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Analysis of the variability between national EQS values across Europe for selected Water Framework Directive River Basin-Specific Pollutants

Scientific Report from DCE – Danish Centre for Environment and Energy No. 198 2016

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Data sheet

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Abstract: Under the Water Framework Directive of the European Union (EU), member states are to establish national environmental quality standards (EQSs) for River Basin Specific Pollutants. A technical guidance document (TGD) exists, which was published in 2011. Despite of this, previous studies have shown a significant variation between national EQS values. The aim of the present study was to investigate possible reasons for the variability observed for some EQS values derived by individual member states.Based on questionnaires targeting 19 selected substances with relatively large EQS variations, the member states provided details on how the national EQSs for these substances had been derived . The analysis showed that the year of the different national EQSs (e.g. older than the TGD) likely caused some variation. While other EU guidance and directives had been used frequently, the TGD had only been used for few of the selected substances. Furthermore, the protection endpoint and hence assessment factor used also contributed to the variation.

Keywords: Environmental Quality Standards (EQS); Freshwater; Member States; Pollutants; Technical Guidance Document (TGD); Water Framework Directive (WFD)

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1 Introduction

As part of a common implementation strategy of the Water Framework Directive (EU, 2000), a technical guidance document (EC, 2011) was developed in which methods for deriving environmental quality standards (EQSs) are elaborated. In addition to maximum allowable concentration (MAC) EQSs and annual average (AA) EQSs, protecting aquatic organisms from acute and chronic effects, respectively, EU-wide EQSs in biota have been set for some priority substances to protect against secondary poisoning or to protect human health. For River Basin Specific Pollutants, member states are to establish national EQSs, according to the procedure described in the WFD and the guidance document no. 27 (EU, 2000; EC, 2011). Alternatively to water EQSs, member states can set sediment or biota EQSs, as long as they provide the same level of protection. Depending on the amount and character of the data, the derivation is performed according to 3 approaches: (i) the assessment factor (AF) approach, (ii) the species sensitivity distribution (SSD) approach and (iii) the multispecies test.

Previous work by the German Federal Environment Agency (Irmer et al., 2012; 2014; Claussen et al., 2012; 2014) and others showed that 452 substances were regulated in Europe by national EQS values. Of these, 263 substances were regulated by at least two countries, leading to a possibility of variation. For 54 substances, Claussen et al. (2014) found a > 100fold divergence between minimum and maximum value. Initial work on analyzing the reasons for the observed EQS variability was performed by Ceriani et al. (2013) for examples of metals, pesticides and industrial chemicals, identifying not one consistent cause of variability, but a combination of several factors.

The aim of the present study was to investigate possible reasons for the high degree of variability observed for some EQS values determined by different member states. The study focussed on AA-EQS values in freshwater.

2 Methods

We selected the compounds in Table 1 for the assessment, based on the previous work by the German Federal Environment Agency (Irmer et al., 2012; 2014) and the following self-defined criteria:

- Ratio of >100 between maximum and minimum EQS values,
- logK$_{OW}$ >2
- at least 6 countries that have set an EQS value.

As some EQS values were subsequently corrected by member states, not all of these criteria are met in the final compound list (Table 1). The study includes several of the substances for which most EQS values exist (Claussen et al., 2012), e.g. zinc, selenium, chlorobenzene, ethylbenzene and bentazone.

Table 1. Selected compounds for assessment, based on data availability as of March 2015 and the selection criteria described in the text.

CAS no.	Compound name	Maximum EQS value (µg/L)	Minimum EQS value (µg/L)	Ratio Max/Min	Number of values	logK$_{OW}$
64743-03-9	Phenols (petroleum)	300	8	38	3	3.2
1066-51-9	(Aminomethyl)-phophonic acid (AMPA)	452	79.7	6	3	-2.5
106-93-4	1,2-Dibromo-ethane	2	0.002	1000	5	2.1
25057-89-0	Bentazone	500	0.1	5000	14	2.3
37680-73-2	PCB-101	0.0005	0.0001	5	4	7
75-01-4	Vinylchloride	100	0.008	12500	9	1.7
7440-61-1	Uranium	24	0.015	1600	6	-
108-90-7	Chlorobenzene	32	1	32	10	2.88
4770-48-4	Cobalt	50	0.2	250	8	-
7782-49-2	Selenium	20	0.052	385	12	-
298-00-0	Methyl-parathion	0.1	0.0002	500	9	2.75
121-75-5	Malathion	0.1	0.0002	500	11	2.4
86-50-0	Azinphos-methyl	0.1	0.001	100	7	2.5
7440-66-6	Zinc	1300	3.1	419	25	-
10-46-7	1,4-Dichloro-benzene	20	0.25	80	12	3.44
95-50-1	1,2-Dichloro-benzene	20	0.25	80	10	3.43
90-13-1	1-Chloro-naphthalene	2.7	0.01	270	6	3.8
7440-22-4	Silver	5	0.01	500	7	-
100-41-4	Ethylbenzene	65	1	65	14	3.1

A questionnaire was circulated to all EU countries in autumn 2014, to consolidate the data set and to explore the background for EQS derivation. The questionnaire included the national EQS values taken from Irmer et al. (2012; 2014), and the following ten questions:

1. If the value is incorrect, please add the correct value.
2. Which year was the EQS set?
3. Did you use Technical Guidance Document No. 27 for deriving EQS?
4. Did you employ the deterministic (assessment factor, AF) method or species sensitivity distribution (SSD) plus AF method?
5. Did you employ micro- or mesocosm studies and / or field studies?
6. What was the value of the assessment factor used?

7. Which endpoint and value triggered the EQS?
8. What was the reliability index score (e.g. Klimisch) of the trigger value?
9. Please provide the reference for the trigger value.
10. Please provide a brief summary of your weight-of-evidence rationale. Alternatively, you may attach your data sheet or dossier for the substance.

The results have been summarized in fact sheets for each compound in Annex 1. These fact sheets provide a quick overview of the data and their background and they have been used to address the overall comparisons and analyses.

3 Results and discussion

In a first step, the responses received to the questionnaire were used to correct and complete the data set. No response to the questionnaire was received from Bulgaria, Hungary, Malta, Poland and Romania. As no EQS values were on the orginal list for Malta and Hungary, the data set might be incomplete with regard to these two countries. For Bulgaria, Poland and Romania this means that their EQS values on the list were not confirmed and might be erroneous. Some other countries did respond, but did not fill in the questionnaire (Austria, Belgium / Wallonia, Finland, Greece, UK). While Austria and Finland provided background material instead, no EQS confirmation or elucidation was received from the other three countries. Belgium generally has two sets of EQS values for Wallonia and Flanders, which were treated separately in the data analysis. Thus, a total of 18 countries provided information, however, the level of detail in the response to the questionnaire and the amount of additional background material provided differed considerably between member states.

Based on the original list and questionnaire responses, we worked with a total of 175 EQS values. As can be seen from Table 1, the pollutant with the highest number of EQS values was zinc (25 EQS values). Five of the selected pollutants (bentazone, selenium, malathion, 1,4-dichlorobenzene and ethylbenzene) had more than ten EQS values. At the other end of the spectrum, phenols (petroleum) and (aminomethyl)phosphonic acid (AMPA) only had three EQS values each (Table 1).

Broken down by country, the highest number of EQS values (for the selected specific pollutants and the present data set) has been set by the Netherlands, followed by Belgium (Flanders) and Germany (Figure 1). In those cases where only one EQS value was set for the selected pollutants (Croatia, Cyprus, Estonia, Lithuania, Slovakia), this was for zinc. The only countries not reporting an EQS value for zinc are Finland and Italy.

The following factors will be discussed with regard to their importance for explaining the variation observed between national EQS values:

1. Year of deriving the EQS value

Ceriani et al. (2013) concluded that one of the main reasons for the variability of EQS values was the fact that they had been adopted in previous regimes. The majority of the EQS values analysed in this study had also been derived prior to the publication of the EU guidance document (EC, 2011). Figure 2 shows that 63% of all values analysed in this study (111 EQS values) were derived in 2010 or earlier. For 25% of the values (44 values), the year of their derivation was unknown, either because the countries with EQS values did not reply to the questionnaire or because this piece of information was not provided. The remaining 20 values (12%) have been set since 2010. In cases where an original value was set before 2010, but confirmed after 2010, the date of the original derivation was counted. This was the case, for example, for vinylchloride in Denmark and bentazone in Portugal and where original values of 2009 were confirmed in 2013 and 2014, respectively.

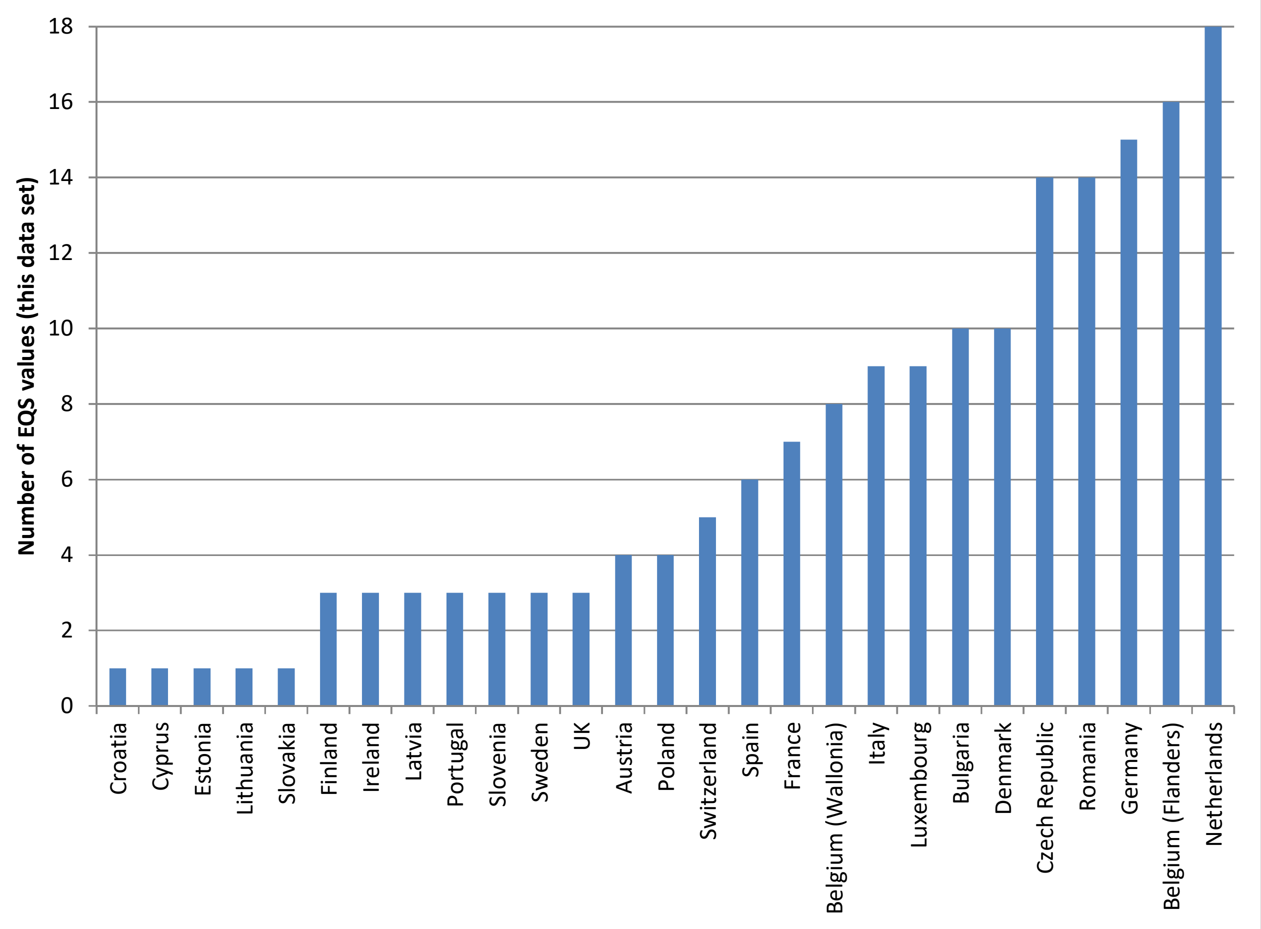
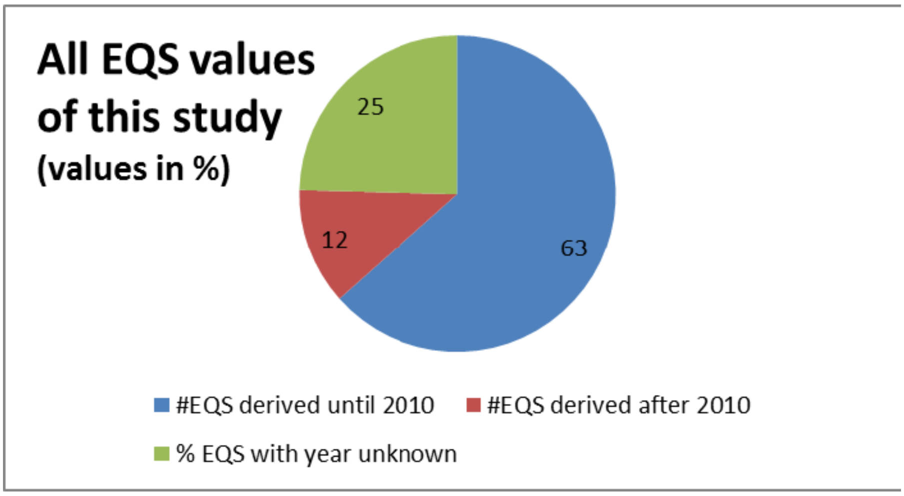


Figure 1. Number of EQS values in each member state for the specific pollutants selected for this study.

Figure 2. Percental distribution of dates of EQS derivation (N=175) before and after 2010.



For all individual pollutants, the majority of EQS values (50-86%) were derived prior to (or in) 2010, the only exception being 1-chloronaphthalene for which two values exist in each of the three categories (i.e. 33% in each category). Figure 3 shows the distribution for the three pollutants with the highest number of EQS values, i.e. zinc (24 EQS values), bentazone and ethylbenzene (14 EQS values each). Ethylbenzene is the pollutant with the highest number of EQS values in the "after 2010" time category (4 values, corresponding to 29%). Of these four values, three values are identical, i.e. France, the Netherlands and Portugal use a value of 65 µg/L.

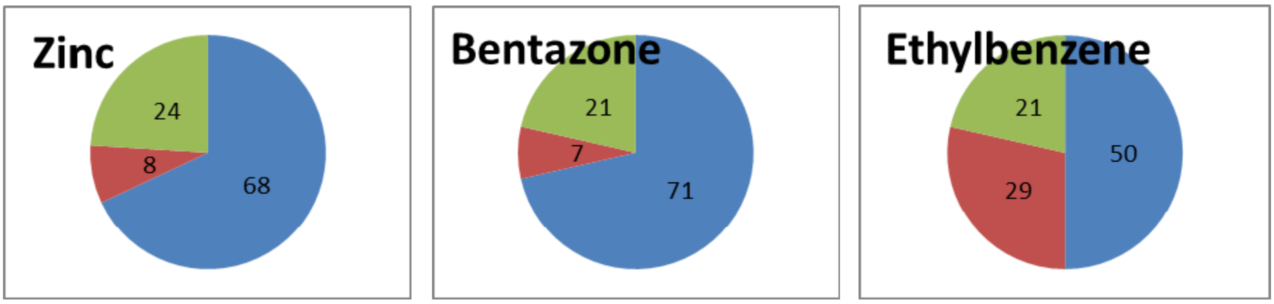


Figure 3. Percental distribution of dates of EQS derivation for the compounds with the highest number of EQS values: Zinc (N=24), bentazone (N=14) and ethylbenzene (N=14). Legend: See Figure 2.

There are only six pollutants in our data set for which more than one EQS value has been derived since 2010 (uranium, zinc, 1,4-dichlorobenzene, 1-chloronaphthalene, silver, ethylbenzene). With the exception of ethylbenzene, as discussed above, none of these pollutants had identical EQS values for two countries. For all of these compounds except uranium, one value is that from Germany, where several EQS values were defined in national legislation (“Gewässerschutzverordnung“) in 2011, but most likely derived prior to 2011. Two of these values (1,4-dichlorobenzene, 1-chloronaphthalene) are based on a previous evaluation of the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission (CSTE, 1994). These few examples do not support higher agreement between recently set EQS values, but they are most likely not representative of all specific pollutants.

Given the low number of EQS values derived on the basis of the EU technical guidance document (EC, 2011), its influence on EQS variations can hardly be assessed in this study. It could also be argued that our approach of focussing on large EQS variations might have favoured the selection of pollutants for which EQS values had been derived prior to the publication of EC (2011). However, the previous study by Irmer et al. (2014) covering all substances – as opposed to those with the largest maximum/minimum ratios – showed that only 3 out of 19 member states had used EC (2011) at the time. More data would be needed on the past-2010/2011 variation, to assess whether the use of EC (2011) is associated with lower EQS variability.

2. Use of other EU documents

As discussed above, the majority of EQS values in this study had been derived prior to the publication of the EU technical guidance document (EC, 2011). Some countries referred to documents which can be considered predecessors of EC (2011), e.g. Lepper (2005), or to national guidance in line with Lepper (2005) and the subsequent technical guidance document EC (2011), e.g. the Netherlands and Sweden. Furthermore, several other EU documents have been used in the context of EQS derivation, as summarised in table 2.

In the EU Risk Assessment Report on zinc where a directly applicable value was published (EU, 2010), this value was adopted by several countries. However, technical details such as dependence on water hardness or relevant natural background concentrations (added risk approach), were not specified by all countries which had based their EQS value on EU (2010). Interestingly, a limit value for zinc in freshwater was also given in the EU Directive 2006/44/EC (EU, 2006), but this was only adopted by Cyprus.

Table 2. Summary of EU issued documents used in the EQS derivation (other than EC, 2011).

Document source	Countries	Resulting EQS values (µg/L)	Reference
Selenium			
Directive 98/83/EC on the quality of water intended for human consumption	Italy	10	EU (1998)
Azinphos-methyl			
Directive 2000/60/EC, Annex V, Section 1.2.6 ("Procedure for the setting of chemical quality standards by the member states")	Italy	0.01 µg/L	EU (2000)
Zinc			
Technical Guidance Document in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances.	Spain	30; 200; 300 and 500 µg/L (depending on water hardness)	EC (2003)
EU Risk Assessment Report	Austria, Bulgaria, Croatia, Denmark, France, Netherlands, Portugal, Slovakia, Slovenia, Sweden.	7.8 (+C_b) µg/L. Not all countries specify whether or not the natural background (+C_b) has to be added. Some countries give additional values for other hardness categories.	EU (2010)
EU Directive 2006/44/EC on the quality of fresh waters needing protection or improvement in order to support fish life	Cyprus	1100 and 1300 µg/L (for river and lakes, respectively).	EU (2006)
1,4-Dichlorobenzene			
Directive 2000/60/EC, Annex V, Section 1.2.6 ("Procedure for the setting of chemical quality standards by the member states")	Finland, Italy	20 µg/L; 2 µg/L	EU (2000)
Technical Guidance Document in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances.	Finland, Spain	20 µg/L	EC (2003)
1-Chloronaphthalene			
Technical Guidance Document in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances.	Denmark	2.7 µg/L	EC (2003)
Silver			
Directive 2000/60/EC, Annex V, Section 1.2.6 ("Procedure for the setting of chemical quality standards by the member states")	Austria	0.1 µg/L	EU (2000)
Ethylbenzene			
Technical Guidance Document in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances.	Austria, Denmark, Spain	10 µg/L; 20 µg/L; 30 µg/L.	EC (2003)

The guidance document on risk assessment (EC, 2003) has been used in several cases. For 1,4-dichlorobenzene, the two countries referring to EC (2003) set the same EQS value. For ethylbenzene, however, the three countries using EC (2003) have three different EQS values.

For several substances, EQS values were set with a reference to Annex V of Directive 2000/60/EC (EU, 2000), for example for 1,4-dichlorobenzene. Although Finland and Italy mentioned the same approach they used different studies for their trigger value (NOEC/EC_{50} values) and different assessment factors. Irmer et al. (2014) reported that 11 out of 19 member states used this guidance, clearly more than had used EC (2011) at the time of the study.

3. Species sensitivity distribution (SSD) vs. deterministic approaches

The majority of EQS values was derived in deterministic approaches, i.e. from a specific study combined with an assessment factor (Figure 4). It has to be noted that nine of the EQS values for zinc are based on the EU Risk Assessment Report for Zinc (EU, 2010), which uses a species sensitivity distribution. It should also be noted that for approximately half of all the EQS values analysed in this study, the approach was unknown or largely unspecified. We assumed deterministic approaches for these EQS values (Figure 4), which account for approximately 60% of the values in the group of “deterministic and unspecified approaches”. The primary choice of deterministic approaches seems to be related to limited data.

Selenium, silver and zinc are the only substances in this data set for which more than one country applied an SSD approach (Figure 4). Zinc is not suitable for further analysis in this context because all but one of these SSD applications refer back to the EU Risk Assessment Report for Zn (EU, 2010). The case of selenium is described in detail in Table 3 where it becomes apparent that the initial data selection seems to be the main factor in this particular SSD outcome. The example of silver (see Annex 1) further shows the influence of different assessment factors applied to the HC_5 values[1], whose range from 1-5 can contribute to the overall variation accordingly.

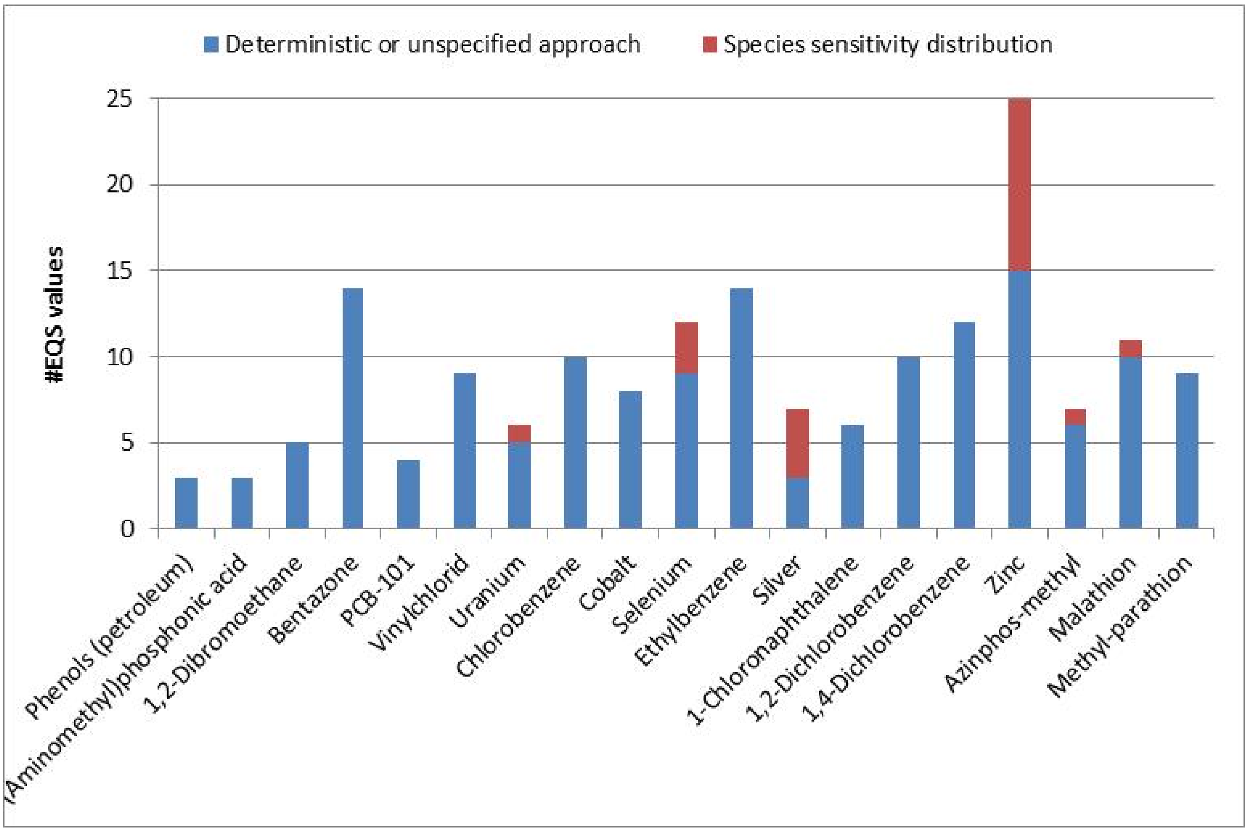


Figure 4. Number of EQS values with a determinisitic (or unspecified) approach or based on species sensitivity distributions.

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[1] Hazardous concentration threshold for 5% of the species, result of the species sensitivity distribution.

In the case of selenium, two countries stated that the deterministic approach would result in a value of 0.2 µg/L, based on the lowest NOEC of the available data and an assessment factor of 10 (Nendza et al., 2003; van Vlaardingen et al., 2005). Not only demonstrates this comparison the large difference to the SSD-derived values (Table 3), it is also striking that amongst the remaining nine EQSs (derived in deterministic approaches) the value of 0.2 µg/L does not appear (Annex 1). In one case (the Netherlands), the SSD-derived value was higher than that considering secondary poisoning and was therefore disregarded (not included in Fig. 4). Differences in the overall approaches were also considered one of the main reasons for inconsistent EQS values by Ceriani et al. (2013).

Table 3. Selenium – a case study for a detailed analysis of variations in SSD approaches. AF: Assessment Factor. MPA: Maximum permissible addition. C_b: Natural background concentration. MPC: Maximum permissible concentration (here used equivalently to EQS).

	Data source	HC_5 (µg/L)	AF	MPA (µg/L)	C_b (µg/L)	MPC (µg/L)
Austria	Toxicity data on 31 freshwater and marine species (Crommentuijn et al. , 1997)	5.3	1	5.3	0.04*	5.3
Belgium (Flanders)	Toxicity data on 23 freshwater and marine species (Van Vlaardingen et al., 2005)	4.2	2	2.1	0.04*	2.1
Germany	Toxicity data on 23 freshwater species (Nendza et al., 2003)	5.3	2	2.5	<< 10% of MPA*	2.5

*disregarded in MPC calculation because of the low concentration.

4. Assessment factors

Although assessment factors were involved in the majority of EQS derivations, very little information was available on the reasons for a specific assessment factor.

The influence of different assessment factors can be illustrated by the example of ethylbenzene (Table 4). Three countries used the same study and the initial value of 1000 µg/L (Denmark, France, the Netherlands), but different assessment factors. Denmark used an assessment factor of 50 to account for potential specific effects, while the other two countries used an assessment factor of 10. These concentration differences have further implications in comparisons with EQS values derived for secondary poisoning or human exposure: The EQS values considering the risk of secondary poisoning and the risk of human health were lower than the EQS_{fresh} value if an assessment factor of 10 was used in deriving EQS_{fresh}. Consequently, the $EQS_{Human\ health}$ was chosen as the final EQS value for freshwater by France and the Netherlands. This comparison illustrates that the EQS values are derived in a complex process and that a difference of 5 in an assessment factor can have consequences in other parts of this process.

