SOBRAL, BRAIS

Estudiante de doctorado

UNIVERSIDADE DA CORUÑA

CICA

ESCOLA TÉCNICA SUPERIOR DE ENXEÑERÍA DE CAMIÑOS, CANAIS E PORTOS

14th International HCH and Pesticides Forum

3D GROUNDWATER FLOW AND CONTAMINANT TRANSPORT MODEL OF THE SARDAS LANDFILL (HUESCA, SPAIN)

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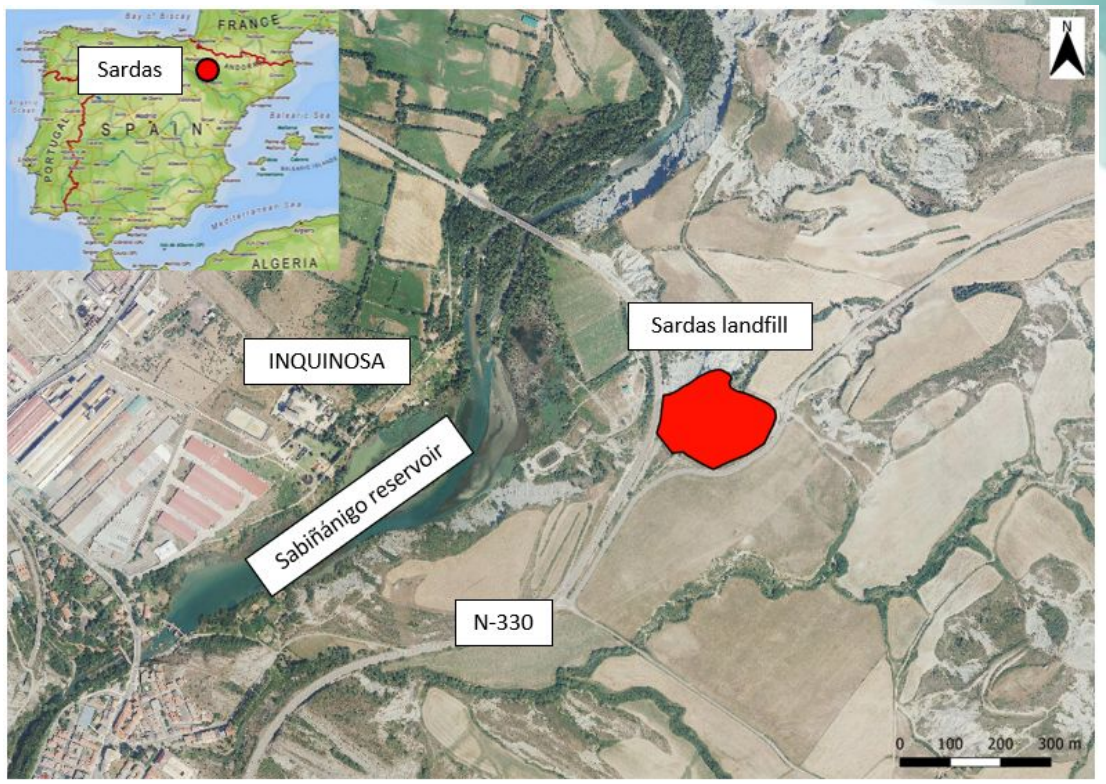
Outline

- Introduction
- Conceptual model
- 3D groundwater flow model
- 3D contaminant transport model
- Conclusions

Introduction

- Sardas landfill is located on the Larrés marls formation.
- Upper surface sealed with a 2 mm thick HDPE sheet.
- Slurry-wall with variable depth up to the underlying marls was constructed to prevent water outflow from the landfill.
- Layer of fractured, altered and decompressed (FAD) marls underneath leachates to the Gállego river alluvial aquifer.
- Perimeter drainage ditches not collecting all the surface runoff and the interflow.



Conceptual model

- Wastes from landfill and glacis around the landfill.
- Landfill wastes very heterogeneous.
- Infiltration recharges from the landfill perimeter and from watersheds upstream of the landfill.

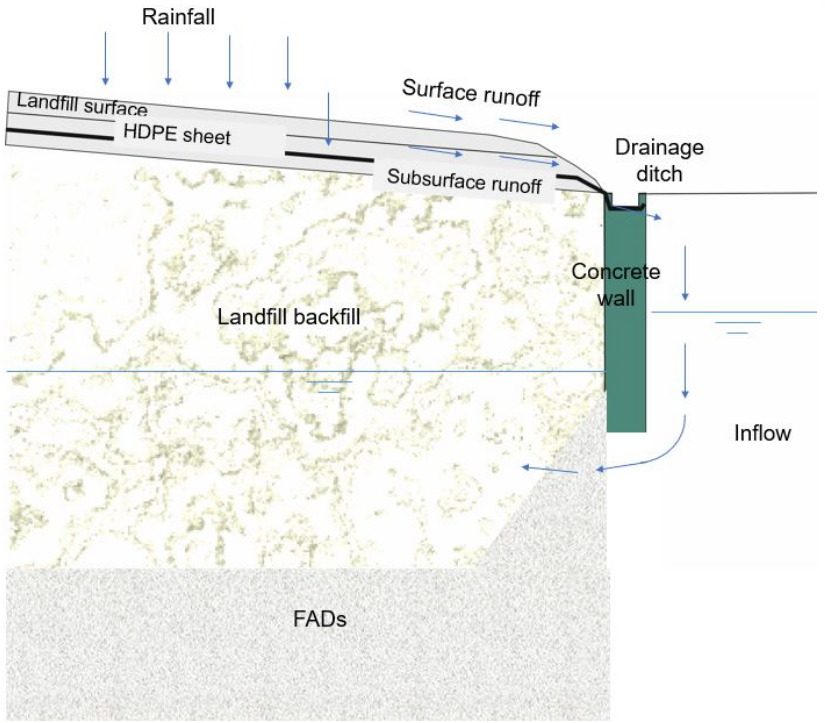


Diagram of the surface runoff and interflow at the contact between the landfill cover layer and the concrete wall.

