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Environmental Quality Objectives for Hazardous Substances in the Aquatic Environment

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Abstract

Environmental quality criteria are established and used in most industrialized countries to determine whether organisms, public health or materials are jeopardized by hazardous substances. The criteria are determined by means of different methods, however, depending on the legal context and individual national characteristics. This paper compares and analyses different methods used to derive quality criteria for hazardous substances in the aquatic environment. It describes various protected assets, i.e. aquatic communities, wildlife, fishery, suspended matter/sediments and drinking water supply. Special attention is focussed on a comparison of different methodologies to derive quality criteria for the protection of aquatic communities. Special emphasis is placed on compensation factors and statistical extrapolation methods that serve to assess safe environmental concentrations.

The report gives an overview of the state of affairs relating to the derivation and use of quality criteria in Germany, the Netherlands, Canada, the United States, the European Union and other countries. It further provides a comparison of the concentrations that were established as quality criteria for a number of selected substances in different countries. A good accordance could be recorded for most of the established values. The values for some substances, however, vary considerably, i.e. by more than one order of magnitude. This variance is caused by differences in derivation methodologies, available input data sets and times of derivation. In addition, the report draws up proposals for a harmonization of methods.

The appendix features a comprehensive summary of existing quality criteria, quality objectives and quality standards for the aquatic environment.

1. Introduction

The water protection policy of the member states of the European Union (EU) was recently harmonized by adopting the so-called Water Framework Directive with the objective to achieve a good water quality in all waters of the European Union. For surface waters, the Water Framework Directive aims at a "good ecological status" and a "good chemical status" which are both meant to form the basis for the "good quality" that is targeted.

Until the late 1970s the pollution of running waters caused by toxicants and easily biodegradable organic substances was the centrepiece of the environmental discussion. In 1976 the first water quality map for the Federal Republic of Germany was published by the "Länder Working Commission Water" (LAWA) introducing the first quality classification system for running waters which is still used today without ever having been modified. Water quality is classified according to a scale of seven levels. The quality of a water body is assessed by its biological state. The occurrence of certain kinds of indicators is established by applying the saprobity index which is based on the saprobiotic system. The saprobity index is an appropriate tool to assess the contamination of running water biocoenoses caused by biologically degradable organic matter. The procedure to establish the saprobity index is a German Industrial Standard (DIN 38 410 part 2). The water quality map has helped to point out heavily stressed areas and take successful action to reduce the impact caused by organic, i.e. oxygen-consuming substances (LAWA 1996). The Federal Government, the federal states (*Länder*), science and the water supply industry agreed some time ago that the water quality map and the underlying classification system need to be extended because they are no longer sufficient (Friedrich 1992, McGirr et al. 1991).

As the removal of coarse pollution reveals new kinds of water contamination, a whole range of further classification units (acidification, micro-contamination, carcinogenic potential, ecological and morphological assessment) is likely to become necessary to assess their intensity. As regards the ecological and morphological assessment of running waters, a working group initiated by the LAWA worked out a draft water structure quality map which was adopted in essence by the federal state of North Rhine-Westphalia (LUA NRW 1998). Analogous to the biological water quality classification, the LAWA (1998) commissioned the elaboration and testing of a chemical water quality classification system (LAWA 1999). Schäfer (1999) provided a comparison and evaluation of national and international biological and chemical quality classification approaches.

An evaluation and classification of micro-contamination of waters (e.g. by industrial chemicals, metals or pesticides) requires substance-related quality criteria to be available. However, the questions which quality level is strived for or which assets or features should be given priority protection can only be answered and decided by social politics.

The pollution of the majority of running waters in Germany by hazardous substances could be reduced considerably during the past few years, mainly thanks to the fact that the best available techniques have rigorously been used for waste water clarification and waste water

prevention. Separate statutory minimum waste water treatment requirements were determined for each industry sector in the Waste Water Decree (*AbwV*) and the Framework Waste Water Administrative Decree (*Rahmen-AbwasserVwV*).
Dependant on the degree of industrialization and urbanization, however, residual loads from dischargers or entry of pesticides/biocides and/or other diffuse sources have the potential to add up to a significant contamination of waters. Consequently, the use and the natural balance of a river or lake might be spoilt even if the best available techniques are applied.

Therefore the federal government/federal states working group "Hazardous Substances - Quality Objectives for Surface Waters" (BLAK QZ), which was founded in late 1986 on the initiative of the Länder Working Commission Water and the Federal Ministry of the Environment, started a co-operation with the Federal Environmental Agency to assess hazardous substances in surface waters in order to develop quality criteria for different protected assets. Status reports on the progress of the BLAK QZ work have been regularly submitted by various working group members (Dinkloh 1989, 1991, Markard 1992, Scherer 1993, Irmer et al. 1994, 1995). The methodical basics of establishing quality criteria were summarized on 10 October 1989 in the BLAK QZ report "Concept to Derive Quality Objectives to Protect Inland Surface Waters from Hazardous Substances" (*Konzeption zur Ableitung von Qualitätszielen zum Schutz oberirdischer Binnengewässer vor gefährlichen Stoffen*; BLAK QZ 1989) and continued on 6 May 1993 in the report "Concept to Derive Quality Targets to Protect Inland Surface Waters from Hazardous Substances" (*Konzeption zur Ableitung von Zielvorgaben zum Schutz oberirdischer Binnengewässer vor gefährlichen Stoffen*; LAWA 1997). The concept forms a basis for internal work groups and contains basic principles for the derivation of quality targets (*Zielvorgaben*). These quality targets are intended to assess the water quality and to protect aquatic communities and the different uses of water, e.g. for fishery, irrigation of arable land, use of sediments and drinking water supply. A certain use or activity considered worth protecting is also referred to as "protected asset". Separate quality targets are derived for each protected asset. Rather than representing normative limit values, the derived quality targets should be regarded as reference values that help to assess the water quality with regard to a certain protected asset. It is now up to the enforcing authorities which protected assets they consider, which intermediate levels they determine and which time frame each intermediate level is given.

The objective of water protection policy is to maintain or restore a community of plants, animals and micro-organisms that is as natural, site-specific, self-reproducing and self-regulating as possible (LAWA 1997). This goal can only be achieved if the chemical and ecomorphological water conditions meet the requirements of each of the represented species. During this process it is essential to assess the concentration of a toxicant below which none the of the species representing an aquatic community will suffer adverse effects. Substance-related ecotoxicological tests on members of four trophic levels of the water biocoenosis (bacteria, green algae, small crustaceans and fish) provide a basis for the derivation of quality targets for **aquatic communities**, a particular protected asset. The derivation of quality targets relies on data obtained from generally accepted test methods that allow to establish the concentration that will have no effect after long-term exposure (No Observed Effect Concentration, NOEC). To account for the uncertainty in transferring single test results obtained from a few species to the water conditions in the real world, the lowest test result for the most sensitive species is typically multiplied by a compensation factor of 0.1.

Apart from protecting the life of fish as components of aquatic communities, the derivation of quality targets should also consider the threat posed to human health by the ingestion of contaminated fish parts. As regards the protected asset **commercial and sport fishing**, quality targets are derived on the basis of existing maximum values for food from aquatic sources considering bioconcentration factors.

For the protected asset **suspended matter and sediments**, existing soil quality standards from the German Sewage Sludge Decree (*Klärschlammverordnung*) are used as quality targets in order to exclude hazards posed by excavated material deposits on arable land. In contrast, it has not yet been possible to establish ecological water quality targets to protect organisms living in the sediment because generally accepted methods are missing to test the effect of toxic material on sediment organisms. However, procedures to assess the ecotoxicological effects on sediments are currently being developed. The BLAK QZ intends to consider them in future concepts.

The quality of surface waters for drinking water supply should be such that drinking water can be easily processed by means of soil passage and low-velocity sandfilters. As regards the protected asset **drinking water supply**, the quality targets correspond to the legally binding quality objectives established in the EC Council Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water. For those substances not considered in the above-mentioned directive (e.g. pesticides), the derivation of quality targets is based either on the limit values determined in the EC Drinking Water Directive (80/778/EEC) or on national limit values and guidelines for drinking water.

Based on the concept described above, the Federal Environmental Agency derived and tested 28 hazardous organic environmental chemicals and 7 heavy metals with regard to individual protected assets or protected uses, respectively (LAWA 1997, 1998). Furthermore, preliminary quality targets for pesticides aimed at the protected asset aquatic communities were established (Kussatz et al. 1999).

1.1 Objective

The process of establishing quality objectives within the framework of the EC Dangerous Substances Directive (76/464/EEC) and putting the International Rhine Action Programme into practice have demonstrated that transparent, clearly defined and comprehensible criteria should be determined and complied with.

This report presents a comparative analysis of the most important methods to derive water protection quality criteria and aims at doing some groundwork for the further development of the BLAK QZ concept (LAWA 1997). The EU Water Framework Directive provides a basis for the derivation of legally binding quality objectives. However, this will only make sense if a common procedure exists that is harmonized between the EU member states. Such harmonization should also be a common goal for all OECD member states. This comparative analysis of different methodologies is intended to stimulate further steps in that direction.

The comparison focuses on the analysis of methods to establish quality criteria to protect aquatic and benthic communities, piscivorous wildlife, fishery and drinking water supply. For some selected substances, numerical quality criteria will be compared and scrutinized.

A comparison of derivation methods is also useful to the work that will follow the EU Water Framework Directive. The latter contains a guidance document describing the derivation of quality standards for the protection of aquatic organisms (EU 2000). A standard can be set for water, sediments or biota (organisms); however, the directive does not yet contain specific methods for the derivation of quality standards for sediments and biota.

1.2 Stocktaking

Queries to the environmental authorities of the most important industrial countries and research work in the environmental literature database of the Federal Environmental Agency helped to establish which water quality derivation criteria actually exist. This work revealed that basically only the United Kingdom, Canada, the Netherlands, the United States and the International Commission for the Protection of the Rhine (ICPR) have so far developed water quality criteria derivation methods that are similar to the German BLAK QZ (LAWA 1997) concept.

As Chapters 2 to 4 contain ample information about the German regulations related to the work of the Länder Working Commission Water, the national concept is not included in Chapter 5 which focuses on international approaches and concepts instead.

2. Water Quality Objectives and Legal Foundations

2.1 Terms and Definitions

In the concepts and guidelines for the derivation of quality criteria and target values, a confusing variety of terms is used to describe similar facts. In order to determine a clearly defined terminology for the comparison of the individual concepts, the terms "effect values", "water quality criteria", "water quality objectives" and "water quality standards" are subsequently defined following the proposals of the German Federal Environmental Agency (1994) and the Canadian Council of Ministers of the Environment (CCME 1999).

Effect Values (*Wirkungswerte*) represent scientific data established by means of (eco)toxicological effect tests. They are used for deriving recommended values to protect particular assets.

Water quality criteria/guidelines (*Wasserqualitätskriterien*) represent a certain quality requirement which is recommended from a scientific point of view in order to achieve a particular protection target. Quality criteria are linked to the best available knowledge, i.e. they are subject to be revised whenever knew information becomes available. Quality criteria form a basis for establishing quality objectives and quality standards as well as for adopting legislation affecting toxic substances.

Water quality objectives (*Wasserqualitätsziele*) represent a desired water quality status (protection level) in a designated area that should be pursued. Quality objectives are reference values determined by environmental politics. They are normally based on scientifically founded quality criteria. However, social or ethical considerations may also be taken into account.

Water quality standards (*Wasserqualitätsstandards*) represent legally binding values that have to be achieved or maintained to meet a quality standard determined by the government (laws, EC directives or subordinate regulations, e.g. decrees, administrative provisions or circular orders issued by ministries).

The following overview is an attempt to assign individual terms used in different countries and regulation areas to the definitions above (Table 1). The desired protection level depends on the selected derivation method or on political objectives. The listed criteria do not necessarily refer to the same protection level. In some cases the protection level or the implied risk level can be recognized by the label.

Table 1 Assignment of the terms "Quality Criteria", "Quality Objectives" and "Quality Standards"

Quality criteria		
Water supply and distribution		
Water quality criterion	USA	U.S. EPA 1999
Water quality guideline	Canada	CCME 1999
Toxic substances		
Concern concentration/level	USA	U.S. EPA 1984
Predicted no effect concentration	EU	EC 1996
Risk limits: maximum permissible concentration and negligible concentration	Netherlands	Slooff 1992, Bruijn et al. 1999
Quality objectives		
Water supply and distribution		
Water quality objective	Canada	CCME 1999
Quality target	Germany	LAWA 1997
Quality target	ICPR	IKSR 1993
Toxic substances		
Maximum permissible concentration (maximum value)	Netherlands	VROM 1999
Target value	Netherlands	VROM 1999
Quality standards		
Water supply and distribution		
Quality standard	Canada, USA	CCME 1999, U.S. EPA 1988a
Environmental quality standard	United Kingdom	NRA 1991, Agg and Zabel 1989
Guide(line) values in EC directives	EC directives	e.g. 78/659/EEC
Quality objectives	EC directives	e.g. 84/491/EEC
General quality requirements	North Rhine-Westphalia	MBl.NW.1991 p. 863
Toxic substances		
Maximum values	Germany	e.g. Decree on Maximum Quantities of Pesticides (*Pflanzenschutzmittel-Höchstmengenverordnung)*

2.2 Legal Foundations

The need for establishing and applying immission-related quality requirements to protect surface waters from hazardous substances is demonstrated by the existence of various German environmental acts, EC directives, environmental policy objectives and international environmental agreements. The following list shows some especially important environmental laws and directives that should be considered in this context.

- Water Resources Act (*Wasserhaushaltsgesetz, WHG*)
- Detergent Act (*Wasch- und Reinigungsmittelgesetz, WRMG*)
- Plant Protection Act (*Pflanzenschutzgesetz, PflSchG*)
- Toxic Substances Control Act (*Chemikaliengesetz, ChemG*)
- Federal Nature Conservation Act (*Bundesnaturschutzgesetz, BNatSchG*)
- Council Directive 76/464/EEC of 4 May 1976 on pollution caused by certain dangerous substances discharged into the waters of the Community
- EU Water Framework Directive (EU, 2000)

The following paragraphs briefly compare the most important laws and regulations relating to the aquatic environment against laws and regulations relating to other environmental domains.

Legislation Relating to Water

Section 1a subsection 1 of the German Water Resources Act stipulates that water bodies – being a constituent part of the ecosystem – shall be managed in a way that they serve the public weal and, in harmony therewith, the benefit of individuals and that any avoidable spoiling shall be prevented. This principle of the Water Resources Act should now be put into concrete forms by establishing precise emission standards and immission-related parameters.

Water protection policy in the Federal Republic of Germany is based on the emission principle. Section 7a of the Water Resources Act says that waste water has to be avoided in the first place and purified by using the best available techniques, regardless of whether or not toxic effects materialize or can be expected after hazardous substances have been discharged into the water. Hence no proof of the actual potential hazards to the water is needed for authorities to impose initial waste water clarification obligations. However, precise quality criteria are needed in addition to existing water protection regulations. On the one hand, even if the best available waste water clarification techniques are applied, it cannot be excluded that toxic substances cause detrimental effects on aquatic communities or certain protected uses like drinking water supply or fishery. On the other hand, surface waters are not only polluted directly by municipal or industrial discharges but also by diffuse sources, e.g. by run-off from farmland or deposition of air pollutants. This is why the LAWA (1997), among others, calls for a derivation of water quality criteria and a determination of quality targets in order to enhance the emission principle by an appropriate examination of immission that considers the water industry's interests in water protection policy. In this context, the LAWA issued the following principles (LAWA 1991):

"In each case the most sensitive component of all water systems including marine waters sets the standard for quality objectives. Water protection must start at the contamination source but should also consider all media and sources for pollution."

"The protection of surface waters must focus on a conservation of water bodies as habitats of diverse plant and animal life by reducing toxic impact and maintaining or restoring a water bottom that is as natural as possible. Criteria relating exclusively to protected uses are not sufficient."

Consequently, a management plan as justified in section 36b of the Water Resources Act may also require determining immission-related quality targets and quality standards.

Legislation Relating to Toxic Substances

In addition to the legislation affecting the aquatic sector, the laws regulating the marketing of chemical products (e.g. Toxic Substances Control Act, Plant Protection Act, Detergent Act) exert an influence on the entry of hazardous substances into water bodies. However, the regulations concerning toxic substances are only partially comparable with the above-mentioned emission regulations for industrial installations.

In the assessment of substances pursuant to the Toxic Substances Control Act, the Plant Protection Act and the Detergent Act, the test results are compared to the extrapolated or measured environmental concentrations. Substance-related regulations (risk mitigation measures including a ban of a substance) are intended to protect human beings and the environment from being harmed by hazardous substances. In order to keep the risk of environmental impact as small as possible it is necessary, among other things, to maintain a safe enough distance between the concentration that does not yet cause an observable damage (NOEC) and the material's environmental concentration. The concepts for an assessment of existing and new substances have been harmonized among the member states of the European Union (Beulshausen and Ahlers 1997). The Technical Guidance Document (EC 1996) issued by the Commission of the European Communities provides a basis for evaluating substances pursuant to the Toxic Substances Control Act.

The approval of pesticides is based on the German Plant Protection Act and on the EC Directive 91/414/EEC (Klein et al. 1993). The legal provisions issued by the European Union for testing and approving pesticides and active ingredients were summarized by the Federal Biological Research Centre for Agriculture and Forestry in 1996. Provisions concerning the placing of biocidal products on the market are laid down in the EU Biocide Directive (98/8/EC, O.J.EC No L 123/1, 24.4.1998). Similar to the assessment of substances, biocides in the EU are going to be evaluated by comparing the exposure concentration to the effect concentration.

The methodical procedure used for establishing the potential danger of existing and new substances is very similar to the procedure used for deriving quality criteria and quality objectives. In the Netherlands, for example, environmental quality objectives similar to the German quality targets for water protection were proposed and established to control the entry of hazardous substances (VROM 1991a, VROM 1999).

Figures 1 and 2 provide an overview of the workflow in the assessment of substances and the derivation of quality criteria for water protection. They show that statutory provisions with regard to toxic substances and immission are needed to reduce diffuse material input because legislation affecting water policy alone is not sufficient.

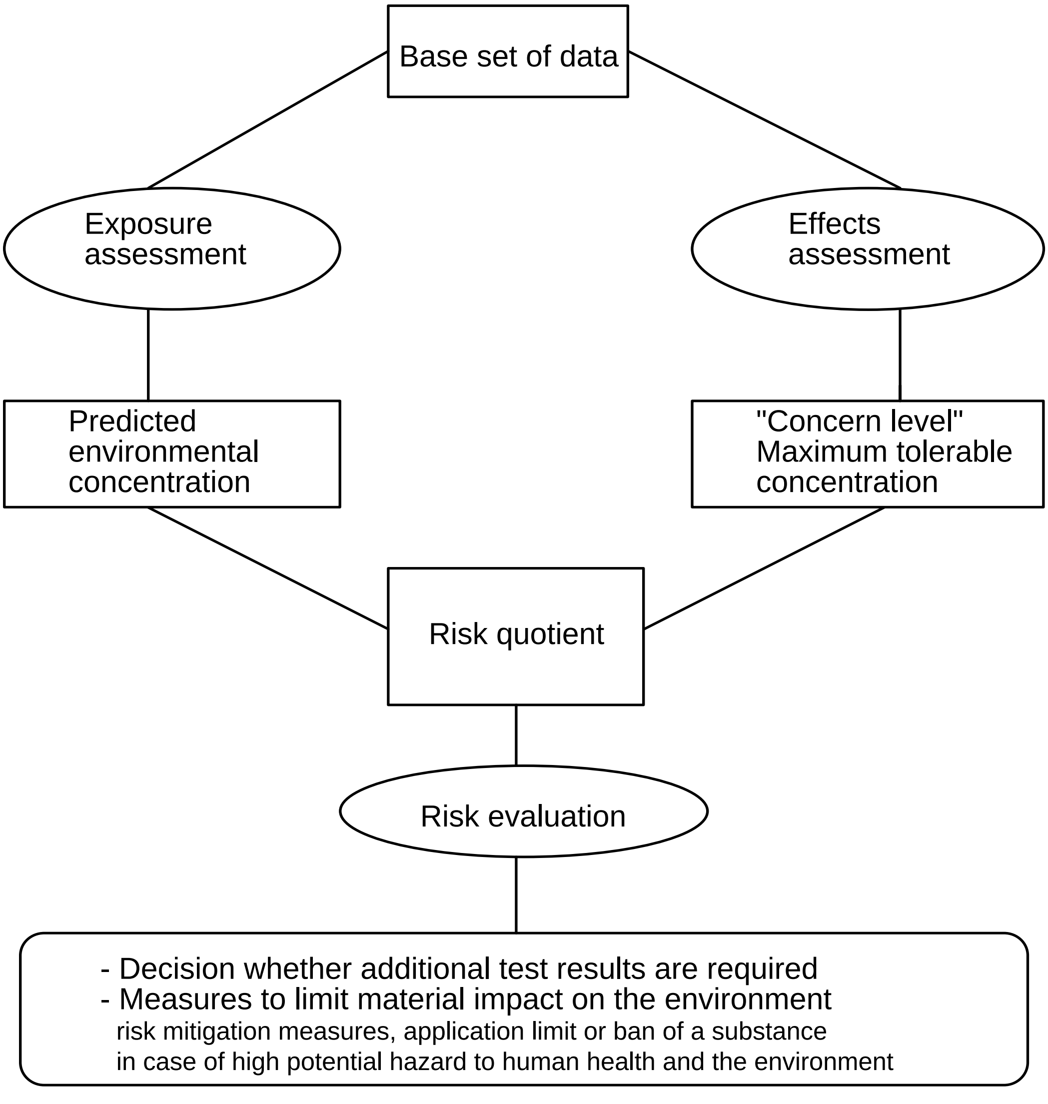
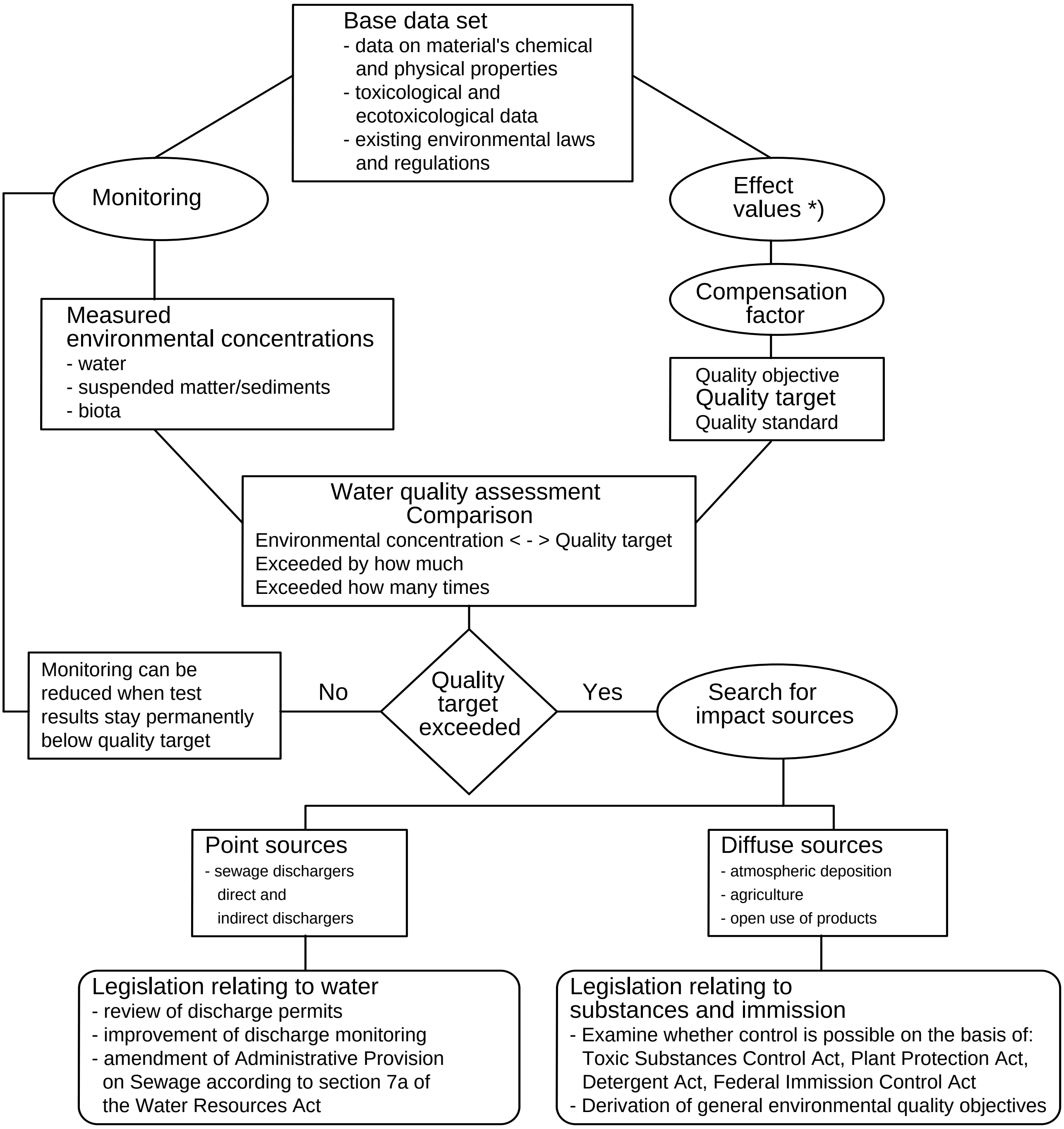


Fig. 1: Risk assessment for toxic substances (according to Van Leeuwen 1991)



*) plus guidelines and maximum values for drinking water, food and soils

Fig. 2: Derivation and monitoring of quality targets *(Zielvorgaben - ZV)*

2.3 Protected Assets

The early days of water control policy focused on the immediate protection of human health, i.e. maintaining and restoring water quality to a level safe enough for drinking water abstraction and fishing. For example, the EC had already established directives as early as 1975 to protect surface waters for drinking water abstraction (75/440/EEC) and in 1978 to protect freshwater fish (78/659/EEC). However, the EC directives mention only a few quality standards for hazardous organic substances. Yet surface waters are not only there to be used; they represent a constituent part of the ecosystem serving as habitats for aquatic organisms and their communities which have to be considered when quality criteria are established. In most countries this aspect was neglected until the 1980s when the first concepts were developed for a derivation of quality criteria to protect aquatic communities from hazardous substances. In general, separate quality criteria are derived for each protected asset. The following list shows the protected assets or uses that have been considered:

- Aquatic communities
- Commercial and sport fishing
- Leisure and recreation
- Marine environment with regard to pollution caused by inland waters
- Irrigation of farmland/livestock watering
- Drinking water supply
- Suspended matter and sediments

The following chapter explains the principles of deriving quality criteria which can subsequently be used as a basis to establish quality objectives and quality standards.

3. Environmental Quality Criteria - Methods of Derivation

In the past few years the subject of developing methods to derive environmental quality criteria has been closely connected to the discussion about the assessment of substances. The methods that have been developed aim at estimating concentrations for certain substances which are unlikely to trigger detrimental effects on our ecosystems.

Whether it is possible to evaluate the risk of a hazardous substance and to derive an environmental quality criterion depends largely on the available data concerning the material's toxicitiy to humans and the environment. When only few data exist or no information at all is available for a certain substance, it is often suggested to use the "quantitative structure-activity relationships" (QSARs) for the assessment of quality criteria (OECD 1991, Slooff 1992, Van Leeuwen 1992, Bol et al. 1993). This method has gained acceptance especially in the US where the number of mandatory test results is considerably lower.

A simple ecotoxicological risk assessment can be made by extrapolating acute or chronic test results with the so-called regression method (Suter et al. 1985, Blanck 1984, Slooff et al. 1986). However, none of these procedures was considered for the development of concepts for the derivation of national quality criteria. The OECD (1992b) distinguishes between a preliminary, a refined and a comprehensive aquatic effect assessment, depending on the quality and the amount of available base data. A preliminary effect assessment is normally based either on acute effect data or on a few chronic effect data. For a preliminary risk assessment it would be sufficient to have only one acute test result or even only one QSAR value (Slooff 1992). Data from long-term toxicity tests provide a basis for a refined effect assessment while a comprehensive assessment requires data from field tests or model ecosystems (Table 2).

Table 2: Hazard assessment levels

Hazard Assessment Level	**Required Test Results**
Preliminary effect assessment	Acute data or a small number of chronic effect data
Refined effect assessment	Effect data from chronic toxicity tests
Comprehensive effect assessment	Field tests or tests performed with model ecosystems

On the other hand, well-conducted and comparable model ecosystem tests are rare while the few existing studies on various complex systems are somewhat difficult to evaluate (Okkerman et al. 1993). Consequently, the process of deriving quality criteria for hazardous substances typically considers only a material's physical and chemical characteristics and toxicity data from monospecies tests. Then again a multispecies test may provide additional information concerning the environmental behaviour of chemicals and their effect on complex systems, thus improving the results obtained from a monospecies test (Kussatz 1994).

3.1 Protected Asset: Aquatic Communities

Freshwater

Surface water bodies provide a habitat for aquatic communities. It is recommended to maintain or restore a community of plants, animals and micro-organisms in a stretch of water that is as natural, site-specific, self-reproducing and self-regulating as possible (LAWA 1997).

Derivation methods for quality criteria and quality standards to protect freshwater organisms were developed by the U.S. EPA (Stephan et al. 1985), the Canadian Council of Ministers of the Environment (CCME 1993), Dutch environmental authorities (Stortelder 1989, Slooff 1992), the Water Research Centre in the United Kingdom (WRC 1993) and the ICPR (IKSR 1993). The individual methods are described in Chapter 5.

Marine Waters and Coastal Areas

As ecological, chemical and physical developments in marine waters take place in very large areas and over very large periods of time, seas and oceans are regarded as some of the most sensitive ecosystems on earth (Jonkers and Everts 1992). The need for quality criteria and quality standards to protect marine aquatic communities is controversial because any potential damage whatsoever to marine waters should be excluded in the first place out of precaution. There is a danger that the pursued "principle of precaution" could be undermined by mere fulfilment of given standards (Hoppenheit et al. 1991). Notwithstanding the political and environmental debate about the necessity of special quality criteria to protect seas and oceans, the following paragraphs provide a brief overview of existing approaches to establish toxicology-based quality criteria to protect marine life forms. The main differences between the individual concepts revolve around the questions a) whether or not test results from freshwater organisms can be used to replace missing data from marine organisms and b) what kind of replacements exist for unavailable chronic tests.

The United States and Canada do not intend to merge effect data from freshwater and marine life forms because there is a concern that the organisms might respond differently in terms of sensitivity. A comparison of existing data reveals that the results are quite similar in most cases.

A paper by Van Wezel (1998) provides an overview of the reasons why freshwater organisms and marine life forms might react differently in terms of sensitivity. By and large, however, only small differences have been observed so far. In the case of certain substances, e.g. organophosphorus compounds and organotin compounds, a higher toxicity with a higher salinity was observed.

In the UK, auxiliary freshwater results may be used when marine effect data are unavailable. A study conducted in the Netherlands examines the question whether special quality criteria to protect the North Sea and the Wadden Sea (mud flats) are needed for substances which have already been assigned general environmental quality objectives and standards for freshwater. Based on their evaluations, Jonkers and Everts (1992) draw the conclusion that marine organisms in general are not more sensitive to harmful substances than freshwater organisms. That is why they recommend to merge the test results of freshwater organisms and marine species when establishing quality criteria in the future. Their methodology to derive quality criteria for marine organisms did not differ from the one they had used for freshwater (Slooff 1992).

However, one problem in the derivation of toxicology-based quality criteria to protect marine organisms is the fact that acknowledged chronic effect tests have been available only for a few species so far, while numerous marine organisms can't be cultivated under laboratory conditions. Various experts have therefore proposed to establish quality objectives for marine ecosystems that are based on the background contamination. During the 4th International Conference on the Protection of the North Sea (1995) the ministers agreed on the objective to ensure a sustainable, stable and healthy ecosystem. The principle of precaution is the guiding principle towards this end.

It was agreed to prevent pollution of the North Sea by continuously reducing discharges, emissions and losses of hazardous substances, thereby moving towards the target of their cessation within one generation (25 years) with the ultimate aim of concentrations in the environment near background values for naturally occurring substances and close to zero concentrations for man-made synthetic substances. In the context of the declaration hazardous substances are defined as substances, or groups of substances, that are toxic, persistent and liable to bioaccumulate. In this definition toxicity should be taken to include chronic effects such as carcinogenicity, mutagenicity and teratogenicity as well as adverse effects on the functioning of the endocrine system.

Likewise, EU substance policy is discussing an evaluation for marine areas focussing on intrinsic characteristics like degradability, bioaccumulation and toxicity. Local and regional coastal areas are planned to be evaluated by means of a PEC/PNEC comparison. Because of the high risks involved in the marine sector, the assessment factors used for PNEC derivation purposes should be higher compared to the limnic sector.

Selection of Species and Minimum Data Set

A minimum data set is needed for deriving quality criteria in order to guarantee reliable results with regard to the desired protection level. The following criteria can be used when selecting the species (Van Straalen and Denneman 1989):

1. Ecological function (trophic level): The data set should include primary producers, consumers and saprotrophic organisms.

2. Anatomic features: The data set should also include organisms from different taxonomic groups (LeBlanc 1984).

3. Type of exposure: The data set should include data of organisms representing different ways of material uptake. This is especially important to the derivation of sediment and soil quality criteria.

The purpose of selecting various species that play a key role in an ecosystem is to derive quality criteria which are appropriate to safeguard the protection of the entire ecosystem. Effect data of those key species are needed to derive quality criteria. Which derivation method is used to establish quality criteria and to assess substances depends on the amount of available data. Statistical procedures typically require chronic test results from at least 4 species from different taxonomic groups representing different trophic levels. Table 3 provides an overview of those taxonomic groups for which test results (preferably NOEC values) are normally needed to derive quality criteria for the protection of aquatic organisms. An ideal scenario would include the most important trophic levels being represented by species from different taxonomic groups.

Table 3: Minimum data set required to derive quality criteria for the protection of aquatic communities

Approach/ Source	Minimum number of test results	Taxonomic Groups
LAWA (1997)	4	Bacteria, algae, crustaceans and fish
CCME (1993)	6	Fish (3 species), invertebrates (2 species, one of them Daphnia), one alga species or one vascular plant species
Stephan et al. (1985)	8	Fish (2 species from different families plus another fish or amphibian species), crustaceans (2 species), one insect species, non-arthropods, another species not already represented
Stortelder et al. (1989)	4	Algae, molluscs, crustaceans and fish
Slooff (1992)	4	Species from different taxonomic groups
WRC (1993)	8	Algae, crustaceans, fish, insects and non-arthropods, e.g. molluscs
EC (1996)	4	Algae, crustaceans, fish, (bacteria)

3.1.1 Methods Using Compensation Factors

A quality criterion is typically derived by multiplying the lowest effect threshold value with a compensation factor (uncertainty factor). The use of compensation factors is intended to make sure that detrimental effects on ecosystems become unlikely if an assessed quality criterion is complied with. The value of the compensation factor depends, among other things, on the available data; in a substance assessment it will normally range between 1/10 and 1/10000 (OECD 1989). It is impossible to give an exact scientific explanation why a particular compensation factor is used. It is usually based on empirical values obtained from the risk assessment of hazardous substances. A compensation factor should account for the following uncertainties:

- interspecies sensitivity variability,
- different test results for the same species,
- acute-to-chronic effects ratio,
- extrapolation from laboratory to field conditions.

Interspecies Sensitivity Variability

The sensitivity of individual species in a community towards a certain substance may differ by a factor of 1000 to 10000 or more. For instance, the acute effect data for copper and endosulfan (U.S. EPA water quality criteria) range between 1200 and 810 (Chapman 1983). Rudolph (1986) provides more examples of interspecies sensitivity variability.

Variability of Test Results

Test results relating to a statistical endpoint (e.g. LC50, LOEC or NOEC) may differ by a factor of 10 for the same species. For example, round-robin tests on fish growth revealed that a NOEC value (reproducibility) may vary by a factor of 5 to 10 between different laboratories (Lacey and Mallett 1991). Soares et al. (1992) examined the variability of test results in a 21-day reproduction test on Daphnia with sodium bromide and dichloroaniline. Although the differences between the NOEC values of various genotypes were small, they could be clearly identified. The authors concluded from their experiments that the interaction between genotype and environmental conditions was the crucial factor in the variability of test results for both substances.

Acute-to-Chronic Effects Ratio

The ratio of acute to chronic effects frequently ranges between < 10 and 100. Tests on *Daphnia magna* with 73 compounds that were very different in structure revealed that the ratio of acute (24h, LC50) and chronic (21d, NOEC) effects (acute-to-chronic ratio, ACR) was > 50 in 26 compounds or 36% and > 100 in 16 compounds or 22% (Kühn et al. 1989). Pattard and Pernak (1992) obtained similar results. Biotests on *Daphnia magna* with 24 organic substances from different substance groups showed a median ACR value of 19 (24h EC50/21d NOEC). The measurements ranged from 2 to > 312. A comparison of acute and chronic effects of 50 substances tested on different species demonstrated that the ACR value may differ by three orders of magnitude and was smaller than or equalled 45 in 80% of the substances (Giesy and Graney 1989). Heger et al. (1995) evaluated the data of experiments on crustaceans and fish with existing and new substances and pesticides. The authors found that from a scientific point of view it would be justified to use a general factor of 100 to account for the ratio of the EC/LC50 from an acute test to the NOEC from a long-term toxicity test. In addition, surveys conducted by the U.S. EPA (1991c) showed that the ratio of acute to chronic toxicity in *Ceriodaphnia dubia* ranged between 1.4 and > 50 in tests on 20 chemical industry effluents and between 1.4 and 16 in tests on 21 municipal effluents.

Extrapolation from Laboratory to Field Conditions

The transfer from a few test results obtained in a laboratory to the real-world environment is another factor that has to be considered. Van Straalen and Denneman (1989) summarized the main arguments that support the use of compensation factors to account for the transfer of laboratory test results to field conditions. Compensation factors should be used for the following reasons:

1. A laboratory provides perfect conditions to test organisms.
2. Field organisms are exposed to several harmful substances in most cases.
3. Adaptation to contamination often has a detrimental effect on the genetic diversity of the organisms living in an ecosystem. Natural selection is distorted, i.e. unilaterally adapted organisms are selected.

The following reasons may be held against applying or adapting compensation factors in individual cases:

1. Bioavailability of a pollutant in the field is in most cases lower, relative to the laboratory test.
2. Ecological compensation mechanisms are active in the field.
3. Field organisms are able to adapt to pollutants.

The use of a compensation factor for extrapolation to field conditions to account for the lowest chronic NOEC value is supported by comparative data supplied by Okkerman et al. (1993) and Girling et al. (2000). They showed that the NOEC values from multispecies tests were in some cases lower than the ones from available monospecies tests.

During an OECD Workshop (OECD 1992b) it was agreed to use the compensation factors listed in Table 4 for the assessment of "concern levels". The suggested procedure is a modification of the method used by the U.S. EPA (1984) to assess concern levels. A concern level is not a safe concentration but rather a concentration above which an adverse impact on the environment is likely to occur. A harmful effect on the environment can only be excluded with a very high probability when concentration remain substantially below the concern level.

Table 4: Compensation factors for the assessment of concern levels

Available data	**Compensation factor**
Lowest LC50/EC50 value or QSAR assessment using a data set of 1 or 2 aquatic species.	0.001
Lowest LC50/EC50 value or QSAR assessment using a minimum data set of algae, crustaceans and fish.	0.01
Lowest chronic NOEC value or QSAR assessment using a minimum data set of algae, crustaceans and fish.	0.1

The compensation factors above were suggested in the Netherlands where they are used to derive maximum acceptable toxicant concentrations in order to establish preliminary environmental quality objectives (Slooff 1992). The U.S. EPA applies similar compensation factors in the US in evaluation procedures to establish legal provisions for substances. However, there are certain discrepancies in comparison with the EU Guidance Document to assess existing and new substances. In order to assess a PNEC (predicted no effect concentration), the lowest L(EC)50 from the base data set (fish, Daphnia, alga) should be multiplied by a compensation factor of 1/1000. If NOEC values for two or three taxonomic groups are available, a compensation factor of 1/50 or 1/10 is applied (EC 1996).

In the assessment of environmental hazards caused by toxic substances, the BLAK QZ has been following those methods that require a minimum number of ecotoxicological tests to derive a quality criterion (quality target) for the protection of aquatic communities. The derivation of quality targets relies on data obtained from generally accepted test methods allowing to establish the concentration that will have no observable effect after long-term exposure (no observed effect concentration, NOEC). When chronic toxicity data are missing (i.e. NOEC values are available for two or three trophic levels only), the acute values are multiplied by 0.1 to assess a chronic effect threshold value whenever the acute-to-chronic toxicity ratio for at least one multicellular organism is known and does not exceed 10. Otherwise each case is looked at individually.

In order to derive a quality target, the lowest chronic effect threshold value is multiplied by 0.1 (compensation factor F1). Another compensation factor (F2) may be applied if additional risk factors occur, e.g. if lower effect data have been established for other than the typically required taxa, or if metabolites form in the water that are confirmed to be more toxic to aquatic organisms compared to the original substance (LAWA 1997). A suspicion of metabolite occurrence and a material's persistence get no special treatment.

Whenever better ecologically relevant studies on the effect of hazardous substances on aquatic systems (e.g. field tests) are available, they should be taken into account provided they are closer to reality, reproducible, generally accepted and validated. In individual cases it should be checked whether it makes sense to increase the compensation factor F1 (LAWA 1997).

3.1.2 Statistical Extrapolation Methods for Risk Assessment

Fig. 3 illustrates the use of statistical extrapolation methods for risk assessment based on the species sensitivity distribution. If it was feasible to conduct acute or chronic effect tests on hundreds of different species to examine the relative frequency of the EC/LC50 or NOEC values, the result would be a central distribution of the values, provided the same toxic mechanism is in effect. Only a few species would reveal a very high sensitivity or a very high tolerance, respectively, towards the toxicant they are exposed to. An ecosystem faces a high risk whenever a material's environmental concentration exceeds the harmless concentration (NOEC) in a certain percentage of the tested organisms. The risk to an ecosystem may be tolerated whenever the exposure concentration (e.g. the 90th percentile) is smaller than the hazardous concentration for 5% of the species (HC5 or 95% protection). The risk may be regarded as negligible when the exposure concentration falls below the hazardous concentration HC5 by several orders of magnitude. That is the reason why different risk levels were defined in the Netherlands in the process of establishing environmental quality objectives; the negligible risk level amounts to one percent of the maximum tolerable risk level (see Fig. 4).

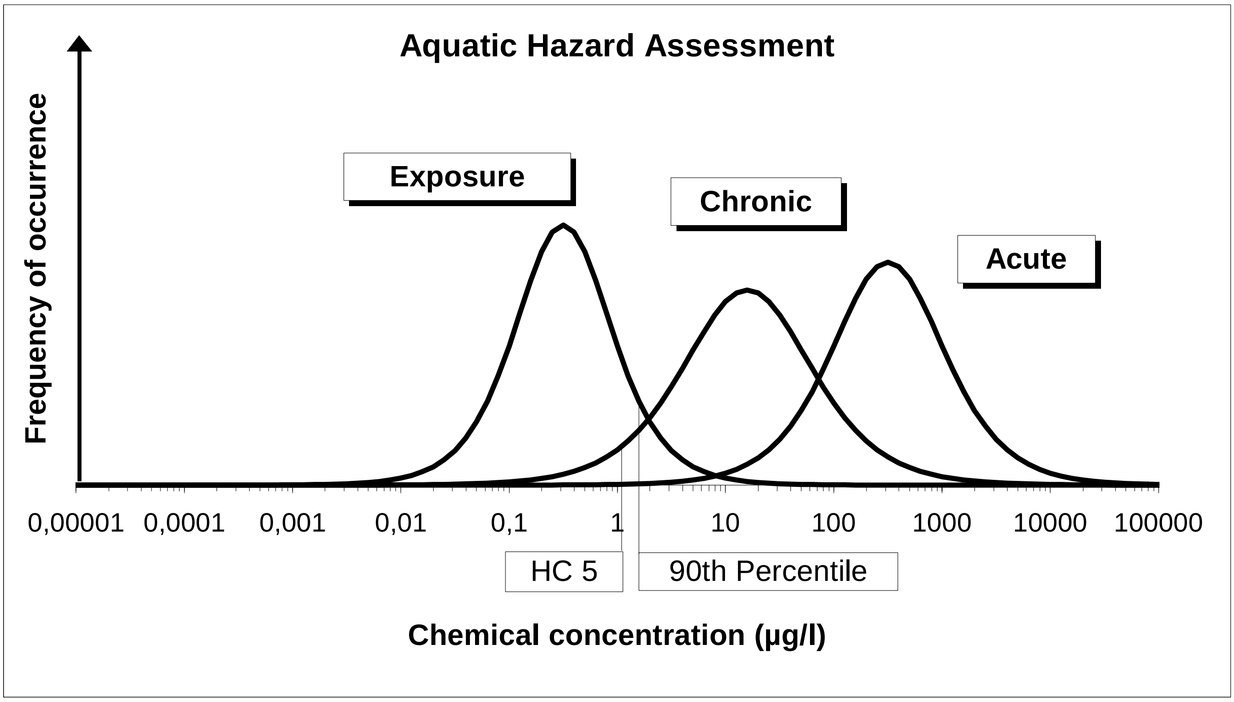


Fig. 3: Interspecies Sensitivity distribution for risk evaluation. The exposure values show that no safe distance exists to the estimated hazardous concentration for 5% of the species (HC5).

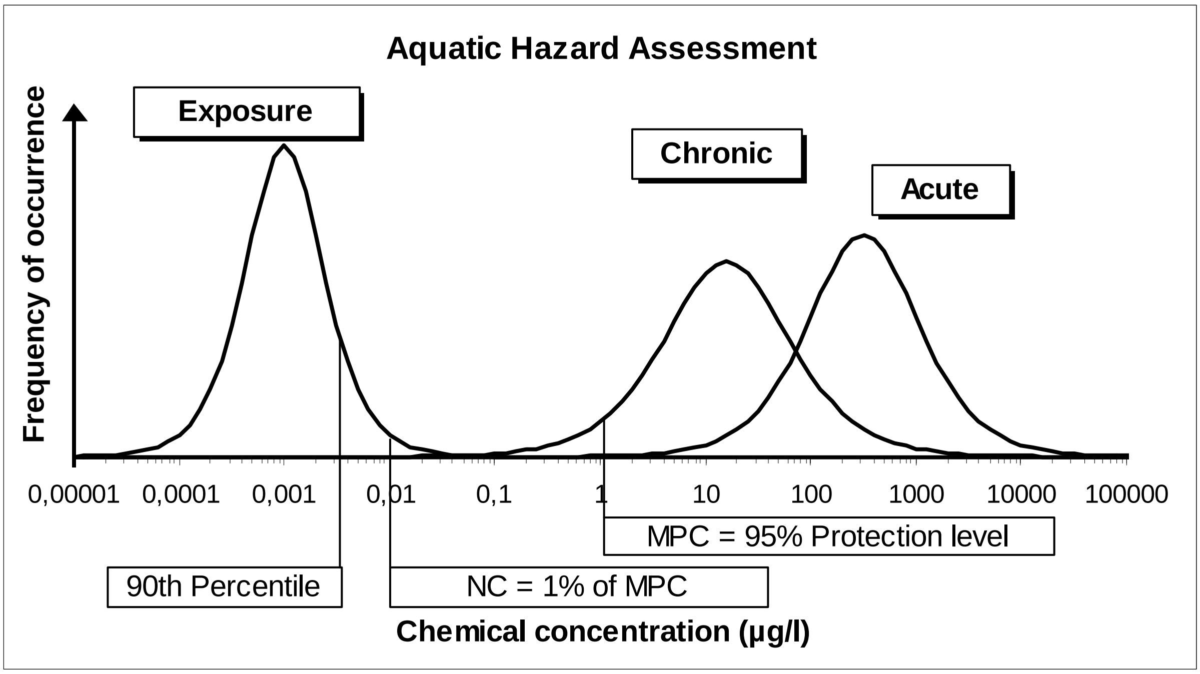


Fig. 4: Risk limits in the determination of environmental quality objectives in the Netherlands (MPC = maximum permissible concentration, NC = negligible concentration).

The first method aiming at a 95% protection level for taxonomic groups was published in 1985 by the EPA (Stephan et al. 1985). Kooijman (1987) developed a statistical approach to demonstrate how differences in the species sensitivity to a chemical can be used to predict the range of sensitivity of all remaining untested species. His method was modified by Van Straalen and Denneman (1989) with the purpose to derive protection values for 95% of the organisms in an ecosystem. Aldenberg and Slob (1991) as well as Wagner and Løkke (1991) suggested major modifications to this approach and brought them up for discussion during the OECD "Workshop on the Extrapolation of Laboratory Aquatic Toxicity Data to the Real Environment" (OECD 1992b).

Their models are based on the following assumptions:

- the species forming an ecosystem are subject to a certain sensitivity distribution; few species are very sensitive while many species are moderately sensitive;
- the sensitivity distribution of the species tested in the laboratory is similar to the distribution of species in the field;
- the sensitivity of an individual species under laboratory conditions is comparable to its sensitivity under field conditions.

Three initial points are of importance in the discussion of these extrapolation methods:

1. A key aspect in a model description of species sensitivity is the **assumption of frequency distribution**. Fig. 5 shows different distribution graphs used to illustrate the species sensitivity. Stephan et al. (1985) suggest to use a log-triangular distribution. In contrast, Wagner and Løkke (1991) prefer a log-normal distribution as a basis for their extrapolation model while a log-logistic distribution is used by Kooijman (1987), Van Straalen and Denneman (1989) and Aldenberg and Slob (1991).

2. The targeted **protection level** is defined by the selected endpoint of the test results (LC50, MATC or NOEC) and the percentage of species to be protected (e.g. 95% of the species).

3. The **statistical uncertainty** which is due to a limited data set has to be defined. Its definition depends on the selected distribution, the protection level and the required confidence level.

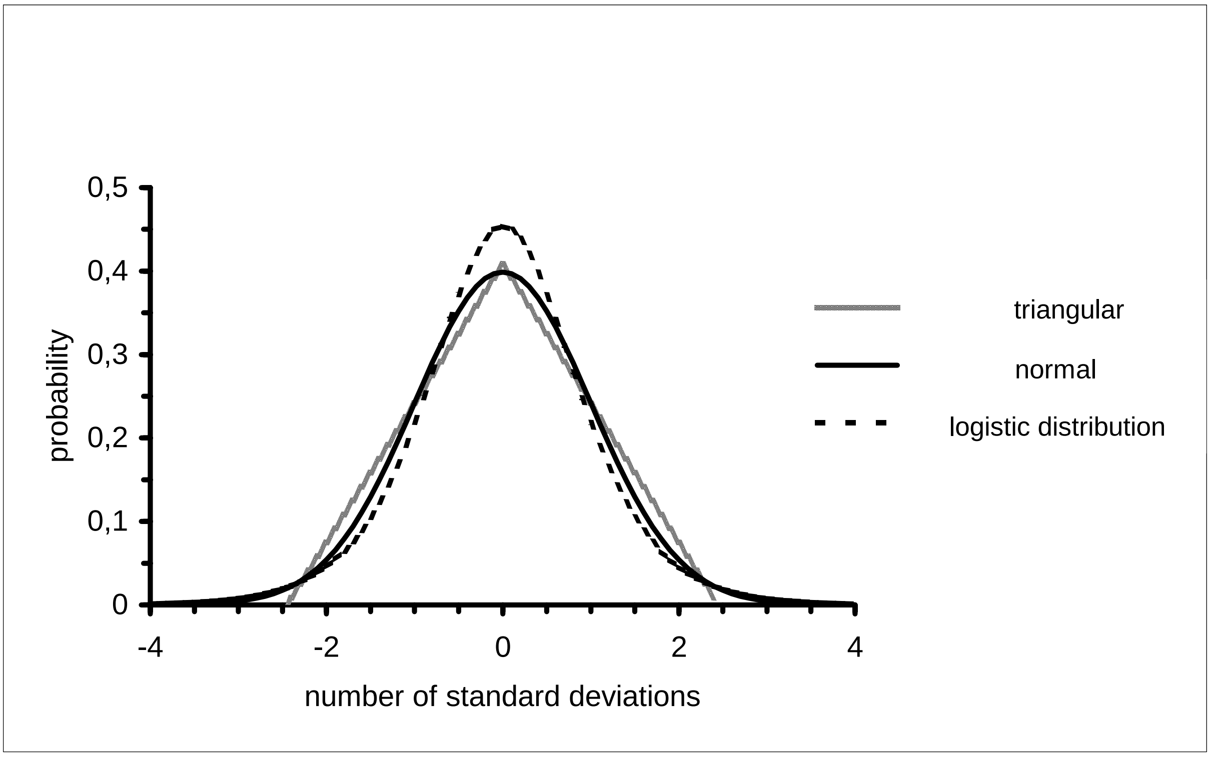


Fig. 5: Frequency distributions (distribution functions with a mean value of 0 and a standard deviation of 1) serving as models for interspecies sensitivity distribution (according to Van Leeuwen 1990)

The **EPA method to assess a final chronic value (FCV)** is aimed at establishing a "criterion continuous concentration" (CCC) for permanent loads. This criterion represents a threshold concentration for unacceptable effects and is intended to protect 95% of all species. It results from the lowest of the following three values: the final chronic value (FCV) for aquatic animals, the final plant value (FPV) for aquatic plants and the final residue value (FRV) to account for bioaccumulation.

Depending on the available chronic effect data for aquatic organisms, the FCV can be calculated in the same way as the final acute value (FAV). The calculation requires the NOEC values of at least 8 animal families (Table 5). The geometric mean is calculated from all available chronic NOEC values for a certain species. The resulting value is referred to as "species mean chronic value" (SMCV). The geometric mean of all SMCV of a family is taken to assess the "genus mean chronic value" (GMCV). Based on the four lowest GMVCs and assuming that they are subject to a triangular distribution, the FCV can be calculated as follows:

$$S = \sqrt{\frac{(\Sigma((\ln GMCV)^2) - (\Sigma(\ln GMCV))^2 / 4)}{\Sigma(P) - ((\Sigma\sqrt{(P)})^2 / 4)}} \qquad \text{Eq.(1)}$$

$$L = (\Sigma(\ln GMCV) - S(\Sigma(\sqrt{P}))) / 4 \qquad \text{Eq.(2)}$$

$$A = S\sqrt{0.05} + L \qquad \text{Eq.(3)}$$

$$FCV = e^{A} \qquad \text{Eq.(4)}$$

P = sum frequency
S = standard deviation of ln(GMVC) for the number of genera

The calculation corresponds to a linearization of the sum frequency distribution assuming that the ln GMCV values are subject to a triangular distribution. Only the 4 values closest to the 5th percentile are used in the calculation.

If the available chronic effect values are insufficient, the FCV is calculated from the FAV (the 5th percentile of the acute toxicity data) by applying the acute-to-chronic effect ratio. The FAV is established by using the above equations and applying the acute effect values.

Table 5: Information required to derive a quality criterion for the protection of freshwater organisms and their uses (Stephan et al. 1985)

1. Results of tests with at least one species in at least eight different families such that all of the following are included:
   a. the family Salmonidae in the class Osteichthyes
   b. a second family in the class Osteichthyes (preferably a commercially important species)
   c. a third family in the phylum Chordata
   d. a planktonic crustacean
   e. a benthic crustacean
   f. an insect
   g. a family in a phylum other than Arthropoda or Chordata (e.g. Rotifera, Annelida, Mollusca etc.)
   h. a family in any order of insect or any phylum not already represented.

2. Acute-chronic ratios with species in at least three different families provided that of the three species:
   a. at least one is a fish
   b. at least one is an invertebrate
   c. at least one is an acutely sensitive freshwater species (the other two may be saltwater species).

3. Test results of an alga species or a higher aquatic plant species. If plants are the most sensitive species among the aquatic organisms, a plant in another phylum should be tested.

4. At least one bioconcentration factor determined with an appropriate freshwater species, if a maximum permissible tissue concentration is available.

The EPA extrapolation model uses only part of the effect values. This is an advantage whenever the species sensitivity distribution is not clearly defined. The deviation from the estimated distribution is limited to the upper part of the distribution anyway and will not affect the calculation if only the smallest effect values of the data set are used. Another advantage of using the smallest values is that this allows to include test results listed as "greater than" (>). In other models those data are of no use. Stephan et al. (1985) say that one outstanding characteristic of the triangular distribution is the fact that due to its upper and lower limits none of the species will respond to an infinitely small concentration nor will a species tolerate an infinitely high concentration. This model could also be used to calculate a 100% protection level.

The **method of Wagner and Løkke** (1991) is based on a statistical and parametric procedure. The sensitivity distribution of individual species is assumed to be log-normal, i.e. the natural logarithm of the NOEC values (ln NOEC) is normally distributed with a location parameter μ and a scale parameter σ^2. However, the decimal logarithm (log NOEC) may be used as well. The density function of the log-normal distribution is determined by the following equation:

$$f(x) = \frac{1}{\sigma \cdot \sqrt{2\Pi}} \cdot e^{\frac{-(\bar{x} - \mu)}{2\sigma^2}} \quad \text{with} \quad x = \ln(\text{NOEC}) \text{ or } x = \log(\text{NOEC}) \qquad \text{Eq.(5)}$$

A hazardous concentration K_p is estimated for the most sensitive species based on the sensitivity distribution of the tested species; hence the NOEC values of (1-p) 100% of the species in a community are greater than K_p. The probability of the ln NOEC of a species in a community being smaller than or equal to ln K_p equals p.

$$P\ \{\ln \text{NOEC} < \ln K_p\} = p \qquad \text{Eq.(6)}$$

The fractile u_p of the standardized normal distribution can be expressed as

$$u_p = (\ln K_p - \mu / \sigma). \qquad \text{Eq.(7)}$$

Replacing ln K_p by the variable k_p and solving for k_p will result in

$$k_p = \mu + \sigma\, u_p\ , \qquad \text{Eq.(8)}$$

where k_p is the variable in the ln NOEC distribution and u_p is taken from statistical tables. Hence the result for K_p is

$$K_p = \exp(\mu + \sigma\, u_p). \qquad \text{Eq.(9)}$$

Normally only the estimates x_m and s_m of the parameters μ and σ are known.

$$\hat{\mu} = \bar{x}_m = \sum_{i=1}^{m} \frac{x_i}{m} \qquad \text{Eq.(10)}$$

$$\hat{\sigma}^2 = s_m{}^2 = \left(\sum_{i=1}^{m} \frac{\left(x_i - \bar{x}_m\right)}{m-1} \right) \qquad \text{Eq.(11)}$$

If μ and σ in equation (8) are replaced by their estimates, the estimate z for k_p can be calculated as follows:

$$z = x_m + s_m \cdot u_p\ . \qquad \text{Eq.(12)}$$

When a test is repeated, i.e. new sets of data are used, the estimate z will vary in a way that in some cases more than 95% of all species are protected while in other cases less than 95% are protected. It would now come in handy to know how the estimate z is distributed. At least it would be useful to know the distribution's variance.

As regards a fraction of a normal distribution, this can be solved by establishing the statistical tolerance limits. Tolerance limits are often used in statistical quality assurance. A lower statistical tolerance limit helps to establish a concentration telling with (1-δ) confidence that the NOEC value of no more than p 100% of all species in an aquatic community is smaller than the concentration of the corresponding tolerance limit.

To make sure that more than p 100% of all species have a NOEC value smaller than K_p, a value k must be calculated which tells with (1 - δ) statistical confidence that the concentration exp (x_m - s_m k) will harm no more than p 100% of all species. There are three different ways to determine the value k:

1. an exact calculation based on a non-central *t*-distribution;
2. by means of the likelihood theory;
3. an approximate calculation assuming a normal distribution of (x_m - s_m k).

Wagner and Løkke (1991) did an exact calculation of k based on the first method according to the description of Johnson and Kotz (1970). The number of species with a NOEC value smaller than

$$\exp(x_m - s_m k) \text{ is} < p \text{, if } (x_m - s_m k - \mu) / \sigma \text{ is} < u_p. \qquad \text{Eq.(13)}$$

The confidence level of equation (13) to be valid is (1-δ).
The parameter k is obtained by

$$k = (1/\sqrt{m}) \cdot t_{1-\delta}(m-1, -\sqrt{m} \cdot u_p) \qquad \text{Eq.(14)}$$

where $t_{1-\delta}(m-1, \sqrt{m} \cdot u_p)$ is a non-central *t*-distribution
with (m-1) degrees of freedom and non-centrality parameter $-\sqrt{m} \cdot u_p$.

The values of k for 1-p = 0.95 and 1-δ = 0.95 are listed in the appendix.

K_p is redefined by

$$K_p = \exp(x_m - s_m k) = \exp(x_m) / T , \qquad \text{Eq.(15)}$$

$$T = \exp(s_m \cdot k). \qquad \text{Eq.(16)}$$

In this context, T is referred to as "safety factor" or "application factor" by which the geometric mean of the NOEC values should be divided to establish the hazardous concentration. However, this designation is rather confusing in this context as T is quite different from an application factor used in a preliminary effect assessment.

Designations:

$(1 - \delta)$	Confidence level or statistical certainty
$\hat{\mu}$	Estimate of μ
$\hat{\sigma}^2$	Estimate of variance
μ	Mean value of the normal distribution
δ	Error probability
k	(One-sided) tolerance limit factor for the normal distribution
K_p	Hazardous concentration for sensitive species in the log-normal distribution model
k_p	$\ln K_p$
m	Number of test species
σ^2	Variance of the normal distribution
s_m	Sample standard deviation of m ln NOEC values
T	Application factor between K_p and $\exp(x_m)$
u_p	Fractile (standardized normal variate) of the standardized normal distribution
x_m	Mean of m ln NOEC values or log NOEC
z	Estimate for k_p
p	$p = P\{\ln \text{NOEC} < \ln K_p\}$

The **method of Aldenberg and Slob** (1991) is based on the work of Kooijman (1987). While Kooijman (1987) uses acute effect values as input data for his model in order to be able to establish a hazardous concentration (HCS) for the most sensitive of n species, Aldenberg and Slob (1991) use NOEC values to estimate a hazardous concentration (HCp) for p 100% of all species. The HCp value is defined as follows: The probability of the log NOEC of a species in a community being smaller than or equal to log HCp equals p 100% (e.g. 5%).

$$P\{\log \text{NOEC} < \log \text{HCp}\} = p \qquad \text{Eq.(17)}$$

The HC5 value is the upper limit of the concentration which is expected to have a harmful effect on an ecosystem. The assumed protection level is arbitrarily chosen and will not be closely examined in this chapter.

