

Imprint

Publisher:

International Commission for the Protection of the Rhine (ICPR)
Kaiserin-Augusta-Anlagen 15, D 56068 Koblenz
P.O. box 20 02 53, D 56002 Koblenz
Telephone +49-(0)261-94252-0, Fax +49-(0)261-94252-52
E-mail: sekretariat@iksr.de
www.iksr.org

ISBN 978-3-946501-25-1
© IKSr-CIPR-ICBR 2018

Micropollutants in the Rhine Catchment Area

Summary 2017

1. Introduction

In 2008, the ICPR set itself the goal that "substances in the Rhine water, either individually or in combination, must not have adverse effects on the communities of flora, fauna and micro-organisms, and the water quality must be such that drinking water production can be achieved through simple, natural processing methods. This means avoiding pollution by reducing the introduction, emissions and loss of micro-contaminants with adverse effects, with the aim of achieving concentrations close to the background values of naturally occurring substances and, in the case of synthetic materials, achieving concentrations close to zero."

As mandated by the 14th Conference of Rhine Ministers in 2007, the ICPR has laid the foundations for a joint, comprehensive strategy for reducing and avoiding the influx of micropollutants from urban wastewater and other (diffuse) sources into the Rhine and its tributaries, by improving knowledge regarding emissions and ecotoxicological reactions in the environment, and drafting suitable treatment methods.

From the immense range of chemicals used today along the Rhine and its tributaries, the most significant groups of substances were selected using a pragmatic approach and based on the most up to date knowledge. Taking into account various relevancy criteria, the occurrence of the substances in the environment and important influx pathways into the waters, indicator substances were identified, on the basis of a qualitative analysis. These indicator substances were considered in more detail as representative of these substance groups (Annex 1).

Since 2008, the ICPR has compiled information regarding the relevance of various micropollutants in the Rhine catchment area and approaches to reducing water pollution, and published ICPR technical reports on groups of substances.

In 2013, on the basis of the ["Integrated assessment of micropollutants and measures aimed at reducing inputs of urban and industrial wastewater"](#) (ICPR Technical Report No. 203), the [15th Conference of Rhine Ministers](#) agreed that national and international measures should be taken to prevent and reduce the influx of micropollutants. These measures could in particular include the following:

- a. Measures at source e.g. restriction of the use of substances;
- b. Stipulations for production processes and the treatment of operational wastewater, in particular the application of the best available techniques;
- c. Promoting the development and implementation of innovative methods to reduce emissions of micropollutants;
- d. The use of advanced procedures for eliminating micropollutants from wastewater from municipal wastewater treatment plants;
- e. Reviewing and updating existing monitoring concepts, taking into account decomposition products;
- f. Informing the public about use, prevention and disposal.

Due to the fact that many measures exceed the responsibilities of the ICPR and/or the level of the Rhine catchment area, in 2013 the responsible parties took the initiative to increase efforts to develop activities aimed at preventing and reducing the influx of micropollutants. In particular, the following should be achieved:

- a. the establishment of a consistent chain of measures from source to disposal for products containing substances relevant to water, e.g. through the
 - further development of the best available techniques for production or processing;
 - greater consideration of environmental aspects when authorising substances and obtaining marketability of substances, in particular through the improvement or establishment of methods to demonstrate the effects of substances on the ecosystem;
 - stipulations for bringing substances to market and their use, such as restrictions and prohibitions;
 - labelling requirements;
- b. harmonising methods for assessing the effects of micropollutants on aquatic flora and fauna;
- c. aligning the existing and future substance-related legislation with rules for the protection of water resources and the aquatic environment.

When selecting possible measures, it must be taken into account that there may be regional differences in the Rhine catchment area in terms of the pollution situation. In the main stream of the Rhine, the issue of total loads is often dominant, with acute contamination only occurring during temporary waves of pollutants. However, chronic effects on the ecosystem can also occur at significantly lower concentrations. In the Rhine tributaries and especially the smaller inlets, the issue of concentration can play a much greater role.

The aim and purpose of the 2017 Summary is firstly to present the current state of the pollution of the Rhine with micropollutants in comparison to the situation described in the 2011 ICPR technical reports, and secondly to prepare a decision about the joint measures of the relevant countries in the Rhine catchment area for reducing the influx of micropollutants. Accordingly, the 2017 Summary describes which of the options for mitigation strategies presented in the technical reports have been initiated, fully implemented or planned in the meantime within the countries, or how the current national discussion on the matter stands.

This 2017 Summary makes it clear that all of the countries are taking action in terms of micropollutants, and that progress can be noted in many areas.

The 2017 Summary is intended to present both existing challenges and knowledge deficiencies. In addition, it serves as a basis for the discussion of a future action plan for improving water quality, and for taking into account further developments in dealing with unknown substances.

2. Pollution of the Rhine with micropollutants from urban and industrial wastewater

The "[Strategy for micropollutants - Integrated assessment of micropollutants and measures aimed at reducing inputs of urban and industrial wastewater](#)" (ICPR Technical Report No. 203) contains statements on the pollution situation for individual groups of substances in the Rhine catchment area, the validity of which it was possible to check and fundamentally confirm - in terms of up-to-date records at the German-Swiss (Weil am Rhein) and German-Dutch (Bimmen) borders **in the main stream of the Rhine**.

The relevance of the respective substances was considered for two objects of protection: aquatic communities in surface waters and the supply of drinking water, from an ecological or human-toxicological point of view.

A comparison of the concentrations of certain substances at the ICPR Rhine measuring stations in the Basel area and at the German-Dutch border (2010-2016) shows some

significant differences. For this summary, substances were chosen for which reliable data were available at both measuring stations (cf. Annex 2, Figures 1 and 2).

Some substances, such as the active pharmaceutical substances carbamazepine and the anticorrosive agent benzotriazole (cf. Figures 1 and 4) show significantly higher concentrations at the German-Dutch border than in the Basel area. There are also some significant differences between the substances themselves. For complexing agents such as DTPA and NTA, the concentrations are higher than for the other substance groups, by several orders of magnitude. These are therefore shown separately in Figure 3 in Appendix 2.

2.1 Active pharmaceutical substances

Active pharmaceutical substances are widely detected in the Rhine catchment area.

The highest concentrations are detected in the lower reaches of the Rhine and in tributaries with a high proportion of municipal wastewater (e.g. carbamazepine, cf. Figure 1).

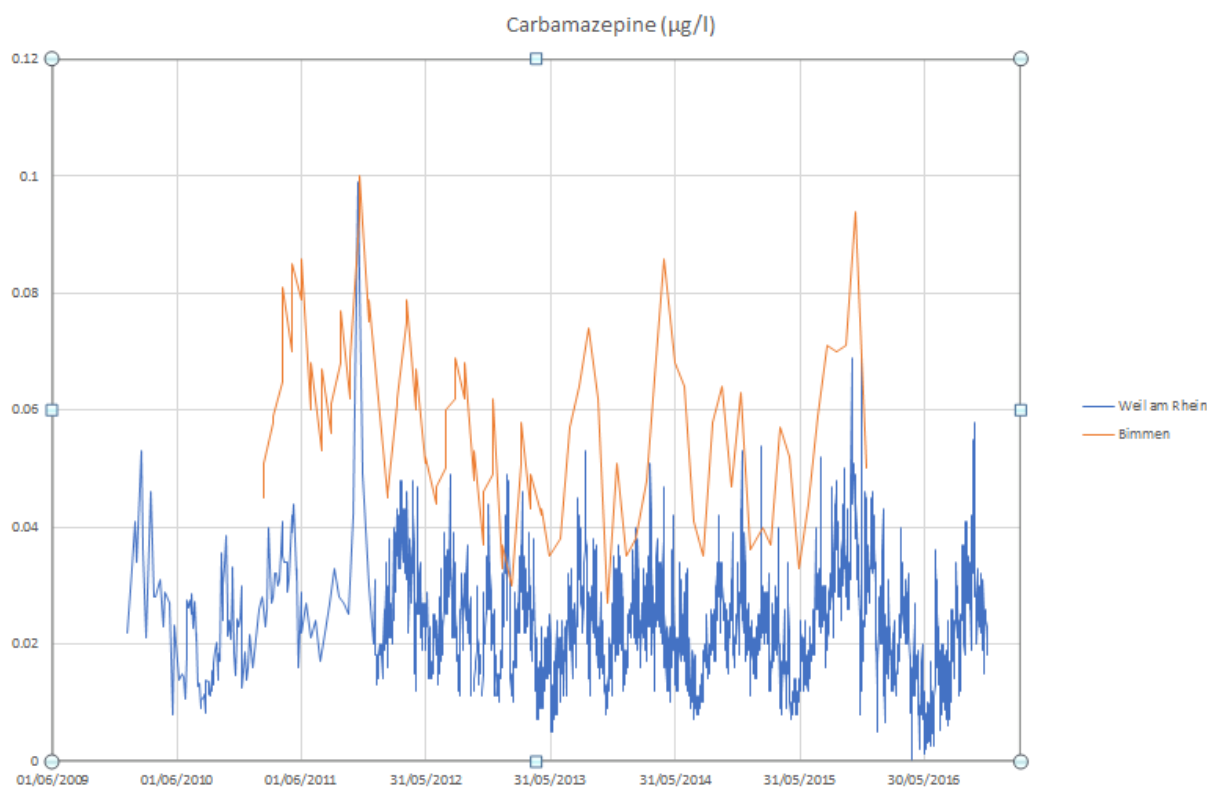


Figure 1: Carbamazepine in the main stream of the Rhine (Weil am Rhein and Bimmen).

The highest individual readings lie above the previous EU recommendations¹ for environmental quality standards (EU-EQS) and therefore in the region of ecotoxicologically relevant concentrations. There are currently no legally binding EU-EQS².

In Luxembourg, carbamazepine was identified as a river basin-specific pollutant within the framework of the assessment of the ecological status and/or potential of water

¹ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011PC0876>. The substance diclofenac was not included in Directive 2013/39/EU, but was included in the first watch list (Commission Implementing Decision 2015/495 of 20 March 2015) - for collecting monitoring data to facilitate the identification of appropriate measures against the risks posed by this substance.

² [Directive 2013/39/EU](http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013L0039)

bodies under the Water Framework Directive (WFD), and a national Environmental Quality Standard was established³.

Active pharmaceutical ingredients are found in the untreated water in drinking water production plants and partly also in drinking water, for example in the German state of North Rhine-Westphalia and in the Netherlands.

In some cases, seasonal fluctuations can be seen, with higher concentrations in winter (e.g. in the case of the analgesic diclofenac, Figure 2).

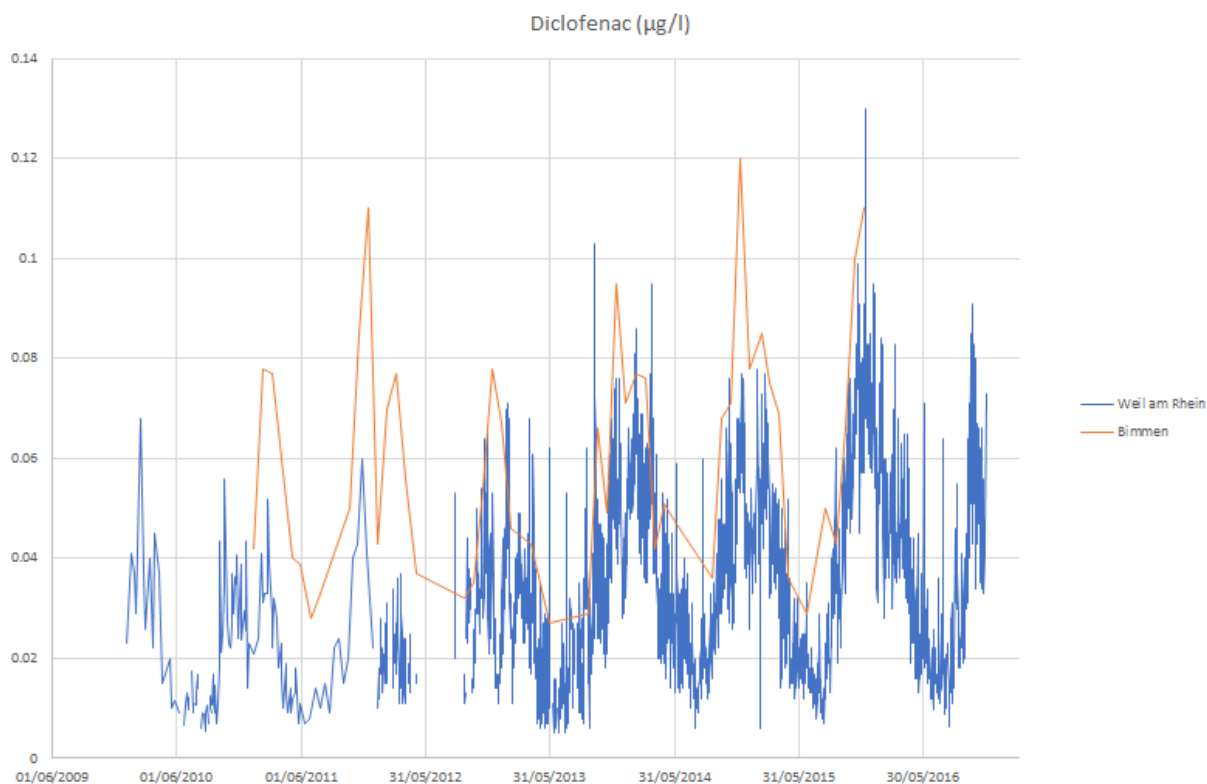


Figure 2: Diclofenac in the main stream of the Rhine (Weil am Rhein and Bimmen).

2.2 Biocides and corrosion inhibitors

Biocides and corrosion inhibitors are still detected in strongly fluctuating concentrations in the Rhine catchment. For some substances a reduction in the maximum concentration can be observed (e.g. DEET, cf. Figure 3).

The comparison between the measuring stations in the Basel area and at the German-Dutch border shows increasing concentrations along the Rhine for some substances (e.g. benzotriazole, cf. Figure 4).