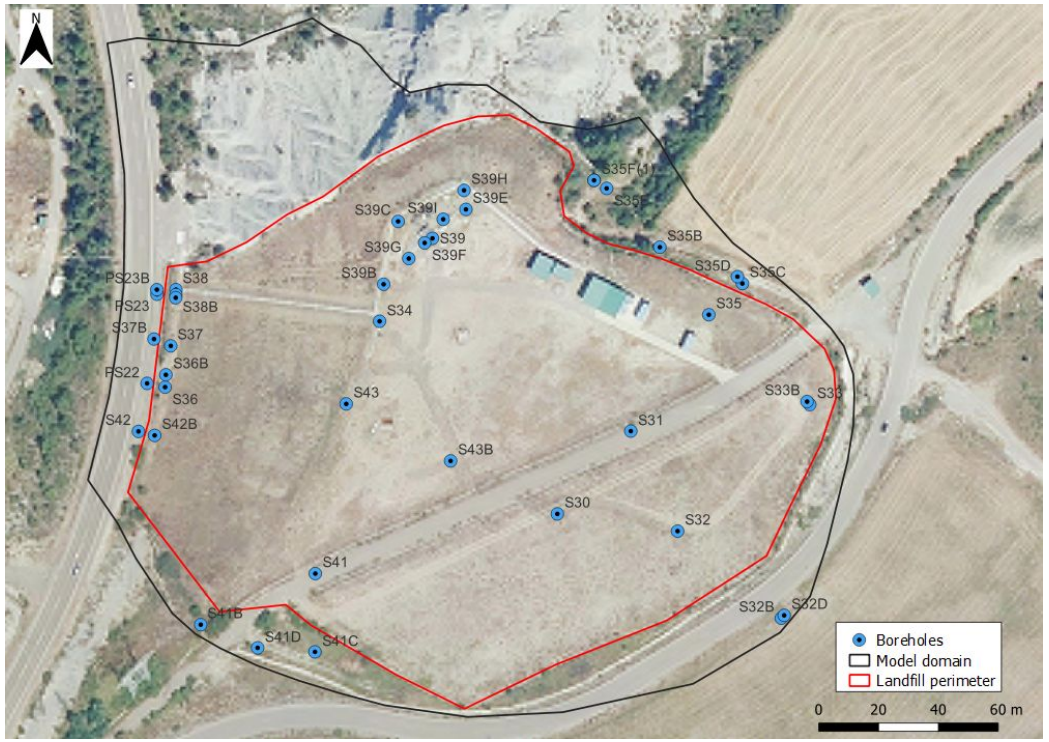
3D groundwater flow model

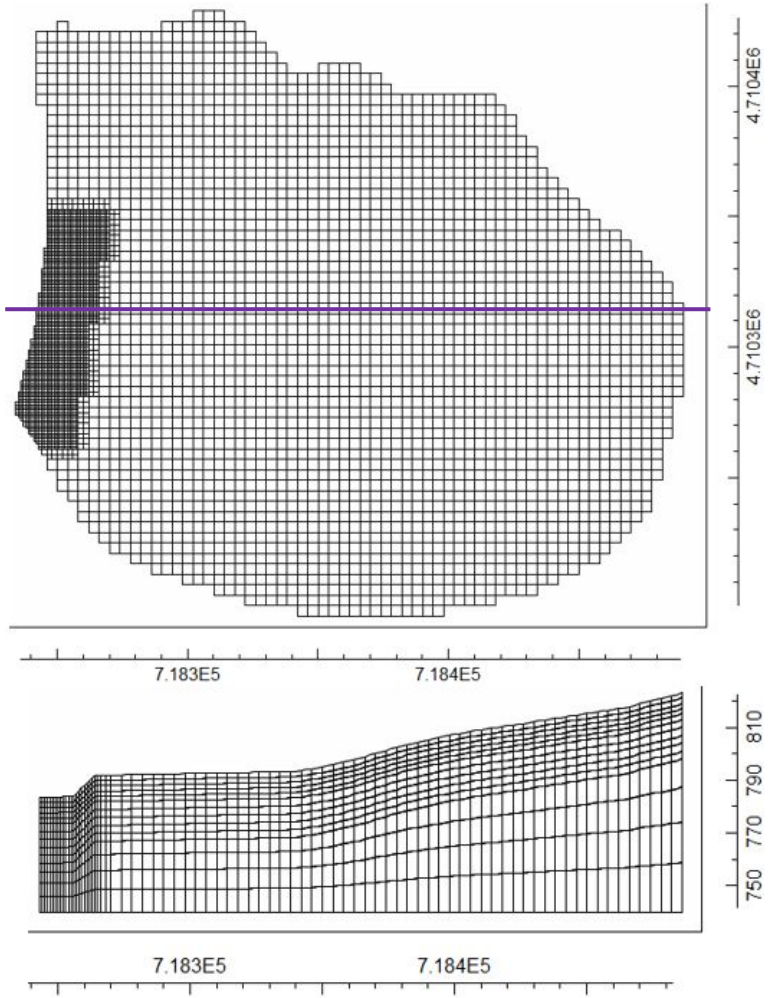
Objectives

- Test the conceptual hydrogeological model of the landfill and the surrounding rocks.
- Quantify groundwater flow through the landfill and the surrounding rocks.
  - Identify inflow and outflow areas.
  - Quantify daily values of inflows and outflows.
- Test difference hypotheses about the inflow and outflow areas.
- The flow model can be later used to:
  - Construct a contaminant transport model.
  - Assess management options such as the worth of water pumping.
  - Quantify the flux of contaminants leaving the landfill.