Table 4. Ethylbenzene – a case study for the effect of differences in assessment factors (AF).

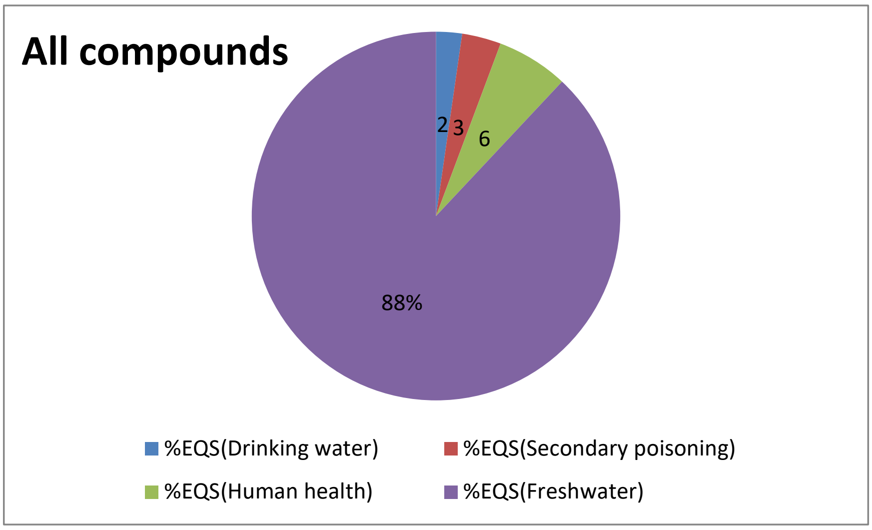
	Data source for EQS_{fresh}	AF	EQS_{fresh} (µg/L)	$EQS_{Secondary\ poisoning}$ (µg/L)	$EQS_{Human\ health}$ (µg/L)	Final EQS (µg/L)
Denmark	NOEC of 1000 □g/L for *Ceriodaphnia dubia* (7 days) (Niederlehner et al., 1998)	50	20	Not considered	Not considered	20
France		10	100	119	65	65
The Netherlands		10	100	237	65	65

5. Considerations of secondary poisoning or human health

As described above, the trigger for the EQS was in some cases obtained via a focus on protection of drinking water, higher trophic level animals via secondary poisoning or human health via consumption of fish. However, this was the case for a minority of all EQS values analysed in this study (Figure 5). Based on individual substances, 1,2-dibromoethane and vinylchloride had a higher percentage of EQS values derived for drinking water, secondary poisoning or human health, i.e. 56% and 40%, respectively. Based on countries deriving the EQS values, Denmark had 4 EQS values out of a total of 10 EQS values (40%) focussing on drinking water, secondary poisoning or human health. Other countries with a higher percentage of these values (relatively to their total number of EQS values) were the Netherlands (39%) and Italy (88%), the latter only referring to drinking water.

In detail, EQS values based on drinking water, secondary poisoning and human health were set for 1,2-dibromoethane for the Netherlands and Belgium (Flanders) (human health); chlorobenzene for Finland (human health); bentazone for Germany (drinking water); PCB-101 for Germany (human health); vinylchloride for Germany and Italy (drinking water) and the Netherlands, Belgium (Flanders) and Denmark (human health); uranium for Denmark (human health); selenium for Italy (drinking water) and the Netherlands and Denmark (seondary poisoning); ethylbenzene for the Netherlands and France (human health); 1-chloronaphthalene for Denmark (secondary poisoning); 1,2-dichlorobenzene and 1,4-dichlorobenzene for the Netherlands (both secondary poisoning). We also consider the EQS values set by Cyprus for zinc as protective of secondary poisoning as they originate from the EU Directive 2006/44/EC on the quality of fresh waters needing protection or improvement in order to support fish life (EU, 2006), see Table 2. In all other case the trigger was the environmental protection aim for freshwater (see Annex 1).

Figure 5. Percentages of EQS values of this study derived for protection of drinking water and human health or for protection from secondary poisoning.



Besides the obvious source of variation introduced by different approaches, the example of ethylbenzene (Table 4) also shows variation within one approach, for example the protection from secondary poisoning. In the example given in table 4, identical values were used by France and the Netherlands for the bioconcentration factor and the biomagnification factor, yet the result differs by approximately a factor of 2 because of different source data.

6. Geography

It is clear that national geography plays a role in the implementation of EQSs. Below is a table of the distribution of EQS maximum (red) and minimum (green) values distributed between Northern and Western Europe and Southern and Eastern Europe. They are fairly evenly distributed, however, the level of available detail behind the EQS values is significantly higher in N / W Europe.

Table 5. Geographical distribution of lowest (green) and highest (red) EQS value for each compound.

CAS-No	Name of Substance	EU-N/W	EU-S/E
64743-03-9	Phenols (petroleum)	🟩	🟥
1066-51-9	(Aminomethyl)phosphonic acid	🟥	🟩
106-93-4	1,2-Dibromoethane	🟥	🟩
25057-89-0	Bentazone	🟥	🟩
37680-73-2	PCB-101	🟥	🟩
75-01-4	Vinylchloride	🟥	🟩
7440-61-1	Uranium	🟩	🟥
108-90-7	Chlorobenzene	🟥	🟩
7440-48-4	Cobalt	🟩	🟥
7782-49-2	Selenium	🟩	🟥
100-41-4	Ethylbenzene	🟥	🟩
7440-22-4	Silver	🟩	🟥
90-13-1	1-Chloronaphthalene	🟥	🟩
95-50-1	1,2-Dichlorobenzene	🟥	🟩
106-46-7	1,4-Dichlorobenzene	🟥	🟩
7440-66-6	Zinc	🟩	🟥
86-50-0	Azinphos-methyl	🟥	🟩
121-75-5	Malathion	🟥	🟩
298-00-0	Parathion-methyl	🟥	🟩

7. Added risk concept

The added risk concept is relevant for compounds where there is a natural background level to be taken into account. Five naturally occuring chemical elements were included in our data set (Co, Se, Ur, Ag, Zn) for which the added risk concept was applied by some, but not all countries. In the majority of the cases that did not use an added risk approach, no or insufficient further information was provided. In a few cases, specific limit values were adopted from other directives, as outlined in Table 2, for example for selenium by Italy (EU, 1998) or for zinc by Cyprus (EU, 2006).

Some countries did use an added risk approach, but did not distinguish between maximum permissible addition (MPA) and maximum permissible concentrations (MPC) because of very low natural background concentrations. This is also apparent from the example of selenium in Table 3. A natural background of zero or of a negligible concentration was also considered or assumed, for example, for silver by Austria, Belgium (Flanders), Germany and the Netherlands.

For zinc, several countries used the same EQS value which originates from an EU Risk Assessment Report (EU, 2010). This report used the added risk approach, with the consequence that the individual countries would have to add specific natural background concentrations to the MPA value. However, this has only been addressed by a few countries, so several countries are either not aware of the potential difference between MPA and MPC, work with a natural background of zero or have not provided this specific piece of information.

The added risk approach was applied in the following cases: Uranium for Belgium (Flanders), Denmark, the Netherlands and Sweden; Cobalt for Denmark and Belgium (Flanders); Selenium for Austria, Belgium (Flanders) and Denmark; Zinc for Austria, Belgium (Flanders), Croatia, Denmark, France, Germany, the Netherlands and Sweden. Metals represent a specific methodological challenge, which was not always very well described by the respondents. In principle all countries should consider added risk for metals and other naturally occuring compounds.

8. Other determinants

The Klimisch score was not reported often. Mesocosm studies were not reported in very many EQS values as the trigger value. The specific trigger value and study did also vary significantly between the countries, while there were also some EQS values where the same study was used by multiple countries, as for example shown for ethylbenzene in table 4.

In summary, the main reasons previously identified for EQS variability by Ceriani et al. (2013), i.e. EQS values adopted from previous regimes, differences in choice of critical data, deterministic vs. probabilistic approaches and inclusion of other routes than direct ecotoxicity have also been found to be important factors in this study. Other factors seem to play a role as well, as discussed above, and add to the overall complexity.

4 Conclusions

In this analysis, we have identified several factors which contribute to the high variability observed for some EQS values set by individual member states. The EU Technical Guidance Document (EC, 2011) had little influence on the EQS values discussed here as the majority of these EQS values was in place before the guidance document was published. As illustrated in Table 2, we observed a general interest in using values or following guidance issued by the EU, however, as multiple documents were used, this rather increased than reduced the variability. It can probably be expected that reference to just one document (EC, 2011) will reduce some of this variability. The example of Zn showed that the value published in EU (2010) was adopted by about half of the countries. But even here, scientific and technical details (water hardness, dissolved vs. total Zn, added risk approach) were handled differently.

We have shown that only a relatively small number of EQS values were derived from species sensitivity distributions, apparently still owing to a lack of data. Deterministic approaches are less robust and more likely to result in a higher EQS variation because of a high number of possible combinations of source data and assessment factors. The potential variation obviously increases with other approaches (secondary poisoning, human health) used in parallel as more and more potentially varying parameters are used (e.g. bioconcentration factors, partition coefficients).

A large number of EQS values remains which cannot be adequately analysed and explained because of insufficient background data. In several cases, we received the information that even at the EQS setting national authority, this background material was not available and the methods of EQS derivation could not be explained.

5 References

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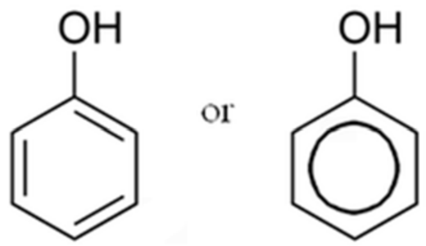
Annex 1. Fact sheets for specific pollutants

1. Phenols (CAS-nr. 64743-03-9)

Hans Sanderson



EQS values have been set for phenols by three European countries (see Table 1). The values range from 7.7 µg/L (Ireland) to 300 µg/L (Latvia). The original table also included a value of 1 µg/L for Lithuania (which would be the lowest of the data set). However, this value was not confirmed in the reply to the questionnaire and has therefore been removed from the data set.

None of the three countries had used the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011). Ireland used a deterministic approach and AF = 10 whereas Latvia explained in a general comment on their EQS values that they had reviewed other countries' EQS values. However, this might not have been the case for phenol for which very few EQS values exist. No reply has been received from Romania. The Irish value is the most appropriate from a technical point of view.

Table 1: List of EQS values for Phenols and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Latvia	300	Reply from Latvia: "The EQS for river basin specific substances were set in 2002. It was time when my country carried out a lot of work to joint to the EU, inter alia, developed national legislative acts in the water sector. A lot of bilateral projects together with experts from the EU countries were also realized to transpose the EU requirements regarding water protection. Taking into account that we didn't have previous experience/knowledge how to derive these EQS's, our approach was quite simple: we collected information about the EQS's from those EU countries where they were already established and then made final decision about EQS's relevant for us keeping in mind local conditions as well as following recommendations of project partners. Up to now these EQS's are not revised."	No
Ireland	7.7	The value was derived in 2009 and is identical with the UK value (of which no information has been received). The value is based on a NOEC of 77 µg/L (60d for fish *C. mirigala*). An assessment factor of 10 was applied because algae, crustaceans and fish were available in the chronic dataset.	No
Romania	11	No reply	Unknown

The current analysis is also summarized in Figure 1.

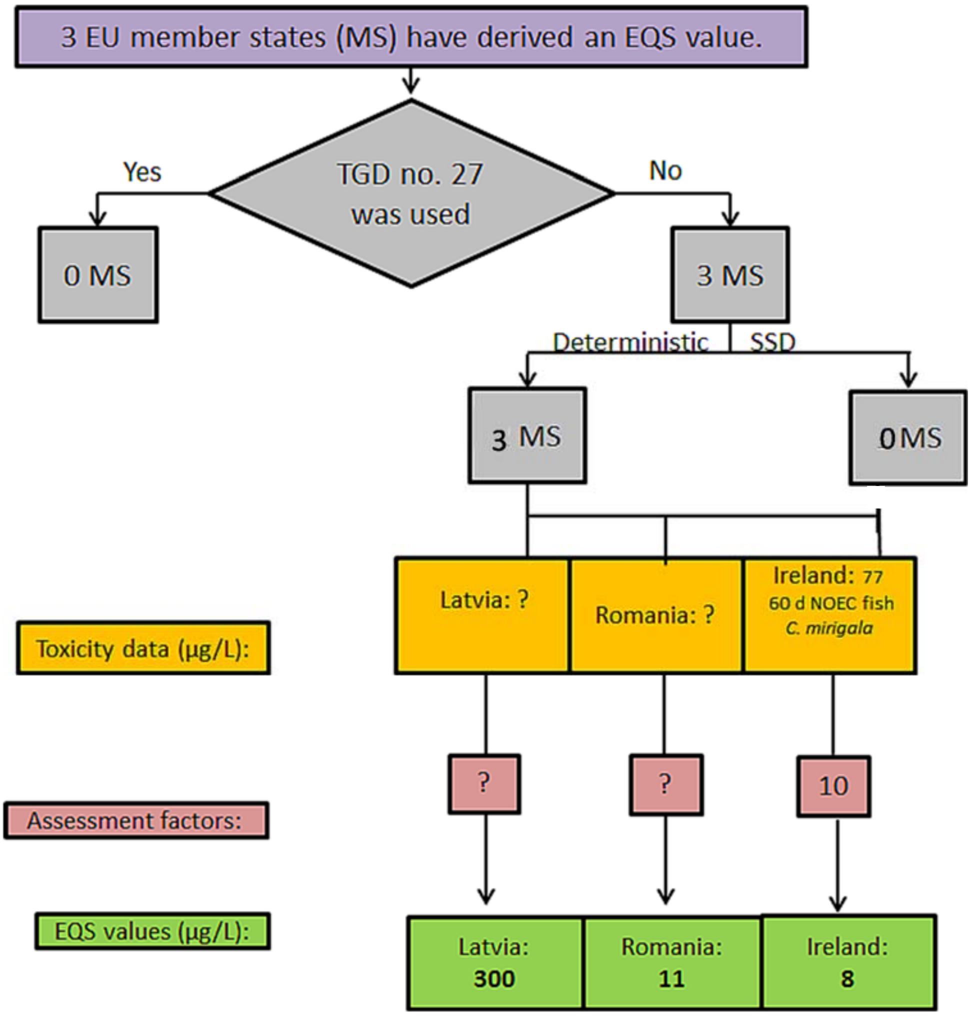
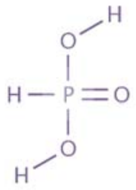


Figure 1: Analysis of EQS values for phenols. For Romania, it was assumed that the TGD no. 27 was not used.

2. (Aminomethyl)phosphonic acid (CAS-nr. 106 6-51-9)

Hans Sanderson



Three countries have national EQS values (Czech, France and Netherlands) ranging from 79.7 (Netherlands) to 452 µg/L (France). One country (France) had used the TGD, and one country (Netherlands) has an EQS from before the TGD. They all used deterministic and AF =1000.The value from France is the most recent and the only one which used the TDG (2011), and is hence the technically most sound value.

Table 2: List of EQS values for methyl-parathion and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Czech Republic	250	The value was derived in 2010. The basis apparently was a concentration of 249500 µg/l (acute LC50 - fish) – no reference is given. To reach a final value of 250 µg/L, the 249500 µg/L must be divided by an assessment factor of 1000. One acute LC50 value for fish and one acute LC50 for invertebrates data. AF factor under Annex V WFD has been chosen. Main reference was: USEPA OPP aquatic bench mark values.	No, but reference to Annex V of EU (2000)
France	452	The value was derived in 2014. Algae ErC50 (72h) = 452000 µg/l was the trigger values with an assessment factor of 1000, resulting in a concentration of 452 µg/L. Reference: Traas, T. P. and C. E. Smit (2003). Environmental Risk Limits for aminomethylphosphonic acid (AMPA). RIVM, National Institute of Public Health and the Environment. At least 3 EC50 for algae and daphnia and fish, which are in the same order of magnitude, but only one NOEC, for algae, hence AF = 1000.	Yes
The Netherlands	79.7	The value was derived in 2003 before the TGD. EC50 79.7 mg/L for algae, with the dossier data on glyphosate from national authorization. An assessment factor of 1000 was used, resulting at a concentration of 79.7 µg/L. http://www.rivm.nl/bibliotheek/rapporten/601501018.pdf	No

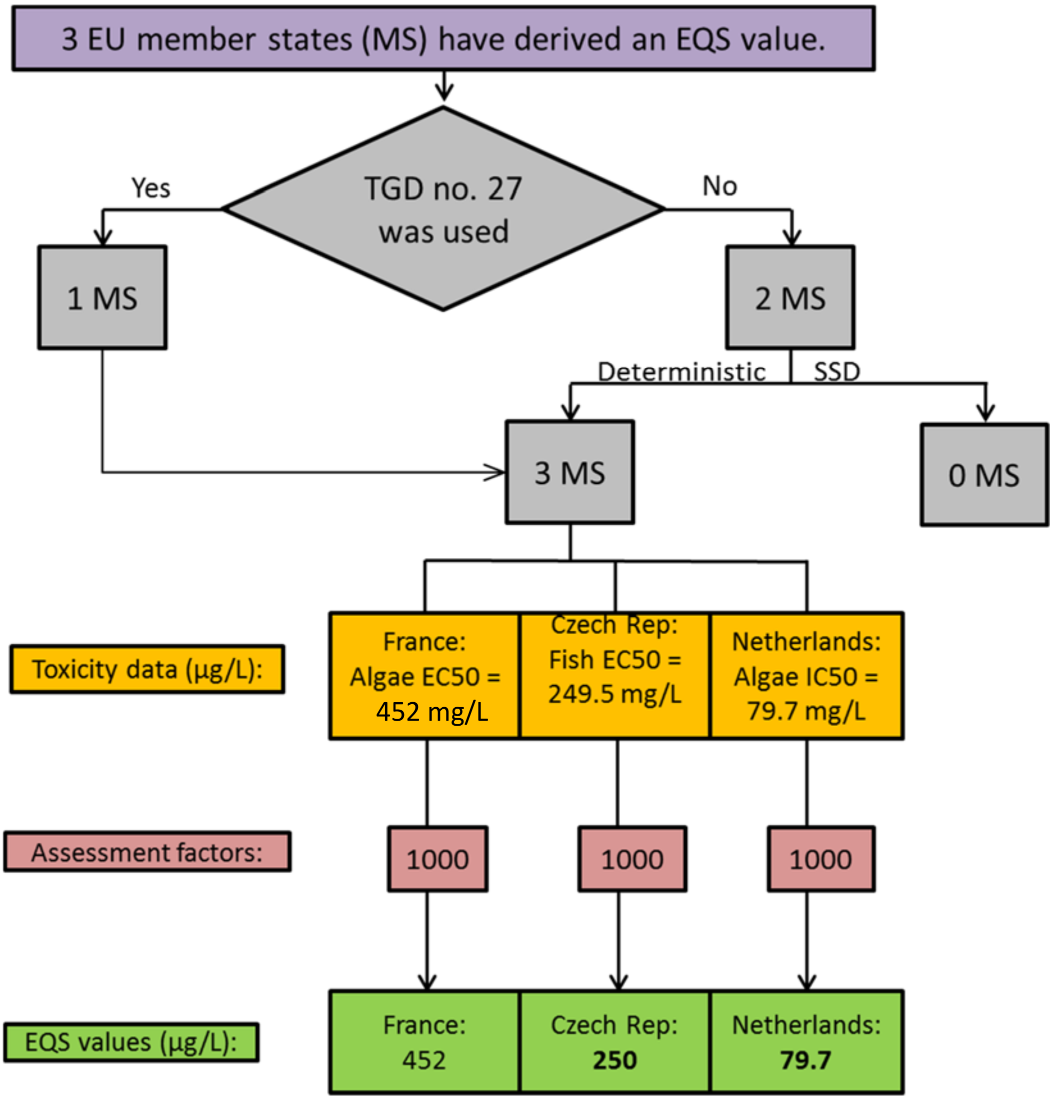


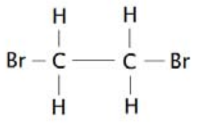
Figure 2: Analysis of EQS values for aminomethyl phosponic acid.

References:

EU (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal of the European Communities L 327/1

3. 1,2-Dibromoethane (CAS-nr. 106-93-4)

Hans Sanderson



1, 2 - dibromoethane

EQS values have been set for 1,2 dibromothane by five European countries (see Table 3). The values range from 0.002 µg/L (Denmark) to 2 µg/L for Romania (this value was not confirmed) and Germany, also at 2 µg/L. One of the five countries (Belgium-FL) had used the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011), which thus presumably resulted in the technically most sound value of 0.003. The values of Denmark and Netherlands are very close, and virtually identical, whereas the values of Germany and Romania are significantly higher and older.

Table 3: List of EQS values for dibromoethane and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	0.003	The EQS is from 2014. AA-EQS: no assessment factor used - derivation based on human health / MAC-EQS: 100 µg/L. AA-EQS: TL = 5*10^{-7} mg/(kg bw*d) / MAC-EQS: LC50 36 h *Centropomus undecimalis* = 40 µg/l. 0.003 (AA-EQS) / 0.4 (MAC-EQS) (PROPOSAL). Databases from RIVM, INERIS, USEPA were used to find the data. AA-EQS: TERA-database / MAC-EQS: Landau and Tucker, (1984) was a key reference.	Yes
Romania	2	No reply to the questionnaire.	Unknown
Denmark	0.002	The value was derived in 2009. The Danish guidance document from 2004 was used. This document refers to the TGD on risk assessment for existing and new substances. 48 h LC50 for *Cyprinodon variegatus* = 4.8 mg/l with an assessment factor of 1000 was used. Landau,M., and J.W.,Jr. Tucker 1984: Acute Toxicity of EDB and Aldicarb to Young of Two Estuarine Fish Species. Bull. Environ. Contam. Toxicol.33(2): 127-132 with Klimisch of 2 was a key reference.	No
Germany	2	The number is from 1992 and confirmed in 2011 by UBA. Bacteria, *Methanococcus thermolithotrophicus* EC (0,0188 mg/L) with an assessment factor of 100. Databases; risk assessments; open literature was used.	No
The Netherlands	0.0033	The value derived in 2009, i.e. before TGD-EQS was published; national guidance of 2007 is in line with Lepper 2005 and TGD-EQS in 2009. Human exposure via fish was the trigger concern. Using the ecotoxicity approach, a concentration of 0.04 µg/L was reached. As the EQS value derived for protection of human health was lower, this was chosen. Reference: http://www.rivm.nl/bibliotheek/rapporten/601782003.pdf	No, the number is from 2009

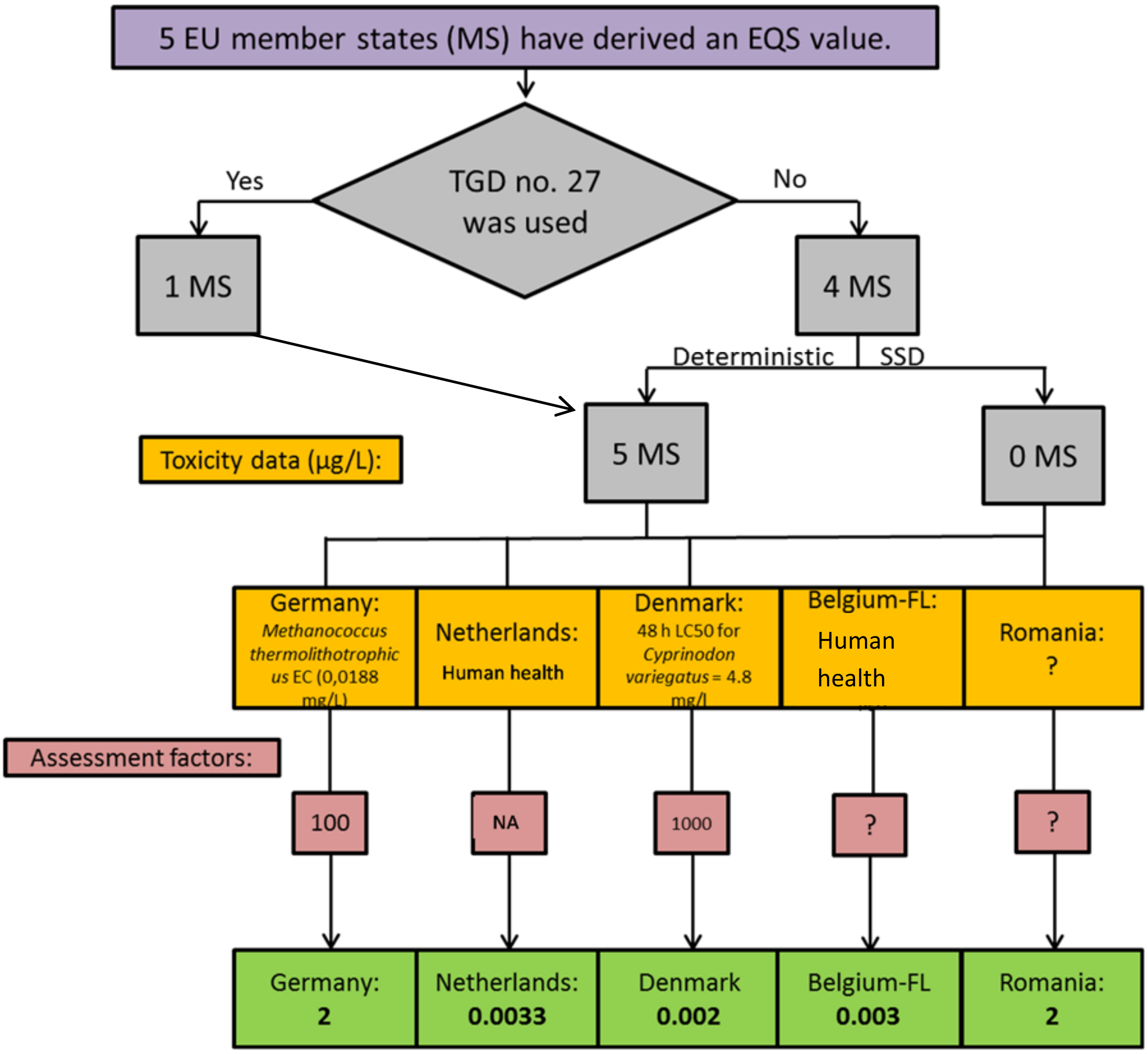
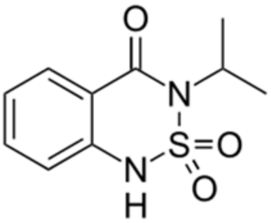


Figure 3: Analysis of EQS values for 1,2-dibromoethane. For Romania, it was assumed that the TGD no. 27 was not used. NA: not applicable (because the value was based on the protection of human health).

4. Bentazone (CAS-nr. 250527-89-0)

Hans Sanderson



EQS values have been set for bentazone by fourteen European countries (see Table 4). The values range from 0.1 µg/L in Luxemburg to 500 µg/L in the UK. Two of the fourteen countries (Portugal, Switzerland) had used the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011). Germany set the value as to protect drinking water. The other countries had algae LC_{50} = 4.5 mg/L as the trigger value from the USEPA OPP data base, but also NOECs of 0.7 mg/L and 1.14 mg/L for algae. Sweden used a *Lemna gibba* value. The assessment factors rage from 10 to 1000 between the countries.

