

INTEGRATING MULTI-SOURCE DATA FOR TARGETED REMEDIATION OF LONG-TERM CHLORINATED SOLVENT CONTAMINATION IN GROUNDWATER: A 3-D GEOSPATIAL APPROACH

Paolo Ciampi, Damiano Feriaud, Ernst Bartsch, Eduard Alesi, Marco Petrangeli Papini

paolo.ciampi@uniroma1.it



SAPIENZA
UNIVERSITÀ DI ROMA



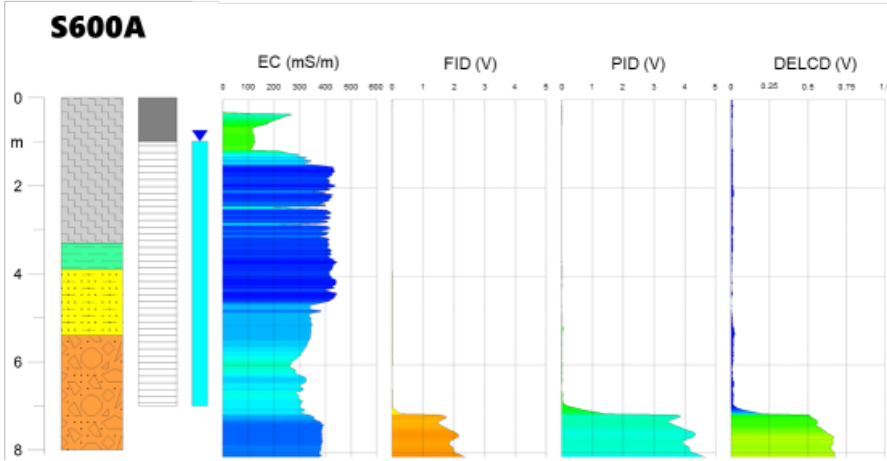
2024 Chlorinated Conference

June 2-6, 2024 | Denver, Colorado

battelle.org/chlorcon | [#Chlorinated2024](https://twitter.com/Chlorinated2024)

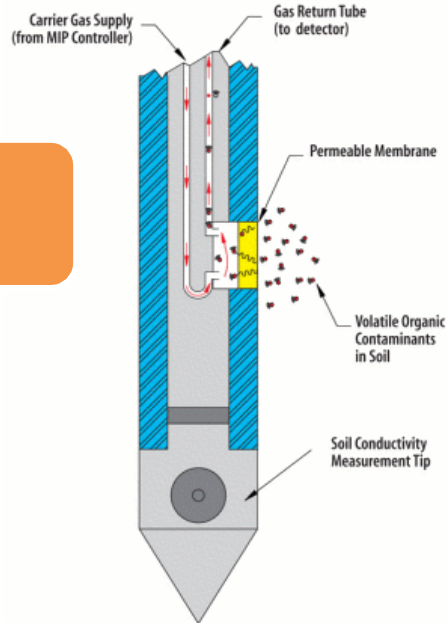
BATTELLE

Methodology



Geological boreholes

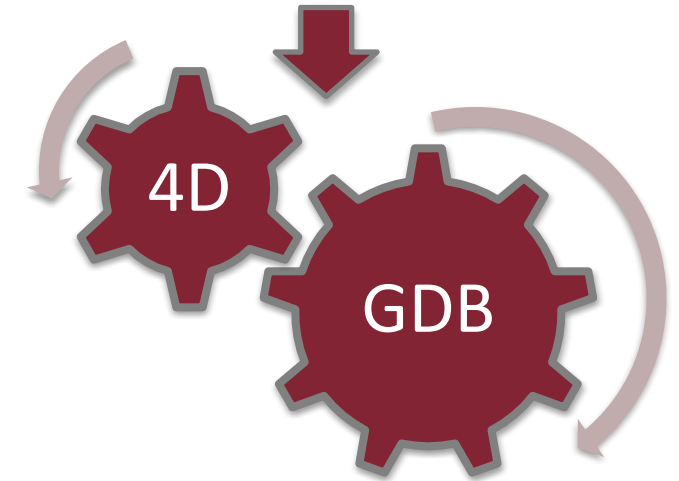
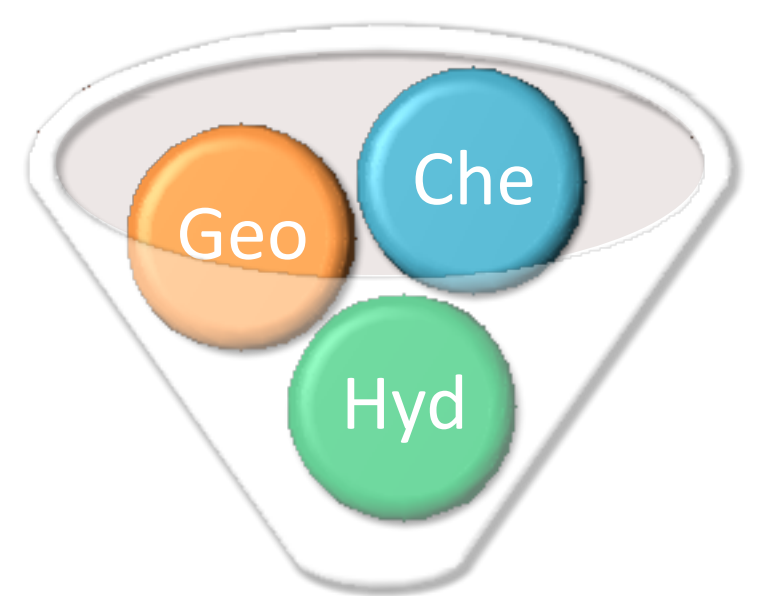
Geophysical Investigations (ERT, LIF, MIP)



GW level measurements

[illegible]

Chemical analyses



Multi Criteria Decision Analysis Tool

INTEGRATING MULTI-SOURCE DATA FOR TARGETED REMEDIATION OF LONG-TERM CHLORINATED SOLVENT CONTAMINATION IN GROUNDWATER: A 3-D GEOSPATIAL APPROACH



SAPIENZA
UNIVERSITÀ DI ROMA



2024 Chlorinated Conference

June 2-6, 2024 | Denver, Colorado

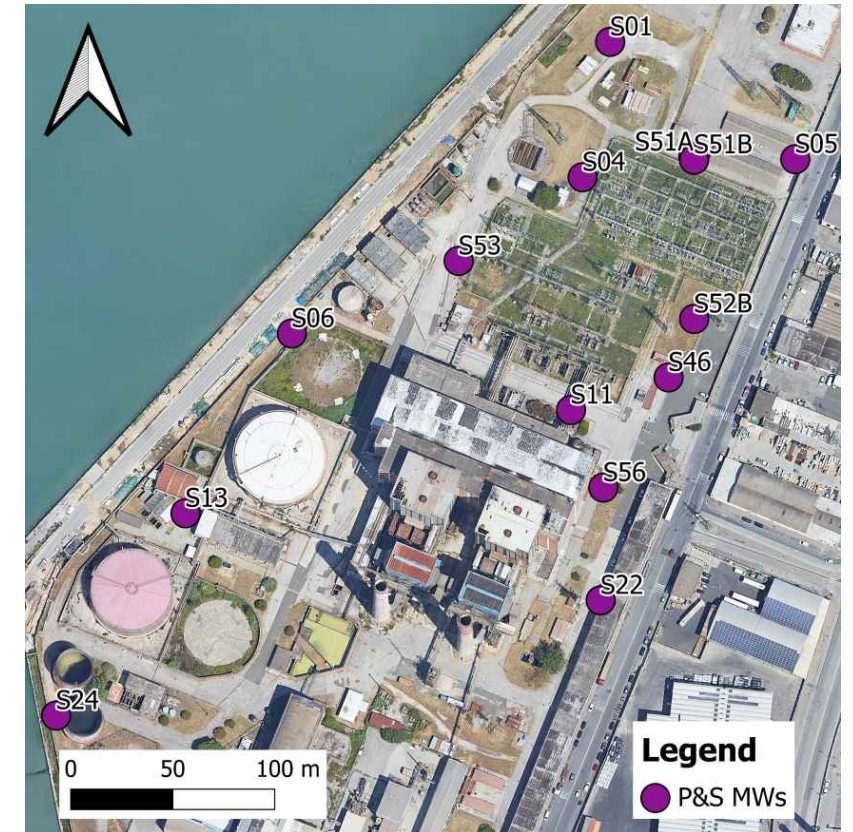
[battelle.org/chlorcon](https://www.battelle.org/chlorcon) | #Chlorinated2024