3D groundwater flow model

Model domain and finite differences grid

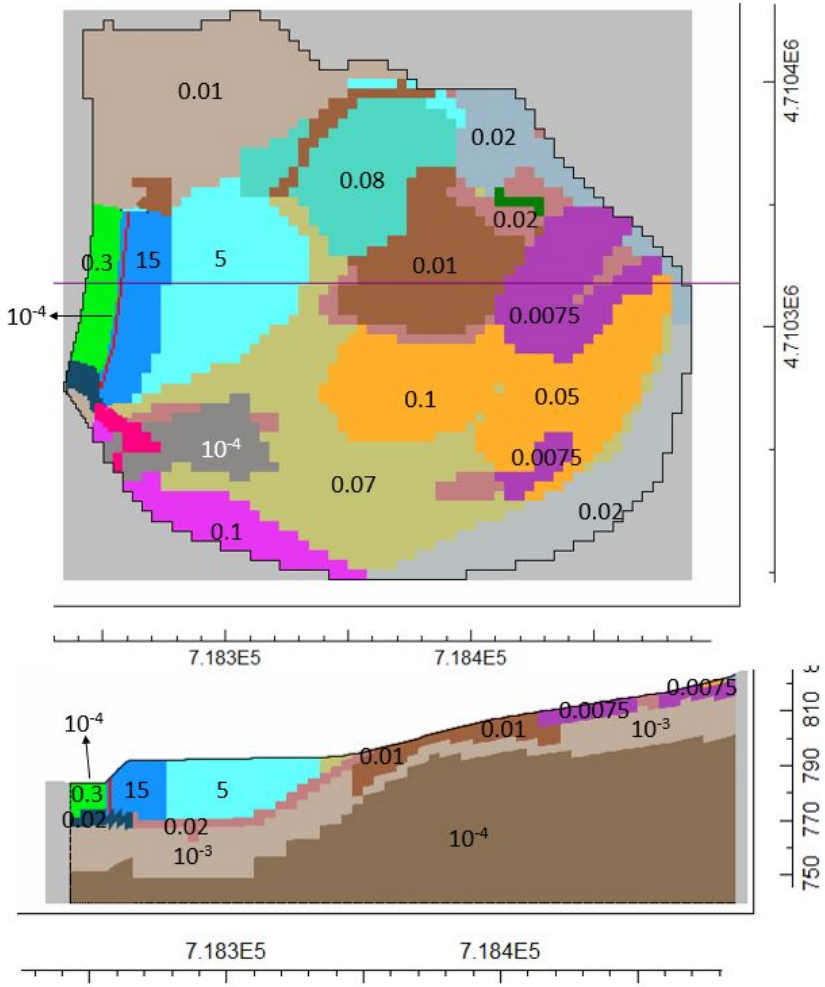




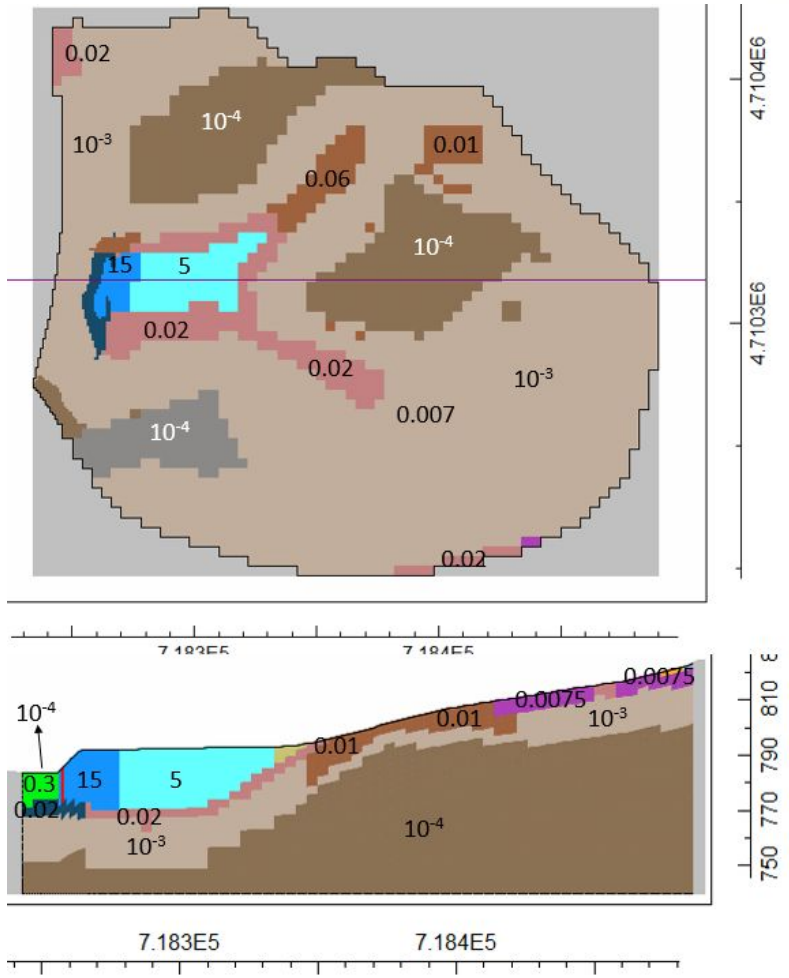
3D groundwater flow model

Material zones

Top layer

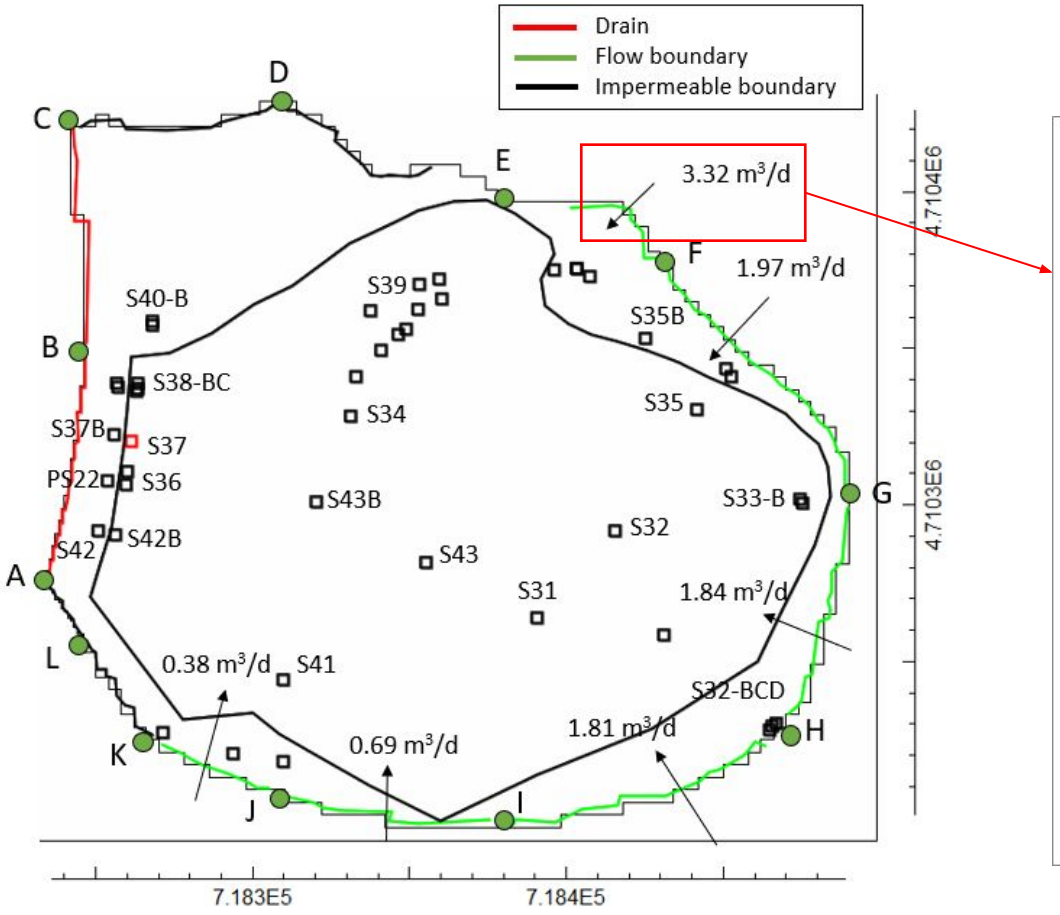