³ <http://legilux.public.lu/eli/etat/leg/rgd/2016/01/15/n2/jo>

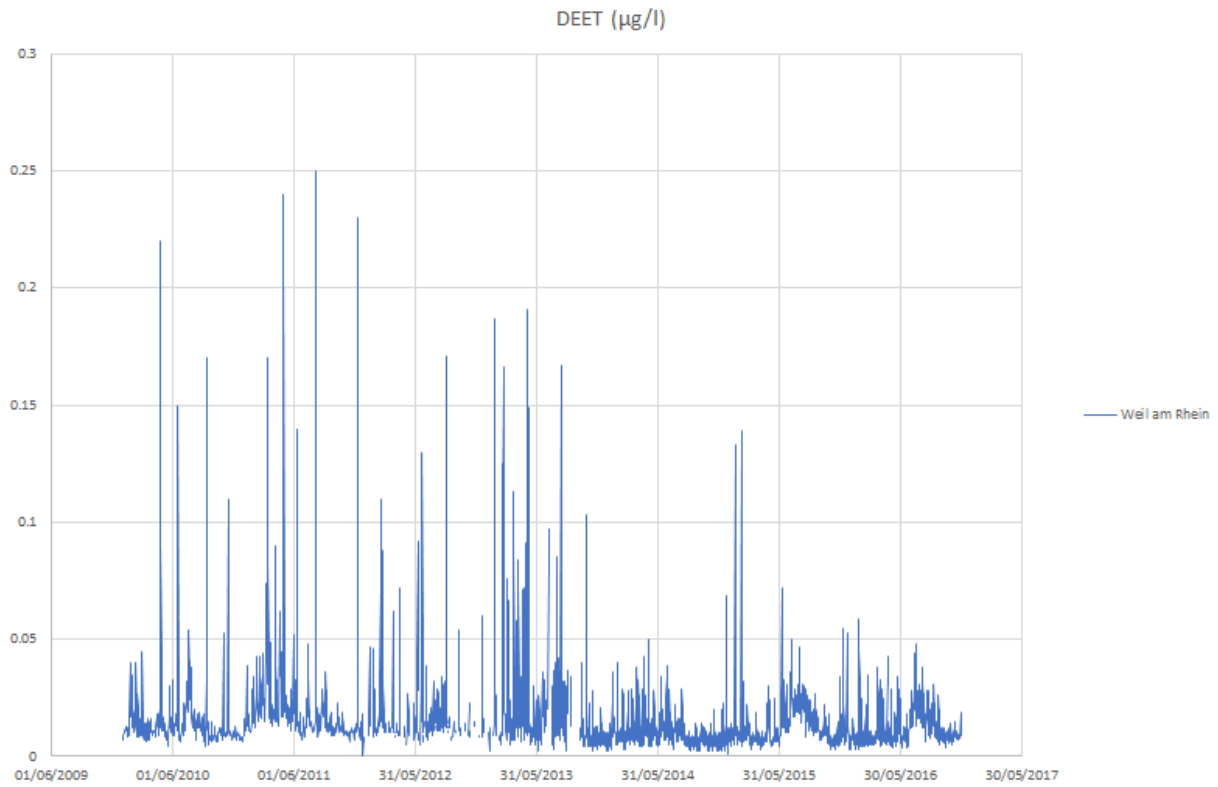


Figure 3: DEET in the main stream of the Rhine (Weil am Rhein).

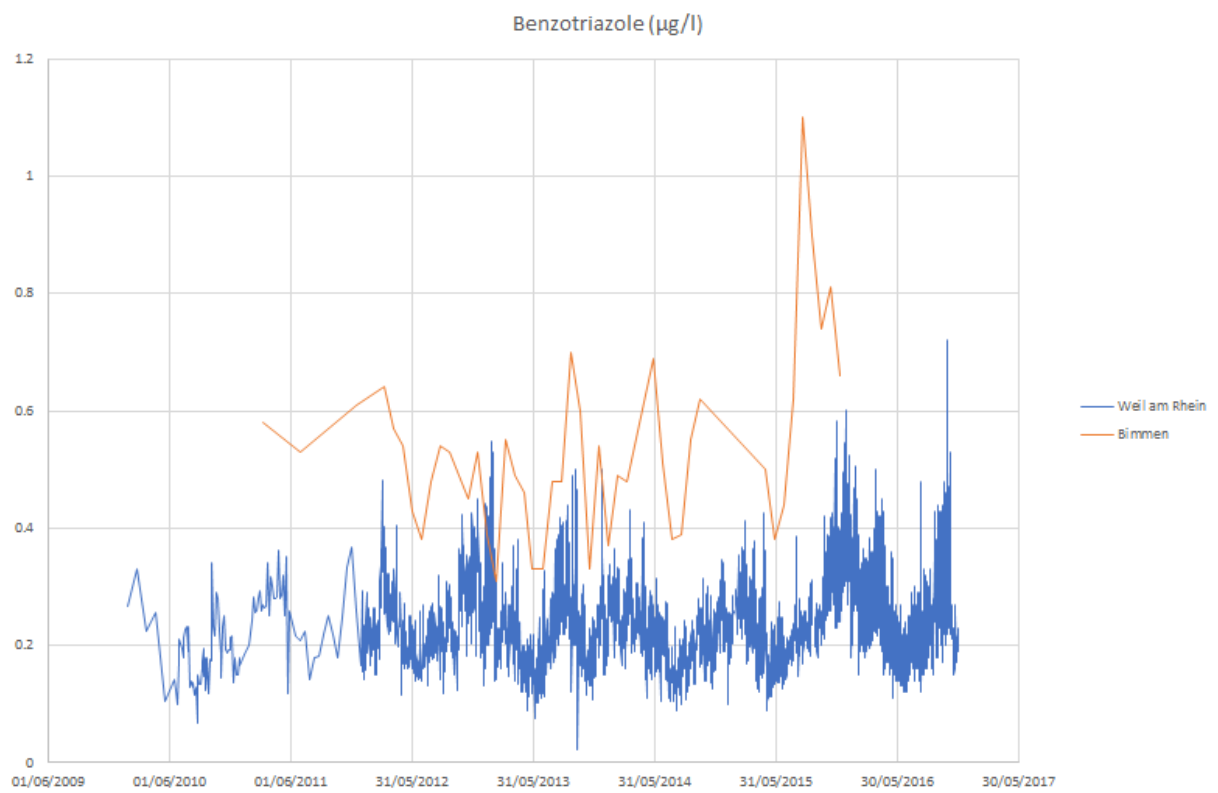


Figure 4: Benzotriazole in the main stream of the Rhine (Weil am Rhein and Bimmen).

Biocide concentrations may be in the region of ecotoxicologically relevant values. Legally binding EU-EQS are only available sporadically, e.g. for the priority substance Cybutryn (Irgarol).

For biocides and corrosion inhibitors, the data is in part insufficient, and complex data patterns were found.

2.3 Oestrogens

For oestrogens, there is still only a limited amount of data from the main stream of the Rhine. In the Rhine and in the major tributaries, the measured values are consistently below the detection limit of less than 1 ng/l; in other tributaries in the range of a few ng/l. However, the threshold for the occurrence of endocrine effects lies even lower than this.⁴

The current EU-EQS recommendations⁵ for oestrogens are presently below the possible analytical limits of quantification. At EU level, however, projects are currently underway that demonstrate with sufficient sensitivity these oestrogens, by means of effect-based methods.

2.4 Radiocontrast agents

Radiocontrast agents (XCMs) are being developed as biologically inactive substances. Due to their polarity and stability, they are partially detected in drinking water. Due to the lack of ecotoxicological relevance, there is no need to derive EU-EQS for aquatic communities.

Concentrations of XCMs, including their transformation products, are found in the lower reaches of the Rhine and in the tributaries used for drinking water, and exceed the International Association of Waterworks in the Rhine Catchment [IAWR]⁶ values and GOW values (health guidance values, in this case, general precautionary values for drinking water production; specific XCM GOW values⁷ are not currently available).

2.5 Complexing agents

Complexing agents are conspicuous in terms of the supply of drinking water, as they cannot be removed through conventional treatment processes. The total emissions of EDTA in the Rhine catchment have been significantly reduced in the last two decades. In recent years, concentrations of several µg/l have been measured in the Rhine and in the major tributaries. The concentrations increase in the longitudinal course of the Rhine, with the IAWR value for complexing agents of 5 µg/l being exceeded more often. The

⁴ European Commission 2002: Study on the scientific evaluation of 12 substances in the context of endocrine disrupter priority list of actions; report: UC 6052. Johnson I und P Harvey (2002).

⁵ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011PC0876>. The substances 17 alpha-ethinylestradiol and 17-beta-estradiol were not included in Directive 2013/39/EU, but were included in the first watch list (Commission Implementing Decision 2015/495 of 20 March 2015) - for collecting monitoring data to facilitate the identification of appropriate measures against the risks posed by these substances.

⁶ Targets for anthropogenic non-natural substances of the International Association of Waterworks in the Rhine Catchment [IAWR] (cf. Danube, Meuse and Rhine memorandum 2008):

- Substances affecting biological systems: 0.1 µg/l per substance, unless toxicological results require a lower value;
- poorly biodegradable substances without known effects: 1 µg/l per substance,
- synthetic complexing agents, 5.0 µg/l per substance.

Surface waters that meet these target values usually allow the production of drinking water through just simple treatment techniques.

⁷ The GOW is considered to be the German precautionary value for XCMs in drinking water and drinking water resources and/or in waters from which untreated water is extracted for drinking water supply. This entails a general precautionary measure for non-genotoxic substances for which data on oral toxicity, immunotoxicity and germ cell damaging potential do not lead to a value lower than 1 µg/l (GOW4) (cf. UBA, 2003). As such, it also applies to components of combinations of simultaneously acting substances.

tolerable concentrations in drinking water in terms of human toxicology under lifelong exposure, and the ecotoxicological efficacy thresholds (PNEC 2.2 mg/l)⁸ are many times higher than the measured EDTA concentrations.

2.6 Odoriferous substances

The odoriferous substances HHCB (Galaxolide) and AHTN (Tonalid), which are highly fat-soluble, poorly biodegradable and highly bioaccumulating, continue to be found in the Rhine, but are below levels expected to have adverse effects on aquatic organisms. The IAWR value of 1 µg/l is also not exceeded (e.g. Galaxolide, cf. Figure 5). There are no legally binding EU-EQS for either substance.

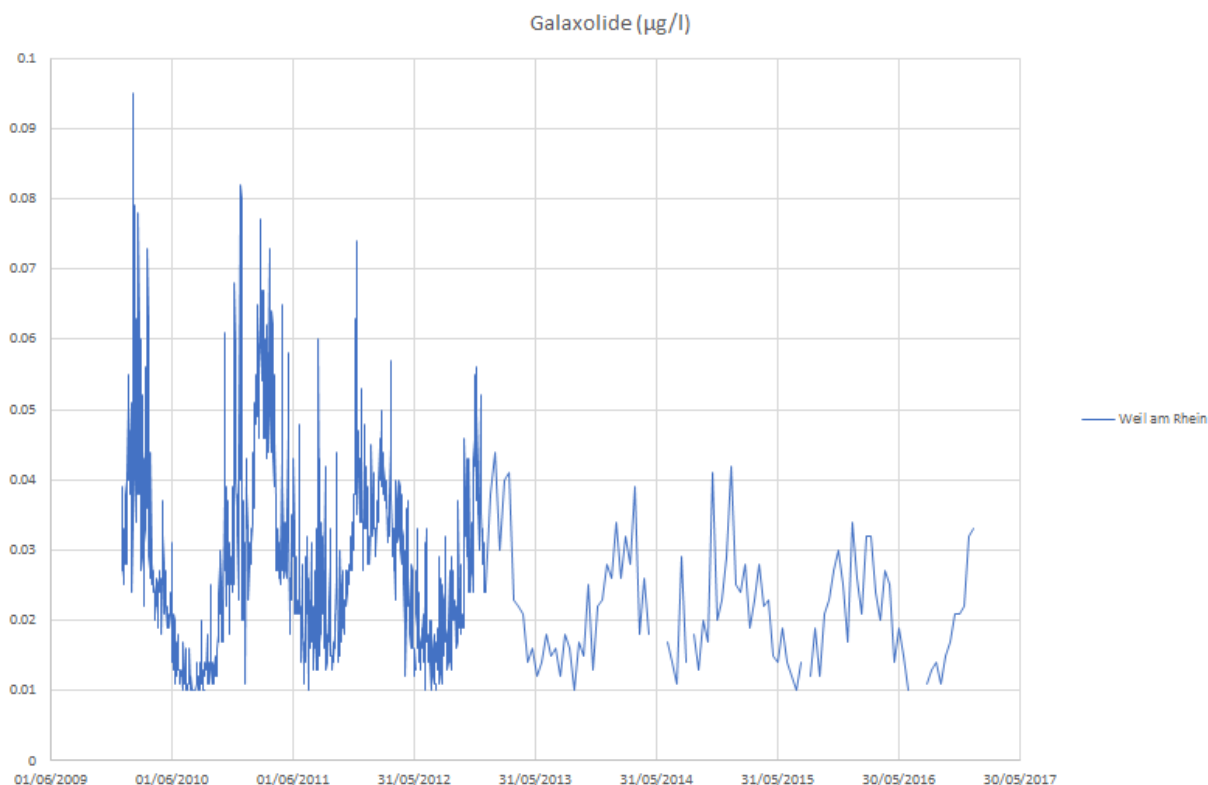


Figure 5: Galaxolide in the main stream of the Rhine (Weil am Rhein).

2.7 Industrial chemicals

For industrial chemicals:

- (i) The diglyme concentration in the main stream of the Rhine exceeds the relevant IAWR target of 1.0 µg/l in the case of temporary peak loads due to individual operations. In Weil am Rhein, the measured values are currently mostly below the determination limit. As a rule, no danger to the drinking water supply and the aquatic biocenoses is to be expected.
- (ii) For the substances TCEP and TCPP there is no relevance for the aquatic communities on the basis of the concentrations proven. However, there is an IAWR target value of 0.1 µg/l, which is exceeded in the main stream of the Rhine. The IAWR value for TCPP is also exceeded in some tributaries of the Rhine, partly showing a rising trend (e.g. Ruhr). There are no legally binding EU-EQS for this substance group yet.

⁸ Report EUR 27142 EN (Development of the first Watch List under the Environmental Quality Standards Directive)

- (iii) In the case of the perfluorinated surfactant PFOS, the concentrations measured along the Rhine and in its tributaries in many cases greatly exceed the annual average EQS specified in EU Directive 2013/39/EU. The IAWR value of 0.1 µg/l is exceeded in individual cases.

According to the obligations under Directive 2013/39/EU, PFOS must be measured in biota from 2018. According to current knowledge, the EU-EQS for fish will repeatedly be exceeded for PFOS in France, Luxembourg, Germany, Austria and the Netherlands.

- (iv) The flame retardants (TCPP, TCEP and TBEP) and PFOS can be detected in bank filtrates along the main stream of the Rhine or its tributaries. In the case of TCPP and TBEP, the values measured in the bank filtrate are above the target values of the IAWR and could therefore represent a problem for the production of drinking water.

3. Pollution of the Rhine with micropollutants from diffuse sources

For the most part, the diffuse influxes of micropollutants comprise extensive influxes of substances that are not precisely localisable, and which generally enter bodies of water in an arbitrary manner. In addition to "point sources", from wastewater treatment plants and industrial plants, diffuse influxes originating from agriculture, traffic emissions or settlements/industry lead to the significant pollution of water bodies and groundwater.

In the [ICPR Technical Report No. 240](#), the diffuse sources were considered using the example of selected plant protection products (PPPs). Plant protection products are used worldwide, and European countries represent significant consumers. They are one of the most important diffuse substance groups and the agricultural sector by far entails the most important field of application for PPPs. For the PPPs selected as indicator substances, only a small quantity of the measured data falls above the determination limit.

The concentrations of PPPs, e.g. bentazon, chlortoluron and isoproturon, vary greatly depending on the application times and subsequent (heavy) rain, and are therefore difficult to detect through measuring programmes with constant sampling intervals. Peak loads are often larger in smaller, regional surface water bodies and occur, limited in a localised manner, in groundwater. In larger streams, such as the main stream of the Rhine, pollution is mitigated and averaged through dilution, however, increased PPP loads do occur here.

The available data for glyphosate and its decomposition product AMPA show that the degradation products of PPP can have higher concentrations than the active substance itself.

4. Database/measurement programmes: Assessment of current data situation, presentation of current measurement programmes relating to micropollutants

In principle, nothing has changed in the statements of the ICPR Technical Report No. 203 regarding the substance groups.

The data situation for the Rhine and its tributaries is still in need of improvement.

Many measurements are below the determination limit, or there are too few datasets available for an assessment of the pollutant situation. The reasons for this are the very low concentrations and sometimes quite complex analysis methods.

Annual averages may not provide a reliable overview, as there are seasonal variations (e.g. in plant protection products and partly for pharmaceuticals) and/or high maximum concentrations (e.g. plant protection products after heavy rainfall).