Introduction

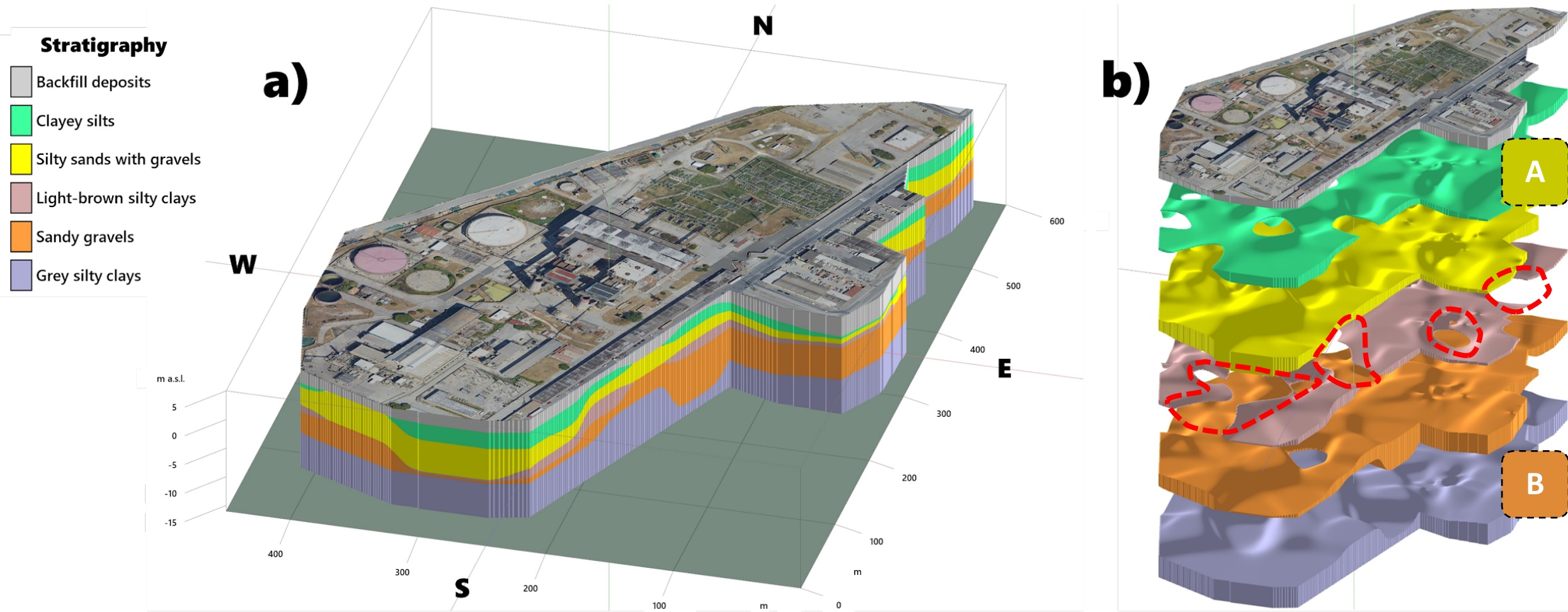


TCE contamination plume with concentrations up to about 10 mg/L



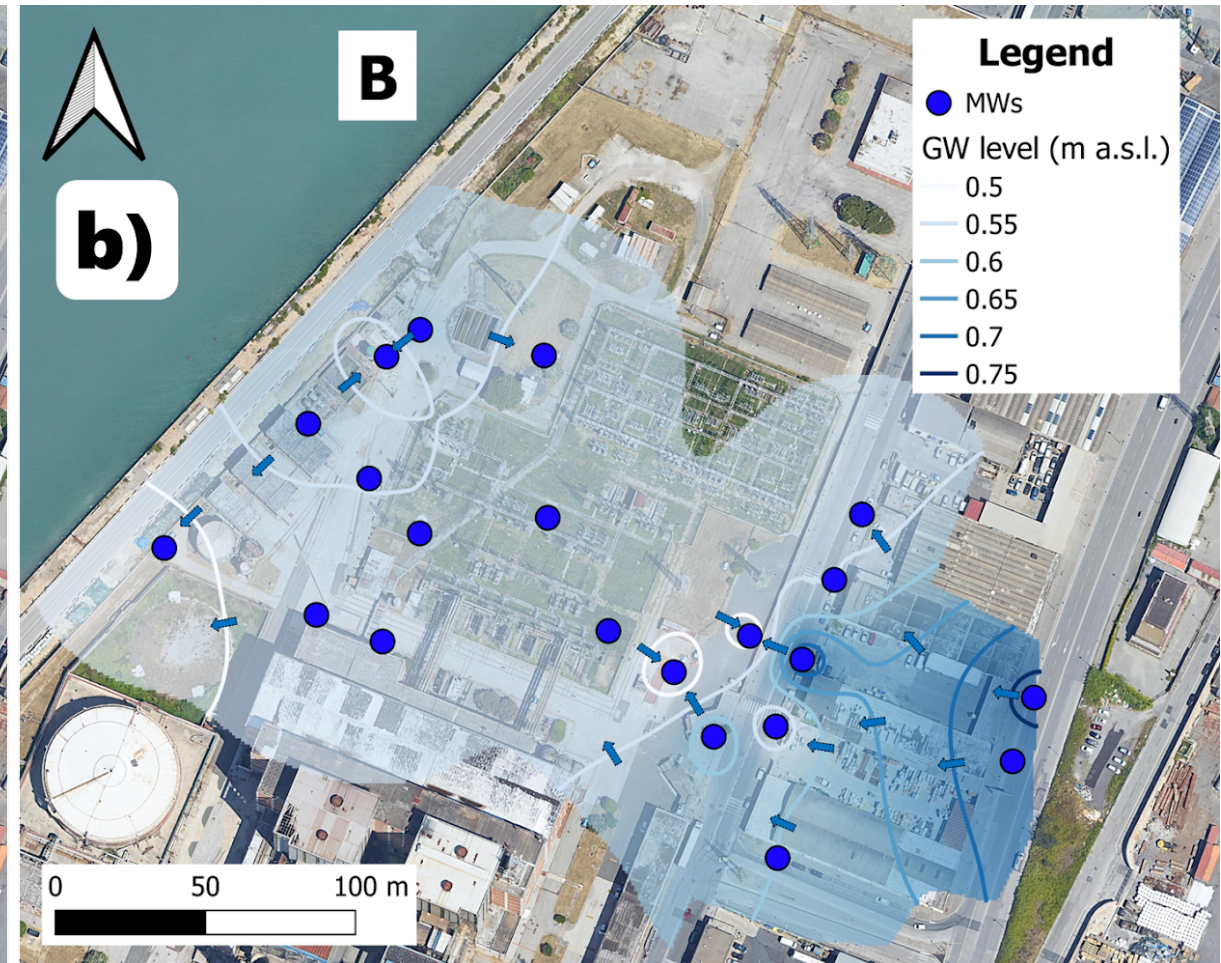
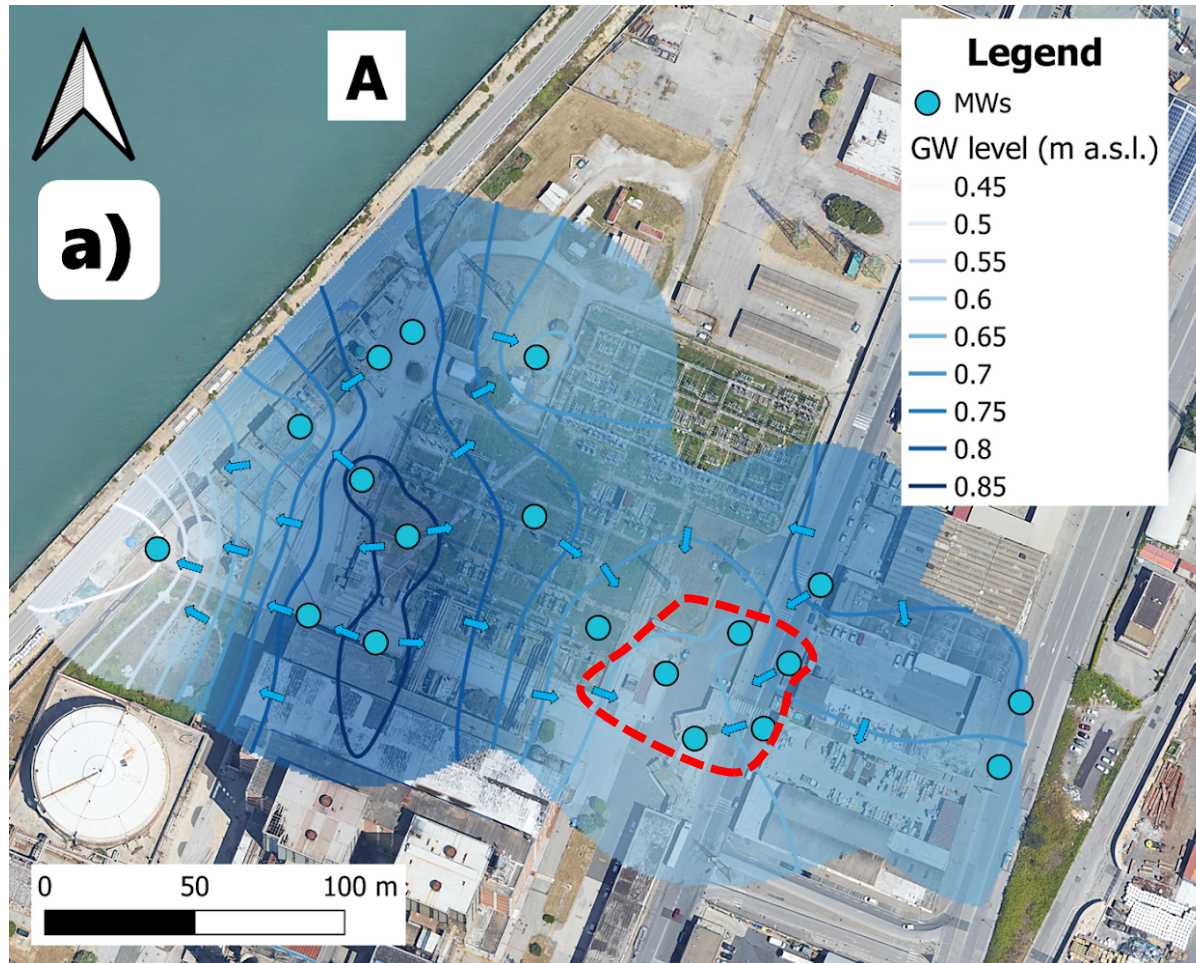
14 wells (P&S) with a pumping rate of 6.3 m³/day

