RIWA

RIWA-Meuse

Annual Report 2023
The Meuse

Go all out to improve water quality

RIWA - Vereniging van Rivierwaterbedrijven

Contents

Introduction

The Meuse, a top destination of which we should take better care

The Meuse was referred to as a top destination in a recent article by ANWB. 'A number of delightful spots in city and nature' were discussed. I also like to visit these beautiful places along the river. On the other hand, as a tourist – or as a resident – you do not see any of the underlying problems. That is, all the harmful substances that end up in the Meuse and the fact that water quality is deteriorating as a result of climate change.

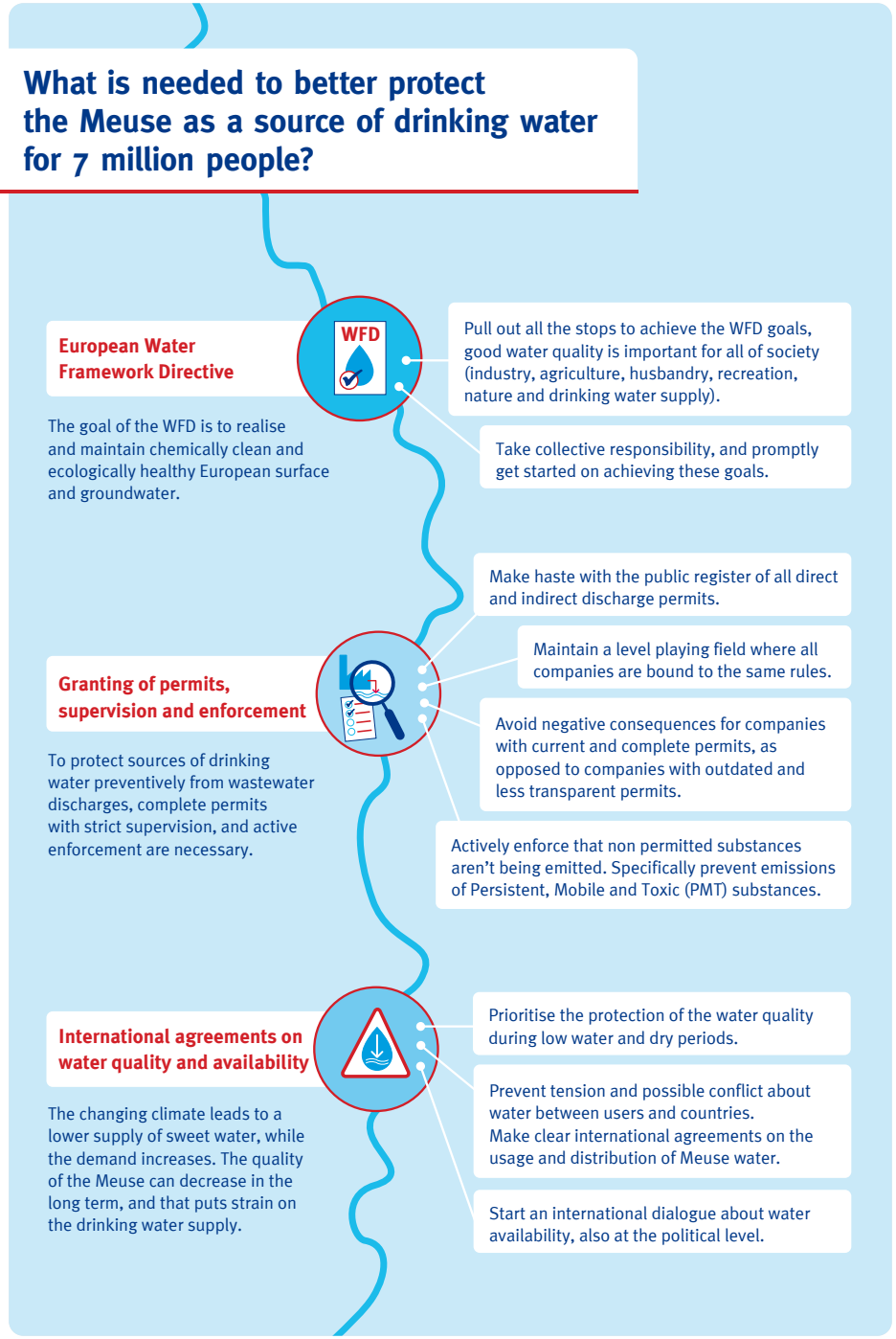
Our members, drinking water companies in the Netherlands and Belgium, extract around 450 billion litres of water from the Meuse every year for 7 million households and companies in the south-west of the Netherlands and parts of Limburg, Flanders and Brussels. As an association of these six drinking water companies, we call attention to this problem and are working to make this source of drinking water cleaner.

"Persistent, mobile and toxic substances are a problem for the production of drinking water."

Climate change and permits

Two themes came to our attention in 2023 and these themes are also reflected in this annual report. Firstly, the influence of the changing climate on the availability of sufficient good-quality water from the Meuse as a source of drinking water supply. Secondly, the fact that there is still no up-to-date and public overview of waste-water discharge permits. Both issues underline the need for better agreements on the use and distribution of water, particularly internationally. This is because the Meuse and its tributaries flow through the Netherlands, Belgium, France, Germany and a small part of Luxembourg.

What is needed to better protect the Meuse as a source of drinking water for 7 million people?



Extreme weather is going to become the norm: read the 2023 climate scenarios of the KNMI (Royal Netherlands Meteorological Institute). For the Netherlands and Belgium, this means more frequent and longer dry periods and heatwaves in the summer and more rain in the winter. Both countries broke several weather records last year. “What does the changing climate mean for the flow rate of water in the Meuse?” was the question that Deltares then asked. This study showed that, in all scenarios, the amount of water is unfortunately decreasing.

Higher concentrations

More and more harmful man-made substances are finding their way into our water. Take, for example, pesticides, industrial discharges, drug residues and PFAS. In particular, substances that are persistent, mobile and toxic (PMT) are a problem for drinking water companies. These substances are toxic, accumulate in the environment and are difficult to clean up with existing technologies or the clean-up costs a lot of energy, raw materials and money. Not very sustainable.

Less water in the river means less dilution of the harmful and persistent substances. The concentrations of chemicals increase, as does the salt content, and the amount of algae also increases due to an increase in water temperature. In short, you have less water, and the quality of that water deteriorates. As a result, the river is particularly susceptible to an incident.

Up-to-date permits

In order to detect and stop contaminants, a complete, up-to-date and public overview of the permits of industrial waste-water discharges, which RIWA-Meuse has been advocating for years, is needed. This overview should include not only the permits for direct discharges into surface water, in this case the Meuse and its tributaries, but also the indirect discharges, which ultimately enter the river via the sewage system and the waste-water treatment plants.

According to the ruling of the administrative court, all substances discharged by a company may be included in a permit; that which is not licensed must not be discharged. However, many permits only list general substance groups and are therefore not complete. One Dutch company has a permit that now provides openness in an extensive, and in our view exemplary, permit, as can be read later in this report. Because the impression may emerge that this company discharges more harmful substances than others, it is important to get all the permits in order as quickly as possible. That creates a level playing field in terms of rules: all rules are the same for all companies.

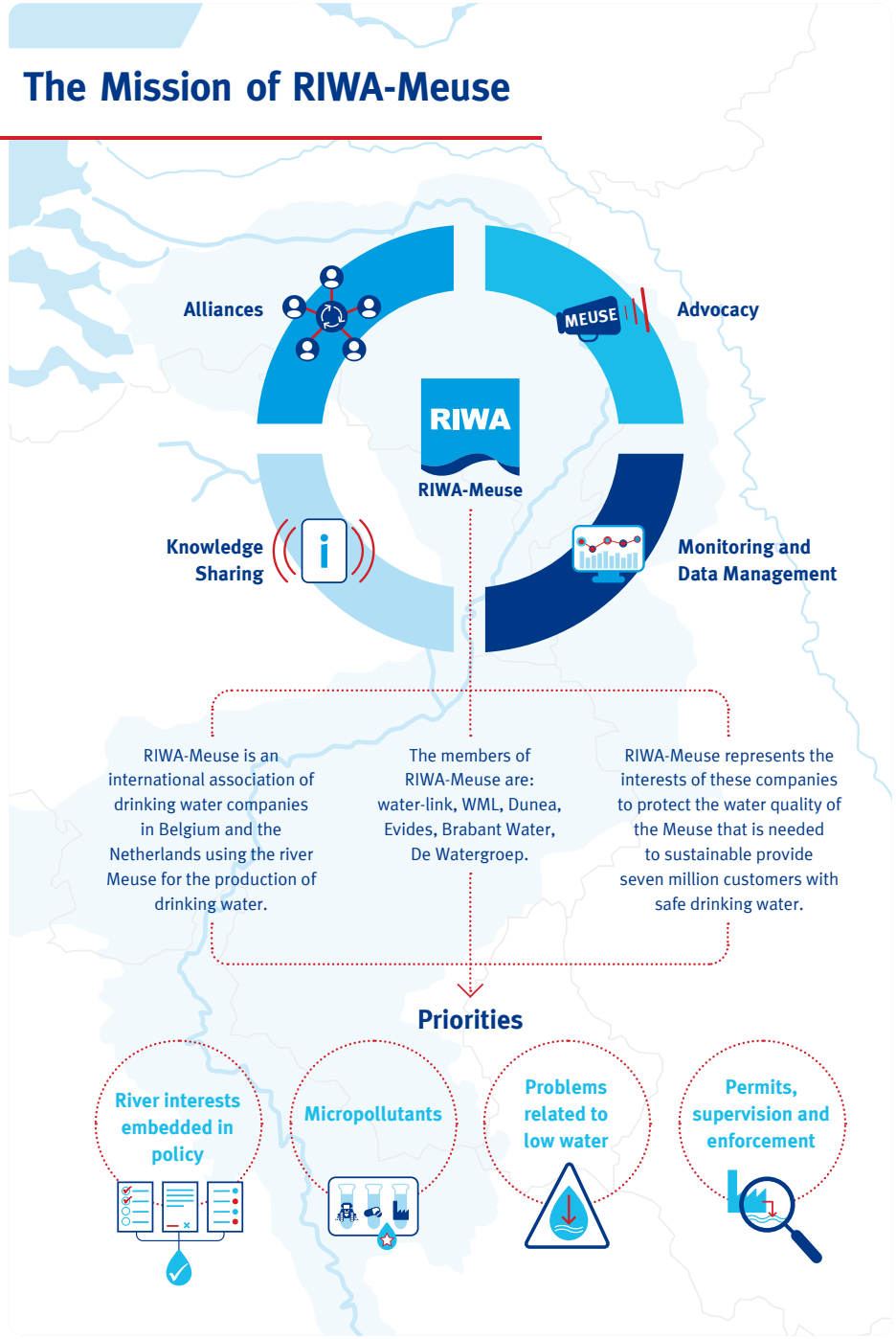
The water boards and Rijkswaterstaat are in the process of reviewing the direct permits (in 2019, a sample showed that three-quarters were not up to date). RIWA would like to know which permits are reviewed when the drinking water companies are consulted on the matter. Understanding the harmfulness of substances in the drinking water supply helps to carefully consider which substances should be kept out of the environment.

Households, agriculture and businesses

Delta Commissioner Co Verdaas recently stressed the importance of measures to mitigate the effects of climate change. This is also important in order to ensure the availability of sufficient fresh water. The demand for good quality water is increasing worldwide, including in the Netherlands and Belgium. Access to safe water is essential for households, as it is for agriculture and businesses. Large industries, including the energy sector, are highly dependent on significant amounts of water. The concerns about water quantity often come first – the impact on water quality is virtually invisible and therefore receives less attention.

In view of all this, RIWA has also been advocating more international co-operation for years. This urgency is still not sufficiently recognised and has become even more important as a result of the changing climate. Permits must be mapped out and the quantity of harmful substances must be limited, but good agreements about the use and distribution of water from the Meuse are also

The Mission of RIWA-Meuse



essential. Tensions and conflicts about water are global and exacerbated by the changing climate. This also applies to our part of the world and can happen both between sectors and between countries, as one of the interviews in this report shows. It is time to make clear agreements – and it is better to not have to do so during a heatwave when there is stress due to water shortages.

"It is in everyone's best interest to do all that is possible to meet the WFD targets"

Collective interest

We should be ashamed of the fact that the Netherlands is lagging far behind in improving water quality. The (twice delayed) deadline for the Water Framework Directive (WFD) is fast approaching. In 2027, this legal obligation must be met in order to ensure that the water in the European Union is in good condition with healthy, resilient ecosystems. One of the interviews in this report discusses the consequences of this and why it is so important to do everything possible to achieve the objectives. For nature, our own health and – surprisingly, perhaps – also our economy. For example, industrial activities that pollute the water too much could be dealt with and shut down by means of legal proceedings. This can have far-reaching consequences. Yet the WFD is often seen as an abstract, distant goal of the EU, but in the end we are collectively dependent on clean and safe water, including farmers and businesses.

Maarten van der Ploeg, Director of RIWA-Meuse

A

The Meuse as a source of drinking water

How did things go in 2023 for the Meuse as a source of drinking water? What events affected the water quality?

A1 A list of the facts about measurements in the Meuse

In order to monitor the water quality of the Meuse, drinking water companies together with Rijkswaterstaat conducted a total of 83,405 measurements of 974 parameters in 2023. Of these 974 parameters, 804 were testable, and of these, 64 (8%) exceeded the European River Memorandum (ERM) target value once or more at one or more of measurement points. The reason that 170 parameters were not testable has to do with the fact that there is no ERM target value for them. It is possible to prepare drinking water in a sustainable way with natural purification methods from water that meets the ERM target values.

Of the 64 exceeded parameters, 40.6% (26) belong to the category industrial pollutants and consumer products and 25% (16) to the category pharmaceuticals and endocrine-disrupting chemicals. These two categories mainly include non-standardised ('upcoming' or new) substances.

A2 Insight into abstraction restrictions

There were in total 53 abstraction stops and restrictions at the joint drinking water companies as a result of water pollution in 2023. Due to these, normal operations were interrupted or disrupted during 3,252 hours (135 days, cumulative for seven abstraction points). An overview of the numbers and duration of abstraction restrictions in the period 2007 to 2023 is provided in Figure 1. Whether and how often drinking water companies shut off their water abstraction (abstraction stop) differs per location.

"The intake of water from the River Meuse in 2023 was stopped for a total of 135 days."

The furthest upstream abstraction point at Tailfer in Wallonia is never shut off. Further on in Flanders, the Belgian drinking water company Water-Link prefers to shut off the abstraction from the Albert Canal as little as possible, because clean fresh water is scarce there. Across the Dutch border, at the Heel abstraction point, drinking water company WML frequently closes the gate. In 2023, just as in 2022, there were once again no abstraction stops at the Brakel abstraction point. This is due to the new abstraction concept, in which drinking water companies employ different water sources. To be less dependent on the availability of Meuse water, water from the Afgedamde Maas and the Lek (Rhine water) are mixed. The Evides abstraction points at Keizersveer (until 2021) and the Bergsche Maas (from 2021) would seem to be the best gauge for the condition of the river, because only Meuse water is available there. The water abstraction from the Haringvliet mainly consists of Rhine water.

Whether and how often drinking water companies shut off their water abstraction (abstraction stop) differs per location. The furthest upstream abstraction point at Tailfer in Wallonia is never shut off. Further on in Flanders, the Belgian drinking water company Water-Link prefers to shut off the abstraction from the Albert Canal as little as possible, because clean fresh water is scarce there. Across the Dutch border, at the Heel abstraction point, drinking water company WML frequently closes the gate.

In 2023, just as in 2022, there were once again no abstraction stops at the Brakel abstraction point. This is due to the new abstraction concept, in which drinking water companies employ different water sources. To be less dependent on the availability of Meuse water, water from the Afgedamde Maas and the Lek (Rhine water) are mixed. The Evides abstraction points at Keizersveer[1] (until 2021) and the Bergsche Maas (from 2021) would seem to be the best gauge for the condition of the river, because only Meuse water is available there. The water abstraction from the Haringvliet mainly consists of Rhine water.

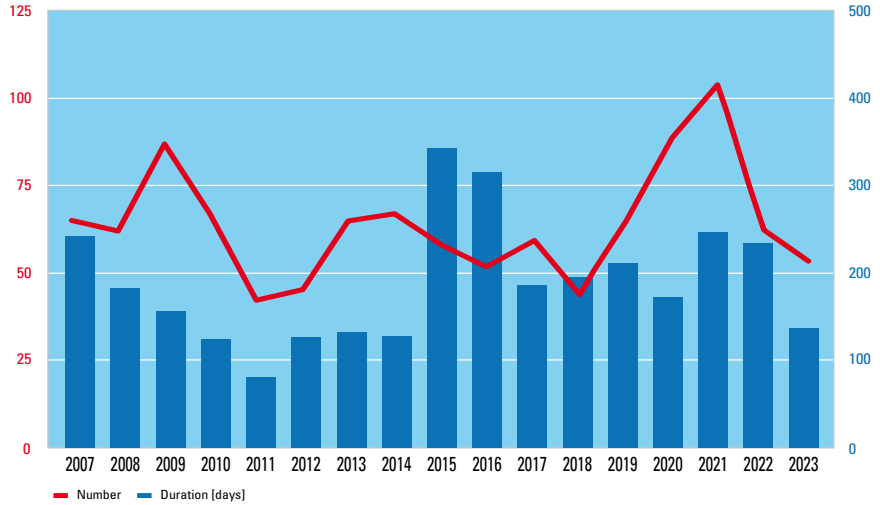


Figure 1: Duration and number of abstraction restrictions (cumulative) along the river Meuse, 2007-2023.

1 *The actual abstraction point was situated at Gat van de Kerksloot; the Keizersveer measurement point was representative for this abstraction point.*

A3 Monitoring and measurement results

Every three years, RIWA-Meuse evaluates the substances in the Meuse that are relevant to the drinking water sector. We do this based on a broad monitoring programme. This evaluation was also conducted in 2021. In 2023, monitoring was done according to the results of this evaluation for the second time.

Since 2007, along with a series of legally stipulated parameters, RIWA-Meuse has worked with a priority system. This system is intended to allow substances to be monitored in a more targeted way and to be able to take proper advantage of new developments. Every three years, RIWA-Meuse evaluates the system, with the last evaluation[2] taking place in 2021. The report 'Drinking water-relevant substances in the Meuse 2021' describes how we did[3] this.

For this monitoring, RIWA-Meuse has since 2015 applied a classification into three categories of substance:

1. Drinking water-relevant substances. These are the substances on which RIWA-Meuse focuses its advocacy:
2. Candidate drinking water-relevant substances (substances that have not yet been measured, or not sufficiently).
3. Substances that are no longer relevant to the drinking water.

The results from this monitoring in 2023 can be found in Annex 1. Because the substance properties persistence, mobility and toxicity are important for the production of drinking water, we will first consider these further. After this, we will discuss into which substances were detected in the Meuse in 2023 in concentrations above the target value in the European River Memorandum (ERM target value).

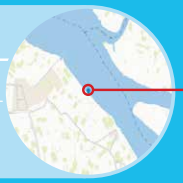
2 *The next evaluation will take place in 2024.*
3 *https://www.riwa-Meuse.org/publicatie/drinking-water-relevant-substances-in-the-meuse-2021/*

The Meuse as source of drinking water

HARINGVLIET

Abstraction: Evides

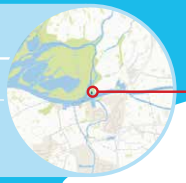
Profile: Dune infiltration



BERGSCHE MAAS

Abstraction: Evides/WBB

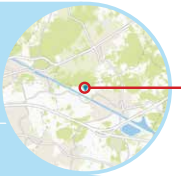
Profile: Reservoirs in the Biesbosch



ALBERT CANAL

Abstraction: water-link

Profile: Provides 40% of Flanders with drinking water (also through deliveries to Watergroup, Farys and PIDPA)



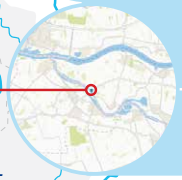
NETE CANAL

BERGAMBACHT

Abstraction: Dunea

Profile: Dune infiltration (emergency intake from the Lek)

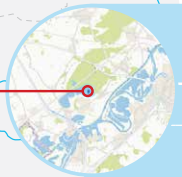
BRAKEL



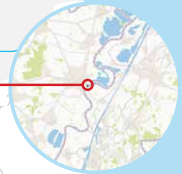
HEEL

Abstraction: WML

Profile: Infiltration into riverbank (by infiltration from Lange Vlieter at Heel)



ROOSTEREN



TAILFER

Abstraction: Vivaqua*

Profile: Direct intake from the Meuse

SURFACE WATER AS SOURCE FOR DRINKING WATER

RIWA-Meuse member utilities	*Surface water extraction (%)*	*Surface water extraction (10^6 m^3/year)*	*Customers supplied with surface water*
Evides (+WBB)	80%	200,4	2,0 million
water-link	100%	143,5	2,5 million
Dunea	100%	66,5	1,5 million
Vivaqua*	30%	39,8	750.000
WML	25%	8,3	280.000
Total		**458,5**	**7,0 million**

* Vivaqua is no longer a member of RIWA since 2021, however water quality data continues to be exchanged.

A3.1 Clarity about PMT substances thanks to RIVM screening tool

In the previous annual report (from 2022) by RIWA-Meuse, Julia Hartmann of the National Institute for Public Health and the Environment (RIVM) referred to a method of screening PMT properties during an interview. These persistent, mobile and toxic (PMT) substances have been listed in the European CLP (classification, labelling and packaging) Regulation since 20 April 2023. It will take some time before manufacturers have this information on the labels, but in the interim RIVM has developed a method for screening potential PMT substances. “We hope that this will help in identifying harmful substances as early as possible,” said Julia Hartmann in that interview. In this chapter, we will outline some developments around the PMT screening tool.

What can we do with the PMT screening tool?

On 25 October 2023, RIVM gave an explanation and instructions on the PMT screening tool in a webinar. Researchers at RIVM explained why the tool was developed and how it works and can be applied. Relevant employees of Rijkswaterstaat explained what this tool can mean in practice:

- Theo Traas, Head of the Department for Sustainability, Drinking Water and Soil at RIVM, gave an introduction and answered previously submitted questions.
- Erik Verhofstad, senior policy officer at the Ministry of Infrastructure and Water Management, told webinar participants about the ‘Approach to Upcoming Substances’ working group.
- Emiel Rorije, Chemical Risk assessor at RIVM, gave a substantive explanation of the PMT tool.
- Colet Eggermont, advisor to Chemical Water Quality at Rijkswaterstaat, described the use of the PMT tool in practice.

The recording of the webinar can be found on the RIVM website[4]. RIVM also plans to organise a webinar in English.

More information about PMT substances

The development of the PMT screening tool by RIVM was an idea of the PMT theme group, a consultation of the Approach to Upcoming Substances working group of the Ministry of Infrastructure and Water Management. This theme group asked Deltares to find out in 2024 where substances with a PMT score are used, produced and discharged. The purpose of this is to make a ranking of substances or groups of substances that are most harmful, with proposals on how to reduce their amount in the water. This research may also reveal substances which we still know too little about. In that case, further research may be interesting.

Quantity of PMT substances and practice

The PMT theme group has proposed expanding the database, which forms the basis of the screening tool. Currently, the PMT screening tool includes scores of about 6,000 substances, based on properties of around 65,000 substances. RIVM is basing its scores on the properties of some 750,000 substances. This is expected to lead to a significant increase in the number of substances with a PMT score.

Scores from the PMT screening tool are based on an estimation of the properties of a substance. “The screening is based on models and not on experimental data,” Julia Hartmann explained in the interview in the previous annual report. The PMT theme group has therefore proposed, after the database has been expanded, to compare the measurement data of the drinking water companies with the PMT scores from the screening tool. This will make it clear whether the theory and calculations behind the scores correspond to real-world information.

The PMT screening tool has now been expanded with PBT screening, making the new name ‘PBT and PMT screening tool’. PBT stands for persistent, bio-accumulative and toxic. Substances that have been identified as PBT under the REACH (Registration, Evaluation and Authorisation of Chemicals) Regulation of the European Union are included in the candidate list of Substances of Very

4 *https://rvs.rivm.nl/onderwerpen/gevaarsindeling/PMTvPvM*

High Concern (SVHCs) for authorisation. There is a difference in the P-score for PMT screening and PBT screening. This is because the PBT assessment focuses on substances that accumulate in soil and sediment – these are highly absorbent, hydrophobic substances (substances that are water-repellent or do not mix (or mix very poorly) with water). The PMT assessment focuses on substances that tend to stay in the water: hydrophilic substances.

A3.2 Per- and polyfluoroalkyl substances (PFAS)

A special category of substances with PMT properties are the per- and polyfluoroalkyl substances (PFAS). The target value set out in the European River Memorandum for anthropogenic non-natural substances with an impact on biological systems is 0.1 micrograms per litre, unless a lower value is required as a result of advancing toxicological understanding. This is the case for PFAS. The new EU Drinking Water Directive[5] provides for a choice in PFAS standard: PFAS total (500 nanograms per litre) or the sum of 20 PFAS (100 nanograms per litre). Belgium and the Netherlands chose the sum of 20 PFAS. When choosing PFAS total, it is crucial to know whether trifluoroacetic acid (TFA) is considered PFAS, as under the OECD definition. TFA is regularly measured in the Meuse in concentrations above 1 microgram per litre, or 1,000 nanograms per litre. TFA is not included in the sum of PFAS. The 20 PFAS listed in Part B of the EU Drinking Water Directive were assessed as a relevant group of drinking water in 2021.

There is currently a discussion among scientists and policy makers regarding the assessment against what is known as EFSA 4, the sum of four PFAS: PFOA, PFOS, PFNA and PFHxS. In Belgium, the sum of the concentrations is used and tested against 4 nanograms per litre, while in the Netherlands the sum of the PFOA equivalents (PEQ) is used and tested against 4.4 nanograms PEQ per litre[6]. The Netherlands takes as a starting point the inclusion of as many PFAS as possible in a risk assessment.

Table 1: 20 PFAS from Part B of the EU Drinking Water Directive 2020/2184 and their PMT scores from the RIVM screening tool.

20 PFAS EU Drinking Water Directive	PMT-score	P-score	M-score	T-score
Heptafluorobutyric acid (PFBA)	0.57	0.62	0.61	0.48
Perfluorovaleric acid (PFPeA)	0.63	0.83	0.55	0.54
Perfluoro-n-hexanoic acid (PFHxA)	0.65	0.93	0.49	0.61
Perfluoroheptanoic acid (PFHPA)	0.63	0.98	0.42	0.61
Perfluorooctanoate (PFOA)	0.60	0.99	0.36	0.61
Perfluorononanoic acid (PFNA)	0.57	1.00	0.31	0.61
Perfluorodecanoic acid (PFDA)	0.54	1.00	0.25	0.61
Perfluoroundecanoic acid (PFUnDA)	0.50	1.00	0.21	0.61
Perfluorododecanoic acid (PFDoDA)	0.47	1.00	0.17	0.61
Perfluorotridecanoic acid (PFTrDA)	0.44	1.00	0.14	0.61
Perfluorobutane sulfonic acid (PFBS)	0.63	0.92	0.51	0.53
Perfluoropentane sulfonic acid (PFPeS)	0.69	0.97	0.45	0.77
Perfluorohexane sulfonic acid (PFHxS)	0.60	0.99	0.39	0.55
Perfluoroheptane sulfonic acid (PFHpS)	0.57	1.00	0.33	0.55
Perfluorooctane sulfonic acid (PFOS)	0.53	1.00	0.27	0.55
Perfluorononane sulfonic acid (PFNS)	0.50	1.00	0.23	0.55
Perfluorodecane sulfonate (PFDS)	0.47	1.00	0.18	0.55
Perfluoroundecanesulfonic acid (PFUdAS)	0.43	1.00	0.15	0.55
Perfluorododecanesulfonic acid (PFDoAS)	0.40	1.00	0.12	0.55
Perfluorotridecanesulfonic acid (PFTDAS)	0.37	1.00	0.09	0.55

RIVM has developed the RPF method (Relative Potency Factors). This allows PFAS to be assessed as a group in mixtures that people ingest.

What these choices can mean for the Meuse as a source for drinking water is shown in Figure 2, Figure 3 and Figure 4

5 *Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption (recast)*

6 *https://www.rivm.nl/pfas/drinkwater*

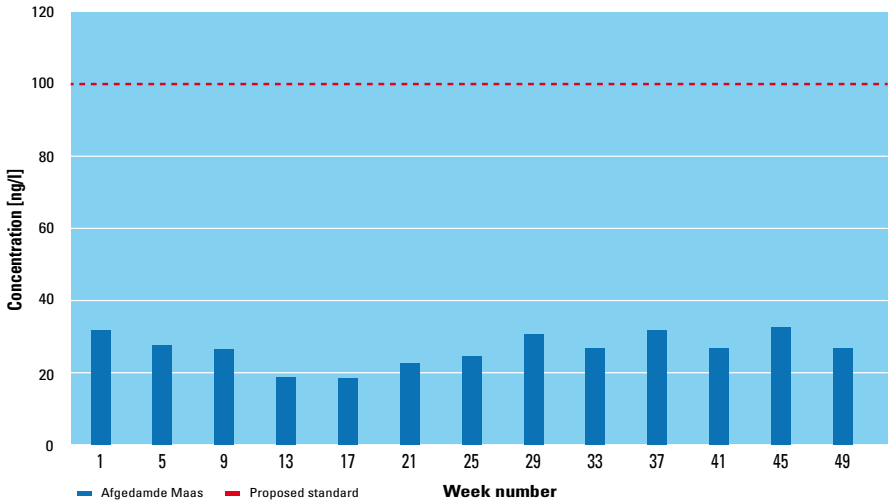


Figure 2: Concentration of the sum of 20 PFAS from the European Drinking Water Directive in 2023 in the Afgedamde Maas at Brakel.

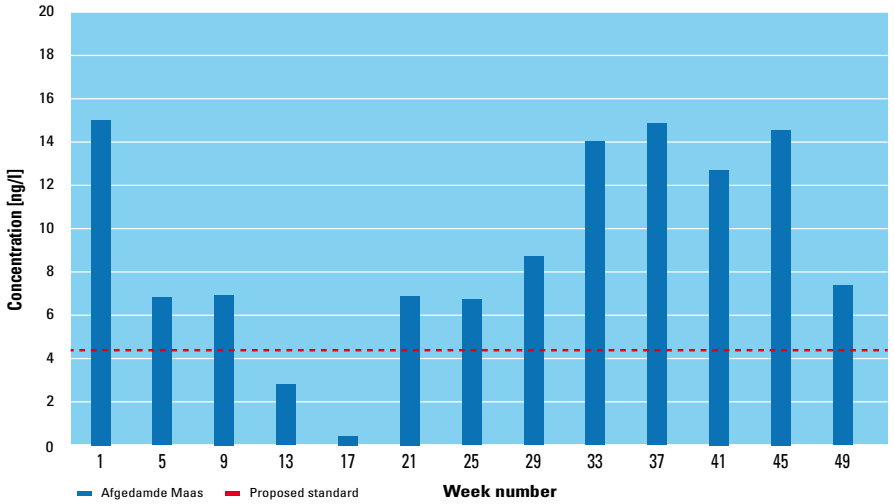


Figure 3: Concentration of the sum of the 4 EFSA PFAS in the Afgedamde Maas at Brakel in 2023, in PFOA-equivalents.

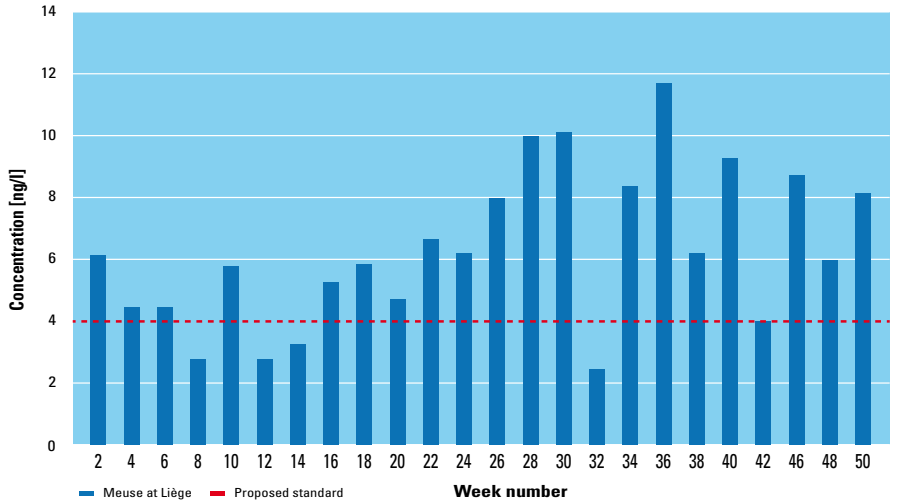


Figure 4: Concentration of the sum of 4 EFSA PFAS in the river Meuse at Liège in 2023.

A3.3 Monitoring results from 2023

Table 2: Summary of substances that exceeded the ERM target value in 2023 (maximum concentrations).

