GeoERA
RESOURCE GROUNDWATER
Resources of groundwater, harmonized at Cross-Border and Pan-European Scale

Deliverable 3.6

Overview of groundwater policy and management strategies on different sides of common borders

Authors and affiliation:

Cis Slenter
VMM

E-mail of lead author:
c.slenter@vmm.be

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SUMMARY

H3O-PLUS is a work package on the groundwater in the German, Flemish and Dutch Roer Valley Graben within the GeoERA RESOURCE project on cross boundary groundwater resources. This deliverable 3.6 of the H3O-PLUS work package gives an overview of the main strategies that the groundwater and subsurface managers in the H3O-PLUS project area have embraced in their policy and management. We will pay special attention to licensing for groundwater abstraction and subsurface and geothermal energy exploitations. Furthermore, we will look at how the various administrative regions deal with the theme drought and how they monitor the groundwater. Finally, we will make some recommendations for the future.

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1 INTRODUCTION

1.1 H3O-PLUS project

The cross-border demonstration project H3O-PLUS intends to set a new standard for harmonization across borders, not only for hydrostratigraphy, but also for hydrological data such as groundwater heads and groundwater quality. H3O-PLUS, Work Package 3 (WP3) of Resource, aims to be an advanced demonstration of a joint assessment of transboundary groundwater resources. It is 'advanced' in the sense that it builds on and extends previous work, trying to make it more useful for groundwater policy and management and for subsurface spatial planning. A 3D hydrogeological model has been developed in a series of so called 'H3O' projects in the transboundary region around the Roer Valley Graben, comprising parts of Germany, the Netherlands and Belgium. The model contains 3D maps of the top, base and thickness of aquifers and aquitards.

The first tasks of H3O-PLUS aim to add attribute data to these maps to facilitate the use of the maps in decision making processes. Note that the project does not aim to produce new maps or spatial delineations. The objective is to characterize units on existing maps and hence support the interpretation and use of those existing maps.

The overall study area coincides with the study areas of previous H3O projects (see **Error! Reference source not found.**). Vertically, the study covers the entire Cenozoic part of the subsurface. This coincides with the vertical scope of the recently developed transboundary 3D (hydro)geological models of the H3O projects. The base of the models is thus located at the top of the Chalk deposits or the top of the Carboniferous deposits where the Chalk is absent.

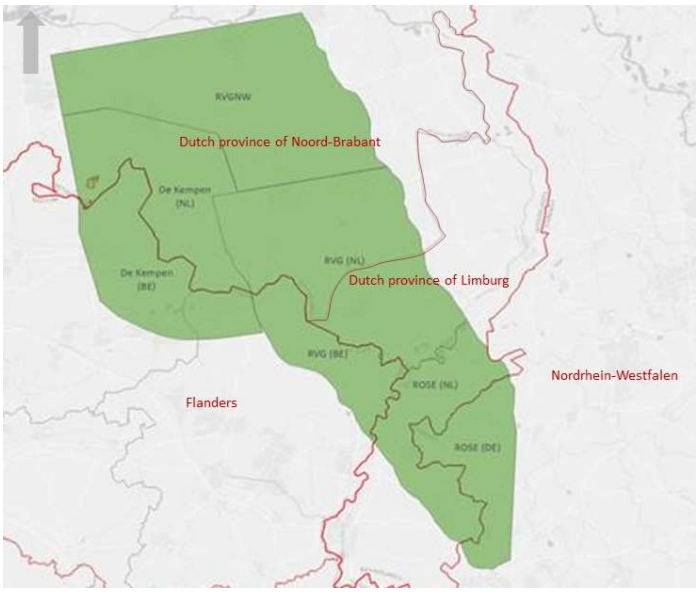

Figure 1.1 Location of the administrative regions of the Roer Valley Graben and the different H3O-areas

In this report 3.6 of H3O-PLUS, we describe the inventory of groundwater management strategies on the different sides of common borders in the Roer Valley Graben. To arrive at this inventory, we organised several formal and informal stakeholder meetings. A synthesis of the results, as well as a comparison with the other deliverables of this WP, are beyond the scope of this report.

The results of this study can stand alone, but the project also has a supporting function for further research and development and for a more cross-border oriented policy and management of the Roer Valley Graben. Together with the results of other existing studies and tools (see Textbox 1.1) and along with furthering cross-border cooperation, this study hopefully is a step forward to a generally accepted understanding of the hydrogeological system of the Roer Valley Graben, a generally accepted view of the problems we face, and to solutions that fit within evidence-based decision making. Sustainable management of groundwater in the Roer Valley Graben will maintain its broad functionality, which future generations can also enjoy.

1.2 Roer Valley Graben area

The Roer Valley Graben is a heavily used area. The pressure on land use, groundwater and on raw materials is therefore very high, just like the pressure induced by climate change.
The typical hydrogeological structure of the Roer Valley Graben, with its poorly permeable faults on the sides, means that the Roer Valley Graben can be seen as a separate groundwater system. Thick, water-bearing sedimentary deposits are separated from each other by a few relatively thin but rather continuous clay layers. The sediments contain sufficient and adequately clean groundwater.
The region has a high potential for drinking water production (and for water for food production) and a high potential for the use of geothermal energy. The future utilization of this energy contributes to the current energy transition. The region is also important for groundwater dependent ecosystems, groundwater fed surface waters, and water recreation etcetera which take place at the interface with surface water. There also are large groundwater abstractions for the purpose of open cast brown coal mining in the German part of the Roer Valley Graben.

The dry summers of 2018-2020 impacted strongly all water users as well as receptors of groundwater such as nature in this region, making the impact of climate change also cautiously clear. Furthermore, in the Roer Valley Graben declining trends of groundwater heads at different sides of the borders are observed (see D3.5, Zaadnoordijk et al., 2021, and D3.7, Broers et al., 2021) and the region is sensitive to water scarcity and drought and also pollution (see Deliverable D3.3, van Vliet et al., 2021).

The borders of the administrative regions in the Roer Valley Graben are close to each other (**Error! Reference source not found.**). Users of groundwater and the subsurface may influence each other across the borders. And the different subsurface and groundwater demands compete for each other.

The policy and management of groundwater and subsurface spatial planning of the Roer Valley Graben are divided over four different administrative regions: Flanders, the Dutch province of Noord-Brabant, the Dutch province of Limburg and Nordrhein-Westfalen, one of the 'Bundesländer' in Germany. This makes sustainable policy and management, with the aim of sufficient and sufficiently clean groundwater and sustainable use of the subsurface for future generations, a challenge.

Since 2002, the various administrative regions of the Roer Valley Graben have been working together through the sub-working group Groundwater of the International Meuse Commission and by various (in)formal bi- and trilateral consultations on a better understanding and harmonization of groundwater policy and management in the Roer Valley Graben. Some examples are given in Textbox 1.1.

Textbox 1.1 Transboundary groundwater management in the Roer Valley Graben (work in progress) (source: VMM, 2021)

TRANSBOUNDARY GROUNDWATER MANAGEMENT IN THE ROER VALLEY GRABEN (WORK IN PROGRESS)

Since 2002, the various administrative regions of the Roer Valley Graben have been working together through the sub-working group Groundwater of the International Meuse Commission and by various (in)formal bi- and trilateral consultations on a better understanding and harmonization of groundwater policy and management in the Roer Valley Graben. Some examples:

Benekempen (since 2002)

Flemish-Dutch research and management plan for tackling the historical contamination with heavy metals in the Kempen.
(by OVAM and ABdK)
BeNeKempen - OVAM EN (ovamenglish.be)

Maas convention (1994 replaced 2002 and in effect since 2006)

Convention to implement the European "Water Framework Directive" (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy) and aims to sustainable and integrated water management for the international river basin of the Meuse). Establishment of the International Meuse Commission.
(by The Netherlands, Germany, Belgium and it´s regions, Luxembourg and France)
CIM - Verdragen (meuse-maas.be)

International River Basin Management Plans (2010-2015, 2016-2021, draft 2022-2027)

Management plan for the international Meuse river basin district.
(by The Netherlands, Germany, Belgium and it´s regions, Luxembourg and France)
Stroomgebiedbeheerplannen voor Schelde en Maas 2016-2021 — nl (integraalwaterbeleid.be)

H3O-projects (since 2011)

3D cross border (hydro)geological geometric models of the subsurface (see Figure 1.1):
H3O-Roerdalslenk
H3O-Rose
H3O-De Kempen
H3O-Kempen NO
(by TNO, Vito, BGD, Geological Survey of North Rhine-Westphalia (GD NRW) commissioned by VPO, VMM, TNO, BGD, Dutch provinces of Limburg and Noord-Brabant, Ministry of Economic Affairs, Energy and Industry NRW, drinking water supply companies)
Grondwater | DOV (vlaanderen.be) and https://www.grondwatertools.nl/thema-grondwater-projecten/h3o

Scenarios Roer Valley Graben (2020)

Different scenarios have been calculated with the help of the transboundary groundwater flow model IBRAHYM-ROERDAL.
Effecten onttrekkingen op de stijghoogten in de Roerdalslenk, 2020.
The impact of Groundwater Extractions in the Roer Valley Graben, 2020.
(by: Deltares, commissioned by the Dutch Provinces of Limburg and Noord Brabant, Vlaamse Milieu Maatschappij (VMM) and Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen (LANUV))
https://www.limburg.nl/onderwerpen/water/drinkwater/

2 METHOD TO ACHIEVE AN OVERVIEW OF GROUNDWATER POLICY AND MANAGEMENT STRATEGIES ON DIFFERENT SIDES OF COMMON BORDERS IN THE ROER VALLEY GRABEN

Policy and management of groundwater and subsurface protection applied to different scales are described extensively in the administrative regions of the Roer Valley Graben (RVG). It is impossible to include all in this report. As an outsider, it is also difficult to understand how different national administrations are organised as well as the finesses of legislation ("the thought of the law"). Therefore, stakeholder involvement is very important for this task.

The stakeholders that contributed to the H3O-PLUS project and this specific deliverable are listed below:

- Regional and national authorities:
  - Province of Noord-Brabant (NL)
  - Province of Limburg (NL)
  - The waterboards Dommel, Aa and Maas and Brabantse Delta (NL)
  - Landesamt für Natur, Umwelt und Verbraucherschutz Nordrhein-Westfalen – LANUV (D)
  - Flanders Environment Agency – VMM (B)
  - The Flemish Planning Bureau for the Environment (VPO), as part of the Department of Environment & Spatial Development of the Flemish government (B)
- Drinking Water Companies:
  - Waterleiding Maatschappij Limburg (NL)
  - De Watergroep (B)
  - Brabant Water (NL)

Between June 2019 and October 2021, we organized several formal and informal stakeholder meetings. The stakeholders helped to delineate the project, collect data and thoughts about policy recommendations for the future.

In consultation with the stakeholders, the following topics were delineated:

- The way in which groundwater abstraction licenses are granted in the different administrative regions (Section 3.2);
- The way in which licenses for geothermal energy exploitations are granted in the different administrative regions (Section 3.2);
- The way the licensing is embedded in legislation (Section 3.3);
- The way in which protection zones for drinking water supply are demarcated in the different regions and what restrictions apply within them (Section 3.4);
- The way the different administrative regions deal with drought (Section 3.5);
- The way the monitoring is set-up and the strategies in the different regions (Section 3.6).

Finally, we address in Chapter 4 the questions:

- How can the project outcomes be useful for groundwater policy and management?
- How can the harmonisation and data exchange be continued after the project?

We will focus on the first two topics, as licensing policies for groundwater extraction and geothermal energy exploitation are the main management tools for governments. With these tools they are able to implement sustainable groundwater management in order to achieve a good status of groundwater, in line with the objectives of the Water Framework Directive and Groundwater Directive. We reflect on the philosophy behind the policy and management and try to identify similarities and differences between the administrative regions.

Drought is included as a separate theme. This theme has become more urgent in recent years and its approach is pre-eminently multi-track and still in full evolution. By putting approaches to drought in the different administrative regions next to each other, we hope the administrations will inspire each other.

In addition to mapping and parameterization of the subsurface, monitoring data on the quality and quantity of groundwater is important basic information on which (tools for) policy and management of groundwater and the subsurface are based. Monitoring strategies determine which statements can be made. By putting the methodologies used by the different administrative regions side by side, we hope to enhance understanding of the applicability and comparison of the results.

Finally, we will make some recommendations for the future in order to work towards a more common groundwater and subsurface policy and management of the Roer Valley Graben.

Most management en policy strategies will be described with reference to representative websites, to enable the reader to look up additional information, and also because these matters are regularly adapted.

The Dutch provinces of Noord-Brabant and Limburg, VMM, VPO and LANUV contributed to this report (especially to the administrative region-specific texts and the tables 3.1 and 3.2). We received less information from the German stakeholders, so the report will mainly focus on the Dutch and Flemish approaches.

3 RESULTS

3.1 Introduction

To provide the reader with a framework and to make it easier to find additional information we first give a short overview on how the different administrative regions organize their groundwater, subsurface and geothermal energy licensing (section 3.2) and on what legislation they rely (section 3.3). Subsequently, a brief overview of the groundwater and utilization strategies, in terms of groundwater abstraction, use of subsurface and geothermal energy and drinking water protected areas, is given per administrative region. The approaches of the different administrative regions are then compared: what are the main similarities and differences (section 3.4). We reflect on the origin of these differences come, draw some conclusions and look for inspiration and gaps.
Next, we will take a look at the first approaches of the theme drought in the different administrative regions because this theme is an urgent topic in recent years and the approaches to this issue are eminently multi-track and still in full evolution (section 3.5).
Finally, we will take a look at the groundwater monitoring strategies that the administrative regions use because understanding this allows for better interpretation of each other's measurement data (section 3.6). This is important as the demand for data sharing increases.

3.2 Overview of the organization structure within the different administrative regions in the Roer Valley Graben for licensing policy

The Roer Valley Graben can be divided into four administrative regions:

- Nordrhein-Westfalen (LANUV, Wasserverbände, district government, municipalities, mining authority);
- The Dutch province of Limburg (Provincial government of Limburg, Waterboard Limburg, municipalities);
- The Dutch province of Noord-Brabant (Provincial government of Noord-Brabant, the waterboards Aa en Maas, Dommel and Brabantse Delta, municipalities);
- Flanders (Flanders Environment Agency (VMM), Vlaams Planbureau voor Omgeving (VPO), government of the Flemish region, province of Limburg, municipalities).

Within these administrative regions, different organizations and administrators are responsible for the licensing of groundwater and subsurface and geothermal energy systems (

Table 3.1).

Table 3.1 Overview of which government is responsible for the main license applications in the Roer Valley Graben (source: VMM, 2021)

country	administr. region	subject of application	licensing government	advice
THE NETHERLANDS	province of Noord-Brabant	well drainage, remediation	water boards	
		abstractions outside protected areas[1] <=150,000m³/y but >10m³/h. Abstractions inside protected areas[1] <=150,000m³/y until 0m³/h	water boards	
		industrial abstraction > 150,000m³/y	Province, delegated to regional environmental services (omgevingsdiensten)	
		abstraction for drinking water supply	Province, delegated to regional environmental services (omgevingsdiensten)	
		subsurface energy systems (<500m)	Province, delegated to regional environmental services (omgevingsdiensten) for open systems, municipalities for closed systems	
		geothermal energy systems (>500m)	Ministry for economic affairs and climate	province
	province of Limburg	well drainage, remediation	water board	
		Abstractions outside protected areas[1] <=150,000m³/y but >10m³/h. Abstractions inside protected areas[1] <=150,000m³/y until 0m³/h	water board	
		industrial abstractions > 150,000m³/y	province of Limburg	municipality
		abstractions for drinking water supply	province of Limburg	municipality
		subsurface energy systems (<500m)	province of Limburg	
		geothermal energy systems (>500m)	ministry for economic affairs and climate	province
FLANDERS[4]	Flanders	non-classified (domestic) groundwater abstraction[2]	only to be reported administratively to the Flanders Environment Agency, regarding taxation on waste water (VMM)	
		Klasse 3 groundwater abstraction[2]	municipality (notification)	

country	administr. region	subject of application	licensing government	advice
		Klasse 2 groundwater abstraction[2]	municipality	VMM
		Klasse 1 groundwater abstraction[2]	province or the Flemish Region[3]	VMM
		Klasse 2 groundwater abstractions used for subsurface energy systems	municipality	VMM
		Klasse 1 groundwater abstractions used for subsurface energy systems	province of the Flemish Region	VMM
		deep geothermal energy systems	the Flemish Region	VPO
GERMANY	**Nordrhein-Westfalen**	domestic groundwater extraction	lower water authority	
		introduction of rainwater	lower water authority	
		industrial abstraction	district government or lower water authority	
		abstraction for mining	municipalities, mining authority	
		abstraction for drinking water supply <= 600,000m³/y	lower water authority	
		abstraction for drinking water supply > 600,000m³/y	district government	
		subsurface energy systems < 100m	lower water authority	
		deep geothermal energy systems >= 100m	mining authority	

1 Protected areas: eg buffer zone around Natura 2000, or in a layer reserved for drinking water.
2 The classification depends on the requested flow rate and the depth criterion of VLAREM rubriek 53.8 (VLAREM=Vlaams Reglement betreffende de Milieuvergunning/Flemish Regulatios regarding the Environmental Permit).
3 Does the application have a major social importance (e.g. drinking water extraction, major infrastructure works) than Flemish Region, otherwise province.
4 This list in not complete, for the complete classification list see VLAREM.