Table 4: List of EQS values for Bentazone and background information on their derivation.

Country	**Value (µg/L)**	**Explanation**	**Technical guidance document used?**
Belgium (Flanders)	50	The value was derived in 2010 50 (AA-EQS) / 500 (MAC-EQS). The assessment was insprired by the TDG but not directly used as it was not published at the time. An assessment factor of 10 was applied AA-EQS: 100 / MAC-EQS: 10. EC50 5 d *Pseudokirchneriella subcapitata* = 4500 µg/l was the trigger value. OPP Draft Assessment Report, AQUIRE-database (USEPA) was used.	No
Bulgaria	3.2	No reply to the questionnaire.	Unknown
Czech Republic	4.5	The value is from 2010. 4500 µg/l (EC50, 5 days - green algae) was the main trigger value. AF = 1000. http://www.pesticideinfo.org/ was the main source. The lowest value from three trophic levels LC or EC50. AF factor under Annex V WFD has been chosen.	No
Germany	0.1	From 2011. Based protection of drink water value 0.1 µg/L. Umweltbundesamt Texte 76/99; http://webetox.uba.de/webETOX/public/basics/literatur.do?id=1358, Version in English Texte 08/01 URL: http://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/1947.pdf	No
Italy	0.5	The value was set in 2002. No other information is given.	No from before the guidance
The Netherlands	73	The value was derived in 2009. NOEC 732 µg/L for algae with an AF of 10. Derived from a German database. http://www.iksr.org/uploads/media/Rapport_Nr._164nl_02.pdf (NL) or http://www.iksr.org/uploads/media/Bericht_Nr._164d_02.pdf (DE)	No. Values derived by the Rhine-commission derived before TGD-EQS was published; derivation in line with Lepper 2005 and TGD-EQS

Belgium-Wallonia	70	No reply	Unknown
Switzerland	28	The value was derived in 2014. Data for freshwater and marine organisms were combined as no indication existed on marine organisms being more sensitive. The lowest NOEC for chronic toxicity was that of 1.14 mg/L for algae. A value for fish was available as well, but not for crustaceans. Therefore, an assessment factor of 50 was chosen, which resulted in a value of 28 µg/L.	Yes
Luxemburg	0.1	The value is from 2010, no other information is provided.	Unknown
Sweden	30	The value is from 2008. The trigger was NOEC *Lemna gibba*, endpoint not specified with an AF of 100. 1996. Rapporteur Member State: Germany. European Commission Peer Review Programme. Bentazone Review report. Appendix II -Endpoints and related information, 2000. Rapporteur Member State: Germany.	No, but according to Fraunhofer-Institute, 2005. Manual on the Methodological Framework to Derive Environmental Quality Standards for Priority Substances in accordance with Article 16 of the Water Framework Directive (2000/60/EC).
Portugal	80	The value is from 2009 and was confirmed in 2014.	Yes
United Kingdom	500	No reply.	Unknown
Denmark	45	The value is from 2005. EC50 = 4.5 mg/l for algae with an AF of 100 was used. Office of Pesticide Programs (2000). Pesticide Ecotoxicity Database, Environmental Fate and Effects Division, U.S.EPA, Washington DC. Klimisch = 1-2.	No. The Danish guidance document from 2004 was used. This document refers to the TGD on risk assessment for existing and new substances
France	70	The value is from 2009. Algae NOEC (72h) = 700 µg/l with AF = 10. E.C. (2000). Review report for the active substance bentazone. Finalised in the Standing Committee and open literature was used. at least 3 NOEC for algae and daphnia and fish > AF = 10 ; factsheet available at http://www.ineris.fr/substances/fr/page/9	No

The figure 4 below summarizes the findings in the table.

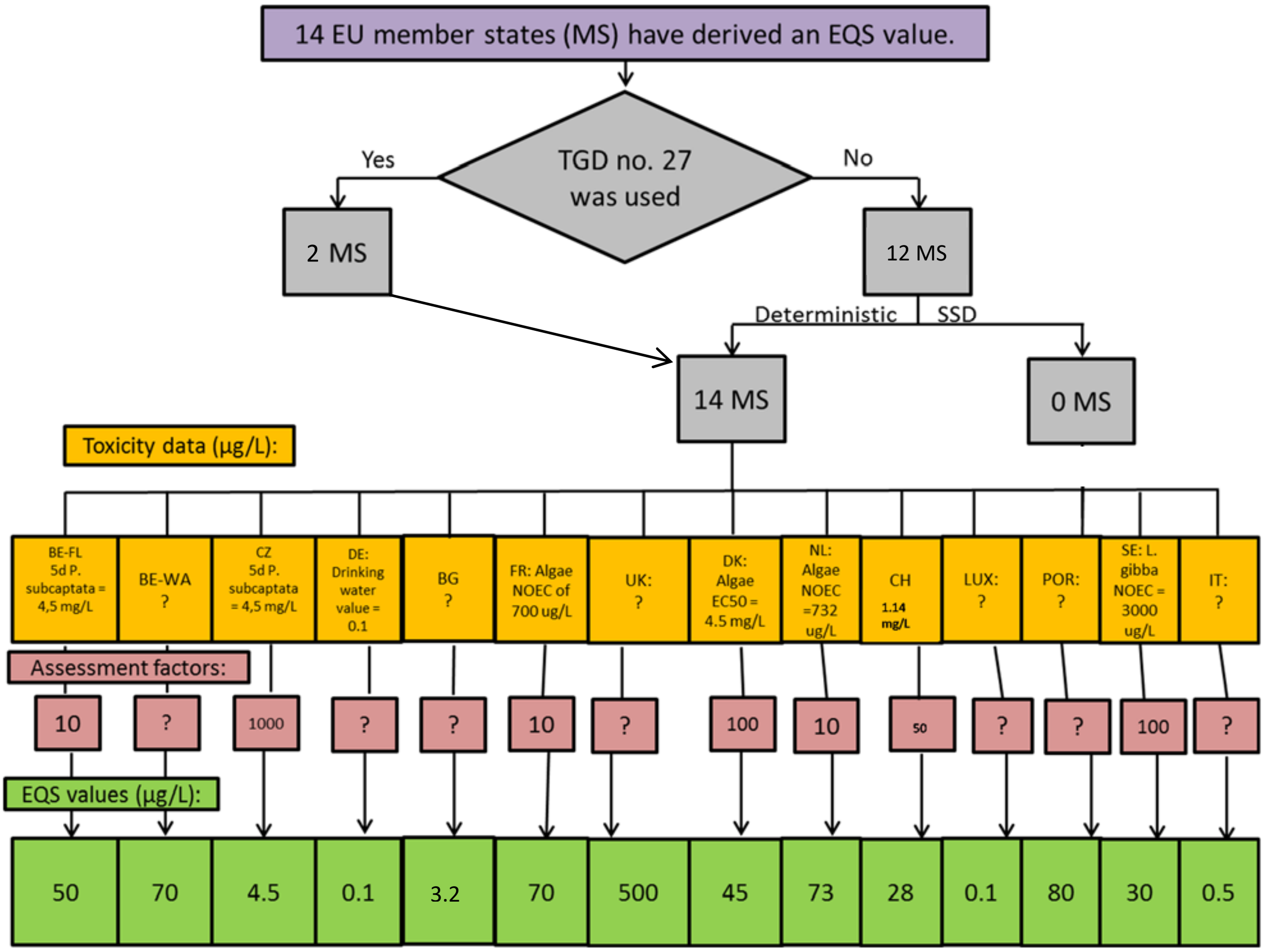
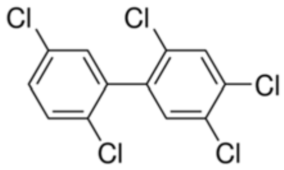


Figure 4: Analysis of EQS values for bentazone. In case of no information on the use of TGD no. 27 (Belgium (Wallonia), Bulgaria, Luxembourg, UK) it was assumed that TGC no. 27 was not used.

5. PCB-101 (CAS-nr. 37680-73-2)

Hans Sanderson



EQS values have been set for PCB-101 by four European countries (see Table 5). The values range from 0.0001 µg/L (Luxembourg) to 0.0005 µg/L (Germany and Bulgaria). The Netherlands have a different approach and have set for sediments at 8 µg/kg DW. None of the four countries had used the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011). From a technical point of view the German value is the best argued and most recent EQS, but in reality the numbers are all so low that they are vitually identical. No reply was received from Bulgaria, and the reply from Luxembourg was not very detailed. In fact, the response was quite sparse in general.

Table 5: List of EQS values for PCB-101

Country	Value (µg/L)	Explanation	Technical guidance document used?
Bulgaria	0.0005	No reply to the questionnaire.	Unknown
Germany	0.0005	The value is from 2011 and is mainly oriented towards human health protection from fish consumption	No
The Netherlands	8 µg/kg	The value is from before 1990, and will be removed from the national legislation	No
Luxemburg	0.0001	The value is from 2010 no other information is given	Unknown

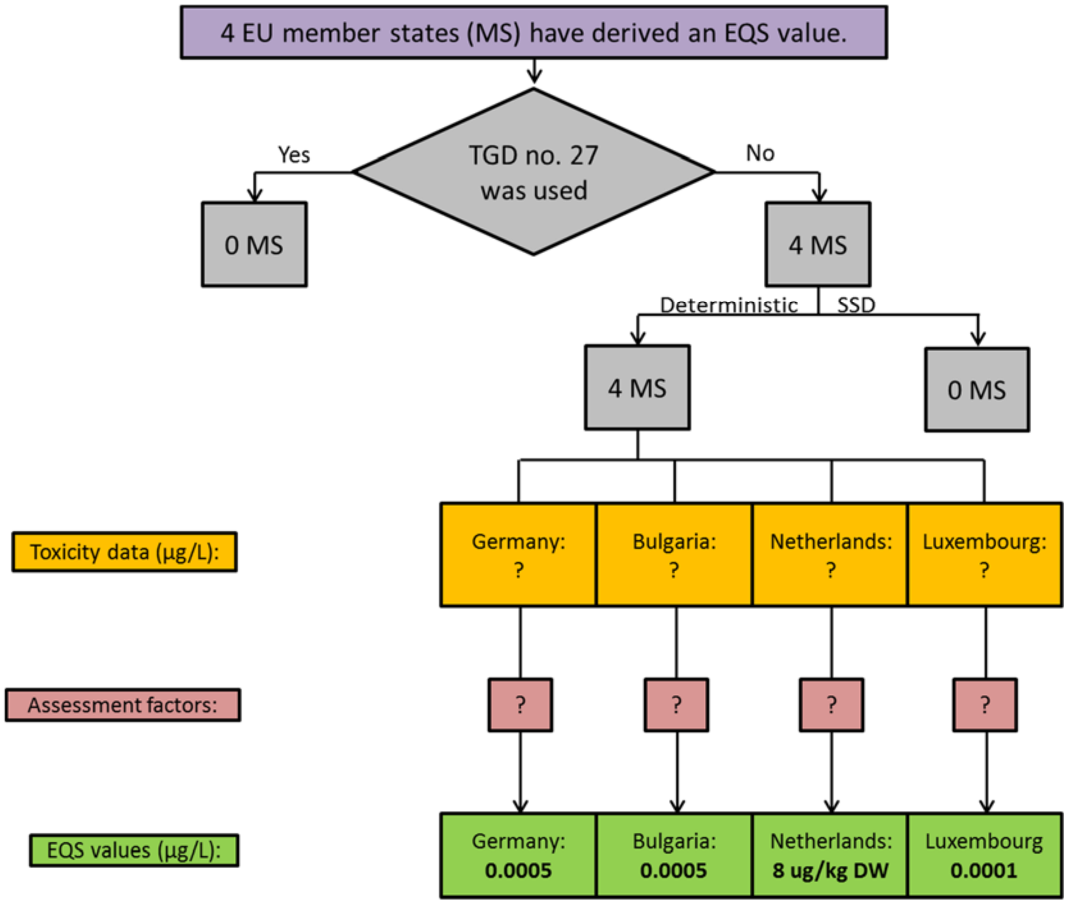
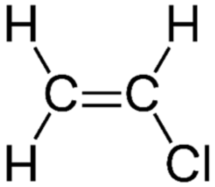


Figure 5: Analysis of EQS values for PCB-101. For Bulgaria and Luxembourg who did not provide information, it was assumed that TGD no. 27 was not used.

6. Vinylchloride (CAS-nr. 75-01-4)

Hans Sanderson



EQS values have been set for vinylchloride by nine European countries (see Table 6). The values range from 0.008 µg/L (in Belgium-Wallonia, but remains to be confirmed) to 100 µg/L (Belgium-Flanders). Belgium (Flanders) had used the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011), however, this value was not effectuated. The Netherlands used a predecessor of Lepper (2005). Most values are from before the Technical Guidance Document. All the values are derived with a drinking water or human health protection in view. Assessment factors were used in the calculation of the tolerable daily intakes.

Table 6: List of EQS values for vinylchloride and reasoning behind these

Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	100	A value of 0.09 µg/L was proposed (in line with the value from the Netherlands). Its derivation was based on human health. TL = 6×10^{-3} µg/kgbw/d. The main reference was RIVM-report 711701025, 2001 Subsequently, Belgium (Flanders) informed that a descision was taken to implement a value of 100 µg/L.	Yes
Belgium (Wallonia)	0.008	No reply	Unknown
Czech Republic	1	The value is from 2010, it was based on a trigger value of 1 µg/L. Limit of quantification of the best laboratory technique has been chosen. No AF was used.	No
Germany	2	The value is set as a safe drinking water value in 2011. There was no AF used, the main reference is http://webetox.uba.de/webETOX/public/basics/literatur.do?id=1332 .	No
Italy	0.5	The value is from 1999, and only for water bodies used for drinking waters purposes. In order to reduce water treatment the QSs for water bodies used for drinking water production are the same defined by COUNCIL DIRECTIVE 98/83/EC on the quality of water intended for human consumption	No
The Netherlands	0.09	The value is confirmed in 2009. Values derived before TGD-EQS was published; national guidance of 2007 is in line with Lepper (2005) and TGD-EQS. Open literature was used and the aim is to protect human exposure via fish consumption. http://www.rivm.nl/bibliotheek/rapporten/601782013.pdf	No
Romania	2	No reply	Unknown

Bulgaria	10	No reply	Unknown
Denmark	0.05	The value is from 2009 and confirmed in 2013. The Danish guidance document from 2004 was used. This document refers to the TGD on risk assessment for existing and new substances. For the EQSfreshwater, eco: 1000. But the overall EQS is 0.05 µg/l based on PNECwater, human health with a TDI = 0.008 µg/kg bw/day. IUCLID and USEPA databases was used to derive the values. Miljøstyrelsen (1995). Toksikologiske kvalitetskriterier for jord og drikkevand. Projekt om jord og grundvand fra Miljøstyrelsen, nr. 12 is the main outcome reference.	No

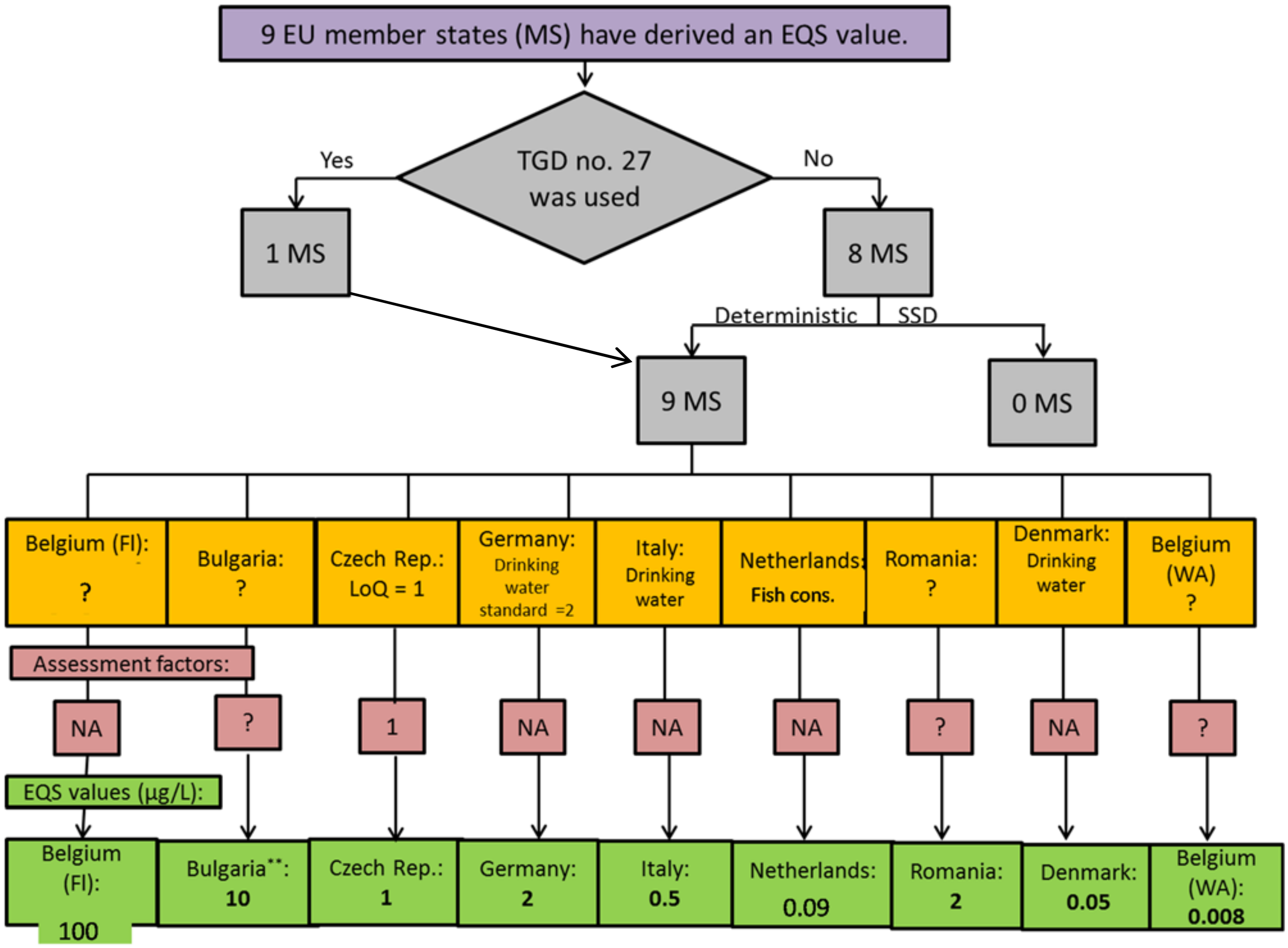
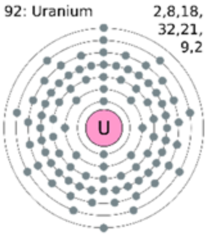


Figure 6: Analysis of EQS values for vinylchloride. In case of no information on the use of TGD no. 27 (Belgium (Wallonia), Bulgaria, Romania) it was assumed that TGD no. 27 was not used. Belgium (Flanders) informed that a value of 100 µg/L was chosen despite a proposal of a value of 0.09 µg/L, but no further background for the derivation of this value (100 µg/L) was given.

7. Uranium (CAS-nr. 7440-61-1)

Hans Sanderson



EQS values have been set for Uranium by six European countries (see Table 7). The values range from 0.015 µg/L (Denmark) to 24 µg/L (Czech Republic). Three of the six countries had used the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011). The three values from before the TGD could deserve a review. The two (Denmark and Sweden) which are derived using the TGD (2011) are virtually identical. The Dutch value will be reviewed in 2015. An added risk approach was used by most of the countries with a public health protection goal in mind.

Table 7: List of EQS values for uranium

Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	1	The value is from 2010 based on NOEC *Moinodaphnia macleayi* = 10 µg/l with an AF of 10. AA-EQS: Hyne et al., 1993 was the main reference and they used an added risk approach.	No
Bulgaria	5	No reply	Unknown
Czech Republic	24	The value was set in 2010. 40 mg/L was the trigger concentration based on a study. Government Regulation No. 229/2007 Coll. C90 concentration to annual average value conversion in 2010. Method of the EQS derivation is not available. No AF or key endpoint was given.	No
Denmark	0.015	The value is from 2011. They used an added risk approach. For $EQS_{freshwater, eco}$: 10 µg/L, but $EQS_{water, human health}$ = 0.015 µg/L based on a TDI = 0.17 µg/kg bw/day. No AF was used. The main reference is Nielsen, Elsa; K. Greve, O. Ladefoged 2008: Evaluation of health hazards by exposure to uranium, inorganic and soluble salts and proposal of a health based quality criterion for drinking water. Rapport fra Fødevareinstituttet, Danmarks Tekniske Universitet	Yes
The Netherlands	0.17	They used the open literature and risk assessment to create an SSD and used an AF of 5 to the HC_5. This is an added risk approach. The natural background is not included, to keep flexibility about setting the natural background concentration. Reference: http://www.rivm.nl/bibliotheek/rapporten/270006003.pdf	Yes

Sweden	**0.07**	**The value is from 2014. Secondary poisoning and human health not considered. They used an AF of 10 to an EC10 for Chlorella sp. Data point from Charles et al 2002. An added risk approach was applied. The main reference is: CCME, 2011. Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life. Uranium.**	**Yes**

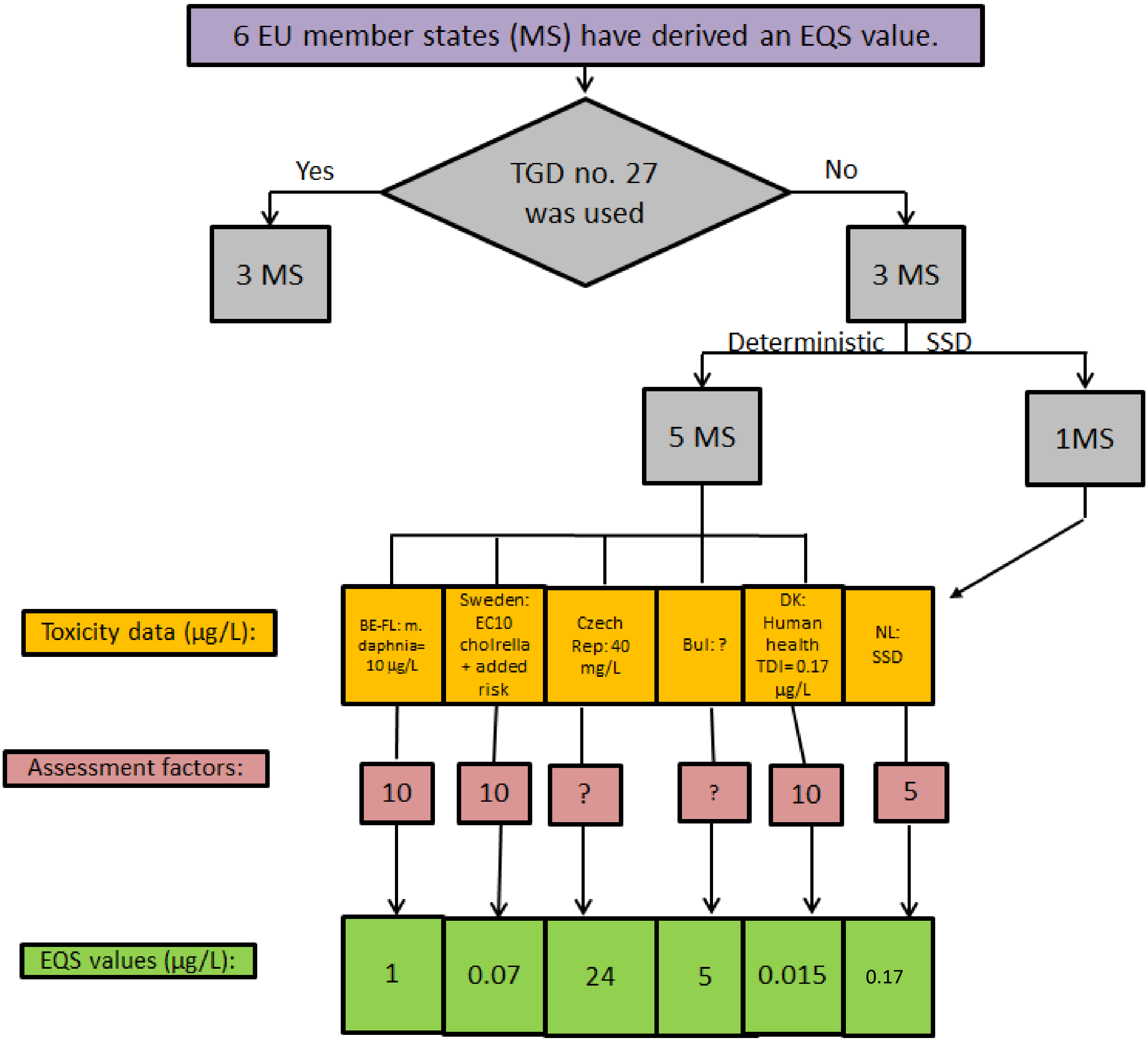
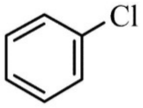


Figure 7: Analysis of EQS values for Uranium. For Bulgaria, it was assumed that TGD no. 27 was not used. The value for Denmark is based on protection of human health.

8. Chlorobenzene (CAS-nr. 108-90-7)

Hans Sanderson



EQS values have been set for chlorobenzene by ten European countries (see Table 8). The values range from 1 µg/L shared by several countries (Czech Republic, Germany, Romania) to 32 µg/L (Netherlands). One of the ten countries (Finland) had used the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011). The protection aim varies between countries if the focus is on public health or environmental ditto.

