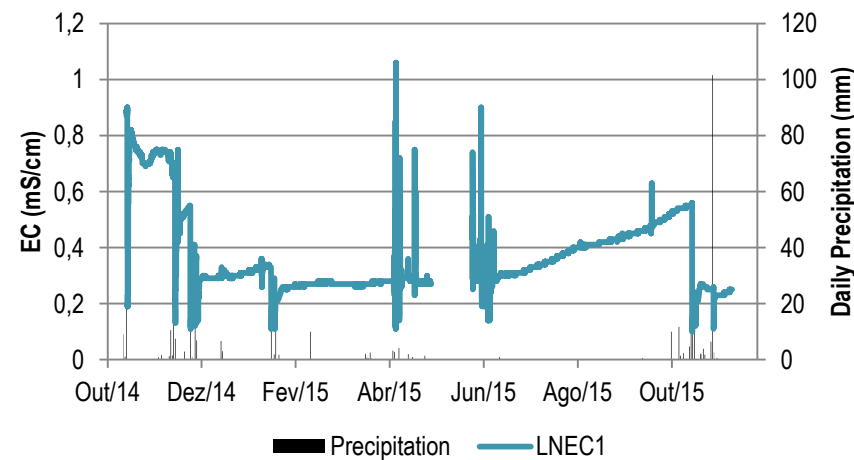
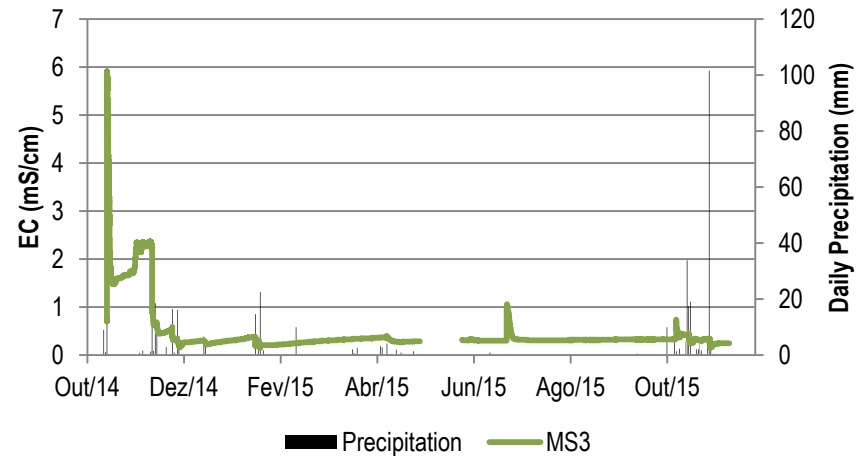
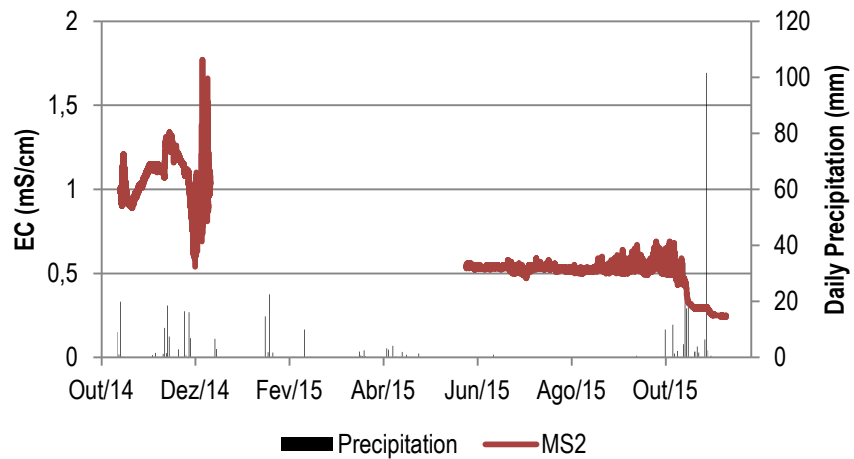


Nitrate concentration in the groundwater of Campina de Faro aquifer (PT1_3 Campina de Faro) in April 2008 and May 2014