In the Netherlands the provinces and waterboards are responsible for groundwater protection. They develop subsurface and groundwater management policy, while in de Dutch province of Noord-Brabant enforcement and licensing is delegated to the so-called regional environmental services (Omgevingsdiensten). The Ministry of Infrastructure and Waterworks (I&W) supports them with a national point of view. For abstractions and installations deeper than 500 m the Ministry of Economic Affairs and climate is responsible.
In Flanders, the licenses are granted by municipalities, provinces and the Flemish Region using advice of the VMM or VPO.
In Nordrhein-Westfalen, the lower water authorities are responsible for the small abstractions. For bigger groundwater abstractions, depending on the size and application, the municipalities, lower water authorities, district government or mining authority are/is responsible. For geothermal questions it depends on the depth. For deep the mining authority, otherwise the local authority must be involved.

3.3 Licensing legislations

Table 3.2 indicate per main application of groundwater abstraction or geothermal energy systems the related legislation, the name of the permit and the organisation that is responsible for the enforcement and supervision.

Table 3.2 Main applications of groundwater and the subsurface and the associated legislation of the four administrative regions of the Roer Valley Graben (source: VMM, 2021)

country	Administr. region	subject of application	legislation	license	enforcement and supervision
THE NETHERLANDS	province of Noord-Brabant	groundwater abstraction/ subsurface energy systems	Waterwet	Omgevingsvergunning	regional environmental services (omgevingsdiensten)
		geothermal energy systems (>500m)	Mijnbouwwet	Opsporingsvergunning, Exploitatievergunning	Staatstoezicht op de Mijnen
	province of Limburg	groundwater abstraction/ subsurface energy systems	Waterwet	Waterwetvergunning	waterboard/province
		geothermal energy systems (>500m)	Mijnbouwwet	Opsporingsvergunning, Exploitatievergunning	Staatstoezicht op de Mijnen
FLANDERS		groundwater abstraction/ groundwater abstraction for subsurface energy systems	VLAREM	Omgevingsvergunning	municipality/department Omgeving
		deep geothermal energy systems (>500m TAW*)	Decree of 8 May 2009 on the deep underground (DDO)	environmental permit, exploration permit, production licenses for geothermal energy	department Omgeving
GERMANY	Nordrhein-Westfalen	domestic groundwater extraction	WHG, LWG	wasserrechtliche Anzeige; i.d.R. erlaubnisfrei für den häuslichen Gebrauch	
		introduction of rainwater	WHG, LWG	wasserrechtliche Erlaubnis	
		industrial abstraction	WHG, LWG; ZustVU	wasserrechtliche Erlaubnis	
		abstraction for mining	BImSchG, WHG, LWG, BBergG	wasserrechtliche Erlaubnis (ggf. im Zusammenhang mit bergrechtlichem Betriebsplan)	
		abstraction for drinking water supply <= 600,000m³/y	WHG, LWG, ZustVU	wasserrechtliche Erlaubnis, gehobene Erlaubnis oder Bewilligung	
		abstraction for drinking water supply > 600,000m³/y	WHG, LWG, ZustVU	gehobene Erlaubnis oder Bewilligung	
		subsurface energy systems < 100m	WHG, LWG, (BBergG)	wasserrechtliche Erlaubnis	
		deep geothermal energy systems >= 100m	BBergG, WHG	bergrechtliche Betriebsplanzulassung mit wasserrechtlicher Erlaubnis	

**TAW= The Second General Leveling (TAW) is the reference level for height measurements in Belgium*

The three countries apply a separation between mining legislation and environmental legislation depending on the depth. Both the Netherlands and Flanders use a depth of approximately 500m below the surface (500m TAW[1] in Flanders), Nordrhein-Westfalen makes this separation at 100m depth.

[1] *The Second General Leveling (TAW) is the reference level for height measurements in Belgium.*

3.4 Overview of groundwater protection and utilization strategies in the four administrative regions of the Roer Valley Graben per region

The Water Framework Directive (WFD - 2000/60/EC) and its daughter directive the Groundwater Directive (GWD - 2006/118/EC) provide the framework for the groundwater policy and management in the different regions of the Roer Valley Graben. In the four administrative regions of the Roer Valley Graben the transposition of the directives into legislation were done at two levels: national and subregional with more attention to area-specific (environmental and socio-economic) factors. The result is that the broad philosophy behind policy and management in the four administrative regions is largely the same, but there are differences because of different area-specific factors and because the regions have objectives that fit within the objectives pursued by their country/region (although they face the same problems).

3.4.1 Province of Noord-Brabant

Groundwater abstraction

The waterboards grant permits for the abstractions of groundwater for agriculture, for drainage and for remediation of contaminations, as well as for other abstractions where less than 150.000 m³/yr of groundwater is extracted. There is an exemption for notification/permit when the pump capacity is less than 10 m³/h, provided that this groundwater abstraction is located outside a protected area and is not deeper than the maximum permitted depth at that location (if the extraction is in a protected area, then a license is always required) (see also

Table 3.1).

Different rules apply for agricultural irrigation. If an irrigation well is located in a protected area, the following applies:

- No new permits will be issued for irrigation
- But it is allowed that existing wells are moved outside the protected areas
- Grassland is not to be irrigated before the 1st of June and in June and July irrigation is not allowed between 11 am – 5 pm. But an exemption, known as the "5% scheme", can be applied. With this exemption, the application limitation can be lifted for a certain period of time during an extremely dry period.

If an irrigation well is located outside a protected area, there are options for flexible agricultural irrigation. A "Company Water Plan" is required for this. In a Company Water Plan, the famer describes which water-conserving or saving measures are taken. How

many measures are needed to be granted a permit, depends on the size and location of the area to be irrigated.

Applications for new industrial abstractions or expansions will always be screened for uses that can be categorized under “human consumption”. In the Netherlands, groundwater is a water source that is primarily intended for this. Operators are also urged to use alternatives such as tap water, surface water or reuse (treated) wastewater.

When groundwater abstractions and infiltrations are subject to a permit, an environmental impact assessment (MER) must always be done. This assessment must examine whether there is a possibility of significant negative consequences for the environment as a result of the proposed activity.

The water permits for industrial abstractions of more than 150.000m³ per year and for the drinking water supply, are granted by the provinces. As described earlier in section 3.2, the province of Noord-Brabant has delegated this to an “environmental service”. This environmental service performs many tasks in the field of licensing, enforcement and supervision of the various laws.

Permits for the abstraction of groundwater are granted for an indefinite period, but the legislation provides that a license can be revoked if it remains unused for 3 consecutive years.

Before granting a permit, a number of tests are carried out with the following criteria that the activity to be licensed, must meet:

1. The activity is not at the expense of the capacity of the water system;
2. The total amount of extracted groundwater does not increase significantly;
3. This does not lead to overexploitation and damage to nature reserves.

Furthermore, to protect the quality of the deep groundwater:

- The depth of the extraction well is not deeper than necessary for the purpose of use;
- A maximum abstraction depth is set for the geohydrological regions in Brabant (West Brabant, Roer Valley Graben, Peelhorst).

Applications for a permit for the abstraction of groundwater for the purpose of public drinking water supply or for industrial use shall be subject to the following requirements:

a) The company or the new abstraction is located within a built-up area;
b) The application must show that the use of groundwater is necessary;
c) The application is partly for human consumption, with the notion that in urban areas with flooding, abstractions for purposes other than human consumption are also permitted;
d) The depth of the wells is a maximum of 80 meters, unless:
    1) There is a displacement (reconstruction) at the same depth and an equal level of protection;

2) Research has been conducted to the effect of extraction on the dependent receptors;

e) If a displacement as referred to under d) is not possible, a deeper extraction may be considered, provided it has been investigated whether:
   1) It is possible to reduce the total capacity;
   2) The use of large-scale alternatives, such as the purification of surface water, is possible;
   3) Small-scale alternatives at the level of individual groundwater abstractors are possible;

f) With the applied abstraction, the total abstraction volume for the public drinking water supply and industrial usage in Noord-Brabant, does not exceed 250 million m³ per year.

In the assessment of the application, the effects that occur as a result of changes in the groundwater level and groundwater potential will be investigated in particular. These are:

- Impact of effects for other groundwater users;
- Impact on other dependent receptors;
- Effects on groundwater quality;
- Environmental effects;
- Influence on soil and groundwater pollution;
- Subsidence;
- Filter depth.

Websites:
https://www.brabantsedelta.nl/onttrekken-van-grondwater
https://www.aaenmaas.nl/onswerk/regels/grondwateronttrekking/
https://www.dommel.nl/grondwater-onttrekken .0
https://www.brabant.nl/onderwerpen

Geothermal energy systems and subsurface energy (storage) systems

In the Netherlands, a distinction is made between “geothermal energy” and “subsurface energy (storage) systems”.

For subsurface energy (storage) systems, a distinction is made between closed and open soil energy systems.

- In closed subsurface energy (storage) systems (HVAC, heating, ventilation and air conditioning), water, often with added antifreeze agents, is led through the ground in (deep) pipes. The liquid in the pipes does not come into contact with the groundwater. There are national rules for these systems and the companies that install and manage the systems must be certified (BRL 2100 for drilling the systems and BRL 11000 for construction, management and maintenance). The initiator who wants to install a system, reports this to the municipality. The municipalities check whether a notification complies with the rules. The municipality can also have the assessment done by the regional environmental service. Closed systems are not permitted near drinking water abstractions (in the Drinking Water Protected Areas in groundwater) and additional rules apply in the drilling-free zones.

- Groundwater is abstracted and injected from open subsurface energy (storage) systems (including ATES, Aquifer Thermal Energy Storage). The province is authorized to grant permits for the ATES systems under the Water Act, and delegates the licensing task to the regional environmental service of South East Brabant. Because groundwater is abstracted and this can affect the groundwater quality and the water regime, ATES systems are not permitted in groundwater protected areas and in nature reserves or so called “water regime attention zones”). The companies that install and manage the systems also need to be certified (BRL 2100 for drilling the systems and BRL 11000 for construction, management and maintenance).

The term “Geothermal energy” applies from a depth of 500 m and the Ministry of Economic Affairs and Climate is the licensing authority for these systems. Multiple permits from the ministry are required for geothermal energy systems. Firstly, an “Exploration permit” that grants the applicant a concession to search for a suitable location within the area of the permit. An “Environmental permit” is then required for drilling the geothermal source. Once the well has been drilled, a “Production license” must be applied for in order to be able to exploit geothermal energy. The way in which the heat is exploited is specified in a production plan, which also requires approval from the ministry.
In the future, the process for permits for geothermal energy systems will change. The “Exploration permit” will then be replaced by a “Search Area Assignment”, followed by a “Start Permit” (for exploration and the first year of abstraction) and “Follow-up permit” (for abstraction after the first year).

Website:
https://hoewerktaardwarmte.nl/
https://www.sodm.nl/sectoren/geothermie
https://www.brabant.nl/onderwerpen/handhaving/omgevingsdiensten

Drinking Water Protected Areas

The legal framework for the protection of groundwater is formed by the Environmental Management Act. This gives provinces the power to designate environmental protection zones, as a result of which certain functions of groundwater, e.g. the public production of drinking water, can be reserved in specific zones.

In the province of Noord-Brabant there are 3 types of zones for the protection of groundwater that make up the Drinking Water Protected Area:

1. The water abstraction area where the wells for drinking water abstraction are located;
2. The groundwater protection zone (25-year or 100-year zones. These are calculated by flow path calculations with a residence time of 25 years or 100 years). There are land use restrictions within the 25-year zone. The 100-year zone is used for monitoring compliance with the EU WFD, but with fewer legal opportunities for groundwater protection;

3. The drilling-free zone surrounding various drinking water and some industrial abstraction sites (for human consumption). In a drilling-free zone, the clay layers under which groundwater abstraction takes place are protected. On average, these layers lie at a depth of 50 to 80 m. Developments at ground level can take place within these areas as long as they do not pass through the clay layers.

The Drinking Water Protected Areas are protected both spatially and environmentally. Spatially, because these are also laid down in the Spatial Planning Regulation by the province, which states that within the areas the only function that is permitted, is for drinking water supply. Municipalities must adhere to this in spatial developments.
In addition, these areas are environmentally protected, because of the provincial environmental ordinance with requirements and restrictions within these areas.

The demarcation of the zones and the restrictions that apply within them can be found on the following website:

Website:
http://www.brabant.nl/omgevingsverordening

3.4.2 Province of Limburg

Groundwater abstraction
In general, permits are granted if other interests (such as nature, agriculture, surface water, etc.) are not adversely affected. To determine this, the effects of the abstraction are calculated using a model and it is examined whether the interests are harmed. Maps are available showing areas with hydrologically sensitive vegetation where the groundwater level should not be lowered. The cumulative effect of all abstractions in the area should also be investigated. The ground and surface water model IBRAHYM is available for the model-based calculation of the effects for the entire province of Limburg. Should there nevertheless be effects on interests, mitigating measures can be sought, for example infiltrating water or raising a weir to increase the surface water level.
The groundwater in the deep layers of the Roer Valley Graben, i.e., the aquifer under the principal Kieseloolite aquitard (Kieseloolite clay 1 or KIk1), is reserved for 'human consumption'. Permits are only granted here for abstractions for the drinking water supply or if the water is used for (the production of) foodstuffs.
Agreements have also been made, which are laid down in the Water Plan and soon to be published Water Programme, allowing to extract a maximum of 27 million m³/year from the deep Roer Valley Graben for the public drinking water supply WML. In addition, 3 million m³/year of groundwater has been reserved as a back-up for surface water abstraction from the Meuse at the abstraction point Heel. This may only be used in the event the Meuse water at the abstraction point Heel cannot be used (e.g. due to contamination) and if the capacity of the other existing groundwater abstractions is fully utilized.
The deep aquifers in the Roer Valley Graben are further protected by blocking all penetrations of the covering Kieseloolite clay 1 (KIk1), other than those necessary for

the construction and monitoring of the abstraction wells for human use and for the construction of occasional research wells. Deep geothermal projects are therefore not possible here.
If a license application complies with this, it can be granted. A draft decision is then drawn up and laid out for consultation. The draft decree may be amended in response to reactions to the submission for consultation.
The permits for groundwater abstraction are perpetual, except for drainage or remediation. For the latter, there is often a limit in time.

The authority for granting permits under the Dutch Water Act is the water board, except for abstractions for the public drinking water supply, industrial abstractions larger than 150.000 m³/year and for abstractions for open subsurface energy (storage) systems. The province is the authority for this. See also

Table 3.1.
In general, groundwater abstractions bigger than 10 m/h require a permit. In protected areas, e.g. in a buffer zone around nature areas with Natura2000 status or in a subsurface layer intended for the supply of drinking water, a permit is always required (from 0 m³/hour).

By calculating drawdown for the cumulative effect of all abstractions, the impact of a groundwater abstraction is assessed. In principle, there should be no drawdown in relevant groundwater-dependent nature reserves. An uncertainty margin in the calculation of 5 cm is used in the evaluation of the drawdowns.

Website:
https://www.limburg.nl/onderwerpen/milieu-toezicht/@1859/watervergunning/
Hydrogeological model REGIS II, https://www.dinoloket.nl/en/subsurface-models

Geothermal energy systems and soil energy systems

The permits of the soil energy systems (<500m) are organised as in the province of Noord-Brabant, but they are issued here by the province.

As explained in Section 3.4.1, geothermal projects (>500m) in the Netherlands fall under the Mining Act and the Ministry of Economic Affairs is the competent authority for this.