The definition of the hazardous concentration is the same as in the model developed by Wagner and Løkke (1991). The major difference between both models is the assumed frequency distribution. The model of Aldenberg and Slob (1991) is based on the assumption that the logarithms of the NOEC values of the tested species and the species living in communities are logistically distributed. If the parameters α and β determining location and scale of the distribution are known, it is possible to calculate the HCp value of a given value p. The density and distribution functions of the logistic distribution are stated in equations (18) and (19):

$$f(x) = \frac{1}{\beta} \cdot \frac{\exp\left(-(x-\alpha)/\beta\right)}{\left(1+\exp\left(-(x-\alpha)/\beta\right)\right)^2} \qquad \text{Eq.(18)}$$

$$F(x) = \frac{1}{1+\exp(-(x-\alpha)/\beta} \qquad \text{Eq.(19)}$$

Solving the distribution function for x and equating F(x) to p and x to log HC_p yields:

$$\begin{aligned} & x = \log HC_p = \alpha - \beta \cdot C_p^1 \\ & with \qquad \text{Eq.(20)} \\ & C_p^1 = \ln\left(\frac{1-p}{p}\right) \quad \text{e.g.} \;\; \text{p} = \; 0.05 \text{ will produce } \; \text{C}_5^1 = 2.9444 \end{aligned}$$

Equating p to 0.05 allows us to calculate a numerical value for the 95% protection level. Hence the hazardous concentration logarithm for 5% of the species can be expressed by the following equation:

$$\begin{aligned} \log HC_5 &= \alpha - \beta \cdot C_5^1 \\ &= \alpha - \frac{\sqrt{3}}{\pi} \cdot 2.9444 \cdot \sigma \qquad \text{Eq.(21)} \\ &= \alpha - 1.6234 \cdot \sigma \end{aligned}$$

The standard deviation σ can be derived from the scale parameter β of the logistic distribution as follows:

$$\sigma = \beta \cdot \frac{\pi}{\sqrt{3}} = 1.8138 \cdot \beta \qquad \text{Eq.(22)}$$

In reality, however, the parameters α and β are unknown and must therefore be estimated. The parameters can be estimated based on the NOEC values of the tested species on the assumption that these were obtained from independent random samples of the supposed distribution. The location parameter α can be estimated from the mean value x_m while the scale parameter β can be estimated from the standard deviation s_m of the log NOEC values of m species.

$$\hat{\alpha} = \bar{x}_m = \sum_{i=1}^{m} \frac{x_i}{m} \ , \qquad \text{Eq.(23)}$$

$$\hat{\sigma} = s_m = \sqrt{\left(\sum_{i=1}^{m} \frac{\left(x_i - \bar{x}_m\right)}{m-1} \right)} \qquad \text{Eq.(24)}$$

The estimated parameters α and β can now be used to assess an estimate Z for the HCp value; Z is expressed as: P{Z < log HCp} = δ.

$$Z = \log \hat{H}C_5 = \bar{x}_m - 1.6234 \cdot s_m \qquad \text{Eq.(25)}$$

If the parameters and the distribution type of the estimate Z are known, it is possible to establish a lower statistical tolerance limit for the HCp value for a given confidence level (1-δ). However, as those data are not available, the HCp value could not be calculated.
By computer simulation Aldenberg and Slob (1991) established a factor k_L which tells with a given confidence level (1-δ) that no more than 5% of all species have a NOEC value smaller than the estimated hazardous concentration (HC5, $k_L = 10^L$). L represents a lower statistical tolerance limit according to the definition of k_L:

$$L = \bar{x}_m - k_L \cdot s_m = \log HC_5, k_L \qquad \text{Eq.(26)}$$

The method of Aldenberg and Slob (1991) is an improvement over the extrapolation method proposed by Van Straalen and Denneman (1989). It is used in the Netherlands to assess maximum permissible concentrations provided at least 4 appropriate NOEC values are-available (Slooff 1992, Crommentuijn et al. 1997b).

x_m	Mean of m log NOEC values
α	Location parameter of the log-logistic distribution
β	Scale parameter of the log-logistic distribution
1–δ	Confidence level (1-δ) = P{L < log HC5}
σ	Standard deviation
p	p = P{log NOEC < log HC_p}
HC_p	Hazardous concentration for p% of the species
m	Number of test species
d_m	Factor such that P{S_m > d_m} = δ
k_L	Factor
C^n	Factor
L	log HC5, k_L

3.1.3 Theoretical Comparison of the Fundamental Extrapolation Methods

The reason for including a theoretical comparison of the two fundamental extrapolation methods in the following paragraphs is based on the fact that we cannot depart from the assumption that simply multiplying the lowest available NOEC value by a compensation factor of 0.1 will automatically yield a quality criterion which provides sufficient protection for an ecosystem (e.g. by protecting more than 95% of its species). It is intended to give an answer to the following questions:

- Which protection level (percentage of protected species) can be reached if a minimum data set of only 4 NOEC values ($m = 4$) is available for the derivation of quality targets?
- How does an increase in the number of available NOEC values affect the extrapolation result?
- How does the shape (scale parameter) of the sensitivity distribution affect the extrapolation result?

The comparison is based on the following assumptions:

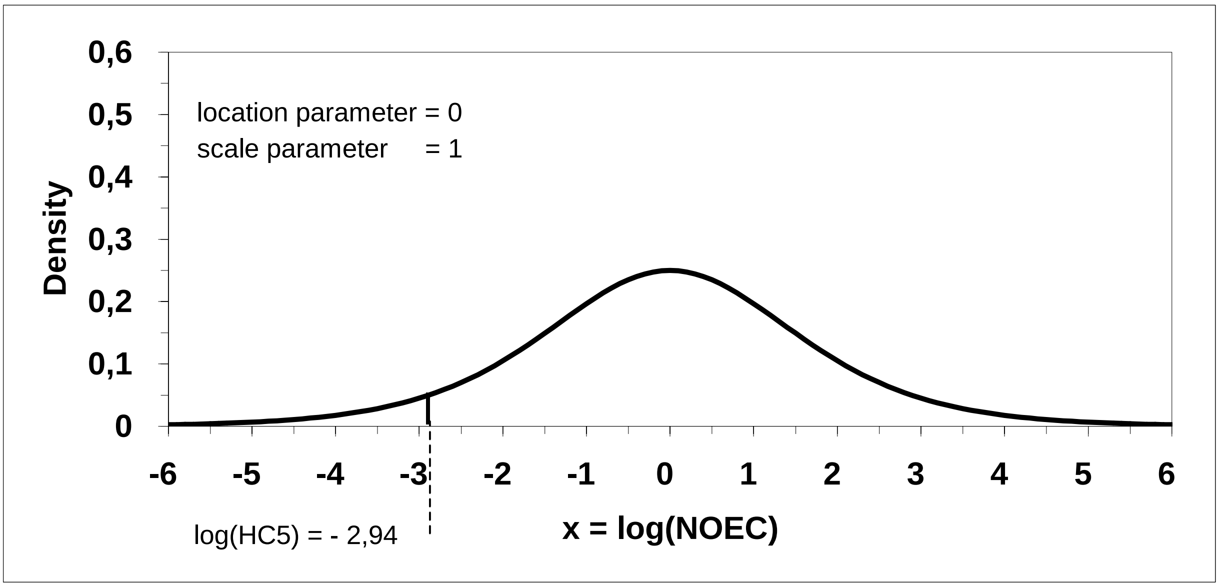
- The distribution of the NOEC values of all species with regard to a given substance is log-logistic.
- The NOEC values of m tested species with regard to a given substance are part of the same log-logistic distribution.
- The NOEC values of m tested species with regard to a given substance are random samples from that distribution.
- Each NOEC value is a fixed numerical value.

In an initial experiment it was assumed that the species sensitivity distribution has a location parameter $\alpha = 0$ and a scale parameter $\beta = 1$. Fig. 6 illustrates the density function f(x) and the distribution function F(x) of the assumed sensitivity distribution. It is assumed that the hazardous concentration logarithm for 5% of the species (log HC5) equals -2.94, i.e. 5% of the species have a log NOEC smaller than or equal to -2.94. If this is expressed in a unit of measurement (µg/l) the assumed distribution would produce the following values:

- the geometric mean of the NOEC values for the material is 1 µg/l;
- less than 5% of the species have NOEC values smaller than 0.001 µg/l;
- 90% of the species have NOEC values between 0.001 µg/l and 1000 µg/l.

This means a very large range may exist between the NOEC values of the most sensitive species and the NOEC values of the least sensitive species with regard to a certain material.

Density function f(x) of the log-logistic distribution $\alpha = 0$, $\beta = 1$



Distribution function F(x)

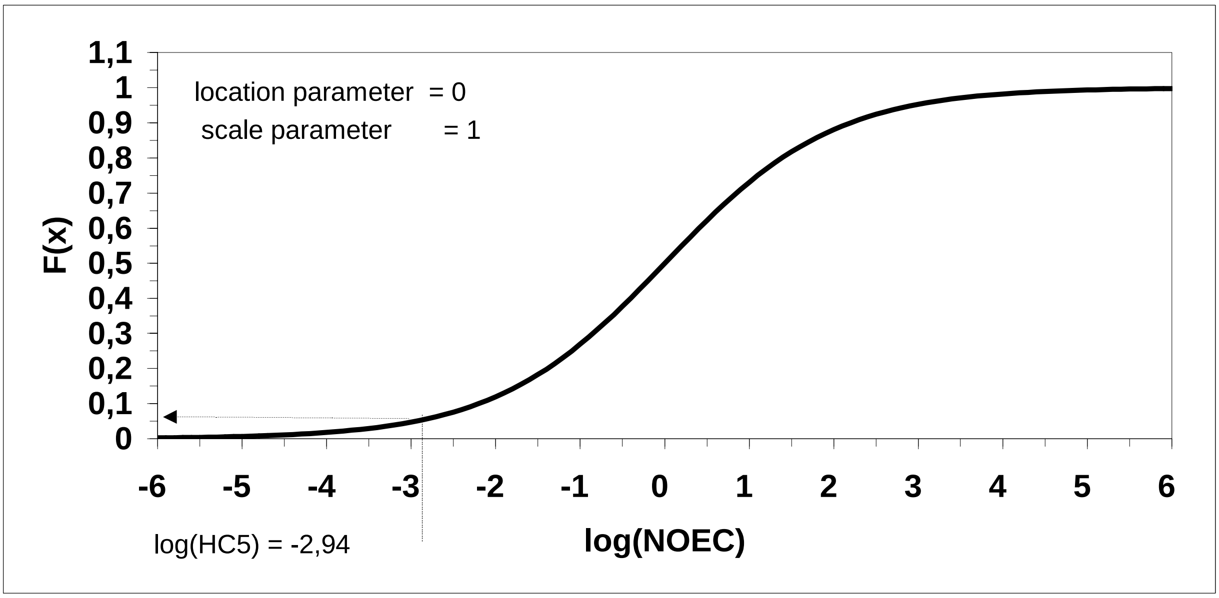


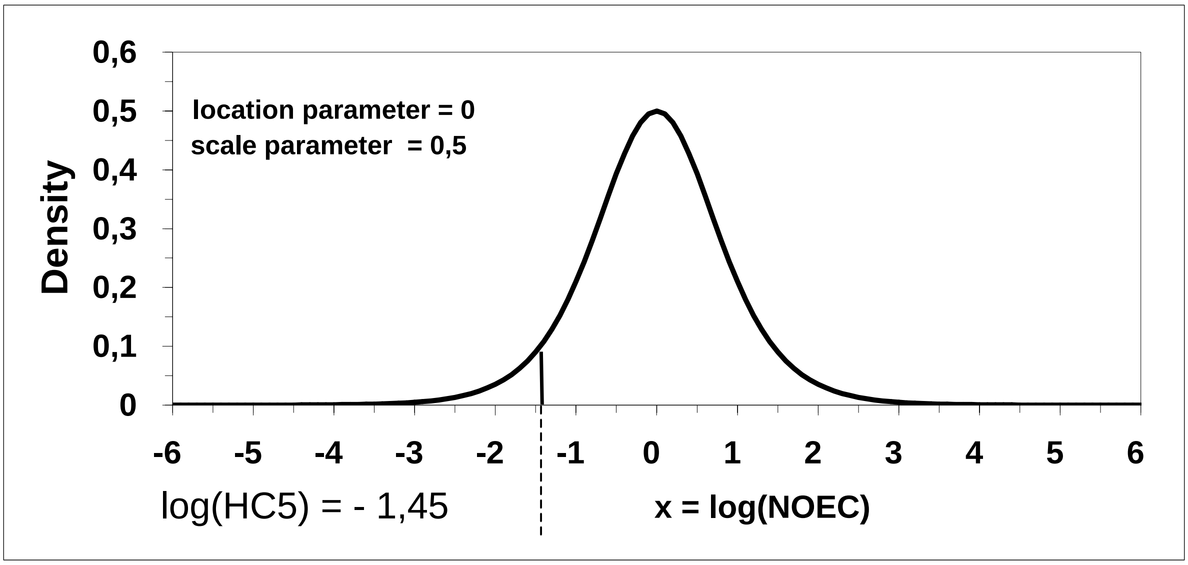
Fig. 6: Density and distribution functions of the log-logistic distribution with a location parameter $\alpha = 0$ and a scale parameter $\beta = 1$. F(x)·100% corresponds to the fraction of species with a log NOEC value < x. log HC5 = -2.94, i.e. 5% of the species have a log NOEC value < -2.94.

In a second experiment it was assumed that the distribution has a location parameter $\alpha = 0$ and a scale parameter $\beta = 0.5$ (Fig. 5), i.e. it was assumed that

- the geometric mean of the NOEC values for this material is 1 µg/l ;
- less than 5% of the species have NOEC values smaller than 0.03 µg/l;
- 90% of the species have NOEC values between 0.03 µg/l and 30 µg/l.

As many substances well suited for an estimation of NOEC values have an estimated scale parameter β between 0.3 and 0.8, both assumed models should be representative of a large number of substances.

Density function f(x) of the log-logistic distribution α = 0 , β = 0.5



Distribution function F(x)

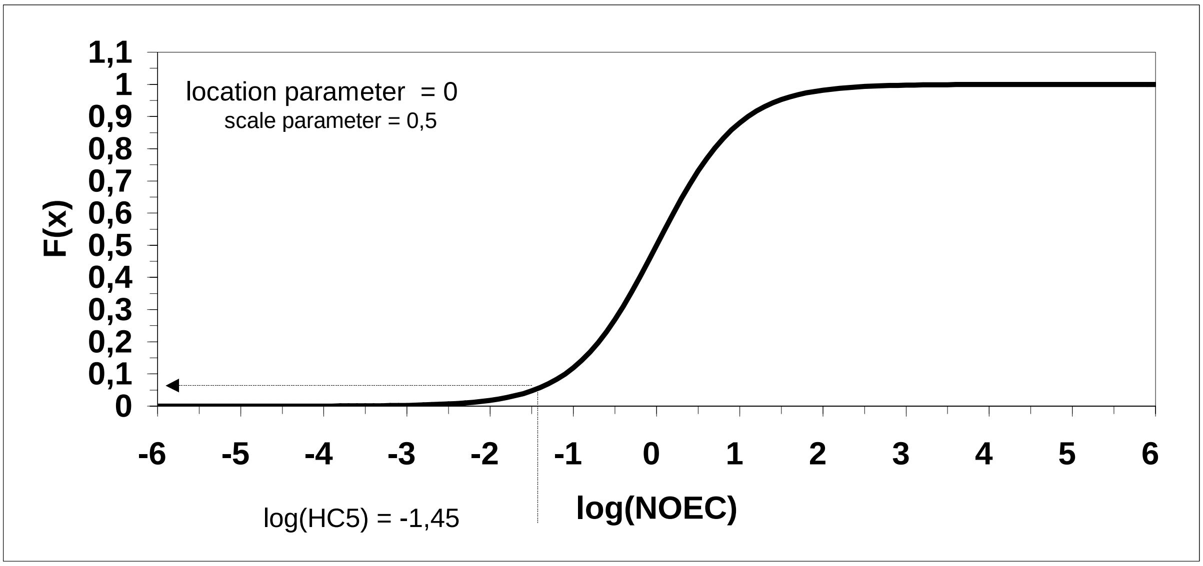


Fig. 7: Density and distribution functions of the log-logistic distribution with a location parameter α = 0 and a scale parameter β = 1. F(x)·100% corresponds to the fraction of species with a log NOEC value < x. log HC5 = -1.45, i.e. 5% of the species have a log NOEC value < -1.45.

The equation below (logistic distribution function solved for x and F(x) = U) was used with both models (location parameter $\alpha = 0$, scale parameters $\beta = 1$ and $\beta = 0.5$) to generate m = 20 values each for x = log(NOEC) in 1000 random samples by means of random numbers U.

$$x^{\alpha,\beta} = \alpha - \beta \cdot \ln\left(\frac{1-U}{U}\right)$$

Note:

$$x^{\alpha,\beta} = \alpha + \beta \cdot x^{0.1} \qquad \text{Eq.(27)}$$

U = uniform random variable

Generating the above values is comparable to establishing NOEC values for a certain substance for each of 20 randomly selected species in 1000 repetitions.

The smallest value $Min_m(x)$, the mean value x_m and the standard deviation s_m were calculated for each of the values m = 4, 8, 12 and 20 of x = log(NOEC). These results were used to calculate a quality target (*Zielvorgabe - ZV*) and the estimates of a hazardous concentration with a confidence level of 50% (HC5, k50) or 95% (HC5, k95) respectively, by multiplying the smallest NOEC value in each case by a compensation factor of 0.1.

$$\log(ZV) = Min_m(x) - 1 \qquad \text{Eq.(28)}$$

$$\log(HC_5, k_{50}) = \overline{x}_m - s_m \cdot k_{50} \qquad \text{Eq.(29)}$$

$$\log(HC_5, k_{95}) = \overline{x}_m - s_m \cdot k_{95} \qquad \text{Eq.(30)}$$

with $x = \log(NOEC)$ $m = 4,\ 8,\ 12$ and 20

The values were recalculated in each of the 1000 random samples. The established values log $Min_m(x)$, log(ZV), log(HC5, k50) and log(HC5, k95) were sorted in ascending order before calculating the corresponding 50th percentiles (median values) and the 95th percentiles. As the distribution's parameters α and β were known from the applied models, it was possible to calculate the achieved protection levels (percentage of protected species) for the 50th and the 95th percentiles based on the following equation:

$$F(x) = \frac{1}{1 + \exp(-(x-\alpha)/\beta)} \mathrel{\hat{=}} \text{percentage of species with a log(NOEC)} < x \qquad \text{Eq.(31)}$$

with $x = \mathrm{Min_m(x)},\ \log(\mathrm{ZV}),\ \log(\mathrm{HC_5},\ \mathrm{k_{50}}),\ \log(\mathrm{HC_5},\ \mathrm{k_{95}})$

$$(1 - F(x)) \cdot 100\% \mathrel{\hat{=}} \text{percentage of protected species}$$

The results are listed in Table 6 while Fig. 8 and 9 show the results for m = 4, 8 and 12 NOEC values.

The study reveals that the more NOECs (m) were available the smaller the values of the median and the 95th percentile of the derived quality targets log (ZV) became. On the other hand, the median values of the hazardous concentration log(HC5, k50) and the 95th percentiles of log(HC5, k95) hardly ever changed, no matter how many NOECs were used.

In the first model ($\alpha = 0$, $\beta = 1$) the percentage of species protected by a quality target derived from four NOEC values (m = 4 species) is greater than 94% in 50% of all cases (50th percentile). In 95% of all cases (95th percentile), however, only more than 71% of the species are protected. Only when the number of available NOEC values is increased to m = 20 species, the result is a quality target which protects more than 94% of the species in 95% of all cases.

In the second model ($\alpha = 0$, $\beta = 0.5$) the quality target derived from four NOEC values (m = 4 species) protects more than 98% of the species in 50% of all cases. In 95% of all cases, however, again only more than 87% of the species are protected.
Only when the number of available NOEC values is increased to m = 12 species, the result is a quality target which protects more than 96% of the species in 95% of all cases.
It is true that extrapolating a criterion to protect 95% of the species with a 50% confidence level (HC5, k50) using the method of Aldenberg and Slob (1991) guarantees that at least 95% of the species are protected in 50% of all cases, regardless of the number of available NOEC values or the distribution (scale parameter of the logistic distribution). In 95% of all cases, however, it only protects more than 69%, 80%, 85% or 87% of the species depending on the number of available NOEC values for m = 4, 8, 12 and 20 species. Consequently, a hazardous concentration which only protects substantially less than 95% of the species is calculated in a considerable number of cases.

As expected, the calculation of a hazardous concentration with a confidence level of 95% (HC5, k95) produced a value that protected more than 95% of the species in more than 95% of all cases regardless of the number of NOECs and the distribution. Depending on the number of available NOECs, however, 50% of the cases produced values that fell several orders of magnitude short of the hazardous concentration for 5% of the species (log HC5 from the species sensitivity distribution). If only 4 NOEC values were available in real life, the result would be that the hazardous concentration which has a 95% confidence level would fall several orders of magnitude short of the hazardous concentration which has a 50% confidence level. Hence it is understandable that this value will not be easily accepted and acknowledged as a quality criterion. The difference between the hazardous concentrations that were calculated using different confidence levels can be regarded as a degree of uncertainty (Emans et al. 1992).

Table 6: Calculated median values and 95th percentiles of $\mathrm{Min}_m(x)$, log(ZV), log(HC5, k50) and log(HC5, k95) from 1000 random samples and percentage of protected species (1-F(x) 100%) relating to the different median values and 95th percentiles

a) Model: logistic distribution with a location parameter $\alpha = 0$ and a scale parameter $\beta = 1$

	Species	**$\mathrm{Min}_m(x)$**	**log(ZV)**	**log(HC5, k50)**	**log(HC5, k95)**
Median, P50	m = 4	-1.67	-2.67	-2.92	-8.17
95th percentile, P95	m = 4	0.09	-0.91	-0.79	-3.11
1-F(x) 100%, x = P50	m = 4	84%	94%	95%	100%
1-F(x) 100%, x = P95	m = 4	48%	71%	69%	96%
Median, P50	m = 8	-2.42	-3.42	-2.98	-5.65
95th percentile, P95	m = 8	-0.80	-1.80	-1.36	-2.94
1-F(x) 100%, x = P50	m = 8	92%	97%	95%	100%
1-F(x) 100%, x = P95	m = 8	69%	86%	80%	95%
Median, P50	m = 12	-2.82	-3.82	-2.95	-4,92
95th percentile, P95	m = 12	-1.27	-2.27	-1.72	-3.04
1-F(x) 100%, x = P50	m = 12	94%	98%	95%	99%
1-F(x) 100%, x = P95	m = 12	78%	91%	85%	95%
Median, P50	m = 20	-3.31	-4.31	-2.94	-4.38
95th percentile, P95	m = 20	-1.79	-2.79	-1.86	-2.98
1-F(x) 100%, x = P50	m = 20	96%	99%	95%	99%
1-F(x) 100%, x = P95	m = 20	86%	94%	87%	95%

b) Model: logistic distribution with a location parameter $\alpha = 0$ and a scale parameter $\beta = 0.5$

	Species	**$\mathrm{Min}_m(x)$**	**log(ZV)**	**log(HC5, k50)**	**log(HC5, k95)**
Median, P50	m = 4	-0.84	-1.84	-1.46	-4.08
95th percentile, P95	m = 4	0.04	-0.96	-0.40	-1.55
1-F(x) 100%, x = P50	m = 4	84%	98%	95%	100%
1-F(x) 100%, x = P95	m = 4	48%	87%	69%	96%
Median, P50	m = 8	-1.21	-2.21	-1.49	-2.82
95th percentile, P95	m = 8	-0.40	-1.40	-0.68	-1.47
1-F(x) 100%, x = P50	m = 8	92%	99%	95%	100%
1-F(x) 100%, x = P95	m = 8	69%	94%	80%	95%
Median, P50	m = 12	-1.41	-2.41	-1.47	-2.46
95th percentile, P95	m = 12	-0.64	-1.64	-0.86	-1.52
1-F(x) 100%, x = P50	m = 12	94%	99%	95%	99%
1-F(x) 100%, x = P95	m = 12	78%	96%	85%	95%
Median, P50	m = 20	-1.66	-2.66	-1.47	-2.19
95th percentile, P95	m = 20	-0.90	-1.90	-0.93	-1.49
1-F(x) 100%, x = P50	m = 20	96%	100%	95%	99%
1-F(x) 100%, x = P95	m = 20	86%	98%	87%	95%

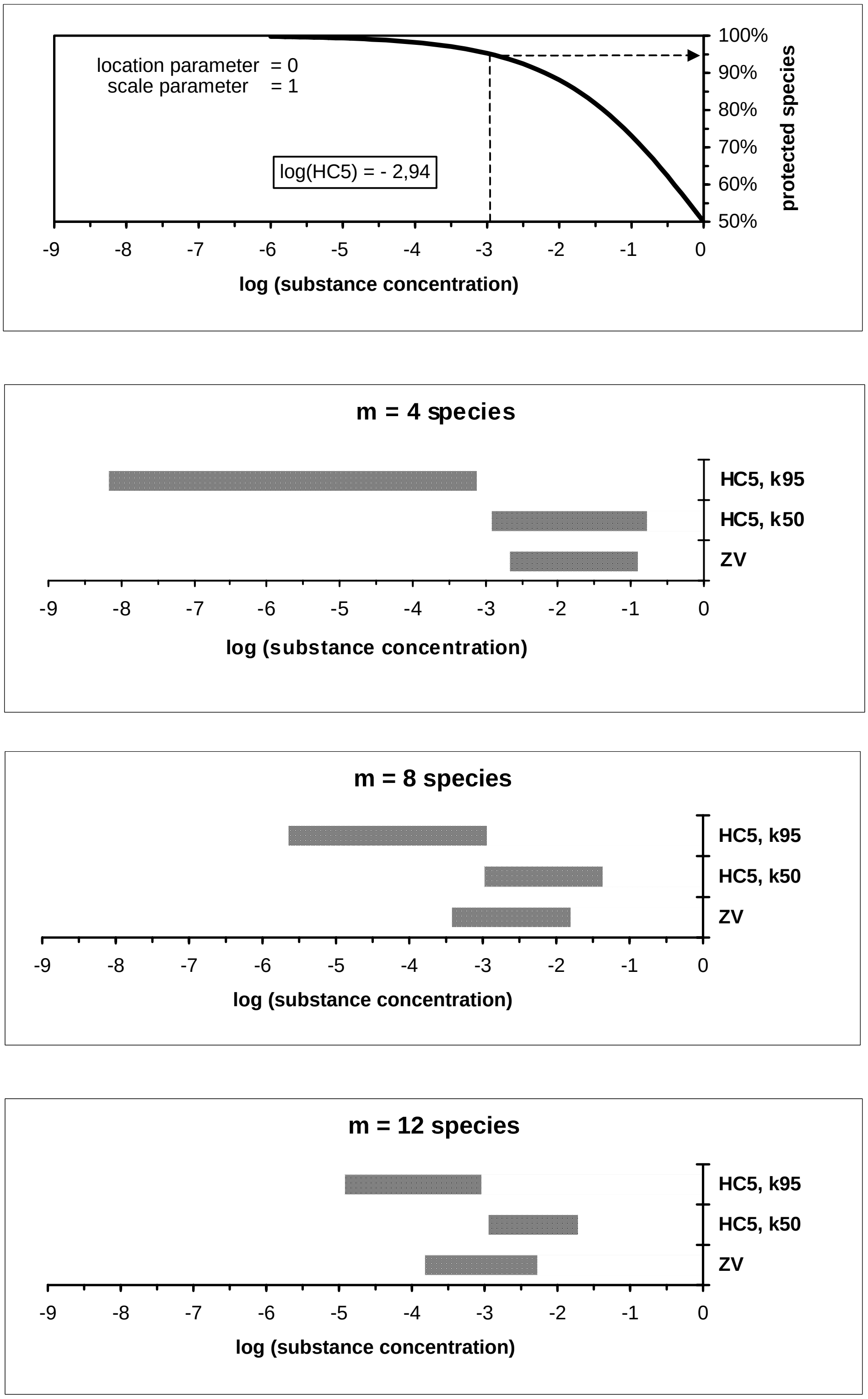
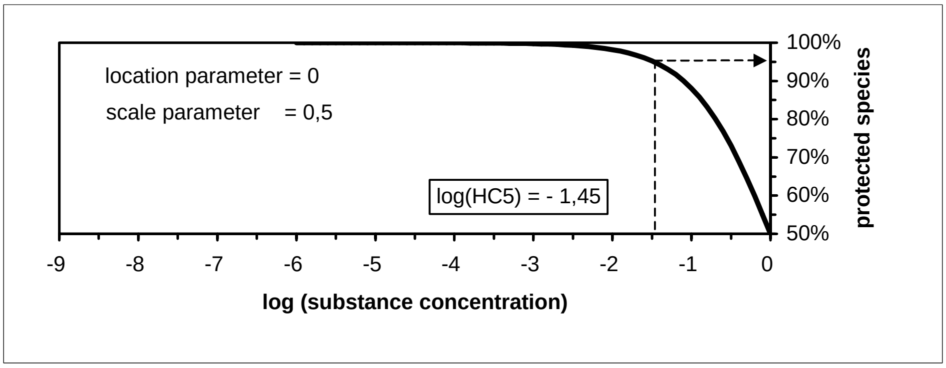
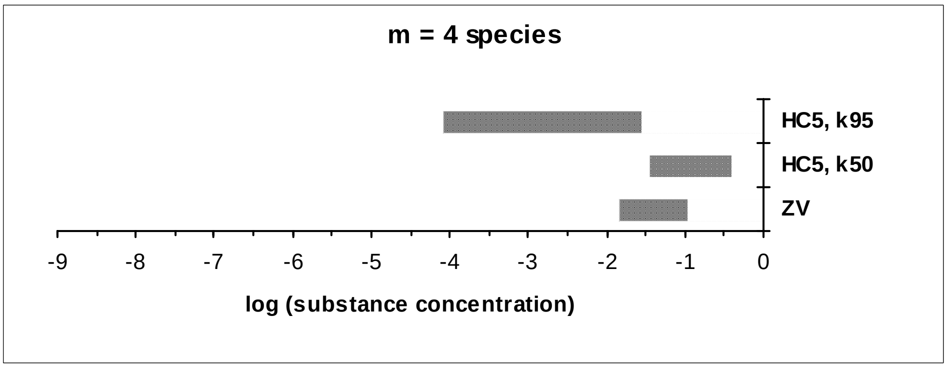
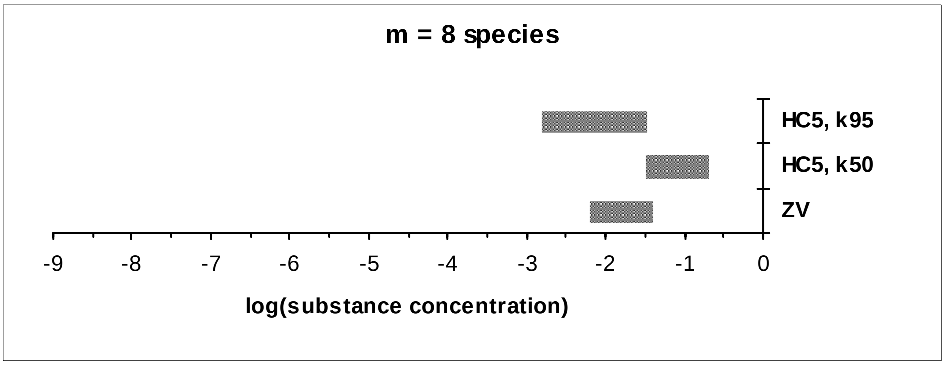


Fig. 8: Number of protected species compared to the extrapolation results (model: $\alpha = 0$, $\beta = 1$)

Bars: median value (left) and 95th percentile (right). ZV = smallest NOEC x 0.1, HC5, k50 = HC5 value calculated with a 50% probability, HC5, k95 = HC5 value calculated with 95% probability







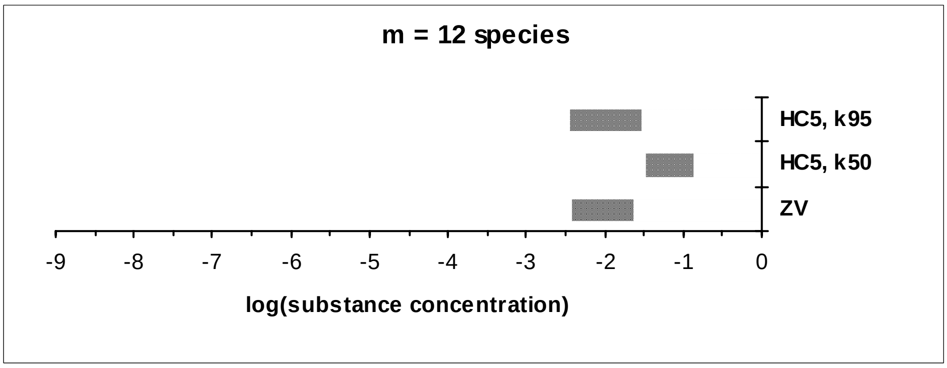


Fig. 9: Number of protected species compared to the extrapolation results (model: $\alpha = 0$, $\beta = 0.5$)

Bars: median value (left) and 95th percentile (right). ZV = smallest NOEC x 0.1, HC5, k50 = HC5 value calculated with a 50% probability, HC5, k95 = HC5 value calculated with 95% probability

3.2 Food Chain Effects (Secondary Poisoning)

The BLAK QZ approach to derive water quality criteria does not truly consider the hazards to piscivorous mammals and birds posed by substances that accumulate in the food chain. The quality criteria established on a basis of limit values for food and drinking water to protect human health are not automatically sufficient to provide adequate protection for specialized feeders like otters or predatory birds. The ICPR (IKSR 1993) is considering to include the protection of piscivorous animal species in the derivation of quality targets within its Rhine Action Programme. However, an exact methodological approach to derive quality targets has not been presented to date.

USA

Possible strategies to derive water quality criteria that include wildlife protection were discussed during a U.S. EPA workshop (Kilkelly 1989). The participants recommended to add a final wildlife value to the existing water quality criterion derivation scheme. The five aspects below should be considered in the examination of hazards to wild animals that are exposed to toxic substances:

- the bioaccumulation of the substance in the food chain,
- the persistence of the substance,
- the physiological differences in the metabolic mechanisms between mammals, birds and aquatic organisms,
- increased exposure resulting from the way a certain species lives,
- increased exposure or extreme toxic effects resulting from certain characteristics in the course of life of a species. For example, hibernating and migrating species deplete their fat reserves while the pollutants stored in the fat are released in the animal's body.

The maximum values for food established in the United States do not always appear to be sufficient to provide adequate wildlife protection as they were developed in view of the consumptional behaviour of humans. The only water quality criteria considering wildlife protection that have been derived by the U.S. EPA to date relate to DDT, PCB, mercury and selenium.

The typical contamination pathway considered in the derivation of quality criteria would be: water – animal and water – food (fish) – animal. However, exposure via - sedimentary ingestion in the search of food, particle ingestion while preening the cleaning of fur and plumage, dermal contact, and the respiratory tract - was not accounted for. As regards lipophilic substances which accumulate in the food chain and sediment, the main type of exposure is the uptake through food. Drinking water consumption and an uptake through the respiratory tract are generally considered less significant exposure pathways.

The Great Lakes Water Quality Initiative suggested to establish water quality criteria for DDT, mercury, 2,3,7,8-TCDD and PCB to protect wild birds and mammals (U.S. EPA 1995a) which are listed in the appendix. The Wildlife Value (WV) was calculated pursuant to the U.S. EPA guidance document (1995b) as follows:

$$WV = \frac{TD \cdot \left[1/(UF_A \cdot UF_S \cdot UF_L) \right] \cdot Wt}{W + \sum \left(F_{TLi} \cdot BAF_{TLi} \right)} \qquad \text{Eq.(32)}$$

WV = Species-specific Wildlife Value (mg/l)
W = Daily drinking water ingestion (l/d)
F_{TLi} = Average daily food uptake from a trophic level (kg/d)
BAF_{TLi} = Bioaccumulation factor for wildlife food from trophic level i (l/kg)
Wt = Average weight of a typical species
TD = Test material dose (mg/kg d) for tested species (NOAEL or LOAEL from tests on mammals or birds)
UF_A = Uncertainty factor to account for extrapolation of species (1-100)
UF_S = Uncertainty factor to account for extrapolation subchronic – chronic (1-10)
UF_L = Uncertainty factor to account for extrapolation from LOAL to NOAEL (1-10)

The WV for mammals was calculated from the geometric mean of the WVs of river otter (*Lutra canadensis*) and American mink (*Mustela vison*). The WV for birds was calculated from the geometric mean of the WVs of belted kingfisher (*Ceryle alcyon*), herring gull (*Larus argentatus*) and bald eagle (*Haliaeetus leucocephalus*). The WV is the concentration that is assumed to have no harmful effect on the tested species or species group if it is complied with. The lowest WV of both taxonomic groups was established as a Great Lakes Wildlife Criterion to protect all piscivorous species that are listed. The uncertainty factors (UF) were selected depending on the available effect tests and account for the uncertainty in transferring the test results to real-world environmental conditions. The principles of establishing the uncertainty factors are laid down in the U.S. EPA guidance document (1995b). The report of the U.S. EPA (1995a) gives examples of how the factors are handled.

The Netherlands

In the Netherlands, a methodology for the evaluation of new substances was developed which includes the contamination pathway water – fish – piscivorous mammal or bird in the derivation of environmental quality criteria (Romijn et al. 1991, 1993). The extrapolation is based on effect values that relate to the hazardous concentration in food. No observed effect concentration (NOEC) values from chronic effect tests on mammals and birds that examine the endpoints mortality, reproduction and growth are best suited for this derivation.

Two extrapolation methods are used to establish the maximum permissible concentration (MPC). If NOEC values for at least 4 species are available, a hazardous concentration for 5% of the species (HC5) is calculated with a 50% confidence level according to the method of Aldenberg and Slob (1991) and used as a maximum permissible concentration in food. Assessment factors are used whenever less than 4 NOEC values are available (see Table 7).

Table 7: Assessment factors used to establish the maximum permissible concentrations in the food of mammals and birds (MPC)

Available information	**Point of departure**	**Assessment factor**
Less than 3 LC50 values, no NOEC value	Lowest value	1/1000
At least 3 LC50 values, no NOEC value	Lowest value	1/100
Less than 3 NOEC values	Lowest value	1/10 [1]
At least 3 NOEC values	Lowest value	01/10

[1] The extrapolated MPC value is compared to the MPC value which was extrapolated from the LC50 values. The lowest MPC value is used.

If several NOEC values for a species are available when the same parameter is tested, the geometric mean of the values is calculated. The compensation factors are based on the comparison of acute and chronic test results. Subchronic effect values based on exposure periods longer than one month are used without an extra assessment factor. Test results based on an exposure period of one month are still regarded as chronic if the effects on reproduction were examined. In contrast, if only mortality or growth were examined, the data are classified as subacute.

The maximum permissible concentration in water (MPC_{aqu}) and the negligible concentration (NC) in water are calculated using the bioconcentration factor (BCF) and the estimated maximum permissible concentration in food organisms (MPC):

$$MPC_{aqu} = MPC / BCF \qquad \text{Eq. (33)}$$

$$NC = (MPC / BCF) \times 0.01 = MPC_{aqu} \times 0.01 \qquad \text{Eq. (34)}$$

The geometric mean of the BCF values of fish which is calculated based on literature data normally provides an estimate which comes close to reality. The fact whether the effect values of mammals and birds are used jointly or individually may produce different extrapolation results in statistical extrapolation methods.

The works of Romijn et al. (1991) were considered in the elaboration of a guidance document for the derivation of environmental quality criteria (Slooff 1992). Whenever the NOEC values of at least four different species of aquatic organisms are available, the NOEC values of birds and mammals are extrapolated to the concentration in the aqueous phase; subsequently they are combined with the data of aquatic organisms to calculate a HC5 value with a 50% confidence using the method of Aldenberg and Slob (1991). If not enough NOEC values are available to use the statistical extrapolation method, the assessment factors listed in Table 7 are applied (preliminary evaluation method). In a final step it is examined whether sufficient protection for "endangered species" is provided by comparing the MPC value with the NOEC values of carnivorous species.

Jonkers and Everts (1992) and Van de Plassche (1994) provided proposals for a modification of this method. In contrast to the original method, Jonkers and Everts (1992) use correction factors for the energy contained in nutrients and for the metabolic rate because the food for laboratory animals has a higher nutritional value than the food consumed by fish and shells, while animals living in the wild consume more energy than those living in a laboratory. However, there is a lot of controversy about the use of correction factors (Slooff et al. 1995). As only the differences in the energy content of food have been sufficiently verified, Van de Plassche (1994) uses a correction factor only to account for the different nutritional values of food. The method proposed by Slooff (1992) to derive MPC values by merging the effect data of mammals and birds with the ones of aquatic organisms is subject to raise doubts concerning the transfer of the NOEC values (among other things). This is the reason why the Health Council of the Netherlands favours a separate derivation of MPC values for aquatic organisms and carnivorous mammals and birds (Van de Plassche 1994).

$$MPC_{water} = \frac{NOEC_{bird;mammal} \cdot C}{BCF_{fish;shell}}$$

C = 0.32 for fish and C = 0.2 for shells serving as food

European Union

Section 3.8 (Assessment of Secondary Poisoning) of the Technical Guidance Document (EC 1996) on the risk assessment for existing and new substances contains an approach to derive a criterion value to protect carnivorous animals ($PNEC_{oral}$). The procedure is very similar to the Dutch approach. However, the use of a statistical extrapolation method is not provided for. The assessment factors listed in Table 8 are used for derivation. The differences in the nutrient value of the food of piscivorous animal species and laboratory animals (predominantly cereals) can be accounted for by an additional correction factor. The test results of laboratory animals are multiplied by a factor of 1/3 if applicable.

Table 8: Assessment factors used for the derivation of a $PNEC_{oral}$ value

Available information	**Point of departure**	**Assessment factor ***
LC50 values (5 d test)	Lowest value	1/1000
NOEC values (28 d test)	Lowest value	1/100
NOEC values (90 d test)	Lowest value	1/30
NOEC values (chronic test)	Lowest value	1/10

* additional correction factor of 1/3 to account for differences in nutritional values if applicable

Canada

Canadian scientists have selected a modified procedure to protect wildlife that feeds on aquatic organisms (CCME 1998). It comprises the derivation of quality guidelines for hazardous concentrations of DDT, PCB and toxaphene in fish (Tissue Residue Guidelines, TRG). A transfer of the values to the aqueous phase is not provided for.

A derivation of quality guidelines (Tissue Residue Guidelines; TRG) requires test results of three mammal species and two bird species (preferably those feeding on aquatic organisms). A minimum of two subchronic or chronic tests with sensitive endpoints must be available for mammals. Acute, subchronic or chronic tests on three mammal species and one bird species are regarded as sufficient for a derivation of interim quality guidelines. The first step in the derivation of a quality guideline would be to calculate a "tolerable daily intake" (TDI) for birds and mammals based on the most sensitive endpoint taken from the toxicology literature. The TDI value is calculated as the geometric mean of LOAEL and NOAEL by applying an appropriate uncertainty factor (UF).

$$TDI = (LOAEL \times NOAEL)^{0.5} / UF \qquad \text{Eq. (35)}$$

TDI = Tolerable daily intake (mg/kg body weight per day)

LOAEL = Lowest observed adverse effect level (mg/kg body weight per day)

NOAEL = No observed adverse effect level (mg/kg body weight per day)

UF = Uncertainty factor (10 - 1000)

If the NOAEL cannot be extrapolated from the dose-response relationship graph, the NOAEL is estimated (NOAEL = LOAEL ÷ 5.6). The uncertainty factor used to derive the TDI value should not be smaller than 10. The uncertainty factor may be greater than 10, depending on the tested substance and the amount and quality of available data.

As the lowest TDI does not automatically produce the lowest acceptable food concentration due to the differences in the ratio of food ingestion rate (FI) to body weight (BW), "reference concentrations" are calculated for selected mammals and birds. American mink (*Mustela vison,* BW = 0.6 kg, FI = 0.143 kg/d) and Wilson's Petrel (*Oceanites oceanicus,* BW = 0.032 kg, FI = 0.03 kg/d) are selected as potentially endangered species. The lowest calculated reference concentration (RC) is used as a quality guideline (Tissue Residue Guideline) for the residue in predatory fishes (fishes from the 4th trophic level).

$$RC_n = TDI \times BW / FI \qquad \text{Eq. (36)}$$

RC_n = Reference concentration (mg/kg), where n refers to one of several wildlife species for which a RC can be calculated.

TDI = Tolerable daily intake (mg/kg/d)

BW = Body weight (kg)

FI = Food ingestion rate (kg/d fresh weight)

Comparison of Concepts

A comparison of the concepts reveals that the methods differ mainly in the input data they require and in the extrapolation procedures that are used (see Table 9). This explains the differences in the numerical values of the quality criteria for piscivorous species that have been proposed to date (see Table 10). In principle, however, the existing concepts are definitely comparable although they need further harmonization and development. An essential point in this context will be to establish food chain models to transfer derived quality criteria to other media (tissue of birds/mammals, sediments). The Canadian approach provides a good foundation for a German or European derivation method. Other species would have to be selected as reference species while the NOAEL should be used instead of the geometric mean of LOAEL and NOAEL.

Table 9: Derivation of quality criteria to protect wildlife species (aquatic food chain) Overview of methods

	Canada CCME (1998)	**European Union (1996)**	**The Netherlands Van de Plassche (1994)**	**U.S. EPA (1995b)**
Designation of values	Tissue Residue Guideline (TRG)	Predicted No Effect Concentration (PNEC)	Maximum Permissible Concentration (MPC) / Negligible Concentration (NC)	Great Lakes Wildlife Criterion (WLC)
Exposure pathway	Fish - bird/mammal	Water - fish - bird/mammal	Water - fish/shell - bird/mammal	Water - fish - bird/mammal
Protection level	Protection of all species	Protection of piscivorous species	MPC: 95% of all species NC: all species	Mink, river otter, belted kingfisher, herring gull, bald eagle
Minimum data set	NOAEL and LOAEL (dose) from subchronic and chronic tests Full guideline: 3 mammal species and 2 bird species	NOEC or LOEC (food concentration) from subchronic and chronic tests on mammals (28/90 days) and birds (28 days, 5-day LC50 if necessary)	Statistical model (at least 4 NOECs) Assessment factors (less than 4 NOECs)	NOAEL or LOAEL (dose) from subchronic and chronic tests on mammals (28/90 days) and birds (28/70 days)
Compensation factor (total)	Uncertainty factor (UF) UF > = 10	Assessment factor (AF) AF = 1000, 100, 30, 10	Assessment factor AF = 1000, 100, 10	Uncertainty factor $UF = UF_A * UF_S * UF_L$
Interspecies	10 or 100	10	10 or 100	UF_A = 1-100
Acute-chronic	-	100 (5 d test on birds)	10	-
Subchronic - chronic	1-10 (subchronic data only: 10)	10 (28 d test) 3 (90 d test) 1 (chronic)	-	UF_S = 1-10
LOAEL - NOAEL	NOAEL = LOAEL / 5.6	NOEC = LOEC / 2 (mortality < 20%)	NOEC = LOEC / AF AF = 2, 3, 10 or NOEC = EC 10	UF_L = 1-10
Differences in nutrient values laboratory-field	Accounted for by ratio of body weight to food ingestion rate	NOEC (predator) = NOEC (laboratory animals) x 1/3	NOEC (predator) = NOEC (lab animals) x C C (Fish) = 0.32 C (Shells) = 0.20	Accounted for by ratio of body weight to food ingestion rate
Derivation methods	Calculation of tolerable daily intake (TDI) values for birds and mammals by using uncertainty factors Derivation of a TRG value considering body weight and food ingestion rate of consumers in the field	$PNEC_{oral}$ = NOEC / AF Transfer to aqueous phase by using bioconcentration factors	Statistical model Calculation of HC_5 with 50% confidence, HC_5 = MPC Assessment factors MPC = NOEC / AF NC = MPC / 100 Transfer of values to the aqueous phase by using bioconcentration factors	Derivation of a WLC by use of uncertainty factors; bioaccumulation factors, body weight, food and water ingestion rate of consumers in the field are accounted for
Monitoring to evaluate the concentration in:	Maximum value, fishes from the 4th trophic level (e.g. pike, pikeperch, wels)	Water (Fish)	Water	Water

HC_5 = Hazardous concentration for 5% of the species
NOEC = No observed effect concentration
NOAEL = No observed adverse effect level
EC = Effect concentration,
LOEC = Lowest observed effect concentration
LOAEL = Lowest observed adverse effect level

Table 10: Quality criteria to protect wildlife species (aquatic food chain)

Parameter	**Area**	**Criterion**	**Water (ng/l)**	**Food (µg/kg) FG**	**Reference**	**Note**	**Literature**
DDT including metabolites	CAN	TRG	-	14	Fish TL 4	-	1
DDT including metabolites	USA-GL	WLC	0.011	19 103	Fish TL 3 Fish TL 4	a	2
DDT including metabolites	NL	MPC	0.44	-	-	c	5
PCB total 28, 52, 101, 118, 138, 153, 180	NL	SL	-	6	Fish	b	4
PCB total	USA-GL	WLC	0.074	137 460	Fish TL 3 Fish TL 4	a	2
PCB (TEQs)	CAN	TRG	-	0.00079	Fish TL 4	-	1
PCB (TEQs)	NL	SL	-	0.0007	Fish	b	4
Mercury including methyl mercury	USA-GL	WLC	1.3	36 182	Fish TL 3 Fish TL 4	a	2
Methyl mercury	NL	MPC	1.9	24	Shells	-	3, 5
Toxaphene	CAN	TRG	-	6.3	Fish TL 4	-	1
Tetrachlorodibenzo-p-dioxine, 2,3,7,8-	USA-GL	WLC	0.0000031	0.00053 0.00082	Fish TL 3 Fish TL 4	a	2

Abbreviations:

CAN:	Canada	TEQ:	Dioxin toxic equivalent
FG:	Fresh weight	TL:	Trophic level
MPC:	Maximum permissible concentration	TRG:	Tissue residue guideline
NL:	The Netherlands	USA-GL:	U.S. Great Lakes
SL:	Safe level	WLC:	Wildlife criterion

Notes:

a	The residue in fishes from TL3 and TL4 was calculated by using the bioaccumulation factors (BAF) based on the available WLC (see sources).
b	Quality criterion to protect river otters. The value is based on 6.2% fat in all food.
c	The value was derived from the effect values of p,p'-DDD.

Sources:

1 CCME (1999)
2 U.S. EPA (1995a)
3 Slooff et al. (1995)
4 Smit et al. (1996)
5 Van de Plassche (1994)

3.3 Protected Asset: Fishery

Apart from protecting fishes as components of aquatic communities, the derivation of quality criteria should also consider the threat posed to human health by the ingestion of contaminated fish. This is why the approach of the German BLAK QZ accounts for the derivation of quality targets to protect commercial and sport fishing which are based on the valid maximum values for aquatic food. The quality target, which considers the bioconcentration factor (BCF) of a substance, is derived as follows (LAWA 1997):

$$\text{ZV (mg / l)} = \frac{\text{Maximum value for food referring to fresh weight (mg / kg)}}{\text{BCF (l / kg)}} \qquad \text{Eq.(37)}$$

A similar procedure is proposed in the United States (Stephan et al. 1985, Devonald and Maxted 1989, U.S. EPA 1991c). When a water quality criterion is derived to protect human health, however, an integration of additional exposure pathways (drinking water, miscellaneous food) is provided for. In addition, the bioaccumulation factor (BAF) is used to establish the criterion value. The BAF may be assessed based on the BCF value by means of a food chain multiplier. The BAF accounts for an uptake through all exposure pathways, whereas the BCF only accounts for an uptake by fish through the aqueous phase. When the BCF value is used for highly lipophilic substances, the accumulation in aquatic organisms might be underestimated (see Chapter 5.5).

3.4 Protected Asset: Drinking Water Supply

The quality of surface waters for drinking water abstraction should be such that drinking water can be easily processed by means of soil passage and low-velocity sandfilters. This requires the corresponding quality criteria to be closely associated with the limit values for drinking water. This involves accounting for the fact that drinking water limit values are maximum values that must not be exceeded, which means that it cannot be our goal to fully exploit the maximum values for surface waters (Markard 1992). The BLAK QZ (LAWA 1997) concept to establish quality criteria for the protection of drinking water generally uses the A1 values from the EC Surface Water Directive (75/440/EEC), the parameter values of the EC Drinking Water Directive (98/83/EC), the limit values of the German Drinking Water Decree (*Trinkwasserverordnung - TrinkwV*) as well as scientifically founded recommended values (BGA, WHO, U.S. EPA etc.). For reasons of aquatic and environmental hygiene, a maximum concentration of 10 µg/l should be targeted as a quality criterion and as an absolute upper limit for substances which are synthetic, can be toxicologically evaluated, are not hazardous in a genotoxic sense and for which no maximum values have been derived yet (LAWA 1997, Markard 1992).

As far as genotoxic material is concerned, however, Section II 4.7-Dieter of the Federal Environmental Agency suggests that the maximum concentration of those substances should be

- limited to 0.10 µg/l

in order to protect drinking water consumers.

Depending on the available data, the absolute upper limits for non-genotoxic substances which can be toxicologically assessed to some extent should be

- 0.30 µg/l (no other information is available apart from negative genotoxic data),
- 1.0 µg/l (additional positive data on reproduction toxicity and affected germ cells are available yet do not produce a lower value),
- 3.0 µg/l (additional positive data from at least one subchronic study are available yet do not produce a lower value),
- 10 µg/l (if an almost complete toxicological data set does not produce a deeper value).

The absolute upper limit of 10 µg/l (even for substances that can be thoroughly evaluated from a toxicological point of view) accounts for the so-called "rule of minimization" (*Minimierungsgebot*) established in Section 2 (3) of the German Drinking Water Decree as well as for the fundamental provisions established in the German Industrial Standard DIN 2000 which envisions water bodies that are essentially free of pollution, as a contamination is always associated with anthropogenic discharges which may be prevented in the first place. With regard to material for which no statutory limit values have yet been established, the principle of prevention and the rule of minimization imply that only very small amounts, i.e. more or less negligible concentrations of those substances should be present or expected in drinking water (Dieter 1999). It should be added that a cooperation between the water supply industry and the agricultural sector has contributed to reduce the use of pesticides in the vicinity of drinking water processing areas in a way that the pollution of groundwater in those areas is less than 0.10 µg/l for a single substance. This kind of cooperation should be regarded as a model for extensive groundwater protection and would help to further relieve surface waters as well, because values greater than 0.10 µg/l would only occur during a few days when pesticides are actually applied.

Hence, instead of focussing merely on (eco)toxicological derivations, the search for quality objectives should also include technological options following the principles of prevention and cooperation.

Dieter (1994) provided the most recent summary of the WHO guidelines and the German and European limit values for drinking water.

Likewise, national drinking water standards are used to derive water quality criteria to protect drinking water supply in the Netherlands (VROM 1991b) and the United States (U.S. EPA 1986, 1999). In contrast, Canadian scientists do not plan to apply drinking water guidelines to surface waters (CCME 1999). However, the main differences in fundamental maximum values relate to pesticides. While EC Directive 80/778/EEC and the Drinking Water Decree

determine a general precautional value for all pesticides (0.1 µg/l for a single substance, 0.5 µg/l for the total of all substances), the derivation methods for maximum concentrations of those substances in drinking water used by Canadian, US and WHO experts are based exclusively on human toxicology criteria. Consequently, the permissible or tolerable concentrations of numerous active ingredients of pesticides in drinking water are greater than those in the EU. For an overview of the maximum values for drinking water pollutants in the United States please visit the U.S. EPA website at:
http://www.epa.gov/ostwater/pc/drinking.html).

Carcinogenic Effects of Genotoxic Substances

Any genotoxic material with the potential to get from a surface water body into the drinking water during abstraction is suspected to have a carcinogenic effect on humans. As far as the aquatic exposure pathway is concerned, consumption of drinking water and freshwater fish are the main sources of contamination for human beings. As genotoxic-carcinogenic substances in general should have no effect threshold, a concentration is calculated for the tested substances which corresponds to an additional "socially acceptable" cancer risk (Markard 1992). For instance, an acceptable additional risk value of 10^{-5} per lifetime (70 years) was determined by the government (LAWA 1997). This would be equivalent to one additional cancer case in a population of 100,000 in case of a lifelong exposure to the calculated concentration in 2 litres per day. In the case of drinking water, however, the EU regards a maximum additional risk value of 10^{-6} as acceptable fur human health (and as politically accepted).

A derivation of a quality criterion for drinking water accounting for the consumption of freshwater fish requires the material's risk unit (the number of additional cancer cases per mg of contaminant per kg of body weight per day) and a mean BCF value to be known. The calculation of a preliminary cancer risk quality target below is based on a methodological approach of the U.S. EPA (Superfund Public Health Evaluation Manual, EPA 540/1-86/060). The following values serve as initial parameters (LAWA 1997): Body Weight = 70 kg, Drinking Water Consumption = 2 l/d, Freshwater Fish Consumption = 10 g/d. Due to the uncertainties involved in the derivation of quality criteria for cancer risk, the values are only used for comparative reasons so far, unless binding limit values exist which account for the carcinogenic risk (LAWA 1997). The suggested quality criteria for cancer risk (U.S. EPA 1986, Gottschalk 1994) are listed in the appendix. The U.S. EPA (1991c) recommends to derive the values based on current information contained in the IRIS (Integrated Risk Information System) database which can be viewed on the Internet at: http://www.epa.gov/iris

Individual quality criteria (WQC) may be calculated as follows for each exposure pathway based on U.S. EPA data (1991c):

Drinking water

$$\mathrm{WQC}\ (\mathrm{mg/l}) = \frac{10^{-x} \cdot 70\ \mathrm{kg}}{q_1^* \cdot 2\ \mathrm{l/d}} \qquad \text{Eq.(38)}$$

Fish consumption

$$\mathrm{WQC}\ (\mathrm{mg/l}) = \frac{10^{-x} \cdot 70\ \mathrm{kg}}{q_1^* \cdot \mathrm{BCF} \cdot 0.01\ \mathrm{kg/d}} \qquad \text{Eq.(39)}$$

Drinking water and fish consumption

$$\mathrm{WQC}\ (\mathrm{mg/l}) = \frac{10^{-x} \cdot 70\ \mathrm{kg}}{q_1^* \cdot \left(\mathrm{BCF} \cdot 0.01\ \mathrm{kg/d} + 2\ \mathrm{l/d}\right)} \qquad \text{Eq.(40)}$$

10^{-x} = Risk level $(x=5)$

q_1^* = Carcinogenic potency factor (kg d / mg)

BCF = Bioconcentration factor (l / kg)

It should be noted that in the case of substances which have a mutagenic and a non-threshold carcinogenic effect, the effects of individual substances might add up such that an analysis of individual agents will not suffice to provide an overview of the overall genotoxic contamination of a water body. Various methodological approaches to establish mutagenic potentials and their effects are currently being developed and tested (Burnison and Rao 1999, Zahn 1992, Herbert and Hansen 1992, Hansen 1992). Furthermore, a joint research programme by the Federal Ministry of Education, Science, Research and Technology called "Trial, Comparison, Further Development and Evaluation of Genotoxicity Tests on Surface Water" (*Erprobung, Vergleich, Weiterentwicklung und Beurteilung von Gentoxizitätstests für Oberflächenwasser*) is in its final stages. The programme comprised 15 integrated projects (project numbers 02 WU 9549 to 02 WU 9563) from 1995 until 1999. Section II 4.7-Grummt of the Federal Environmental Agency contributed two projects to this programme.

The procedure is to establish a relation between the mutagenic effect of a water sample determined in a biotest and a reference mutagen. In most cases, however, this kind of approach does neither allow an allocation nor a final evaluation of the established genotoxic potential. In addition, appropriate waste water tests and/or quality criteria for individual substances are required to identify sources of impact.

3.5 Suspended Matter and Sediments

3.5.1 Introduction

Sediments represent both a sink and a source of impact for numerous organic environmental chemicals and metals which accumulate in suspended matter. This is the reason why the concentrations of hazardous substances in suspended matter and sediments must not reach values which might affect the community of benthic organisms, the food chain ("secondary poisoning") or water engineering activities.

Various methodological approaches to derive quality criteria to protect benthic organisms are currently being developed. Evaluations of existing approaches were presented during an OECD workshop (1992a), in a U.S. EPA documentation (1992a) and in a literature research study commissioned by the Federal Environmental Agency (Zimmer and Ahlf 1994).

The effects of local sediment pollution on benthic communities may be established in retrospect by means of biological classification procedures (Ahlf and Gratzer 1999), whereas substance-specific sediment quality criteria are required in order to be able to evaluate monitoring data and the substances themselves.

In principle, the following approaches seem to be appropriate when establishing chemical and numerical sediment quality criteria:

- equilibrium partitioning approach
- effect tests on sedimentary organisms
- integrating approaches
- tissue residue approach
- background approach
- integration of existing sediment quality criteria and standards
- integration of soil quality criteria and standards

As some of the approaches above are still being developed, it is impossible to make a final evaluation of all methods. The individual approaches will be briefly outlined in the following paragraphs.

3.5.2. Equilibrium Partitioning Approach

The equilibrium partitioning (EP) method is based on the theory that sediment-sorbed substances reach a state of equilibrium between sediment and pore water in an appropriate period of time. The principle of this method is that a hazardous concentration in the pore water which was assessed from the equilibrium distribution does not exceed an existing quality criterion (WQC). Parting from an existing water quality criterion, the partition coefficient (Kd) is used to assess the corresponding sediment quality criterion. The partition coefficient is defined as the quotient of the equilibrium concentration of a substance in the sediment (C_S) over that of a substance in the pore water (C_W).

$Kd = C_S / C_W$ Eq.(41)

The partition coefficient Kd may be assessed using either the sediment-water partition coefficient with reference to the organic carbon content (Koc) or the octanol-water partition coefficient (Kow). Karickhoff (1981) established a correlation between Koc and Kow. The Kd value may be assessed by using an empirically established coefficient according to the following equation:

$Kd = Koc \cdot f_{OC}$ Eq.(42)

$Kd = 10^{-0.21} \cdot Kow \cdot f_{OC}$ Eq.(43)

f_{OC} = Percentage of organic carbon in total sediment mass

The average percentage of organic carbon is approximately 10% in suspended matter and 5% in sediments. Hence, the values 0.1 or 0.05, respectively, are mostly used for f_{OC} (Van Leeuwen et al. 1992, Stortelder et al. 1989).

In other studies the calculation of the Kd value is slightly modified as follows:

Van de Meent et al. (1990), Jonkers and Everts (1992)	$Kd = 0.5 \cdot Kow \cdot f_{OC}$	Eq.(44)
EC (1996)	$Kd = Koc \cdot f_{OC}$	Eq.(45)
U.S. EPA (1991)	$Kd = Koc \cdot f_{OC}$ with $\log Koc = 0.00028 + 0.983 \log Kow$	Eq.(46)

It is also possible to assess the Koc based either on laboratory experiments on particle suspension or sediment toxicity tests (U.S. EPA 1991).