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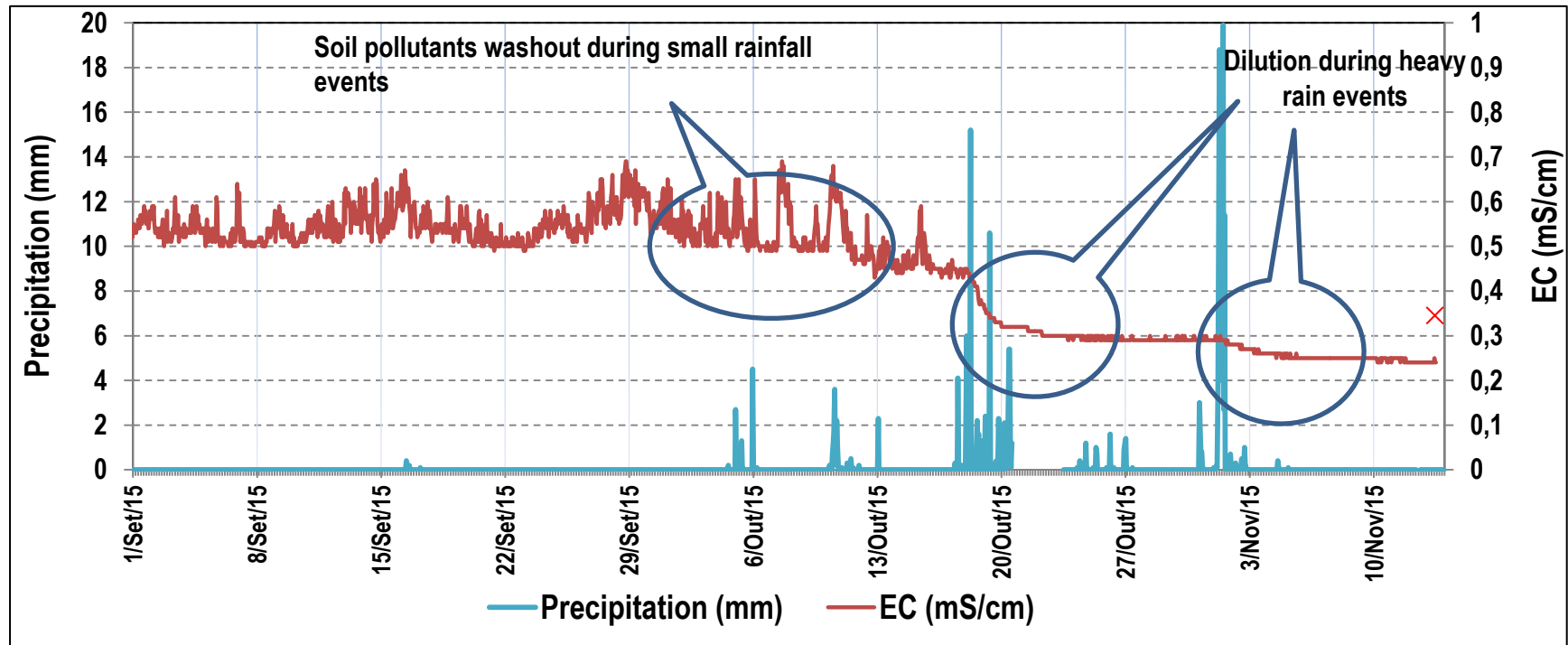
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PT1_2 Algarve, MARSol basins:

- Continuous monitoring of natural infiltration (on-going)



Source: LNEC

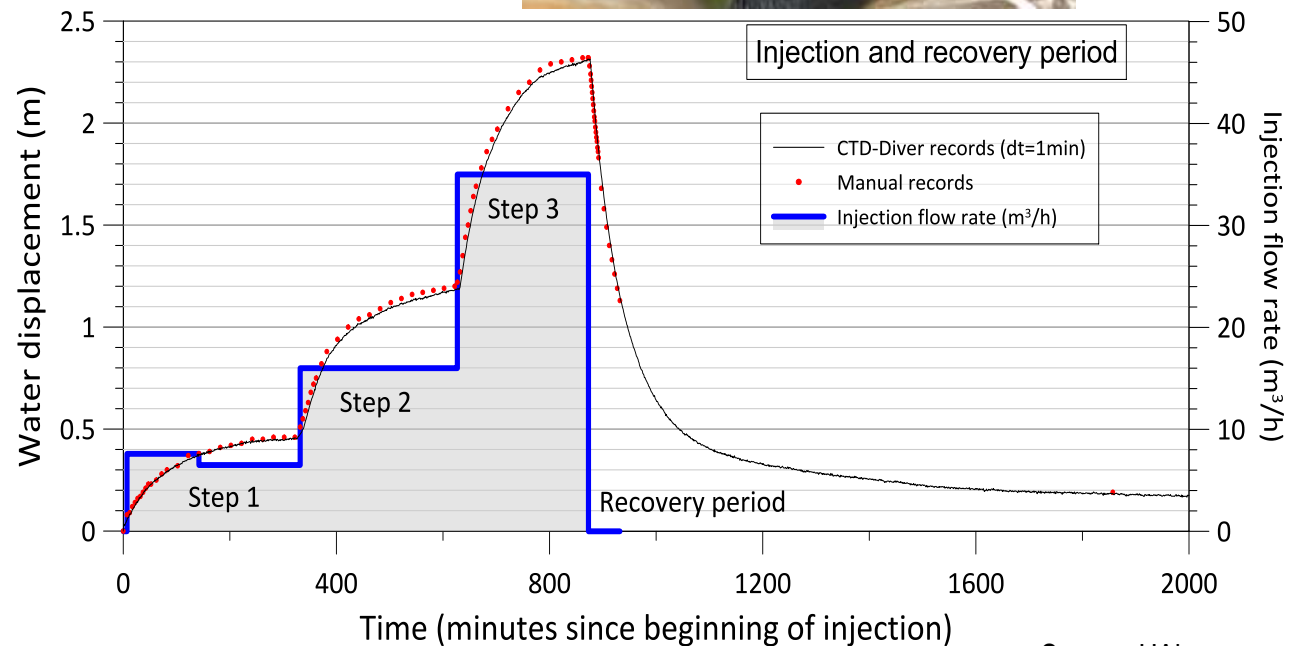
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PT1_3 Algarve, large-diameter wells:

- Infiltration test, 3 flowrates (Sept 2014)



Infiltration capacity
> 34 m³/h!