Parameter	CASRN	ERM-	tv	TAI	NAM	LUI	EYS	ROO	STV	HEE	BRA	HEU	KEI	BSM	HAR	n/	N	%
Industrial pollutants and consumer products																719	2612	27,53%
ethylenediaminetetraacetic acid (EDTA)	60-00-4	1	µg/l		7,2	9,1	16	7,3		8,3	22			48	12	85	85	100,00%
sulfamic acid	5329-14-6	1	µg/l					41		30	33			49	61	54	54	100,00%
trifluoroacetic acid	76-05-1	0,1	µg/l				1,41	1,2		1,3	1,8		1,48	1,5	1,7	97	102	95,10%
cyanuric acid	108-80-5	0,1	µg/l				3,38	1,8		2,2	1,1		1,94	1,5	1,1	67	80	83,75%
sucralose	56038-13-2	1	µg/l				2,77				5,3	3,5	6,66	6	2,5	51	64	79,69%
dichloro-methanesulfonic acid	53638-45-2	0,1	µg/l					0,3		0,33	0,19			0,32	0,62	43	54	79,63%
trichloroacetic acid	76-03-9	0,1	µg/l								0,11	0,56		0,64	0,17	32	52	61,54%
8-Hydroxypenillic acid	3053-85-8	0,1	µg/l							<0.05				0,85	0,16	28	50	56,00%
methenamine	100-97-0	1	µg/l		5,41	4,15	6,96	6,7		2,7	2		2,07	2,9	1,5	51	110	46,36%
dimethyl ketone (acetone)	67-64-1	1	µg/l					7,9								64	147	43,54%
1,4-dioxane	123-91-1	0,1	µg/l				<0.5	0,24		0,32	0,22			0,33	0,55	25	74	33,78%
tetrahydrofuran	109-99-9	0,1	µg/l					1,1		0,5				0,33	0,45	13	53	24,53%
melamine	108-78-1	1	µg/l		0,27	0,41	0,75	4,5		2,9	1,3	1,9	1,89	2	1,3	28	129	21,71%
diethylenetriaminepentaacetic acid (DTPA)	67-43-6	1	µg/l		0,27	0,41	0,76	<1		<1	1,6			5,1	1,7	17	85	20,00%
nitriloacetic acid (NTA)	139-13-9	1	µg/l		<1	<1	4,3	<1		<1	1,5			1,2	<1	16	85	18,82%
diisopropyl ether	108-20-3	1	µg/l		<0.1	6,84	4,3	2,5	0,93	0,95	0,02	0,9	0,8	0,68	0,21	23	204	11,27%
monobromoacetic acid	79-08-3	0,1	µg/l								0,13	0,07		0,08	<0,06	3	52	5,77%
dibromoacetic acid	631-64-1	0,1	µg/l								0,57	<0.06		<0.06	<0.06	2	44	4,55%
Dibromomethanesulfonate	859073-88-4	0,1	µg/l					<0.1		<0.1	0,2			<0.1	<0.1	2	54	3,70%
1,2-dichloroethane	107-06-2	0,1	µg/l	<0.1	140	<0.1	0,12	0,05	<0.25	0,11	<0.02	0,16	0,08	0,08	<0.06	8	218	3,67%
tributyl phosphate	126-73-8	1	µg/l		<0.02	1,09			0,83		<0.1	0,41				1	39	2,56%
1,2,3-Benzotriazole	95-14-7	1	µg/l		0,98	1,98		0,59		0,9	0,67	0,97		0,77	0,6	2	94	2,13%
bromoform	75-25-2	0,1	µg/l	<0.2	<0.1	<0.1	<0.1		<0.12	0,02	0,26	0,04	<0.1	<0.06	<0.06	4	193	2,07%
ethyl hydrogen sulphate	540-82-9	0,1	µg/l					<0.1		<0.1	<0.1			<0.1	0,1	1	54	1,85%
Methyl tert-butyl ether	1634-04-4	1	µg/l	0,24	0,4	<0.1	0,11	0,12	0,28	0,67	1	0,8	0,39	0,78	0,11	1	218	0,46%
bromo(dichloro)methane	75-27-4	0,1	µg/l	<0.3	<0.1	<0.1	<0.1	<0.05	<0.12	<0.05	<0.02	<0.02	<0.1	<0.06	0,12	1	218	0,46%

ERM-sw = ERM target value, TAI = Tailfer, NAM = Namêche, LUI = Liège, EYS = Eijsden, ROO = Roosteren, STV = Stevensweert, HEE = Heel, BRA = Brakel, HEU = Heusden, KEI = Keizersveer, BSM = Bergsche Maas, HAR = Haringvliet.

In the table, the highest-measured value is presented if the parameter exceeded the ERM target value, where n is the number of breaches and N is the number of measurements.

Parameter	CASRN	ERM-	tv	TAI	NAM	LUI	EYS	ROO	STV	HEE	BRA	HEU	KEI	BSM	HAR	n/	N	%
Residues of pharmaceuticals and endocrine-disrupting chemicals																163	895	18,21%
oxypurinol	2465-59-0	0,1	µg/l								1,1					13	13	100,00%
valsartanic acid	164265-78-5	0,1	µg/l					0,11		0,16	0,28			0,36	0,33	30	56	53,57%
vigabatrin	60643-86-9	0,1	µg/l					0,84		0,79				0,62	0,51	20	43	46,51%
N-formyl-4-aminoantipyrine	1672-58-8	0,1	µg/l					0,011		0,02	0,1			0,12	0,22	15	56	26,79%
di-isobutyl phthalate	84-69-5	0,1	µg/l					0,01			0,15					1	4	25,00%
metformin	657-24-9	1	µg/l		1,19	1,64	1,79	1,7		1,1	0,51		0,82	0,87	0,61	27	116	23,28%
guanylurea	141-83-3	1	µg/L				1,15	1,4		1,4	0,65		1,08	2,1	1,9	19	90	21,11%
lamotrigine	84057-84-1	0,1	µg/l					0,09		0,11	0,1			0,14	0,13	10	56	17,86%
di(2-ethylhexyl)phthalate (DEHP)	117-81-7	0,1	µg/l						1		0,13					2	12	16,67%
candesartan	139481-59-7	0,1	µg/l					0,01		0,02	0,07			0,1	0,15	8	55	14,55%
N-Acetylaminoantipyrine	83-15-8	0,1	µg/l					0,02		0,04	0,06			0,08	0,15	8	56	14,29%
tramadol	27203-92-5	0,1	µg/l		0,13	0,16		0,06		0,07	0,05			0,06	0,04	5	82	6,10%
valsartan	137862-53-4	0,1	µg/l		0,06	0,06		0,03		0,04	0,03			0,09	0,1	2	80	2,50%
paracetamol	103-90-2	0,1	µg/l					0,06		0,08	0,01			0,11	0,03	1	56	1,79%
sitagliptin	486460-32-6	0,1	µg/l					0,02		0,02	0,03			0,07	0,1	1	56	1,79%
bisphenol A	80-05-7	0,1	µg/l		<0.05	<0.05		0,05		0,22	0,01			0,04	0,03	1	64	1,56%

ERM-sw = ERM target value, TAI = Tailfer, NAM = Namêche, LUI = Liège, EYS = Eijsden, ROO = Roosteren, STV = Stevensweert, HEE = Heel, BRA = Brakel, HEU = Heusden, KEI = Keizersveer, BSM = Bergsche Maas, HAR = Haringvliet.

In the table, the highest-measured value is presented if the parameter exceeded the ERM target value, where n is the number of breaches and N is the number of measurements.

Parameter	CASRN	ERM-	tv	TAI	NAM	LUI	EYS	ROO	STV	HEE	BRA	HEU	KEI	BSM	HAR	n/	N	%
Plant protection products, biocides and their metabolites																254	2322	10,94%
aminomethylphosphonic acid (AMPA)	1066-51-9	0,1	µg/l	0,24	0,44	0,70	1,2	2,2	2,06	1,2	0,90	1,13	0,96	0,92	0,6	119	135	88,15%
chloridazone-desphenyl	6339-19-1	0,1	µg/l	0,08	0,14	0,16		0,26		0,22				0,22	0,25	43	81	53,09%
metolachlor-ESA	171118-09-5	0,1	µg/l		0,11	0,06					0,15	0,16				21	48	43,75%
fluopyram	658066-35-4	0,1	µg/l								0,18	0,05				5	24	20,83%
metolachlor-OA	152019-73-3	0,1	µg/l		0,06	0,04				<0.05	0,10	0,16		0,16	0,07	20	102	19,61%
flonicamid	158062-67-0	0,1	µg/l								0,25	0,01				4	26	15,38%
methyldesphenylchloridazon	17254-80-7	0,1	µg/l					0,04		0,03	0,13	0,14		0,05	0,07	7	66	10,61%
propamocarb	24579-73-5	0,1	µg/l					1,2		0,78	0,04	0,07		0,14	<0.06	17	354	4,80%
dicamba	1918-00-9	0,1	µg/l					<0.1		0,23	0,01	0,01		<0.1	<0.1	3	66	4,55%
cyprodinil	121552-61-2	0,1	µg/l								0,1	<0.02				1	26	3,85%
(4-chloro-2-methylphenoxy)acetic acid (MCPA)	94-74-6	0,1	µg/l	0,03	<0.03	<0.03	<0.05	<0.02	<0.025	0,48	0,12	0,06	0,05	0,05	<0.05	4	157	2,55%
dimethomorph	110488-70-5	0,1	µg/l		<0.02	<0.02					<0.07	0,08		0,15	<0.06	2	82	2,44%
glyphosate	1071-83-6	0,1	µg/l	<0.05	0,04	0,04	<0.2	0,1	0,1	0,06	0,03	0,06	<0.2	0,07	0,03	2	135	1,48%
diethyltoluamide (DEET)	134-62-3	0,1	µg/l					0,03		0,04	0,03	0,1		0,05	0,03	1	71	1,41%
dimethenamid	87674-68-8	0,1	µg/l	0,02	0,03	0,18					0,03	0,05				1	78	1,28%
metamitron	41394-05-2	0,1	µg/l	<0.01	<0.02	0,11		<0.02		<0.02	<0.02	<0.02		<0.02	<0.02	1	127	0,79%
hexachloorbenzene (HCB)	118-74-1	0,1	µg/l	<0.00	0,09	0,15	<0,0002	<0.02	<0.00	<0.02	<0.02	<0.02	<0,0002	<0.02	<0.02	1	179	0,56%
terbuthylazine	5915-41-3	0,1	µg/l	0,01	<0.02	<0.02	0,02	<0.02	0,01	0,02	0,02	0,03	0,01	0,11	<0.02	1	211	0,47%
prosulfocarb	52888-80-9	0,1	µg/l					0,05		0,16	0,03	0,03		<0.06	<0.06	1	354	0,28%

Parameter	CASRN	ERM-	tv	TAI	NAM	LUI	EYS	ROO	STV	HEE	BRA	HEU	KEI	BSM	HAR	n/	N	%
General parameters and nutrients																295	607	48,60%
Dissolved Organic Carbon (DOC)		3	mg/l C	4,11			8,8		5,1	4,7	6,3	5,49	5,9	6,2	4,4	182	228	79,82%
Total organic carbon (TOC)		4	mg/l C				20	4,7		5,9	7		10	6,6	7,8	112	175	64,00%
Ammonium	92075-50-8	0,3	mg/l NH4	0,05			0,2		0,10	0,14	0,29		0,34	0,16	0,14	1	204	0,49%

ERM-sw = ERM target value, TAI = Tailfer, NAM = Namêche, LUI = Liège, EYS = Eijsden, ROO = Roosteren, STV = Stevensweert, HEE = Heel, BRA = Brakel, HEU = Heusden, KEI = Keizersveer, BSM = Bergsche Maas, HAR = Haringvliet.

In the table, the highest-measured value is presented if the parameter exceeded the ERM target value, where n is the number of breaches and N is the number of measurements.

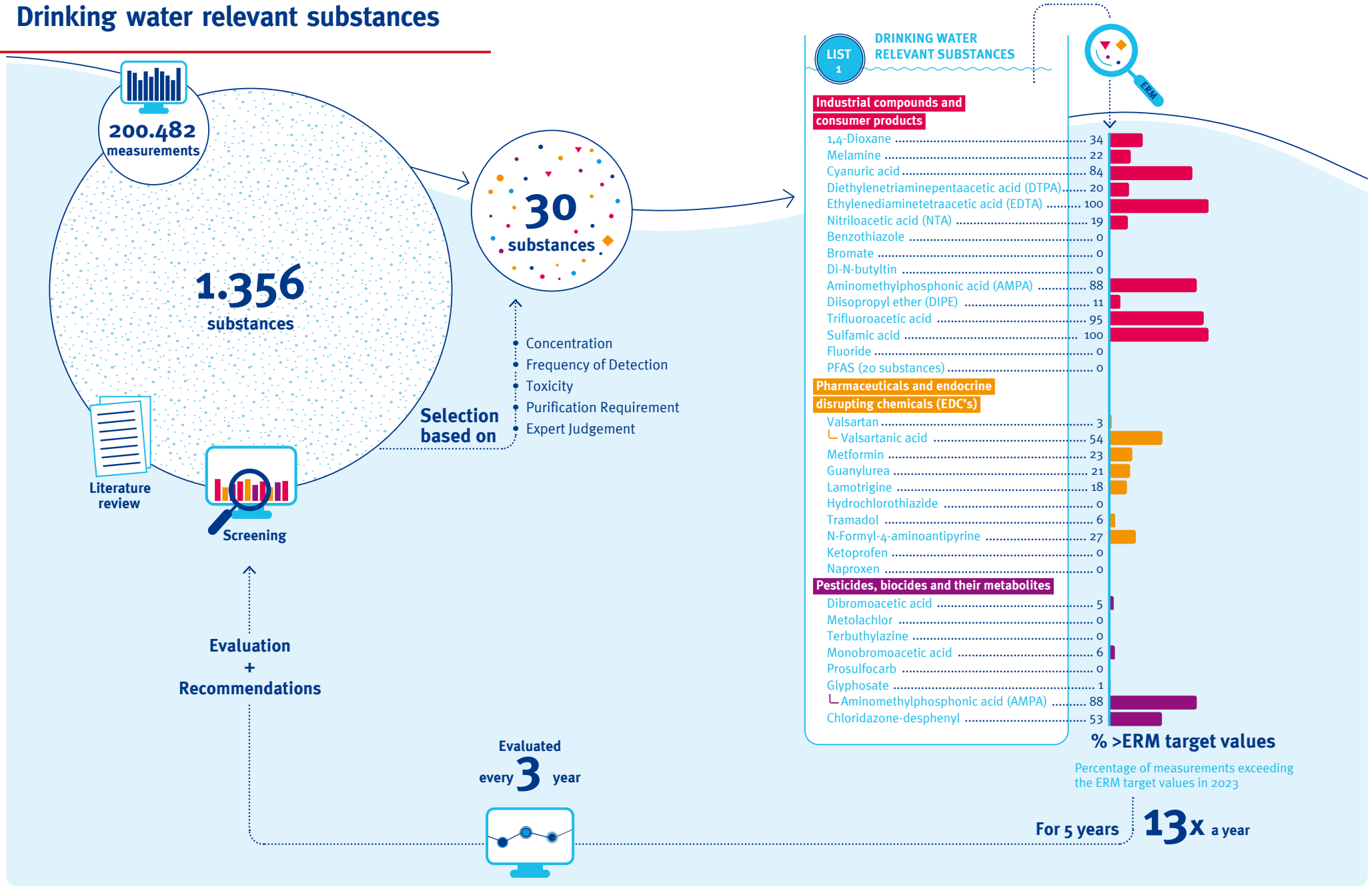
Number of measurements

In 2023, the members of RIWA-Meuse and Rijkswaterstaat conducted a total of 83,405 measurements on 974 parameters at various monitoring points along the Meuse (see Table 3). The substances monitored were tested against the target values in the European River Memorandum (ERM). These target values are mainly used to test upcoming substances that do not have (or do not yet have) a legal standard in the context of drinking water legislation.

Table 3: Summary of numbers of water quality measurements on the Meuse in 2023.

Monitoring point (km)	Number of measurements	Number of parameters	Number of testable measurements	Number of testable parameters
Tailfer (520)	2,333	180	1,763	132
Namêche (540)	3,861	317	2,585	270
Liège (600)	6,709	391	3,298	306
Eijsden (615)	9,435	369	3,235	253
Roosteren (660)	3,208	552	2,853	529
Stevensweert (675)	2,820	254	1,896	194
Heel (690)	11,701	713	8,858	584
Brakel (845)	9,723	626	6,863	494
Heusden (845)	4,639	296	4,069	280
Keizersveer (865)	4,498	347	2,661	249
Bergsche Maas (868)	12,605	723	8,523	592
Haringvliet (870)	11,873	721	8,533	588
Total	**83,405**	**974**	**55,137**	**804**

Drinking water relevant substances



A3.5 Testing against ERM

To test the measured substances, the drinking water companies use the ERM target value, the yardstick in the European River Memorandum (ERM). Drinking water companies in the river basins of the Meuse, Rhine, Danube, Elbe, Ruhr and Scheldt drafted the ERM for surface water. It is possible to prepare drinking water in a sustainable way with natural purification methods from water that meets the ERM target values.

Drinking water companies also test plant protection products, biocides and their metabolites against the ERM target value. For active substances and their metabolites that are toxicologically relevant to humans, the ERM target value is equal to the legal standard of 0.1 micrograms per litre (µg/L).

It is stated in the ERM that toxicologically 'well-assessed substances' must be tested against 1 µg/L, while for a number of these substances, testing was previously done against a target value of 0.1 µg/L. That is why, in 2021, the drinking water companies that use Meuse water decided from then on to use a different ERM target value from before for a number of parameters from then on. Substances with an indicative drinking water target value over 10 µg/L have been tested against 1 µg/L since 2021. This concerns the substances listed in Annex 3.

Of the 974 parameters monitored in 2023, 804 were testable and, of these, 64 (7.9%) exceeded or equalled the ERM target value one or more times for at least one monitoring point (see Table 2). That 170 parameters were not testable has to do with the fact that there is no ERM target value for them. In total, a breach of the ERM target value was observed 1,431 times; this is 2.6% of the testable measurements (55,137).

Result: number of ERM breaches

Table 4 presents the numbers and percentages of breaches of the ERM target value for each substance category.

Table 4: Summary of breaches of ERM target values by substance category.

	Industrial pollutants and consumer products	Residues of pharmaceuticals and endocrine-disrupting chemicals	Plant protection products, biocides and their metabolites
Permanent 100%	2 (7.7%)	1 (6.2%)	0 (0%)
Structural 50-99%	6 (23.1%)	1 (6.2%)	2 (10.5%)
Frequent 10-49%	8 (30.8%)	9 (56.3%)	5 (26.3%)
Incidental 1-9%	10 (38.4%)	5 (31.3%)	12 (63.2%)
Total	**26 (100%)**	**16 (100%)**	**19 (100%)**

In 2023, EDTA, sulfamic acid and oxypurinol exceeded the ERM target value in all measurements.

Classification of a substance in a category depends on the main route by which it can end up in water. Therefore AMPA, for example, is classified under 'Plant protection products, biocides and their metabolites', while cooling water additives are also known to break down into AMPA. However, we did not choose to also classify AMPA under 'Industrial pollutants and consumer products', because this application does not lead to the highest emissions and we want to avoid double counting.

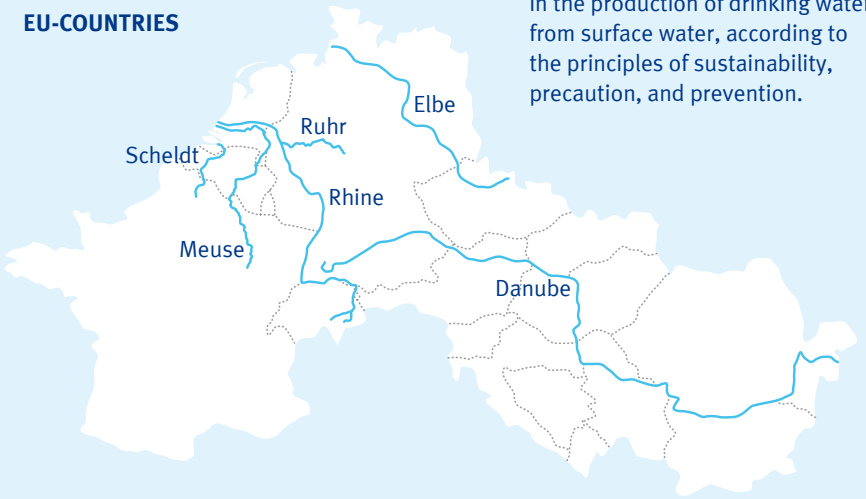
Something similar is going on with some PFAS. Some active substances in pharmaceuticals (sitagliptin) or plant protection products (fluopyram, flonicamide) meet the OECD definition of PFAS. Although PFAS are classified as 'Industrial pollutants and consumer products', we still classify these substances in their specific categories to avoid double counting. This also applies to the breakdown product TFA, which we do not classify under 'plant protection products, biocides and their metabolites', but under 'Industrial pollutants and

Target Values of the European River Memorandum

Drinking water companies from the river basins of the Meuse, Rhine, Danube, Elbe, Ruhr and Scheldt have had the European Memorandum River (ERM) formulated in order to safeguard the quality of surface water that is used for the production drinking water. Surface water that meets the ERM Target Values can be used to sustainably produce drinking water, making use of natural purification technologies.

EUROPEAN RIVER MEMORANDUM

18
EU-COUNTRIES



JOINED STRATEGY AND VISION

in the production of drinking water from surface water, according to the principles of sustainability, precaution, and prevention.

Important ERM principles

- Prioritising drinking water supply
- Sustainable management of water resources
- Insight into harmful substances
- Preventative protection of water bodies
- Responsible discharging of wastewater

TARGET VALUES

- ERM – Industrial pollutants
- ERM – Pharmaceuticals
- ERM – Pesticides / Other

WATER QUALITY ASSESSMENT

Water quality indicators for

170
DRINKING WATER COMPANIES

188
MILLION CUSTOMERS

consumer products'. The industrial substances DEHP, di-isobutyl phthalate and bisphenol-A are known as Endocrine Disrupting Chemicals (EDCs) and are therefore classified under 'Remnants of drugs and endocrine-disrupting chemicals'.

Analysis: seriousness of breach

Not every breach of the ERM is equally relevant. Broadly, there are three types of breach:

- Chronic breaches: substances that breach the ERM target value once every year
- 'Flashing light' breaches: substances that breach the ERM target value one year and not the next year
- New breaches: substances that we now see for the first time because analysis methods are available

A summary of the number of breaching substances since 2015 is presented in Figure 5 for all monitoring points. Because different substance categories were sometimes used in previous reports, the breaches were determined again based on the choices in 2020 and 2021. This presentation may therefore deviate from what was stated in previous reports. It may also concern new substances compared to before. This is due to the assignment of ERM target values to substances that were not included in the testing in the past, because they already had a (legal) drinking water standard (see appendix 1).

Besides the number and the type of substances that exceed the ERM target values, it is relevant to investigate how often these substances are above the ERM target values. For this reason, the percentage of breaches was determined. Figure 6 shows a summary of the breach percentages of the ERM target values within the substance categories since 2015.

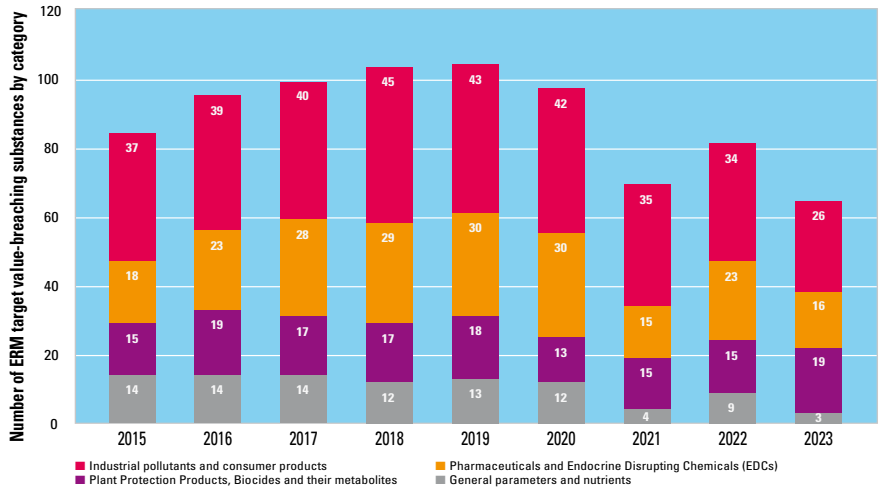


Figure 5: Number of ERM target value-breaching substances by category, 2015-2023.

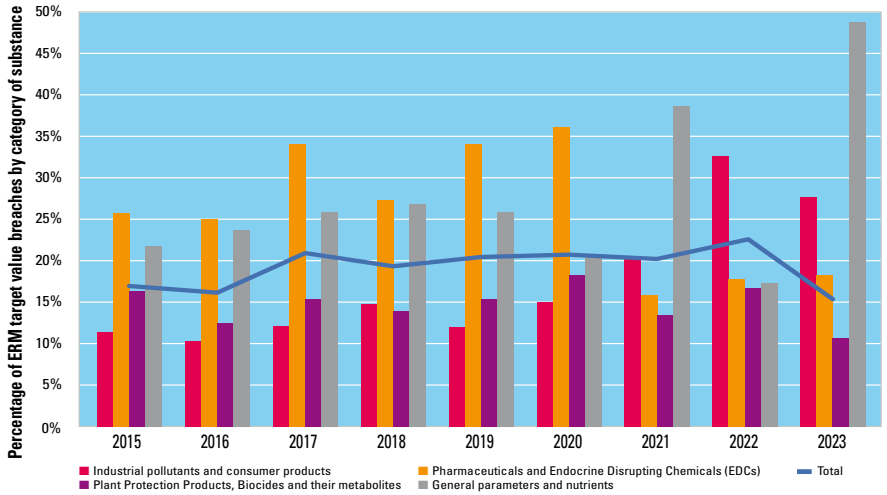


Figure 6: Percentage of ERM target value breaches at all monitoring points, by category of substance, 2015-2023.

Trends and other developments

After testing against the ERM, it emerges that the number of breaching substances in the categories 'Industrial pollutants and consumer products' is the highest (26). The number of breaching substances in the category 'Pharmaceuticals and endocrine-disrupting chemicals' (16) proves to be lower than in 2022 (23). It can further be concluded that the number of breaching substances in the category 'plant protection products, biocides and their metabolites' are slightly higher than in previous years.

It is striking that the percentage of breaching measurements in the 'General parameters and nutrients' category is the highest, but this can be explained almost entirely by the parameters dissolved and total organic carbon (DOC and TOC). After this, the percentage of breaching measurements in the category 'Industrial pollutants and consumer products' is the highest. The percentage of breaching measurements in the category 'Medicinal products and endocrine-disrupting chemicals' is approximately the same as in 2022 and 2021. The decrease in this category after 2020 was mainly caused by opting to test some substances against a different ERM target value. It is also noteworthy that while the number of substances exceeding the ERM target value in the category 'plant protection products, biocides and their metabolites' was higher than in previous years, the number of breaching measurements in this category is the lowest compared to previous years.

In Figure 7 a decrease in the percentage of breaches for melamine is noticeable, as is an increase in the percentage of breaches for TFA. The decrease for melamine may be related to decreasing discharges from the IAZI of the Chemelot complex since 2016, which is the largest melamine plant in the world. The increase in the percentage of breaches for TFA is due to the reduction of the ERM target from 1 to 0.1 µg/l in 2021. There does not appear to be a clear trend for EDTA, DIPE and methenamine.

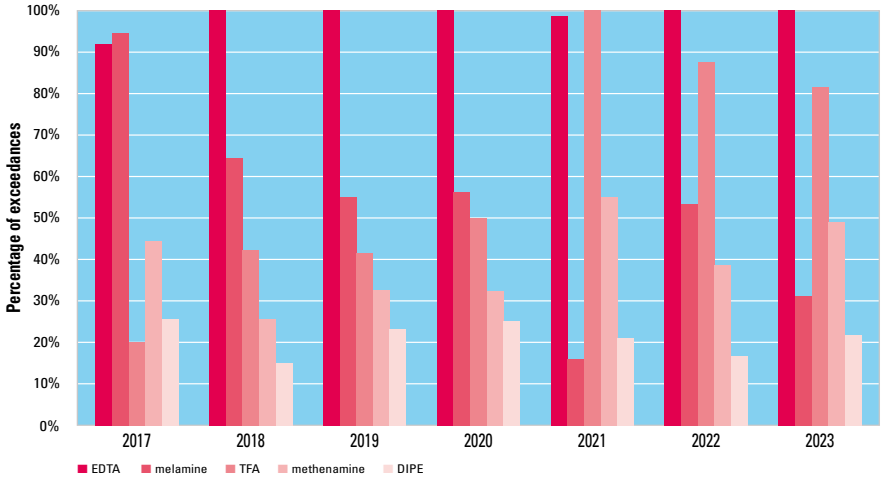


Figure 7: Percentage of ERM targe value breaches for five substances in the category 'Industrial pollutants and consumer products', 2017-2023.

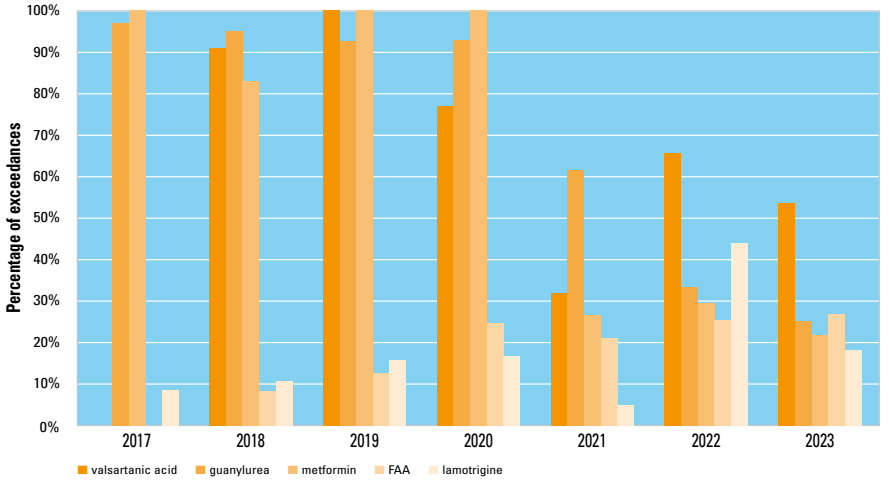


Figure 8: Percentage of ERM targe value breaches for five substances in the category 'Residues of pharmaceuticals and endocrine-disrupting chemicals', 2017-2023.

In Figure 8 a decrease in the percentage of breaches for guanylurea and metformin is apparent: this may represent the initial results of measures taken in the river basin, such as the Implementation Programme 'Chain Approach to Medicine Residues from Water'[7]. For valsartanic acid this seems to fluctuate a bit, but in recent years the percentage has dropped somewhat. Since 2018, the FAA seems to be rising slightly. No clear trend can be observed for lamotrigine.