Table 8: List of EQS values for chlorobenzene and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	6	The value was set in 2010. AA-EQS: NOEC 16 d *Daphnia magna* = 320 µg/l / MAC-EQS: LC50 84 h *Micropterus salmoides* = 365 µg/l AA-EQS: Hermens et al., 1984 / MAC-EQS: Birge and Black, 1979, were the main references used, together with the use of RIVM, AQUIRE-database (USEPA), IUCLID. Assessment factors: AA-EQS: 50 / MAC-EQS: 10	No
Belgium (Wallonia)	2.7	No Reply	Unknown
Czech Republic	1	The value was set in 2010. 2 µg/l in accordance with Government Regulation No. 229/2007 Coll. C_{90} concentration to annual average value conversion in 2010. Method of the EQS derivation is not available.	No
Germany	1	The value is from 1992. There is no key study referred, but the AF = 10. http://webetox.uba.de/webETOX/public/basics/literatur.do?id=2200	No
Ireland	1.3	The value was set in 2009. It is based on a Canadian value. The lowest toxicity value is that of 13 µg/L (27d LC10 for effects on 4 day post-hatch rainbow trout *O.mykiss).* To this value, an assessment factor of 10 was applied.	No
Italy	3	The value was set in 2002. We used the TGD in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances. Method for EQS derivatisation not available.	No

The Netherlands	32	AA-EQS 32 µg/L; MAC-EQS 40 µg/L report published in 2010; values are approved and will be set officially in 2015 upon revision of the national decree; chlorobenzene will then be no longer listed. Values derived before TGD-EQS was published; national guidance of 2007 is in line with Lepper 2005 and TGD-EQS. NOEC 0.32 mg/L for *D. magna* with an AF of 10 was used. Hermens et al., 1984. http://www.rivm.nl/bibliotheek/rapporten/601782020.pdf	No
Romania	1	No reply	Unknown
Spain	20	The value is from 2000. They used the TGD in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances.	No
Finland	9.3	The value is from 2005. In a deterministic approach, an NOEC value for *Daphnia Magna* of 320 µg/L was used, in combination with an assessment factor of 10 (resulting in 32 µg/L). However, the EQS derived for human health was lower:QSfood uptake by humans = 6 mg/kg / 645 l/kg = 9.3 µg/l was the trigger for the value as a protection of human health from fish consumption.	Yes

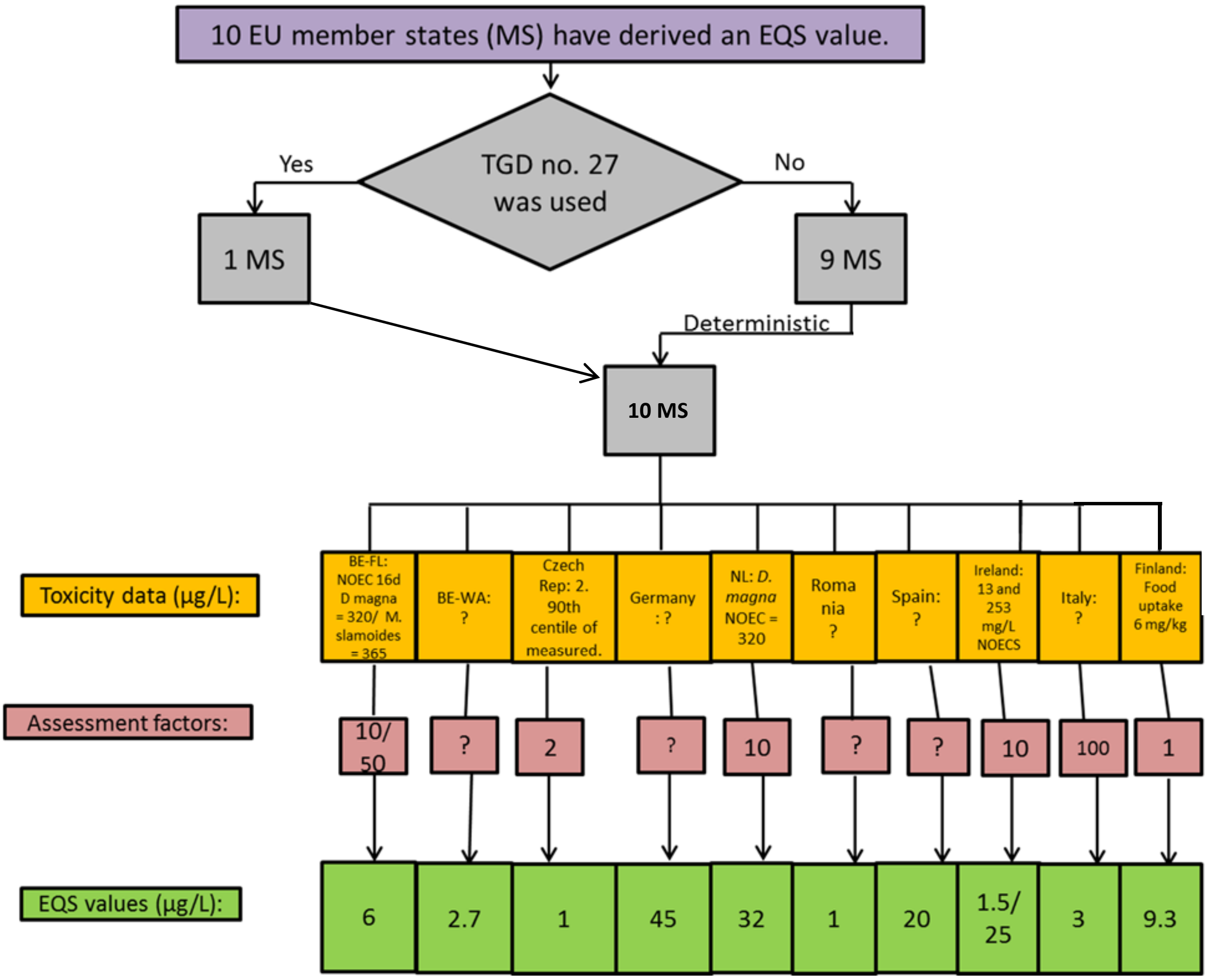
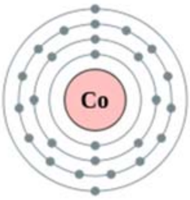


Figure 8: Analysis of EQS values for chlorobenzene. For Belgium (Wallonia) and Romania, it was assumed that TGD no. 27 was not used.

9. Cobalt (CAS-nr. 7440-48-4)

Hans Sanderson



EQS values have been set for cobalt by eight European countries (see Table 9). The values range from 0.2 µg/L (Netherlands) to 50 µg/L (Poland). None of the eight countries had used the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011). The EQS values from Belgium-Flanders, Denmark and Netherlands vary from 0.2 to 0.5 µg/L, which is quite narrow. They all used an added risk approach and an assessment factor of 10. The trigger behind the Belgium-Flanders and Denmark EQS is the environmental health, whereas the Netherlands have a protection aim of human health from fish consumption.

Table 9: List of EQS values for cobalt and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	0.5	The value is from 2010. They used a deterministic and added risk approach with an AF of 10. The main study was AA-EQS: NOEC 21 d *Daphnia magna* = 0,005 mg/l by Bissinger and Christensen, 1972.	No
Poland	50	No reply	Unknown
Czech Republic	3	2010 was the year of the ECS. 7 mg/l was the trigger result. C90 concentration to annual average value conversion in 2010. Method of the EQS derivation is not available. No AF was used.	No
Denmark	0.28	The value is from 2009. The Danish guidance document from 2004 was used. This document refers to the TGD on risk assessment for existing and new substances. 28 d NOEC for Daphnia magna = 2.8 µg/l. EC10 = 0.34 µg/l was not used. Kimball, G. (1978). The effect of lesser known metals and one organic to fathead minnows (*Pimephales promelas*) and *Daphnia magna*. Manuscript, Department of Entomology, Fisheries and Wildlife, University of Minnesota, Minneapolis. USEPA ECOTOX and Nagpal, N.K. (2004). Technical report – water quality guidelines for cobalt. Water Protection Section. Ministry of Water, Land and Air Protection. Canada. They used an added risk approach with an AF of 10.	No
Luxemburg	3.1	The value is from 2010. No other information given.	No

The Netherlands	**0.2**	**The first reported value of 0.089 µg/L derived in 2009, but < background; upon revision of the national decree in 2015, AA-EQS will be set to background of 0.2 µg/L (dissolved). Values derived before TGD-EQS was published; national guidance of 2007 is in line with Lepper (2005) and TGD-EQS. Protection of human exposure via fish consumption was the trigger. http://www.rivm.nl/bibliotheek/rapporten/601714011.pdf**	**No**
Romania	0.7	No reply	Unknown
Slovenia	0.3	No reply	Unknown

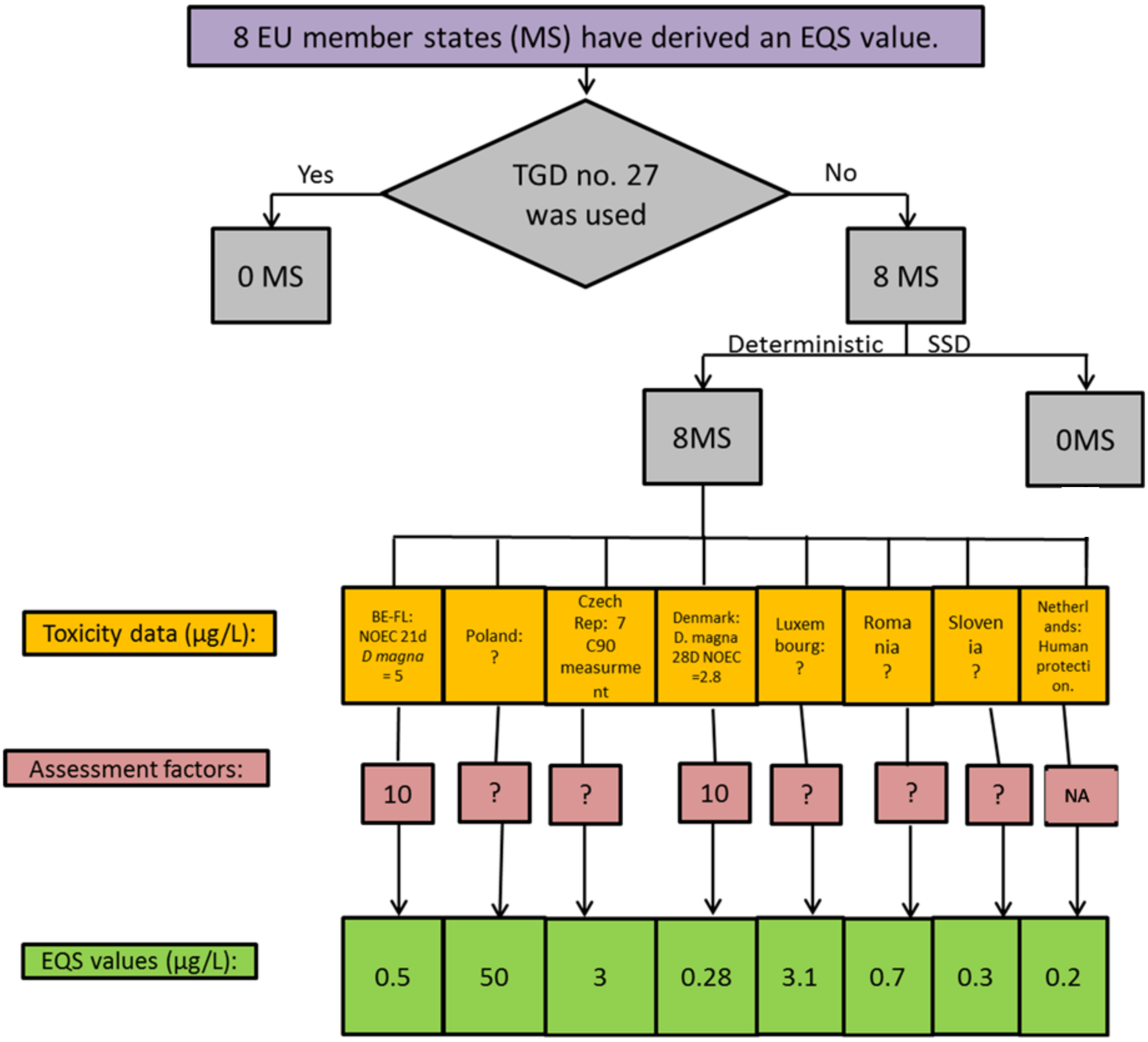
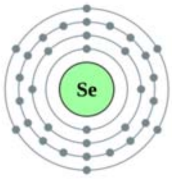


Figure 9: Analysis of EQS values for cobalt. In case of missing information (Poland, Romania, Slovenia) it was assumed that TGD no. 27 was not used.

10. Selenium (CAS-nr. 7782-49-2)

Hans Sanderson and Katrin Vorkamp

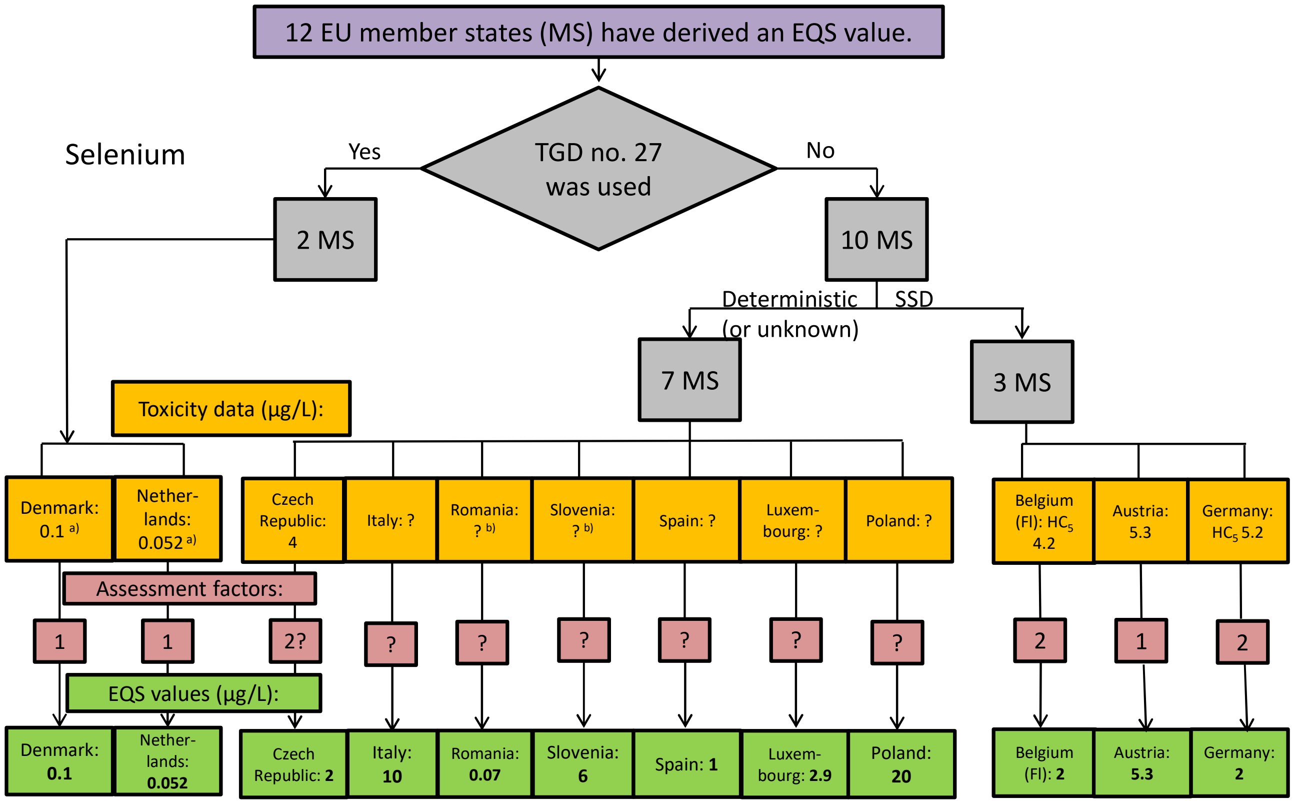


EQS values have been set for Selenium by twelve European countries (see Table 10). The values range from 0.052 µg/L (The Netherlands) to 20 µg/L (Poland). However, the value from Poland was not confirmed. Two of the twelve countries (Denmark and The Netherlands) had used draft versions of the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011). In both cases, the EQS values are based on secondary poisoning. They are similar to each other, but not identical. Three countries specified that they had used an SSD approach (Belgium (Flanders), Austria and Germany). Most countries applied an added risk approach. From a purely technical point of view the Danish EQS is the most recent and did make use of a draft version of the EC (2011) and is thus the most robust EQS value.

Table 10: List of EQS values for selenium and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Austria	5.3	The value is from 2002 and based on an SSD (freshwater and marine species were combined). USEPA, van de Plassche (1997) - RIVM report (1997) were the main references in the added risk approach that was applied. Based on this Austria proposed the value of 5.3	No
Belgium (Flanders)	2	The EQS is from 2010. An assessment factor of 2 was used on the HC_5 values from the SSD (freshwater and marine species combined). RIVM-report 601501029 (2005) was the main reference and they used an added risk approach.	No
Czech Republic	2	The value is from 2010. C90 concentration to annual average value conversion in 2010 was 4 µg/L. A reference is given to the Government Regulation No. 229/2007 Coll., but the method of the EQS derivation is not available. The reply ot the questionnaire says that no assessment factor was used. But as the final EQS is 2 µg/L, it seems that an AF of 2 was used.	No
Denmark	0.1	The value is from 2010 (proposed value) and a draft version of the TGD was used in the added risk approach. The $EQS_{freshwater}$ was first determined to be 0.8 µg/L (based on a chronic NOAE of 40 µg/L and an assessment factor of 50). Then, an EQSbiota was determined, in terms of a $PNEC_{oral}$ of 15 µg/kg food. Converted to a water concentration, this results in an $EQS_{biota, water}$ = 0.1 µg/l. As this value is lower than the 0.8 µg/L, it is chosen as the EQS value for water. WHO 1987. Selenium. Environmental Health Criteria 58. IPCS International Programme on Chemical Safety, World Health Organisation Geneva, was a key reference. USEPA ECOTOX, USEPA IRIS, WHO, and other was also used. Value has to be added to natural background.	Yes

Germany	3	The value is from 2003. Germany used an SSD approach with an AF = 2 (freshwater and marine species combined, Se (IV) and Se (VI) combined) on the dissolved concentration. The reference document states an EQS value of 2.5 µg/L. Main reference was: http://webetox.uba.de/webETOX/public/basics/literatur.do?id=2202	No
Italy	10	The value is from 1999 and refers to water bodies used for drinking water. The EQSs for water bodies used for drinking water production are the same as defined by COUNCIL DIRECTIVE 98/83/EC on the quality of water intended for human consumption	No, but reference to EU Directive 98/83/EC
Luxem-bourg	2.9	The EQS value is from 2010. No other information is given.	No
Nether-lands	0.052	The value is from 2009 and replaced values derived before the availability of the TGD-EQS document. The EQS_{water} calculated from an SSD resulted in a concentration of 1.24 µg/L. However, the EQS based on secondary poisoning was lower: The conversion of a value of 21 µg/kg food resulted in an EQS_{water} of 0.052 µg/L. The procedure is described (in Dutch) in http://www.rivm.nl/bibliotheek/rapporten/601714011.pdf	Yes
Poland	20	No reply	Unknown
Romania	0.07	No reply	Unknown
Slovenia	6	No reply	Unknown
Spain	1	The value is from 2000. They used the TGD in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances.	No

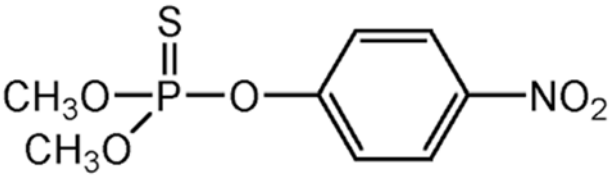


[a] Based on secondary poisoning. [b] No reply to questionnaire.

Figure 10: Analysis of EQS values for selenium. In case of missing information (Poland, Romania, Slovenia) it was assumed that TGD no. 27 was not used.

11. Methyl-parathion (CAS-nr. 298-00-0)

Katrin Vorkamp



EQS values have been set for methyl-parathion by nine European countries (see Table 11). The values range from 0.0002 µg/L (Romania) to 0.1 µg/L (Switzerland). However, the low value from Romana has not been confirmed. None of the nine countries had used the Technical Guidance Document no. 27 for deriving the EQS values (EC, 2011).

It is striking that most of the EQS values are relatively old, i.e. they were derived prior to 2000 or based on toxicity data from before 2000. However, with the information currently available, it was not always possible to trace the EQS value back to specific toxicity studies (e.g. Czech Republic, Italy, Luxembourg). The current analysis is also summarized in Figure 11.

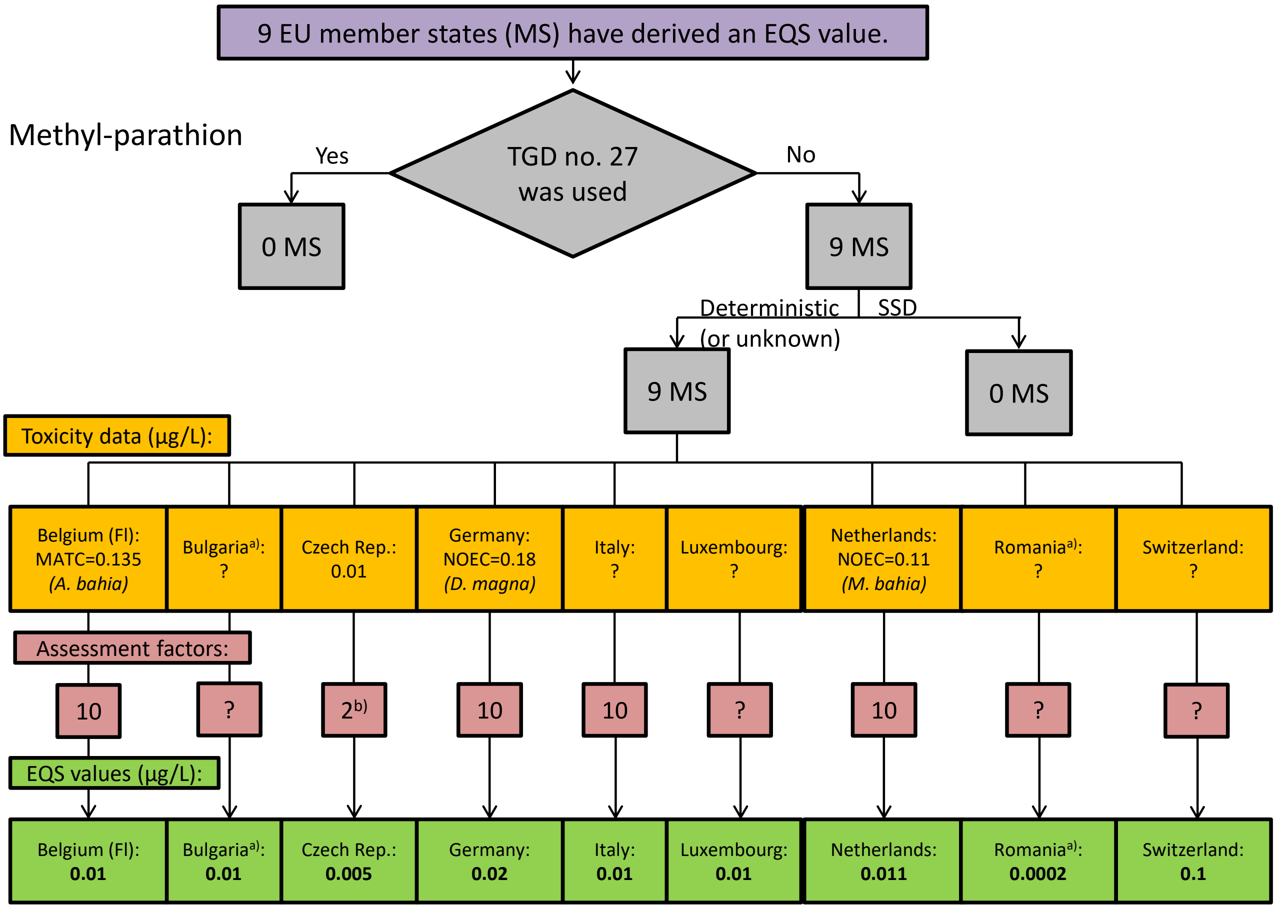
Table 11: List of EQS values for methyl-parathion and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	0.01	The value was derived in 2010 and is based on a study by Nimmo et al. (1981), which gave an MATC* of 0.135 µg/L for *Americamysis bahia* (28 days). An assessment factor of 10 was applied, leading to a value of 0.0135 µg/L, which was rounded down to 0.01 µg/L.	No
Bulgaria	0.01	No reply to the questionnaire.	Unknown
Czech Republic	0.005	The value was derived in 2010. The basis apparently was a concentration of 0.01 µg/L, but it is not clear where this originates from. The answer in the questionnaire calls this a C_{90} concentration. In the German list of studies (Kussatz et al., 1999; 2001), there is no value as low as this, but it was compiled long before 2010. To reach a final value of 0.005 µg/L, the 0.01 µg/L must be divided by an assessment factor of 2. Further search has led to a Decree 61/2003, which should include the EQS value of methyl-parathion (and other pesticides) in Annex 3.	No

Germany	0.02	The value was published in 1999, in the German version of ”Quality targets for active ingredients of pesticides to protect inland surface waters” (Kussatz et al., 1999; 2001). Thus, it was part of German legislation (“Gewässerschutzverordnung”) prior to the Water Framework Directive and has not been amended since. The value was derived on the basis of toxicity data for 4 trophic levels of water species (bacteria, green algae, small crustaceans, fish). A total of 62 values were reviewed, of which 9 were described as “other species and/or parameters”. Amongst these values, the lowest NOEC “at prolonged exposure” was chosen, in this case a value of 0.18 µg/L for *Daphnia magna* (21 days, reproduction endpoint). The value originated from UBA’s own database for pesticides, not from the open literature. This value was then divided by an assessment factor (here called “compensation factor”) of 10. The resulting value of 0.018 µg/L was rounded to 0.02 µg/L.	No
Italy	0.01	The value was set in 2006. It was originally suggested as a Water Quality Objective by the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission in 1992 following the Committee’s evaluation in 1987 (CSTE, 1994). This document states that an application factor of 10 was used for subchronic and chronic toxicity values, but the original toxicity data are not given. The document contains a reference to “Advice No. CSTE/87/69/com”, which might include these data. It should also be noted that the document refers to “Parathion (including parathion-methyl)”. This seems to suggest that the value of 0.01 µg/L refers to the sum of parathion and methyl-parathion. Vighi et al. (2001) addressed these Water Quality Objectives by means of QSAR, multivariate statistics and predictive classification models. While Vighi et al. (2001) arrived at different toxicity classifications for some compounds, no changes in toxicity class were made for parathion/methyl-parathion.	No
Luxembourg	0.01	The value was set in 2010. Luxembourg informed that usually, they did not set EQS values themselves, but aligned with decisions for the river basins of the rivers Rhine and Meuse. This indicates coordination with France, Belgium, Germany and the Netherlands. The value for methyl-parathion is identical with that of Belgium (Flanders) and the Netherlands (if rounded).	No, unknown whether or not a draft version was used.

Netherlands	0.011	The value was derived in 1997. It was called a maximum permissible concentration (MAC) (Crommentuijn et al., 1997). The Dutch document discussed the toxicity data available at the time (Crommentuijn et al., 1997). The lowest NOEC for *Daphnia magna* was 1.2 µg/L, but the authors argued that a concentration of 0.12 µg/L (having applied an assessment factor of 10) would be underprotective in comparison with acute toxicity data. The toxicity data listed in the German document (Kussatz et al., 1999; 2001) refers to Dortland (1980) for an NOEC of 1.2 µg/L for *Daphnia magna* (21 days, immobillisaton and reproduction endpoints). Therefore, an NOEC of 0.11 µg/L for *Mysidopsis bahia* was used. The toxicity data listed in the German document (Kussatz et al., 1999; 2001) refers to Nimmo et al. (1981) for an MATC of 0.11 µg/L for *Mysidopsis bahia* (4 days, mortality endpoint). See also explanation for Belgium (Flanders). An assessment factor of 10 was used, resulting at a concentration of 0.011 µg/L (which the authors considered in line with acute toxicity data).	No
Romania	0.0002	This is the lowest value in the data set, but we have not received a reply to the questionnaire.	Unknown
Switzerland	0.1	This is the highest value of the data set. It has not been derived, but originates from a general quality criterion of 0.1 µg/L for pesticides in surface waters, according to Swiss water protection ordinance.	No

*MATC is the maximum acceptable toxicant concentration. It is the geometric mean between NOEC and LOEC.