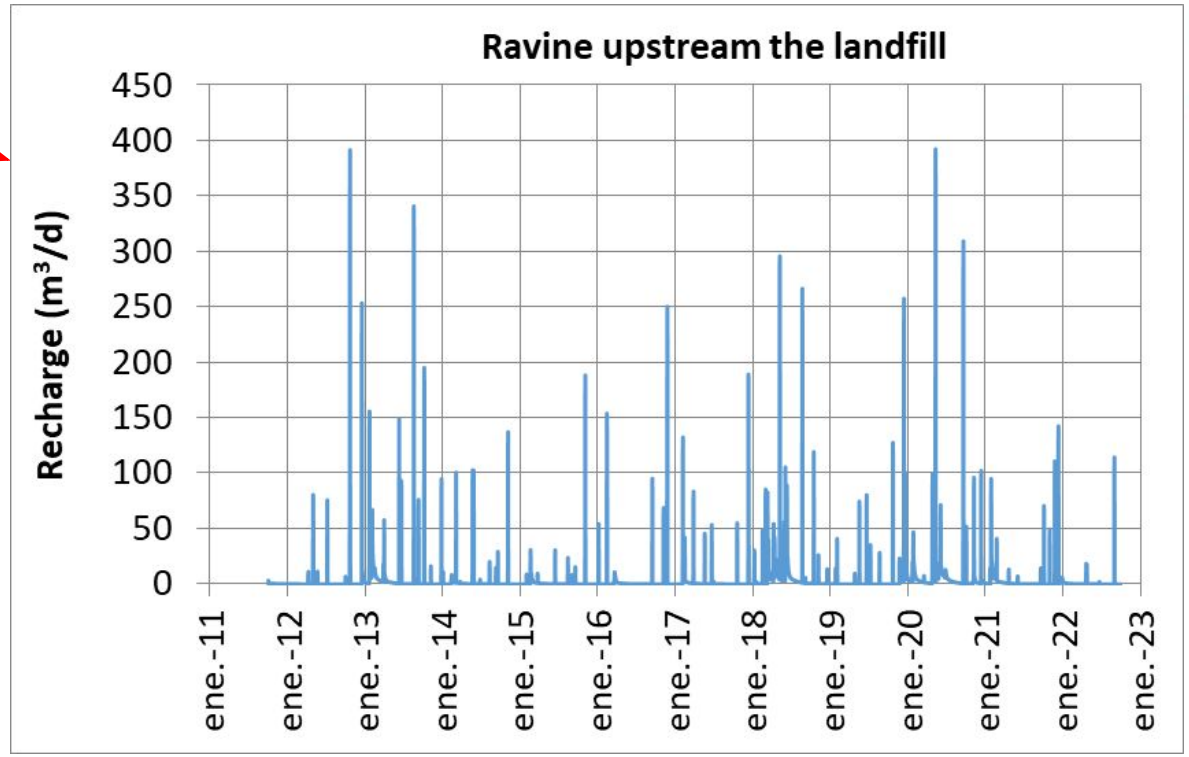
Eight layer



3D groundwater flow model

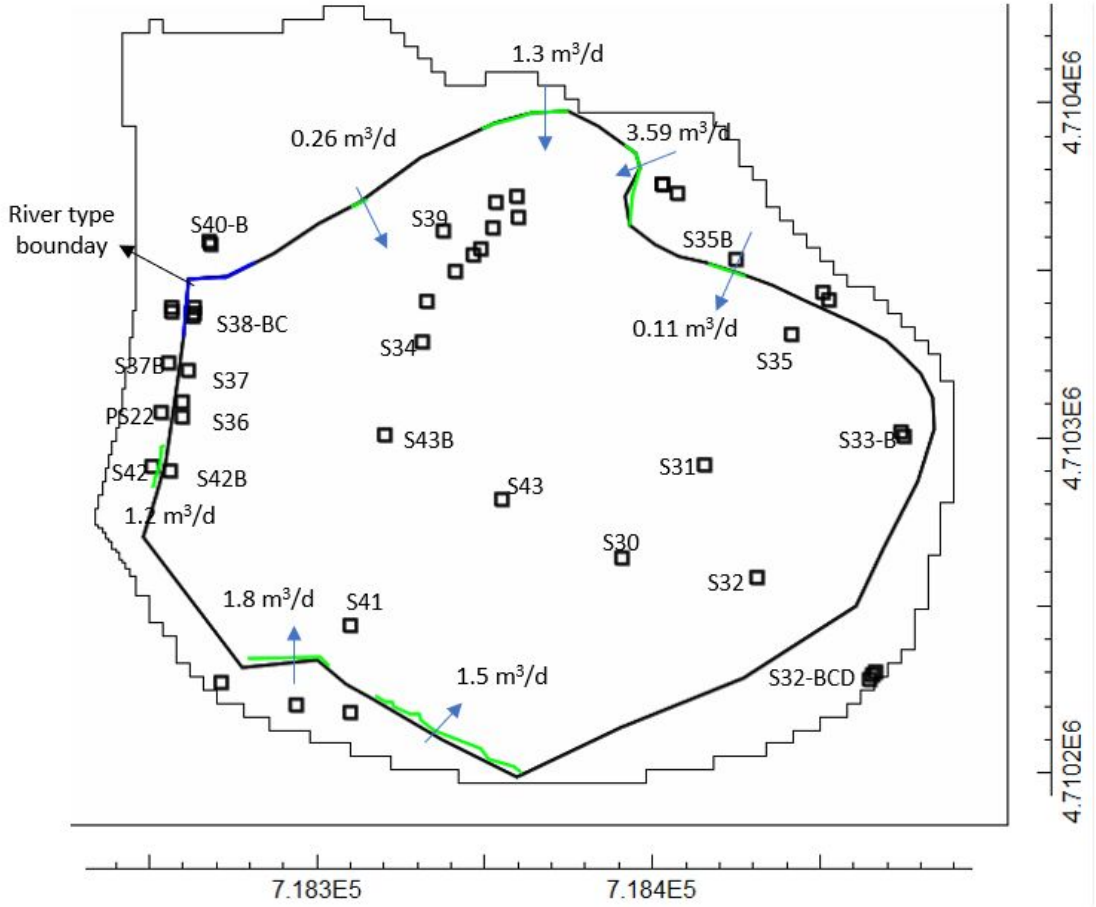
Boundary conditions

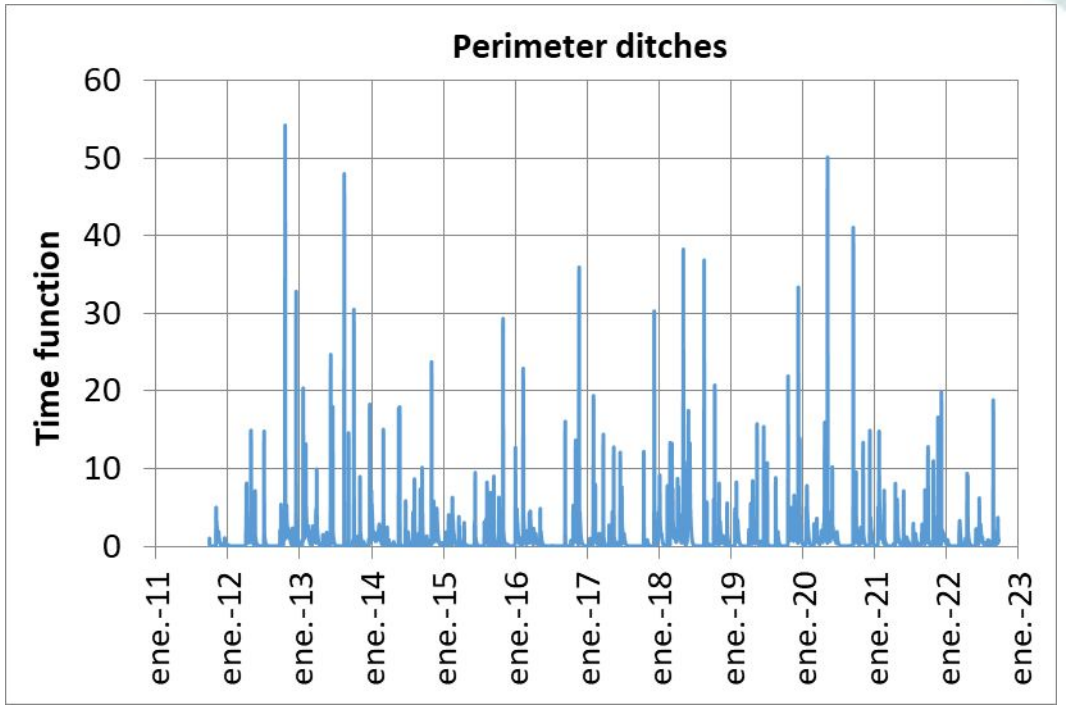




3D groundwater flow model