Hydrogeological Conceptual Site Model



Ciampi et al. 2024

Hydrogeological Conceptual Site Model



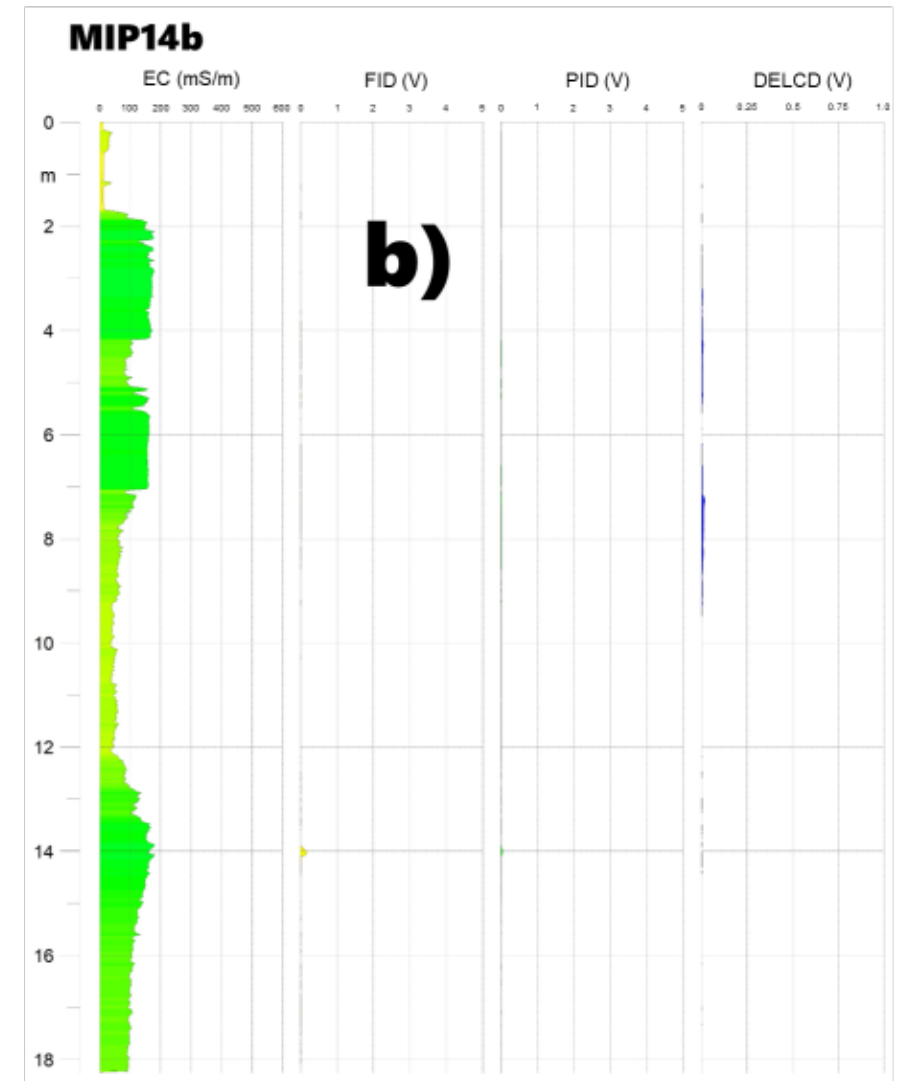
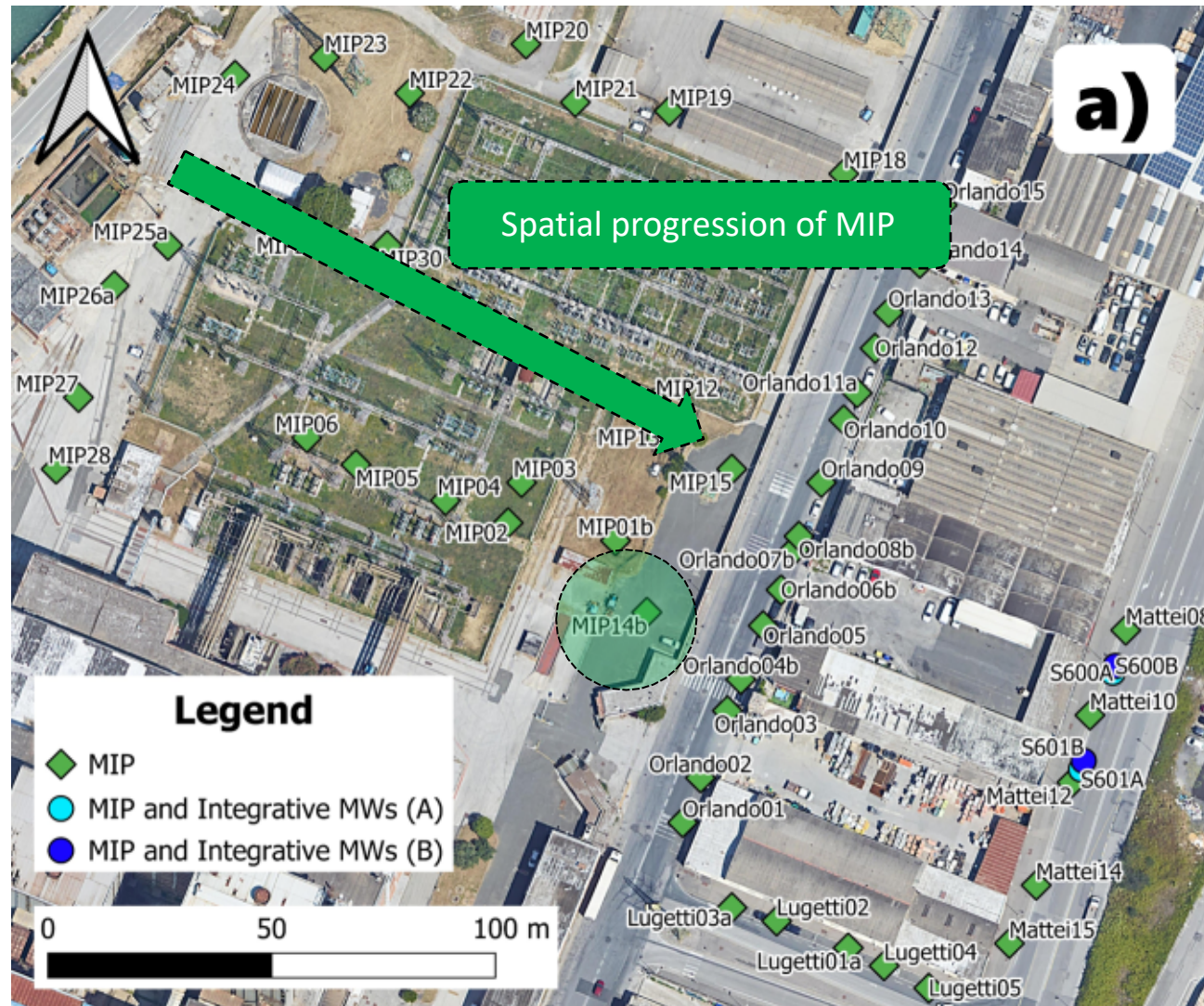
$$K = 2 \times 10^{-5} \text{ m/s}$$

$$v = 3.46 \text{ m/year}$$

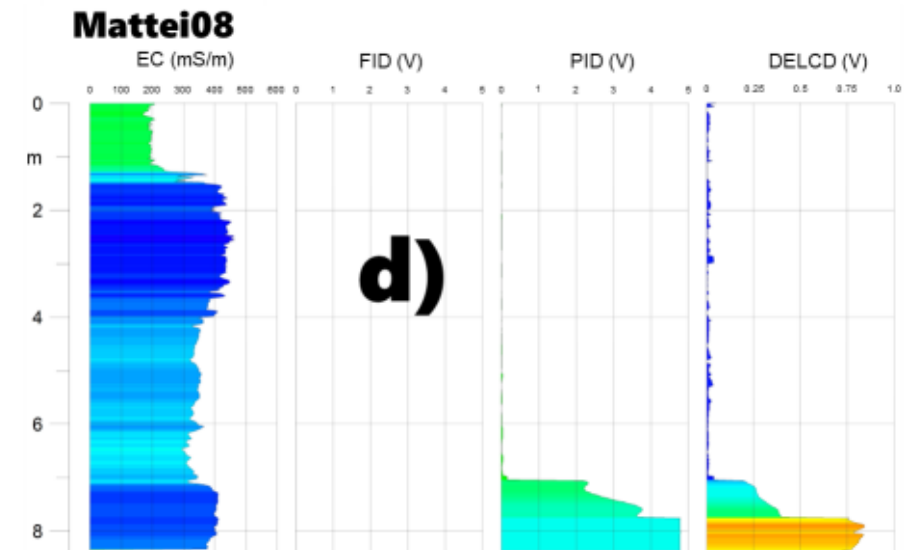
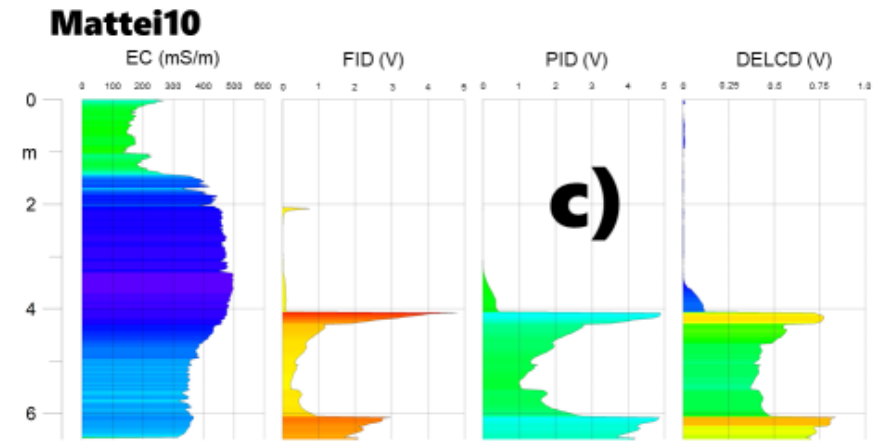
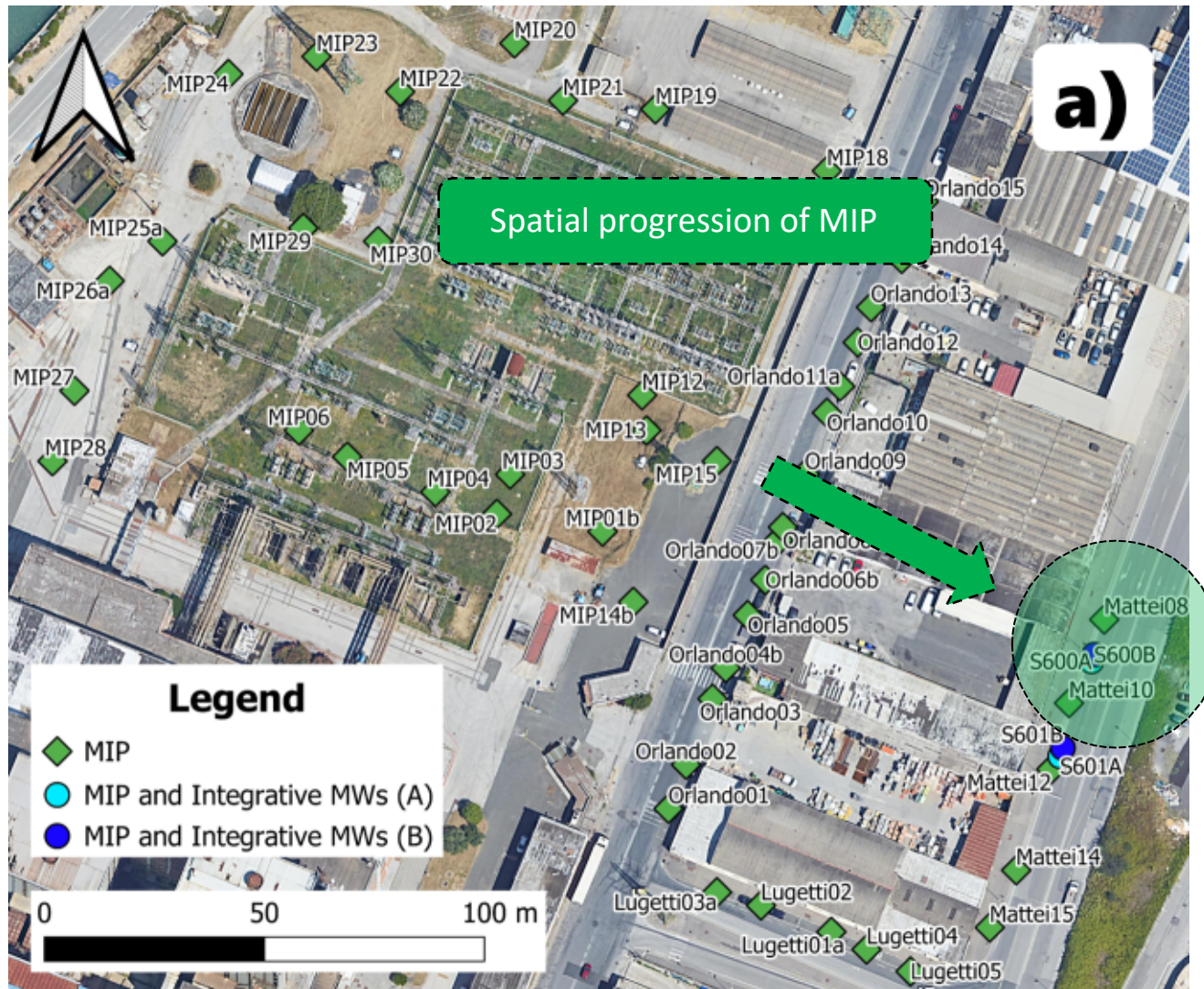
$$K = 9 \times 10^{-4} \text{ m/s}$$