Decomposition products must be taken into account in the measurement programmes, as they sometimes have even higher concentrations than the original substances and may also be hazardous to water. However, it will not be possible to measure all decomposition products.

In the ICPR, the relevant countries endeavour to integrate at least the main decomposition products into the measurement programmes (e.g. Rhine Monitoring Programme - Chemical Component 2015 to 2020, Special Measurement Programme 2017). In addition, a regular exchange on non-target screening takes place, which could help to detect previously unknown loads.

5. Measures

Some countries in the Rhine catchment have already developed a strategy on micropollutants or are currently working on this.

The strategies either revolve around micropollutants as a whole (e.g. trace substance strategy in Germany, micropollutants plan in France, or the Delta approach regarding water quality and fresh water in the Netherlands) or are separated by substance groups or approaches (e.g. in Austria, Switzerland and Luxembourg). The problem of micropollutants has thus been recognised in the different countries and is addressed holistically.

A more detailed description of the measures in the individual countries in the Rhine catchment can be found in Annex 3.

The following summary shows a general overview, providing an impression of the different measures already underway. It should not be seen as exhaustive.

5.1 Measures at source

Authorisation of substances

When authorising the marketing of substances, an extended environmental impact assessment may be useful, to reduce influxes into the aquatic environment. The approval of substances is regulated by European directives and national legislation, depending on the substance group. For some groups of substances, such as pesticides, the environmental aspect is currently already more strongly integrated than for other groups of substances such as e.g. pharmaceuticals.

Regulation of substances

In general, governments use bans and restrictions on substances as a measure to reduce them directly at the source. Here, both international regulations such as the EU Plant Protection Products Regulation, and national regulations come into effect. This mainly concerns industrial chemicals and plant protection products (PPPs). For these, provisions of use, e.g. regarding the application methods of PPPs, are implemented.

In the non-agricultural sector, the usage bans on sealed public areas, which are already in force in the countries in the Rhine catchment area, or should be introduced in the future, are an important step towards the reduction of PPP influxes. There are also partial bans on the use of PPPs and biocides in the private sector. There is already a usage ban in place for herbicides on sealed areas in all ICPR member countries.

In the case of substance bans, it must be taken into account that as a consequence of individual bans, so-called "substitutes" are often developed and used. The effects often cannot be estimated directly or their use may potentially have a more negative effect than the prohibited substance.

The Sustainable Use of Pesticides Directive (2009/128/EC) also requires EU countries to develop national action plans to make the use of pesticides more sustainable. In 2017, Switzerland also adopted an action plan for risk reduction and the sustainable use of PPPs.

On the flip side, incentives for reducing the use of these substances are also created, for example the promotion of organic farming.

Disposal

Provisions and guidelines for the proper disposal e.g. of pharmaceuticals, serve as a measure for reducing the sources, and are promoted in some countries in the Rhine catchment. Other "special waste" is also collected separately and recycled, or disposed of accordingly.

Influence on consumer behaviour

The influencing of consumer behaviour takes place, for example, via labelling systems which are applied in all of the relevant countries, e.g. for the labelling of organically grown products. In addition, targeted information campaigns are held, in order to reduce the influx of micropollutants into bodies of water.

Further measures

Other measures that have been taken in individual countries include reductions at source (such as banning pesticides in households), the remediation of contaminants, comprehensive agri-environment programmes, information campaigns aimed at reducing the prescription of pharmaceuticals, or initiatives to collect urine and to reduce the discharge of radiocontrast agents (see also Appendix 3).

5.2 Stipulations for production processes and the treatment of operational wastewater, in particular the application of the best available techniques

Industry and trade

Decentralised measures are often implemented internally within the relevant countries. For example, state of the art technology is required to reduce emissions (emission-based minimum standard); in addition, however, further measures from an immission perspective are required in individual cases.

For industrial applications in particular, the ICPR Technical Report No. 202 stated that the individual wastewater streams could be treated more easily for the specific contaminants than the mixed wastewater in a municipal water treatment plant, and therefore decentralized local minimization on site is a sensible way forward.

Healthcare

Hospitals and other healthcare institutions may in individual cases, under certain conditions and depending on the substance, contribute in relevant proportions to the loads of human pharmaceutical products in surface waters, via the wastewater treatment plants. Therefore, in some pilot projects, a reduction of drugs and radiocontrast agents is being introduced in these facilities.

Agriculture

The ICPR Technical Report 240 clearly demonstrates that **diffuse substances should be reduced as far as possible at source**. With regard to PPPs in the agricultural sector, a reduction in influxes into water bodies, and the concomitant risks, can be achieved e.g. through the use of modern, precise application methods, the cultivation of adapted crops, and the promotion of integrated production or organic farming.

Decentralised measures are already being used for diffuse influx pathways, for example by stipulating the necessity of buffer strips of land bordering water bodies in agricultural areas, or by setting up special washing and filling stations for agricultural sprayers, intensifying consultancy and testing new techniques in model farms.

5.3 Promoting the development and implementation of innovative methods to reduce emissions of micropollutants

Innovative processes are promoted in different ways in all of the relevant countries. These procedures can range from measures at source to centralised measures at wastewater treatment plants.

Substitution of substances

As an example, more environmentally-friendly alternatives to products that result in micropollutants are sought, e.g. for medicines, odoriferous substances and pesticides, to directly reduce the source.

Cleaning techniques

In wastewater treatment plants, more and more innovative treatment techniques are being tested within pilot projects in various countries and federal states, and in some cases are already being implemented on a large scale. Innovative processes are also used in industrial facilities, in terms of decentralised measures or monitoring.

Human medicine

In some areas of the Rhine catchment there are programmes to reduce the effects of pharmaceuticals. Here, doctors (and veterinarians) are trained to prescribe fewer drugs in total, or to select drugs with a lower environmental impact. These mostly involve pilot studies to assess whether these measures can reduce the risk of pharmaceuticals to the environment.

5.4 Use of advanced procedures for eliminating micropollutants from wastewater from municipal wastewater treatment plants

One of the most important feasible measures is to equip wastewater treatment plants with a further purification process (e.g. ozonation, activated carbon treatment). This can significantly improve efficiency in eliminating micropollutants in wastewater treatment plants, with regard to a wide range of substances. The elimination capacity per substance or substance group may vary and, depending on the treatment (ozonation), possible decomposition products must be taken into account. The greater the proportion of wastewater treatment plant effluent in the body of water, the higher the contamination with micropollutants in the water; consequently, in these cases, by upgrading the wastewater treatment plant for micropollutant elimination, the concentrations of micropollutants in surface water can be significantly reduced. The proportion of biologically treated wastewater in the Rhine can be up to 20% or more in periods of low water levels (see ICPR Technical Report No. 203); in the tributaries, the proportion can be significantly higher. In general, the proportion of wastewater in the main stream of the Rhine increases along the length of the river. Tied in with this are increasing concentrations and loads of certain micropollutants (cf. Chapter 2).

It was estimated in the ICPR Technical Report No. 182 that the upgrading of the 191 largest of a total of around 5,000 wastewater treatment plants in the Rhine catchment, which account for 54% of the total wastewater treatment capacity, would reduce the influxes of pharmaceutical substances for human use (and many other organic micropollutants from urban water management) into the Rhine by at least 30%. The upgrading of small to medium-sized wastewater treatment plants can in individual cases also contribute to the improvement of the ecological/chemical state of the Rhine tributaries.

The extent and timing of this key measure varies considerably between the different countries. Some countries are in favour of the introduction of the fourth purification stage in accordance with certain selection criteria, others want to take further measures only if the water status makes this necessary - on a case-by-case basis. The selection criteria formulated thus far in individual countries should maximize the benefits for water protection. In order to better protect flora and fauna, the aim here is to upgrade the wastewater treatment plants on flowing waters with a high proportion of wastewater. The upgrading of wastewater treatment plants in the catchment areas of lakes, which is planned in some countries, primarily serves to protect drinking water resources, but also improves, for example, the quality of the lakes as bathing waters. With the upgrading of the largest wastewater treatment plants, above all, the total amount of unwanted trace substances is efficiently reduced (responsibility of those situated upriver).

In some places, investigations are still currently being carried out on the substances in wastewater treatment plants, in order to identify the best measures. In some of the relevant countries, pilot projects are underway to expand wastewater treatment plants, while others are already implementing the upgrading of selected wastewater treatment plants (see also Annex 3).

In some countries, rainwater overflow basins in sensitive zones are also equipped with retention bottom filter basins. With regard to pollution and the technical possibilities for reducing the influx of micropollutants via precipitation water paths (and/or mixed water discharges from rainstorms), there is still a need for investigation.

5.5 Reviewing and updating existing monitoring concepts, taking into account decomposition products

Monitoring

Monitoring and evaluation systems in the different countries are being continuously adapted and further developed. The aim here is to capture the full diversity of micropollutants and also to consider substances for which there are currently no quality requirements.

The extensive range of substances and their constant further development prevent measurement and monitoring programmes from representing a comprehensive overview. Therefore, it is often necessary to look to indicator substances. Ideally, as is already the case at some measuring stations, this should be supplemented with a non-target analysis/screening investigation, which allows a more comprehensive insight into the pollution situation in the body of water and can also identify decomposition products etc. In some regions, communication with industry is actively sought, in order to quickly identify new substances and to reduce influxes as quickly as possible.

For the evaluation systems, the focus is increasingly falling on ecotoxicological principles, the effects on the aquatic community and the effects on drinking water production. In some cases, monitoring is used to prioritise relevant substances for further measures.

Balance of substances

In addition to recording as many substances as possible, in some of the countries, the prominent influx pathways are identified and substance balance calculations are established.

5.6 Informing the public about use, prevention and disposal

In all of the relevant countries, information campaigns are underway - for the professional public and the general public. In some countries and federal states, "competence centres" have been set up specifically for the purpose of the exchange of information (see also Annex 3).

Professional public

For the professional public, there are usually training and further education options, as well as guidelines and online portals with important information. For the individual sectors, there are associations or voluntary meetings through which important information can be passed on and a practical exchange can take place.

General public

For the general public, there are information campaigns such as those regarding the proper disposal of medicines. Environmental labels are used as a guide for the consumer in some countries.

In some cases, special campaigns such as a "week without pesticides" are organised for the private and public sectors.

5.7 Financing measures

Funding

The government partially finances or promotes these measures.

These range from information campaigns and pilot projects, to the upgrading of wastewater treatment plants. In addition, there are some subsidies for environmentally-friendly agriculture or individual measures such as retention soil filtering.

Training and further education are provided by the companies themselves or by the respective associations, in addition to the government incentives.

Individual countries have made special provisions, such as the legally consolidated financing of wastewater treatment plant development, with the costs being allocated to the population served by the measures, or the financing of a plant protection product atlas.

6. Summary

In 2008, the ICPR set itself the goal that "substances in the Rhine water, either individually or in combination, must not have adverse effects on the communities of flora, fauna and micro-organisms, and the water quality must be such that drinking water production can be achieved through simple, natural processing methods."

Since 2008, the ICPR has compiled information regarding the relevance of various micropollutants in the Rhine catchment area and approaches to reducing water pollution, and published ICPR technical reports on groups of substances.

It is already clear for some groups of substances that they can have a negative impact on the quality of the water and pose a challenge both for the ecology and for the production of drinking water. For example, pharmaceuticals in ecotoxicologically significant concentrations are found in the untreated water of drinking water production plants.

However, the data situation for the Rhine and its tributaries still requires improvement, with the exception of a few substances. The reason for this is on the one hand the very low EU-EQS (for some plant protection products, amongst various other substances) and the rather elaborate analytical methods in some cases (e.g. for oestrogens).

In principle, nothing has changed in the statements of the ICPR Technical Report No. 203 regarding the substance groups. Substances from all processed substance groups still occur in the water of the Rhine, and are detected in measurable concentrations.

For most micropollutants, wastewater from the wastewater treatment plant effluent is the most significant influx pathway into surface water. For diffuse sources, such as plant protection products, other influx pathways are relevant, meaning that a reduction directly at source is sensible.

Measures are being taken at various levels in all countries in the Rhine catchment area to reduce the presence of micropollutants. The focus may vary depending on the country, and the implementation of individual pilot projects may extend to fully established measures.

Measures at source are important because they are the most efficient, especially in terms of the diffuse influx of substances. Here, the aim is to achieve a reduction in micropollutant influxes through certain approvals, regulations, information regarding disposal or by influencing consumption behaviour.

Measures in the technical, decentralised sector are mainly applied in industry and commerce, but also in healthcare and agriculture.

Through the promotion of innovative methods, pilot projects often seek ways to substitute problematic substances, to improve cleaning techniques or to influence influxes from human and veterinary medicines.

A central measure is the addition of a further purification process in wastewater treatment plants. Depending on the group of substances, this can greatly reduce the influx of micropollutants. The extent and timing of this key measure varies considerably, however, between the different countries.

In order to obtain the most comprehensive picture possible of the pollution situation, the monitoring, measurement techniques and assessment systems in the various countries are continuously adapted and further developed. A complete overview will not be possible, however.

In all of the countries, information campaigns are running for the professional public and the general public in order to achieve a reduction in influxes through the improved management of micropollutants.

The problem of micropollutants has thus been recognised in the countries in the Rhine catchment area, and is being addressed holistically. Strategies and "packages" of measures have been, or will be initiated, and applied at various levels (see Annex 3).

Annex 1 Qualitative assessment of substance groups according to ICPR Technical Report No. 181 (adapted).

	Group of substances	Name of substance	CAS No.	Emission path		Relevancy criteria						Remarks	Publication
				Diffuse	Point sources	Influx pathway number (cf. ICPR Technical Report No. 181) / Comment	Measured in Rhine catchment	Surface water bodies	Bank filtrate	Emission	Persistent*		
1	X-ray contrast medium	Diatrizoic acid Iopamidol Iopromid Iomeprol	117-96-4 62883-00-5 60166-93-0 73334-07-03 78649-41-9		X X X	8 (hospital, households)	X X X	X X X	X X X		X X X		ICPR Technical Report No. 187
2	Pharmaceutical substances for human use	Bezafibrate Carbamazepine Diclofenac Sulfamethoxazole	41859-67-0 298-46-4 15307-86-5 723-46-6		X X X X	8 (households, hospital) 8 (households, hospital) 8 (households, hospital) 5,6 also as veterinary medicines	X X X X	X X X X		X X X X	X X X X		ICPR Technical Report no. 182, ICPR Technical Report no. 182 Annex
3	Veterinary medicines	Ciprofloxazin Oxytetracycline Sulfamethazine Sulfadiazine	85721-33-1 79-57-2 35762-76-6 57-68-1 68-35-9	X X X X								Diffuse sources were dealt with using plant protection products as a model.	