Boundary conditions





3D groundwater flow model

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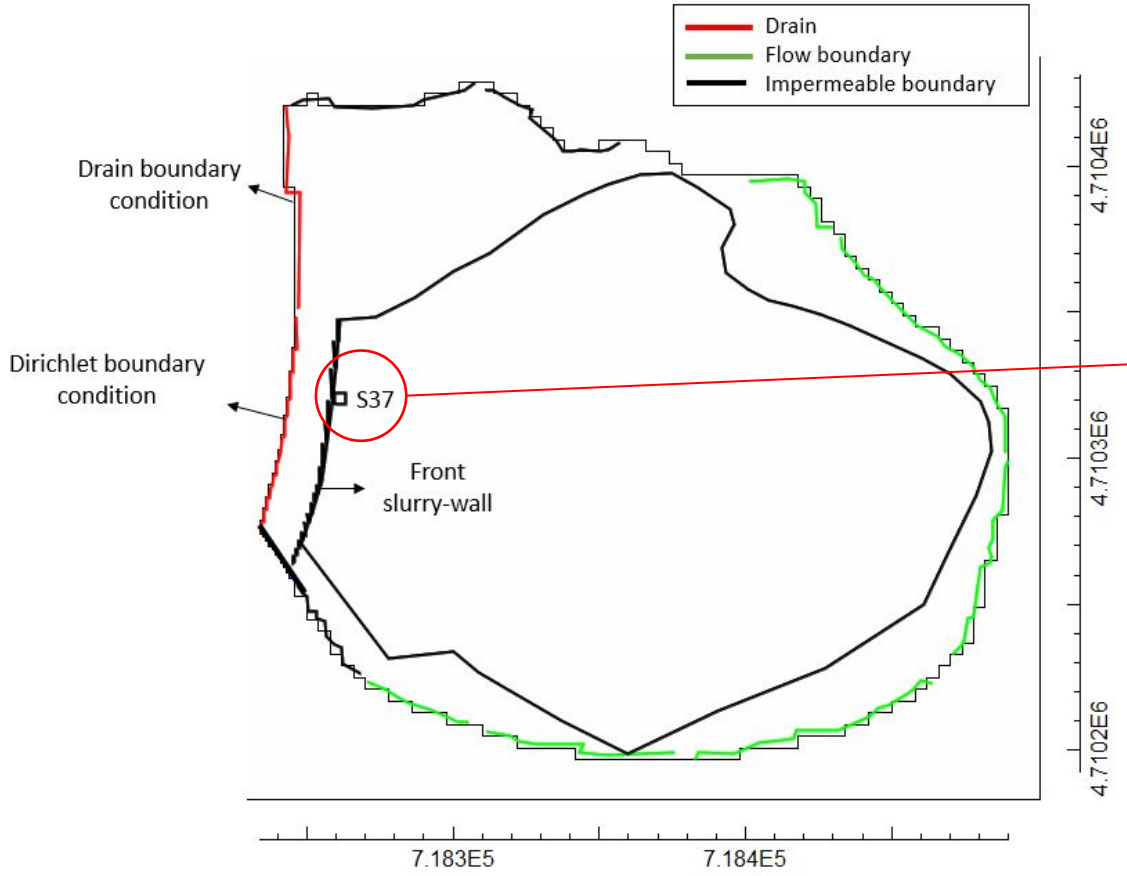
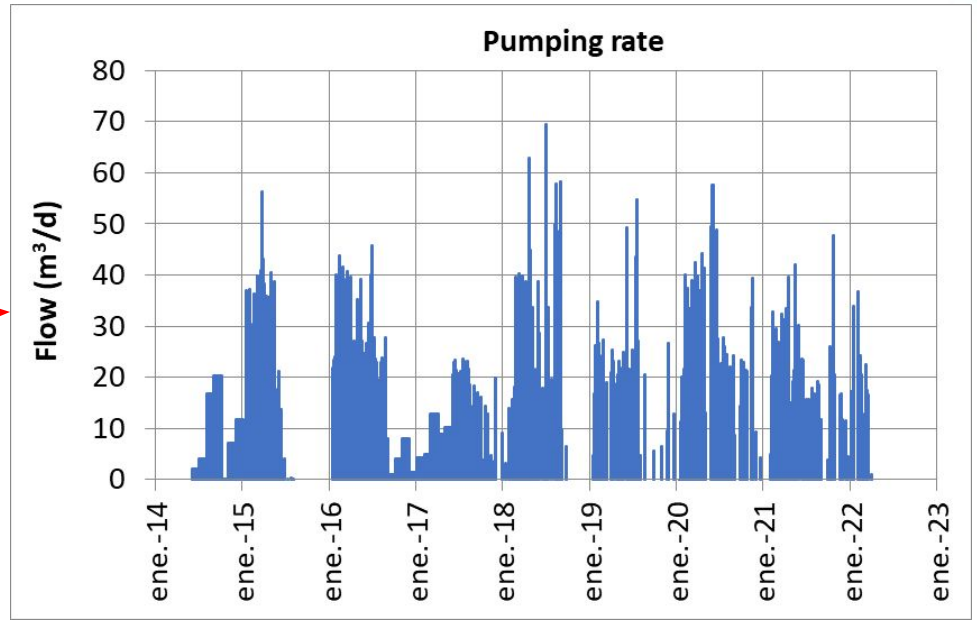
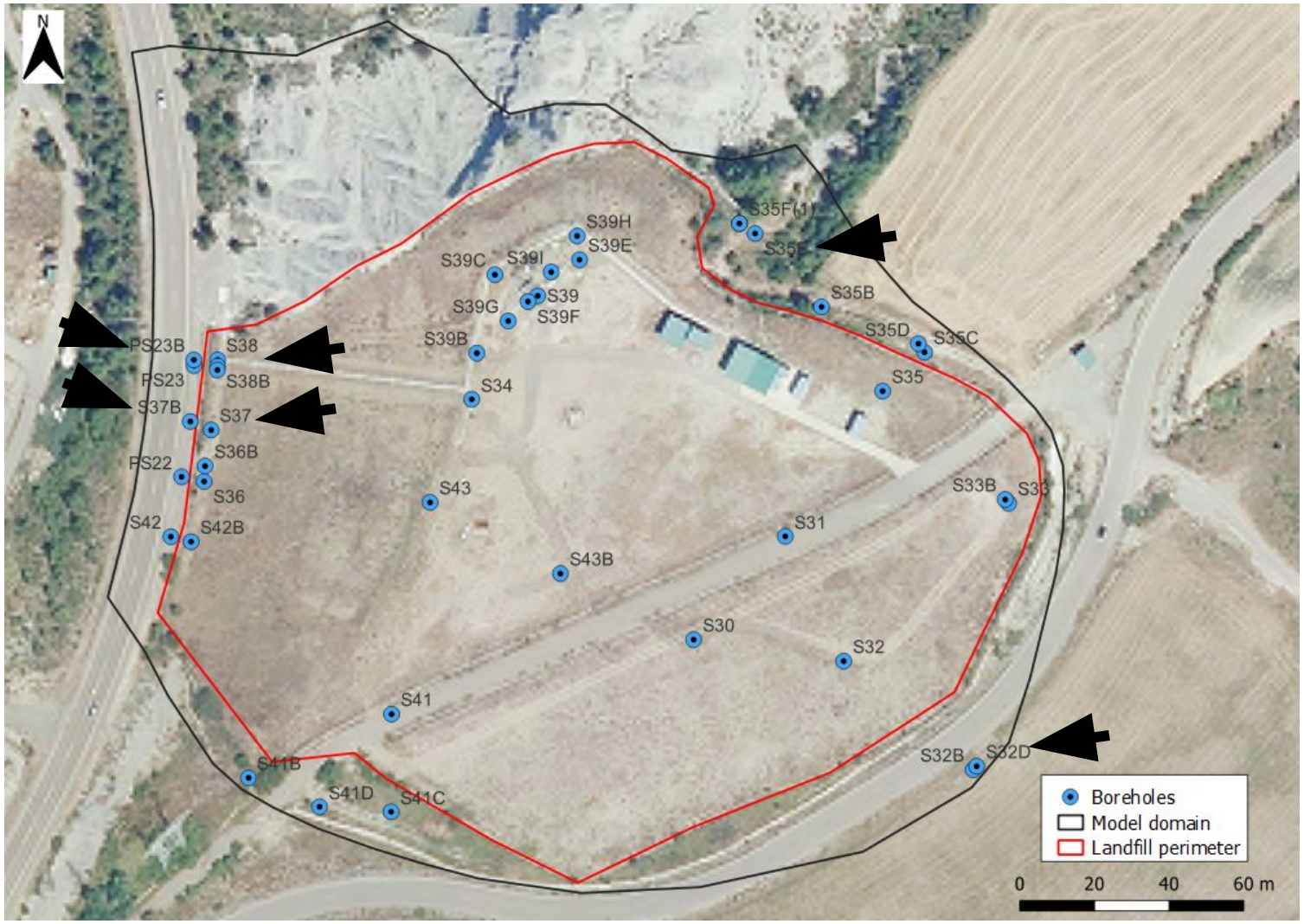