Using the Kd or the Koc value, respectively, a sediment quality criterion can be calculated either for the overall content in sediments (SQC) or for the organic carbon content (SQC_{OC}) as follows:

$SQC = Kd \cdot WQC$ (gel.) Eq.(47)

or

$SQCoc = Koc \cdot WQC$ (gel.) Eq.(48)

WQC (gel.) = Water quality criterion for the dissolved hazardous concentration

gel. = dissolved

The partition coefficient (Kd) may also be assessed on the basis of how a substance is distributed between water and an argillaceous mineral (e.g. fuller's earth, Merck No. 1901). Argillaceous minerals represent a major component of suspended matter and have a high absorbency. The BLAK QZ (LAWA 1997) approach recommends Kd values based on argillaceous minerals to derive quality targets for the protected asset suspended matter/sediments (SQC). The Kd value may also be assessed from field data. As the BLAK

QZ quality targets (WQC) refer to the total concentration in the aqueous phase, they may be recalculated as follows:

$$SQC = WQC\,(ges.) \cdot Kd \,/\, (10^{-6} \cdot Kd \cdot C_{sch} + 1). \qquad \text{Eq.(49)}$$

ges. = total

C_{sch} = concentration of suspended matter

The choice of the total concentration as a basis to derive quality criteria for suspended matter and sediments is a conservative approach as it is assumed out of precaution that the hazardous substances in suspended matter are fully bioavailable.

The following example (Table 11) shows the distinctions between both approaches (equations 47 and 49):

Table 11: Arithmetic example: SQC for hexachlorobenzene based on WQC(gel.) and WQC(ges.)

WQC(gel.) = 0.001 µg/l or WQC(ges.) = 0.001 µg/l

log Kow = 5.73 (Van Leeuwen 1992) and 6.18 (Van der Kooij 1991)

foc = 0.05 (sediment) and 0.1 (suspended matter)

Kd (average value) = 500,000 l/kg (Irmer et al. 1994)

C_{sch} = 25 mg/l

WQC µg/l	**Log(Kow)**	**Kow**	**foc**	**Kd** l/kg	**SQC** µg/kg	
WQC (gel.)						
0.001	5.73	537,032	0.05	**20,369**	**17**	$SQC = 10^{-0.21} \times foc \times Kow \times WQC\,(gel.)$
0.001	5.73	537,032	0.1	**40,738**	**33**	$SQC = 10^{-0.21} \times foc \times Kow \times WQC\,(gel.)$
0.001	6.18	1,513,561	0.05	**46,663**	**47**	$SQC = 10^{-0.21} \times foc \times Kow \times WQC\,(gel.)$
0.001	6.18	1,513,561	0.1	**93,325**	**93**	$SQC = 10^{-0.21} \times foc \times Kow \times WQC\,(gel.)$
0.001				**500,000**	**500**	SQC = Kd (average value) x WQC (gel.)
WQC (ges.)						
0.001	5.73	537,032	0.05	**20,369**	**13**	$SQC = WQC\,(ges.) \times Kd / (10^{-6} \times Kd \times c_{sch} + 1)$
0.001	5.73	537,032	0.1	**40,738**	**20**	$SQC = WQC\,(ges.) \times Kd / (10^{-6} \times Kd \times c_{sch} + 1)$
0.001	6.18	1,513,561	0.05	**46,663**	**22**	$SQC = WQC\,(ges.) \times Kd / (10^{-6} \times Kd \times c_{sch} + 1)$
0.001	6.18	1,513,561	0.1	**93,325**	**28**	$SQC = WQC\,(ges.) \times Kd / (10^{-6} \times Kd \times c_{sch} + 1)$
0.001				**500,000**	**37**	$SQC = WQC\,(ges.) \times Kd / (10^{-6} \times Kd \times c_{sch} + 1)$

The example shows that the Kd values which were assessed from the Kow values range from 20,000 to 90,000 l/kg, i.e. they are 5 to 20 times lower than the average value of 500,000 l/kg. If the calculation is based on the dissolved (gel.) HCB concentration, the resulting sediment quality criteria range from 17 to 500 µg/kg, depending on the Kd values.

A calculation based on the total concentration (ges.) yields criterion values ranging from 13 to 37 µg/l. The table shows that a calculation based on the total concentration produces slightly lower results and that heavily fluctuating Kd values exert less influence. A Kd value of 500,000 l/kg (average value) is possibly too great in this example and should therefore be revised.

Zimmer and Ahlf (1994) report that the use of the EP method is subject to several preconditions:

- The partition between sediment and pore water may for the most part be assessed from the organic carbon content in the sediment while the influence of other physical and chemical factors is negligible.
- The benthic organisms are as sensitive as the organisms living in the water column.
- Pollutant uptake from pore water is the main pathway of exposure.
- The aquatic system is at equilibrium.
- The Koc is roughly equal to the Kow such that the Kow may be used whenever the Koc should be missing.
- The experimental conditions (partition coefficients are established based on relatively small sediment/water proportions) may be transferred to the natural sedimentary environment.

Another major drawback of the EP method is the fact that it neglects the exposure of benthic organisms to sedimentary ingestion. There are signs that a simple sorption model is not sufficient to describe bioavailability (Meyer et al. 1993). For example, the smaller the grains, the easier non-polar organic substances will be sorbed into solid particles; however, this does not necessarily imply reduced bioavailability (Zimmer and Ahlf 1994). In general, sediment-sorbed hazardous substances appear to be more persistent, less mobile and more concentrated than those in the water column (Larson 1989). Various studies have shown that pore water is not the dominating exposure pathway in all systems. Bioavailability does not exclusively depend on the properties of the sediment but also on the nutrition of the tested species (Zimmer and Ahlf 1994).

The equilibrium partitioning approach was proposed by the U.S. EPA to establish national sediment quality criteria for non-polar organic substances (U.S. EPA 1992a) while it was used in the Netherlands to derive environmental quality criteria (Slooff 1992).

3.5.3 Effect Tests on Sedimentary Organisms

In the past only a few acknowledged test methods were available to establish the acute and chronic effects of hazardous substances on sedimentary organisms. This is the reason why no final recommendations exist in Europe as to what types of test results should be at hand in order to be able to derive a SQC with adequate confidence. For the purpose of risk assessment as part of the evaluation of hazardous substances in the EU, it was proposed to conduct long-term tests on the organisms *Lumbriculus variegatus, Tubifex spec., Chironomus tentans, Chironomus riparius, Hyalella azteca* and *Gammarus spec*. (Schwarz-Schulz 1999). The selection of test organisms accounts for interspecies differences in the way they live and develop food uptake strategies. The Canadian approach requires a minimum data set as a prerequisite (CCME 1995a). Table 12 provides a list of species that are often used in the US to examine toxic effects of sediments. Reports on test methods for sedimentary organisms were published by, inter alia, Ahlf and Grazer (1999), ASTM (1984), ASTM (1990a-e), ASTM (1991a-e), Burton (1991, 1992) and Environment Canada (1992).

Another problem consists in establishing appropriate compensation factors to account for the uncertainties in extrapolating the test results to real-life environmental conditions. One option would be to determine compensation factors analogous to the procedure used in the derivation of water quality criteria. The Canadian guidance document issued by the CCME (1995a) provides suggestions for selecting compensation factors. In the derivation of SQC, however, special risk factors should be accounted for by applying an additional compensation factor. For example, possible combined effects caused by a contamination of a sediment with numerous hazardous substances at a time must be considered. Another risk is represented by the fact that during microbial decomposition of poorly soluble organic substances, intermediary products with a higher water-solubility are generated which are more toxic than the original substance (Zimmer and Ahlf 1994).

A derivation of sediment quality criteria based on effect data requires selecting suitable test organisms, developing and standardizing new test methods for sedimentary organisms and establishing the necessary base data and appropriate compensation factors. As far as a standardization of sediment toxicity tests is concerned, it is most important to clarify the selection of appropriate reference sediments or artificial sediments.

Table 12: Benthic organisms frequently used in sediment toxicity tests in the US (according to Burton 1991, extract from Zimmer and Ahlf 1994)

Biological Level / Tested Organisms	**Endpoint**
Benthic Invertebrates	
Panagrellus redivivus	Survival
Caenorhabditis elegans	Survival
Tubifex tubifex	Survival
Stylodrilus heringianus	Survival, avoidance, sediment reworking rate, growth
Hyalella azteca	Survival, growth, reproduction
Pontoporeia hyi (Diporeia spec.)	Survival, avoidance
Corbicula fluminea	Survival, growth
Anodonata imbecilis	Survival
Chironomus tentans	Survival, growth, emergence
Chironomus riparius	Survival, growth
Hexagenia limbata	Survival, moulting frequency
Macrobenthic biocoenosis	Community and population indices
Macrophytes	
Hydrilla verticilata	Shoot length, root length, dehydrogenase activity, chlorophyll a, peroxidase

3.5.4 Integrating Approaches

The Canadian derivation method is an example how to combine data from field studies on contaminated sediments with sedimentary biotests and sediment quality criteria (CCME 1995a, Smith et al. 1996). To begin with, all data referring to a certain substance are listed in a table, the so-called "Biological Effects Database for Sediments" (BEDS). Separate data are evaluated and derived for freshwater and seawater organisms, respectively. In order to establish the sediment's quality, a Threshold Effect Level (TEL) and a Probable Effect Level (PEL) are derived for each substance listed in the BEDS table. TEL and PEL are calculated for all substances for which a minimum of 20 data sets is available both in the effect data set and in the no-effect data set. The TEL is calculated as the geometric mean of the 15th percentile of the effect data set and the 50th percentile of the no-effect data set. The TEL is meant to represent the concentration below which adverse effects are hardly ever observed. The PEL is calculated as the geometric mean of the 50th percentile of the effect data set and the 85th percentile of the no-effect data set. The PEL is meant to represent the concentration beyond which adverse biological effects are frequently observed. In Canada, the TEL is proposed as an interim Sediment Quality Guideline (SQG) when a derivation of a SQC based on biotests is prevented by missing data. The Canadian derivation method is based on the approach developed by the US National Status and Trends Program (Long and MacDonald 1992).

3.5.5 Tissue Residue Approach

This method aims at establishing the sediment chemical concentration that results in unacceptable tissue residue levels in fishes and benthic organisms. The steps below must be followed to be able to assess a SQC by means of the tissue residue approach:

1. A critical tissue concentration must be calculated which causes or slightly misses to cause, respectively, an unacceptable effect ($PNEC_{BW}$).
2. The calculation of the critical sedimentary concentration is based on the "biota sediment accumulation factor" (BSAF).

The SQC may be assessed as follows:

$$SQC_{oc} = PNEC_{BW,\ Fett} / BSAF \qquad \text{Eq.(50)}$$

$$PNEC_{BW,\ Fett} = PNEC_{BW} / f_{Fett} \qquad \text{Eq.(51)}$$

$$SQC = f_{oc} \cdot PNEC_{sed,\ oc} \qquad \text{Eq.(52)}$$

BSAF	Biota sediment accumulation factor standardized with regard to the fat content and the organic carbon content (OC) in the sediment	kg OC/kg Fett
f_{fett}	Percentage of fat in the fresh weight (FG) of aquatic organisms	kg Fett/kg FG
f_{oc}	Percentage of organic carbon in the default sediment (f_{oc} = 0.05)	kg OC/kg
$PNEC_{BW}$	Predicted no effect concentration of residue in biota relating to the total concentration in the body	mg/kg FG
$PNEC_{BW,\ Fett}$	Predicted no effect concentration of residue in biota relating to the concentration in the fat	mg/kg Fett
$PNEC_{sed}$	Predicted no effect concentration of residue in the sediment (f_{oc} = 0.05) relating to the overall concentration	mg/kg TS
$PNEC_{sed,\ oc}$	Predicted no effect concentration of residue in the sediment standardized with regard to the organic carbon content	mg/kg OC

Several procedures exist to derive the $\mathrm{PNEC}_{\mathrm{BW}}$ value for the maximum tolerable tissue residue:

- derivation from the critical concentration in the bodies of aquatic and sedimentary organisms as established in a toxicity test;
- multiplication of the criterion value for the protection of aquatic organisms (WQC) by an appropriate BCF value;
- derivation from maximum values for food or from "human health risk criteria" which have been established with regard to the consumption of contaminated aquatic organisms;
- derivation from the quality criterion for the protection of birds and mammals which was established with regard to the consumption of contaminated aquatic organisms.

The tissue residue approach requires an appropriate bioaccumulation factor (BSAF) to describe the proportion of the concentrations biota/sediment. The BSAF may be established by conducting experiments, by using chemical and physical distribution models or by applying phamarcokinetic models that allow to predict the tissue residue. The tissue residue approach is still being developed. One of its strong points is that it allows a better consideration of bioavailability compared to the EP method (OECD 1992a). The approach was used to develop a maximum tolerable concentration of 2,3,7,8-TCDD in the sediment of Lake Ontario. The derived quality criteria are intended to protect fish and wildlife species (U.S. EPA 1993b).

Although the EP method, the interstitial water method and sediment tests are recommended by the OECD (1992a) as preferable concepts, the tissue residue approach is regarded as having a good potential for development as it integrates different exposure pathways (pore water, sedimentary contact, sedimentary ingestion, nutrition). This is especially true for heavily lipophilic substances (log Kow > 5).

3.5.6 Background Approach

The background approach to derive quality criteria involves the use of natural background values (metals, PAHs) or the concentrations of largely unaffected sediments, provided their quality has been appropriately confirmed, e.g. by indicator organisms.

The background approach has the following advantages:

- Appropriately confirmed data on background contamination are available for metals and PAHs
- It does not require extensive effect studies.
- It can be combined with other approaches

One of the major drawbacks of the background approach is that it is neither truly accepted nor especially meaningful when no data are available to support its use. Supported by effect data, the background approach was primarily used to derive quality criteria for metals and PAHs (Crommentuijn et al. 1997a, Jonkers and Everts 1992, Schudoma 1994, Van de Plassche 1992).

3.5.7 Integration of Derived Sediment Quality Criteria and Standards

Toxicologically justified sediment quality criteria and standards are available for numerous substances in certain member states of the EU and the OECD (CCME 1999, Smith et al. 1996, VROM 1992a, U.S. EPA 1992a, Ginn and Pastorok 1992). The derived values are based both on the EP method and on evaluations of effect data from existing sedimentary contaminations. They may be used for a preliminary evaluation of the contamination of suspended matter and sediments.

3.5.8 Integration of Soil Quality Criteria and Standards

Apart from protecting both benthic and terrestrial communities (flood areas), sediment quality criteria are intended to make sure that excavated material may be used without hazard. It was proposed to use existing soil quality standards as additional sediment quality criteria (LAWA 1993, IKSR 1993, Schudoma 1994) in order to preserve the use of excavated material to elevate agricultural areas and protect terrestrial communities in flood areas.

3.5.9 Summary

The abstract of the different approaches above shows that several methods may be appropriate to develop quality criteria for suspended matter and sediments. The equilibrium partitioning method (LAWA 1997, Slooff 1992, U.S. EPA 1992a), the critical tissue concentration method (U.S. EPA 1993b) and integrating approaches (CCME 1999, Smith et al. 1996, U.S. EPA 1992a) have been the most frequently used methods to derive chemical and numerical SQC to date. For the derivation of sediment quality criteria, the maximum values and target values from the terrestrial sector are being used (LAWA 1997, Slooff 1992, Schudoma 1994, IKSR 1993). The quality of an established criterion will be better when the derivation is backed up by different methods as all existing approaches have their methodological limitations. Without doubt, the extrapolation of water quality criteria and the use of background values are pragmatic approaches to establish comprehensive quality criteria for suspended matter and sediments. Alternative methods are either still in the development stage or they require significant financial efforts and lots of time (including the methodological development) which doesn't appear to be justified in most cases. In general, compliance with quality criteria that protect aquatic communities should make sure that benthic communities are protected as well. An evaluation of contaminated sites, however, may require additional studies (e.g. sedimentary biotests) similar to those used, for example, in the ecotoxicological assessment of the sediments of the German river Elbe (Ahlf and Gratzer 1999).

4. Monitoring of Quality Criteria

The availability of appropriate analytical methods is a fundamental requirement for routine quality criteria monitoring. The analytical methods used for assessment purposes should be intercomparable and standardized (DIN, ISO). The quality of the analytical results must be confirmed by applying appropriate quality assurance procedures (Funk et al. 1985).
The following sample matrices allow quality criteria to be monitored: aqueous phase (total or dissolved), suspended matter, sediments, biological samples (fishes, shells, aquatic moss species and aufwuchs). Which sample matrix is best suited for monitoring purposes depends largely on the protected asset and the level of the analytical detection limit or determination limit, respectively. The concentrations of some harmful substances established as water quality criteria are so small that they make aqueous phase monitoring difficult. For example, a comparison of the determination limits of 1,2-dichloromethane, dichlorvos, hexachlorobenzene, malathion, parathion-ethyl and parathion-methyl with the quality targets established by the LAWA and the ICPR reveals that the quality targets are lower than or equivalent to the determination limits (Irmer et al. 1994). The development of new generations of highly effective pesticides with very small application rates generates a new problem, namely that it becomes almost impossible to detect biologically effective concentrations by chemical means. In some of those cases it might make sense to monitor other sample matrices, e.g. when the active ingredient accumulates in suspended matter and sediments.

When chemicals accumulate in suspended matter and sediments, the equilibrium partitioning method may be used to convert quality criteria into suspended matter content values (LAWA 1997).

$$
\begin{aligned}
c_{ges} &= c_s + c_{gel} \\
&= w_s \cdot c_{sch} \cdot 10^{-6} + w_s / Kd \qquad \text{Eq.(53)}
\end{aligned}
$$

c_{ges}	$(\mu g / l)$	Total concentration of the substance in the water sample
c_s	$(\mu g / l)$	Concentration of the portion of the substance adsorbed to suspended matter
c_{gel}	$(\mu g / l)$	Concentration of the portion of the substance dissolved in water
w_s	$(\mu g / kg)$	Content of the substance adsorbed to suspended matter
c_{sch}	(mg / l)	Concentration of suspended matter in the water sample
Kd	(l / kg)	Partition coefficient

After solving equation 53 for w_s the quality target can be compared by using the suspended matter values obtained from measuring programmes.

$$w_s = c_{ges} \cdot \frac{Kd}{10^{-6} \cdot Kd \cdot c_{sch} + 1} \qquad \text{Eq.(54)}$$

A value roughly equivalent to the average concentration of suspended matter contained in major running waters may be used as a default value for the concentration of suspended matter. The LAWA concept (LAWA 1997) provides for a standardized suspended matter concentration C_{sch} of 25 mg/l.

The partition coefficient is a material-specific value reflecting the material's distributional behaviour between water and suspended matter. Suspended matter is composed of argillaceous minerals, quartz and feldspar, plankton and dead organic matter. As clayey material has an extraordinary adsorption capacity, argillaceous minerals of known composition are well suited for establishing a standardized partition coefficient (Kd). A material's adsorptional behaviour in a natural environment depends on the composition of the suspended matter and other hydrochemical parameters. It should also be noted that a perfect equilibrium is hardly ever achieved in a running water body. This is why the Kd values for heavy metals established in the field (Rhine) fluctuate by roughly one order of magnitude (Stortelder 1989). Kd values derived from field data can be used as replacements and for comparisons. Due to the fluctuation of partition coefficients, a conversion of quality targets to the aqueous phase is always subject to doubt. The lower the Kd value, the less certain becomes the conversion. If a substance has a Kd value of 1000 l/kg, for example, only 2.5% of the substance is adsorbed to suspended matter (see Table 13). That is why the BLAK QZ concept provides only for a conversion of substances with a Kd value of 1000 l/kg or greater.

Table 13: Possible distribution of substances between the solid and fluid phases; initial conditions: 25 mg of argillaceous mineral (fuller's earth, Merck No. 1901) per litre; initial concentration: 10 µg/l

Partition coefficient (Kd)	Percentage of dissolved material	Percentage of adsorbed material	Concentration in argillaceous mineral
(l/kg)	%	%	(mg/kg)
10^3	97.5	2.5	10
4×10^3	90	10	40
10^4	80	20	80
4×10^4	50	50	20
10^5	28	72	290
10^6	3.6	96.2	385

As far as the protection of fishing and piscivorous animal species is concerned, quality criteria are often transferred to the aqueous phase or – for reasons of analyzability – to the suspended matter phase. Nevertheless, transferring maximum values or guidelines for tissue concentration to other phases will always produce an estimate rather than a definite value because both the partition coefficient Kd and the BCF value depend – among other things – on hydrochemical parameters and may fluctuate heavily. Quality criteria and quality standards for fish tissue concentrations should be directly monitored whenever possible. Monitoring of aqueous and suspended matter phases is sufficient to identify heavy impact areas.

Many problems are caused by substances which have quality criteria below the determination and detection limits of routine monitoring and do not accumulate in suspended matter. Improved analytical methods are needed to account for these cases. When emission data are available, a gross assessment can be made to check if quality criteria might be exceeded.

Frequency of Measurement and Statistical Parameters

When monitoring programmes are planned, the question how often measurements should be taken is frequently neglected (Hoppenheit 1991). Yet it is necessary to determine the number of measurements needed to calculate a 90th percentile. The approach of the ICPR (IKSR 1992a) recommends that normally a 90th percentile should only be given when the number of measurements N is > 12. As regards monitoring quality targets established by the LAWA, experts say that N = 11 measured values or a minimum of N = 6 measured values should be available to assess a 90th percentile. Monitoring of quality targets (90th percentile) involves defining the confidence level or certainty (S) with which it can be excluded that a quality target is exceeded in a series of measurements. Draft VDI 2450 sheet 5 (1977) of the Association of German Engineers (*Verein Deutscher Ingenieure*, VDI) says that if none of 13 measured values in N = 13 measurements exceeds or equals the quality target, there is a confidence level S > 75% that the quality target (90th percentile) has been complied with.

If less than 6 measurements of a chemical were taken, monitoring a quality target based on a 90th percentile does no longer make sense, as the statistical confidence will fall clearly below 50%. A pragmatic approach was suggested by the BLAK QZ, namely to compare either the mean value (3 - 5 measurements) or the maximum value (less than 3 measurements) with the 50% value of a quality target. In that case no statistical statement can be made as to the probability of compliance with the quality target.

If N = 6 measurements were taken, the confidence to assume that the 90th percentile is below the quality target is reduced to 50% even if all measured values were below the quality target. A 50% confidence level for the 90th percentile may be regarded as just about sufficient because aquatic communities usually suffer no severe adverse effects should a quality target be slightly exceeded. Limit value monitoring, however, requires a greater confidence level.

The 90th percentile method has the advantage that extreme values caused by exceptional conditions or measuring errors will not be considered. Furthermore, statistical evidence can be given on the compliance with the percentile. To protect the water biocoenosis, however, it must be ensured that the measured maximum values do not reach acutely toxic areas even if the quality target based on the 90th percentile is complied with.

The BLAK QZ concept suggests to monitor the derived quality targets by measuring the chemical's total concentration in the aqueous phase. In this context it is assumed out of precaution that a hazardous material – even if it is adsorbed to suspended matter – is fully bioavailable and may contribute to an increase of adverse effects. This is also common practice in Canada and the USA (CCME 1993, U.S. EPA 1986).

International Concepts

In Canada quality guidelines are always compared to the highest measured values such that no statement can be made as to the probability of compliance with the quality guidelines.

The proposal made by the U.S. EPA (Stephan et al. 1985) to tie quality criteria for continuous loads to a 4-day average value is hardly practicable in Germany because very few measuring points would allow daily measurements of single pollutant contents and such a high measuring rate would hardly make sense anyway.

In the Netherlands the quality criteria derived from effect data initially refer to the dissolved concentration. Using the equilibrium partitioning method, the quality criteria are then converted to the total concentration in a default water containing 30 mg of suspended matter per kg (Bruijn et al. 1999, Slooff 1992). Quality criteria of substances with a high partition coefficient (> 10,000 l/kg) differ substantially depending on whether they refer to the dissolved or the total concentration in the water. This method has a couple of shortcomings:

- The conversion is always prone to error as the partition coefficients my vary by more than 100%.
- Pollutants adsorbed to particles are potentially bioavailable, e.g. for filter feeders and sediment feeders.
- It is often difficult to determine the dissolved chemicals as the dissolved concentrations of substances with a high partition coefficient are frequently close to the determination limit.
- Conventionally, the concentration in the filtrate obtained from filtering with a 0.45 µm filter is regarded as the dissolved portion of the substance.

For precautional reasons, quality criteria monitoring should always be based on the total concentration. If available, appropriate methods to establish the bioavailability of chemicals adsorbed to pollutants could be considered in individual cases.

5. International Concepts and Approaches

5.1 United Kingdom

In the United Kingdom, protected asset-related "Environmental Quality Standards" (EQS) are used within the existing water quality monitoring system for a series of hazardous substances. Publications by Agg and Zabel (1989) and the National River Authority (NRA 1991) provide an overview of how EQSs are used to safeguard certain protected uses of water bodies. Chemicals included in List I of the EC Dangerous Substances Directive 76/464/EEC are subject to the quality standards taken from the existing EC directives that are based on directive 76/464/EEC. Chemicals included in List II of directive 76/464/EEC are subject to quality standards for heavy metals, arsenic, organotin compounds and mothproofing agents established by a circular order issued by the British Department of the Environment (NRA 1991). Various proposals to establish EQSs for a series of other dangerous substances – mainly pesticides – have been worked out by the British Water Research Centre. Proposed and adopted quality standards are listed in the appendix.

Quality standards are used by the National River Authority (NRA) as guidelines for issuing discharge consents. As a general rule, an EQS should not be exceeded at the border to a specified mixing zone. An EQS is defined as the maximum concentration of a substance in the water which must not be exceeded to protect aquatic communities and water uses (drinking water supply, fishing). The objective is to protect all species representing an aquatic community. Separate quality standards are derived for freshwater and seawater, respectively. A special protection of piscivorous animal species has not been provided for to date. So far no EQSs have been derived for sediments (Matthiessen 1993). EQS monitoring in the UK is based either on the 95th percentile or on the mean of the measured values.

Measures are taken whenever a certainty > 95% exists that a standard has been exceeded at a measuring point. The list below published by the NRA (1991) shows the maximum number of samples allowed to exceed the EQS in relation to the total number of samples.

Total number of samples	Number of samples allowed to exceed the EQS (95th percentile)
4 - 7	1
8 - 16	2
17 - 28	3
29 - 40	4
41 - 53	5
54 - 67	6

The methodology used for deriving quality standards was determined in an internal report by the Water Research Centre (WRC 1993). The EQS derivation method to protect the aquatic community is based on empirical safety factors. Safety factors of 1/100, 1/10 and 1 are used to account for variability of acute, chronic and field studies. Miscellaneous data (e.g. source of chemical entry, sample substance purity, environmental behaviour and persistence, bioaccumulation potential) are included in the derivation in individual cases. The safety factor may be modified by a body of experts. An additional safety factor of 1/10 is used when a substance is persistent and has a large potential to bioaccumulate (log BCF > 4). The derivation of EQSs requires a minimum number of effect data to be available. Test results of species from the following taxonomic groups are needed: algae, crustaceans, fish, insects (freshwater only) and non-arthropods (e.g. molluscs). Toxicity data on at least 8 species must be available to account properly for variations in interspecies sensitivity distribution. The ideal scenario would be a mix of acute and chronic data. The following specific situations require a modified data set:

- If a substance is especially toxic to a certain taxonomic group, that group (preferably at least two species) should be represented in the data set. Insecticide tests should include effect data for the aquatic life-stage of two insect species.
- If water quality parameters exert an influence on the toxicity response, a suitable number of water conditions need to be tested, preferably for the most sensitive species.
- If the data set does not properly account for saltwater organisms, data from freshwater studies can be used under certain circumstances (comparable chemical behaviour and similar sensitivity of freshwater and saltwater organisms) to derive EQSs for the marine environment.
- If data are not available for some of the above taxonomic groups, a preliminary quality standard should be derived.

When an EQS is derived, a safety factor will be applied to the lowest credible adverse toxicity level (LOEC, EC50) in the minimum data set. The following cases are distinguished when an extrapolation factor is applied:

- If the lowest effect level is from an acute study, the lowest acute LC50 value is multiplied by a factor of 0.01. This factor incorporates a ratio of 10 to account for extrapolation from acute to chronic effects (ACR). However, if data exist to suggest that the ACR is less than 10 (e.g. 2 or 5), the factor of 0.01 can be increased (e.g. to 1/20 or 1/50).
- If the lowest effect value is from a chronic study, it is recommended to multiply the lowest sublethal or lethal effect value (50% effect) by a 0.1 factor. The studies should look at an early life-stage and reproduction.
- The safety factor of 0.1 accounts for extrapolation of chronic effects in the laboratory to field no effects. However, if data exist to suggest that the ratio of chronic effects in the laboratory to field effects is less than 10, the safety factor can be increased.
- If the lowest effect value is a NOEC (highest no observed effect level) from a field study, that value can be used as an EQS provided the NOEC value was determined for relevant target organisms.

5.2 The Netherlands

Three different methods were used in the Netherlands in the past to derive quality criteria: the approach to derive "ecotoxicological values" described by Stortelder et al. (1989), the statistical extrapolation model suggested by Van Straalen and Denneman (1989) and a modified method to assess concern levels (Van de Meent et al. 1991) which was originally developed by the U.S. EPA (1984).

Since 1990 Dutch environmental protection policy has been favouring an approach to assess tiered risk levels (Hekstra 1992). Based on the risk philosophy, three different risk levels are defined and assigned particular effect or protection levels, respectively, as well as different value designations.

Risk Level	**Effect Level**	**"Environmental Quality Standard"**
Unacceptable risk level	HC50	Intervention value (C-value)
Maximum permissible risk level	HC5	Limit value (A-value)
Negligible risk level	0.01 x HC5	Target value

The derivation of scientifically founded quality criteria is made by the National Institute for Public Health and Environmental Protection (RIVM).

Provided sufficient data are available, the hazardous concentration (HC) should be established by using the extrapolation method developed by Aldenberg and Slob (1991). The HC5 value is calculated as the maximum permissible concentration (MPC). The negligible concentration (NC) typically corresponds to one percent of the MPC value. For more information on the derivation method see Chapter 3.1.2. The procedure of deriving environmental quality criteria was recorded in a report by the RIVM (Slooff 1992). Food chain effects should be accounted for in the derivation of ecotoxicologically justified quality criteria for surface water, groundwater, sediments, soil and air. Romijn et al. (1991a, 1991b, 1993, 1994) and Van de Plassche (1994) submitted proposals how to evaluate the hazards to animal species posed by chemicals that accumulate in the aquatic and terrestrial food chains. In addition, Van de Plassche and de Bruijn (1992) suggested environmental quality criteria for various trace metals (Sb, Ba, Be, Co, Mo, Se, Sn, Tl, V). For upcoming quality criteria derivations, it is planned to take the background contamination of metals into account (Crommentuijn et al. 1997a). Furthermore, the quality criteria for pesticides were revised (Crommentuijn et al. 1997b).

Quality criteria for different media are being harmonized, i.e. the transfer between media will be accounted for in future MPC value derivations. Among other things, it is envisioned to make sure that the MPC for water does not cause the MPC for sediments to be exceeded.

Environmental risk limits were established for about 200 chemicals from the substance groups, monocyclic and polycyclic aromatic hydrocarbons, aliphatic hydrocarbons, pesticides and metals. The environmental risk limits and the methodology that was used to derive them were published in a comprehensive compendium (Bruijn et al. 1999). For an overview of published substance reports visit the website of the RIVM on the Internet at: http://www.rivm.nl/csr

Supported by various other ministries, the Ministry of the Environment of the Netherlands (VROM) determined non-legally binding environmental quality standards which are based on the maximum permissible concentrations and the negligible concentrations established by the RIVM (VROM 1999). As the question which quality standards should be established must always be weighed against other government priorities, not all numerical values originally calculated by the RIVM were finally adopted as quality objectives. A VROM manual (1991b) is currently being updated listing the standards that have been set in the Netherlands for different media.

An overview of the Dutch environmental quality standards for surface water (VROM 1999) is included in the appendix. The objective of Netherlands environmental policy is that the listed maximum concentrations are complied with until the year 2000. The target values are intended to be reached by 2010.

5.3 European Union

The European Union established quality requirements in various directives to protect water bodies and their uses:

- Council Directive of 16 June 1975 concerning the quality required of surface waters intended for the abstraction of drinking water in the Member States (75/440/EEC)
- Council Directive of 8 February 1975 on the quality of bathing waters (76/160/EEC)
- Council Directive of 18 July 1978 on the quality of freshwater bodies that are capable, or should be capable, of supporting fish life (78/659/EEC)
- Council Directive of 30 October 1979 on the quality required of shellfish waters (79/923/EEC)

Directives 84/491/EEC, 86/280/EEC, 88/347/EEC and 90/415/EEC set quality objectives (quality standards) for specific pollution caused by discharges of certain toxic chemicals in water bodies. The quality standards for dangerous substances mentioned in the directives are listed in the appendix.

In 1997 the European Commission submitted a proposal to create a legal framework for water policy within the Community (Water Framework Directive) which is meant to replace existing water protection directives and further develop and harmonize European legislation with regard to water policy.[1] However, the Commission's proposal does not yet contain explicit standards to ascertain water quality. It is intended to have such standards worked out by a technical committee in the near future. Hence the proposal does not define exact quality standards for chemicals that should be complied with (Rechenberg 1997).

So far the EU has not presented a guidance document that could serve as a basis for deriving quality criteria or standards. That is the reason why different methods to derive quality criteria are used in the substance reports commissioned by the EC. Within the framework of legislation on hazardous substances, the EU adopted a guidance document (EC 1996) which describes the evaluation of environmental risks posed by existing and new substances. The document contains the basic principles of substance assessment which can be used to derive water quality standards and are also considered in the draft of the water framework directive.

Appendix V Chapter 1.2.6 of the recently adopted Water Framework Directive briefly describes the method that should be used to derive quality standards for the protection of aquatic organisms (EU 2000). A standard can be established for water, sediments or biota. Depending on the available data, the safety factors listed in Table 14 should be applied when deriving a quality standard. The minimum taxa required are algae and/or macrophytes, Daphnia or organisms typically found in salt water, and fishes. Persistence and bioaccumulation data as well as field studies should be included in the derivation whenever possible. The derived values refer to the maximum annual average concentration.

The selection of roughly 30 priority substances for the derivation of quality standards, a joint project by the Commission of the EU and the Federal Environmental Agency, was made by the Fraunhofer Institute of Ecotoxicology and Environmental Chemistry (Herrchen & Lepper 1999, Klein et al. 1999). The result was COMMPS (Combined Monitoring-Based and Modelling-Based Priority Setting), a method considering data on environmental and human toxicology, monitoring data and other factors, e.g. production and application rates or application patterns.

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[1] The Water Framework Directive was adopted In the meantime (EU 2000). In the process of putting the Water Framework Directive into practice, EU-wide quality standards for 32 priority substances are being established.

Table 14: Safety factors applied in the EU for the derivation of quality standards

Available Data	**Safety Factor**
At least one acute L(E)C50 out of three trophic levels from the base data set	1000
One chronic NOEC (fish, Daphnia or a typical saltwater organism)	100
Two chronic NOEC values of species from two trophic levels (fish and/or Daphnia or a typical saltwater organism and/or algae)	50
Chronic NOECs of at least three species (usually fish, Daphnia or a typical saltwater organism and algae) representing three trophic levels	10
Other data (including those originating from field studies or model ecosystems) allowing a calculation and application of accurate safety factors	Case by case evaluation

5.4 Canada

In Canada, a working group commissioned by the Canadian Council of Resource and Environment Ministers (CCREM) worked out the so-called "Canadian Water Quality Guidelines". On that occasion they tested the applicability of existing guidelines and criteria (e.g. those developed by the U.S. EPA), adjusted them to Canadian conditions when necessary and adopted them as quality guidelines. Guidelines were established and published in a corresponding paper (CCREM 1987) for the following protected assets and uses: drinking water supply, recreation and aesthetics, aquatic communities, irrigation and livestock water and industrial water supply.

Apart from information about the derivation of guideline values, the documentation provides a summary of effect data, parameter-specific background information (e.g. data on the environmental fate and persistence of certain substances) and lists factors that should be considered in the development of site-specific quality objectives based on the quality guidelines. However, it does not describe the procedure how to adjust the quality guidelines to local conditions.

The documentation is permanently being extended. In the meantime, more criteria have been derived for a number of additional substances, e.g. biocides, pesticides and chlorinated hydrocarbons (CCME 1996b) while a revised derivation method for quality guidelines to protect aquatic communities was published (CCME 1993). All guideline values formerly adopted by the CCREM (now the Canadian Council of Ministers of the Environment - CCME) remain valid until a review becomes necessary. The method is based on the principle to derive separate quality guidelines for freshwater and marine organisms. The first step is to check the validity of the published effect data. The classification criteria for test results are listed in Table 15.

Table 15: Classification of test results (CCME 1993)

Primary Data

- Toxicity tests must employ currently acceptable laboratory practices. Novel approaches will be evaluated on a case-by-case basis.
- As a minimum requirement, variable concentrations must be measured at the beginning and end of the test. Calculated concentrations or measurements taken in stock solutions only are unacceptable.
- Generally, static tests are unacceptable unless it can be shown that variable concentrations did not change during the test and that adequate environmental conditions for the test species were maintained.
- Preferred endpoints from a partial or full life-cycle test include a determination of effects on embryonic development, hatching, germination success, survival of juvenile stages, growth, reproduction and survival of adults.
- Responses and survival of controls must be measured and should be appropriate for the life stage of the test species used.
- Measurements of abiotic variables such as temperature, pH, dissolved oxygen and water hardness should be reported so that any factors that may affect toxicity can be included in the evaluation process.

Secondary Data (limited validity)

- Toxicity tests may employ a wider array of methodologies (e.g. measuring toxicity while the test species is exposed to additional stresses such as low temperatures, lack of food or high salinity).
- Static tests are acceptable.
- Preferred test endpoints include those listed for primary data as well as pathological, behavioural and physiological effects.
- Calculated variable concentrations are acceptable.
- All relevant environmental variables should be measured and reported. The survival of controls must be measured and reported.

Unacceptable Data

- Toxicity data that do not meet the criteria listed above.

In order to derive a quality guideline, a minimum number of chronic effect data must be available from valid tests (primary data) on aquatic plants, crustaceans and fish (see Table 16). In the event that these requirements cannot be met but at the same time sufficient acute and chronic data on crustaceans and fish are available, interim guidelines are derived (see Table 17). Secondary data are sufficient to derive an interim guideline value. Insufficiently validated test results are not used.

Table 16: Minimum data set required for the derivation of a guideline value (CCME 1993)

a) To protect freshwater organisms

Fish
At least three tests on three or more fish species should be available, one of them accounting for a North-American cold water species (e.g. trout) and another for a warm water species (e.g. fathead minnow). Two of these tests must be chronic effect tests (partial or full life-cycle).

Invertebrates
At least two chronic tests on two or more invertebrates from different classes should be available. One of them should account for a North-American plankton species (*Daphnia spec.*).

Plants
At least one test on a North-American vascular plant species or freshwater alga should be available. For heavily phytotoxic substances four acute and/or chronic tests on aquatic plants or alga species should be available.

b) To protect marine organisms

Fish
At least three tests on three or more marine fish species from a temperate climatic zone should be available, at least two of which should be chronic (partial or full life-cycle).

Invertebrates
At least two chronic (partial or full life-cycle) tests on two or more marine species from a temperate climatic zone and different classes should be available.

Plants
At least one test on a vascular plant or marine alga species from a temperate climatic zone should be available.

When available, the quality guidelines are derived from the LOEC value of a non-lethal endpoint for the most sensitive life stage of the most sensitive species. If these are unavailable, the quality guideline may be assessed by using acute data.

A quality guideline is derived by multiplying the lowest LOEC value by a safety factor of 0.1. This safety factor was selected to account for interspecies sensitivity variability, extrapolation from laboratory to field conditions and statistical endpoint variability. If the minimum data set is available, a quality guideline can also be derived from the lowest effect test result for a species group not represented in the ones above (e.g. amphibians, protozoa, bacteria).

Table 17: Minimum data set required for the derivation of an interim guideline value (CCME 1993)

a) To protect freshwater organisms

Fish
At least two acute and/or chronic tests on two or more fish species should be available, one of them accounting for a North-American cold water species (e.g. trout).

Invertebrates
At least two acute and/or chronic tests on two or more invertebrates from different classes should be available. One of them should account for a North-American plankton species (*Daphnia spec.*).

b) To protect marine organisms

Fish
At least two acute and/or chronic tests on two or more marine fish species should be available, at least one of them accounting for a species from a temperate climatic zone.

Invertebrates
At least two acute and/or chronic tests on two or more marine species should be available, one of them accounting for a species from a temperate climatic zone.

The following procedure is preferred to derive a quality guideline from acute data: The acute-to-chronic ratio (ACR) can be used to assess a quality guideline (no-effect concentration) based on the LC50 value of a short-term test. Subsequently the guideline value is calculated by dividing the lowest LC50 value by the most appropriate ACR value. In the event that no appropriate ACR value is available, the guideline value is calculated by multiplying the LC50 by a universal application factor. The application factor (AF) for non-persistent substances (persistence in water < 8 weeks) is 0.05 while the AF for persistent substances is 0.01. Although the above application factors have been empirically tested, they may be inappropriate for several substances (e.g. diazinon, zinc). Therefore, universal application factors for deriving a full guideline or an interim guideline should be used only in the absence of chronic effect data and in the absence of ACRs for acute data; the factors do not always appropriately account for the acute-to-chronic ratio (CCME 1993). An overview of the quality guideline derivation procedure is given in Fig. 10.

It is particularly emphasized that the derived guideline values should not be regarded as universal values for national water quality but that local conditions should always be considered when they are used. The derived quality guidelines for hazardous substances as well as fundamental water quality parameters for the protected asset aquatic communities are listed in the appendix.

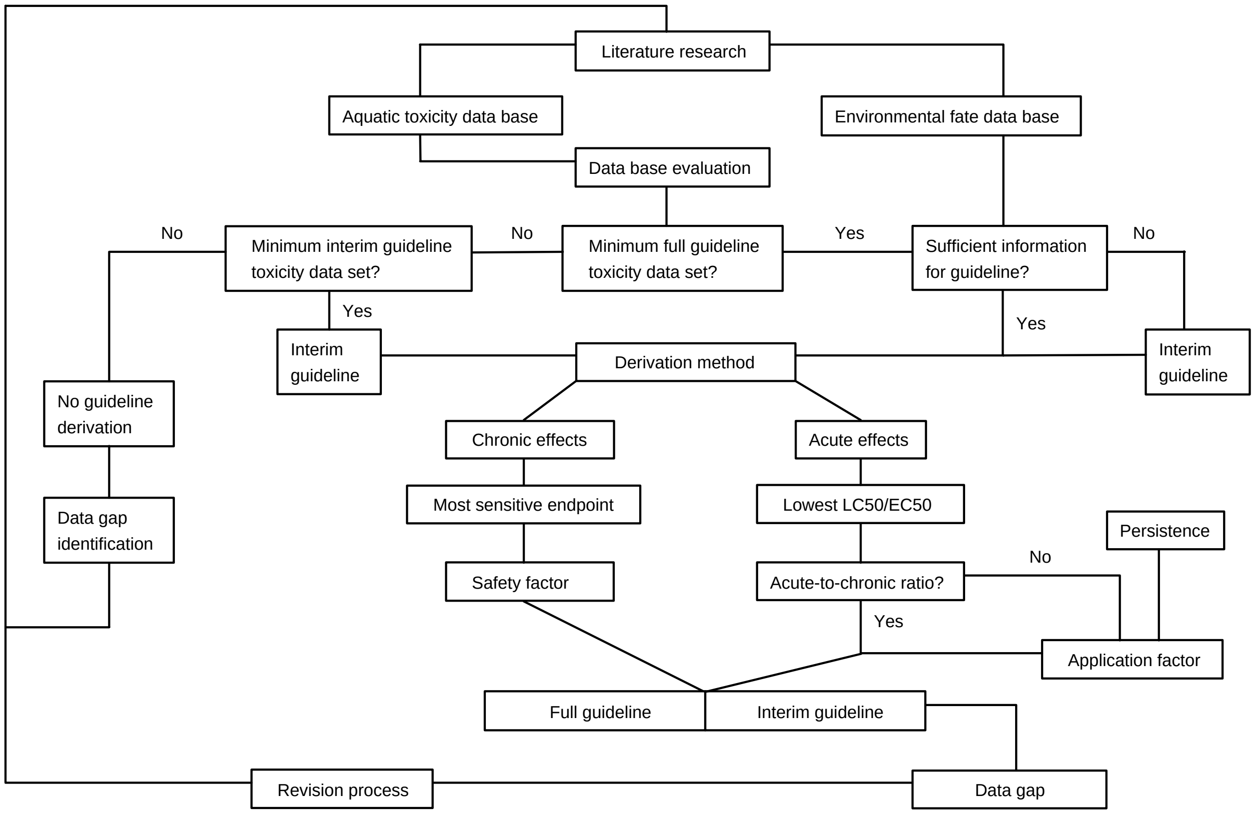

Fig. 10: Derivation of water quality guidelines in Canada (CCME 1993)

The documentation contains a list of "Maximum Acceptable Concentrations" to maintain the quality of drinking water (CCME 1995b). If the maximum values for drinking water are exceeded, adverse effects on health or taste can be expected.

Quality guidelines were developed for substances that are potentially toxic to arable crops in order to prevent them from being harmed by contaminated irrigation water. The study shows that the irrigation water quality guideline for heavily phytotoxic chemicals (herbicides) is sometimes more stringent compared to the quality guidelines for the protection of drinking water or aquatic communities. For example, the following values are listed for the active ingredient dicamba (CAS No. 1918-00-9): irrigation water 0.006 µg/l; drinking water 120 µg/l; aquatic communities 10 µg/l.

To prevent adverse effects on livestock by polluted water, either maximum concentrations were derived for a number of substances or the maximum concentrations for drinking water were adopted as interim guideline values. The maximum values used in Canada for drinking water, irrigation water and livestock water are listed in the appendix.

A protocol for deriving quality guidelines to protect organisms living in the sediment (Sediment Quality Guidelines) was published in March 1995 (CCME 1995a). Sediment Quality Guidelines were derived, inter alia, for cadmium, mercury, various PAHs and PCB (Smith et al. 1996, CCME 1999).

Another guidance document was worked out to illustrate the derivation of Tissue Residue Guidelines for the protection of wildlife consumers of aquatic biota, i.e. quality guidelines for concentrations in the bodies of piscivorous animal species (CCME 1998). Tissue Residue Guidelines have so far been derived for DDT, PCBs and toxaphene (CCME 1999). Quality guidelines for dioxins and furans as well as mercury and cadmium are currently being developed.

A guidance document for the derivation of soil quality guidelines was published as early as 1996 (CCME 1996a). Quality guidelines to protect soil – depending on how it is used – exist for heavy metals, various PAHs and 8 organic chemicals (CCME 1997).

In 1999 a compendium of Canadian environmental quality guidelines was published (CCME 1999) which summarizes the quality requirements established for individual environmental domains. The compendium contains data sheets with derived quality guidelines for different media (water, biota, soil, sediment, air) as well as information about the derivation methods used for each domain. The former water quality guidelines set by the CCREM (1987) are replaced by the current guideline values established by the CCME (1999). Some guideline values were adopted from the CCREM (1987), others were revised or published for the first time. As regards the substances aldrin and dieldrin, chlordane, DDT, endrin, heptachlor, lindane, PCB and toxaphene, water quality guidelines were no longer recommended because a derivation of values for those substances is very vague and water is not very well suited for monitoring them. Instead, sediment and tissue quality guidelines are regarded as more effective when it comes to persistent and bioaccumulating substances. Furthermore, Canadian politics seek to remove the above chemicals (except lindane) from the environment altogether. A table listing quality guidelines for different media can be viewed on the Internet by visiting the website at
http://www.ec.gc.ca/ceqg-rcqe/index_e.htm

5.5 USA

The control of toxic substances discharged into US waters is based on the Clean Water Act (CWA). The Federal Water Pollution Control Act (1972) proclaims the following environmental policy objectives: "... it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited". This political declaration has been maintained unchanged to the present day. The CWA aims at achieving "zero emission" of pollutants into US waters. As this cannot be accomplished within a short period of time, the CWA and the National Pollutant Discharge Elimination System (NPDES) provide for the issuing of permits for the discharge of waste water. The NPDES permits expire after five years and consider the use of the best available techniques. Whenever the minimum requirements based on the best available techniques do not provide sufficient water quality protection, additional maximum values based on the water quality criteria are included in the NPDES discharge permits to make sure that the goal stated in the CWA ("no toxic pollutants in toxic amounts") is achieved. Narrative and numerical water quality standards are added to the EPA water quality criteria and other toxicity data sources in order to establish whether the limit values in the discharge permit based on the best available techniques are appropriate or whether additional action must be taken to ensure water quality.

The EPA endeavours to achieve the goals set in the Clean Water Act, i.e. to restore and maintain the integrity of US water resources. The EPA is committed by the Clean Water Act to develop Water Quality Criteria (WQC) and Sediment Quality Criteria (SQC) which reflect the best available scientific knowledge concerning the effects of toxic substances on aquatic communities, wildlife and human health. These criteria are used by the federal states to establish water quality standards. Background information and recommendations on the use of quality standards are published in various EPA documents (U.S. EPA 1983, 1988a, 1988b, 1991c).

In a first step to establish quality standards, the federal states identify the assets that should be protected in each water body (e.g. fishery, aquatic communities, drinking water supply, farmland irrigation, recreational activities or shipping). Using the EPA criterion values or other scientific data, the federal states develop quality standards for an identified protected asset related to a stretch of water. National WQC may be adapted to local conditions in this process. Carlson et al. (1984) provided instructions on how to derive local WQC. Alternatively, the federal states can set standards for the biological quality of a water body based on the existing biodiversity. Those standards are the basis for monitoring and limiting pollutant discharges from waste waters and surface effluents.

As far as the substance-related approach of monitoring toxic substances for the protection of aquatic communities is concerned, limit values for individual substances are used in the NPDES discharge permits to control the entry of pollutants. These limit values are based on WQC which were derived from biotests and adopted as WQSs by the federal states. When discharge permits according to the NPDES are issued, site-related discharges and their effects on the water body are taken into consideration. This information may include data on dischargers and water quality. The assessment is used to develop admissible waste water loads ("wasteload allocation") and "total maximum daily loads" from the total of all sources. As soon as a numerical WQC has been established, maximum values for individual substances in the NPDES discharge permit have to be developed to make sure that authorized discharges into the water body do not cause the acute or chronic WQC for hazardous substances to be exceeded. This regulation only affects substances which have the potential to cause the criteria to be exceeded. The procedure of issuing discharge permits (legal foundations, data collection, calculation models, establishing maximum values etc.) was documented in detail and explained in three realistic examples by the U.S. EPA (1991c). The document also contains thorough information about the derivation of quality criteria to protect public health as well as detailed recommendations for waste water toxicity assessment by means of biotests, quality assurance of biotests and monitoring of water quality requirements.

Criterion values established by the EPA must be published in individual documents and summaries (U.S. EPA 1986). Each criterion consists of two values, one acute (criterion maximum concentration or CMC) and one chronic (criterion continuous concentration or CCC). The criteria are derived using the best available scientific knowledge on the mode of action and the extent of observed effects of chemicals on aquatic organisms, wildlife, plants and human health. The water quality criteria for continuous exposure published in a revised edition (U.S. EPA 1999) are listed in the appendix. The basic principles of WQC derivation were described by Stephan et al. (1985), Hansen (1989) and the U.S. EPA (1991c). The derivation of quality criteria is illustrated in Fig. 11. Essential facts on the derivation of quality criteria for certain protected assets were described in the preceding chapters.

The criterion for the maximum short-time exposure (CMC) is calculated by dividing the final acute value by two. The one-hour-mean of all measured values should not exceed the CMC more than once in three years. The lowest value out of final chronic value, final plant value and final residue value is used as a criterion for the continuous load (CCC), unless other available data suggest that a lower value should be used. The four-day-mean of all measured values should not exceed the CCC more than once in three years. Compliance is supervised by statistical models based on the values measured during water and discharge monitoring.

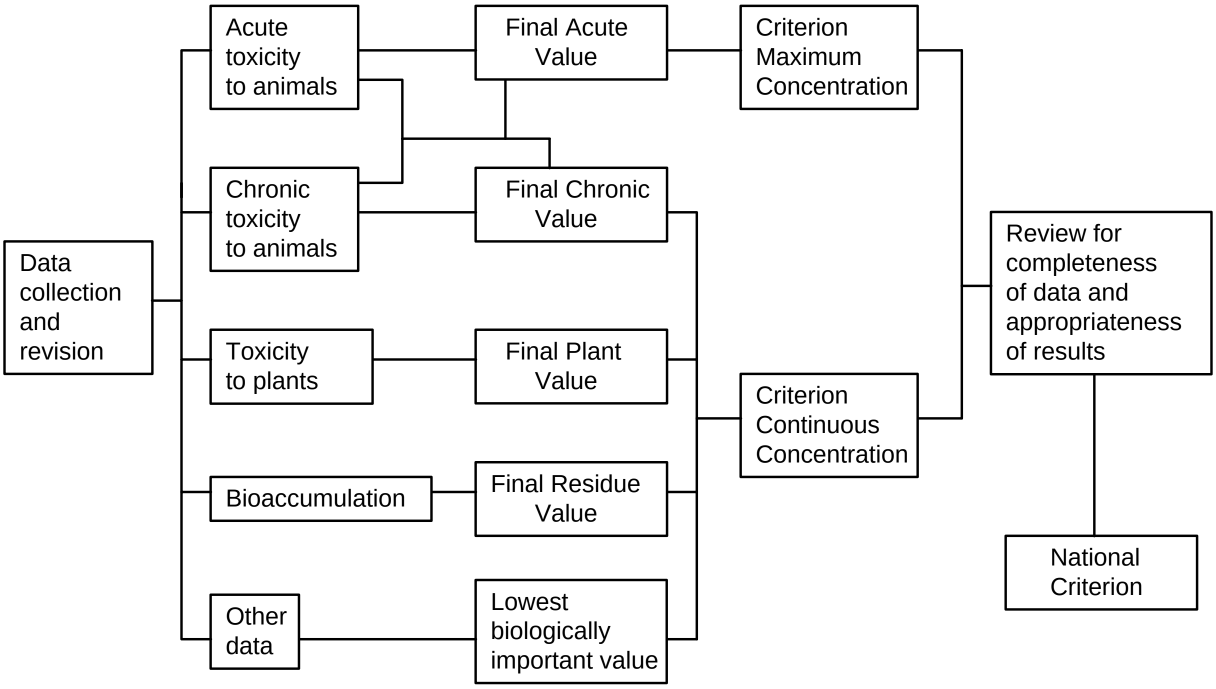

Fig. 11: Derivation of US Water Quality Criteria (WQC) for the protection of aquatic organisms and their uses (Stephan et al. 1985)

When an effluent is suspected to be toxic to aquatic organisms, a waste water sample is examined for 126 "priority chemicals". Subsequently, the concentration of each priority substance from the waste water sample is compared with toxicity data in the literature, EPA water quality criteria or federal states standards for each substance. This examination is aimed at identifying those chemicals that might be responsible for the effluent's toxicity (U.S. EPA 1991c).

Apart from the analysis of individual substances, the acute and (sub)chronic waste water toxicity is established. This step is deemed necessary for the following reasons:

- analytical procedures are available for a limited number of substances only,
- not enough data are available on the toxicity of some of the substances to aquatic organisms,
- it is impossible to establish the combined effects of all substances contained in the waste water.

The toxicity of waste water is measured in "toxic units" (TU). The toxic units of an effluent are calculated as follows: TU = 100 / effect value (dilution percentage). "Toxic units acute" are based on the LC50 of a short-term test (TU_a = 100/LC50) whereas "toxic units chronic" are based on the NOEC of a long-term test (TU_c = 100/NOEC).

The EPA recommends to comply with a maximum value (CMC) of 0.3 TU_a after immediate and complete intermixture of the effluent in the preclarifier to prevent acute effects, while a continuous load value (CCC) of 1 TU_c is regarded as necessary to prevent chronic effects in the most sensitive out of a minimum of three tested species. In the event that no chronic tests could be conducted (e.g. to save funds) an assessment can be made by using the ratio of TU_a to TU_c. If possible the ratio should be established by experiment. Otherwise, a value of 10 may be used. Establishing maximum values for discharge permits should account for fluctuations in measuring results (99th percentile) and be based on a low water drainage rate.

With regard to national water protection policy an integrated approach is recommended to control toxic substances. It considers the use of the best available techniques to derive material-specific quality criteria and standards, the assessment of waste water toxicity by biotests to complete material-specific evaluation as well as monitoring by means of biological water quality criteria (U.S. EPA 1991c).

The U.S. EPA (1991c) recommends to calculate a so-called "reference ambient concentration" (RAC) to assess the hazards for human health posed by toxic and carcinogenic substances which may get into bodies of water by way of waste water discharges and surface effluents. The derivation of RAC values is primarily based on the drinking water and fish consumption exposure pathways where bioaccumulation is taken into account and the RAC values refer to a continuous load. The ratio of the material's concentration in the fish tissue to the concentration in the water is either expressed as a bioconcentration factor (BCF) or a bioaccumulation factor (BAF). Bioconcentration is defined as the uptake of a toxicant through water only, whereas bioaccumulation is the uptake through both water and food. The BAF of extremely lipophilic substances (log Kow > 5) can be much higher than its BCF. Table 18 shows the estimated ratio of BAF to BCF (food chain multiplier, FM) depending on the trophic level and the log Kow. The models of Thomann (1987, 1989) were used to calculate the values. Considerable uncertainty exists as to the accumulation of substances with a log Kow of approximately 7 or higher.

Table 18: Estimated food chain multipliers (FM)

log Kow	Trophic level 2	Trophic level 3	Trophic level 4
5.0	1.6	2.1	2.6
5.5	2.8	5.9	11.0
6.0	6.8	21.0	67.0
6.5	19.0	45.0	100.0

Source: U.S. EPA (1991c)

The BAF value can be calculated as follows: BAF = FM x BCF. As a general rule, the FM for trophic level 4 should be selected as it comprises popular species for sports fishing. Measured BAF values should be preferred when available. It should be noted that an extrapolation of BAF values from another aquatic ecosystem is always subject to uncertainties. Substances which are not prone to bioaccumulate can be assessed by applying drinking water criteria.

When RAC values are derived, the latest knowledge should be made available and the Human Health Criteria published in 1980 should be updated (U.S. EPA 1991c). Information about the effects of substances on human health is available from the Integrated Risk Information System (IRIS). IRIS contains data on the estimated Reference Dose (RfD) and the carcinogenic potency factor for the estimated carcinogenic potential (q1*). The RfD values (formerly referred to as ADI values) are derived from NOAEL or LOAEL values which have been established in epidemiological studies or in animal experiments. The lowest NOAEL or LOAEL value is multiplied by an uncertainty factor to calculate a RfD value. Depending on the available data, the factor may range from 1/10 to 1/10000. It accounts for sensitivity variations among individual persons, extrapolation from animal experiment results to human health, duration of exposure and effect level. The factor is selected such that below the RfD value adverse effects are unlikely to occur. An exposure below the RfD value provides no guarantee, however, that no effects will occur in any person.

The estimate of the carcinogenic potential represents the upper limit of the carcinogenic potential at lifelong exposure. The q1* value may be extrapolated from animal experiments by means of a linearized multistage procedure or it can be assessed from epidemiological data. It is noted that the carcinogenic potential accounted for by the carcinogenic potency factor might in reality be lower. Due to the extrapolation from animal test results to human health and limited information on the mechanisms that generate cancer, there is often great uncertainty as to the actual risk incurred. The risk may be smaller than expected or might even tend towards zero, especially when no information is available about the carcinogenic effect of a substance on humans. The following risk levels are used by the federal states for establishing standards: 10^{-5}, 10^{-6} and 10^{-7}.

The EPA takes the carcinogenic risk to be additive, which means that the total risk of exposure to pollutants through the water pathway can be higher than the risk assessed for a single substance.

When a substance has both toxic and carcinogenic effects, a RAC value should be calculated for both effect types; the lower value should then be used as a quality criterion. The RAC value for toxic substances can be calculated using the following equation:

$$\mathrm{RAC\ (mg/l)} = \frac{(\mathrm{RfD} \cdot \mathrm{WT}) - (\mathrm{DT} + \mathrm{IN}) \cdot \mathrm{WT}}{\mathrm{WI} + \left(\mathrm{FC} \cdot \mathrm{L} \cdot \mathrm{FM} \cdot \mathrm{BCF}\right)}$$

The RAC value for carcinogenic substances can be calculated using the following equation:

$$\mathrm{RAC\ (mg/l)} = \frac{(\mathrm{RL} \cdot \mathrm{WT})}{\mathrm{q1}^{*}\left(\mathrm{WI} + \mathrm{FC} \cdot \mathrm{L} \cdot \mathrm{FM} \cdot \mathrm{BCF}\right)}$$

RAC	Reference ambient concentration (mg/l)
RfD	Reference Dose (mg/kg d)
WT	Body weight (70 kg)
DT	Pollutant uptake through food, except fish (mg/kg d)
IN	Exposure through the respiratory tract (mg/kg d)
WI	Average drinking water ingestion (2 l/d)
FC	Average freshwater fish consumption (0.0065 kg/d); some states use a value of 20 g/d (average total fish consumption).
L	Ratio of fat content in consumed fish tissue to 3% fat
FM	Food chain multiplier
BCF	Bioconcentration factor (l/kg) of fish with a fat content of 3%
q1*	Factor of carcinogenic potential (kg d/mg)
RL	Risk level (10^{-x})

If a body of water is not used for drinking water abstraction or if data on the uptake through other food or the respiratory tract are unavailable, those factors can be removed from the equation. Maximum levels for drinking water (MCL) or food (FDA action levels) may also be applied to derive appropriate quality criteria.

Sediment Quality Criteria

The EPA can develop sediment quality criteria (SQC) pursuant to the provisions laid down in the Clean Water Act. The development of SQC is primarily based on the equilibrium partitioning method. So far the EPA has derived SQC based on this method for phenanthrene, fluoranthene, DDT, dieldrin, acenaphtene and endrin (U.S. EPA 1992a).

In addition to developing SQC the EPA is working on the development of standardized sediment toxicity tests which can be used alone or in combination with substance-related SQC so that long-term effects on freshwater and seawater organisms can be immediately identified. The EPA is convinced that a combination of substance-related SQC and biological test methods is perfectly suited to serve as a basis for decisions as to whether remediation measures should be taken. SQC should only be used in a gradual approach. When a SQC is exceeded it is expected that the sediment causes adverse effects. A decision as to whether further studies should be conducted depends on the local conditions and on how much the criterion was exceeded. A sediment load should not automatically be assumed to be harmless simply because existing SQC are complied with, as sediments often contain toxicants for which no criteria are available. In addition, synergistic, antagonistic or additive effects may give reasons for concern (U.S. EPA 1991c).