The province is responsible for protecting the quality of the groundwater for the drinking water supply. In the current provincial Environmental Ordinance Limburg, geothermal and deep soil energy systems in the Roer Valley Graben are prohibited because it is not allowed to drill through the Kieseloolite clay 1 (Klk1) for installing a geothermal plant. In view of the importance of the deep aquifers of the Roer Valley Graben for the drinking

water supply, it has been decided not to allow any additional risks in the form of drilling through the clay layer or having a borehole with a risk of leakage.
Furthermore, geothermal and soil energy systems are prohibited in groundwater protection areas and water abstraction areas (for both areas see Drinking Water Protected Areas) and drilling through the clay layer in the drill-free Venlo Block (east of the Roer Valley Graben) is only permitted under certain additional conditions. The conditions relate to measures to reduce the risk of leakage.

There are two deep geothermal systems in Limburg, both for greenhouse horticulture.

Website:
https://hoewerktaardwarmte.nl/
https://www.sodm.nl/sectoren/geothermie

Drinking Water Protected Areas

As stated in Section 3.4.1, the legal framework for the protection of groundwater is formed by the Environmental Management Act. This gives provinces the power to designate environmental protection zones, as a result of which certain functions of groundwater, e.g. the public production of drinking water, can be reserved in certain zones.

Several zones have been demarcated (see *Figure 3.1*):
Water abstraction area = area with travel time to pumping well less than 60 days in sand and 100 days in limestone. In principle, this area is reserved for drinking water supplies, new initiatives that do not fit in with this are not allowed. The Dutch province of Limburg is currently developing policy on what is and is not desirable in the future (regular agriculture or only organic, whether or not recreation?) and how must be dealt with existing activities that are actually undesirable (e.g. certain industries).

Groundwater protection area = area with travel time to pumping well less than 25 years in sand and the entire withdrawal area for phreatic extractions in limestone. Rules apply here to limit the risks to the quality of the groundwater for the drinking water supply as much as possible. For example, by prohibiting or regulating certain industrial activities or the use of substances in agriculture. Geothermal energy systems are prohibited and only pesticides with a special permit may be used in a groundwater protection area.

Drill-free zone (Venloschol and Roer Valley Graben) = area delimited on the basis of the presence of a clay layer in the subsurface that must be protected. The clay layer may only be drilled through for special applications, such as for the construction of pump wells for the public drinking water supply or for monitoring wells needed for research. The water under the clay layer is reserved for human consumption. In the Roer Valley Graben, all subsurface energy (storage) systems below the upper Kieseloolite clay layer are prohibited. In the Venloschol, open subsurface energy (storage) systems and

geothermal energy systems are permitted under certain conditions. This was decided at the time when sustainable energy and the interests of drinking water were being weighed up. Closed systems are not permitted here (too many perforations of the clay for too little energy yield).

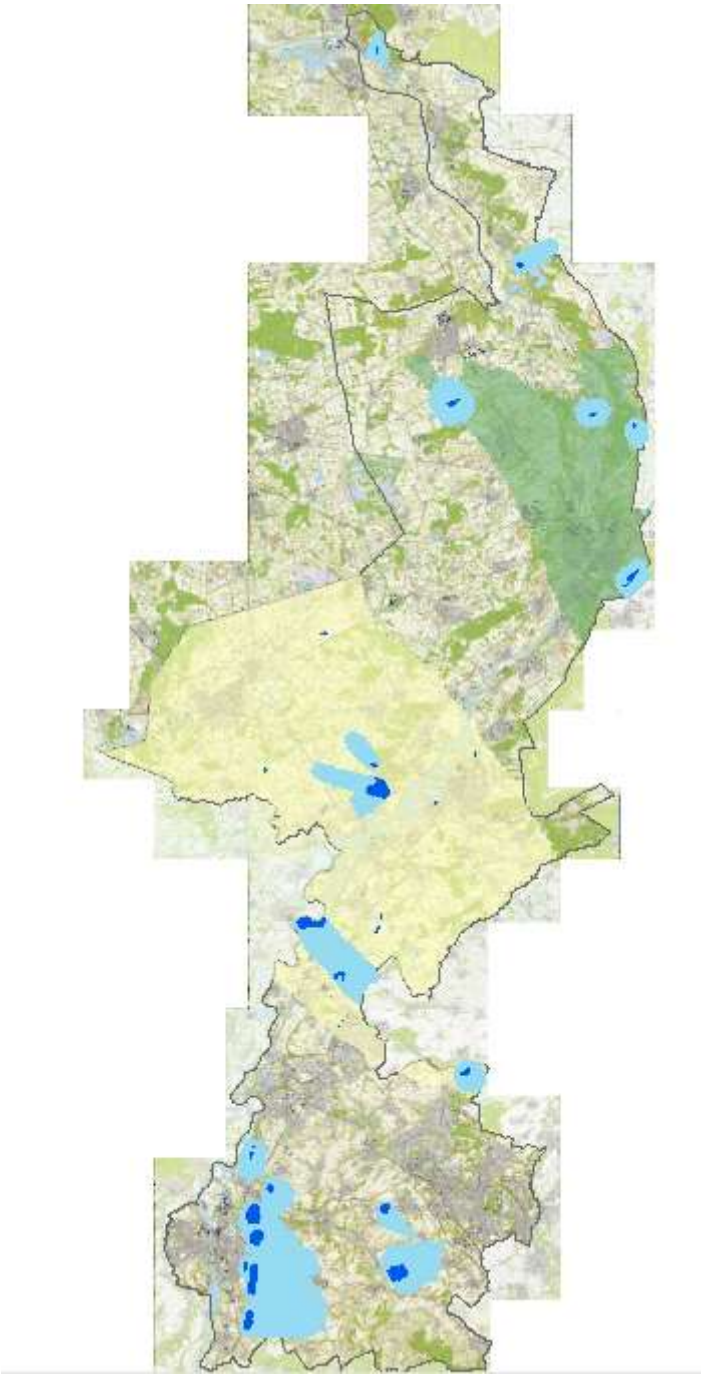

Figure 3.1 Location of the water extraction areas (dark blue), the groundwater protection areas (light blue) and the drilling-free zones (Venloschol green, Roer Valley Graben (yellow) in the province of Limburg (source: Dutch province of Limburg, 2021).

Website:
Grondwater is drinkwater - Provincie Limburg

3.4.3 Flanders

Groundwater abstractions

The existing permit policy

Controlling the water demand is a permanent concern, also in groundwater bodies that are in quantitatively good status. In order to protect groundwater resources, a general policy of reducing (ground)water use, reusing water and using alternatives is implemented. The permit policy is the most efficient instrument to reduce groundwater use. After all, this makes it possible to intervene directly at the permit holder to use less (or different) water. In the concrete application of this instrument, socio-economic preconditions, the possible alternatives and the necessary quality of the water used are taken into account. Communication with and raise awareness of the sectors and the licensing authorities is a critical success factor in this regard.

Generic vs. area-specific permit policy

Any extraction of groundwater, whether it is for the purpose of providing water or lowering the groundwater level, falls under VLAREM section 53. Currently, only groundwater extraction via a hand pump and for purely domestic applications (up to max. 500m³/year and located outside a protection zone demarcated around a drinking water abstraction) is exempt from this. The latter, the so-called “own water abstraction”, must be registered and deregistered with the Flanders Environment Agency (VMM) in the context of the levy on water pollution.
Whether a permit must be requested, or a notification must be submitted for pumping up groundwater under section 53.8 ('traditional' groundwater abstractions) depends on the location-specific depth criterion and the volume of groundwater that one wishes to use annually. The depth criterion[2] indicates for which (parts of) phreatic aquifers no specific

[2] *The map with **the depth criterion for VLAREM section 53.8** combines generic with area-specific policy. A combination of the thickness of the phreatic package and the occurrence of special protection zones is tested:*
- at the location of the application, the phreatic package must be at least 5m and not be deeper than 100m - mv
- the application must be located outside the 100m buffer zone around bird and habitat directive areas, outside drinking water protection zones and there must be no salinized phreatic groundwater in the vicinity. If these conditions are met, a notification is sufficient for an application <5,000 m³/yr, otherwise a groundwater permit must be applied for.
NOTE that the starting point is that only groundwater abstractions are included here, which we assume have no significant negative impact on the groundwater system and on the groundwater-dependent aquatic and terrestrial ecosystems, cf. WFD final quantitative good status. However, this has been taken out of the effects of climate change/precipitation deficit/persistent drought. This method is currently under discussion. There

qualitative or quantitative policy is pursued for small abstractions. For groundwater abstractions that are not deeper than the depth criterion and that extract a maximum of 5.000 m³ per year, it is assumed that the effect on people and the environment in these zones is limited and acceptable. A notification is sufficient for this. Salinized areas, special protection zones (for nature) and drinking water abstraction areas are examples of areas where an area-specific policy is pursued via an adapted depth criterion. Also, for groundwater abstractions that are deeper than the depth criterion for section 53.8, a permit requirement applies from the first m³ and, when applying for a permit, it is always checked whether the generic groundwater policy can be complied with, and/or, if applicable, the prevailing area-specific policy (see below) eg whether the application is compatible with the intended nature management or with the policy that applies within a specific action or monitoring area[3].
According to the generic permit policy, the use of groundwater from confined or semi-phreatic aquifers is generally unfavourably advised for low-value applications (including irrigation). This water is reserved for only high-quality applications[4]. If the phreatic alternative is not sufficient for the requested application and the abstraction is located outside the groundwater action areas or monitoring areas in connection with the recovery programs for groundwater bodies in insufficient quantitative status, VMM may advice to exceptionally grant a permit for specific period.
Environmental permits are normally granted for an indefinite period with a possibility of revision at the start of a new permit cycle of 20 years. The duration can also be limited for groundwater abstractions. This is used for confined abstractions and abstractions for which an area-specific policy (see below) has been developed. However, in view of climate change and the uncertainty of preserving the groundwater supply, the VMM recently advised a maximum period of 10 years for groundwater extraction for low value applications such as irrigation. In this way, the status of the groundwater body and the permit can be re-evaluated.

In addition to the generic permit policy, the Scheldt River Basin Management Plan 2016-2021 also applies an area-specific groundwater permit policy within groundwater action and monitoring areas (while most of the Flemish part of the H3O-PLUS area lies in the Meuse River basin, a portion in the west is located in the Scheldt River basin). The demarcation of these areas is established in the so-called recovery programs for

is a proposal on the table that every permit application for the abstraction of groundwater from 125m³/yr will be subject to a permit requirement.

The map with the depth criteria for VLAREM section 53.8 can be consulted via the online theme viewer for section 53.8 of Database Ondergrond Vlaanderen.

[3] ***Action and monitoring areas*** *are areas where an area-specific policy applies to groundwater bodies for which a* ***recovery program*** *has been drawn up because they are in an insufficient quantitative status. No recovery programs have been drawn up for the Roer Valley Graben.*

[4] ***High-quality applications*** *are applications with strict quality requirements that require the use of specific water compositions. The main ones are the applications that require drinking water quality. But other applications for which strict quality requirements apply, such as drinking water for livestock or production water for the food industry etc., can also be included.*

groundwater bodies with a deficient status. This area-specific policy aims to restore the groundwater to a good quantitative status as well as to protect the most vulnerable aquifers. With the current drafting of the river basin management plans for the period 2022-2027, the impact of the recovery programs and thus the evolution in the status of the groundwater bodies is analysed and, if necessary, a proposal is drawn up to optimize the recovery programs and related action and monitoring areas. For the groundwater bodies within the Sokkelsysteem, no or only a limited adjustment has been made to the recovery program as established for the period 2016-2021. For the groundwater bodies in the Centraal Vlaams Systeem and the Brulandkrijt Systeem (especially those demarcated within the confined Oligoceen Aquifersysteem), greater adaptations to the demarcation of the action and monitoring areas and the gradual phasing-out policy should be made with a view to long-term restoration and good status of these groundwater bodies

In addition, there is an area-specific groundwater permit policy in certain protection zones:

- In a buffer zone of 100m around Birds and Habitats Directive areas, a preliminary assessment and, if necessary, appropriate assessment must be carried out for groundwater permits (see later in this paragraph under “Appropriate assessment”);
- In protection zones around drinking water abstractions (see later in this paragraph under “Drinking Water Protected Areas”);
- Near salinized phreatic groundwater.

Barring a few exceptions, since 2010, every groundwater abstraction (also for groundwater abstractions used for irrigation in the open air in agriculture and horticulture) must be equipped with a sealed flow meter and large-scale users must annually declare their water consumption. The levy on water pollution and the extraction of groundwater is calculated for large consumers on the basis of the data stated in the declaration or for small consumers on the basis of a flat-rate consumption per domicile.

The advice issued by the VMM department responsible for groundwater for permit applications for groundwater extraction consists of 3 parts:

- An assessment of the requested flow rate for the requested applications;
- An assessment of the requested resource for the requested applications;
- An evaluation of the impact of the extraction on the aquifer/groundwater recourse and the influence on other receptors:
    - that there are no significant negative effects on the groundwater system, i.e. that extraction and recharge are in balance, there is no excessive extraction, salinisation does not increase, and if a negative effect is expected anyway, it is made manageable/acceptable subject to mitigating measures being taken.

Environmental impact assessment (in Dutch: MER) aims to map out the possible consequences of plans, programs or projects for the environment and for human health,

so that they are included in an equivalent manner (as other aspects and interests) in the preparation of and the decision-making about these plans, programs or projects.

An **appropriate assessment** (in Dutch: passende beoordeling) is a report that provides reasoned arguments as to why the conservation objectives of an SBZ (special areas of conservation, in particular Habitats Directive areas) may or may not be affected by a planned activity. All activities, plans and programs requiring a permit that can cause significant damage to the integrity of an SBZ fall within the scope of an appropriate assessment.

Websites:

Flemish Regulatios regarding the Environmental Permit (VLAREM):

VLAREM — Vlaamse Milieumaatschappij (vmm.be)

Certification of drillers, Flemish regulations regarding recognitions with regard to the environment (VLAREL):

Erkende boorbedrijven — Vlaamse Milieumaatschappij (vmm.be)

Information about Flemish groundwater (VMM):

Grondwater — Vlaamse Milieumaatschappij (vmm.be)

All Environment, Nature and Energy legislation in one place:

EMIS Navigator (vito.be)

Appropriate assessment Voortoets/Passende beoordeling

https://pww.natuurenbos.be/wijziging-grondwaterstand

MER:

https://omgeving.vlaanderen.be/omgevingsvergunning/milieueffectrapportage

Geothermal energy systems and subsurface energy (storage) systems

Shallow geothermal systems (untill -500mTAW)

Shallow geothermal energy systems are prohibited within protection zones type I and II of the Drinking Water Protected Areas.

Open subsurface energy (storage) systems (KWO, ATES, WKO) always require a permit with accompanying conditions concerning full return of all abstracted water, pressure monitoring, water sampling and analysis, etc..

Closed systems are usually not classified (but must be reported by a certificated drilling company, see Section 2.3.5), but depending on the depth and location they may require a permit (desk 55.1: VLAREM Section 55.1). All closed systems also must fulfil certain requirements (regardless of whether they are unclassified or require a permit). These include compulsory filling of the borehole with impermeable and frost-resistant grout, permitted fillers, and so on.

All drillings may also only be carried out by drilling companies that are certificated in accordance with VLAREL.