Source: UAlg

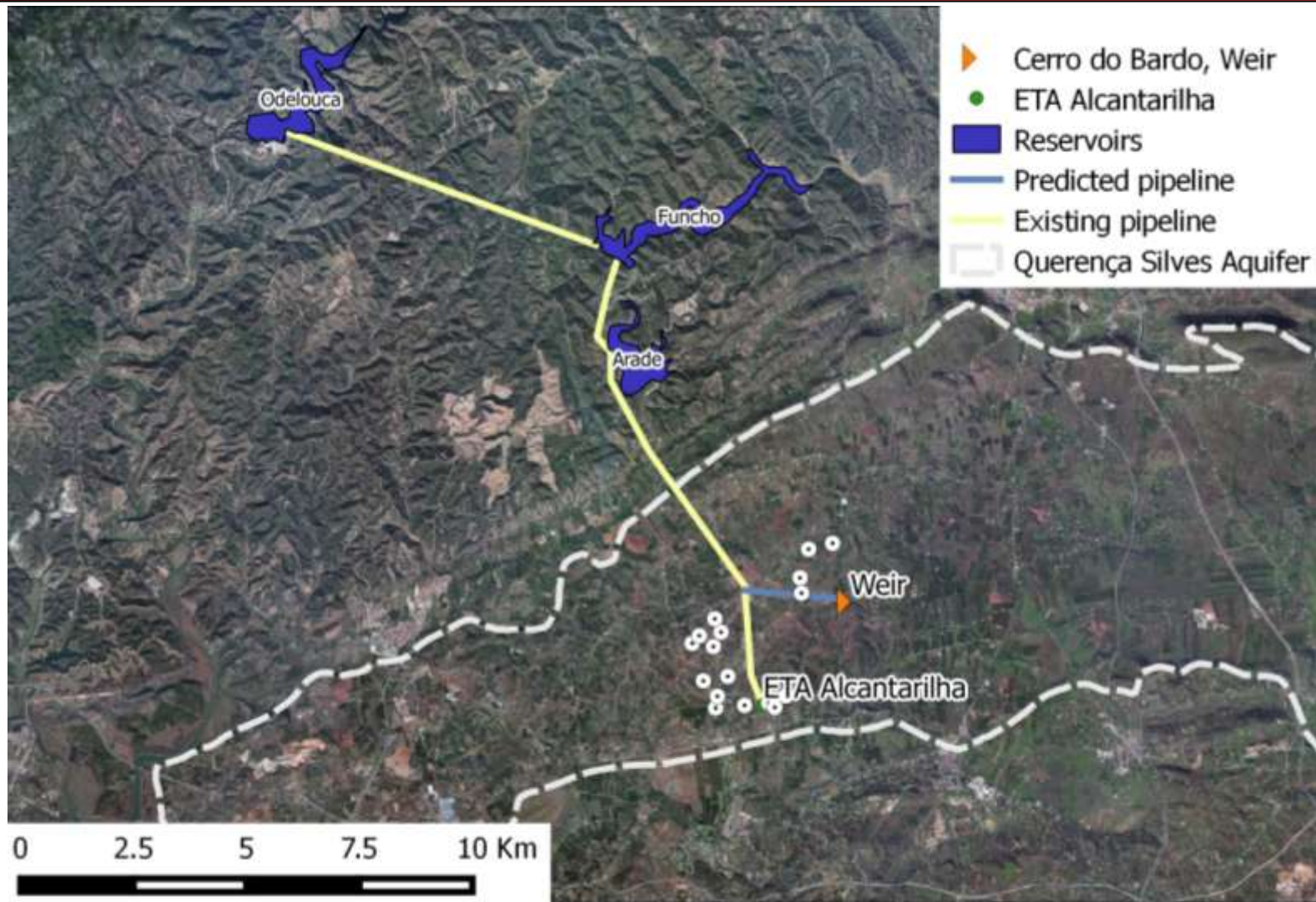
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PT2_6 Algarve, Cerro do Bardo