$$v = 119 \text{ m/year}$$

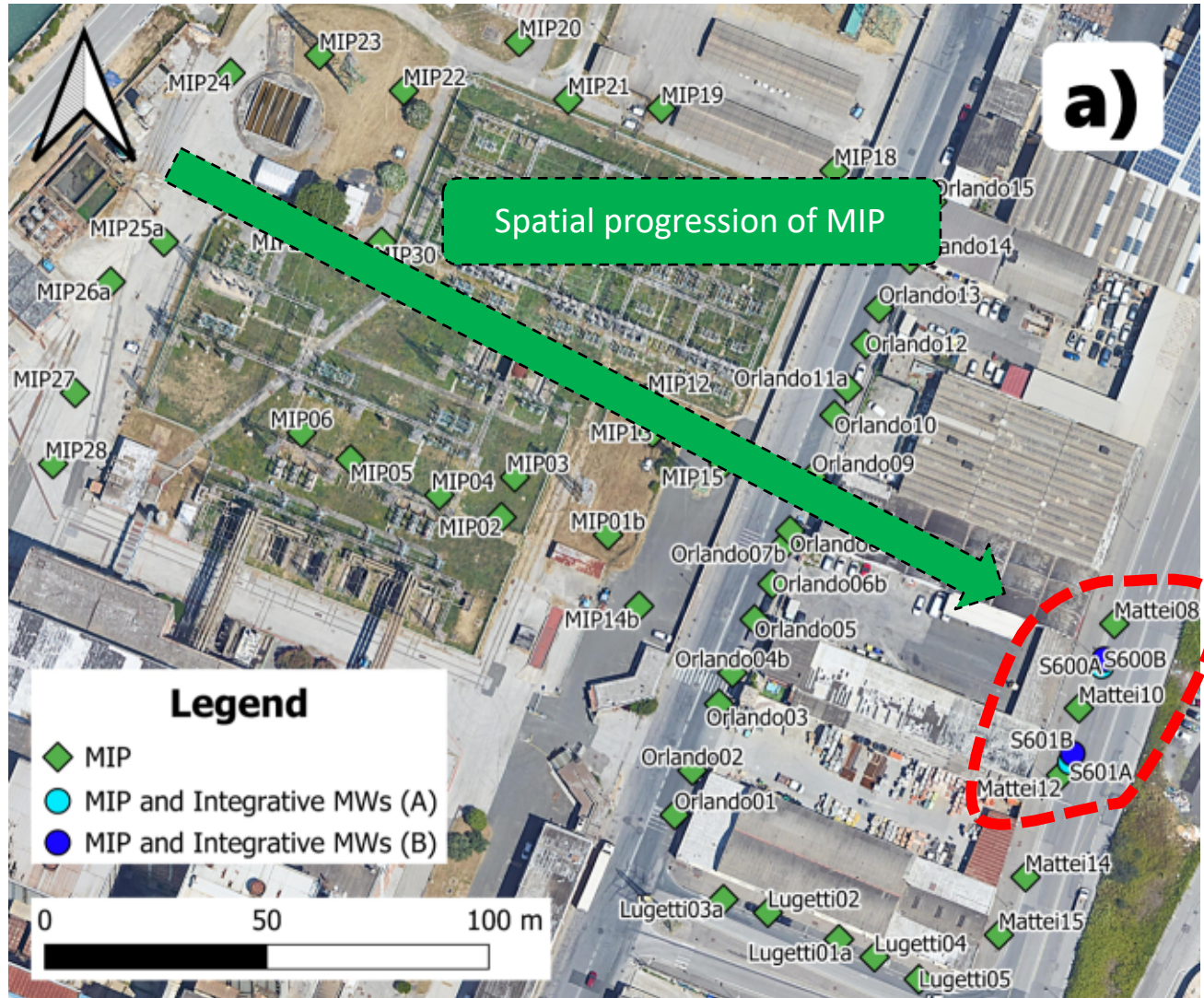
High Resolution Site Characterization (HRSC)