	Group of substances	Name of substance	CAS No.	Emission path			Relevancy criteria						Remarks	Publication
				Diffuse	Point sources	Influx pathway number (cf. ICPR Technical Report No. 181) / Comment	Measured in Rhine catchment		Emission	Persistent*	Ecotoxic	Relevant to drinking water		
						Surface water bodies	Bank filtrate							
4	Biocides and Corrosion inhibitors	BHT (Butylhydroxytoluene)	128-37-0		X	8 (households, industry)	X			X	X		ICPR Technical Report no. 183 and substance data sheet, ICPR Technical Report no. 183 Annex	
		Benzotriazole	95-14-7		X	8 (households, industry)	X	X	X	X		X		
		Carbendazim	10605-21-7	X	X	8 (households, industry) 5,6,13 (agriculture)	X			X	X			
		DEET	134-62-3	X	X	8 (households)	X			X				
		Cybutryne (Irgarol)	28159-98-0	X	X	8 (when used as biocide) 13 (passenger shipping)	X				X			
		Mecoprop	93-65-2	X	X	8 (when used as biocide)	X	X		X		X		
		Triclosan	3380-34-5		X	8 (households, industry)	X							
5	Pesticides	AMPA	1066-51-9	X	X	8 (sealed surfaces) 5,6,13 (agriculture)	X	X	X		X	X	ICPR Technical Report No. 240	
		Diurone	330-54-1	X	X	8 (sealed surfaces); 13 (passenger shipping)	X				X	X		
		Glyphosate	1071-83-6	X	X	8 (sealed surfaces); 5, 6, 13 (agriculture)	X		X		X	X		

	Group of substances	Name of substance	CAS No.	Emission path		Relevancy criteria						Remarks	Publication
				Diffuse	Point sources	Influx pathway number (cf. ICPR Technical Report No. 181) / Comment	Measured in Rhine catchment		Emission	Persistent*	Ecotoxic		
						Surface water bodies	Bank filtrate						
		Isoproturon	34123-59-6	X		5, 6, 13 (agriculture)	X		X		X		
		Mecoprop	93-65-2	X	X	5, 6, 13 (agriculture)	X		X		X		
6	Industrial chemicals	Bisphenol A	80-05-7		X	8 (industry, households)	X				X		
		Diglyme	111-96-6		X	8, 12 (industry)	X			X		X	
		Nonylphenol	25154-52-3 68152-92-1		X	8, 12 (industry)	X			X	X		
		Dioxine	1746-01-6 33857-26-0 40321-76-4 57653-85-7 19408-74-3 35822-46-9	X						X		Measures have already been regulated in other international bodies. In particular, reference is made to the EU Dioxin Strategy.	The evaluation report "Bisphenol A, Diglyme Nonylphenol" was integrated into the industrial chemical evaluation report and published as ICPR Technical Report No. 202. The substance data sheet was published separately as an attachment.

	Group of substances	Name of substance	CAS No.	Emission path			Relevancy criteria						Remarks	Publication
				Diffuse	Point sources	Influx pathway number (cf. ICPR Technical Report No. 181) / Comment	Measured in Rhine catchment	Surface water bodies	Bank filtrate	Emission	Persistent*	Ecotoxic		
		HCB	262-12-4 39227-28-6 3268-87-9 118-74-1			Only legacy contamination in sediment				X			Remedial measures are recommended in the sediment management plan.	
	Flame retardant media	Tris(2-chloroethyl) phosphate (TCEP) Tris(2-chloroethyl) phosphate Tris(dichlorpropyl)phosphate (TDCP) Tributyl phosphate (TBP) Triphenyl phosphate (TPP) Tris(butoxyethyl) phosphate (TBEP) Triphenylphosphine oxide (TPPO)	115-96-8 13674-84-5 13674-87-8 126-73-8 115-86-6 78-51-3 791-28-6		X	8 (industry, households)	X			X			The water-soluble, organophosphorus flame retardants have been taken into account, as some of these substances are relevant to drinking water.	The evaluation report on flame retardants was integrated into the industrial chemical evaluation report and published as ICPR Technical Report No. 202. The substance data sheet was published separately as an attachment.
		MTBE ETBE	1634-04-4 637-92-3	X		13 (shipping)	X		X	X		X	As the peak loads are caused by shipping, these substances were treated in the WG S.	

	Group of substances	Name of substance	CAS No.	Emission path		Relevancy criteria						Remarks	Publication	
				Diffuse	Point sources	Influx pathway number (cf. ICPR Technical Report No. 181) / Comment	Measured in Rhine catchment		Emission	Persistent*	Ecotoxic			Relevant to drinking water
						Surface water bodies	Bank filtrate							
		PCB	(209 Congener)	X		Only inherited legacy contamination in sediment				X	X		The substance group has already been regulated by the EU; the use of the substance group and its discharges into the Rhine have been discontinued. Remedial measures for contaminated sites are recommended in the sediment management plan	
	PFT	Perfluorooctanoic acid (PFOA), Perfluorooctanesulfonic acid (PFOS) Perfluorobutyric acid (PFBA) Perfluoropentanoic acid (PFPA) Perfluorohexanoic acid (PFHxA) Perfluoroheptanoic acid (PFHpA) Perfluorononanoic acid (PFNA)	335-67-1 1763-23-1 375-22-4 2706-90-3 307-24-4 375-85-9 375-95-1		X		X			X				The PFT evaluation report was integrated into the industrial chemical evaluation report and published as ICPR Technical Report No. 202. The PFT substance data sheet was published separately as an attachment.

	Group of substances	Name of substance	CAS No.	Emission path			Relevancy criteria					Remarks	Publication	
				Diffuse	Point sources	Influx pathway number (cf. ICPR Technical Report No. 181) / Comment	Measured in Rhine catchment	Surface water bodies	Bank filtrate	Emission	Persistent*			Ecotoxic
		Perfluorodecanoic acid (PFDA) Perfluorobutanesulfonic acid (PFBS) Perfluorhexanesulfonic acid (PFHxS)	335-76-2 375-73-5 355-46-4											
		PAK	(16 as per EPA)	X		1 (combustion processes) 13 (shipping, coating, wood preservation)	X			X	X		Since these substances mainly reach the Rhine through the atmosphere, only a pan-European strategy for improving air quality can lead to the objective.	
7	Synthetic complexing agents	DTPA EDTA NFA	67-43-6 60-00-4 64-02-8 139-13-9		X	12 (industry)	X			X	X		ICPR Technical Report no. 197, ICPR Technical Report no. 197 Annex	
					X	8, 12 (industry, households)	X		X	X	X		Not representative, for pollution through complexing agents.	
					X	Industry, households	X				X			
8	Oestrogens	17 Alpha-ethinylestradiol 17 Beta-estradiol	57-63-6 50-28-2		X	8 (households)	X				X		ICPR Technical Report no. 186 and ICPR Technical Report no. 186 Annex	
				X	X	8 (households) 5,6 (agriculture,	X		X		X			

	Group of substances	Name of substance	CAS No.	Emission path		Relevancy criteria						Remarks	Publication	
				Diffuse	Point sources	Influx pathway number (cf. ICPR Technical Report No. 181) / Comment	Measured in Rhine catchment	Surface water bodies	Bank filtrate	Emission	Persistent*			Ecotoxic
		Estrone	53-16-7	X	X	livestock breeding) 8 (households) 5,6 (agriculture, livestock breeding)	X		X		X			
9	Cleaning agents (including dishwashing detergent)												This group of substances has not been reviewed, as a Dutch study that examined all detergents for their effect on the aquatic environment has shown that above all, odoriferous substances are relevant as a chemical constituent.	
10	Personal care products												Only the group of odoriferous substances was treated as a separate group of substances; other components of personal care	

	Group of substances	Name of substance	CAS No.	Emission path		Relevancy criteria						Remarks	Publication
				Diffuse	Point sources	Measured in Rhine catchment		Emission	Persistent*	Ecotoxic	Relevant to drinking water		
					Influx pathway number (cf. ICPR Technical Report No. 181) / Comment	Surface water bodies	Bank filtrate						
		Musk ketone										Idem	

Key:

Name of substance = substance from the List of Rhine Substances 2007

Name of substance = no longer analysed, see reasoning under remarks.

* = persistence as per REACH

Annex 2

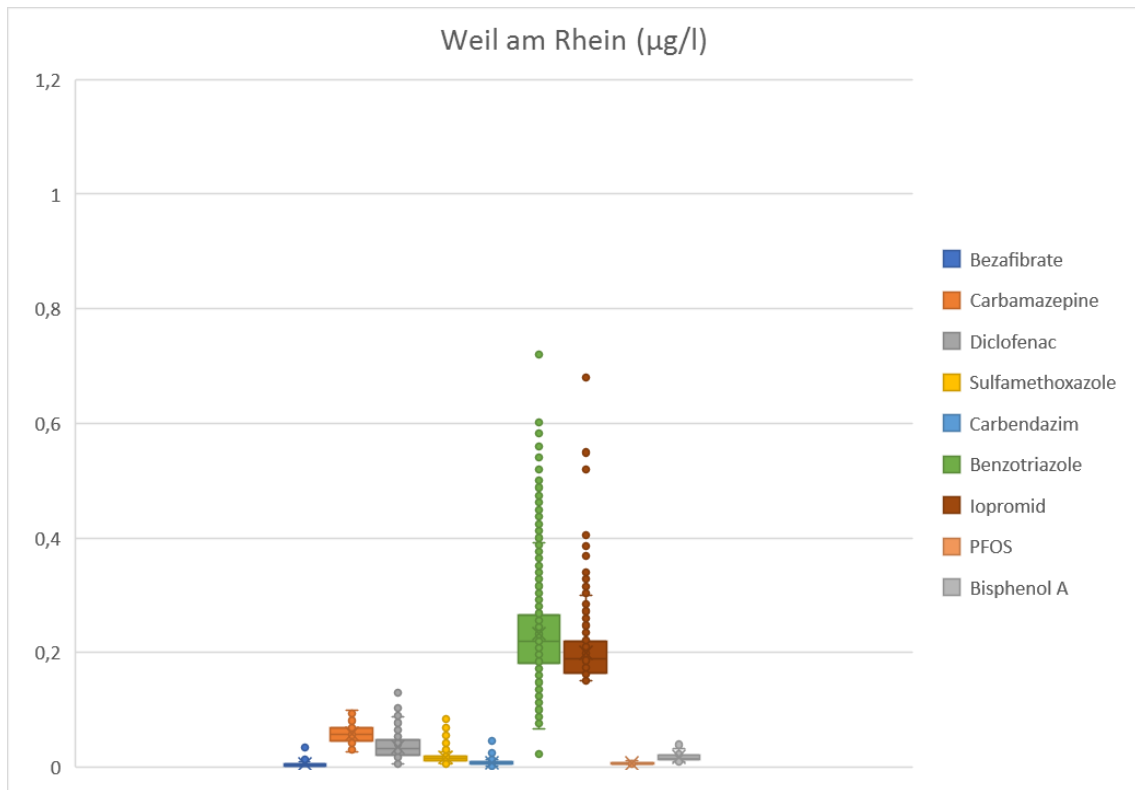


Figure 1: Concentrations of selected substances in Weil am Rhein (main stream of the Rhine).

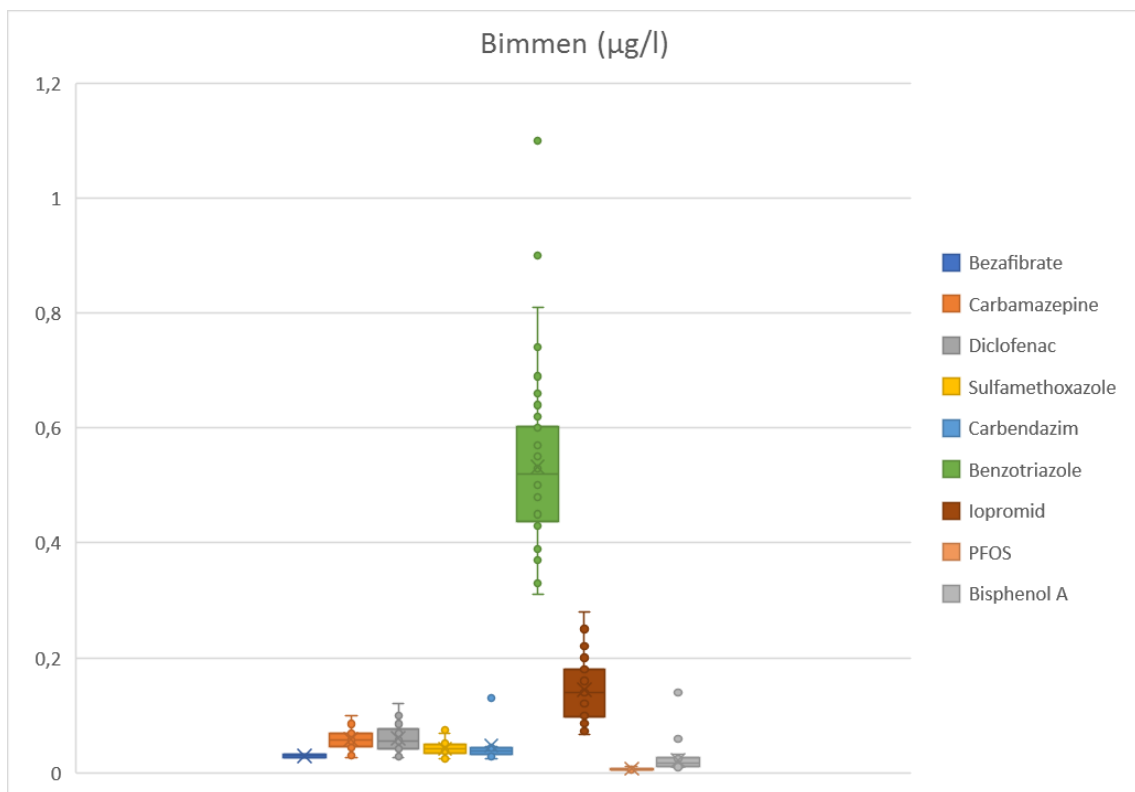


Figure 2: Concentrations of selected substances in Bimmen (main stream of the Rhine).

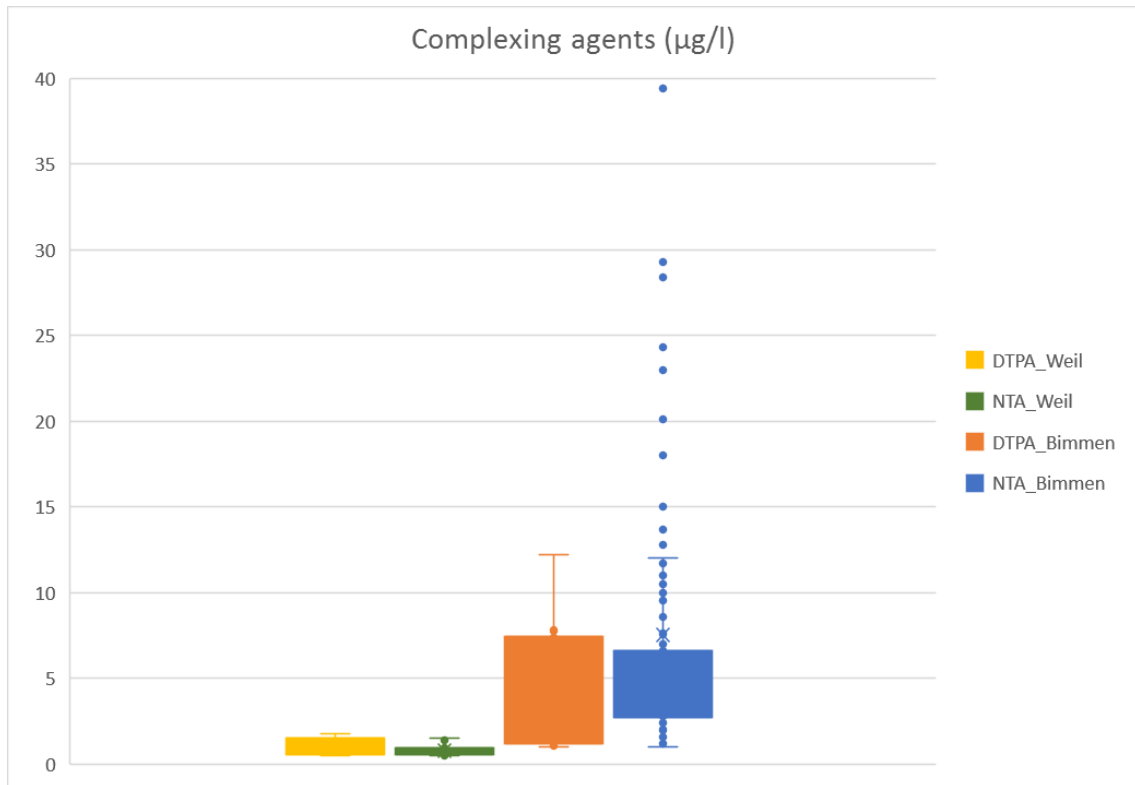


Figure 3: Complexing agents DTPA and NTA in the main stream of the Rhine (Weil am Rhein and Bimmen). Two outliers for NTA concentrations in Bimmen (89.7 and 152 µg/l) were removed for better presentation of the remaining data.