Average pumping rate = 5.60 m^3/d

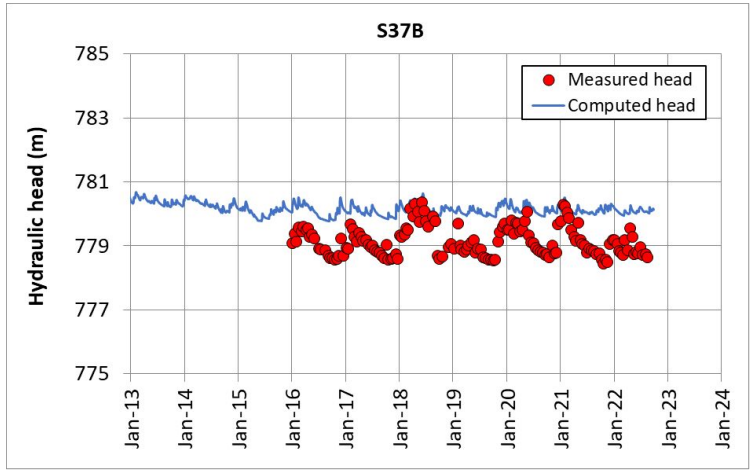
3D groundwater flow model

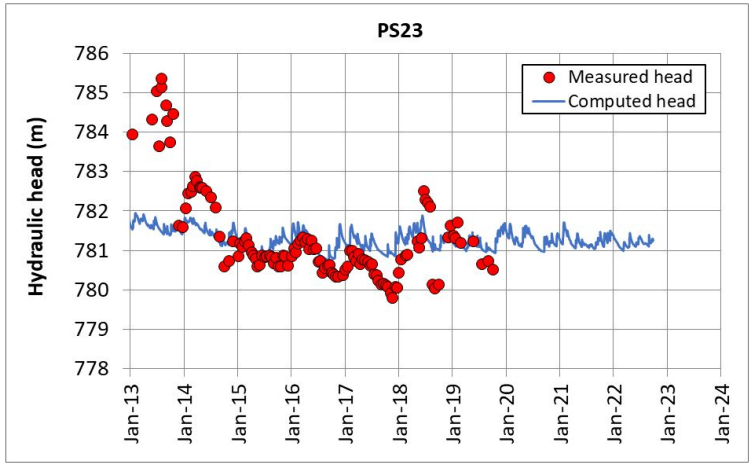
Hydrographs

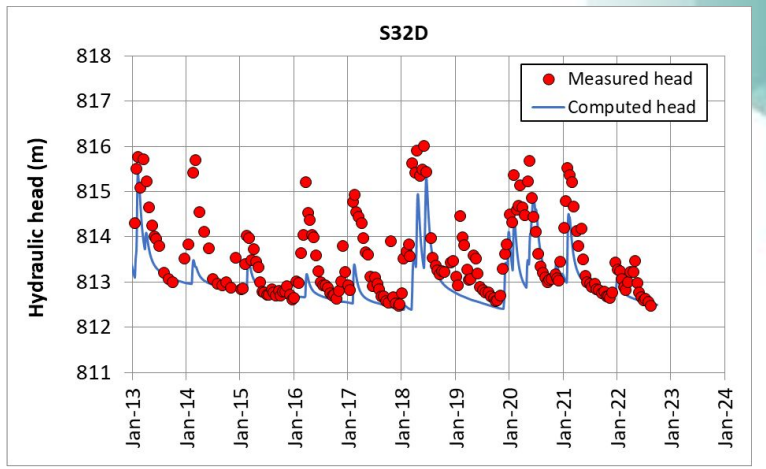


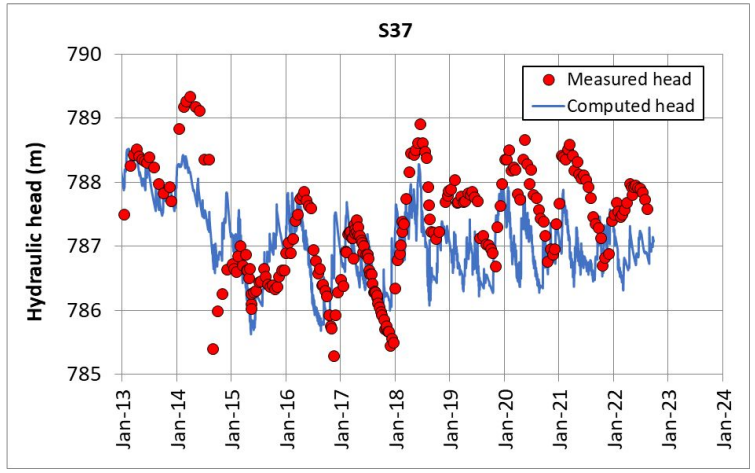
3D groundwater flow model

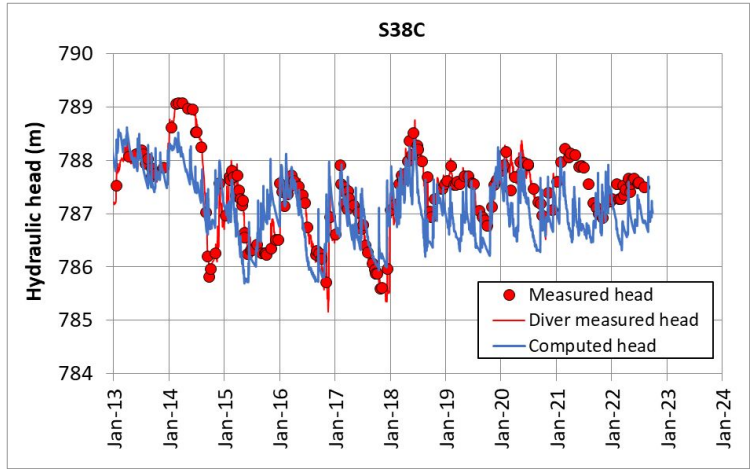
Hydrographs

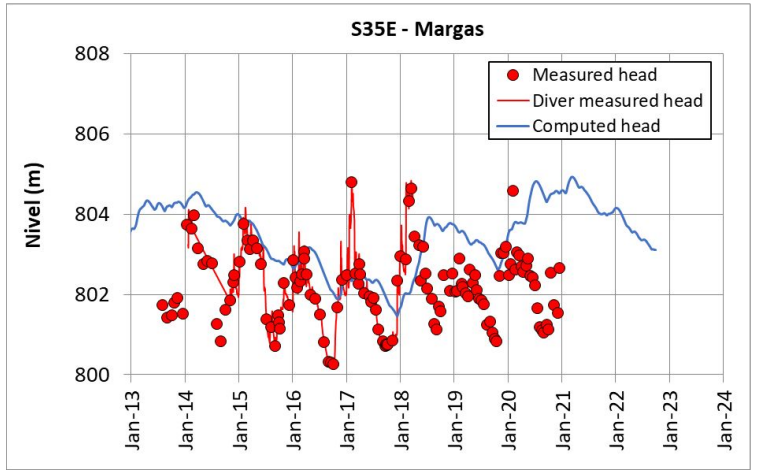








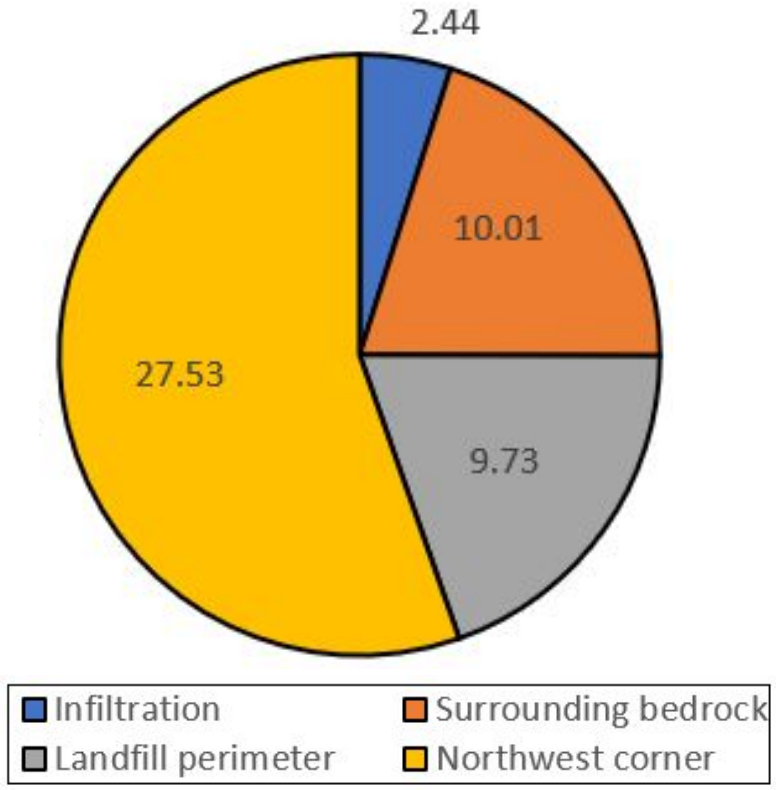




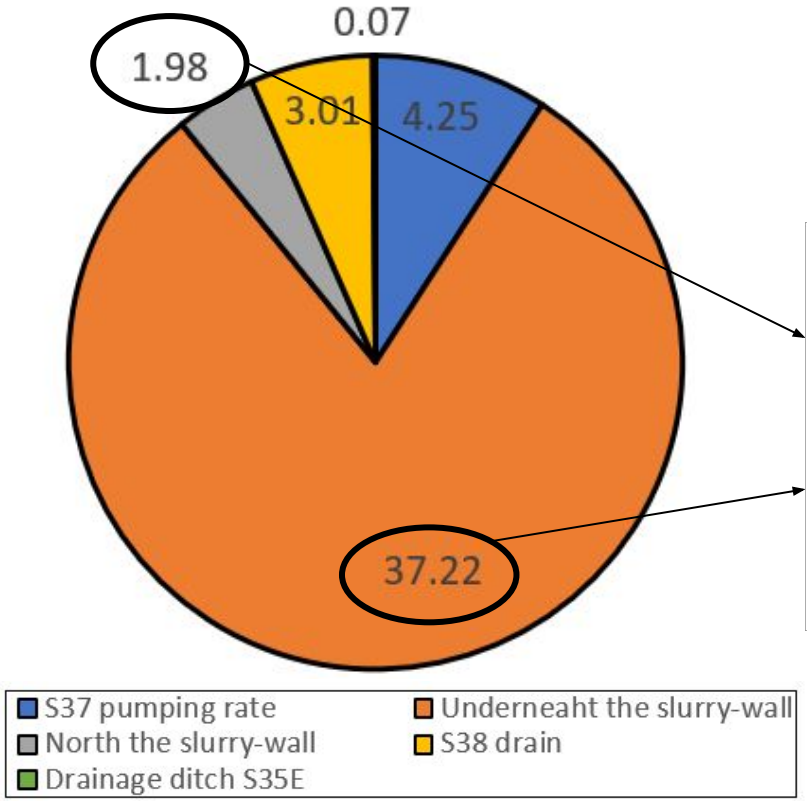
3D groundwater flow model

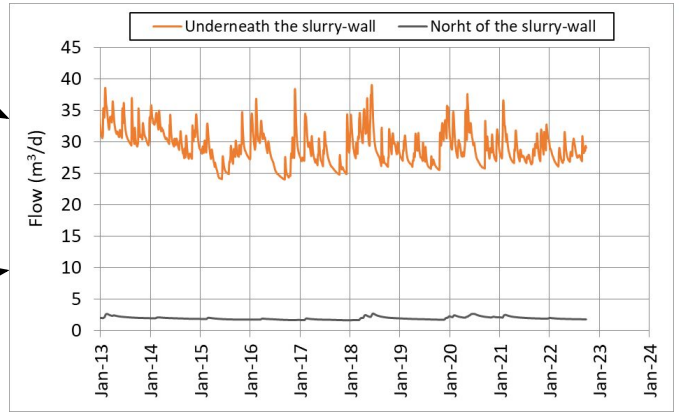
Groundwater model balance

Inflows (m^3/d)



Discharges (m^3/d)