Deep geothermal (from -500mTAW)

Flanders has legally demarcated the “deep subsurface” border at -500m TAW. Only deep geothermal energy projects that are intended deeper than -500m TAW can obtain a permit under the Decree of 8 May 2009 on the deep subsurface (DDO). Shallower projects, such as ATESs, are regulated via VLAREM. Key points of the DDO are:

- In the first place, the DDO offers legal certainty to investors in deep geothermal energy applications by obtaining an exclusive volume area within which only the permit holder may explore or extract deep geothermal energy. This certainty is necessary for the various activities in the deep subsurface to co-exist safely and well-defined in terms of impact and liability, and it provides applicants with security before making large initial investments associated with these activities. The DDO therefore regulates matters on a more abstract level: the right to detect geothermal energy over a large area. It is the Flemish Government that decides on permit applications. The environmental aspects are regulated independently via the law on environmental impact assessments (MER) and the environmental permit. It is not enough for a project to only obtain an exploration permit to get started; the environmental permit must also be obtained before drilling can be carried out;
- Development of a deep geothermal energy systems typically takes place in two steps: first, an exploration permit is obtained, which is valid for 5 years as standard. With an exploration license for geothermal energy, the holder can not only trace geothermal energy, but he can also immediately extract this geothermal energy in accordance with the conditions stipulated in the permit. Within that period (possibly to be extended if necessary), crucial parameters must be sufficiently quantified to draw up a realistic extraction plan. A production license can only be granted if it has been made plausible that the geothermal energy found can be extracted in a responsible manner and the production plan has been approved by the Flemish Government. The period of validity of production licenses for geothermal energy is stated in the license itself;
- As a rule, a license application gives rise to the start of a competition procedure, in which other interested parties also get a chance to submit an application for a similar license for the same volume area. Applications are assessed according to established permit criteria (see DDO and BVR =Besluit van de Vlaamse regering, Decision of the Flemish govenment);
- Exploration and production licenses for geothermal energy always indicate to which volume area they apply. The aim is to delineate the permit area in such a way that the entire area in which the licensed activities have a significant influence falls within the permit area. The DDO works with the concept of “volume area” whereby the permit is clearly limited in the depth dimension; so the entire vertical column is not permitted from a certain depth. It is thus clear that several volume areas at different depths can be licensed under the same area on the earth's surface, the vertical projections onto the earth´s surface may overlap;
- In addition to the general duty of care, the Flemish Government can lay down a whole range of other obligations in the permit conditions, such as the imposition of a measurement plan for seismic monitoring;
- Just as for the other applications in the deep subsurface, an liability regime applies to geothermal heat abstraction. In addition, the Flemish Government can oblige the holder or last holder of an exploration or production license for geothermal energy to provide financial security to cover liability for damage suspected of being caused by seismicity, for the removal of infrastructure from occupied land and for the safe closure of boreholes after cessation of activities.

Currently, 2 exploration licences have been issued. In time, a map layer will become available on DOV for licences, but this is not yet the case. The duration of an extraction permit is determined on the basis of the specific project, but typical durations are around 30 to 40 years. Potential maps are interesting as a first approximation, but an applicant needs to explain the local geology and estimated potential in detail. In addition, additional research (e.g. seismic acquisition) is usually carried out to visualise the structure of the subsurface. Each application must also submit dynamic reservoir modelling (coupled heat & mass transport) to predict impacts.

It is uncertain how geothermal energy usage will develop. The investment climate is currently not very favourable (less subsidy opportunities). Plans are being made for a project in the Kempen, that may soon lead to an application.

Websites:
Open systems (KWO, ATES, WKO):
https://navigator.emis.vito.be/mijn-navigator?woId=19118&woLang=nl
Closed systems:
https://www.dov.vlaanderen.be/index.php/page/vlarem-rubriek-551
https://navigator.emis.vito.be/mijn-navigator?woId=62328&woLang=nl
The Decree of 8 May 2009 on the deep underground (DDO):
https://codex.vlaanderen.be/Portals/Codex/documenten/1018090.html

Drinking Water Protected Areas
Water abstraction areas are the zones in which the water companies pump up groundwater for the production of drinking water. Of course, stricter rules apply here than elsewhere. After all, it is of crucial importance that the quality of the groundwater in these zones remains assured.

A map with an overview of the water extraction areas is available at: https://www.dov.vlaanderen.be/index.php/page/waterwingebieden-en-beschermingszones

Three protection zones
There are three protection zones around each water abstraction area:
Zone I or the 24 hour zone. This is the zone within which the water can reach the wells of the water abstraction area within 24 hours.
Zone II or bacteriological zone. The water in this zone can reach the wells of the water abstraction area in less than 60 days. This zone extends to a maximum of 300 meters around the water abstraction area.
Zone III or the chemical zone. This zone contains the recharge area of the groundwater abstraction up to a distance of maximum 2 kilometres around the water abstraction area.

The acts and activities allowed within the protection zones are listed in the Flemish Government Decree of 27 March 1985. The VLAREM and VLAREBO environmental

legislation and the Manure Decree also contain provisions on what is and what is not allowed within the demarcated protection zones. In zone II, which is closer to the actual abstraction, stricter measures obviously apply than in zone III. The water extraction areas themselves and the areas that comprise zone I are owned by the drinking water companies.

In the river basin management plans for Scheldt and Meuse 2022-2027, "catchment areas" of the drinking water abstractions are additionally designated as part of the drinking water source protection linked to the new European Drinking Water Directive. For each catchment area, a risk assessment will be carried out and, if necessary, measures will be drawn up. For more information, see Chapter 2 of the Flemish part of the river basin management plans and the background document "Drinking water source protection".

Strategic Planning for Water Supply (SPW)
The aim of the Strategic Plan for Water Supply (SPW) is to ensure as much as possible that the demand and need for water can be met in a sustainable way, now and in the future (inclusive Source protection Drinking water).

Websites:
Protection zones:
Drinkwater — Vlaamse Milieumaatschappij (vmm.be)
Strategic Planning for Water Supply:
Strategisch plan waterbevoorrading in Vlaanderen - drinkwaterbevoorrading via openbare waterdistributie — Vlaamse Milieumaatschappij (vmm.be)
Source protection Drinking water:
Achtergronddocument Bronbescherming Drinkwater (integraalwaterbeleid.be)

3.4.4 Comparison between the administrative regions

The Water Framework Directive forms the basis of groundwater policy and management, supplemented by generic policy and management of the country/region to which the administrative regions belong and area-specific policy and management. The generic and area-specific policy of a certain administrative region is determined by, on the one hand, the tension between water demand (how much water of what quality is needed) and water availability (supply of possible water sources and their quality) and, on the other hand, the tension between the various functions that require the same groundwater/subsurface under and on the surface (spatial planning of the surface and the subsurface). Both types of tension deserve attention for a sustainable management of the groundwater and the subsurface.
For this brief comparison a broader view than just the licensing policy was taken and we selected a few outstanding aspects from each administrative region.

Main similarities
When applying for a permit:

In the administrative regions of the Netherlands and Flanders, the applicant must demonstrate that he needs the requested quantity of groundwater, with the exception of drinking water companies, which can ask for an additional amount to use under certain conditions. In the Netherlands this is called demonstrating economical and efficient use; in Flanders use must be made of water audit, BBT, Codes of good practice, key numbers, and the principle that high quality groundwater may only be used for high quality applications.
Each applicant must investigate the impact of his abstraction and the administrative region does this as well, also the cumulative impact with other groundwater abstractions. Environmental Impact Assessments and other instruments, (e.g. in Flanders appropriate assessments/Passende Beoordelingen), help to visualize the environmental impact in an equivalent way.

In the assessment/policy:

- The capacity of the aquifer determines whether additional groundwater abstraction is possible;
- Stricter rules apply to certain areas (e.g. protection zones around drinking water abstraction areas, nature reserves, etc.) to better protect the groundwater quality and quantity;
- Certain (parts of) aquifers are (to a certain extent) reserved for certain applications (a prioritization in use/application);
- Protecting the quality of confined groundwater in Flanders is done by means of: the certification of drillers, in the Dutch province of Limburg through a ban on drilling through Kieseloolite clay 1 (Klk1) for applications other than drinking water abstraction or the construction of research wells;
- Confined and semi-phreatic groundwater is reserved in Flanders for high-value applications, in the Dutch province of Limburg confined groundwater is reserved for the production of drinking water (or for the food industry), and in the Dutch province of Noord-Brabant a maximum abstraction depth is set for the geohydrological regions (West Brabant, Roer Valley Graben, Peelhorst).

When granting the permit:

- Smaller permits, with smaller impact are mostly issued by other authorities than bigger permits;
- Permits for the abstraction of groundwater can be revoked/amended under certain circumstances (operational reliability vs. strength of the permit instrument to control the quantitative status of an aquifer);
- Flanders and the Netherlands use the 500m depth for the depth below which mining legislation applies.
- There is a duty to register the subsurface data, which can be consulted in an open government database.

Deep geothermal systems:

There are not many current permits yet, but Flanders and the Netherlands are approaching these permits in the same way. The Dutch province of Noord-Brabant made

already a bigger step forwards towards the valorisation of the deep subsurface by doing more research around the potentials of the deep subsurface. The Dutch province of Limburg applies a strict zoning of the subsurface.

In addition to the policy and management that has a direct influence on the quantitative status of the groundwater, the quality of the groundwater in the administrative regions of the Roer Valley Graben is also protected and measures are in place to improve the quality of infiltrating water. This prevents the groundwater becoming less usable. In addition to nitrate, pesticides, heavy metals and salinization, more and more work is being done on new emerging substances from the EU watch list (see e.g. Bunting et al., 2019).

The concrete implementation of the above policy and management differs between administrative regions. Although they work with the same criteria listed in the WFD for the quantitative status of groundwater bodies, the objectives they pursue are not always the same.

Main differences

Roughly speaking, groundwater quantity protection measures are mainly about 'using less water, reusing water and using other water sources' or 'increasing the capacity of and replenishing ground- and surface-water sources'. Both the Netherlands and Flanders currently pursue a multi-track policy and an integrated policy to manage the groundwater and the subsurface in a sustainable manner, but they place different accents. In order to better understand the differences in policy and management between the two countries, it is necessary to look at the past. The policy and management differences between the Dutch and Flemish administrative regions of the Roer Valley Graben have their origin in a general difference in water availability between the Netherlands and Flanders. Flanders has a lower water availability than the Netherlands for the following reasons:

- Although the hydrogeological conditions in the different administrative regions of the Roer Valley Graben are roughly the same, the hydrogeological structure differs between the Netherlands and Flanders. Flanders has more clay and loam layers and more hilly areas that make it more difficult to replenish the groundwater;
- Compared to the Netherlands, Flanders has no large rivers and has fewer fresh surface water reservoirs, reducing the availability of surface water in Flanders;
- In addition, the high population density and the spatial order with its Flemish “ribbon development” and associated paving (paving is laid so that rainwater is drained away as quickly as possible) also play a role.

More than 20 years ago, Flanders faced an enormous challenge to eliminate two large depression cones of groundwater heads in confined water layers in the south of the provinces of Oost- and West-Vlaanderen. These had been created by historical overexploitation and depletion of the groundwater (see Figure 3.2). One turned out to be caused by a number of large mainly industrial and drinking water supply abstractions and the other by a many mainly agricultural small groundwater abstractions. The Flemish

Government introduced a first "recovery programme" via the Water Policy Note of 8 April 2005: on the basis of modelling (2003), it was assumed that in order to achieve long-term (>50 years) sustainable recovery, the permitted volume of groundwater abstraction had to be very drastic reduced by 75% compared to the permitted volume in 2000. Parallel to this, a first campaign of reorientation towards other water sources, water saving and reuse was started with several actors and researchers involved. In the area, there was a lack of alternative water sources (phreatic groundwater, surface water) and a package of mitigating measures based on the principle that the problem should not be transferred to other layers or water sources were introduced. The grey water Decree, for instance, provides for the possibility of using "grey water" tailored to the customer's needs.

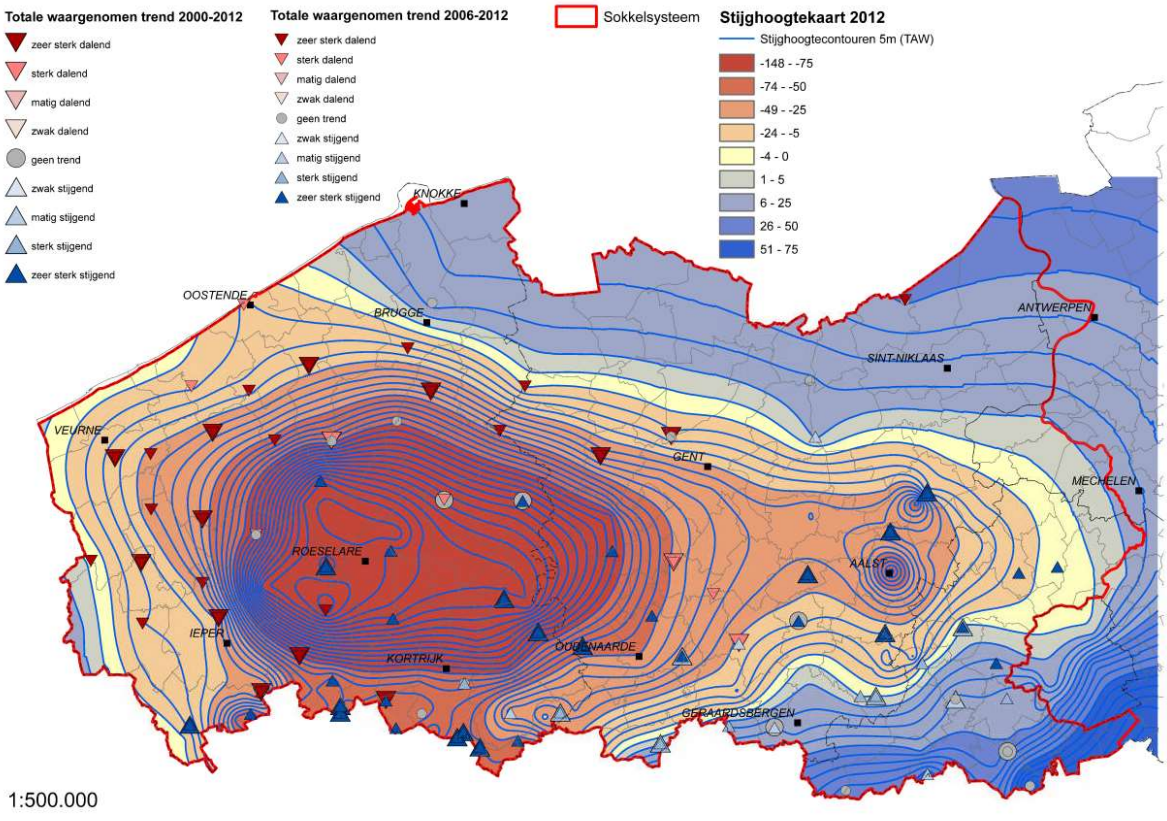

Figure 3.2 Position of two large depression cones of groundwater heads in confined water layers of the Cambro-Siluur Massief van Brabant in the south of the provinces of Oost- and West-Vlaanderen (source: VMM, 2012)

This recovery policy was updated over the years with further specification to regions where there were alternative water sources compared to those where there were only limited alternatives, to sensitisation to the use of the right water (quality & quantity) for the right applications and with a steering levy policy. In the river basin management plans, the area-specific recovery policy is evaluated and, if necessary, adjusted.
In the year 2000, a volume of about 33.6 million m³ was licensed for groundwater abstraction in the Sokkelsysteem. In total, the licensed volume for groundwater

abstraction in the Sokkelsysteem decreased by 66% from 2000 to 2018 (see *Figure 3.3*). The largest reduction was realised between 2006 and 2012. The number of licensed installations decreased from 1.467 in 2000 to 558 in 2018.

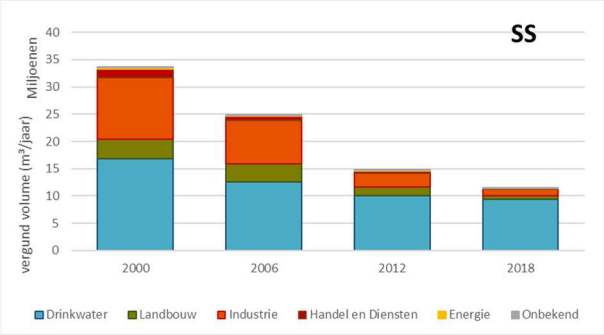

Figure 3.3 Distribution of the permitted volume (in million m³/year) for groundwater abstraction by sector for the Sokkelsysteem (status 27/12/2018) (source: VMM, 2019)

Today, within the Sokkelsysteem, a large reduction of the use of this confined groundwater has already been realised and in many locations a trend reversal in the falling headwater heads, and thus effective recovery of the layer, has started. The future river basin management plan of the Scheldt (2022-2027) will perpetuate the existing, area-specific recovery programme: after all, in order not to jeopardise recovery, it is advisable to continue the policy and groundwater management of these confined aquifers in order to ultimately achieve a good status and sustainable exploitation of this groundwater reserve.
Later on, other confined (parts of) aquifers, although in much better shape than those in the south of the provinces of Oost- and West-Vlaanderen, were also found to be under so much pressure in relation to their capacity that more recovery programs were necessary.

This has ensured that Flanders, in its generic policy, and therefore also in the Roer Valley Graben, where there is a lot of water by Flemish standards, is extensively regulated and very strongly focused on water saving, reuse of water and use of alternative water sources.

