Managed Aquifer Recharge in Wallonia (Belgium)
The **MARWAL** Project

S. Durieux, Ph.Orban, J.-M. Compère, J. Derouane, S. Brouyère

Serge.Brouyere@uliege.be

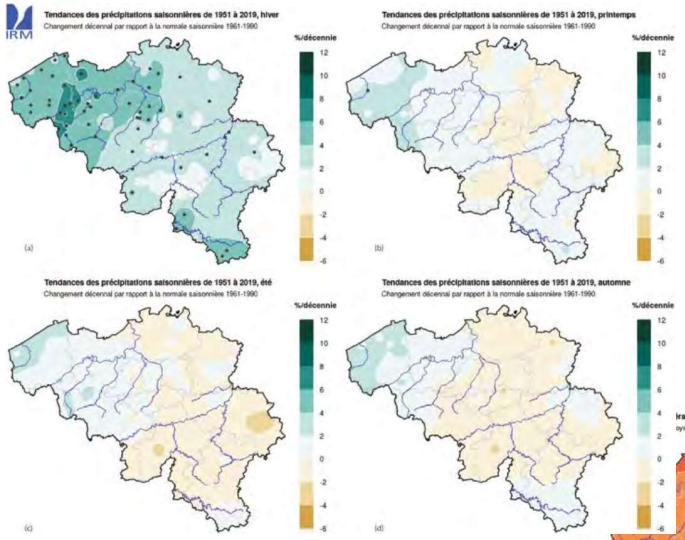
LIÈGE université
Urban & Environmental Engineering

Hydrogeology
Environmental Geology

World Groundwater Congress
IAH2024DAVOS
Switzerland
Interacting Groundwater
8.-13.9.2024

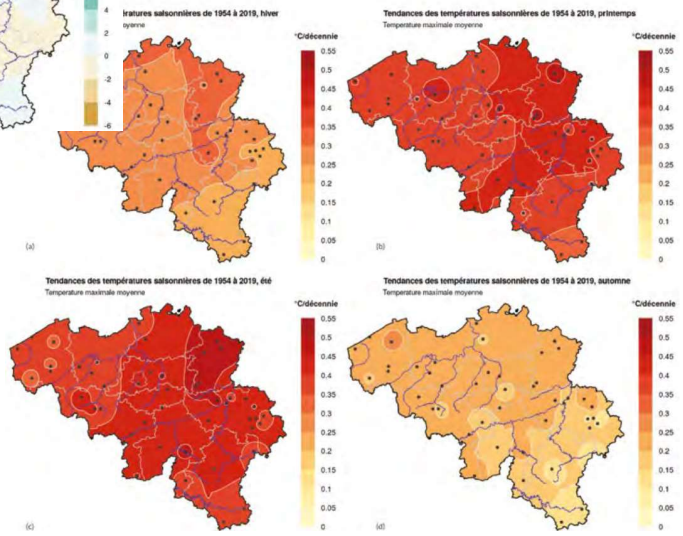
General context

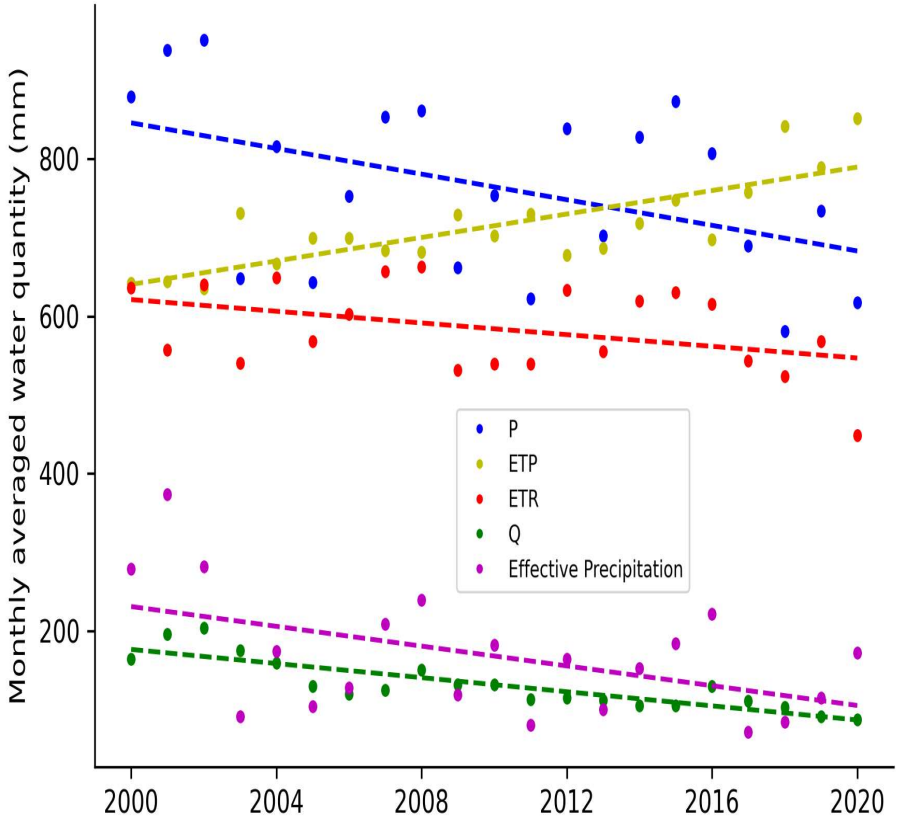
Over the last decades, initial impacts of climate change with repeated summer and winter droughts



Precipitations

Temperatures



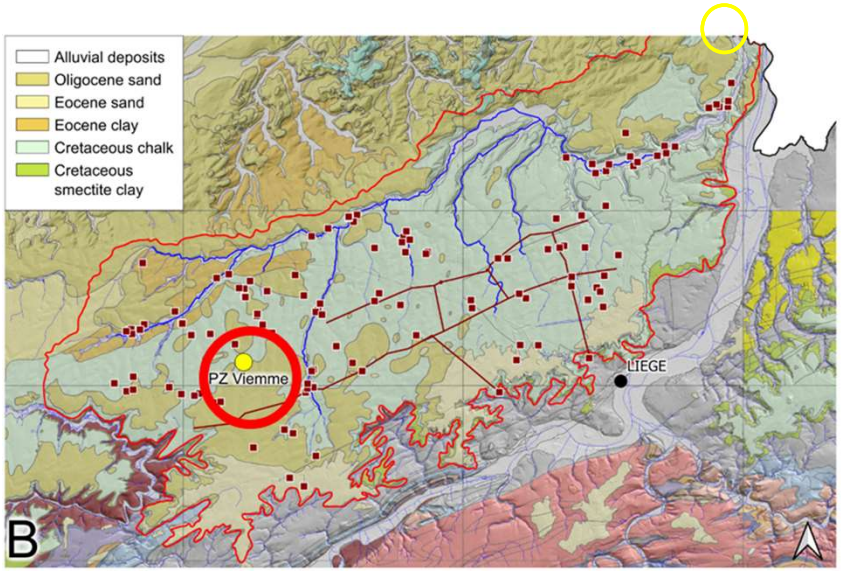


Source : IRM-KMI climatic 2020, 92p.,
Ed. : Dr. D. Gellens | ISSN 2033-8562 |
Coordination : Rozemien De Troch |

General context

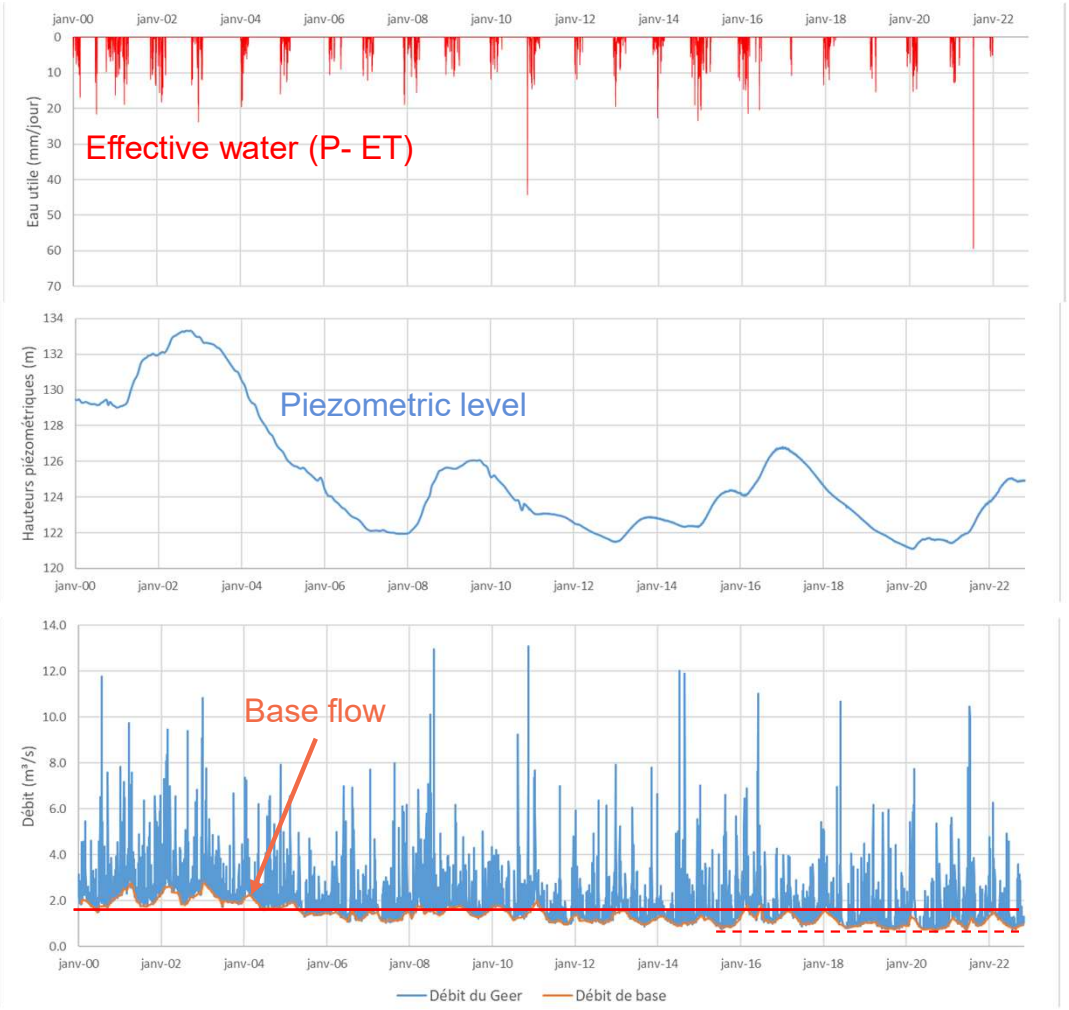
Over the last decades, initial impacts of climate change with repeated summer and winter droughts

Example : Hesbaye chalk aquifer
in the region of Liège



Source: Goderniaux et al. 2021,
Brouyère et al. 2021.