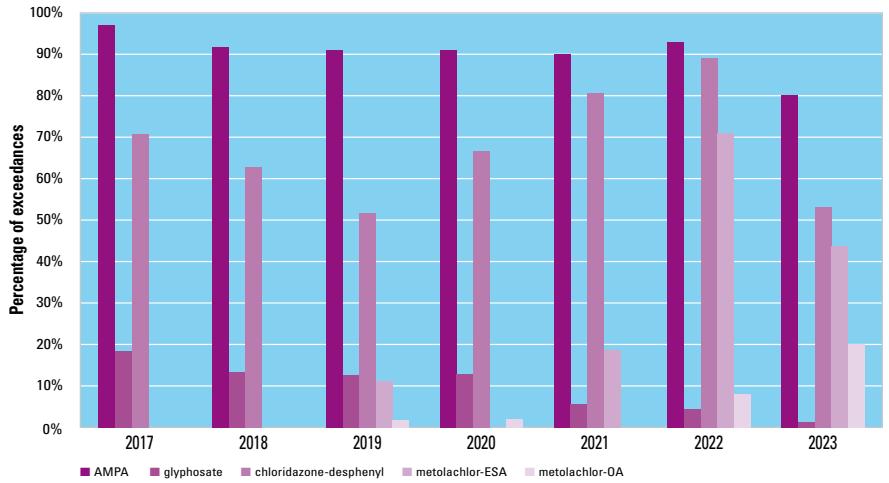
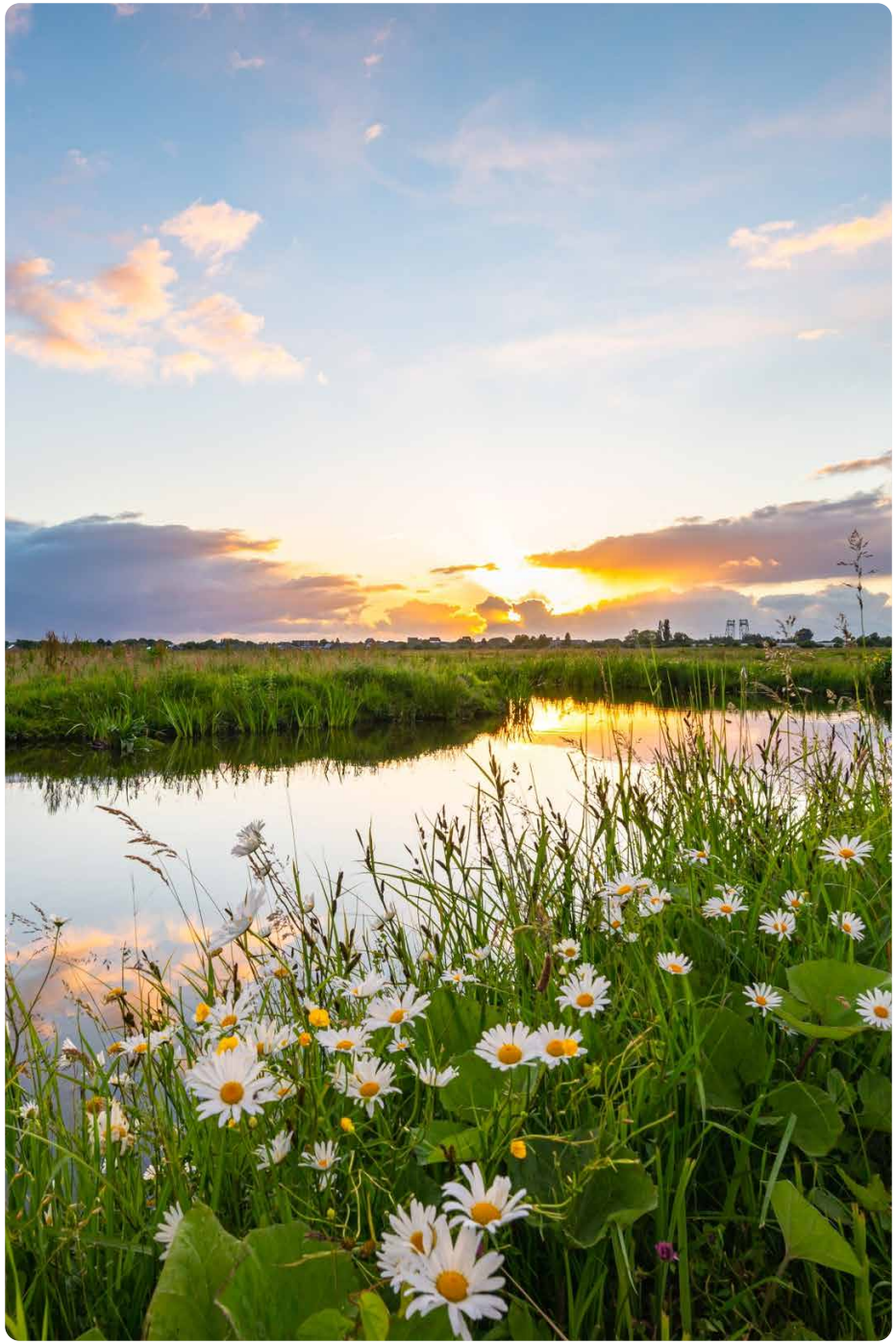


Figure 9: Percentage of ERM target value breaches for five substances from the category 'plant protection products, biocides and their metabolites', 2017-2023.

In Figure 9 a decrease in the percentage of breaches for glyphosate is noticeable and, to a slightly lesser extent, also for AMPA. No clear trend can be observed for chloridazone-desphenyl. The percentages for metolachlor-ESA and OA are rising. The European approval of the active substance S-metolachlor will not be renewed and all authorisations for plant protection products containing that active substance must be withdrawn by 23 April 2024.



7 *https://www.rijksoverheid.nl/documenten/rapporten/2023/05/08/bijlage-rapport-evaluatie-ketenaanpak-medicijnresten-uit-water-2023*

Monitoring the water quality of the Meuse

RIWA-Meuse assesses the water quality of the Meuse according to the target values of the European River Memorandum. Surface water that meets the ERM Target Values can be used to sustainably produce drinking water, making use of natural purification technologies.

83.405 measurements

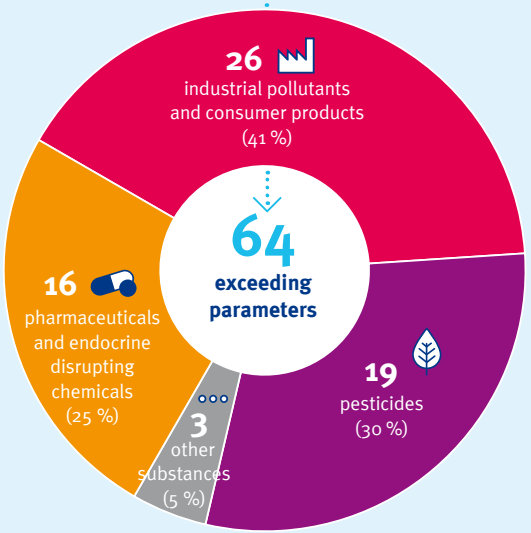
55.137 verifiable measurements

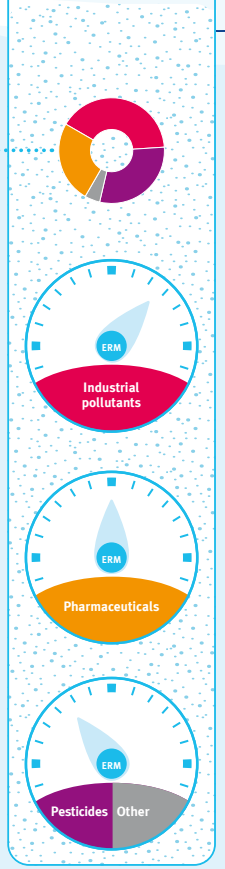
804 parameters

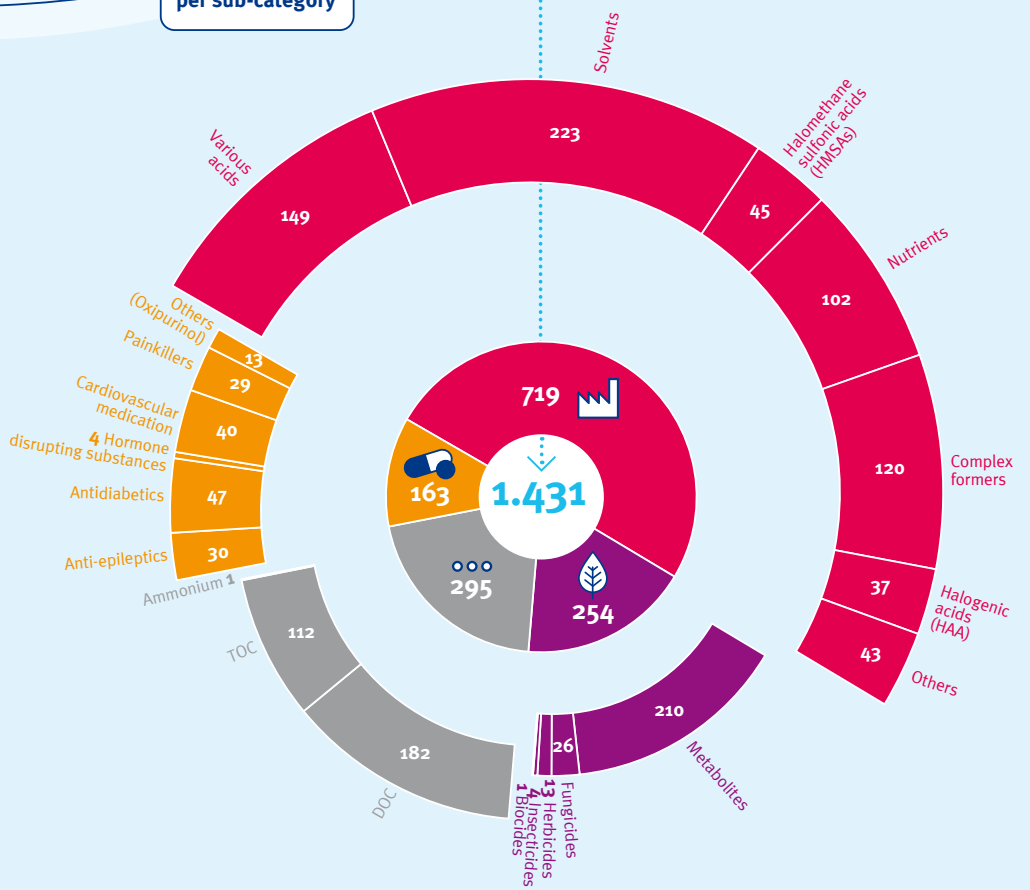
64 exceeding parameters

1.431 exceedances per sub-category

Proper monitoring and data management are crucial to safeguard the water quality of the Meuse as a source of drinking water.







RIWA-Maas

A4 “Glyphosate does not belong in sources of drinking water, nor do any alternatives.”

Thijs Blom

Thijs Blom, water trainee and data analyst at RIWA-Meuse.

Only trace amounts of glyphosate should be found in drinking water. However, the EU has recently authorised the controversial substance once again for 10 years. Thijs Blom joined the RIWA-Meuse National Water Traineeship as a data analyst and, along with his fellow trainees, has investigated how farmers and experts view this agent.

Glyphosate, a commonly used herbicide, is regularly in the news, if only because its results are clearly visible on the fields in the spring. They turn ochre yellow as farmers spray the so-called green fertilisers (plants that serve as fertilisers) to death, after which they sow the crops they wish to grow. The substance has recently become controversial due to a possible link with an increased risk of Parkinson’s and cancer, among other things[8]. Weed control agent, plant protection product, herbicide, pesticide or agricultural poison – how the substance is referred to depends on the point of view.

Drinking water companies are prohibited from producing drinking water from water containing more than 0.1 micrograms per litre of plant protection product. Glyphosate, the most commonly used agent, has been causing the most breaches of standards in the Meuse for years in the plant protection products category. However, in November 2023, the European Union decided to renew the authorisation of the contested product for 10 years.

The future of glyphosate

This was reason enough for the National Water Traineeship to conduct a study on the use of glyphosate. The future of glyphosate is a report by Thijs Blom, Sophie Luijendijk, Simone Runtulalo and Hugo Bosland, all trainees at the National Water Traineeship. They conducted interviews with farmers who use the agent, with a number of experts, such as a philosopher of agricultural and food ethics, and with Bayer employees. This is one of the largest producers of glyphosate and the company that acquired Monsanto, which put glyphosate on the market in the 1970s. Because the agent is so controversial, all the interviewees will remain anonymous.

8 *https://www.newscientist.nl/nieuws/hoe-zit-het-nu-echt-met-glyfosaat/*

"We were curious about their experiences and opinions," says Thijs Blom, who as data analyst at RIWA-Meuse manages the database with data about the water quality of the Meuse. "We asked questions like, how do you feel about this tool, what are your experiences, do you want to use less of it? Are there any good alternatives?"

'Probably the most extensively investigated substance in the world' is how the European Food Safety Authority (EFSA) and the European Chemicals Agency (ECHA) refer to glyphosate in the substance evaluation in 2023[9]. These organisations decided to carry out this evaluation, after the licence to use glyphosate expired a few years ago and the producers applied for an extension. However, these organisations were not able to evaluate the harmful effects of the substance on humans, animals and plants.

Combination with other substances

For drinking water companies, it is very important to know how harmful a substance is. "Enforced water quality standards help with this," explains Blom. "You just don't want to have glyphosate in sources of drinking water; every breach of standards in the Meuse is one too many."

Complicating the issue is the fact that glyphosate is regularly used in combination with other, toxic substances to enhance its effectiveness. In Roundup, for example, the most commonly used anti-weed agent. "They include substances that may be more harmful than glyphosate," says Blom, referring to information from the Dutch Board for the Authorisation of Plant Protection Products and Biocidal Products (CTGB)[10], the licensing authority for these substances in the Netherlands.

Drinking water companies discontinue the abstraction of water from the Meuse when glyphosate levels are too high. Stopping the abstraction of Meuse water is the first barrier in the purification process to prevent the substance from entering the drinking water. "That is why RIWA-Meuse always advocates the source approach: making sure that harmful substances do not end up in the water," says Blom. "Or as the now famous statement of RIWA-Meuse goes: you don't have to take out what doesn't go into the water!"

More stringent measures

RIWA-Meuse annually shares water quality data on plant protection products that exceed the permitted 0.1 micrograms per litre with the Board for the Authorisation of Plant Protection Products and Biocides (CTGB). The CTGB then takes that data into account in their assessments. "Because glyphosate has been the main cause of the breaches of standards for so many years now, the CTGB has taken increasingly stringent measures," says Blom. "They're working, because the number of breaches is declining. But only when it reaches zero will we, as an advocate for the drinking water companies, be satisfied."

Professional gardeners and water boards are now allowed to use plant protection products containing glyphosate only in exceptional cases, while growers and farmers are allowed to (still) use the substance. In the past, the municipal gardening services sprayed the product everywhere between the grey concrete tiles, but since 2016 glyphosate is no longer allowed for private use on closed and semi-open pavements, such as asphalt, concrete, stones and gravel. And since 2019, all applications on closed and semi-open pavements in the Meuse river basin have been banned. This applies to both professional and private users, in agriculture and for other applications[11]. It is striking that private individuals can still buy products containing glyphosate on the internet as of the writing of this report.

Alternatives

The producer and the farmers cite in the report The future of glyphosate the fact that alternatives to glyphosate are often more expensive and sometimes more harmful or polluting. You can plough in the plants that serve as fertiliser, but that costs diesel, which means CO_2 and particulate matter emissions. And heavy tractors in the fields are also bad for the soil. Blom: "What is more harmful is unknown. That calculation has not yet been made and is very complex. In short, there are pros and cons to be found."

9 https://www.efsa.europa.eu/en/factsheets/efsa-explains-scientific-assessment-glyphosate
10 https://www.ctgb.nl/onderwerpen/glyfosaat/intrekking-tallowamine-houdende-middelen
11 https://www.ctgb.nl/actueel/nieuws/2019/10/10/principebesluiten-middelen-met-glyfosaat

Some of those interviewed mentioned food security as an advantage of using glyphosate, says Blom. “Though the philosopher thought that it might provide more food now, but that it will cause so much damage to the soil that you will have less fertile soil in a few decades.”

The farmers who spoke to the trainees are actively reducing the use of glyphosate, but this is not the case for all other farmers. Blom thinks that a possible ban in the future could lead to more innovations. “On the other hand, farmers are now willing to test more alternatives, because they have this agent as a backup.”

Much more complex

The trainees conclude their report with a recommendation to start a follow-up project and to begin a serious discussion about this. Such a discussion can focus on the different interests involved and it is an accessible way to give trainees insight into a complex situation.

Blom concludes: “I had a strong opinion beforehand. You don’t want this substance in your sources of drinking water, of course. But over time, we’ve found that the situation is much more complex, because there is more to consider than we initially thought. It would be unfortunate if another harmful substance were to be used in agriculture, because alternatives could be more harmful.”

The Clean Meuse Water Chain (SMWK)

The Clean Meuse Water Chain (SMWK) is a partnership of drinking water companies and water boards around the Meuse, Rijkswaterstaat, the Ministry of Infrastructure and Water Management, and RIWA-Meuse.

By 2040, the SMWK wants to reduce organic micropollutants in the Meuse by at least 30% compared to the current situation. Within these organic micropollutants, the SMWK focuses on drug residues and industrial substances – these substances have grown from 10 to 160 million registered substances in 30 years. The SMWK also wants the Substances of Very High Concern (SVHCs) and Persistent, Mobile and Toxic Substances (PMT) to be minimised as soon as possible.

The SMWK started the collaboration with two pilot projects in 2015. A study was done on the use of powdered coal in waste-water treatment plants (PACAS). Another study was conducted on regional hotspots of drug residues, locations in the Meuse where these substances are widely found.

Atlas for a Clean Meuse

One of the initiatives of the SMWK is the Atlas for a Clean Meuse, an interactive database with permits for wastewater discharges. In it, you can search by company, type of substance and permit issuer, among other things. The Atlas provides a clear picture of the water quality, indicates the sources of pollution and shows what improvements are possible. It contains many of the direct permits (for wastewater discharges into surface water) from Rijkswaterstaat and the water authorities. Unfortunately, it does not contain the indirect permits (for waste-water discharges into the sewage network) yet. The Atlas will be further developed in the coming period.

More information: www.schonemaaswaterketen.nl

The Clean Meuse Water Chain

A5 “The partners of the Clean Meuse Water Chain are working together more smoothly now.” Aisha Maeda

Aisha Maeda, former water trainee at RIWA-Meuse.

The partnership known as the Clean Meuse Water Chain (SMWK) has been working on the goal - a cleaner River Meuse - since 2015. Project co-ordinator Aisha Maeda talks about the efforts over the past year. These efforts include a hotspot analysis, the basic measurement network and better co-operation with companies.

The Clean Meuse Water Chain (SMWK, see box) is working to improve the quality of the water in the Meuse. “There is an urgent need to improve water quality,” says Aisha Maeda. “This means harmful discharges need to be reduced.” She was project co-ordinator for two years in this partnership from RIWA-Meuse and part of the National Water Traineeship.

Hotspot Analysis

During her traineeship, Maeda was closely involved in an investigation into hotspots of industrial substances. Companies discharge into the sewer, into rivers and streams that flow to the Meuse and into the Meuse itself. It is often not clear from which company or companies a specific substance originates, she explains. “Not all substances are listed in the permits. There are smaller companies that don’t have a permit at all. And we don’t have a clear picture of the discharges from commercial activities.”

The SMWK wants more insight into the sources of the pollution. Using the website bedrijvenopdekaart.nl (businesses mapped out) where information from the Chamber of Commerce has been unlocked, the partners mapped all the companies that are all located around the Meuse last year. This company data was then linked to the SVHC database of the RIVM. Maeda commented: “We have linked the geographical distribution of commercial activities to the water boards’ purification areas. This, in turn, is linked to the information on the expected Substances of Very High Concern, categorised by commercial activity. Those insights give us a better picture of the substances that we can expect.”

This hotspot analysis also helps to identify test results. Maeda: “For example, a test result indicates that there is a high concentration of a given substance in a given location. Then you can use the hotspot analysis to find out which commercial activities, locations and purification zones we can investigate further to find the origin of the substance. With that information, you can talk to companies or industry associations.” In the coming years, SMWK aims to gain even better insight into the nature, extent and origin of organic micropollutants and their impact on humans, animals and the environment.

Collaboration with companies

Together with other trainees of the National Water Traineeship, Maeda has also committed to involving companies in the Clean Meuse Water Chain (in Dutch, SMWK). “We looked at what companies think of this and how they could work with SMWK’s partners.” There are indeed companies that are open to this, she says.

“Partners have understood each other better by getting together.”

The SMWK offers these companies the option to analyse the waste water using the latest research techniques and to identify which harmful substances may be in the waste water using the expertise of the partner organisations’ labs. The company can then pay more attention to what is used in the production process and is ultimately discharged into the waste water. “These companies want to take social responsibility,” Maeda says. They have good measurement techniques and labs themselves, but focus on specific substances. The SMWK invites them to test innovative measurement methods and look at the results together for a complete picture.”

Basic measurement network

In 2023, the Clean Meuse Water Chain brought together the 30 measuring points of the drinking water companies and water boards in the Meuse in the Basic Measurement Network. The SMWK measures various substances to monitor water quality.

Maeda talks about the innovative measurement methods, which allow the researchers to identify potentially harmful substances that previously went unnoticed. “At first, the partners mainly looked at their own stretch of river and the substances they consider important. And now they get the complete picture. More information helps to better protect the water in the Meuse. This collaboration also prevents double measurements.”

Five countries

Improving co-operation with neighbouring countries – the Meuse river basin encompasses five countries – is also on the agenda of the SMWK. Last year, the SMWK co-organised the annual international Meuse symposium, which Deltares and the University of Liège have been organising for years. “Usually it’s about hydrology and quantity,” Maeda says. “We have organised practical parallel sessions on the quality of the Meuse water.” For example, questions were raised such as: what permits are there in Belgium and the Netherlands and where can they be found? What calculation models for water pollutants exist and what data do we have?

Does Maeda think that the SMWK is on the right track: does she expect the Meuse water to actually become cleaner? “We are gathering more and more knowledge,” she responds. “About the permits, for example. That is why we did a hotspot analysis. Meanwhile, measurements are taking place. In short, we are all taking the appropriate steps to eventually reach our goal: reduction.”

Understanding each other

The Clean Meuse Water Chain ensures that the partners know how to find each other better and work together more easily, emphasises Maeda. “By coming together, the partners have come to understand each other better. They all have an interest in a cleaner Meuse, but they have a different focus and have different interests,” she explains.

The SMWK also aims to improve the process of authorisation, supervision and enforcement. Since the end of 2022, the permit providers of the various water boards and Rijkswaterstaat have met four times in a year. In addition, representatives of drinking water companies sometimes participate in these meetings. We discuss case studies and, for example, difficulties in the issuing of permits.

“Partners have understood each other better by getting together.”

That’s an interesting interaction, Maeda has noticed. This allows the permit issuer to take into account the importance of drinking water and allows drinking water companies to better understand the perspective of the permit issuer, if necessary asking questions about the permit and the impact on water quality. “This way you get the two parties to interact rather than oppose each other. If you understand each other’s point of view, you can have a better conversation and work together more efficiently.”

B

Permits

Circle Infra Partners

B1 “This transparent permit means we are miles ahead.”

Sylvia Vanhommerig and Karin Meeuwsen

Sylvia Vanhommerig, Director of Operations and Karin Meeuwsen, QESH-Permits Manager at Circle Infra Partners.

Drinking water companies view the discharge permit of Circle Infra Partners, formerly Sitech Services BV, as an example. The company purifies the waste water from 60 factories at the Chemelot industrial estate in Limburg. There has been a lot of criticism in the media. We discussed this with Sylvia Vanhommerig and Karin Meeuwsen from Circle Infra Partners.

The waste water from the factories on the Chemelot site ends up in the Integral waste-water Treatment Plant, or IAZI, of Circle Infra Partners. After treatment, the water flows through a branch of the Ur into the Meuse, near the Natura 2000 site known as the Grensmaas. About 30 kilometres downstream, the Limburg drinking water company WML draws water from the Lateral Canal, after which the water is purified for use as drinking water.

The current discharge permit for this, which has been in force since the end of 2020, has been drawn up in cooperation with the Limburg water board, the provincial authorities, Rijkswaterstaat and the drinking water companies. For drinking water companies, this permit is a model for other permits: it lists all substances that could be discharged, with reduction targets for the discharge of a number of harmful substances.

A total of 630 substances are listed in the permit. “We have described at substance level what we discharge and in what concentrations,” says Sylvia Vanhommerig, Director of Operations. “Other chemical companies may discharge more substances, but they only mention a few substance groups in the permit, not every substance in them.” Her colleague Karin Meeuwsen, QESH Permits Manager: “By being so transparent, we really are miles ahead of the rest in the Netherlands.”

The reason

According to the Environment Act, which incorporates most of the Water Act, all substances discharged by a company must be listed in a permit, but – strangely enough – this often does not happen. In many cases, relatively general parameters are included in permits that are important for proper biological

treatment. The complete picture is often still missing, for instance for all Substances of Very High Concern (ZZS), which are on the RIVM list, and for substances that are difficult to purify by drinking water companies.

So why do the permits for the Chemelot plant include all the substances? The reason was an incident in 2015, Vanhommerig and Meeuwsen recount: one of the factories had discharged the harmful substance pyrazole in quantities that were well above the drinking water standard in the Meuse. Vanhommerig: “We never wanted to see that again and that’s when we gained momentum. As Chemelot and Circle Infra Partners, we want to ensure that the water we release does not cause problems for drinking water and ecology.”

The Integral Waste-Water Treatment Plant, or IAZI, of Circle Infra Partners.

The drinking water companies have seen fewer incidents from Chemelot since the permit came into force: fewer harmful discharges from the factory site. “When we exceed the standard, which fortunately happens less and less, we contact the drinking water companies directly,” says Meeuwsen. “Because then they can be alert to it in their abstraction. Drinking water companies would be able to trace the source and act much faster if all companies had transparent permits like us.”

Alternative substances

In the past, the drinking water companies that use the Meuse as a source often had to deal with, for example, the substance AMPA, which ended up in the Meuse both as a breakdown product of herbicides in agriculture and from the Chemelot site. In recent years, the emission of this substance from Chemelot has been greatly reduced. A number of companies used a substance that was converted into AMPA during biological treatment to prevent deposits and corrosion in cooling water systems. The cooling water can then be reused. “The companies have started using alternatives to this AMPA-forming substance that are not as harmful to drinking water or not as difficult to purify,” says Meeuwsen. “A number of installations have been converted and experiments have been done. Not all products were equally effective, but we eventually found good alternatives.”

Circle Infra Partners is continuing to work on reducing the substances on the list of Substances of Very High Concern (SVHCs). Meeuwsen: “We are obliged to minimise the SVHCs. But at a certain point, technically, it hits a limit.” She cites mercury as an example. “We have already done a great deal, and only 200 grammes were discharged last year. Removing these kinds of quantities from the treated waste-water - more than 3,500 Olympic swimming pools a year - is a nonstarter.”

More and more substances discovered

In searching for possibilities to reduce the discharge of Substances of Very High Concern, Circle Infra Partners also looks at the source, namely the factory

on the Chemelot site where a specific substance originates. “There still might be some room for improvement,” says Meeuwsen. “Smarter purchasing of materials, trying alternative substances. We will keep looking, because we need to reduce emissions of SVHCs.” In addition, she said: “We see that we have been a little too ambitious on some of the regulations in the permit and that we are running into technical limits.”

Her colleague explains: “As measuring and analysis techniques continue to improve, we are discovering more and more substances in the water. Of course, we want the quality of the water we are discharging to be good, but how far should you go? That is a trade-off we have to make. Should you put all your energy into those substances that are found in very small quantities or first make sure that those larger quantities are well regulated? Especially because the ecology and drinking water quality is now reasonably well guaranteed. We can’t do everything at once.”

Criticism in the media

The drinking water companies are satisfied with the current permit and the course of action by Circle Infra Partners, but there is a lot of criticism from the media, politicians and environmental organisations. “There is a perception that we pollute more, discharge more than other companies,” says Meeuwsen. “It is difficult to explain that you discharge 630 substances and that this is actually better than five groups of substances.”

Vanhommerig adds to this: “We’re still figuring out how to better explain that. For example, we want to engage more in a dialogue. In what form and with whom is still an ongoing search.”

Cold feet

RIWA-Meuse fears that, because the waste-water permit for Chemelot chemical park is so under fire, other companies will get cold feet and be reluctant to opt for a similar extensive discharge permit. “A justifiable fear,” Vanhommerig responds. “But to gain social acceptance, transparency is ultimately needed.”

The ambition of Circle Infra Partners is to eventually stop discharging harmful substances into the Meuse altogether and continue to reuse all the water. In other words: to make all processes circular. “Unfortunately, this will not be possible tomorrow, but hopefully will be in 20 or 30 years, depending on how fast technological development occurs,” says Vanhommerig. “We are aware that the environment will soon no longer accept the discharge of any substance, in any small quantity.”

Sharing the burden together

Both interviewees point out that even if the chemical industry stops discharging, many harmful substances will still end up in the water. “We understand that the water board wants us to continue to improve, but we argue that this should also apply to other types of discharges, such as from other industries, from farms and from municipal waste-water treatment plants.”

They would also like to see more shared responsibility within the chemical sector. “We are front-runners, which means we have to figure out a lot of things,” says Vanhommerig. “For that, we need a lot of people and have to incur a lot of costs.” This, she explains, is detrimental to the competitive position of the companies on the site and also to the investment climate: new users are being subjected to more stringent permit requirements than on other sites.

Finally, she says: “We don’t want to run away from this responsibility; we are all served by this, but other big dischargers can now ride along for free. We’d rather do that innovation together, learn from each other and share the costs.”

Water Management Company Limburg

B2 “We need to do more and more to keep drinking water quality up to par.”

Mirte van den Boogaard

Mirte van den Boogaard, Adviser for Environmental Management Water Quality at WML.

WML (Water Management Company Limburg) appealed against the new discharge permit of chemical company Prayon in Wallonia. The drinking water company prefers to meet with discharging companies, as in the Mutual Gains Approach meeting with Circle Infra Partners, says Mirte van den Boogaard of WML.

WML supplies drinking water to more than 560,000 private customers and almost 14,500 business customers in Limburg. Self-evidently, the sources for drinking water - the Meuse and groundwater - should be of the best possible quality. This is what Mirte van den Boogaard deals with, as Advisor for Environmental Management Water Quality.

“Governments manage our resources, so we need to work with them to ensure the quality of our resources,” she says. “We also seek cooperation with companies that discharge waste water into the surface water in the Meuse river basin.”

The water quality of the Meuse can fluctuate greatly, she also says. “Due to changing production processes of companies or calamities, other substances may be discharged into the river. At the same time, it may be due to the weather: if it has rained a lot, there is more water to dilute discharges than when the river is low.”

Appeal

Last September, WML submitted an appeal in Wallonia against the new discharge permits issued to Prayon, a Belgian chemical company that makes phosphate products such as plant food, fertiliser and baking products. “In their production process, a number of chemicals are released that cause difficulties for us when making drinking water,” says Van den Boogaard.

These are mainly di-isopropyl ether (DIPE) and tributyl phosphate (TBP). “These are substances that we absolutely do not want in our drinking water. So this does not belong in our sources either, because we don’t have to remove what’s not in them.”

Abstraction stops

If there is an excessive amount of certain substances in surface water, a drinking water company is not allowed to extract water for drinking water production, according to the Drinking Water Regulations. WML has regularly had such abstraction stops in recent years. In 2023 it was for 126 days, in 2022 for 218 days, and in 2021 for 184 days. Van den Boogaard: “The number of days with abstraction stops has increased in recent years. For us, that means intervening and adjusting all the time.”

Apart from increased discharges of harmful substances, this is because new techniques and innovation make it possible to measure more substances. “In addition, there is a connection with climate change,” explains Van den Boogaard. “It has been very dry for a couple of years, which reduced the dilution of contaminants by rain. We’ll see this more often in the future.” She also says that in 2022, there was an abstraction stop for a long period of time because of explosive algae growth. This was caused by a lack of flow in the Grensmaas (Border Meuse), a higher water temperature and high solar radiation. “The substances released in the process, neophytadiene and heptadecane, were only identified after several weeks. As long as the investigation was ongoing, the abstraction of Meuse water was stopped as a precautionary measure.”

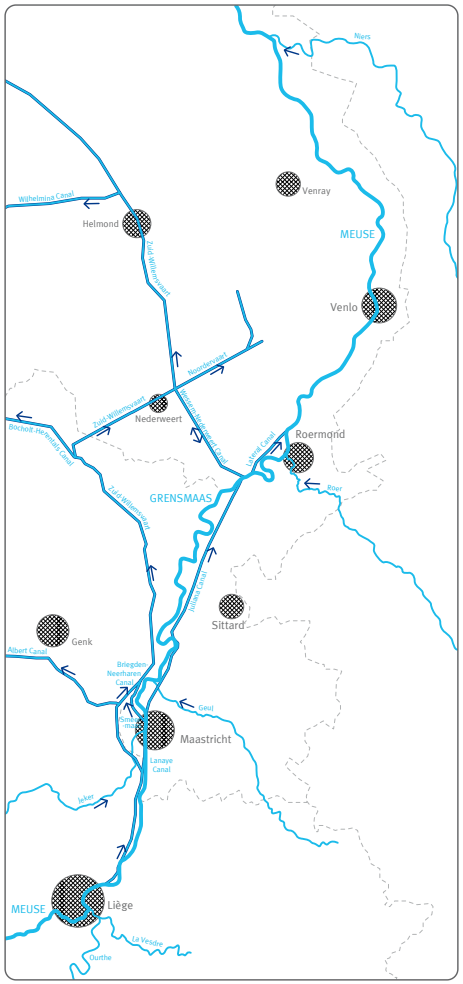
Groundwater

The drinking water company does not directly purify the water that WML pumps from the Meuse, she continues explaining. First, the water enters a large reservoir, where it is pumped up via the bank after about two years. A well-filled reservoir also serves as a buffer in case of an abstraction stop. When no more water from the reservoir can be used, WML switches to groundwater. However, drinking water companies are only allowed to pump up limited amounts of groundwater, as this could otherwise possibly have a negative impact on nature. The permits allow for little flexibility. “Basically we want to use the surface water as much as possible,” says Van den Boogaard. “Groundwater is more calcareous, so you have to inform customers about that. This is not unhealthy, but can cause limescale deposits on household appliances.”

Not future-proof

WML and Rijkswaterstaat discussed WML’s problem due to Prayon’s discharges with the Service Public de Wallonie (SPW), the public authority similar to Rijkswaterstaat that issues permits to Wallonian companies. However, Prayon’s new permit, issued in August 2023, was not a solution for WML. The drinking water company decided to appeal against the permit.

The permit states that Prayon is adapting a part of the plant, achieving a reduction of DIPE emissions from 300.9 tons to 88.8 tons per year from 2028. Van den Boogaard: “A big reduction, but unfortunately not enough, because even with that amount we have to shut off our abstraction at low Meuse flow rates.” She adds to this: “The permit states that the company will commit to further reduction of DIPE and TBP after 2028, but this is not specified.”



This new permit is valid for 20 years, until 2043. “The efforts to be made between 2028 and 2043 are unclear. In any case, a 20-year permit is extremely long,” Van den Boogaard believes, “especially at a time when a lot is in flux, both in the sector in which Prayon operates and in the drinking water sector. In short, the permit contains good intentions, but it is not concrete, enforceable and future-proof.”