The following publications, inter alia, give information on hazard assessment procedures and the quality status of water bodies in the United States: U.S. EPA (1984), Bascietto et al. (1990), Cairns and Mount (1990), Hoffman et al. (1990), Harris et al. (1990), Foran, J.A. (1990), Barnthouse (1992), Norton et al. (1992), Bretthauer (1992), Rodier and Norton (1992), U.S. EPA (1992b).

5.6 Other Countries and Institutions

Japan

Revised environmental quality standards are available for the aquatic sector in Japan (Environment Agency 1993, 1999). The quality standards are aimed at protecting human health (consumption of drinking water, fish and crustaceans) and refer to all types of waters. The quality standards established in Japan are listed in the appendix.
No recommended values are available for the protection of aquatic communities.

Sweden

Quality criteria aimed at permitting a classification of impact were established in Sweden for nutrients, heavy metals, oxygen and oxygen-consuming substances, light and acidification status (Gustafsson 1992, Bingman 1991). It was not determined, however, which standards or which water quality should be targeted. The main classification components are:

- Assessment of natural background load (C_o)
- Measurement of current concentrations (C)
- Classification of impact level ($C_f = C/C_o$).

The current water quality for each parameter is assessed by using different quality classes while the impact is divided into four levels. The classification for most parameters is based on the average of monthly random samples taken over a period of three years. A sum index is calculated to classify impact levels caused by heavy metals such that combined effects can be accounted for. The quality classes for heavy metals are also listed in the appendix.

Switzerland

An ultimately defined concept for the derivation of water quality criteria does not exist in Switzerland. In the context of the amendment of the Swiss Decree on the Protection of Water Bodies, requirements for the quality of running waters were suggested relating to seven heavy metals; these requirements are closely related to the ICPR quality targets for the Rhine Action Programme (Müller 1992). While the ICPR quality targets refer to heavy metal contents in suspended matter, the quality requirements proposed for the amendment of the Swiss Decree on the Protection of Water Bodies refer to dissolved and total concentrations. The numerical values are listed in the appendix.

ICPR- The International Commission for the Protection of the Rhine

Within the framework of the Rhine Action Programme, the ICPR has established numerical values for the contamination of water and suspended matter (quality targets) as well as narrative quality targets relating to the ecomorphology of the Rhine for the year 2000 (IKSR 1992b 1993). The derivation of the quality targets is based on the concept of the BLAK QZ (1989) and on Dutch approaches (Stortelder et al. 1989). It includes the protected assets aquatic communities, drinking water supply, suspended matter/sediments and fishery as well as the protection of piscivorous animal species. Each of the determined values is based on the most sensitive protected asset.

The quality targets for the protection of aquatic communities are normally based on NOEC values from standardized (sub)chronic biotests. In general, test results from primary producers, primary consumers, secondary consumers and decomposers are required. If no NOEC values are available, acute effect data are used.

Depending on the base data set, the quality target is derived by multiplying the lowest NOEC value or the acute effect value by a compensation factor of 1/10, 1/100 or 1/1000, respectively (IKSR 1991, 1993). In contrast to the BLAK QZ concept, a quality target is still derived even if data are incomplete. The numerical quality targets of the ICPR (IKSR 1993, 1995) are listed in the appendix.

OSPAR - The Oslo and Paris Commission

Quality criteria for metals and organic environmental chemicals which are intended to serve as comparative values for monitoring the pollution of the North-East Atlantic were established during a workshop conducted by the Oslo and Paris Commission (OSPAR 1993). These quality criteria were updated during the third OSPAR Workshop on Ecotoxicological Assessment Criteria (OSPAR 1998). The quality criteria listed in the OSPAR 1998 report vary in certainty and are only used for a preliminary evaluation of chemical monitoring results from seawater, sediments, fishes and shells. Instead of representing legal standards they are rather used as auxiliary values to identify possible areas of concern. The values are based both on existing quality criteria from countries bordering the North-East Atlantic and on effect data of marine aquatic and sediment organisms, mammals and birds. Data of freshwater organisms were also included in the derivation of preliminary quality criteria. The minimum data set deemed necessary to derive quality criteria is listed in Table 19.

Table 19: Data set required to derive a quality criterion for the marine environment (OSPAR 1993)

Water	**Sediment**	**Biota**
At least one effect value should be available for fishes, algae and crustaceans (or another sensitive invertebrate species) each.	log Kow > 5: a sensitive sediment eater log Kow < 5: equilibrium partitioning method	log Kow > 5: a mammal and a bird species log Kow > 5: an experimentally established BCF value should be available for one fish species and one shell species.

Depending on the data set, the lowest NOEC or LC50 value was multiplied by a compensation factor of 1/10, 1/100 or 1/1000, respectively, to calculate a quality criterion.
The sediment quality criteria were calculated with the equilibrium partitioning method; alternatively, data from the North American Biological Effects Database for Sediments (BEDS) were used.

Due to the uncertainties in the derivation, the Ecotoxicological Assessment Criteria were not established as specific values but as ranges of concentrations. Adverse effects cannot be completely excluded for the indicated concentration ranges. Only if the concentrations stay below the given range limits, no adverse effects are expected for the marine environment.

6. Comparison of Quality Requirements for Selected Substances

The following paragraphs provide a comparison of quality targets established both by the LAWA and other institutions for selected substances. In essence, the comparison is limited to quality requirements for the protection of aquatic communities. With regard to the comparison of numerical values it should be noted, however, that the monitoring is based on different reference values. Among other things, the comparison is aimed at clarifying whether the quality standards that have been established by the EU to date are appropriate to provide sufficient protection for aquatic communities and other protected assets. The appendix contains a comprehensive list of quality requirements for other protected assets and other substances.

Even if a comparison of the quality requirements listed in Tables 20 and 21 reveals that the established values are in general very much the same, it is still true that the values for certain substances vary by more than one order of magnitude. This variance is caused by differences in derivation methodologies, data sets and times of derivation. An in-depth analysis of the reasons for the discrepancies for individual substances is not included in this report.

In general, the quality targets established by the LAWA are similar to the quality criteria derived in Canada and the Netherlands. They usually ensure a high protection level and are mostly located somewhere between the target values and limit values derived in the Netherlands. On the whole, the Canadian quality guidelines are somewhat higher than the LAWA quality targets as their derivation is based on LOEC values instead of NOEC values. Final U.S. EPA quality criteria for the protected asset aquatic communities were available only for a couple of substances for this comparison, as the body of data for most industrial chemicals was insufficient when the criterion documents were produced. The quality objectives for industrial chemicals and pesticides which have been established or proposed by the EU so far should in general provide a certain degree of protection for aquatic communities. The quality objectives for cadmium and mercury, however, are insufficient. In addition, the existing quality objectives for hexachlorobenzene and mercury will probably cause the maximum values for food consisting of fish and aquatic organisms to be exceeded while a protection of piscivorous animal species is not provided for.

Table 20: Quality requirements to protect aquatic communities from industrial chemicals and pesticides (in µg/l)

Parameter	**Germany**	**EU**	**Netherlands**	**Canada**	**USA**
	Quality target (*Zielvorgabe*)	**Quality objective** [a]	**Target value / MPC**	**Quality guideline**	**Criteria Continuous Concentration**
Monitoring	**90th percentile, total**	**Mean value, total**	**Total**	**Maximum, total**	**4-day average**
Bromacil	0.6	-	-	5	
2,4-D	2	-	0.1 / 10	4	-
1,4-Dichlorobenzene	10	-	3 / 250	26	-
Dichlorobenzenes		(10)	3 / 250 (single)		763[b]
1,2-Dichloroethane	2	10	7 / 700	100	20000[b]
Dichloromethane	10	(10)	200 / 20000	98.1	-
Dimethoate	0.2	-	0.230 / 23	6.2	-
Endosulfan	0.005	(0.001)	0.0002 / 0.02	0.02	0.056
Hexachlorobenzene	0.01	0.03	0.00009 / 0.009	-	-
Hexachlorobutadiene	0.5	0.1	-	1.3	9.3
Linuron	0.3	(1)	0.003 / 0.250	7	-
MCPA	2	-	0.02 / 2	2.6	-
Metolachlor	0.4	-	0.002 / 0.2	7.8	-
Simazine	0.1	(1)	0.001 / 0.14	10	-
Tetrachloroethene	40	(10)	3 / 330	111	840[b]
Tetrachloromethane	7	(10)	11 / 1100	13.3	-
Tributyltin	0.0001	(0.001)	0.0001 / 0.014 0.000001 / 0.0001[c]	0.0001	
1,2,3-Trichlorobenzene	8	-	0.7 / 67	8	-
1,2,4-Trichlorobenzene	4	(0.1)	0.7 / 67	24	-
1,3,5-Trichlorobenzene	20	-	0.7 / 67	-	-
Trichlorobenzenes		0.4	0.7 / 67 (single)		
Trichloroethene	20	10	24 / 2400	21	21900[b]
Trichloromethane	0.8	12	6 / 590	1.8	1240[b]
Trifluralin	0.03	(0.1)	0.004 / 0.038	0.2	-
Triphenyltin	0.0005	(0.01)	0.00005 / 0.005 0.000009 / 0.0009[c]	0.022	-

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[a] The data in parentheses are proposals for establishing quality objectives (Bro-Rasmussen et al. 1994).

[b] Not enough data available; lowest LOEL

[c] Values to protect marine communities

Table 21: Quality requirements to protect aquatic communities from heavy metals (in µg/l)

Parameter	**Germany**	**EU**	**Netherlands**	**Canada**	**USA**
	Quality target (*Zielvorgabe*)	**Quality objective**	**Target value / MPC**	**Quality guideline**	**Criteria Continuous Concentration**
Monitoring	**90th percentile, total**	**Mean value, total**	**Total**	**Maximum, total**	**4-day average**
Lead	3.4	-	5.3 / 220	1-7[a]	3.2[b]
Cadmium	0.072	1 / 5	0.4 / 2	0.01-0.06[a]	1.1[b]
Chromium	(total) 10	-	2.4 / 84	Cr(III) 8.9 Cr(VI) 1	Cr(III) 210[b] Cr(VI) 11
Copper	4	-	1.1 / 3.8	2-4[a]	12[b]
Nickel	4.4	-	4.1 / 6.3	25-150[a]	160[b]
Mercury	0.04	1	0.07 / 1.2 (inorg. Hg) 0.06 / 0.1 (methyl Hg)	0.1	0.012
Zinc	14	-	12 / 40	30	110[b]

[a] Value depends on water hardness

[b] Value refers to a water hardness of 100 mg / $CaCO_3$

Heavy Metals

A comparison of the quality criteria, objectives and standards for heavy metals listed in the appendix allows the general conclusion that the most stringent requirements for environmental quality have to be made when the protection of aquatic communities is at stake. In many cases the established values are equivalent to or slightly higher than the natural background contamination. The quality objectives in the Netherlands, for example, are based on the background values of unpolluted areas (VROM 1991a,b). The BLAK QZ formulated a long-term objective of achieving the natural background values wherever possible in order to protect the aquatic communities. Consequently, the established quality target was four times higher than the average background concentration (LAWA 1998, Schudoma 1994). As far as mercury is concerned, piscivorous animals represent the most sensitive protected asset. The Wildlife Criterion for mercury proposed by the U.S. EPA (1995a) is roughly equivalent to the natural background concentration, too.

In contrast, the quality standards set by the EC for cadmium and mercury do not provide sufficient protection for aquatic communities, fishery and piscivorous animal species and should therefore be revised. The same applies to some of the quality criteria which were derived by the U.S. EPA in the early 1980s. For example, test results for nickel are available which indicate that the existing quality criterion set by the U.S. EPA should be lowered as it does not provide sufficient protection for aquatic communities (Kszos et al. 1992). The same is probably true for the Canadian nickel guidelines established in 1987 (CCREM 1987).

The comparison reveals a high degree of similarity between the quality targets set by the BLAK QZ and the quality guidelines and concentrations derived in Canada and the Netherlands. For the time being those quality guidelines and concentrations may be used for a primary assessment of those substances for which no quality targets have been derived yet.

7. Evaluation and Discussion

Table 22 provides an overview of the most important contents of the different concepts to derive quality criteria and quality standards for the protection of aquatic communities. The concepts can be basically divided into methods using compensation factors and methods using statistical models. While the compensation factor approaches are aimed at protecting every single species of an aquatic community, the statistical extrapolation methods are used to assess a value designed to protect at least 95% of all species.

Selection of Species and Minimum Data Set Required to Derive a Quality Criterion

A minimum number of effect data for selected species is required to be able to derive a methodologically verified quality criterion. In a normal case scenario, a minimum of 4 to 8 NOEC values is needed to derive a quality criterion. All concepts have in common that they require effect data on algae, crustaceans and fish.

The U.S. EPA concept requires additional effect data on insects and other species groups. Effect threshold values for bacteria should be available according to the approaches developed by the BLAK QZ (LAWA 1997) and the ICPR (IKSR 1993).

As a general rule, both the U.S. EPA and the Canadian environmental authorities do not consider effect data other than those obtained from studies on native North-American species. Furthermore, tests on several fish species are required and a distinction is made between cold water species and warm water species. Some OECD countries do not make a distinction between cold and warm water fish species for lack of plausibility. It would be more promising to use fish species from different orders instead (OECD 1992b). Considering the facts that the number of fish species in an aquatic community is relatively small and interspecies sensitivity is pretty insignificant compared to invertebrates or algae, a number of 3 fish species among a total of 8 species required as a minimum data set in the approach of the U.S. EPA (Stephan et al. 1985) seems to be out of proportion. When species for the data set are selected, the relative sensitivity of fish compared to other species should be considered. Fewer fish species should be tested especially if fish are rather insensitive to a particular substance. If it becomes apparent that a combination (e.g. herbicide and insecticide) provokes a greater response in a particular group of organisms, it is recommended to conduct further tests on organisms closely related to the organisms on which the active ingredient was tested. Species selection should also consider that less soluble combinations might be more bioavailable to benthic organisms. In some cases benthic species may be better suited to assess toxicity than pelagic species (OECD 1992b).

Table 22: Methods to derive water quality criteria and water quality standards for the protection of aquatic communities (ACs)

	Germany **BLAK QZ** **LAWA (1997)**	**Canada** **Canadian Water Quality Guideline, CCME (1991)**	**United Kingdom** **WRC (1993)**	**EU Water Framework Directive (2000)**	**Netherlands** **Slooff (1992)**	**US EPA** **Stephan et al. (1985)**
Status	Quality criterion*)	Quality criterion	Quality standard	Quality standard	Quality criterion	Quality criterion
Designation	Quality target (*Zielvorgabe*)	Water quality guideline	Environmental quality standard	Environmental quality standard	Maximum permissible concentration (MPC) / Negligible concentration (NC)	Final chronic value (FCV) / Criteria continuous concentration (CCC)
Protection level	Protection of all AC species	Protection of all AC species	Protection of all AC species		95% of all species (MPC)	95% of all species
Method	Compensation factors	Compensation factors	Compensation factors	Compensation factors	Statistical model	Statistical model
Minimum data set	4 NOEC values from long-term tests on bacteria, algae, crustaceans and fish	Acute and chronic tests on 6 species: fish, invertebrates and plants	Acute and chronic tests on 8 species: algae, crustaceans, fish, insects, non-arthropods, e.g. molluscs	Acute and chronic tests on algae and/or macrophytes, Daphnia or organisms typically found in saltwater, fishes	4 NOEC values of species from different taxonomic groups	Acute and chronic tests on 8 species: fish, crustaceans, insects, other species
Extrapolation acute/chronic	If only 2 NOEC values are available (multicellular species): 0.1 compensation factor	Acute-to-chronic ratio (ACR); alternatively: 0.05 compensation factor (non-persistent compounds) or 0.01 compensation factor (persistent compounds)	0.1 compensation factor which can be modified depending on the acute-to-chronic ratio	See derivation	No	Unless sufficient chronic test results are available, the ACR is used to calculate a Final Acute Value (FAV)
Bioaccumulation	No	No	Additional compensation factor of 0.1	Persistence and bioaccumulation data should be included in the derivation of the final value	Separate derivation of a quality criterion to protect piscivorous animal species (Van de Plassche 1994)	Separate derivation of a Final Residue Value
Field test integration	Compensation factor can be increased in individual cases	No, only when establishing local quality objectives	Compensation factor can be increased in individual cases; alternatively: EQS = "NOEC" obtained from a field study	Case by case evaluation	No	In individual cases, field data my be considered in establishing the WQC
Combined effects	No	No	No	No	NC = HC5 x 0.01	No
Derivation	NOEC x 0.1 LC/EC50 x 0.1 x 0.1	LOEC x 0.1 LC/EC50 x AF	LOEC x 0.1 LC50 x 0.01	NOEC x 0.1 (three trophic levels) NOEC x 0.02 LC/EC50 x 0.001 (acute data only) Compensation factor according to: Technical Guidance Document (EC 1996)	Calculation of HC5 with 50% confidence HC5 = MPC	Calculation of FCV
Monitoring	90th percentile	Maximum value	95th percentile, annual average	Maximum annual average concentration	No data available	4-day average
Reference matrix	Total concentration in the water or concentration in suspended matter	Total concentration in the water	Total concentration in the water or concentration in settled water sample ("total dissolved")	Water, sediments or biota	Dissolved in the water, calculation of the total concentration in the water and the concentration of suspended matter by using the equilibrium partitioning method	Total concentration

*) Quality targets that are verified and published by the LAWA may be classified as "quality objectives" according to the definitions in Chapter 2.1.

A derivation according to the approaches developed in Germany, Canada and the Netherlands typically requires 4 chronic NOEC or LOEC values, respectively, while the British concept does not specify the exact number of necessary long-term tests. The EPA concept requires a minimum of 3 chronic effect values to be available to calculate the acute-to-chronic effect ratio (ACR) and assess a final chronic value (FCV) based on the final acute value (FAV).

Extrapolation From Acute to Chronic Effects

When chronic effect values are assessed the acute data are typically multiplied by a fixed compensation factor of 0.1 or by the inverse ACR value. However, the acute-to-chronic extrapolation is subject to uncertainties. The extrapolation of a NOEC value by means of a fixed compensation factor appears to be inappropriate due to the substance-specific and species-specific ratios between NOEC and LC50 (Van Straalen and Denneman 1989, Heger et al. 1995). Hence an acute-to-chronic extrapolation should normally be dispensed with.

Bioaccumulation

The British approach is the only one to include a compensation factor for substances that have a high potential to bioaccumulate. In Germany, the Netherlands and the United States separate derivations are made to protect human health (GER, NL, USA) and wildlife (CAN, NL, USA).

Field Tests and Model Ecosystems

None of the existing concepts includes an obligatory use of field data. Some approaches (GER, UK, USA), however, provide for the possibility to modify a quality criterion or standard in individual cases by including data obtained from field studies. In the United Kingdom, the NOEC value from a field test is used as a quality standard in certain cases.

Properly conducted model ecosystem or field studies can contribute to reduce uncertainties in the derivation of quality criteria, even though they are expensive and standardization and interpretation of the results may create problems. Then again uncertainties will always remain when results are transferred to real-world conditions.

Most tests are typically conducted during a couple of months in spring or summer only. Yet especially in wintertime the toxic effect of a substance may be enhanced by stress resulting from lack of food and low temperatures. For example, proof exists that selenium becomes more toxic to fish when water temperatures drop (Lemly 1993).

Moreover, eutrophic or mesotrophic pond systems are often used as models. Yet it is doubtful to what extent those test results are transferable to other types of ecosystems. Lozano and Pratt (1994) demonstrated in their studies on a system of microcosms that the toxic effect of a herbicide (diquat) on the periphyton community depends on the nutrient content, with the oligotrophic test system showing the most sensitive response to the pollution.

Evaluation is often limited to a few selected species or to aggregate endpoints (e.g. algal biomass or oxygen production) which are inappropriate to account for shifts in species diversity.
Moreover, it may be years or even decades later until alterations in the ecosystem structure caused by pollution become visible (see Fig. 12).
The adaptation of an organism to the stress caused by hazardous substances may lead to an increase in the organism's or ecosystem's sensitivity to other forms of stress caused by other pollutants and factors. It is not common practice to examine the combined effects of a tested substance and other chemicals.

Hence one study conducted in a model ecosystem or in the field cannot be representative for all ecosystems. As far as the ensuing necessity of applying extrapolation factors is concerned, multispecies and field tests do not differ from standardized single-species tests (Van Leeuwen 1990). This means that a direct transfer of the NOEC values established in multispecies and field tests to real-world conditions – as proposed in the concepts of the Water Research Centre (WRC 1993) and the pro-industry European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC 1993) – is doubtful and unjustified from a scientific point of view.

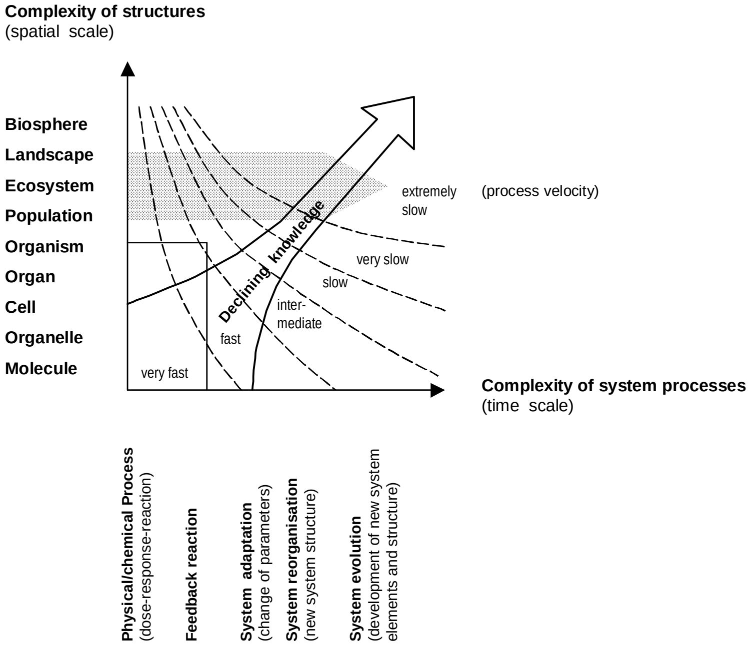

Fig. 12: Structural and functional hierarchies in biological systems (Hansen 1992a)

Combined Effects

Until today water quality criteria have been derived for single substances only, such that they merely reflect the hazardous effects of an individual material. This deficiency was emphasized by several authors (Deneer et al. 1988, Enserink et al. 1991, Calamari et al. 1992, Grimme et al. 1998, Forget et al. 1999), based on test results on the combined effect of metals and organic substances. Even small concentrations of single substances with no observed effect of their own (NOECs) may cause considerable toxicity in combination with other chemicals (Grimme et al. 1998). The works of, inter alia, Broderius (1990), Calamari et al. (1991), Grimme et al. (1995) and Grimme et al. (1998) provide comprehensive overviews of the methodology to describe combined effects.

In the Netherlands possible combined effects are accounted for in the derivation of the negligible concentration (NC) by pragmatically applying an additional compensation factor of 0.01. Even though a guidance document on the use of quality criteria in discharge monitoring published by the U.S. EPA (1991c) mentions a possible hazard posed by combined effects, the U.S. EPA does not consider combined effects in the process of establishing quality criteria for individual substances. It is intended instead to gauge combined effects by assessing the toxicity of waste water and conducting sedimentary biotests.

An assessment of possible combined effects of selected pesticides on the mouth areas of European rivers based on monitoring and effect data was presented by Steen et al. (1999). For their study they used the toxic units method and a modified statistical extrapolation method. Based on their findings the authors cautiously conclude that the total of all pesticides exerts a significant pressure on the observed aquatic ecosystems. The lack of toxicological data was considered a major hindrance to the study.

It is not a simple task to account for combined effects when deriving quality criteria as the impact on a specified body of water varies in composition, extent and time. This is why in most cases only a combination of different approaches will help to appropriately consider combined effects when assessing the water quality. Table 23 shows possible approaches with their pros and cons.

Derivation of Quality Criteria and Quality Standards

In all concepts (GER, CAN, UK) that use compensation factors, the values are derived by multiplying the lowest chronic effect threshold value by a compensation factor of 0.1. Whereas the German concept is based on the NOEC value, derivation in the United Kingdom and Canada departs from the LOEC value. As a result, the British and Canadian values are at least 2 to 10 times higher in real life than the German values provided the body of data is identical.

Moreover, certain differences in the statistical methods concerning the assumption on interspecies sensitivity and required data sets lead to small discrepancies in the extrapolated quality criteria (OECD 1992b).

Table 23: Approaches to account for combined effects in the derivation of quality criteria, water quality monitoring and discharge control

	Advantage	Disadvantage
Constant additional compensation factor	• Straightforward, pragmatic approach • No knowledge required on occurrence of other (all) hazardous substances	• Selection of factor is arbitrary • Factor does not depend on the number of occurring pollutants and may be too conservative in individual cases
Biological effect parameters	• Biological effect of substances with a certain mode of action can be integrally assessed, e.g. genotoxic cholinesterase inhibition, genotoxic potential	• Only effects can be detected; however, quality criteria are designed to make sure that no effects occur in the first place • Complicated extrapolation of measured data to possible adverse effects on aquatic communities • Allocation of an established effect to a source of impact is often complicated
Determination of sewage toxicity in the waste water and at the point of discharge	• Biological effects can be integrally assessed, e.g. fish toxicity (acute, subchronic). • No compulsory chemical analysis of single pollutants	• Diffuse impact sources are not accounted for • No standardized test methods to establish (sub)chronic sewage toxicity to fish and crustaceans are available in Germany • Ethical questions of animal protection must be considered
Evaluation based on monitoring data and effect data (e.g. as aggregate toxic units)	• Impact must has been proven to exist before it is considered • Method has been adequately validated for substances with a similar mode of action	• Substances which were not measured or for which measured values are below determination limit are not considered • Quality criteria or a sufficient number of acute and chronic effect data are indispensable

Monitoring

The way quality criteria and quality standards are monitored differs depending on the applied concept (see Chapter 5). This is why the derived quality criteria (numerical values) can only be compared to a certain degree. It appears appropriate to use percentiles (e.g. the 90th percentile) because even a relatively small number of measured values is sufficient to determine with a given statistical certainty whether a quality criterion was complied with or exceeded. Monitoring based on the 90th percentile allows the value to be exceeded for a limited period of time. Unless acute toxic effects occur, the effects on aquatic communities can be neglected if quality criteria are only temporarily exceeded. The issue for how long and how often a quality criterion may be exceeded without facing a risk to a community is discussed in detail in a guidance document published by the U.S. EPA (1991c).

Another dissimilarity between the different concepts relates to the reference matrix used for the derivation of quality criteria. Whereas the values normally refer to the total concentration in the water, the criterion values used in the Netherlands refer to the dissolved concentration. Partition coefficients are subsequently applied to convert the values to the total concentration. The conversion from the dissolved portion of a substance to its total content may produce very different values, especially for substances with a high potential to bioaccumulate. To simplify things, it is assumed that pollutants adsorbed to suspended matter are not bioavailable.

Filter feeding organisms, however, may very well take up pollutants adsorbed to particles. Unfortunately, no appropriate methods have been developed so far to establish the bioavailability of substances adsorbed to solid particles. Consequently, as a precaution it appears justified to refer quality criteria derived from laboratory test results to the total concentration, even if the majority of the tested substances was dissolved. It should also be noted that the partition coefficient of a substance may vary by more than one order of magnitude depending on the chemical and physical water conditions.

Statistical Extrapolation Methods

When extrapolation methods are evaluated it should be observed that some assumptions made in the models are only partially true in the real world (Wagner and Løkke 1991, Van Leeuwen 1990, OECD 1992b). It is assumed that interspecies sensitivity variability is the only reason for differences in toxicity. Instead of being a constant value, a species' NOEC is in reality influenced by the test conditions and various environmental factors.

Instead of being arbitrarily chosen, the species are selected to fit the available test methods. This is why the distribution of existing NOEC values among individual taxonomic groups is often quite unbalanced. For example, if a substance has been thoroughly tested, NOEC values may be available for ten different species of fish while only one NOEC is available for other species groups. This may cause the distribution parameters to be distorted. Even though the effect values are often log-normally distributed, no theoretical foundation exists to prove a certain type of distribution. A data set analysis is the only way to verify an assumed distribution. This is why the assumed distribution function of the NOEC values of the species needs to be looked at with a statistical test method. Aldenberg (1993) suggests to conduct an adaptation test (modified Kolmogorov-Smirnov test) as described by D'Agostino and Stephens (1986). It still remains to be seen how the hazardous concentration can be extrapolated should a significant deviation from the assumed distribution occur. One possible solution would be to classify the data into different taxonomic groups. In that case, at least 4 NOEC values for the most sensitive taxonomic group(s) would be required. It is still a general issue how many and which species should be tested in order to reflect the entire range of sensitivity variations as comprehensively as possible (Mayer and Ellersieck 1986).

It should also be noted that existing toxicity data for most chemicals reflect nothing but the direct effect on a single organism. An ecosystem, however, consists of whole communities of organisms and is defined, among other things, by intercommunity interactions. Extrapolation methods based on interspecies sensitivity distribution do not account for interactions among different species (indirect effects). The results convey the false impression that an ecosystem consisted of non-interacting species (OECD 1992b, Smith and Cairns 1993, Forbes and Forbes 1993). The method based on compensation factors (factor method) is being criticized for the same reasons.

Compensation Factors or Statistical Extrapolation Method

Notwithstanding their general limitations, the theoretical comparison of different extrapolation methods made in Chapter 3.1.3 allows us to bring the following facts up for discussion:

The quality target derivation concept developed by the BLAK QZ is aimed at protecting all species living in an aquatic ecosystem. However, the theoretical comparison between the factor method and the statistical extrapolation method has revealed that to get close to this goal at least 12-20 NOEC values of species from different taxonomic groups must be available and the lowest NOEC value must be multiplied by a compensation factor of 0.1. Possible effects resulting from a combination with other pollutants are not yet accounted for. If only 4 NOEC values are available, it is likely that no more than an average 95% of all species will be protected. This means that the goal of protecting all species is missed. All statistical methods are based on the principle of assessing a toxic concentration aimed at protecting a certain percentage of all species (typically 95%).

If the BLAK QZ concept was aimed at deriving a quality target based on no more than 4 NOEC values for species from different trophic levels which will protect approximately 95% of the species in approximately 95% of all cases, the compensation factor F1 would have to be lowered. If a compensation factor F1 of 0.1 is maintained, at least 12-20 NOEC values of different species would be required to achieve the goal stated above.

A less ambitious goal to protect at least approximately 95% of all species in only approximately 50% of all cases could be achieved by merely multiplying the lowest of 4 NOEC values by a compensation factor F1 of 0.1. However, this means that in 50% of all cases a quality target would be derived which would only protect substantially less than 95% of the species. Hence the derived quality target would be inappropriate in a considerable number of cases to exclude adverse effects on an ecosystem.

Likewise, it can not be recommended to use a hazardous concentration assessed from 4 NOEC values with a confidence level of 50% (HC5, k50) as a quality target because this involves the risk that substantially less than 95% of the species would be protected in a considerable number of cases. A 95% protection level calculated with a 50% confidence level is certainly sufficient to assess a hazard potential or set a concern level. From an ecological point of view it is doubtful whether the NOEC of 5% of the species may be exceeded without jeopardizing the soundness of an ecosystem. From a scientific point of view, the assumption that an aquatic community is protected when the NOEC value of only 5% of the species is exceeded is not properly founded, while the percentage was arbitrarily chosen. It should be noted that an ecosystem is not protected when key organisms are among the 5% that are not offered enough protection (Van Leeuwen 1990). It's a question of principle whether 5% of the species can be dispensed with and a reduction of genetic diversity is acceptable (Bias 1993). The OECD (1992b) recommends to elevate the protection level when it becomes apparent that key species show more sensitive responses than the 95th percentile of the species.

When target values (negligible concentrations) are determined, the assessed hazardous concentrations should be multiplied by an additional compensation factor. Dutch scientists proposed to multiply the numerical value of the maximum tolerable risk level by a factor of 0.01 in order to establish a numerical value for the negligible risk level. The compensation factor should account for possible combined effects in the real world and other uncertainties concerning the derivation of values (Slooff 1992).

Level of Uncertainty

Uncertainties in the derivation of quality criteria can either be triggered by selecting data which are inappropriate to support the targeted protection level (lack of accuracy) or by data variations (lack of precision). However, there is no general consensus as to which confidence level would be appropriate with regard to the protection level (OECD 1992b). The 50% confidence level determined in the Netherlands to calculate the hazardous concentration was a somewhat pragmatic decision. If only a few (4-8) NOEC values are available, the hazardous concentration calculated with a confidence of 95% (HC5, k95) would often be generally refused for being extremely low compared to the lowest NOEC value.

It can be expected, however, that a representative selection of species will increase the degree of certainty for an assessed hazardous concentration; in fact the certainty is likely to be greater in reality than previously assumed.

In principle, the Dutch concept (Brujin et al. 1999, Slooff 1992) allows to assess a preliminary quality criterion for the protection of aquatic organisms based on QSAR models which can subsequently be converted into a quality criterion for sediments by using the equilibrium partitioning method. However, this procedure is doubtful as multilevel extrapolation entails an extremely elevated degree of uncertainty.

Comparative Evaluation of Approaches to Water Quality Monitoring

Quality criteria and quality standards as elements of water protection policy have proven to be a useful supplement to the emission principle. They are being used in the United States, Canada, the United Kingdom, the Netherlands and the Federal Republic of Germany as well as by the ICPR to monitor water management objectives. It has to be considered, however, that only a limited number of hazardous substances can be evaluated when the study is based on a substance-related approach. Additional approaches are required to assess the hazardous potential of other substances and possible additive or synergistic effects. This is why biotests and biological quality assessment procedures should be included in the monitoring of sewage and water bodies as long as these are appropriate to reveal structural and functional changes in aquatic biocoenoses resulting from exposures to hazardous substances. As all described approaches have their pros and cons, aquatic communities can only be effectively protected when those approaches are used simultaneously. A finding from one approach should not cancel a result obtained from another approach or lead to a relaxation of the minimum requirements established in the discharge permit (U.S. EPA 1991c). The pros and cons of the individual approaches are listed in Table 24.

Table 24: The pros and cons of approaches to water quality monitoring

Monitoring	**Strength**	**Weakness**
Material-specific quality criteria, objectives and standards	A simultaneous assessment for the protected assets human health and the environment is possible. The development of sewage clarification methods can be adapted to material-specific requirements. This method makes it easier to monitor or model the persistence of substances in the environment and allocate them to specific emission sources. A chemical analysis can be more economical compared to a biotest when only a few toxically active substances occur in the waste water.	Not all toxically active substances are accounted for. Bioavailability is not sufficiently considered. Combined effects are not accounted for. Analytical monitoring of a high number of single substances can be expensive. Direct biological effects on the water body are not established.
Biotests to assess sewage toxicity	Hazardous effects are integrally established for all substances in the waste water. Toxicity is established for hazardous substances not considered in an analysis. Bioavailability is partially accounted for. It is easier to include combined effects and previous contamination of the water body. Waste water toxicity can be directly assessed based on the tested species. Adverse effects on the water body can be prevented by corresponding provisions in the discharge permit.	Waste water toxicity is established for a limited number of species only. Often nothing but the acute fish toxicity is assessed. No test methods are available in Germany that would allow an assessment of the chronic waste water toxicity to fish and crustaceans. Information as to which hazardous substances cause the effects is incomplete. Additional studies are required to find out how the waste water toxicity can be reduced. Environmental conditions in the waste water may be different from test conditions. Persistence and accumulation of substances in organisms and sediments are not accounted for. The protection of human health has to be considered separately.
Biological quality assessment	The current effect on the water body is established. The effects of duration of impact and impact fluctuations can be integrally determined. New sources of impact can be discovered. The biological quality assessment can contribute to examine whether the current water management is good enough to protect aquatic communities.	Adverse effects have already occurred. Often it cannot be established what caused the effects. Exact allocations to different sources are impossible. Appropriate biomonitoring and bioindication procedures to assess toxic effects must be available. It is often difficult to interpret the effects (i.e. to draw a boundary between natural changes and those caused by human activity).

8. Conclusions and Recommendations

The concept for the derivation of quality targets developed by the BLAK QZ (LAWA 1997) is an appropriate approach to establishing quality criteria and quality standards. It is comparable to the methods used in Canada, the United Kingdom, the Netherlands and the United States. Some aspects of the concept, however, should be modified and extended. It is deemed necessary to adapt the LAWA concept to the Technical Guidance Document on risk assessment of substances published by the EC (1996). This is especially important with regard to the protected assets aquatic communities and suspended matter/sediments and an integration of the protection of piscivorous animal species.

Quality of Data

A derivation of quality criteria should generally be based on valid test results. Effect data obtained from tests which were only partially documented may be included in individual cases if the test appears to be valid or has been validated by other institutions. Secondary data or inadequately validated effect data of sensitive organisms should nonetheless be documented because they may provide additional support to a derivation and have the potential to reveal further demand for research. Further studies are required in the event that the available data for the most sensitive species are limited or inadequately validated.

Selection of Species and Minimum Data Set

In the majority of cases, the availability of thoroughly conducted chronic and subchronic toxicity tests for a spectrum of species that is as comprehensive as possible is still the most critical element in the extrapolation of "safe" environmental concentrations. Even when it comes to priority substances, chronic effect data for other species groups which are important to the soundness of an ecosystem are often missing (Slooff 1992, Gottschalk 1994). Apart from the well-established OECD and DIN test methods to assess acute and long-term toxic effects on bacteria, algae, Daphnia and fish, additional test methods for other taxonomic groups are required, at least for molluscs, insects and aquatic macrophytes in order to enhance the quality of the derivation of water quality criteria. A development and standardization of (sub)chronic tests on selected sedimentary organisms would as well be appreciated (Van Leeuwen 1990, OECD 1992b). If additional effect data on aquatic organisms are required to assess the toxicity of a substance, these should account for the sensitivity distribution among the tested species and for the material's mode of action.

Assessment of NOEC Values Based on Acute Effect Data

In the event that NOEC values are available for two or three trophic levels only, the acute-to-chronic ratio for multicellular organisms must be established. The following aspects should be observed in this context:

- The acute-to-chronic ratio for a species should be established in a separate study if possible.
- If acute and chronic values for several species from the same genus are available, the geometric mean can be used to calculate the average ratio for a taxonomic group.
- A transfer of the ratio to other taxonomic groups is dubious and should therefore not be made.
- If the acute-to-chronic ratio is > 10 the compensation factor to assess a NOEC value from acute data should be modified accordingly.

The quality target derivation concept developed by the LAWA (1997) does not recommend a clearly defined procedure how to incorporate a test result into the derivation if it is the lowest result from an acute test. It is recommended to assess the NOEC value based on the acute-to-chronic ratio and use it to derive a preliminary quality target which is maintained until a NOEC value from a long-term test becomes available for the tested species.

Derivation of Quality Targets Based on LOEC or EC/LC Values

The quality target derivation concept developed by the LAWA (1997) does not recommend a clearly defined procedure how to incorporate a LOEC or EC/LC value from a valid long-term test into the derivation if no other data are available. If no NOEC value for the target species is available from another long-term test, a NOEC value should be assessed by using either the LOEC, the MATC or the EC/LC value as described in the Technical Guidance Document (EC 1996). In order to assess an NOEC, the LOEC value (effect > 10% and < 20%) is divided by 2, whereas the MATC value is divided by the root of 2. If the effect is > 20% is should be checked whether it is possible to extrapolate an EC/LC10 value from the test data by using an appropriate statistical method, e.g. the probit method.

Compensation Factors

The LAWA concept (1997) should clearly define which uncertainties are to be accounted for by the compensation factor. The compensation factor could be outlined as follows: The compensation factor accounts for the possibility that more sensitive species exist than the ones that were tested and that species in the real world may be more sensitive because they are often exposed to several stress factors at a time. It should be made clear that all species might not be fully protected when only a small data set (less than 20 NOEC values) is available. It should also be made clear that the existing compensation factor (F1 = 0.1) does not account for possible combined effects which means that even if the quality targets for individual substances are complied with, there is still a risk that aquatic communities suffer from toxic effects when a water body is contaminated with a large number of hazardous substances.

With regard to the facts that combined effects can be expected from numerous hazardous substances and that in most cases several pollutants occur simultaneously in the field, an additional compensation factor should be introduced to account for combined effects.

Compensation Factors or Extrapolation

The use of statistical extrapolation methods must be further investigated. Quality criteria that were derived by compensation factors can be supported by these methods. The derived quality target should stay clearly below the hazardous concentration (HC5). If that is not the case it is likely that the quality target does not fully protect all species.

Further validation of existing statistical extrapolation methods can be effected by analyzing the interspecies sensitivity distribution with regard to thoroughly tested substances and establishing the effect of non-random sampling on the extrapolation results. Comparative studies of laboratory test results and data obtained from model ecosystems need to be continued. The comparisons of extrapolated hazardous concentrations against effect data from model ecosystem tests made by Versteeg et al. (1999), Emans et al. (1992) and Okkerman et al. (1993) represent a helpful step forward in that direction.

Field Studies

Model ecosystem studies should only be conducted after sufficient NOEC values have been collected from monospecies tests on a wide variety of species. Existing data on the material's chemical and physical properties, its persistence, its toxicity and its estimated exposure concentration should then be used to decide whether the uncertainties resulting from the extrapolation of laboratory test results to field conditions can be cleared up by an appropriate model ecosystem study. If the exposure concentration is substantially lower than the concentration regarded as safe for aquatic communities, a mesocosm study is no longer needed (Crossland and La Point 1991).

Protection of Piscivorous Animal Species

The protection of animal species feeding on fish and aquatic organisms should be included in the BLAK QZ concept. A derivation of quality criteria for the protected asset fishery based on maximum values for food does not automatically provide sufficient protection for piscivorous animals. A proposal of a concept to derive quality criteria for the food of piscivorous animal species (Schudoma et al. 1999) could be taken as a starting point for discussion. For an evaluation of international methods to derive quality criteria for the protection of piscivorous animal species see Chapter 3.2.

Combined Effects

Combined effects have to be accounted for when quality criteria are established. The compensation factor used in the BLAK QZ concept is not sufficient to cover the potential of combined effects. Alongside monitoring the quality criteria for individual substances, an assessment of the combined effects of waste water ingredients should also include the use of active biological parameters which are based on prolonged or chronic studies. Acute biotests are basically the only discharge monitoring procedures that are currently being used in the Federal Republic of Germany. However, appropriate methods with a duration of less than 7 days to assess the (sub)chronic effects are available (U.S. EPA 1991a, Grothe et al. 1996) and might be included in the water legislation after they have been properly established and standardized.

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Appendix A: Glossary

Acute: Acute toxicity is the harmful effect of a substance or physical impact after a short-term exposure or uptake. The normal observation period to determine acute toxicity is 1 to 4 days.

Aquatic community (AC): An AC is a community of various reciprocally interconnected populations of aquatic organisms in a water body or habitat.

Assessment factor: An assessment factor (compensation factor in the OECD sense) is a number applied to assess a hazardous concentration by using active concentration data (laboratory L(E)50, NOEC etc.), e.g. the concentration of a chemical that – should it be reached or exceeded – has a potential harmful effect on an ecosystem. Concern levels do not represent "safe" concentrations for aquatic ecosystems. Whenever the environmental concentration of a substance reaches or exceeds the concern level, further assessment or information will become necessary.

Bioaccumulation factor (BAF): The BAF indicates the ratio of the concentration of a substance in the water to its concentration in the tested organism. The BAF takes both the uptake of a substance through the water and the food chain into account. The BAF can be either determined experimentally or assessed by applying calculation models based on the BCF.

Bioconcentration factor (BCF): The BCF indicates the ratio of the concentration of a substance in the water to its concentration in the tested organism. The BCF value describes the degree of enrichment of a substance in an aquatic organism or its tissue in comparison to the aqueous phase. A BCF value determined in a field test is also referred to as "bioaccumulation factor" (BAF).

Benthic zone: The bottom area of a water body.

Benthos: The sum total of organisms living in, on or just above the bottom of freshwater or saltwater habitats.

Biocoenosis (biotic community): A community of organisms (plants and/or animals) living together with mutual interactions and interdependencies.

Chronic: In toxicology, the term "chronic" is used for a test duration exceeding 10% of an organism's lifespan. In aquatic ecotoxicology the test duration depends on the tested species and should comprise at least one entire reproductive cycle. A chronic test on daphnia has a duration of 21 days; a chronic test on fish lasts between 6 and 30 months. The endpoints to be determined include mortality, growth and reproduction. Frequent measures (statistical endpoints) are the NOEC (no observed effect concentration), the NOEL (no observed effect level), the LOEC (lowest observed effect concentration) and the LOEL (lowest observed effect level). The statistical endpoints resulting from a prolonged short-term test or an early life-stage test are often referred to as "subchronic" or "semichronic" effect values. The endpoints obtained from a prolonged short-term tests or an early life-stage test are often referred to as subchronic or semichronic effect values.

Compensation factor: A number applied to make up for uncertainties in the derivation of quality criteria. The value of the compensation factor normally depends on the available test results and the targeted protection level (maximum tolerable concentration, negligible concentration etc.). Synonymous terms: safety factor, uncertainty factor, assessment factor, application factor.

Concern level: Concentration of a substance that – if exceeded – is likely to have a detrimental effect on an ecosystem.

Consumers: Organisms that feed on organic matter and convert it into material characteristic that is of a species. Depending on the level they occupy in the food chain, they are referred to as primary consumers, secondary consumers etc.

Cyprinid waters: A water body inhabited mainly by minnows and carps (Cyprinidae). These fish species typically live in lower/central reaches of rivers or in lakes and ponds.

Decomposers: Organisms that break down constituents of organic matter into inorganic initial substances. Bacteria and fungi are typical decomposers.

Detection limit: In an analytical procedure, the detection limit is the smallest concentration that can be qualitatively distinguished with a specified degree of statistical certainty (e.g. P=95%) from the amount zero.

Determination limit: In an analytical procedure, the determination limit is the smallest concentration that can be quantitatively distinguished with a specified degree of statistical certainty (e.g. P=95%) from the amount zero.

Early life-stage test: 28 to 32 days (60 days for salmonids) exposures of the early life stages of a species of fish from shortly after fertilization through embryonic, larval and early juvenile development. Data are obtained, among other things, on survival and growth.

EC (effective concentration):

EC10: The calculated concentration (with regard to a certain test criterion) of a substance in the water which will cause a toxic effect in 10% of the organisms exposed to it for a set time period.

EC50: The calculated concentration (with regard to a certain test criterion) of a substance in the water which will cause a toxic effect in 50% of the organisms exposed to it for a set time period.

Effect values: Scientific data established in order to derive recommended values to protect various assets.

Endpoint: Parameter determined at the end of a biotest, e.g. mortality, cell multiplication, growth rate. The statistical measure characteristic of a test result (e.g. LC50, LOEC, NOEC) is also referred to as endpoint or statistical endpoint.

FDA action level: Concentration of a toxic substance in an organism (widely consumed edible portions of fish) which is regarded as unacceptable by the U.S. Food and Drug Administration.

Field test: Experimental study on toxic effects caused by chemicals in biotic and abiotic system components under natural or near natural conditions.

Full life-cycle test: See life-cycle test.

Genotoxic: A substance is genotoxic when it is capable of altering the genetic material (DNA) of an organism.

Hazard assessment: Identification and evaluation of the potential adverse effects resulting from the exposure to a material in a specified quantity and manner (comparison of a predicted environmental concentration - PEC/PNEC values).

Interstitial space: Interstitial system in the sediment or in the ground filled with water or air and serving as a habitat for micro-organisms.

Interstitial water: Pore water in the bottom sediment filling cavities and channels between grains and particles.

Kow: See n-octanol/water partition coefficient (Pow).

LC (lethal concentration):

LC50: Concentration that kills 50% of the organisms exposed to the test conditions within a set time period.

Lethal: Causing death in a toxicity test.

Life-cycle test: A chronic test which exposes a tested organism in all its important life stages to a certain test material. Generally, a life-cycle test comprises an entire reproductive cycle of the organism. There is a distinction between a full and a partial life-cycle test. In the case of fish a full life-cycle test involves the exposure of embryos, larvae, young fish and adults of the F1 generation as well as the embryonic and larval development of the F2 generation. A partial life-cycle test includes the effect on egg production and a subsequent early life-stage test.

Lipophilic: A material having a strong affinity for lipids (fats, waxes etc.) is referred to as lipophilic.

LOEC (lowest observed effect concentration): The lowest concentration of a test material that has a statistically significant adverse effect in a long-term test as compared with the controls, e.g. death of parent animals, reduced reproduction rate or other biologically relevant parameters. The LOEC value is numerically equivalent to the "upper limit" of a MATC (maximum acceptable toxicant concentration) value or to the "chronic value".

LOAEL (lowest observed adverse effect level): The lowest dose or concentration of a substance that causes a recognizable effect or a recognizable adverse effect in the test organism after continuous feeding.

MATC (maximum acceptable toxicant concentration): The geometric mean between the NOEC and LOEC concentration in a long-term test. The MATC is the highest concentration supposed not to cause an adverse effect. In the U.S. EPA literature the MATC value is referred to as "chronic value".

Mesotrophic: A mesotrophic water body contains an amount of dissolved nutrients (inorganic material, animal and plant plankton) and oxygen that is lower than in a eutrophic and higher than in a an oligotrophic water body.

Model ecosystem: Reproduction of an ecosystem on a laboratory scale considering its basic structure and main features. Standardized technical arrangements make sure that test results may be easily compared and reproduced. (A mathematical simulation may also serve as a model ecosystem.)

Monospecies test: A test conducted with only one animal or plant species to determine the behaviour or effect of a toxicant.

Mortality: The ratio of the number of deaths to the total population during a set time period. The ratio of reproduction to mortality is the decisive factor in the increase or decrease of a population.

Multispecies test: An experiment conducted to collect data on the behaviour or effects of chemicals on natural or artificial groups of organisms in a partial ecosystem.

n-octanol/water partition coefficient (Pow): The Pow value of a substance is its ratio of solubility in the n-octanol and water phases at equilibrium. The value is frequently referred to as log Pow or log Kow.

Neuston: Community of micro-organisms like algae (mainly diatoms), fungi, bacteria, protozoa and various stages of larvae living at the air-water interface.

NOEC (no observed effect concentration): The highest concentration of the test material which causes no death among the parent animals, no reduced reproduction rate, no delay in the first emergence of offspring and no adverse effect on any other biologically relevant parameter in a long-term test as compared to the controls.

NOEL (no observed effect level): The highest dose or concentration of a substance that causes neither a recognizable effect nor any recognizable adverse effect (NOAEL, no observed adverse effect level) in the tested organism after continuous feeding.

Oligotrophic: A stretch of water or soil having low levels of nutrients.

Partial life-cycle test: See life-cycle test.

PEC (predicted environmental concentration): Environmental concentration estimated on the basis of emission data by using models.

Pelagic zone: The open water of a sea or lake.

PNEC (predicted no effect concentration): Estimated concentration of a substance that is likely to have no detrimental effect on the environment. Normally, the lowest valid NOEC, EC and LC values are multiplied by compensation factors to calculate the PNEC. However, the term is also used in models to estimate chronic endpoints from acute fish tests.

Population: The population is the amount of all possible realizations of a random variable. A random sample is equivalent to n realizations.

Pow: See n-octanol/water partition coefficient.

Probability density function: See probability function.

Probability distribution: The probability distribution of a random variable indicates the degree of probability for the values of the x-variable to occur. $F(X) = P(X<x)$
F(X) is also referred to as "sum frequency distribution" or "cumulated probability distribution". The distribution function F (X) for a continuous random variable is established by means of integration and the so-called probability density.

Probability function (probability density function, frequency function): The assignment of the characteristics xi to the probabilities f(xi) is called probability function. See probability distribution.

Primary consumers: Organisms that feed on autotrophic organisms. In an aquatic ecosystem for instance, small crustaceans are primary consumers. They form the second level of the food pyramid.

Primary producers: Organisms that form the first level of the food chain in an ecosystem. They build up their bodily substance photoautotrophically or chemoautotrophically from inorganic matter and serve as food for other organisms. Examples: algae, green plants, photolithotrophic and chemoautotrophic bacteria.

Quality criterion: A certain quality recommended from a scientific point of view in order to achieve a specified protection target.

Quality objective: A desired quality status (numerical value or narrative statement) for a particular area. Quality objectives are reference values established by environmental politics. They are normally based on scientifically founded quality criteria. In addition, social or ethical considerations may be taken into account.

Quality standard: A legally binding value imposed by the government that has to be pursued or complied with.

Quantile (fractile): A quantile (also: fractile) is a measure of localization defined as F(x)=p; xp is the value of a continuous distribution where the probability of a smaller value equals p while the probability of a higher value equals 1-p. In a discrete distribution, p would be the maximum probability of a smaller value while 1-p would be the maximum probability of a higher value.

Random variable (stochastic variable): A random variable X is a value that might occur in a random experiment. When the random variable X results in a value x in an experiment, x is called a realization of X.

RfD (reference dose): Estimated amount of a material that in the case of lifelong exposure is likely not to have any significant detrimental effect on a human being.

Salmonid zone: A water body inhabited mainly by trouts, salmons, whitefishes and graylings (Salmonidae). Salmonid fish are common in rivers, streams and lakes in mountains or foothills.

Saprobity: The total heterotrophic bioactivity in a water body, including animals. The term is more often than not restricted to the activity of heterotrophic micro-organisms and an organically loaded stretch of water. In reality, the term "saprobity" is complimentary to the term "trophy".

Saprobity index: The saprobity index represents ecological effects of water pollution (particularly organically degradable material). There are 7 different saprobity levels, each with a corresponding saprobity index. The saprobity index can be established in accordance with the German Industrial Standard DIN 38 410 part 2.

Saprobiotic system: A system of various organisms which are ecologically distributed (in terms of incidence and rate of occurrence) mainly in certain impact zones of a preclarifier with degradable organic matter, thus serving as an indicator to measure impact situations of that kind. In conjunction with chemical and biological indicators, the saprobiotic system is used to evaluate the biological quality of waters.

Secondary consumers: Consumers occupying the third level of a food chain, e.g. fish.

Subchronic: See chronic.

Taxon: Plural: taxa, a classified group of living organisms, e.g. species, genus, order etc. Significant taxonomic groups in aquatic ecosystems (among others): algae, blue-green algae, higher aquatic plants, crustaceans, insects, fish, amphibians, mollusks, unicellular organisms, rotifers, bacteria etc.

Taxonomy: The science of ordering living organisms in a biological classification system.

Tolerance limits (statistics): The limits on a percentage of the basic total are referred to as tolerance limits. Tolerance limits indicate between which limits a certain fraction of the population can be expected with a given probability S=(1-a). In a normally distributed population, these limits are described as x+/- k.s, where k is a suitable constant, x the mean value and s the standard deviation. Factors for unilateral tolerance limits facilitate the statement that below x + k.s or above x - k.s the fraction g of the basic total can be expected to occur, for instance, in an average 95% of all cases.

Toxicity: The potential of a chemical substance to cause adverse effects in humans, animals and plants. There is a distinction between acute toxicity (after a one-time uptake of the active ingredient), subacute toxicity (after repetitive uptake within a short time period) and chronic toxicity (after continuous long-term uptake, e.g. several years).

Trophic level: One of several interdependent nutrition groups energetically interconnected in an ecosystem. Primary producers, primary consumers, secondary consumers and decomposers represent the most important trophic levels. A synonymous term would be "feeding level".