Data : SWDE Project Modelling droughts impacts on groundwater



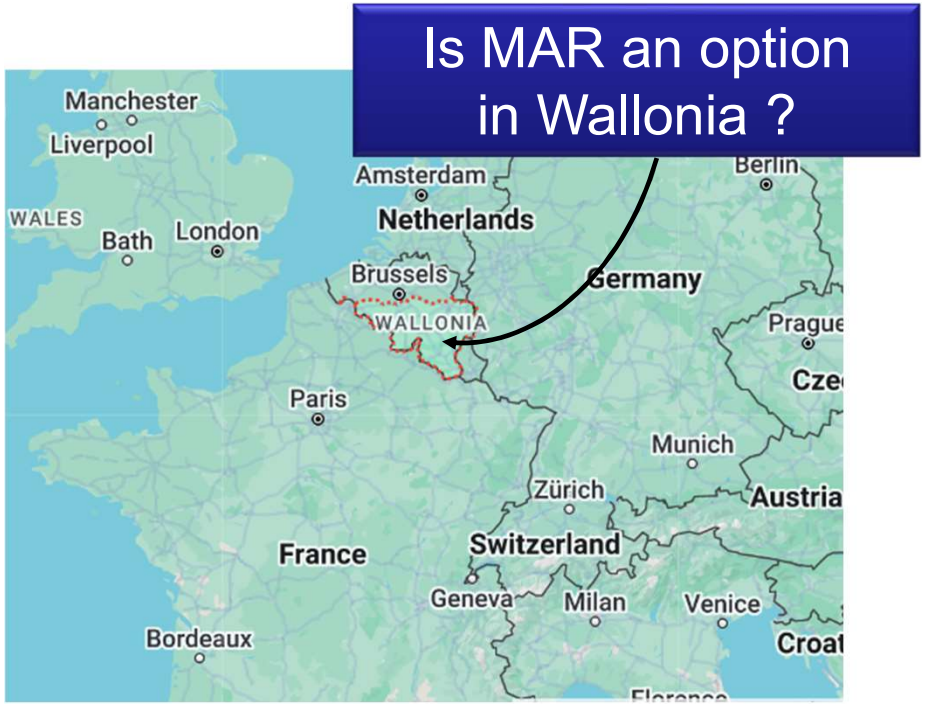
General context

The MARWAL Project

Feasibility study and pilot tests to evaluate if MAR is a possible response to secure groundwater resources in Wallonia

Aim of MAR in Wallonia:

- Storage of water for a delayed use
- Overcome droughts and support irrigation in agriculture



MARWAL project

3 main activities

1. International benchmarking

   (questionnaire + data mining

   in IGRAC MAR Portal

   (https://ggis.un-igrac.org/view/marportal

   Stefan & Ansems, 2017)

2. General feasibility study

   at the scale of Wallonia

3. Detailed feasibility study

   in the Hesbaye chalk aquifer

1.

INOWAS database - IGRAC

2.

3.

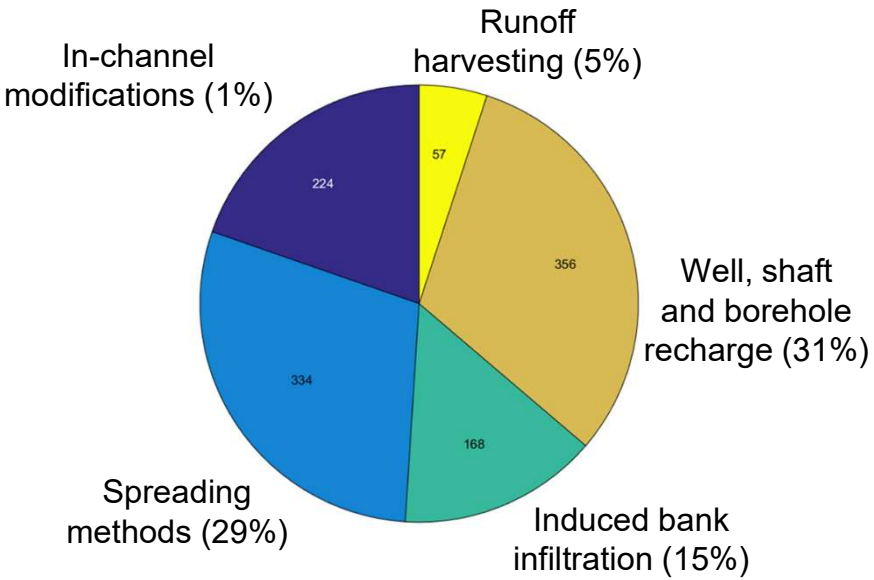
Google maps layer

International Benchmarking

Main data source : IGRAC database

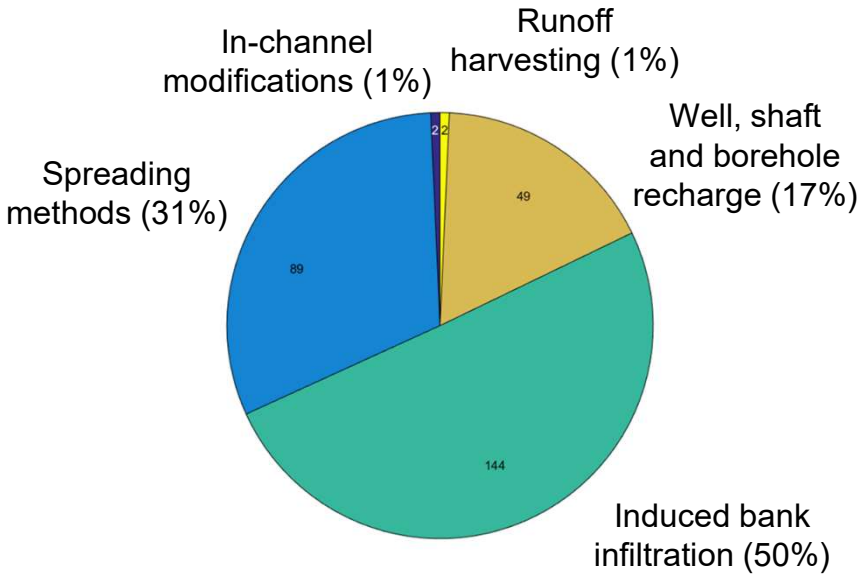
Most Used MAR techniques

Worldwide



type of MAR technique	Number
"Well, shaft and borehole recharge"	356
"Spreading methods"	334
"In-channel modifications"	224
"Induced bank infiltration"	168
"Runoff harvesting"	57

Europe



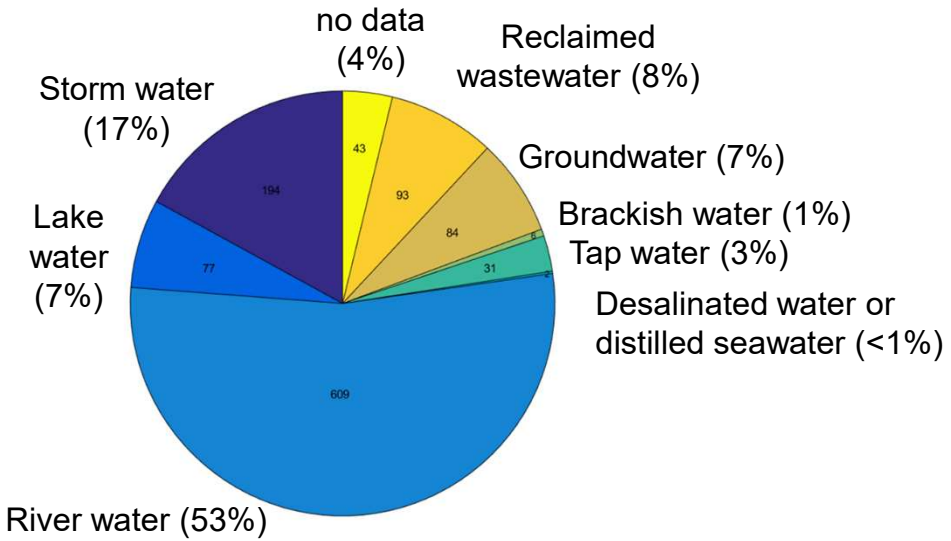
type of MAR technique	Number
"Induced bank infiltration"	144
"Spreading methods"	89
"Well, shaft and borehole recharge"	49
"In-channel modifications"	2
"Runoff harvesting"	2