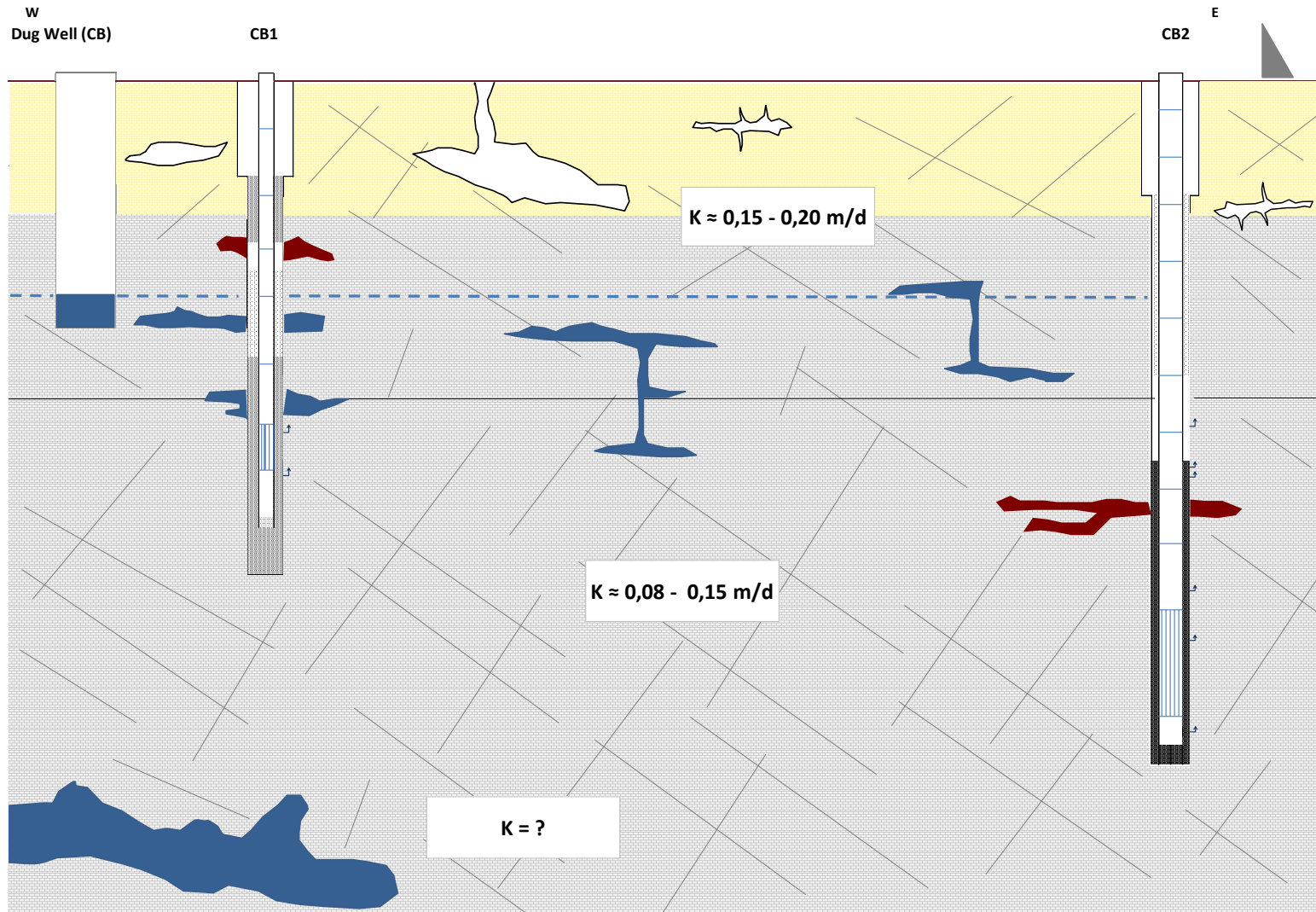
- Recharge goal: Improve availability of groundwater resources in a high yield karst aquifer, using winter surface water surplus;
- Recharge concept: Infiltration in a dug well and natural sinkholes
- Monitoring concept:
 - 1 Dug well
 - 2 Piezometers
 - Private water wells



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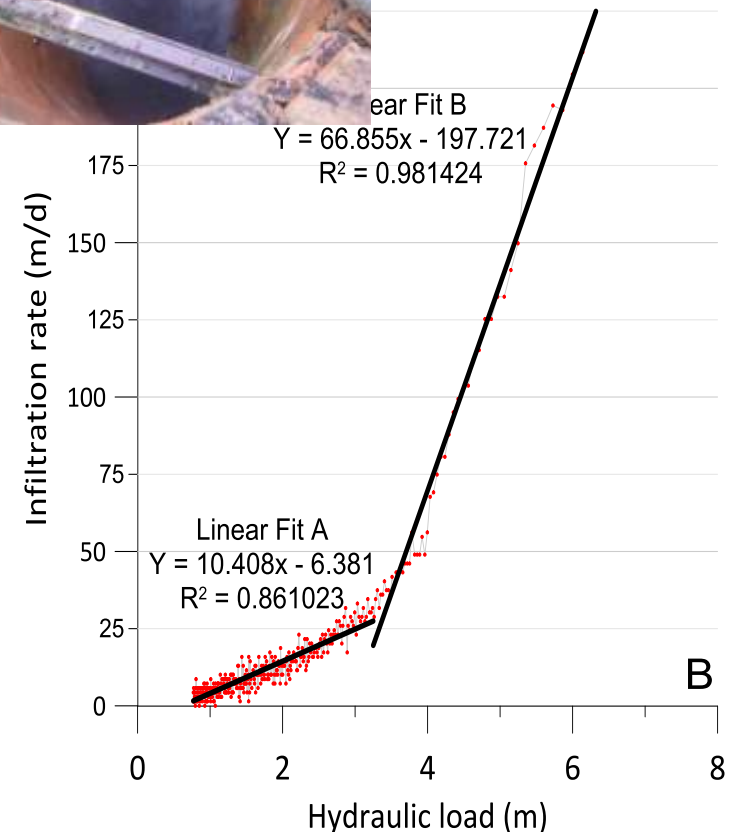
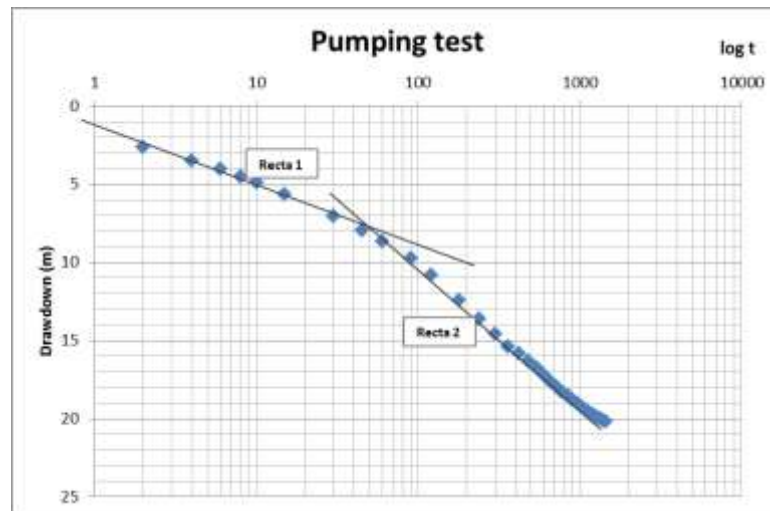
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PT2_6 Algarve, Cerro do Bardo