Appendix B: Extrapolation Constants

Table B-1: Extrapolation constants of the normal distribution model to establish a log HC5 value with a statistical certainty (confidence level) of 95% or 50%, respectively (Aldenberg, 1993)

m	k95	k50
2	26.206	2.35
3	7.6556	1.94
4	5.144	1.82
5	4.210	1.78
6	3.711	1.77
7	3.401	1.76
8	3.188	1.74
9	3.032	1.72
10	2.911	1.70
11	2.815	1.69
12	2.736	1.68
13	2.670	1.68
14	2.614	1.68
15	2.566	1.68
20	2.396	1.67
30	2.220	1.67
50	2.065	1.67
100	2.065	1.67
200	1.840	1.65
500	1.763	1.645
infinite	1.645	1.645

Table B-2: Extrapolation constants of the logistic distribution model to establish a log HC5 value with a statistical certainty (confidence level) of 95% or 50%, respectively (Aldenberg, 1993)

m	k95	k50
2	27.70	2.49
3	8.14	2.05
4	5.49	1.92
5	4.47	1.85
6	3.93	1.81
7	3.59	1.78
8	3.37	1.76
9	3.19	1.75
10	3.06	1.73
11	2.96	1.72
12	2.87	1.72
13	2.80	1.71
14	2.74	1.70
15	2.68	1.70
20	2.49	1.68
30	2.28	1.66
50	2.10	1.65
100	1.95	1.63
200	1.85	1.63
500	1.76	1.63
infinite	1.62	1.62

Appendix C: Quality criteria, Quality Objectives and Quality Standards

This appendix contains a table with quality criteria, quality objectives and quality standards intended to protect surface waters and marine waters. The listed values refer to continuous loads whereas no maximum values are listed for short-term loads. Numerical values of nutrients, chemical and physical parameters, sum parameters and biological parameters are listed alongside the quality criteria for hazardous substances. The list of values is sorted alphabetically and hierarchically according to parameter, area and protected asset or use, respectively. Below is a list of abbreviations of areas, statuses, protected assets and designations of values used in the relevant literature:

Area Abbreviations

CAN	Canada
CHE	Switzerland
DEU	Germany
DEU-NRW	Germany, North Rhine-Westphalia
EEC	European Economic Community
GBR	United Kingdom
JPN	Japan
NL	The Netherlands
Nordsee	North Sea and North-East Atlantic, quality criteria established by the Oslo and Paris Commission
Rhein	River Rhine, quality objectives (quality targets) established by the International Commission for the Protection of the Rhine
SWE	Sweden
USA	United States of America
USA-GL	USA, Great Lakes

Status Abbreviations

QC	Quality criterion
QO	Quality objective
QS	Quality standard
QS, E.	Quality standard (draft)

Protected Asset/Use Abbreviations

AGRIC-IRRI	Agriculture, irrigation
AGRIC-LIVE	Agriculture, water for livestock
AMBI	Environment, all water bodies
AQL	Aquatic communities, general
AQL-FRESH	Aquatic communities, freshwater
AQL-MARIN	Aquatic communities, marine water including brackish water
AQL-RIVER	Aquatic communities, flowing waters
DRINK	Drinking water
DRINK-FISH	Drinking water and fish consumption
DRINK-SURF	Surface water for drinking water supply
ESTUA	Estuaries
FISH	Fish, fishing, general
FISH-CONSM	Fish consumption, human health protection
INDST	Industry, industrial uses
MARIN	Marine water
REC	Recreation and leisure
RIVER	Flowing waters
SED-SOIL	Sediments

SURF	Surface water
SURF-CLASS	Surface water quality class
WILD-BIRD	Wild bird species
WILD-MAMM	Wild mammal species

Value Abbreviations

AGA	General quality requirements
AO	Aesthetic objective
BACKG	Background value
CCC	Criterion continuous concentration
Class 2	Quality class 2
EAC	Ecotoxicological assessment criteria
EQS	Environmental quality standard
FCV	Final chronic value
G	Guideline
G, A1	Guideline, category A1: simple physical treatment and disinfection, e.g. rapid filtration and disinfection
G, A2	Guideline, category A2: normal physical treatment, chemical treatment and disinfection, e.g. pre chlorination, coagulation, flocculation, decantation, filtration and disinfection (final chlorination)
G, A2, A1	Guideline, categories A1 and A2
G, Cyp.	Guideline for cyprinid waters
G, Salmo.	Guideline for salmonid waters
GL	Guideline
GL (I)	Guideline (Interim)
GW	Limit value
I	Compulsory value
I, A1	Compulsory value, category A1: simple physical treatment and disinfection, e.g. rapid filtration and disinfection
I, A2	Compulsory value, category A2: normal physical treatment, chemical treatment and disinfection, e.g. pre-chlorination, coagulation, flocculation, decantation, filtration and disinfection (final chlorination)
I, A2, A1	Compulsory value, categories A1 and A2
I, Cyp.	Compulsory value for cyprinid waters
I, Salmo.	Compulsory value for salmonid waters
IMAC	Interim maximum acceptable concentration
LV	Limit value (Grenswaarde)
MAC	Maximum acceptable concentration
MCL	Maximum contaminant level
PEQS	Proposed environmental quality standard
PWQS	Proposed water quality standard
QZ	Quality objective
TV	Target value (Streefwaarde)
WQC	Water quality criterion
WV	Wildlife value
ZV	Quality target
ZV (v)	Quality target (preliminary)

Literature:

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(2) CCME - Canadian Council of Ministers of the Environment (1989). Canadian Water Quality Guidelines: Updates (September 1989), Appendix V. Guidelines Division, Eco-Health Branch, Ecosystem Sciences and Evaluation Directorate, Environment Canada, Ottawa, Ontario, Canada K1A OE7

(3) CCME - Canadian Council of Ministers of the Environment (1990). Canadian Water Quality Guidelines: Updates (March 1990), Appendix VI. Guidelines Division, Eco-Health Branch, Ecosystem Sciences and Evaluation Directorate, Environment Canada, Ottawa, Ontario, Canada K1A OE7

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Quality Criteria, Quality Objectives and Quality Standards for the Aquatic Environment (Values in µg/l unless otherwise indicated)

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Acenaphthene	83-32-9	CAN	QC	AQL-FRESH	GL (I)	5.8	total, max. value		75
Acenaphthene	83-32-9	USA	QC	AQL-FRESH	FCV	23			57
Acenaphthene	83-32-9	USA	QC	AQL-MARIN	FCV	40			57
Acenaphthene	83-32-9	USA	QC	DRINK-FISH	WQC	1200		Derivation based on: IRIS database, updated 08/04/1998	77
Acenaphthene	83-32-9	USA	QC	FISH-CONSM	WQC	2700		Derivation based on: IRIS database, updated 08/04/1998	77
Acenaphthene	83-32-9	USA	QC	Taste	WQC	20			77
Acridine	260-94-6	CAN	QC	AQL-FRESH	GL (I)	4.4	total, max. value		75
Acrolein	107-02-8	USA	QC	AQL-FRESH	CCC	21		Not enough data available; lowest LOEL	23
Acrolein	107-02-8	USA	QC	DRINK-FISH	WQC	320			77
Acrolein	107-02-8	USA	QC	FISH-CONSM	WQC	780			77
Acrylonitrile	107-13-1	NL	QO	SURF	MPC	8	diss.	Acute data only; compensation factor 1000	76
Acrylonitrile	107-13-1	NL	QO	SURF	MPC	0.08	total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Acrylonitrile	107-13-1	NL	QO	SURF	TV	8	total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Acrylonitrile	107-13-1	USA	QC	AQL-FRESH	CCC	2600		Not enough data available; lowest LOEL	23
Acrylonitrile	107-13-1	USA	QC	DRINK-FISH	WQC	0.059		Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Acrylonitrile	107-13-1	USA	QC	FISH-CONSM	WQC	0.66		Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Alachlor	15972-60-8	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	80
Aldicarb	116-06-3	CAN	QC	AGRIC-IRRI	GL	54.9	total, max. value	Total, aldicarb, aldicarb sulfoxide, aldicarb sulfone, (legumes 67.5 µg/l)	75, 10
Aldicarb	116-06-3	CAN	QC	AGRIC-LIVE	GL	11	total, max. value	Total, aldicarb, aldicarb sulfoxide, aldicarb sulfone	75, 10
Aldicarb	116-06-3	CAN	QC	AQL-FRESH	GL (I)	1	total, max. value	Total, aldicarb, aldicarb sulfoxide, aldicarb sulfone	75, 10
Aldicarb	116-06-3	CAN	QC	AQL-MARIN	GL (I)	0.15	total, max. value	Total, aldicarb, aldicarb sulfoxide, aldicarb sulfone	75, 10
Aldicarb	116-06-3	CAN	QC	DRINK	MAC	9	total, max. value	Aldicarb, including aldicarb sulfoxide, aldicarb sulfone	75, 69
Aldicarb	116-06-3	DEU	QC	AQL-FRESH	ZV (E)	0.5	total, 90th perc.		81
Aldicarb	116-06-3	NL	QO	SURF	MPC	0.098	diss.		76
Aldicarb	116-06-3	NL	QO	SURF	MPC	0.098	total	Value standardized to a suspended matter content of 30 mg/l.	76
Aldicarb	116-06-3	NL	QO	SURF	TV	0.001	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Aldicarb sulfone	1646-88-4	DEU	QC	AQL-FRESH	ZV (E)			total, 90th perc.	Insufficient data	81
Aldicarb sulfoxide	1646-87-3	DEU	QC	AQL-FRESH	ZV (E)			total, 90th perc.	Insufficient data	81
Aldrin	309-00-2	CAN	QC	DRINK	MAC		0.7	total, max. value	Value not valid for aldrin and dieldrin	75, 69
Aldrin	309-00-2	EEC	QS	SURF	QZ		0.01	ann. mean		43
Aldrin	309-00-2	NL	QO	SURF	MPC		0.0009	diss.	Value is below detection/determination limit.	76
Aldrin	309-00-2	NL	QO	SURF	MPC		0.001	total	Value standardized to a suspended matter content of 30 mg/l.	76
Aldrin	309-00-2	NL	QO	SURF	TV		0.00001	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Aldrin	309-00-2	Rhein	QO	RIVER	ZV		0.001	total, 90th perc.	AQL & FISH-CONSM	45
Aldrin	309-00-2	USA	QC	AQL-FRESH	CMC		3		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Aldrin	309-00-2	USA	QC	AQL-MARIN	CMC		1.3		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Aldrin	309-00-2	USA	QC	DRINK-FISH	WQC		0.00013		Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Aldrin	309-00-2	USA	QC	FISH-CONSM	WQC		0.00014		Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Alkalinity		USA	QC	AQL-FRESH	CCC		20000		Derivation see Red Book (EPA 440/9-76-0239)	77
Aluminium	7429-90-5	CAN	QC	AGRIC-IRRI	GL		5000	total, max. value	All soils with permanent irrigation	75, 1
Aluminium	7429-90-5	CAN	QC	AGRIC-LIVE	GL		5000	total, max. value		75, 1
Aluminium	7429-90-5	CAN	QC	AQL-FRESH	GL		5	total, max. value	pH<6.5, [Ca++]<4.0 mg/l, DOC<2.0 mg/l. QC dependent on pH, calcium and DOC concentrations.	75, 1
Aluminium	7429-90-5	CAN	QC	AQL-FRESH	GL		100	total, max. value	pH>6.5, [Ca++]>4.0 mg/l, DOC>2.0 mg/l. QC dependent on pH, calcium and DOC concentrations.	75, 1
Aluminium	7429-90-5	DEU	QS	DRINK	GW		200			78
Aluminium	7429-90-5	DEU-NRW	QS	AGRIC-IRRI	GL		5000			38
Aluminium	7429-90-5	USA	QC	AQL-FRESH	CCC		87	total concentration	pH 6.5 - 9	77
Aluminium	7429-90-5	USA	QC	AQL-FRESH	CMC		750	total concentration	pH 6.5 - 9	77
Ametryne	834-12-8	DEU	QC	AQL-FRESH	ZV (v)		0.5	total, 90th perc.		73
Ammonia, NH3-N		DEU-NRW	QS	FISH	G, Cyp.	<	4	NH3-N, 95th perc.	According to EC Directive 78/659/EEC	38
Ammonia, NH3-N		DEU-NRW	QS	FISH	G, Salmo.	<	4	NH3-N, 95th perc.	According to EC Directive 78/659/EEC	38
Ammonia, NH3-N		DEU-NRW	QS	FISH	I, Cyp.	<	20	NH3-N, 95th perc.	According to EC Directive 78/659/EEC	38
Ammonia, NH3-N		DEU-NRW	QS	FISH	I, Salmo.	<	20	NH3-N, 95th perc.	According to EC Directive 78/659/EEC	38
Ammonia, NH3-N		GBR	QS, E.	AQL-FRESH	PEQS		15	NH3-N (non-ionic)		35
Ammonia, NH3-N		GBR	QS, E.	AQL-MARIN	PEQS		21	NH3-N (non-ionic)		35

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Ammonia, NH3-N		GBR	QS, E.	FISH	PWQS		21	NH3-N, non-ionic	Salmonid fishing	24
Ammonium		DEU	QS	DRINK	GW		500	as NH4		78
Ammonium	7664-41-7	USA	QC	AQL-FRESH	CCC				Criterion values depend on pH value. See reports: EPA822-R-98-008 and EPA440/5-88-004	77
Ammonium	7664-41-7	USA	QC	AQL-FRESH	CMC				Criterion values depend on pH value. See reports: EPA822-R-98-008 and EPA440/5-88-004	77
Ammonium	7664-41-7	USA	QC	AQL-MARIN	CCC				Criterion values depend on pH value and temperature. See reports: EPA822-R-98-008 and EPA440/5-88-004	77
Ammonium	7664-41-7	USA	QC	AQL-MARIN	CMC				Criterion values depend on pH value and temperature. See reports: EPA822-R-98-008 and EPA440/5-88-004	77
Ammonium, NH4-N		DEU-NRW	QS	DRINK-SURF	G, A1		40		According to EC Directive 75/440/EEC	38
Ammonium, NH4-N		DEU-NRW	QS	DRINK-SURF	G, A2		780		According to EC Directive 75/440/EEC	38
Ammonium, NH4-N		DEU-NRW	QS	DRINK-SURF	I, A2		1170		According to EC Directive 75/440/EEC	38
Ammonium, NH4-N		DEU-NRW	QS	FISH	G, Cyp.	<	160	NH4-N, 95th perc.	According to EC Directive 78/659/EEC	38
Ammonium, NH4-N		DEU-NRW	QS	FISH	G, Salmo.	<	30	NH4-N, 95th perc.	According to EC Directive 78/659/EEC	38
Ammonium, NH4-N		DEU-NRW	QS	FISH	G, Cyp.	<	780	NH4-N, 95th perc.	According to EC Directive 78/659/EEC	38
Ammonium, NH4-N		DEU-NRW	QS	FISH	I, Salmo.	<	780	NH4-N, 95th perc.	According to EC Directive 78/659/EEC	38
Ammonium, NH4-N		DEU-NRW	QS	SURF	AGA	<=	1000	NH4-N, 90th perc.		38
Ammonium, NH4-N		NL	QO	SURF	MPC		20	total		76
Ammonium, NH4-N		Rhein	QO	RIVER	ZV		200	total, 90th perc.	AQL	45
Ammonium, total		CAN	QC	AQL-FRESH	GL		1370	total, max. value	pH 8.0; 10 °C; QC depends on temperature and pH value.	75, 1
Ammonium, total		CAN	QC	AQL-FRESH	GL		2200	total, max. value	pH 6.5; 10 °C; QC depends on temperature and pH value.	75, 1
Ammonium, total		GBR	QS, E.	FISH	PWQS		780	NH4-N	Salmonid fishing	24
Anilazine	101-05-3	NL	QO	SURF	MPC		0.085	diss.		76
Anilazine	101-05-3	NL	QO	SURF	MPC		0.085	total	Value standardized to a suspended matter content of 30 mg/l.	76
Anilazine	101-05-3	NL	QO	SURF	TV		0.0009	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Aniline	62-53-3	CAN	QC	AQL-FRESH	GL		2.2	total, max. value		75, 9
Aniline	62-53-3	USA	QC	AQL-FRESH	CCC		14	4-day average		66
Aniline	62-53-3	USA	QC	AQL-MARIN	CCC		37	4-day average		66
Anthracene	120-12-7	CAN	QC	AQL-FRESH	GL (I)		0.012	total, max. value		75
Anthracene	120-12-7	NL	QO	SURF	MPC		0.07	diss.		76
Anthracene	120-12-7	NL	QO	SURF	MPC		0.08	total	Value standardized to a suspended matter content of 30 mg/l.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range			Reference	Notes	Lit. No.
Anthracene	120-12-7	NL	QO	SURF	TV		0.0008			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Anthracene	120-12-7	Nordsee	QC	MARIN	EAC		0.001	0.01		diss.	Preliminary values	27
Anthracene	120-12-7	USA	QC	DRINK-FISH	WQC		9600				Derivation based on: IRIS database, updated 08/04/1998	77
Anthracene	120-12-7	USA	QC	FISH-CONSM	WQC		110000				Derivation based on: IRIS database, updated 08/04/1998	77
Antimony	7440-36-0	CAN	QC	DRINK	IMAC		6					75
Antimony	7440-36-0	DEU	QS	DRINK	GW		10					78
Antimony	7440-36-0	NL	QO	SURF	BACKG		0.3			diss.		76
Antimony	7440-36-0	NL	QO	SURF	BACKG		0.3			total	Value standardized to a suspended matter content of 30 mg/l.	76
Antimony	7440-36-0	NL	QO	SURF	MPC		6.5			diss.		76
Antimony	7440-36-0	NL	QO	SURF	MPC		7.2			total	Value standardized to a suspended matter content of 30 mg/l.	76
Antimony	7440-36-0	NL	QO	SURF	TV		0.4			diss.		76
Antimony	7440-36-0	NL	QO	SURF	TV		0.4			total	Value standardized to a suspended matter content of 30 mg/l.	76
Antimony	7440-36-0	USA	QC	AQL-FRESH	CCC		30			4-day average		67
Antimony	7440-36-0	USA	QC	AQL-MARIN	CCC		500			4-day average		67
Antimony	7440-36-0	USA	QC	DRINK-FISH	WQC		14				Derivation based on: IRIS database, updated 08/04/1998. A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Antimony	7440-36-0	USA	QC	FISH-CONSM	WQC		4300				Derivation based on: IRIS database, updated 08/04/1998	77
Antimony 125	7440-36-0	CAN	QC	DRINK	IMAC		100		Bq/l		If several radionuclides are present: Total Ci / MACi <= 1	75
AOX		DEU-NRW	QS	SURF	AGA	<=	40			90th perc.		38
AOX		Rhein	QO	RIVER	ZV		50			total, 90th perc.	DRINK-SURF	45
Arsenic	7440-38-2	CAN	QC	AGRIC-IRRI	GL (I)		100			total, max. value	All soils with permanent irrigation	75, 1
Arsenic	7440-38-2	CAN	QC	AGRIC-LIVE	GL (I)		25			total, max. value		75, 1
Arsenic	7440-38-2	CAN	QC	AQL-FRESH	GL		5			total, max. value		75, 1
Arsenic	7440-38-2	CAN	QC	AQL-MARIN	GL		12.5			total, max. value		75
Arsenic	7440-38-2	CAN	QC	DRINK	IMAC		25			total, max. value		75, 69
Arsenic	7440-38-2	CHE	QS, E.	AQL	QZ		10			diss. total		26
Arsenic	7440-38-2	CHE	QS, E.	AQL	QZ		10			diss. total		26
Arsenic	7440-38-2	DEU	QS	DRINK	GW		10					78
Arsenic	7440-38-2	DEU-NRW	QS	AGRIC-IRRI	GL		40					38
Arsenic	7440-38-2	DEU-NRW	QS	DRINK-SURF	G, A1		10				According to EC Directive 75/440/EEC	38

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Arsenic	7440-38-2	DEU-NRW	QS	DRINK-SURF	I, A1	50			According to EC Directive 75/440/EEC	38
Arsenic	7440-38-2	DEU-NRW	QS	DRINK-SURF	I, A2	50			According to EC Directive 75/440/EEC	38
Arsenic	7440-38-2	GBR	QS, E.	AGRIC-IRRI	PWQS	40		ann. mean		24
Arsenic	7440-38-2	GBR	QS, E.	AGRIC-LIVE	PWQS	200		ann. mean		24
Arsenic	7440-38-2	GBR	QS	FRESH	EQS	50		diss., ann. mean		63
Arsenic	7440-38-2	GBR	QS	MARIN	EQS	25		total diss., ann. mean	More stringent standards may be required when alga species that play an important part in the ecosystem are sensitive to arsenic.	28
Arsenic	7440-38-2	JPN	QS	AMBI	EQS	10			Health aspects	37
Arsenic	7440-38-2	NL	QO	SURF	BACKG	0.8		diss.		76
Arsenic	7440-38-2	NL	QO	SURF	BACKG	1		total	Value standardized to a suspended matter content of 30 mg/l.	76
Arsenic	7440-38-2	NL	QO	SURF	MPC	25		diss.		76
Arsenic	7440-38-2	NL	QO	SURF	MPC	32		total	Value standardized to a suspended matter content of 30 mg/l.	76
Arsenic	7440-38-2	NL	QO	SURF	TV	1		diss.		76
Arsenic	7440-38-2	NL	QO	SURF	TV	1.3		total	Value standardized to a suspended matter content of 30 mg/l.	76
Arsenic	7440-38-2	Nordsee	QC	MARIN	EAC	1	10	diss.		27
Arsenic	7440-38-2	SWE	QC	SURF-CLASS	Class 2	0.2	1		Class 2 = good	56
Arsenic	7440-38-2	USA	QC	AQL-FRESH	CCC	150			Derived from data on arsenic III. Dissolved concentration. Derivation published in document EPA-820-B-96-001.	77
Arsenic	7440-38-2	USA	QC	AQL-FRESH	CMC	340			Derived from data on arsenic III. Dissolved concentration. Derivation published in document EPA-820-B-96-001.	77
Arsenic	7440-38-2	USA	QC	AQL-MARIN	CCC	36			Derived from data on arsenic III. Dissolved concentration.	77
Arsenic	7440-38-2	USA	QC	AQL-MARIN	CMC	69			Derived from data on arsenic III. Dissolved concentration.	77
Arsenic	7440-38-2	USA	QC	DRINK	MCL	50				23
Arsenic	7440-38-2	USA	QC	DRINK-FISH	WQC	0.018			Carcinogenic risk (risk level 10-6). Arsenic criteria are currently being updated. Refers to the inorganic form only.	77
Arsenic	7440-38-2	USA	QC	FISH-CONSM	WQC	0.14			Carcinogenic risk (risk level 10-6). Arsenic criteria are currently being updated. Refers to the inorganic form only.	77
Arsenic (III)	7440-38-2	USA	QC	AQL-FRESH	CCC	190				23
Arsenic (III)	7440-38-2	USA	QC	AQL-MARIN	CCC	36				23
Arsenic (III)	7440-38-2	USA-GL	QC	AQL-FRESH	CCC	150		total		52
Arsenic (V)	7440-38-2	USA	QC	AQL-FRESH	CCC	48			Not enough data available; lowest LOEL	23
Arsenic (V)	7440-38-2	USA	QC	AQL-MARIN	CCC	13			Not enough data available; lowest LOEL	23

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Asbestos	1332-21-4	USA	QC	DRINK-FISH	WQC		7	million fibers/L		Maximum Contaminant Level (MCL)	77
Atrazine	1912-24-9	CAN	QC	AGRIC-IRRI	GL (I)		10		total, max. value	All soils with permanent irrigation	75, 2
Atrazine	1912-24-9	CAN	QC	AGRIC-LIVE	GL (I)		5		total, max. value		75, 2
Atrazine	1912-24-9	CAN	QC	AQL-FRESH	GL		1.8		total, max. value		75, 2
Atrazine	1912-24-9	CAN	QC	DRINK	IMAC		5		total, max. value		75, 69
Atrazine	1912-24-9	DEU	QC	AQL-FRESH	ZV (E)		2.2		total, 90th perc.		81
Atrazine	1912-24-9	GBR	QS, E.	AQL-FRESH	PEQS		2		total dissolved, ann. mean	Refers to the sum of atrazine and simazine	16
Atrazine	1912-24-9	GBR	QS, E.	AQL-MARIN	PEQS		2		total dissolved, ann. mean	Refers to the sum of atrazine and simazine	16
Atrazine	1912-24-9	NL	QO	SURF	MPC		2.9		diss.		76
Atrazine	1912-24-9	NL	QO	SURF	MPC		2.9		total	Value standardized to a suspended matter content of 30 mg/l.	76
Atrazine	1912-24-9	NL	QO	SURF	TV		0.029		total	Value standardized to a suspended matter content of 30 mg/l.	76
Atrazine	1912-24-9	Rhein	QO	RIVER	ZV		0.1		total, 90th perc.	DRINK-SURF & AQL	45
Azinphos-ethyl	2642-71-9	DEU	QC	AQL-FRESH	ZV (v)		-		total, 90th perc.	Insufficient data	73
Azinphos-ethyl	2642-71-9	NL	QO	SURF	MPC		0.011		diss.		76
Azinphos-ethyl	2642-71-9	NL	QO	SURF	MPC		0.011		total	Value standardized to a suspended matter content of 30 mg/l.	76
Azinphos-ethyl	2642-71-9	NL	QO	SURF	TV		0.0001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Azinphos-ethyl	2642-71-9	Rhein	QO	RIVER	ZV		0.1		total, 90th perc.	DRINK-SURF	45
Azinphos-methyl	86-50-0	CAN	QC	DRINK	MAC		20		total, max. value		75, 69
Azinphos-methyl	86-50-0	DEU	QC	AQL-FRESH	ZV (v)		0.01		total, 90th perc.		73
Azinphos-methyl	86-50-0	GBR	QS, E.	AQL-FRESH	PEQS		0.01		total dissolved, ann. mean		22
Azinphos-methyl	86-50-0	GBR	QS, E.	AQL-MARIN	PEQS		0.01		total dissolved, ann. mean		22
Azinphos-methyl	86-50-0	NL	QO	SURF	MPC		0.012		diss.		76
Azinphos-methyl	86-50-0	NL	QO	SURF	MPC		0.012		total	Value standardized to a suspended matter content of 30 mg/l.	76
Azinphos-methyl	86-50-0	NL	QO	SURF	TV		0.0001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Azinphos-methyl	86-50-0	Rhein	QO	RIVER	ZV		0.001		total, 90th perc.	AQL	45
Bacteria		USA	QC	DRINK	MCL	<	1	/100 ml			23
Barium	7440-39-3	CAN	QC	DRINK	MAC		1000		total, max. value		75, 69

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Barium	7440-39-3	DEU	QS	DRINK	GW	1000			78
Barium	7440-39-3	DEU-NRW	QS	DRINK-SURF	I, A1	100		According to EC Directive 75/440/EEC	38
Barium	7440-39-3	DEU-NRW	QS	DRINK-SURF	I, A2	1000		According to EC Directive 75/440/EEC	38
Barium	7440-39-3	NL	QO	SURF	BACKG	73	diss.		76
Barium	7440-39-3	NL	QO	SURF	BACKG	76	total	Value standardized to a suspended matter content of 30 mg/l.	76
Barium	7440-39-3	NL	QO	SURF	MPC	220	diss.		76
Barium	7440-39-3	NL	QO	SURF	MPC	230	total	Value standardized to a suspended matter content of 30 mg/l.	76
Barium	7440-39-3	NL	QO	SURF	TV	75	diss.		76
Barium	7440-39-3	NL	QO	SURF	TV	78	total	Value standardized to a suspended matter content of 30 mg/l.	76
Barium	7440-39-3	USA	QC	DRINK	MCL	1000			23
Barium	7440-39-3	USA	QC	DRINK-FISH	WQC	1000			77
Bendiocarb	22781-23-3	CAN	QC	DRINK	MAC	40	total, max. value		75, 69
Benomyl	17804-35-2	NL	QO	SURF	MPC	0.15	diss.		76
Benomyl	17804-35-2	NL	QO	SURF	MPC	0.15	total	Value standardized to a suspended matter content of 30 mg/l.	76
Benomyl	17804-35-2	NL	QO	SURF	TV	0.002	total	Value standardized to a suspended matter content of 30 mg/l. Value standardized to a suspended matter content of 30 mg/l.	76
Bentazon	25057-89-0	DEU	QC	AQL-FRESH	ZV (v)	70	total, 90th perc.		73
Bentazon	25057-89-0	NL	QO	SURF	MPC	64	diss.		76
Bentazon	25057-89-0	NL	QO	SURF	MPC	64	total	Value standardized to a suspended matter content of 30 mg/l.	76
Bentazon	25057-89-0	NL	QO	SURF	TV	0.6	total	Value standardized to a suspended matter content of 30 mg/l.	76
Bentazon	25057-89-0	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	45
Benz(a)anthracene	56-55-3	CAN	QC	AQL-FRESH	GL (I)	0.018	total, max. value		75
Benzene	71-43-2	CAN	QC	AQL-FRESH	GL (I)	370	total, max. value		75
Benzene	71-43-2	CAN	QC	AQL-MARIN	GL (I)	110	total, max. value		75
Benzene	71-43-2	CAN	QC	DRINK	MAC	5	total, max. value		75, 69
Benzene	71-43-2	JPN	QS	AMBI	EQS	10		Health aspects	37
Benzene	71-43-2	NL	QO	SURF	MPC	240	diss.		76
Benzene	71-43-2	NL	QO	SURF	MPC	240	total	Value standardized to a suspended matter content of 30 mg/l.	76
Benzene	71-43-2	NL	QO	SURF	TV	2	total	Value standardized to a suspended matter content of 30 mg/l.	76
Benzene	71-43-2	Rhein	QO	RIVER	ZV	2	total, 90th perc.	AQL	45
Benzene	71-43-2	USA	QC	AQL-MARIN	CCC	700		Not enough data available; lowest LOEL	23

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Benzene	71-43-2	USA	QC	DRINK-FISH	WQC	1.2			Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Benzene	71-43-2	USA	QC	FISH-CONSM	WQC	71			Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Benzidine	92-87-5	USA	QC	DRINK-FISH	WQC	0.00012			Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Benzidine	92-87-5	USA	QC	FISH-CONSM	WQC	0.00054			Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Benzo(a)anthracene	56-55-3	NL	QO	SURF	MPC	0.01		diss.	Value standardized to a suspended matter content of 30 mg/l.	76
Benzo(a)anthracene	56-55-3	NL	QO	SURF	MPC	0.03		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Benzo(a)anthracene	56-55-3	NL	QO	SURF	TV	0.0003		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Benzo(a)anthracene	56-55-3	USA	QC	DRINK-FISH	WQC	0.0044			Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Benzo(a)anthracene	56-55-3	USA	QC	FISH-CONSM	WQC	0.049			Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Benzo(a)pyrene	50-32-8	CAN	QC	AQL-FRESH	GL (I)	0.015		total, max. value		75
Benzo(a)pyrene	50-32-8	CAN	QC	DRINK	MAC	0.01		total, max. value		75, 69
Benzo(a)pyrene	50-32-8	NL	QO	SURF	MPC	0.05		diss.		76
Benzo(a)pyrene	50-32-8	NL	QO	SURF	MPC	0.2		total	Value standardized to a suspended matter content of 30 mg/l.	76
Benzo(a)pyrene	50-32-8	NL	QO	SURF	TV	0.002		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Benzo(a)pyrene	50-32-8	Nordsee	QC	MARIN	EAC	0.01	0.1	diss.	Preliminary values	27
Benzo(a)pyrene	50-32-8	Rhein	QO	RIVER	ZV	0.01		total, 90th perc.	DRINK-SURF	74
Benzo(a)pyrene	50-32-8	USA	QC	DRINK-FISH	WQC	0.0044			Derivation based on: IRIS database, updated 08/04/1998. Carcinogenic risk (risk level 10-6)	77
Benzo(a)pyrene	50-32-8	USA	QC	FISH-CONSM	WQC	0.049			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Benzo[b]fluoranthene	205-99-2	USA	QC	DRINK-FISH	WQC	0.0044			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Benzo[b]fluoranthene	205-99-2	USA	QC	FISH-CONSM	WQC	0.049			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Benzo[g,h,i]perylene	191-24-2	NL	QO	SURF	MPC	0.03		diss.		76
Benzo[g,h,i]perylene	191-24-2	NL	QO	SURF	MPC	0.5		total	Value standardized to a suspended matter content of 30 mg/l.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Benzo[g,h,i]perylene	191-24-2	NL	QO	SURF	TV	0.05	total	Value standardized to a suspended matter content of 30 mg/l.	76
Benzo[k]fluoranthene	207-08-9	NL	QO	SURF	MPC	0.04	diss.		76
Benzo[k]fluoranthene	207-08-9	NL	QO	SURF	MPC	0.2	total	Value standardized to a suspended matter content of 30 mg/l.	76
Benzo[k]fluoranthene	207-08-9	NL	QO	SURF	TV	0.002	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Benzo[k]fluoranthene	207-08-9	USA	QC	DRINK-FISH	WQC	0.0044		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Benzo[k]fluoranthene	207-08-9	USA	QC	FISH-CONSM	WQC	0.049		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Beryllium	7440-41-7	CAN	QC	AGRIC-IRRI	GL	100	total, max. value	All soils with permanent irrigation	75, 1
Beryllium	7440-41-7	CAN	QC	AGRIC-LIVE	GL (I)	100	total, max. value		75, 1
Beryllium	7440-41-7	DEU-NRW	QS	AGRIC-IRRI	GL	50			38
Beryllium	7440-41-7	NL	QO	SURF	BACKG	0.02	diss.	Value is below detection/determination limit.	76
Beryllium	7440-41-7	NL	QO	SURF	BACKG	0.02	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Beryllium	7440-41-7	NL	QO	SURF	MPC	0.2	diss.		76
Beryllium	7440-41-7	NL	QO	SURF	MPC	0.2	total	Value standardized to a suspended matter content of 30 mg/l.	76
Beryllium	7440-41-7	NL	QO	SURF	TV	0.02	diss.	Value is below detection/determination limit.	76
Beryllium	7440-41-7	NL	QO	SURF	TV	0.02	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Beryllium	7440-41-7	USA	QC	AQL-FRESH	CCC	5.3		Not enough data available; lowest LOEL	23
Beryllium	7440-41-7	USA	QC	DRINK-FISH	WQC	0.0068		Carcinogenic risk (risk level 10-6)	23
Beryllium	7440-41-7	USA	QC	FISH-CONSM	WQC	0.117		Carcinogenic risk (risk level 10-6)	23
Biphenthrin	82657-04-3	NL	QO	SURF	MPC	0.001	diss.	Value is below detection/determination limit.	76
Biphenthrin	82657-04-3	NL	QO	SURF	MPC	0.001	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Biphenthrin	82657-04-3	NL	QO	SURF	TV	0.00001	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Bis(2-chloroethyl)ether	111-44-4	USA	QC	DRINK-FISH	WQC	0.031		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Bis(2-chloroethyl)ether	111-44-4	USA	QC	FISH-CONSM	WQC	1.4		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Bis(2-chloroisopropyl)ether	39638-32-9	USA	QC	DRINK-FISH	WQC	1400		Derivation based on: IRIS database, updated 08/04/1998	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Bis(2-chloroisopropyl)ether	39638-32-9	USA	QC	FISH-CONSM	WQC		170000			Derivation based on: IRIS database, updated 08/04/1998	77
Bis(chloromethyl)ether	542-88-1	USA	QC	DRINK-FISH	WQC		0.00013				77
Bis(chloromethyl)ether	542-88-1	USA	QC	FISH-CONSM	WQC		0.00078				77
Blue-green algae		CAN	QC	AGRIC-LIVE	GL					Blossoms of blue-green algae should be avoided.	75, 1
BOD		GBR	QS, E.	FISH	PWQS		6000			Salmonid fishing	24
BOD5 w. ATH		DEU-NRW	QS	DRINK-SURF	G, A2	<	5000			According to EC Directive 75/440/EEC	38
BOD5 w. ATH		DEU-NRW	QS	DRINK-SURF	G, A2	<	3000			According to EC Directive 75/440/EEC	38
BOD5 w. ATH		DEU-NRW	QS	FISH	G, Cyp.	<	6000		95th perc.	According to EC Directive 78/659/EEC	38
BOD5 w. ATH		DEU-NRW	QS	FISH	G, Salmo.	<	3000		95th perc.	According to EC Directive 78/659/EEC	38
BOD5 w. ATH		DEU-NRW	QS	SURF	AGA	<=	5000		90th perc.		38
Boron	7440-42-8	CAN	QC	AGRIC-IRRI	GL		500	6000	total, max. value	All soils with permanent irrigation. Depends on sensitivity of cultivated plants.	75, 1
Boron	7440-42-8	CAN	QC	AGRIC-LIVE	GL		5000		total, max. value		1
Boron	7440-42-8	CAN	QC	DRINK	IMAC		5000		total, max. value		75, 69
Boron	7440-42-8	DEU	QS	DRINK	GW		1000				78
Boron	7440-42-8	DEU-NRW	QS	AGRIC-IRRI	GL		500				38
Boron	7440-42-8	DEU-NRW	QS	DRINK-SURF	G, A1		1000			According to EC Directive 75/440/EEC	38
Boron	7440-42-8	DEU-NRW	QS	DRINK-SURF	G, A2		1000			According to EC Directive 75/440/EEC	38
Boron	7440-42-8	GBR	QS, E.	AGRIC-IRRI	PWQS		2400		ann. mean		24
Boron	7440-42-8	GBR	QS	FRESH	EQS		2000		total, ann. mean		63
Boron	7440-42-8	GBR	QS	MARIN	EQS		7000		total, ann. mean		63
Boron	7440-42-8	USA	QC	AGRIC-IRRI	EQS		750				23
Bromacil	314-40-9	CAN	QC	AGRIC-IRRI	GL (I)		0.2		total, max. value		75, 64
Bromacil	314-40-9	CAN	QC	AGRIC-LIVE	GL (I)		1100		total, max. value		75, 64
Bromacil	314-40-9	CAN	QC	AQL-FRESH	GL (I)		5		total, max. value		75, 64
Bromacil	314-40-9	DEU	QC	AQL-FRESH	ZV (v)		0.6		total, 90th perc.		73
Bromacil	314-40-9	DEU	QC	AQL-FRESH	ZV (E)		0.6		total, 90th perc.		81
Bromide (Br)		NL	QO	SURF	MPC		8000		total		76
Bromoform	75-25-2	USA	QC	DRINK-FISH	WQC		4.3			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Bromoform	75-25-2	USA	QC	FISH-CONSM	WQC		360			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Bromoxynil	1689-84-5	CAN	QC	AGRIC-IRRI	GL		0.33		total, max. value		75, 8
Bromoxynil	1689-84-5	CAN	QC	AGRIC-LIVE	GL (I)		11		total, max. value		75, 8
Bromoxynil	1689-84-5	CAN	QC	AQL-FRESH	GL		5		total, max. value		75, 8
Bromoxynil	1689-84-5	CAN	QC	DRINK	IMAC		5		total, max. value		75, 69
Butyl benzyl phthalate	85-68-7	USA	QC	DRINK-FISH	WQC		3000			Derivation based on: IRIS database, updated 08/04/1998	77
Butyl benzyl phthalate	85-68-7	USA	QC	FISH-CONSM	WQC		5200			Derivation based on: IRIS database, updated 08/04/1998	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Cadmium	7440-43-9	CAN	QC	AGRIC-IRRI	GL		5.1		total, max. value	All soils with permanent irrigation	75, 71
Cadmium	7440-43-9	CAN	QC	AGRIC-LIVE	GL		80		total, max. value		75, 71
Cadmium	7440-43-9	CAN	QC	AQL-FRESH	GL (I)		0.06		total, max. value	Hardness = 210 mg/l CaCO3	75, 71
Cadmium	7440-43-9	CAN	QC	AQL-FRESH	GL (I)		0.05		total, max. value	Hardness = 150 mg/l CaCO3	75, 71
Cadmium	7440-43-9	CAN	QC	AQL-FRESH	GL (I)		0.03		total, max. value	Hardness = 90 mg/l CaCO3	75, 71
Cadmium	7440-43-9	CAN	QC	AQL-FRESH	GL (I)		0.01		total, max. value	Hardness = 30 mg/l CaCO3	75, 71
Cadmium	7440-43-9	CAN	QC	AQL-MARIN	GL		0.12		total, max. value		75, 71
Cadmium	7440-43-9	CAN	QC	DRINK	MAC		5		total, max. value		75, 69
Cadmium	7440-43-9	CHE	QS, E.	AQL	QZ		0.05		diss. total		26
Cadmium	7440-43-9	CHE	QS	AQL	QZ		5		diss. total		26
Cadmium	7440-43-9	DEU	QC	AGRIC-IRRI	ZV		5		total, 90th perc.		46
Cadmium	7440-43-9	DEU	QC	AQL-FRESH	ZV		0.072		total, 90th perc.	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Cadmium	7440-43-9	DEU	QS	DRINK	GW		5				78
Cadmium	7440-43-9	DEU	QC	DRINK-SURF	ZV		1		total, 90th perc.		46
Cadmium	7440-43-9	DEU	QC	FISH-CONSM	ZV		1		total, 90th perc.		46
Cadmium	7440-43-9	DEU	QC	RIVER	BACKG		0.018		total	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Cadmium	7440-43-9	DEU-NRW	QS	AGRIC-IRRI	GL		6				38
Cadmium	7440-43-9	DEU-NRW	QS	DRINK-SURF	G, A1		1			According to EC Directive 75/440/EEC	38
Cadmium	7440-43-9	DEU-NRW	QS	DRINK-SURF	G, A2		1			According to EC Directive 75/440/EEC	38
Cadmium	7440-43-9	DEU-NRW	QS	DRINK-SURF	I, A2		5			According to EC Directive 75/440/EEC	38
Cadmium	7440-43-9	DEU-NRW	QS	DRINK-SURF	I, A2		5			According to EC Directive 75/440/EEC	38
Cadmium	7440-43-9	DEU-NRW	QS	SURF	AGA	<=	1		total, 90th perc.		38
Cadmium	7440-43-9	EEC	QS	ESTUA	QZ		0.3		total, ann. mean	Minimum requirement to protect AQL	41
Cadmium	7440-43-9	EEC	QS	MARIN	QZ		0.3		diss., ann. mean	Minimum requirement to protect AQL	41
Cadmium	7440-43-9	EEC	QS	SURF	QZ		5		diss., ann. mean	Minimum requirement to protect AQL	41
Cadmium	7440-43-9	GBR	QS, E.	AGRIC-IRRI	PWQS		20		ann. mean		24
Cadmium	7440-43-9	JPN	QS	AMBI	EQS		10			Health aspects	37
Cadmium	7440-43-9	NL	QO	SURF	BACKG		0.08		diss.		76
Cadmium	7440-43-9	NL	QO	SURF	BACKG		0.4		total	Value standardized to a suspended matter content of 30 mg/l.	76
Cadmium	7440-43-9	NL	QO	SURF	MPC		0.4		diss.		76
Cadmium	7440-43-9	NL	QO	SURF	MPC		2		total	Value standardized to a suspended matter content of 30 mg/l.	76
Cadmium	7440-43-9	NL	QO	SURF	TV		0.08		diss.		76
Cadmium	7440-43-9	NL	QO	SURF	TV		0.4		total	Value standardized to a suspended matter content of 30 mg/l.	76
Cadmium	7440-43-9	Nordsee	QC	MARIN	EAC		0.01	0.1	diss.		27
Cadmium	7440-43-9	SWE	QC	SURF-CLASS	Class 2		0.01	0.05		Class 2 = good	56

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Cadmium	7440-43-9	USA	QC	AQL-FRESH	CCC	2.2		dissolved concentration	Depends on hardness Value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77
Cadmium	7440-43-9	USA	QC	AQL-FRESH	CMC	4.3		dissolved concentration	Depends on hardness Value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77
Cadmium	7440-43-9	USA	QC	AQL-MARIN	CCC	9.3		dissolved concentration		77
Cadmium	7440-43-9	USA	QC	AQL-MARIN	CMC	42		dissolved concentration		77
Cadmium	7440-43-9	USA	QC	DRINK	MCL	10				23
Cadmium	7440-43-9	USA	QC	DRINK-FISH	WQC	10				23
Cadmium	7440-43-9	USA-GL	QC	AQL-FRESH	CCC	0.78		total	If water hardness is 50 mg/l	52
Caesium 134		CAN	QC	DRINK	MAC	7	Bq/l	total, max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Caesium 137		CAN	QC	DRINK	MAC	10	Bq/l	total, max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Calcium	7440-70-2	CAN	QC	AGRIC-LIVE	GL	1000	mg/l	total, max. value		1
Calcium	7440-70-2	DEU	QS	DRINK	GW	400	mg/l			78
Captafol	2425-06-1	NL	QO	SURF	MPC	0.028		diss.	Value is below detection/determination limit.	76
Captafol	2425-06-1	NL	QO	SURF	MPC	0.028		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Captafol	2425-06-1	NL	QO	SURF	TV	0.0003		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Captan	133-06-2	CAN	QC	AGRIC-LIVE	GL (I)	13		total, max. value		75, 5
Captan	133-06-2	CAN	QC	AQL-FRESH	GL (I)	1.3		total, max. value		75, 5
Captan	133-06-2	NL	QO	SURF	MPC	0.11		diss.	Value is below detection/determination limit.	76
Captan	133-06-2	NL	QO	SURF	MPC	0.11		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Captan	133-06-2	NL	QO	SURF	TV	0.001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Carbaryl	63-25-2	CAN	QC	AGRIC-LIVE	GL	1100		total, max. value		75
Carbaryl	63-25-2	CAN	QC	AQL-FRESH	GL	0.2		total, max. value		75
Carbaryl	63-25-2	CAN	QC	AQL-MARIN	GL (I)	0.32		total, max. value		75
Carbaryl	63-25-2	CAN	QC	DRINK	MAC	90		total, max. value		75, 69
Carbaryl	63-25-2	NL	QO	SURF	MPC	0.23		diss.		76
Carbaryl	63-25-2	NL	QO	SURF	MPC	0.23		total	Value standardized to a suspended matter content of 30 mg/l.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Carbaryl	63-25-2	NL	QO	SURF	TV	0.002		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Carbendazim	10605-21-7	DEU	QC	AQL-FRESH	ZV (E)	0.3		total, 90th perc.		81
Carbendazim	10605-21-7	NL	QO	SURF	MPC	0.11		diss.		76
Carbendazim	10605-21-7	NL	QO	SURF	MPC	0.11		total	Value standardized to a suspended matter content of 30 mg/l.	76
Carbendazim	10605-21-7	NL	QO	SURF	TV	0.001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Carbofuran	1563-66-2	CAN	QC	AGRIC-LIVE	GL	45		total, max. value		75, 2
Carbofuran	1563-66-2	CAN	QC	AQL-FRESH	GL	1.8		total, max. value		75, 2
Carbofuran	1563-66-2	CAN	QC	DRINK	MAC	90		total, max. value		75, 69
Carbofuran	1563-66-2	NL	QO	SURF	MPC	0.91		diss.		76
Carbofuran	1563-66-2	NL	QO	SURF	MPC	0.91		total	Value standardized to a suspended matter content of 30 mg/l.	76
Carbofuran	1563-66-2	NL	QO	SURF	TV	0.009		total	Value standardized to a suspended matter content of 30 mg/l.	76
Carbofuran	1563-66-2	Rhein	QO	RIVER	ZV	0.1		total, 90th perc.	DRINK-SURF	80
Cerium 141		CAN	QC	DRINK	MAC	100	Bq/l	total, max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Cerium 144		CAN	QC	DRINK	MAC	20	Bq/l	total, max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Chloramine		CAN	QC	DRINK	MAC	3000		total, max. value		75
Chlordane	57-74-9	NL	QO	SURF	MPC	0.002		diss.	Value is below detection/determination limit.	76
Chlordane	57-74-9	NL	QO	SURF	MPC	0.002		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Chlordane	57-74-9	NL	QO	SURF	TV	0.00002		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Chlordane	57-74-9	USA	QC	AQL-FRESH	CCC	0.0043			Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77
Chlordane	57-74-9	USA	QC	AQL-FRESH	CMC	2.4			Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Chlordane	57-74-9	USA	QC	AQL-MARIN	CCC	0.004			Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Chlordane	57-74-9	USA	QC	AQL-MARIN	CMC		0.09			Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Chlordane	57-74-9	USA	QC	DRINK-FISH	WQC		0.0021			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Chlordane	57-74-9	USA	QC	FISH-CONSM	WQC		0.0022			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Chlorfenvinphos	470-90-6	NL	QO	SURF	MPC		0.002		diss.	Value is below detection/determination limit.	76
Chlorfenvinphos	470-90-6	NL	QO	SURF	MPC		0.002		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Chlorfenvinphos	470-90-6	NL	QO	SURF	TV		0.00002		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Chloridazon	1698-60-8	DEU	QC	AQL-FRESH	ZV (v)		10		total, 90th perc.		73
Chloridazon	1698-60-8	NL	QO	SURF	MPC		73		diss.		76
Chloridazon	1698-60-8	NL	QO	SURF	MPC		73		total	Value standardized to a suspended matter content of 30 mg/l.	76
Chloridazon	1698-60-8	NL	QO	SURF	TV		0.73		total	Value standardized to a suspended matter content of 30 mg/l.	76
Chloridazon	1698-19-2	Rhein	QO	RIVER	ZV		0.1		total, 90th perc.	DRINK-SURF	80
Chloride		CAN	QC	DRINK	AO	<=	250	mg/l	total, max. value		9
Chloride		DEU	QS	DRINK	GW		250	mg/l			78
Chloride		DEU-NRW	QS	AGRIC-IRRI	GL		200	mg/l			38
Chloride		DEU-NRW	QS	DRINK-SURF	G, A2, A1		200	mg/l		According to EC Directive 75/440/EEC	38
Chloride		GBR	QS, E.	AGRIC-IRRI	PWQS		100	900 mg/l		Depends on cultivated fruit type	24
Chloride		GBR	QS, E.	AGRIC-LIVE	PWQS		1000	mg/l			24
Chloride		NL	QO	SURF	MPC		200	mg/l	total		76
Chloride	16887-00-6	USA	QC	AQL-FRESH	CCC		230000				77
Chloride	16887-00-6	USA	QC	AQL-FRESH	CMC		860000				77
Chloride		CAN	QC	AGRIC-IRRI	GL		100	700 mg/l	total, max. value	All soils with permanent irrigation. Depends on sensitivity of cultivated plants.	75, 1
Chlorinated benzenes		USA	QC	AQL-FRESH	CCC		50			Not enough data available; lowest LOEL	23
Chlorinated benzenes		USA	QC	DRINK-FISH	WQC		488			Taste approx. 20 µg/l	23
Chlorine	7782-50-5	USA	QC	AQL-FRESH	CCC		11				23
Chlorine	7782-50-5	USA	QC	AQL-FRESH	CCC		11				77
Chlorine	7782-50-5	USA	QC	AQL-FRESH	CMC		19				77
Chlorine	7782-50-5	USA	QC	AQL-MARIN	CCC		7.5				77
Chlorine	7782-50-5	USA	QC	AQL-MARIN	CMC		13				77
Chlorine (reactive)		CAN	QC	AQL-FRESH	GL		0.5		total, max. value	Hypochlorous acid, chloramine	75
Chlorine (reactive)		CAN	QC	AQL-MARIN	GL		0.5		total, max. value	Hypochlorous acid, chloramine	75

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Chloro-2-nitrobenzene, 1-	88-73-3	DEU	QC	AQL-FRESH	ZV	10	total, 90th perc.		15
Chloro-2-nitrobenzene, 1-	88-73-3	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Chloro-2-nitrobenzene, 1-	88-73-3	Rhein	QO	RIVER	ZV	1	total, 90th perc.	DRINK-SURF	45
Chloro-2-nitrotoluene, 4-	89-59-8	DEU	QC	AQL-FRESH	ZV	20	total, 90th perc.		15
Chloro-2-nitrotoluene, 4-	89-59-8	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Chloro-2-nitrotoluene, 6-	83-42-1	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Chloro-3-nitrobenzene, 1-	121-73-3	Rhein	QO	RIVER	ZV	1	total, 90th perc.	DRINK-SURF	45
Chloro-4-nitrobenzene, 1-	100-00-5	DEU	QC	AQL-FRESH	ZV	30	total, 90th perc.		15
Chloro-4-nitrobenzene, 1-	100-00-5	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Chloro-4-nitrobenzene, 1-	100-00-5	Rhein	QO	RIVER	ZV	1	total, 90th perc.	DRINK-SURF	45
Chloro-4-nitrotoluene, 2-	121-86-8	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Chloroaniline, 2-	95-51-2	DEU	QC	AQL-FRESH	ZV	3	total, 90th perc.		15
Chloroaniline, 2-	95-51-2	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Chloroaniline, 2-	95-51-2	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	45
Chloroaniline, 3-	108-42-9	DEU	QC	AQL-FRESH	ZV	1	total, 90th perc.		15
Chloroaniline, 3-	108-42-9	DEU	QC	DRINK-SURF	ZV	0.1	total, 90th perc.		15
Chloroaniline, 3-	108-42-9	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	45
Chloroaniline, 4-	106-47-8	DEU	QC	AQL-FRESH	ZV	0.05	total, 90th perc.		15
Chloroaniline, 4-	106-47-8	DEU	QC	DRINK-SURF	ZV	0.1	total, 90th perc.		15
Chloroaniline, 4-	106-47-8	Rhein	QO	RIVER	ZV	0.05	total, 90th perc.	AQL	45
Chlorobenzene	108-90-7	CAN	QC	AQL-FRESH	GL (I)	1.3	total, max. value		75
Chlorobenzene	108-90-7	CAN	QC	AQL-MARIN	GL (I)	25	total, max. value		75
Chlorobenzene	108-90-7	CAN	QC	DRINK	MAC	80	total, max. value	A target value of <30 µg/l is envisaged in order to avoid adverse effects on taste.	75, 69
Chlorobenzene	108-90-7	NL	QO	SURF	MPC	690	diss.		76
Chlorobenzene	108-90-7	NL	QO	SURF	MPC	690	total	Value standardized to a suspended matter content of 30 mg/l.	76
Chlorobenzene	108-90-7	NL	QO	SURF	TV	7	total	Value standardized to a suspended matter content of 30 mg/l.	76
Chlorobenzene	108-90-7	USA	QC	DRINK-FISH	WQC	680		Derivation based on: IRIS database, updated 08/04/1998 A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Chlorobenzene	108-90-7	USA	QC	FISH-CONSM	WQC	21000		Derivation based on: IRIS database, updated 08/04/1998 No WQC value is stated in the 1980 and 1986 criterion documents. Nonetheless the data contained in the documents allow a WQC to be calculated.	77
Chlorobenzene	108-90-7	USA	QC	Taste	WQC	20			77
Chlorodibromomethane	124-48-1	USA	QC	DRINK-FISH	WQC	0.41		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Chlorodibromomethane	124-48-1	USA	QC	FISH-CONSM	WQC	34		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Chloroform, extractable substances		DEU	QS	DRINK	GW	1000	as evaporation residue		78
Chloroform, extractable substances		DEU-NRW	QS	DRINK-SURF	G, A1	100		According to EC Directive 75/440/EEC	38
Chloroform, extractable substances		DEU-NRW	QS	DRINK-SURF	G, A2	200		According to EC Directive 75/440/EEC	38
Chloronaphthalene, 2-	91-58-7	USA	QC	DRINK-FISH	WQC	1700		Derivation based on: IRIS database, updated 08/04/1998	77
Chloronaphthalene, 2-	91-58-7	USA	QC	FISH-CONSM	WQC	4300		Derivation based on: IRIS database, updated 08/04/1998	77
Chlorophenol, 2-	95-57-8	USA	QC	AQL-FRESH	CCC	2000		Not enough data available; lowest LOEL	23
Chlorophenol, 2-	95-57-8	USA	QC	DRINK-FISH	WQC	120		Derivation based on: IRIS database, updated 08/04/1998	77
Chlorophenol, 2-	95-57-8	USA	QC	FISH-CONSM	WQC	400		Derivation based on: IRIS database, updated 08/04/1998	77
Chlorophenol, 2-	95-57-8	USA	QC	Taste	WQC	0.1			77
Chlorophenol, 3-	108-43-0	USA	QC	Taste	WQC	0.1			77
Chlorophenol, 4-	106-48-9	USA	QC	Taste	WQC	0.1			77
Chlorophenols		CAN	QC	AQL-FRESH	GL	7	total, max. value		75, 1
Chlorophenols (single)		NL	QO	SURF	MPC	25	diss.		76
Chlorophenols (single)		NL	QO	SURF	MPC	25	total	Value standardized to a suspended matter content of 30 mg/l.	76
Chlorophenols (single)		NL	QO	SURF	TV	0.3	total	Value standardized to a suspended matter content of 30 mg/l.	76
Chlorophyl-a		NL	QO	SURF	MPC	100	total	Average summer value for stagnant waters sensitive to eutrophication	76
Chloropropylene, 3-	107-05-1	NL	QO	SURF	MPC	3	diss.		76
Chloropropylene, 3-	107-05-1	NL	QO	SURF	MPC	3	total	Value standardized to a suspended matter content of 30 mg/l.	76
Chloropropylene, 3-	107-05-1	NL	QO	SURF	TV	0.03	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Chlorotoluene, 2-	95-49-8	Rhein	QO	RIVER	ZV	1	total, 90th perc.	DRINK-SURF	45
Chlorotoluene, 4-	106-43-4	Rhein	QO	RIVER	ZV	1	total, 90th perc.	DRINK-SURF	45
Chlorotoluron	15545-48-9	DEU	QC	AQL-FRESH	ZV (v)	0.4	total, 90th perc.		73
Chlorpyrifos	2921-88-2	CAN	QC	AGRIC-LIVE	GL (I)	24	total, max. value		75
Chlorpyrifos	2921-88-2	CAN	QC	AQL-FRESH	GL	0.0035	total, max. value		75
Chlorpyrifos	2921-88-2	CAN	QC	AQL-MARIN	GL (I)	0.002	total, max. value		75
Chlorpyrifos	2921-88-2	CAN	QC	DRINK	MAC	90	total, max. value		75, 69
Chlorpyrifos	2921-88-2	NL	QO	SURF	MPC	0.003	diss.	Value is below detection/determination limit.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Chlorpyrifos	2921-88-2	NL	QO	SURF	MPC		0.003		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Chlorpyrifos	2921-88-2	NL	QO	SURF	TV		0.00003		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Chlorpyrifos	2921-88-2	USA	QC	AQL-FRESH	CCC		0.041				77
Chlorpyrifos	2921-88-2	USA	QC	AQL-FRESH	CMC		0.083				77
Chlorpyrifos	2921-88-2	USA	QC	AQL-MARIN	CCC		0.0056				77
Chlorpyrifos	2921-88-2	USA	QC	AQL-MARIN	CMC		0.011				77
Chlorthalonil	1897-45-6	CAN	QC	AGRIC-IRRI	GL (I)		5.8		total, max. value		75, 12
Chlorthalonil	1897-45-6	CAN	QC	AGRIC-LIVE	GL (I)		170		total, max. value		75, 12
Chlorthalonil	1897-45-6	CAN	QC	AQL-FRESH	GL (I)		0.18		total, max. value	Value refers to total concentration of chlorothalonil including 4-hydroxy metabolites.	75, 12
Chlorthalonil	1897-45-6	CAN	QC	AQL-MARIN	GL (I)		0.36		total, max. value	Value refers to total concentration of chlorothalonil including 4-hydroxy metabolites.	75, 12
Cholinesterase inhibitors		NL	QO	SURF	MPC		0.5		total	Cholinesterase inhibition in µg paraoxon units/l.	25, 76
Chromium	7440-47-3	CAN	QC	DRINK	MAC		50		total, max. value		75, 69
Chromium	7440-47-3	CHE	QS, E.	AQL	QZ		2		diss. total, chromium (III + IV)		26
Chromium	7440-47-3	DEU	QC	AGRIC-IRRI	ZV		50		total, 90th perc.		46
Chromium	7440-47-3	DEU	QC	AQL-FRESH	ZV		10		total, 90th perc.	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Chromium	7440-47-3	DEU	QS	DRINK	GW		50				78
Chromium	7440-47-3	DEU	QC	DRINK-SURF	ZV		50		total, 90th perc.		46
Chromium	7440-47-3	DEU	QC	RIVER	BACKG		2.5		total	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Chromium	7440-47-3	DEU-NRW	QS	AGRIC-IRRI	GL		100				38
Chromium	7440-47-3	DEU-NRW	QS	DRINK-SURF	G, A1		50			According to EC Directive 75/440/EEC	38
Chromium	7440-47-3	DEU-NRW	QS	DRINK-SURF	G, A2		50			According to EC Directive 75/440/EEC	38
Chromium	7440-47-3	DEU-NRW	QS	SURF	AGA	<=	30		total, 90th perc.		38
Chromium	7440-47-3	GBR	QS, E.	AGRIC-IRRI	PWQS		2000		ann. mean		24
Chromium	7440-47-3	GBR	QS, E.	AGRIC-LIVE	PWQS		1000		ann. mean		24
Chromium	7440-47-3	GBR	QS	FRESH	EQS		2	20	diss., ann. mean	Depends on water hardness	63
Chromium	7440-47-3	GBR	QS	MARIN	EQS		15		total diss., ann. mean		28
Chromium	7440-47-3	GBR	QS	MARIN	PEQS		5		total diss., ann. mean		28
Chromium	7440-47-3	NL	QO	SURF	BACKG		0.2		diss.		76
Chromium	7440-47-3	NL	QO	SURF	BACKG		1.6		total	Value standardized to a suspended matter content of 30 mg/l.	76
Chromium	7440-47-3	NL	QO	SURF	MPC		8.7		diss.		76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Chromium	7440-47-3	NL	QO	SURF	MPC	84		total	Value standardized to a suspended matter content of 30 mg/l.	76
Chromium	7440-47-3	NL	QO	SURF	TV	0.3		diss.		76
Chromium	7440-47-3	NL	QO	SURF	TV	2.4		total	Value standardized to a suspended matter content of 30 mg/l.	76
Chromium	7440-47-3	Nordsee	QC	MARIN	EAC	1	10	diss.		27
Chromium	7440-47-3	SWE	QC	SURF-CLASS	Class 2	0.4	2		Class 2 = good	56
Chromium (III)	7440-47-3	CAN	QC	AGRIC-IRRI	GL (I)	4.9		total, max. value	All soils with permanent irrigation	75
Chromium (III)	7440-47-3	CAN	QC	AGRIC-LIVE	GL (I)	50		total, max. value		75
Chromium (III)	7440-47-3	CAN	QC	AQL-FRESH	GL (I)	8.9		total, max. value		75
Chromium (III)	7440-47-3	CAN	QC	AQL-MARIN	GL (I)	56		total, max. value		75
Chromium (III)	7440-47-3	CHE	QS	AQL	QZ	50		diss. total		26
Chromium (III)	16065-83-1	USA	QC	AQL-FRESH	CCC	74			Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77
Chromium (III)	16065-83-1	USA	QC	AQL-FRESH	CMC	570			Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77
Chromium (III)	7440-47-3	USA	QC	DRINK	MCL	50				23
Chromium (III)	7440-47-3	USA	QC	DRINK-FISH	WQC	170000				23
Chromium (III)	7440-47-3	USA	QC	FISH-CONSM	WQC	3433000				23
Chromium (III)	7440-47-3	USA-GL	QC	AQL-FRESH	CCC	49		total	If water hardness is 50 mg/l	52
Chromium (VI)	7440-47-3	CAN	QC	AGRIC-IRRI	GL (I)	8		total, max. value	All soils with permanent irrigation	75
Chromium (VI)	7440-47-3	CAN	QC	AGRIC-LIVE	GL (I)	50		total, max. value		75
Chromium (VI)	7440-47-3	CAN	QC	AQL-FRESH	GL	1		total, max. value		75
Chromium (VI)	7440-47-3	CAN	QC	AQL-MARIN	GL	1.5		total, max. value		75
Chromium (VI)	7440-47-3	CHE	QS	AQL	QZ	10		diss. total		26
Chromium (VI)	7440-47-3	JPN	QS	AMBI	EQS	50			Health aspects	37
Chromium (VI)	18540-29-9	USA	QC	AQL-FRESH	CCC	11			Dissolved concentration. Derivation published in document EPA-820-B-96-001.	77
Chromium (VI)	18540-29-9	USA	QC	AQL-FRESH	CMC	16			Dissolved concentration. Derivation published in document EPA-820-B-96-001.	77
Chromium (VI)	18540-29-9	USA	QC	AQL-MARIN	CCC	50			Dissolved concentration	77
Chromium (VI)	18540-29-9	USA	QC	AQL-MARIN	CMC	1100			Dissolved concentration	77
Chromium (VI)	7440-47-3	USA	QC	DRINK	MCL	50				23
Chromium (VI)	7440-47-3	USA	QC	DRINK-FISH	WQC	50				23
Chromium (VI)	7440-47-3	USA-GL	QC	AQL-FRESH	CCC	11		total		52
Chrysene	218-01-4	NL	QO	SURF	MPC	0.3		diss.		76
Chrysene	218-01-4	NL	QO	SURF	MPC	0.9		total	Value standardized to a suspended matter content of 30 mg/l.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Chrysene	218-01-4	NL	QO	SURF	TV		0.009		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Chrysene	218-01-9	USA	QC	DRINK-FISH	WQC		0.0044			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Chrysene	218-01-9	USA	QC	FISH-CONSM	WQC		0.049			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Cobalt	7440-48-4	CAN	QC	AGRIC-IRRI	GL		50		total, max. value	All soils with permanent irrigation	75, 1
Cobalt	7440-48-4	CAN	QC	AGRIC-LIVE	GL		1000		total, max. value		75, 1
Cobalt	7440-48-4	CHE	QS, E.	AQL	QZ		10		diss. total		26
Cobalt	7440-48-4	CHE	QS	AQL	QZ		50		diss. total		26
Cobalt	7440-48-4	DEU-NRW	QS	AGRIC-IRRI	GL		200				38
Cobalt	7440-48-4	NL	QO	SURF	BACKG		0.2		diss.	Value is below detection/determination limit.	76
Cobalt	7440-48-4	NL	QO	SURF	BACKG		0.2		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Cobalt	7440-48-4	NL	QO	SURF	MPC		2.8		diss.		76
Cobalt	7440-48-4	NL	QO	SURF	MPC		3.1		total	Value standardized to a suspended matter content of 30 mg/l.	76
Cobalt	7440-48-4	NL	QO	SURF	TV		0.2		diss.	Value is below detection/determination limit.	76
Cobalt	7440-48-4	NL	QO	SURF	TV		0.2		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Cobalt 60		CAN	QC	DRINK	MAC		2	Bq/l	total, max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
COD		DEU-NRW	QS	SURF	AGA	<=	20000		90th perc.		38
Coliform bacteria		DEU-NRW	QS	DRINK-SURF	G, A1		50	/100 ml		According to EC Directive 75/440/EEC	38
Coliform bacteria		DEU-NRW	QS	DRINK-SURF	G, A2		5000	/100 ml		According to EC Directive 75/440/EEC	38
Coliform bacteria (feacal)		DEU-NRW	QS	DRINK-SURF	G, A1		20	/100 ml		According to EC Directive 75/440/EEC	38
Coliform bacteria (feacal)		DEU-NRW	QS	DRINK-SURF	G, A2		2000	/100 ml		According to EC Directive 75/440/EEC	38
Coliform bacteria (feacal)		DEU-NRW	QS	REC	G		100	/100 ml		According to EC Directive 76/160/EEC	38
Coliform bacteria (feacal)		DEU-NRW	QS	REC	I		2000	/100 ml		According to EC Directive 76/160/EEC	38
Coliform bacteria (total)		DEU-NRW	QS	REC	G		500	per 100 ml		According to EC Directive 76/160/EEC	38
Coliform bacteria (total)		DEU-NRW	QS	REC	I		10000	per 100 ml		According to EC Directive 76/160/EEC	38

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Coliform germs (feacal)		DEU-NRW	QS	AGRIC-IRRI	GL		1	/ml			38
Coliform germs (feacal, escherichia coli)		CAN	QC	AGRIC-IRRI	GL (I)		100	/100 ml			75, 1
Coliform germs (feacal, escherichia coli)		CAN	QC	DRINK	GL (I)					Narrative, see guideline	75
Coliform germs (total)		CAN	QC	AGRIC-IRRI	GL (I)		1000	/100 ml			75, 1
Coliform germs (total)		CAN	QC	DRINK	GL (I)					Narrative, see guideline	75
Coliform germs (total)		DEU-NRW	QS	AGRIC-IRRI	GL		10	germs/ ml			38
Colour		CAN	QC	DRINK	AO	<=	15	TCU	total, max. value		75, 69
Colour		DEU	QS	DRINK	GW		0.5	1/m	absorption coeff. Hg 436nm		78
Conductivity		DEU	QS	DRINK	GW		2000	µS/cm			78
Conductivity		DEU-NRW	QS	DRINK-SURF	G, A1		1000	µS/cm		According to EC Directive 75/440/EEC	38
Conductivity		DEU-NRW	QS	DRINK-SURF	G, A2		1000	µS/cm		According to EC Directive 75/440/EEC	38
Conductivity		GBR	QS, E.	AGRIC-IRRI	PWQS		1500	µS/cm			24
Conductivity		GBR	QS, E.	AGRIC-LIVE	PWQS		3000	µS/cm			24
Copper	7440-50-8	CAN	QC	AGRIC-IRRI	GL		200		total, max. value	All soils with permanent irrigation. Sensitive plants (cereals).	75, 1
Copper	7440-50-8	CAN	QC	AGRIC-IRRI	GL		1000		total, max. value	All soils with permanent irrigation. Tolerant plants.	75, 1
Copper	7440-50-8	CAN	QC	AGRIC-LIVE	GL		500		total, max. value	Sheep	75, 1
Copper	7440-50-8	CAN	QC	AGRIC-LIVE	GL		1000		total, max. value	Cattle	75, 1
Copper	7440-50-8	CAN	QC	AGRIC-LIVE	GL		5000		total, max. value	Pigs and poultry	75, 1
Copper	7440-50-8	CAN	QC	AQL-FRESH	GL		4		total, max. value	Hardness >180 mg/l CaCO3	75, 1
Copper	7440-50-8	CAN	QC	AQL-FRESH	GL		2		total, max. value	Hardness 0-120 mg/l CaCO3	75, 1
Copper	7440-50-8	CAN	QC	AQL-FRESH	GL		3		total, max. value	Hardness 120-180 mg/l CaCO3	75, 1
Copper	7440-50-8	CAN	QC	DRINK	AO	<=	1000		total, max. value		75
Copper	7440-50-8	CHE	QS, E.	AQL	QZ		2		diss. total		26
Copper	7440-50-8	CHE	QS	AQL	QZ		10		diss. total		26
Copper	7440-50-8	DEU	QC	AGRIC-IRRI	ZV		50		total, 90th perc.		46
Copper	7440-50-8	DEU	QC	AQL-FRESH	ZV		4		total, 90th perc.	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Copper		DEU	QS	DRINK	RW		3000				78
Copper	7440-50-8	DEU	QC	DRINK-SURF	ZV		20		total, 90th perc.		46
Copper	7440-50-8	DEU	QC	RIVER	BACKG		1		total	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Copper	7440-50-8	DEU-NRW	QS	AGRIC-IRRI	GL		200				38
Copper	7440-50-8	DEU-NRW	QS	DRINK-SURF	G, A1		20			According to EC Directive 75/440/EEC	38
Copper	7440-50-8	DEU-NRW	QS	DRINK-SURF	G, A2		50			According to EC Directive 75/440/EEC	38
Copper	7440-50-8	DEU-NRW	QS	DRINK-SURF	I, A1		50			According to EC Directive 75/440/EEC	38