[a] no reply to questionnaire. [b] deduced from remaining data.

Figure 11: Analysis of EQS values for methyl-parathion. In case of missing information (Bulgaria, Luxembourg, Romania) it was assumed that TGD no. 27 was not used.

References:

Crommentuijn, T.; Kalf, D.F.; Polder, M.D.; Posthumus, R.; van de Plassche, E.J. (1997). Maximum Permissible Concentrations and Negligible Concentrations for pesticides. National Institute of Public Health and the Environment, Bilthoven, The Netherlands, RIVM report number 601501 002, 174 p.

CSTE (1994). EEC Water Quality Objectives for chemicals dangerous to aquatic environments (List 1). Reviews of Environmental Contamination and Toxicology 137, 83-110.

Dortland, R.J. (1980). Toxicological evaluation of parathion and azinphosmethyl in freshwater model ecosystems. Agricultural Research Reports No. 898, Netherlands Centre for Agricultural Publishing and Documentation, 112 p.

EC (2011). Guidance document no. 27: Technical guidance for deriving environmental quality standards. Common implementation strategy for the water framework directive (2000/60/EC). Technical report – 2011 – 055. ISBN 978-92-79-16228-2.

Kussatz, C.; Schudoma, D.; Throl, C.; Kirchhoff, N.; Rauert, C. (1999). Zielvorgaben für Pflanzenschutzmittelwirkstoffe zum Schutz oberirdischer Binnengewässer. Umweltbundesamt, Texte 76/99, ISSN 0722-186X, Berlin, October 1999.

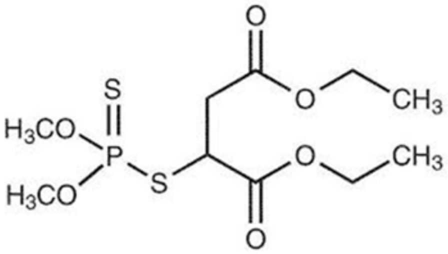
Kussatz, C.; Schudoma, D.; Throl, C.; Kirchhoff, N.; Rauert, C. (2001). Quality targets for active ingredients of pesticides to protect inland surface waters. Umweltbundesamt, Texte 08/01, ISSN 0722-186X, Berlin, February 2001.

Nimmo, W.R.; Hamaker, T.L.; Matthews, E.; Moore, J.C. (1981). An overview of the acute and chronic effects of first and second generation pesticides on an estuarine mysid. In: Vernberg, F.J.; Calabresa, A.; Thurberg, F.P.; Vernberg, W.B. (Eds.): Biological monitoring of marine pollutants. Proceedings of a symposium on pollution and physiology of marine organisms. Milford, Connecticut, 7-9 November 1980, Academic Press, pp. 3-19.

Vighi, M.; Gramatica, P.; Consolaro, F.; Todeschini, R. (2001). QSAR and chemometric approaches for setting water quality objectives for dangerous chemicals. Ecotoxicology and Environmental Safety 49, 206-220.

12. Malathion (CAS-nr. 121-75-5)

Katrin Vorkamp



EQS values have been set for malathion by nine European countries, with two different values for Belgium (Flanders) and Belgium (Wallonia) (see Table 12). In addition, an EQS-value for freshwater of 0.006 µg/L has been proposed in France (INERIS, 2011), giving a total of eleven EQS values currently available/proposed. These values range from 0.0002 µg/L (Romania) to 0.1 µg/L (Switzerland), i.e. corresponding to the situation for methyl-parathion.

For four of these values, no further background information is available since the EQS questionnaire was not returned (Belgium (Wallonia), Bulgaria, Romania, UK). Of the remaining seven values, only the proposed French EQS value was derived by including the Technical Guidance Document no. 27 (EC, 2011).

It is striking that most of the EQS values are based on relatively old, but different toxicity studies. In fact, the compilation of toxicity data in different countries includes different studies. The Netherlands are the only country to use a species sensitive distribution. Table 12 summarises the background information on how the EQS values had been derived.

Table 12: List of EQS values for malathion and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	0.0008	The value was derived in 2010, with a reference to EPA (1972). Apparently, the EQS value is based on a 30 days study with *Gammarus pseudolimnaeus*, which resulted in an NOEC of 0.008 µg/L. An assessment factor of 10 was applied, leading to a value of 0.0008 µg/L. Belgium (Flanders) also reported an MAC for malathion of 0.03 µg/L. For this value, no reference is given except for a study with *Daphnia magna*, which resulted in an EC_{50} value (24 hours) of 0,033 µg/L. An assessment factor of 10 has been reported as well, but this would lead to an MAC 10x lower than the reported value. Unclear whether the MAC, the EC_{50} or the assessment factor is incorrect.	No
Belgium (Wallonia)	0.006	No reply to the questionnaire, but general reference to INERIS data. Consequently, the same value is used as that proposed in France.	Unknown

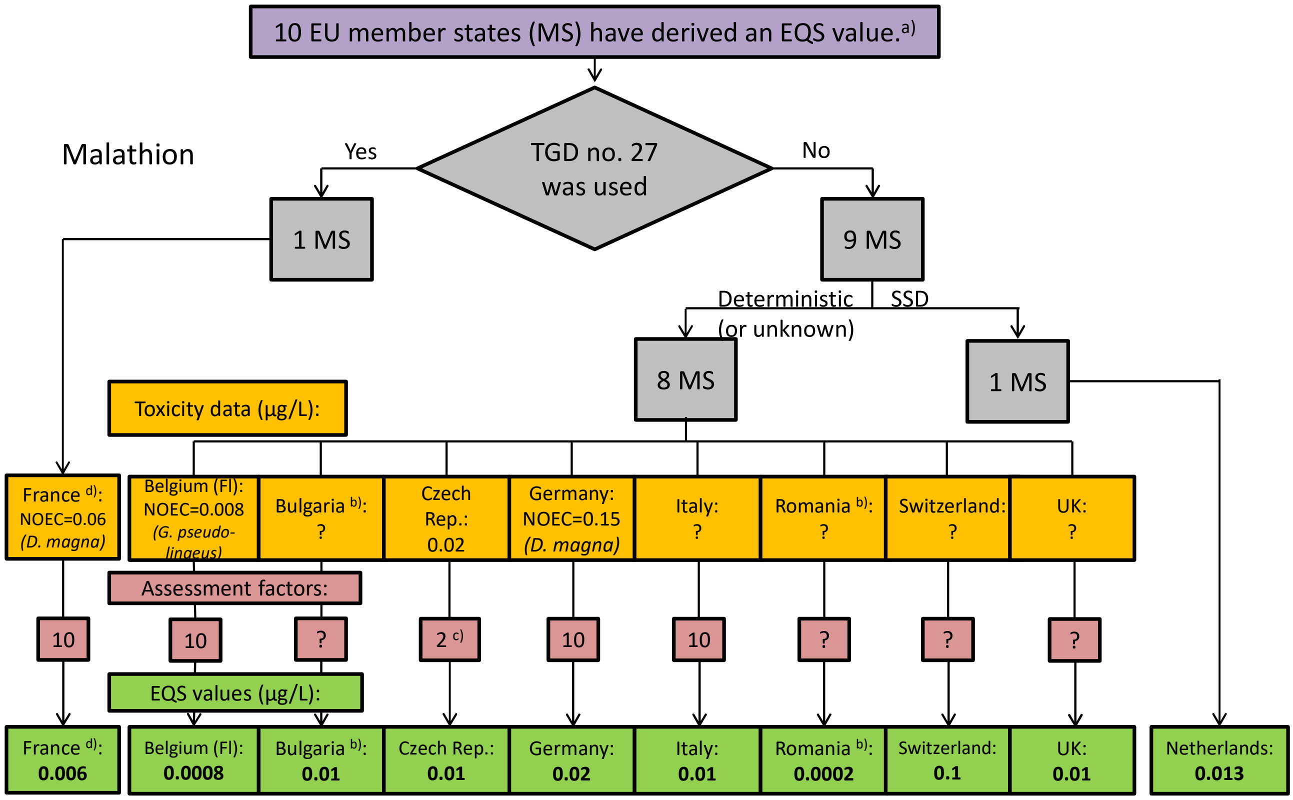
Bulgaria	0.01	No reply to the questionnaire.	Unknown
Czech Republic	0.01	The value was derived in 2010. The basis apparently was a concentration of 0.02 µg/L, but it is not clear where this originates from. The answer in the questionnaire calls this a C_{90} concentration, which was converted to an annual average. It is reported that no assessment factor was used. Yet, the EQS is only half of the trigger value, suggesting an assessment factor of 2. A reference is given to a Government Regulation No. 229/2007 Coll. This was also given for methyl-parathion, and some research led to a Decree 61/2003. However, it was not possible to find this document on the internet.	No
France	0.006	Proposed “QS_{eco}” for freshwater. In deriving this value, toxicity data for algae, invertebrates and fish were reviewed, and it was concluded that invertebrates would be the most sensitive species (INERIS, 2011). Thus, the proposed EQS value is based on an NOEC (21 days; reproduction) of 0.06 µg/L for *Daphnia magna* (EFSA, 2009). An assessment factor of 10 was additionally applied to this value. The value for *Gammarus pseudolimnaeus* applied by Belgium (Flanders) and the Netherlands did not occur in the compilation of toxicity data. In addition, an MAC-EQS of 0.05 µg/L is proposed for freshwater (INERIS, 2011).	Yes
Germany	0.02	The value was published in 1999, in the German version of ”Quality targets for active ingredients of pesticides to protect inland surface waters” (Kussatz et al., 1999; 2001). Thus, it was part of German legislation (“Gewässerschutzverordnung”) prior to the Water Framework Directive and has not been amended since. Following a review of the toxicity data available for malathion, an NOEC (21 days; immobilization) of 0.15 µg/L for *Daphnia magna* was used (Dortland, 1980). Applying an assessment factor of 10 and rounding led to the value of 0.02 µg/L.	No
Italy	0.01	The value was set in 2006. It was originally suggested as a Water Quality Objective by the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission in 1992 following the Committee’s evaluation in 1987 (CSTE, 1994). This document states that an “application factor” of 10 was used for chronic toxicity values and an “application factor” of 100 was used to acute toxicity levels. However, the original toxicity data are not given. The document contains a reference to “Advice No. CSTE/87/103/com”, which might include these data. It was also reported that Vighi et al. (2001) was reviewed as well and that their values were used if lower than the values given by CSTE (1994). For malathion, there was no change.	No

The Netherlands	0.013	The value was derived in 1997. Unlike the other values, it was derived from the species sensitivity distribution (SSD). Toxicity data were compiled for algae, protozoa, crustaceans, insects and fish, with the lowest NOEC being 0.008 µg/L for *Gammarus pseudolimnaeus* (Crommentuijn et al., 1997). This seems to be the same value as used by Belgium (Flanders). The freshwater toxicity data were combined with one marine study. The SSD yielded a maximum permissible concentration (MPC) of 0.013 µg/L. It was highlighted that no acute toxicity data were searched for because several studies were available on chronic toxicity in sensitive taxonomy groups. The *Gammarus pseudolimnaeus* study does not seem to be included in the lists compiled by Germany. The value will not be revised in the Netherlands because malathion is no longer used.	No
Romania	0.0002	This is the lowest value in the data set, but we have not received a reply to the questionnaire.	Unknown
Switzerland	0.1	This is the highest value of the data set. It has not been derived, but originates from a general quality criterion of 0.1 µg/L for pesticides in surface waters, according to Swiss water protection ordinance.	No
UK	0.01	No reply to the questionnaire.	Unknown

The current analysis is also summarized in Figure 12. Belgium (Flanders) and the Netherlands refer to the same study on *Gammarus pseudolimnaeus*, but used different approaches, i.e. a deterministic approach in Belgium (Flanders) and an SSD-approach in the Netherlands. This leads to a factor of nearly 20 between the two EQS values.

Belgium (Wallonia) and France used the same approach and the same EQS value, i.e. an NOEC for *Daphnia magna* (reproduction endpoint). Germany also used an NOEC for *Daphnia magna*, but a different endpoint (immobilisation), which was about twice the value used by Belgium (Wallonia) and France.

Italy used a “historical” value based on recommendations in the 1980s. Switzerland uses a general value of 0.1 µg/L for pesticides in surface waters, without substance-specific evaluations. For the Czech Republic and the UK, information was insufficient to analyse how the EQS values had been derived. The lowest value of the data set was from Romania, but lacks confirmation.



[a] Two values for Belgium. [b] No reply to questionnaire. [c] Deduced from remaining data. [d] Proposed value.

Figure 12: Analysis of EQS values for malathion. Belgium (Wallonia) and the Netherlands were not included in the figure because of lack of space. In case of missing information (Belgium (Wallonia), Bulgaria, Romania, UK) it was assumed that TGD no. 27 was not used.

References:

Crommentuijn, T.; Kalf, D.F.; Polder, M.D.; Posthumus, R.; van de Plassche, E.J. (1997). Maximum Permissible Concentrations and Negligible Concentrations for pesticides. National Institute of Public Health and the Environment, Bilthoven, The Netherlands, RIVM report number 601501 002, 174 p.

CSTE (1994). EEC Water Quality Objectives for chemicals dangerous to aquatic environments (List 1). Reviews of Environmental Contamination and Toxicology 137, 83-110.

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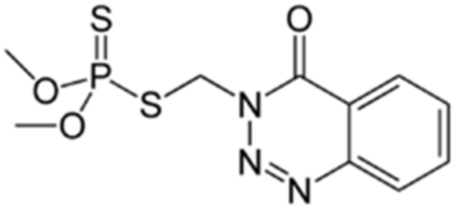
13. Azinphos-methyl (CAS-nr. 86-50-0)

Katrin Vorkamp



EQS values have been set for azinphos-methyl by seven European countries (see Table 13). In Belgium, only Flanders has set an EQS value for azinphos-methyl. The lowest value is that in Luxembourg (0.001 µg/L), which has been confirmed. The highest value of 0.1 µg/L was set by Romania and Switzerland. No confirmation has been received from Romania, where EQS values were the lowest of the data set for other pesticides (malathion, methyl-parathion). Thus, the max/min ratio is 100, in contrast to 500 for malathion and methyl-parathion.

Of the six values for which background information is available, none seems to be derived on the basis of the Technical Guidance Document no. 27 (EC, 2011). However, this question in the questionnaire was not answered by Luxembourg. The Netherlands reported that their national guidance was in line with the Technical Guidance Document no. 27.

One country (The Netherlands) used a species sensitivity distribution. The remaining EQS values were derived deterministically, according to the information available. They are generally based on studies published before the year 2000.

Table 13: List of EQS values for azinphos-methyl and background information on their derivation.

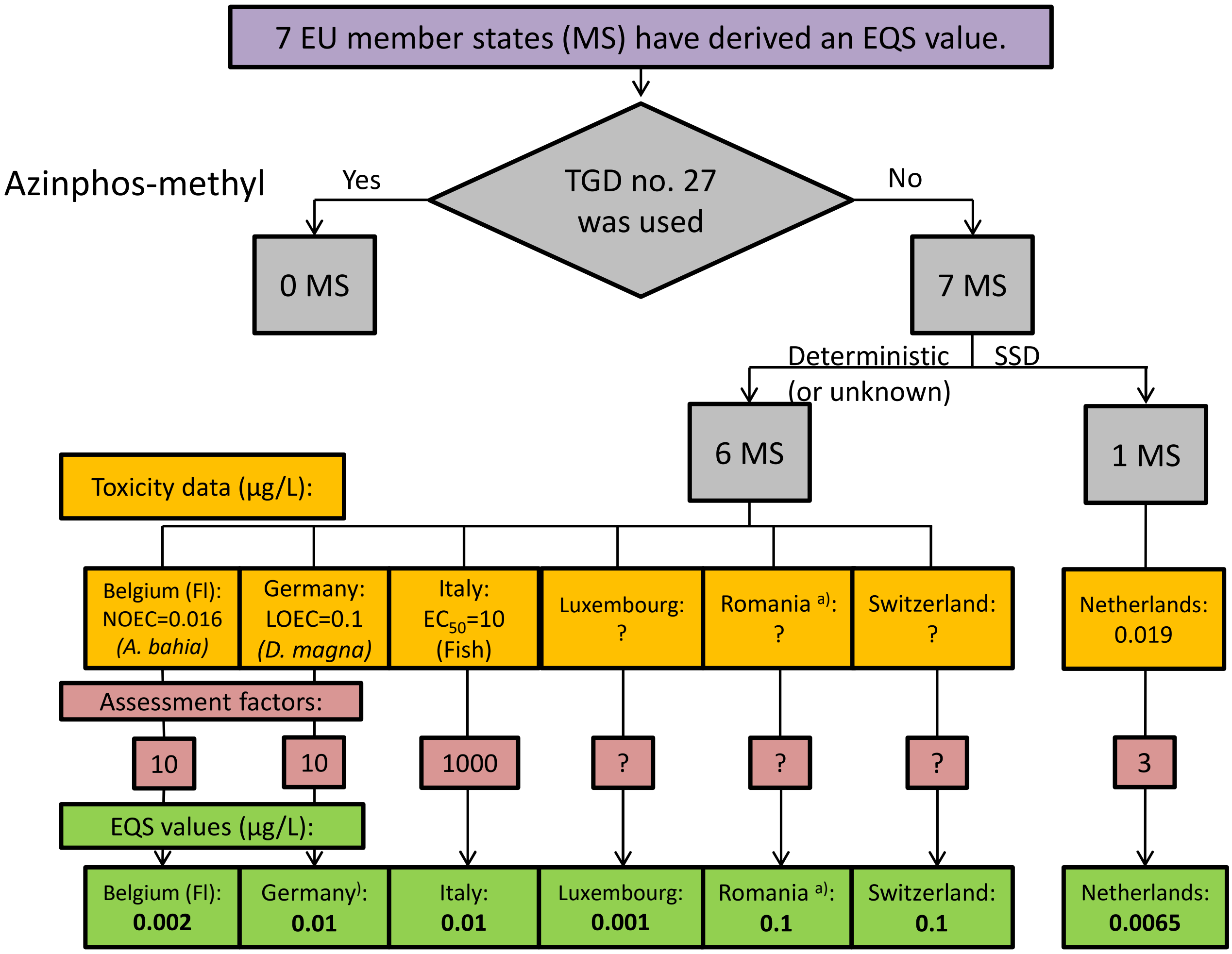
Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	0.002	The value was derived in 2010. With reference to Morton et al. (1997), Belgium (Flanders) reported an NOEC (26 days) of 0.016 µg/L for *Americamysis bahia*. The original reference, however, gives an NOEC (reproduction) of 0.020 µg/L. An assessment factor of 10 was applied, leading to a value of 0.002 µg/L. Belgium (Flanders) also reported an MAC for azinphos-methyl of 0.01 µg/L, with reference to Gaufin et al. (1965) and Sanders (1969). This is based on an LC_{50} for *Gammarus lacustris* (96 hours) of 0.014 µg/L and an assessment factor of 10.	No
Germany	0.01	The value was published in 1999, in the German version of "Quality targets for active ingredients of pesticides to protect inland surface waters" (Kussatz et al., 1999; 2001). Thus, it was part of German legislation ("Gewässerschutzverordnung") prior to the Water Framework Directive and has not been amended since.	No

		Following a review of the toxicity data available for azinphos-methyl, an LOEC (21 days; immobilization) of 0.1 µg/L for *Daphnia magna* was used (Dortland, 1980). Applying an assessment factor of 10 led to the value of 0.01 µg/L.	
Italy	0.01	The value was set in 2006. It is based on a fish EC_{50} of 0.01 mg/L, but no reference is given. The EQS value was derived according to Annex V Section 1.2.6. ("Procedure for the setting of chemical quality standards by the member states") of Directive 2000/60/EC (EU, 2000), i.e. a fish EC_{50} was combined with an assessment factor of 1000. This led to the concentration of 0.01 µg/L. This value was compared with a Water Quality Objective set by the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission in 1992 (CSTE, 1994) and with Vighi et al. (2001). In case of differences, the lowest value would have been chosen. However, the Water Quality Objective had the same value of 0.01 µg/L (including an assessment factor of 10), and the study by Vighi et al. (2001) did not lead to changes either.	No, but the procedure described in Annex V of Directive 2000/60/EC was followed.
Luxembourg	0.001	The value was derived in 2010. No further information has been given.	Unknown
The Netherlands	0.0065	The value was derived in 2008. The derivation followed national guidance of 2007, which is reported to be in line with Lepper (2005). Unlike the other national EQS values, the Dutch EQS value for azinphos-methyl is based on a species sensitivity distribution (SSD). It is noted that the requirements were not fully met because no data were available on macrophytes, but chronic toxicity data were compiled for a total of 25 species (Moermond et al., 2008). The lowest NOEC value was that of 0.02 µg/L for *Mysidopsis bahia*, which seems to be the study by Morton et al. (1997) also used by Belgium (Flanders). Two mesocosm studies were reviewed as well, but as their NOEC values were > 0.02 µg/L, they were deselected. The SSD resulted in an HC_5 value of 0.019 µg/L. An assessment factor of 3 was used, which lowered the EQS value to 0.0065 µg/L.	No
Romania	0.1	No reply to the questionnaire. Highest value of the data set, together with the value from Switzerland.	Unknown
Switzerland	0.1	This is the highest value of the data set. It has not been derived, but originates from a general quality criterion of 0.1 µg/L for pesticides in surface waters, according to Swiss water protection ordinance.	No

The current analysis is also summarized in Figure 13. In general, rather different studies and approaches have been chosen for the EQS value of azinphos-methyl. While Belgium (Flanders) and the Netherlands refer to the same study by Morton et al. (1997), Belgium (Flanders) used it in a deterministic approach (applying an assessment factor of 10) and the Netherlands included them in a species sensitivity distribution. Their EQS values thus differ by a factor of 3.25.

The German value was derived from a different toxicity study with an LOEC that was 5 times higher than that by Morton et al. (1997). Consequently, the German EQS value is 5 times higher than the value in Belgium (Flanders). It is possible that the study by Morton et al. (1997) was not yet available when the German EQS value was derived (published in 1999).

The Italian value is based on acute toxicity data (EC_{50}) and a high assessment factor (1000), i.e. a different approach, which, however, follows the procedure of Annex 5 of EU (2000). The Swiss EQS value is a general value for pesticides in water.



[a] No reply to questionnaire.

Figure 13: Analysis of EQS values for azinphos-methyl. For Luxembourg and Romania, it was assumed that TGD no. 27 was not used.

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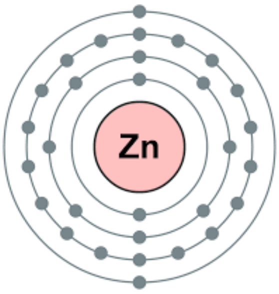
Vighi, M.; Gramatica, P.; Consolaro, F.; Todeschini, R. (2001). QSAR and chemometric approaches for setting water quality objectives for dangerous chemicals. Ecotoxicology and Environmental Safety 49, 206-220.

14. Zinc (CAS-nr. 7440-66-6)

Katrin Vorkamp



EQS values have been set for zinc by 24 European countries (see Table 14). Belgium has set two values for Flanders and Wallonia, respectively, which leads to a total of 25 values. The German concentration of 800 mg/kg dry weight refers to zinc attached to suspended particulate matter, not a dissolved concentration. Thus, this value cannot be compared to the concentrations of the remaining countries, which are given in mass per volume.

The majority of countries have set several values for zinc, taking into account differences in water hardness. Only one value for zinc has been set by the Belgium (Flanders) (20 µg/L), the Czech Republic (92 µg/L), Latvia (120 µg/L), Lithuania (100 µg/L), Poland (1000 µg/L, remains to be confirmed), Slovenia (7.8 µg/L, remains to be confirmed), the Netherlands (7.8 µg/L) and Luxembourg (7.2 µg/L).

Cyprus has set two values of 1100 and 1300 µg/L for rivers and lakes, respectively. The concentrations refer to total zinc. Switzerland has specified two values for dissolved and total zinc, respectively (5 µg/L for dissolved, 20 µg/L for total zinc). Belgium (Flanders) and Sweden have also specified that their values refer to dissolved zinc.

The lowest EQS values seem to be those of Sweden (3 µg/L, valid for $CaCO_3$ < 24 mg/L), Denmark and France (3.1 µg/L, valid for $CaCO_3$ < 24 mg/L). The highest values are those from Cyprus (1100 µg/L for rivers, 1300 µg/L for lakes). However, these values refer to total Zn, while most of the other values refer to dissolved Zn.

Most countries reported that they had not used Technical Guidance Document no. 27 (EC, 2011). Only Portugal reported that they had used EC (2011). Two countries (The Netherlands, Sweden) specified that their EQS values had been set according to Lepper (2005), a former guidance document, which was updated and essentially replaced by EC (2011). Spain reported the use the Technical Guidance Document in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances (EC, 2003). Many countries refered to the EU risk assessment report for zinc, and used the same values as published in that report (EU, 2010), which is also based on the guidance provided by EC (2003).

The value of 7.8 µg/L is the most frequent value, used by nine countries (including the value of 8 µg/L in Sweden). This value was also given in the EU risk assessment report (EU, 2010). The value of 8 µg/L is also used by Ireland and the UK, but these have a different history, as explained below. Bulgaria uses as value of 8 µg/L as well, but its origin has not been specified.

Most countries have applied an added risk approach, recognizing that zinc can occur naturally. However, some countries have included a natural background in their EQS values, while other countries report an EQS value to which the natural background concentration still needs to be added.

Table 14: List of EQS values for zinc and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Austria	7.8 (< 50 mg $CaCO_3$/l) 35.1 (50-100 mg $CaCO_3$/l) 52 > 100 mg $CaCO_3$/l) + 1 µg/L natural background	The EQS-value finally set for Austrian waters is that of 7.8 µg/L, with reference to the EU Risk Assessment Report for Zn (EU, 2010). The value was set in 2004 (when a draft version was available of EU, 2010). It was not changed in subsequent revisions in 2010 and 2015.	No
Belgium (Flanders)	20 Dissolved Zn	The value was derived in 2010. An SSD approach was used in combination with an assessment factor of 1. Belgium (Flanders) reported that an added risk approach was used.	No
Belgium (Wallonia)	30 (for water hardness ≤ 5°F) 200 (for water hardness 5-20°F) 300 (for water hardness > 20°F) Dissolved Zn 1°F = 10 mg $CaCO_3$/l	Values are taken from original list and have not been confirmed. Questionnaire not filled in.	Unknown
Bulgaria	8 100	Values have not been confirmed. Questionnaire not filled in.	Unknown

Croatia	7.8 (Category 1 and 2) 35 (Category 3) 52 (Category 4) >52 (Category 5)[1] Dissolved Zn Category 1: < 40 mg $CaCO_3$/L Category 2: 40-50 mg $CaCO_3$/L Category 3: 50-100 mg $CaCO_3$/L Category 4: 100-200 mg $CaCO_3$/L Category 5: ≥ 200 mg $CaCO_3$/L	No additional information provided in the questionnaire, except for the following: "If the background levels of metal is higher than the limit values (AAC) or if the hardness, pH-value or other parameters of water quality influence biological availability of metal, this will be also taken into consideration during comparison of monitoring results with AAC and MAC." The value of 7.8 µg/L also appears for Denmark and France, with reference to EU (2010).	Unknown
Czech Republic	92	The value was derived in 2010. The basis apparently was a concentration of 160 µg/L, but it is not clear where this originates from. The answer in the questionnaire calls this a C_{90} concentration, which was converted to an annual average. It is reported that no assessment factor was used. A reference is given to a Government Regulation No. 229/2007 Coll. This was also given for several other parameters, but no primary reference could be found.	No
Cyprus	1100 (Rivers) 1300 (Lakes) Total Zn	The value was derived in 2009. It is based on EU Directive 2006/44/EC (on the quality of fresh waters needing protection or improvement in order to support fish life) (EU, 2006). This directive gives limit values for total zinc in salmonid and cyprinid waters, taking into account different water hardness categories. Cyprus reported that the EQS values used for Zinc had been interpolated from the values referred in Directive 2006/44/EC for cyprinides. For the interpolation, the minimum water hardness observed in rivers and lakes of Cyprus (from measured data of hardness) was used. The original reference (in Greek) is Karavokyris et al. (2009).	No, but based on EU (2006)

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[1] We are not sure how the number >52 µg/L should be understood, it might be a typing error.