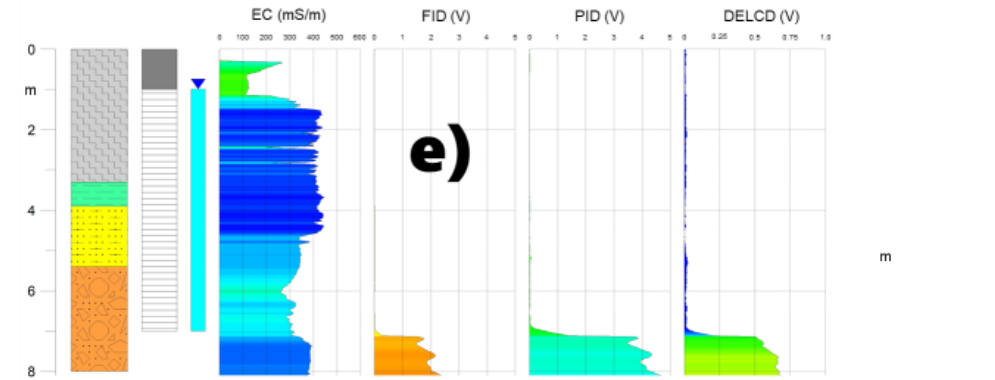
Source Identification



Source Identification



S600A



Stratigraphy

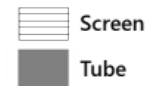


Aquifer

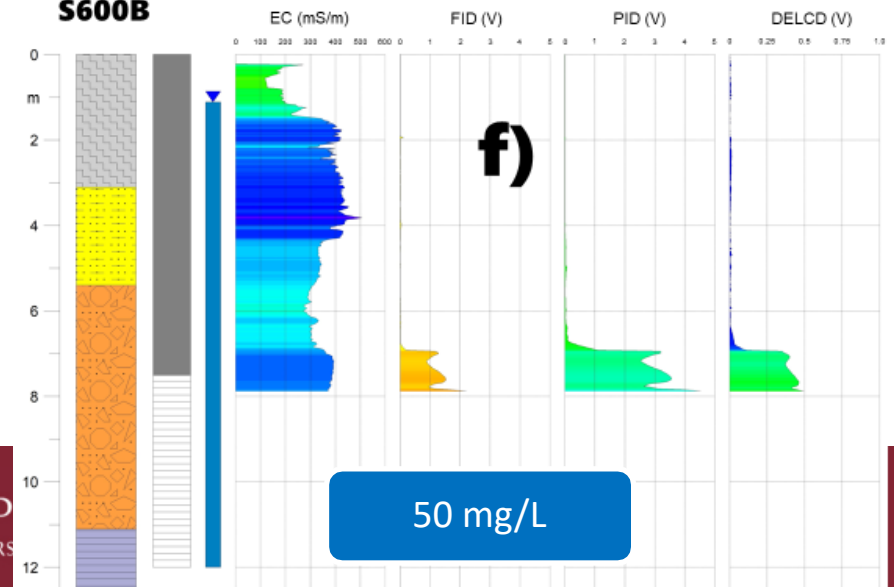


163 mg/L

Well construction

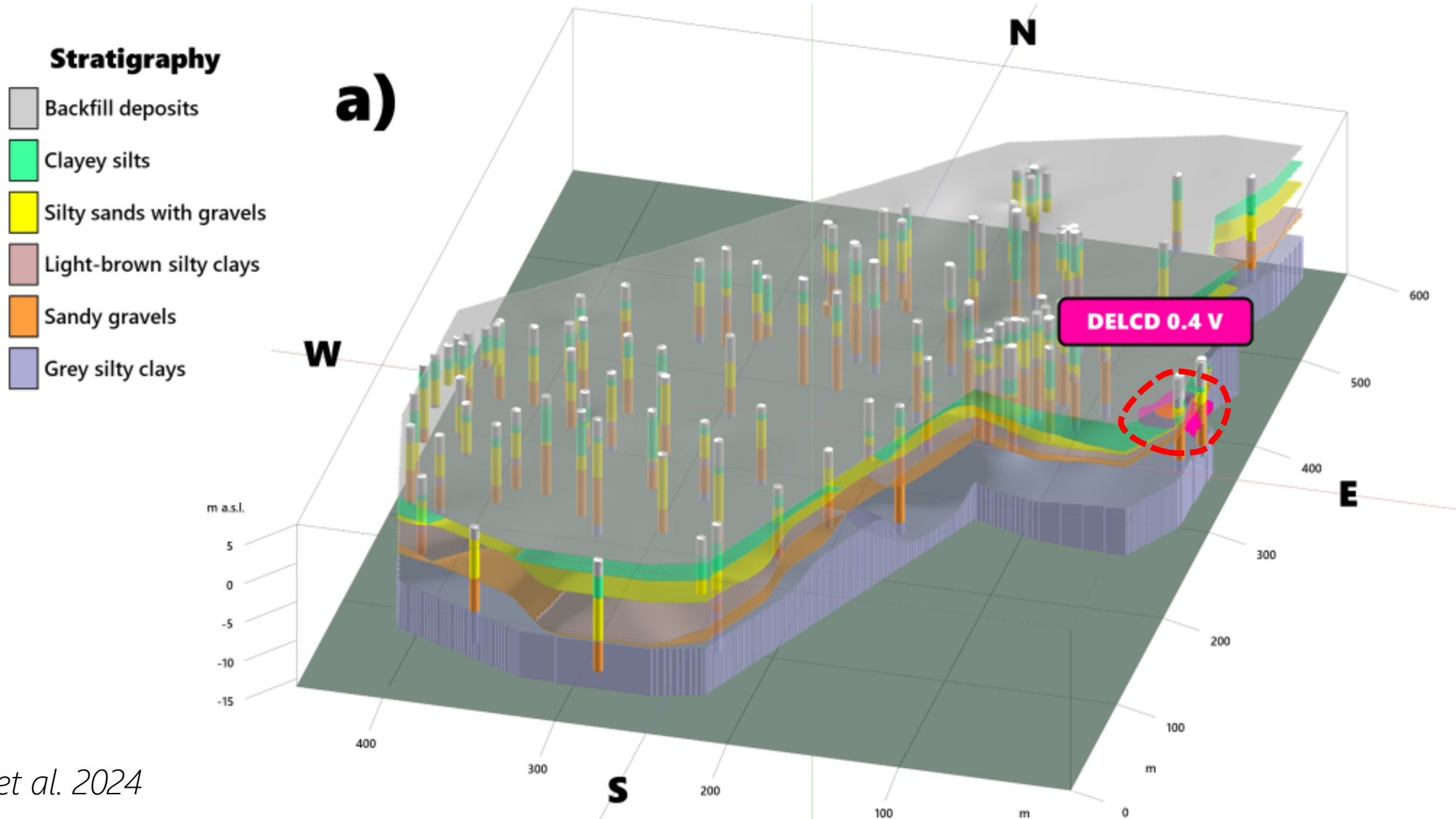


S600B



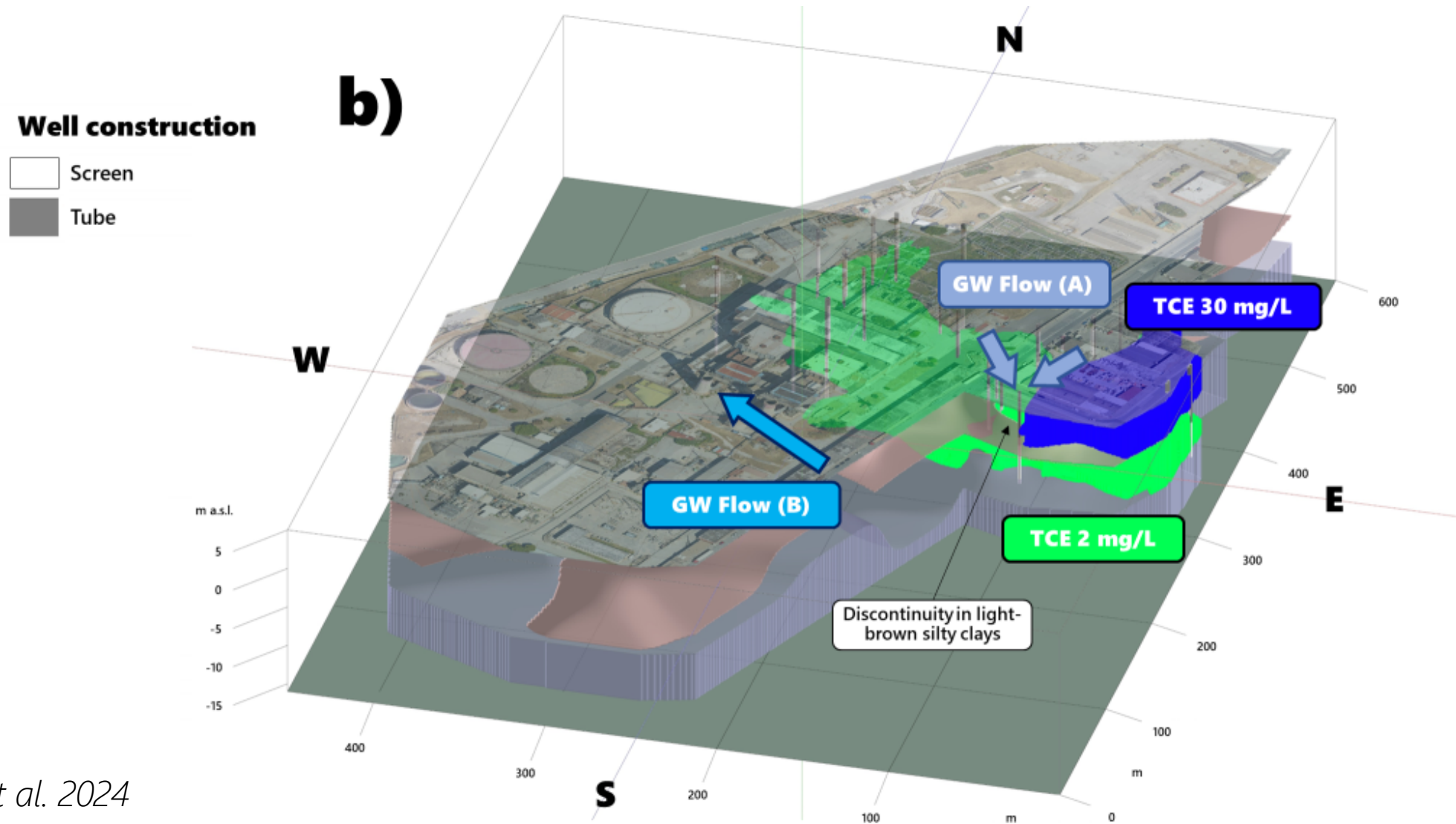
50 mg/L

