Australian Government
Department of the Environment
Supervising Scientist

Toxicant guideline values for the protection of aquatic ecosystems – an improved derivation method and overview of priority toxicants

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Overview

- Background – ANZECC (2000) toxicants

The current revision:

- Revised GV derivation method
- Updated derivation software – Burrlioz 2.0
- Revision of toxicant GVs – process and progress
  - Priority toxicants
  - Third party contributed toxicant GVs
- Four key messages

Terminology		
1992	**2000**	**2016**
'Guideline value'	'Trigger value'	'Guideline value'

A measurable quantity (e.g. concentration) or condition of an indicator for a specific community value below which (or above which, in the case of stressors such as pH, dissolved oxygen and many biodiversity responses) there is considered to be a low risk of unacceptable effects occurring to that community value. Guideline values for more than one indicator should be used simultaneously in a multiple lines of evidence approach.

Background – ANZECC (2000) toxicants

- Toxicant default guideline values (GVs) a key component of the WQGs (notwithstanding emphasis on preference for local data over national defaults)
- Adopted species sensitivity distribution (SSD) approach to deriving GVs
  - Burrlioz 1.0
- Enormous effort to attempt to derive GVs for >250 toxicants (f'water & marine)

Table 3.4.1 Trigger values for toxicants at alternative levels of protection. Values in grey shading are the trigger values applying to typical *slightly–moderately disturbed systems*; see table 3.4.2 and Section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Chemical		Trigger values for freshwater (µgL^{-1})				Trigger values for marine water (µgL^{-1})			
		Level of protection (% species)				Level of protection (% species)			
		99%	95%	90%	80%	99%	95%	90%	80%
METALS & METALLOIDS									
Aluminium	pH >6.5	27	55	80	150	ID	ID	ID	ID
Aluminium	pH <6.5	ID	ID	ID	ID	ID	ID	ID	ID
Antimony		ID	ID	ID	ID	ID	ID	ID	ID

ANZECC/ARMCANZ (2000)

  - <30% high or moderate reliability (SSD method – chronic or converted acute data, respectively)
  - >70% low reliability (Assessment factor method)
- No GVs updated post-2000 – even erroneous ones!

Current revision – toxicants

1. **Revised GV derivation method**
2. Updated GV derivation software – Burrlioz 2.0
3. Derivation of GVs for selected high priority GVs

Revised GV derivation method

- Critical to have a technically robust approach for deriving default and site-specific GVs
- Opportunity to update the methodology

Key features

1. Updated classifications for acute and chronic toxicity tests
2. Non-traditional endpoints admissible if ecological relevance can be demonstrated
3. Updated hierarchy of acceptable toxicity estimates
4. Ability to combine chronic and acute (converted to chronic) data
5. More flexibility in decisions – best professional judgment
6. Revised Reliability classification
7. SSD model fitting – log-logistic when $n < 8$, Burr Type III when $n \geq 8$

Revised GV derivation method

Updated hierarchy of acceptable toxicity estimates

- Chronic no/low effect data – NEC, EC/IC/LCx where x≤10, BEC10, EC/IC/LC15-20, NOEC

If too few or none of these:

  - Chronic effect data (e.g. EC50) converted to chronic no/low effect data
  - Acute data converted to chronic data

- Can combine chronic and (converted) acute data

More flexibility in decision making – use of best professional judgment

- Within the existing 'rules', can exercise some best professional judgement, including:
  - Acute and chronic toxicity test classifications
  - Age of toxicity data
  - inclusion of "≤" and "≥" values
  - Data quality
  - Data selection when multiple data for a single species
- All decisions need to be justified and documented
- Promote good decision making to suit the situation