International Benchmarking

Main data source : IGRAC database

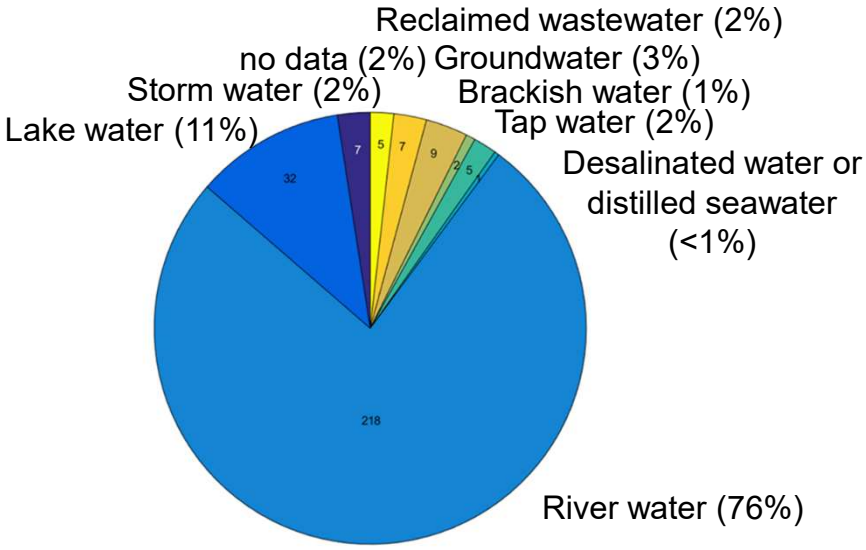
Most Used water sources

Worldwide



Water source	Number
"River water"	609
"Storm water"	194
"Reclaimed wastewater"	93
"Groundwater"	84
"Lake water"	77
"no data"	43
"Tap water"	31
"Brackish water"	6
"Desalinated water or distilled seawater"	2

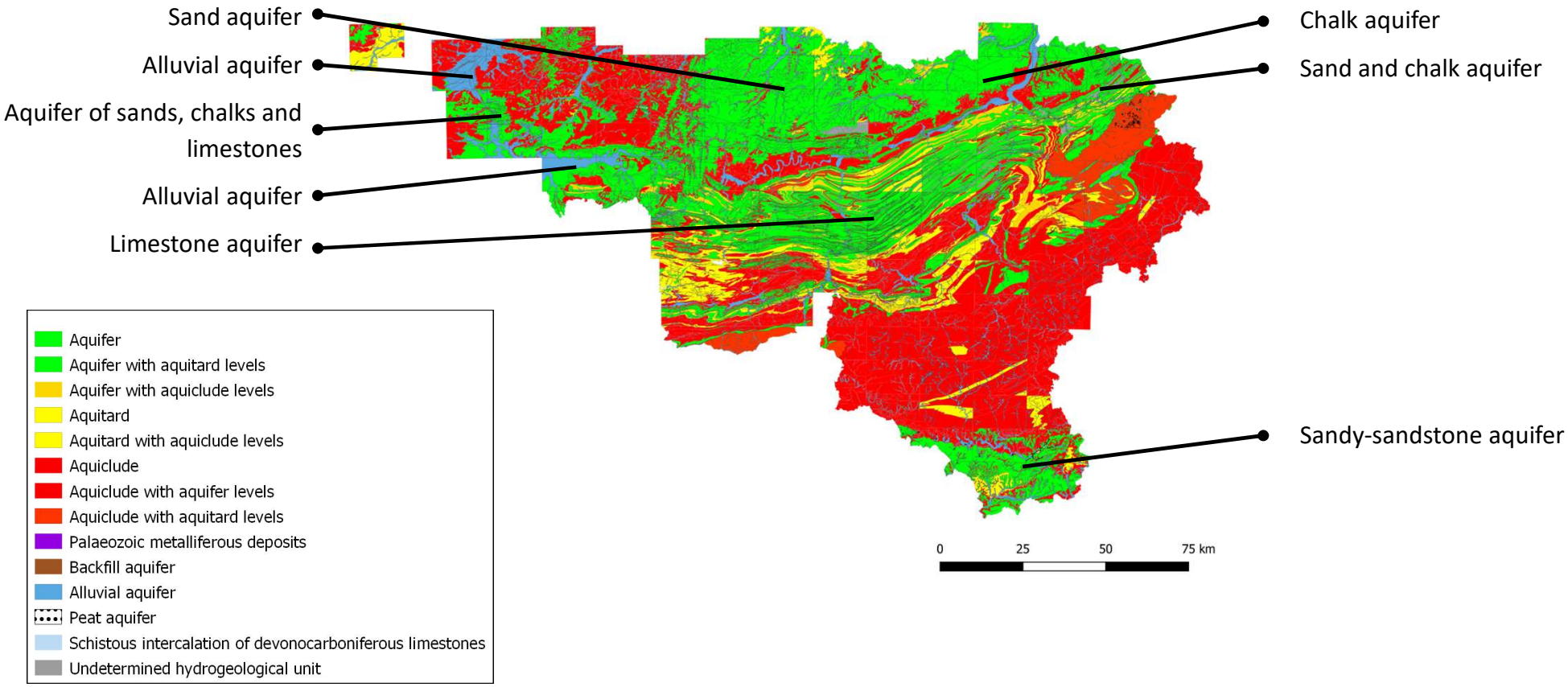
Europe



Water source	Number
"River water"	218
"Lake water"	32
"Groundwater"	9
"Storm water"	7
"Reclaimed wastewater"	7
"Tap water"	5
"no data"	5

Regional-scale feasibility study

Main aquifers of Wallonia



Map based on the hydrogeological maps of Wallonia, produced by Service public de Wallonie

Regional-scale feasibility study (1st screening)

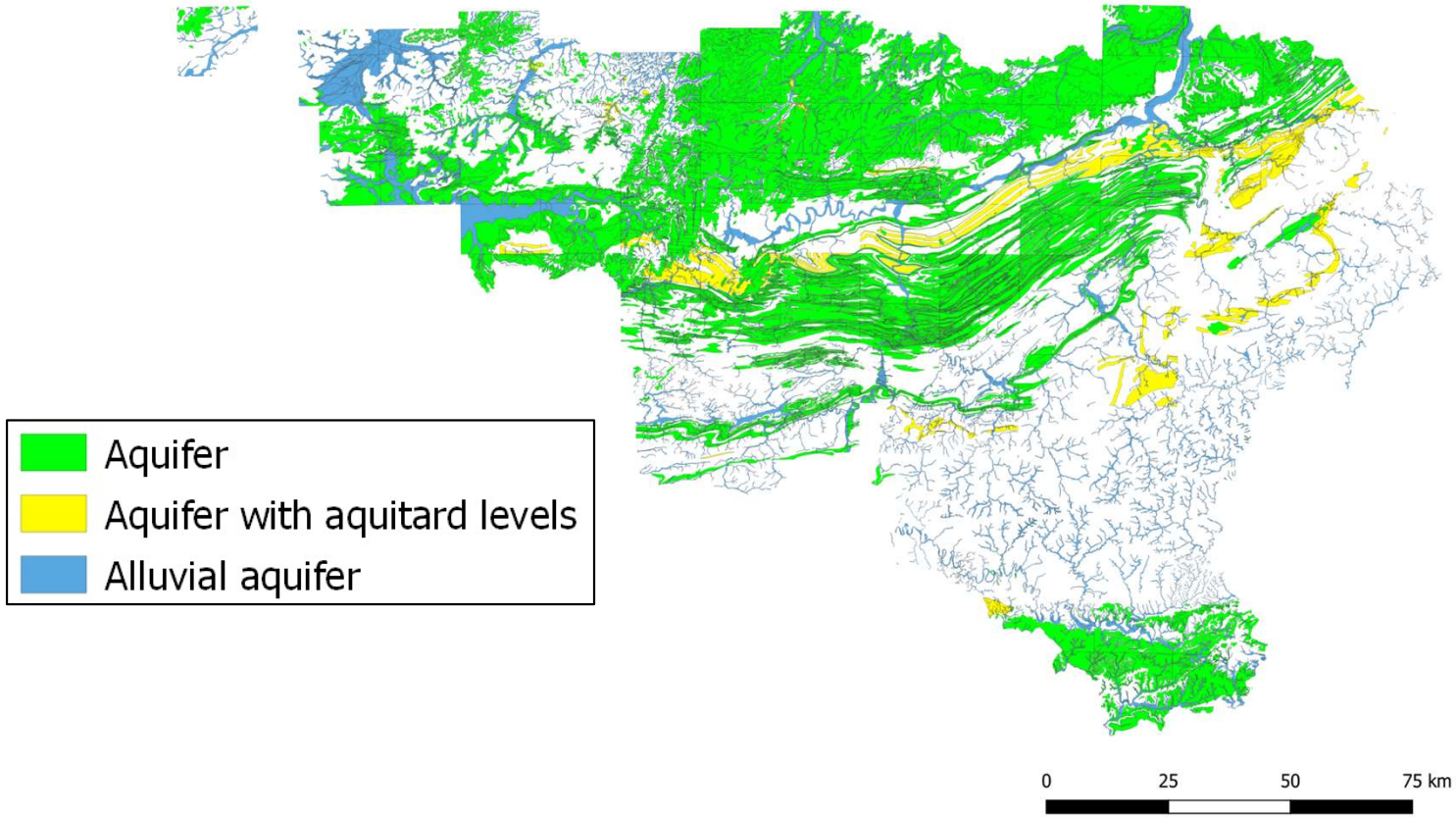
Factors considered

- **Hydrogeological units**
  - Geological contexts categorized as:
    - aquifers
    - Aquifers with aquitard levels
    - alluvial aquifers
- **Land slopes**
  - Classified into 4 categories: <2%, [2;5]%, [5;10]%, >10%]
- **Thickness of the Unsaturated Zone**