Delimitation of the secondary contamination source



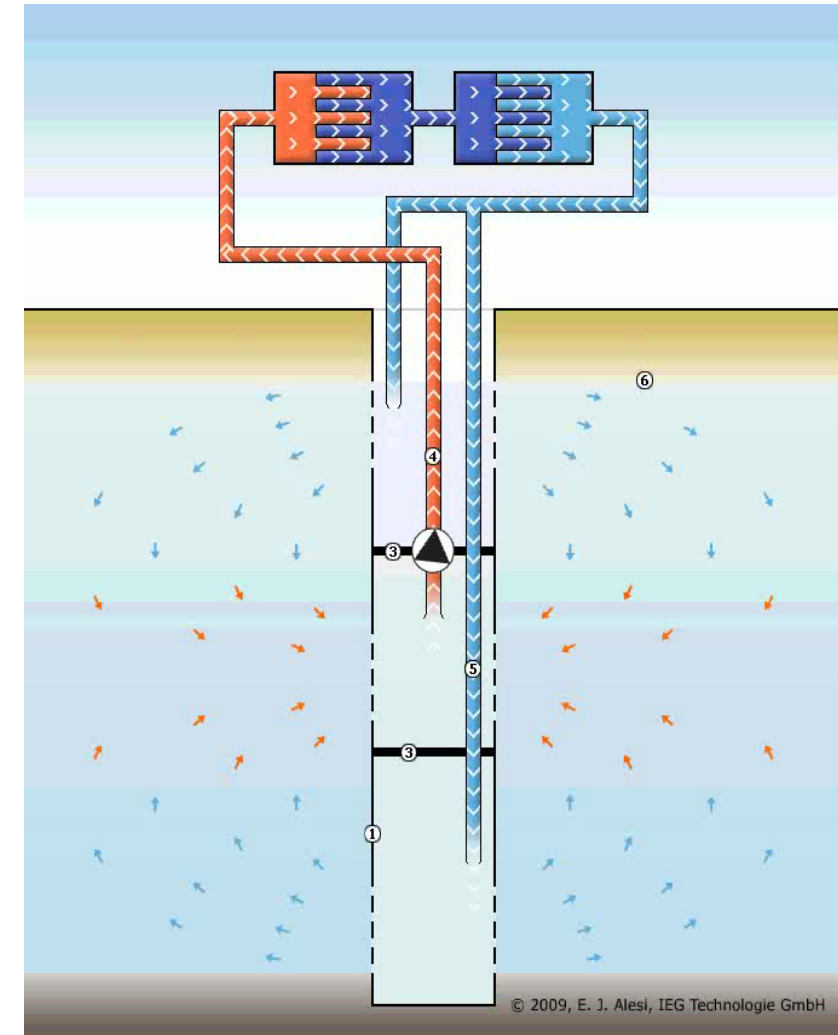
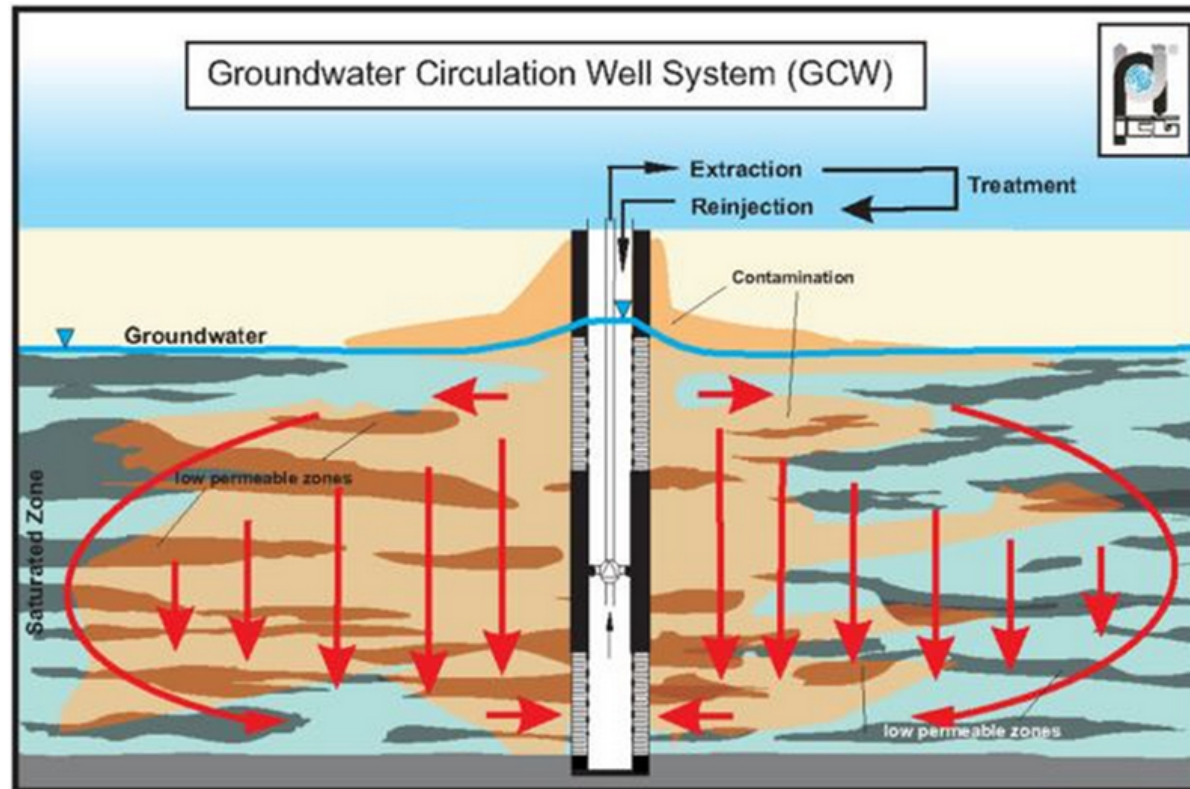
Ciampi et al. 2024

Reconstruction of CSM and "geo-driven" contamination dynamics

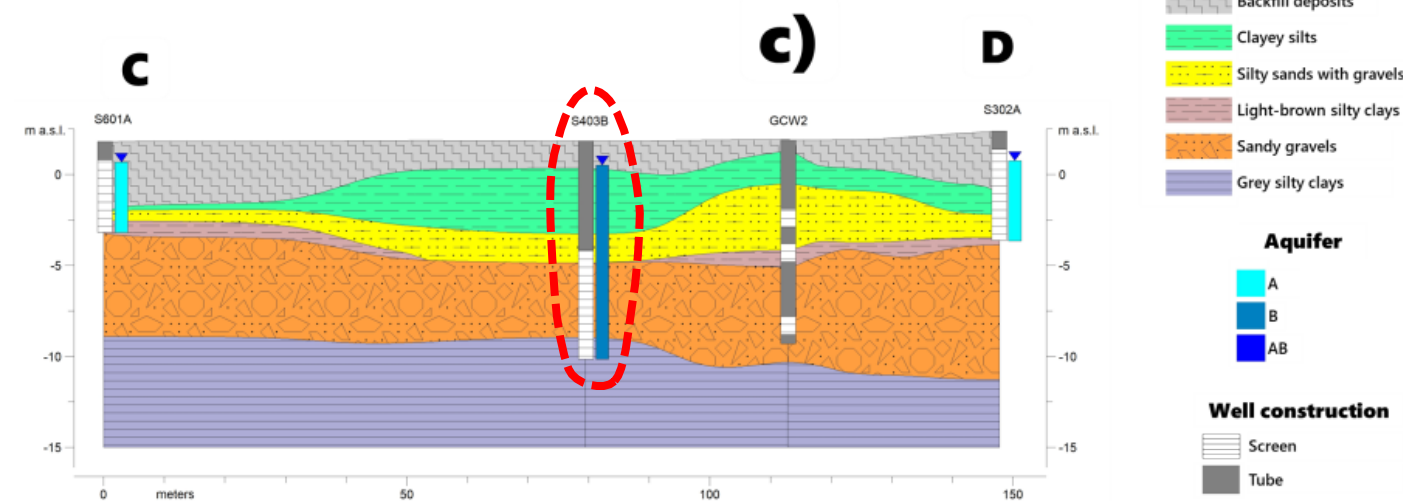
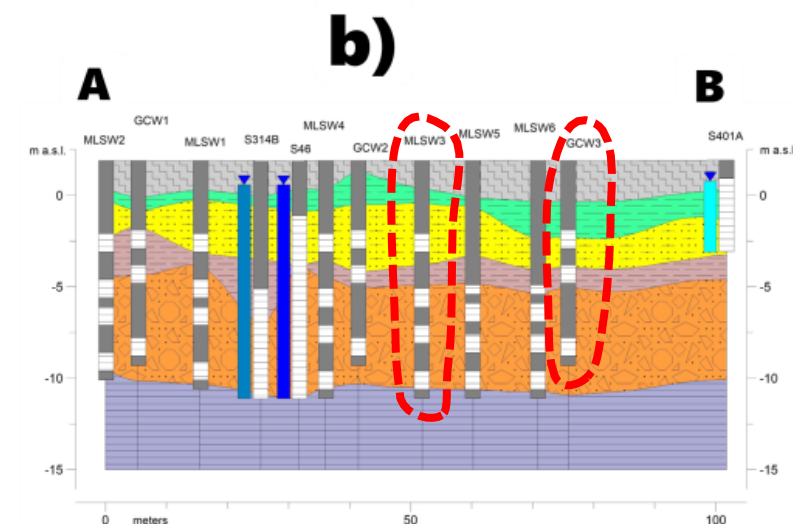
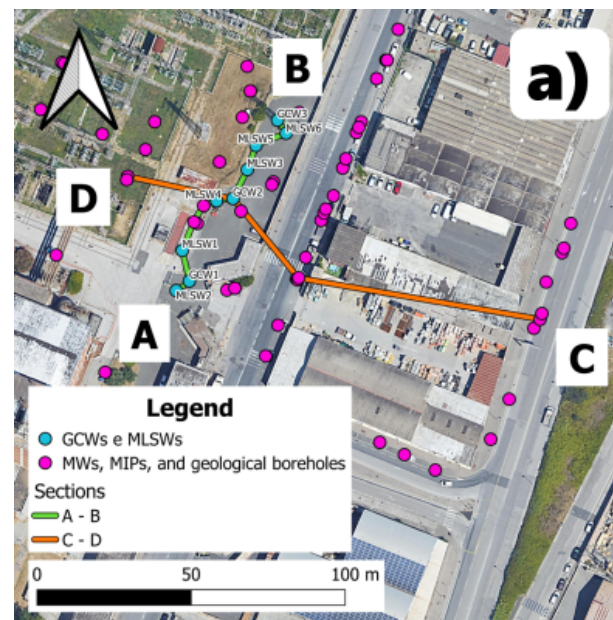
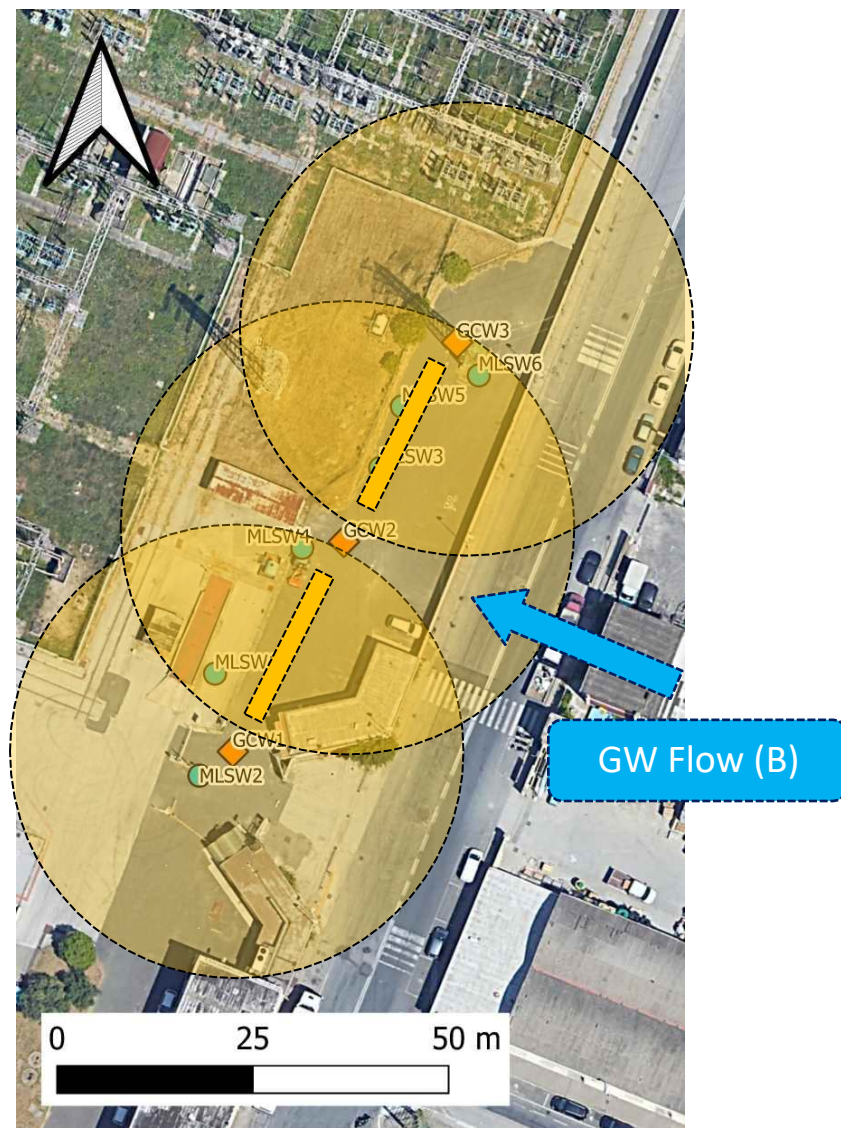