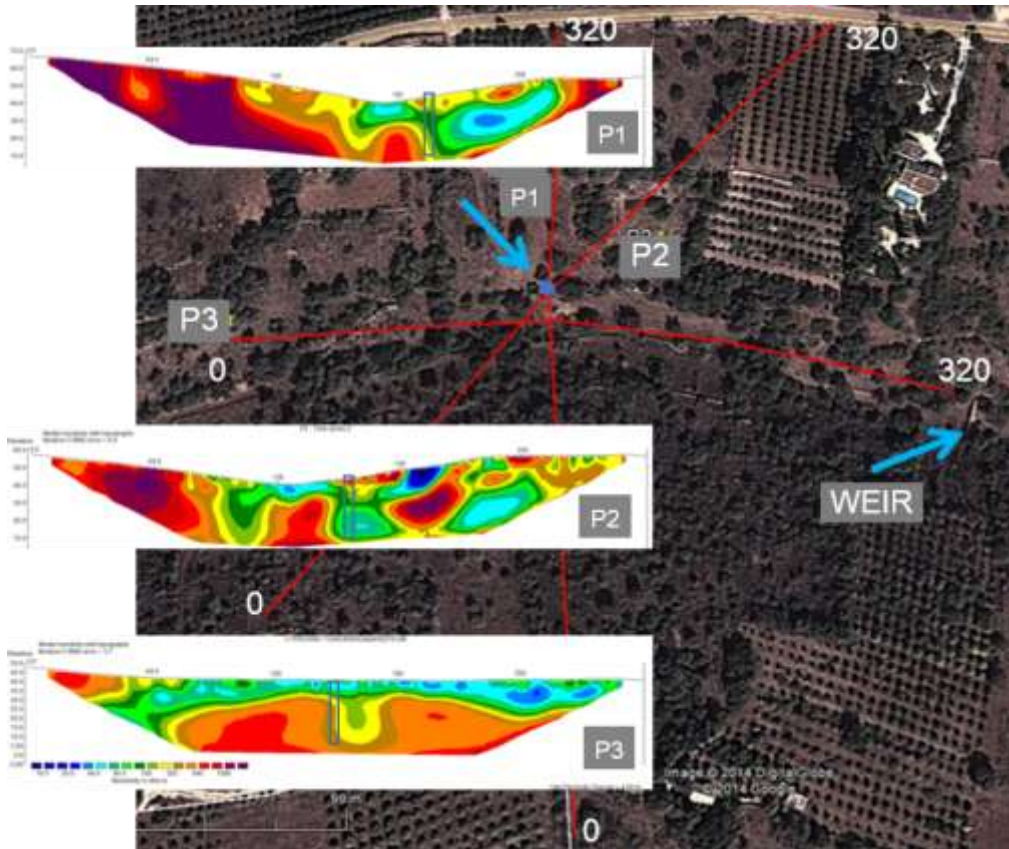
- Infiltration test in the large well (April 2014).
- Infiltration test with tracer (NaCl) with geophysics support (Dec 2014).
- Pumping test in CB2 in February 2016
- Infiltration rates (in the well): above 20 m³/h.
- Local hydraulic conductivities between 0,08 to 0,20 m/d.



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PT2_6 Algarve, Cerro do Bardo