Denmark	3.1 (for < 24 mg $CaCO_3$/L) 7.8 (for ≥ 24 mg $CaCO_3$/L) Dissolved Zn. + natural background	The values were derived in 2008. They are based on a draft version of the EU risk assessment report for zinc (EU, 2010). The report has calculated the following $PNEC_{added}$ values: 3.1 µg/L for < 24 mg $CaCO_3$/L. 7.8 µg/L otherwise. These values were derived as the 5th percentile of an SSD, combined with an assessment factor of 5. These values have to be added to the natural background concentration. No natural background concentration was defined by Denmark.	No, but based on a draft version of EU (2010)
Estonia	10	The value was set in 2010. With regard to primary data sources, the following information was given: Scientific studies, EQS values set in other countries, expert group opinions.	No
France	3.1 7.8	The EQS value was set in 2010. A reference was given to the EU risk assessment report for zinc, i.e. EU (2010). Consequently, these are the same values as those given by Denmark. They refer to dissolved zinc. The natural background has not been added to these values.	No, but based on EU (2010)
Germany	800 mg/kg dw of suspended particulate matter	The value was set in German legislation of 2011 ("Gewässerschutzverordnung"). This document can be accessed at http://www.gesetze-im-internet.de/ogewv/BJNR142900011.html This value is 8 times above background concentrations.	No
Ireland	8 (for ≤ 10 mg $CaCO_3$/L) 50 (for 10 - 100 mg $CaCO_3$/L) 100 (for > 100 mg $CaCO_3$/L)	The values were originally set in 2001 (Dangerous Substances Regulations S.I. No. 12 of 2011). EQS values were formally set in 2009 (Statutory Instrument no. 272 of 2009). The values for Zn were not updated to provide continuity of data for trending assessment purposes. Ireland generally used relevant specific pollutant EQSs from the UK, where possible. The UK generally used Lepper (2005) for guidance on deriving EQSs. The UK also reviewed the data for Zn, but decided not to bring the values forward, which originally were proposed, due to a lack of adequate data (UKTAG, 2007). See below for UK. Therefore, the value originally set in the Dangerous Substances Regulations in 2001 was used in Ireland. Ireland also referred to the EU Commission's Advisory Scientific Committee on Toxicity, Ecotoxicity and the Environment (SCTEE) as a data source, but it was not clear to which documents.	No

Latvia	120	The value was set in 2002. The procedure was explained as follows: “We collected information about the EQS’s from those EU countries where they were already established and then made final decision about EQS’s relevant for us keeping in mind local conditions as well as following recommendations of project partners.” The value of 120 µg/L does not appear for other countries, but there are several values around 100 (Czech Republic, Belgium/Wallonia, Ireland, Lithuania, Spain UK), some of these for high water hardness.	No
Lithuania	100	The value was set in 2001. The questionnaire was filled in with “no information”, which suggests that no further information is available.	No
Luxembourg	7.2	The value was set in 2010. Luxembourg informed that usually, they did not set EQS values themselves, but aligned with decisions for the river basins of the rivers Rhine and Meuse. This indicates coordination with France, Belgium, Germany and the Netherlands. The value for Zn is similar to values in France and the Netherlands, but not identical with them.	No
The Netherlands	7.8 Dissolved Zn. + natural background	The value was derived in 2007. It is reported in the questionnaire that the EQS was derived in line with Lepper (2005). The EQS value is taken from the EU risk assessment report for zinc, which used an SSD and an assessment factor of 2 (EU, 2010). The value is a maximum permissible addition (MAP). The natural background to be added for the Rhine is 3 mg/L (Bodar, 2007). This will result in a concentration of 10.8 µg/L. The document by Bodar (2007) also gives an SPM-based maximum concentration for zinc of 1020 mg/kg dry weight, which can be compared to the German value of 800 mg/kg dry weight (see above). The German value is based on a background concentration of 100 mg/kg dry weight, while Bodar (2007) used a concentration of 140 mg/kg dry weight. Bodar (2007) emphasized the potential bioavailability correction, which might be applied to the monitoring data, based on biotic ligand models (BLM). It was also reported in the questionnaire that site-specific BLM-based EQS values can be derived in a 2nd tier assessment.	No, but based on EU (2010). Further reference to Lepper (2005).

Poland[2]	1000	No reply to the questionnaire.	Unknown
Portugal	7.8 Dependent on pH, DOC and water hardness.	The value was set in 2014. As Portugal referred to existing risk assessments, the value is probably also taken from EU (2010), as was the case for Denmark, France and the Netherlands.	Yes, with reference to “2.8 Using existing risk assessments”.
Romania	11.8 73	Values have not been confirmed. No reply to questionnaire.	Unknown
Slovakia	7.8 35.1 52	The EQS values were set in 2008. They were taken from the Austrian values.	No
Slovenia	7.8	Values have not been confirmed. No reply to questionnaire.	Unknown
Spain	30 (≤10 mg $CaCO_3$/L) 200 (10-50 mg $CaCO_3$/L) 300 (50-100 mg $CaCO_3$/L) 500 (> 100 mg $CaCO_3$/L) Dissolved Zn.	The values were set in 2000. Four values were chosen reflecting differences in water hardness. Reference was made to BOE (2015).	No, but reference to EU (2003)
Sweden	3 (for < 24 mg $CaCO_3$/L) 8 (for > 24 mg $CaCO_3$/L) Dissolved Zn + natural background	The values were set in 2008, but are being revised at the moment. The values are taken from EU (2010). The risk assessment was based on an SSD with an assessment factor of 2 (Naturvårdsverket, 2008). Same values as used in Denmark, see above. [The value of 8 µg/L is the same as that of 7.8 µg/L used by several other countries.] The report by Naturvårdsverket (2008) also describes the possibility of site-specific limit values which are based on biotic ligand modelling. This approach was also described as a potential alternative or supplementary approach by the Netherlands.	No, but reference to a draft version of EU (2010). Further reference to Lepper (2005).

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[2] The value has not been confirmed. The original list also gave a value of 1000 µg/L for Lithuania, which was subsequently corrected to 100 µg/L.

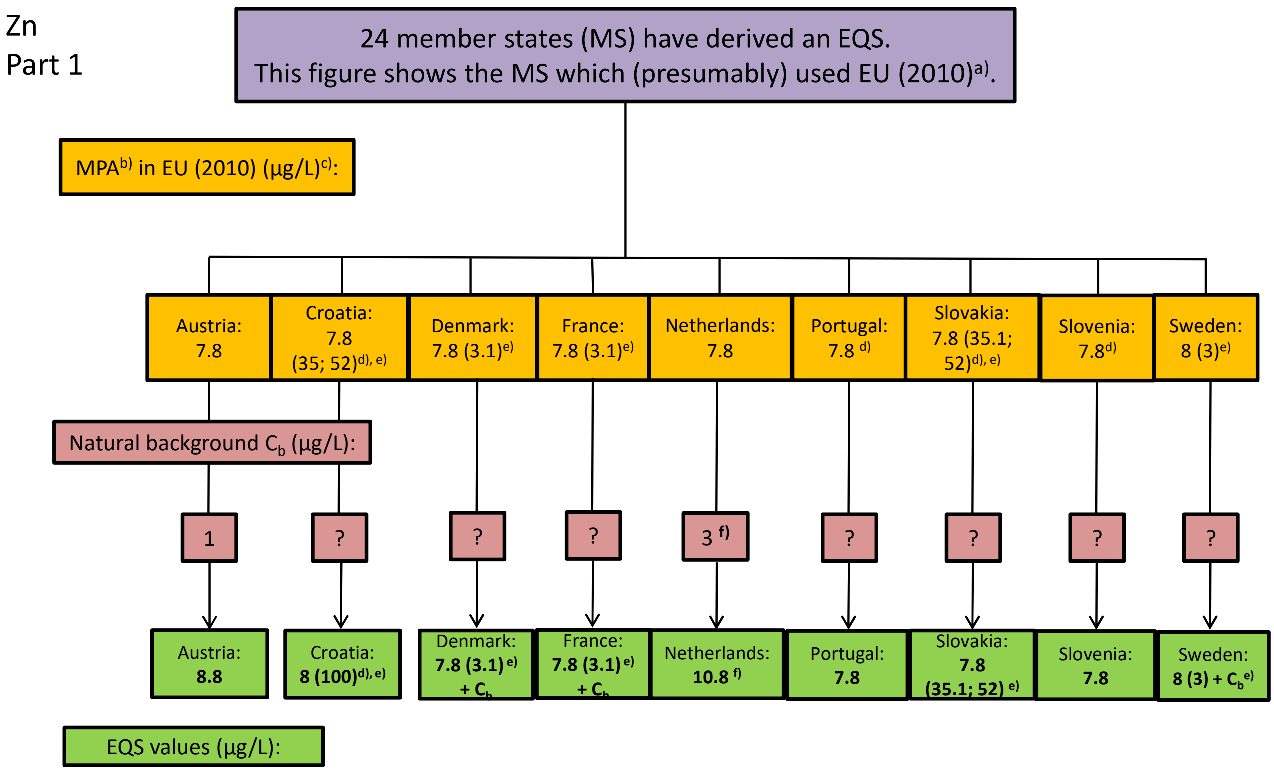
Switzerland	5 (dissolved Zn) 20 (total Zn)	Swiss legislation ("Gewässerschutzverordnung") of 1998 states limit values for Zn in surface waters (Schweizerischer Bundesrat, 2014). The document states that the value for dissolved Zn is the deciding value. However, if the value for total Zn is met, it is assumed that the value for dissolved Zn is met as well.	No
UK	8 (0-50 mg $CaCO_3$/L) 50 (50-100 mg $CaCO_3$/L) 75 (100-250 mg $CaCO_3$/L) 125 (> 250 mg $CaCO_3$/L) "Total metal"	No reply to questionnaire, but values are explained in UKTAG (2007). The UK Technical Advisory Board proposed the continued use of existing values for Zn as EQS value for specific pollutants. This is considered an interim solution (UKTAG, 2007). The values were originally derived in 1984. The reason for this proposal is that UKTAG felt that more work was needed with regard to metal speciation and natural background concentrations. This work is in progress. UKTAG (2007) also mentioned the potential use of biotic ligand models for tiered approaches. See comments from the Netherlands and Sweden.	Unknown

The current analysis is also summarized in Figures 14 and 15. Figure 14 covers all the countries which have based their EQS value on the EU risk assessment report of Zn (EU, 2010), i.e. Denmark, France, the Netherlands, Portugal and Sweden. In addition, those countries are included in Figure 14 whose EQS values presumably are based on EU (2010). This includes Croatia, Slovakia and Slovenia.

Figure 15 covers the remaining countries, with the exception of Bulgaria, Spain and Switzerland (because of lack of space). Cyprus stands out because the EQS values of Cyprus are based on a fish related EU directive (EU, 2006) which provides a limit value for total Zn. It is interesting that no other country uses this existing limit value.

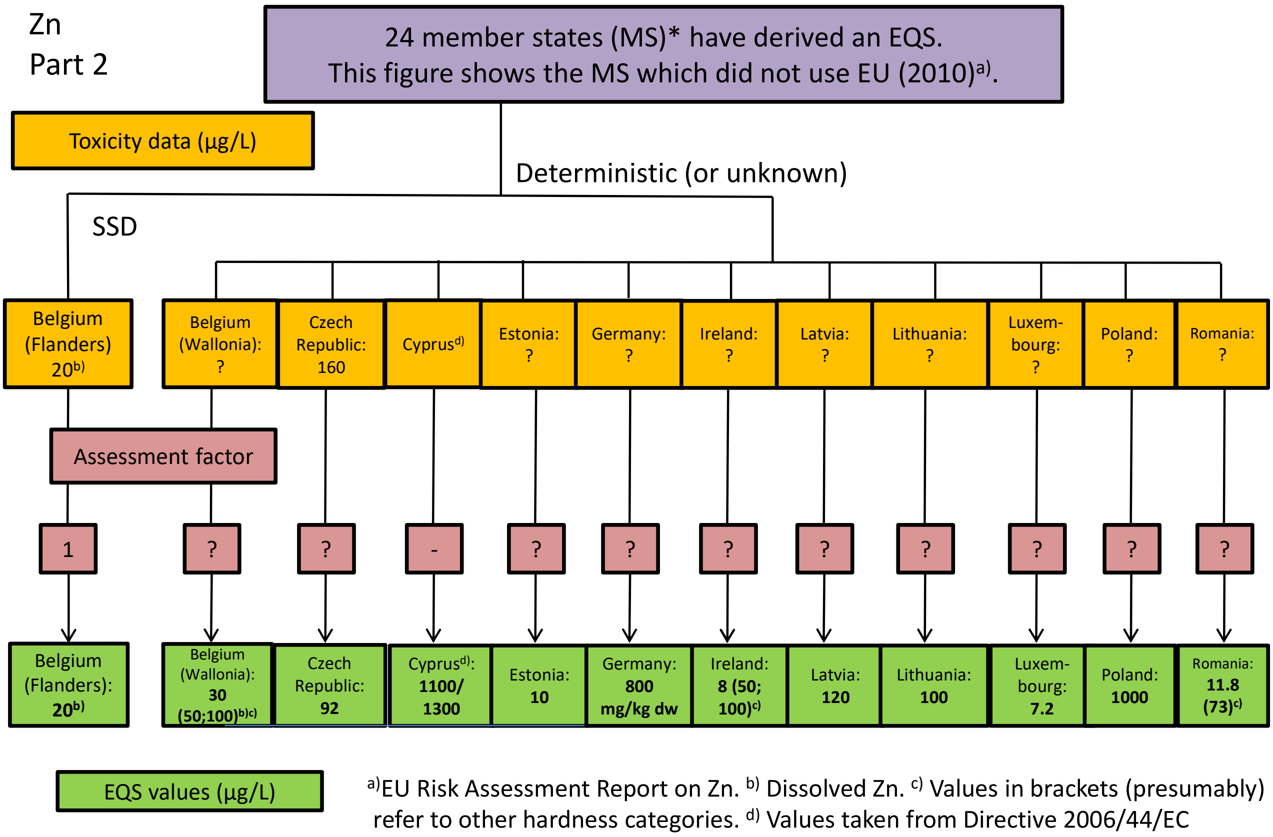
In contrast to the organic pollutants, some circumstances and environmental conditions have to be considered with regard to assessments of environmental Zn concentrations:

1. Most countries have given several EQS values, referring to different categories of water hardness. However, several countries do not address water hardness. It is not clear from the material available to us whether these countries only cover one category of water hardness or if this issue is disregarded.
2. Some countries have specified whether their EQS values refer to dissolved Zn or total Zn. Germany has an EQS value which only refers to particle-bound Zn. An SPM-related EQS for Zn has also been calculated by the Netherlands, which is similar to, but not identical with the German value.
3. Most countries have used an added risk approach, as Zn also occurs naturally. This has been stated explicitly by some countries (e.g. Denmark, the Netherlands, Sweden), but it is left unspecified for other countries (e.g. Portugal, France). We assume that more countries have an EQS value that is different from the MPA (than those presented in Fig. 1) and take into account a natural background concentration.



a) EU Risk Assessment Report on Zn. b) Maximum permissible addition. c) Refers to ≥ 24 mg $CaCO_3$/L.
d) MPA values assumed, no information provided. e) Values in brackets (presumably) refer to other hardness categories. f) For river Rhine.

Figure 14: Analysis of EQS values for zinc, covering those countries that refer to EU (2010) or that are assumed to have used EU (2010).



[a] EU Risk Assessment Report on Zn. [b] Dissolved Zn. [c] Values in brackets (presumably) refer to other hardness categories. [d] Values taken from Directive 2006/44/EC and refer to total Zn.

*See also Figure 14.

Figure 15: Analysis of EQS values for zinc in the remaining countries. Bulgaria (8 and 100 µg/L), Spain (30 and 500 µg/L), Switzerland (5 µg/L) and the UK (8, 50, 75 and 125 µg/L) are not included in the figurebecause of lack of space. For Belgium (Wallonia), Bulgaria, Croatia, Poland, Romania and the UK, no information was available on the use of TGD no. 27 was available, and it was assumed that TGD no. 27 was not used.

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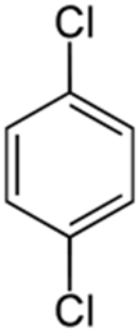
Schweizerischer Bundesrat (2014). Gewässerschutzverordnung vom 28. Oktober 1998, Stand 1. Januar 2014. 814.201.

UKTAG (2007). Proposals for Environmental Quality Standards for Annex VIII Standards. Consultation Report SR1-2007, June 2007. United Kingdom Technical Advisory Group on the Water Framework Directive.

15. 1,4-Dichlorobenzene (CAS-nr. 106-46-7)

Katrin Vorkamp



EQS values have been set for 1,4-dichlorobenzene by ten European countries (see Table 15). Belgium has set two values for Flanders and Wallonia, respectively, leading to a total of eleven values. In addition, a proposed value is available for France. Czech Republic, Belgium (Flanders) and Spain have EQS values for the sum of several dichlorobenzenes.

The lowest EQS value is that of the Czech Republic (0.25 µg/L) although this covers the sum of 1,2-, 1,3- and 1,4-dichlorobenzene. The highest EQS value is 20 µg/L, which several countries use (Belgium (Flanders), Bulgaria, Finland, France, Spain). No reply was received from Bulgaria, so this value could not be confirmed. While the values from Belgium (Flanders) and Spain refer to a sum of dichlorobenzenes, the proposed French and the Finnish EQS values only address 1,4-dichlorobenzene. The max/min ratio for this compound is 80.

The EQS values were generally derived before the Technical Guidance Document no. 27 was available (EC, 2011). Spain reports consistence with the Technical Guidance Document on risk assessment in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances (EC, 2003). Finland reports that the EQS values were derived according to Annex V, section 1.2.6 of the Water Framework Directive 2000/60/EU (EU, 2000) and according to EC (2003), i.e. the same document Spain referred to. The Netherlands reported that their national guidance was in line with the Technical Guidance Document no. 27 (EC, 2011). The proposed value by France was derived according to EC (2011) as well as EC (2003).

For the twelve values available, including the proposed French value, no background information is available from Belgium (Wallonia), Bulgaria and Romania.

Table 15: List of EQS values for 1,4-dichlorobenzene and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	20	The value was derived in 2010. It is described as a sum concentration, but not further specified. A reference is given to an NOEC of 185 µg/L for *Daphnia magna* (14 days) studied by Calamari et al. (1983). An assessment factor of 10 was applied, leading to an EQS value of 20 µg/L. Belgium (Flanders) also reported an MAC for 1,4-dichlorobenzene (or sum of dichlorobenzenes) of 70 µg/L, with reference to Rose et al. (1998).	No
Belgium (Wallonia)	1	No reply to questionnaire.	Unknown
Bulgaria	20	No reply to questionnaire.	Unknown
Czech Republic	0.25	This value refers to the sum of 1,2-, 1,3- and 1,4-dichlorobenzene. It was set in 2010. The basis apparently was a concentration of 0.5 µg/L, but it is not clear where this originates from. The answer in the questionnaire calls this a C_{90} concentration, which was converted to an annual average. It is reported that no assessment factor was used. Yet, the EQS is only half of the trigger value, suggesting an assessment factor of 2. A reference is given to a Government Regulation No. 229/2007 Coll. This was also given for methyl-parathion and malathion, and seems to refer back to a Decree 61/2003.	No
Finland	20	The value was set in 2005 (Londesborough, 2005). It is based on an NOEC value for fish *(Jordnella floridae)* of 200 µg/L (Smith et al., 1991), which according to the Finnish report is the lowest NOEC value available. It is explained that an assessment factor of 10 considers justified because NOEC values exist for three trophic levels (Londesborough, 2005). This leads to an EQS concentration of 20 µg/L. It is highlighted that this value agrees with the $PNEC_{aquatic}$ proposed in an EU risk assessment of 1,4-dichlorobenzene (Londesborough, 2005).	No, but derived according to Annex V, section 1.2.6 of the Water Framework Directive 2000/60/EU.
France	20 (proposed)	The same value and line of argumentation is used as for the Finnish EQS value (INERIS, 2009).	Yes
Germany	10	The value was set in German legislation of 2011 ("Gewässerschutzverordnung").The value is a Water Quality Objective based on an evaluation of the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission (CSTE, 1994). This reference explains that an assessment factor of 100 was applied to a lower value of the acute toxicity range, but no further background was given.	No

Italy	2	The value was set in 2006. It is based on an algae EC_{50} of 1.61 mg/L, but no reference is given. The EQS value was derived according to Annex V Section 1.2.6. ("Procedure for the setting of chemical quality standards by the member states") of Directive 2000/60/EC (EU, 2000), i.e. an EC_{50} value was combined with an assessment factor of 1000. This led to the concentration of 2 µg/L. This value was compared with a Water Quality Objective set by the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission in 1992 (CSTE, 1994) and with Vighi et al. (2001). In case of differences, the lowest value would have been chosen. The Water Quality Objective gave a value of 10 µg/L, which is the value used by Germany (CSTE, 1994). The study by Vighi et al. (2001) indicated higher toxicity for dichlorobenzenes, in particular for fish and *Daphnia*. This is consistent with a value < 10 µg/L derived by Italy.	No, but the procedure described in Annex V of Directive 2000/60/EC was followed.
Luxembourg	10	The value was derived in 2010. No further information has been given.	No
The Netherlands	6.9	The value was derived in 2010. The derivation followed national guidance of 2007, which is reported to be in line with Lepper (2005). Identical EQS values were derived for all dichlorobenzenes. The report first states an EQS value of 20 µg/L which was derived in the same way as described for France and Finland, i.e. from an NOEC of 200 µg/L for *Jordanella floridae* (Smith et al., 1991; van Leeuwen et al., 2010). However, because of BCFs > 100 L/kg, secondary poisoning was considered. Based on an LOAEL of 150 mg/kg bw (WHO, 2003) and an assessment factor of 30, the maximum permissible concentration is 5 mg/kg_{food} (van Leeuwen et al., 2010). Applying a BCF of 728 L/kg results in an EQS value of 6.9 µg/L (van Leeuwen et al., 2010). In the same way, an EQS value for human health was calculated, but this was higher than the value derived for secondary poisoning. Therefore, the lowest value was chosen as the EQS value.	No
Romania	10	No reply to the questionnaire.	Unknown
Spain	20	The value was set in 2000. It refers to the sum of 1,2, 1,3 and 1,4-dichlorobenzene.	No, but see text above for other Technical Guidance used.

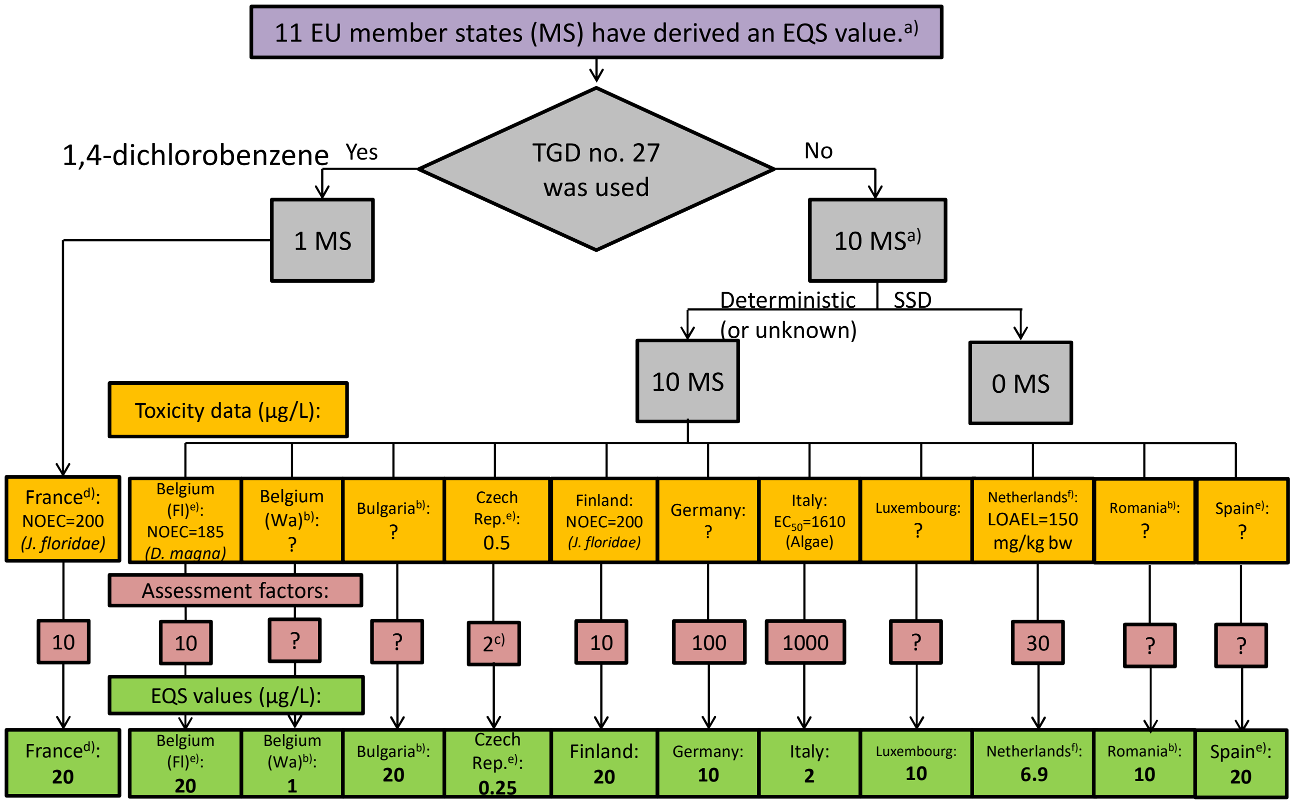
The current analysis is also summarized in Figure 16. In general, rather different studies and approaches have been chosen for the EQS value of 1,4-dichlorobenzene. In addition, some EQS values refer to the sum of several dichlorobenzenes, while others refer to 1,4-dichlorobenzene individually.