Regional-scale feasibility study

Factors considered

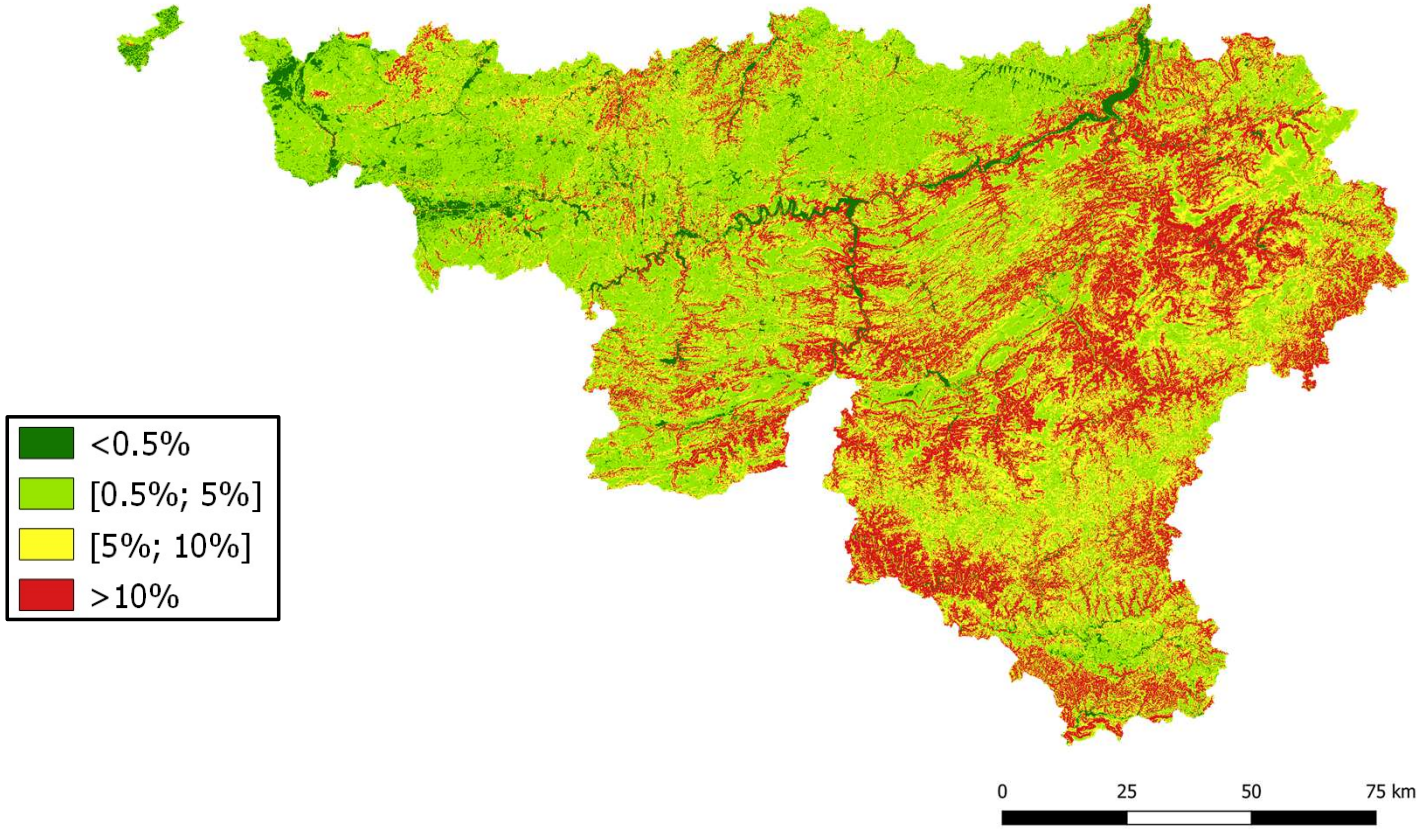
- Hydrogeological contexts



Regional-scale feasibility study

Factors considered

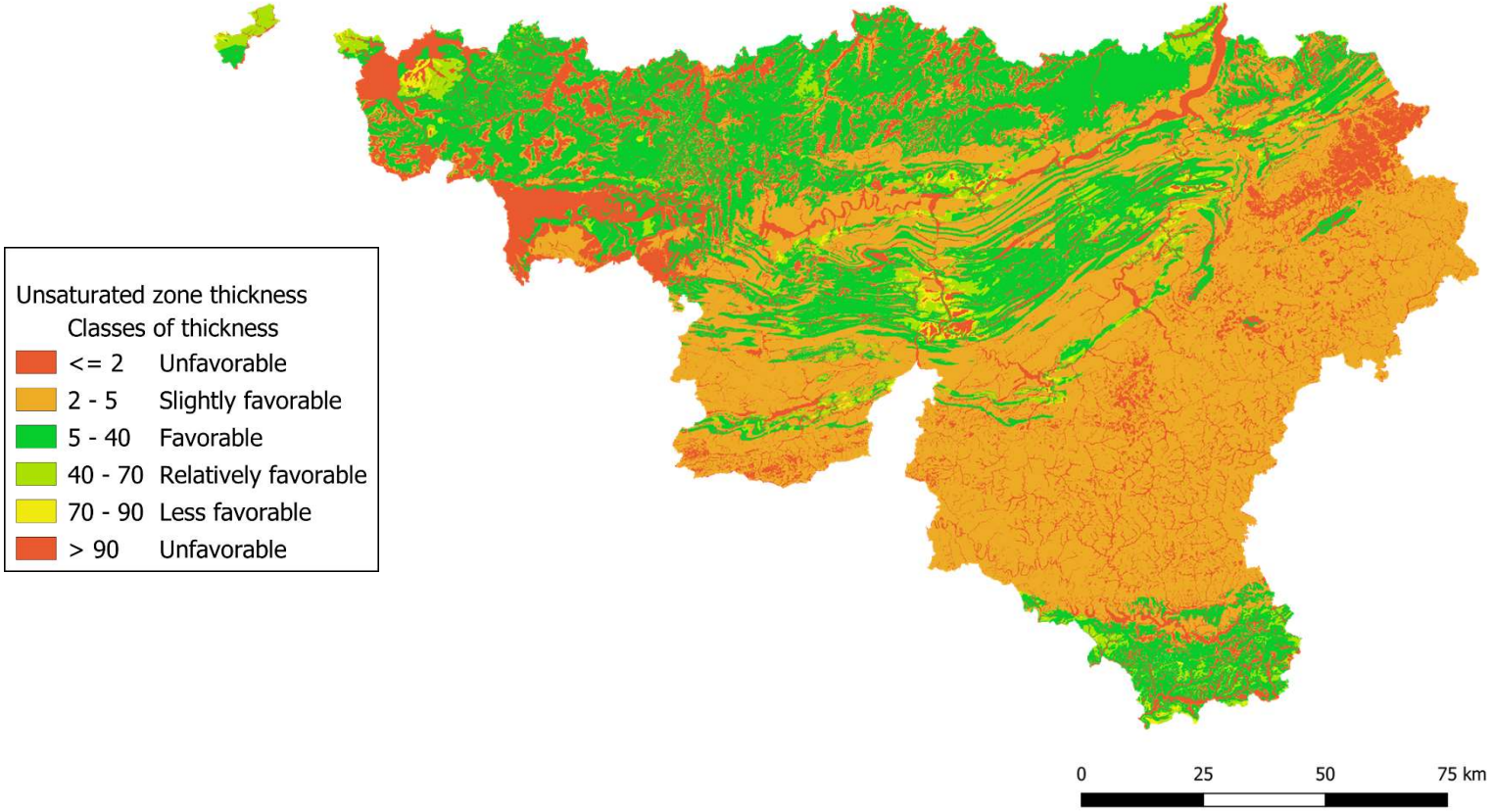
- Land slopes



Regional-scale feasibility study

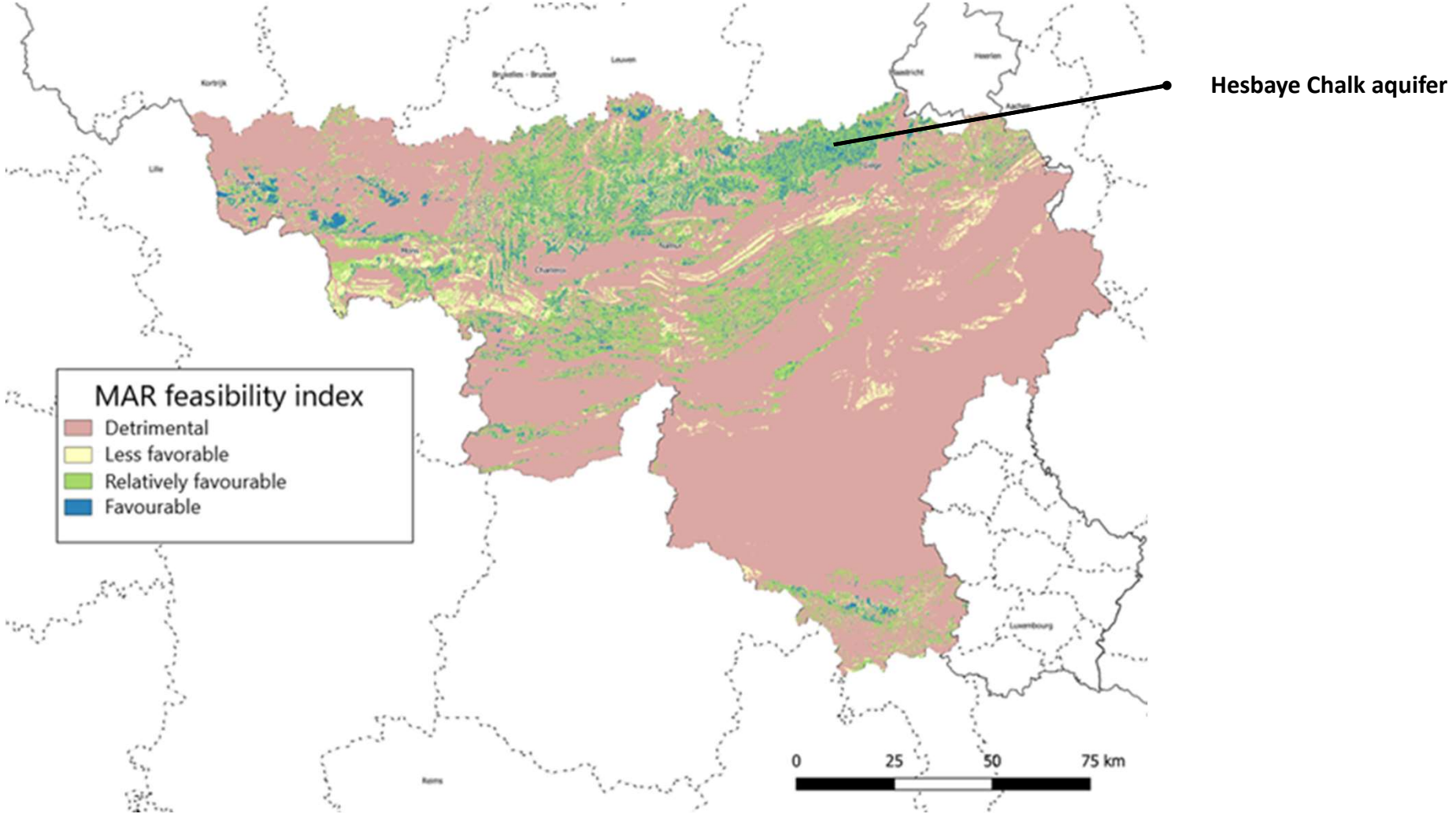
Factors considered

- Thickness of the Unsaturated Zone



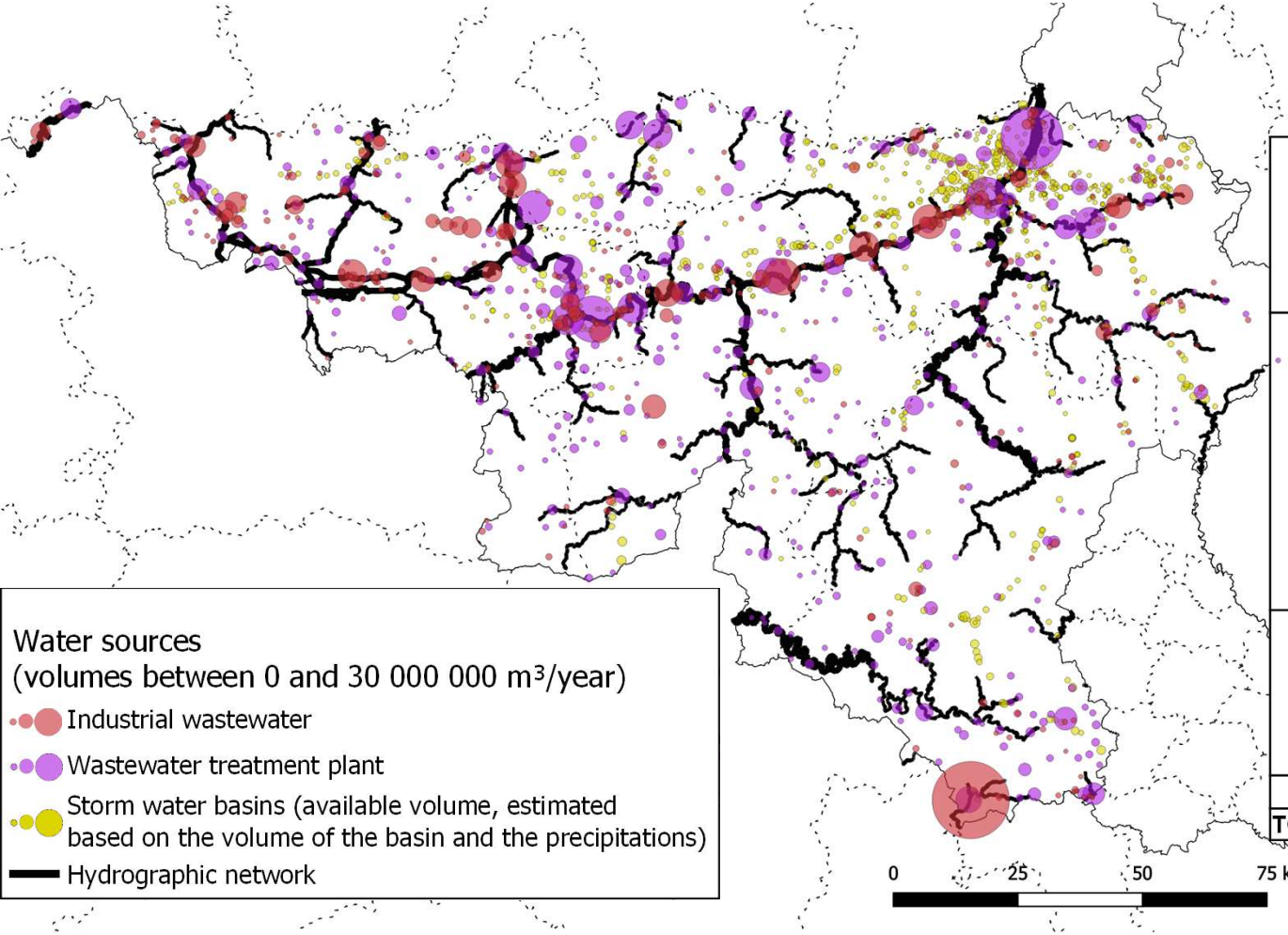
Regional-scale feasibility study

Final MAR feasibility map



Regional-scale feasibility study

Identification of water sources



Hydrographic Basin	Sub-basin	Mean flow (between 1990 and 2021) [m³/s]	Potentially available volumes (6 month per year, 20h per day) [Mm³]
Meuse	Basse Meuse	123.5	320.0
	Haute Meuse	91.2	236.3
	Ourthe	33.9	87.8
	Sambre (outflow)	14.9	38.5
	Semois	12.9	33.5
	Lesse	9.6	25.0
	Amblève	12.2	31.6
	Chiers	9.5	24.7
	Vesdre	7.4	19.1
Escaut	Escaut (outflow)	24.4	63.3
	Haine	4.8	12.6
	Dendre	3.3	8.5
	Dyle	2.6	6.8
	Senne	1.7	4.3
Rhin	Our	3.2	8.2
TOTAL			920.3