Some notable projects in Flanders:

- A **permit policy** in which virtually every groundwater abstraction is known. Because of the specific hydrogeological structure of Flanders and the pressure on water sources, Flanders tries to use as little water as possible at every scale and in every sector. In order to maintain a strict permitting policy, it is possible to limit the **term** for both confined and phreatic groundwater permits. This makes it possible to better control the quantitative status of the groundwater;
- **Certification of drillers**: Since 2017, certification for drillers has been mandatory for certain activities. These include the drilling of groundwater abstraction wells, dewatering and drainage, stability and geotechnical drilling, etc.. This protects the subsoil and groundwater (quality and quantity), illegal abstraction is discouraged and subsurface data is collected in a structured manner;

- **Collection and reuse of rainwater** is anchored in the urban planning permit or the environmental permit. Mandatory collection and use of rainwater (primarily to reduce peak discharges during heavy rainfall (flooding), but also as an important source of low-quality water for all kinds of applications such as toilet flushing, cleaning stables, irrigation) for both private individuals and companies;
- **Rational water use**, **water audit**, **BBT** and **key figures;**
- **High-quality groundwater** (confined and semi-phreatic) for high-value applications, **low-quality** (surface water, rainwater, re-use of water, …) for the rest;
- **Greywater circuits;**
- A steering **levy policy** with layer and area factors. By making groundwater from certain (parts of) aquifers more expensive, users are encouraged to use other water sources or less water;.
- **Recovery programs** with action and monitoring areas: on the basis of scenario calculations, phase-out scenarios have been drawn up taking into account socio-economic preconditions and possible alternatives to achieve a good quantitative status.

Initially, the emphasis was mainly on protecting the confined groundwater reserves and the groundwater-dependent nature and counteracting the increase in salination. In the meantime, the Flemish groundwater policy and management is following more tracks at the same time. These tracks are often less generic and more area oriented. In recent years, many new projects have been started to make the phreatic groundwater more climate proof (see Section 3.5 with the Blue Deal), whereby also more attention is put on infiltration and retention (increasing water availability).

In the past, the Netherlands often concentrated on increasing the capacity of water availability and the protection of the drinking water resources. For example with:

- Managing reservoirs for fresh surface water (e.g. in De Biesbosch area);
- Infiltration projects;
- Adjustable drainage;
- Areas designated for drinking water production and drinking water reserves through comprehensive spatial planning of the subsurface.

But in the meantime, the Netherlands is pursuing its groundwater policy and management on many more tracks simultaneously. The organizational structure allows for easy area-specific work. And the Netherlands is well advanced in developing tools to perform scenario and impact calculations on the water system at different scales.

The province of Noord-Brabant focuses nowadays on increasing the replenishment of groundwater in order to reduce water shortages. This is because the water system drains the precipitation more quickly than appropriate under the current circumstances. In addition, this province focusses on reducing the use of groundwater by more local projects.

Some notable projects are:

- For the entire province, a **maximum amount of groundwater** that may be **abstracted** for drinking water production and industry together has been set, namely a maximum of 250 million m³/year;
- **Reuse of industrial process water** from a beer brewery for surrounding farmers website: bierboerwater.nl;
- **Water saving efforts**, reuse of process water from the drinking wate supply company Brabant Water by industry and farmers at various pumping stations;
- New residential development Brainport Smart District (Helmond) by using **alternative water sources** (instead of drinking water) for homes (including for toilet flushing);
  website: https://brainportsmartdistrict.nl/?s=waterlab

In addition, the province of Noord-Brabant is fully committed to the valorisation of the subsurface, including (seismic) research, in order to contribute to the energy transition and at the same time to better protect the confined groundwater:

- A refined **zoning of the subsurface** is currently being implemented. Currently, Noord-Brabant uses the "80m limit", which allows drilling to a maximum depth of 80m. A new policy is being developed, based on the depth of the most important separating clay layers (taken from the hydrogeological model REGIS II). The choice of clay-layer differs per hydrogeological region. They are situated more or less around 80m, sometimes slightly higher or lower, depending on the area. In the draft proposal, the 1st clay layer in the Kieseloolite clay 1 (Klk1) on the south side of the Roer Valley Graben is used, which is also directly related and consistent with the policy of the Dutch province of Limburg, which has a drilling-free zone below this clay layer in the Limburg part of the Roer Valley Graben;
- There is a **ban on the use of certain liquids** in geothermal and closed subsurface energy (storage) systems. This ban only applies to systems that reach into confined aquifers. To this end, a trade-off was made between meeting the energy transition (systems with these fluids have a higher efficiency) and the further deterioration of the groundwater;
- The **industry** may only use confined groundwater if the application falls under the category of "human consumption".

The Dutch province of Limburg is committed to better protection of the confined groundwater by **strict spatial planning of the subsurface**. Groundwater from confined aquifers is reserved for the production of drinking water (or use for human consumption):

- **The Kieseloolite clay** 1 (Klk1) may **not be perforated** except for drinking water production or use for human consumption;
- A **strategic reserve** has been delineated as a reserve for surface water abstraction for drinking water production;
- A **maximum abstraction** rate has been established (with a margin as a reserve) for drinking water production, in order to be able to continue extracting confined groundwater in a sustainable manner;
- The drinking water abstraction areas are better protected than in the other administrative regions by a more **radical zoning of the subsurface**;

- **Water retention** is also done in Limburg with small-scale dams in ditches, e.g. the "bermslotenproject": water retention along municipal roads with roadside dams.

3.5 Water scarcity and drought

Drought refers to a temporary reduced availability of water, for example due to low precipitation. The lower availability of water during drought may cause water scarcity. Water scarcity means that the demand for water exceeds the amount that can be sustainably withdrawn from reserves. Water scarcity is thus a shortage (temporary or otherwise) of sufficient clean water.
The droughts of the past years of 2018-, 2019 and 2020 and the resulting water scarcity have increased the awareness of the vulnerability of various so-called "water receptors" (including phreatic aquifers, nature, agriculture, surface waters, confined aquifers, subsidence-sensitive soils, etc.) to climate change. Climate adaptation and ensuring climate resilient groundwater systems are therefore high on the agenda of groundwater policy and management in every administrative region of the Roer Valley Graben. Its approach is pre-eminently multi-track. Therefore, drought is included here as a separate theme.
Because the approaches are still under development, we will present here only the approaches of the Netherlands and Flanders, instead of differentiating between the administrative regions. We will show how the issue of drought is currently being addressed, along with initial initiatives to prevent or mitigate the groundwater scarcity. The approaches are presented below from a groundwater perspective.

3.5.1 The Netherlands

National Water Distribution Commission/Landelijke Commissie Waterverdeling
The Watermanagement Centre of the Netherlands is the network centre for knowledge and information about the Dutch water system (https://waterberichtgeving.rws.nl/LCW). All products and services in the field of water management are bundled in the water management centre. From current water levels to water quality, from information about water policy and water management to crisis management when water is too high, too low or too dirty.

The National Water Distribution Coordination Committee (LCW) is also part of the water management centre. The LCW is active in (imminent) water shortage situations. In these situations, the LCW publishes drought monitors describing the current situation and the committee advises on measures to be taken during drought.

Drought season in the Netherlands
(see https://www.rijkswaterstaat.nl/water/waterbeheer)
The drought season runs from April 1st to September 30th, coinciding with the growing season of trees and plants. The demand for water and therefore the risk of water scarcity will increase. There is water scarcity when there is less water than needed. There can also be water scarcity outside the drought season, but the chance is less.

Regional differences

The Netherlands depends on rainwater and river water inflow from the Rhine and Meuse. The rivers carry melt water and precipitation from upstream countries. The river water can be directed to a large portion of the further downstream parts of the Netherlands, but some regions have to rely solely on rain water. The approach to drought therefore differs per region and from year to year:

- The higher parts of the South and East Netherlands are completely dependent on rainwater; their elevation is too high for the river water to reach these areas. The available water must therefore be retained or conserved. Water boards can, for example, impose a ban on irrigation for farmers;
- Fresh water supply is also limited in parts of the province of Zeeland which are located in a brackish (ground)water setting;
- In the remaining part of The Netherlands, water supply from the rivers Rhine, Waal, Meuse, and IJssel is possible with weirs, locks, inlets and pumping stations;
- During droughts, salt water intrusion from the North Sea into surface waters (website: verzilting) can occur in the western Netherlands and the IJsselmeer.

Prioritisation scheme

If less water is available than needed, the water is distributed on the basis of a prioritisation scheme (website: verdringingsreeks), see Figure 3.4. Flood defences and dikes that are sensitive to drought are the first to receive water (Category 1). Extreme drought can cause cracks in dikes and damage flood defences. If the water then rises again, they can no longer protect the land behind. Likewise, peat areas sensitive to land subsidence, and water-dependent nature fall in this category. Drinking water and energy supply are second in line (Category 2).

The current prioritisation scheme came about after the water scarcity of 2003 and the subsequent document "Evaluatienota Waterbeheer" (website: Evaluatienota Waterbeheer - Aanhoudende droogte 2003)

Figure 3.4. Prioritisation scheme (in Dutch: verdringingsreeks) for the allocation of available fresh water (source Rijkswaterstaat, 2003)

The prioritisation scheme is described in more detail in Appendix 2.

Drought communication and monitoring
The drought monitor is a communication instrument in which real time drought monitoring information and countermeasures are brought together (website: https://waterberichtgeving.rws.nl/owb/droogtemonitor). An example of a drought monitor from 2020 can be found in Appendix 1.

Information on precipitation and evaporation can be found here:
https://www.knmi.nl/nederland-nu/klimatologie/droogtemonitor

3.5.2 Flanders

The dry springs and summers of recent years caused water shortages. Due to climate change, such water shortages will probably occur more often in the future, with potentially major consequences for the water system: low water discharges in waterways and canals, tidal streams and pools, low groundwater levels, declining water quality, etc.. This will also lead to increasing competition between water uses (drinking water supply, industry, agriculture, shipping, nature conservation and recreation).

The Integral Water Policy Coordination Committee (CIW) is a Flemish consultation and coordination platform for the various policy domains and levels of government involved in water policy. As a drought coordinator, the CIW is responsible for ensuring the necessary consultation between water managers and other authorities and coordination between measures during a drought period.

Drought Measures
In the event of a persistent drought that leads to water scarcity, water managers, water companies and other government services will do everything in their power to reduce the impact of the drought. They set higher levels of surface water/drainage levels, adjust the barrage control for ships, provide supplement from other waterways, etc..

The minister or the governor can announce additional drought measures. Examples are water use restrictions for specific applications, a capping ban or a recreation ban due to the presence of toxic blue-green algae.

More information can be found at www.vlaanderen.be/droogtemaatregelen.

Blue Deal fights drought
The Flemish government is increasing its efforts in the fight against water scarcity and drought through the programme “the Blue Deal”.
With this deal, she wants to tackle the drought problem in a structural way, with an increased deployment of resources and the right instruments, with the involvement of industry and farmers as part of the solution and with a clear exemplary role for the Flemish and other governments.

The Blue Deal contains 70 measures and bets on 6 tracks:

1. Public administrations lead by example and ensure appropriate regulation;
2. Circular water use is becoming the rule;
3. Agriculture and nature become part of the solution;
4. Individuals are sensitized and encouraged to remove pavements;
5. Security of water supply is increased;
6. Joint investment in innovation to make water system smarter, more robust and more sustainable.

The measures from the Blue Deal form the basis of the chapter “Minimizing the risks of water shortages and flooding” of the Flemish Climate Adaptation Plan 2021-2030, which will be submitted to the Flemish government in the Autumn of 2021. The deal also forms a cornerstone of the “Water Scarcity and Drought Risk Management Plan”, part of the 2022-2027 River Basin Management Plans, whose public review will start in this Autumn.

More info at https://www.integraalwaterbeleid.be/nl/nieuws/blue-deal-bindt-strijd-aan-tegen-droogte

Water scarcity and drought status

Indicators are used to better estimate the seriousness of a water scarcity and drought situation. Measurement results and predictions of precipitation amounts, river discharges, groundwater levels and water quality parameters are processed into indicators that classify the drought status or the impact of the drought into four levels. The indicators are calculated at least every month. In drier periods this happens every 14 days or every week. An overarching indicator informs about the need for measures and coordination.

The four levels of the overarching indicator are (see *Figure 3.4*5)

Figure 3.4 Four levels of the overarching indicator (source VMM, 2020)

The groundwater level indicator

The groundwater level indicator provides a picture of the current level of the phreatic groundwater compared to the past.
This analysis of the groundwater levels is based on monthly water level measurements by the VMM, SCK CEN and De Watergroep. These monthly level measurements are supplemented with daily model calculations for the past 30 years. (Indicator measuring network see Section 3.6.3).
Only the phreatic levels are discussed. The phreatic screens of the primary monitoring network with continuous measurement series of 11 years or more and with relatively shallow groundwater levels are used for the analysis. The groundwater levels of these screens best reflect the influence of recent climatic variations, while they can also be tested against a relatively longer measurement history.
For each screen, the current groundwater level is compared with the levels in recent years. At the same time, it is determined whether there has been a relative increase or decrease in the past month. The data is processed in a map and a number of graphs (for an example see Figure 3.6). This gives an idea of how high or how low the groundwater level is compared to the levels in previous years and what direction the groundwater level is going.
The groundwater level indicator is drawn up monthly (around the 8th of the month). In periods of very dry weather, the indicator may be updated more frequently.

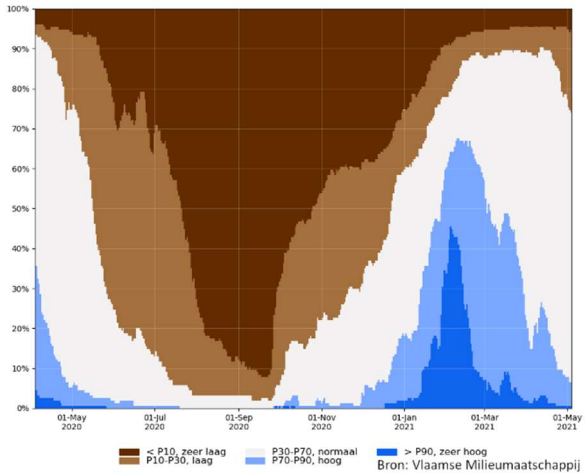

Figure 3.5 Absolute state of the phreatic groundwater level: percentage of the measurement points with a very low, low, normal, high or very high groundwater level (compared to all daily water levels of the past 30 years) (source VMM, 2021)

On https://www.dov.vlaanderen.be/page/actuele-grondwaterstandindicator there is a link to the full monthly report “State of the water system”

Consultation on water scarcity and drought

The Flemish Drought Commission is embedded in the CIW operation and takes action in the event of persistent or imminent dry periods with general and water shortages.

In the event of local drought and water scarcity, consultation and coordination takes place through the provincial crisis meeting under the leadership of the governor.

https://www.integraalwaterbeleid.be/nl/overleg/droogtecommissie

3.6 Groundwater monitoring strategies

In addition to mapping and parameterization of the subsurface, monitoring data on the quality and quantity of groundwater is important basic information on which (tools for) policy and management of groundwater and the subsurface is based. The monitoring results are used to determine the status and trends, to determine the effects of measures, and ultimately to adjust policy and management. The monitoring strategies determine what statements can be made based on the measurement results in the different administrative regions. Putting the methodologies used by the different administrative regions side by side allows for better interpretation of each other's measurement data and the applicability of the monitoring results.

Although there are groundwater monitoring strategies on different scales, we will limit ourselves here to the regional monitoring strategies used to evaluate compliance to the Water Framework Directive.

3.6.1 Province of Noord-Brabant

Primary groundwater level monitoring network

The primary groundwater level monitoring network consists of around 400 observation wells with approximately 1.000 screens (of which 700 are currently active) and is spread across the entire province. Since 2016, the entire monitoring network has been automated. This means that every hour the groundwater level is recorded, processed and visible the next day on a publicly accessible website (https://grondwaterstand.brabant.nl). Strict requirements are set on data quality and delivery.

