# Field hydrogeology characterization campaign in EMR

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Wallonia geological maps

# CONTEXT



- ▲ Complex folded and faulted geological context with highly heterogeneous properties
- ▲ Most of the available hydrogeological data are for the superficial formations
- ▲ Need for more data for the deeper formations to assess the impact of the ET infrastructures and the volume of groundwater to drain



#### DEEP GROUNDWATER LEVEL MONITORING NETWORK

Equipement of new deep and already existing piezometers with pressure probes





#### DEEP GROUNDWATER LEVEL MONITORING NETWORK







EINSTEIN TELESCOPE - GROUNDWATER LEVEL MONITORING Groundwater level relative variations from 21/03/2025 (raw data)



# **MULTI-LEVEL PIEZOMETERS**

▲ New piezometers equiped pressure probes in the annular space to identify connections between aquifers



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# **HYDRAULIC PACKER TESTS**

- A Carried out along the new boreholes
- Testing of different parts of the borehole (faulted zones, fractured zones, intact zones, ...)
- ▲ Local estimations of the hydraulic conductivity values

#### Abbreviations

Abbr.	Nomenclature of Test Phases				
INF	Packer inflation				
DEF	Packer deflation				
PSR	Initial pressure recovery				
SI	Slug injection test				
SIS	Pressure recovery after SI test				
SW	Slug withdrawal test				
SWS	Pressure recovery after SW test				
PI	Pulse injection test				
PW	Pulse withdrawal test				
RI	Constant rate injection test				
RIS	Pressure recovery after RI test				
RW	Constant rate withdrawal test				
RWS	Pressure recovery after RW test				
HI	Constant head injection test				
HIS	Pressure recovery after HI test				
HW	Constant head withdrawal test				
HWS	Pressure recovery after HW test				
MR	Multi rate test				
MRS	Pressure recovery after MR test				
SAT	Saturation of the test zone				
WAP	Step rate taste (Lugeon test)				
DST	Drill stem test				



Abbr.	Common					
GOK	Ground level					
FD	final depth					
GWL	Aquifer					
IARF	Infinite Acting Radial Flow; Flow phase					
	conform with the Theis-Modell					
OK	Top end					
ROK	Top end of tubing					
UK	Lower end					
WSP	Water level					
RR	Annulus space					
т	Transmissivity (m/s <sup>2</sup> )					
к	Permeability, k <sub>f</sub> (m/s)					
тс	Type curve analysis					
SLA	Straight line analysis					
SSA	Steady state approximation					
RSLA	Straight line recovery analysis					
Abbr.	Test Equipment					
DPSS	Double Packer Standard System					
P1	Pressure below the lower Packer					
P2	Pressure between the packers					
P3	Pressure in the annulus above packer 1					
Pa1	Packer 1, lower Packer					
Pa2	Packer 2, upper Packer					
DP	Double packer					
SP	Single packer					
SIT	Shut In Tool					

#### 3.1 Position DP1 (298.30 - 305.66 m)











#### HYDRAULIC PACKET TESTS

	Pulse tests Slug tests		Pump tests (constant rate)			cers	
	PI/PW	SI/SW	SIS/SWS	RI (SLA)	RI (SSA)	RIS	tests pack
Well	#	#	#	#	#	#	Total Total
ETB06a	3[2]	7[1]	0101	7[1]	0+0	7 [6]	24 [10]
ETB08	4[4]	5 [2]	0[0]	13[1]	0101	13[12]	35 [19]
ETB09	6[5]	8 [4]	0[0]	5[4]	0101	5[0]	24 [13]
ETB10	9[6]	7 [6]	0[0]	3[2]	0101	3[0]	22 [14]
ETB11	3[0]	11[5]	1[1]	11[10]	0[0]	11[1]	37 [17]
ETB13	3[0]	8 [3]	5[4]	3[3]	3[0]	0[0]	22 [10]
Total tests	28	46	6	42	3	39	164
Total packers	[17]	[21]	[5]	[21]	[0]	[19]	[83]
% chosen	60,71%	45,65%	83,33%	50,00%	0,00%	48,72%	50,61%
% w.r.t. tot.	17,07%	28,05%	3,66%	25,61%	1,83%	23,78%	100,00%

Nb.: Partial data set available at 07/05/2025









Data will be used later on for constraining the groundwater modelling & water management during civil engineering works



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#### IN THE NEXT WEEKS : PUMPING TESTS



- A Pumping test in deep borehole:
- Identification of hydraulic features in key formations
  - Hydraulic conductivity
  - Storativity
  - Interconnection between different aquifer levels
  - ✓ Peripheral effects
  - Geochemical characterization





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#### IN THE NEXT WEEKS : PUMPING TESTS

- ▲ Testing of the hydraulic behaviour of fault
- Detection of faults & type of boundary
- Drilling of boreholes on each side of the fault
- Characterization of the faults using pumping tests, tracer tests, geophysics...







Objectives :

- A Identify potential interactions between groundwater and infrastructure (e.g. interactions with concrete, liners, steel structures, ...), aggressiveness status of groundwater and recommendations for civil works
- ▲ Identify potential water reuse / valorization
- Answer to legal issues related to the release of drainage water in sewers or surface water
- ▲ Identify of potential safety problems (radon for example)
- A Next steps: Sampling in existing boreholes and new boreholes



- $\triangle$  Up to now: preliminary tests in 3 boreholes
- ▲ Waiting for the results
- △ Other tests planned





## ▲ Interpretation in terms of hydraulic properties (!! Assumptions!!)





# ▲ Valorization of data acquired during sampling in slug test interpretation



## **OBJECTIVES OF THE ONGOING PROCESS**



- Progressing in terms of hydrogeological characterization and aquifer behaviour understanding for each concerned formation
- Assessing the hydraulic effects of lithology, depth, faults, fractured zones, joints density, filling of apertures,...
- Contribution to the constraining of the future flow modelling (FEFLOW regional & local) in terms of static situation, calibration, compartimentation & interconnection between aquifer levels, ... (in addition of the future Engineering Geological Model)
- Contribution to the water management issues to be considered for the future civil & underground works (design of tunnel & structures, expected hydraulic head, necessity of grouting, flow to be managed during and after works, ...)
- Contribution to the environmental impact assessment