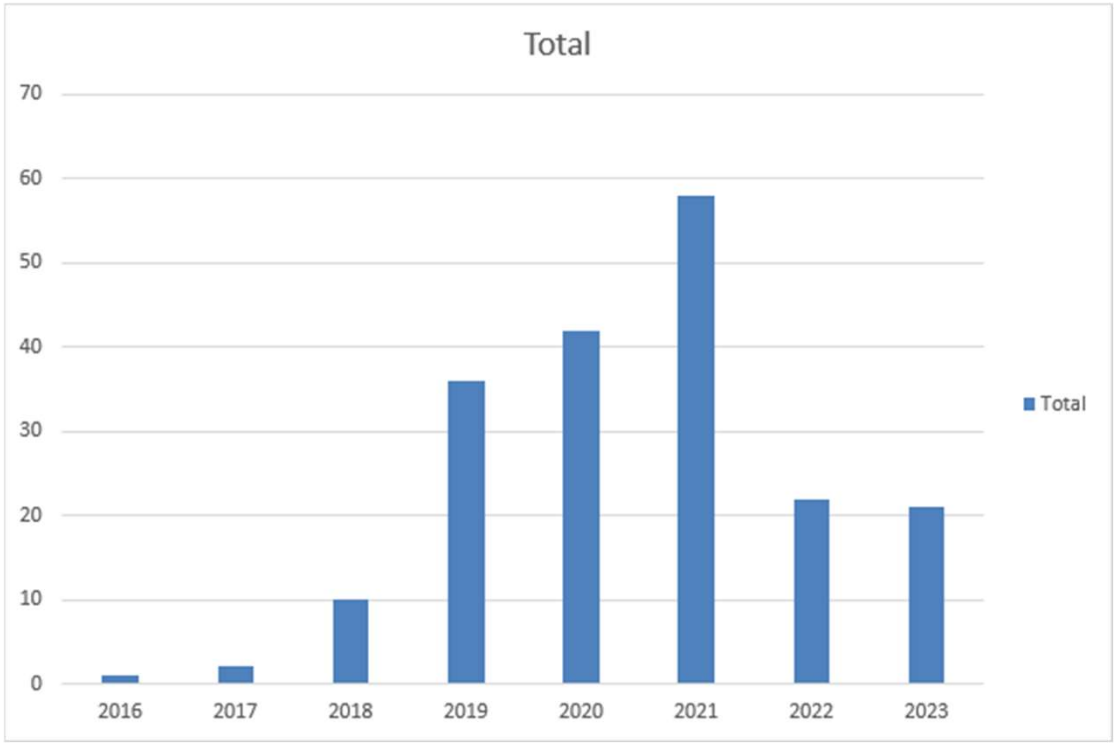
Regional-scale feasibility study

Identification of water sources

Type of Potential Water Sources	Quantitative Aspect		Qualitative Aspect			
	Minimum and Maximum Volumes Potentially Available	Seasonal Variability	Chemical Characteristics	Biological Characteristics	Suspended Matter	Temporal Variability
Roof Water or Runoff from Other Impermeable Surfaces	Low to Moderate (10 000 – 600 000 m³/year)	High	Low to moderately mineralized	Low biological impact	Low to Moderate	High
Surface Water	Moderate to High (100 000 – 5 000 000 m³/year)	High	Variable depending on the source, possible presence of contaminants	Presence of biological diversity	Moderate to High	High
Gray and Treated Water	Moderate (50 000 – 200 000 m³/year)	Low to Moderate	Presence of domestic chemicals, pre-treatment necessary	Moderate to low biological impact, possible treatment to remove contaminants	Low to Moderate	Moderate
Industrial Process Wastewater	Low to Moderate (10 000 – 2 500 000 m³/year)	Variable	Significant variability depending on the industrial process, specific treatment required	Variable biological impact depending on the industry, treatment often required	Moderate to High	Variable
Mine Dewatering or Mine Drainage Water	Low to Moderate (5 000 – 1 000 000 m³/year)	Variable	Presence of heavy metals, acids, and other substances from mining	Variable biological impact, treatment required to reduce contaminants	Moderate to High	Variable

Initial analysis of supply and demand

Projected demand for water resources



Number of requests to drill wells for agricultural irrigation in Wallonia

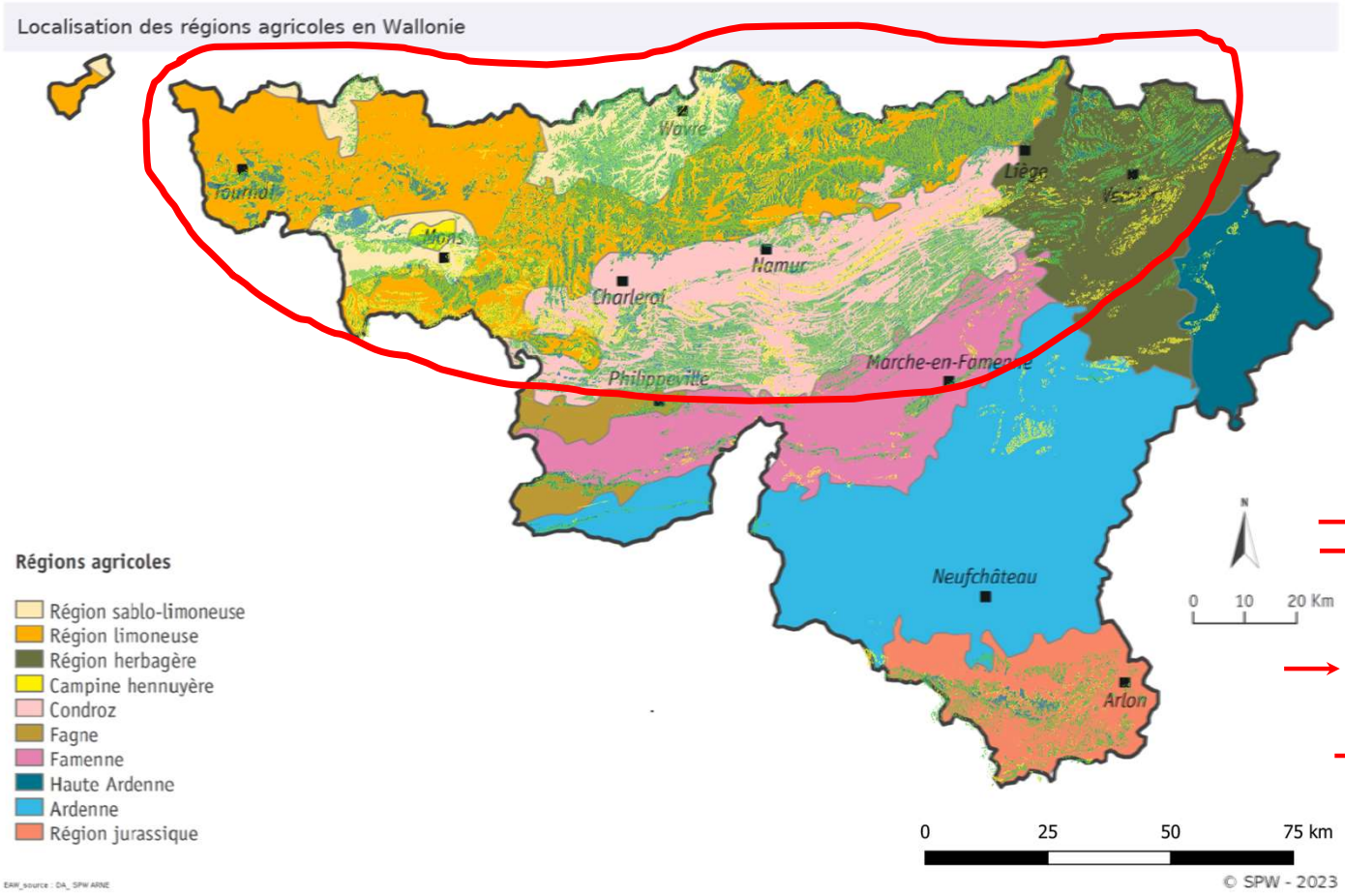
Director Walloon region Groundwater Directorate, com. pers. Jan. 2024:

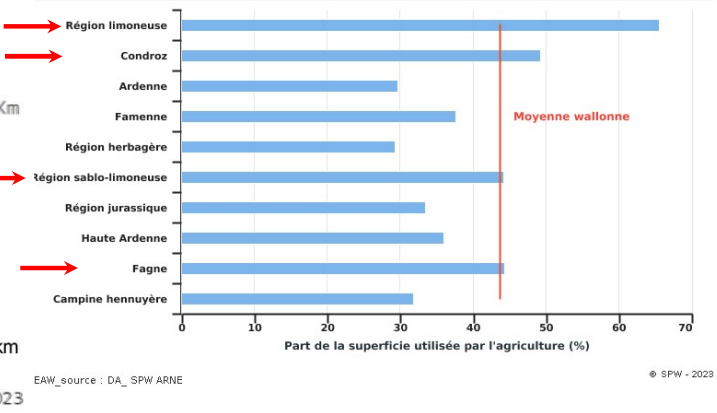
« Between 2018 and 2022, it is estimated that the volume of groundwater withdrawn annually for irrigation would has risen from just under 600,000 m³ to 2,000,000 m³. » …

➔ Expected strong increase of the demand for irrigation

Initial analysis of supply and demand

Agricultural regions of Wallonia

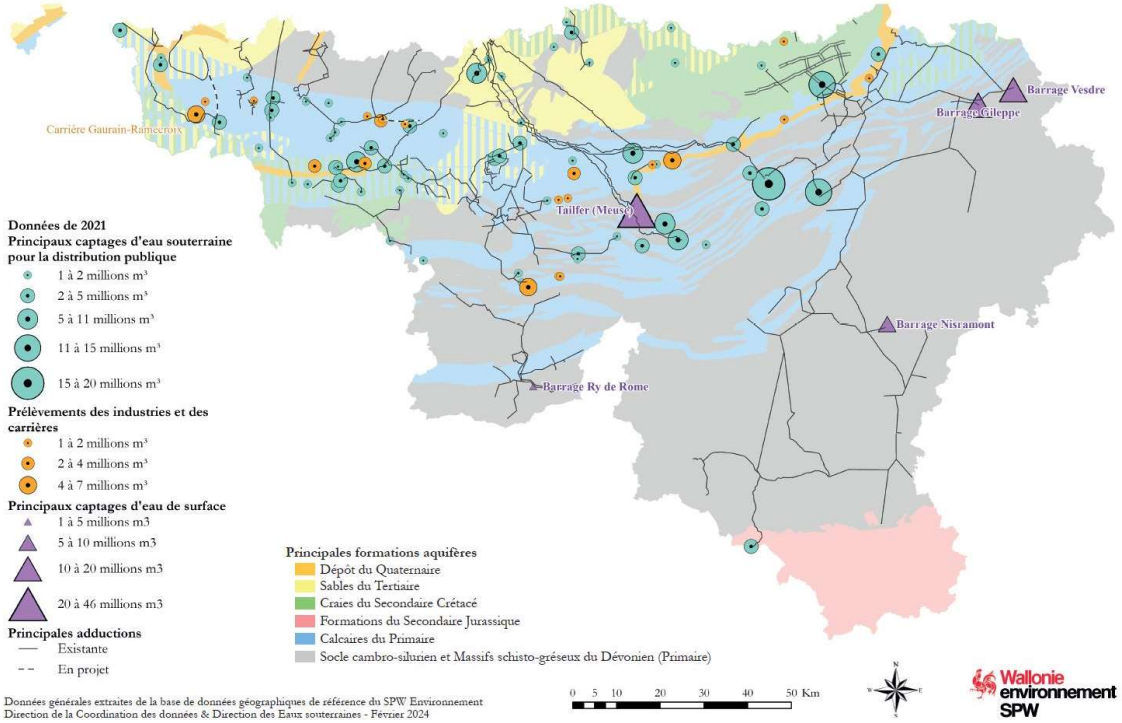




Initial analysis of supply and demand

Projected demand for water resources

Source: http://environnement.wallonie.be/de/eso/atlas/



En 2021: Total volume for water distribution = **362,5 millions m³** of which:

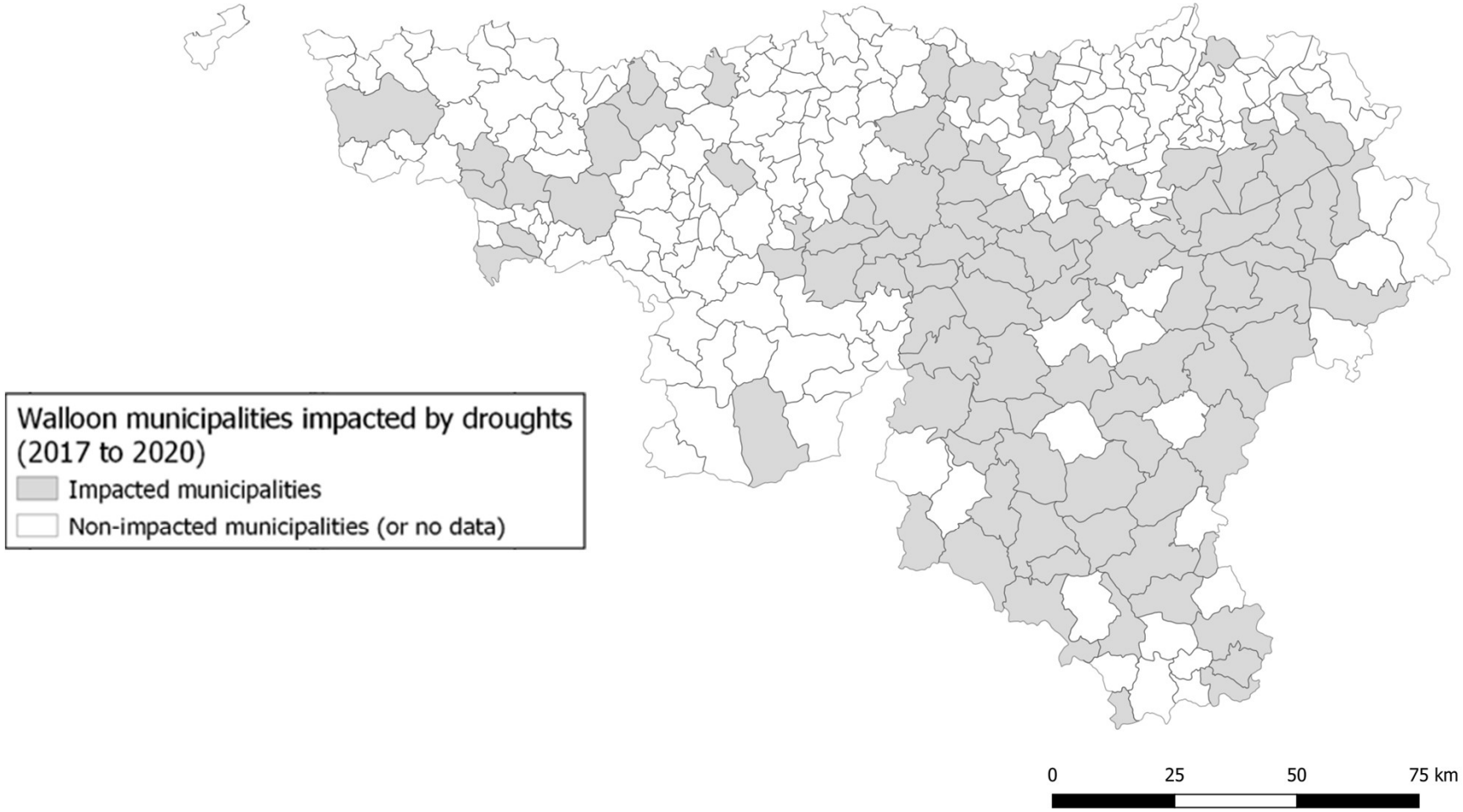
- Groundwater = **289,9 millions m³ (79%)**
- Surface water = **75,6 millions m³ (21%)**

Rem: a significant part of this abstracted water is exported to Brussels & Flandrers (~38%)

➔ No reason to think that public water distribution will be reduced in the future