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Copper	7440-50-8	DEU-NRW	QS	FISH	G, Cyp.	<	40		diss., 95th perc.	According to EC Directive 78/659/EEC. The values in the directive are graded by water hardness degrees; indicated value refers to 100 mg CaCO3/l.	38
Copper	7440-50-8	DEU-NRW	QS	FISH	G, Salmo.	<	40		diss., 95th perc.	According to EC Directive 78/659/EEC. The values in the directive are graded by water hardness degrees; indicated value refers to 100 mg CaCO3/l.	38
Copper	7440-50-8	DEU-NRW	QS	SURF	AGA	<=	40		total, 90th perc.		38
Copper	7440-50-8	GBR	QS, E.	AGRIC-IRRI	PWQS		500		ann. mean		24
Copper	7440-50-8	GBR	QS, E.	AGRIC-LIVE	PWQS		200		ann. mean		24
Copper	7440-50-8	GBR	QS	AQL-FRESH	EQS		0.5	12	diss., ann. mean	Depends on water hardness	63
Copper	7440-50-8	GBR	QS	MARIN	EQS		5		diss., ann. mean		28
Copper	7440-50-8	NL	QO	SURF	BACKG		0.4		diss.		76
Copper	7440-50-8	NL	QO	SURF	BACKG		1.1		total	Value standardized to a suspended matter content of 30 mg/l.	76
Copper	7440-50-8	NL	QO	SURF	MPC		1.5		diss.		76
Copper	7440-50-8	NL	QO	SURF	MPC		3.8		total	Value standardized to a suspended matter content of 30 mg/l.	76
Copper	7440-50-8	NL	QO	SURF	TV		0.5		diss.		76
Copper	7440-50-8	NL	QO	SURF	TV		1.1		total	Value standardized to a suspended matter content of 30 mg/l.	76
Copper	7440-50-8	Nordsee	QC	MARIN	EAC		0.005	0.05	diss.		27
Copper	7440-50-8	SWE	QC	SURF-CLASS	Class 2		0.3	1		Class 2 = good	56
Copper	7440-50-8	USA	QC	AQL-FRESH	CCC		9		dissolved concentration	Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77
Copper	7440-50-8	USA	QC	AQL-FRESH	CMC		13		dissolved concentration	Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77
Copper	7440-50-8	USA	QC	AQL-MARIN	CCC		3.1		dissolved concentration	Dissolved concentration. Ambient Water Quality Criteria Saltwater Copper Addendum (Draft, 14 April 1995), published in Interim Final National Toxics Rule (60FR22228-222237, 5 May 1995).	77
Copper	7440-50-8	USA	QC	AQL-MARIN	CMC		4.8		dissolved concentration	Dissolved concentration. Ambient Water Quality Criteria Saltwater Copper Addendum (Draft, 14 April 1995), published in Interim Final National Toxics Rule (60FR22228-222237, 5 May 1995).	77
Copper	7440-50-8	USA	QC	DRINK-FISH	WQC		1300				77
Copper	7440-50-8	USA	QC	Taste	WQC		1000				77
Copper	7440-50-8	USA-GL	QC	AQL-FRESH	CCC		5.2		total	If water hardness is 50 mg/l	52
Coumaphos	56-72-4	NL	QO	SURF	MPC		0.0007		diss.	Value is below detection/determination limit.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Coumaphos	56-72-4	NL	QO	SURF	MPC	0.0007	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Coumaphos	56-72-4	NL	QO	SURF	TV	0.000007	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Cyanazin	21725-46-2	CAN	QC	AGRIC-LIVE	GL (I)	10	total, max. value		75, 3
Cyanazin	21725-46-2	CAN	QC	AQL-FRESH	GL (I)	2	total, max. value		75, 3
Cyanazin	21725-46-2	CAN	QC	DRINK	IMAC	10	total, max. value		75, 69
Cyanazin	21725-46-2	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.	Insufficient data	81
Cyanazin	21725-46-2	NL	QO	SURF	MPC	0.19	diss.		76
Cyanazin	21725-46-2	NL	QO	SURF	MPC	0.19	total	Value standardized to a suspended matter content of 30 mg/l.	76
Cyanazin	21725-46-2	NL	QO	SURF	TV	0.002	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Cyanazine	21725-46-2	CAN	QC	AGRIC-IRRI	GL (I)	0.5	total, max. value		75, 3
Cyanide	57-12-5	CAN	QC	AQL-FRESH	GL	5		Free cyanide as CN	75, 1
Cyanide	57-12-5	CAN	QC	DRINK	MAC	200	total, max. value		75, 69
Cyanide	57-12-5	DEU	QS	DRINK	GW	50	as CN		78
Cyanide	57-12-5	DEU-NRW	QS	DRINK-SURF	I, A2, A1	50		According to EC Directive 75/440/EEC	38
Cyanide	57-12-5	JPN	QS	AMBI	EQS			Health aspects. Cyanides should not be detectable for reasons of human health.	37
Cyanide	57-12-5	USA	QC	AQL-FRESH	CCC	5.2		Derivation published in document EPA-820-B-96-001. Refers to free cyanide (µg CN / l).	77
Cyanide	57-12-5	USA	QC	AQL-FRESH	CMC	22		Derivation published in document EPA-820-B-96-001. Refers to free cyanide (µg CN / l).	77
Cyanide	57-12-5	USA	QC	AQL-MARIN	CCC	1		Refers to free cyanide (µg CN / l).	77
Cyanide	57-12-5	USA	QC	AQL-MARIN	CMC	1		Refers to free cyanide (µg CN / l).	77
Cyanide		USA	QC	DRINK-FISH	WQC	200			23
Cyanide	57-12-5	USA	QC	DRINK-FISH	WQC	700		Derivation based on: IRIS database, updated 08/04/1998 A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Cyanide	57-12-5	USA	QC	FISH-CONSM	WQC	220000		Derivation based on: IRIS database, updated 08/04/1998 No WQC value is stated in the 1980 and 1986 criterion documents. Nonetheless the data contained in the documents allow a WQC to be calculated.	77
Cyanide	57-12-5	USA-GL	QC	AQL-FRESH	CCC	5.2	free cyanide		52
Cyfluthrin	68359-37-5	GBR	QS	FRESH	EQS	0.001	total, 95th perc.		63

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Cyfluthrin	68359-37-5	GBR	QS	MARIN	EQS	0.001	total, 95th perc.		63
Cypermethrin	52315-07-8	DEU	QC	AQL-FRESH	ZV (E)	0.0009	total, 90th perc.		81
Cypermethrin	52315-07-8	NL	QO	SURF	MPC	0.00009	diss.	Value is below detection/determination limit.	76
Cypermethrin	52315-07-8	NL	QO	SURF	MPC	0.0001	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Cypermethrin	52315-07-8	NL	QO	SURF	TV	0.00001	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
D, 2,4-	94-75-7	CAN	QC	AQL-FRESH	GL	4	total, max. value		1
D, 2,4-	94-75-7	CAN	QC	DRINK	IMAC	100	total, max. value		75, 69
D, 2,4-	94-75-7	DEU	QC	AQL-FRESH	ZV (v)	2	total, 90th perc.		73
D, 2,4-	94-75-7	NL	QO	SURF	MPC	10	diss.		76
D, 2,4-	94-75-7	NL	QO	SURF	MPC	10	total	Value standardized to a suspended matter content of 30 mg/l.	76
D, 2,4-	94-75-7	NL	QO	SURF	TV	0.1	total	Value standardized to a suspended matter content of 30 mg/l.	76
D, 2,4-	94-75-7	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	74
D, 2,4-	94-75-7	USA	QC	DRINK-FISH	WQC	100		A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
DDAC (Didecyl dimethyl ammonium chloride)	7173-51-5	CAN	QC	AQL-FRESH	GL	1.5	total, max. value		75
DDD	72-54-8	NL	QO	SURF	MPC	0.0004	diss.	Value is below detection/determination limit.	76
DDD	72-54-8	NL	QO	SURF	MPC	0.0005	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
DDD	72-54-8	NL	QO	SURF	TV	0.000005	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
DDD	72-54-8	Rhein	QO	RIVER	ZV	0.001	total, 90th perc.	FISH-CONSM	45
DDD, 4,4-	72-54-8	USA	QC	DRINK-FISH	WQC	0.00083		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
DDD, 4,4-	72-54-8	USA	QC	FISH-CONSM	WQC	0.00084		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
DDE	72-55-9	NL	QO	SURF	MPC	0.0004	diss.	Value is below detection/determination limit.	76
DDE	72-55-9	NL	QO	SURF	MPC	0.0004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
DDE	72-55-9	NL	QO	SURF	TV	0.000004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
DDE	72-55-9	Rhein	QO	RIVER	ZV	0.001	total, 90th perc.	FISH-CONSM	45
DDE, 4,4-	72-55-9	USA	QC	DRINK-FISH	WQC	0.00059		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
DDE, 4,4-	72-55-9	USA	QC	FISH-CONSM	WQC	0.00059		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
DDT	50-29-3	GBR	QS	MARIN	EQS	0.01	diss., (para-para-isomer), ann. mean	Standard adopted from EC Directive 86/280/EEC (for estuaries)	28
DDT	50-29-3	GBR	QS	MARIN	EQS	0.025	diss., (DDT total), ann. mean	Standard adopted from EC Directive 86/280/EEC (for coastal waters and coastal seawaters)	28
DDT	50-29-3	NL	QO	SURF	MPC	0.0004	diss.	Value is below detection/determination limit.	76
DDT	50-29-3	NL	QO	SURF	MPC	0.0009	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
DDT	50-29-3	NL	QO	SURF	TV	0.000009	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
DDT	50-29-3	Rhein	QO	RIVER	ZV	0.001	total, 90th perc.	FISH-CONSM	45
DDT	50-29-3	USA	QC	AQL-FRESH	CCC	0.001			23
DDT	50-29-3	USA	QC	AQL-FRESH	CCC	0.001		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77
DDT	50-29-3	USA	QC	AQL-FRESH	CMC	1.1		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
DDT	50-29-3	USA	QC	AQL-MARIN	CCC	0.001		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77
DDT	50-29-3	USA	QC	AQL-MARIN	CMC	0.13		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
DDT	50-29-3	USA	QC	DRINK-FISH	WQC	0.00059		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
DDT	50-29-3	USA	QC	FISH-CONSM	WQC	0.00059		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
DDT (para-para isomer)	50-29-3	EEC	QS	AMBI	QZ	0.01	ann. mean		39
DDT (total)	50-29-3	EEC	QS	AMBI	QZ	0.025	ann. mean		39

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
DDT including metabolites	50-29-3	USA-GL	QC	WILD	WC	0.000011			51
DDT including metabolites	50-29-3	USA-GL	QC	WILD-BIRD	WV	0.000011			51
DDT including metabolites	50-29-3	USA-GL	QC	WILD-MAMM	WV	0.00028			51
Deethylatrazine	6190-65-4	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.	Insufficient data	81
Deltamethrin	52918-63-5	CAN	QC	AGRIC-LIVE	GL	2.5	total, max. value		75
Deltamethrin	52918-63-5	CAN	QC	AQL-FRESH	GL	0.0004	total, max. value		75
Deltamethrin	52918-63-5	NL	QO	SURF	MPC	0.0003	diss.	Value is below detection/determination limit.	76
Deltamethrin	52918-63-5	NL	QO	SURF	MPC	0.0004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Deltamethrin	52918-63-5	NL	QO	SURF	TV	0.000004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Demeton	298-03-3	NL	QO	SURF	MPC	0.14	diss.		76
Demeton	298-03-3	NL	QO	SURF	MPC	0.14	total	Value standardized to a suspended matter content of 30 mg/l.	76
Demeton	298-03-3	NL	QO	SURF	TV	0.001	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Demeton	8065-48-3	USA	QC	AQL-FRESH	CCC	0.1		Derivation see Red Book (EPA 440/9-76-0239)	77
Demeton	8065-48-3	USA	QC	AQL-MARIN	CCC	0.1		Derivation see Red Book (EPA 440/9-76-0239)	77
Desmetryn	1014-69-3	NL	QO	SURF	MPC	34	diss.	Acute data only; compensation factor 1000	76
Desmetryn	1014-69-3	NL	QO	SURF	MPC	34	total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Desmetryn	1014-69-3	NL	QO	SURF	TV	0.34	total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Di(2-ethylhexyl) phthalate	117-81-7	Rhein	QO	RIVER	ZV	0.8	total, 90th perc.	AQL	80
Di(2-ethylhexyl)phthalate	117-81-7	CAN	QC	AQL-FRESH	GL	16	total, max. value		75, 9
Di(2-ethylhexyl)phthalate	117-81-7	USA	QC	AQL	CCC	360			54
Di(2-ethylhexyl)phthalate	117-81-7	USA	QC	DRINK-FISH	WQC	1.8		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Di(2-ethylhexyl)phthalate	117-81-7	USA	QC	FISH-CONSM	WQC	5.9		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Di-n-butyl phthalate	84-74-2	CAN	QC	AQL-FRESH	GL (I)	19	total, max. value		75, 9
Di-n-butyl phthalate	84-74-2	USA	QC	DRINK-FISH	WQC	2700		Derivation based on: IRIS database, updated 08/04/1998	77
Di-n-butyl phthalate	84-74-2	USA	QC	FISH-CONSM	WQC	12000		Derivation based on: IRIS database, updated 08/04/1998	77
Diazinon	333-41-5	CAN	QC	DRINK	MAC	20	total, max. value		75, 69
Diazinon	333-41-5	NL	QO	SURF	MPC	0.037	diss.		76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Diazinon	333-41-5	NL	QO	SURF	MPC		0.037	total	Value standardized to a suspended matter content of 30 mg/l.	76
Diazinon	333-41-5	NL	QO	SURF	TV		0.0004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Diazinon	333-41-5	Rhein	QO	RIVER	ZV		0.02	total, 90th perc.	AQL	80
Dibenzo[a,h]anthracene	53-70-3	USA	QC	DRINK-FISH	WQC		0.0044		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dibenzo[a,h]anthracene	53-70-3	USA	QC	FISH-CONSM	WQC		0.049		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dibromochloromethane	124-48-1	CAN	QC	AGRIC-LIVE	GL		100	total, max. value		75
Dibutyltin		Rhein	QO	RIVER	ZV		0.8	total, 90th perc.	AQL	45
Dicamba	1918-00-9	CAN	QC	AGRIC-IRRI	GL		0.006	total, max. value		75, 8
Dicamba	1918-00-9	CAN	QC	AGRIC-LIVE	GL		122	total, max. value		75, 8
Dicamba	1918-00-9	CAN	QC	AQL-FRESH	GL (I)		10	total, max. value		75, 8
Dicamba	1918-00-9	CAN	QC	DRINK	MAC		120	total, max. value		75, 69
Dichloro-2-nitrobenzene, 1,4-	89-61-2	DEU	QC	AQL-FRESH	ZV		20	total, 90th perc.		15
Dichloro-2-nitrobenzene, 1,4-	89-61-2	DEU	QC	DRINK-SURF	ZV		1	total, 90th perc.		15
Dichloro-3-nitrobenzene, 1,2-	3209-22-1	DEU	QC	AQL-FRESH	ZV		20	total, 90th perc.		15
Dichloro-3-nitrobenzene, 1,2-	3209-22-1	DEU	QC	DRINK-SURF	ZV		1	total, 90th perc.		15
Dichloro-4-nitrobenzene, 1,2-	99-54-7	DEU	QC	AQL-FRESH	ZV		20	total, 90th perc.		15
Dichloro-4-nitrobenzene, 1,2-	99-54-7	DEU	QC	DRINK-SURF	ZV		1	total, 90th perc.		15
Dichloroaniline, 3,4-	95-76-1	DEU	QC	AQL-FRESH	ZV		0.5	total, 90th perc.		15
Dichloroaniline, 3,4-	95-76-1	DEU	QC	DRINK-SURF	ZV		0.1	total, 90th perc.		15
Dichloroaniline, 3,4-	95-76-1	Rhein	QO	RIVER	ZV		0.1	total, 90th perc.	DRINK-SURF	45
Dichlorobenzene, 1,2-	95-50-1	CAN	QC	AQL-FRESH	GL (I)		1.7	total, max. value		75
Dichlorobenzene, 1,2-	95-50-1	CAN	QC	AQL-MARIN	GL (I)		1.7	total, max. value		75
Dichlorobenzene, 1,2-	95-50-1	CAN	QC	DRINK	MAC		200	total, max. value		75, 69
Dichlorobenzene, 1,2-	95-50-1	CAN	QC	DRINK	AO	<=	3	total, max. value	A target value of <3 µg/l is envisaged in order to avoid adverse effects on taste.	75, 69
Dichlorobenzene, 1,2-	95-50-1	USA	QC	DRINK-FISH	WQC		2700		Derivation based on: IRIS database, updated 08/04/1998 A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Dichlorobenzene, 1,2-	95-50-1	USA	QC	FISH-CONSM	WQC		17000		Derivation based on: IRIS database, updated 08/04/1998	77
Dichlorobenzene, 1,3-	541-73-1	CAN	QC	AQL-FRESH	GL (I)		150	total, max. value		75
Dichlorobenzene, 1,3-	541-73-1	USA	QC	DRINK-FISH	WQC		400			77
Dichlorobenzene, 1,3-	541-73-1	USA	QC	FISH-CONSM	WQC		2600			77
Dichlorobenzene, 1,4-	106-46-7	CAN	QC	AQL-FRESH	GL		26	total, max. value		75
Dichlorobenzene, 1,4-	106-46-7	CAN	QC	DRINK	MAC		5	total, max. value		75, 69
Dichlorobenzene, 1,4-	106-46-7	CAN	QC	DRINK	AO	<=	1	total, max. value	A target value of <1 µg/l is envisaged in order to avoid adverse effects on taste.	75, 69
Dichlorobenzene, 1,4-	106-46-7	DEU	QC	AQL-FRESH	ZV		10	total, 90th perc.		15
Dichlorobenzene, 1,4-	106-46-7	DEU	QC	DRINK-SURF	ZV		1	total, 90th perc.		15
Dichlorobenzene, 1,4-	106-46-7	Rhein	QO	RIVER	ZV		0.02	total, 90th perc.	Fish consumption	74
Dichlorobenzene, 1,4-	106-46-7	USA	QC	DRINK-FISH	WQC		400		A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Dichlorobenzene, 1,4-	106-46-7	USA	QC	FISH-CONSM	WQC		2600			77
Dichlorobenzenes		USA	QC	AQL-FRESH	CCC		763		Not enough data available; lowest LOEL	23
Dichlorobenzenes (single)		NL	QO	SURF	MPC		250	diss.		76
Dichlorobenzenes (single)		NL	QO	SURF	MPC		250	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichlorobenzenes (single)		NL	QO	SURF	TV		3	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichlorobenzidine, 3,3'-	91-94-1	NL	QO	SURF	MPC		0.2	total		25
Dichlorobenzidine, 3,3'-	91-94-1	USA	QC	DRINK-FISH	WQC		0.04		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichlorobenzidine, 3,3'-	91-94-1	USA	QC	FISH-CONSM	WQC		0.077		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichlorobromomethane	75-27-4	CAN	QC	AGRIC-LIVE	GL		100	total, max. value		75
Dichlorobromomethane	75-27-4	USA	QC	DRINK-FISH	WQC		0.56		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichlorobromomethane	75-27-4	USA	QC	FISH-CONSM	WQC		46		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichloroethane, 1,2	107-06-2	JPN	QS	AMBI	EQS		4		Health aspects	37
Dichloroethane, 1,2-	107-06-2	CAN	QC	AGRIC-LIVE	GL (I)		5	total, max. value		75, 4
Dichloroethane, 1,2-	107-06-2	CAN	QC	AQL-FRESH	GL (I)		100	total, max. value		75, 4
Dichloroethane, 1,2-	107-06-2	CAN	QC	DRINK	IMAC		5	total, max. value		75, 69
Dichloroethane, 1,2-	107-06-2	DEU	QC	AQL-FRESH	ZV		2	total, 90th perc.		15
Dichloroethane, 1,2-	107-06-2	DEU	QC	DRINK-FISH	ZV (v)		3.47	total, 90th perc.	Carcinogenic risk (risk level 10-5)	15
Dichloroethane, 1,2-	107-06-2	DEU	QC	DRINK-SURF	ZV		1	total, 90th perc.		15
Dichloroethane, 1,2-	107-06-2	EEC	QS	AMBI	QZ		10	ann. mean		44
Dichloroethane, 1,2-	107-06-2	GBR	QS, E.	AQL-FRESH	PEQS		1000	ann. mean		17

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Dichloroethane, 1,2-	107-06-2	GBR	QS, E.	AQL-MARIN	PEQS	1000	ann. mean		17
Dichloroethane, 1,2-	107-06-2	Rhein	QO	RIVER	ZV	1	total, 90th perc.	DRINK-SURF	45
Dichloroethane, 1,2-	107-06-2	USA	QC	AQL-FRESH	CCC	20000		Not enough data available; lowest LOEL	23
Dichloroethane, 1,2-	107-06-2	USA	QC	DRINK-FISH	WQC	0.38		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichloroethane, 1,2-	107-06-2	USA	QC	FISH-CONSM	WQC	99		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichloroethanes (single)		NL	QO	SURF	MPC	700	diss.		76
Dichloroethanes (single)		NL	QO	SURF	MPC	700	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloroethanes (single)		NL	QO	SURF	TV	7	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloroethene, 1,1-	75-35-4	CAN	QC	DRINK	MAC	14	total, max. value		75, 69
Dichloroethene, 1,1-	75-35-4	JPN	QS	AMBI	EQS	20		Health aspects	37
Dichloroethene, 1,1-	75-35-4	NL	QO	SURF	MPC	3400	diss.		76
Dichloroethene, 1,1-	75-35-4	NL	QO	SURF	MPC	3400	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloroethene, 1,1-	75-35-4	NL	QO	SURF	TV	34	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloroethene, 1,1-	75-35-4	USA	QC	DRINK-FISH	WQC	0.057		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichloroethene, 1,1-	75-35-4	USA	QC	FISH-CONSM	WQC	3.2		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichloroethene, 1,2-		NL	QO	SURF	MPC	6100	diss.		76
Dichloroethene, 1,2-		NL	QO	SURF	MPC	6100	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloroethene, 1,2-		NL	QO	SURF	TV	61	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloroethene, cis-1,2-	156-59-2	JPN	QS	AMBI	EQS	40		Health aspects	37
Dichloroethene, trans-1,2-	156-60-5	USA	QC	DRINK-FISH	WQC	700		IRIS database, updated 08/04/1998 A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Dichloroethene, trans-1,2-	156-60-5	USA	QC	FISH-CONSM	WQC	140000		IRIS database, updated 08/04/1998	77
Dichloromethane	75-09-2	CAN	QC	AGRIC-LIVE	GL (I)	50	total, max. value		75, 6
Dichloromethane	75-09-2	CAN	QC	AQL-FRESH	GL (I)	98.1	total, max. value		75, 6
Dichloromethane	75-09-2	CAN	QC	DRINK	MAC	50	total, max. value		75, 69
Dichloromethane	75-09-2	DEU	QC	AQL-FRESH	ZV	10	total, 90th perc.		15
Dichloromethane	75-09-2	DEU	QS	DRINK	GW			See organochlorine compounds	78
Dichloromethane	75-09-2	DEU	QC	DRINK-FISH	ZV (v)	37.36	total, 90th perc.	Carcinogenic risk (risk level 10-5)	15
Dichloromethane	75-09-2	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Dichloromethane	75-09-2	JPN	QS	AMBI	EQS		20		Health aspects	37
Dichloromethane	75-09-2	NL	QO	SURF	MPC		20000	diss.		76
Dichloromethane	75-09-2	NL	QO	SURF	MPC		20000	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloromethane	75-09-2	NL	QO	SURF	TV		200	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloromethane	75-09-2	USA	QC	DRINK-FISH	WQC		4.7		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichloromethane	75-09-2	USA	QC	FISH-CONSM	WQC		1600		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichlorophenol, 2,3-	576-24-9	USA	QC	Taste	WQC		0.04			77
Dichlorophenol, 2,4-	120-83-2	CAN	QC	DRINK	MAC		900	total, max. value		75, 69
Dichlorophenol, 2,4-	120-83-2	CAN	QC	DRINK	AO	<=	0.3	total, max. value	Target value of <0.3 µg/l envisaged for 2,4-dichlorophenol in order to avoid adverse effects on taste.	75, 69
Dichlorophenol, 2,4-	120-83-2	USA	QC	AQL-FRESH	CCC		365		Not enough data available; lowest LOEL	23
Dichlorophenol, 2,4-	120-83-2	USA	QC	DRINK-FISH	WQC		93		Derivation based on: IRIS database, updated 08/04/1998	77
Dichlorophenol, 2,4-	120-83-2	USA	QC	FISH-CONSM	WQC		790		Derivation based on: IRIS database, updated 08/04/1998	77
Dichlorophenol, 2,4-	120-83-2	USA	QC	Taste	WQC		0.3			77
Dichlorophenol, 2,5-	583-78-8	USA	QC	Taste	WQC		0.5			77
Dichlorophenol, 2,6-	87-65-0	USA	QC	Taste	WQC		0.2			77
Dichlorophenol, 3,4-	95-77-2	USA	QC	Taste	WQC		0.3			77
Dichlorophenols		CAN	QC	AQL-FRESH	GL		0.2	total, max. value		75, 1
Dichlorophenols (single)		NL	QO	SURF	MPC		15	diss.		76
Dichlorophenols (single)		NL	QO	SURF	MPC		15	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichlorophenols (single)		NL	QO	SURF	TV		0.2	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloropropane, 1,2-	78-87-5	NL	QO	SURF	MPC		76	diss.		76
Dichloropropane, 1,2-	78-87-5	NL	QO	SURF	MPC		76	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloropropane, 1,2-	78-87-5	NL	QO	SURF	TV		0.8	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloropropane, 1,2-	78-87-5	USA	QC	DRINK-FISH	WQC		0.52		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichloropropane, 1,2-	78-87-5	USA	QC	FISH-CONSM	WQC		39		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dichloropropane, 1,3-	142-28-9	JPN	QS	AMBI	EQS		2		Health aspects	37
Dichloropropane, 1,3-	142-28-9	NL	QO	SURF	MPC		76	diss.		76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Dichloropropane, 1,3-	142-28-9	NL	QO	SURF	MPC	76	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloropropane, 1,3-	142-28-9	NL	QO	SURF	TV	0.8	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloropropanes		USA	QC	AQL-FRESH	CCC	5700		Not enough data available; lowest LOEL	23
Dichloropropanes		USA	QC	AQL-MARIN	CCC	3040		Not enough data available; lowest LOEL	23
Dichloropropene, 1,3-	542-75-6	NL	QO	SURF	MPC	8	diss.		76
Dichloropropene, 1,3-	542-75-6	NL	QO	SURF	MPC	8	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloropropene, 1,3-	542-75-6	NL	QO	SURF	TV	0.08	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloropropene, 1,3-	542-75-6	USA	QC	DRINK-FISH	WQC	10		Derivation based on: IRIS database, updated 08/04/1998	77
Dichloropropene, 1,3-	542-75-6	USA	QC	FISH-CONSM	WQC	1700		Derivation based on: IRIS database, updated 08/04/1998	77
Dichloropropene, 2,3-	78-88-6	NL	QO	SURF	MPC	8	diss.		76
Dichloropropene, 2,3-	78-88-6	NL	QO	SURF	MPC	8	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloropropene, 2,3-	78-88-6	NL	QO	SURF	TV	0.08	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichloropropenes		USA	QC	AQL-FRESH	CCC	244		Not enough data available; lowest LOEL	23
Dichloropropenes		USA	QC	AQL-MARIN	CCC	790		Not enough data available; lowest LOEL	23
Dichlorprop	120-36-5	NL	QO	SURF	MPC	40	diss.		76
Dichlorprop	120-36-5	NL	QO	SURF	MPC	40	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichlorprop	120-36-5	NL	QO	SURF	TV	0.4	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dichlorprop	120-36-5	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	80
Dichlorprop-P	136-66-9	DEU	QC	AQL-FRESH	ZV (v)	10	total, 90th perc.		73
Dichlorvos	62-73-7	DEU	QC	AQL-FRESH	ZV (v)	0.0006	total, 90th perc.		73
Dichlorvos	62-73-7	GBR	QS, E.	AQL-FRESH	PEQS	0.001	ann. mean		20
Dichlorvos	62-73-7	GBR	QS, E.	AQL-MARIN	PEQS	0.04	ann. mean		20
Dichlorvos	62-73-7	NL	QO	SURF	MPC	0.0007	diss.	Value is below detection/determination limit.	76
Dichlorvos	62-73-7	NL	QO	SURF	MPC	0.0007	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Dichlorvos	62-73-7	NL	QO	SURF	TV	0.000007	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Dichlorvos	62-73-7	Rhein	QO	RIVER	ZV	0.0007	total, 90th perc.	AQL	45
Diclofop-methyl	51338-27-3	CAN	QC	AGRIC-IRRI	GL	0.18	total, max. value		75, 8
Diclofop-methyl	51338-27-3	CAN	QC	AGRIC-LIVE	GL (I)	9	total, max. value		75, 8

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Diclofop-methyl	51338-27-3	CAN	QC	AQL-FRESH	GL	6.1	total, max. value		75, 8
Diclofop-methyl	51338-27-3	CAN	QC	DRINK	MAC	9	total, max. value		75, 69
Dieldrin	60-57-1	CAN	QC	DRINK-SURF	MAC	0.7	total, max. value	Value not valid for aldrin and dieldrin	75, 1
Dieldrin	60-57-1	EEC	QS	AMBI	QZ	0.01	ann. mean		43
Dieldrin	60-57-1	GBR	QS	MARIN	EQS	0.01		Standard adopted from EC Directive 88/347/EEC	28
Dieldrin	60-57-1	NL	QO	SURF	MPC	0.012	diss.		76
Dieldrin	60-57-1	NL	QO	SURF	MPC	0.039	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dieldrin	60-57-1	NL	QO	SURF	TV	0.0004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Dieldrin	60-57-1	Rhein	QO	RIVER	ZV	0.001	total, 90th perc.	AQL & FISH-CONSM	45
Dieldrin	60-57-1	USA	QC	AQL-FRESH	FCV	0.0625			58
Dieldrin	60-57-1	USA	QC	AQL-FRESH	CCC	0.056		Derivation published in document EPA-820-B-96-001. Derivation does not account for exposure by food.	77
Dieldrin	60-57-1	USA	QC	AQL-FRESH	CMC	0.24		Derivation published in document EPA-820-B-96-001.	77
Dieldrin	60-57-1	USA	QC	AQL-MARIN	FCV	0.1147			58
Dieldrin	60-57-1	USA	QC	AQL-MARIN	CCC	0.0019		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77
Dieldrin	60-57-1	USA	QC	AQL-MARIN	CMC	0.71		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Dieldrin	60-57-1	USA	QC	DRINK-FISH	WQC	0.00014		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dieldrin	60-57-1	USA	QC	FISH-CONSM	WQC	0.00014		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Dieldrin	60-57-1	USA-GL	QC	AQL-FRESH	CCC	0.056			52
Diethyl phthalate	84-66-2	USA	QC	DRINK-FISH	WQC	23000		Derivation based on: IRIS database, updated 08/04/1998	77
Diethyl phthalate	84-66-2	USA	QC	FISH-CONSM	WQC	120000		Derivation based on: IRIS database, updated 08/04/1998	77
Dikegulac	18467-77-1	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.	Insufficient data	81
Dimethoate	60-51-5	CAN	QC	AGRIC-LIVE	GL (I)	3	total, max. value		75, 10
Dimethoate	60-51-5	CAN	QC	AQL-FRESH	GL (I)	6.2	total, max. value		75, 10
Dimethoate	60-51-5	CAN	QC	DRINK	IMAC	20	total, max. value		75, 69
Dimethoate	60-51-5	DEU	QC	AQL-FRESH	ZV (v)	0.2	total, 90th perc.		73
Dimethoate	60-51-5	NL	QO	SURF	MPC	23	diss.		76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Dimethoate	60-51-5	NL	QO	SURF	MPC	23	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dimethoate	60-51-5	NL	QO	SURF	TV	0.23	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dimethoate	60-51-5	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	80
Dimethyl phthalate	131-11-3	USA	QC	DRINK-FISH	WQC	313000			77
Dimethyl phthalate	131-11-3	USA	QC	FISH-CONSM	WQC	2900000			77
Dimethylphenol, 2,4-	105-67-9	USA	QC	AQL-FRESH	CCC	530	4-day average		65
Dimethylphenol, 2,4-	105-67-9	USA	QC	AQL-MARIN	CCC	110	4-day average		65
Dimethylphenol, 2,4-	105-67-9	USA	QC	DRINK-FISH	WQC	540		Derivation based on: IRIS database, updated 08/04/1998	77
Dimethylphenol, 2,4-	105-67-9	USA	QC	FISH-CONSM	WQC	2300		Derivation based on: IRIS database, updated 08/04/1998	77
Dimethylphenol, 2,4-	105-67-9	USA	QC	Taste	WQC	400			77
Dinitro-2-cresol, 4,6-	534-52-1	NL	QO	SURF	MPC	0.3	total		25
Dinitro-2-cresol, 4,6-	534-52-1	USA	QC	DRINK-FISH	WQC	13.4			77
Dinitro-2-cresol, 4,6-	534-52-1	USA	QC	FISH-CONSM	WQC	765			77
Dinitrophenol, 2,4-	51-28-5	USA	QC	DRINK-FISH	WQC	70		Derivation based on: IRIS database, updated 08/04/1998	77
Dinitrophenol, 2,4-	51-28-5	USA	QC	FISH-CONSM	WQC	14000		Derivation based on: IRIS database, updated 08/04/1998	77
Dinitrophenols	25550-58-7	USA	QC	DRINK-FISH	WQC	70			77
Dinitrophenols	25550-58-7	USA	QC	FISH-CONSM	WQC	14000			77
Dinitrotoluene, 2,4-	121-14-2	USA	QC	DRINK-FISH	WQC	0.11		Carcinogenic risk (risk level 10-6)	77
Dinitrotoluene, 2,4-	121-14-2	USA	QC	FISH-CONSM	WQC	9.1		Carcinogenic risk (risk level 10-6)	77
Dinitrotoluenes		USA	QC	AQL-FRESH	CCC	230		Not enough data available; lowest LOEL	23
Dinitrotoluenes		USA	QC	AQL-MARIN	CCC	370		Not enough data available; lowest LOEL	23
Dinitrotoluenes		USA	QC	DRINK-FISH	WQC	70			23
Dinitrotoluenes		USA	QC	FISH-CONSM	WQC	14300			23
Dinoseb	88-85-7	CAN	QC	AGRIC-IRRI	GL	16	total, max. value		75, 7
Dinoseb	88-85-7	CAN	QC	AGRIC-LIVE	GL	150	total, max. value		75, 7
Dinoseb	88-85-7	CAN	QC	AQL-FRESH	GL	0.05	total, max. value		75, 7
Dinoseb	88-85-7	CAN	QC	DRINK	MAC	10	total, max. value		75, 69
Dinoseb	88-85-7	NL	QO	SURF	MPC	0.03	diss.		76
Dinoseb	88-85-7	NL	QO	SURF	MPC	0.03	total	Value standardized to a suspended matter content of 30 mg/l.	76
Dinoseb	88-85-7	NL	QO	SURF	TV	0.0003	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Dinoterb	1420-07-1	NL	QO	SURF	MPC	0.03	diss.		76
Dinoterb	1420-07-1	NL	QO	SURF	MPC	0.03	total	Value standardized to a suspended matter content of 30 mg/l.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Dinoterb	1420-07-1	NL	QO	SURF	TV	0.0003	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Dinoterb	1420-07-1	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	80
Dioxin, 2,3,7,8-TCDD								See Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	
Diphenylhydrazine, 1,2-	122-66-7	USA	QC	DRINK-FISH	WQC	0.04		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Diphenylhydrazine, 1,2-	122-66-7	USA	QC	FISH-CONSM	WQC	0.54		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Diquat	2764-72-9	CAN	QC	DRINK	MAC	70	total, max. value		75, 69
Disulfoton	298-04-4	NL	QO	SURF	MPC	0.082	diss.		76
Disulfoton	298-04-4	NL	QO	SURF	MPC	0.082	total	Value standardized to a suspended matter content of 30 mg/l.	76
Disulfoton	298-04-4	NL	QO	SURF	TV	0.0008	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Disulfoton	298-04-4	Rhein	QO	RIVER	ZV	0.004	total, 90th perc.	AQL	80
Diuron	330-54-1	CAN	QC	DRINK	MAC	150	total, max. value		75, 69
Diuron	330-54-1	DEU	QC	AQL-FRESH	ZV (v)	0.05	total, 90th perc.		73
Diuron	330-54-1	NL	QO	SURF	MPC	0.43	diss.		76
Diuron	330-54-1	NL	QO	SURF	MPC	0.43	total	Value standardized to a suspended matter content of 30 mg/l.	76
Diuron	330-54-1	NL	QO	SURF	TV	0.004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Diuron	330-54-1	Rhein	QO	RIVER	ZV	0.006	total, 90th perc.	AQL	74
DNOC	534-52-1	NL	QO	SURF	MPC	21	diss.		76
DNOC	534-52-1	NL	QO	SURF	MPC	21	total	Value standardized to a suspended matter content of 30 mg/l.	76
DNOC	534-52-1	NL	QO	SURF	TV	0.2	total	Value standardized to a suspended matter content of 30 mg/l.	76
Endosulfan	115-29-7	CAN	QC	AQL-FRESH	GL	0.02	total, max. value		75, 1
Endosulfan	115-29-7	DEU	QC	AQL-FRESH	ZV (v)	0.005	total, 90th perc.		73
Endosulfan	115-29-7	GBR	QS, E.	AQL-FRESH	PEQS	0.003	total dissolved, ann. mean	Refers to the sum of alpha-endosulfan, beta-endosulfan and endosulfan sulfate	14
Endosulfan	115-29-7	GBR	QS, E.	AQL-MARIN	PEQS	0.003	total dissolved, ann. mean	Refers to the sum of alpha-endosulfan, beta-endosulfan and endosulfan sulfate	14
Endosulfan	115-29-7	Rhein	QO	RIVER	ZV	0.001	total, 90th perc.	AQL	45
Endosulfan	115-29-7	USA	QC	AQL-FRESH	CCC	0.056			23
Endosulfan	115-29-7	USA	QC	AQL-MARIN	CCC	0.0087			23
Endosulfan	115-29-7	USA	QC	DRINK-FISH	WQC	74			23
Endosulfan	115-29-7	USA	QC	FISH-CONSM	WQC	159			23

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Endosulfan sulfate	1031-07-8	USA	QC	DRINK-FISH	WQC	110		Derivation based on: IRIS database, updated 08/04/1998	77
Endosulfan sulfate	1031-07-8	USA	QC	FISH-CONSM	WQC	240		Derivation based on: IRIS database, updated 08/04/1998	77
Endosulfan, alpha-	959-98-8	NL	QO	SURF	MPC	0.02	diss.		76
Endosulfan, alpha-	959-98-8	NL	QO	SURF	MPC	0.02	total	Value standardized to a suspended matter content of 30 mg/l.	76
Endosulfan, alpha-	959-98-8	NL	QO	SURF	TV	0.0002	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Endosulfan, alpha-	959-98-8	USA	QC	AQL-FRESH	CCC	0.056		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value refers to the sum of alpha-endosulfan and beta-endosulfan.	77
Endosulfan, alpha-	959-98-8	USA	QC	AQL-FRESH	CMC	0.22		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value refers to the sum of alpha-endosulfan and beta-endosulfan.	77
Endosulfan, alpha-	959-98-8	USA	QC	AQL-MARIN	CCC	0.0087		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value refers to the sum of alpha-endosulfan and beta-endosulfan.	77
Endosulfan, alpha-	959-98-8	USA	QC	AQL-MARIN	CMC	0.034		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value refers to the sum of alpha-endosulfan and beta-endosulfan.	77
Endosulfan, alpha-	959-98-8	USA	QC	DRINK-FISH	WQC	110		Derivation based on: IRIS database, updated 08/04/1998	77
Endosulfan, alpha-	959-98-8	USA	QC	FISH-CONSM	WQC	240		Derivation based on: IRIS database, updated 08/04/1998	77
Endosulfan, alpha-	959-98-8	USA	QC	AQL-FRESH	CCC	0.056		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value refers to the sum of alpha-endosulfan and beta-endosulfan.	77
Endosulfan, beta-	33213-65-9	USA	QC	AQL-FRESH	CMC	0.22		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value refers to the sum of alpha-endosulfan and beta-endosulfan.	77
Endosulfan, beta-	33213-65-9	USA	QC	AQL-MARIN	CCC	0.0087		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value refers to the sum of alpha-endosulfan and beta-endosulfan.	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Endosulfan, beta-	33213-65-9	USA	QC	AQL-MARIN	CMC	0.034		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value refers to the sum of alpha-endosulfan and beta-endosulfan.	77
Endosulfan, beta-	33213-65-9	USA	QC	DRINK-FISH	WQC	110		Derivation based on: IRIS database, updated 08/04/1998	77
Endosulfan, beta-	33213-65-9	USA	QC	FISH-CONSM	WQC	240		Derivation based on: IRIS database, updated 08/04/1998	77
Endrin	72-20-8	EEC	QS	AMBI	QZ	0.005	ann. mean		43
Endrin	72-20-8	NL	QO	SURF	MPC	0.004	diss.		76
Endrin	72-20-8	NL	QO	SURF	MPC	0.004	total	Value standardized to a suspended matter content of 30 mg/l.	76
Endrin	72-20-8	NL	QO	SURF	TV	0.00004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Endrin	72-20-8	Rhein	QO	RIVER	ZV	0.001	total, 90th perc.	AQL & FISH-CONSM	45
Endrin	72-20-8	USA	QC	AQL-FRESH	FCV	0.061			60
Endrin	72-20-8	USA	QC	AQL-FRESH	CCC	0.036		Derivation published in document EPA-820-B-96-001. Derivation does not account for exposure by food.	77
Endrin	72-20-8	USA	QC	AQL-FRESH	CMC	0.086		Derivation published in document EPA-820-B-96-001.	77
Endrin	72-20-8	USA	QC	AQL-MARIN	FCV	0.011			60
Endrin	72-20-8	USA	QC	AQL-MARIN	CCC	0.0023		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77
Endrin	72-20-8	USA	QC	AQL-MARIN	CMC	0.037		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Endrin	72-20-8	USA	QC	DRINK	MCL	0.2			23
Endrin	72-20-8	USA	QC	DRINK-FISH	WQC	0.76		Derivation based on: IRIS database, updated 08/04/1998	77
Endrin	72-20-8	USA	QC	FISH-CONSM	WQC	0.81		Derivation based on: IRIS database, updated 08/04/1998 No WQC value is stated in the 1980 and 1986 criterion documents. Nonetheless the data contained in the documents allow a WQC to be calculated.	77
Endrin	72-20-8	USA-GL	QC	AQL-FRESH	CCC	0.037			52
Endrin aldehyde	7421-93-4	USA	QC	DRINK-FISH	WQC	0.76		Derivation based on: IRIS database, updated 08/04/1998	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Endrin aldehyde	7421-93-4	USA	QC	FISH-CONSM	WQC		0.81		Derivation based on: IRIS database, updated 08/04/1998 No WQC value is stated in the 1980 and 1986 criterion documents. Nonetheless the data contained in the documents allow a WQC to be calculated.	77
Esfenvalerate	66230-04-4	DEU	QC	AQL-FRESH	ZV (E)		0.0001	total, 90th perc.		81
Ethene	74-85-1	NL	QO	SURF	MPC		8500	diss.	Value is below detection/determination limit.	76
Ethene	74-85-1	NL	QO	SURF	MPC		8500	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Ethene	74-85-1	NL	QO	SURF	TV		85	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Ethoprophos	13194-48-4	NL	QO	SURF	MPC		0.063	diss.		76
Ethoprophos	13194-48-4	NL	QO	SURF	MPC		0.063	total	Value standardized to a suspended matter content of 30 mg/l.	76
Ethoprophos	13194-48-4	NL	QO	SURF	TV		0.0006	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Ethylbenzene	100-41-4	CAN	QC	AGRIC-LIVE	GL		2.4	total, max. value		75, 70
Ethylbenzene	100-41-4	CAN	QC	AQL-FRESH	GL (I)		90	total, max. value		75, 70
Ethylbenzene	100-41-4	CAN	QC	AQL-MARIN	GL (I)		25	total, max. value		75, 70
Ethylbenzene	100-41-4	CAN	QC	DRINK	AO	<=	2.4	total, max. value		75, 69
Ethylbenzene	100-41-4	NL	QO	SURF	MPC		370	diss.		76
Ethylbenzene	100-41-4	NL	QO	SURF	MPC		370	total	Value standardized to a suspended matter content of 30 mg/l.	76
Ethylbenzene	100-41-4	NL	QO	SURF	TV		4	total	Value standardized to a suspended matter content of 30 mg/l.	76
Ethylbenzene	100-41-4	USA	QC	DRINK-FISH	WQC		3100		Derivation based on: IRIS database, updated 08/04/1998 A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Ethylbenzene	100-41-4	USA	QC	FISH-CONSM	WQC		29000		Derivation based on: IRIS database, updated 08/04/1998	77
Ethylene glycol	107-21-1	CAN	QC	AQL-FRESH	GL (I)		192000	total, max. value		75
Ethylene oxide	75-21-8	NL	QO	SURF	MPC		84	diss.	Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Ethylene oxide	75-21-8	NL	QO	SURF	MPC		84	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit. Acute data only; compensation factor 1000	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Ethylene oxide	75-21-8	NL	QO	SURF	TV	8	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Etrimphos	38260-54-7	DEU	QC	AQL-FRESH	ZV (v)	0.004	total, 90th perc.		73
ETU, Ethylene thiourea	96-45-7	NL	QO	SURF	MPC	0.005	total	Degradation product of maneb and zineb	76
Fenitrothion	122-14-5	DEU	QC	AQL-FRESH	ZV (v)	0.009	total, 90th perc.		73
Fenitrothion	122-14-5	GBR	QS, E.	AQL-FRESH	PEQS	0.01	total dissolved, ann. mean		18
Fenitrothion	122-14-5	GBR	QS, E.	AQL-MARIN	PEQS	0.01	total dissolved, ann. mean		18
Fenitrothion	122-14-5	NL	QO	SURF	MPC	0.009	diss.	Value is below detection/determination limit.	76
Fenitrothion	122-14-5	NL	QO	SURF	MPC	0.009	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Fenitrothion	122-14-5	NL	QO	SURF	TV	0.00009	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Fenitrothion	122-14-5	Rhein	QO	RIVER	ZV	0.001	total, 90th perc.	AQL	45
Fenthion	55-38-9	DEU	QC	AQL-FRESH	ZV (v)	0.004	total, 90th perc.		73
Fenthion	55-38-9	NL	QO	SURF	MPC	0.003	diss.	Value is below detection/determination limit.	76
Fenthion	55-38-9	NL	QO	SURF	MPC	0.003	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Fenthion	55-38-9	NL	QO	SURF	TV	0.00003	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Fenthion	55-38-9	Rhein	QO	RIVER	ZV	0.007	total, 90th perc.	AQL	45
Fenvalerate	51630-58-1	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.	Insufficient data	81
Flucofuron	370-50-3	GBR	QS, E.	AGRIC-IRRI	PEQS	1	total, active ingredient, 95th perc.		33
Flucofuron	370-50-3	GBR	QS, E.	AQL-FRESH	PEQS	1	total, active ingredient, 95th perc.	(Freshwater fish only)	33
Flucofuron	370-50-3	GBR	QS	FRESH	EQS	1	total, 95th perc.		63
Flucofuron	370-50-3	GBR	QS	MARIN	EQS	1	total, 95th perc.		63
Fluoranthene	206-44-0	CAN	QC	AQL-FRESH	GL (I)	0.015	total, max. value		75
Fluoranthene	206-44-0	NL	QO	SURF	MPC	0.3	diss.		76
Fluoranthene	206-44-0	NL	QO	SURF	MPC	0.5	total	Value standardized to a suspended matter content of 30 mg/l.	76
Fluoranthene	206-44-0	NL	QO	SURF	TV	0.005	total	Value standardized to a suspended matter content of 30 mg/l.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Fluoranthene	206-44-0	Nordsee	QC	MARIN	EAC	0.01	0.1	diss.	Preliminary values	27
Fluoranthene	206-44-0	USA	QC	AQL-FRESH	FCV	8.12				61
Fluoranthene	206-44-0	USA	QC	AQL-MARIN	CCC	16			Not enough data available; lowest LOEL	23
Fluoranthene	206-44-0	USA	QC	AQL-MARIN	FCV	10.55				61
Fluoranthene	206-44-0	USA	QC	DRINK-FISH	WQC	300			Derivation based on: IRIS database, updated 08/04/1998	77
Fluoranthene	206-44-0	USA	QC	FISH-CONSM	WQC	370			Derivation based on: IRIS database, updated 08/04/1998	77
Fluorene	86-73-7	CAN	QC	AQL-FRESH	GL (I)	3		total, max. value		75
Fluorene	86-73-7	USA	QC	DRINK-FISH	WQC	1300			Derivation based on: IRIS database, updated 08/04/1998	77
Fluorene	86-73-7	USA	QC	FISH-CONSM	WQC	14000			Derivation based on: IRIS database, updated 08/04/1998	77
Fluoride		CAN	QC	AGRIC-IRRI	GL	1000		total, max. value	All soils with permanent irrigation	75, 1
Fluoride		CAN	QC	AGRIC-LIVE	GL	1000	2000	total, max. value	1000 µg/l if food contains fluoride	75, 1
Fluoride		CAN	QC	DRINK	MAC	1500		total, max. value		75, 69
Fluoride		DEU	QS	DRINK	GW	1500				78
Fluoride		DEU-NRW	QS	AGRIC-IRRI	GL	1000				38
Fluoride		DEU-NRW	QS	DRINK-SURF	G, A1	700	1000		According to EC Directive 75/440/EEC	38
Fluoride		DEU-NRW	QS	DRINK-SURF	G, A2	700	1700		According to EC Directive 75/440/EEC	38
Fluoride		DEU-NRW	QS	DRINK-SURF	I, A1	1500			According to EC Directive 75/440/EEC	38
Fluoride		GBR	QS, E.	AGRIC-IRRI	PWQS	1000				24
Fluoride		GBR	QS, E.	AGRIC-LIVE	PWQS	2000				24
Fluoride		NL	QO	SURF	MPC	1500		total		76
Glyphosate	1071-83-6	CAN	QC	AGRIC-LIVE	GL (I)	280		total, max. value		75, 2
Glyphosate	1071-83-6	CAN	QC	AQL-FRESH	GL (I)	65		total, max. value		75, 2
Glyphosate	1071-83-6	CAN	QC	DRINK	MAC	280		total, max. value		69
Glyphosate	1071-83-6	DEU	QC	AQL-FRESH	ZV (E)	28		total, 90th perc.		81
Guthion	86-50-0	USA	QC	AQL-FRESH	CCC	0.01				23
Guthion	86-50-0	USA	QC	AQL-FRESH	CCC	0.01			Derivation see Red Book (EPA 440/9-76-0239)	77
Guthion	86-50-0	USA	QC	AQL-FRESH	CMC					77
Guthion	86-50-0	USA	QC	AQL-MARIN	CCC	0.01				23
Guthion	86-50-0	USA	QC	AQL-MARIN	CCC	0.01			Derivation see Red Book (EPA 440/9-76-0239)	77
Guthion	86-50-0	USA	QC	AQL-MARIN	CMC					77
Guthion	86-50-0	USA	QC	DRINK-FISH	WQC					77
Guthion	86-50-0	USA	QC	FISH-CONSM	WQC					77
Haloether		DEU	QC	AQL-FRESH	ZV (E)			total, 90th perc.	Insufficient data	81
Haloether		USA	QC	AQL-FRESH	CCC	122			Not enough data available; lowest LOEL	23
Halomethanes		USA	QC	AQL-MARIN	CCC	6400			Not enough data available; lowest LOEL	23
Halomethanes		USA	QC	DRINK-FISH	WQC	0.19			Carcinogenic risk (risk level 10-6)	23
Halomethanes		USA	QC	FISH-CONSM	WQC	15.7			Carcinogenic risk (risk level 10-6)	23
HCH	608-73-1	EEC	QS	ESTUA	QZ	0.02		total, ann. mean	Minimum requirement to protect AQL	42

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
HCH	608-73-1	EEC	QS	MARIN	QZ	0.02		total, ann. mean	Minimum requirement to protect AQL	42
HCH	608-73-1	EEC	QS	SURF	QZ	0.1		total, ann. mean	Minimum requirement to protect AQL	42
HCH	608-73-1	USA	QC	DRINK-FISH	WQC	0.0123			Carcinogenic risk (risk level 10-6)	23
HCH	608-73-1	USA	QC	FISH-CONSM	WQC	0.0414			Carcinogenic risk (risk level 10-6)	23
HCH technical	319-86-8	USA	QC	DRINK-FISH	WQC	0.0123				77
HCH technical	319-86-8	USA	QC	FISH-CONSM	WQC	0.0414				77
HCH, alpha-	319-84-6	NL	QO	SURF	MPC	3.3		diss.		76
HCH, alpha-	319-84-6	NL	QO	SURF	MPC	3.3		total	Value standardized to a suspended matter content of 30 mg/l.	76
HCH, alpha-	319-84-6	NL	QO	SURF	TV	0.033		total	Value standardized to a suspended matter content of 30 mg/l.	76
HCH, alpha-	319-84-6	Rhein	QO	RIVER	ZV	0.1		total, 90th perc.	FISH-CONSM	45
HCH, alpha-	319-84-6	USA	QC	DRINK-FISH	WQC	0.0039			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
HCH, alpha-	319-84-6	USA	QC	FISH-CONSM	WQC	0.013			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
HCH, beta-	319-85-7	NL	QO	SURF	MPC	0.8		diss.		76
HCH, beta-	319-85-7	NL	QO	SURF	MPC	0.86		total	Value standardized to a suspended matter content of 30 mg/l.	76
HCH, beta-	319-85-7	NL	QO	SURF	TV	0.009		total	Value standardized to a suspended matter content of 30 mg/l.	76
HCH, beta-	319-85-7	Rhein	QO	RIVER	ZV	0.1		total, 90th perc.	FISH-CONSM	45
HCH, beta-	319-85-7	USA	QC	DRINK-FISH	WQC	0.014			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
HCH, beta-	319-85-7	USA	QC	FISH-CONSM	WQC	0.046			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
HCH, delta-	319-86-8	Rhein	QO	RIVER	ZV	0.1		total, 90th perc.	FISH-CONSM	45
HCH, gamma- (lindane)	58-89-9	CAN	QC	DRINK	MAC	4		total max. value		69
HCH, gamma- (lindane)	58-89-9	DEU	QC	AQL-FRESH	ZV (v)	0.3		total, 90th perc.		73
HCH, gamma- (lindane)	58-89-9	GBR	QS	MARIN	EQS	0.02			Standard adopted from EC Directive 84/491/EE	28
HCH, gamma- (lindane)	58-89-9	NL	QO	SURF	MPC	0.91		diss.		76
HCH, gamma- (lindane)	58-89-9	NL	QO	SURF	MPC	0.92		total	Value standardized to a suspended matter content of 30 mg/l.	76
HCH, gamma- (lindane)	58-89-9	NL	QO	SURF	TV	0.009		total	Value standardized to a suspended matter content of 30 mg/l.	76
HCH, gamma- (lindane)	58-89-9	Nordsee	QC	MARIN	EAC	0.0005	0.005	diss.	Preliminary values	27
HCH, gamma- (lindane)	58-89-9	Rhein	QO	RIVER	ZV	0.002		total, 90th perc.	AQL	45
HCH, gamma- (lindane)	58-89-9	USA	QC	AQL-FRESH	CCC	0.08				23
HCH, gamma- (lindane)	58-89-9	USA	QC	AQL-FRESH	CMC	0.95			Derivation published in document EPA-820-B-96-001.	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
HCH, gamma- (lindane)	58-89-9	USA	QC	AQL-MARIN	CMC	0.16		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
HCH, gamma- (lindane)	58-89-9	USA	QC	DRINK	MCL	4			23
HCH, gamma- (lindane)	58-89-9	USA	QC	DRINK-FISH	WQC	0.019		Carcinogenic risk (risk level 10-6)	77
HCH, gamma- (lindane)	58-89-9	USA	QC	FISH-CONSM	WQC	0.063		Carcinogenic risk (risk level 10-6)	77
HCH, gamma- (lindane)	58-89-9	USA-GL	QC	AQL-FRESH	CCC	0.057			52
Heptachlor	76-44-8	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.	Insufficient data	81
Heptachlor	76-44-8	NL	QO	SURF	MPC	0.0005	diss.	Value is below detection/determination limit.	76
Heptachlor	76-44-8	NL	QO	SURF	MPC	0.0005	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Heptachlor	76-44-8	NL	QO	SURF	TV	0.000005	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Heptachlor	76-44-8	USA	QC	AQL-FRESH	CCC	0.0038		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77
Heptachlor	76-44-8	USA	QC	AQL-FRESH	CMC	0.52		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Heptachlor	76-44-8	USA	QC	AQL-MARIN	CCC	0.0036		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77
Heptachlor	76-44-8	USA	QC	AQL-MARIN	CMC	0.053		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Heptachlor	76-44-8	USA	QC	DRINK-FISH	WQC	0.00021		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Heptachlor	76-44-8	USA	QC	FISH-CONSM	WQC	0.00021		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Heptachlor epoxide	1024-57-3	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.	Insufficient data	81
Heptachlor epoxide	1024-57-3	NL	QO	SURF	MPC	0.0005	diss.	Value is below detection/determination limit.	76
Heptachlor epoxide	1024-57-3	NL	QO	SURF	MPC	0.0005	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Heptachlor epoxide	1024-57-3	NL	QO	SURF	TV	0.000005	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Heptachlor epoxide	1024-57-3	USA	QC	AQL-FRESH	CCC	0.0038		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77
Heptachlor epoxide	1024-57-3	USA	QC	AQL-FRESH	CMC	0.52		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Heptachlor epoxide	1024-57-3	USA	QC	AQL-MARIN	CCC	0.0036		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC. Value based on the derivation of a Final Residue Value.	77
Heptachlor epoxide	1024-57-3	USA	QC	AQL-MARIN	CMC	0.053		Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Heptachlor epoxide	1024-57-3	USA	QC	DRINK-FISH	WQC	0.0001		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Heptachlor epoxide	1024-57-3	USA	QC	FISH-CONSM	WQC	0.00011		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Heptenophos	23560-59-0	NL	QO	SURF	MPC	0.02	diss.		76
Heptenophos	23560-59-0	NL	QO	SURF	MPC	0.02	total	Value standardized to a suspended matter content of 30 mg/l.	76
Heptenophos	23560-59-0	NL	QO	SURF	TV	0.0002	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Heptenophos	23560-59-0	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.	Insufficient data	81
Herbicides		CAN	QC	AGRIC-IRRI	GL			In general, concentrations < 1 µg/l are not toxic to tolerant plants. Revised index values are available for various herbicides. See single substances	1
Hexachloro-1,3-cyclopentadiene, 1,2,3,4,5,5-	77-47-4	USA	QC	AQL-FRESH	CCC	5.2		Not enough data available; lowest LOEL	23
Hexachloro-1,3-cyclopentadiene, 1,2,3,4,5,5-	77-47-4	USA	QC	DRINK-FISH	WQC	240		Derivation based on: IRIS database, updated 08/04/1998 A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Hexachloro-1,3-cyclopentadiene, 1,2,3,4,5,5-	77-47-4	USA	QC	FISH-CONSM	WQC	17000		Derivation based on: IRIS database, updated 08/04/1998 No WQC value is stated in the 1980 and 1986 criterion documents. Nonetheless the data contained in the documents allow a WQC to be calculated.	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Hexachloro-1,3-cyclopentadiene, 1,2,3,4,5,5-	77-47-4	USA	QC	Taste	WQC	1			77
Hexachlorobenzene	118-74-1	CAN	QC	AGRIC-LIVE	GL (I)	0.52	total, max. value		75
Hexachlorobenzene	118-74-1	DEU	QC	AQL-FRESH	ZV	0.01	total, 90th perc.		15
Hexachlorobenzene	118-74-1	DEU	QC	DRINK-FISH	ZV (v)	0.0008	total, 90th perc.	Carcinogenic risk (risk level 10-5)	15
Hexachlorobenzene	118-74-1	DEU	QC	DRINK-SURF	ZV	0.1	total, 90th perc.		15
Hexachlorobenzene	118-74-1	DEU	QC	FISH-CONSM	ZV	0.001	total, 90th perc.		15
Hexachlorobenzene	118-74-1	EEC	QS	AMBI	QZ	0.03	ann. mean		43
Hexachlorobenzene	118-74-1	NL	QO	SURF	MPC	0.009	diss.		76
Hexachlorobenzene	118-74-1	NL	QO	SURF	MPC	0.009	total	Value standardized to a suspended matter content of 30 mg/l.	76
Hexachlorobenzene	118-74-1	NL	QO	SURF	TV	0.00009	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Hexachlorobenzene	118-74-1	Rhein	QO	RIVER	ZV	0.001	total, 90th perc.	FISH-CONSM	45
Hexachlorobenzene	118-74-1	USA	QC	AQL-FRESH	CCC	3.68	4-day average		64
Hexachlorobenzene	118-74-1	USA	QC	DRINK-FISH	WQC	0.00075		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Hexachlorobenzene	118-74-1	USA	QC	FISH-CONSM	WQC	0.00077		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Hexachlorobutadiene	87-68-3	CAN	QC	AQL-FRESH	GL (I)	1.3	total, max. value		75
Hexachlorobutadiene	87-68-3	DEU	QC	AQL-FRESH	ZV	0.5	total, 90th perc.		15
Hexachlorobutadiene	87-68-3	DEU	QC	DRINK-FISH	ZV (v)	1.1	total, 90th perc.	Carcinogenic risk (risk level 10-5)	15
Hexachlorobutadiene	87-68-3	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Hexachlorobutadiene	87-68-3	EEC	QS	AMBI	QZ	0.1	ann. mean		43
Hexachlorobutadiene	87-68-3	NL	QO	SURF	MPC	0.12	total		25
Hexachlorobutadiene	87-68-3	Rhein	QO	RIVER	ZV	0.5	total, 90th perc.	AQL	45
Hexachlorobutadiene	87-68-3	USA	QC	AQL-FRESH	CCC	9.3		Not enough data available; lowest LOEL	23
Hexachlorobutadiene	87-68-3	USA	QC	DRINK-FISH	WQC	0.44		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Hexachlorobutadiene	87-68-3	USA	QC	FISH-CONSM	WQC	50		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Hexachloroethane	62-72-1	NL	QO	SURF	MPC	83	diss.		76
Hexachloroethane	62-72-1	NL	QO	SURF	MPC	83	total	Value standardized to a suspended matter content of 30 mg/l.	76
Hexachloroethane	62-72-1	NL	QO	SURF	TV	0.8	total	Value standardized to a suspended matter content of 30 mg/l.	76
Hexachloroethane	62-72-1	USA	QC	AQL-FRESH	CCC	540		Not enough data available; lowest LOEL	23
Hexachloroethane	67-72-1	USA	QC	DRINK-FISH	WQC	1.9		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Hexachloroethane	67-72-1	USA	QC	FISH-CONSM	WQC		8.9			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Hexazinone	51235-04-2	DEU	QC	AQL-FRESH	ZV (v)		0.07		total, 90th perc.		73
Hydrocarbons		DEU-NRW	QS	DRINK-SURF	I, A1		50			According to EC Directive 75/440/EEC	38
Hydrocarbons		DEU-NRW	QS	DRINK-SURF	I, A2		200			According to EC Directive 75/440/EEC	38
Hydrocarbons		DEU-NRW	QS	FISH	I, Salmo.					According to EC Directive 78/659/EEC; see directive	38
Hydrocarbons		DEU-NRW	QS	FISH	I, Cyp.					According to EC Directive 78/659/EEC; see directive	38
Hydrocarbons		DEU-NRW	QS	REC	G	<=	300			According to EC Directive 76/160/EEC	38
Hydrocarbons; mineral oils		DEU	QS	DRINK	GW		10		dissolved or emulsified		78
Hydrogen sulfide	7783-06-4	USA	QC	AQL-FRESH	CCC		2			Derivation see Red Book (EPA 440/9-76-0239)	77
Hydrogen sulfide	7783-06-4	USA	QC	AQL-MARIN	CCC		2			Derivation see Red Book (EPA 440/9-76-0239)	77
Indeno[1,2,3-cd]pyrene	193-39-5	USA	QC	DRINK-FISH	WQC		0.0044			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Indeno[1,2,3-cd]pyrene	193-39-5	USA	QC	FISH-CONSM	WQC		0.049			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Indeno[1,2,3-cd]pyrene	193-39-5	NL	QO	SURF	MPC		0.04		diss.		76
Indeno[1,2,3-cd]pyrene	193-39-5	NL	QO	SURF	MPC		0.4		total	Value standardized to a suspended matter content of 30 mg/l.	76
Indeno[1,2,3-cd]pyrene	193-39-5	NL	QO	SURF	TV		0.004		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Intestinal viruses		DEU-NRW	QS	DRINK-SURF	G, A2		0	PFU/ 10 l		According to EC Directive 75/440/EEC	38
Iod 125		CAN	QC	DRINK	MAC		10	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Iod 131		CAN	QC	DRINK	MAC		6	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
IPBC (3-Iodo-2-propynyl butyl carbamate)	55406-53-6	CAN	QC	AQL-FRESH	GL (I)		1.9		total, max. value		75
Iron	7439-89-6	CAN	QC	AGRIC-IRRI	GL		5000		total, max. value	All soils with permanent irrigation	75, 1
Iron	7439-89-6	CAN	QC	AQL-FRESH	GL		300		total, max. value		75, 1
Iron	7439-89-6	CAN	QC	DRINK	AO	<=	300		total, max. value		75, 69
Iron	7439-89-6	DEU	QS	DRINK	GW		200				78
Iron	7439-89-6	DEU-NRW	QS	AGRIC-IRRI	GL		2000				38
Iron	7439-89-6	DEU-NRW	QS	DRINK-SURF	G, A2		1000		diss.	According to EC Directive 75/440/EEC	38
Iron	7439-89-6	DEU-NRW	QS	DRINK-SURF	G, A2		100		diss.	According to EC Directive 75/440/EEC	38
Iron	7439-89-6	DEU-NRW	QS	DRINK-SURF	I, A2		2000		diss.	According to EC Directive 75/440/EEC	38
Iron	7439-89-6	DEU-NRW	QS	DRINK-SURF	I, A2		300		diss.	According to EC Directive 75/440/EEC	38

