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WATER QUALITY LIMIT VALUE DERIVATION: AN INTERNATIONAL PERSPECTIVE

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INTRODUCTION

A water quality limit value is a numerical concentration of a substance against which water quality objectives are measured. Such limits are termed differently in different countries and regions but the derivation of all involves the assessment of ecotoxicological data to estimate a concentration of a substance below which environmental effects are not expected to occur, or to occur in an acceptably small percentage of species or life stages.

This poster presents a summary of the guidance applied in different countries and regions (EU, Canada, USA, Australia and Ne w Zealand) to derive limit values, highlights the effect of application of the different procedures on the water quality standard value derived and assesses the potential for water quality values derived in one jurisdiction to be applied directly in another.

METHODS

Two separate methods were applied to assess the effects of the specific differences in approaches between the derivation procedures (Table 1). The first investigated the variation in water quality standard values generated by deriving guideline values for four identical aquatic, long-term ecotoxicity substance datasets, using each derivation procedure. The second assessed the potential for standard values derived in one jurisdiction to be applied in another by assessing the specific standard derived in the EU (including the underpinning dataset) against the requirements for deriving a Canadian Federal (CCME) water quality standard. For both methods, the guidance on the derivation of standard values for each jurisdiction was strictly applied.

RESULTS

Standard values were derived using each of the procedures in Table 1, for identical ecotoxicity datasets generated for four substances (chloride (CCME dataset), copper (Alberta Environment dataset), carbaryl (CCME dataset) and endosulfan (CCME dataset). The results obtained for two of the substances (chloride and carbaryl) are shown in Figures 1 and 2. The variation in the values generated across the different procedures was similar for all four assessments, with no one derivation methodology consistently generating the most conservative or least conservative value.

In the second part of the assessment, 71 EU EQS / PNECs were assessed against the requirements of the CCME derivation procedures to investigate how many would be suitable for adoption in Canada. Based on assessment of each substance-specific dataset against the requirements of the CCME derivation guidelines, only seven values could be directly adopted in Canada, while a further six could be adopted following adaptation (e.g. of the assessment factor). It is considered that the EU and CCME approaches are relatively similar, however, the results show that even in such a case the potential for direct adoption between jurisdictions is limited.

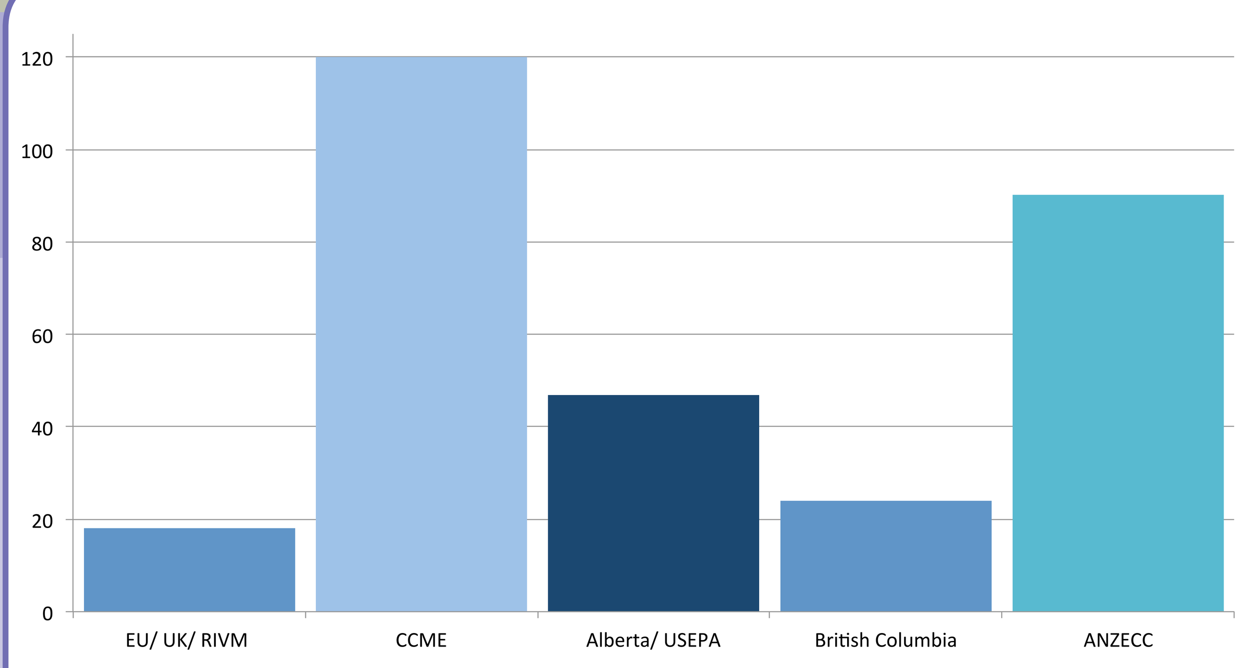

Figure 1. Water Quality Standard Values for Chloride (mg/L) Derived by Different Derivation Approaches (most conservative value)