Annex 3

Measures

1. Measures in Austria

Under Chapter 6.3 of the 2015 National Water Management Plan, there is a list of measures for the different contamination types of pollutant influxes (including priority and hazardous priority substances) from point sources, and for the contamination types from diffuse sources. Essentially, these measures were assigned to the groups below, and supplemented by a number of specific measures in the Austrian Rhine catchment area and exemplary individual projects.

Key areas of legislation are governed by the Austrian Water Act and subsequent ordinances. These include the permit requirement for discharges (§§ 32 and 32b), limitations as per the combined approach (§§ 30g, 33b), § 32b in connection with the indirect discharger ordinance, water surveillance (§§ 130ff), the adjustment obligation for legally established plants (§ 33c), the modification of public interest authorisations (§21a), the establishment of a legal status (§138) and §59a in conjunction with the ordinance on an electronic register for recording all significant pollution of surface water bodies by emissions of substances from point sources.

1.1 Measures at source

In order to reduce water pollution, substance-related or application-related restrictions on the marketing and use of pollutants were introduced under the Chemicals Act 1996 in conjunction with the Chemicals Prohibition Regulation. These include, for example: a ban on the marketing and use of pentabromodiphenyl ethers, octabromodiphenyl ethers, and antifoulings, which amongst other substances contain organotin compounds and nonylphenol. It is also due to measures relating to chemicals legislation or the policy on chemical products that some priority hazardous substances such as endosulfan, hexachlorobutadiene, hexachlorbenzol and pentachlorbenzol are nowadays absent from the inflows and outflows of municipal wastewater treatment plants.

Further successes have been achieved through measures such as the withdrawal of approvals for plant protection products with dangerous substances (e.g. atrazine, Plant Protection Product Act), the restriction of pollutant contents in agricultural fertilizers (e.g. copper, fertilizer ordinance), a limitation on the pollutant emissions of the manufacturing industry into the air (e.g. mercury; emission limitations for air), traffic speed limits for reducing nitrogen oxide and a comprehensive approach to good agricultural practice.

The Land Action Plan Plant Protection Vorarlberg lists the following measures for the implementation of precise application methods via plant protection devices:

- surveys on the amount of tractor-drawn and tractor-driven plant protection equipment in use in Vorarlberg and the technical equipment and possibilities for retrofitting
- the mandatory inspection of tractor-drawn and tractor-driven plant protection equipment every three years
- an advisory focus on the subject of filling and cleaning plant protection equipment.

Furthermore, no use of pesticides with hazardous properties, or of total herbicides (such as Roundup), is permitted in public areas.

The Act on the Remediation of Contaminated Sites makes provisions for the systematic protection and remediation of contaminated sites.

1.2 Decentralised measures

Initial status reports and environmental inspections of companies in accordance with the Industrial Emissions Directive provide (inter alia) data on trace substances and in-house avoidance strategies.

In addition to the general comprehensive measures, some targeted further measures (e.g. adjustments to the state of technology, derivation of the effluent into more suitable receiving waters as well as work in the area of the sewer system, in-house optimisations) have been established at certain point sources. They mainly concern the reduction of emissions for ammonium and, in isolated cases, copper, AOX and zinc.

1.3 Central measures

Wastewater discharges into bodies of water are subject to authorisation. The typically expected pollutants or parameters of wastewater discharges from different origins are restricted, taking into account the water management conditions and the state of technology. The state of technology is defined in municipal and industry-specific wastewater emission regulations. If the restrictions in accordance with the state of technology are not sufficient to achieve the environmental goals, stricter emission limits must be specified. Provisions are made for the corresponding monitoring of the specifications.

At the outflow of the main wastewater treatment plant in Vienna, the two projects KomOzon and KomOzAk analysed the further purification of municipal wastewater using ozone and activated carbon to remove organic trace elements. A comprehensive retrofitting of the municipal wastewater treatment plants with discharges into rivers and streams is at least for the time being considered unnecessary, and not appropriate in Austria.

1.4 Adaptation of monitoring and evaluation systems

The significant influx pathways for relevant priority substances were identified in a study by the Vienna University of Technology and the Federal Environment Agency on behalf of the Federal Ministry of Agriculture, Forestry, Environment and Water Management (at point sources/diffuse). In a follow-up study currently in progress, these results will be applied in a substance balance calculation at catchment level (STOBIMO trace substances) in order to implement a meaningful monitoring programme.

Another measure concerns the recording of substance loads for which there are currently no quality requirements in rivers and streams. Here, as part of the 2015 Water Status Surveillance Ordinance, a multi-month pesticide measurement programme was conducted in selected streams. The aim is to obtain a representative record and evaluation of the pollution situation in larger and smaller rivers and streams, in order to be able to derive any further reduction measures. On this basis, the Chemical Quality Objective Ordinance for surface waters will be reviewed in relation to the nationally relevant pollutants.

The TEMPEST project investigates the entry of trace substances via rainwater channels.

The Land Action Plan for Plant Protection Vorarlberg provides as a measure the outsourcing of plant protection product use monitoring to a suitable facility.

1.5 Informing the public (and professional sector)

“Sewer and wastewater treatment plant neighbourhoods” are the facilities of wastewater systems operators that do not have a specific legal form, which are supported and organised by the Austrian Water and Waste Management Association (ÖWAV) in co-operation with the federal states. Participation in the neighbourhoods is voluntary and open to all operators of wastewater systems (municipal, industrial and other private sewerage and treatment plants). The aim of the neighbourhoods is to continually adapt the knowledge and skills of the operating staff in line with technical progress and legal developments. Here, the aim is to ensure a professional and economical operation of the facilities and to achieve the best possible effect on the cleanliness of our waters through neighbourly advice and assistance. There are currently over 900 wastewater treatment plants in 57 neighbourhoods. About 90% of all wastewater treatment plants in Austria are included.

Furthermore, ÖWAV seminars on trace and road effluents are held, and advisory and training programmes have been set up for farmers and professional users, such as the Nitrate Information Service and a water protection advisory service.

The Land Action Plan for Plant Protection Vorarlberg makes provision for the following measures:

- uniform documentation of the use of plant protection products for professional use
- training and counselling of those who use plant protection products professionally
- strengthening the expert knowledge of users of plant protection products
 - compulsory training for those who use plant protection products professionally
 - adaptation of the curriculum of the agricultural college in Hohenems to meet the requirements of the Directive 2009/128/EC
 - information for people who use plant protection products in allotment areas, in community newsletters, at the events of the orchards and horticultural associations, by the Professional Association of Tree Wardens, and at garden shows
 - training for professional users available to all interested persons
 - development of an internet portal in cooperation with the other federal states

1.6 Financing measures

The subsidies for urban water management within the framework of the Environmental Aid Act provide major support for the implementation of measures for the proper disposal of municipal and operational wastewater. From 1993 to 2015, an average annual investment volume of around €700 million was provided for municipal and operational wastewater disposal. Subsidies are provided for the construction of wastewater disposal infrastructure for municipal facilities, the adaptation of facilities that are no longer state-of-the-art, and the renovation of existing facilities before a certain deadline. In addition, voluntary additional benefits are promoted at companies.

The Austrian Programme for the Promotion of Environmentally Friendly and Extensive Agriculture that Protects Natural Habitats (ÖPUL 2015) contains numerous measures that support groundwater protection in relation to pesticides: abstaining from the use of chemical-synthetic plant protection products (organic farming, abstaining from yield-increasing resources on arable land and grassland); abstaining from chemical synthetic fungicides on cereal fields.

The Land Action Plan for Plant Protection Vorarlberg lists the following support measures:

- Promotion of organic farming and integrated production
- Further development of a Vorarlberg quality label for agricultural products
- Promoting multi-faceted crop rotation with the aim of achieving a higher degree of self-sufficiency in market crops
- In the case of publicly funded agricultural brand programmes, the use of plant protection products that can be applied is restricted to the resources allowed in integrated production

2. Measures in Switzerland

2.1 Measures at source

Existing and further measures at source are presented as part of the answer to the postulate of Ständerat Hêche (SR 12.3090 - Micropollutants in Water, Reinforcement of Measures at Source) (*Lit.cit.*: report in preparation).

Households and outdoor spaces in residential settlements

Numerous regulations exist for the reduction of micropollutant influxes into bodies of water from households and outdoor spaces in residential settlements. There are positive implications for (amongst other things) the correct disposal of problematic substances within the framework of municipal waste management, as well as public disposal points and the obligation to take packaging back to the point of sale. Furthermore, there are also extensive substance bans, application restrictions, and the labelling of hazardous substances and preparations in accordance with the globally harmonized system for the classification and labelling of chemicals (GHS)⁹. For example, for outdoor spaces in residential settlements there is a ban on the use of herbicides on and around roads, paths and squares. In addition, as part of the biocide and plant protection product authorisation process, the applications of the various active substances are examined and, if necessary, product-specific additional requirements are established. In addition, the general public is informed about the environmentally friendly use, storage and disposal of products (-> see *Chapter 2.5 Informing the public*)

Industry and trade

The regulations of the Swiss Chemicals Act cover a broad spectrum of substances. In addition, EU regulations are also relevant to the cross-border economy - in particular the REACH regulations. In accordance with the Water Protection Ordinance of 28 October 1998 (GSchV, SR 814.201), Annex 3.2, in terms of production processes and wastewater treatment, the necessary measures in accordance with the latest technology must be taken in order to avoid polluting the waters.

Due to the need for authorisation for discharging wastewater, the industrial and commercial enterprises that discharge directly into bodies of water (direct dischargers) are almost completely covered by the cantons. There is only limited data, however, on the concentrations and loads of micropollutants in the water. For companies that discharge their wastewater into the sewage system (indirect dischargers), there is even less knowledge available about the quantities and composition of substances¹⁰. A systematic overview of the substances used in manufacturing or processing plants throughout Switzerland and released into the environment with wastewater, is therefore lacking.

In order to be able to better assess the situation with regard to substance discharges from industry and trade, a broad Switzerland-wide problem analysis is required. This is intended to analyse the pollution of waters, identify problematic substance influxes - such as large loads of substances which are difficult to biodegrade or particularly toxic substances - and determine their sources from industry and trade. New information can be gained in particular through the use of state-of-the-art analytical methods in wastewater and water body monitoring.

Healthcare

Most pharmaceutical substances for human use are widely used in private households. Hospitals, nursing homes and laboratories can, however, represent the major sources for a few selected substances such as individual antibiotics and in particular iodinated radiocontrast agents. As this topic is relatively new, there are still few measures in place to reduce the presence of micropollutants from healthcare facilities. However, there are

⁹ See www.cheminfo.ch

¹⁰ C. Braun, R. Gälli, 2014. Mikroverunreinigungen aus Industrie und Gewerbe [Micropollutants from industry and trade]. On behalf of the FOEN. BMG Engineering AG.

various training courses on the subject of water pollution for the healthcare stakeholders concerned, in order to make the population aware of the moderate use of medicinal products. Pharmaceutical substances for human use are also sold in various packaging sizes to avoid the improper disposal of surplus medicines.

Conclusion

In order to strengthen measures at source, the following general strategic focuses should be pursued in cooperation with cantons, professional associations, research institutions and the private sector:

- Reinforcing the implementation of existing regulations and promoting the environmentally conscious behaviour of the public and the private sector through targeted information campaigns. Here, professional, environmental and industry associations play an important role.
- Increasing the level of knowledge through the further development of water surveys with regard to micropollutants and a more in-depth look at the sources of health and industry and trade.

2.2 Decentralised measures

Wastewater from industry and trade

The Water Protection Ordinance defines discharge requirements for industrial wastewater. Measures include the optimisation of production processes (e.g. wastewater-free production), the optimisation of washing processes and the pre-treatment of wastewater prior to discharge into the sewage system or into central wastewater treatment plants. There are enforcement aids from the federal government, cantonal regulations or recommendations of the trade associations as well as various training and further education programmes for operational environmental and water protection for different sectors. There are also various efforts at a technical material level. For example, improvements in formulations or the encapsulation of problematic biocide active ingredients used in façades are constantly being developed. Likewise, more environmentally-friendly alternative substances are constantly being developed and tested. In order to be able to better assess the situation with regard to substance discharges from industry and trade, a Switzerland-wide problem analysis is currently being carried out (see also the chapter "Measures at source"). If certain substance influxes from industrial and commercial enterprises are very widely proven, a check can be made as to whether existing legal regulations need to be supplemented, e.g. with additional prohibitions or application restrictions for chemicals. If necessary, new requirements can be defined in the Water Protection Ordinance [GSchV].

Measures for the reduction of diffuse substance influxes - focus on plant protection products in agriculture (*NOTE: Part of this is also included in Chapter 2.1 Measures at source!*)

There are some legal provisions already in place today to reduce the influx of plant protection products (PPPs) from agriculture into bodies of water. For example, a minimum distance from water of at least 3 m is obligatory (all farmers) and for those receiving direct payments from the federal government (around 98% all farmers) a minimum distance from water of 6 m applies. A ban is also in place on the use of herbicides on and along roads, paths and public spaces (untreated conservation buffers of at least 50 cm between effective area and road is obligatory). In addition, various regional programmes (mainly funded by the federal government) are running with the aim of reducing PPP influxes into waters.

However, additional, effective measures are needed to significantly reduce the existing water pollution. The evaluation of the consideration and revision of the *Action Plan for Risk Reduction and Sustainable Use of Plant Protection Products [AP PSM]* is currently underway. With the implementation of the action plan, the current risks of PPPs should

be halved, and the use of PPPs made more sustainable (Version AP PSM, which was assessed in 2016: <https://www.blw.admin.ch/blw/de/home/nachhaltige-produktion/pflanzenschutz/pflanzenschutzmittel/aktionsplan-pflanzenschutzmittel.html>).

2.3 Central measures

Municipal wastewater treatment

On 21 March 2014, the Swiss Parliament approved an amendment to the Water Protection Act, thereby laying the foundations for equipping selected wastewater treatment plants with an additional purification stage for the removal of micropollutants. The measures are implemented where they are most urgent and where they are most useful for water conservation. Corresponding provisions in the law thus guarantee the optimal use of financial resources. In order to better protect flora and fauna, the aim here is to upgrade the wastewater treatment plants on flowing waters with a high wastewater content. The planned upgrading of wastewater treatment plants in the catchment areas of lakes primarily serves to protect drinking water resources, but also improves, for example, the quality of the lakes as bathing waters. And with the upgrading of the largest wastewater treatment plants, above all, the total amount of unwanted trace substances is efficiently reduced (responsibility of those situated upriver). The retrofitting of wastewater treatment plants will be financed up to the end of 2040 by the fund. Several wastewater treatment plant operators are already working on projects for the elimination of micropollutants. Three plants have already installed the required cleaning stage. In continuous operation, the plants are reducing the micropollutants, as desired, by 80 percent.