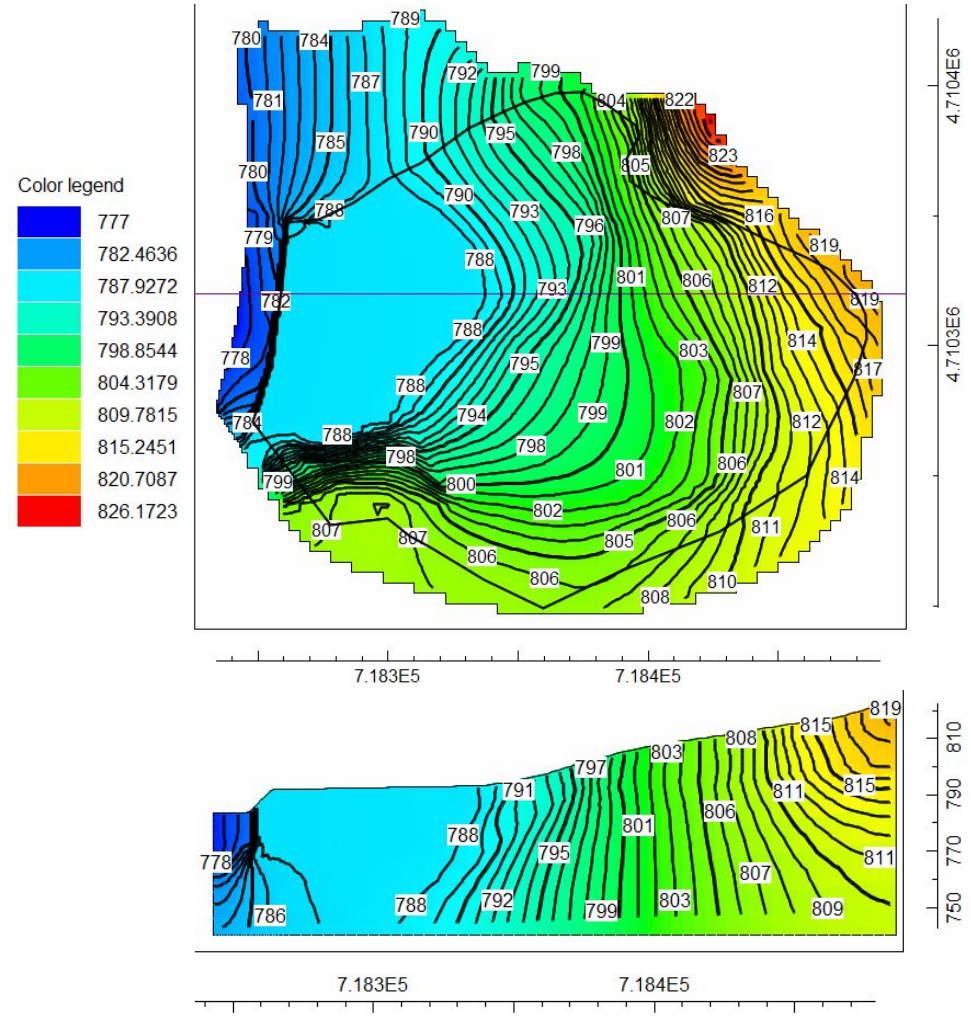




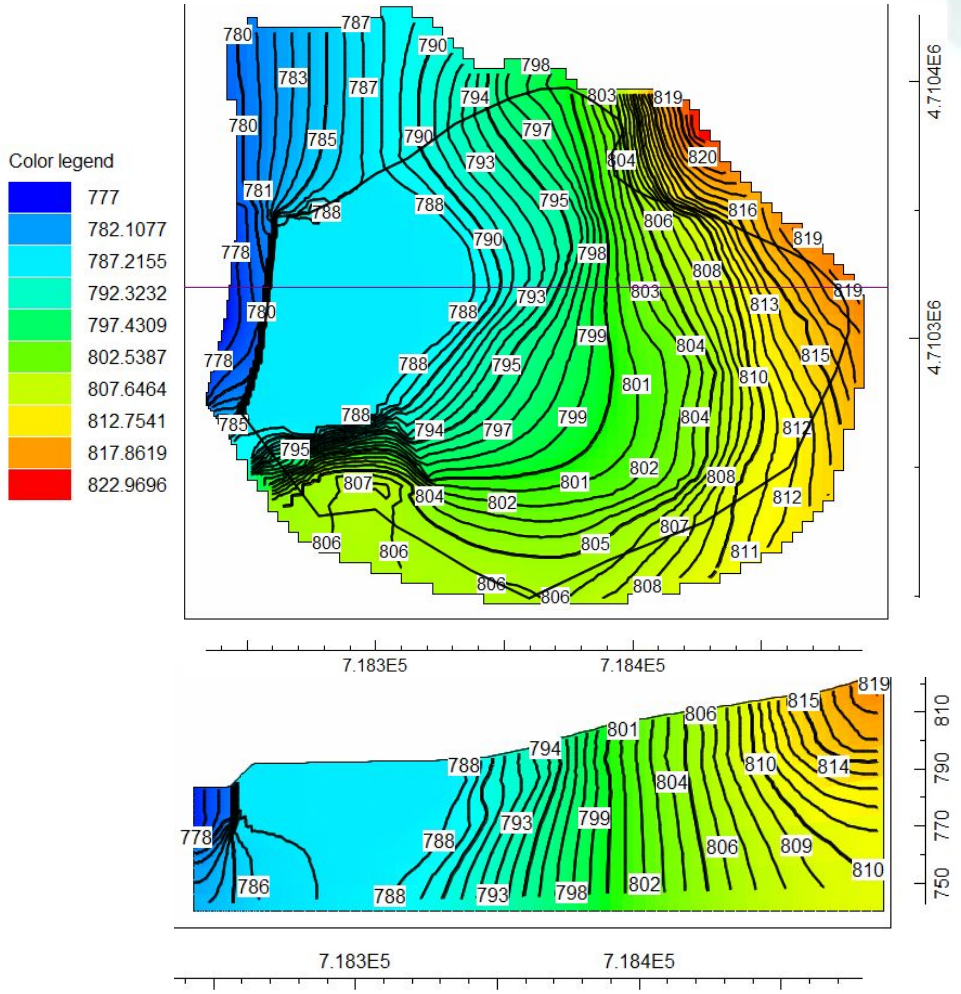
3D groundwater flow model

Computed hydraulic heads

November 2021

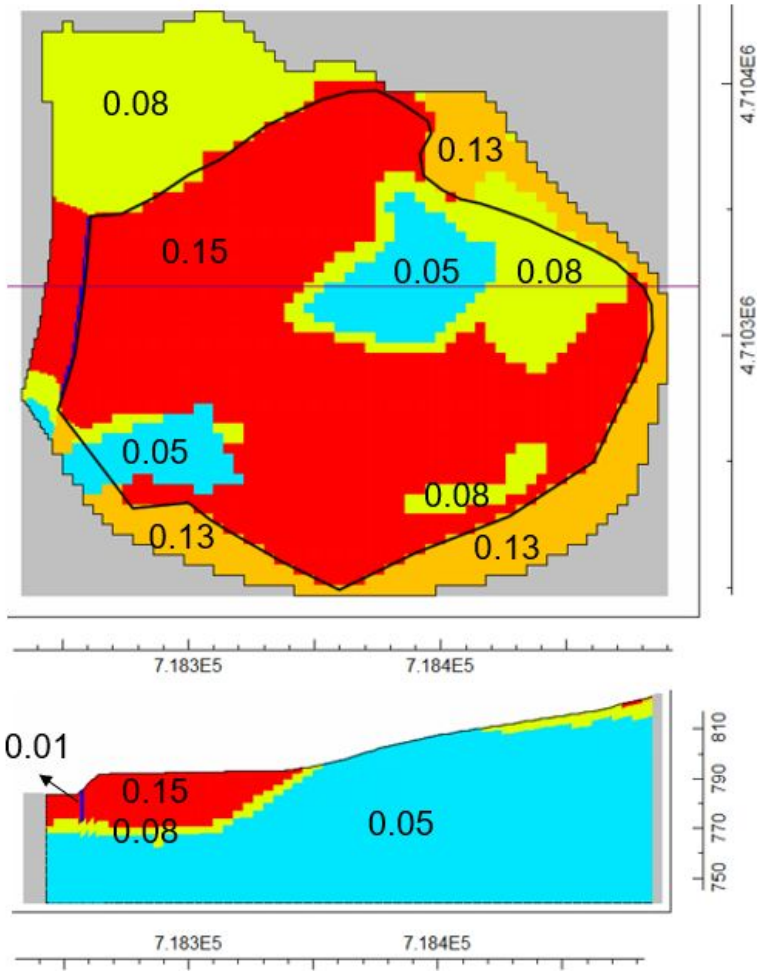


September 2022

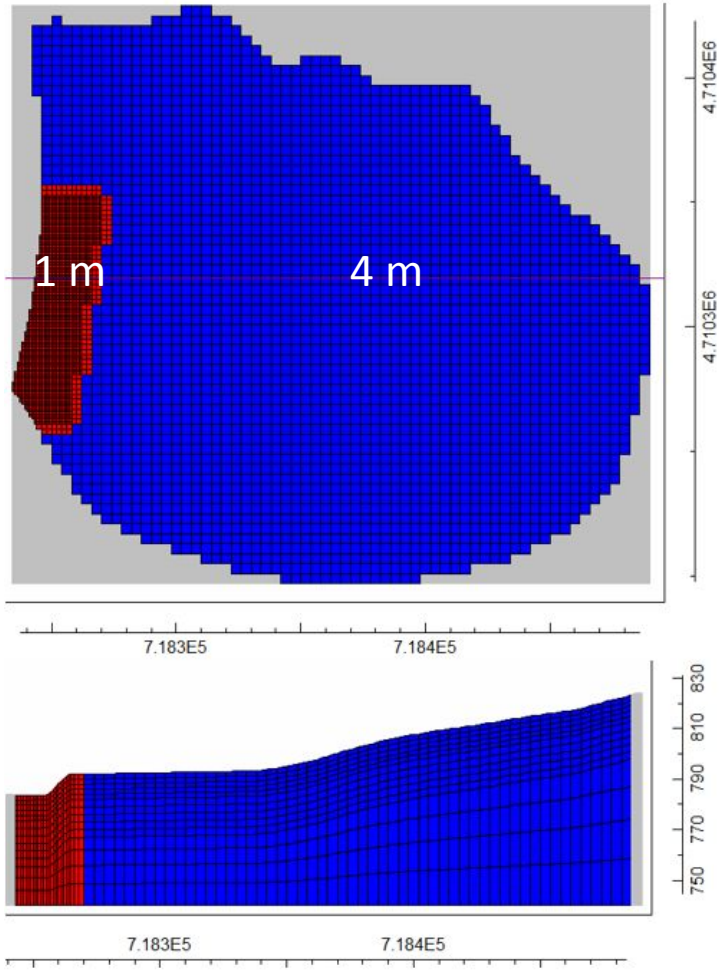


3D contaminant transport model

Top layer porosity



Top layer longitudinal dispersivity



3D contaminant transport model

Distribution coefficient

- Dissolved HCH is in equilibrium with HCH in the DNAPL phase and HCH sorbed on the solid phase Distribution coefficient, K_d.
- K_d calibrated equal to 3 L/kg.
- Estimated from Lorenzo *et al.* (2020) Adjusted for the conditions of the landfill during the model calibration stage.