Ciampi et al. 2024

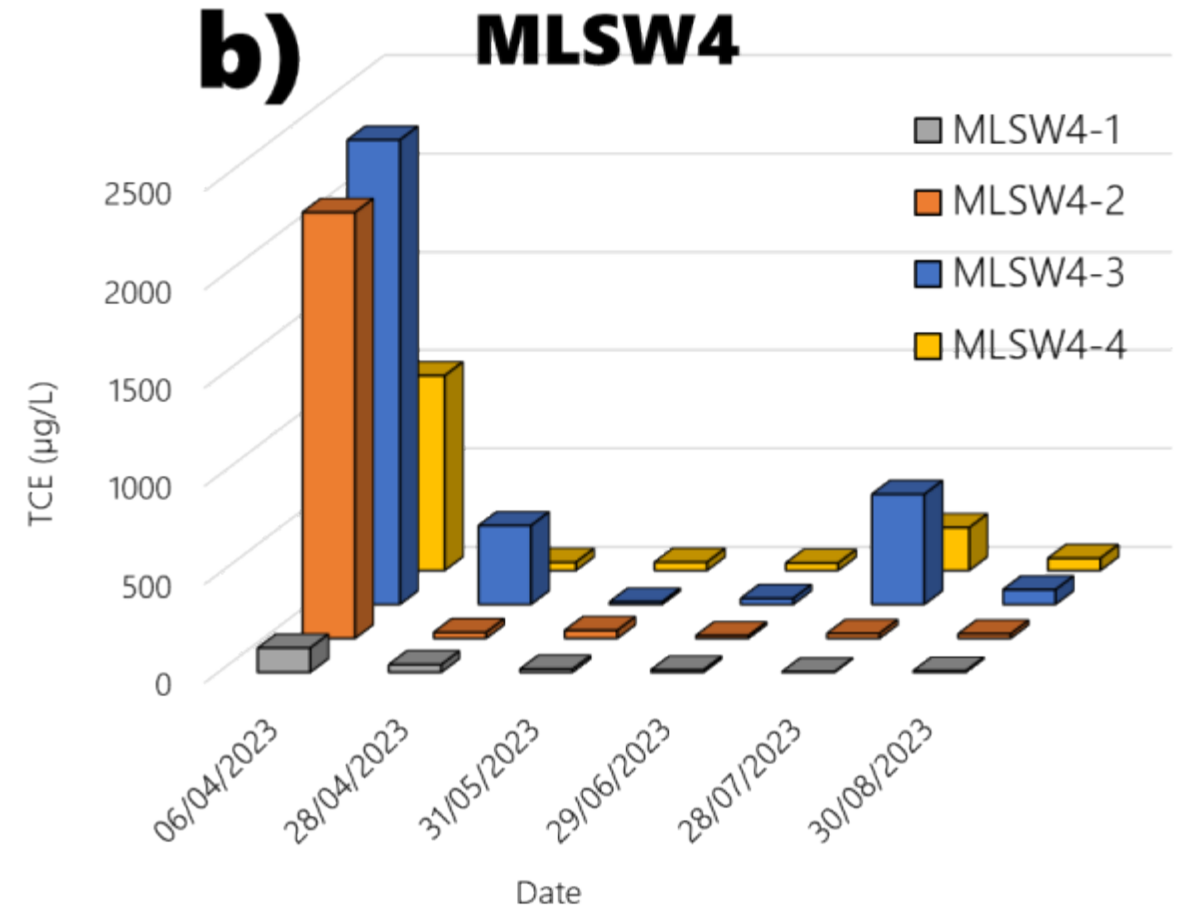
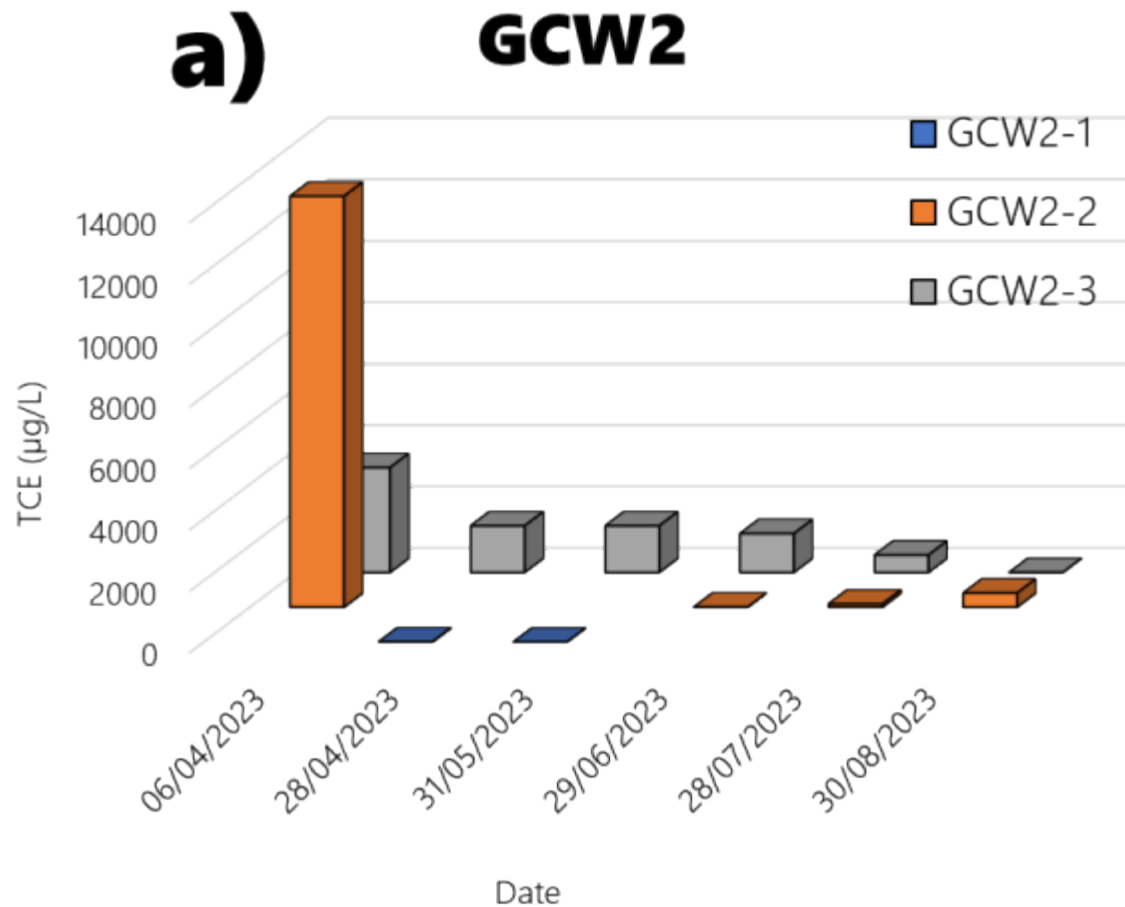
Remediation Strategy (Groundwater Circulation Wells)