Water Framework Directive

According to WML, the permit is also a violation of the Water Framework Directive. “The water that Prayon is discharging is classified as ‘not in good condition’ and should not deteriorate further,” explains WML’s adviser. “The European member states have agreed with each other that it should be possible to make drinking water from surface water with minimal interventions, and that is not possible with this kind of discharge.”

WML decided to appeal without involving other water companies and RIWA-Meuse, although they support the appeal, Van den Boogaard says. “WML is the only drinking water company with a direct interest in stopping these discharges. Our abstraction point is closest to Prayon’s discharge point. At the other drinking water companies, the contaminants have already dissipated or diluted to the extent that an abstraction stop is not necessary.”

Understanding each other

WML would rather avoid these kinds of legal processes. Therefore, the drinking water company is participating in the Mutual Gains Approach (MGA) on Circle Infra Partners’ discharge permit together with Circle Infra Partners (formerly Sitech Services BV), Evides, Dunea, Waterschap Limburg, the Province of Limburg, Het Waterlaboratorium and Rijkswaterstaat.

An MGA is a consultation about a particular permit, in which stakeholders meet regularly, with the idea of helping each other rather than getting in each other’s way. WML is very positive about it. Van den Boogaard: “We make arrangements in advance so that we get a permit that is workable for all parties. As a result, you don’t have to go down the legal route, or less so. Everyone serves their own interests, but they also have an understanding of each other.”

Finger on the pulse

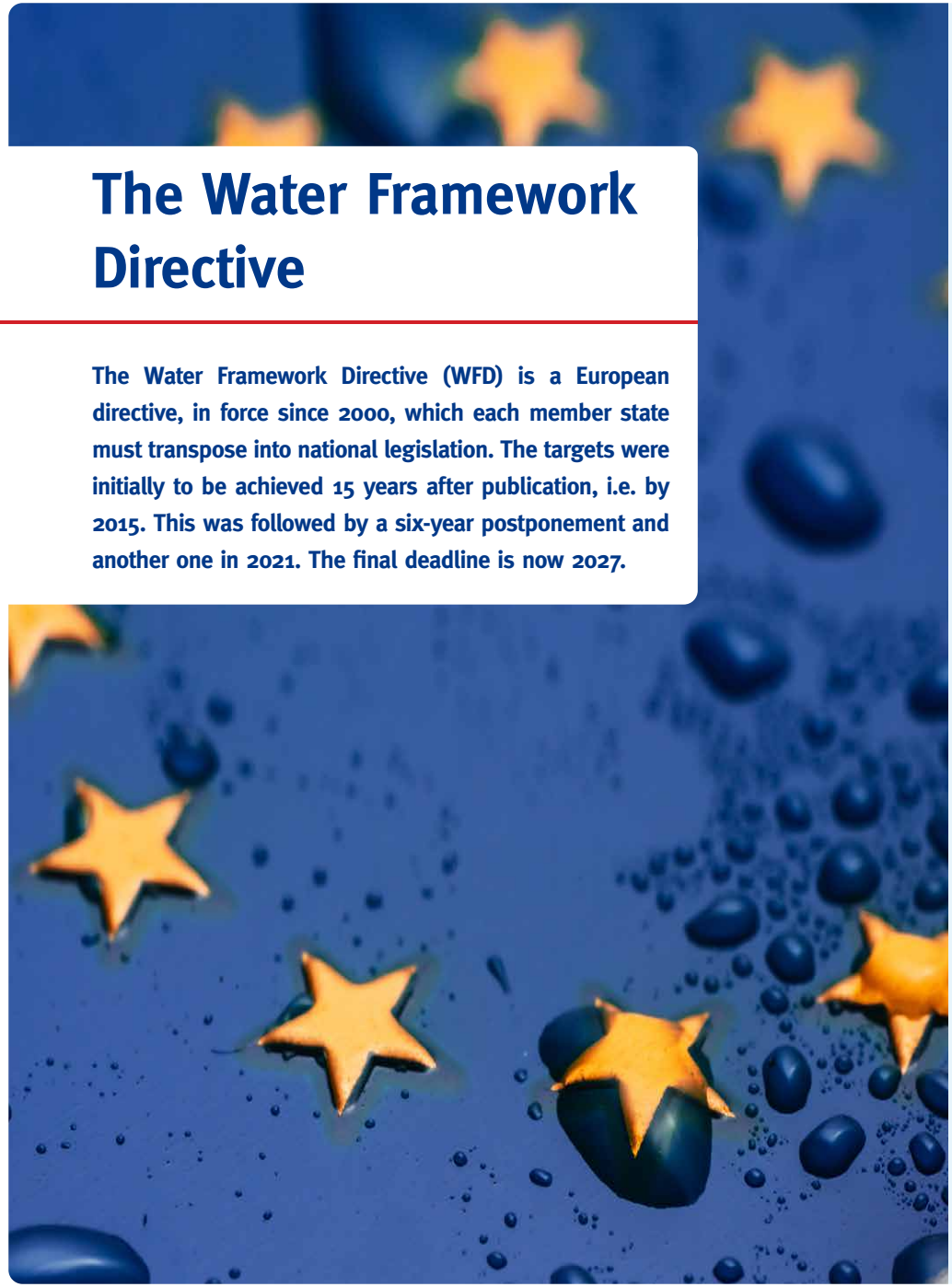
The consultation started around 2017 following the permit of Circle Infra Partners (then Sitech Services BV) from 2016, which WML also appealed against at the time. The new permit was published in 2020.

The new permit of Circle Infra Partners contains over 600 substances. Van den Boogaard points out that the company discharges many of the substances in such low concentrations that WML is not affected. However, for AMPA for example, one of the drinking water-relevant substances, the situation is different. It was regularly found at the abstraction point in concentrations higher than the norm, which forced the drinking water company to stop the abstraction of Meuse water. The permit has been in use for a number of years, but the parties involved still meet several times a year. “For example, this permit contains concrete requirements on the reduction of AMPA,” Van den Boogaard explains, “and states that the company will conduct research on microplastics. In such an MGA process you keep your finger on the pulse.”

More effort

A company may have to modify a permit at some point because new purification techniques are available, or more is known about certain substances, she further states. “The developments follow each other quickly, so it’s good to stay in a dialogue, and not just talk to each other when the permit needs to be changed.” She emphasises: “Of course, we would prefer not to have harmful substances in the surface water, but we try to look at this with a realistic eye. This approach allows us to have a better understanding of what is being discharged and to bring in our interests.”

In short, WML, like other drinking water companies, faces challenges regarding water quality. But, says Van den Boogaard: “The drinking water that we ultimately supply to our customers remains of very high quality and we are obliged to do this. And then, very clean, safe drinking water just comes out of the tap. But that takes a lot of effort, raw materials and energy. “We need to do more and more to keep quality up to par.”



The Water Framework Directive

The Water Framework Directive (WFD) is a European directive, in force since 2000, which each member state must transpose into national legislation. The targets were initially to be achieved 15 years after publication, i.e. by 2015. This was followed by a six-year postponement and another one in 2021. The final deadline is now 2027.

The WFD is a follow-up to previous European Union directives from the 1970s onwards. They all took a different approach. One regulated that member states should not discharge hazardous substances, while the other regulated the quality that water has to meet in order to extract drinking water or if you want to swim in it. Other directives dealt with nitrate pollution from agriculture, pollution from industry or the treatment of urban waste water. As a result, it was a kind of patchwork of directives, while water quality did not improve sufficiently. The WFD brought together many of these directives.

Ecology

The overall objective of the WFD is to ensure that all water in the European Union is in good condition and that there are healthy, resilient ecosystems. There should also be fish and plantlife and natural banks, for example, and sustainable use for current and future generations. This is a different approach from before, when only a maximum of toxic substances that could be discharged was considered.

In order to ensure that water is in good condition and that there are healthy resilient ecosystems, a lot had to be figured out first. Answers were needed to questions such as, ‘what measures should you take to improve the ecology?’, and ‘Are they having the effect you hope for?’ For example, are certain amphibians, plants and fish actually returning? Questions about the interpretation of certain wording and obligations have long caused ambiguity. In the meantime, the European Court of Justice has provided answers to a number of questions. For example, it has recently become clear that the environmental targets only apply to designated WFD water bodies, because the obligation to characterise waters and to have a monitoring system for them applies only to designated water bodies.

Environmental objectives

The environmental objectives are further elaborated in Article 4 of the WFD, which contains many different obligations and opportunities to invoke an exemption, which is justified for each water body. These include a good chemical status for surface water and groundwater, a good ecological status for surface water and a good quantitative status for groundwater. If more than one target applies simultaneously, the most stringent target applies; for example when WFD targets are combined with targets for protected areas from which drinking water is abstracted or areas designated under the Nature Protection Directives.

The WFD is characterised by an integrated approach, both internally within water system management and externally through coordination with measures in other policy areas, such as agriculture (fertilisers and pesticides) and nature. Additional stringent requirements apply to water bodies from which drinking water companies extract water. The WFD is based on a combined emission-immission approach for all discharges, which must include the effects of diffuse sources.

No-deterioration obligation and improvement obligation

The WFD includes a no-deterioration obligation and an improvement obligation. These are two separate and substantially different obligations and these obligations apply only to designated WFD water bodies. The no-deterioration and improvement obligations apply at every stage of the procedure laid down by the Directive, such as river basin management plans, programmes of measures and the implementation measures and the granting of authorisations. The test for the no-deterioration and improvement obligations must be carried out in advance and on a project-by-project basis.

To the extent that projects violate the non-deterioration and improvement obligations, authorisation must be refused (barring a justified invocation of one of the exceptions). The no-deterioration obligation also applies to temporary deterioration. Activities in non-designated WFD bodies of water that may affect the quality of designated bodies of water or that interfere with the achievement of the objectives must also be assessed and regulated. Furthermore, the measures as included in the programme of measures for the entire river basin should be implemented as a matter of course because this is how the member states believe they can meet the WFD objectives.

“Waterbodies in the EU have to be in good status for healthy and resilient ecosystems to exist.”

Priority substances

In October 2022, the European Commission adopted a proposal to revise the lists of pollutants in surface water and groundwater. If the proposal is adopted by the Council and the European Parliament, member states will have to take measures to comply with the quality standards for the additional pollutants and to make their monitoring data available more frequently.

Of the 70 substances and substance groups included in the proposal, measurement data for 57 are available in 2023 in the Meuse database. Of these 57 substances, five exceeded or equalled the ERM target value in 2023: 1,2-dichloroethane, DEHP, glyphosate, HCB and bisphenol-A (see Annex 1). None of the measurements of these 57 substances was above the maximum environmental quality standard. For seven substances, the maximum value was at or above the annual average environmental quality standard in the proposal: so these are not breaches. These are 1,2-dichloroethane, glyphosate, diclofenac, PFOS, lead, nickel and bisphenol-A.

Utrecht University

B3 “It is important to get as close as possible to the objectives of the Water Framework Directive.”

Marleen van Rijswick

Marleen van Rijswick, Professor of European and National Water Law at Utrecht University.

The objectives of the Water Framework Directive (WFD) need to be achieved by 2027. Why are we not going to meet these targets and what are the consequences, including for the Meuse? Professor Marleen van Rijswick of Utrecht University talks about her view on this ‘vitriolic issue’.

In a few years – by 2027 – European countries are obligated to have met the objectives of the Water Framework Directive (WFD, see box), save in exceptional cases. Marleen van Rijswick: “That’s why everyone is getting so nervous right now.” As Professor of European and National Water Law at Utrecht University, she focuses on how law can contribute to equitable and sustainable water management based on shared responsibilities.

The objectives of the WFD revolve around water in the European Union that is in good condition and, in addition, that there must be healthy, resilient ecosystems. There have already been two postponements: the targets were to be achieved first in 2015 and then in 2021. The Netherlands, like the rest of the European member states, did not meet the earlier deadlines. “A bit surprising,” Van Rijswick says, “because most of the obligations were already laid out in directives that we had from the 70s, 80s and 90s. The only real new element is the ecosystem mindset.”

Digging in heels

Unfortunately, it is already clear that the Netherlands is not going to meet the targets in 2027 either, just like many other countries. “There is too little time for everything that still needs to be done.” This is evident from recent reports by the Council for the Environment and Witteveen and Bos. “The nutrient problem in particular, the amount of fertilisers on the land, is too complicated. Furthermore, the waste-water treatment plants, our own excrement, are an issue. Medicine residues and other new substances are not yet well controlled or regulated either.”

Marleen van Rijswick received her PhD in 2001 for a study on legal instruments to improve water quality and has been following the Water Framework Directive

since its inception. She points to the Aquarein report[12] published by Wageningen University in 2003 on behalf of the Ministry of Agriculture, Nature and Food Quality. “The authors had investigated what it would mean if the Netherlands met all the objectives in 2015 and all waters were considered natural waters. They assumed a worst-case scenario, which was a far cry from reality. The conclusion was that agriculture would no longer be possible in the Netherlands. Then everyone dug in their heels.”

Besides fertilisers polluting the water, Van Rijswick mentions pesticides and, in that context, the recent proposal to ban glyphosate, but that it can now still be used for the next 10 years. “Also, the Nature Restoration Act which is on hold for now could be very helpful in achieving good water quality. Things like that obviously don’t help you meet your goals in time.”

No sacrifices

While we have met the deadline for a lot of chemicals, that is not yet the case for some of them, Van Rijswick explains. “The so-called ‘one out, all out principle’: if you fail to comply for one substance, then you have not met the WFD targets. This is, of course, a bit discouraging for people who have put in a lot of effort. On the other hand, we have to be careful not to paralyse ourselves and give up.”

Furthermore, new chemicals are coming on to the market all the time and there is no immediate legislation for them. It is still unknown exactly how harmful these are, and standardisation takes time. “You have to do that very carefully. In the meantime, these new substances naturally result in poorer water quality.”

That it is so difficult to meet the targets, the professor attributes in part to the strong lobby: “People are not willing to make those sacrifices. Not just farmers or industry, but especially politicians. The main political trend now is: please, let us not put anything in anyone’s way. Do not hamper economic activities or restrict agriculture.’

Who discharges where and what

Van Rijswick also points to the fact that there is no good, up-to-date overview of the permits granted: who discharges what and where. “That is a very worrying aspect. Because if you don’t know what harmful substances are getting into the water, then you don’t know what is needed to tackle the issue.”

We don’t know enough about the indirect discharges in particular, she also says. The permits issued by Rijkswaterstaat and the water boards are called the direct discharges: these go directly into the rivers, for example the Meuse or the tributaries. In addition, you have regulation of discharges by municipalities, by means of general rules or permits: the indirect discharges that first enter the sewage and are treated, only then making their way into the rivers. “Many municipalities do not know exactly what companies are discharging. In addition, Rijkswaterstaat and the water boards don’t have a clear picture of what exactly has been authorised and these permits are often outdated.” In view of the targets to be met for the Water Framework Directive, the Ministry of Infrastructure and Water Management did launch the ‘WFD Impulse Programme’ last year to map and update Rijkswaterstaat’s permits, among other things.

No political urgency

The reason for these delays? Van Rijswick: “A major lack of capacity for monitoring and enforcement. And, of course, supervision and enforcement has not really been given political priority in recent decades. As a result, there is no money to spend time on this, to develop knowledge and to train and hire people for it. If it is not a priority, it does not happen.” She adds to this: “I do think that in recent times we have been so lax and careless with our living environment that there are now huge backlogs, so that one crisis follows another.”

RIWA-Meuse has started making a list of direct and indirect permits in an Excel file. Van Rijswick: “This is very positive. It’s a very important first step. Environmental organisations would of course very much like to have this list.” In addition, she said: “Actually, the government ought to do this. We have legislati-

12 *https://edepot.wur.nl/41380*

on which says that these permits are public, and the WFD also requires that permits be up to date. You should actually be able to refer to them very easily."

Fines and periodic penalty payments

What if we indeed fail to meet the targets? Van Rijswick: "First of all, Europe's goal is to have sufficient healthy water. When our water quality deteriorates, it is naturally detrimental to human health and nature. This is the main argument for wanting to meet the WFD objectives, but it often gets too little attention."

In addition, the European Commission can take a Member State to the European Court of Justice. If the targets are not met, a Member State can invoke exceptions provided for in the WFD, van Rijswick explains. For example, if there is force majeure, such as extreme weather. Or if it is necessary to build dykes or dams to generate renewable energy or if, for example, the restoration of brooks is necessary. "Then the quality goes down for a while at first. If you have good reasons, you can invoke an exception."

If there are no grounds to invoke an exception, the court can issue an order against a country. "That may only be a piece of paper, but it doesn't look good and you need to do something about it." After all, a Member State can also face fines and periodic penalty payments. For the Netherlands, this involves a fine of up to € 40 million per year and a penalty of up to € 219,170.40 per day. Van Rijswick: "Of course, that's definitely going to add up."

Legal cases against companies

If the targets are not met by 2027, environmental organisations and other parties can also submit appeals against permits. This can already be done today if there is a deterioration in water quality. "That's even more risky, because then you'll end up in the national court," says Van Rijswick. "And then a company may be denied a permit because standards have been exceeded and no further pollution is allowed. This has all kinds of negative effects on the economy and can lead to unfair distribution of the burden due to failure to comply in time." These kinds of lawsuits are already being prepared, she says, by, for example, the Dutch organisation Mobilisation for the Environment (MOB), which previously fought and won lawsuits over nitrogen emissions.

Will this also affect companies in the other countries that the Meuse river basin crosses? "Yes, it will" van Rijswick responds. The Netherlands recently launched a lawsuit against Flanders for discharges into the Scheldt River that flow into the Netherlands. And the Belgian government has just started a case against the Netherlands over discharges from Chemelot into the Meuse near Sittard-Geleen. "This is why international cooperation is so hugely important. When you consider that a third of the pollution in the Meuse originates outside the Netherlands, more attention should be paid to this, even though we are responsible for most of the pollution. In short, you need to approach the problem from both sides."

The WFD includes the obligation for countries sharing a river basin, as is the case with the Meuse, to cooperate. "We should no longer just look at where specific pollution occurs, but at the entire river basin, mapping the sources of pollution and how we can tackle them together."

Continual postponement

The Netherlands has in fact planned to make full use of the extensions of the WFD from the beginning, Van Rijswick knows. The other countries have also taken advantage of the possibilities for postponement. "This continual postponement has led to many years of delay: discussing what kind of obligation it is, whether it is feasible and affordable and looking for makeshift solutions have proved counterproductive to meet the goals on time."

In addition, she said: "If everyone had just accepted their own responsibility, instead of pointing the finger at each other we would obviously have been much further ahead." The fact that so many parties are responsible for water quality does not help: the water boards, Rijkswaterstaat, the Ministry of Agriculture, Nature and Food Quality, municipalities, provincial authorities and companies.

Accepting responsibility

Van Rijswick has been working on the Water Framework Directive (WFD) for about 25 years. “It has proved to be a very prickly issue,” she says. “And that’s partly because we Dutch are very spoiled. We live in a delta that is very dangerous, but we all feel safe because the government is constantly investing in water safety. The same applies to our drinking water. We can drink water from the tap, swim outside in summer without fear of catching nasty diseases. In many countries this is not the case. We lack a sense of urgency. Not only people, but unfortunately also the government, which after all is responsible for ensuring a healthy environment and the health of citizens.”

Nevertheless, she believes we should now do everything possible to get as close as possible to WFD targets. “We all have to accept that responsibility. All those involved. Also because the court will look differently at a country that has done a lot to achieve the objectives than a country that keeps trying to get out from under the agreements made. And maybe we will meet those targets a few years after 2027.”

The Meuse at Ravenstein.

Gaining control over discharges of wastewater

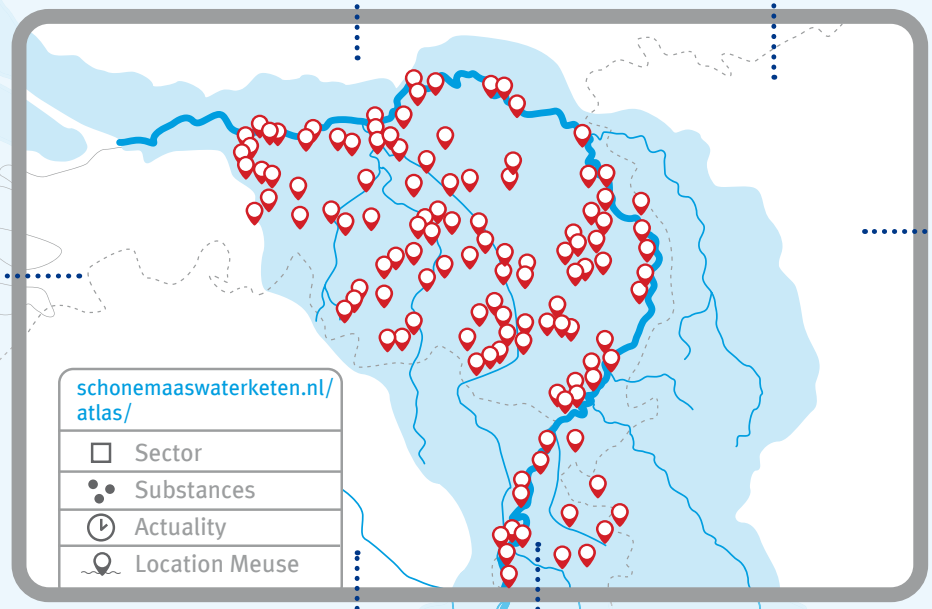
WHY

? Protection of the water quality

- Reduction of harmful emissions
- Relation between water quality & availability
- Quickly detect and resolve incidents

EVERY PERMIT

- Complete
- Transparent
- Current/Up-to-date



ALWAYS IMPORTANT

1. Know what you're emitting
2. Know what you're permitting
3. Supervision + enforcement

Ruling of the Dutch Council of State
What is not permitted, can not be discharged.
2019

NEEDED

- Total overview of permitted wastewater discharges
- Ensure climate-proof discharge permits of wastewater
- International dialogue and agreements on water usage and distribution

MAPPING ALL PERMITS

- Direct: RWS + Water board
- Indirect: province + municipality
- All notifications

GOAL

A clean and safe environment

- Everyone has to take responsibility
- Legal obligation
- Realisation of the WFD goals in 2027 and beyond

C

Climate change

Deltares

C1. “According to all scenarios, the Meuse will be lower in the summer.”

Frederiek Sperna Weiland

Frederiek Sperna Weiland, Senior Adviser at Deltares.

How much water will flow through the Meuse during the different seasons in the future? Deltares investigated this based on the KNMI 2023 climate scenarios. All scenarios show that less water can be expected in the summer. Frederiek Sperna Weiland of Deltares explains further.

By the end of this century, between 10% and 30% less water is expected to flow through the Meuse in summer than now. This is according to research by Frederiek Sperna Weiland, senior adviser on climate change analysis in flooding, drought and water availability.

Last year, the Royal Netherlands Meteorological Institute (KNMI) released the 2023 climate scenarios. In them, KNMI translated the findings of the sixth report of the Intergovernmental Panel on Climate Change (IPCC) for the years 2050, 2100 and 2150 to the Netherlands.

Deltares then used the KNMI scenarios to analyse what this means for the flow regime of the Meuse and Rhine at these dates, the amount of water flowing through the river by season. The study was commissioned by the Ministry of Infrastructure and Water and conducted jointly with KNMI and Rijkswaterstaat. Frederiek Sperna Weiland led the research on these national flow scenarios, as in 2014, when KNMI’s 2014 climate scenarios came out after the fifth IPCC report was published.

Wet or dry

The Meuse and Rhine are the most important rivers for the Netherlands, she says. “We therefore wanted to know: how are these flow rates going to change according to the new climate scenarios? And secondly, how do those changes compare to what we had previously determined with KNMI ‘14?” The main conclusion of the sixth IPCC report is that we are starting to see changes all over the world owing to climate change. She summarises: “It’s very likely going to get drier in many parts of the world. Like in the southern half of Europe.”

The Netherlands is a bit in the middle in this respect: it is less clear whether it will become drier or wetter here. “This gives an extra incentive to do an analysis specifically for the Meuse and the Rhine,” she considers.

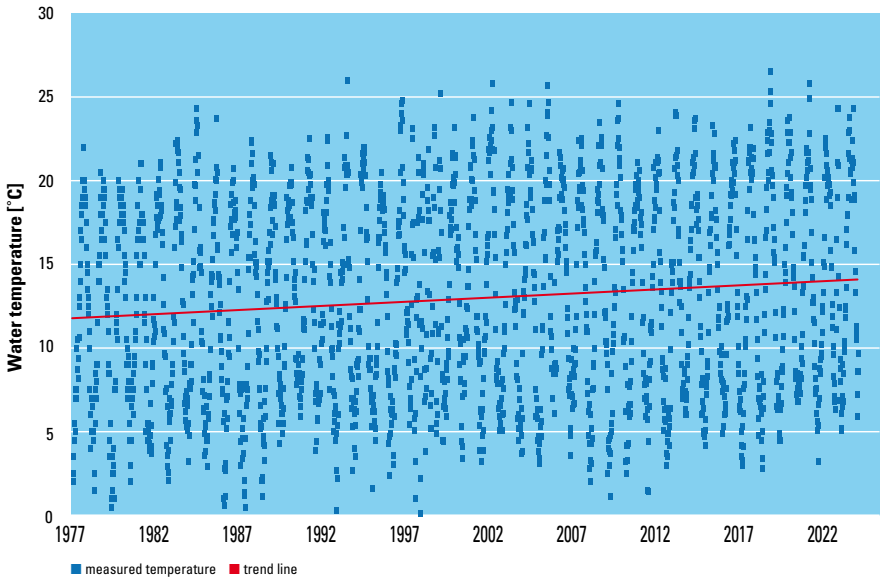


Figure 10: Water temperature in the Bergsche Maas 1977-2023.

Soil and plants

Researchers at Deltares looked at changes in the entire Meuse river basin upstream of the Dutch border in France, Luxembourg and Belgium to determine how much water enters the Netherlands. “KNMI determined the temperature and precipitation, and we then used our water models to investigate what that means for both rivers,” explains Sperna Weiland. “In the results, we see that the increase in winter precipitation causes an increase in the flow rate of the Meuse in winter. But the decrease in summer precipitation and the fact that precipitation falls more as heavy showers will make the low-water flow even lower. This is not helped by the fact that temperatures are rising, causing more water to evaporate in the river basin.”

Into these hydrological computer models, the researchers put all the characteristics of these two rivers and their tributaries: data on soils, vegetation, the river network and how that affects water availability. In doing so, they looked only at the impact of climate change: how does precipitation and therefore the supply of water change? “The influence of human activities has not yet been included in this study,” says Sperna Weiland. “Changing water use upstream and in the Netherlands, and modified barrage management will also affect the lowest flow rates and could turn out both positive and negative for the Netherlands.”

Low and high water

The main difference between the Rhine and the Meuse is that, unlike the Meuse, the Rhine flows partly through high mountains, with snow and glaciers, says Sperna Weiland. “In the Rhine, we are going to see a lot of change as temperatures start to rise. As a result, there is less meltwater flowing through the Rhine from the Alps into the Netherlands.”

She adds that the Meuse is a rain river and here the flow is directly affected by the amount of rainfall in the river basin. “A prolonged dry period greatly affects the flow rate in the Meuse, especially when dry periods occur more frequently in succession and last longer. This is because less groundwater flows out into the river basin.”

The researchers looked not only at low water due to drought but also at high water – as it rains heavily, how often and to what extent floods occur change too. They are still calculating the impact on the amount of water in the rivers, including the evaluation of dyke heights.

Much or little CO_2

Deltares works with a total of six CO_2 emission scenarios from the KNMI: one is low, one medium and one high – for each scenario there is a dry and a wet variant. If emissions are low, a high level of sustainability has been achieved, and if emissions are high, only a low level.

The latest scenarios assume little change in the Meuse in terms of average annual flow. But in summer, things are different. Sperna Weiland: “In all scenarios, the weekly flow goes down in summer. The models agree that it will become drier in summer anyway.”

10-30% less

Under the high emission scenario, and the dry variant of it, the researchers expect that in a week with low water relative to the current situation, almost 30% less water will flow through the Meuse by the end of this century (see Figure 11). The low emission scenario and the wet variant involve 5% less water. This is similar in the Rhine. But it might even go down a little more there: around 35%.

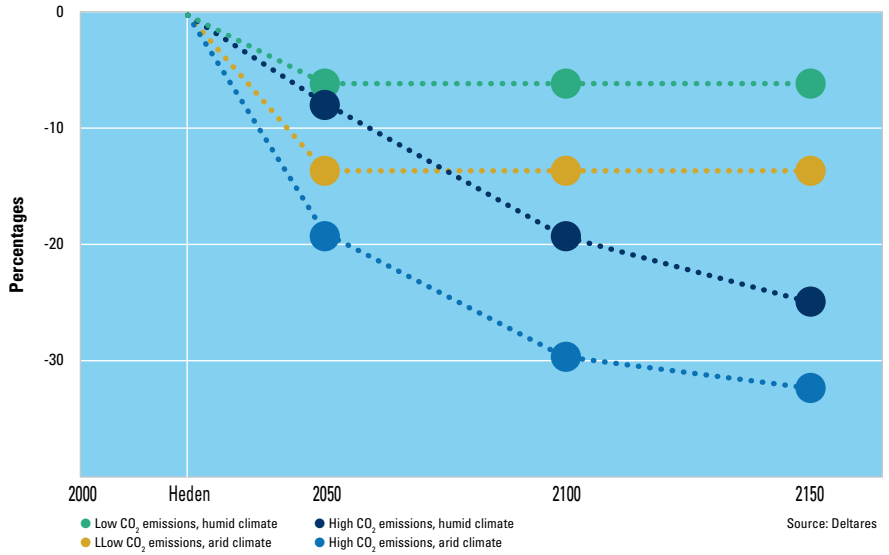


Figure 11: Expected relative change of 7-day minimum flow in Meuse.

In the 2014 KNMI climate scenarios, there were still a number of scenarios that assumed that it might get wetter and there would be a small increase in the Meuse flow rate. But in addition, the idea was that summers would be even drier than current forecasts and even less water would flow through the Meuse. “In that sense, it’s a windfall for the Meuse that it is unlikely to get that much drier,” says Sperna Weiland.

Drinking water, agriculture, shipping

What are the consequences of less water flowing through the Meuse in summer? “The pressure on the water will rise,” responds Sperna Weiland. “That applies to drinking water, agriculture, shipping and other sectors. When there are long periods with low flow rates, we really start to notice problems.”

According to the 2023 KNMI climate scenarios, heat waves will also become more frequent and more severe in the Netherlands in the future. These changes in high temperatures are also included in the hydrological modelling and cause an increase in evaporation and a further reduction in the flow.

Water quality

How long can those periods of low water last? What exactly will be the impact for all these sectors that use water? And what are the actual implications for water quality? These essential questions will be further investigated in the National Water Model of the DELTA programme of the Ministry of Infrastructure and Water Management.

Sperna Weiland: “Less water will obviously have no positive impact in any event: the water becomes more concentrated, pollutants less diluted and the water temperature goes up. As a result, the oxygen in the water decreases. That is not good for the ecology, for the fish and plants.”

Drying up

In Italy, the River Po completely dried up in 2023. Will it get as bad for us in the coming decades - is this a scenario we should consider for the Meuse too? “Of course, the Meuse, like the Po, is highly dependent on precipitation,” Sperna Weiland responds. “But there is definitely a difference between southern and northern Europe. In the south, it is probably going to be drier than where we are.”

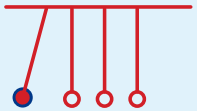
“International agreements can help to manage our water resources effectively and in a sustainable way”.

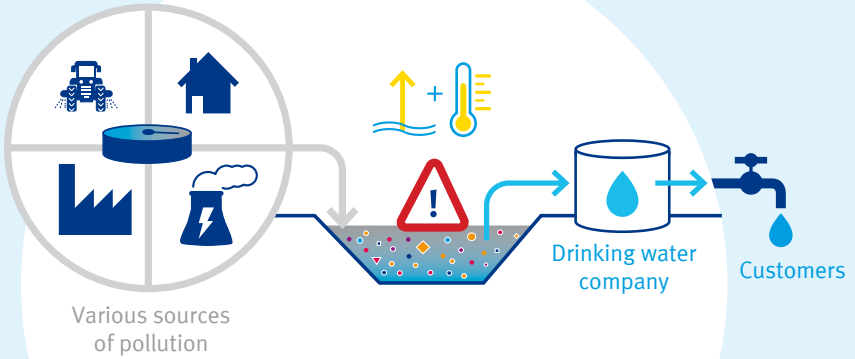
She also mentions the fact that there is a treaty on the distribution of water between the Netherlands and Flanders, which clarifies the distribution of water brought from Wallonia and shared between the Netherlands and Flanders. “There are reservoirs upstream to keep the water level up in the rivers. In short, I’m not very afraid that the Meuse will run completely dry.”

International cooperation

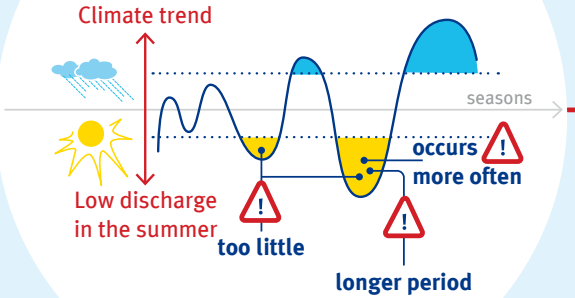
She points to the increasing importance of such international agreements and treaties to ensure that countries in the Meuse river basin also take into the account the interests of other countries in their water management and help ensure a minimum flow rate. It is important to consider the interests of different sectors. “Reservoir management in Wallonia and Germany can potentially contribute to a basic flow in the Meuse, and with good international agreements on water use, we can use water optimally and as sustainably as possible. This international coordination calls for further international research and more cooperation.”