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range			Reference	Notes	Lit. No.
Iron	7439-89-6	DEU-NRW	QS	SURF	AGA	<=	2000			total, 90th perc.		38
Iron	7439-89-6	GBR	QS, E.	AGRIC-IRRI	PWQS		1000	2000		ann. mean		24
Iron	7439-89-6	GBR	QS, E.	AGRIC-IRRI	PEQS		1000			diss., 95th perc.		32
Iron	7439-89-6	GBR	QS, E.	AQL-FRESH	PEQS		2000			total, ann. mean		32
Iron	7439-89-6	GBR	QS, E.	AQL-MARIN	PEQS		10000	25000		total, ann. mean		32
Iron	7439-89-6	GBR	QS, E.	DRINK-SURF	EQS						According to EC Directive 75/440/EEC	32
Iron	7439-89-6	GBR	QS	FRESH	EQS		1000			diss., ann. mean		63
Iron	7439-89-6	GBR	QS	MARIN	EQS		1000			diss., ann. mean		63
Iron	7439-89-6	GBR	QS, E.	REC	PEQS		3000			total, 95th perc.		32
Iron	7439-89-6	USA	QC	AQL-FRESH	CCC		1000				Derivation see Red Book (EPA 440/9-76-0239)	77
Iron	7439-89-6	USA	QC	DRINK-FISH	WQC		300					77
Iron	7439-89-6	USA	QC	FISH-CONSM	WQC							77
Iron 59		CAN	QC	DRINK	MAC		40		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Isodrin	465-73-6	EEC	QS	AMBI	QZ		0.005			ann. mean		43
Isodrin	465-73-6	Rhein	QO	RIVER	ZV		0.001			total, 90th perc.	AQL & FISH-CONSM	45
Isophorone	78-59-1	USA	QC	DRINK-FISH	WQC		36				Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Isophorone	78-59-1	USA	QC	FISH-CONSM	WQC		2600				Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Isoproturon	34123-59-6	DEU	QC	AQL-FRESH	ZV (v)		0.3			total, 90th perc.		73
Isoproturon	34123-59-6	NL	QO	SURF	MPC		0.32			diss.		76
Isoproturon	34123-59-6	NL	QO	SURF	MPC		0.32			total	Value standardized to a suspended matter content of 30 mg/l.	76
Isoproturon	34123-59-6	NL	QO	SURF	TV		0.003			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Isoproturon	34123-59-6	Rhein	QO	RIVER	ZV		0.1			total, 90th perc.	DRINK-SURF	74
Kjeldahl nitrogen, N		DEU	QS	DRINK	GW		1000					78
Kjeldahl nitrogen, N		DEU-NRW	QS	DRINK-SURF	G, A1		1000				According to EC Directive 75/440/EEC	38
Kjeldahl nitrogen, N		DEU-NRW	QS	DRINK-SURF	G, A2		2000				According to EC Directive 75/440/EEC	38
Lead	7439-92-1	CAN	QC	AGRIC-IRRI	GL		200			total, max. value	All soils with permanent irrigation	75, 1
Lead	7439-92-1	CAN	QC	AGRIC-LIVE	GL		100			total, max. value		75, 1
Lead	7439-92-1	CAN	QC	AQL-FRESH	GL		7			total, max. value	Hardness >180 mg/l CaCO3	75, 1
Lead	7439-92-1	CAN	QC	AQL-FRESH	GL		2			total, max. value	Hardness 60-120 mg/l CaCO3	75, 1
Lead	7439-92-1	CAN	QC	AQL-FRESH	GL		1			total, max. value	Hardness 0-60 mg/l CaCO3	75, 1
Lead	7439-92-1	CAN	QC	AQL-FRESH	GL		4			total, max. value	Hardness 120-180 mg/l CaCO3	75, 1
Lead	7439-92-1	CAN	QC	DRINK	MAC		10			total, max. value		75, 69
Lead	7439-92-1	CHE	QS, E.	AQL	QZ		1			diss. total		26
Lead	7439-92-1	CHE	QS	AQL	QZ		50			diss. total		26
Lead	7439-92-1	DEU	QC	AGRIC-IRRI	ZV		50			total, 90th perc.		46

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range			Reference	Notes	Lit. No.
Lead	7439-92-1	DEU	QC	AQL-FRESH	ZV		3.4			total, 90th perc.	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Lead	7439-92-1	DEU	QS	DRINK	GW		40					78
Lead	7439-92-1	DEU	QC	DRINK-SURF	ZV		50			total, 90th perc.		46
Lead	7439-92-1	DEU	QC	FISH-CONSM	ZV		5			total, 90th perc.		46
Lead	7439-92-1	DEU	QC	RIVER	BACKG		0.8			total	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Lead	7439-92-1	DEU-NRW	QS	AGRIC-IRRI	GL		50					38
Lead	7439-92-1	DEU-NRW	QS	DRINK-SURF	I, A1		50				According to EC Directive 75/440/EEC	38
Lead	7439-92-1	DEU-NRW	QS	DRINK-SURF	I, A2		50				According to EC Directive 75/440/EEC	38
Lead	7439-92-1	DEU-NRW	QS	SURF	AGA	<=	20			total, 90th perc.		38
Lead	7439-92-1	GBR	QS, E.	AGRIC-LIVE	PWQS		100			ann. mean		24
Lead	7439-92-1	GBR	QS	FRESH	EQS		4	20		diss., ann. mean	Depends on water hardness	63
Lead	7439-92-1	GBR	QS	MARIN	EQS		25			diss., ann. mean		28
Lead	7439-92-1	GBR	QS	MARIN	PEQS		10			diss., ann. mean		28
Lead	7439-92-1	JPN	QS	AMBI	EQS		10				Health aspects	37
Lead	7439-92-1	NL	QO	SURF	BACKG		0.2			diss.		76
Lead	7439-92-1	NL	QO	SURF	BACKG		3.1			total	Value standardized to a suspended matter content of 30 mg/l.	76
Lead	7439-92-1	NL	QO	SURF	MPC		11			diss.		76
Lead	7439-92-1	NL	QO	SURF	MPC		220			total	Value standardized to a suspended matter content of 30 mg/l.	76
Lead	7439-92-1	NL	QO	SURF	TV		0.3			diss.		76
Lead	7439-92-1	NL	QO	SURF	TV		5.3			total	Value standardized to a suspended matter content of 30 mg/l.	76
Lead	7439-92-1	Nordsee	QC	MARIN	EAC		0.5	5		diss.		27
Lead	7439-92-1	SWE	QC	SURF-CLASS	Class 2		0.2	1			Class 2 = good	56
Lead	7439-92-1	USA	QC	AQL-FRESH	CCC		2.5				Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Criterion is being developed and subject to change.	77
Lead	7439-92-1	USA	QC	AQL-FRESH	CMC		65				Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Criterion is being developed and subject to change.	77
Lead	7439-92-1	USA	QC	AQL-MARIN	CCC		8.1			dissolved concentration		77
Lead	7439-92-1	USA	QC	AQL-MARIN	CMC		210			dissolved concentration		77
Lead	7439-92-1	USA	QC	DRINK	MCL		50					23
Lead	7439-92-1	USA	QC	DRINK-FISH	WQC		50					23
Lead 210	7439-92-1	CAN	QC	DRINK	MAC		0.1		Bq/l	total, max. value	If several radionuclides are present: Total Ci / MACi <= 1	75, 69
Linuron	330-55-2	CAN	QC	AGRIC-IRRI	GL		3.3			total, max. value	Cereal farming and pasture management	69

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Linuron	330-55-2	CAN	QC	AGRIC-IRRI	GL (I)		0.071		total, max. value	Miscellaneous farming	75, 69
Linuron	330-55-2	CAN	QC	AQL-FRESH	GL (I)		7		total, max. value		75, 69
Linuron	330-55-2	DEU	QC	AQL-FRESH	ZV (v)		0.3		total, 90th perc.		73
Linuron	330-55-2	NL	QO	SURF	MPC		0.25		diss.		76
Linuron	330-55-2	NL	QO	SURF	MPC		0.25		total	Value standardized to a suspended matter content of 30 mg/l.	76
Linuron	330-55-2	NL	QO	SURF	TV		0.003		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Linuron	330-55-2	Rhein	QO	RIVER	ZV		0.1		total, 90th perc.	DRINK-SURF	80
Lithium	7439-93-2	CAN	QC	AGRIC-IRRI	GL		2500		total, max. value	All soils with permanent irrigation	75, 1
Magnesium	7439-95-4	DEU	QS	DRINK	GW		50	mg/l			78
Malathion	121-75-5	CAN	QC	DRINK	MAC		190		total, max. value		75, 69
Malathion	121-75-5	DEU	QC	AQL-FRESH	ZV (v)		0.02		total, 90th perc.		73
Malathion	121-75-5	GBR	QS, E.	AQL-FRESH	PEQS		0.01		ann. mean		19
Malathion	121-75-5	GBR	QS, E.	AQL-MARIN	PEQS		0.02		ann. mean		19
Malathion	121-75-5	NL	QO	SURF	MPC		0.013		diss.		76
Malathion	121-75-5	NL	QO	SURF	MPC		0.013		total	Value standardized to a suspended matter content of 30 mg/l.	76
Malathion	121-75-5	NL	QO	SURF	TV		0.0001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Malathion	121-75-5	Rhein	QO	RIVER	ZV		0.02		total, 90th perc.	AQL	45
Malathion	121-75-5	USA	QC	AQL-FRESH	CCC		0.1			Derivation see Red Book (EPA 440/9-76-0239)	77
Malathion	121-75-5	USA	QC	AQL-MARIN	CCC		0.1			Derivation see Red Book (EPA 440/9-76-0239)	77
Maneb	12427-38-2	NL	QO	SURF	MPC				total	See ETU (degradation product)	76
Manganese	7439-96-5	CAN	QC	AGRIC-IRRI	GL		200		total, max. value	All soils with permanent irrigation	75, 1
Manganese	7439-96-5	CAN	QC	DRINK	AO	<=	50		total, max. value		75, 69
Manganese	7439-96-5	DEU	QS	DRINK	GW		50				78
Manganese	7439-96-5	DEU-NRW	QS	AGRIC-IRRI	GL		2000				38
Manganese	7439-96-5	DEU-NRW	QS	DRINK-SURF	G, A2		100			According to EC Directive 75/440/EEC	38
Manganese	7439-96-5	DEU-NRW	QS	DRINK-SURF	G, A2		100			According to EC Directive 75/440/EEC	38
Manganese	7439-96-5	USA	QC	DRINK-FISH	WQC		50				77
Manganese	7439-96-5	USA	QC	FISH-CONSM	WQC		100				77
Manganese-54	7439-96-5	CAN	QC	DRINK	MAC		200	Bq/l	total, max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
MCPA	94-74-6	CAN	QC	AGRIC-IRRI	GL		0.16		total, max. value	Cereal farming and pasture management	68
MCPA	94-74-6	CAN	QC	AGRIC-IRRI	GL		0.025		total, max. value	Miscellaneous farming	75, 68
MCPA	94-74-6	CAN	QC	AGRIC-LIVE	GL (I)		25		total, max. value		75, 68
MCPA	94-74-6	CAN	QC	AQL-FRESH	GL (I)		2.6		total, max. value		75, 68
MCPA	94-74-6	CAN	QC	AQL-MARIN	GL (I)		4.2		total, max. value		75, 68
MCPA	94-74-6	DEU	QC	AQL-FRESH	ZV (v)		2		total, 90th perc.	All MCPA variants	73

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
MCPA	94-74-6	NL	QO	SURF	MPC		2		diss.		76
MCPA	94-74-6	NL	QO	SURF	MPC		2		total	Value standardized to a suspended matter content of 30 mg/l.	76
MCPA	94-74-6	NL	QO	SURF	TV		0.02		total	Value standardized to a suspended matter content of 30 mg/l.	76
Mecoprop	7085-19-0	NL	QO	SURF	MPC		4		diss.		76
Mecoprop	7085-19-0	NL	QO	SURF	MPC		4		total	Value standardized to a suspended matter content of 30 mg/l.	76
Mecoprop	7085-19-0	NL	QO	SURF	TV		0.04		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Mecoprop-P	16484-77-8	DEU	QC	AQL-FRESH	ZV (v)		50		total, 90th perc.	All Mecoprop variants	73
Mecoprop-P	16484-77-8	Rhein	QO	RIVER	ZV		0.1		total, 90th perc.	DRINK-SURF	74
Mercury	7439-97-6	CAN	QC	AGRIC-LIVE	GL		3		total, max. value		75, 1
Mercury	7439-97-6	CAN	QC	AQL-FRESH	GL		0.1		total, max. value		75, 1
Mercury	7439-97-6	CAN	QC	DRINK	MAC		1		total, max. value		75, 69
Mercury	7439-97-6	CHE	QS, E.	AQL	QZ		0.01		diss. total, (org. + inorg.)		26
Mercury	7439-97-6	CHE	QS	AQL	QZ		1		diss. total		26
Mercury	7439-97-6	DEU	QC	AGRIC-IRRI	ZV		1		total, 90th perc.		46
Mercury	7439-97-6	DEU	QC	AQL-FRESH	ZV		0.04		total, 90th perc.	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Mercury	7439-97-6	DEU	QS	DRINK	GW		1				78
Mercury	7439-97-6	DEU	QC	DRINK-SURF	ZV		0.5		total, 90th perc.		46
Mercury	7439-97-6	DEU	QC	FISH-CONSM	ZV		0.1		total, 90th perc.		46
Mercury	7439-97-6	DEU	QC	RIVER	BACKG		0.01		total	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Mercury	7439-97-6	DEU-NRW	QS	AGRIC-IRRI	GL		4				38
Mercury	7439-97-6	DEU-NRW	QS	DRINK-SURF	G, A1		0.5			According to EC Directive 75/440/EEC	38
Mercury	7439-97-6	DEU-NRW	QS	DRINK-SURF	G, A2		0.5			According to EC Directive 75/440/EEC	38
Mercury	7439-97-6	DEU-NRW	QS	DRINK-SURF	I, A2		1			According to EC Directive 75/440/EEC	38
Mercury	7439-97-6	DEU-NRW	QS	DRINK-SURF	I, A2		1			According to EC Directive 75/440/EEC	38
Mercury	7439-97-6	DEU-NRW	QS	SURF	AGA	<=	0.5		total, 90th perc.		38
Mercury	7439-97-6	EEC	QS	ESTUA	QZ		0.5		diss., ann. mean		40
Mercury	7439-97-6	EEC	QS	ESTUA	QZ		0.5		diss., ann. mean		40
Mercury	7439-97-6	EEC	QS	MARIN	QZ		0.3		diss., ann. mean		40
Mercury	7439-97-6	EEC	QS	MARIN	QZ		0.3		diss., ann. mean		40
Mercury	7439-97-6	EEC	QS	SURF	QZ		1		total, ann. mean		40
Mercury	7439-97-6	GBR	QS	MARIN	EQS		0.3	0.5	diss.	Standard for seawaters and estuaries adopted from EC Directive 84/156/EEC.	28
Mercury	7439-97-6	JPN	QS	AMBI	EQS		0.5			Health aspects	37
Mercury	7439-97-6	NL	QO	SURF	BACKG		0.01		diss.		76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Mercury	7439-97-6	NL	QO	SURF	BACKG	0.06		total	Value standardized to a suspended matter content of 30 mg/l.	76
Mercury	7439-97-6	NL	QO	SURF	MPC	0.2		diss.		76
Mercury	7439-97-6	NL	QO	SURF	MPC	1.2		total	Value standardized to a suspended matter content of 30 mg/l.	76
Mercury	7439-97-6	NL	QO	SURF	TV	0.01		diss.		76
Mercury	7439-97-6	NL	QO	SURF	TV	0.07		total	Value standardized to a suspended matter content of 30 mg/l.	76
Mercury	7439-97-6	Nordsee	QC	MARIN	EAC	0.005	0.05	diss.		27
Mercury	7439-97-6	SWE	QC	SURF-CLASS	Class 2	0.003	0.006		Class 2 = good	56
Mercury	7439-97-6	USA	QC	AQL-FRESH	CCC	0.012			Value based on the derivation of a Final Residue Value. Method no longer used for new or revised QC.	23
Mercury	7439-97-6	USA	QC	AQL-FRESH	CCC	0.77			Dissolved concentration. Derivation published in document EPA-820-B-96-001. Derivation based on inorganic mercury data. Criterion probably insufficient for methyl mercury.	77
Mercury	7439-97-6	USA	QC	AQL-FRESH	CMC	1.4			Dissolved concentration. Derivation published in document EPA-820-B-96-001. Derivation based on inorganic mercury data. Criterion probably insufficient for methyl mercury.	77
Mercury	7439-97-6	USA	QC	AQL-MARIN	CCC	0.025			Value based on the derivation of a Final Residue Value. Method no longer used for new or revised QC.	23
Mercury	7439-97-6	USA	QC	AQL-MARIN	CCC	0.94			Dissolved concentration. Derivation based on inorganic mercury data. Criterion probably insufficient for methyl mercury.	77
Mercury	7439-97-6	USA	QC	AQL-MARIN	CMC	1.8			Dissolved concentration. Derivation based on inorganic mercury data. Criterion probably insufficient for methyl mercury.	77
Mercury	7439-97-6	USA	QC	DRINK	MCL	2				23
Mercury	7439-97-6	USA	QC	DRINK-FISH	WQC	0.05			IRIS database, updated 08/04/1998	77
Mercury	7439-97-6	USA	QC	FISH-CONSM	WQC	0.051			IRIS database, updated 08/04/1998	77
Mercury	7439-97-6	USA-GL	QC	AQL-FRESH	CCC	0.44		total		52
Mercury including methyl mercury	7439-97-6	USA-GL	QC	WILD	WC	0.0013				51
Mercury including methyl mercury	7439-97-6	USA-GL	QC	WILD-BIRD	WV	0.0013				51
Mercury including methyl mercury	7439-97-6	USA-GL	QC	WILD-MAMM	WV	0.0024				51
Mercury, alkyl mercury		JPN	QS	AMBI	EQS				Health aspects. Alkyl mercury should not be detectable for reasons of human health.	37

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Mercury, methyl		NL	QO	SURF	BACKG	0.01	diss.		76
Mercury, methyl		NL	QO	SURF	BACKG	0.06	total	Value standardized to a suspended matter content of 30 mg/l.	76
Mercury, methyl		NL	QO	SURF	MPC	0.02	diss.		76
Mercury, methyl		NL	QO	SURF	MPC	0.1	total	Value standardized to a suspended matter content of 30 mg/l.	76
Mercury, methyl		NL	QO	SURF	TV	0.01	diss.		76
Mercury, methyl		NL	QO	SURF	TV	0.06	total	Value standardized to a suspended matter content of 30 mg/l.	76
Metam-sodium	137-42-8	NL	QO	SURF	MPC	0.035	diss.	Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Metam-sodium	137-42-8	NL	QO	SURF	MPC	0.035	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Metam-sodium	137-42-8	NL	QO	SURF	TV	0.0004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Metamitron	41394-05-2	NL	QO	SURF	MPC	10	diss.		76
Metamitron	41394-05-2	NL	QO	SURF	MPC	10	total	Value standardized to a suspended matter content of 30 mg/l.	76
Metamitron	41394-05-2	NL	QO	SURF	TV	0.1	total	Value standardized to a suspended matter content of 30 mg/l.	76
Metamitron	41394-05-2	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	80
Metazachlor	67129-08-2	DEU	QC	AQL-FRESH	ZV (v)	0.4	total, 90th perc.		73
Metazachlor	67129-08-2	NL	QO	SURF	MPC	34	diss.		76
Metazachlor	67129-08-2	NL	QO	SURF	MPC	34	total	Value standardized to a suspended matter content of 30 mg/l.	76
Metazachlor	67129-08-2	NL	QO	SURF	TV	0.34	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Metazachlor	67129-08-2	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	80
Methabenzthiazuron	18691-97-9	DEU	QC	AQL-FRESH	ZV (v)	2	total, 90th perc.		73
Methabenzthiazuron	18691-97-9	NL	QO	SURF	MPC	1.8	diss.		76
Methabenzthiazuron	18691-97-9	NL	QO	SURF	MPC	1.8	total	Value standardized to a suspended matter content of 30 mg/l.	76
Methabenzthiazuron	18691-97-9	NL	QO	SURF	TV	0.018	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Methomyl	16752-77-5	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.	Insufficient data	81
Methomyl	16752-77-5	NL	QO	SURF	MPC	0.08	diss.		76
Methomyl	16752-77-5	NL	QO	SURF	MPC	0.08	total	Value standardized to a suspended matter content of 30 mg/l.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Methomyl	16752-77-5	NL	QO	SURF	TV	0.0008	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Methoxychlor	72-43-5	CAN	QC	DRINK	MAC	900	total, max. value		75, 69
Methoxychlor	72-43-5	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.	Insufficient data	81
Methoxychlor	72-43-5	USA	QC	AQL-FRESH	CCC	0.03		Derivation see Red Book (EPA 440/9-76-0239)	77
Methoxychlor	72-43-5	USA	QC	AQL-FRESH	CMC				77
Methoxychlor	72-43-5	USA	QC	AQL-MARIN	CCC	0.03		Derivation see Red Book (EPA 440/9-76-0239)	77
Methoxychlor	72-43-5	USA	QC	AQL-MARIN	CMC				77
Methoxychlor	72-43-5	USA	QC	DRINK	MCL	100			23
Methoxychlor	72-43-5	USA	QC	DRINK-FISH	WQC	100		A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Methyl-4-chlorophenol, 2-		USA	QC	Taste	WQC	1800			77
Methyl-4-chlorophenol, 3-	59-50-7	USA	QC	Taste	WQC	3000			77
Methyl-4-chlorophenol, 3-		USA	QC	Taste	WQC	20			77
Methyl bromide	74-83-9	USA	QC	DRINK-FISH	WQC	48		Derivation based on: IRIS database, updated 08/04/1998	77
Methyl bromide	74-83-9	USA	QC	FISH-CONSM	WQC	4000		Derivation based on: IRIS database, updated 08/04/1998	77
Metobromuron	3060-89-7	NL	QO	SURF	MPC	10	diss.		76
Metobromuron	3060-89-7	NL	QO	SURF	MPC	10	total	Value standardized to a suspended matter content of 30 mg/l.	76
Metobromuron	3060-89-7	NL	QO	SURF	TV	0.1	total	Value standardized to a suspended matter content of 30 mg/l.	76
Metolachlor	51218-45-2	CAN	QC	AGRIC-IRRI	GL (I)	28	total, max. value		75, 5
Metolachlor	51218-45-2	CAN	QC	AGRIC-LIVE	GL (I)	50	total, max. value	The value is based on the preliminry maximum value (IMAC) for raw water used for drinking water abstraction.	75, 5
Metolachlor	51218-45-2	CAN	QC	AQL-FRESH	GL (I)	7.8	total, max. value		75, 5
Metolachlor	51218-45-2	CAN	QC	DRINK	IMAC	50	total, max. value		75, 69
Metolachlor	51218-45-2	DEU	QC	AQL-FRESH	ZV (v)	0.4	total, 90th perc.		73
Metolachlor	51218-45-2	NL	QO	SURF	MPC	0.2	diss.		76
Metolachlor	51218-45-2	NL	QO	SURF	MPC	0.2	total	Value standardized to a suspended matter content of 30 mg/l.	76
Metolachlor	51218-45-2	NL	QO	SURF	TV	0.002	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Metolachlor	51218-45-2	Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	80
Metribuzin	21087-64-9	CAN	QC	AGRIC-IRRI	GL (I)	0.5	total, max. value		75, 3
Metribuzin	21087-64-9	CAN	QC	AGRIC-LIVE	GL	80	total, max. value		75, 3

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Metribuzin	21087-64-9	CAN	QC	AQL-FRESH	GL	1		total, max. value		75, 3
Metribuzin	21087-64-9	CAN	QC	DRINK	MAC	80		total, max. value		75, 69
Mevinphos	26718-65-0	NL	QO	SURF	MPC	0.002		diss.	Value is below detection/determination limit.	76
Mevinphos	26718-65-0	NL	QO	SURF	MPC	0.002		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Mevinphos	26718-65-0	NL	QO	SURF	TV	0.00002		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Mevinphos	7786-34-7	Rhein	QO	RIVER	ZV	0.0002		total, 90th perc.	AQL	80
Mirex	2385-85-5	USA	QC	AQL-FRESH	CCC	0.001			Derivation see Red Book (EPA 440/9-76-0239)	77
Mirex	2385-85-5	USA	QC	AQL-MARIN	CCC	0.001			Derivation see Red Book (EPA 440/9-76-0239)	77
Molybdenum	7439-98-7	CAN	QC	AGRIC-IRRI	GL	10		total, max. value	All soils with permanent irrigation	75, 1
Molybdenum	7439-98-7	CAN	QC	AGRIC-LIVE	GL	500		total, max. value		75, 1
Molybdenum	7439-98-7	CAN	QC	AQL-FRESH	GL (I)	73		total, max. value		75
Molybdenum	7439-98-7	DEU-NRW	QS	AGRIC-IRRI	GL	5				38
Molybdenum	7439-98-7	GBR	QS, E.	AGRIC-IRRI	PWQS	30		ann. mean		24
Molybdenum	7439-98-7	NL	QO	SURF	BACKG	1.4		diss.		76
Molybdenum	7439-98-7	NL	QO	SURF	BACKG	1.4		total	Value standardized to a suspended matter content of 30 mg/l.	76
Molybdenum	7439-98-7	NL	QO	SURF	MPC	290		diss.		76
Molybdenum	7439-98-7	NL	QO	SURF	MPC	300		total	Value standardized to a suspended matter content of 30 mg/l.	76
Molybdenum	7439-98-7	NL	QO	SURF	TV	4.3		diss.		76
Molybdenum	7439-98-7	NL	QO	SURF	TV	4.4		total	Value standardized to a suspended matter content of 30 mg/l.	76
Molybdenum-99		CAN	QC	DRINK	MAC	70	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Monochlorophenols (single)									See: Chlorophenols	
Monochlorotoluenes (single)		NL	QO	SURF	MPC	310		diss.	Value is below detection/determination limit.	76
Monochlorotoluenes (single)		NL	QO	SURF	MPC	310		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Monochlorotoluenes (single)		NL	QO	SURF	TV	3		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Naphthalene	91-20-3	CAN	QC	AQL-FRESH	GL (I)	1.1		total, max. value		75
Naphthalene	91-20-3	NL	QO	SURF	MPC	1.2		total		76
Naphthalene	91-20-3	NL	QO	SURF	TV	0.01		total		76
Naphthalene	91-20-3	NL	QO	SURF	MPC	1.2		diss.		76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Naphthalene	91-20-3	Nordsee	QC	MARIN	EAC		5	50	diss.	Preliminary values	27
Naphthalene	91-20-3	USA	QC	AQL-FRESH	CCC		620			Not enough data available; lowest LOEL	23
Nickel	7440-02-0	CAN	QC	AGRIC-IRRI	GL		200		total, max. value	Hardness >180 mg/l CaCO3	75, 1
Nickel	7440-02-0	CAN	QC	AGRIC-LIVE	GL		200		total, max. value	Hardness >180 mg/l CaCO3	75, 1
Nickel	7440-02-0	CAN	QC	AQL-FRESH	GL		150		total, max. value	Hardness >180 mg/l CaCO3	75, 1
Nickel	7440-02-0	CAN	QC	AQL-FRESH	GL		65		total, max. value	Hardness 0-120 mg/l CaCO3	75, 1
Nickel	7440-02-0	CAN	QC	AQL-FRESH	GL		25		total, max. value	Hardness 0-60 mg/l CaCO3	75, 1
Nickel	7440-02-0	CAN	QC	AQL-FRESH	GL		110		total, max. value	Hardness 120-180 mg/l CaCO3	75, 1
Nickel	7440-02-0	CHE	QS, E.	AQL	QZ		5		diss. total		26
Nickel	7440-02-0	CHE	QS	AQL	QZ		50		diss. total		26
Nickel	7440-02-0	DEU	QC	AGRIC-IRRI	ZV		50		total, 90th perc.		46
Nickel	7440-02-0	DEU	QC	AQL-FRESH	ZV		4.4		total, 90th perc.	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Nickel	7440-02-0	DEU	QS	DRINK	GW		50				78
Nickel	7440-02-0	DEU	QC	DRINK-SURF	ZV		50		total, 90th perc.		46
Nickel	7440-02-0	DEU	QC	RIVER	BACKG		1.1		total	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Nickel	7440-02-0	DEU-NRW	QS	AGRIC-IRRI	GL		100				38
Nickel	7440-02-0	DEU-NRW	QS	SURF	AGA	<=	30		total, 90th perc.		38
Nickel	7440-02-0	GBR	QS, E.	AGRIC-IRRI	PWQS		150		ann. mean		24
Nickel	7440-02-0	GBR	QS, E.	AGRIC-LIVE	PWQS		1000		ann. mean		24
Nickel	7440-02-0	GBR	QS	AQL-FRESH	EQS		8	40	diss., ann. mean	Depends on water hardness	63
Nickel	7440-02-0	GBR	QS	AQL-MARIN	EQS		15		diss., ann. mean	Sensitive algae and invertebrates may suffer from adverse effects in waters with a low salt content when this standard is applied.	28, 63
Nickel	7440-02-0	NL	QO	SURF	BACKG		3.3		diss.		76
Nickel	7440-02-0	NL	QO	SURF	BACKG		4.1		total	Value standardized to a suspended matter content of 30 mg/l.	76
Nickel	7440-02-0	NL	QO	SURF	MPC		5.1		diss.		76
Nickel	7440-02-0	NL	QO	SURF	MPC		6.3		total	Value standardized to a suspended matter content of 30 mg/l.	76
Nickel	7440-02-0	NL	QO	SURF	TV		3.3		diss.		76
Nickel	7440-02-0	NL	QO	SURF	TV		4.1		total	Value standardized to a suspended matter content of 30 mg/l.	76
Nickel	7440-02-0	Nordsee	QC	MARIN	EAC		0.1	1	diss.		27
Nickel	7440-02-0	SWE	QC	SURF-CLASS	Class 2		1	5		Class 2 = good	56
Nickel	7440-02-0	USA	QC	AQL-FRESH	CCC		52			Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Nickel	7440-02-0	USA	QC	AQL-FRESH	CMC		470			Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77
Nickel	7440-02-0	USA	QC	AQL-MARIN	CCC		8.2			Dissolved concentration	77
Nickel	7440-02-0	USA	QC	AQL-MARIN	CMC		74			Dissolved concentration	77
Nickel	7440-02-0	USA	QC	DRINK-FISH	WQC		610			Derivation based on: IRIS database, updated 08/04/1998	77
Nickel	7440-02-0	USA	QC	FISH-CONSM	WQC		4600			Derivation based on: IRIS database, updated 08/04/1998	77
Nickel	7440-02-0	USA-GL	QC	AQL-FRESH	CCC		29		total	If water hardness is 50 mg/l	52
Niobium-95	7440-03-1	CAN	QC	DRINK	MAC		200	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Nitrate	14797-55-8	CAN	QC	AQL-FRESH	GL					Growth of aquatic macrophytes not supported	75, 1
Nitrate	14797-55-8	CAN	QC	DRINK	MAC		45000		NO3, total, max. value	Value corresponds to 10 mg/l NO3-N. If nitrate and nitrite are measured separately, nitrite should not exceed a value of 3.2 mg/l.	75, 69
Nitrate	14797-55-8	DEU	QS	DRINK	GW		50000		as NO3		78
Nitrate	14797-55-8	DEU-NRW	QS	DRINK-SURF	G, A1		5750		NO3-N	According to EC Directive 75/440/EEC	38
Nitrate	14797-55-8	DEU-NRW	QS	DRINK-SURF	I, A1		11500		NO3-N	According to EC Directive 75/440/EEC	38
Nitrate	14797-55-8	DEU-NRW	QS	DRINK-SURF	I, A2		11500		NO3-N	According to EC Directive 75/440/EEC	38
Nitrate	14797-55-8	DEU-NRW	QS	SURF	AGA	<=	8000		NO3-N, 90th perc.		38
Nitrate	14797-55-8	USA	QC	DRINK	MCL		10000				23
Nitrate	14797-55-8	USA	QC	DRINK-FISH	WQC		10000				77
Nitrate + Nitrite		CAN	QC	AGRIC-LIVE	GL		100000		total, max. value		75, 1
Nitrite		CAN	QC	AGRIC-LIVE	GL		10000		total, max. value		75, 1
Nitrite		CAN	QC	AQL-FRESH	GL		60		total, max. value		75, 1
Nitrite		CAN	QC	DRINK	MAC		3200		total, max. value		75, 1
Nitrite		DEU	QS	DRINK	GW		100		as NO2		78
Nitrite		DEU-NRW	QS	FISH	I, Cyp.	<	9		NO2-N, 95th perc.	According to EC Directive 78/659/EEC	38
Nitrite		DEU-NRW	QS	FISH	I, Salmo.	<	3		NO2-N, 95th perc.	According to EC Directive 78/659/EEC	38
Nitrobenzene	98-95-3	DEU	QC	AQL-FRESH	ZV		0.1		total, 90th perc.		15
Nitrobenzene	98-95-3	DEU	QC	DRINK-SURF	ZV		10		total, 90th perc.		15
Nitrobenzene	98-95-3	USA	QC	DRINK-FISH	WQC		17			Derivation based on: IRIS database, updated 08/04/1998	77
Nitrobenzene	98-95-3	USA	QC	FISH-CONSM	WQC		1900			Derivation based on: IRIS database, updated 08/04/1998 No WQC value is stated in the 1980 and 1986 criterion documents. Nonetheless the data contained in the documents allow a WQC to be calculated.	77
Nitrobenzene	98-95-3	USA	QC	Taste	WQC		30				77
Nitrogen (N), total		NL	QO	SURF	MPC		2200		total	Average summer value for stagnant waters sensitive to eutrophication	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Nitrogen (N), total		NL	QO	SURF	TV	1000	total	Average summer value for stagnant waters sensitive to eutrophication	76
Nitrophenols		USA	QC	AQL-FRESH	CCC	150		Not enough data available; lowest LOEL	23
Nitrosamin		USA	QC	FISH-CONSM	WQC	1.1			77
Nitrosamine		USA	QC	DRINK-FISH	WQC	0.0008			77
Nitrosodi-N-propylamine, N-	621-64-7	USA	QC	DRINK-FISH	WQC	0.005		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Nitrosodi-N-propylamine, N-	621-64-7	USA	QC	FISH-CONSM	WQC	1.4		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Nitrosodibutylamine, N-	924-16-3	USA	QC	DRINK-FISH	WQC	0.0064		Carcinogenic risk (risk level 10-6)	23
Nitrosodibutylamine, N-	924-16-3	USA	QC	DRINK-FISH	WQC	0.0064			77
Nitrosodibutylamine, N-	924-16-3	USA	QC	FISH-CONSM	WQC	0.587			77
Nitrosodiethylamine, N-	55-18-5	USA	QC	DRINK-FISH	WQC	0.0008		Carcinogenic risk (risk level 10-6)	23
Nitrosodiethylamine, N-	55-18-5	USA	QC	DRINK-FISH	WQC	0.0008			77
Nitrosodiethylamine, N-	55-18-5	USA	QC	FISH-CONSM	WQC	1.1		Carcinogenic risk (risk level 10-6)	23
Nitrosodiethylamine, N-	55-18-5	USA	QC	FISH-CONSM	WQC	1.1			77
Nitrosodimethylamine, N-	62-75-9	USA	QC	DRINK-FISH	WQC	0.0014		Carcinogenic risk (risk level 10-6)	23
Nitrosodimethylamine, N-	62-75-9	USA	QC	FISH-CONSM	WQC	16		Carcinogenic risk (risk level 10-6)	23
Nitrosodimethylamine, N-	62-75-9	USA	QC	DRINK-FISH	WQC	0.00069		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Nitrosodimethylamine, N-	62-75-9	USA	QC	FISH-CONSM	WQC	8.1		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Nitrosodiphenylamine, N-		USA	QC	FISH-CONSM	WQC	16.1		Carcinogenic risk (risk level 10-6)	23
Nitrosodiphenylamine, N-	86-30-6	USA	QC	DRINK-FISH	WQC	5		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Nitrosodiphenylamine, N-	86-30-6	USA	QC	FISH-CONSM	WQC	16		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Nitrosopyrrolidine, N-	930-55-2	USA	QC	DRINK-FISH	WQC	0.016			77
Nitrosopyrrolidine, N-	930-55-2	USA	QC	FISH-CONSM	WQC	91.9		Carcinogenic risk (risk level 10-6)	23
Nitrosopyrrolidine, N-	930-55-2	USA	QC	FISH-CONSM	WQC	91.9			77
Nitrotoluene, 2-	88-72-2	DEU	QC	AQL-FRESH	ZV	50	total, 90th perc.		15
Nitrotoluene, 2-	88-72-2	DEU	QC	DRINK-SURF	ZV	10	total, 90th perc.		15
Nitrotoluene, 3-	99-08-1	DEU	QC	AQL-FRESH	ZV	50	total, 90th perc.		15
Nitrotoluene, 3-	99-08-1	DEU	QC	DRINK-SURF	ZV	10	total, 90th perc.		15
Nitrotoluene, 4-	99-99-0	DEU	QC	AQL-FRESH	ZV	70	total, 90th perc.		15
Nitrotoluene, 4-	99-99-0	DEU	QC	DRINK-SURF	ZV	10	total, 90th perc.		15
Nonyl phenol (isomers)	25154-52-3	DEU	QC	AQL-FRESH	ZV (E)	0.3	total, 90th perc.		81
Nonyl phenol, 4-	84852-15-3	DEU	QC	AQL-FRESH	ZV (E)		total, 90th perc.		81
NTA	139-13-9	CAN	QC	DRINK	MAC	400	total, max. value		75, 69
NTA	139-13-9	NL	QO	SURF	MPC	200	total	Value standardized to a suspended matter content of 30 mg/l.	76
Oil and fats		USA	QC	AQL-FRESH	CCC			Verbal description. See NTIS PB-263943	23

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Oil and fats		USA	QC	AQL-MARIN						Verbal description. See NTIS PB-263943	23
Olfactory threshold value		DEU	QS	DRINK	GW		2	degree of dilution		At 12 degrees Celsius	78
Olfactory threshold value		DEU	QS	DRINK	GW		3	degree of dilution		At 25 degrees Celsius	78
Omethoate	1113-02-6	DEU	QC	AQL-FRESH	ZV (E)		0.004		total, 90th perc.		81
Organochlorine compounds (single), unless accounted for in the EC Drinking Water Directive 98/83/EEC		DEU	QO	DRINK-SURF	ZV		1				79
Organochlorine compounds, total: 1,1,1-Trichloroethane, Trichloroethane, Tetrachloroethene, Dichloromethane		DEU	QS	DRINK	GW		10				78
Oxamyl	23135-22-0	NL	QO	SURF	MPC		1.8		diss.		76
Oxamyl	23135-22-0	NL	QO	SURF	MPC		1.8		total	Value standardized to a suspended matter content of 30 mg/l.	76
Oxamyl	23135-22-0	NL	QO	SURF	TV		0.018		total	Value standardized to a suspended matter content of 30 mg/l.	76
Oxidizability		DEU	QS	DRINK	GW		5000		as O2	Potassium permanganate consumption	78
Oxydemeton-methyl	301-12-2	NL	QO	SURF	MPC		0.035		diss.	Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Oxydemeton-methyl	301-12-2	NL	QO	SURF	MPC		0.035		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Oxydemeton-methyl	301-12-2	NL	QO	SURF	TV		0.0004		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Oxygen, dissolved	7782-44-7	CAN	QC	AQL-FRESH	GL		5.5	9.5 mg/l		Cold water organisms: Early life stages 9.5 mg/l, others 6.5 mg/l; aquatic organisms: Early life stages 6.0 mg/l, others 5.5 mg/l	75
Oxygen, dissolved	7782-44-7	CAN	QC	AQL-MARIN	GL (I)	>	8	mg/l		Oxygen contents below recommended value should only be caused by natural processes.	75, 72
Oxygen, dissolved	7782-44-7	DEU-NRW	QS	FISH	G, Cyp.	>	8	mg/l	50th perc.	According to EC Directive 78/659/EEC	38
Oxygen, dissolved	7782-44-7	DEU-NRW	QS	FISH	G, Cyp.	>	5	mg/l	100th perc.	According to EC Directive 78/659/EEC	38
Oxygen, dissolved	7782-44-7	DEU-NRW	QS	FISH	G, Salmo.	>	7	mg/l	100th perc.	According to EC Directive 78/659/EEC	38

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range			Reference	Notes	Lit. No.
Oxygen, dissolved	7782-44-7	DEU-NRW	QS	FISH	I, Cyp.	>	7		mg/l	50th perc.	According to EC Directive 78/659/EEC	38
Oxygen, dissolved	7782-44-7	DEU-NRW	QS	FISH	I, Salmo.	>	9		mg/l	50th perc.	According to EC Directive 78/659/EEC	38
Oxygen, dissolved	7782-44-7	DEU-NRW	QS	FISH	G, Salmo.	>	9		mg/l	50th perc.	According to EC Directive 78/659/EEC	38
Oxygen, dissolved	7782-44-7	DEU-NRW	QS	SURF	AGA	>=	6		mg/l	90th perc.		38
Oxygen, dissolved	7782-44-7	GBR	QS, E.	AGRIC-LIVE	PWQS		3		mg/l			24
Oxygen, dissolved	7782-44-7	GBR	QS, E.	FISH	PWQS	>	5		mg/l		Salmonid fishing	24
Oxygen, dissolved	7782-44-7	USA	QC	AQL-FRESH	CCC						Verbal description. See NTIS: PB 86-208253	23
Oxygen, dissolved	7782-44-7	USA	QC	AQL-MARIN	CCC						See NTIS: PB 86-208253	23
Oxygen, saturated	7782-44-7	DEU-NRW	QS	DRINK-SURF	G, A1	>	50		%		According to EC Directive 75/440/EEC	38
Oxygen, saturated	7782-44-7	DEU-NRW	QS	DRINK-SURF	G, A2	>	70		%		According to EC Directive 75/440/EEC	38
Oxygen, saturated	7782-44-7	DEU-NRW	QS	REC	G		80	120	%		According to EC Directive 76/160/EEC	38
Paraquat	4685-14-7	CAN	QC	DRINK	IMAC		10			total, max. value	As praquat dichloride	75, 69
Parathion-ethyl	56-38-2	CAN	QC	DRINK	MAC		50			total, max. value		75, 69
Parathion-ethyl	56-38-2	DEU	QC	AQL-FRESH	ZV (v)		0.005			total, 90th perc.		73
Parathion-ethyl	56-38-2	NL	QO	SURF	MPC		0.002			diss.	Value is below detection/determination limit.	76
Parathion-ethyl	56-38-2	NL	QO	SURF	MPC		0.002			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Parathion-ethyl	56-38-2	NL	QO	SURF	TV		0.00002			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Parathion-ethyl	56-38-2	Rhein	QO	RIVER	ZV		0.0002			total, 90th perc.	AQL	45
Parathion-ethyl	56-38-2	USA	QC	AQL-FRESH	CCC		0.013					77
Parathion-ethyl	56-38-2	USA	QC	AQL-FRESH	CMC		0.065					77
Parathion-ethyl	56-38-2	USA-GL	QC	AQL-FRESH	CCC		0.013					52
Parathion-methyl	298-00-0	DEU	QC	AQL-FRESH	ZV (v)		0.02			total, 90th perc.		73
Parathion-methyl	298-00-0	NL	QO	SURF	MPC		0.011			diss.		76
Parathion-methyl	298-00-0	NL	QO	SURF	MPC		0.011			total	Value standardized to a suspended matter content of 30 mg/l.	76
Parathion-methyl	298-00-0	NL	QO	SURF	TV		0.0001			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Parathion-methyl	298-00-0	Rhein	QO	RIVER	ZV		0.01			total, 90th perc.	AQL	45
Pathogenic germs and parasites		CAN	QC	AGRIC-LIVE	GL						Only high quality water should be used in intensive animal farming. Water quality should be monitored in outdoor animal keeping. Chlorination required in certain cases.	1
PCB	1336-36-3	JPN	QS	AMBI	EQS						Health aspects. PCB should not be detectable for reasons of human health.	37
PCB		USA	QC	AQL-FRESH	CCC		0.014				Refers to technical PCB mixtures. Value based on the derivation of a Final Residue Value.	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
PCB		USA	QC	AQL-MARIN	CCC	0.03			Refers to technical PCB mixtures. Value based on the derivation of a Final Residue Value.	77
PCB		USA	QC	DRINK-FISH	WQC	0.00017			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6). Refers to the sum of single PCB congeners and isomers.	77
PCB		USA	QC	FISH-CONSM	WQC	0.00017			Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6). Refers to the sum of single PCB congeners and isomers.	77
PCB	1336-36-3	USA-GL	QC	WILD	WC	74	pg/l		Sum of PCB congeners	51
PCB	1336-36-3	USA-GL	QC	WILD-BIRD	WV	230	pg/l		Sum of PCB congeners	51
PCB	1336-36-3	USA-GL	QC	WILD-MAMM	WV	74	pg/l		Sum of PCB congeners	51
PCB no. 118	31508-00-6	Rhein	QO	RIVER	ZV	100	pg/l	total, 90th perc.	Fish consumption	74
PCB no. 28, 52, 101,138, 153, 180 (single)		Rhein	QO	RIVER	ZV	100	pg/l	total, 90th perc.	Fish consumption	45
PCSDs	60787-09-9	GBR	QS, E.	AGRIC-IRRI	PEQS	0.05		total, active ingredient, 95th perc.		33
PCSDs	60787-09-9	GBR	QS, E.	AQL-FRESH	PEQS	0.05		total, active ingredient, 95th perc.		33
PCSDs	60787-09-9	GBR	QS	FRESH	EQS	0.05		total, 95th perc.		63
PCSDs	60787-09-9	GBR	QS	MARIN	EQS	0.05		total, 95th perc.		63
Pentachlorobenzene	608-93-5	CAN	QC	AQL-FRESH	GL (I)	6		total, max. value		75
Pentachlorobenzene	608-93-5	NL	QO	SURF	MPC	0.3		diss.		76
Pentachlorobenzene	608-93-5	NL	QO	SURF	MPC	0.3		total	Value standardized to a suspended matter content of 30 mg/l.	76
Pentachlorobenzene	608-93-5	NL	QO	SURF	TV	0.003		total	Value standardized to a suspended matter content of 30 mg/l.	76
Pentachlorobenzene	608-93-5	USA	QC	DRINK-FISH	WQC	3.5				77
Pentachlorobenzene	608-93-5	USA	QC	FISH-CONSM	WQC	4.1				77
Pentachloroethane	76-01-7	NL	QO	SURF	MPC	230		diss.	Value is below detection/determination limit.	76
Pentachloroethane	76-01-7	NL	QO	SURF	MPC	230		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Pentachloroethane	76-01-7	NL	QO	SURF	TV	2		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Pentachloroethane	76-01-7	USA	QC	AQL-FRESH	CCC	1100			Not enough data available; lowest LOEL	23
Pentachloroethane	76-01-7	USA	QC	AQL-MARIN	CCC	281			Not enough data available; lowest LOEL	23
Pentachloronitrobenzene	82-68-8	NL	QO	SURF	MPC	0.4		total		25

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Pentachlorophenol	87-86-5	CAN	QC	AQL-FRESH	GL		0.5	total, max. value		75, 1
Pentachlorophenol	87-86-5	CAN	QC	DRINK	MAC		60	total, max. value		75, 69
Pentachlorophenol	87-86-5	CAN	QC	DRINK	AO	<=	30	total, max. value	A target value of <30 µg/l is envisaged in order to avoid adverse effects on taste.	75, 69
Pentachlorophenol	87-86-5	EEC	QS	AMBI	QZ		2	ann. mean		39
Pentachlorophenol	87-86-5	NL	QO	SURF	MPC		4	diss.		76
Pentachlorophenol	87-86-5	NL	QO	SURF	MPC		4	total	Value standardized to a suspended matter content of 30 mg/l.	76
Pentachlorophenol	87-86-5	NL	QO	SURF	TV		0.04	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Pentachlorophenol	87-86-5	Rhein	QO	RIVER	ZV		0.1	total, 90th perc.	DRINK-SURF	45
Pentachlorophenol	87-86-5	USA	QC	AQL-FRESH	CCC		15		Value depends on pH value (CMC = exp(1.005(pH)-4 869) and CCC = exp(1.005(pH)-5 134)). Value refers to pH 7.8. Derivation published in document EPA-820-B-96-001.	77
Pentachlorophenol	87-86-5	USA	QC	AQL-FRESH	CMC		19		Value depends on pH value (CMC = exp(1.005(pH)-4 869) and CCC = exp(1.005(pH)-5 134)). Value refers to pH 7.8. Derivation published in document EPA-820-B-96-001.	77
Pentachlorophenol	87-86-5	USA	QC	AQL-MARIN	CCC		7.9		Not enough data available; lowest LOEL	23
Pentachlorophenol	87-86-5	USA	QC	AQL-MARIN	CCC		7.9		Derivation see report EPA 440/5-86-009	77
Pentachlorophenol	87-86-5	USA	QC	AQL-MARIN	CMC		13			77
Pentachlorophenol	87-86-5	USA	QC	DRINK-FISH	WQC		0.28		Derivation based on: IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Pentachlorophenol	87-86-5	USA	QC	FISH-CONSM	WQC		8.2		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6): No WQC value is stated in the 1980 and 1986 criterion documents. Nonetheless the data contained in the documents allow a WQC to be calculated.	77
Pentachlorophenol	87-86-5	USA-GL	QC	AQL-FRESH	CCC		4.1		If pH value is 6.5	52
Permethrin	52645-53-1	DEU	QC	AQL-FRESH	ZV (E)			total, 90th perc.		81
Permethrin	52645-53-1	GBR	QS, E.	AGRIC-IRRI	PEQS		0.01	total, active ingredient, 95th perc.		33
Permethrin	52645-53-1	GBR	QS, E.	AQL-FRESH	PEQS		0.01	total, active ingredient, 95th perc.		33
Permethrin	52645-53-1	GBR	QS, E.	AQL-MARIN	PEQS		0.001	total, active ingredient, 95th perc.		33

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Permethrin	52645-53-1	GBR	QS, E.	DRINK-SURF	PEQS	0.01		total, active ingredient, 95th perc.		33
Permethrin	52645-53-1	GBR	QS, E.	FISH	PEQS	0.01		total, active ingredient, 95th perc.		33
Permethrin	52645-53-1	GBR	QS	FRESH	EQS	0.01		total, 95th perc.		63
Permethrin	52645-53-1	GBR	QS, E.	INDST	PEQS	0.01		total, active ingredient, 95th perc.		33
Permethrin	52645-53-1	GBR	QS	MARIN	EQS	0.01		total, 95th perc.		63
Permethrin	52645-53-1	GBR	QS, E.	REC	PEQS	0.01		total, active ingredient, 95th perc.		33
Permethrin	52645-53-1	NL	QO	SURF	MPC	0.0002		diss.	Value is below detection/determination limit.	76
Permethrin	52645-53-1	NL	QO	SURF	MPC	0.0003		total	Value is below detection/determination limit. Value standardized to a suspended matter content of 30 mg/l.	76
Permethrin	52645-53-1	NL	QO	SURF	TV	0.000003		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Pesticides (single)		DEU	QS	DRINK	GW	0.1			Including main toxic degradation products	78
Pesticides (total)		DEU	QS	DRINK	GW	0.5			Including main toxic degradation products	78
Pesticides total (parathion, HCH, dieldrin)		DEU-NRW	QS	DRINK-SURF	I, A1	1			According to EC Directive 75/440/EEC	38
Pesticides total (parathion, HCH, dieldrin)		DEU-NRW	QS	DRINK-SURF	I, A2	2.5			According to EC Directive 75/440/EEC	38
pH		CAN	QC	AQL-FRESH	GL	6.5	9			75, 1
pH		CAN	QC	AQL-MARIN	GL (I)	7	8.7			75, 72
pH		CAN	QC	DRINK	AO	6.5	8.5			75, 69
pH		DEU	QS	DRINK	GW	6.5	9.5 pH			78
pH		DEU-NRW	QS	AGRIC-IRRI	GL	5	8.5			38
pH		DEU-NRW	QS	DRINK-SURF	G, A1	6.5	8.5		According to EC Directive 75/440/EEC	38
pH		DEU-NRW	QS	DRINK-SURF	G, A2	5.5	9		According to EC Directive 75/440/EEC	38
pH		DEU-NRW	QS	FISH	I, Cyp.	6	9	95th perc.	According to EC Directive 78/659/EEC. Allowed to be exceeded under extraordinary conditions.	38
pH		DEU-NRW	QS	FISH	I, Salmo.	6	9	95th perc.	According to EC Directive 78/659/EEC. Allowed to be exceeded under extraordinary conditions.	38
pH		DEU-NRW	QS	REC	I	6	9		According to EC Directive 76/160/EEC Values allowed to be exceeded under extraordinary conditions.	38
pH		DEU-NRW	QS	SURF	AGA	6.5	8.5	90th perc.		38

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
pH		GBR	QS, E.	AGRIC-IRRI	PWQS		5.5	8.5			24
pH		GBR	QS, E.	AGRIC-LIVE	PWQS		6	9			24
pH		GBR	QS, E.	AQL-FRESH	PEQS		6.5	8.5	ann. mean		34
pH		GBR	QS, E.	AQL-MARIN	PEQS		6.5	8.5			34
pH		GBR	QS, E.	FISH	PWQS		6	9		Salmonid fishing	24
pH		GBR	QS	FRESH	EQS		6	9			63
pH		GBR	QS	MARIN	EQS		6	8.5		To protect crustaceans: 7-8.5	63
pH		USA	QC	AQL-FRESH	CCC		6.5	9		Derivation see Red Book (EPA 440/9-76-0239)	77
pH		USA	QC	AQL-FRESH	CMC						77
pH		USA	QC	AQL-MARIN	CCC		6.5	8.5		Derivation see Red Book (EPA 440/9-76-0239)	77
pH		USA	QC	AQL-MARIN	CMC						77
pH		USA	QC	DRINK-FISH	WQC		5	9			77
Phenanthrene	85-01-8	CAN	QC	AQL-FRESH	GL (I)		0.4		total, max. value		75
Phenanthrene	85-01-8	NL	QO	SURF	MPC		0.3		diss.		76
Phenanthrene	85-01-8	NL	QO	SURF	MPC		0.3		total	Value standardized to a suspended matter content of 30 mg/l.	76
Phenanthrene	85-01-8	NL	QO	SURF	TV		0.003		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Phenanthrene	85-01-8	USA	QC	AQL-FRESH	CCC		6.3				48
Phenanthrene	85-01-8	USA	QC	AQL-FRESH	FCV		6.32				59
Phenanthrene	85-01-8	USA	QC	AQL-MARIN	CCC		4.6				48
Phenanthrene	85-01-8	USA	QC	AQL-MARIN	FCV		8.26				59
Phenol		CAN	QC	AGRIC-LIVE	GL		2		total, max. value		75, 1
Phenol	108-95-2	NL	QO	SURF	MPC		2		total		25
Phenol	108-95-2	USA	QC	AQL-FRESH	CCC		2560			Not enough data available; lowest LOEL	23
Phenol	108-95-2	USA	QC	DRINK-FISH	WQC		21000			IRIS database, updated 08/04/1998.	77
Phenol	108-95-2	USA	QC	FISH-CONSM	WQC		4600000			IRIS database, updated 08/04/1998 No WQC value is stated in the 1980 and 1986 criterion documents. Nonetheless the data contained in the documents allow a WQC to be calculated.	77
Phenol	108-95-2	USA-GL	QC	AQL-FRESH	CCC		110				52
Phenole index		DEU-NRW	QS	DRINK-SURF	G, A2		1			According to EC Directive 75/440/EEC	38
Phenole index		DEU-NRW	QS	DRINK-SURF	I, A1		1			According to EC Directive 75/440/EEC	38
Phenole index		DEU-NRW	QS	DRINK-SURF	I, A2		5			According to EC Directive 75/440/EEC	38
Phenole index		DEU-NRW	QS	FISH	I, Cyp.					According to EC Directive 78/659/EEC; no adverse effect on taste	38
Phenole index		DEU-NRW	QS	FISH	I, Salmo.					According to EC Directive 78/659/EEC; no adverse effect on taste	38
Phenole index		DEU-NRW	QS	REC	G	<=	5			According to EC Directive 76/160/EEC	38
Phenole index		DEU-NRW	QS	REC	I	<=	50			According to EC Directive 76/160/EEC	38
Phenols (total)		CAN	QC	AQL-FRESH	GL		4		total, max. value		75

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Phenols (total)		DEU	QS	DRINK	GW		0.5	as phenol		78
Phenoxybenzoic acid	3739-38-6	DEU	QC	AQL-FRESH	ZV (E)			total, 90th perc.	Insufficient data	81
Phenoxybenzyl alcohol	13826-35-2	DEU	QC	AQL-FRESH	ZV (E)			total, 90th perc.	Insufficient data	81
Phorate	298-02-2	CAN	QC	DRINK	MAC		2	total, max. value		75, 69
Phosphate (P), Gesamt-		NL	QO	SURF	MPC		150	total	Average summer value for stagnant waters sensitive to eutrophication	76
Phosphate (P), Gesamt-		NL	QO	SURF	TV		50	total	Average summer value for stagnant waters sensitive to eutrophication	76
Phosphoric acid, triphenyl ester	115-86-6	Rhein	QO	RIVER	ZV		0.3	total, 90th perc.	AQL	80
Phosphorus		DEU	QS	DRINK	GW		6.7	as PO4		78
Phosphorus		DEU-NRW	QS	SURF	AGA	<=	300	total, 90th perc.		38
Phosphorus	7723-14-0	USA	QC	AQL-MARIN	CCC		0.1		Derivation see Red Book (EPA 440/9-76-0239)	77
Phosphorus (total)		DEU-NRW	QS	DRINK-SURF	G, A1		170		According to EC Directive 75/440/EEC	38
Phosphorus (total)		DEU-NRW	QS	DRINK-SURF	G, A2		300		According to EC Directive 75/440/EEC	38
Phosphorus (total)		Rhein	QO	RIVER	ZV		150	total, mean value	AQL	45
Phoxim	14816-18-3	NL	QO	SURF	MPC		0.082	diss.	Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Phoxim	14816-18-3	NL	QO	SURF	MPC		0.082	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Phoxim	14816-18-3	NL	QO	SURF	TV		0.0008	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit. Acute data only; compensation factor 1000	76
Phthalic acid ester		USA	QC	AQL-FRESH	CCC		3		Not enough data available; lowest LOEL	23
Phthalic acid ester		USA	QC	AQL-MARIN	CCC		3.4		Not enough data available; lowest LOEL	23
Picloram	1918-02-1	CAN	QC	AGRIC-LIVE	GL (I)		190	total, max. value		75, 3
Picloram	1918-02-1	CAN	QC	AQL-FRESH	GL (I)		29	total, max. value		75, 3
Picloram	1918-02-1	CAN	QC	DRINK	IMAC		190	total, max. value		75, 69
Pirimicarb	23103-98-2	NL	QO	SURF	MPC		0.09	diss.		76
Pirimicarb	23103-98-2	NL	QO	SURF	MPC		0.09	total	Value standardized to a suspended matter content of 30 mg/l.	76
Pirimicarb	23103-98-2	NL	QO	SURF	TV		0.0009	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Pirimicarb	23103-98-2	Rhein	QO	RIVER	ZV		0.09	total, 90th perc.	AQL	80
Polychlorinated, polybrominated biphenyls and terphenyls (single)		DEU	QS	DRINK	GW		0.1			78
Polychlorinated, polybrominated biphenyls and terphenyls (total)		DEU	QS	DRINK	GW		0.5			78