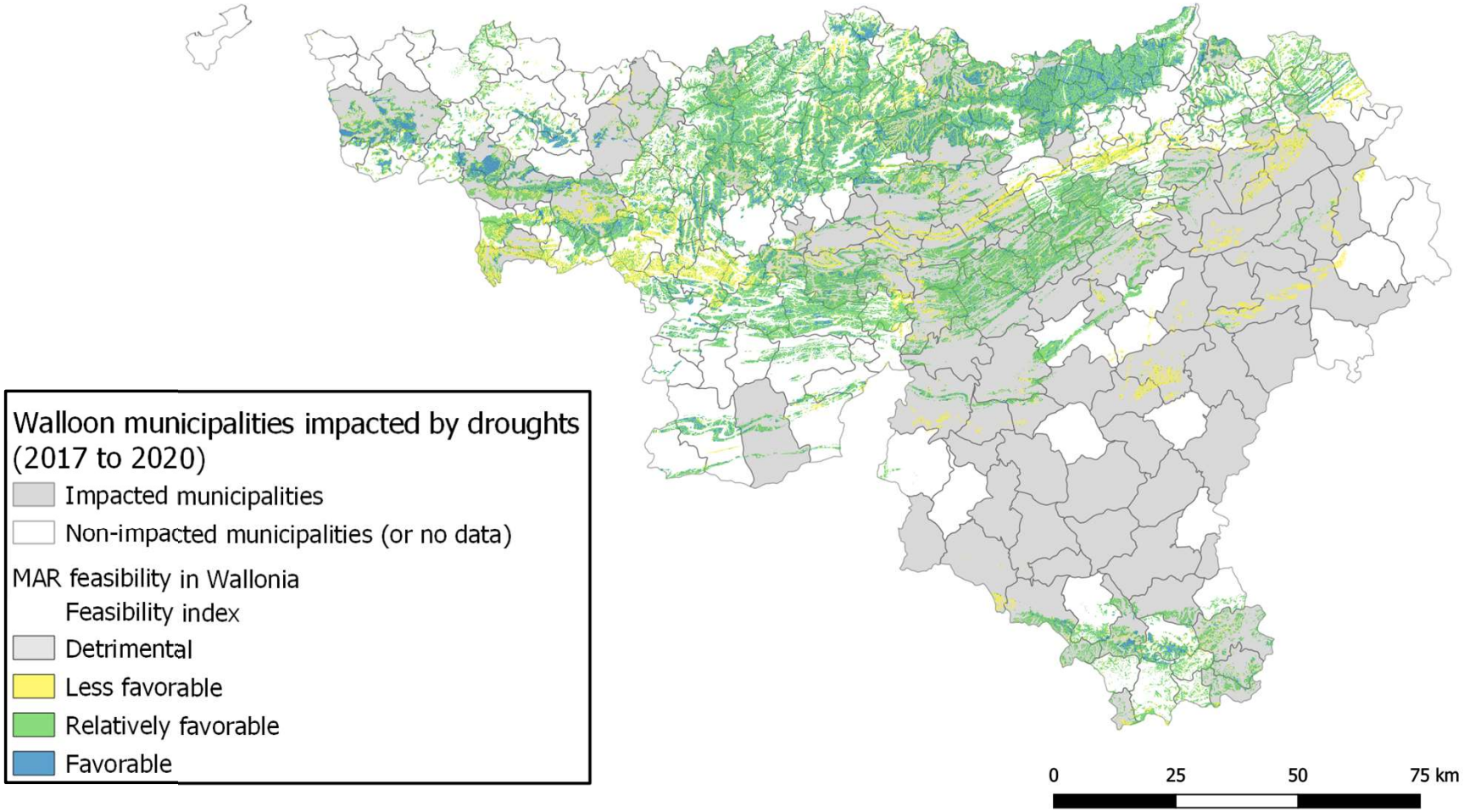
Initial analysis of supply and demand

Municipalities impacted by droughts



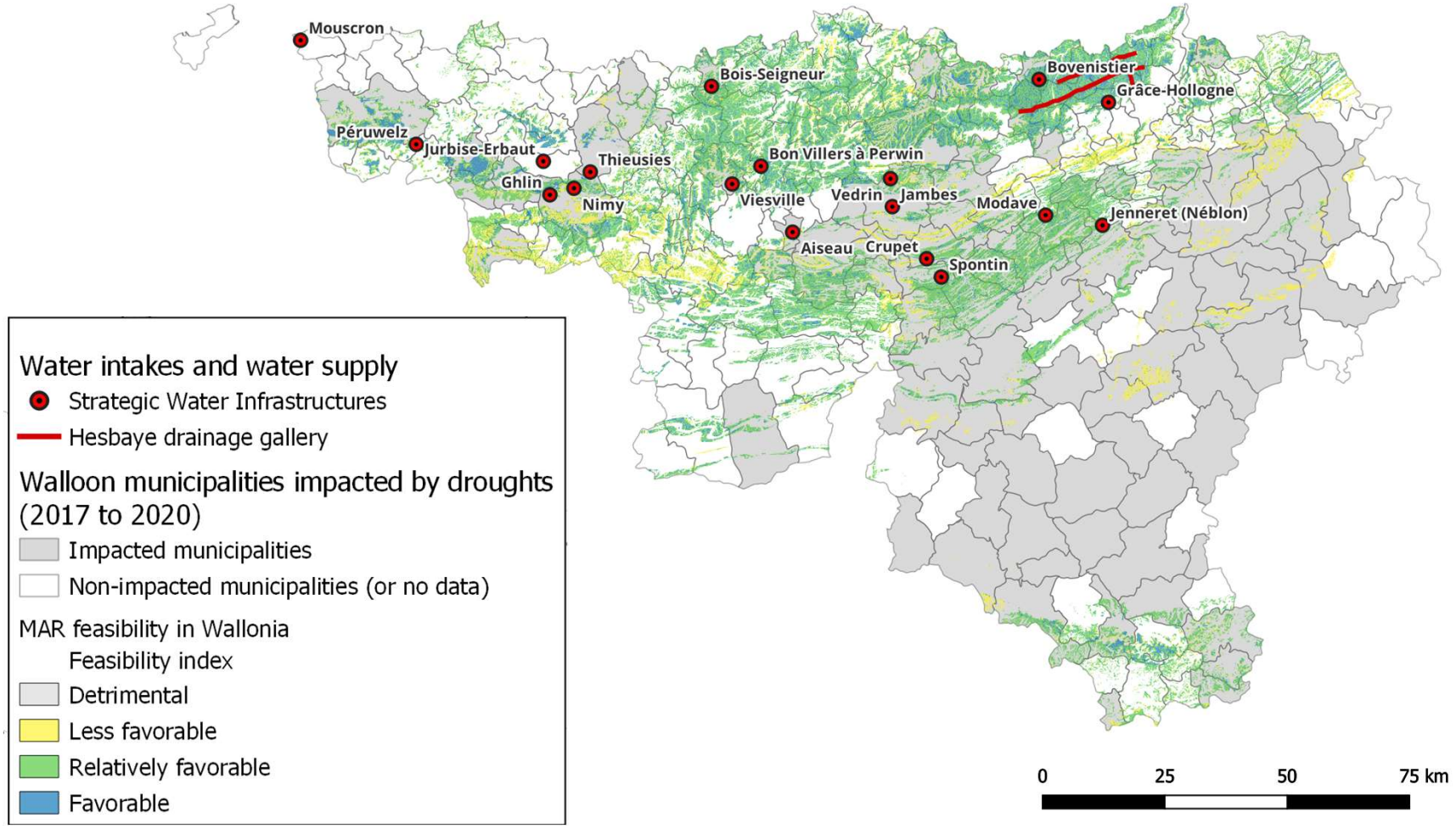
Initial analysis of supply and demand

Municipalities impacted by droughts



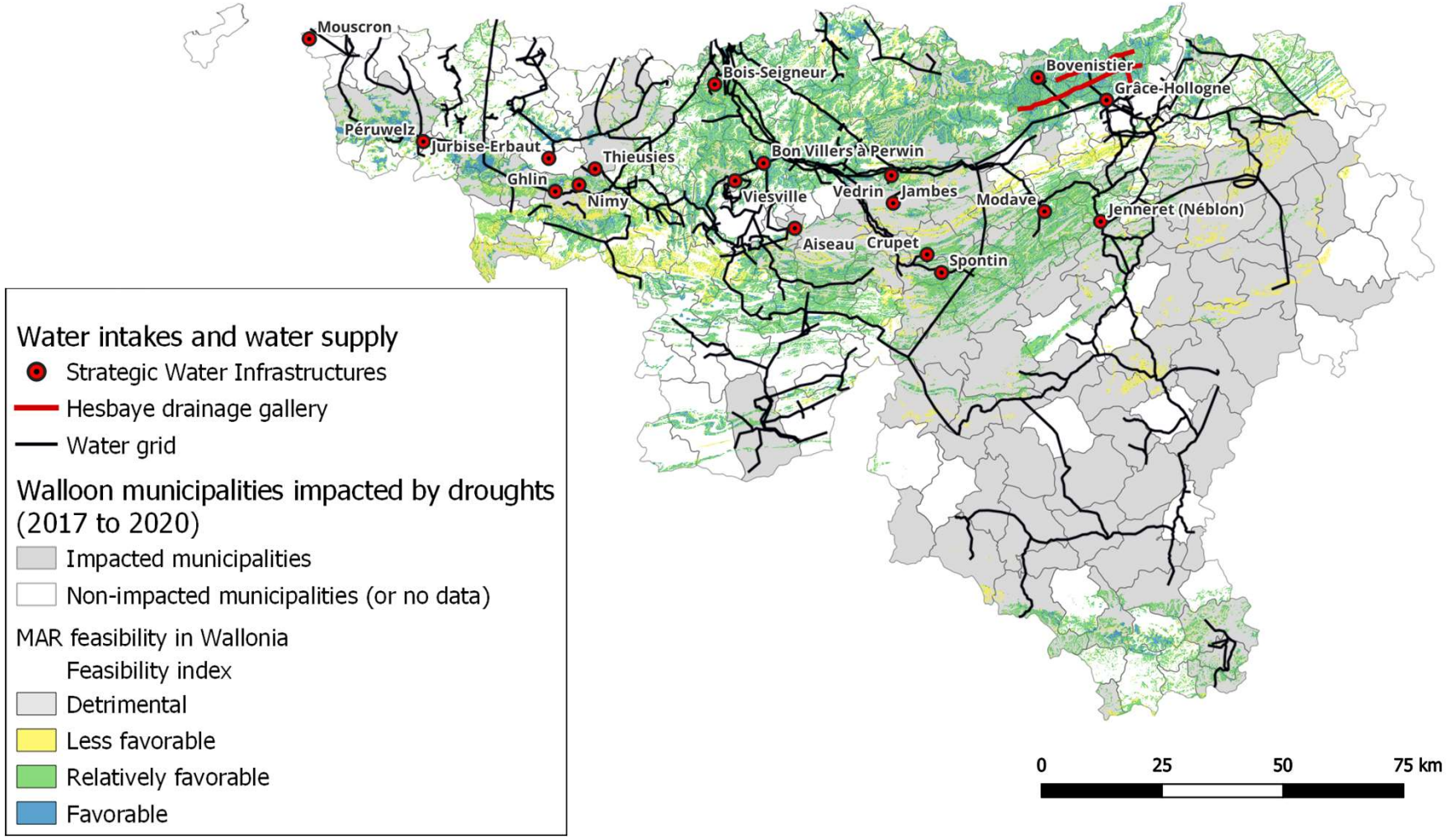
Initial analysis of supply and demand

Municipalities impacted by droughts



Initial analysis of supply and demand

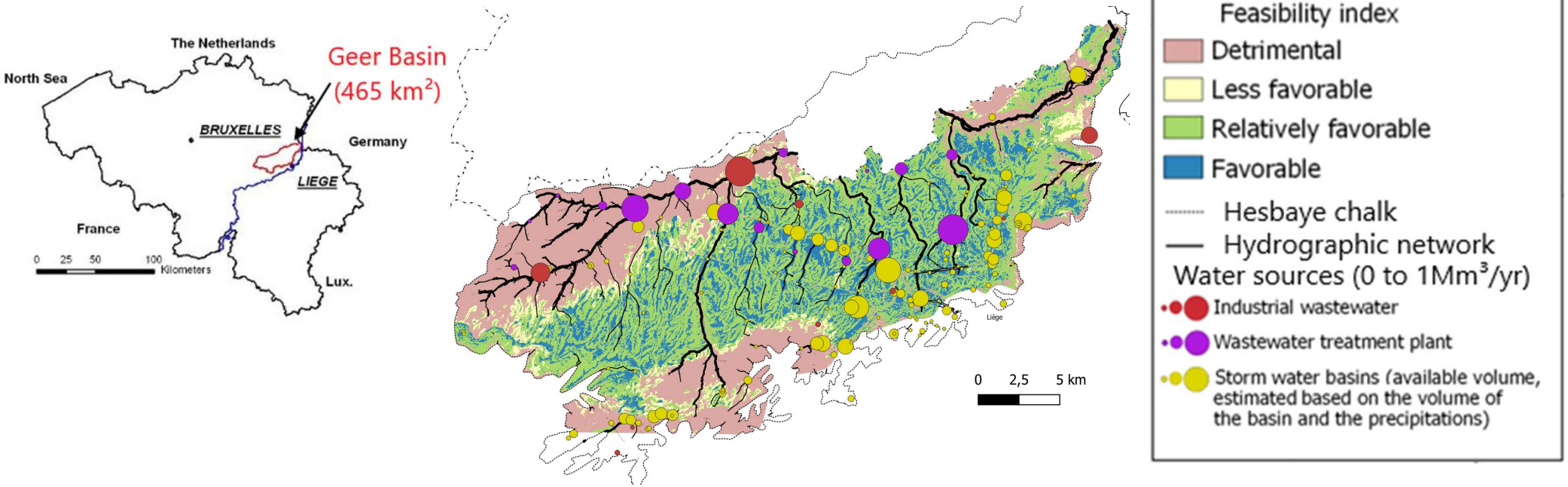
Municipalities impacted by droughts



Next steps

MAR Feasibility study in the Hesbaye chalk aquifer:

- Different MAR systems envisaged (infiltration basins, direct recharge, etc.)
- Series of investigations to implement a pilot site afterwards
- Identification of potential sites for MAR



Next steps

MAR Feasibility study in the Hesbaye chalk aquifer:

See poster of Robin Glaude : quantifying infiltration rates and their spatial variability within a MAR pilot site using Distributed Temperature Sensing technology

Objective: test the usefulness of a new innovative method to measure the infiltration rate of water through the eolian loess of Hesbaye

How: distributed measures of temperature along an optic fibre buried underneath the infiltration basin

MARWAL project partners:

CEBEDEAU aide RAISO GEOLYS ECLAIRE VOTRE AVENIR cile

MARWAL financial support:

SPGE Société Publique de Gestion de l'Eau — La société wallonne des eaux — Wallonie Relance

Infiltration tests in the Kemexhe basin, by Robin Glaude