The primary groundwater level monitoring network measures groundwater levels and pressures from shallow groundwater to maximum depths of about 500 metres below the surface (see Figure 3.7). The data from the network provide insight into the quantitative status of groundwater, both the current status and the trend in the groundwater levels. It is not an operational monitoring network that is used for daily activities, but a monitoring network with long time series and deep screens. This makes this network very important for the execution of a number of tasks:

- Legal obligations: Determine whether there are trends in groundwater quantities in Brabant (balance between extraction and replenishment of groundwater) in the context of the Water Framework Directive (WFD);
- System insight and information transfer: Modelling: e.g. Brabant-wide groundwater model and calculation of carrying capacity groundwater;
- Policy review and reporting:

- Status report Water & Soil evaluations for which time series analyses of groundwater levels are performed;
- Strategic policy decisions: e.g. irrigation policy for water boards;
- Impact studies such as the evaluation of the regional water and soil programme.

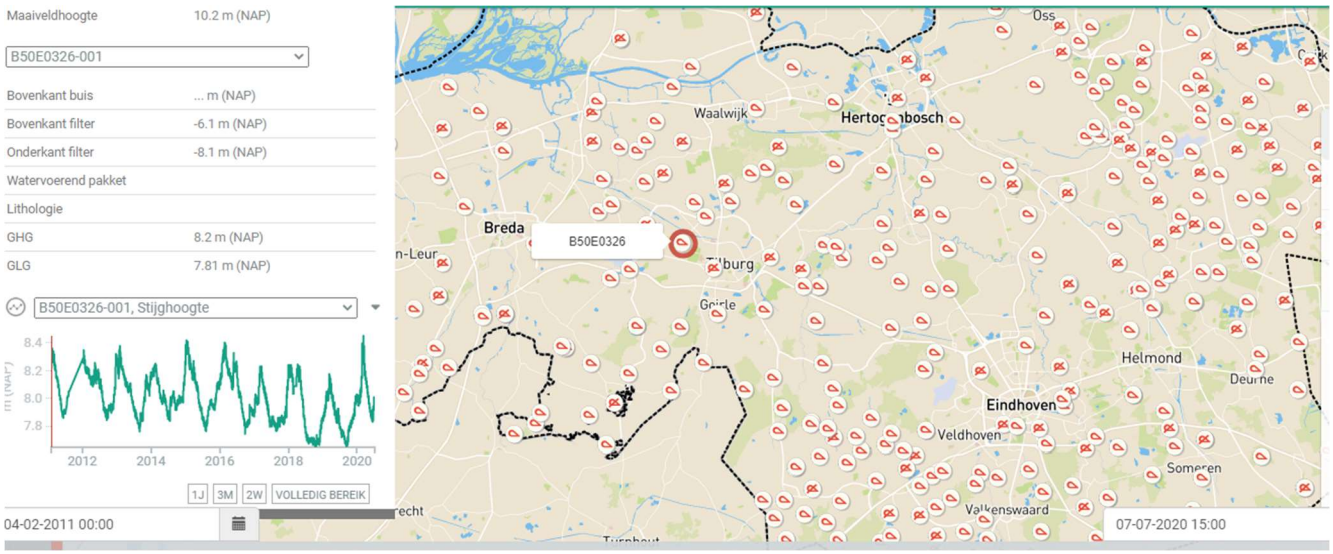

Figure 3.7 Example of the website groundwaterlevel.brabant.nl with monitoring well B50E0326 in Tilburg highlighted (source: https://grondwaterstand.brabant.nl, 07/07/2020)

Provincial groundwater quality monitoring network

The provincial groundwater quality monitoring network, together with the national groundwater quality monitoring network (operated by the Dutch National Institute for Public Health and the Environment, RIVM), contains about 120 observation wells spread throughout the province of Noord-Brabant. The provincial groundwater quality monitoring network provides an average picture of groundwater quality in the province, per area type. The area types are a combination of soil type, land use and geohydrology. The measurements are, depending on the monitoring strategy determined by the Water Framework Directive (WFD) and agreements within the Maas river basin, carried out periodically. The monitoring network is primarily intended to report on the state of the groundwater quality to the WFD but based on provincial objectives we also specifically monitor for emerging substances (such as pharmaceutical substances, PFAS).

The wells have several screens, of which the screens at 10 and 25 metres below ground level are sampled). From 2007 onwards, the provincial monitoring network has been further integrated with the WFD assignment; all observation wells are now used for the WFD. Furthermore, the age of the groundwater has been determined at most locations, which makes it easier to evaluate trends (see Figure 3.8).

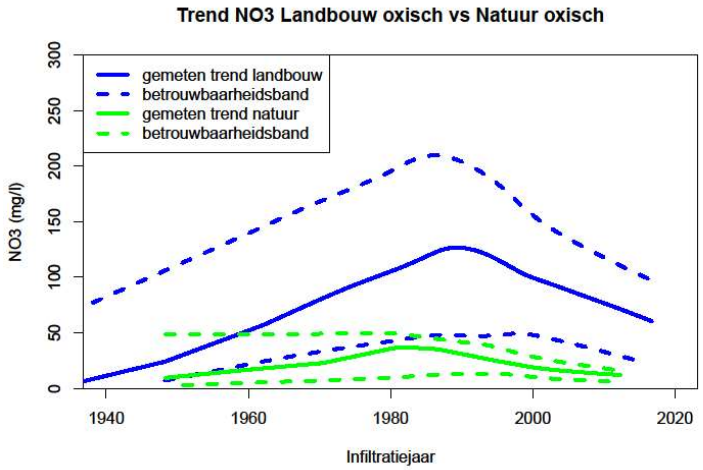

Figure 3.6 With knowledge of the age of groundwater (infiltration year), it is better possible to identify trends of substances (example nitrate) (Kivits et al., 2019)

Monitoring of groundwater quality (see Figure 3.9) is important to the province for the following reasons:

- Legal obligations: Monitoring obligation for the Water Framework Directive (WFD);
- Understanding the system and information transfer:
    - Obtaining a spatial picture of groundwater quality, at different depths, in order to identify any regional differences in quality;
    - Having sufficient data on the relationship between groundwater quality at different depths and soil type, land use and geohydrology;
    - Informing stakeholders about the situation of groundwater quality in the province;
- Policy Evaluation and Determination:
    - Timely identification of trend and/or undesirable changes in groundwater quality (e.g., new/emerging substances).
    - Determine the effects of provincial or national environmental policies on groundwater quality.
    - Assess whether additional measures should be taken.

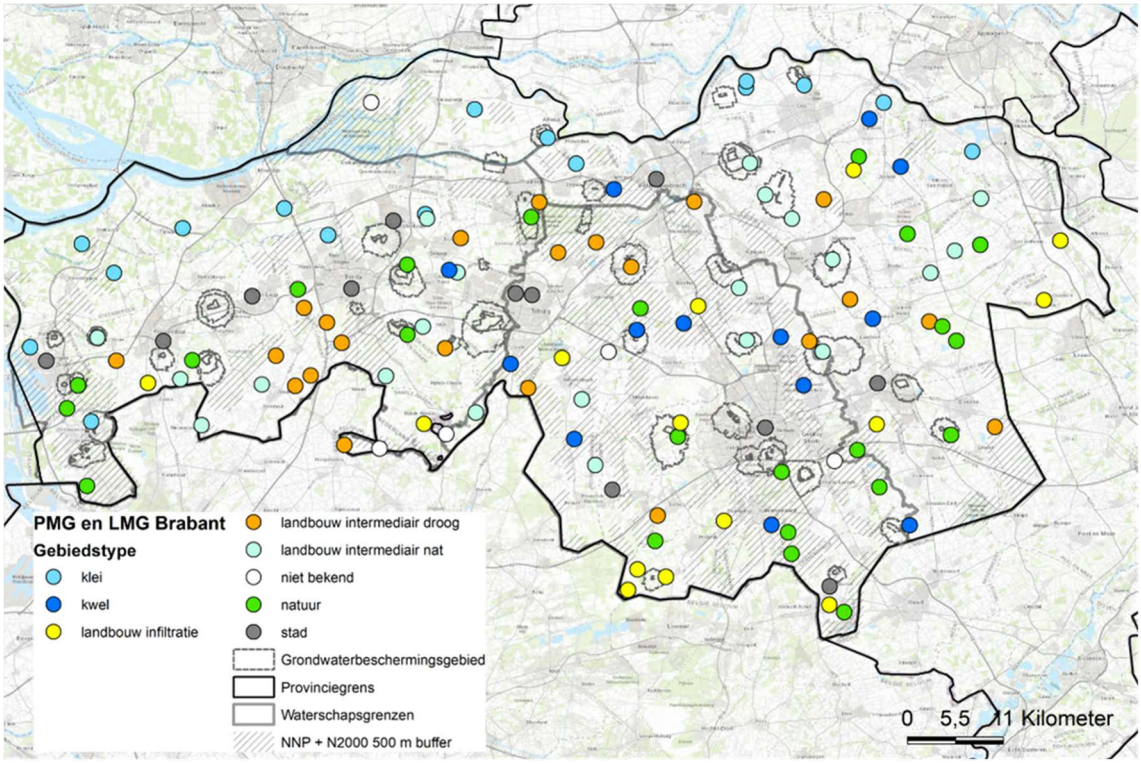

Figure 3.7 Overview of observation wells within the provincial groundwater quality monitoring network (PMG) and wells from the national groundwater quality monitoring network (LMG) (source: kaartbank.brabant.nl, 2021)

Policy Monitoring Network Drought

Since 2003, the Policy Monitoring Network Drought (Beleids Meetnet Verdroging, BMV) has been operational in Noord-Brabant (see Figures 3.10 and 3.11). In 33 nature reserves (including 15 Natura2000 areas) groundwater and surface water quality and quantity are measured at fixed locations. The aim of the monitoring network is to obtain a general impression of the groundwater situation in the nature reserves, which are highly dependent on (ground) water, the so-called Wet Nature Pearls (Natte Natuur Parels). A provincial government assignment was adopted early 2021 to halt the adverse effects of drought in Brabant by water robust spatial planning. Also, the WFD requires "Good preconditions for groundwater-dependent nature". Therefore, the monitoring network was set up based on an ecohydrological system analysis.

Currently, the Policy Monitoring Network Drought is being evaluated and updated. This is an joint task for the province, water boards, land management organizations and drinking water companies. The updated network integrates, as much as possible, other existing monitoring networks, so that monitoring can be carried out more efficiently. The agreements between the stakeholders are also being redrafted. By the end of 2021 it is hoped to have achieved a reliable and efficient monitoring network that is capable of determining the drought status of nature areas dependent on groundwater.

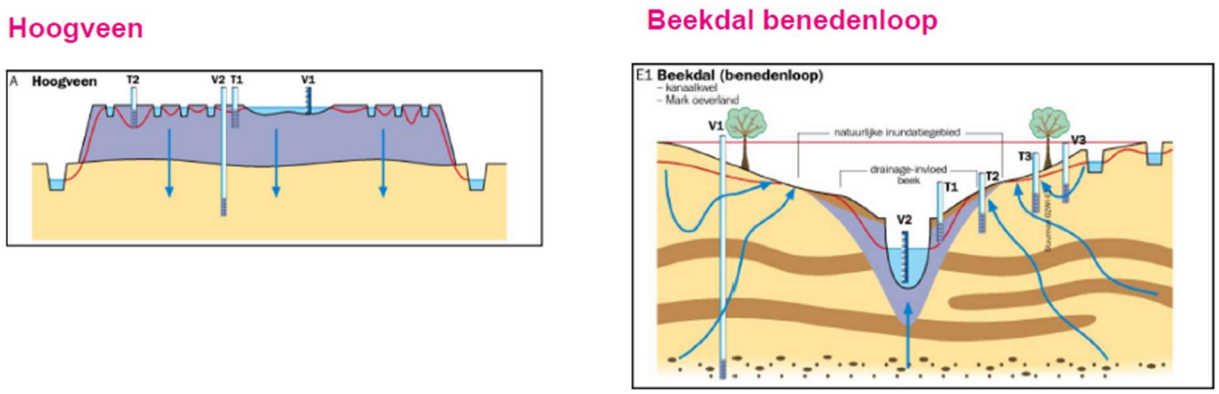

Figure 3.8 Example of the set-up of the Policy Monitoring Network Drought in two ecohydrological system types, peat bog (hoogveen) and downstream valley reach (beekdal benedenloop) (T= observation well for status evaluation , V= observation well for cause-effect analysis?) (source: Beleidsmeetnet verdroging Provincie Noord-Brabant, Stuurman et al. , juni 2002)

Figure 3.11 Overview of measurement locations from current Policy monitoring network drought (until 2022) (source: kaartbank.brabant.nl, 2021)

Monitoring campaign

The measuring frequency of the primary groundwater level monitoring network (quantity) is 1x per hour.

The measuring frequency of the groundwater quality monitoring network is about 4 times every 6 years.

In groundwater-dependent nature areas we have the Policy monitoring network drought (BMV) where both groundwater quantity and groundwater quality are measured, but the measurement frequency is currently very fragmented. From 2022 onwards, this will become more uniform (quantity probably 1x per hour, quality 2x per year every 3 years). At the moment, the measuring frequency within the BMV is quality 1x per 2 years, and quantity varies per manager (1x per hour to 1x per 14 days).

Websites:
Many subsoil data (subsoil models and groundwater data) are available on https://www.dinoloket.nl/en/.

The xy-locations of the 3 monitoring networks can also be viewed and consulted via (soil-water-atlas->groundwater-measuring networks): https://kaartbank.brabant.nl/viewer/app/Kaartbank

Current data of our primary groundwater monitoring network can be found on: https://grondwaterstand.brabant.nl/

Via https://www.brabantinzicht.nl/toestand-natuur-water-en-milieu/water / you can also find a lot of information on groundwater quality.

Groundwater quality data can be downloaded from https://www.waterkwaliteitsportaal.nl/wkp.webapplication

Visualisations of groundwater quality data in combination with subsurface models can be created at http://www.grondwaterkwaliteitinbeeld.nl/.

Groundwater quantity tools are available at http://www.grondwaterstandeninbeeld.nl.

3.6.2 Province of Limburg

Provincial Primary Monitoring Network
The province of Limburg uses the Provincial Primary Monitoring Network (*Figure 3.9*2) to measure head and water levels. Spread across the province, this network consists of some 300 locations with approximately 600 screens. When setting up the monitoring network, the aim was to have a more or less equal coverage of the province. Screen depths differ greatly. It can be 1 screen at a depth of 5 metres up to 7 screens spread over a depth of 600 metres. The monitoring network was designed in the 1990's to get a regional picture of the groundwater levels.

In the screens, automatic pressure transducers are installed, and the monitoring results are sent daily to a server so that up-to-date measurements are always available (although not yet validated).

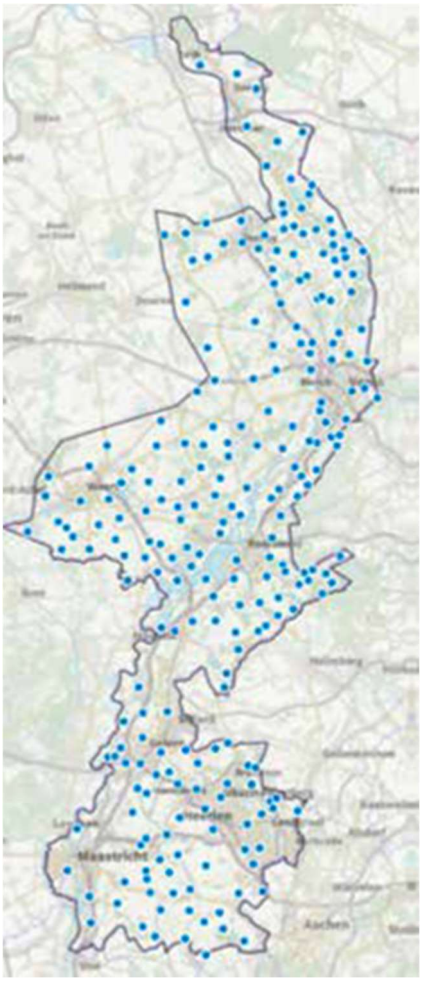

Figure 3.9 Observation wells of the Provincial Primary Measuring Network (Dutch province of Limburg, 2021)

Quality measurement network

The province has a separate monitoring network for quality measurements (*Figure 3.*3). In the monitoring wells of this network, measurements are taken at about 10 and 25 metres below ground level and in several springs (26 natural springs spread over 5 plateaus in Zuid-Limburg). The regular package of macro parameters is measured in the wells 1 time a year and since 2020 1 time in three years. The springs are measured 4 times a year.
In addition, there are also other organizations that measure the quality of groundwater in the province, such as the RIVM (national monitoring network), the WLM (water supply company).