2.4 Adaptation of monitoring and evaluation systems

Further development of water assessments

The micropollutants comprise a large number of chemicals which are continuously, or intermittently (e.g. rain-driven or controlled by production processes) introduced into bodies of water. This leads to large local differences. The changes in the use of products and substances in private households, in agriculture and in industry and trade are leading to an ever-increasing variety of substances in the waters. In terms of organisms and resources, the reduction measures must be focused on the chemicals that pose the highest risk. In the water surveys, the micropollutants must be taken into account in all their diversity and the current monitoring programmes must be adapted accordingly.

Introduction of new numerical requirements for water quality for micropollutants

The assessment of the pollution of waters with micropollutants is based on new *ecotoxicological principles* for surface waters. This means that the pollution situation for aquatic organisms is optimally depicted, and the focus can be placed on the greatest risks, or measures to combat the effectively harmful micropollutants. The supplementation of the Water Protection Ordinance of 28 October 1998 (GSchV, SR 814.201) with new requirement values such as these, is underway.

2.5 Informing the public

Measures to inform the general public about the use, storage and disposal of products that cause micropollutants are paramount. These include, for example, various information campaigns^{11,12,13}, and various training and further education courses, which include the handling of chemicals and aspects of water protection¹⁴. There are also instructions for the correct disposal of problematic substances within the framework of municipal waste management, as well as public disposal points and the obligation to take packaging back to the point of sale. In addition, environmental labels¹⁵ allow consumers to buy environmentally-friendly products.

2.6 Financing measures

Central measures - municipal wastewater treatment

With the amendment of the Water Protection Act of 24 January 1991 (GSchG, SR 814.20) on 21 March 2014, the parliament approved the creation of nationwide financing of the upgrading of selected wastewater treatment plants for the elimination of organic trace substances. These provisions entered into force on 1 January 2016. To finance the measures, all wastewater treatment plants will be charged an annual fee of up to CHF 9 per connected resident.

Informing the public

Information campaigns for the general public are supported by the authorities and, where possible, by industry associations.

Training facilities, government advice centres and professional and industry associations pay the costs for consultation services and further education/training. Appropriate programmes often receive financial support from the authorities.

¹¹ Foundation for Practical Environmental Protection [Praktischer Umweltschutz Schweiz PUSCH], www.giftzweg.ch

¹² Campaign by Aqua Viva: <http://www.aquaviva.ch/aktuell/news/776-mikroverunreinigungen>

¹³ Campaign by Pro Natura: <http://www.pronatura.ch/pestizide>

¹⁴ See e.g. www.sanu.ch, www.eawag.ch, www.svgw.ch, www.vsa.ch, www.pusch.ch

¹⁵ Foundation for Practical Environmental Protection [Praktischer Umweltschutz Schweiz PUSCH], <http://www.labelinfo.ch/>

3. Measures in Germany

3.1 Measures at source

3.1.1 Plant protection products (PPP)

- According to § 12 (2) of the Plant Protection Act, the use of all PPPs is banned on paved outdoor areas and on other outdoor areas that are neither used for agriculture, forestry or horticulture. Some exceptions are possible. The use of PPPs in or directly on surface water and coastal waters is prohibited.
- A certificate of competence is required for the application of PPPs in agriculture. Since 2014, all non-private users must provide a certificate of competence in accordance with the Plant Protection Act. The agricultural administrative body therefore offers nationwide courses on the water-friendly use of plant protection products, which are now mandatory for farmers and other professional users.
- On April 10 2013, the "National Action Plan for the Sustainable Use of Plant Protection Products in accordance with § 4 Plant Protection Act" was approved by the federal government. The NAP deals with mitigation strategies for the use of PPPs and for the possibilities of downstream measures (disposal of PPPs and management of soil and water pollution). See also <https://www.nap-pflanzenschutz.de/>
- The federal states have set up comprehensive agri-environmental programmes (example from Baden-Württemberg Support programme for agri-environment, climate protection and animal welfare (FAKT)). Agricultural enterprises can receive subsidies, for example, for the following measures: environmentally-conscious operational management, abstaining from the use of chemical-synthetic production substances or extensive and environmentally-friendly plant production. The proposed measures must be carried out for a period of at least 5 years. In some federal states, the funding is linked to the requirement that no municipal sewage sludge may be spread throughout the enterprise area.
Since 2015, the EU's Common Agricultural Policy has also enabled farmers to meet their commitments to the creation of 5% ecological priority zones in the form of buffer margins along waterways. It is not yet possible to assess the extent to which this option is utilised in the federal states.
- In the 8 federal states in the Rhine catchment there are different requirements and/or procedures (including financial support) for the definition of buffer strips at the water's edge, which (amongst other things) should also reduce PPP influxes into the waters.
- Examples of measures in the federal states:
 - In North Rhine-Westphalia, integrated production or organic farming is financially supported. Furthermore, as part of the implementation of the WFD, advisory programmes for agriculture were established as a central element. These measures are bolstered by the possibility of also taking agri-environmental measures, for example the promotion of intercropping. The establishment of cooperation agreements between water service suppliers and agricultural businesses is also common practice. In addition, the Chamber of Agriculture NRW offers comprehensive advice on the reduction of nutrient surplus through fertilisation. Model farms also help identify agricultural reduction potentials and make them usable for other farms (<https://www.landwirtschaftskammer.de/landwirtschaft/wasserschutz/wrrl/index.htm>).
 - In Bavaria, the use of bentazone in sensitive catchment areas, such as Karst landscapes, is no longer recommended in official consultation.
 - In Hessen, advising on, and the control of good professional practice and integrated cropping has been strengthened by the use of modern nozzle

technology and residual spray mixtures, through measures relating to the continuous internal cleaning of plant protection equipment and the requirement for keeping a record of PPP utilisation. In addition, the specialist brochure "Plant protection? Of course!" has been issued, and an information website for the Hessian Plant Protection Service can be found at <http://pflanzenschutzdienst.rp-giessen.de/home/>. From 2011 to 2015, water conservation advice for farmers in Hesse was provided across the board, with staggered intensity in measure focus areas via external advisory bureaus commissioned by those bodies implementing the measures (e.g. municipalities). Over the period 2011-2015, up to €6.5 million was made available annually by the state to advisory services. An overhaul of consultation services began in 2016.

- In Rhineland-Palatinate, the water protection advisory service is located at the Service Centres for the Rural Area [DLR]. The water protection consultancy at the DLR sites is part of the "Water Conservation Agriculture" programme and works across all divisions and disciplines on consultation in agriculture, viticulture and horticulture. The term "water protection measures" is used here for all planning and activities that are intended to reduce the influx of substances (nutrients, plant protection products, soil material) through agricultural activity or from land usage into bodies of water. Many of these measures, such as fertilizer planning, are prescribed in agricultural sectoral legislation as good professional practice (e.g. Fertilizer Ordinance), others go beyond this and are voluntary. Voluntary measures may be financially supported in subsidy programmes (EULLa) or cooperations between agriculture and water companies, or beverage producers in water conservation areas.
http://www.dlr.rlp.de/Internet/global/inetcntr.nsf/dlr_web_full.xsp?src=G0T9J0VD57&p1=8101396LJR&p3=3SB1HG99AA&p4=Z70SC9RQEE

3.2 Decentralised measures (measures only for specific influx paths or treatment of wastewater partial flows)

3.2.1 Plant protection products

In some federal states special washing and filling stations have been set up for agricultural spraying.

3.2.2 Radiocontrast agents

The possibility of reductions in the area of hospitals or x-ray practices is assessed within pilot projects. Results of a study by Fraunhofer ISI in Baden-Württemberg: www.minder-rkm.de. As part of the model project "MERK'MAL" (minimisation of radiocontrast agents in the catchment area of the Ruhr), the use of urine bags to prevent the influx of radiocontrast agents is tested, and their contribution to the minimisation of the influx and the associated costs are investigated. (See also www.merkmal-ruhr.de/)

3.2.3 Industrial chemicals

Depending on the substance and load situation in the water body, measures have been and are being taken to reduce the influx in individual cases. Examples of such substances are PFT or, more recently, pyrazole.

3.3 Central measures

3.3.1 Pharmaceutical substances for human use, biocides and corrosion inhibitors, oestrogens, odoriferous substances, industrial chemicals and plant protection products

- With the support of the state of Rhineland-Palatinate, the River Basin Community of the Rhine held a workshop "Positioning of the River Basin Community of the Rhine on the subject of micropollutants" on 20 March 2013.
- The 150th plenary meeting of the German Working Group on Water Issues of the Federal States and the Federal Government [LAWA] adopted the report "Micropollutants in waters" on 17/18 September 2015. This deals with the importance of micropollutants, the pollution situation in the waters and the need for investigation programmes http://www.lawa.de/documents/Uml24-2016_20160126_LAWA_Bericht_Mikroschadstoffe_in_Gewaessern_final_761.pdf
- In order to develop a federal government strategy for the protection of waters from anthropogenic trace substances, the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) implemented the stakeholder dialogue "Trace Substance Strategy of the German Federal Government". On 27 June 2017, the recommendations from the stakeholder dialogue on the reduction of trace substance influxes into water bodies were given to the BMUB in the form of a "policy paper", and also presented to the public. With the newly available "policy paper", a broad coalition of industry, civil society, water management and the federal states is committed to significantly reducing trace elements in the waters. In the "policy paper" the common, technical understanding and practicable options in terms of action for reducing the influx of trace substances into waters are presented. The principle of precaution plays a central role here. The aim is to reduce the influx of micropollutants from production and to create a nationwide framework for the treatment of these substances in wastewater treatment plants. Within the framework of product responsibility, manufacturers and producers should also develop additional precautionary measures. Of paramount importance is the definition of relevant trace substances. A comprehensive approach to solutions at all levels of action is to be promoted through the suitable exchange of information between all relevant parties. The key parties explicitly affirm the need for a coordinated strategy at a federal level to effectively reduce trace elements. The BMUB is currently examining the 14 recommendations for action and, on this basis, is planning the subsequent phase for the further specification and design of the trace substance strategy.

The policy paper "Trace Substance Strategy of the German Federal Government" can be found at www.bmub.bund.de/N54267/

- With the "Competence Centre Trace Elements Baden-Württemberg [KomS]" <http://www.koms-bw.de/>, Baden-Württemberg promotes the advice and support of wastewater treatment plant operators, authorities and planners in the introduction of new technologies. In addition, KomS collects and aggregates knowledge and operating experience on the topic of the elimination of trace substances in wastewater and offers a platform for the exchange of knowledge and information. On 11 July 2013, together with the German Association for Water and Waste Management (DWA) and the German Association of the Gas and Water (DVGW), the Ministry of the Environment organised the congress "Trace Elements in the Aquatic Environment", which illuminated the topic in broad detail.
- The upgrading of wastewater treatment plants in Baden-Württemberg is supported in selected wastewater treatment plants in justified cases, e.g. in sensitive waters, where there is a high wastewater content in the waters, or waters that serve to produce drinking water. In 2016 in Baden-Württemberg, twelve wastewater

treatment plants were equipped with an activated carbon adsorption stage to eliminate trace substances. Further plants are under construction or planning.

- North Rhine-Westphalia has set up a Competence Centre "Micropollutants NRW" <http://www.masterplan-wasser.nrw.de/das-kompetenzzentrum/>, in order to promote the national and international exchange of experience, to aggregate competencies and existing knowledge and to provide this to the wider general public. The Competence Centre "Micropollutants NRW" forms the umbrella for the integration of competencies from science, municipalities and industry. Regular information events (amongst others) are held - see also <http://www.masterplan-wasser.nrw.de/veranstaltungsbericht-zur-fachveranstaltung-arzneimittelmikroschadstoffe-vom-19-und-20-september-2016/>

Measures for micropollutant elimination at wastewater treatment plants are tested and implemented, through which the contamination level of the water with micropollutants is determined (in particular high proportions of wastewater in the water) and thereby identifying areas which are falling short of the management objectives. Currently, 20 wastewater treatment plants are being expanded or are under development.

Micropollutant elimination in municipal wastewater treatment plants (measurements, feasibility studies, development) was included in the WFD Action Programme 2016-2021, (see also <http://www.flussgebiete.nrw.de/index.php/WRRL/Bewirtschaftungsplan/2015>).

To this end see also 3.6

- On March 16 2017 in Frankfurt, through its state office, Hesse conducted a symposium "Trace substances in the waters of the Hessian Ried and strategies of elimination". The symposium was intended to present and classify the pollutants and to identify possible solutions for effectively reducing the influx of trace substances into surface waters and regionally into groundwater.
- Rhineland-Palatinate intensively examines the subject in various studies, in addition to concrete source-oriented measures. At the same time, possible central measures are evaluated. These include the projects Mikro N(ahe), Mikro-System and EMISÛRE. Within the projects, the relevant courses of action are compared in different scenario analyses. The aim is also to improve the basis for decision-making in order to reduce the influxes of micropollutants in a targeted manner, while avoiding any possible misinvestments in key measures. Relevant criteria include the relevance of substances and the costs as well as the benefits (efficiency) of the possible measures.

More information about the projects is available using the following links:

<https://www.interreg-gr.eu/de/emisure-initiativen-zum-umgang-mit-mikroschadstoffen/> [EMISÛRE]

<http://www.bauing.uni-kl.de/siedlungswasserwirtschaft-und-abfallwirtschaft/fachtagungen/mikroschadstoffe-aus-abwasseranlagen-in-rheinland-pfalz/> [Mikro Nahe]

- On 9/10 October 2014, Bavaria carried out the symposium "Anthropogenic trace substances: between scientific knowledge and practical action". In addition, the "Guidelines on the Preliminary Assessment of PFC Impurities in Water and Soil" of January 2015 were updated (April 2017). The Bavarian State Office for the Environment will soon be publishing "Guidelines for the Environmentally-Friendly Use of Fire-Extinguishing Foams" developed jointly with fire brigade associations. The aim is to further reduce the influx of PFC-containing extinguishing foams into the environment.

3.4 Adaptation of monitoring and evaluation systems

In North Rhine-Westphalia, measurements are carried out as part of the self-monitoring of municipal wastewater treatment plants (both in the effluent of wastewater treatment plants and in the water) and in the water by the State Office.

The measuring methods are continuously developed with regard to new techniques, more sensitive methods, new substances (including non-target analysis, see https://www.lanuv.nrw.de/umwelt/umweltanalytik/non_target_news/). In the assessment of the ecological and chemical status in relation to the protective designation of drinking water production and the aquatic community, those substances not previously regulated by law are also taken into account.

3.5 Informing the public

3.5.1 Pharmaceutical substances for human use

There is a national website of the Federal Ministry of Education and Research regarding the correct disposal of drugs, see <http://www.arzneimittelentsorgung.de/>, where people can find out information at a municipal level about the different disposal options.

In several federal states such as Baden-Württemberg (cf. http://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/Dokumente/2_Presse_und_Service/Publikationen/Umwelt/Arzneimittel_richtig_entsorgen_1.pdf), North Rhine-Westphalia (see also <http://www.masterplan-wasser.nrw.de/downloads/flyer/>), Bavaria ([http://www.bestellen.bayern.de/application/applstarter?APPL=STMUG&DIR=stmug&ACTIONxSETVAL\(artdtl.htm,APGxNODENR:200594,AARTxNR:lfu_was_00104,AARTxNODENR:339881,USERxBODYURL:artdtl.htm,KATALOG:StMUG,AKATxNAME:StMUG,ALLE:x\)=X](http://www.bestellen.bayern.de/application/applstarter?APPL=STMUG&DIR=stmug&ACTIONxSETVAL(artdtl.htm,APGxNODENR:200594,AARTxNR:lfu_was_00104,AARTxNODENR:339881,USERxBODYURL:artdtl.htm,KATALOG:StMUG,AKATxNAME:StMUG,ALLE:x)=X)), Rhineland-Palatinate (https://mueef.rlp.de/fileadmin/mulewf/Themen/Klima-_und_Ressourcenschutz/Kreislaufwirtschaft/IFAG/IFAG_Praxistipp_8.pdf) and the Saarland (<http://www.saarland.de/134043.htm>) there are flyers to inform the public about the proper disposal of medicines.