Finland, France and the Netherlands used the same study by Smith et al. (1991) and the resulting NOEC value for *Jordanella floridae*. However, the Netherlands further addressed the risk of secondary poisoning, which resulted in an EQS value lower than that derived from *Jordanella floridae.* Finland addressed secondary poisoning as well, but the quantification resulted in a higher value than the water EQS (Londesborough, 2005). No other countries seem to have included secondary poisoning in their EQS derivation, however, detailed information is lacking from Belgium (Wallonia), Bulgaria, Luxembourg, Romania and Spain.

The toxicity data used by Belgium (Flanders) seems to originate from a different study using *Daphnia magna* (Calamari et al., 1983). As the NOEC is similar to that for *Jordanella floridae* by Smith et al. (1991) and the same assessment factor is used, the EQS value is identical with those from Finland and France (proposed). However, the discussion of 1,2-dichlorobenzene has caused some doubt about the correctness of the value used as an NOEC by Belgium (Flanders).

The Italian value is based on acute toxicity data (EC_{50}) and a high assessment factor (1000), i.e. a different approach, which, however, follows the procedure of Annex 5 of EU (2000). The value suggested by CSTE (1994) was used by Germany. It was discussed by Italy as well, but overruled by the lower value combining the EC_{50} value with the high assessment factor.

The lowest value is that from the Czech Republic although it refers to the sum of three dichlorobenzenes. It is not clear what toxicity data was used, but it seems to be a value of 0.5 µg/L, which would be considerably lower than the data used by other countries.



a) Two values for Belgium. b) No reply to questionnaire. c) Deduced from remaining data.
d) Proposed value. e) Sum of several dichlorobenzenes. f) Secondary poisoning, calculation involves a BCF.

Figure 16: Analysis of EQS values for 1,4-dichlorobenzene. In case of missing information (Belgium (Wallonia), Bulgaria and Romania), it was assumed that TGD no. 27 was not used.

References:

Calamari, D.; Galassi, S.; Setti, F.; Vighi, M. (1983). Toxicity of selected chlorobenzenes to aquatic organisms. Chemosphere 12(2), 253-262.

CSTE (1994). EEC Water Quality Objectives for chemicals dangerous to aquatic environments (List 1). Reviews of Environmental Contamination and Toxicology 137, 83-110.

EC (2003). Technical Guidance Document on Risk Assessment in support of Commission Directive 93/67/EEC on Risk Assessment for new notified substances, Commission Regulation (EC) No 1488/94 on Risk Assessment for existing substances, Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market. Part II. European Chemicals Bureau, Institute for Health and Consumer Protection, EUR 20418 EN/2.

EC (2011). Guidance document no. 27: Technical guidance for deriving environmental quality standards. Common implementation strategy for the water framework directive (2000/60/EC). Technical report – 2011 – 055. ISBN 978-92-79-16228-2.

EU (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal of the European Communities L 327/1.

INERIS (2009). 1,4-Dichlorobenzene. Validation groupe d'experts, version 3, July 2009.

Lepper, P. (2005) Manual on the Methodological Framework to Derive Environmental Quality Standards for Priority Substances in accordance with Article 16 of the Water Framework Directive (2000/60/EC). 15 September 2005 ed. Schmallenberg, Germany: Fraunhofer-Institute Molecular Biology and Applied Ecology.

Londesborough, S. (2005). Proposal for Environmental Water Quality Standards in Finland. Finnish Environment Institute. ISBN 952-11-1950-0, 952-11-1951-9 (pdf).

Rose, R.M.; Warne, M.St.J.; Lun, R.P. (1998). Quantitative structure-activity relationships and volume fraction analysis for nonpolar narcotic chemicals to the Australian cladoceran *Ceriodaphnia cf. dubia*. Archives of Environmental Contamination and Toxicology. 34, 248-252.

Smith, A.D.; Bharath, A.; Mallard, C.; Orr, D.; Smith, K.; Sutton, J.A.; Vukmanich, J.; McCarty, I.S.; Ozburn, G.W. (1991). The acute and chronic toxicity of ten chlorinated organic compounds to the American flagfish *(Jordanella floridae)*. Archives of Environmental Contamination and Toxicology 20, 94-102.

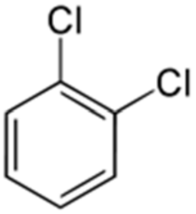
Van Leeuwen, L.C.; Moermond, C.T.A.; van der Veen, M.; van Herwijnen, R. (2010). Environmental risk limit for various chlorobenzenes. RIVM National Institute for Public Health and the Environment. Report 601782020/2010.

Vighi, M.; Gramatica, P.; Consolaro, F.; Todeschini, R. (2001). QSAR and chemometric approaches for setting water quality objectives for dangerous chemicals. Ecotoxicology and Environmental Safety 49, 206-220.

WHO (2003). Dichlorobenzenes in drinking-water. Background document for preparation of WHO guidelines for drinking-water quality. Geneva, Switzerland.

16. 1,2-Dichlorobenzene (CAS-nr. 95-50-1)

Katrin Vorkamp



EQS values have been set for 1,2-dichlorobenzene by nine European countries (see Table 16). Belgium has set two values for Flanders and Wallonia, respectively, giving a total of ten values.

Czech Republic, Belgium (Flanders) and Spain have EQS values for the sum of several dichlorobenzenes. Most of the other countries use the same value as for 1,4-dichlorobenzene. However, differences exist between the EQS values for 1,2-dichlorobenzene and 1,4-dichlorobenzene for Belgium (Wallonia), Bulgaria and Finland. It is an interesting question in itself why some countries consider the EQS values applicable for both compounds, while others do not. However, of the three countries with differing values, only Finland has provided background information.

The lowest EQS value is that of the Czech Republic (0.25 µg/L) although this covers the sum of 1,2-, 1,3- and 1,4-dichlorobenzene. The highest EQS value is 20 µg/L, which two countries use (Belgium (Flanders) and Spain). In all three cases, the values refer to a sum of dichlorobenzenes. The max/min ratio for this compound is 80, i.e. the same as for 1,4-dichlorobenzene.

The EQS values were generally derived before the Technical Guidance Document no. 27 was available (EC, 2011). Spain reports consistency with the Technical Guidance Document on risk assessment in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances (EC, 2003). Finland reports that the EQS values were derived according to Annex V, section 1.2.6 of the Water Framework Directive 2000/60/EU (EU, 2000) and according to EC (2003), i.e. the same document Spain referred to. The Netherlands reported that their national guidance was in line with the Technical Guidance Document no. 27.

Table 16: List of EQS values for 1,2-dichlorobenzene and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	20	The value was derived in 2010. It is described as a sum concentration, but not further specified. A reference is given to an NOEC of 185 µg/L for *Daphnia magna* (14 days) studied by Calamari et al. (1983). An assessment factor of 10 was applied, leading to an EQS value of 20 µg/L. Belgium (Flanders) also reported an MAC for 1,2-dichlorobenzene (or sum of dichlorobenzenes) of 70 µg/L, with reference to Rose et al. (1998).	No

Belgium (Wallonia)	6.3	No reply to questionnaire.	Unknown
Bulgaria	10	No reply to questionnaire.	Unknown
Czech Republic	0.25	This value refers to the sum of 1,2-, 1,3- and 1,4-dichlorobenzene. It was set in 2010. The basis apparently was a concentration of 0.5 µg/L, but it is not clear where this originates from. The answer in the questionnaire calls this a C_{90} concentration, which was converted to an annual average. It is reported that no assessment factor was used. Yet, the EQS is only half of the trigger value, suggesting an assessment factor of 2. A reference is given to a Government Regulation No. 229/2007 Coll. This was also given for methyl-parathion and malathion, and seems to refer back to a Decree 61/2003.	No
Finland	7.4	The value was set in 2005 (Londesborough, 2005). Finland compiled a long list of toxicity studies for 1,2-dichlorobenzene. The EQS value is based on an NOEC value for zebrafish *(Danio rerio)* of 370 µg/L (Röderer, 1990), which according to the Finnish report is the lowest NOEC value available for long-term studies. However, as the study had only run for 14 days, it was not considered a true chronic study. Consequently, chronic NOECs were only available for two trophic levels. For this reason, an assessment factor of 50 was applied (Londesborough, 2005). This leads to an EQS concentration of 7.4 µg/L. [The Finnish report also includes the reference Calamari et al. (1983) used by Belgium (Flanders). However, it is cited with an EC_{50} of 550 µg/L, i.e. a different value than that used by Belgium (Flanders). The value of 550 µg/L is correct according to the original reference. The corresponding value for 1,4-dichlorobenzene was 930 µg/L.]	No, but derived according to Annex V, section 1.2.6 of the Water Framework Directive 2000/60/EU.
Germany	10	The value was set in German legislation of 2011 (“Gewässerschutzverordnung“).The value is a Water Quality Objective based on an evaluation of the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission (CSTE, 1994). This reference explains that an assessment factor of 100 was applied to a lower value of the acute toxicity range, but no further background was given.	No

Italy	2	The value was set in 2006. It is based on a fish EC_{50} of 2.30 mg/L, but no reference is given. The EQS value was derived according to Annex V Section 1.2.6. ("Procedure for the setting of chemical quality standards by the member states") of Directive 2000/60/EC (EU, 2000), i.e. an EC_{50} value was combined with an assessment factor of 1000. This led to the concentration of 2 µg/L. It should be noted that this is the same EQS value as for 1,4-dichlorobenzene, but it is derived from a different study (fish instead of algae, EC_{50} of 2.3 instead of 1.6 mg/L). This value was compared with a Water Quality Objective set by the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission in 1992 (CSTE, 1994) and with Vighi et al. (2001). In case of differences, the lowest value would have been chosen. The Water Quality Objective gave a value of 10 µg/L, which is the value used by Germany (CSTE, 1994). The study by Vighi et al. (2001) indicated higher toxicity for dichlorobenzenes, in particular for fish and *Daphnia*. This is consistent with a value < 10 µg/L derived by Italy.	No, but the procedure described in Annex V of Directive 2000/60/EC was followed.
The Netherlands	6.9	The value was derived in 2010. The derivation followed national guidance of 2007, which is reported to be in line with Lepper (2005). Identical EQS values were derived for all dichlorobenzenes because differences in toxicity were considered small for the individual dichlorobenzenes (van Leeuwen et al., 2010). The report first states an EQS value of 20 µg/L derived from an NOEC of 200 µg/L for *Jordanella floridae* (Smith et al., 1991; van Leeuwen et al., 2010). [This study was used by Finland for the EQS value for 1,4-dichlorobenzene, but not for 1,2-dichlorobenzene.] However, because of BCFs > 100 L/kg, secondary poisoning was considered. Based on an LOAEL of 150 mg/kg bw (WHO, 2003) and an assessment factor of 30, the maximum permissible concentration is 5 mg/kg_{food} (van Leeuwen et al., 2010). Applying a BCF of 728 L/kg results in an EQS value of 6.9 µg/L (van Leeuwen et al., 2010). In the same way, an EQS value for human health was calculated, but this was higher than the value derived for secondary poisoning. Therefore, the lowest value was chosen as the EQS value.	No, but national guidance was in line with the technical guidance document (EC, 2011).
Romania	10	No reply to the questionnaire.	Unknown
Spain	20	The value was set in 2000. It refers to the sum of 1,2-, 1,3- and 1,4-dichlorobenzene.	No, but see text above for other Technical Guidance used.

The current analysis is also summarized in Figure 17. Several countries used the same studies and approaches as for 1,4-dichlorobenzene (Belgium (Flanders), Czech Republic, Germany, the Netherlands). In the information provided by the Netherlands, it was stated explicitly that toxicity differences between individual dichlorobenzenes were considered small, leading to a combined dataset.

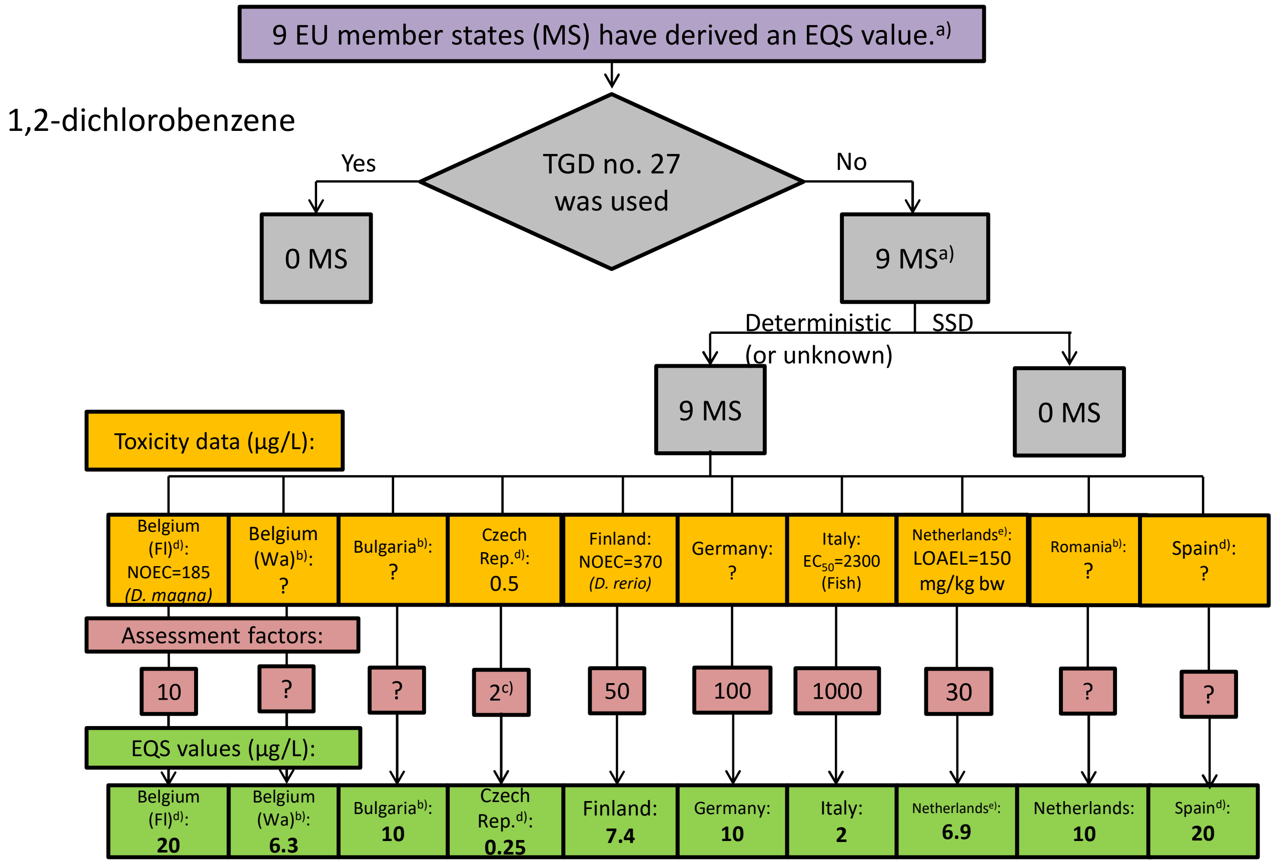
Finland and Italy used the same approach as for 1,4-dichlorobenzene, but referred to different toxicity studies for NOEC values. In the Finnish approach, the NOEC for 1,2-dichlorobenzene was higher than that for 1,4-dichlorobenzene. However, applying a higher assessment factor led to a lower EQS value (Londesborough, 2005). The studies chosen in the Italian approach showed the same tendency, but after application of the assessment factor, the difference was within the rounding uncertainty.

As discussed for 1,4-dichlorobenzene, Italy chose an approach based on EC_{50} values and an assessment factor of 1000, while most other countries – for which this piece of information was available – based the EQS values on NOECs. The Netherlands chose an EQS value based on secondary poisoning, which was lower than the water EQS value. Secondary poisoning was addressed in the Finnish approach as well, but resulted in an EQS value of 150 µg/L, i.e. much higher than the water EQS value (Table 1) (Londesborough, 2005; van Leeuwen et al., 2010).

The Italian value was also compared with the value suggested by CSTE (1994), which was used by Germany. However, as the Italian EQS value was lower than the Water Quality Objective by CSTE (1994), the lowest value was used.

Some uncertainty seems to exist with regard to the NOEC values used by Belgium (Flanders) as they could not be unambiguously confirmed in the original reference (Calamari et al., 1981). Furthermore, Finland listed the same reference, but cited a different parameter (EC_{50} instead of NOEC) and a different concentration (which could be unambiguously confirmed).

The lowest value is that from the Czech Republic although it refers to the sum of three dichlorobenzenes. It is not clear what toxicity data was used, but it seems to be a value of 0.5 µg/L, which would be considerably lower than the data used by other countries.



[a] Two values for Belgium. [b] No reply to questionnaire. [c] Deduced from remaining data.
[d] Sum of several dichlorobenzenes. [e] Secondary poisoning, calculation involves a BCF.

Figure 17: Analysis of EQS values for 1,2-dichlorobenzene. In case of missing information (Belgium (Wallonia), Bulgaria and Romania), it was assumed that TGD no. 27 was not used.

References:

Calamari, D.; Galassi, S.; Setti, F.; Vighi, M. (1983). Toxicity of selected chlorobenzenes to aquatic organisms. Chemosphere 12(2), 253-262.

CSTE (1994). EEC Water Quality Objectives for chemicals dangerous to aquatic environments (List 1). Reviews of Environmental Contamination and Toxicology 137, 83-110.

EC (2003). Technical Guidance Document on Risk Assessment in support of Commission Directive 93/67/EEC on Risk Assessment for new notified substances, Commission Regulation (EC) No 1488/94 on Risk Assessment for existing substances, Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market. Part II. European Chemicals Bureau, Institute for Health and Consumer Protection, EUR 20418 EN/2.

EC (2011). Guidance document no. 27: Technical guidance for deriving environmental quality standards. Common implementation strategy for the water framework directive (2000/60/EC). Technical report – 2011 – 055. ISBN 978-92-79-16228-2.

EU (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal of the European Communities L 327/1.

Lepper, P. (2005) Manual on the Methodological Framework to Derive Environmental Quality Standards for Priority Substances in accordance with Article 16 of the Water Framework Directive (2000/60/EC). 15 September 2005 ed. Schmallenberg, Germany: Fraunhofer-Institute Molecular Biology and Applied Ecology.

Londesborough, S. (2005). Proposal for Environmental Water Quality Standards in Finland. Finnish Environment Institute. ISBN 952-11-1950-0, 952-11-1951-9 (pdf).

Röderer, G. (1990). Testung wassergefährdender Stoffe als Grundlage fur Wasserqualitätsstandards. Testbericht: Wassergefährdende Stoffe, Fraunhofer-Institut für Umweltchemie und Ökotoxikologie, Schmallenberg, Germany.

Rose, R.M.; Warne, M.St.J.; Lun, R.P. (1998). Quantitative structure-activity relationships and volume fraction analysis for nonpolar narcotic chemicals to the Australian cladoceran *Ceriodaphnia cf. dubia*. Archives of Environmental Contamination and Toxicology. 34, 248-252.

Smith, A.D.; Bharath, A.; Mallard, C.; Orr, D.; Smith, K.; Sutton, J.A.; Vukmanich, J.; McCarty, I.S.; Ozburn, G.W. (1991). The acute and chronic toxicity of ten chlorinated organic compounds to the American flagfish *(Jordanella floridae)*. Archives of Environmental Contamination and Toxicology 20, 94-102.

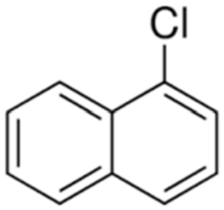
Van Leeuwen, L.C.; Moermond, C.T.A.; van der Veen, M.; van Herwijnen, R. (2010). Environmental risk limit for various chlorobenzenes. RIVM National Institute for Public Health and the Environment. Report 601782020/2010.

Vighi, M.; Gramatica, P.; Consolaro, F.; Todeschini, R. (2001). QSAR and chemometric approaches for setting water quality objectives for dangerous chemicals. Ecotoxicology and Environmental Safety 49, 206-220.

WHO (2003). Dichlorobenzenes in drinking-water. Background document for preparation of WHO guidelines for drinking-water quality. Geneva, Switzerland.

17. 1-Chloronaphthalene (CAS-nr. 90-13-1)

Katrin Vorkamp



EQS values have been set for 1-chloronaphthalene by six European countries (see Table 16), including a proposed value by France. Belgium, which often has two values for Flanders and Wallonia, respectively, has only set an EQS value for Flanders.

The lowest of these six values is that of Romania (0.01 µg/L), while the highest value is the value of Denmark (2.7 µg/L).There was a comment in the original compound list raising doubts about the Romanian value, but we do not know the reasons for this doubt. We have not received a reply from Romania which could have confirmed or corrected this value. The max/min ratio for 1-chloronaphthalene is thus 270.

Denmark and France have considered 1-chloronaphthalene and 2-chloronaphthalene together, i.e. the toxicity data of these two compounds was pooled for the derivation of the EQS value (MST, 2009; INERIS, 2009). However, the EQS value seems to refer to each of these compounds, not the sum.

The EQS values were generally derived before the Technical Guidance Document no. 27 was available (EC, 2011), except for the French proposed value. The data sheet specifying how the proposed French value was derived refers to EC (2011). The Danish EQS value was derived on the basis of national guidance, which further refers to Technical Guidance Document on risk assessment in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances (EC, 2003).

Besides the absence of confirmation from Romania, the Netherlands reported that 1-chloronaphthalene would not be listed as a specific pollutant anymore after a revision in 2015.

Table 17: List of EQS values for 1-chloronapthalene and background information on their derivation.

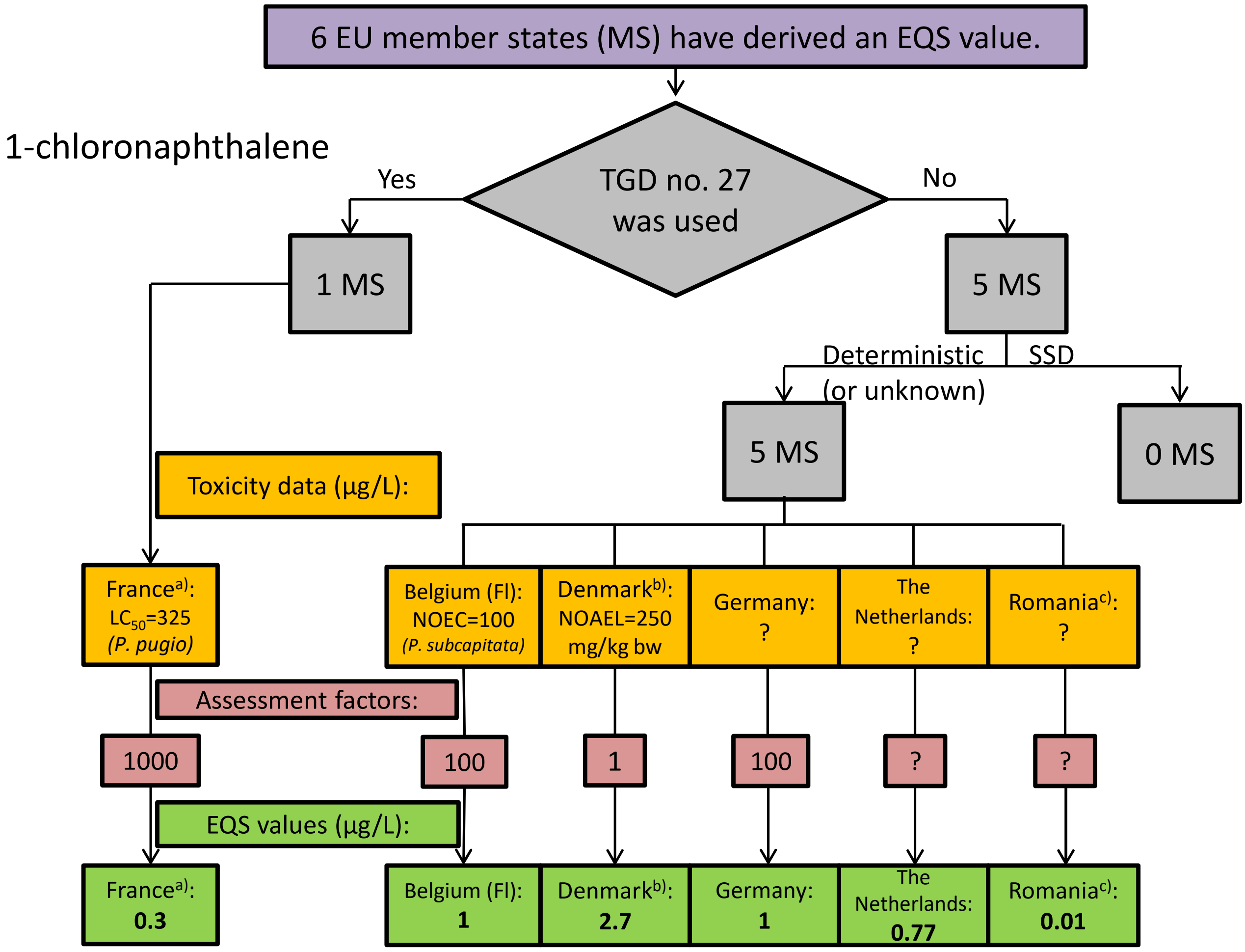
Country	Value (µg/L)	Explanation	Technical guidance document used?
Belgium (Flanders)	1	The value was derived in 2010. It is based on an NOEC of 100 µg/L for *Pseudokirchneriella subcapitata* (96 hours). A reference to Duluth (1978) is given. An assessment factor of 100 was applied, leading to an EQS value of 1 µg/L. It was not specified why an assessment factor of 100 was chosen, in contrast to 10 for some of the other specific pollutants. Belgium (Flanders) also reported an MAC for 1-chloronaphthalene of 40 µg/L, with the same reference.	No

Denmark	2.7	The value was derived in 2009. The toxicity studies available included short term tests with species from three trophic levels, one chronic study with fish and an NOEC from an algae study. In a first calculation, the MATC of the long term fish test was converted to an NOEC, more specifically a range of > 0.27 - < 0.56 mg/L (MTS, 2009). The original study was by Ward et al. (1981). As chronic studies were available for two trophic levels (algae and fish), an assessment factor of 50 was applied to the lower value of the concentration range, resulting in a value of 25.4 µg/L. On the basis of BCF available in the literature, it was concluded that 1-chloronapthalene was potentially bioaccumulative. Therefore, an EQS was calculated including the risk of secondary poisoning. This calculation was based on a $PNEC_{oral}$ of 23.1 mg/kg derived from an NOAEL of 250 mg/kg/day for mice. Including a BCF (4.266) and a biomagnification factor (2) resulted in an EQS value of 2.7 µg/L. No assessment factor was applied to this calculation. The lower value (i.e. 2.7 µg/L) was chosen as the EQS value for 1-chloronaphthalene.	No, but see text above for other Technical Guidance used (EC, 2003).
France	0.3 (proposed)	According to the report by INERIS (2011), only one long terms study (on algae) is available, which does not show higher sensitivity than the short term studies. With reference to EC (2003), the lowest value of the acute studies was chosen, i.e. an LC_{50} (96 hours) of 0.325 mg/L for *Palaemonetes pugio*. The original reference is Green and Neff (1977). An assessment factor of 1000 results in an EQS value of 0.325 µg/L. Another value was calculated taken into account the risk of secondary poisoning. The calculation is identical to that described for Denmark (MST, 2009). However, the resulting value of 2.7 µg/L is higher than the water EQS of 0.3 µg/L.	Yes
Germany	1	The value was set in German legislation of 2011 (“Gewässerschutzverordnung“).The value is a Water Quality Objective based on an evaluation of the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission (CSTE, 1994). This reference explains that an assessment factor of 100 was applied to the lower end of LC_{50} values, but no further background information is given. The value of 1 µg/L was recommended in June 1992, with a reference to cste/91/23/com.	No
The Netherlands	0.77	The Netherlands reported that the actual method for this value was not known. 1-Chloronapthalene will no longer be listed as a specific pollutant in the Netherlands upon the revision in 2015.	No
Romania	0.01	No reply to the questionnaire.	Unknown

The current analysis is also summarized in Figure 18. Interestingly, the Danish and French approach to deriving an EQS value based on the risk of secondary poisoning used the same original study and arrived at the same value. However, only for Denmark this value was chosen as an effective EQS value because it was lower than the value derived from chronic toxicity tests. For France, the value was higher than the value derived from toxicity tests. The chronic toxicity test used by Denmark was not among the tests considered by France. Therefore, France used an acute toxicity test and an assessment factor of 1000, which resulted in a lower EQS value than that derived from the risk of secondary poisoning.