Figure 3.13 The black dots indicate the locations of the screens for measuring the groundwater quality, the light blue dots are springs (Dutch province of Limburg, 2021)

Monitoring network for hydrologically sensitive nature

A monitoring network has also been set up in the hydrologically sensitive nature areas (*Figure 3.*4). In the areas both the quality and quantity are measured at a depth of approximately 1,5 metres. The measuring network has about 240 groundwater measuring wells and about 35 surface water measuring wells.

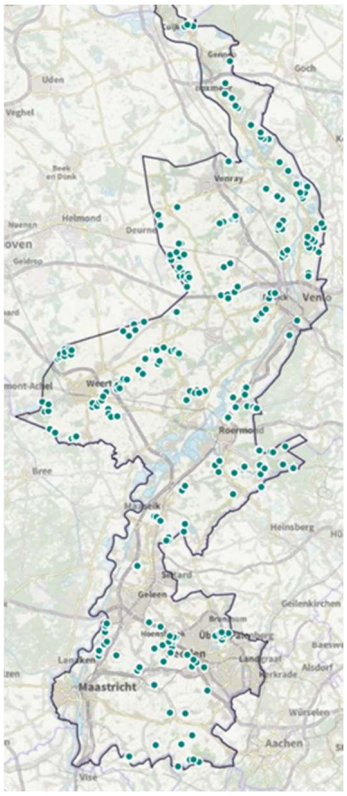

Figure 3.14 Location of measuring wells (groundwater and surface water) of the hydrologically sensitive nature monitoring network (Dutch province of Limburg, 2021)

The objectives of the monitoring in the province of Limburg are in principle the same as those of the province of Noord-Brabant. There are minor differences in nuance.

Websites:

Het Ontwerp Provinciaal Waterprogramma 2022-2027:
https://www.limburg.nl/onderwerpen/water/provinciaal/

Many subsoil data (subsoil models and groundwater data) are available on https://www.dinoloket.nl/en/.

Groundwater quality data can be downloaded from https://www.waterkwaliteitsportaal.nl/wkp.webapplication

Visualisations of groundwater quality data in combination with subsurface models can be created at http://www.grondwaterkwaliteitinbeeld.nl/.

Groundwater quantity tools are available at http://www.grondwaterstandeninbeeld.nl.

3.6.3 Flanders

The VMM uses groundwater monitoring data among others to establish background levels and threshold values in Flanders, for the quantitative and chemical status and

trend assessment of groundwater bodies and to draw up and evaluate a programme of measures to improve the status of groundwater.

For the status and trend monitoring the VMM uses two monitoring networks: the primary groundwater monitoring network and the phreatic groundwater monitoring network.
The primary groundwater monitoring network consists of single and multilevel monitoring wells. The screens are evenly distributed over the various aquifers. The wells are placed outside anthropogenic influences if possible.
The configuration of the (mostly) multilevel wells of the phreatic groundwater monitoring network is based on the behaviour of nitrates. Where the top screen is located directly below the water table and the second and third screen are located just above and just below the oxidation-reduction zone, respectively. The wells are mostly situated in agricultural areas and in nature reserves.
The location of the monitoring wells in the Flemish H3O-Plus area is shown in *Figure 3.10*5.

The monitoring networks of the VMM are multifunctional and complementary. In the wells of the primary groundwater monitoring network, groundwater levels are measured manually on a monthly basis, groundwater quality measurements are carried out twice a year. In the wells of the phreatic groundwater monitoring network, groundwater quality and level measurements are carried out twice a year.

Additional monitoring can be performed in existing groundwater monitoring networks of other organisations, especially for areas with special objectives, such as drinking water abstraction areas and groundwater-dependent terrestrial ecosystems and for the follow up of bigger groundwater abstractions and projects to monitor the impact on the groundwater. Point source pollution is monitored within the framework of the implementation of the Soil Decontamination Decree. The groundwater monitoring networks can be found on https://dov.vlaanderen.be/.

For more information on the 'Groundwater monitoring programme', please refer to the background document 'Groundwater methodologies' (see website link below).

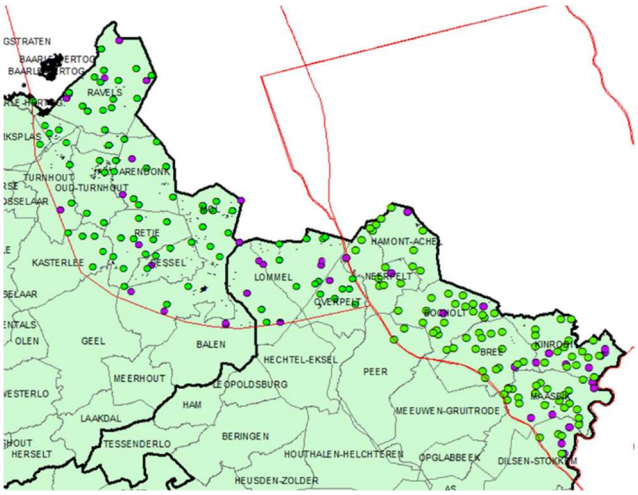

Figure 3.10 Primary groundwater monitoring wells (purple dots) and the phreatic groundwater monitoring wells (green dots) of the VMM in the Belgian part of the H3O-PLUS area (source: VMM, 2021)

Drought monitoring network

The “GroundWater head Indicator (GWI) monitoring network” (for monitoring of drought events) is part of the primary groundwater monitoring network (supplemented with some measuring points of the drinking water companies and SCK CEN). The GWI monitoring points are screens used for the preparation of the groundwater level indicator and for trendanalysis of measured and predicted phreatic groundwater levels. These groundwater levels provide the most reliable picture of recent climate variations, which are tested against a relatively long history of field measurements.

Monitoring and measuring networks of protected areas

See background documents "Assessment of the status of groundwater-dependent terrestrial ecosystems (GWATEs): 2019 update" and "Source protection drinking water"

Websites:

https://www.integraalwaterbeleid.be/nl/stroomgebiedbeheerplannen/stroomgebiedbeheerplannen

Welkom bij Databank Ondergrond Vlaanderen | DOV

4 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1 Summary and conclusions

The subsurface of the Roer Valley Graben is important for groundwater abstraction and also has a high potential for subsurface and geothermal energy use. The subsurface is heavily used, and an improved status of the groundwater system is desired. The borders of the four administrative regions of the Roer Valley Graben are very close to each other, so there is mutual influence.

The transboundary geometric models of the subsurface (H3O-projects), the harmonized hydraulic properties (Vernes et al., 2021), groundwater quality data (van Vliet et al., 2021), groundwater head data (Zaadnoordijk et al., 2021), water balances (Buma and Reindersma, 2021), and the juxtaposition of policy and management strategies in this report, form steps towards a more common groundwater policy and management of the Roer Valley Graben. These H3O-PLUS reports help understanding each other on different sides of border and exchanging information mutually. The harmonised data are valuable by itself and the project also has a supporting function for further joint research and development of groundwater policy and management.

In de Roer Valley Graben, declining trends on groundwater heads at all sides of the borders are observed and the region is sensitive to water scarcity and drought and also for pollution (mainly from the surface).

The groundwater policy makers and managers of the various administrative regions of the Roer Valley Graben face similar challenges towards quantitative status. And although there are many similarities, they place different accents in their policy and management. These different emphases are easier to understand when one considers the differences in water availability in the two countries/regions on which the generic policies and management strategies of the countries/regions have traditionally been based.

Both in the Netherlands and in Flanders, a multi-track policy and an integrated policy are pursued to manage the groundwater and the subsurface in a sustainable way.
Flanders used to focus mainly on reducing the demand and the consumption of (ground)water with a lot of detail and with a great eye for socio-economic preconditions and nuance. Almost every groundwater permit is known, a far-reaching generic policy of 'use less water, use other water sources, reuse water' is applied, for each application the most sustainable way to meet the water demand is considered on an application- and area-specific basis. This creates a lot of rules. Sensitisation, coordination and mitigation measures ensure support from large users to households. The far-reaching approach is there to achieve as much environmental gain as possible at every level and in every sector.
The focus in the Netherlands was on retaining water longer and less on reducing the demand and consumption of groundwater. The Dutch province of Limburg is radical and unambiguous with regard to the zoning of the subsurface, which protects drinking water supply in particular. Both Dutch provinces are much more lenient than Flanders for the

(by Dutch standards) smaller users. In this way, the Dutch provinces have a clear policy and management, and they focus on the areas where the greatest environmental benefits can be achieved with minimal efforts, but they have less grip on the smaller users. The lack of knowledge on smaller groundwater abstraction prevents a good evaluation of (the cumulative impact of) these smaller abstractions.
Alternative water sources are important in all regions. In Flanders, more emphasis is put on the use of rainwater and the reuse of process water, in the Netherland more on the reuse of process water and treated effluent.
Policy and management of groundwater and the subsurface is more fragmented in the Netherlands than in Flanders. The organizational structure of the Netherlands can make it easier to work area-specifically. For, for example, increasing the groundwater recharge and addressing drought, this structure is an advantage.
Furthermore, the Netherlands have developed more tools to perform scenario and impact calculations on the water system at different scales (such as the groundwater models IBRAHYM and the Brabant model as well as the national hydrological model of the National Hydrological Instrument (http://nhi.nu/nl/index.php/en/). The cumulative impact of groundwater abstractions on receptors (nature, surface water, etc.) and thus compliance with other policies are still working points for Flanders.
After the recent dry years 2018-2020, both countries are embracing a more multi-track and area-based approach and policies seem to become more similar. The approaches are still under development. The Dutch Landelijke Commissie Waterverdeling and the Flemish CIW coordinate the approach of water scarcity and drought in their respective countries.
Since the onset of the energy transition, integrated water policy must be increasingly incorporated into the spatial planning of the subsurface and the topsoil. This domain is still under development. The province of Noord-Brabant has already taken more steps towards the potential valorisation of the deep subsurface.

Demand for cross-border exchange of monitoring data is growing. By comparing the methodologies used by the different administrative regions for groundwater monitoring, a better understanding of the applicability of the monitoring results is obtained.

4.2 Recommendations for groundwater policy and management and subsurface spatial planning

After presenting and discussing the draft results of this study we formulated together with the stakeholders some recommendations for the future (see Appendix 3 for the full syntheses of the stakeholder workshop H3O-PLUS on 22 April 2021)

With the potential of and the pressure and impact on the groundwater and the subsurface of the Roer Valley Graben in mind, it seems important to work more together across the borders, in order to protect this groundwater and the subsurface for the future generations.

The geometric model of the subsurface and the harmonized subsurface date and methodologies and the comparison of the policy and management in the different administrative regions of the Roer Valley Graben form the first steps towards a more common groundwater policy and management of the Roer Valley Graben.

There is a demand for a (more) common monitoring strategy and a joint generally accepted groundwater flow model which will lead to a generally accepted assessment of the current status and the problem areas. Then generally accepted common objectives for the different aquifers can be formulated with options for improvement of the status. This will lead to a more aligned policy and management and more sustainable groundwater resources in the Roer Valley graben.

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6 APPENDIX 1. EXAMPLE DROUGHT MONITOR FROM 2020, PROVINCE OF NOORD-BRABANT

(source: https://waterberichtgeving.rws.nl/owb/droogtemonitor, 08/06/2020)

Droogtemonitor

8 juli 2020 / nummer 2020-8

Rivierafvoer Rijn en Maas voldoende, neerslagtekort stabiliseert

De aanzienlijke hoeveelheid neerslag van de afgelopen weken heeft voor verlichting gezorgd in grote delen van het land. Het neerslagtekort is de afgelopen twee weken niet verder toegenomen, maar nog steeds groot. De grondwaterstanden blijven regionaal, met name in Oost- en Zuid-Nederland, laag.

Zowel de Rijn als de Maas voeren de komende weken naar verwachting voldoende water aan om aan de watervraag te voldoen in de gebieden waar aanvoer van rivierwater mogelijk is. De afvoer van beide rivieren blijft daarmee boven het LCW-criterium.

De neerslag van de afgelopen periode heeft verlichting gebracht voor landbouw en natuur. Er zijn echter nog wel regionale verschillen.

Er is voldoende grond- en oppervlaktewater voor de bereiding van drinkwater. De oproep van de sector aan gebruikers blijft om bewust om te gaan met drinkwater.

Er is op dit moment geen sprake meer van een dreigend landelijk watertekort. Daarom gaat de LCW over van niveau 1 (dreigend watertekort) naar niveau 0 (normaal waterbeheer). De genomen maatregelen blijven waar nodig van kracht, zoals het opzetten van waterpeilen, het vasthouden van water, het regionaal instellen van beregeningsverboden en het inspecteren van droogtegevoelige kades.

De waterschappen en Rijkswaterstaat blijven de situatie nauwlettend monitoren, nemen waar nodig aanvullende maatregelen en stemmen onderling af.

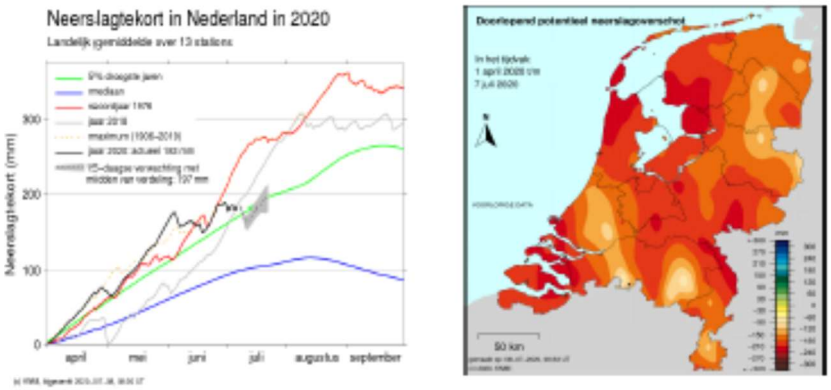
Weer

Op woensdag 8 juli tot en met vrijdag 10 juli trekt een langgerekt neerslaggebied over het noorden van de stroomgebieden van Rijn en Maas, waaronder Nederland. De verwachte neerslagsom is 30-40 mm. Komend weekend wordt het vrijwel overal droog, enkel op zaterdag kunnen in het zuiden van het Rijnstroomgebied, tegen de Alpen, enkele onweersbuien tot ontwikkeling komen. Vanaf zondag neemt de invloed van hogedrukgebieden toe en wordt het vrijwel overal droog. Op dinsdag (14 juli) trekt naar verwachting nog een storing van west naar oost over delen van het stroomgebied met wat neerslag.

Aanvankelijk liggen de temperaturen in het noorden van de stroomgebieden van de Rijn en de Maas onder de normale waarden. Vanaf komend weekeinde stijgen de temperaturen richting normaal.

Het actuele landelijk gemiddelde neerslagtekort bedraagt circa 183 mm. Door de neerslag van de afgelopen periode is het neerslagtekort gestabiliseerd, maar zal na het weekend weer licht toenemen.

Pagina 1 van 4



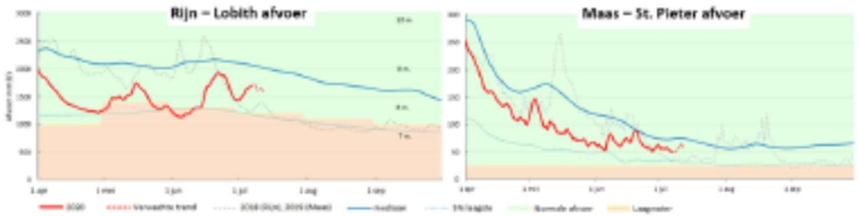
Figuur 1: Landelijk gemiddeld neerslagtekort en Potentieel neerslagoverschot, 7 juli. Bron: KNMI

Afvoer Rijn en Maas

Momenteel is de afvoer van de Rijn bij Lobith rond de 1700 m³/s. De komende twee weken zal de afvoer langzaam dalen tot 1400 – 1600 m³/s. Voor de Rijn is de kans klein dat de afvoer bij Lobith onder het LCW criterium van juli (1200 m³/s) komt.

De 3-daagse gemiddelde afvoer van de Maas te St. Pieter ligt rond de 60 m³/s, een niveau dat eigenlijk al vanaf eind mei relatief stabiel is. De verwachting is dat met de voorspelde neerslag deze gemiddelde afvoer komende twee weken redelijk stabiel zal blijven. Wel zijn als gevolg van lokale regenbuien kortstondig hogere afvoeren mogelijk. Voor de Maas is de kans klein dat de afvoer bij St. Pieter onder het LCW-criterium komt (3-daagse gemiddelde van 25 m³/s).