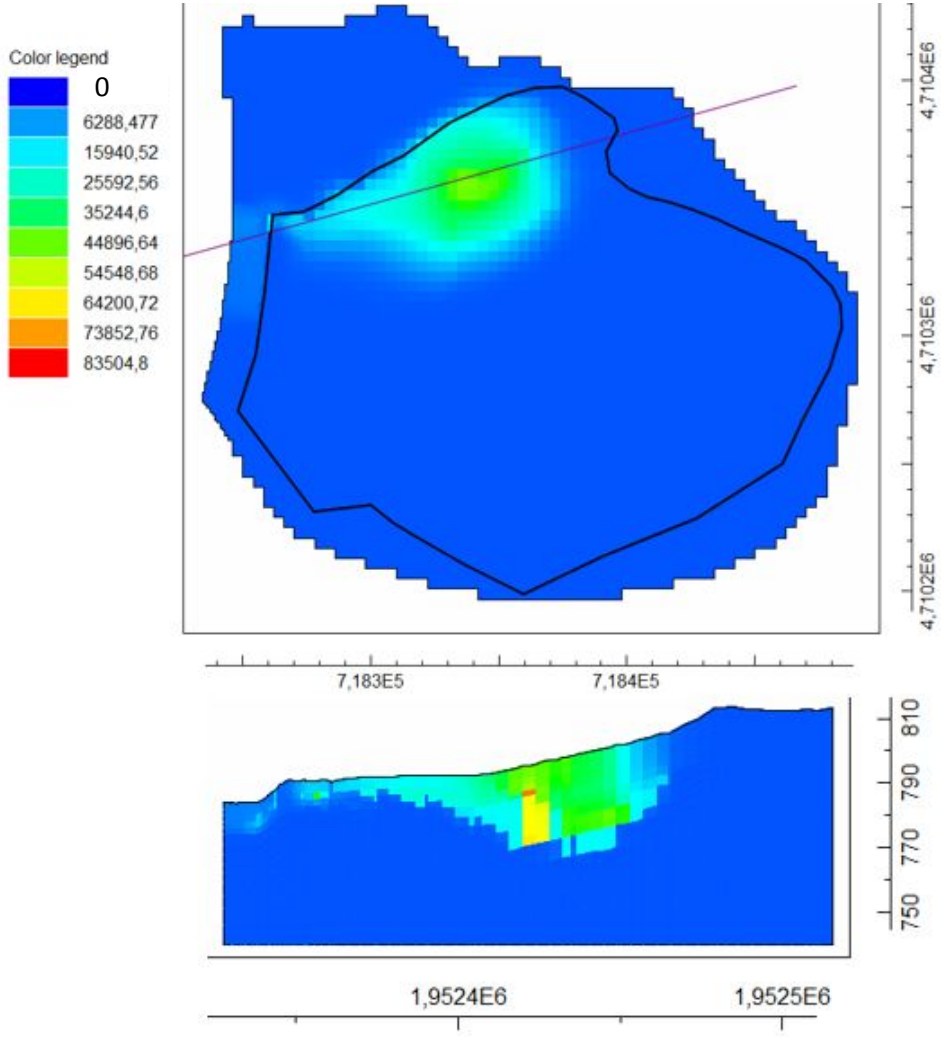
Distribution coefficients estimated in Lorenzo *et al.* (2020).

Isomer	K_d F soil sample (diameter<0.25 mm)	K_d F soil sample (diameter 0.25 - 2 mm)
α-HCH	256	85
β-HCH	-	-
γ-HCH	625	156
δ-HCH	81	29
ε-HCH	130	53.5

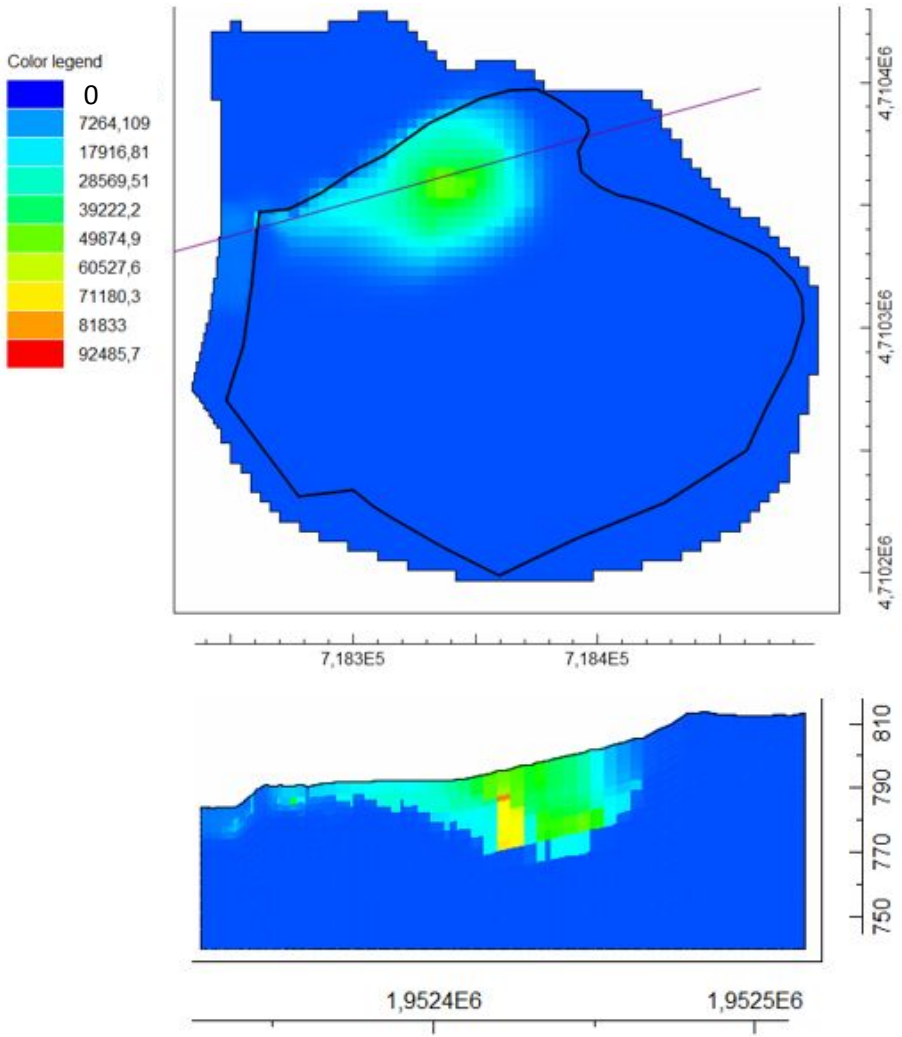
3D contaminant transport model

Computed HCH halos

January 2018



December 2022



Conclusions

- We have presented 3D transient groundwater flow and contaminant transport model of the Sardas landfill.
- The results of the 3D flow model confirm the previous hypotheses about the water inflows and outflows.
- Most of the inflow to the landfill takes place along the NW corner of the landfill with an average value of 16.1 m^3/d.
- The transport model accounts for the migration of total dissolved HCH.
- The computed flux of total dissolved HCH leaving the landfill is estimated to be equal to 12.4 kg/year and takes place underneath the front slurry-wall.

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THANK YOU FOR YOUR ATTENTION

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ACKNOWLEDGEMENTS

Gobierno de Aragón

EMGRISA

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