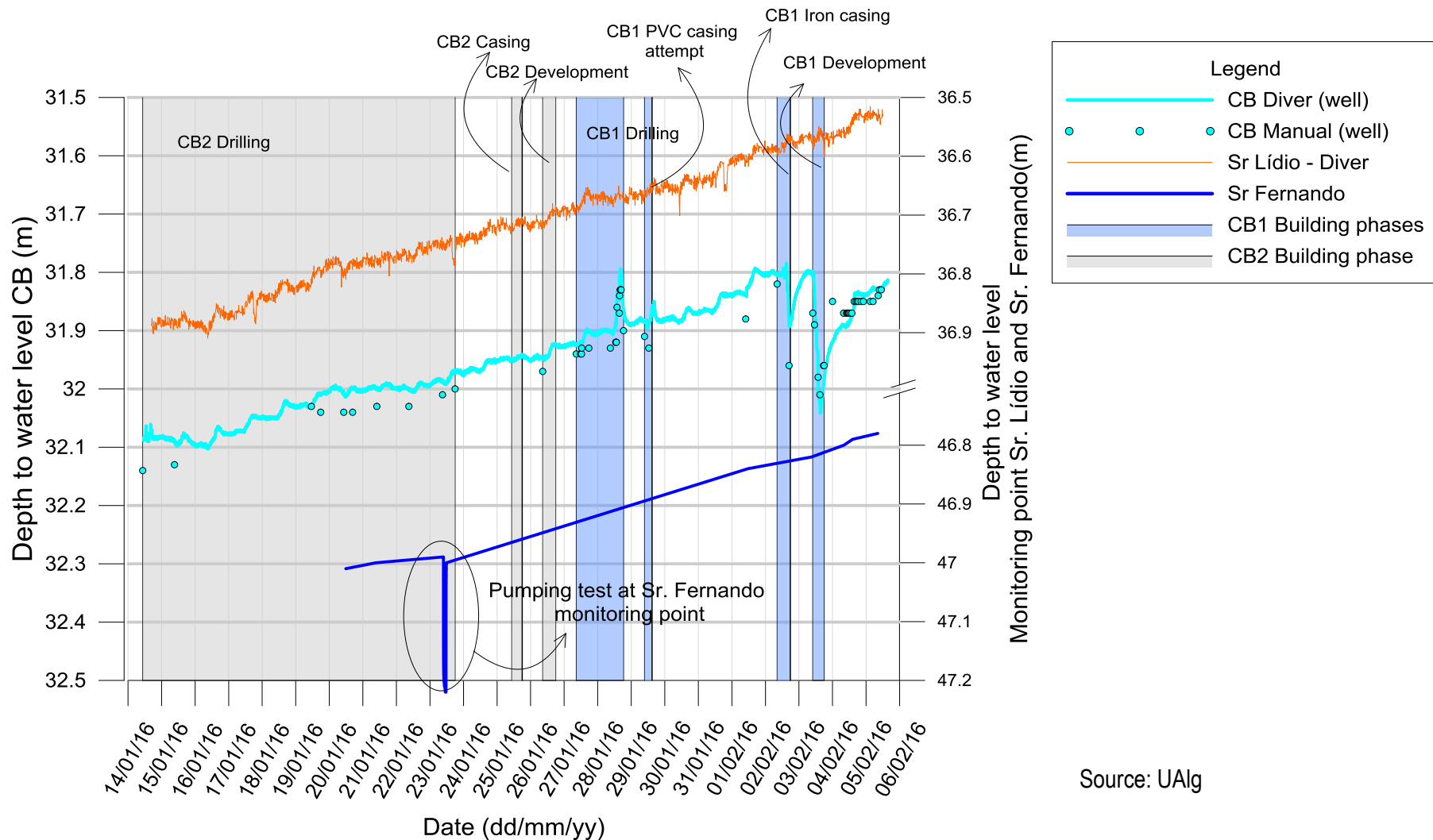
- Geophysical Monitoring



Source: LNEC

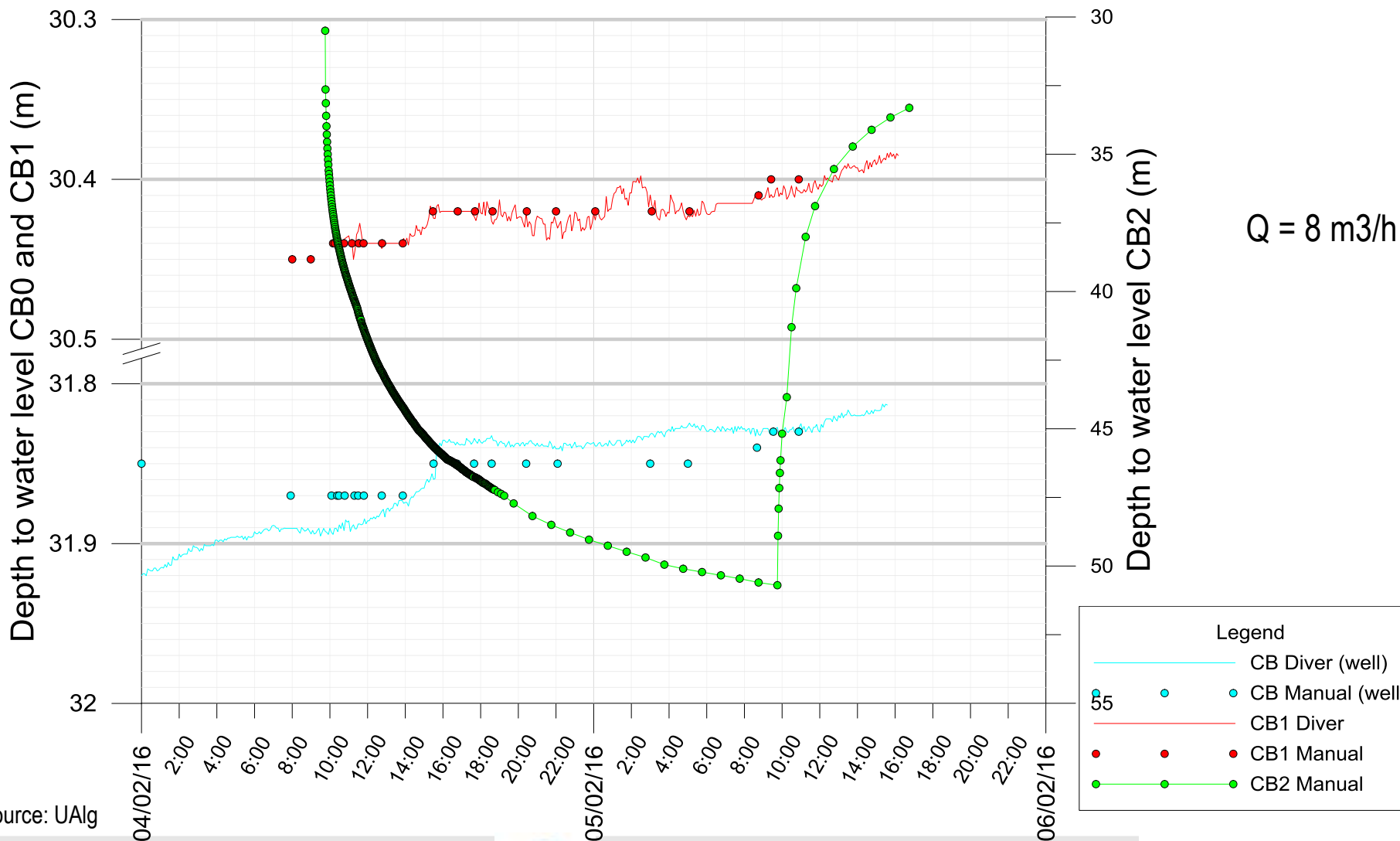