Effects of climate change





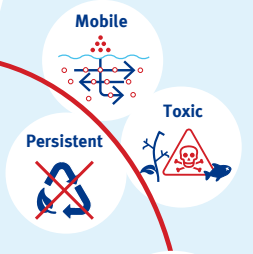
FUTURE
Scenarios KNMI'23

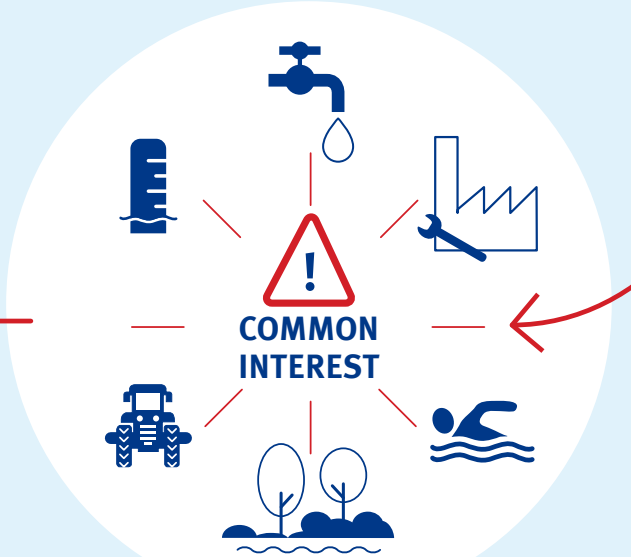


WATER SHORTAGE

DETERIORATION WATER QUALITY

- Increasing water temperature
- Less dilution, more pollution
- Increasing concentration of PMT-substances





Wageningen University & Research

C2. “Power plants and shipping are particularly affected by low river flows.”

Floor Hermans

Floor Hermans of Wageningen University & Research (WUR)

How will climate change affect the flow regime of the Meuse? How much water will still flow through the river in the coming decades and in which economic sectors can we expect issues in particular? The now-graduated Floor Hermans talks about the results of her graduation internship.

Last year, KNMI published the 2023 KNMI climate scenarios for the years 2050, 2100 and 2150. In them, the organisation translated what the findings of the sixth report of the United Nations Intergovernmental Panel on Climate Change (IPCC) mean for the Netherlands. As mentioned in the previous article, Deltares used these KNMI scenarios to analyse the impact of climate change on the Meuse flow regime: the amount of water flowing through the Meuse in a given period.

With these insights, Floor Hermans of Wageningen University & Research (WUR), working with research firm HKV Lijn in Water and RIWA-Meuse, investigated what these flow regimes could mean for the various users of Meuse water. Indeed, climate change is expected to make the flow regime more extreme: in wetter winters much more water will flow through the Meuse and in drier summers much less.

Issues

For her research, Hermans, who specialises in hydrology and water management, looked at where issues may start to arise in the river basin, and also which economic sectors would suffer. “This way, we can see what we should focus on in the future.”

The study focused on the Franco-Belgian part of the Meuse river basin. This upstream part of the Meuse obviously has a lot of influence on the situation in Flanders and the Netherlands. Hermans zoomed in on 40 locations. Of these, 13 are designated as problematic with the current climate. This means that at least one day a year less water is available than needed for all sectors and groups that use water. Under all the scenarios calculated, not only does the number of issues increase, the water shortage itself also worsens.

Lower flow rate

The KNMI works with six different scenarios in 2050, 2100 and 2150. The scenarios vary and depend on the amount of CO_2 we continue to emit, Hermans explains. There is a low, moderate and high scenario and there is a wet and a dry version for each scenario. “One extreme is when our winters become significantly wetter and the other extreme is when summers become very dry.” The scenarios are all possible futures - there is no single, most-likely scenario.

Hermans also compared the 2014 and 2023 KNMI climate scenarios in her study. “The old scenarios showed a much wider distribution in the minimum flow,” she says. “Now we know that the minimum flow is getting lower in any event because of climate change. All scenarios now show a decline, but it is less extreme than in the old scenarios. So it’s not too bad.”

The study showed that the number of issues will increase in the future. And especially in the dry scenarios. The higher the emissions scenario, the greater the water shortage and therefore the more extreme the problems.

What do the sectors use?

The RIBASIM model (RIver BAsin SImulation Model) for the Meuse River was used for the study. This was developed in 2022 by Deltares on behalf of RIWA-Meuse, Rijkswaterstaat and the drinking water companies. Hermans explains: “RIBASIM is a water equilibrium model. I looked at how much water goes in and out under different climate scenarios.”

In doing so, she examined both the effect of climate change on the number of problems, more or less rainfall and what that means for the flow rates, as well as the abstractions. In other words, how much water different sectors use: agriculture, industry, energy, shipping and drinking water consumers. To do so, she used data from the 2017 Delta scenarios. These scenarios, provided by Deltares and others, give a picture of how much water these sectors use, what the consequences of climate change will be in 2050 and what problems they will pose for these sectors.

Energy and shipping

Two issues stood out in particular in the study by Hermans and her colleagues. First, power plants. These use the largest amount of Meuse water, namely as cooling water, although they eventually discharge most of the water back into the river. Hermans: “When little water flows through the river, power plants may not have enough water for cooling. Or the temperature of the water could be too high.” In this context, she points to the importance of developments in the energy sector: “By using more solar and wind energy and less fossil fuels, you will reduce the water consumption by the current power plants.”

The second major issues lies in shipping. “The locks in the Flemish canals are already faced with water shortages,” says Hermans. “Low water flows compromise the proper functioning of the locks.”

The Nete Canal (Flanders) is a bottleneck for drinking water, the study also found. “In the current climate, this is already a bottleneck, but under the dry scenarios it will become a serious bottleneck.” It means the demand for water will be as much as twice the supply.

Water quality

Hermans thinks her research provides good initial insights into where problems are going to occur. But, she says: “This study dealt with issues relating to water quantity, not the impact of climate change on water quality. If you have little water, the concentration of dissolved substances obviously increases, because there is much less dilution. That in turn creates other kinds of problems.” She therefore recommends follow-up research on water quality issues.

In a follow-up study, Deltares will first look at what issues there are in the amount of water in the Dutch part of the Meuse river basin. This study will be based on a new version of the RIBASIM model. It will also takes into account the groundwater that agriculture uses extensively. “If you extract a lot of groundwater, the groundwater flow to the river decreases,” explains Hermans. “That may affect the bottlenecks. Possibly more than we have mapped out now.”

Hermans expects the bottleneck analysis to be useful in discussions on water availability with the various users of the Meuse water. “Hopefully, with this overview, we can start an international dialogue on how to tackle these problems together,” she said.

Want to read more about this research? Read it on the RIWA-Meuse website[13].

Sampling in 1982 near the source of the Meuse in Val-de-Meuse, France.

13 https://www.riwa-maas.org/en/publicatie/water-availability-bottlenecks-in-the-french-belgian-meuse-catchment/

Wet, dry and hot

several weather records broken

According to the Royal Netherlands Meteorological Institute (KNMI), 2023 was the wettest and warmest year since measurements began in the Netherlands in 1901. An average of 1060 mm of rain fell in the Netherlands – the normal amount is 795 mm. With an average temperature of 11.8°C, 2023 was the hottest year since 1901. It was also a very sunny year: there was a record amount of sunshine in June.

Several weather records were also broken in Belgium in 2023, reports the Royal Meteorological Institute of Belgium (KMI). There was more rain than normal and, according to measurements in the town of Ukkel, 2023 was the third hottest year since observations began in 1833. Moreover, according to the World Meteorological Organization (WMO), 2023 was the hottest year worldwide since observations began in 1860.

So for Belgium, like the Netherlands, 2023 was a wet year: a total of 1011.4 mm (normally: 837.1 mm) fell in Ukkel. This amount fell during 207 days (normally: 189.8 days). With this amount of rainfall, 2023 ranked fourth after 2001 (1088.5 mm), 2002 (1077.8 mm) and 2021 (1038.8 mm). But if you look at the earlier measurements (since 1833), 2023 is not in Belgium's top 10 wettest years.

Sunshine

It was a sunny year in the Netherlands. The sun shone for an average of 1913 hours, compared to the normal average of 1774 hours. Especially in June, the sun shone a lot. This combination of an extremely wet and very sunny year is extraordinary. Earlier wet years usually passed without much sunshine. With an average temperature of 18.4°C, the summer entered the top 10 hottest summers since records began in 1901. June was the hottest and sunniest June month since 1901.

In 2023, the sun shone in Belgium (Ukkel) for 1610 hours and 19 minutes (normally: 1603 hours and 40 minutes). There were four months that were sunnier than average: February, May, June and September. In all other months, the sun shone less than average. However, June was the sunniest June month since observations began in 1887. The sun shone for 307 hours and 50 minutes in Ukkel (normally: 199 hours and 16 minutes). The previous record was from 1976 (302 hours and 17 minutes).

Record drought in wettest year

Never before this century has the Netherlands been as dry as this year. On the other hand, 2023 was the wettest year since measurements began in 1906. How can that be? Because wet and dry periods alternated. Both spring and summer were dry. Both seasons were sunny, so there was a lot of evaporation. Moreover, there was little precipitation in summer. Still, 2023 was less dry than previous years. However, the national precipitation deficit in the summer half-year reached a maximum value of 318 millimetres, twice as much as normal, and at that time the summer season was among the 5% driest years. But by the end of September, the deficit stood at around 120 mm, which is not exceptional.

"2023 was a year with several records: wet, dry and warm."

Sources:
https://www.meteo.be/resources/climatology/pdf/klimatologisch_jaaroverzicht_2023.pdf
https://www.knmi.nl/over-het-knmi/nieuws/weeroverzicht-2023
https://www.knmi.nl/over-het-knmi/nieuws/droge-zomerhalfjaar-van-2022/
https://www.knmi.nl/over-het-knmi/nieuws/knmi23klimaatscenario-s

Utrecht University

C4 “Owing to drought, there is less water available to dilute contaminants.”

Michelle van Vliet:

Michelle van Vliet, Professor of Water Quality and Sustainable Water Systems at Utrecht University.

What are the effects of droughts and heat waves on the water quality of rivers worldwide, including the Meuse? Michelle van Vliet, Professor of Water Quality and Sustainable Water Systems at Utrecht University, is researching this. She talks about the results and what she thinks needs to be done.

Globally, 30% of the population is suffering from water shortage. This percentage is as much as 40% of the world’s population if we take into account water quality, in addition to the amount of water needed by different sectors. This is according to research by Michelle van Vliet from the Department of Physical Geography at the Faculty of Geosciences, Utrecht University.

She and her colleagues developed a water scarcity concept in which water quality is included in the calculations. “Many studies on water scarcity only look at the amount of water: how much water do we need and how much is available?” she explains. “We also included quality and the quality requirements by sector.”

Quality requirements by sector

In many parts of the world, including the Netherlands, the quality of water in rivers is not good. “Climate change only aggravates this,” says Van Vliet. Her research focuses on the effects that global changes have on the availability and demand for good-quality water. In addition to climate change, the growing world population plays an important role. The demand for clean water is increasing, but at the same time more pollutants are entering our water, especially in areas with little waste-water treatment.

Apart from households, much water is used in agriculture, mainly for irrigating crops and additionally for livestock farming. Furthermore, companies and industries use large amounts of water, as does the power sector for cooling power plants. The researchers also looked at the quality requirements of different sectors and when water scarcity exists for each sector. For example, for irrigating crops in agriculture, there cannot be too much salt in the water and, for the energy sector, the water temperature cannot be too high.

Increase in chemicals

The study found that large parts of the world suffer from poor water quality. However, the type of water quality problems varies globally, Van Vliet observed. For instance, developing countries are especially struggling with organic pollutants and pathogens in water, often caused by poor sanitation and leaky sewers. Due to limited capabilities to purify water, such concentrations are too high in large parts of Asia, Africa and South America.

In affluent countries, the main issue is the huge rise of man-made substances, she says, such as pesticides, medicine residues and PFAS (per- and polyfluoroalkyl substances). “These are often difficult to remove or it is expensive to purify the water. There is a lot of focus on this and rightly so.”

Less dilution

The study further revealed that water demand increases especially when there is both a drought and a heat wave. “Both are expected to become more frequent and extreme globally due to climate change,” says Van Vliet. “This means that less water flows through rivers, including the Meuse, in summer, while the demand for water is likely higher: this means there is an imbalance between the availability of good-quality water relative to the demand.”

At the same time, water quality is often worse during these periods of drought, she says, as there is less water to dilute contaminants. “Salinity and concentrations of pollutants that are difficult to degrade then increase. As a result, water quality standards are increasingly being breached.” This is mainly due to discharges from industry and from waste-water treatment plants.

Concentrations of medicines in rivers, including the Meuse, become higher in many cases during dry periods. Van Vliet cites as an example the drug carbamazepine, which is used as an anti-epileptic and in bipolar disorders, and has been found in the Meuse, among other rivers. During the 2018 drought, this caused the target values of the European River Memorandum (ERM) to be exceeded. Drinking water companies from the river basins of Meuse, Rhine, Danube, Elbe, Ruhr and Scheldt can sustainably prepare drinking water using natural treatment methods if surface water meets these ERM target values.

“The impact of drought on water quality is a more invisible problem and therefore gets less attention.”

The impact on the Meuse

In addition to their global research, Van Vliet and her colleagues conducted two studies on what the droughts and the heat waves mean for the water quality of the Meuse River specifically. The research also clearly showed that when the flow rate is low, there is less water to dilute contaminants. “The concentrations of pollutants then go up, as do salinity levels. The water temperature rises, which increases the amount of algae.”

Remarkably, drought and high temperatures do not mean deterioration of water quality for all substances, she continues. “Thus, when rainfall is low, less fertiliser and pesticide residue flows from farmland into ditches and rivers. Some contaminants also break down faster at high temperatures.”

Adapting to changes

The researchers looked at how best to deal with such changes to prevent further deterioration of water quality. Van Vliet: “Especially for rain-fed rivers like the Meuse, it is important that we start taking into account lower river flow rates and more frequent droughts when issuing discharge permits. We need to avoid higher concentrations of hazardous substances in rivers during those warmer, drier summers. In short, greatly reduce the amount of discharged substances, taking into account the amount of water in the river.”

Van Vliet mentions the fact that some of the Dutch discharge permits are quite outdated and assume there is much more water in the rivers than now and in the future. “Updates are needed and, when doing so, it remains important to properly co-ordinate discharge permits with our neighbouring countries.”

In addition to better permits Van Vliet stressed that, in view of more frequent droughts, we need to better retain water instead of conveying it to the sea as quickly as possible. “Storing more water in buffers, so that we can benefit from it during drier periods.”

Better water quality

So about 40% of the world’s population is currently suffering from a shortage of good-quality water. This is the case, during certain periods of the year, in India and China and in large parts of the US and Europe. In the Netherlands too we sometimes face water scarcity due to low water availability and poor water quality. For example, during dry summers when salinity increases, there is limited ability to use the water for irrigation of crops.

Will this percentage increase in the coming years because of climate change? Van Vliet and her colleagues are currently researching this. It is already clear that in areas where the population is going to increase, such as Central Africa, the demand for water will increase and its quality will decrease. In some parts of the world, such as China, quality is actually expected to improve due to population decline as well as improvement and expansion of water treatment plants.

More awareness needed

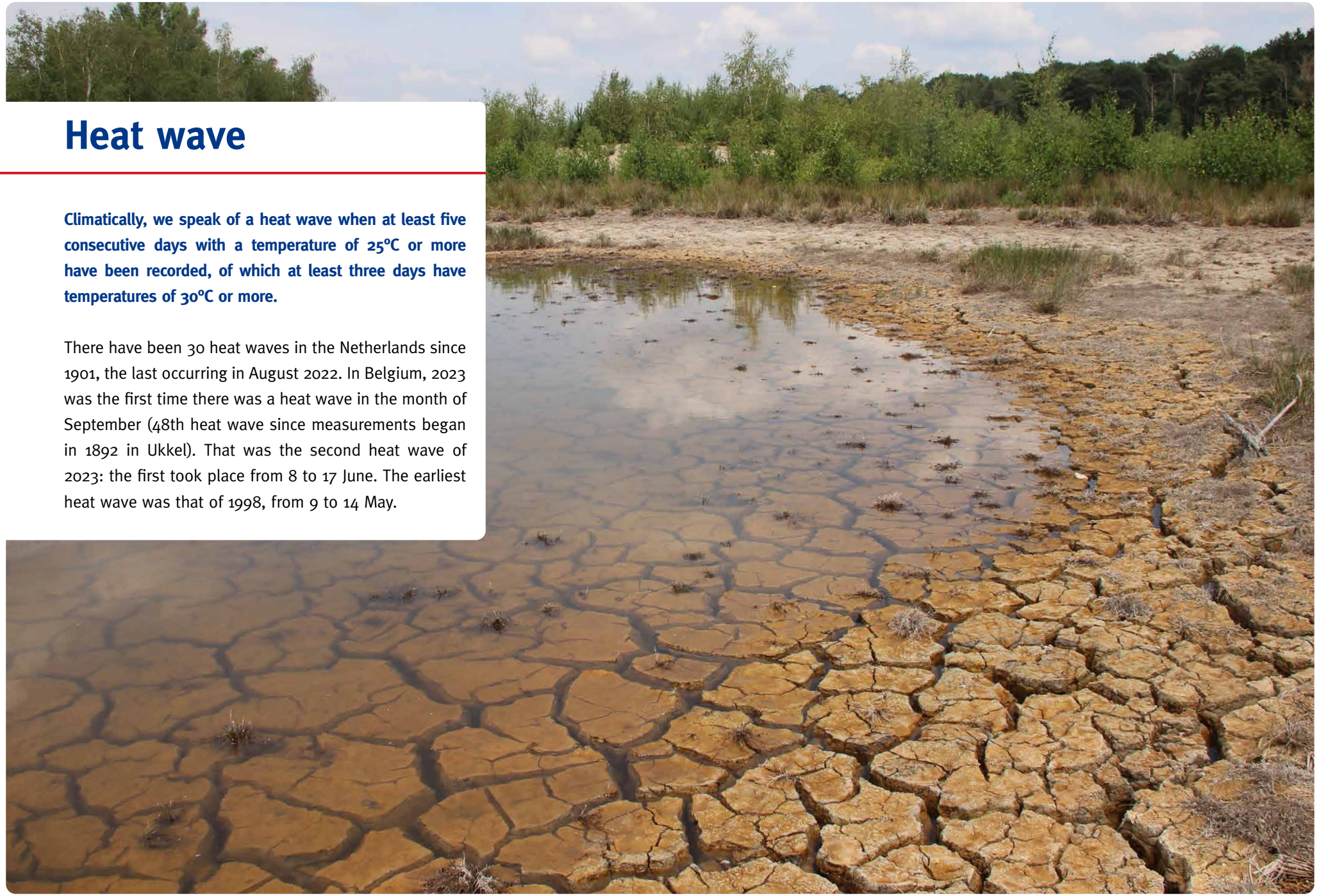
Van Vliet is looking forward to communicating the results of these studies to the general public, water managers and policymakers. She hopes this information will contribute to improving water quality. “There is still relatively little understanding about the effects of global change on water quality. We still have many questions, for example about the long-term health risks.”

When there is too little water owing to drought or too much water owing to heavy rainfall, there are usually concerns about water quantity first, as it is the most noticeable issue. Van Vliet: “The impact on water quality is a less obvious problem and therefore gets less attention. Although, fortunately, awareness ofthis is growing.”

Heat wave

Climatically, we speak of a heat wave when at least five consecutive days with a temperature of 25°C or more have been recorded, of which at least three days have temperatures of 30°C or more.

There have been 30 heat waves in the Netherlands since 1901, the last occurring in August 2022. In Belgium, 2023 was the first time there was a heat wave in the month of September (48th heat wave since measurements began in 1892 in Ukkel). That was the second heat wave of 2023: the first took place from 8 to 17 June. The earliest heat wave was that of 1998, from 9 to 14 May.



Delft Institute for Water Education

C4. “Better co-operation around the Meuse to avoid conflict.”

Susanne Schmeier

Susanne Schmeier, Associate Professor of Water Law and Diplomacy at the IHE Delft Institute for Water Education.

When we think of tensions or conflicts over water, we may mainly think of the Middle East and Africa. But they also exist in Europe and around the Meuse River. We talked about it with Susanne Schmeier of the IHE Delft Institute for Water Education.

Susanne Schmeier is the Associate Professor of Water Law and Diplomacy, and her work revolves around conflicts over water, “because there is too little or too much of it. Or because the water is highly polluted,” she says. We might expect these kinds of tension to play out in the Middle East and Africa, but she says: “They also occur in Europe, and the potential for conflict is greater because of climate change, increased use of water in agriculture and households.”

Water diplomacy is Schmeier’s field: “We try to prevent the escalation of tensions and conflicts to subsequently avoid negative impacts on people, animals and the environment. Water can be a source of conflict, but fortunately it can also bring us together.”

In Europe, we have good ways of dealing with water conflicts, she says. For example, talks and negotiations between politicians and the staff of organisations such as Rijkswaterstaat (the Department of Waterways and Public Works) and the International Meuse Commission, or going to court if necessary. “But relationships are not so good in other parts of the world, and then problems can arise more easily.”

Cars and greenery

Schmeier, who is from Germany, cites the Tesla plant which recently opened near Berlin as an example of conflict in Europe – producing cars requires huge amounts of water. “This is an area with a lot of water scarcity. In summer, residents are subject to restrictions: you are not allowed to water your garden or wash your car, and then suddenly this big factory arrives. As a result, there are tensions, and residents have started legal cases against the company.”

Another example is the battle for water between Spain and Portugal. Several rivers flow through both countries and treaties define who gets how much. “In recent years, Spain took more water than allowed from the river flowing into Portugal,” she says. In addition, she said: “The water all goes to agriculture for vegetables we eat here, while people there don’t have enough water.”

Pointing at each other

Closer to home, Schmeier points to the fact that river flows in recent summers have been quite low in the Netherlands and surrounding countries. Too little water flowed through the Rhine, and in the Meuse, besides quantity, quality was a problem because pollutants were not diluted enough.

When water contains overly high concentrations of pollutants and drinking water companies have to stop their abstraction, tensions can arise between countries and sectors as to where the pollution comes from, she explains. “Everyone then points at each other.” There is no accurate, complete overview of permits for discharging pollutants, so we do not have a good idea of what is entering the Meuse.

Dykes instead of drinking water

To avoid tensions, it must first be clear which sectors and groups use water and exactly how much they need, Schmeier explains: households, agriculture, industry, shipping, the energy sector, tourism, fishing.

But what if there is not enough for everyone – who gets priority? “Yes, that is a challenge,” she says. Countries can use legal rankings to distribute water in case of water scarcity. In the Netherlands this is called the priority sequence, and in Flanders it is known as the assessment framework for priority water use. Unlike in most other countries, the Netherlands’ first priority is dykes rather than drinking water. “These need to stay damp,” Schmeier explains. “If the water in the rivers and groundwater is too low, they can break up and then when there is a lot of rain, you have a problem.” The priority sequence and the assessment framework for priority water use do not take water quality into account.

And what do you do when rivers flow through multiple countries? Schmeier: “This is often not regulated internationally, including in the Meuse river basin. It is difficult to explain to people from another country that they will be getting less drinking water because their neighbours need the water for something.” In short, you have to deal with all kinds of feelings: make everyone understands who needs water for what and then find a compromise. So it is helpful to have an accurate picture of which sectors and groups use water and exactly how much they need.

More research on drought

Tensions about water are still fairly new in Europe, says Schmeier. “We are now slowly looking at what can be done about it.” Better data are needed first of all, she stresses. On how much water flows through rivers, what the difference is between summer and winter and what we can expect in 10, 30 and 50 years in light of climate change. And what effect could that have on pollutants and what does that mean for our drinking water and also for animals and plants?

Most studies on water in Europe focus on water quality, not water scarcity, says Schmeier. “The subject of drought has not been on the map in the Netherlands for a long time, as there was always the feeling that we had plenty of water. The Netherlands has a lot of experience in flood management, which we now need to reinforce with knowledge and expertise in drought management.”

Better technology

With the right data on drought in the Netherlands, we can negotiate, reach agreements and take policy measures for the international Meuse river basin: prepare together, adapt, develop and invest in better technology. As an example, she cites more efficient irrigation technology by delivering water directly to the roots of plants instead of spraying over them, which leads to water evaporation. And if we invest more in solar and wind power, less cooling water will be needed for power plants.

Another option is to build more dams and reservoirs to hold water when it

rains large amounts. Schmeier: “But that would result in many environmental problems. That’s why we must carefully weigh up all the different options and consider how to deal with the challenges ahead. Thus, in this context, investments across borders can potentially contribute to solutions.”

It is important that countries inform each other about what they want to do and plan together, she says. A few years ago, for instance, the Egyptian president threatened to send his army to Ethiopia because the Ethiopians were building a dam, affecting the amount of water in Egypt’s Nile.

Greater understanding through serious games

The IHE Delft Institute for Water Education, where Schmeier works, uses ‘serious games’ to illustrate theory and build understanding of different water needs. The Institute uses these for teaching students and for training staff from foreign government agencies, research institutes and NGOs.

Different scenarios are built into the serious games: more or less population growth, climate change, one or more dams, for example. Participants are given different roles: one plays the minister of environmental affairs, another an NGO representative, a third a resident. “Normally you think mainly about your own perspective and national interests,” says Schmeier. “By playing a game like this, you can look at it much more neutrally and objectively and discuss the best solution together.”

War about water

Water conflicts come in many gradations. Conflicts like the one between Egypt and Ethiopia are unknown in Europe and, as far as we know, only once in history has a real war broken out over water, says Schmeier. That was more than 3,000 years ago between the kingdoms of Umma and Lagash in present-day Iraq.

After all, you can’t win a war about water. “Water is so important that countries eventually decide to work together,” she says. “Because what can you do if your neighbour builds a dam? If you blow up the dam, you’ll get flooded.”

Moreover, countries in conflict about water often still have trade relations. “Are you going to risk that and fight about water? I don’t think so.”

Tensions that persist for a long time do occur. In Turkey, Iran, Iraq and Syria, for example, around the Euphrates and Tigris rivers. “Then it’s the local population that suffers.” Another example she cites are areas in Africa where there is competition and local violence between farmers and shepherds about access to a water source.

“It is high time for countries and sectors along the River Meuse to cooperate and get into action.”

Taking action

Back to the Meuse. Schmeier stresses that the countries around this river have been co-operating for a long time: in 1863, there was already a treaty on the use of Meuse water. “Very good, this long history of co-operation. On the other hand, there are many new problems, with not enough being done about them yet.” She is referring to the decline in water quality as there is often less water flowing through the Meuse, leading to the rise in harmful chemicals, such as PFAS. “Everyone knows about these problems, but too little is being done about them.”

As a good example of how things can be done, she cites the countries around the Danube River that have agreed on a strategy on how to deal with low water levels due to climate change. “I think there is still a lot of work to do in the Meuse river basin. If those 19 countries around the Danube can do it, it should also be possible for the Meuse. It is high time for the countries and sectors around the Meuse to co-operate more and take action. This will allow us to avoid tensions that affect the population, the environment and the economy.”

International water management in serious games for the Meuse

RIWA-Meuse is working with Gijs van Nes of Com'n Good Games to develop a serious game to draw attention to the international dependencies that arise during very low river flows in the Meuse river basin.

Playing the game helps to gain a better understanding of the challenges that climate change poses to the availability and quality of Meuse water. The game illustrates the complexity of water management affected by the changing climate in a fun and innovative way. Aspects of the game include filling reservoirs in Germany and keeping nuclear power plants in France running while water quality deteriorates, and producing drinking water for seven million people. How do you work with your neighbours to ensure that everyone can continue to use the water and that no problems and conflicts arise?

"Participants gain a better understanding for the situation and the interests of others."

Playing the game promotes international co-operation and dialogue between different stakeholders. Players gain a better understanding of what impact their water management decisions may have on others and learn about the need for cross-border co-operation in addressing water-related issues. By not playing their own role, but rather that of other countries and sectors, participants gain a better understanding of the situation and interests of others. This helps to produce a more objective view of the whole and invites proactive participation in devising solutions.

With lecturers from IHE Delft Institute for Water Education and PhD students from Panama, Spain, Zimbabwe and Vietnam, the game has been further developed and can actually be played in the second half of 2024. RIWA's aim is to encourage the necessary international dialogue to sustainably manage the water of the Meuse now and in the future, so that quality is guaranteed and all users can continue using this important resource.

D

Annexes

Annex 1

Substances that exceeded the ERM target value in 2023

Many environmentally-foreign substances (pollutants) are found in Meuse water. In 2023, 64 substances exceeded the target value in the European River Memorandum (ERM target value) in target substance analyses. This happened 1,431 times in 6,436 measurements that were conducted for these 64 substances - in 22.2% of the cases. It is possible to produce drinking water in a sustainable way with natural purification methods from river water that meets the ERM target values.

To gain an impression of the types of substances that drinking water companies had to deal with in 2023, a 'mugbook' for substances in the Meuse that exceeded the ERM target value in this year is presented below. RIVM's PMT screening tool was used to look up the PMT scores of these substances, insofar as they are available.

This concerned the following substance groups:

- Industrial pollutants and consumer products
- Residues of pharmaceuticals and endocrine-disrupting chemicals
- plant protection products, biocides and their metabolites

Industrial pollutants and consumer products

In 2023, 64 parameters exceeded the ERM target values one or more times. Industrial pollutants were the culprit in 40.6% of cases (26). Of the 2,612 measurements that were done for these 26 substances, 719 (27.5%) exceeded the ERM target value.

Table 5: Industrial pollutants and consumer products that exceeded the ERM target value in 2023 (maximum concentrations).

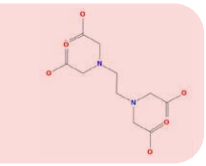
Parameter	CASRN	ERM-	tv	TAI	NAM	LUI	EYS	ROO	STV	HEE	BRA	HEU	KEI	BSM	HAR	n/	N	%
Industrial pollutants and consumer products																**719**	**2612**	**27,53%**
ethylenediaminetetraacetic acid (EDTA)	60-00-4	1	µg/l		7,2	9,1	16	7,3		8,3	22			48	12	85	85	100,00%
sulfamic acid	5329-14-6	1	µg/l					41		30	33			49	61	54	54	100,00%
trifluoroacetic acid	76-05-1	0,1	µg/l				1,41	1,2		1,3	1,8		1,48	1,5	1,7	97	102	95,10%
cyanuric acid	108-80-5	0,1	µg/l				3,38	1,8		2,2	1,1		1,94	1,5	1,1	67	80	83,75%
sucralose	56038-13-2	1	µg/l				2,77				5,3	3,5	6,66	6	2,5	51	64	79,69%
dichloro-methanesulfonic acid	53638-45-2	0,1	µg/l					0,3		0,33	0,19			0,32	0,62	43	54	79,63%
trichloroacetic acid	76-03-9	0,1	µg/l								0,11	0,56		0,64	0,17	32	52	61,54%
8-Hydroxypenillic acid	3053-85-8	0,1	µg/l							<0.05				0,85	0,16	28	50	56,00%
methenamine	100-97-0	1	µg/l		5,41	4,15	6,96	6,7		2,7	2		2,07	2,9	1,5	51	110	46,36%
dimethyl ketone (acetone)	67-64-1	1	µg/l					7,9								64	147	43,54%
1,4-dioxane	123-91-1	0,1	µg/l				<0.5	0,24		0,32	0,22			0,33	0,55	25	74	33,78%
tetrahydrofuran	109-99-9	0,1	µg/l					1,1		0,5				0,33	0,45	13	53	24,53%
melamine	108-78-1	1	µg/l		0,27	0,41	0,75	4,5		2,9	1,3	1,9	1,89	2	1,3	28	129	21,71%
diethylenetriaminepentaacetic acid (DTPA)	67-43-6	1	µg/l		0,27	0,41	0,76	<1		<1	1,6			5,1	1,7	17	85	20,00%
nitriloacetic acid (NTA)	139-13-9	1	µg/l		<1	<1	4,3	<1		<1	1,5			1,2	<1	16	85	18,82%
diisopropyl ether	108-20-3	1	µg/l		<0.1	6,84	4,3	2,5	0,93	0,95	0,02	0,9	0,8	0,68	0,21	23	204	11,27%
monobromoacetic acid	79-08-3	0,1	µg/l								0,13	0,07		0,08	<0,06	3	52	5,77%
dibromoacetic acid	631-64-1	0,1	µg/l								0,57	<0.06		<0.06	<0.06	2	44	4,55%
Dibromomethanesulfonate	859073-88-4	0,1	µg/l					<0.1		<0.1	0,2			<0.1	<0.1	2	54	3,70%
1,2-dichloroethane	107-06-2	0,1	µg/l	<0.1	140	<0.1	0,12	0,05	<0.25	0,11	<0.02	0,16	0,08	0,08	<0.06	8	218	3,67%
tributyl phosphate	126-73-8	1	µg/l		<0.02	1,09			0,83		<0.1	0,41				1	39	2,56%
1,2,3-Benzotriazole	95-14-7	1	µg/l		0,98	1,98		0,59		0,9	0,67	0,97		0,77	0,6	2	94	2,13%
bromoform	75-25-2	0,1	µg/l	<0.2	<0.1	<0.1	<0.1		<0.12	0,02	0,26	0,04	<0.1	<0.06	<0.06	4	193	2,07%
ethyl hydrogen sulphate	540-82-9	0,1	µg/l					<0.1		<0.1	<0.1			<0.1	0,1	1	54	1,85%
Methyl tert-butyl ether	1634-04-4	1	µg/l	0,24	0,4	<0.1	0,11	0,12	0,28	0,67	1	0,8	0,39	0,78	0,11	1	218	0,46%
bromo(dichloro)methane	75-27-4	0,1	µg/l	<0.3	<0.1	<0.1	<0.1	<0.05	<0.12	<0.05	<0.02	<0.02	<0.1	<0.06	0,12	1	218	0,46%

ERM-sw = ERM target value, TAI = Tailfer, NAM = Namêche, LUI = Liège, EYS = Eijsden, ROO = Roosteren, STV = Stevensweert, HEE = Heel, BRA = Brakel, HEU = Heusden, KEI = Keizersveer, BSM = Bergsche Maas, HAR = Haringvliet.