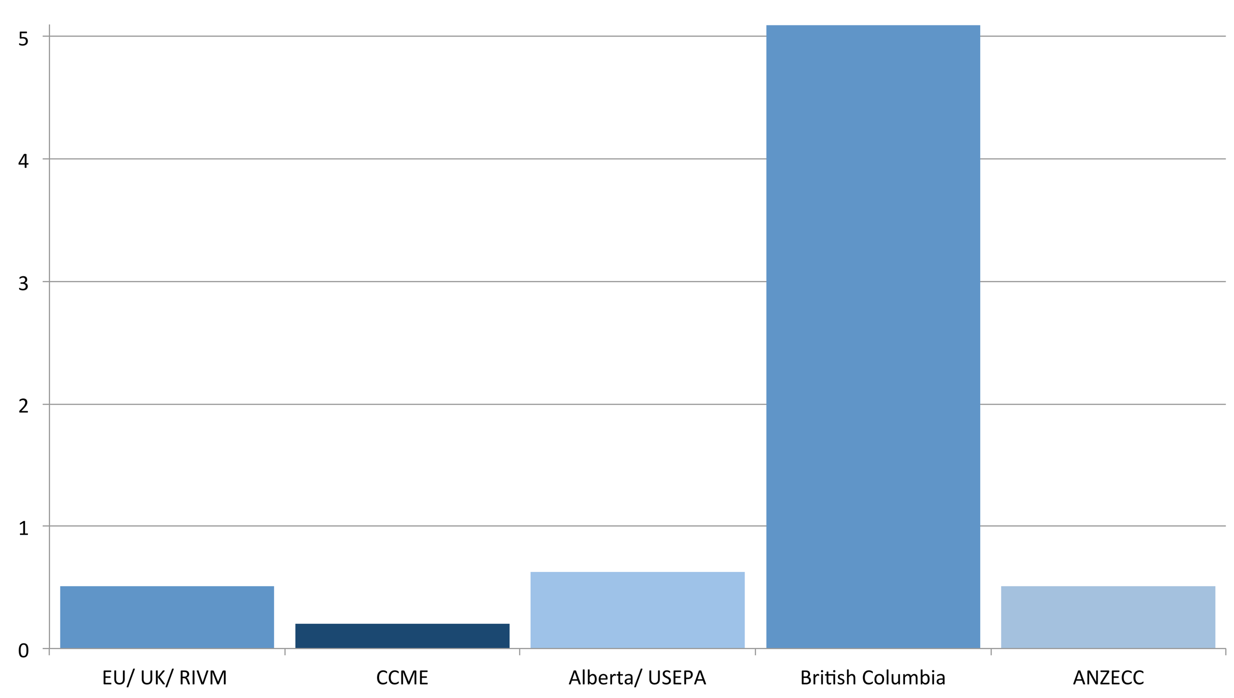

Figure 2. Water Quality Standard Values for Carbaryl (µg/L) Derived by Different Derivation Approaches (most conservative value)

LONG-TERM TERM WATER QUALITY STANDARDS

Table 1 summarises the range of procedures used to derive long-term water quality standards values across regulatory jurisdictions around the world (Europe, USA, Canada, Australia and New Zealand). The approaches applied are all relatively mature in that the methods used to derive water quality standards have been developed over the last 50 years. Despite similarities in the fundamentals of the procedures used, specific differences mean that very different values are generated and applied even within different parts of the same country.

CONCLUSIONS

- While similar in general approach, the different water quality standard derivation procedures applied in different jurisdictions can generate significantly different values, even when using identical underpinning ecotoxicology data.
- The differences in the value derived are affected by the preferred methods of derivation (deterministic or probabilistic), the taxonomic and geographical requirements for ecotoxicity data, the type of ecotoxicity endpoint values used in the assessment, and specific rules governing the value that are not applied across all jurisdictions.
- While it may be possible to adopt some guidelines directly from one jurisdiction to another, saving time and effort, this is unlikely to be possible in most cases without the application of some flexibility in the approach taken in the adopting jurisdiction.
- It is recommended therefore that jurisdictions developing new or revised methods to water quality standard derivation review the full complement of available approaches and develop a specific approach which incorporates the most robust elements of each of the procedures evaluated in this poster.

References:

Alberta Environmental Protection. 1996. Protocol to Develop Alberta Water Quality Guidelines for Protection of Freshwater Aquatic Life.

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EC (European Commission). 2011. Guidance Document No. 27. Technical Guidance For Deriving Environmental Quality Standards. Technical Report - 2011 - 055.

RIVM, The Netherlands. 2007. Guidance for the Derivation of Environmental Risk Limits Within the Framework of 'International and National Environmental Quality Standards for Substances in the Netherlands'

UK Technical Advisory Group on the Water Framework Directive. 2008. Proposals for Environmental Quality Standards for Annex VIII Substances.

US Environmental Protection Agency. 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and their Uses.