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Source: UAIG

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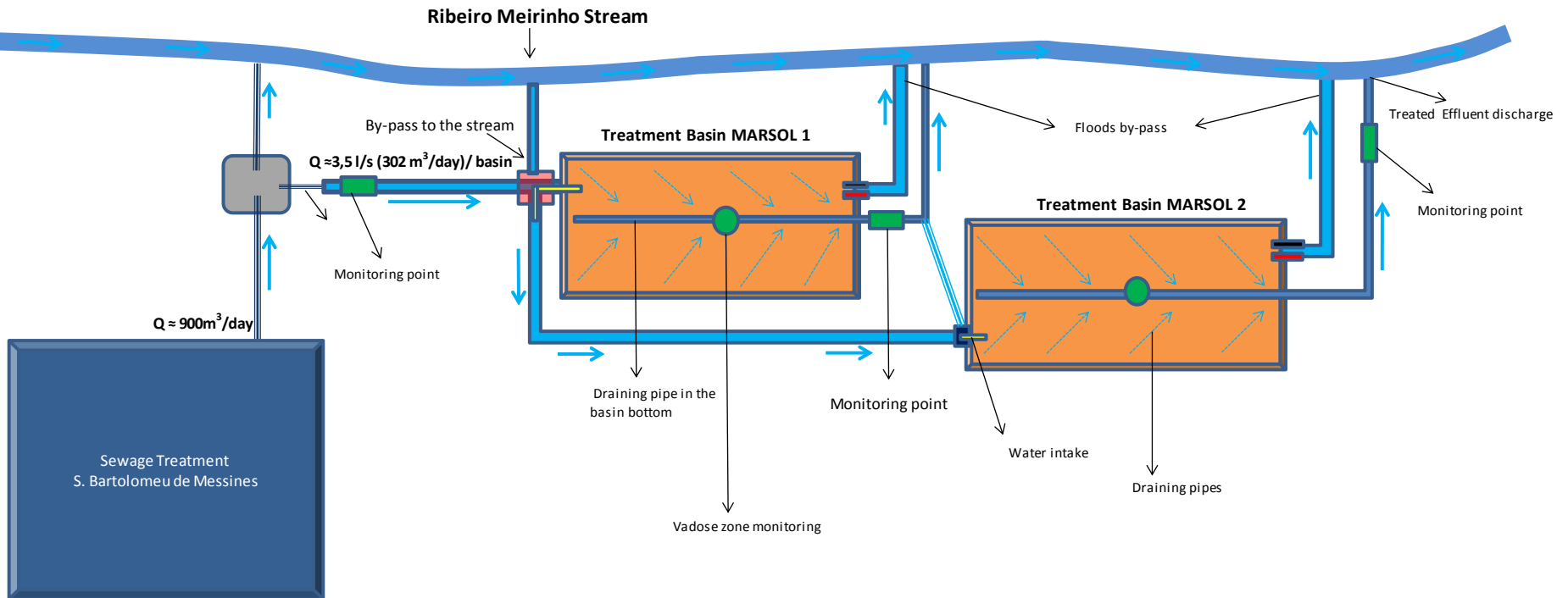