In the table, the highest-measured value is presented if the parameter exceeded the ERM target value, where n is the number of breaches and N is the number of measurements.

Complex formers

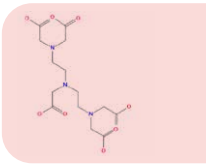
Complex formers (chelates) are chemical substances that form complex, soluble molecules with certain metal ions, thanks to which these metal ions are inactivated. This means that they cannot react in a normal way with other elements or ions to form a precipitate or deposit. They are used as ingredients in cleaning agents such as limescale removers and strippers and as stabilisers in bleaches and soap products.



EDTA (CASRN 60-00-4)

PMT-score 0.23
(P=0.02 | M=0.95 | T=0.68)

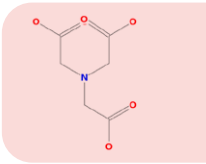
Application: EDTA (ethylenediaminetetraacetic acid) is a complex former that is used in detergents and in medicine to trap and remove calcium and other metals, including heavy metals such as arsenic, copper and mercury.
Origin: this substance mainly ends up in surface water via waste-water treatment plants.
Distribution of contamination: EDTA was found to be well above the ERM target value of 1 µg/L at all monitoring points where it was measured. The indicative drinking water target value for EDTA is 600 µg/L.
Notable: since 1990, this substance has been detected at concentrations between 0 and 30 µg/L in drinking and surface water. EDTA is a compound only slightly toxic to humans, but it has the property of releasing heavy metals from silt and keeping them dissolved in water.



DTPA (CASRN 67-43-6)

PMT-score 0.26
(P=0.03 | M= 0.96 | T=0.68)

Application: from the 1960s onwards, DTPA (pentetic acid or diethylenetriaminepentaacetic acid) has been used to combat internal contamination with radioactive material. DTPA and its derivatives are used to form complexes with gadolinium, which in their turn are used as contrast agents in MRI scans. DTPA is also used in the extraction of soil samples.
Origin: this substance mainly ends up in surface water via waste-water treatment plants.
Distribution of contamination: DTPA was detected at above the ERM target value at Namêche, Liège, Roosteren, Heel, Brakel, Bergsche Maas and Haringvliet. Since July 2022, DTPA has been on the Netherlands' list of Substances of Very High Concern [source: RIVM). The indicative drinking water target value for DTPA is 700 µg/L.
Notable: In the past (2018), Dunea and Evides had an exemption to allow them to continue to use surface water with DTPA at Brakel and Keizersveer (Gat van de Kerksloot) for the production of drinking water. Similarly to EDTA, DTPA forms stable complexes with many metals.



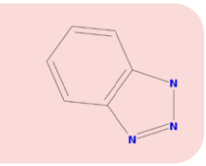
NTA (CASRN 139-13-9)

PMT-score 0.13
(P=0.01 | M=0.94 | T=0.18)

Application: NTA (nitrilotriacetic acid) is suitable for softening water and for preventing or removing limescale deposits. It is therefore frequently added to water in boilers. NTA was used increasingly from the late 1960s as a replacement for phosphates in detergents.
Origin: This substance mainly ends up in surface water via cooling water discharges and waste-water treatment plants.

Distribution of contamination: NTA was detected at above the ERM target value in measurements at Eijsden, Brakel and Bergsche Maas. The indicative drinking water target value for NTA is 400 µg/L.

Notable: NTA is effectively biologically degradable, better than the similar EDTA. It is mainly the water-soluble trisodium salt of NTA that is used in soaps and detergents. The WHO IARC (the International Agency for Research on Cancer, part of the United Nations World Health Organization) considers NTA a possible human carcinogen (IARC class 2B).



1,2,3-Benzotriazole (CASRN 95-14-7)

PMT-score 0.27

(P=0.11 | M=0.54 | T=0.35)

Application: 1,2,3-Benzotriazole is a chelating agent[14] that has applications including as a corrosion inhibitor in cooling water, antifreeze/anti-icing agents (including de-icing aircraft) and as protective agents for silverware in washing-up liquid. 1,2,3-Benzotriazole is, for example, a constituent of the cooling water additive Nalco 3D TRASAR 3DT151, a copper corrosion inhibitor.

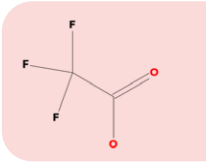
Origin: this substance mainly ends up in surface water via waste-water treatment plants.

Distribution of contamination: 1,2,3-Benzotriazole was detected above the ERM target value at Liège. The indicative drinking water target value for 1,2,3-Benzotriazole is 700 µg/L.

Notable: In the past, WML (2018) and Evides (2019) had an exemption to allow them to continue to use surface water with 1,2,3-Benzotriazole from the Meuse for the production of drinking water.

14 From a chemical standpoint, chelation is the same as complex formation with the understanding that, in chemistry, the concept complex formation is applied to mono-, di- and polydentate ligands, while chelation explicitly excludes the monodentate ligands (source: Wikipedia).

Solvents



Trifluoroacetic acid (TFA, CASRN 76-05-1)

PMT-score 0.34

(P=0.16 | M=0.75 | T=0.34)

Application: trifluoroacetic acid (TFA) is used in the production of trifluoroacetic fluoride and 2,2,2-trifluoroethanol. The acid is added to some HPLC analyses in the mobile phase to reduce the occurrence of 'tailing'. The acid is also frequently used as a building block in the synthesis of pharmaceutical substances and agricultural chemicals and as a catalyst in polymerisations and condensation reactions. On the boundary between organic chemistry and biochemistry, trifluoroacetic acid is used during in vitro peptide synthesis to remove the protective tert-butoxycarbonyl group from amino groups. TFA is used in the form of its salts (trifluoroacetates) in the production of ceramic materials. TFA is a much-used solvent in NMR spectroscopy, and it is used in mass spectrometry to calibrate the equipment (source: Wikipedia). TFA is also a breakdown product of hydrofluorocarbons or HFCs that are used in applications including air conditioners, foam blowing agents and propellant gases in aerosols (source: UBA report FB000452/ENG). TFA can also be a metabolite of, among others, plant protection products based on flurtamone, fluopyram, tembotrione and flufenacet, of the drugs fluoxetine (antidepressant) and sitagliptin (antidiabetic) and of the substance 4:2 fluorotelomer sulphonate[15].

Origin: This substance mainly ends up in surface water via industrial waste-water treatment plants. TFA has also been detected in rainwater.

15 https://pubmed.ncbi.nlm.nih.gov/28992593/

Distribution of contamination: TFA was detected above the ERM target value at Eijsden, Roosteren, Heel, Brakel, Keizersveer, Bergsche Maas and Haringvliet. TFA is a potential substance of Very High Concern (source: RIVM). According to the OECD definition, TFA belongs to the PFAS and has an advised indicative drinking water guidance value of 2.2 µg/L[16] if no other PFAS are present, which is not very likely given the ubiquity of several PFAS.

Notable: in September 2016, at the LUBW (Landesanstalt für Umwelt Baden-Württemberg), there were indications of an industrial contamination of the Neckar tributary with TFA. For this reason, monitoring was started. High concentrations of TFA (above 10 µg/L) were found in the Neckar. In the Netherlands part of the Rhine, the concentrations in the surface water are around 1.5 µg/L (source: fact sheet from Het Waterlaboratorium).

1,4-Dioxane (CASRN 123-91-1)

PMT-score 0.38
(P=0.09 | M=0.73 | T=0.84)

Application: 1,4-Dioxane is an ether that is mainly used as a solvent in the paper, cotton and textile industry, in vehicle coolants, as an initial substance for the synthesis of other substances, as a foaming agent in the polymer industry, and in the production of cosmetics and shampoos. On 12 July 2021, 1,4-dioxane was added to REACH Annex XIV (Substance of Very High Concern, SVHC). In the Netherlands, the substance was added to the list of Substances of Very High Concern (SVHC). 1,4-Dioxane may be formed in the production and processing of ethylene oxide, a major raw material in the chemical industry. Two cases are known in which the production of ethylene oxide led to emissions of 1,4-dioxane: at INEOS in Dormagen (Rhine) and at KLK Kolb Specialties in Delden (Twente Canal). Ethylene oxide is used, among other things, as an intermediate product in processes including the production of ethylene glycols. It is also used as a disinfecting agent for heat-sensitive materials in hospitals.

Origin: it emerges from the REACH dossier that at least one ethylene oxide factory is situated on the Meuse (source: ECHA). There are also at least two manufacturers on the Albert Canal.

Distribution of contamination: 1,4-Dioxane was detected above the ERM target value at Roosteren, Heel, Brakel, Bergsche Maas and Haringvliet. The indicative drinking water guideline value for 1,4-dioxane is 3 µg/L, but recently RIVM concluded that 38 µg/L can be considered a safe value.

Notable: the WHO IARC states that this ether could possibly be carcinogenic to humans (IARC class 2B).

Tetrahydrofuran (THF, CASRN 109-99-9)

PMT-score 0.35
(P=0.08 | M=0.65 | T=0.80)

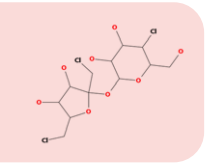
Application: Tetrahydrofuran (THF) is a solvent that is used in the chemicals industry. It can be polymerised by strong acids or electrophiles (such as trityl tetrafluoroborate) into a linear polymer, poly(tetramethylene ether) glycol or PTMEG (also known as polytetramethylene oxide). This glycol is mainly used for the production of elastomer polyurethanes, in particular polyurethane fibres such as elastane (Spandex, Lycra).

Origin: this substance mainly ends up in surface water via wastewater treatment plants.

Distribution of contamination: THF was detected above the ERM target value at Roosteren, Heel, Brakel, Bergsche Maas and Haringvliet.

16 *https://www.rivm.nl/documenten/bijlage-bij-rivm-brief-aan-ilt-indicatieve-drinkwaterrichtwaarde-trifluorazijnzuur-tfa*

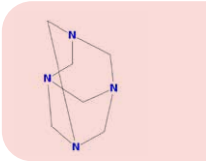
Foodstuffs



Sucralose (E955, CASRN 56038-13-2)

PMT-score 0.62
(P=0.45 | M=0.87 | T=0.61)

Application: sucralose (E955) is an artificial sweetener that is used as a sugar replacement in various foodstuff products and soft drinks.
Origin: this substance mainly ends up in surface water via waste-water treatment plants.
Distribution of contamination: sucralose was detected at concentrations above the ERM target value at Eijsden, Heusden, Brakel, Keizersveer, Bergsche Maas and Haringvliet. It is stable and is not broken down or absorbed in the body. This property means that it is also not (well) broken down in the environment, a waste-water treatment plant or a simple drinking water purification plant. The indicative drinking water target value for sucralose is 5,000 µg/L.
Notable: sucralose is in Annex III of the REACH Regulation due to the suspicion of carcinogenicity, hazard to the aquatic living environment, mutagenicity and persistence (source: ECHA).

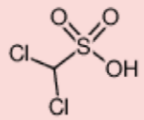


Methenamine (E239, CASRN 100-97-0)

PMT-score 0.63
(P=0.81 | M=0.93 | T=0.34)

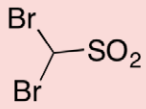
Application: methenamine (urotropine, hexamine) is one of the trivial names for a compound that is much used in phenol resin and many other industrial applications, and also as a preservative against mould (E239 in products including caviar, rollmop herring, tinned fish and pickled herring). Methenamine is also the main constituent of solid fuel tablets, known by the name Esbit, much used for example in stoves for campers, mountain climbers and the military, and in miniature steam engines. Methenamine may also be used as a corrosion inhibitor and antibiotic.
Origin: this substance mainly ends up in surface water via waste-water treatment plants.
Distribution of contamination: methenamine was detected above the ERM target value at Namêche, Liège, Eijsden, Roosteren, Heel, Keizersveer, Bergsche Maas and Haringvliet. The indicative drinking water target value for methenamine is 500 µg/L.
Notable: since 2010, methenamine has been monitored in the water abstracted at Brakel and it is detected regularly at over the ERM target value. Since 2012 this substance has also been detected systematically at Keizersveer and Haringvliet at above the ERM target value.

Halomethanesulfonic acids (HMSAs)



Dichloro-methanesulfonic acid (CASRN 53638-45-2)

PMT-score 0.46
(P=0.22 | M=0.72 | T=0.61)



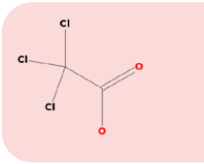
Dibromomethanesulfonic acid (CASRN 859073-88-4)

PMT-score 0.38
(P=0.22 | M=0.72 | T=0.61)

Application: Halomethanesulfonic acids (HMSAs) are recently discovered polar disinfectant byproducts. Due to its acid strength, trifluoromethanesulfonic acid is mainly applied in chemical reactions as a catalyst or a source for the triflyl group.
Origin: HMSAs arise frequently and at high levels in drinking water and could potentially be very persistent and very mobile (vPvM).[17]
Distribution of contamination: Dichloromethanesulfonic acid was detected above the ERM target value at Roosteren, Heel, Brakel, Bergsche Maas and Haringvliet. Dibromomethanesulfonate was detected above the ERM target value at Brakel.

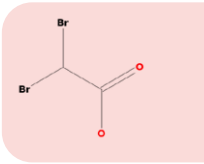
17 https://www.ufz.de/promote/index.php?en=33621

Halogenated acetic acids (HAA)



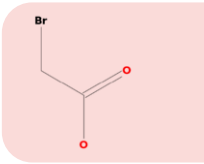
Trichloroacetic acid (TCA, CASRN 76-03-9)

PMT-score 0.54
(P=0.36 | M=0.68 | T=0.62)



Dibromoacetic acid (DBA, CASRN 631-64-1)

PMT-score 0.33
(P=0.06 | M=0.73 | T=0.81)



Monobromoacetic acid (MBA, CASRN 79-08-3)

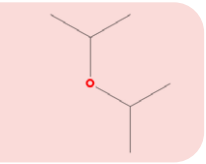
PMT-score 0.28
(P=0.04 | M=0.75 | T=0.82)

Application: These substances are known byproducts that arise from the chlorination of water. TCA has many applications, including as a solvent in the plastics industry, production of sodium trichloroacetic acid (a herbicide), an etchant in metal processing, an additive in mineral lubricant oils and a catalyst for polymerisation reactions (source: Wikipedia). In biochemistry, TCA is used to precipitate out proteins and other macromolecules. Other applications are to be found in the medical (treatment of skin conditions and removal of warts) and cosmetic spheres (chemical peeling). TCA has been detected in the Meuse since 1986[18].
Origin: chlorination of water in industrial processes is probably the source of HAA in the Meuse.
Distribution of contamination: TCA was detected above the ERM target value at Heusden, Brakel, Bergsche Maas and Haringvliet. DBA and MBA only at Brakel.

18 H2O article by Versteegh, J.F.M, Peters, R.J.B. & De Leer, E.W.B. (1990), https://edepot.wur.nl/376185

Notable: TCA has been detected above the reporting limit for years in Meuse water at Heusden and Brakel.

Substances that are used in the Prayon process



Di-isopropyl ether (DIPE, CASRN 108-20-3)

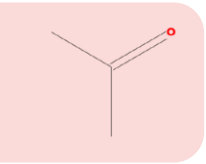
PMT-score 0.35

(P=0.10 | M=0.56 | T=0.75)

Tributyl phosphate (TBP, CASRN 126-73-8)

PMT-score 0.14

(P=0.01 | M=0.30 | T=0.80)



Dimethyl ketone (acetone, CASRN 67-64-1)

PMT-score 0.11

(P=0.08 | M=0.67 | T=0.02)

Application: There is a known industrial discharge in the Wallonian part of the river basin that for decades has been responsible for the presence of the substances fluoride, DIPE and tributyl phosphate in the Meuse. The company Société de Prayon developed and patented an extraction process that uses the solvents di-isopropyl ether (DIPE, 85-95%) and tributyl phosphate (5-15%) with which technical grade phosphoric acid can be upgraded to phosphoric acid of food quality (source: Gilmour, 2013). Since 1983, this process has been used in the factory at Engis and there is presently a plant with which 120,000 tonnes per year (expressed as P2O5) can be processed with the Prayon process as it is known. In the first step of the pre-treatment in the Prayon process, the impurities sulphate and fluoride in industrial grade phosphoric acid are reduced to 0.3% and 0.1% respectively. Part of the fluoride is recovered from the process and sold in the form of hexafluorosilicic acid (H2SiF6). Research has shown that dimethyl ketone (acetone) can be formed from DIPE via 2-propanol (isopropyl alcohol, IPA). From a chemical reaction in the production process, DIPE can be converted to 2-propanol, which can then be converted to acetone by biodegradation during or after discharge into the Meuse. This conversion takes place at different times of the year and depends mainly on flow and temperature. Incidentally, it is known that 2-propanol may be discharged into the Meuse by a plant at the Chemelot chemical park in Sittard/Geleen.

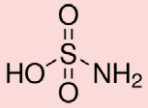
Origin: waste-water discharges by the company Société de Prayon in Engis.

Distribution of contamination: Acetone was detected above the ERM target value at Roosteren. DIPE was detected above the ERM target value at Liège, Eijsden and Roosteren. Tributyl phosphate was detected above the ERM target value at Liège once. The indicative drinking water target value for tributyl phosphate is 350 µg/L. The indicative drinking water target value for DIPE is 1,400 µg/L.

Notable: Société de Prayon further optimised the fluoride recovery process in their factory at Engis by installing a vapour separator and air scrubber in October 2014. This ought to deliver an extra yield of around 250 tonnes of fluoride per year, which would no longer be discharged. In recent years, a single breach of fluoride arose; the last time fluoride regularly exceeded the ERM target value was in 2011: then, this applied to 34% of the measurements at Liège. The drinking water companies are delighted that the contaminations have been reduced, partly through reuse of the substances. They hope that this positive trend continues and that all emissions finally come below the ERM target value. Société de

Prayon has made known that, in the future, it plans to reduce the discharges of DIPE and TBP by means of an additional purification step.

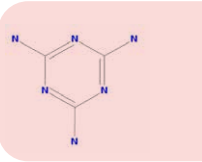
Other industrial substances and consumer products



Sulfamic acid (CASRN 5329-14-6)

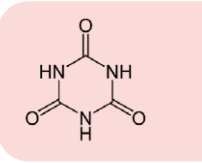
Anorganische verbinding (geen PMT-score)

Application: sulfamic acid, an inorganic substance, is an ingredient of many acidic cleaning agents for the removal of deposits: limescale deposit in coffee machines and on chrome or stainless steel in places such as milking sheds and breweries, in steam boilers, cement residue on tiles and urine scale on sanitary ware. Sulfamic acid is also used in the synthesis of artificial sweeteners (cyclamic acid and sodium cyclamate).
Origin: the use of cleaning agents in both industry and households probably leads to the concentrations observed.
Distribution of contamination: sulfamic acid was detected far above the ERM target value in all measurements at Roosteren, Heel, Brakel, Bergsche Maas and Haringvliet. The indicative drinking water target value for sulfamic acid is 1,400 µg/L[19].



Melaminee (CASRN 108-78-1)

PMT-score 0.64
(P=0.53 | M=0.80 | T=0.61)



Cyanuric acid (CASRN 108-80-5)

PMT-score 0.27
(P=0.12 | M=0.50 | T=0.33)

Application: melamine is a synthetic substance mainly used in the production of plastics. Under high pressure (>7 MPa) and a temperature over 370°C, isocyanic acid is formed, yielding cyanuric acid via an exothermic reaction. The cyanuric acid condenses with ammonia into melamine and water. Finally, the liquid melamine cools into the intended end-product: a white crystalline powder. Melamine is formed from urea, with ammonia and carbon dioxide as byproducts[20]. Melamine plastics are strong, hard, light and resistant to strong acids among other things. Consumer products into which melamine is processed include plastic plates, cups, dishes and cutlery, and also miracle sponges as they are known (see Photo). The Netherlands Food and Consumer Product Safety Authority (NVWA) recommends no longer using crockery made from bamboo with melamine plastic, such as coffee cups and bowls[21].
Origin: In 1964, DSM built the first melamine factory on the site that is now known as Chemelot, a large industrial complex for the chemicals industry between Stein and Geleen, in the Netherlands province of Limburg. OCI Nitrogen has a melamine factory on the Chemelot premises. It is the only production location of melamine in the Netherlands and it makes products such as MelaminebyOCI™ and Melafine®. OCI Nitrogen is by far the largest production site for melamine in the world.

19 *https://rvs.rivm.nl/sites/default/files/2022-06/Advies_14951A00_drw_rw_sulfaminezuur.pdf*

20 *https://www.helpdeskwater.nl/publish/pages/158977/studie_bedrijfslozingen_melamine_en_cyanuurzuur_in_nederland.pdf*

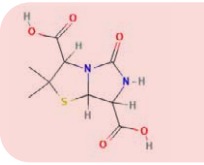
21 *https://nos.nl/artikel/2368846-nvwa-stop-met-gebruik-bekers-en-kommen-van-melamine-en-bamboe*

Melamine miracle sponges

Distribution of contamination: melamine was found above the ERM target value at Roosteren, Heel, Brakel, Keizersveer, Bergsche Maas and Haringvliet, as was cyanuric acid, which also exceeded the ERM target value at Eijsden. Melamine has an indicative drinking water target value of 0.28 µM. This value applies to the sum of melamine, melem and melam. This value takes account of the simultaneous presence of cyanuric acid. If it has been demonstrated that the concentration of cyanuric acid is below 10 µg/L (0.08 µM), a drinking water target value of 2.0 µM applies for the sum of melamine, melem and melam. The values stated only apply if the concentration of cyanuric acid is lower than the sum of melamine, melem and melam.

Notable: in China, milk products were diluted with water and this was covered up by adding melamine, giving an apparent increase in protein percentage. This was the subject of considerable media coverage in 2008[22]. After ingestion into the body, melamine can be converted to compounds including isocyanic acid via hydrolysis. Melamine and isocyanic acid can then form insoluble complexes, leading to the formation of crystals and finally kidney stones, possible obstruction and damage to the renal tissue as a result. Kidney problems arose in the cases of illness and even death in China, probably due to the formation of kidney stones.

8-Hydroxypenillic acid (CASRN 3053-85-8)

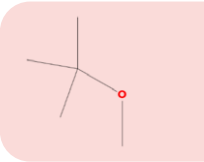


PMT-score 0.23
(P=0.06 | M=0.64 | T=0.33)

Application/Origin: RIVM classifies 8-hydroxypenillic acid under (animal) medicines[23]. In the past, this substance was used as an additive in the purification process of the IAZI of Sitech Services BV (now Circle Infra Partners) in Sittard/Geleen[24]. As the substance is not found at the Heel abstraction point, this is not the origin of the breaches now observed.

Distribution of contamination: 8-Hydroxypenillic acid was detected above the ERM target value at Bergsche Maas and Haringvliet. The indicative drinking water target value for this substance is 10 µg/L.

MTBE (CASRN 1634-04-4)



PMT-score 0.42
(P=0.17 | M=0.61 | T=0.74)

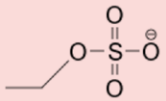
Application: MTBE (methyl-tert-butyl ether) is added to petrol as a lead substitute and to improve the combustion. The Netherlands is the largest producer of MTBE in Europe.

Origin: container ships that do not keep to the guideline for MTBE/ETBE transport on inland waterways, leaks from and during filling of petrol vehicles and vessels.

22 *https://nos.nl/artikel/2032228-babymelk-tekorten-illegale-handel-en-agressie*

23 *https://rvszoeksysteem.rivm.nl/stof/detail/5206*
24 *https://rvs.rivm.nl/sites/default/files/2019-03/2.%20drw%208-hydroxypenillic%20acid.pdf*

Distribution of contamination: MTBE was detected above the ERM target value at Brakel. The indicative drinking water guideline value for MTBE is 9,420 µg/L, but the odour threshold is around 10 to 15 µg/L.
Notable: years ago, peaks of MTBE arose frequently in the Meuse. The reduction in the peaks after 2008 is thanks to: the remediation of the MTBE contamination in Limburg that resulted from leakage from an underground pipe belonging to Sabic on the port site in Stein, and the publication of the guideline for MTBE/ETBE transport on inland waterways from the European Fuel Oxygenates Association (EFOA). The EFOA is the European sector organisation of producers of MTBE and ETBE. The purpose of this 'Code of Best Practice' is to minimise the residual amount of vapour and liquid that arises during the transport of MTBE and ETBE to reduce the risk of release into the water.



Ethyl hydrogen sulphate (CASRN 540-82-9)

PMT-score 0.40
(P=0.11 | M=0.83 | T=0.70)

Application: ethyl hydrogen sulphate, also known as sulfovinic acid and ethyl sulphate, is an organic chemical compound that is used as an intermediate product in the production of ethanol from ethylene. It is the ethyl ester of sulfuric acid. Propane nitrile can be made by distillation of ethyl sulphate in the presence of potassium cyanide. The nickel(II) salt of ethyl sulphate (CASRN 71720-48-4) is a Substance of Very High Concern (source: RIVM and ECHA).
Origin: unknown.
Distribution of contamination: ethyl hydrogen sulphate was detected at a concentration equal to the ERM target value at Haringvliet. This indicates the existence of a source in the Rhine river basin.

Substances with a drinking water standard

There are a number of substances that have drinking water standards in addition to an ERM target value. In the past, we did not report on these substances, because the ERM target value is intended for substances without a drinking water standard. An exception is the category of plant protection products, biocides and their metabolites. These substances are tested against the ERM target value, which is equal to the standard for drinking water, and in the Netherlands also equal to the standard for surface water from which drinking water is made. From 2021 onwards, all substances will be tested against their ERM target value, even if they have a drinking water standard. In 2023, breaches of the ERM target values took place for:

- chlorinated hydrocarbons:
  - 1,2-dichloroethane (Namêche, Eijsden, Heel and Keizersveer)
- trihalomethanes:
  - tribromomethane (Brakel)
  - bromodichloromethane (Haringvliet).

Residues of pharmaceuticals and endocrine-disrupting chemicals

In 2023, 64 parameters exceeded the ERM target values one or more times. In 25% of these cases, the issue was residues of pharmaceuticals and endocrine-disrupting chemicals (16). Of the 895 measurements that were done for these 16 substances, 163 (18.2%) exceeded the ERM target value.

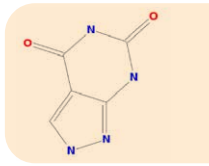
Table 6: Residues of pharmaceuticals and endocrine-disrupting chemicals that exceeded the ERM target value in 2023 (maximum concentrations).

Parameter	CASRN	ERM-	tv	TAI	NAM	LUI	EYS	ROO	STV	HEE	BRA	HEU	KEI	BSM	HAR	n/	N	%
Residues of pharmaceuticals and endocrine-disrupting chemicals																163	895	18,21%
oxypurinol	2465-59-0	0,1	µg/l								1,1					13	13	100,00%
valsartanic acid	164265-78-5	0,1	µg/l					0,11		0,16	0,28			0,36	0,33	30	56	53,57%
vigabatrin	60643-86-9	0,1	µg/l					0,84		0,79				0,62	0,51	20	43	46,51%
N-formyl-4-aminoantipyrine	1672-58-8	0,1	µg/l					0,011		0,02	0,1			0,12	0,22	15	56	26,79%
di-isobutyl phthalate	84-69-5	0,1	µg/l					0,01			0,15					1	4	25,00%
metformin	657-24-9	1	µg/l		1,19	1,64	1,79	1,7		1,1	0,51		0,82	0,87	0,61	27	116	23,28%
guanylurea	141-83-3	1	µg/L				1,15	1,4		1,4	0,65		1,08	2,1	1,9	19	90	21,11%
lamotrigine	84057-84-1	0,1	µg/l					0,09		0,11	0,1			0,14	0,13	10	56	17,86%
di(2-ethylhexyl)phthalate (DEHP)	117-81-7	0,1	µg/l						1		0,13					2	12	16,67%
candesartan	139481-59-7	0,1	µg/l					0,01		0,02	0,07			0,1	0,15	8	55	14,55%
N-Acetylaminoantipyrine	83-15-8	0,1	µg/l					0,02		0,04	0,06			0,08	0,15	8	56	14,29%
tramadol	27203-92-5	0,1	µg/l		0,13	0,16		0,06		0,07	0,05			0,06	0,04	5	82	6,10%
valsartan	137862-53-4	0,1	µg/l		0,06	0,06		0,03		0,04	0,03			0,09	0,1	2	80	2,50%
paracetamol	103-90-2	0,1	µg/l					0,06		0,08	0,01			0,11	0,03	1	56	1,79%
sitagliptin	486460-32-6	0,1	µg/l					0,02		0,02	0,03			0,07	0,1	1	56	1,79%
bisphenol A	80-05-7	0,1	µg/l		<0.05	<0.05		0,05		0,22	0,01			0,04	0,03	1	64	1,56%

ERM-sw = ERM target value, TAI = Tailfer, NAM = Namêche, LUI = Liège, EYS = Eijsden, ROO = Roosteren, STV = Stevensweert, HEE = Heel, BRA = Brakel, HEU = Heusden, KEI = Keizersveer, BSM = Bergsche Maas, HAR = Haringvliet.

In the table, the highest-measured value is presented if the parameter exceeded the ERM target value, where n is the number of breaches and N is the number of measurements.

Oxypurinol (CASRN 2465-59-0)



PMT-score 0.26

(P=0.10 | M=0.52 | T=0.33)

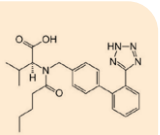
Application: oxypurinol is a metabolite of allopurinol, which inhibits the formation of uric acid by inhibiting the enzyme xanthine oxidase. Allopurinol prevents the body converting purine into uric acid. Purine arises in certain foodstuffs, and the body produces it as well. In this way, allopurinol reduces the amount of uric acid in the blood. Doctors prescribe allopurinol for gout, kidney stones, kidney diseases and cancer. It is also used for certain metabolic conditions in which too much uric acid is produced. Allopurinol (Zyloric®), with 25,407,700 DDD[25], was at position 74 in the top 100 of the most-prescribed medications in the Netherlands in 2022 (source: gipdatabank.nl).

Origin: Allopurinol is converted rapidly (in two hours) into its active metabolite oxypurinol. The half-life of this substance is 18 to 30 hours, which means that the effectiveness of allopurinol largely arises via its conversion product. Oxypurinol is excreted by the body and ends up in the surface water via sewerage systems.

Distribution of contamination: oxypurinol exceeded the ERM target value 13 times in the 13 measurements at Brakel. Oxypurinol has an indicative drinking water target value of 8 µg/L.

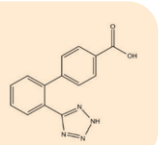
25 *Defined Daily Dose*

Medications for cardiovascular diseases (AIIRAs and beta blockers)



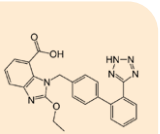
Valsartan (CASRN 137862-53-4)

PMT-score 0.33
(P=0.14 | M=0.47 | T=0.56)



Valsartanic acid (CASRN 164265-78-5)

PMT-score 0.35
(P=0.21 | M=0.63 | T=0.33)



Candesartan (CASRN 139481-59-7)

PMT-score 0.40
(P=0.54 | M=0.28 | T=0.42)

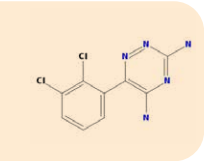
Application: valsartan, candesartan and irbesartan are medications in the category angiotensin II receptor antagonists (AIIRAs). They inhibit the action of a hormone in the blood that contracts the blood vessels and raises the blood pressure. They are prescribed for high blood pressure, heart failure and after a cardiac infarct. In 2022, valsartan was in positions 62 (Diovan®, 30,299,300 DDD), 120 (Entresto® with sacubitril, 12,230,500 DDD), 197 (Codiovan® with diuretics, 5,882,000 DDD), 281 (Exforge® with amlodipine, 2,720,600 DDD) and 293 (Exforge HCT® with amlodipine and hydrochlorothiazide, 2,425,500 DDD) in the top 500 of the most-prescribed medications in the Netherlands [source: gipdatabank.nl). In 2022, candesartan appeared twice in the top 500 of the most-prescribed medications in the Netherlands: at number 29 with 70,216,200 (Atacand®) and at number 230 with 4,522,100 DDD (Atacand plus® with diuretics). In 2022, irbesartan appeared twice in the top 100 of the most-prescribed medications in the Netherlands: at number 32 with 63,411,800 (Aprovel®) and at number 91 with 17,409,200 DDD (Coaprovel® with diuretics).