The NOEC used by Belgium (Flanders) seems to be included in the Danish list of toxicity data (MST, 2009), but under the species name *Selenastrium capricornutum*. Apparently, this is the same species as *Pseudokirchneriella subcapitata.* This study is also mentioned in the Danish approach, but it is noted that no background material was available. Instead, the fish study was used although the MATC (and calculated NOAC) was higher than in the study used by Belgium (Flanders).

Germany uses a value which was already set in 1992. No further background information was available, neither for the Dutch value, which is close to the German one.



[a] Proposed value. [b] Secondary poisoning. [c] No reply to questionnaire.

Figure 18: Analysis of EQS values for 1-chloronaphthalene. For Romania, it was assumed that TGD no. 27 was not used.

References:

CSTE (1994). EEC Water Quality Objectives for chemicals dangerous to aquatic environments (List 1). Reviews of Environmental Contamination and Toxicology 137, 83-110.

EC (2003). Technical Guidance Document on Risk Assessment in support of Commission Directive 93/67/EEC on Risk Assessment for new notified substances, Commission Regulation (EC) No 1488/94 on Risk Assessment for existing substances, Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market. Part II. European Chemicals Bureau, Institute for Health and Consumer Protection, EUR 20418 EN/2.

EC (2011). Guidance document no. 27: Technical guidance for deriving environmental quality standards. Common implementation strategy for the water framework directive (2000/60/EC). Technical report – 2011 – 055. ISBN 978-92-79-16228-2.

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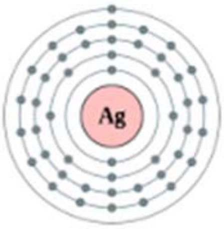
18. Silver (CAS-nr. 7440-22-4)

Katrin Vorkamp



EQS values have been set for silver by seven European countries (see Table 18). In this context, silver is usually considered as Ag^+, which is the most toxic form.

Belgium has only set an EQS value for Flanders, not for Wallonia. The lowest value of the data set is that from the Netherlands (0.01 µg/L). The values from Denmark (0.017 µg/L) and Germany (0.02 µg/L) are similarly low. Several other values are close to 0.1 µg/L (Austria, Belgium (Flanders), the Netherlands). The highest EQS value is that of Poland (5 µg/L), which, however, remains to be confirmed. The value from the Czech Republic is similarly high (3.5 µg/L). Thus the data sets falls into two main groups. The overall max/min ratio for silver is 500.

Most of the EQS values for silver were derived before the Technical Guidance Document no. 27 was available (EC, 2011). The Netherlands reported that they had used EC (2011). The Danish EQS value for silver was derived using a draft version of EC (2011).

While the EQS value for most of the organic contaminants had been derived in a deterministic approach, both deterministic approaches and species sensitivity distributions (SSD) were used by the different countries for the EQS value for silver. The SSD approach was chosen by Austria, Belgium (Flanders), Germany and Denmark. The Netherlands used a deterministic approach. The same seems to be the case for the Czech Republic, while no information was available from Poland.

Table 18: List of EQS values for silver and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Austria	0.1	The value was probably set in 2006. Its derivation uses the same approach as described by van de Plassche et al. (1999). The report describes that $AgNO_3$ is a particularly toxic silver salt. A sufficient number of chronic studies were available including bacteria, algae, protozoa, crustaceans, insects, molluscs and fish, to allow statistical extrapolation. Apparently, fish are the most sensitive taxonomic group after chronic exposure. Applying the method of Aldenberg and Slob (1993) to determine the HC_5 of an SSD, a maximum permissible added concentration of 0.08 µg/L was derived (van de Plassche et al., 1999). A background concentration of 0 µg/L was assumed and the value was rounded to 0.1 µg/L (Wimmer et al., 2003).	No, but reference is given to Annex V, section 1.2.6 of the Water Framework Directive (EU, 2000).

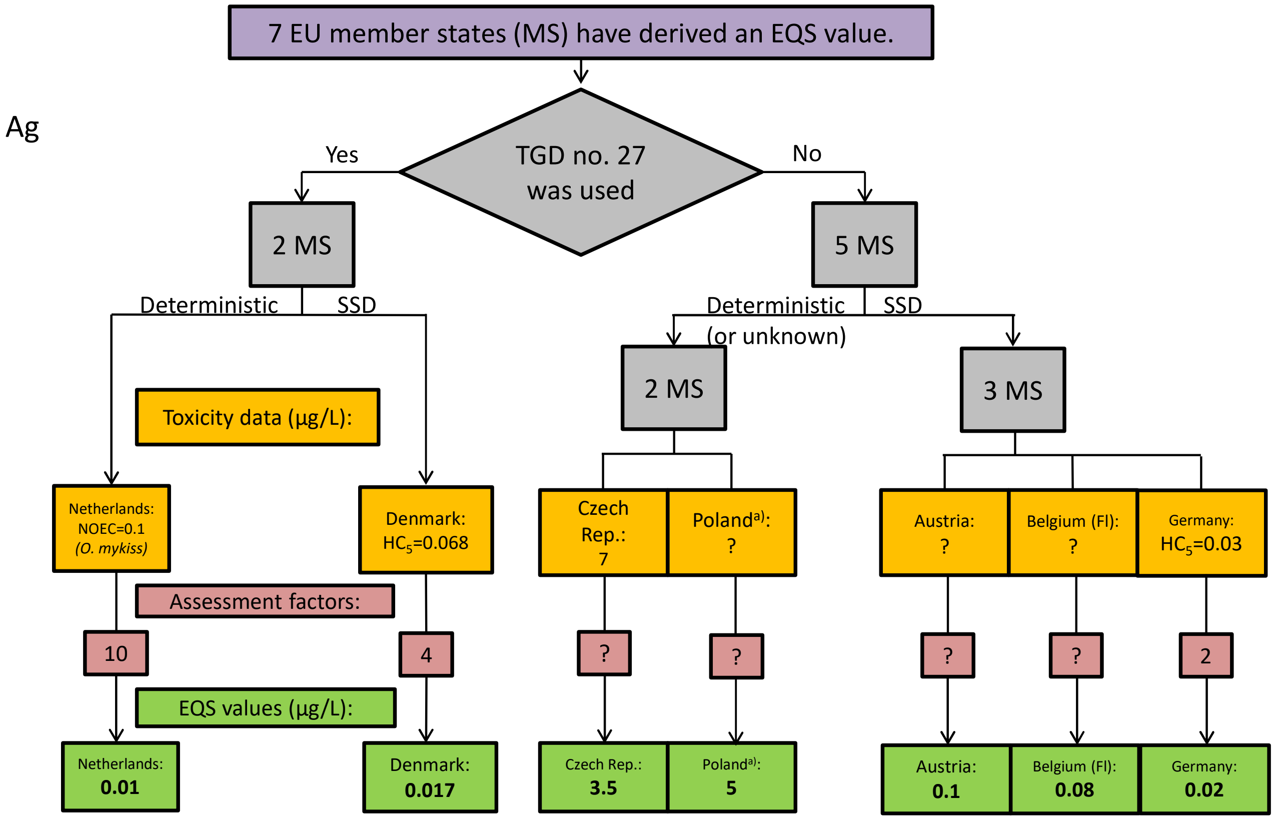
Belgium (Flanders)	0.08	The value was derived in 2010. It is based on the procedure described by van de Plassche et al. (1999). Consequently, this leads to the same value as that for Austria, which was just not rounded.	No
Czech Republic	3.5	The value was derived in 2010. The basis apparently was a concentration of 7 µg/L, but it is not clear where this originates from. The answer in the questionnaire calls this a C_{90} concentration, which was converted to an annual average. It is reported that no assessment factor was used. Yet, the EQS is only half of the trigger value, suggesting an assessment factor of 2. A reference is given to a Government Regulation No. 229/2007 Coll. This was also given for methyl-parathion, and some research led to a Decree 61/2003.	No
Denmark	0.017	The EQS value was derived in 2009. As the statistical analysis showed that silver was considerably more toxic to freshwater species than to marine species, the respective toxicity studies were addressed separately. A sufficiently large number of chronic toxicity studies was available to allow statistical extrapolation. In this context, the usual procedure of using a geometric mean of NOEC values for the same species was not applied because different degrees of water hardness might have affected the results. For this reason, only the lowest NOEC (for each species) was chosen for the SSD. From this, an HC_5 of 0.068 µg/L was calculated (MST, 2009). An assessment factor of 4 was applied, which led to the EQS value of 0.017 µg/L. This is an added concentration. It should be noted that the initial value of 0.068 is very close to the values derived by Austria and Belgium (Flanders), rounded for Austria. The use of an assessment factor introduces the difference compared with Austria and Belgium (Flanders).	Yes, in a draft version.
Germany	0.02	The value was set in German legislation of 2011 (“Gewässerschutzverordnung“). The EQS value was derived from an SSD based on 15 species. This led to an HC5 value of 0.03 µg/L (Nendza, 2003). Because of the relatively large amount of data available for the SSD, an assessment factor of 2 was used. This led to an EQS value of 0.015 µg/L, rounded to 0.02 µg/L. It was discussed that an added risk approach was appropriate. But due to the low background concentration of Ag in surface waster in Germany (< 0.002 mg/L), this would not have an affect on the EQS value (meaning that MPA ~ MPC).	No

The Netherlands	0.01	The value was derived in 2011. It was described that toxicity studies for freshwater and marine water could not be combined, because of potential differences in the speciation of silver. The EQS value is based on an NOEC of 0.1 µg/L for *Onchorhynchus mykiss*. Applying an assessment factor of 10 resulted in an EQS value of 0.01 µg/L (Moermond and van Herwijnen, 2012). The added risk approach was discussed, but as no data were available on natural background concentrations, MPA = MPC was assumed. The Dutch report discussed to what extent secondary poisoning might be relevant for silver. Some bioconcentration was found to occur in zooplankton, but no further biomagnification in the food web. The calculations showed that an EQS value derived from secondary poisoning would only exceed the EQS values for direct toxicity if the bioaccumulation factor was at least 430 000 (Moermond and van Herwijnen, 2012). This would be about 1300 times higher than reported BCFs and bioaccumulation factors for fish, which seems unlikely. It was therefore concluded that the risk of exposure to silver from secondary poisoning was lower than through direct toxicity. The derivation of a human health based EQS values considering exposure to silver from food consumption was not triggered. However, drinking water as an exposure media was considered relevant.	Yes
Poland	5	No reply to the questionnaire	Unknown

The current analysis is also summarized in Figure 19. Both Austria and Belgium (Flanders) used the SSD approach by van de Plassche et al. (1999) and arrived at the same value, the only difference being that of rounding. Denmark used the same approach and arrived at a similar value (possibly not exactly the same because minimum NOECs were used per species, instead of the commonly applied geometric mean). However, the division by an assessment factor of 4 made the Danish EQS value considerably lower. The HC_5 value derived from an SSD by Germany was somewhat lower than the other values.

The value from the Netherlands is the lowest value of the data set. Unlike the other countries with relatively low EQS values, the Netherlands did not use an SSD, but a deterministic approach. The combination of the lowest NOEC and an assessment factor of 10 resulted in the low value of 0.01 mg/L. However, this is still similar to the Danish value although Denmark used the SSD approach.

For the high values of the data set (Czech Republic and Poland) insufficient information was available to explain these.



[a] No reply to questionnaire.

Figure 19: Analysis of EQS values for silver. For Poland, it was assumed that TGD no. 27 was not used.

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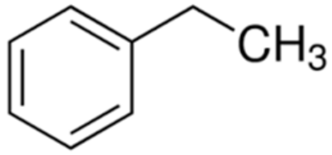
Wimmer, M. et al. (2003). Water Framework Directive. Quality objectives for chemical substances in surface waters. Working Group Chemicals/Monitoring Objectives. Version 2003-04-30.

19. Ethylbenzene (CAS-nr. 100-41-4)

Katrin Vorkamp



EQS values have been set for ethylbenzene by 13 European countries, including a proposed value from France (see Table 17). Belgium has set two values for Flanders and Wallonia, respectively.

The lowest value is that of the Czech Republic (1 µg/L), and the highest EQS value is that of 65 µg/L, which is shared by Belgium (Wallonia), France, the Netherlands and Portugal. Furthermore, five countries have the same value of 10 µg/L (Austria, Bulgaria, Germany, Latvia, Romania).

Belgium (Wallonia), Bulgaria and Romania did not reply to the questionnaire. Some other countries only provided limited details.

Most of the EQS values were derived before the Technical Guidance Document no. 27 was available (EC, 2011). However, the derivation of the Portuguese and the Dutch EQS value had considered this guidance document. It is also referred to in the document by INERIS (2009) specifying how the French EQS value had been derived.

Austria and Spain referred to the Technical Guidance Document on risk assessment in support of Commission Directive 93/67/EEC on risk assessment for new notified substances and Commission Regulation (EC) No 1488/94 on risk assessment for existing substances (EC, 2003). This guideline also was referred to in Danish national guidance which was followed in the derivation of the Danish EQS value. As noted above, the Netherlands and Portugal (and Belgium (Wallonia)) have the same EQS value.

Table 19: List of EQS values for ethylbenzene and background information on their derivation.

Country	Value (µg/L)	Explanation	Technical guidance document used?
Austria	10	The value was published in 2003 (Wimmer et al., 2003). The Austrian report concluded that on the basis of the data currently available it was not possible to derive an EQS value according to Annex V, section 1.2.6 of the Water Framework Directive (EU, 2000). Instead, a value was recommended which had been derived as a Water Quality Objective by the Scientific Advisory Committee on Toxicology and Ecotoxicity of Chemicals of the European Commission (CSTE, 1994). This reference explains that an assessment factor of 100 was applied to acute toxic values, but no further background information is given. The value of 10 µg/L was derived in 1989 and submitted for adoption in June 1992, with a reference to cste/89/43/com.	No

Belgium (Flanders)	5	The value was derived in 2010. It is based on a 96 hours EC_{50} of 490 µg/L for bay shrimps *(Crago franciscorum)* (Benville and Korn, 1977). An assessment factor of 100 was applied, leading to an EQS value of 5 µg/L. The MAC EQS value was based on the same study, but used an assessment factor of 10, thus resulting in a concentration of 50 µg/L.	No
Belgium (Wallonia)	65	No reply to the questionnaire.	Unknown
Bulgaria	10	No reply to the questionnaire.	Unknown
Czech Republic	1	The value was derived in 2010. The basis apparently was a concentration of 2 µg/L, but it is not clear where this originates from. The answer in the questionnaire calls this a C_{90} concentration, which was converted to an annual average. It is reported that no assessment factor was used. Yet, the EQS is only half of the trigger value, suggesting an assessment factor of 2. A reference is given to a Government Regulation No. 229/2007 Coll. This was also given for methyl-parathion, and some research led to a Decree 61/2003. However, it was not possible to find this document on the internet.	No
Denmark	20	The EQS value was derived in 2009. It is based on an NOEC value of 1.0 mg/L for *Ceriodaphnia dubia* (7 days) (Niederlehner et al., 1998). It is discussed in the Danish report that the EC_{50} values for this species are higher than EC_{50} values for Daphnia magna in a 24/48 hours test (Vigano, 1993). However, as no NOEC value existed for *D. magna*, the existing NOEC value for *C. dubia* was used (MST, 2009). It was further discussed that the test duration of 7 days might be on the short site for assessing chronic toxicity. However, an EU risk assessment report had considered this study as representative of chronic toxicity. The NOEC value of 1.0 mg/L was combined with an assessment factor of 50. This is higher than usual because of indications in the literature of endocrine disrupting effects of ethylbenzene (Hill et al., 2002).	No, but see text above for other Technical Guidance used (EC, 2003).

France	65 (proposed)	The French approach uses the same study and the same line of argumentation as described by Denmark (Niederlehner et al., 1998; INERIS, 2009). However, as they expect baseline toxicity, an assessment factor of 10 was applied (instead of 50, as in the Danish approach). This leads to an EQS value of 100 µg/L, i.e. 5 times higher than the Danish EQS value. According to INERIS (2009), this value was validated by a $\text{PNEC}_{\text{aqua}}$ in an EU risk assessment. INERIS (2009) also calculated an EQS value taking into account the risk of secondary poisoning. It is based on an NOEC of 971 $\text{mg/kg}_{\text{biota}}$ (rat). Combining this value with a BCF of 91 and a biomagnification factor of 1 results in an EQS value of 119 µg/L, i.e. similar to, but higher than the water EQS. Furthermore, human exposure was considered and the corresponding EQS value was calculated. The calculation is based on a TDI of 97 mg/kg bw/day. Combining this value with an average body weight and an assumption of average fish consumption led to a concentration of 65 µg/L, which is lower than the EQS values derived from baseline toxicity and from the risk of secondary poisoning (INERIS, 2009).	Yes
Germany	10	The value was set in German legislation of 2011 (“Gewässerschutzverordnung“).The value follows the same approach and references as described for Austria (CSTE, 1994), resulting in the same EQS value.	No
Latvia	10	The EQS value was set in 2002. No further information was given. It is possible that the same approach was chosen as by Austria and Germany, however, this assumption will need confirmation.	No
Luxembourg	2	The value was set in 2010. Luxembourg informed that usually, they did not set EQS values themselves, but aligned with decisions for the river basins of the rivers Rhine and Meuse. This indicates coordination with France, Belgium, Germany and the Netherlands. However, the value for ethylbenzene is different from those of the neighbouring countries.	No, but unknown whether or not a draft version was used.

The Netherlands	65	The value was derived in 2011. The approach identifies the same studies listed by Denmark and France as those indicating highest sensitivity (Niederlehner et al., 1998; Smit and Verbruggen, 2011). This means that it is based on the NOEC of 1.0 mg/L for *Ceriodaphnia dubia* (7 days). Unlike the Danish approach, however, an assessment factor of 10 is used, leading to an EQS value of 100 µg/L. This is identical with the French approach and resulting EQS value. Like the French approach, the Dutch approach also considered an EQS value taking into account the risk of secondary poisoning. The calculation is based on an NOAEL of 136 mg/kg bw (expressed as oral daily dose). This was corrected to 97 mg/kg bw because of adjustments in exposure period. Using a conversion factor of 20, the dietary based NOAEC is 1943 mg/kg biota. An assessment factor of 90 was used. The same BCF and BMF are used as in the French approach, but the resulting EQS value of 237 µg/L is twice the French value. This is most likely due to differences in the derivation of the biota-based NOEC . It is also higher than the water EQS. In addition, an EQS was derived for human health. This starts with the same value of 139 mg/kg bw (corrected to 97 mg/kg bw), i.e. the same value used by France. The resulting value is 65 µg/L, i.e. the same as the French value and lower than the EQS values derived from the long term toxicity studies and from the risk of secondary poisoning.	Yes
Portugal	65	The value was set in 2014. The following information was provided by Portugal: *The methodology used for setting quality standards follows point 2.8-Using existing risk assessments, page 26 of the Guidance Document nº 27 – Technical Guidance for Deriving Environmental Quality Standards (2011): "For some industrial chemicals, detailed evaluations and risk assessment will already have been prepared under Regulation (EC) nº 793/93 or Directives 98/8/EC, and published in Risk Assessment Reports (RARs) .We recommend that the Predicted No effect Concentrations (PNECs) derived from this process are normally adopted as QSs because the assessments and associated data will have undergone thorough peer review. This also promotes consistency between chemical assessment and control regimes".* It seems likely that the approach is the same as described for the Netherlands (Smit and Verbruggen, 2011) and France (INERIS, 2009).	Yes
Romania	10	No reply to the questionnaire.	Unknown

Spain	30	The value was set in 2000. No further information was provided.	No, but see text above for other Technical Guidance used (EC, 2003).

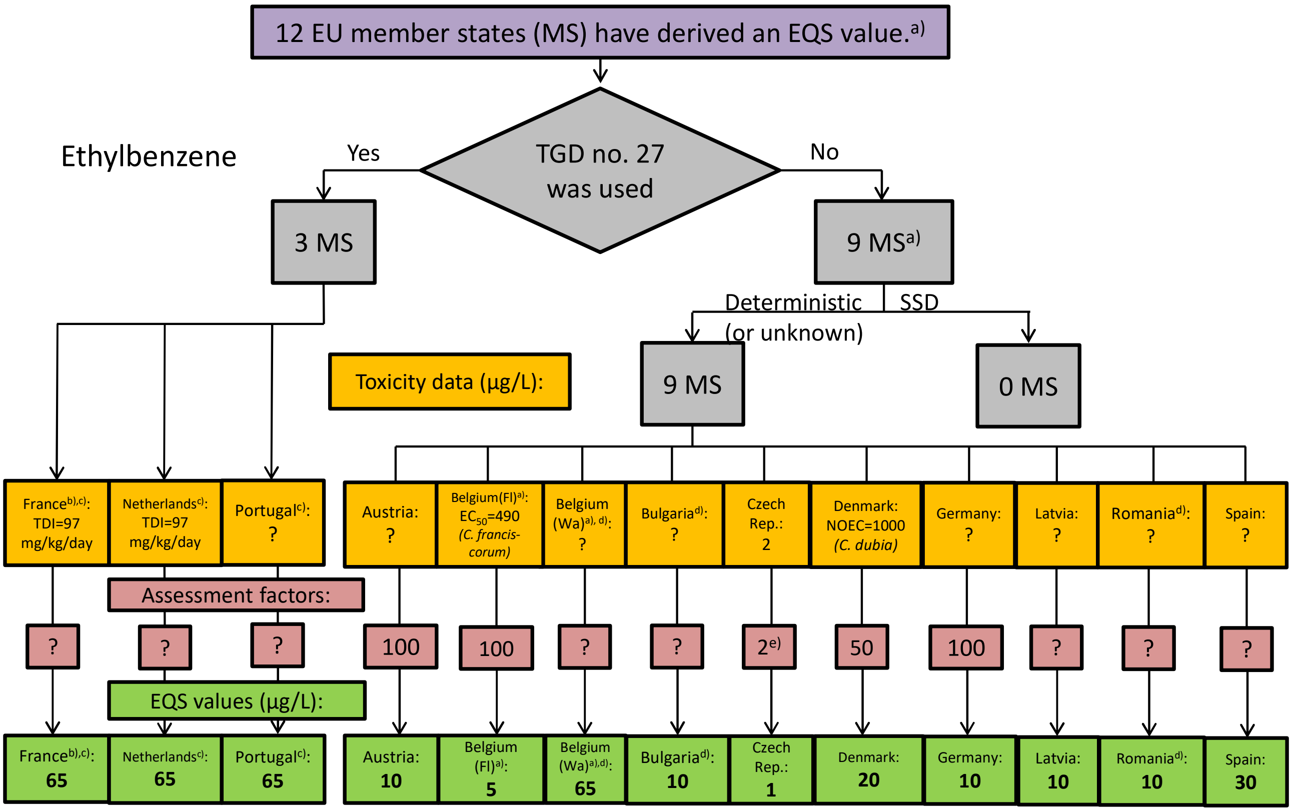
The current analysis is also summarized in Figure 20. Interestingly, Denmark, France and the Netherlands used the same study (Niederlehner et al., 1998) to derive an EQS value, but still arrived at different EQS values for ethylbenzene. Firstly, Denmark used an assessment factor of 50 to account for potential specific effects while France and the Netherlands used an assessment factor of 10. Consequently, the Danish EQS value is lower than the French and Dutch ones derived from the same study.

This has implications for the alternative values considering secondary poisoning or human exposure. Denmark did not calculate an EQS value for secondary poisoning because the bioaccumulation potential was considered low. France and the Netherlands used different biota-based values, resulting in EQS values for secondary poisoning that differed by a factor of 2. Both countries also derived an EQS value for human health. The same input values and calculation steps were used by both countries, resulting in the same EQS value of 65 µg/L. For these two countries, this is the lowest value and thus chosen as the eventual EQS value. Portugal has the same value. As all three countries used EC (2011) for deriving an EQS value, it seems likely that Portugal – and probably Belgium (Wallonia) - also used the same approach as France and the Netherlands.

A second group of countries has an EQS value of 10 µg/L (Austria, Bulgaria, Germany, Latvia, Romania). Austria and Germany provided background information, which documented that the same source had been used (CSTE, 1994). Unfortunately, no details were available from the other three countries.

As was the case for several other organic compounds, the Czech Republic had the lowest value of this data set. However, the background information provided was not sufficient to elucidate the original data which form the basis for this EQS value.

Belgium (Flanders) used a specific study (Benville and Korn, 1997), which none of the other countries used, probably because other studies had shown higher sensitivity. However, since Belgium (Flanders) applied an assessment factor of 100 – instead of 10 as in most other cases – the resulting EQS value of 5 µg/L is lower than in most other countries. The EQS value for Spain (30 µg/L) is an intermediate concentration in this data set, but its background is not known.



[a] Two values for Belgium. [b] Proposed value. [c] Human health. [d] No reply to questionnaire.
[e] Deduced from remaining data.

Figure 20: Analysis of EQS values for ethylbenzene. The figure does not include Luxembourg (2 µg/L) because of lack of space. In case of missing information (Belgium (Wallonia), Bulgaria and Romania), it was assumed that TGD no. 27 was not used.

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EUROPEAN ENVIRONMENTAL QUALITY STANDARDS (EQS) VARIABILITY STUDY

Analysis of the variability between national EQS values across Europe for selected Water Framework Directive River Basin-Specific Pollutants

Under the Water Framework Directive of the European Union (EU), member states are to establish national environmental quality standards (EQSs) for River Basin Specific Pollutants. A technical guidance document (TGD) exists, which was published in 2011. Despite of this, previous studies have shown a significant variation between national EQS values. The aim of the present study was to investigate possible reasons for the variability observed for some EQS values derived by individual member states.Based on questionnaires targeting 19 selected substances with relatively large EQS variations, the member states provided details on how the national EQSs for these substances had been derived . The analysis showed that the year of the different national EQSs (e.g. older than the TGD) likely caused some variation. While other EU guidance and directives had been used frequently, the TGD had only been used for few of the selected substances. Furthermore, the protection endpoint and hence assessment factor used also contributed to the variation.

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