De afvoeren van Rijn en Maas zijn op dit moment voldoende aan om aan de watervraag te voldoen.



Figuur 2: Daggemiddelde afvoeren van de Rijn bij Lobith en de Maas bij Sint Pieter

Grondwater

In juni en begin juli zijn aanzienlijke hoeveelheden neerslag gevallen. Dit is ook terug te zien in een (voorzichtig) herstel van de grondwaterstanden. Op dit moment verschilt de grondwatersituatie regionaal sterk. De standen variëren van zeer laag tot bovengemiddeld voor de tijd van het jaar.

Verzilting en waterkwaliteit

De chlorideconcentraties (zout) zijn normaal voor van de tijd van het jaar. Enkele waterschappen melden lichte verziltingsproblemen, voornamelijk in de diepe polders als gevolg van zout kwelwater. Op verschillende locaties in het land is sprake van blauwalgen, botulisme en vissterfte, soms met een negatief zwemadvies tot gevolg. Dat is niet ongebruikelijk in deze tijd van het jaar.

Landbouw en Natuur
Afgelopen weken heeft het wisselvallige weer gezorgd voor voldoende vocht voor groei van gewassen op akkers en in de natuur. Er zijn echter nog steeds forse regionale verschillen. Bij veel waterschappen zijn de peilen opgezet boven het zomerpeil om aan de watervraag van de landbouw (groeiseizoen) en natuur te kunnen voldoen.

Scheepvaart
Op dit moment zijn er geen belemmeringen voor de scheepvaart. Rijkswaterstaat publiceert minst gepeilde diepten zodat de scheepvaart kan anticiperen op de hoeveelheid lading die meegenomen kan worden.

Drinkwater
Er is voldoende grond- en oppervlaktewater voor de bereiding van drinkwater. Afgelopen periode is als gevolg van de neerslag en lagere temperaturen de drinkwatervraag genormaliseerd. De verwachting voor de komende twee weken is een normale wateraftzet, passend bij gematigd zomerweer.

Regionale bijzonderheden en maatregelen
De neerslag van de afgelopen weken heeft regionaal voor verlichting gezorgd. In een aantal gebieden is de grondwaterstand redelijk hersteld maar nog niet overal (hoge zandgronden). Er is op sommige plaatsen beperkte mate van droogval van watergangen. De regionale wateren zijn zoveel mogelijk opgezet. Het peil van het IJsselmeer en Markermeer wordt gestuurd op NAP -0.15 m. Ook wordt er op een aantal locaties (bijvoorbeeld sluis Terneuzen) waterbesparend geschut om zoveel mogelijk water vast te houden. In het westen van Nederland voeren de meeste waterschappen nog inspecties uit op droogtegevoelige kades.

De volgende droogtemonitor verschijnt 21 juli 2020.

Figuur 3: Overzicht afvoeren, peilen, watertemperatuur en zoutgehalten, daggemiddelde 7 juli 2020 I Bron: WMCN

Colofon

Dit bericht is opgesteld door de Landelijke Coördinatiecommissie Waterverdeling (LCW), onderdeel van het Watermanagementcentrum Nederland. Dit is een samenwerkingsverband van Rijkswaterstaat, de waterschappen en het KNMI.

Contact: wmcn-lcw@rws.nl, 0800-8002.

Voor persvragen: 06-15182130.

Specifiek tav grondwater (droogte monitor nr 8, 8 juli 2020)

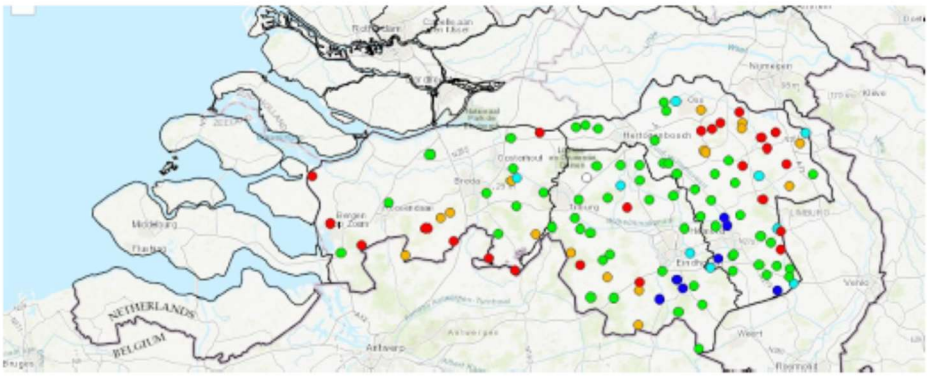
Grondwater

Het groeiseizoen van 2019 (april-september) was voor sommige delen van Nederland, met name in Brabant, Limburg, de Achterhoek en Twente, een erg droge periode, daardoor waren de grondwaterstanden in die gebieden vorig jaar laag tot zeer laag. De winter van 2019-2020 was voor heel Nederland daarentegen vrij nat, met landelijk gemiddeld 245 mm neerslag, ten opzichte van 195 mm langjarig gemiddeld. Met name februari 2020 was een natte maand, met landelijk gemiddeld 136 mm neerslag, terwijl dit gemiddeld 55 millimeter is.

Vanaf halverwege maart tot eind april is er nauwelijks meer neerslag gevallen. Vanaf eind april heeft het af en toe wat geregend, maar dit waren geen grote hoeveelheden neerslag. Door het gebrek aan neerslag zijn de grondwaterstanden sinds maart flink gedaald.

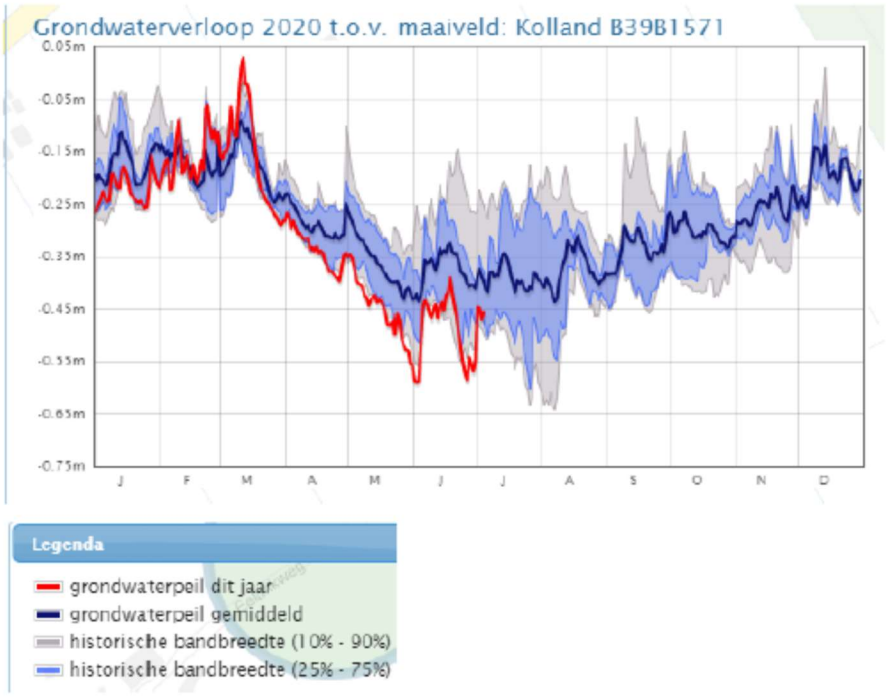
In juni is er met name in grote delen van Noord-Brabant en in delen van Zuid-Holland, Drenthe, Limburg en het oosten van Overijssel een flinke hoeveelheid neerslag gevallen. Daardoor is in die regio's het neerslagtekort relatief laag, zie hiervoor ook figuur 2b.

Dit is terug te zien in het grondwater in deze gebieden, bijvoorbeeld in Noord-Brabant waar de grondwaterstanden in grote delen van de provincie gemiddeld tot hoog zijn (zie figuur 11).



Figuur 11: De huidige toestand van het grondwater in Noord-Brabant in historisch perspectief, op basis van actuele metingen van de grondwaterstand dd. 7 Juli 2020 (bron: https://embed.hydronet.com/embed.aspx?id=6045&h=4610815681).

In andere delen van Nederland, gebieden waar de hoeveelheid neerslag in juni beperkt was, zijn de grondwaterstanden een stuk lager; laag tot zeer laag voor de tijd van het jaar. Dit is zichtbaar in de volgende figuren.



Figuur 12: Tijdreeks van een grondwatermeetpunt het oosten van Utrecht nabij Leersum voor de periode 1 januari 2020 – 4 juli 2020 (bron: www.grondwaterstand.nl)

7 APPENDIX 2. UITLEG VERDRINGINGSREEKS / PRIORITISATION SCHEME

De verdringingsreeks bestaat uit vier categorieën. De rangorde van belangen binnen de categorieën 1 en 2 is op nationaal niveau vastgelegd. Binnen de categorieën 3 en 4 is op nationaal niveau geen rangorde vastgelegd. Binnen (maar niet tussen!) die categorieën kan bij provinciale verordening een verdere rangschikking plaatsvinden.

1. Waterveiligheid in het voorkomen van onomkeerbare schade
Het belang van veiligheid en het voorkomen van onomkeerbare schade is als hoogste categorie opgenomen in de verdringingsreeks. De verdringingsreeks wijkt daarmee af van de mededeling van de Europese Commissie over waterschaarste en droogte, want daarin wordt de drinkwatervoorziening als hoogste te beschermen belang aangemerkt. In Nederland kan vooral in gebieden met veel veen in de ondergrond ook de veiligheid in het geding zijn door droogte. Denk aan het bezwijken van de veenkade bij Wilnis in 2003. Ook kan er onomkeerbare schade optreden door veenoxidatie en klink. Dit rechtvaardigt de afwijking van het Europese beleid.
Onomkeerbare natuurschade kent twee dimensies:
schade aan de habitat (abiotische schade) en
schade aan planten en dieren (biotische schade).

2. Nutsvoorzieningen
Het belang dat is gemoeid met een ongestoorde energievoorziening is de afgelopen jaren steeds groter geworden. De categorie "nutsvoorzieningen" in de verdringingsreeks bevat daarom naast de drinkwatervoorziening ook de energievoorziening. Waar de leveringszekerheid niet in gevaar is, wordt de drinkwatervoorziening en energievoorziening meegewogen binnen categorie 4 van de reeks. Onder energievoorziening worden zowel grote als kleine energiecentrales verstaan (centraal vermogen). Maar ook industriële voorzieningen (via warmtekoppeling, het nuttig toepassen van restwarmte die ontstaat bij energieopwekking) en andere leveranciers (decentraal vermogen).

3. Kleinschalig hoogwaardig gebruik
Het belang van de beregening van kapitaalintensieve gewassen is een uitzondering op de positie die de landbouw en de overige economische behoeften in algemene zin innemen in categorie 4. Het gaat om gewassen waarbij een totale mislukking van de oogst dreigt door watertekorten, terwijl met een relatief kleine hoeveelheid water grote schade kan worden voorkomen.

4. Overige behoeften
De belangen van drinkwatervoorziening, energievoorziening en landbouw vallen in categorie 4 voor zover ze niet onder categorie 2 en 3 vallen. Onder overige belangen valt onder meer de waterkwaliteit in stedelijk gebied.

8 APPENDIX 3. SUMMARY/SYNTHESIS OF THE INPUT OF THE AFTERNOON SESSION SECOND STAKEHOLDER MEETING

On 22 April 2021, we organised the 2nd stakeholder workshop. We discussed the draft reports of task 3.2 to 3.5 and presented the state of affairs of task 3.6. In the afternoon, we held a workshop to collect policy and management recommendations from the stakeholders on the basis of some predetermined questions. The recommendations are listed below.

Summary/synthesis of the input of the afternoon session 2de STAKEHOLDER MEETING

Overall

The subsurface of the Roer Valley Graben is important for groundwater abstraction and it has a high potential for geothermal energy use. The subsurface is heavily used and the status in which the groundwater is in can be better. The borders of the four administrative regions of the Roer Valley are very close to each other. We all agree that we should work together more, in order to protect the groundwater and the subsurface for the future generations.

The harmonized subsurface date and a geometric model of the subsurface form the first steps towards a more common groundwater policy and management of the Roer Valley Graben.

There is a demand for a (more) common monitoring strategy and a generally accepted groundwater flow model which will lead to a generally accepted picture of the current status and the problem areas. Then generally accepted common objectives for the different aquifers can be formulated. This will lead to a more aligned policy and management.

Dream about a common monitoring/strategy for groundwater policy and -management: how would the Roerdalslenk look like/how would it be organized?

We dream are about:

A permanent exchange of (harmonized) subsurface data

A common monitoring strategy,

A generally accepted groundwater flow model

What do we need for a sustainable future (tools, cooperation, common vision, objectives, …)?

<u>Collaborate</u>

We need to get clear what the importance of the groundwater supply in the Roer Valley Graben is.

We need to think integrally together, across borders and policy domains, all water-dependent sectors (including nature).

Tools and data

Keeping existing H3O-projects up to date.
Keeping the existing harmonized subsurface data up to date.
Setting up a database/website/online platform for the exchange of harmonized up-to-date subsurface data in the study area.
A generally accepted groundwater flow model.

- Thinking about a groundwater flow model that covers a much larger area (from Cologne to Antwerp, including the Bruland Chalk System)

A common monitoring strategy, for both:

- Vision formation
- Operational management

Pressure and impact

What is the current and future water demand?

- Who uses which groundwater?
  - What priorities are there in the use of certain groundwater ? (confined/phreatic, general/in times of drought)
  - What zoning of the subsurface is there?
- How much groundwater is used for which application?
  - What are the current and future efforts to reduce water demand?
- When do the users use groundwater?

What is the current and future impact of the groundwater abstractions etc?

- What problems are there
- Where are the problem areas?
- Where do we want to go (in the future)?

Towards a common vision

A common vision, supported by the sectors (the users of groundwater), groundwater managers and policymakers.
Achieve better zoning of the subsurface, but keeping multifunctionality in mind.
A common vision must fit in with the vision, methods, water availability, … of the different countries.
Translation to other policy areas (agriculture, nature, spatial planning, other applications of the subsurface)

Communication and sensitization

An open communication
Accept that other countries are different, not better or worse.

How can we use the harmonized data to improve models/calculations/… and thus improve the technical results (apart from politics)

If the (input) data is harmonized the (model) results will be better.

The harmonized data is a good starting point to go further. We know better what is good, what we are missing and where the difficulties are.

- Groundwater age data needs effort
- It is important to have more grip in the abstraction amounts by other than industry and drinking water companies

The harmonized data is important to increase the understanding of (whole) water system.
Groundwater flow models:

- There are individual local models; it is not easy to link this across the provinces, it will be even more difficult across national borders.
- The existing geometric models of the subsurface and the harmonized data are only a first step. The ultimate goal would be a calculation model based on these cross-border conceptual models. This can even be done outside the original H3O areas, and is ideally a model accepted by all parties, with up-to-date harmonized information.

There must also be a clear intention to keep the information harmonized. A follw-up may be necessary.

How can we use the harmonized data to manage the different groundwater demands (groundwater abstraction, geothermal energy, …). Licensing, checking (illegal abstractions), evaluation of status and trend and if necessary adjusting measures/policy/…
The greatest benefit of the harmonized data can be obtained by putting them into a generally accepted public groundwater flow model and a generally accepted vision for the area.
Harmonized data can be used for answering (sub)regional questions but also for local questions and risk management.
Not only groundwater quantity, but also quality is relevant.
We could extend the harmonization of the subsurface data to deeper layers below the Cenozoic (we have already the geometry available).
Data gaps in border areas could be filled in with data from across the border.

What do we expect from the future for the water balance (climate change, climate adaptation and water scarcity and drought, …)
Water balances have to be used in a proper way, to arrive at right conclusions. All demands need to be considered per area and period of time.

Climate change:

- Wetter winters, more drought in the summer
- In recent years, declines of both deep and shallow groundwater heads in droughts
- Less infiltration of rainwater and storage (especially in the higher areas)

The demand for water is increasing.

- We need agreements for certain periods and places who and how many groundwater can be extracted
- Water from the Meuse is an alternative, but future discharge of Meuse is uncertain (rainwater river, low discharge in summer and lower quality)
- We need more buffers for water storage between the wet and dry seasons

Reviewing past policy choices

- Irrigation
- Water retention will become increasingly important
- More suboptimal agriculture