Application: after being administered, these substances are excreted by the body and end up in the surface water via sewerage systems.

Distribution of contamination: the breakdown product of valsartan, valsartan acid, exceeded the ERM target value in measurements at Roosteren, Heel, Brakel, Bergsche Maas and Haringvliet. Valsartan exceeded the ERM target value in measurements at Haringvliet. Candesartan was detected in amounts above the ERM target value at Bergsche Maas and Haringvliet.

Notable: valsartan was in the news in 2017 and 2018 thanks to large-scale recalls of medication by pharmacists worldwide. Blood pressure-lowering drugs in the sartans group contained elevated concentrations of carcinogenic nitrosamines, including N-nitrosodimethylamine (NDMA) and N-nitrosodiethylamine (NDEA). After this discovery, a study was initiated immediately to investigate the cause of the presence of this contaminant. This study led to the recommendation to permit no measurable quantity of nitrosamines in sartans.

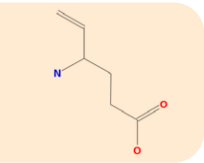
Medications for epilepsy and depression



Lamotrigine (CASRN 84057-84-1)

PMT-score 0.64
(P=0.77 | M=0.47 | T=0.74)

Application: lamotrigine is a substance that brings overstimulated nerves in the brain to rest in epilepsy and manic depression (bipolar disorder). Sometimes also in neuralgia, in post-traumatic stress disorder (PTSD), in complex regional pain syndrome (CPRS, also called post-traumatic dystrophy), singultus (hiccups), muscle cramps and in the treatment of breast cancer to combat hot flushes. In 2022, lamotrigine was at position 184 in the top 500 of the most prescribed medications in the Netherlands with 6,545,000 DDD (Lamictal®).
Origin: after being administered, this substance is excreted by the body and ends up in the surface water via sewerage systems.
Distribution of contamination: lamotrigine was detected at the ERM target value at Heusden, Brakel, Bergsche Maas and Haringvliet.



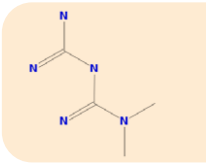
Vigabatrin (CASRN 60643-86-9)

PMT-score 0.18
(P=0.03 | M=0.89 | T=0.18)

Application: vigabatrin is a substance that brings overstimulated nerves in the brain to rest in epilepsy. It is one of the last therapeutic options, because it is less safe and is less well tolerated than other antiepileptic drugs (source: Farmacotherapeutisch Kompas). Vigabatrin was not in the top 500 most-prescribed drugs in 2022.

Origin: after being administered, this substance is excreted by the body and ends up in the surface water via sewerage systems.
Distribution of contamination: vigabatrin was detected at the ERM target value at Roosteren, Heel, Bergsche Maas and Haringvliet.

Antidiabetic drugs



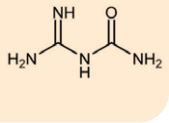
Metformin (CASRN 657-24-9)

PMT-score 0.33
(P=0.12 | M=0.96 | T=0.34)

Application: metformin is an antidiabetic drug, a medication to lower the blood sugar. It is one of the most-produced drugs in the world as regards production volume26. Doctors prescribe metformin not only for diabetes mellitus but sometimes also for reduced fertility caused by a deformity of the ovaries (Polycystic Ovary Syndrome, PCOS). In Belgium, 38 medications with this active substance are approved (fagg-afmps.be). In 2022, metformin, with a total of 161,041,300 DDD (Glucient®), stood in the 12th place of most-prescribed medications in the Netherlands (source: gipdatabank.nl). Metformin is also present at position 352 (Janumet® with sitagliptin, 1,447,200 DDD) and 380 (Eucreas® with vildagliptin, 1,033,300 DDD). Metformin is not available over the counter.
Application: after being administered, these substances are excreted by the body and end up in the surface water via sewerage systems.
Distribution of contamination: metformin was detected above the ERM target value in 2023 at the measurement points Namêche, Liège, Roosteren, Heel and Bergsche Maas. The indicative drinking water target value for metformin is 196 µg/L.

26 *https://pubs.rsc.org/en/content/articlelanding/2009/em/b909311g/unauth*

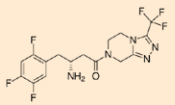
Notable: the primary breakdown product of metformin is guanylurea, which is not broken down further by bacteria or under the influence of light in aerobic conditions (source: [Trautwein and Kümmerer, 2011 in Derksen and Ter Laak, 2013).



Guanylurea (CASRN 141-83-3)

PMT-score 0.29
(P=0.10 | M=0.78 | T=0.33)

Application: none. Guanylurea is a breakdown product of metformin.
Origin: metformin introduced into surface water breaks down into guanylurea, after which no further breakdown happens. Guanylurea is indeed well broken down by passage through soil.
Distribution of contamination: guanylurea was detected above the ERM target value in 2022 at the monitoring points Eijsden, Roosteren, Heel, Heusden, Bergsche Maas and Haringvliet. Guanylurea has an indicative drinking water target value of 22.5 µg/L.
Notable: the breakdown product guanylurea has a lower indicative drinking water target value than the parent substance metformin.

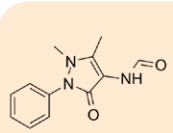


Sitagliptine (CASRN 486460-32-6)

PMT-score 0.57
(P=1,00 | M=0.55 | T=0.33)

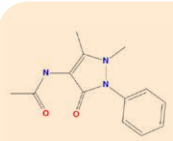
Application: sitagliptin is a blood sugar lowering agent. It is one of the DPP-4 inhibitors. These ensure that the level of insulin after a meal is at a better level and that the body produces less sugar. Doctors prescribe it for diabetes mellitus. In 2021, sitagliptin, with a total of 8,082,400 DDD (Januvia®), stood in the 162nd place of most-prescribed medications in the Netherlands (source: gipdatabank.nl). Sitagliptin is also present at position 352 (Janumet® with metformin, 1,447,200 DDD).
Origin: after being administered, this substance is excreted by the body and ends up in the surface water via sewerage systems.
Distribution of contamination: sitagliptin was detected at the ERM target value in 2023 at Haringvliet.
Notable: sitaglipin is a PFAS according to the OECD definition and can break down into trifluoroacetic acid (TFA).

Analgetics



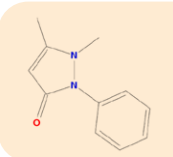
N-Formyl-4-aminoantipyrine (FAA, CASRN 1672-58-8)

PMT-score 0.46
(P=0.24 | M=0.68 | T=0.61)



N-Acetyl-4-aminoantipyrine (AAA, CASRN 83-15-8)

PMT-score 0.48
(P=0.26 | M=0.70 | T=0.61)

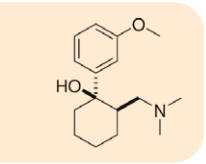


Antipyrine (phenazone, CASRN 60-80-0)

PMT-score 0.40
(P=0.16 | M=0.66 | T=0.61)

Application: N-Formyl-4-aminoantipyrine (FAA) and N-acetyl-4-ami-noantipyrine (AAA) are metabolites of antipyrene, a medication with analgesic and antipyretic effects, also known as phenazone. Phenazone was synthesised for the first time by Ludwig

Knorr in 1887 and used as an analgesic and fever-reducing medication. Phenazone is now only seldom used for the treatment of pain and fever. However, it is frequently used in the testing of the effects of other medications or illnesses in the medication-degrading enzymes in the liver.
Origin: after being administered, this substance is excreted by the body and ends up in the surface water via sewerage systems.
Distribution of contamination: FAA equalled the ERM target value in measurements at Brakel and exceeded it at Bergsche Maas and Haringvliet, while AAA was only detected in breach at Haringvliet. AAA has an indicative drinking water target value of 10 µg/L.



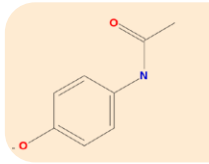
Tramadol (CASRN 27203-92-5)

PMT-score 0.38
(P=0.67 | M=0.51 | T=0.17)

Application: tramadol is a medium-to-strong analgesic that is prescribed for sudden or long-term severe pain, such as after injury, surgery or cancer, and for neuralgia and joint pain caused by osteoarthritis. It can also help in premature ejaculation, if other medicines do not work (source: apotheek.nl). Tramadol is a morphine-like synthetic opioid, but does not come under the Opium Act. In 2021, tramadol appeared twice in the top 200 of the most-prescribed medications in the Netherlands: at number 132 with 11,324,300 DDD (Tramagetic®) and at number 181 with 7,121,600 DDD (Zaldiar® with paracetamol).
Origin: after being administered, this substance is excreted by the body and ends up in the surface water via sewerage systems.
Distribution of contamination: tramadol exceeded the ERM target value at Namêche and Liège.

Notable: the substance has appeared with some regularity in the sports news, and then mainly in connection with its large-scale use in competitive cycling. The Dutch Doping Authority has warned all athletes that from 1 January 2024 tramadol will definitely be on the doping list. In cycling, the painkiller had already been banned since 1 March 2019, but from 2024, world anti-doping agency WADA has also put the drug on the banned list.

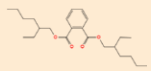
Paracetamol (CASRN 103-90-2)



PMT-score 0.36
(P=0.13 | M=0.62 | T=0.57)

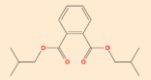
Application: Paracetamol is an over-the-counter analgesic and fever-reducing drug. The name paracetamol is derived from the chemical name para-acetylaminophenol.
Origin: After administration, this substance is excreted by the body, and finds its way into the surface water via sewerage systems.
Distribution of contamination: paracetamol exceeded the ERM target value in measurements at Bergsche Maas.

Endocrine-disrupting chemicals



Bis(2-ethylhexyl) phthalate (Di(2-ethylhexyl) phthalate (DEHP, CASRN 117-81-7)

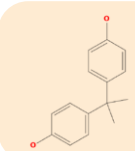
PMT-score 0.15
(P=0.05 | M=0.11 | T=0.71)



Diisobutyl phthalatet (DIBP, CASRN 84-69-5)

PMT-score 0.31
(P=0.13 | M=0.32 | T=0.71)

Application: bis(2-ethylhexyl) phthalate (DEHP) is used as a plasticiser in PVC production, as a hydraulic fluid, as a dielectric in capacitors and as a solvent in organic chemistry. Plastics contain about 1% to 40% DEHP on average. Di-isobutyl phthalate (DIBP) is also a plasticiser, mainly used in the production of adhesives and sealants.
Origin: use of plasticisers in plastic, glue, ink, hydraulic fluid, etc.
Distribution of contamination: DEHP and DIBP exceeded the ERM target value in measurements at Brakel. DEHP was also found above the ERM target value at Brakel in 2017 and in 2011 to 2014.
Notable: DEHP is a priority hazardous substance in the European water policy (Directive 2013/39/EU). DEHP was classified as an endocrine-disrupting chemical (EDC) by the European Commission in July 2017 and identified as Substance of Very High Concern (SVHC) under Article 57(f) of REACH. On 17 December 2018, the European Commission decided to end the use and trade of products containing DEHP, dibutyl phthalate (DBP), benzyl butyl phthalate (BBP) and DIBP in the European Union (EU Regulation No. 2018/2005).



Bisphenol A (BPA, CASRN 80-05-7)

PMT-score 0.43
(P=0.27 | M=0.32 | T=0.90)

Application: bisphenol A (BPA) is used in the production of plastics such as polycarbonate and thermal paper such as is used for receipts, and is also used as a solvent in ink and as a flame retardant.
Origin: use of plasticisers in plastic, glue, ink, hydraulic fluid, etc.
Distribution of contamination: exceeded ERM target value in one measurement at Heel.
Notable: the sale and import of baby bottles containing BPA has been banned in the European Union since June 2011. In the EU, BPA is not allowed in eco-labelled products and is banned in cosmetics. On 12 December 2016, the European Commission issued a regulation regarding the use of BPA in thermal paper. Thermal paper containing BPA has been banned in the EU market since 2 January 2020.

Plant protection products, biocides and their metabolites

In 2023, 64 parameters exceeded the ERM target values one or more times. In 29.7% of cases (19 times), this concerned Plant protection products, biocides and metabolites. Of the 2,322 measurements that were done for these 19 substances, 243 (10.5%) exceeded the ERM target value.

Table 7: plant protection products, biocides and their metabolites that exceeded the ERM target values in 2023 (maximum concentrations).

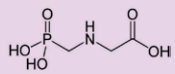
Parameter	CASRN	ERM-	tv	TAI	NAM	LUI	EYS	ROO	STV	HEE	BRA	HEU	KEI	BSM	HAR	n/	N	%
Plant protection products, biocides and their metabolites																254	2322	10,94%
aminomethylphosphonic acid (AMPA)	1066-51-9	0,1	µg/l	0,24	0,44	0,70	1,2	2,2	2,06	1,2	0,90	1,13	0,96	0,92	0,6	119	135	88,15%
chloridazone-desphenyl	6339-19-1	0,1	µg/l	0,08	0,14	0,16		0,26		0,22				0,22	0,25	43	81	53,09%
metolachlor-ESA	171118-09-5	0,1	µg/l		0,11	0,06					0,15	0,16				21	48	43,75%
fluopyram	658066-35-4	0,1	µg/l								0,18	0,05				5	24	20,83%
metolachlor-OA	152019-73-3	0,1	µg/l		0,06	0,04				<0.05	0,10	0,16		0,16	0,07	20	102	19,61%
flonicamid	158062-67-0	0,1	µg/l								0,25	0,01				4	26	15,38%
methyldesphenylchloridazon	17254-80-7	0,1	µg/l					0,04		0,03	0,13	0,14		0,05	0,07	7	66	10,61%
propamocarb	24579-73-5	0,1	µg/l					1,2		0,78	0,04	0,07		0,14	<0.06	17	354	4,80%
dicamba	1918-00-9	0,1	µg/l					<0.1		0,23	0,01	0,01		<0.1	<0.1	3	66	4,55%
cyprodinil	121552-61-2	0,1	µg/l								0,1	<0.02				1	26	3,85%
(4-chloro-2-methylphenoxy)acetic acid (MCPA)	94-74-6	0,1	µg/l	0,03	<0.03	<0.03	<0.05	<0.02	<0.025	0,48	0,12	0,06	0,05	0,05	<0.05	4	157	2,55%
dimethomorph	110488-70-5	0,1	µg/l		<0.02	<0.02					<0.07	0,08		0,15	<0.06	2	82	2,44%
glyphosate	1071-83-6	0,1	µg/l	<0.05	0,04	0,04	<0.2	0,1	0,1	0,06	0,03	0,06	<0.2	0,07	0,03	2	135	1,48%
diethyltoluamide (DEET)	134-62-3	0,1	µg/l					0,03		0,04	0,03	0,1		0,05	0,03	1	71	1,41%
dimethenamid	87674-68-8	0,1	µg/l	0,02	0,03	0,18					0,03	0,05				1	78	1,28%
metamitron	41394-05-2	0,1	µg/l	<0.01	<0.02	0,11		<0.02		<0.02	<0.02	<0.02		<0.02	<0.02	1	127	0,79%
hexachloorbenzene (HCB)	118-74-1	0,1	µg/l	<0.00	0,09	0,15	<0,0002	<0.02	<0.00	<0.02	<0.02	<0.02	<0,0002	<0.02	<0.02	1	179	0,56%
terbuthylazine	5915-41-3	0,1	µg/l	0,01	<0.02	<0.02	0,02	<0.02	0,01	0,02	0,02	0,03	0,01	0,11	<0.02	1	211	0,47%
prosulfocarb	52888-80-9	0,1	µg/l					0,05		0,16	0,03	0,03		<0.06	<0.06	1	354	0,28%

ERM-sw = ERM target value, TAI = Tailfer, NAM = Namêche, LUI = Liège, EYS = Eijsden, ROO = Roosteren, STV = Stevensweert, HEE = Heel, BRA = Brakel, HEU = Heusden, KEI = Keizersveer, BSM = Bergsche Maas, HAR = Haringvliet.

In the table, the highest-measured value is presented if the parameter exceeded the ERM target value, where n is the number of breaches and N is the number of measurements.

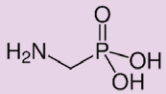
Glyphosate(CASRN 1071-83-6)

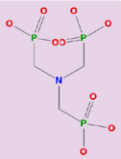
PMT-score 0.25
(P=0.05 | M=0.96 | T=0.34)



Application: glyphosate is a herbicide (weedkiller).
Origin: although the majority of the quantities sold are applied in agriculture, we know from practical investigations and monitoring programmes in the past that emissions of glyphosate into the Meuse mainly originate from sources outside agriculture, such as site management and, in particular, application to surfacing. This was confirmed by calculations of burdens of emissions that were conducted in 2010 for the Netherlands part of the Meuse river basin: 1.5% of the burden comes from agricultural use and 98.5% via rainwater drains, overflows and effluents from waste water treatment plants (RWZIs) (source: Klein et al., 2013). The Board for the Authorisation of Plant Protection Products and Biocides (CTGB) have imposed increasing restrictions on the use of plant protection products containing glyphosate over the years, such as: When applied on temporarily uncultivated land, ditch banks should not be sprayed. To protect drinking water sources, the application of this pesticide is not allowed on closed and semi-open hard surfaces in the Meuse river basin. This concerns the following areas in the Netherlands: the provinces of Limburg and North Brabant (except the municipalities of Woensdrecht and Bergen op Zoom) and the municipalities of Maasdriel, West Maas en Waal, Druten, Wijchen, Beuningen, Heumen and Nijmegen, west of the Meuse-Waal canal.
Distribution of contamination: glyphosate equalled the ERM target value at the Roosteren and Stevensweert monitoring points.
Notable: in 1994, the drinking water companies demonstrated the presence of the glyphosate in the Netherlands part of the Meuse for the first time and, from 1996, the ERM target value was exceeded every year. Particularly in the period 2002-2005, the average concentration of glyphosate in the Meuse rose to above 0.1 µg/L.

The ERM target value has no longer been exceeded at Tailfer for years, which means that very little glyphosate from France ends up in the Meuse. In 2018, an exemption was granted to WML and Evides to allow them to continue to use surface water containing glyphosate at Heel and Keizersveer (Gat van de Kerksloot) for the production of drinking water.





aminomethylfosfonzuur (CASRN 1066-51-9)

PMT-score 0.30
(P=0.10 | M=0.84 | T=0.33)

Application: none. Aminomethylphosphonic acid (AMPA) is a metabolite of glyphosate or ATMP.
Origin: the majority of the AMPA burden increase between Eijsden and Keizersveer was explained in a 2010 monitoring programme by the use of glyphosate as a herbicide, and mainly outside agriculture. In that monitoring programme in 2010, a major source of AMPA was also discovered that did not have its source in the use of glyphosate. High concentrations of AMPA were measured in the Ur tributary, which flows into the Grensmaas (Border Meuse) at Stein. The AMPA in the water of the Ur tributary is a breakdown product of ATMP (aminotrismethylenephosphonic acid) which is added to cooling water on the nearby Chemelot chemistry industrial estate. It was calculated that 34% of the AMPA burden increase between Eijsden and Keizersveer in 2010 was caused by this. These emissions have since been significantly reduced and the effect of this is reflected in Figure 12.
Distribution of contamination: AMPA was detected at above the ERM target value at all monitoring points where it was measured. The Dutch government considers AMPA to be a metabolite of a crop protection product that is toxicologically irrelevant to humans. Since 2011, the Dutch government has applied a standard for metabolites toxicologically irrelevant to humans of 1 µg/L for the raw material for the production of drinking water (Dutch Drinking Water Regulation 2011). Since 2020, a list of metabolites of plant protection products toxicologically irrelevant to humans and their standards has been available[27]. The standard of 1 µg/L was exceeded at Eijsden, Roosteren, Stevensweert, Heel and Heusden in 2023.
Notable: an exemption was temporarily granted to WML (2017), Evides (2017) and Dunea (2018) to allow them to continue to use surface water containing AMPA at Heel, Brakel and Keizersveer (Gat van de Kerksloot) for the production of drinking water.

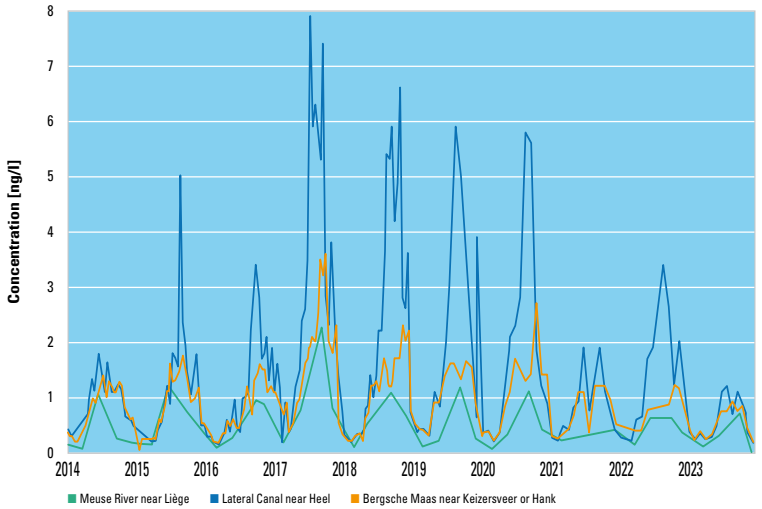
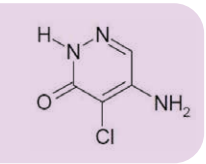


Figure 12: Concentration of AMPA in the Meuse river basin, 2014-2023.

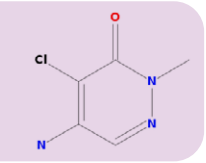
27 https://rvszoeksysteem.rivm.nl/Stoffen



Chloridazon desphenyl (CASRN 6339-19-1)

PMT-score 0.46

(P=0.20 | M=0.80 | T=0.61)



Chloridazon-methyl-desphenyl (CASRN 17254-80-7)

PMT-score 0.47

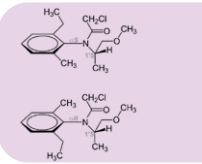
(P=0.21 | M=0.79 | T=0.61)

Application: none. Chloridazon-desphenyl and chloridazon-methyl-desphenyl are metabolites of chloridazon, a herbicide. Authorisations of plant protection products based on the active substance chloridazon have recently been withdrawn in Belgium and the Netherlands. The last authorisations in the Netherlands expired on 31 December 2018, with a use-by date of 30 June 2020. This was done based on the expiry date of the active substance chloridazon set in Implementing Regulation 2008/41/EC. Chloridazon was present in plant protection products with the names: Agrichem Chloridazon 65% Sp.P. (NL), Agrichem Chloridazon F.W. (NL), Alicep N (NL), Alliproc (NL), Better Df (NL), Better Sc (BE, NL), Better Wp (NL), Bietazol 520 (BE), Booster 520 (BE), Chlordex Sc (BE), Chloridazon Df (NL), Chloridazon Flow 3 (NL), Chloridaz-W.G. (NL), Fiesta (NL), Fiesta New (BE), Imex-Chloridazon Flow 2 (NL), Luxan Chloridazon Df (NL), Luxan Chloridazon Flow (NL), Luxan Chloridazon Spuitkorrel (NL), Pyramin DF (NL), Pyramin FL (NL), Pyramin Sc 520 (BE) and Pyroquin Tdi Sc (BE) (source: CTGB and Phytoweb).

Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).

Distribution of contamination: the metabolite chloridazon desphenyl was detected above the ERM target value at Namêche, Liège, Roosteren, Heel, Bergsche Maas and Haringvliet. The metabolite chloridazon-methyl-desphenyl was found above the ERM target value at Heusden and Brakel. The Dutch government considers both chloridazon desphenyl and chloridazon-methyl-desphenyl to be metabolites of a crop protection product toxicologically irrelevant to humans. Since 2011, the Dutch government has applied a standard for metabolites toxicologically irrelevant to humans of 1 µg/L for the raw material for the production of drinking water (Dutch Drinking Water Regulation 2011). Since 2020, a list of metabolites of plant protection products toxicologically irrelevant to humans and their standards has been available22. The standard of 1 µg/L was not exceeded in 2023. In Flanders, both chloridazon desphenyl and chloridazon-methyl-desphenyl[28] are tested against a precautionary value of 4.5 µg/L.

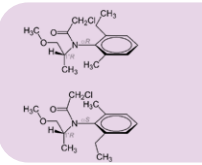
Notable: chloridazon desphenyl is detected in groundwater in many North European countries.



metolachlor (CASRN 51218-45-2)

PMT-score 0.58

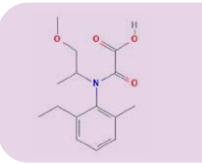
(P=0.60 | M=0.43 | T=0.74)



S-metolachlor (CASRN 87392-12-9)

PMT-score 0.58

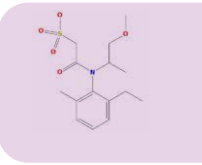
(P=0.60 | M=0.43 | T=0.74)



metolachlor-OA (CASRN 152019-73-3)

PMT-score 0.43

(P=0.19 | M=0.73 | T=0.56)



metolachlor-ESA (CASRN 171118-09-5)

PMT-score 0.49

(P=0.38 | M=0.55 | T=0.56)

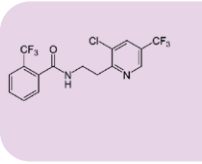
28 https://www.vmm.be/wetgeving/relevante_en_niet-relevante_metabolieten_tw.pdf

Application: In both Belgium and the Netherlands, S-metolachlor (CASRN 87392129) was approved as a herbicide in the cultivation of various fruit and vegetables. Implementing Regulation (EU) 2024/20 of 23 December 2023 stipulates that the approval of the active substance S-metolachlor will not be renewed and that member states must have withdrawn all authorisations of plant protection products containing this active substance by 23 April 2024. This active substance could also be found in the plant protection products with the names: Agan Metolachloor 960 (NL), Camix (BE, NL), Codal (BE), Cropguard S-Metolachloor (NL), Deluge Extra (BE), Dual 720 Ec (NL), Dual Gold (BE), Dual Gold 960 Ec (NL), Efica 960 Ec (BE, NL), Eternity (BE), Gardo Gold (BE, NL), Gardoprim (BE), Gardoprim Plus 500 Sc (NL), Jobber Plus 50 Wp (NL), Lecar (BE), Luxan Metolachloor (NL), Metallica (BE), Metolachloor 960 E.C. (NL), Metolagan 720 (NL), Primagram Gold (BE), S-Metolachlor 960 (BE) en Zeanett 500 Ec (NL) (source: CTGB and Phytoweb).

Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.). The drinking water companies' laboratory analysis methods present metolachlor as the racemic mixture of the R- and S-isomers.[29] Measurement results of both S-metolachlor and metolachlor can be considered representative of S-metolachlor, as the racemic mixture of metolachlor has been banned in the European Union since 30 November 2002 (Regulation No. 2002/2076/EC). The active substance S-metolachlor[30] was placed on Annex I to Directive 91/414/EEC by virtue of Directive 2005/5/EC with effect from 1 October 2005 and subsequently approved in accordance with Regulation (EC) No. 1107/2009 by Implementing Regulation (EU) No 540/2011.

Distribution of contamination: metolachlor-ESA (also called metolachlor-ethane sulfonic acid or metolachlor-S-metabolite) was found above the ERM target value at Namêche, Brakel and Heusden. The concentration of metolachlor-OA (also called metolachlor oxanilic acid or metolachlor-C-metabolite) exceeded the ERM target value at Brakel, Heusden and Bergsche Maas. The Dutch government considers metolachlor-OA to be toxicologically irrelevant to humans. Since 2011, the Dutch government has applied a standard for metabolites toxicologically irrelevant to humans of 1 µg/L for the raw material for the production of drinking water (Dutch Drinking Water Regulation 2011). Since 2020, a list of metabolites of plant protection products toxicologically irrelevant to humans and their standards has been available22. The value of 1 µg/L was not exceeded. However, in support of the termination of the European authorisation, it was concluded that the metabolites of metolachlor are toxicologically relevant to humans[31]. In Flanders, both metolachlor-OA and metolachlor-ESA are tested against a precautionary value of 4.5 µg/L. This value was not exceeded. The parent substance (s-) metolachlor was monitored, but not detected above 0.1 µg/L.

Fluopyram (CASRN 658066-35-4)



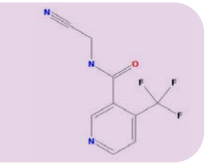
PMT-score 0.44

(P=0.99 | M=0.26 | T=0.33)

Application: fluopyram is approved in the Netherlands and Belgium in several plant protection products as a fungicide (to combat mould) and a nematicide (to combat roundworms including eelworms) in all kinds of arable crops, vegetables, fruit crops and floriculture crops (source: HWL factsheet). These plant protection products are sold in Belgium and the Netherlands under the brand names Ascra Xpro (BE, NL), Bixazor Extra (BE), Caligula (BE), Exteris Stressgard (BE, NL), Inter Blast (BE), Inter Lunar (BE), Keynote Xpro (BE), Luna Care (BE, NL), Luna Experience (BE, NL), Luna Privilege (BE, NL), Luna Sensation (BE, NL), Luna Smart (BE), Moona Duo (BE), Propulse (BE, NL), Propyram 250 Se (BE), Recital (BE), Silvron Xpro (BE, NL), Veldig Xpro (BE), Velum Prime (BE, NL), Verango (NL), VSM Care (BE), Vsm Fluostrobine (BE) and Yearling (BE) (source: CTGB and Phytoweb).

29 The designations R- and S- are abbreviations of the Latin words rectus (right) and sinister (left).
30 the mixture of 80-100% S-metolachlor and 0-20% R-metolachlor
31 https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2023.7852

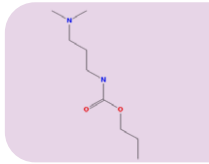
Origin: it emerges from the monitoring data that fluopyram was mainly detected at high concentrations in the polder water at Brakel Pumping Station. Direct application in agriculture, fruit growing and floriculture is probably the main source of fluopyram in the polder water and indirectly the surface water (source: HWL factsheet).
Distribution of contamination: as in 2022, fluopyram was only found above the ERM target value at Brakel. This indicates a local source.
Notable: since 20 December 2022, fluopyram has been considered in the Netherlands as a potential substance of concern, given that it belongs to the PFAS group (source: RIVM). Trifluoroacetic acid is one of the metabolites of fluopyram.



Flonicamid (CASRN 158062-67-0)

PMT-score 0.54
(P=0.83 | M=0.58 | T=0.33)

Application: flonicamid is authorised in the Netherlands for use as an insecticide and belongs to the pyridine carboxamides. It is permitted in the cultivation of various vegetables, fruits and flower bulbs. Flonicamid is or was the active substance in the plant protection products Afinto (BE, NL), Alakazam 500 Wg (BE), Apn Flonicamid 500 (NL), Flonicastar (BE), Flonigold 500 (BE), Hinode (BE, NL), Inter Peki (NL), Inter Peki Wg (NL), Shoori (NL), Teppeki (BE, NL), Teppeki WG (NL) and VSM Flonicamid 50 Wg (NL) (source: CTGB and Phytoweb).
Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).
Distribution of contamination: flonicamid was detected above the ERM target value at Brakel. This indicates a local source.
Notable: flonicamid belongs to the PFAS according to the OECD definition. Trifluoroacetic acid is one of its metabolites.

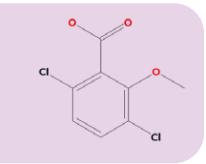


Propamocarb (CASRN 24579-73-5)

PMT-score 0.54
(P=0.36 | M=0.61 | T=0.74)

Application: propamocarb is a fungicide that is used in agriculture in the cultivation of various vegetables, types of lettuce, tomatoes, potatoes and house plants, to combat false mildew, phytophthora and pythium. In Belgium and the Netherlands, plant protection products based on the active substance propamocarb are and were authorised with names such as Budget Propamocarb-Fosetyl (NL), Matix (NL), Previcur Energy (BE, NL), Profo Energy (BE) and Wopro Energy (NL). There are or were also plant protection products authorised on the basis of propamocarb hydrochloride (CASRN 25606-41-1) with names such as Agrichem Propamocarb (NL), Alonso (BE), Axidor (BE, NL), Boreso Flex (BE), Budget Propamocarb 722 (NL), Consento (NL), Curomil 450 Sc (BE), Diprospero (BE, NL), Edipro (BE, NL), Phytocur N (NL), Imex Propamocarb (NL), Infinito (BE, NL), Matix (BE), Obscur (BE), Omix (BE), Omix Duo (BE), Omix Duo Sc (BE), Parimco PROPAMOCARB (NL), Potagold 687.5 Sc (BE), Previcur N (NL), Promess (NL), Proplant (BE, NL), Proxanil (BE, NL), Proxanil Garden (BE), Proxidor (NL), Raport (BE, NL), Rival (BE, NL), Rival Duo (BE), Simpro (BE), Sporax (BE, NL), Tattoo C (NL) and VSM Finito (BE) (source: CTGB and Phytoweb).
Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).
Distribution of contamination: propamocarb exceeded the ERM target value at Roosteren.
Notable: see the section ‘Example of incident with successful tracing’ on page 3537 of the Annual Report on the Meuse 2021[32].