In North Rhine-Westphalia, pilot projects have been or are being carried out to raise public awareness. A project is currently being implemented to raise awareness regarding the reduction of drug residues in the water cycle (SensiMed Essen), as part of the "Green Capital Essen". In addition, the research project "Trace the trace substances in Dülmen" was completed in 2016, see <http://www.dsads.de/wer-sind-wir/> and/or <http://www.dsads.de/worum-geht-es/>.

3.6 Financing measures

- In North Rhine-Westphalia, research projects, feasibility studies and the upgrading of wastewater treatment plants for the elimination of micropollutants have been and are being supported (funding programme for resource-efficient wastewater disposal in NRW II). Thus far, the following have been carried out (the current status can be found on the web pages of the Competence Centre for Micropollutants)
 - 116 feasibility studies
 - 18 large-scale inspections
 - 20 wastewater treatment plants expanded or under development
- In Rhineland-Palatinate, the project Mikro N(ahe) was carried out with regard to the influxes of micropollutants and the pollution situation of (waste)water as well as the costs and benefits of a reduction over the period 2013-2015 (see also point 3.3). The investigations are being intensified in the follow-up project Micro-System. Since

1 January 2017, the cross-border project EMISÛRE has been funded by the project partners and the Interreg subsidy programme.

- In Bavaria, several studies were financed to estimate the pollution situation in Bavaria using a material flow model, to evaluate possible purification technologies. A pilot system is currently being built and government-funded for a fourth purification stage at the wastewater treatment plant Weißenburg in Bavaria (commissioning in the summer of 2017) and a comprehensive accompanying research programme supported.
- In general, reference is made to the joint evaluation of the Swiss and German competence centres on available cost information [http://www.masterplan-wasser.nrw.de/fileadmin/user_upload/Aktuell/Veranstaltungsdokumentation/Arzneimittel Mikroschadstoffe am 11.11.2015/12_151110_Herbst.pdf](http://www.masterplan-wasser.nrw.de/fileadmin/user_upload/Aktuell/Veranstaltungsdokumentation/Arzneimittel_Mikroschadstoffe_am_11.11.2015/12_151110_Herbst.pdf)

4. Measures in France

The Ministries of Ecology, Health and Agriculture have, with the support of the parties concerned (Agences de l'Eau, ONEMA, research and development bodies...), drawn up a plan for micropollutants 2016-2021 with the aim of preserving the quality of the waters and their biodiversity.

The aim of the plan is to achieve the objective of a "good" status of the body of water, which is set out by the WFD, and to contribute to the objectives of the MSFD by reducing the influx of micropollutants into the marine environment via the watercourses.

This new plan on micropollutants - for preserving water quality and biodiversity - is divided into three key objectives and a series of actions. The first objective concerns concrete actions to reduce the already identified pollutant emissions; the second objective involves a large number of research and development measures to identify micropollutants occurring in the waters and the aquatic environment and the associated hazards, and the third objective will enable the creation of lists of micropollutants which should be the subject of the measures - based on the work carried out under the second objective.

For each objective, the non-exhaustive list of the most relevant actions related to the objectives of the ICPR in the field of micropollutants is given below.

OBJECTIVE 1 - IMMEDIATE REDUCTION OF EMISSIONS FROM MICRO-POLLUTION - THE RELEVANCE OF WHICH IS KNOWN - IN WATERS AND THE AQUATIC ENVIRONMENT

Subordinate Objective 1 - Limitation of relevant emissions and discharges

Subordinate objective 2 - Widest possible awareness regarding water pollution

List of measures to potentially be implemented:

- Establishment of an operational guide for local authorities on how to deal with non-domestic sources, in order to contribute to the development of practices
- Implementation of recommendations from the guidelines with regard to the responsible handling of medical waste and liquid waste in healthcare and retirement homes
- Increased monitoring of industrial discharges and the establishment of appropriate reduction plans for industrial plants
- Careful handling of contaminated sediments during environmental interventions (dredging, evacuation, restoration operations)
- Establishment of demonstration facilities for good practice in reducing the emissions of micropollutants in some craft trades

OBJECTIVE 2 - CONSOLIDATION OF KNOWLEDGE FOR ADAPTATION IN TACKLING WATER POLLUTION AND CONSERVING BIODIVERSITY

Subordinate objective 1 - to improve knowledge on discharges and forecasts regarding the presence of micropollutants in waters and the aquatic environment

Subordinate objective 2 - better evaluation of the impact of micropollutants on the state of resources and the impact on health and biodiversity

List of measures to potentially be implemented:

- Better assessment of contaminants entering the environment in agricultural, urban and industrial wastewater via urban rainwater, surface runoff and drainage.
- Continued investigation of substances in untreated water and in the wastewater

- treated in wastewater treatment plants, and identifying mitigation measures
- Analysis of new solutions before and after wastewater treatment plants, in particular with the aim of limiting water pollution
 - Evaluation of innovative monitoring and diagnostic methods and techniques
 - Evaluation of the effect of micropollutants on the aquatic flora and fauna, in particular the interaction of micropollutant mixtures
 - Continuing to develop and update the portal for the dissemination of data on chemical substances
 - Use of international knowledge on environmental and health risks associated with micropollutants in the aquatic environment
 - Developing benchmarks and methods to better assess the quality of surface water and groundwater, taking into account endocrine active substances and relevant decomposition products

OBJECTIVE 3 - PREPARATION OF LIST OF POLLUTING SUBSTANCES FOR WHICH THERE IS A NEED FOR ACTION

- Identification of the decomposition products of plant protection products and strengthening the capacity of the laboratories in the sense of early monitoring
- Classification of molecules according to the need for further environmental knowledge and the risk of not achieving a good environmental status
- Prioritisation of molecules according to potentiality, feasibility and effectiveness of emission reduction.

Each action will be the subject of a specific action fiche which can be found attached to this plan, outlining the background, issues, implementation, those responsible for measures and partners, expected results and indicators, a time plan and funding details.

Attached are two examples of action fiches.

Annex: Example 1 Action fiche**Objective 1 - Immediate reduction of emissions from micro-pollution - the relevance of which is known - in waters and the aquatic environment**

Subordinate Objective 1 - Limitation of emissions and discharges

Lever 1 - Through limitation of discharges from local authorities

Action 2: Implementation of recommendations from the guidelines with regard to the responsible handling of medical waste and liquid waste in healthcare and retirement homes

Main objective: to raise awareness in health facilities and nursing homes for the responsible management of medicinal waste and liquid waste.

Background:

Within the framework of the government's 2015 Environmental Plan in particular, a guide was prepared relating to the responsible handling of pharmaceutical waste and liquid waste in healthcare facilities, retirement homes and nursing homes. This refers to the controlled waste disposal routes, where these exist, and suggests good practice if no specific rules apply, to prevent uncontrolled discharge into the sewage system and subsequent environmental proliferation. The problematic element is the adoption of the principles set out in the aforementioned guidelines by health institutions, retirement and nursing homes.

Implementation:

- awareness-raising activities (including training etc.);
- criteria-dependent reinforcement of incentives by means of support measures by Agences de l'eau or ADEME.

Those responsible for measures and partners

Responsible parties for measures: DGS, DEB

Partners: Agences de l'eau, ARS, DGPR, ADEME, Synprefh

Indicator (if possible) and/or expected product:

- number of awareness campaigns implemented;
- sums paid by the Agences de l'Eau for training and waste disposal support.

Time plan and deadlines

For the duration of the plan.

Budget: Not estimated.

Annex: Example 2 Action fiche

Objective 1 - Immediate reduction of emissions from micro-pollution - the relevance of which is known - in waters and the aquatic environment

Subordinate Objective 1 - Limitation of emissions and discharges

Lever 2 - Through limitation of emissions from industry and trade

Action 6: Establishment of demonstration facilities for good practice in reducing the emissions of micropollutants in some craft trades

Main objective: The LUMIEAU project in Strasbourg includes an approach to the integral management of micropollutants at the level of the local authority. The aim here is to design and implement a hierarchical plan to reduce the emission of micropollutants, which will be validated by means of demonstration facilities or by changing practices. It includes a section on craft trades involving the CNIDEP (Centre National d'Innovation pour le Développement durable et l'Environnement dans les Petites entreprises/State Innovation Centre for Sustainable Development and the Environment in Small Enterprises).

Background: The study conducted by CNIDEP in 2013 and 2014 looked at the dangerous molecular discharges of 10 craft enterprises selected on the basis of extensive wastewater discharges and the use of hazardous substances. The discharges were described in the study and it was possible to determine the occurrence of hazardous molecules in these discharges from craft enterprises. An initial relationship between the identified hazardous molecules and the practices or products used is determined by comparing the analytical results with the products used by the company at the time of sampling. The aim of this first study is to determine which replacement options exist for these products. The second part of this measure concerns the investigation of the treatment methods before discharge into the sewer system.

Implementation:

The LUMIEAU project, chosen as part of a call for projects by ONEMA, the Agences de l'eau and the Ministry of Ecology in 2014, includes a section "Support in Changing Practices" and a section "Demonstration Facilities". The innovative methods of supporting craftsmen in changing practices and demonstration facilities for clean technology are being tested to determine their effectiveness, limitations, cost and acceptance. The project will look at four types of crafts, chosen due to the molecules present in their discharges, and their representation in the area of the Strasbourg Eurométropole. For each type of craft, three voluntary craftsmen are evaluated. For each of these, a demonstration facility is installed and rated. The evaluation criteria concern the quantification of the reduction of hazardous molecules after processing. This quantification takes place through the analysis of micropollutants in the discharges. In addition to chemical analyses, Tronico-VigiCell biological trials are carried out to complete the evaluation of the performance of the demonstration facilities in relation to the reduction of hazardous molecules in the discharges of the companies. These tests, carried out before and after installing the demonstration facility, can be used to measure the development of the environmental response from a biological perspective, to see if there is any obvious benefit after the pre-treatment phase.

Those responsible for measures and partners

Responsible parties for measures: Strasbourg Eurométropole

Partners ONEMA, CNIDEP, INERIS, Tronico-Vigicell, IRES, Agence de l'eau Rhin Meuse, FNCCR,

GESTE, IRH Consulting Engineers

Indicator (if possible) and/or expected product:

Number of companies supported per craft, number of evaluated demonstration facilities, performance rating of demonstration facilities in terms of reducing the number of hazardous molecules in the discharges, evaluation of the costs associated with the establishment of the tested techniques.

Time plan and deadlines: 2015-2018

Budget: Total cost over 4 years: €320,000

5. Measures in Luxembourg

5.1 Measures at source

Measures at source currently include the limit values and discharge conditions for the industrial and craft sectors, which are defined in the context of license application processing under the Luxembourg Water Act¹⁶, where information on micropollutants is available. In essence, these limits relate to heavy metals. In the case of remedial measures for contaminated sites, limit values according to the ALEX leaflet 02 are also defined by the Land Office for the Environment, Water Management and Trade Inspection Rhineland-Palatinate¹⁷.

Furthermore, a national version of the Canal Ordinance (similar to the German Wastewater Ordinance for indirect dischargers) is being drafted, in which limit values for heavy metals are also established for the first time.

The Luxembourg Plant Protection Products Act¹⁸ regulates the distribution and use of plant protection products. For example, the application of pesticides in public spaces has been banned since 1 January 2016. The Act also provides for the establishment of a national action plan to reduce the use of plant protection products. Measures to reduce the use of plant protection products are also included within the framework of the agri-environmental climate measures under the rural development plan¹⁹.

The handling of waste is regulated in the Act via waste management²⁰. The aim of the Act, amongst other things, is that by 2020 at least half of the household waste generated must be recycled and the costs of waste disposal distributed more equitably in accordance with the "polluter pays" principle. The Act also provides for the establishment of a national waste management plan. Numerous problematic substances, such as medication residues, paints, solvents, batteries, etc., can sometimes be disposed of free of charge in municipal recycling parks or SuperDrücksKëscht®²¹.

5.2 Decentralised measures

Rainwater overflow basins are equipped with retention bottom filter basins in sensitive zones (e.g. bodies of water that flow through drinking water protection zones or very small preflows). Although this measure primarily serves to reduce the entry of germs into drinking water protection areas, it can also efficiently withhold various micropollutants.

With a view to reducing the pollution of waters through medication residues, Luxembourg has taken part in the European research projects Pills²² and noPILLS²³. As part of the noPILLS project, the Center Hospitalier Emile Mayrisch has trialled efficient and resource-conserving measures for the removal of pharmaceutical and diagnostic substances from the wastewater of the hospital. On the one hand, this was intended to prevent certain substances that are difficult to remove from getting into hospital wastewater at all. On the other hand, treatment-efficient and resource-conserving methods for the removal of pharmaceutical substances from wastewater were analysed.

¹⁶ Loi modifiée du 19 décembre 2008 relative à l'eau

¹⁷ ALEX-Merkblatt Alex 02 Orientierungswerte für die abfall- und wasserwirtschaftliche Beurteilung (https://mueef.rlp.de/fileadmin/mulewf/Themen/Klima-_und_Ressourcenschutz/Bodenschutz/ALEX/ALEX_Merkblatt_02_1997_Stand_10.2011.pdf)

¹⁸ Loi du 19 décembre 2014 relative aux produits phytopharmaceutiques

¹⁹ <http://www.ma.public.lu/actualites/communiqués/2015/07/031/>

²⁰ Loi modifiée du 21 mars 2012 relative à la gestion des déchets

²¹ <https://www.sdk.lu/index.php/de/>

²² <http://www.pills-project.eu/>

²³ <http://www.no-pills.eu/?lang=de>

5.3 Central measures

Article 22 of the Luxembourg Water Act prohibits the pollution of surface waters and groundwater. However, discharges via point sources, which may cause the pollution of the aquatic environment, may be made subject to authorisation by a waterway authority.

In the wastewater treatment plants of over 50,000 PE that are currently in planning and construction, process control and space requirements for a fourth purification stage are being considered, even if the chosen technology has not yet been established.

Luxembourg contributes financially as a partner to the Interreg Greater Region project "EmiSûre"²⁴, which was launched in early 2017 together with Rhineland-Palatinate, inter alia. The aim is to develop a cross-border strategy for the management of micropollutants from wastewater disposal, which can also be implemented in smaller/medium-sized wastewater treatment plants, as these are the most prevalent in the region.

5.4 Adaptation of monitoring and evaluation systems

In Luxembourg, as part of the monitoring of the Water Framework Directive (WFD), the operational measuring points are sampled alternately in one cycle. In one year, samples will be taken at the operational measuring points which are located in the catchment area of the surveillance monitoring sites sampled in the same year. In the first and fourth year, the sampling of the catchment area of the Sauer takes place; in the second and fifth year sampling is for the catchment area of the Alzette, and in the third and sixth year for the border waters of the Lower Sauer and their tributaries, the Our and their tributaries, the tributaries of the Moselle, the Chiers and its tributaries, as well as the catchment area of the Syr.