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Polycyclic aromatic hydrocarbons		DEU-NRW	QS	DRINK-SURF	I, A1	0.2			According to EC Directive 75/440/EEC	38
Polycyclic aromatic hydrocarbons		DEU-NRW	QS	DRINK-SURF	I, A2	0.2			According to EC Directive 75/440/EEC	38
Polycyclic aromatic hydrocarbons		Rhein	QO	RIVER	ZV	0.1		total, 90th perc.	DRINK-SURF, sum of benzo(b)fluoranthene, benzo(k)fluoranthene, Benzo(ghi)perylene and indeno(1,2,3-cd)pyrene	74
Polycyclic aromatic hydrocarbons		USA	QC	DRINK-FISH	WQC	0.0028			Carcinogenic risk (risk level 10-6)	23
Polycyclic aromatic hydrocarbons		USA	QC	FISH-CONSM	WQC	0.0311			Carcinogenic risk (risk level 10-6)	23
Polycyclic aromatic hydrocarbons (single)		DEU	QS	DRINK-SURF	ZV	1			Except benzo(a)pyrene, which has a special value of 0.01 µg/l according to the EC Drinking Water Directive 98/83/EC.	79
Polycyclic aromatic hydrocarbons, total: Fluoranthene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Benzo(ghi)perylene, Indeno(1,2,3,-cd)pyrene	7440-02-0	DEU	QS	DRINK	GW	0.2		as C		78
Potassium	7440-09-7	DEU	QS	DRINK	GW	12	mg/l			78
Prometryn	7287-19-6	DEU	QC	AQL-FRESH	ZV (v)	0.5		total, 90th perc.		73
Prometryn	7287-19-6	Rhein	QO	RIVER	ZV	0.1		total, 90th perc.	DRINK-SURF	80
Propachlor	1918-16-7	NL	QO	SURF	MPC	1.3		diss.		76
Propachlor	1918-16-7	NL	QO	SURF	MPC	1.3		total	Value standardized to a suspended matter content of 30 mg/l.	76
Propachlor	1918-16-7	NL	QO	SURF	TV	0.013		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Propazine	139-40-2	DEU	QC	AQL-FRESH	ZV (v)	-		total, 90th perc.	Insufficient data	73
Propiconazole	60207-90-1	Rhein	QO	RIVER	ZV	0.01		total, 90th perc.	AQL	80
Propoxur	114-26-1	DEU	QC	AQL-FRESH	ZV (E)	0.3		total, 90th perc.		81
Propoxur	114-26-1	NL	QO	SURF	MPC	0.01		diss.		76
Propoxur	114-26-1	NL	QO	SURF	MPC	0.01		total	Value standardized to a suspended matter content of 30 mg/l.	76
Propoxur	114-26-1	NL	QO	SURF	TV	0.0001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Propylene glycol, 1,2-	57-55-6	CAN	QC	AQL-FRESH	GL (I)	500000		total, max. value	Value refers to the sum of isomers	75
Propylene glycol, 1,3-	504-63-2	CAN	QC	AQL-FRESH	GL (I)	500000		total, max. value	Value refers to the sum of isomers	75

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range			Reference	Notes	Lit. No.
Pyrazophos	13457-18-6	NL	QO	SURF	MPC		0.04			diss.		76
Pyrazophos	13457-18-6	NL	QO	SURF	MPC		0.04			total	Value standardized to a suspended matter content of 30 mg/l.	76
Pyrazophos	13457-18-6	NL	QO	SURF	TV		0.0004			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Pyrazophos	13457-18-6	Rhein	QO	RIVER	ZV		0.0006			total, 90th perc.	AQL	80
Pyrene	129-00-0	CAN	QC	AQL-FRESH	GL (I)		0.025			total, max. value		75
Pyrene	129-00-0	USA	QC	DRINK-FISH	WQC		960				IRIS database, updated 08/04/1998	77
Pyrene	129-00-0	USA	QC	FISH-CONSM	WQC		11000				IRIS database, updated 08/04/1998	77
Quinoline	91-22-5	CAN	QC	AQL-FRESH	GL (I)		3.4			total, max. value		75
Quintozene	82-68-8	NL	QO	SURF	MPC					diss.		76
Quintozene	82-68-8	NL	QO	SURF	MPC					total	Value standardized to a suspended matter content of 30 mg/l.	76
Quintozene	82-68-8	NL	QO	SURF	TV					total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Radium 224		CAN	QC	DRINK	MAC		2		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Radium 226		CAN	QC	DRINK	MAC		0.6		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Radium 228		CAN	QC	DRINK	MAC		0.5		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Ruthenium 103		CAN	QC	DRINK	MAC		100		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Ruthenium 106		CAN	QC	DRINK	MAC		10		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Salmonellae		DEU-NRW	QS	DRINK-SURF	G, A2		0		per l		According to EC Directive 75/440/EEC	38
Salmonellae		DEU-NRW	QS	DRINK-SURF	G, A1		0		per 5 l		According to EC Directive 75/440/EEC	38
Salmonellae		DEU-NRW	QS	REC	I		0		per l		According to EC Directive 76/160/EEC	38
Salt content		CAN	QC	AGRIC-IRRI	GL		500	3500	mg/l	total diss., max. value	All soils with permanent irrigation. Sensitive plants might not be protected.	75, 1
Salt content		CAN	QC	AGRIC-LIVE	GL		3000		mg/l	total diss., max. value	Sensitivity to saltwater dependent on animal species and life stage. Water with a salt content < 1000 mg/l well suited for all livestock. Greater salt contents may be tolerated by a number of livestock species.	75, 1
Salt content		CAN	QC	DRINK	AO	<=	500		mg/l	total/diss., max. value		75, 69
Salt content		DEU-NRW	QS	AGRIC-IRRI	GL		500		mg/l			38
Salts, dissolved		USA	QC	DRINK-FISH	WQC		250000					77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Selenium	7782-49-2	CAN	QC	AGRIC-IRRI	GL	20	total, max. value	All soils with permanent irrigation, a value of 50 µg/l applies for occasional use.	75, 1
Selenium	7782-49-2	CAN	QC	AGRIC-LIVE	GL	50	total, max. value		75, 1
Selenium	7782-49-2	CAN	QC	AQL-FRESH	GL	1	total, max. value		75, 1
Selenium	7782-49-2	CAN	QC	AQL-MARIN	GL	1	total, max. value		5
Selenium	7782-49-2	CAN	QC	DRINK	MAC	10	total, max. value		75, 69
Selenium	7782-49-2	CHE	QS, E.	AQL	QZ	1	diss. total		26
Selenium	7782-49-2	DEU	QS	DRINK	GW	10			78
Selenium	7782-49-2	DEU-NRW	QS	AGRIC-IRRI	GL	20			38
Selenium	7782-49-2	DEU-NRW	QS	DRINK-SURF	I, A1	10		According to EC Directive 75/440/EEC	38
Selenium	7782-49-2	DEU-NRW	QS	DRINK-SURF	I, A2	10		According to EC Directive 75/440/EEC	38
Selenium	7782-49-2	GBR	QS, E.	AGRIC-IRRI	PWQS	20	ann. mean		24
Selenium	7782-49-2	JPN	QS	AMBI	EQS	10		Health aspects	37
Selenium	7782-49-2	NL	QO	SURF	BACKG	0.04	diss.		76
Selenium	7782-49-2	NL	QO	SURF	BACKG	0.04	total	Value standardized to a suspended matter content of 30 mg/l.	76
Selenium	7782-49-2	NL	QO	SURF	MPC	5.3	diss.		76
Selenium	7782-49-2	NL	QO	SURF	MPC	5.4	total	Value standardized to a suspended matter content of 30 mg/l.	76
Selenium	7782-49-2	NL	QO	SURF	TV	0.09	diss.		76
Selenium	7782-49-2	NL	QO	SURF	TV	0.09	total	Value standardized to a suspended matter content of 30 mg/l.	76
Selenium	7782-49-2	USA	QC	AQL-FRESH	CCC	5		Refers to total concentration.	77
Selenium	7782-49-2	USA	QC	AQL-FRESH	CMC			CMC = 1/[(f1/CMC1) + (f2/CMC2], f1, f2 = percentages of selenite and selenate relating to total selenium content, CMC1 = 185.9 µg/l, CMC2 = 12.83 µg/l. Value is being developed and subject to change. Refers to total concentration.	77
Selenium	7782-49-2	USA	QC	AQL-MARIN	CCC	71		Dissolved concentration. Uptake through food is not considered for the marine sector. Status of fish populations should be monitored if selenium concentration exceeds 5.0 µg/l.	77
Selenium	7782-49-2	USA	QC	AQL-MARIN	CMC	290		Dissolved concentration. Uptake through food is not considered for the marine sector. Status of fish populations should be monitored if selenium concentration exceeds 5.0 µg/l.	77
Selenium	7782-49-2	USA	QC	DRINK	MCL	10			23
Selenium	7782-49-2	USA	QC	DRINK-FISH	WQC	170		A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Selenium	7782-49-2	USA	QC	FISH-CONSM	WQC	11000			77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Selenium	7782-49-2	USA-GL	QC	AQL-FRESH	CCC	5	total		52
Selenium (IV)	7782-49-2	USA-GL	QC	AQL-FRESH	CCC	28			52
Selenium (VI)	7782-49-2	USA-GL	QC	AQL-FRESH	CCC	9.5			52
Silver	7440-22-4	CAN	QC	AQL-FRESH	GL	0.1	total, max. value		75, 1
Silver	7440-22-4	CHE	QS, E.	AQL	QZ	0.1	diss. total		26
Silver	7440-22-4	CHE	QS	AQL	QZ	10	diss. total		26
Silver	7440-22-4	DEU	QS	DRINK	GW	10			78
Silver	7440-22-4	USA	QC	AQL-FRESH	CCC	0.12	acid-soluble or total		55
Silver	7440-22-4	USA	QC	AQL-FRESH	CMC	3.4		Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Silver	7440-22-4	USA	QC	AQL-MARIN	CCC	0.92	acid-soluble total		55
Silver	7440-22-4	USA	QC	AQL-MARIN	CMC	1.9		Dissolved concentration. Derivation made in 1980. Derivation method modified in 1985. Value should be divided by 2 to obtain a comparable CMC.	77
Silver	7440-22-4	USA	QC	DRINK	MCL	50			23
Silver	7440-22-4	USA	QC	DRINK-FISH	WQC	50			23
Simazine	122-34-9	CAN	QC	AGRIC-IRRI	GL (I)	0.5	total, max. value		75, 5
Simazine	122-34-9	CAN	QC	AGRIC-LIVE	GL (I)	10	total, max. value		75, 5
Simazine	122-34-9	CAN	QC	AQL-FRESH	GL	10	total, max. value		75, 5
Simazine	122-34-9	CAN	QC	DRINK	IMAC	10	total, max. value		75, 69
Simazine	122-34-9	DEU	QC	AQL-FRESH	ZV (v)	0.1	total, 90th perc.		73
Simazine	122-34-9	GBR	QS, E.	AQL-FRESH	PEQS	2	total dissolved, ann. mean	Refers to the sum of atrazine and simazine	18
Simazine	122-34-9	GBR	QS, E.	AQL-MARIN	PEQS	2	total dissolved, ann. mean	Refers to the sum of atrazine and simazine	18
Simazine	122-34-9	JPN	QS	AMBI	EQS	3		Health aspects	37
Simazine	122-34-9	NL	QO	SURF	MPC	0.14	diss.	Acute data only; compensation factor 1000	76
Simazine	122-34-9	NL	QO	SURF	MPC	0.14	total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Simazine	122-34-9	NL	QO	SURF	TV	0.001	total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Simazine	122-34-9	Rhein	QO	RIVER	ZV	0.06	total, 90th perc.	AQL	45
Smell		CAN	QC	DRINK	AO			Inconspicious	75, 69
Smell (dilution factor)		DEU-NRW	QS	DRINK-SURF	G, A2	10		According to EC Directive 75/440/EEC	38
Smell (dilution factor)		DEU-NRW	QS	DRINK-SURF	G, A1	3		According to EC Directive 75/440/EEC	38
Sodium	7440-23-5	CAN	QC	DRINK	AO	<= 200000			75, 69
Sodium	7440-23-5	DEU	QS	DRINK	GW	150000			78

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range			Reference	Notes	Lit. No.
Sodium	7440-23-5	DEU-NRW	QS	AGRIC-IRRI	GL		150000					38
Streptococcus faec.		DEU-NRW	QS	REC	G		100		/100 ml		According to EC Directive 76/160/EEC	38
Stretococcus faec.		DEU-NRW	QS	DRINK-SURF	G, A1		20		/100 ml		According to EC Directive 75/440/EEC	38
Stretococcus faec.		DEU-NRW	QS	DRINK-SURF	G, A2		1000		/100 ml		According to EC Directive 75/440/EEC	38
Strontium 90		CAN	QC	DRINK	MAC		5		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Styrene	100-42-5	NL	QO	SURF	MPC		570			diss.	Value is below detection/determination limit.	76
Styrene	100-42-5	NL	QO	SURF	MPC		570			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Styrene	100-42-5	NL	QO	SURF	TV		6			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Styrene (Ethenyl benzenes)	100-42-5	CAN	QC	AQL-FRESH	GL (I)		72			total, max. value		75
Sulcofuron	24019-05-4	GBR	QS, E.	AGRIC-IRRI	PEQS		25			total, active ingredient, 95th perc.		33
Sulcofuron	24019-05-4	GBR	QS, E.	AQL-FRESH	PEQS		25			total, active ingredient, 95th perc.	(Freshwater fish only)	33
Sulcofuron	24019-05-4	GBR	QS	FRESH	EQS		25			total, 95th perc.		63
Sulcofuron	24019-05-4	GBR	QS	MARIN	EQS		25			total, 95th perc.		63
Sulphate		CAN	QC	AGRIC-LIVE	GL		1000000			total, max. value		75, 1
Sulphate		CAN	QC	DRINK	AO	<=	500000			total, max. value		75, 69
Sulphate		DEU	QS	DRINK	GW		240		mg/l	as SO4		78
Sulphate		DEU-NRW	QS	DRINK-SURF	G, A2, A1		150		mg/l		According to EC Directive 75/440/EEC	38
Sulphate		DEU-NRW	QS	DRINK-SURF	I, A2, A1		250		mg/l		According to EC Directive 75/440/EEC	38
Sulphate		GBR	QS, E.	AGRIC-IRRI	PWQS		150	1350	mg/l		Depends on cultivated fruit type	24
Sulphate		GBR	QS, E.	AGRIC-LIVE	PWQS		250		mg/l			24
Sulphate		NL	QO	SURF	MPC		100000			total		76
Sulphide, H2S	7783-06-4	CAN	QC	DRINK	AO	<=	50			total, max. value	(Measured as H2S)	75, 69
Sulphide, H2S	7783-06-4	GBR	QS, E.	AQL-FRESH	PEQS		1	2		undissociated hydrogen sulphide, ann. mean	The lower value applies to temperatures > 15 degrees Celsius.	36

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Sulphide, H2S	7783-06-4	GBR	QS, E.	AQL-MARIN	PEQS		1	2	undissociated hydrogen sulphide, ann. mean	The lower value applies to temperatures > 15 degrees Celsius.	36
Sulphide, H2S	7783-06-4	GBR	QS, E.	FRESH	EQS		0.25	1	undissociated hydrogen sulphide, ann. mean		63
Sulphide, H2S	7783-06-4	USA	QC	AQL-FRESH	CCC		2		H2S		23
Sulphide, H2S	7783-06-4	USA	QC	AQL-MARIN	CCC		2		H2S		23
Surface active substances, anionic		DEU	QS	DRINK	GW		200		as methylen blue-active substance		78
Surface active substances, non-ionic		DEU	QS	DRINK	GW		200		as bismuth-active substance		78
Surfactants, anion-active (MBAS)		DEU-NRW	QS	DRINK-SURF	G, A1		200			According to EC Directive 75/440/EEC	38
Surfactants, anion-active (MBAS)		DEU-NRW	QS	DRINK-SURF	G, A2		200			According to EC Directive 75/440/EEC	38
Surfactants, anion-active (MBAS)		DEU-NRW	QS	REC	G	<=	300			According to EC Directive 76/160/EEC	38
Suspended matter		CAN	QC	AQL-FRESH	GL					Increase by 10 mg/l. Refers to a suspended matter background concentration >100 mg/l.	1
Suspended matter		CAN	QC	AQL-FRESH	GL					Increase by 10% compared to background value. Refers to a suspended matter background concentration < 100 mg/l.	1
Suspended matter		DEU-NRW	QS	FISH	G, Cyp.	<	25000		mean	According to EC Directive 78/659/EEC	38
Suspended matter		DEU-NRW	QS	FISH	G, Salmo.	<	25000		mean	According to EC Directive 78/659/EEC	38
Suspended matter and turbidity		CAN	QC	AQL-MARIN	GL (I)					No deviation > 10% from natural conditions.	72
Suspended matter and turbidity		USA	QC	AQL-FRESH	CCC					Verbal description. See NTIS: PB-263943	23
T, 2,4,5-	93-76-5	NL	QO	SURF	MPC		9		diss.	Acute data only; compensation factor 1000	76
T, 2,4,5-	93-76-5	NL	QO	SURF	MPC		9		total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
T, 2,4,5-	93-76-5	NL	QO	SURF	TV		0.09		total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
T, 2,4,5-	93-76-5	USA	QC	DRINK-FISH	WQC		10				23
Taste		CAN	QC	DRINK	AO					Inconspicious	75, 69

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Tebuthiuron	34014-18-1	CAN	QC	AGRIC-IRRI	GL (I)		0.27		total, max. value	Cereal farming and pasture management; insufficient data to account for other types of farming.	75, 69
Tebuthiuron	34014-18-1	CAN	QC	AGRIC-LIVE	GL (I)		130		total, max. value		75, 69
Tebuthiuron	34014-18-1	CAN	QC	AQL-FRESH	GL (I)		1.6		total, max. value		75, 69
Temephos	3383-96-8	CAN	QC	DRINK	IMAC		280		total, max. value		69
Temperature		CAN	QC	AQL-MARIN	GL (I)					No man-made deviation of more than +/- 0.1 °C from default temperature.	75, 72
Temperature		CAN	QC	DRINK	AO	<=	15	°C			75, 69
Temperature		USA	QC	AQL-FRESH	CCC					See NTIS: PB-263943	23
Temperature		USA	QC	AQL-MARIN	CCC					See NTIS: PB-263943	23
Temperature		DEU	QS	DRINK	GW		25	Grad C			78
Temperature		DEU-NRW	QS	DRINK-SURF	G, A1		22	°C		According to EC Directive 75/440/EEC	38
Temperature		DEU-NRW	QS	DRINK-SURF	I, A1		25	°C		According to EC Directive 75/440/EEC	38
Temperature		DEU-NRW	QS	DRINK-SURF	I, A2		25	°C		According to EC Directive 75/440/EEC	38
Temperature		DEU-NRW	QS	FISH	I, Cyp.	<=	28	°C	98th perc.	According to EC Directive 78/659/EEC	38
Temperature		DEU-NRW	QS	FISH	I, Salmo.	<=	21.5	°C	98th perc.	According to EC Directive 78/659/EEC	38
Temperature		DEU-NRW	QS	SURF	AGA					20/3 T.max, °C/TG, K for waters cool in summer	38
Temperature		DEU-NRW	QS	SURF	AGA					25/5 T.max, °C/TG, K for waters warm in summer	38
Temperature		GBR	QS, E.	FISH	PWQS		21.5	°C	max. value	Salmonid fishing. Temperature increase must not exceed 1.5 degrees Celsius.	24
Temperature		DEU-NRW	QS	DRINK-SURF	G, A2		22	°C		According to EC Directive 75/440/EEC	38
Terbufos	13071-79-9	CAN	QC	DRINK	IMAC		1		total, max. value		75, 69
Terbuthylazines	5915-41-3	DEU	QC	AQL-FRESH	ZV (v)		0.5		total, 90th perc.		73
Tetrabutyltin		Rhein	QO	RIVER	ZV		0.001		total, 90th perc.	Quality target adopted from tributyltin	45
Tetrabutyltin (single)		NL	QO	MARIN	MPC		17		diss.	Acute data only; compensation factor 1000	76
Tetrabutyltin (single)		NL	QO	MARIN	MPC		17		total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Tetrabutyltin (single)		NL	QO	MARIN	TV		2		total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Tetrabutyltin (single)		NL	QO	SURF	MPC		1.6		diss.	Acute data only; compensation factor 1000	76
Tetrabutyltin (single)		NL	QO	SURF	MPC		1.6		total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Tetrabutyltin (single)		NL	QO	SURF	TV		0.016		total	Value standardized to a suspended matter content of 30 mg/l. Acute data only; compensation factor 1000	76
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA	QC	AQL-FRESH	CCC		10	pg/l		Not enough data available; lowest LOEL	23

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA	QC	DRINK-FISH	WQC	0.013	pg/l		Carcinogenic risk (risk level 10-6)	77
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA	QC	FISH	HIGH RISK	1	5 pg/l		Mortality might occur in sensitive species.	53
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA	QC	FISH	LOW RISK	0.6	3.1 pg/l			53
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA	QC	FISH-CONSM	WQC	0.014	pg/l		Carcinogenic risk (risk level 10-6)	77
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA	QC	WILD-BIRD	HIGH RISK	0.7	3.5 pg/l		Mortality might occur in sensitive species.	53
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA	QC	WILD-BIRD	LOW RISK	0.07	0.35 pg/l			53
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA	QC	WILD-MAMM	HIGH RISK	0.08	0.4 pg/l		Mortality might occur in sensitive species.	53
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA	QC	WILD-MAMM	LOW RISK	0.008	0.04 pg/l			53
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA-GL	QC	WILD	WC	0.0031	pg/l			51
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA-GL	QC	WILD-BIRD	WV	0.026	pg/l			51
Tetrachloro-dibenzo-p-dioxin, 2,3,7,8-	1746-01-6	USA-GL	QC	WILD-MAMM	WV	0.0031	pg/l			51
Tetrachlorobenzene, 1,2,3,4-	634-66-2	CAN	QC	AQL-FRESH	GL (I)	1.8		total, max. value		75
Tetrachlorobenzene, 1,2,4,5-	95-94-3	USA	QC	DRINK-FISH	WQC	2.3				77
Tetrachlorobenzene, 1,2,4,5-	95-94-3	USA	QC	FISH-CONSM	WQC	48				23
Tetrachlorobenzene, 1,2,4,5-	95-94-3	USA	QC	FISH-CONSM	WQC	2.9				77
Tetrachlorobenzenes (single)		NL	QO	SURF	MPC	24		diss.		76
Tetrachlorobenzenes (single)		NL	QO	SURF	MPC	24		total	Value standardized to a suspended matter content of 30 mg/l.	76
Tetrachlorobenzenes (single)		NL	QO	SURF	TV	0.2		total	Value standardized to a suspended matter content of 30 mg/l.	76
Tetrachloroethane, 1,1,2,2-	79-34-5	NL	QO	SURF	MPC	3300		diss.		76
Tetrachloroethane, 1,1,2,2-	79-34-5	NL	QO	SURF	MPC	3300		total	Value standardized to a suspended matter content of 30 mg/l.	76
Tetrachloroethane, 1,1,2,2-	79-34-5	NL	QO	SURF	TV	33		total	Value standardized to a suspended matter content of 30 mg/l.	76
Tetrachloroethane, 1,1,2,2-	79-34-5	USA	QC	AQL-FRESH	CCC	2400			Not enough data available; lowest LOEL	23

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Tetrachloroethane, 1,1,2,2-	79-34-5	USA	QC	DRINK-FISH	WQC	0.17		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Tetrachloroethane, 1,1,2,2-	79-34-5	USA	QC	FISH-CONSM	WQC	11		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Tetrachloroethene	127-18-4	CAN	QC	AQL-FRESH	GL	111	total, max. value		75, 9
Tetrachloroethene	127-18-4	CAN	QC	DRINK	MAC	30	total, max. value		75
Tetrachloroethene	127-18-4	DEU	QC	AQL-FRESH	ZV	40	total, 90th perc.		15
Tetrachloroethene	127-18-4	DEU	QS	DRINK	GW			See organochlorine compounds	78
Tetrachloroethene	127-18-4	DEU	QC	DRINK-FISH	ZV (v)	1.5	total, 90th perc.	Carcinogenic risk (risk level 10-5)	15
Tetrachloroethene	127-18-4	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Tetrachloroethene	127-18-4	EEC	QS	AMBI	QZ	10	ann. mean		44
Tetrachloroethene	127-18-4	JPN	QS	AMBI	EQS	10		Health aspects	37
Tetrachloroethene	127-18-4	NL	QO	SURF	MPC	330	diss.		76
Tetrachloroethene	127-18-4	NL	QO	SURF	MPC	330	total	Value standardized to a suspended matter content of 30 mg/l.	76
Tetrachloroethene	127-18-4	NL	QO	SURF	TV	3	total	Value standardized to a suspended matter content of 30 mg/l.	76
Tetrachloroethene	127-18-4	Rhein	QO	RIVER	ZV	1	total, 90th perc.	DRINK-SURF	45
Tetrachloroethene	127-18-4	USA	QC	AQL-FRESH	CCC	840		Not enough data available; lowest LOEL	23
Tetrachloroethene	127-18-4	USA	QC	AQL-MARIN	CCC	460		Not enough data available; lowest LOEL	23
Tetrachloroethene	127-18-4	USA	QC	DRINK-FISH	WQC	0.8		Carcinogenic risk (risk level 10-6)	77
Tetrachloroethene	127-18-4	USA	QC	FISH-CONSM	WQC	8.85		Carcinogenic risk (risk level 10-6)	77
Tetrachloromethane	56-23-5	CAN	QC	AGRIC-LIVE	GL (I)	5	total, max. value		75, 6
Tetrachloromethane	56-23-5	CAN	QC	AQL-FRESH	GL (I)	13.3	total, max. value		75, 6
Tetrachloromethane	56-23-5	CAN	QC	DRINK	MAC	5	total, max. value		75, 69
Tetrachloromethane	56-23-5	DEU	QC	AQL-FRESH	ZV	7	total, 90th perc.		15
Tetrachloromethane	56-23-5	DEU	QS	DRINK	GW	3			78
Tetrachloromethane	56-23-5	DEU	QS	DRINK	GW			See organochlorine compounds	78
Tetrachloromethane	56-23-5	DEU	QC	DRINK-FISH	ZV (v)	2.16	total, 90th perc.	Carcinogenic risk (risk level 10-5)	15
Tetrachloromethane	56-23-5	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Tetrachloromethane	56-23-5	EEC	QS	AMBI	QZ	12	ann. mean		39
Tetrachloromethane	56-23-5	JPN	QS	AMBI	EQS	2		Health aspects	37
Tetrachloromethane	56-23-5	NL	QO	SURF	MPC	1100	diss.		76
Tetrachloromethane	56-23-5	NL	QO	SURF	MPC	1100	total	Value standardized to a suspended matter content of 30 mg/l.	76
Tetrachloromethane	56-23-5	NL	QO	SURF	TV	11	total	Value standardized to a suspended matter content of 30 mg/l.	76
Tetrachloromethane	56-23-5	Rhein	QO	RIVER	ZV	1	total, 90th perc.	DRINK-SURF	45
Tetrachloromethane	56-23-5	USA	QC	DRINK-FISH	WQC	0.25		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Tetrachloromethane	56-23-5	USA	QC	FISH-CONSM	WQC	4.4		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Tetrachlorophenol, 2,3,4,6-	58-90-2	CAN	QC	DRINK	MAC		100		total, max. value		75, 69
Tetrachlorophenol, 2,3,4,6-	58-90-2	CAN	QC	DRINK	AO	<=	1		total, max. value	A target value of <1 µg/l is envisaged in order to avoid adverse effects on taste.	75, 69
Tetrachlorophenol, 2,3,4,6-	58-90-2	USA	QC	Taste	WQC		1				77
Tetrachlorophenol, 2,3,5,6-	935-95-5	USA	QC	AQL-MARIN	CCC		440			Not enough data available; lowest LOEL	23
Tetrachlorophenols		CAN	QC	AQL-FRESH	GL		1		total, max. value		75, 1
Tetrachlorophenols (single)		NL	QO	SURF	MPC		1		diss.		76
Tetrachlorophenols (single)		NL	QO	SURF	MPC		1		total	Value standardized to a suspended matter content of 30 mg/l.	76
Tetrachlorophenols (single)		NL	QO	SURF	TV		0.01		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Thallium	7440-28-0	CAN	QC	AQL-FRESH	GL		0.8		total, max. value		75
Thallium	7440-28-0	NL	QO	SURF	BACKG		0.04		diss.	Value is below detection/determination limit.	76
Thallium	7440-28-0	NL	QO	SURF	BACKG		0.04		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Thallium	7440-28-0	NL	QO	SURF	MPC		1.6		diss.		76
Thallium	7440-28-0	NL	QO	SURF	MPC		1.7		total	Value standardized to a suspended matter content of 30 mg/l.	76
Thallium	7440-28-0	NL	QO	SURF	TV		0.06		diss.	Value is below detection/determination limit.	76
Thallium	7440-28-0	NL	QO	SURF	TV		0.06		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Thallium	7440-28-0	USA	QC	AQL-FRESH	CCC		40			Not enough data available; lowest LOEL	23
Thallium	7440-28-0	USA	QC	DRINK-FISH	WQC		1.7			IRIS database, updated 08/04/1998	77
Thallium	7440-28-0	USA	QC	FISH-CONSM	WQC		6.3			IRIS database, updated 08/04/1998	77
Thiobencarp	28249-77-6	JPN	QS	AMBI	EQS		20			Health aspects	37
Thiram	137-26-7	NL	QO	SURF	MPC		0.032		diss.		76
Thiram	137-26-7	NL	QO	SURF	MPC		0.032		total	Value standardized to a suspended matter content of 30 mg/l.	76
Thiram	137-26-7	NL	QO	SURF	TV		0.0003		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Thiuram		JPN	QS	AMBI	EQS		6			Health aspects	37
Thorium 228		CAN	QC	DRINK	MAC		2	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Thorium 230		CAN	QC	DRINK	MAC		0.4	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Thorium 232		CAN	QC	DRINK	MAC		0.1	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Thorium 234		CAN	QC	DRINK	MAC		20	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Tin	7440-31-5	GBR	QS, E.	AQL-FRESH	PEQS		25		total, ann. mean		29, 63
Tin	7440-31-5	GBR	QS, E.	AQL-MARIN	PEQS		10		diss., ann. mean		29, 63
Tin	7440-31-5	GBR	QS	MARIN	EQS		10		total, ann. mean		28
Tin	7440-31-5	NL	QO	SURF	BACKG		0.0002		diss.	Value is below detection/determination limit.	76
Tin	7440-31-5	NL	QO	SURF	BACKG		0.002		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Tin	7440-31-5	NL	QO	SURF	MPC		18		diss.		76
Tin	7440-31-5	NL	QO	SURF	MPC		220		total	Value standardized to a suspended matter content of 30 mg/l.	76
Tin	7440-31-5	NL	QO	SURF	TV		0.2		diss.		76
Tin	7440-31-5	NL	QO	SURF	TV		2.2		total	Value standardized to a suspended matter content of 30 mg/l.	76
TOC		DEU-NRW	QS	SURF	AGA	<=	7000		90th perc.		38
Tolclofos-methyl	57018-04-9	DEU	QC	AQL-FRESH	ZV (E)		4		total, 90th perc.		81
Tolclofos-methyl	57018-04-9	NL	QO	SURF	MPC		0.79		diss.		76
Tolclofos-methyl	57018-04-9	NL	QO	SURF	MPC		0.8		total	Value standardized to a suspended matter content of 30 mg/l.	76
Tolclofos-methyl	57018-04-9	NL	QO	SURF	TV		0.008		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Tolclofos-methyl	57018-04-9	Rhein	QO	RIVER	ZV		0.1		total, 90th perc.	DRINK-SURF	80
Toluene	108-88-3	CAN	QC	AGRIC-LIVE	GL (I)		24		total, max. value		70
Toluene	108-88-3	CAN	QC	AQL-FRESH	GL (I)		2		total, max. value		75, 70
Toluene	108-88-3	CAN	QC	AQL-MARIN	GL (I)		215		total, max. value		75, 70
Toluene	108-88-3	CAN	QC	DRINK	AO	<=	24		total, max. value		75, 69
Toluene	108-88-3	NL	QO	SURF	MPC		730		diss.		76
Toluene	108-88-3	NL	QO	SURF	MPC		730		total	Value standardized to a suspended matter content of 30 mg/l.	76
Toluene	108-88-3	NL	QO	SURF	TV		7		total	Value standardized to a suspended matter content of 30 mg/l.	76
Toluene	108-88-3	USA	QC	AQL-MARIN	CCC		5000			Not enough data available; lowest LOEL	23
Toluene	108-88-3	USA	QC	DRINK-FISH	WQC		6800			IRIS database, updated 08/04/1998 A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77
Toluene	108-88-3	USA	QC	FISH-CONSM	WQC		200000			IRIS database, updated 08/04/1998	77
Toxaphene	8001-35-2	USA	QC	AQL-FRESH	CCC		0.0002			Value based on the derivation of a Final Residue Value.	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Toxaphene	8001-35-2	USA	QC	AQL-FRESH	CMC	0.73				77
Toxaphene	8001-35-2	USA	QC	AQL-MARIN	CCC	0.0002			Value based on the derivation of a Final Residue Value.	77
Toxaphene	8001-35-2	USA	QC	AQL-MARIN	CMC	0.21				77
Toxaphene	8001-35-2	USA	QC	DRINK	MCL	5				23
Toxaphene	8001-35-2	USA	QC	DRINK-FISH	WQC	0.00073			IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Toxaphene	8001-35-2	USA	QC	FISH-CONSM	WQC	0.00075			IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
TP, 2,4,5-	93-72-1	USA	QC	DRINK-FISH	WQC	10				77
Transparency		DEU-NRW	QS	REC	G	2	m		According to EC Directive 76/160/EEC	38
Transparency		DEU-NRW	QS	REC	I	1	m		According to EC Directive 76/160/EEC	38
Triadimenol	55219-65-3	DEU	QC	AQL-FRESH	ZV (E)	10		total, 90th perc.		81
Triallate	2303-17-5	CAN	QC	AGRIC-LIVE	GL	230		total, max. value		75, 7
Triallate	2303-17-5	CAN	QC	AQL-FRESH	GL (I)	0.24		total, max. value		75, 7
Triallate	2303-17-5	CAN	QC	DRINK	MAC	230		total, max. value		69
Triallate	2303-17-5	NL	QO	SURF	MPC	1.9		diss.		76
Triallate	2303-17-5	NL	QO	SURF	MPC	1.9		total	Value standardized to a suspended matter content of 30 mg/l.	76
Triallate	2303-17-5	NL	QO	SURF	TV	0.019		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Triazophos	24017-47-8	DEU	QC	AQL-FRESH	ZV (v)	0.03		total, 90th perc.		73
Triazophos	24017-47-8	NL	QO	SURF	MPC	0.032		diss.		76
Triazophos	24017-47-8	NL	QO	SURF	MPC	0.032		total	Value standardized to a suspended matter content of 30 mg/l.	76
Triazophos	24017-47-8	NL	QO	SURF	TV	0.0003		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Triazophos	24017-47-8	Rhein	QO	RIVER	ZV	0.03		total, 90th perc.	AQL	80
Tribromomethane	75-25-2	CAN	QC	AGRIC-LIVE	GL	100		total, max. value		75
Tributyltin		NL	QO	MARIN	MPC	0.001		diss.		76
Tributyltin		NL	QO	MARIN	MPC	0.001		total	Value standardized to a suspended matter content of 30 mg/l.	76
Tributyltin		NL	QO	MARIN	TV	0.00001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Tributyltin		NL	QO	SURF	MPC	0.014		total	Value standardized to a suspended matter content of 30 mg/l.	76
Tributyltin		NL	QO	SURF	TV	0.0001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Tributyltin, (TBT)		CAN	QC	AGRIC-LIVE	GL (I)	250		total, max. value		75, 6
Tributyltin, (TBT)		CAN	QC	AQL-FRESH	GL (I)	0.008		total, max. value		75, 6
Tributyltin, (TBT)		CAN	QC	AQL-MARIN	GL	0.001		total, max. value		75, 6
Tributyltin, (TBT)		CHE	QS, E.	AQL	QZ	0.002		diss. total, tributyltin + triphenyltin		26
Tributyltin, (TBT)		DEU	QC	AQL-FRESH	ZV (v)	0.0001		total, 90th perc.		73
Tributyltin, (TBT)		GBR	QS, E.	AQL-FRESH	PEQS	0.001		total, 95th perc.		31
Tributyltin, (TBT)		GBR	QS, E.	AQL-MARIN	PEQS	0.001		total, 95th perc.		31
Tributyltin, (TBT)		GBR	QS	FRESH	EQS	0.02		total, max. value		63
Tributyltin, (TBT)		GBR	QS	MARIN	EQS	0.002		total, max. value	A value of 0.001 relating to the 95th percentile had originally been targeted. Cochlea (Nucella lapillus) may suffer from adverse affects on the genital organs ("imposex") even at concentrations of approx. 0.002.	28
Tributyltin, (TBT)		NL	QO	SURF	MPC	0.014		diss.		76
Tributyltin, (TBT)		Nordsee	QC	MARIN	EAC	0.00001	0.0001	diss.		27
Tributyltin, (TBT)		Rhein	QO	RIVER	ZV	0.001		total, 90th perc.	AQL	45
Tributyltin, (TBT)		USA	QC	AQL-FRESH	CCC	0.063				49
Tributyltin, (TBT)		USA	QC	AQL-FRESH	CCC	0.063				77
Tributyltin, (TBT)		USA	QC	AQL-FRESH	CMC	0.46				77
Tributyltin, (TBT)		USA	QC	AQL-MARIN	CCC	0.01				49
Tributyltin, (TBT)		USA	QC	AQL-MARIN	CCC	0.01				77
Tributyltin, (TBT)		USA	QC	AQL-MARIN	CMC	0.37				77
Trichlorfon	52-68-6	NL	QO	SURF	MPC	0.001		diss.	Value is below detection/determination limit.	76
Trichlorfon	52-68-6	NL	QO	SURF	MPC	0.001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Trichlorfon	52-68-6	NL	QO	SURF	TV	0.00001		total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Trichlorobenzene, 1,2,3-	87-61-6	CAN	QC	AQL-FRESH	GL (I)	8		total, max. value		75
Trichlorobenzene, 1,2,3-	87-61-6	DEU	QC	AQL-FRESH	ZV	8		total, 90th perc.		15
Trichlorobenzene, 1,2,3-	87-61-6	DEU	QC	DRINK-SURF	ZV	1		total, 90th perc.		15
Trichlorobenzene, 1,2,4-	120-82-1	CAN	QC	AQL-FRESH	GL (I)	24		total, max. value		75
Trichlorobenzene, 1,2,4-	120-82-1	CAN	QC	AQL-MARIN	GL (I)	5.4		total, max. value		75
Trichlorobenzene, 1,2,4-	120-82-1	DEU	QC	AQL-FRESH	ZV	4		total, 90th perc.		15
Trichlorobenzene, 1,2,4-	120-82-1	DEU	QC	DRINK-SURF	ZV	1		total, 90th perc.		15
Trichlorobenzene, 1,2,4-	120-82-1	USA	QC	DRINK-FISH	WQC	260			A strict limit value for drinking water (MCL) was established by the U.S. EPA. See National Drinking Water Regulations (40 CFR 141) or Safe Dinking Water Hotline (1-800-426-4791).	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Trichlorobenzene, 1,2,4-	120-82-1	USA	QC	FISH-CONSM	WQC	940			77
Trichlorobenzene, 1,3,5-	108-70-3	DEU	QC	AQL-FRESH	ZV	20	total, 90th perc.		15
Trichlorobenzene, 1,3,5-	108-70-3	DEU	QC	DRINK-SURF	ZV	0.1	total, 90th perc.		15
Trichlorobenzenes		EEC	QS	AMBI	QZ	0.4	ann. mean	Value refers to the sum of isomers	44
Trichlorobenzenes (single)		NL	QO	SURF	MPC	67	diss.		76
Trichlorobenzenes (single)		NL	QO	SURF	MPC	67	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichlorobenzenes (single)		NL	QO	SURF	TV	0.7	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichlorobenzenes (single)		Rhein	QO	RIVER	ZV	0.1	total, 90th perc.	DRINK-SURF	45
Trichloroethane, 1,1,1-	71-55-6	DEU	QC	AQL-FRESH	ZV	100	total, 90th perc.		15
Trichloroethane, 1,1,1-	71-55-6	DEU	QS	DRINK	GW			See organochlorine compounds	78
Trichloroethane, 1,1,1-	71-55-6	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Trichloroethane, 1,1,1-	71-55-6	JPN	QS	AMBI	EQS	1000		Health aspects	37
Trichloroethane, 1,1,1-	71-55-6	NL	QO	SURF	MPC	2100	diss.		76
Trichloroethane, 1,1,1-	71-55-6	NL	QO	SURF	MPC	2100	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichloroethane, 1,1,1-	71-55-6	NL	QO	SURF	TV	21	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichloroethane, 1,1,1-	71-55-6	Rhein	QO	RIVER	ZV	1	total, 90th perc.	DRINK-SURF	45
Trichloroethane, 1,1,1-	71-55-6	USA	QC	DRINK-FISH	WQC	18400			23
Trichloroethane, 1,1,1-	71-55-6	USA	QC	FISH-CONSM	WQC	1030000			23
Trichloroethane, 1,1,2-	79-00-5	JPN	QS	AMBI	EQS	6		Health aspects	37
Trichloroethane, 1,1,2-	79-00-5	NL	QO	SURF	MPC	7900	diss.		76
Trichloroethane, 1,1,2-	79-00-5	NL	QO	SURF	MPC	7900	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichloroethane, 1,1,2-	79-00-5	NL	QO	SURF	TV	79	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichloroethane, 1,1,2-	79-00-5	USA	QC	AQL-FRESH	CCC	9400		Not enough data available; lowest LOEL	23
Trichloroethane, 1,1,2-	79-00-5	USA	QC	DRINK-FISH	WQC	0.6		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Trichloroethane, 1,1,2-	79-00-5	USA	QC	FISH-CONSM	WQC	42		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Trichloroethene	79-01-6	CAN	QC	AGRIC-LIVE	GL (I)	50	total, max. value		75, 4
Trichloroethene	79-01-6	CAN	QC	AQL-FRESH	GL (I)	21	total, max. value		75, 4
Trichloroethene	79-01-6	CAN	QC	DRINK	MAC	50	total, max. value		75, 69
Trichloroethene	79-01-6	DEU	QC	AQL-FRESH	ZV	20	total, 90th perc.		15
Trichloroethene	79-01-6	DEU	QS	DRINK	GW			See organochlorine compounds	78
Trichloroethene	79-01-6	DEU	QC	DRINK-FISH	ZV (v)	25.44	total, 90th perc.	Carcinogenic risk (risk level 10-5)	15
Trichloroethene	79-01-6	DEU	QC	DRINK-SURF	ZV	1	total, 90th perc.		15
Trichloroethene	79-01-6	EEC	QS	AMBI	QZ	10	ann. mean		44
Trichloroethene	79-01-6	JPN	QS	AMBI	EQS	30		Health aspects	37

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Trichloroethene	79-01-6	NL	QO	SURF	MPC		2400	diss.		76
Trichloroethene	79-01-6	NL	QO	SURF	MPC		2400	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichloroethene	79-01-6	NL	QO	SURF	TV		24	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichloroethene	79-01-6	Rhein	QO	RIVER	ZV		1	total, 90th perc.	DRINK-SURF	45
Trichloroethene	79-01-6	USA	QC	AQL-FRESH	CCC		21900		Not enough data available; lowest LOEL	23
Trichloroethene	79-01-6	USA	QC	DRINK-FISH	WQC		2.7		Carcinogenic risk (risk level 10-6)	77
Trichloroethene	79-01-6	USA	QC	FISH-CONSM	WQC		81		Carcinogenic risk (risk level 10-6)	77
Trichloromethane	67-66-3	CAN	QC	AGRIC-LIVE	GL		100	total, max. value		75
Trichloromethane	67-66-3	CAN	QC	AQL-FRESH	GL (I)		1.8	total, max. value		75, 6
Trichloromethane	67-66-3	DEU	QC	AQL-FRESH	ZV		0.8	total, 90th perc.		15
Trichloromethane	67-66-3	DEU	QC	DRINK-FISH	ZV (v)		3.46	total, 90th perc.	Carcinogenic risk (risk level 10-5)	15
Trichloromethane	67-66-3	DEU	QC	DRINK-SURF	ZV		1	total, 90th perc.		15
Trichloromethane	67-66-3	EEC	QS	AMBI	QZ		12	ann. mean		43
Trichloromethane	67-66-3	NL	QO	SURF	MPC		590	diss.		76
Trichloromethane	67-66-3	NL	QO	SURF	MPC		590	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichloromethane	67-66-3	NL	QO	SURF	TV		6	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichloromethane	67-66-3	Rhein	QO	RIVER	ZV		0.6	total, 90th perc.	AQL	45
Trichloromethane	67-66-3	USA	QC	AQL-FRESH	CCC		1240		Not enough data available; lowest LOEL	23
Trichloromethane	67-66-3	USA	QC	DRINK-FISH	WQC		5.7		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Trichloromethane	67-66-3	USA	QC	FISH-CONSM	WQC		470		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Trichlorophenol, 2,4,5-	95-95-4	USA	QC	AQL-FRESH	CCC		63	4-day average		50
Trichlorophenol, 2,4,5-	95-95-4	USA	QC	AQL-FRESH	CCC					77
Trichlorophenol, 2,4,5-	95-95-4	USA	QC	AQL-FRESH	CMC					77
Trichlorophenol, 2,4,5-	95-95-4	USA	QC	AQL-MARIN	CCC		11	4-day average		50
Trichlorophenol, 2,4,5-	95-95-4	USA	QC	AQL-MARIN	CCC					77
Trichlorophenol, 2,4,5-	95-95-4	USA	QC	AQL-MARIN	CMC					77
Trichlorophenol, 2,4,5-	95-95-4	USA	QC	DRINK-FISH	WQC		2600		Derivation based on: IRIS database, updated 08/04/1998	77
Trichlorophenol, 2,4,5-	95-95-4	USA	QC	FISH-CONSM	WQC		9800		Derivation based on: IRIS database, updated 08/04/1998	77
Trichlorophenol, 2,4,5-	95-95-4	USA	QC	Taste	WQC		1			77
Trichlorophenol, 2,4,5-	88-06-2	CAN	QC	DRINK	AO	<=	2	total, max. value	A target value of <2 µg/l is envisaged in order to avoid adverse effects on taste.	75,69
Trichlorophenol, 2,4,6-	88-06-2	USA	QC	Taste	WQC		2			77
Trichlorophenol, 2,4,6-	88-06-2	CAN	QC	DRINK	MAC		5	total, max. value		75, 69
Trichlorophenol, 2,4,6-	88-06-2	USA	QC	AQL-FRESH	CCC		970		Not enough data available; lowest LOEL	23

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range	Reference	Notes	Lit. No.
Trichlorophenol, 2,4,6-	88-06-2	USA	QC	DRINK-FISH	WQC	2.1		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Trichlorophenol, 2,4,6-	88-06-2	USA	QC	FISH-CONSM	WQC	6.5		IRIS database, updated 08/04/1998 Carcinogenic risk (risk level 10-6)	77
Trichlorophenols		CAN	QC	AQL-FRESH	GL	18	total, max. value		75, 1
Trichlorophenols (single)		NL	QO	SURF	MPC	3	diss.		76
Trichlorophenols (single)		NL	QO	SURF	MPC	3	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trichlorophenols (single)		NL	QO	SURF	TV	0.03	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Tricyclohexyltin		CAN	QC	AGRIC-LIVE	GL (I)	250	total, max. value		75, 6
Tricyclohexyltin		GBR	QS, E.	AGRIC-LIVE	PEQS	0.01	total, 95th perc.		31
Tricyclohexyltin		GBR	QS, E.	DRINK-SURF	PEQS	0.01	total, 95th perc.		31
Tricyclohexyltin		GBR	QS, E.	REC	PEQS	0.01	total, 95th perc.		31
Trifluralin	1582-09-8	CAN	QC	AGRIC-LIVE	GL (I)	45	total, max. value		75, 7
Trifluralin	1582-09-8	CAN	QC	AQL-FRESH	GL	0.2	total, max. value		75, 7
Trifluralin	1582-09-8	CAN	QC	DRINK	IMAC	45	total, max. value		75, 69
Trifluralin	1582-09-8	DEU	QC	AQL-FRESH	ZV (v)	0.03	total, 90th perc.		73
Trifluralin	1582-09-8	GBR	QS, E.	AQL-FRESH	PEQS	0.1	total dissolved, ann. mean		21
Trifluralin	1582-09-8	GBR	QS, E.	AQL-FRESH	PEQS	0.1	total dissolved, ann. mean		21
Trifluralin	1582-09-8	NL	QO	SURF	MPC	0.037	diss.		76
Trifluralin	1582-09-8	NL	QO	SURF	MPC	0.038	total	Value standardized to a suspended matter content of 30 mg/l.	76
Trifluralin	1582-09-8	NL	QO	SURF	TV	0.0004	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Trifluralin	1582-09-8	Rhein	QO	RIVER	ZV	0.002	total, 90th perc.	AQL	45
Trihalomethanes		CAN	QC	DRINK	IMAC	100	total, floating annual mean		75, 69
Triphenyltin, (TPT)		CAN	QC	AGRIC-LIVE	GL (I)	800	total, max. value		75, 6
Triphenyltin, (TPT)		CAN	QC	AQL-FRESH	GL (I)	0.022	total, max. value		75, 6
Triphenyltin, (TPT)		CHE	QS, E.	AQL	QZ	0.002	diss. total, tributyltin + triphenyltin		26
Triphenyltin, (TPT)		DEU	QC	AQL-FRESH	ZV (v)	0.0005	total, 90th perc.		73
Triphenyltin, (TPT)		GBR	QS, E.	AGRIC-LIVE	PEQS	0.09	total, 95th perc.		31
Triphenyltin, (TPT)		GBR	QS, E.	AQL-FRESH	PEQS	0.02	total, 95th perc.		31
Triphenyltin, (TPT)		GBR	QS, E.	AQL-MARIN	PEQS	0.008	total, 95th perc.		31
Triphenyltin, (TPT)		GBR	QS, E.	DRINK-SURF	PEQS	0.09	total, 95th perc.		31

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range			Reference	Notes	Lit. No.
Triphenyltin, (TPT)		GBR	QS	FRESH	EQS		0.02			total, max. value		63
Triphenyltin, (TPT)		GBR	QS	MARIN	EQS		0.008			total, max. value		63
Triphenyltin, (TPT)		GBR	QS, E.	REC	PEQS		0.09			total, 95th perc.		31
Triphenyltin, (TPT)		NL	QO	MARIN	MPC		0.0008			diss.		76
Triphenyltin, (TPT)		NL	QO	MARIN	MPC		0.0009			total	Value standardized to a suspended matter content of 30 mg/l.	76
Triphenyltin, (TPT)		NL	QO	MARIN	TV		0.000009			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Triphenyltin, (TPT)		NL	QO	SURF	MPC		0.005			diss.		76
Triphenyltin, (TPT)		NL	QO	SURF	MPC		0.005			total	Value standardized to a suspended matter content of 30 mg/l.	76
Triphenyltin, (TPT)		NL	QO	SURF	TV		0.00005			total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Triphenyltin, (TPT)		Rhein	QO	RIVER	ZV		0.005			total, 90th perc.	AQL	45
Tritium		CAN	QC	DRINK	MAC		7000		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Turbidity		CAN	QC	DRINK	MAC		1		NTU			75, 69
Turbidity		CAN	QC	DRINK	AO	<=	5		NTU		Refers to consumer	75, 69
Turbidity		DEU	QS	DRINK	GW		1.5		TU	turbidity unit/ formazine		78
Uranium	7440-61-1	CAN	QC	AGRIC-IRRI	GL (I)		10			total, max. value	All soils with permanent irrigation	75, 1
Uranium	7440-61-1	CAN	QC	AGRIC-LIVE	GL (I)		200			total, max. value		75, 1
Uranium	7440-61-1	CAN	QC	DRINK	MAC		100			total, max. value		75, 69
Uranium 234		CAN	QC	DRINK	MAC		4		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Uranium 235		CAN	QC	DRINK	MAC		4		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Uranium 238		CAN	QC	DRINK	MAC		4		Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Vanadium	7440-62-2	CAN	QC	AGRIC-IRRI	GL		100			total, max. value	All soils with permanent irrigation	75, 1
Vanadium	7440-62-2	CAN	QC	AGRIC-LIVE	GL		100			total, max. value		75, 1
Vanadium	7440-62-2	GBR	QS, E.	AGRIC-IRRI	PWQS		80			ann. mean		24
Vanadium	7440-62-2	GBR	QS, E.	AGRIC-IRRI	PEQS		80			total, ann. mean		30
Vanadium	7440-62-2	GBR	QS, E.	AQL-FRESH	PEQS		20			total, ann. mean	If water hardness is < 200 mg CaCO3/l.	30
Vanadium	7440-62-2	GBR	QS, E.	AQL-FRESH	PEQS		60			total, ann. mean		30
Vanadium	7440-62-2	GBR	QS, E.	AQL-MARIN	PEQS		100			total, ann. mean		30
Vanadium	7440-62-2	GBR	QS	FRESH	EQS		20	60		total, ann. mean	Depends on water hardness	63
Vanadium	7440-62-2	GBR	QS	MARIN	EQS		100			total, ann. mean	Standard based on small number of effect data only	28
Vanadium	7440-62-2	NL	QO	SURF	BACKG		0.8			diss.	Value is below detection/determination limit.	76

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range	Reference	Notes	Lit. No.
Vanadium	7440-62-2	NL	QO	SURF	BACKG		1	total	Value standardized to a suspended matter content of 30 mg/l. Value is below detection/determination limit.	76
Vanadium	7440-62-2	NL	QO	SURF	MPC		4.3	diss.		76
Vanadium	7440-62-2	NL	QO	SURF	MPC		5.1	total	Value standardized to a suspended matter content of 30 mg/l.	76
Vanadium	7440-62-2	NL	QO	SURF	TV		0.9	diss.		76
Vanadium	7440-62-2	NL	QO	SURF	TV		1	total	Value standardized to a suspended matter content of 30 mg/l.	76
Vinyl chloride	75-01-4	CAN	QC	DRINK	MAC		2			75, 69
Vinyl chloride	75-01-4	DEU	QC	DRINK	GL		2		Concentration in drinking water should be kept as low as possible. Up to the indicated value water may be supplied as drinking water.	47
Vinyl chloride	75-01-4	NL	QO	SURF	MPC		820	diss.		76
Vinyl chloride	75-01-4	NL	QO	SURF	MPC		820	total	Value standardized to a suspended matter content of 30 mg/l.	76
Vinyl chloride	75-01-4	NL	QO	SURF	TV		8	total	Value standardized to a suspended matter content of 30 mg/l.	76
Vinyl chloride	75-01-4	USA	QC	DRINK-FISH	WQC		2		Carcinogenic risk (risk level 10-6)	77
Vinyl chloride	75-01-4	USA	QC	FISH-CONSM	WQC		525		Carcinogenic risk (risk level 10-6)	77
VOX (volatile organic halogens)		NL	QO	SURF	MPC		5	total		76
Water quality category, Saprobity index		DEU-NRW	QS	SURF	AGA				Quality class II, saprobity index 1.8 - <2.3	38
Xylenes		CAN	QC	DRINK	AO	<=	300			75, 69
Xylenes (single)		NL	QO	SURF	MPC		380	diss.		76
Xylenes (single)		NL	QO	SURF	MPC		380	total	Value standardized to a suspended matter content of 30 mg/l.	76
Xylenes (single)		NL	QO	SURF	TV		4	total	Value standardized to a suspended matter content of 30 mg/l.	76
Zinc	7440-66-6	CAN	QC	AGRIC-IRRI	GL		1000	total, max. value	All soils with permanent irrigation (soils with pH value < 6.5).	75, 1
Zinc	7440-66-6	CAN	QC	AGRIC-IRRI	GL		5000	total, max. value	All soils with permanent irrigation (soils with pH value > 6.5).	75, 1
Zinc	7440-66-6	CAN	QC	AGRIC-LIVE	GL		50000	total, max. value		75, 1
Zinc	7440-66-6	CAN	QC	AQL-FRESH	GL		30	total, max. value		75, 1
Zinc	7440-66-6	CAN	QC	DRINK	AO	<=	5000	total, max. value		75, 69
Zinc	7440-66-6	CHE	QS, E.	AQL	QZ		5	diss. total		26
Zinc	7440-66-6	CHE	QS	AQL	QZ		200	diss. total		26
Zinc	7440-66-6	DEU	QC	AGRIC-IRRI	ZV		1000	total, 90th perc.		46
Zinc	7440-66-6	DEU	QC	AQL-FRESH	ZV		14	total, 90th perc.	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Zinc		DEU	QS	DRINK	RW		5000			78

Parameter	CAS No.	Area	Status	Protected Asset	Name of value		Value or Range		Reference	Notes	Lit. No.
Zinc	7440-66-6	DEU	QC	DRINK-SURF	ZV		500		total, 90th perc.		46
Zinc	7440-66-6	DEU	QC	RIVER	BACKG		3.5		total	Value refers to waters with a 25 mg/l average concentration of suspended matter.	46
Zinc	7440-66-6	DEU-NRW	QS	AGRIC-IRRI	GL		2000				38
Zinc	7440-66-6	DEU-NRW	QS	DRINK-SURF	G, A1		500			According to EC Directive 75/440/EEC	38
Zinc	7440-66-6	DEU-NRW	QS	DRINK-SURF	G, A2		1000			According to EC Directive 75/440/EEC	38
Zinc	7440-66-6	DEU-NRW	QS	DRINK-SURF	I, A1		3000			According to EC Directive 75/440/EEC	38
Zinc	7440-66-6	DEU-NRW	QS	DRINK-SURF	I, A2		5000			According to EC Directive 75/440/EEC	38
Zinc	7440-66-6	DEU-NRW	QS	FISH	I, Cyp.	<	1000		total, 95th perc.	According to EC Directive 78/659/EEC. The values in the directive are graded by water hardness degrees; indicated value refers to 100 mg CaCO3/l.	38
Zinc	7440-66-6	DEU-NRW	QS	FISH	I, Salmo.	<	300		total, 95th perc.	According to EC Directive 78/659/EEC. The values in the directive are graded by water hardness degrees; indicated value refers to 100 mg CaCO3/l.	38
Zinc	7440-66-6	DEU-NRW	QS	SURF	AGA	<=	300		total, 90th perc.		38
Zinc	7440-66-6	GBR	QS, E.	AGRIC-IRRI	PWQS		1000		ann. mean		24
Zinc	7440-66-6	GBR	QS, E.	AGRIC-LIVE	PWQS		25000		ann. mean		24
Zinc	7440-66-6	GBR	QS	FRESH	EQS		8	50	diss., ann. mean		63
Zinc	7440-66-6	GBR	QS	MARIN	EQS		10		diss., ann. mean	There are signs that invertebrates in waters with low salt content are especially sensitive to zinc.	28, 63
Zinc	7440-66-6	NL	QO	SURF	BACKG		2.8		diss.		76
Zinc	7440-66-6	NL	QO	SURF	BACKG		12		total	Value standardized to a suspended matter content of 30 mg/l.	76
Zinc	7440-66-6	NL	QO	SURF	MPC		9.4		diss.		76
Zinc	7440-66-6	NL	QO	SURF	MPC		40		total	Value standardized to a suspended matter content of 30 mg/l.	76
Zinc	7440-66-6	NL	QO	SURF	TV		2.9		diss.		76
Zinc	7440-66-6	NL	QO	SURF	TV		12		total	Value standardized to a suspended matter content of 30 mg/l.	76
Zinc	7440-66-6	Nordsee	QC	MARIN	EAC		0.5	5	diss.		27
Zinc	7440-66-6	SWE	QC	SURF-CLASS	Class 2		1	5		Class 2 = good	56
Zinc	7440-66-6	USA	QC	AQL-FRESH	CCC		110			Depends on hardness Value refers to 100 (mg/l) CaCO3.	23
Zinc	7440-66-6	USA	QC	AQL-FRESH	CCC		120			Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77
Zinc	7440-66-6	USA	QC	AQL-FRESH	CMC		120			Dissolved concentration; depends on hardness; value refers to 100 (mg/l) CaCO3. Derivation published in document EPA-820-B-96-001.	77
Zinc	7440-66-6	USA	QC	AQL-MARIN	CCC		96				23
Zinc	7440-66-6	USA	QC	AQL-MARIN	CCC		81			Dissolved concentration	77
Zinc	7440-66-6	USA	QC	AQL-MARIN	CMC		90			Dissolved concentration	77

Parameter	CAS No.	Area	Status	Protected Asset	Name of value	Value or Range		Reference	Notes	Lit. No.
Zinc	7440-66-6	USA	QC	DRINK-FISH	WQC	9100				77
Zinc	7440-66-6	USA	QC	FISH-CONSM	WQC	69000				77
Zinc	7440-66-6	USA-GL	QC	AQL-FRESH	CCC	60		total		52
Zinc 65		CAN	QC	DRINK	MAC	40	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75
Zineb	12122-67-7	NL	QO	SURF	MPC			diss.	See ETU (degradation product of zineb)	76
Zirconium 95		CAN	QC	DRINK	MAC	100	Bq/l	max. value	If several radionuclides are present: Total Ci / MACi <= 1	75