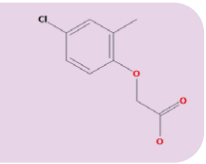
32 https://www.riwa-maas.org/publicatie/riwa-jaarrapport-2021-de-maas/



Dicamba (CASRN 1918-00-9)

PMT-score 0.49
(P=0.48 | M=0.60 | T=0.42)

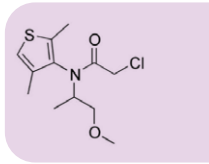
Application: dicamba is a herbicide and plant growth regulator. It is used in agriculture, in the cultivation of maize and other cereal crops, for keeping fallow land and grasslands weed-free and on lawns and grass fields. plant protection products containing dicamba were authorised in the Netherlands in 2024 with the names Arrat, Banvel 4S, CASPER, COMPO Gazonmeststof Plus Onkruidbestrijder, DICASH, DICOPHAR SL, Diniro, Jepolinex Pro, Kalimba (480 SL), Pokon Onkruid Weg!, Rosan, Roundup Gazon Onkruidvrij and Spandis. Previously, there were a total of 58 plant protection products authorised with dicamba as an active substance (source: CTGB). In Belgium, plant protection products containing dicamba as an active substance are authorised with names such as Banvel, Callisto Plus, Caluma Plus, Dicavel Sl, Diniro, Kamba 480 Sl, Landscaper Pro Weed Control + Fertilizer, Lumestra Plus, Spandis, Dicash[33], Dicotex26, Callam[34], Casper27, Clabod27, Frisk27, Interproba27, Piorun27 and Rosan27 (source: Phytoweb).
Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).
Distribution of contamination: dicamba exceeded ERM target value at Heel.



4-chloro-2-methylphenoxyacetic acid (MCPA, CASRN 94-74-6)

PMT-score 0.37
(P=0.17 | M=0.50 | T=0.61)

Application: MCPA is a herbicide. Based on Implementing Regulation (EU) 2023/1757, MCPA will remain on the list of approved active substances until 15 August 2026. There used to be 45 plant protection products authorised in the Netherlands containing MCPA as an active substance. Now, only the following MCPA-based plant protection products are authorised in the Netherlands: Agroxone MCPA, Cirran, CropGuard MCPA 500, Dicophar SL, Jepolinex Pro and U 46 MCPA (source: CTGB). In the Netherlands, the following plant protection products based on MCPA are approved: Cirran, Agroxyl 75027, Cirran Extra27, Damex27, Forte Super27, Dicotex27, Duplosan Super27, Gramix Super27, MCPA 75027, Phybelcozan27, U 46 M27, U 46 M75027, Bofix[35] and Kinvara28 (source: Phytoweb).
Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).
Distribution of contamination: MCPA exceeded the ERM target value at Heel and Brakel.



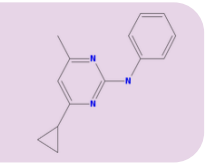
Dimethenamid(-P) (CASRN 87674-68-8)

PMT-score 0.56
(P=0.58 | M=0.50 | T=0.61)

Application: dimethenamid(-P) is a herbicide (weedkiller). Based on Implementing Regulation (EU) 2019/1137, dimethenamid-P will remain on the list of approved active substances until 31 August 2034. In Belgium and the Netherlands, the following plant protection products based on dimethenamid-P (CASRN 163515148) are approved: Agrologic Cleansoil (NL), Akris (BE, NL), Arundo (BE), Butisan Duo 400 Ec (BE), Butisan Gold (BE), Cropguard Metadimemix (NL), Frontier Elite (BE), Frontier Optima (NL), Grometa (BE), Spectrum (NL), Springbok (BE, NL), Tanaris (BE, NL), Terbudime 530 (BE), Wing P (NL) and Wopro Bodem Schoon (NL) (source: CTGB and Phytoweb). These plant protection products may be applied to many arable crops (vegetables, fruit etc.) and in floriculture in both countries. In the Netherlands, Frontier Optima may also be used on field verges and on temporarily uncultivated land.

33 *dimethylamine salt*
34 *sodium salt*
35 *potassium salt*

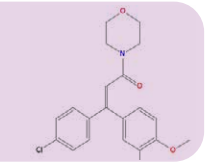
Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).
Distribution of contamination: as in 2022, dimethenamid was detected above the ERM target value once in 2023 at Liège (in 2021, once at Namêche).
Notable: the drinking water companies' laboratory analysis methods usually present dimethenamid as a mix of stereo-isomers; the S-isomer dimethenamid-P is reported only once.



Cyprodinil (CASRN 121552-61-2)

PMT-score 0.32
(P=0.39 | M=0.26 | T=0.33)

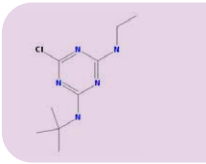
Application: cyprodinil is a fungicide used in many field crops (fruit and vegetables) and ornamentals. Cyprodinil is the active substance in plant protection products authorised in Belgium and the Netherlands with names such as Bontima (NL), Chorus (BE), Chorus 50 Wg (NL), Palladium (NL), Serenva (BE, NL), Shift (BE), Society (BE), Speech (BE), Switch (BE, NL) and VSM Cyproflu Wg (NL) (source: CTGB and Phytoweb).
Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).
Distribution of contamination: cyprodinil equalled the ERM target value at Heel.



Dimethomorph (CASRN 110488-70-5)

PMT-score 0.48
(P=0.76 | M=0.43 | T=0.33)

Application: dimethomorph, the active ingredient in a fungicide authorised in the cultivation of many crops. Dimethomorph is and was in plant protection products with names such as crobat DF (NL), Acrobat Wp (NL), Banjo Forte (BE, NL), Belomorph (BE), Brestan Combi (NL), Cabrio Duo (BE), Dimix 500 SC (NL), Diprospero (BE, NL), Foly Star 400 Sc (NL), Forum (NL), Inter Avigo (BE), Orvego (NL), Orvego Star (BE), Orvego Super (NL), Paraat (BE, NL), Presidium (BE, NL), Prevint (BE), Sitar (BE), Solide (NL) and Turbat Extra (NL) (source: CTGB and Phytoweb).
Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).
Distribution of contamination: dimethomorph was detected above the ERM target value at Bergsche Maas.
Notable: dimethomorph is a Substance of Very High Concern (SVHC) (source: RIVM). For two months in spring 2012, Dunea had to take emergency measures as a result of an illegal point discharge of dimethomorph by a horticultural company which resulted in substandard water quality in the Bommelerwaard and Afgedamde Maas rivers. This incident led to media coverage at the time.



Terbuthylazine (CASRN 5915-41-3)

PMT-score 0.60
(P=0.86 | M=0.42 | T=0.61)

Application: terbuthylazine is a herbicide (weedkiller). The authorisations of terbuthylazine in Belgium (all) and the Netherlands (almost all) are in combination with other active substances (mesotrione, s-metolachlor and sulcotrione) and are used in the cultivation of grain maize, cut maize, maize silage and corn-cob mix. It is or was contained in plant protection products with names such as Agrichem Bentazon-Terbutylazine (NL), Agrichem Terbutryn/Terbutylazine (NL), Agrichem Terbutylazine F.W. (NL), Akris (BE, NL), Andes (BE), Aspect T (BE), Calaris (BE, NL), Callistar (BE, NL), Click (NL), Click Premium (BE, NL), Click Pro (BE, NL),

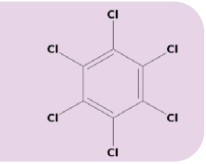
Deluge Extra (BE), Eternity (BE), Gardo Gold (BE, NL), Gardoprim (BE), Gardoprim 500 SC (NL), Gardoprim Plus 500 Sc (NL), Jobber 45 Wp (NL), Jobber Plus 50 Wp (NL), Laddok N (NL), Lido SC (NL), Primagram Gold (BE), Promess (BE), Sulcotrek (NL), Terbudime 530 (BE), Topogard 500 Sc (NL) and Tyllanex 50 Sc (NL) (source: CTGB and Phytoweb).

Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).

Distribution of contamination: terbuthylazine was found in concentrations above the ERM target value at Heel and Bergsche Maas.

Notable: previously, terbuthylazine was also found above the ERM target value:

- 2022 and 2021 in Namêche and Roosteren
- 2020 in Roosteren
- 2019 in Liège, Brakel and Keizersveer
- 2018 in Keizersveer
- 2016 in Heel and Keizersveer
- 2014 in Namêche, Liège, Heel and Heusden
- 2013 in Brakel and Keizersveer
- 2012 in Liège, Heel, Brakel, Heusden and Keizersveer.



Hexachlorobenzene (HCB, CASRN 118-74-1)

PMT-score 0.60
(P=0.86 | M=0.42 | T=0.61)

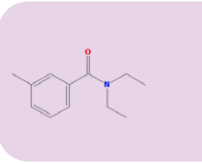
Application: hexachlorobenzene (HCB) was widely used from around 1945 as a fungicide, especially for protecting seeds. Its production and use is now banned by the Stockholm Convention on Persistent Organic Pollutants (POPs). Today, HCB is still released into the environment as it is formed as an intermediate during various industrial processes. HCB is a chemically very stable substance (persistent), which is difficult to degrade in the environment, accumulating in water, soil, and sediment. HCB can also be found in tissues of fish and birds, for example, as well as in human adipose tissue and breast milk.

Origin: it is not likely that this contamination was caused by emissions during/after agricultural use of this substance. Possibly these were re-emissions from silt due to disturbances such as dredging or a very high flow rate.

Distribution of contamination: HCB exceeded the ERM target value at Liège.

Notable: HCB is a Substance of Very High Concern (SVHC).

Diethyltoluamide (DEET, CASRN 134-62-3)



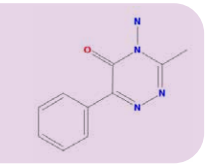
PMT-score 0.38
(P=0.24 | M=0.52 | T=0.44)

Application: DEET (N,N-diethyl-m-toluamide) is the active ingredient in biocides authorised in many insect repellent products, such as sprays, gels, sticks and roll-ons. DEET, in particular, protects against tick bites that can cause Lyme disease and mosquito bites that can cause dengue, West Nile fever and malaria.

Origin: emissions after use of this substance (via skin, clothing, etc. after washing or direct contact with water).

Distribution of contamination: DEET equalled the ERM target value at Heusden.

Notable: DEET was detected above the ERM target value once in 2016 at Liège. Previously, DEET was measured above the ERM target value in 2015 at Heusden, in 2014 at the Heusden and Keizersveer monitoring points and in 2013 at the Heel abstraction point.



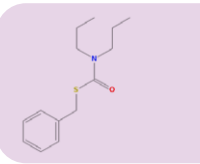
Metamitron (CASRN 41394-05-2)

PMT-score 0.39
(P=0.17 | M=0.55 | T=0.61)

Application: metamitron is a herbicide (weedkiller). It is or was contained in plant protection products with application particularly in beet and ornamental crops with names such as Aako Goltix 700 Sc (NL), Actron 700 Sc (BE), Allitron 700 Sc (BE), Beaver 15 Sg (NL), Beetix 70 Wg (BE), Beetix Sc (BE), Bettatronex Sc (BE), Bettix Sc (NL), Brevis (BE, NL), Brevis SG (NL), Corner Sc (BE), Finex 700 Sc (BE), Glotron 700 Sc (BE, NL), Goltix 700 Sc (BE), Goltix Gold (NL), Goltix Power (NL), Goltix Queen (BE, NL), Goltix SC (NL), Goltix Super (NL), Goltix Titan (BE), Goltix WG (NL), Kezuro (BE, NL), Klaxxon (BE), Kombo Sc (BE), Metafol 700 Sc (BE), Metafol Super (BE, NL), Metaliq 700 Sc (BE), Metaliq Sc (BE), Metatron Sc (BE), Metomat (BE), Mitron Sc (BE), Nymeo (NL), Phybeltron 700 (BE), Revenge (NL), Target Sc (BE), Target Wg (BE), Torero (BE), Tornado (BE) and Vextamitron 700 Sc (BE, NL) .
Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).
Distribution of contamination: metamitron exceeded the ERM target value at Liège.

Prosulfocarb (CASRN 52888-80-9)

PMT-score 0.35
(P=0.26 | M=0.28 | T=0.61)



Application: prosulfocarb is the active ingredient in weedkillers (herbicides). Prosulfocarb-based products are no longer authorised in the Netherlands, but in the past, the herbicide Boxer with prosulfocarb as active ingredient was authorised for winter wheat and barley. In Belgium, prosulfocarb-based herbicides are authorised under brand names such as ADELFO, DEFI, FIDOX, FIDOX EC, JURA, ROXY 800 EC, ROXY EC and SPOW (source: Phytoweb).
Origin: emissions during/after its use in agriculture (farmyard run-off, spray drift, etc.).
Distribution of contamination: prosulfocarb exceeded the ERM target value at Heel.
Notable: In 2021, drinking water companies along the Meuse were also confronted with high levels of the pesticide prosulfocarb, originating in Wallonia. This was not the first time; there was also an incident involving the same substance in 2019. Ultimately, the source of the contamination was identified: Solirem, a company in Wandre that provides cleaning and reconditioning of cans and barrels. The company was also found to have cleaned drums containing residues of plant protection products, even though it had not been licensed to do so. Service Public de Wallonie (SPW), the public authority similar to Rijkswaterstaat that issues licences to Walloon companies, has initiated action against the company.

Annex 2

Abstraction stops and restrictions due to water pollution

There were no abstraction stops or restrictions at Tailfer or Brakel (statements from Vivaqua and Dunea).

Intakepoint: Water-Link, Broechem (Albertkanaal)

No.	Start	End	Duration [d]	Duration [d]	Cause	Reason
1	do 16/03/23 00:20	do 16/03/23 01:30	0,05	1,17	Alarm bio monitoring (algae)	Internal monitoring
2	wo 16/08/23 18:00	do 17/08/23 18:00	1,00	24,00	Alarm bio monitoring (algae)	Internal monitoring
3	di 31/10/23 01:20	di 31/10/23 06:00	0,19	4,67	Alarm bio monitoring (algae)	Internal monitoring
4	do 07/12/23 03:45	do 07/12/23 06:45	0,13	3,00	Increased turbidity	Internal monitoring

Intakepoint: Water-Link, Lier (Netekanaal)

No.	Start	End	Duration [d]	Duration [d]	Cause	Reason
5	za 04/02/23 11:40	za 04/02/23 13:00	0,06	1,33	Warning police and/or fire department	Notification by other authority

Intakepoint: WML, Heel (Lateraalkanaal)

No.	Start	End	Duration [d]	Duration [d]	Cause	Reason
6	za 07/01/23 00:00	di 10/01/23 00:00	3,00	72,00	Cal A1 77 µg/l zinc (also turbidity and oxygen, no flow)	Notification by other authority
7	za 14/01/23 00:00	do 19/01/23 00:00	5,00	120,00	Intakestop t due to discharge >1000m3/s	Notification by other authority
8	wo 15/02/23 00:00	do 16/02/23 00:00	1,00	24,00	Alarm mussel monitoring	Internal monitoring
9	zo 05/03/23 00:00	ma 13/03/23 00:00	8,00	192,00	Cal A6 Terbutylazine 1.6 µg/l, Cal A7 Acetone 11.1 µg/l, Cal A8 Di-isopropylether 10.08 µg/l	Notification by other authority
10	vr 24/03/23 00:00	ma 27/03/23 00:00	3,00	72,00	Cal A10 unknown volatile substance 10.6	Notification by other authority
11	vr 31/03/23 00:00	vr 31/03/23 00:00	0,00	0,00	D-tox alarm ,intakestop due to discharge maas >1000m3/s	Notification by other authority
12	za 01/04/23 00:00	ma 03/04/23 00:00	2,00	48,00	D-tox alarm ,intakestop due to discharge maas >1000m3/s	Internal monitoring
13	do 06/04/23 00:00	zo 09/04/23 00:00	3,00	72,00	06-04 tot 08-04 wrong interpretation, 08-04 Alarm mussel monitoring	Internal monitoring
14	vr 14/04/23 00:00	wo 19/04/23 00:00	5,00	120,00	Cal H1 4-methyl-1H-benzotriazole 2.1 µg/l, Limonene 1.4 µg/l	Notification by other authority
15	wo 03/05/23 00:00	do 04/05/23 00:00	1,00	24,00	D-tox alarm, intakestop	Internal monitoring
16	wo 17/05/23 00:00	do 18/05/23 00:00	1,00	24,00	06:00u Alarm mussel monitoring sampler ID / Cal A11	Internal monitoring
17	wo 31/05/23 00:00	do 01/06/23 00:00	1,00	24,00	Alarm mussel monitoring	Internal monitoring
18	zo 04/06/23 00:00	do 08/06/23 00:00	4,00	96,00	Cal A12 (benzotriazole 1.1 µg/l)	Notification by other authority

Intakepoint: WML, Heel (Lateraalkanaal)

No.	Start	End	Duration [d]	Duration [d]	Cause	Reason
19	vr 09/06/23 00:00	zo 11/06/23 00:00	2,00	48,00	Cal H2 Neophytadieen 1.1 µg/l (10-06-23 12:40 Alarm mussel monitoring)	Notification by other authority
20	vr 09/06/23 00:00	ma 12/06/23 00:00	3,00	72,00	Cal A13 and A14 benzotriazole Eijsden 0.8 µg/l	Notification by other authority
21	wo 21/06/23 00:00	do 22/06/23 00:00	1,00	24,00	Alarm mussel monitoring	Internal monitoring
22	ma 26/06/23 00:00	vr 30/06/23 00:00	4,00	96,00	H3: 1H-benzotriazole 1.0 µg/l and melamine	Notification by other authority
23	vr 07/07/23 00:00	za 08/07/23 00:00	1,00	24,00	Alarm mussel monitoring	Internal monitoring
24	zo 16/07/23 00:00	ma 17/07/23 00:00	1,00	24,00	Alarm mussel monitoring and exceedance notification Pyrazole from WWTP	Internal monitoring
25	vr 28/07/23 00:00	ma 31/07/23 00:00	3,00	72,00	Notification H4	Notification by other authority
26	wo 02/08/23 00:00	ma 07/08/23 00:00	5,00	120,00	Notification H5 1H-benzotriazole	Notification by other authority
27	vr 11/08/23 00:00	ma 28/08/23 00:00	17,00	408,00	H6 Neophytadieen 1.5 µg/, 2 times alarm mussel monitoring	Notification by other authority
28	wo 30/08/23 00:00	do 31/08/23 00:00	1,00	24,00	H7 Propamocarb concentration 0.12 µg/l alarm value is 0.1 µg/l	Notification by other authority
29	vr 01/09/23 00:00	ma 04/09/23 00:00	3,00	72,00	H7 Propamocarb concentration 0.12 µg/l alarm value is 0.1 µg/l	Notification by other authority
30	vr 08/09/23 00:00	wo 13/09/23 00:00	5,00	120,00	H8 1H-benzotriazole >5 µg/l, 4-Methylbenzotriazole >5 µg/l, 5-methylbenzotriazole 1.32 µg/l	Notification by other authority
31	za 16/09/23 00:00	ma 18/09/23 00:00	2,00	48,00	Alarm mussel monitoring	Internal monitoring
32	wo 20/09/23 00:00	do 21/09/23 00:00	1,00	24,00	11-09-2023 Dicamba 0.23 µg/l, 12-09-2023 0.19 µg/l, 13-09-2023 0.15µg/l	Notification by other authority
33	ma 30/10/23 00:00	di 31/10/23 00:00	1,00	24,00	H9 1HBenzotriazole 1.1 µg/l	Notification by other authority
34	vr 03/11/23 00:00	ma 06/11/23 00:00	3,00	72,00	1HBenzotriazole 1.021 µg/l	Notification by other authority
35	di 07/11/23 00:00	wo 08/11/23 00:00	1,00	24,00	10.7 µg/l 1,2 dichloorpropane	Notification by other authority
36	za 18/11/23 00:00	ma 20/11/23 00:00	2,00	48,00	intakestop due to discharge maas >1000 m3/s	Notification by other authority
37	vr 01/12/23 00:00	ma 04/12/23 00:00	3,00	72,00	H10 Caffeine concentration 1.2 µg/l	Notification by other authority
38	vr 08/12/23 00:00	ma 11/12/23 00:00	3,00	72,00	GCAqua-0132 2.19 µg/l, Prosulfocarb 0.16 µg/l	Notification by other authority
39	vr 15/12/23 00:00	do 21/12/23 00:00	6,00	144,00	H12 GCAqua-006 1.82 µg/l, GCAqua-007 1.65 µg/l	Notification by other authority

Intakepoint: Evides Waterbedrijf, Bergsche Maas (Bergsche Maas)						
No.	Start	End	Duration [d]	Duration [d]	Cause	Reason
40	di 10/01/23 08:30	wo 11/01/23 08:45	1,01	24,25	Alarm bio monitoring (daphnia)	Internal monitoring
41	za 14/01/23 02:00	ma 23/01/23 11:00	9,38	225,00	increased turbidity	Internal monitoring
42	ma 06/03/23 20:00	di 07/03/23 15:00	0,79	19,00	Alarm bio monitoring (daphnia)	Internal monitoring
43	vr 10/03/23 11:00	di 14/03/23 14:00	4,13	99,00	warning Vuilwaterwacht	Notification by other authority
44	vr 17/03/23 06:20	vr 17/03/23 16:15	0,41	9,92	Alarm bio monitoring (daphnia)	Internal monitoring
45	wo 05/04/23 13:20	di 11/04/23 12:15	5,95	142,92	Reguliere meting	Internal monitoring
46	zo 05/11/23 08:10	ma 06/11/23 12:00	1,16	27,83	Alarm bio monitoring (daphnia)	Internal monitoring

Intakepoint: Evides Waterbedrijf, Haringvliet (Haringvliet)						
No.	Start	End	Duration [d]	Duration [d]	Cause	Reason
47	Sun 22-01-23 06:30	Sun 22-01-23 11:30	0,21	5	increased turbidity	Internal monitoring
48	Sun 22-01-23 14:30	Sun 22-01-23 20:45	0,26	6,25	increased turbidity	Internal monitoring
49	Fri 22-09-23 21:30	Sat 23-09-23 07:15	0,41	9,75	Alarm bio monitoring (mossel)	Internal monitoring
50	Sun 24-09-23 10:30	Sun 24-09-23 22:45	0,51	12,25	Alarm bio monitoring (mossel)	Internal monitoring
51	Mon 25-09-23 22:30	Tue 26-09-23 09:15	0,45	10,75	Alarm bio monitoring (mossel)	Internal monitoring
52	Thu 21-12-23 11:00	Fri 22-12-23 09:30	0,94	22,5	increased turbidity	Internal monitoring
53	Fri 22-12-23 19:30	Tue 26-12-23 06:30	3,46	83	increased turbidity	Internal monitoring
			135,49	**3251,58**		

Annex 3

Target values in the European River Memorandum (ERM)

(maximum values, unless stated otherwise)

	Unit	Target value
General parameters		
Oxygen content	mg/L	>8
Electrical conductivity	mS/m	70
Acidity	pH	7–9
Temperature	°C	25
Chloride	mg/L	100
Sulphate	mg/L	100
Nitrate	mg/L	25
Fluoride	mg/L	1.0
Ammonium	mg/L	0.3
Organic group parameters		
Total Organic Carbon (TOC) ***	mg/L	4
Dissolved Organic Carbon (DOC) ***	mg/L	3
Adsorbable organic halogen compounds (AOX)	µg/L	25
Adsorbable organic sulfur compounds	µg/L	80
Anthropogenic substances foreign to nature with effects on biological systems		
Pesticides and their breakdown products, by substance	µg/L	0.1*
Endocrine active substances, by substance	µg/L	0.1*
Pharmaceuticals (incl. antibiotics), by substance	µg/L	0.1*
Biocides by substance	µg/L	0.1*
Other organic halogen compounds, by substance	µg/L	0.1*
Evaluated substances without biological effect		
Microbiologically difficult to degrade substances, by substance	µg/L	1.0
Non-evaluated substances		
(substances that possibly penetrate** into the drinking water, or substances that form uncharacterised breakdown and transformation products) by substance	µg/L	0.1
Health and hygiene/microbiological quality		
The health and hygiene/microbiological quality of the surface water must be improved to such an extent that excellent swimming water quality as stipulated in EU Directive 2006/7/EC is permanently guaranteed.		

* *unless, as a result of advancing toxicological insight, a lower value must be kept to here, for example for genotoxic substances.*

** *substances that are not or are not satisfactorily removed with natural methods for the purification of drinking water.*

*** *unless, owing to the geogenic relationships, higher values must be kept to here.*

From 2021, testing is done for the following substances against the ERM target value of 1 µg/L, where previously testing was still done against 0.1 µg/L:

Substance name	CASRN	ERM-tv		IDWR	
1,3,5-trimethylbenzene	108-67-8	1	µg/L	70	µg/L
10,11-dihydro-10,11-dihydroxycarbamazepine	58955-93-4	1	µg/L	50	µg/L
2,5-furandicarboxylic acid	3238-40-2	1	µg/L	1,1	µg/L
2-methoxypropanol	1589-47-5	1	µg/L	10.5	µg/L
2-methyl-2-propanol	75-65-0	1	µg/L	1.5	mg/L
4-methyl-1H-benzotriazole	29878-31-7	1	µg/L	350	µg/L
acesulfame K	55589-62-3	1	µg/L	3,2	µg/L
diatrizoic acid (amidotrizoic acid)	117-96-4	1	µg/L	250	mg/L
1,2,3-benzotriazole	95-14-7	1	µg/L	700	µg/L
butanone	78-93-3	1	µg/L	1.3	mg/L
butoxypolypropylene glycol	9003-13-8	1	µg/L	1,4	µg/L
caffeine	58-08-2	1	µg/L	1,5	µg/L
carbamazepine	298-46-4	1	µg/L	50	µg/L
cis-4,4-diaminostilbene-2,2-disulfonate disodium salt	7336-20-1	1	µg/L	7	mg/L
cis-4,4-diaminostilbene-2,2-disulfonic acid	81-11-8	1	µg/L	7	mg/L
cyclamate	100-88-9	1	µg/L	2,5	µg/L
diethylenetriaminepentaacetic acid	67-43-6	1	µg/L	700	µg/L
diisopropyl ether	108-20-3	1	µg/L	1,4	µg/L
ethylenediaminetetraacetic acid	60-00-4	1	µg/L	600	µg/L
ethylene glycol dimethyl ether	111-96-6	1	µg/L	440	µg/L
ethyl lactate	97-64-3	1	µg/L	500	µg/L
gabapentin	60142-96-3	1	µg/L	100	µg/L
guanylurea	141-83-3	1	µg/L	22.5	µg/L
hexamethylenetetramine	100-97-0	1	µg/L	500	µg/L
iohexol	66108-95-0	1	µg/L	375	mg/L
iomeprol	78649-41-9	1	µg/L	1	mg/L
iopamidol	60166-93-0	1	µg/L	415	mg/L
ioxitalamic acid	28179-44-4	1	µg/L	500	mg/L
metformin	657-24-9	1	µg/L	196	µg/L
methyl-tert-butyl ether	1634-04-04	1	µg/L	9,42	µg/L
naphthalene-1,3,5-trisulfonic acid	6654-64-4	1	µg/L	0.7	mg/L
naphthalene-1,3,6-trisulfonate trisodium salt	5182-30-9	1	µg/L	0.7	mg/L
naphthalene-1,3,6-trisulfonic acid	86-66-8	1	µg/L	0.7	mg/L
naphthalene-1,3,6-trisulfonate sodium salt	19437-42-4	1	µg/L	0.7	mg/L
naphthalene-1,5-disulfonate disodium salt	1655-29-4	1	µg/L	0.7	mg/L
naphthalene-1,5-disulfonic acid	81-04-9	1	µg/L	0.7	mg/L
naphthalene-1,7-disulfonic acid	5724-16-3	1	µg/L	0.7	mg/L
naphthalene-2,7-disulfonic acid	92-41-1	1	µg/L	0.7	mg/L
nitriloacetic acid	139-13-9	1	µg/L	400	µg/L
polysorbate 60	9005-67-8	1	µg/L	175	mg/L
saccharine	81-07-2	1	µg/L	1,3	µg/L
sotalol	3930-20-9	1	µg/L	80	µg/L
sucralose	56038-13-2	1	µg/L	5	µg/L
tolyltriazole	29385-43-1	1	µg/L	350	µg/L
tetraethylene glycol dimethyl ether	143-24-8	1	µg/L	440	µg/L
tributyl phosphate	126-73-8	1	µg/L	350	µg/L
trichloromethane	67-66-3	1	µg/L	25	µg/L
triethyl phosphate	78-40-0	1	µg/L	1,4	µg/L
triglyme	112-49-2	1	µg/L	440	µg/L

CASRN = CAS registry number, ERM-tv = target value in the European River Memorandum, IDRW = indicative drinking water target

In addition to/in deviation from the above, in this report, the following target values are kept to for Meuse water from which drinking water is prepared:

- PFOA: 4.4 ng of PFOA equivalents/L (= indicative drinking water target)
- HFPO-DA (GenX, FRD 903): 4.4 ng of PFOA equivalents/L (= indicative drinking water target)
- NDMA: 12 ng/L (based on the Netherlands Drinking Water Decree)
- Bromate: 1 µg/L (based on https://www.rivm.nl/publicaties/risicogrenzen-voor-bromaat-in-oppervlaktewater-afleiding-volgens-methodiek-van)
- Caffeine: 1 µg/L (based on the indicative drinking water guideline value of 1,500 µg/L, see https://www.rivm.nl/bibliotheek/rapporten/2018-0080.pdf)
- Bromide: 70 µg/L

The target values for bioassays in this report are the effect-based trigger (EBT) values for human health in Been et al., 2021:

- ER-CALUX 17 -estradiol (E2): 0.25 ng E2-eq/L (0.083)
- Anti-AR CALUX Flutamide (Flut): 4800 ng Flut-eq/L (270)
- AR-CALUX Dihydrotestosterone (DHT): 4.5 ng DHT-eq/L (0.51)
- PR-CALUX Progesterone (P4): 15.5 ng P4-eq/L (0.22)
- GR-CALUX Dexamethasone (DEX): 47.9 ng DEX-eq/L (1.7)
- PAH-CALUX Benzo[a]pyrene (BaP): 24.4 ng BaP-eq/L (19)

Annex 4

List of abbreviations used

AMPA	aminomethylphosphonic acid
BPA	bisphenol-A
CALUX	Chemical Activated LUciferase gene eXpression
CAS(RN)	Chemical Abstracts Service (Registry Number)
DEHP	Di-2-EthylHexyl Phthalate (bis(2-ethylhexyl)phthalate)
DIPE	di-isopropyl ether
DOC	Dissolved Organic Carbon
EDC	Endocrine-Disrupting Chemicals
ERM	European River Memorandum
DDD	Defined Daily Dose
HFPO-DA	2,3,3,3-tetrafluoro-2-(heptafluoropropoxy)propanoic acid)
FRD 903	2,3,3,3-tetrafluoro-2-(heptafluoropropoxy)propanoic acid)
GenX	2,3,3,3-tetrafluoro-2-(heptafluoropropoxy)propanoic acid)
HCB	hexachlorobenzene
IAZI	integrated waste-water treatment plant
IDRW	indicative drinking water guide value
IPCC	Intergovernmental Panel on Climate Change
KMI	the Royal Meteorological Institute of Belgium
KNMI	the Royal Netherlands Meteorological Institute
WFD	Water Framework Directive
MGA	Mutual Gains Approach
PEQ	PFOA equivalents
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PMT	Persistent, Mobile, Toxic
QESH	Quality, Environment, Safety and Health
RIBASIM	RIver BAsin SImulation Model
RIVM	National Institute of Public Health and the Environment
RIWA Rijn	Association of River Water Companies
RPF	Relative Potency Factor

Continued list of abbreviations used

RWZI	waste-water treatment plant
SPW	Service Public de Wallonie
SVHC	Substance of Very High Concern
TBP	Tributyl phosphate
TOC	Total Organic Carbon
VMM	Flemish Environment Agency
WUR	Wageningen University & Research
SVHC	Substance of Very High Concern

Imprint

Text	Thessa Lageman (The Storytelling Studio) André Bannink (RIWA-Meuse) Maarten van der Ploeg (RIWA-Meuse) Thijs Blom (RIWA-Meuse) Jasper Ford (Evides) Arco Wagenvoort (Aqwa)
Final editing	Thessa Lageman (The Storytelling Studio)
External contributions	Members of the Expertgroep Waterkwaliteit Maas (Meuse Water Quality Expert Group) RIWA-Meuse Management
Maps	Ilva Besselink (Studio Ilva)
Infographics	Ilva Besselink (Studio Ilva)
Publisher	RIWA-Meuse (Association of River Water Companies)
Designer	Make My Day, Wormer
Photography	© Eelkje Colmjon, eelk.nl fotografie © Maarten de Penning © André Bannink, RIWA-Maas © Rachelledwarka, CC BY-SA 4.0 © Shutterstock, Shutterstock.com *Anton Watman, Heinsdorff Jularlak, Raman Venin, JuShoot, Andrew Balcombe, Foto Para Ti, JGLmarket, r.classen, Billion Photos, Sjors Gijsbers, Menno van der Haven, Minh An photos*
ISBN/EAN	9789083357423
Publication date	09 September 2024