The exact location of the operational measuring points is determined based on logical grounds, using expert knowledge in accordance with the results of risk analyses, and in compliance with the requirements for the mixing zones in bodies of water (new). The location of these measuring points should remain unchanged in the medium term.

In the respective sampled catchment area, all priority and hazardous priority substances as per Directive 2013/39/EU are measured at the surveillance monitoring sites and at 4-5 selected operational measuring points. Here, the minimum frequencies of the WFD are implemented, meaning that priority and hazardous priority substances are sampled 12 times a year. In addition, once a year, the micropollutants in the sediments are sampled at the same measuring points.

At the end of 2017, after all 3 river basins have been sampled, a further course of action will be decided.

5.5 Informing the public

Targeted information campaigns for the public will be provided during the course of the Interreg project "EmiSûre". Attention will be brought to the subject at irregular intervals in newspaper reports and via interviews on the topic.

SuperDrëcksKëscht® campaigns regarding the proper disposal of medical residues²⁵, the annual "week without pesticides"²⁶ (20-30 March) to restrict the use of pesticides in private and public areas, as well as flyers from the wastewater syndicates (e.g. The drain is not a trash can²⁷) are just a few examples of how greater awareness is brought to the public regarding micropollutants.

²⁴ <https://www.interreg-gr.eu/de/archive/3235>

²⁵ <https://www.sdk.lu/images/medi/Flyer-Medikamente-1503-V2.pdf>

²⁶ <http://www.ounipestiziden.lu/semaine-sans-pesticides.html>

²⁷ https://eau.public.lu/publications/divers/egout_poubelle.pdf

The website for the national campaign "Without Pesticides"²⁸, which draws attention to the harmful effects of pesticides on nature and health and demonstrates alternative cultivation methods for public and private land in the settlement area, contains a variety of information relating to the handling and hazards of pesticides.

These campaigns, as well as the development of information materials, are partly funded (financially) by the Environment Department of the Ministry of Sustainable Development and Infrastructure and/or Water Management.

5.6 Financing measures

In recent years, the modernisation of biological wastewater treatment plants to include the third stage of purification has already been co-financed with state aid through the Water Management Fund, in accordance with the provisions of the Luxembourg Water Act²⁹. The establishment of a fourth stage of purification will be a similar situation: at those wastewater treatment plants, for which the results of national surveys suggest that a fourth stage is necessary, the investment costs of modernisation may receive state aid through this fund.

The cost of equipment for retention soil filters or similar measures may also be covered by government subsidies. Furthermore, the amendment to the Water Act also newly provides for the possibility of subsidising pilot plants that contribute to improving water quality. This should mean that newly developed technologies can also be utilised, and therefore also applied to tackle micropollutant problems.

²⁸ <http://www.ounipestiziden.lu/>

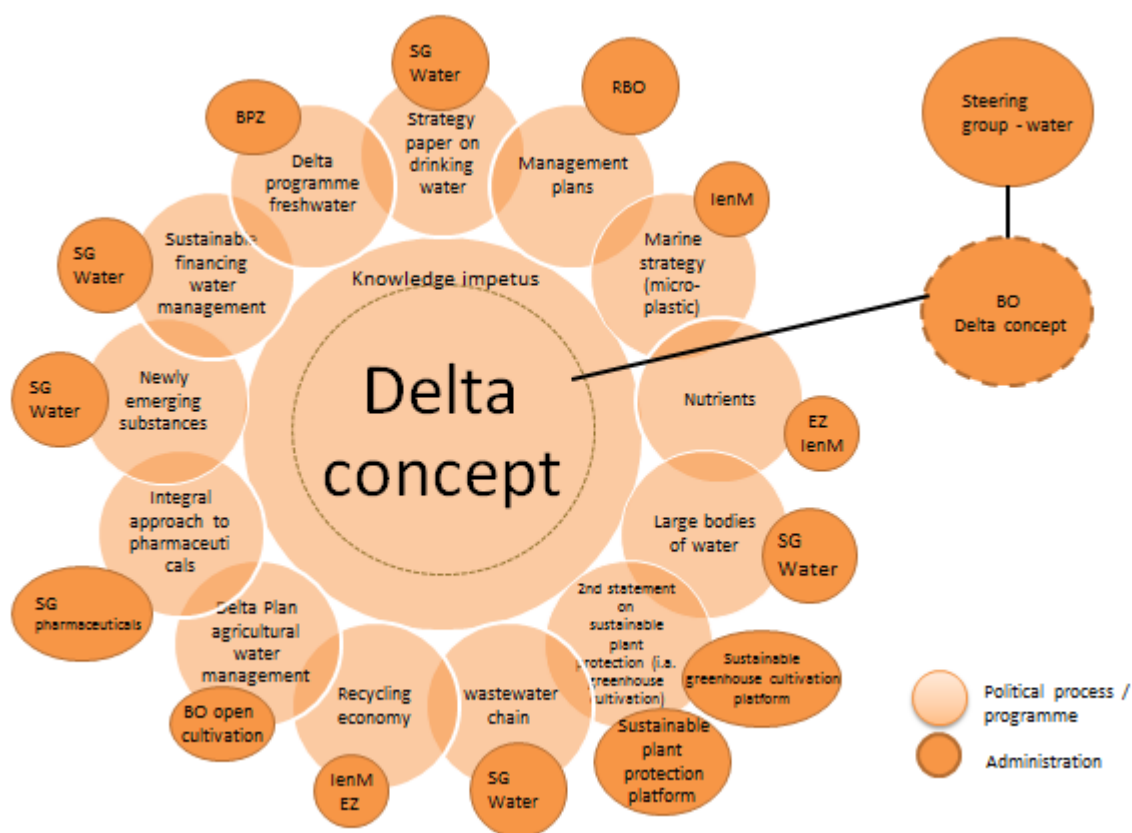
²⁹ Loi modifiée du 19 décembre 2008 relative à l'eau

6. Measures in the Netherlands

Introduction

On 16 November 2016, the authorities, civil society organisations and research institutes signed the Memorandum of Understanding for the Delta Approach for Water Quality and Fresh Water. Water quality has improved significantly in much of the country in recent years, but not enough to meet all of the objectives of the EU Water Framework Directive (WFD) and our objectives. There is thus further need for action. For this reason, the Delta Approach gives authorities, civil society organisations and research institutions a powerful impetus to improve water quality.

With the Delta concept, the parties focus on the connection and progress of ongoing (partial) approaches in the areas of water quality, drinking water and freshwater, and provide additional stimuli where needed. This is illustrated in the figure below, in the "petals".



SG = Steering Group; RBO = Regional Management Consultations; IenM = Ministry of Infrastructure & Water Management; EZ = Ministry of Economic Affairs; BO = Management Consulting Services; BPZ = Freshwater Management Platform

The substantive focuses were on pharmaceutical residues, plant protection products and nutrients/agricultural fertilizers. Beyond these priorities, particular attention must be given to the water quality of large bodies of water such as the IJsselmeer and water for drinking water supply.

The Dutch contribution to the micropollutants summary report is divided into three parts: micropollutants from urban wastewater, from industrial wastewater and from diffuse sources.

6.1 Municipal wastewater

Pharmaceutical residues are among the focal points of the Delta Approach, which includes ongoing approaches such as the integral approach 'pharmaceutical residues from water'. The following sections describe various measures.

Measures at source

Since the end of 2015, parties from the health sector, water sector and the state have been working together under the integrated approach 'pharmaceutical residues from water' to reduce the emission of human 'pharmaceutical products into the water. This comprehensive approach is needed because the problem cannot be solved through a chain approach. The measures to be implemented in this integral approach are summarised under 'Development and Authorisation', 'Prescription and Use' and 'Waste and Recycling'. 'Prescription and Use', includes the following measures:

- The Dutch Ministry of Health, Welfare and Sport is running national programmes (including the concept 'Waste in Healthcare') in order that fewer medicines are prescribed;
- Initiatives in hospitals to distribute plastic bags to patients with the aim of avoiding discharges containing radiocontrast agents;
- Inventory of the environmental hazard considerations for cytostatic drugs, as regards the aquatic environment;
- The improved collection of unused medicines, by increasing awareness among professional groups (general practitioners, nurses, pharmacists) and communities;
- The testing of environmentally-friendly alternatives for certain environmentally harmful medicines has not led to any new findings; this approach does not lead to an improvement in water quality;
- The introduction of water issues within the framework of the Green Deal 'Towards Sustainable Health';
- Making environmental data for medicines more accessible.

Decentralised measures

- Introduction of the Pharmafilter concept in some hospitals.

Central measures

- Carrying out a hotspot analysis of municipal wastewater treatment plants in the Netherlands that may be eligible for further treatment from the point of view of surface water ecology and drinking water abstraction, in order to remove micropollutants. Inventory of (innovative) treatment techniques with costs, sustainability aspects, etc.;
- Carrying out pilot projects for further treatment in wastewater treatment plants, with regard to combinations of treatment techniques that remove pharmaceuticals and (partially) remove a wide range of micropollutants. Not only chemical analyses, but also measurements of biological effectiveness;
- Initiate (scientific) studies to make conventional wastewater treatment plants function better in terms of removing micropollutants;
- Preparation of an implementation programme to accompany the introduction of further treatment in municipal wastewater treatment plants in the Netherlands.

Monitoring and evaluation systems

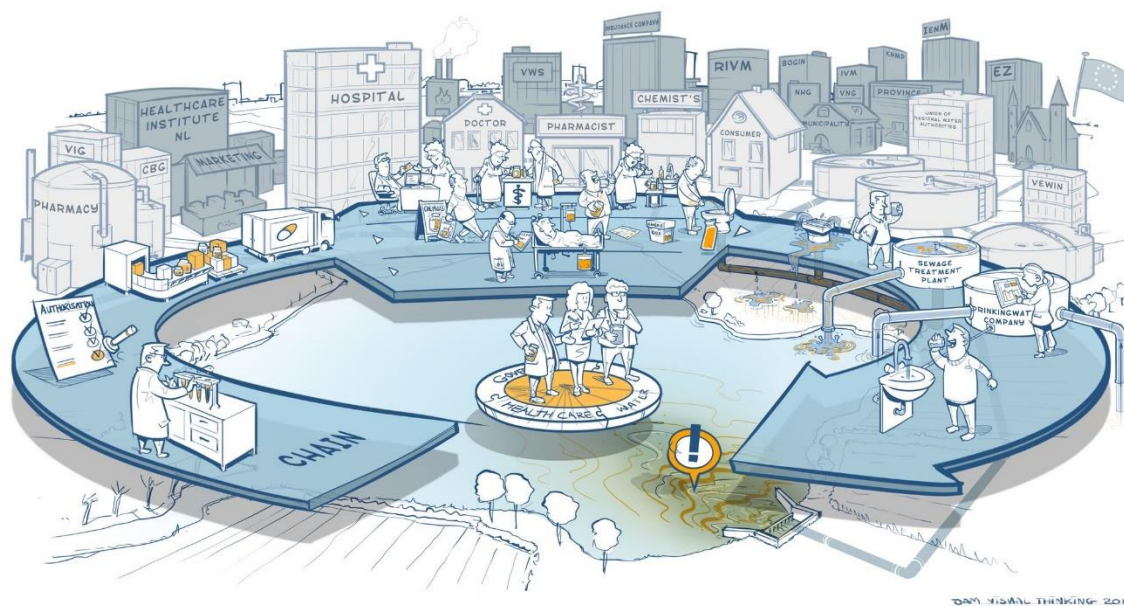
- Assessment of the availability of analytical methods for measuring biocides in the inflow/outflow of wastewater treatment plants.

Informing the public

- Within the framework of the Green Deal 'Towards Sustainable Healthcare', the decision was initially made to provide information to professional groups and to focus on informing the public at a later stage.

Financing

Inventory of opportunities to make provisions for micropollutant elimination within the context of the future (and sustainable) financing of water management.



6.2 Industrial wastewater

The granting of authorisations is an important tool. The discharge of substances falls under the jurisdiction of the Water Act, and from 2021 under the new Habitats Act.

Manuals have been created for this purpose. For substance discharges, the "General Substance Evaluation Methodology Manual (ABM)" and the "Immission Inspection Manual" apply. These were adjusted in 2016 to further strengthen the national policy on Substances of Very High Concern (NL: ZZS). The connection to functions downstream is also elucidated, for example as regards drinking water abstraction. Within the framework of the Delta concept regarding water quality and fresh water, the practice of granting approval is being improved.

According to the WFD, the 'combined approach' is used as the starting point for assessing discharges in the Netherlands. This means that at least the best available emission limitation techniques (ELTs) must be applied at all times. For discharges into a treatment plant (indirect discharge), in terms of the evaluation of the ELT, biological treatment may be considered as part of the technical treatment measures.

The General Assessment Methodology (NL: ABM) is used with regard to discharges as a method of determining the treatment workload required due to the substance properties. In addition, the ELT is derived from EU BREF documents produced under the then IPPC, now IVU and national documents regarding the best available technology.

In addition to the ELT assessment, for the receiving waters, the consequences must be

assessed for the residual discharges. This assessment is based on the immission test. The immission test assesses whether the water quality targets are met locally (near to the discharge) and at the level of the water body. At the same time an assessment will be made as to whether a (new) discharge conflicts with downstream protected areas (drinking water abstraction area, Natura 2000 site, shellfish waters, bathing waters or transitional waters, which may be subject to strict standards for certain substances).

If the immission test does not have positive results, additional measures (ELT+) must be taken. The acceptable expense, expressed in €/kg-removed, is related to the aquatic hazard considerations for a substance. The greater the water hazard, the higher the effort that can be required.

6.3 Diffuse sources

Plant protection products

With regard to plant protection products, reference is made to ICPR Report No. 240, and in particular Chapter 4.3, which describes in particular the measures for the Netherlands from the national strategy paper, 'Healthy Growth, Sustainable Harvest'. In addition, the Delta Approach for Water Quality and Fresh Water for the field of plant protection products contains a further 19 measures. The largely supplementary measures that are relevant in this context are summarised below.

Measures at source

- Gradual cessation of the use of glyphosate in vegetation management of groynes and training walls by the regional RWS authorities;
- Incorporate provisions relating to restrictions on the use of manure and plant protection products in new leases for RWS sites, including improved monitoring;
- Focus on attainable and unambiguous usage provisions (legal measures);
- Implementation of scans of farm emissions (see ICPR Technical Report No. 240, Annex 2, Projects).

Technical measures

- Introduction of a drift reduction technical working group to investigate the effectiveness and feasibility of 90% drift reduction (see ICPR Report 240, Chapter 4.3).

Monitoring and evaluation systems

- Conduct an interim evaluation of the second strategy paper on sustainable crop protection, 'Healthy Growth, Sustainable Harvest' in 2018.

Information for the professional sphere and the public

- Extend to the whole of the Netherlands the Delta Plan on Agricultural Water Management (DAW), which has been integrated into the Delta Approach for Water Quality and Freshwater and running since 2013 (often extra-legal measures for sustainable planning): knowledge transfer and awareness raising by and for farmers on behalf of BOOT (Bestuurlijk Overleg Open Teelt en veehouderij - authoritative advice on open crops and livestock farming);
- Extend the concept of 'Clean Water Brabant' to the whole of the Netherlands (regional measures, including information);
- Greater attention given to the prevention and advice for authorized entities, in addition to area-specific enforcement orders

Financing

- Provide a budget so that the plant protection product atlas can be kept up to date.

Other substances, where relevant, substance groups such as PAHs, heavy metals

If appropriate in the ICPR framework, the application (in adapted form) of the method developed for plant protection products (see ICPR report No. 240) for other substances or groups of substances.