GCWs in a virtual barrier configuration

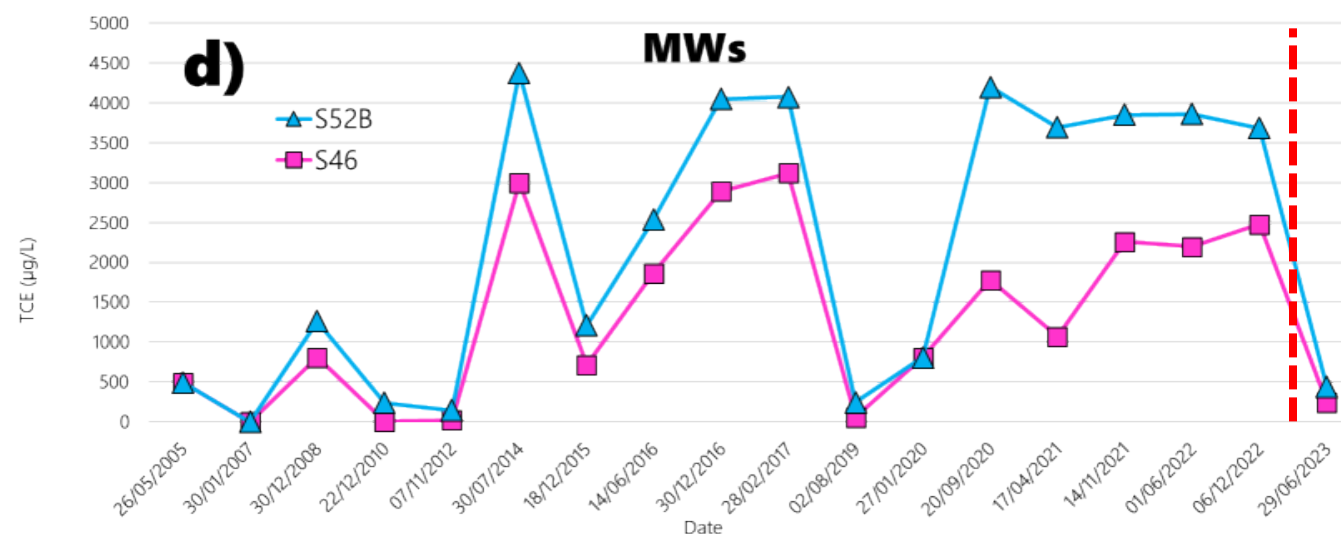
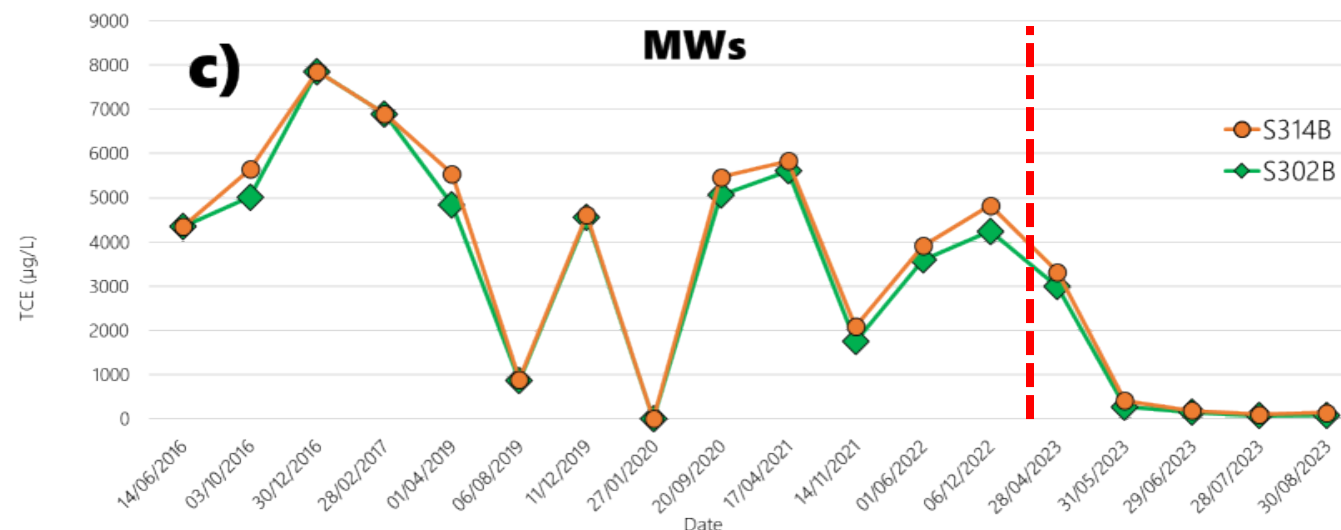


Hydrochemical monitoring GCW e MLSW (virtual barrier)

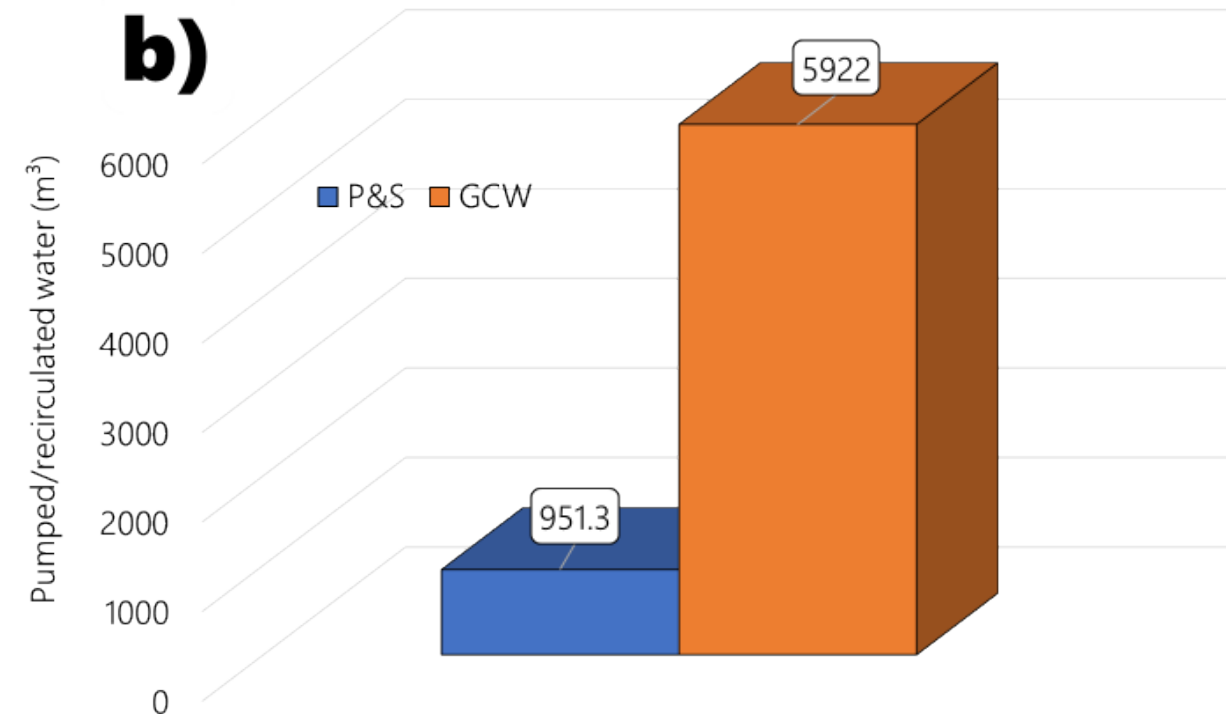
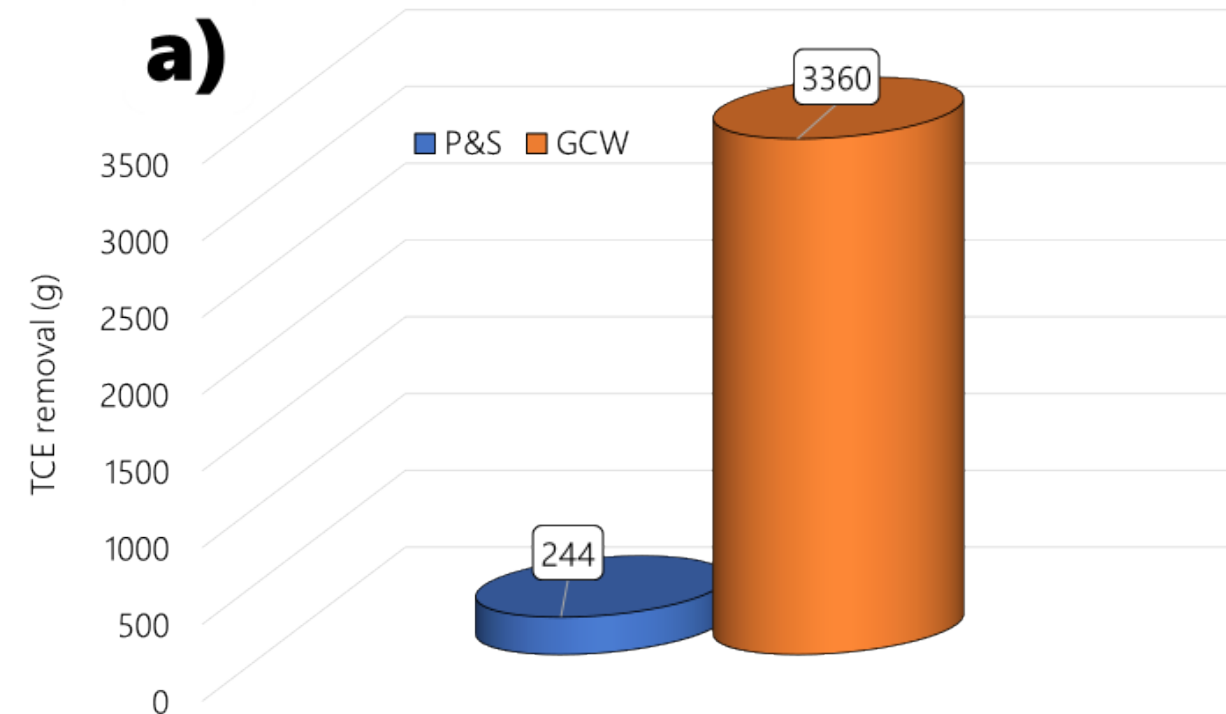


Concentrations of TCE measured in the screened intervals of the GCW (a) and at MLSW4 sampling intervals (b) after the GCW startup

Hydrochemical monitoring of traditional MWs



Performance and sustainability (P&S vs GCW)



Comparison between the 3 GCWs and the on-site P&S system in terms of removed TCE mass (a) and recirculated/treated groundwater (b)

Conclusions

The multi-source data-driven model is the interface that guides the design of an advanced remediation strategy by manipulating information across space-time

The 3D hydrogeophysical clone contextualizes the pollution dynamics and decontamination mechanisms within the geological framework

Hydrochemical monitoring shows the interception of the plume with a GCW virtual barrier

Field evidence offers the prospect of a more sustainable approach than traditional P&S

Remediation Geology: Geology-Focused Approach to the Remediation and Management of Polluted Sites



sustainability

an Open Access Journal by MDPI



Remediation Geology and Technologies: Geology-Focused Approach and Chemical-Physical and Biological Processes for Sustainable Remediation