DEMO Site 2: Algarve and Alentejo, South Portugal



- **PT2_4 Algarve, São Bartolomeu de Messines**
- Recharge goal: Improve WWTP effluent that is currently discharged to a river crossing a high yield karst aquifer
- Recharge concept: Infiltration and drainage in two SAT basins
- Monitoring concept:
 - 3 flowmeters;
 - Manual outflow sampling
 - Teflon cups at 2 different depths in the vadose zone
 - Monitoring of pH, TSS, COD, BOD5, N total, P total, N-NH4, N-NO3, faecal coli, EC, all N forms, phosphates and sulphates (Águas do Algarve)
 - Monitoring of persistent pollutants (LNEC)

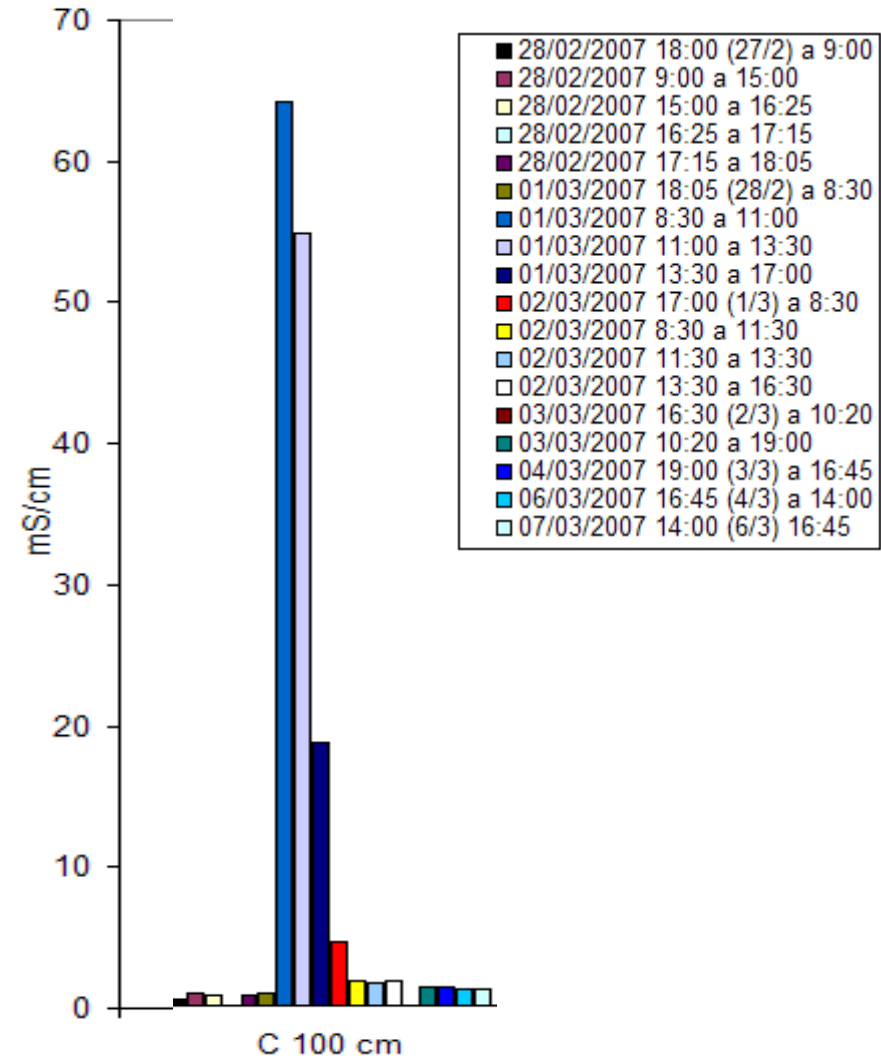
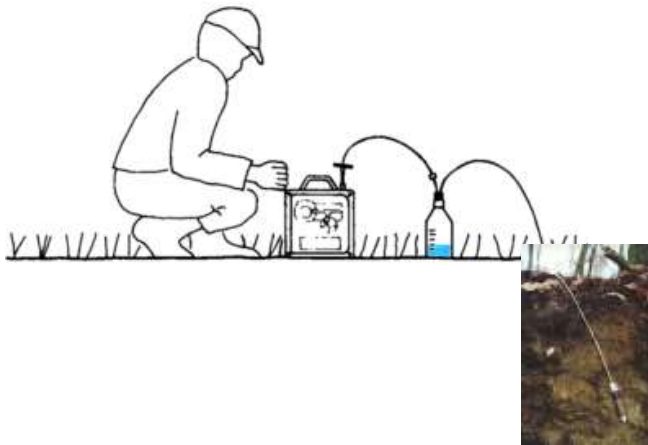
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Vadose zone monitoring equipment



Conclusions:

- All constructed monitoring structures are operational and working properly;
- Monitoring results were fundamental for the calibration of the hydrogeological conceptual model;
- The presence of a control well (out of the MAR influence area) is fundamental to access the role of natural and managed recharge;
- PT_4: S. Bartolomeu de Messines WTPP monitoring network will be implemented soon after basins installation;
- Vadoso Zone:
 - Campina de Faro: Permeable just in the basins,
 - Cerro do Bardo: Hard to monitor (karsified structures)
 - S.Bartolomeu de Messines WWTP SAT basins: No direct connection to aquifer
- Aquifer monitoring: What is the recharge effect range?
- Inventory: make an exhaustive search. Know what you have...