Table 1. Summary of Water Quality Standard Derivation Procedures Across Different Jurisdictions

	European Union	United Kingdom	The Netherlands (RIVM)	Canada (Federal, CCME)	Alberta , Canada	British Columbia, Canada	USA (Federal, USEPA)	Australia and New Zealand (ANZECC)
Types of Long-term Water Quality Standard	Environmental Quality Standard (EQS)	Environmental Quality Standard (EQS)	Maximum Permissible Concentration (MPC)	Type A, B1 and B2	Full and Interim	Full and Interim	Criterion Continuos Concentration (CCC).	Guideline Trigger Values
Derivation Methodology	Probabilistic (SSD) & Deterministic	Probabilistic (SSD) & Deterministic	Probabilistic (SSD) & Deterministic	Probabilistic (SSD, Type A Guideline)) & Deterministic (Type B Guideline)	Probabilistic (non-SSD, Full Guideline) & Deterministic (Interim Guideline)	Deterministic only	Probabilistic (non-SSD) & Deterministic	Probabilistic (SSD) & Deterministic
Ecotoxicity Study Reliability Requirements	Reliability 1 or 2 according to Klimsch et al (1997)	Reliability 1 or 2 according to Klimsch et al (1997)	Reliability 1 or 2 according to Klimsch et al (1997)	Primary or Secondary Data (approximately equivalent to Klimsch 1 and 2)	Primary or Secondary Data (approximately equivalent to Klimsch 1 and 2)	Primary or Secondary Data (approximately equivalent to Klimsch 1 and 2)	None (based on expert judgement)	Complete or Moderate Data (approximately equivalent to Klimsch 1 and 2)
Minimum Data Requirements	Deterministic Approach: Klimisch 1/2 data for 3 species (fish, invertebrates and algae) Probabilistic Approach: Klimisch 1/2 data for at least 10 species covering at least 8 taxonomic groups.	Deterministic Approach: Klimisch 1/2 data for 3 species (fish, invertebrates and algae) Probabilistic Approach: Klimisch 1/2 data for at least 10 species covering at least 8 taxonomic groups.	Deterministic Approach: Klimisch 1/2 data for 3 species (fish, invertebrates and algae) Probabilistic Approach: Klimisch 1/2 data for at least 10 species covering at least 8 taxonomic groups.	Type A: Primary or Secondary data representing 6-7 North American taxonomic groups Type B1: As Type A but all Primary data Type B2: Primary or Secondary data representing 4 North American taxonomic groups	Full Guideline: Primary data representing 9 North American taxonomic groups Interim Guideline: Primary or Secondary data representing 4 North American taxonomic groups	Full guideline: Primary data representing 6-7 North American taxonomic groups Interim Guideline: Primary or Secondary data representing 4 North American taxonomic groups	Data representing 6-7 North American taxonomic groups	Deterministic Approach: Based on expert review of available data Probabilistic Approach: Complete data for 5 species.
Ecotoxicity Endpoint values used in derivation	NOEC or EC10	NOEC or EC10	NOEC or EC10	Type A: Hierarchy of - Most appropriate ECx/ICx representing a no-effects threshold > EC10/IC10 > EC11-25/IC11-25 > MATC > NOEC > LOEC > EC26-49/IC26-49 > nonlethal EC50/IC50. Type B: Hierarchy of - Most appropriate ECx/ICx representing a low-effects threshold > EC15-25/IC15-25 > LOEC > MATC > EC26-49/IC26-49 > nonlethal EC50/IC50 > LC50	MATC	Low effect value according to hierarchy of - Most appropriate ECx/ICx representing a low-effects threshold > EC15-25/ IC15-25 > LOEC > MATC > EC26-49/IC26-49 > nonlethal EC50/IC50 > LC50	MATC or ECx	Chronic = NOEC, Ecx or LOEC
Safety/ Assessment Factors	Deterministic Approach: Magnitude dependent on data quantity Probabilistic Approach: Magnitude dependent on expert judgement and weight of evidence	Deterministic Approach: Magnitude dependent on data quantity Probabilistic Approach: Magnitude dependent on expert judgement and weight of evidence	Deterministic Approach: Magnitude dependent on data quantity Probabilistic Approach: Magnitude dependent on expert judgement and weight of evidence	Type A: None Type B: Consistent magnitude	Full Guideline: None Interim Guideline: Magnitude dependent on data quality	Magnitude dependent on expert judgement	None	Deterministic Approach: Magnitude dependent on data quantity and expert judgement Probabilistic Approach: None
Degree of Prescription/ Expert Judgement	Derivation procedures highly prescriptive Expert judgement only applied in final decision on assessment factor in the probabilistic approach	Derivation procedures highly prescriptive Expert judgement applied in final decision on assessment factor in the probabilistic approach	Derivation procedures highly prescriptive Expert judgement applied in final decision on assessment factor in the probabilistic approach	Derivation procedures highly prescriptive	Derivation procedures highly prescriptive	Derivation procedures highly summarised and not very prescriptive Expert judgement applied throughout entire derivation procedure.	Some prescription in derivation procedures but some critical areas require application of expert judgement	Derivation procedures highly prescriptive but also allow application of expert judgement throughout.

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