Revised GV derivation method

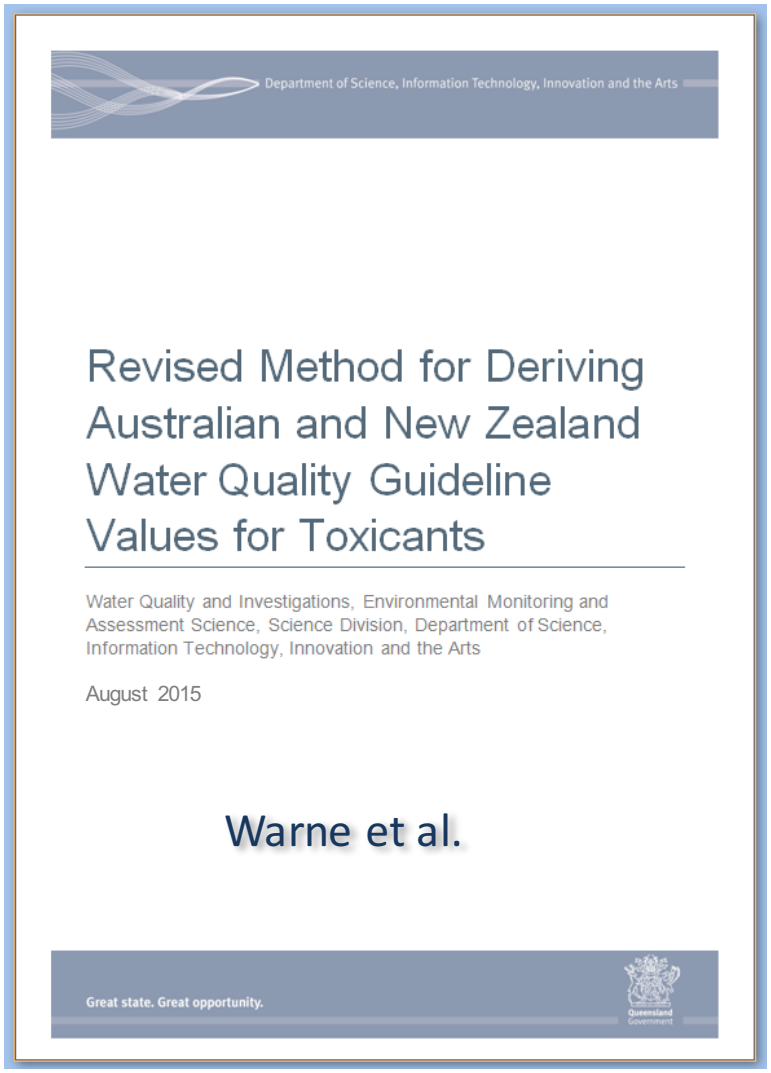
Revised GV Reliability classification

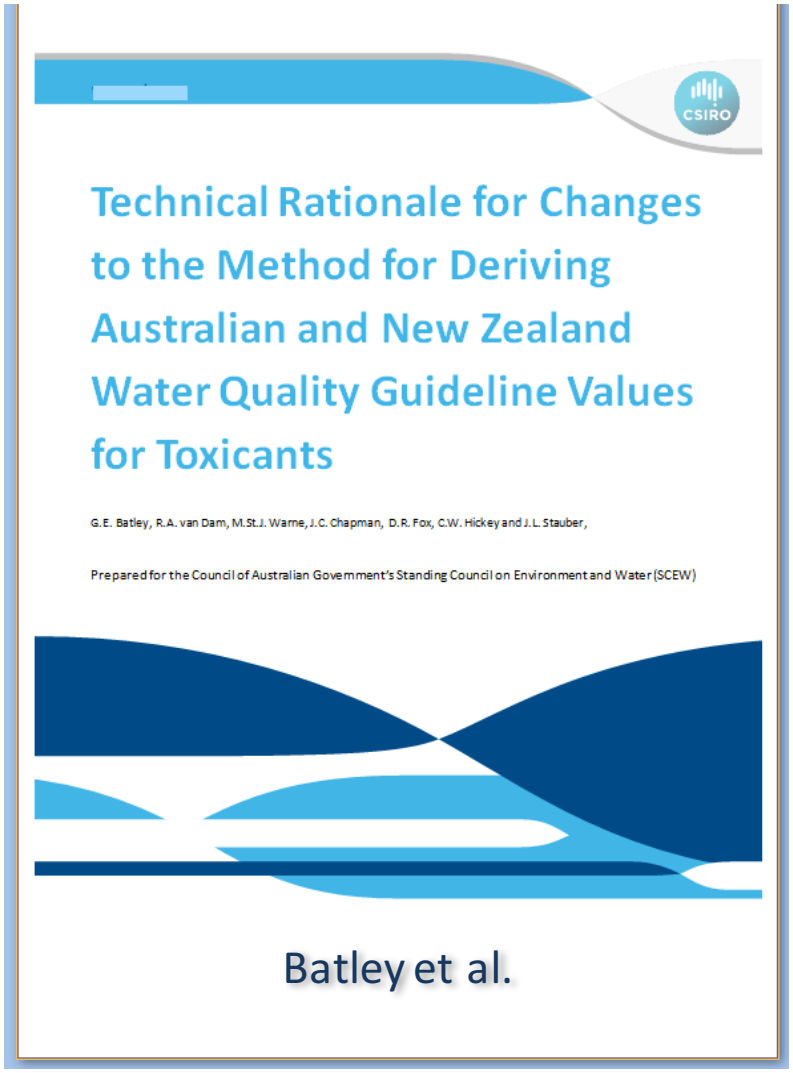
- Based on sample size, type of data and fit of SSD to data

Table 7. Classification scheme for the reliability of guideline values using the SSD method

SAMPLE SIZE[a]	DATA TYPE	ADEQUACY OF SAMPLE SIZE	ADEQUACY OF FIT IN SSD	RELIABILITY
≥15	Chronic	Preferred	Good	Very high
	Chronic	Preferred	Poor	Moderate
8–14	Chronic	Good	Good	High
	Chronic	Good	Poor	Moderate
5–7	Chronic	Adequate	Good	Moderate
	Chronic	Adequate	Poor	Low
≥15	Mixed chronic and converted acute	Preferred	Good	Moderate
	Mixed chronic and converted acute	Preferred	Poor	Low
8–14	Mixed chronic and converted acute	Adequate	Good	Moderate
	Mixed chronic and converted acute	Adequate	Poor	Low
5–7	Mixed chronic and converted acute	Adequate	Good	Moderate
	Mixed chronic and converted acute	Adequate	Poor	Low
≥15	Converted acute	Preferred	Good	Moderate
	Converted acute	Preferred	Poor	Low
8–14	Converted acute	Good	Good	Moderate
	Converted acute	Good	Poor	Low
5–7	Converted acute	Adequate	Good	Low
	Converted acute	Adequate	Poor	Very low

Revised GV derivation method





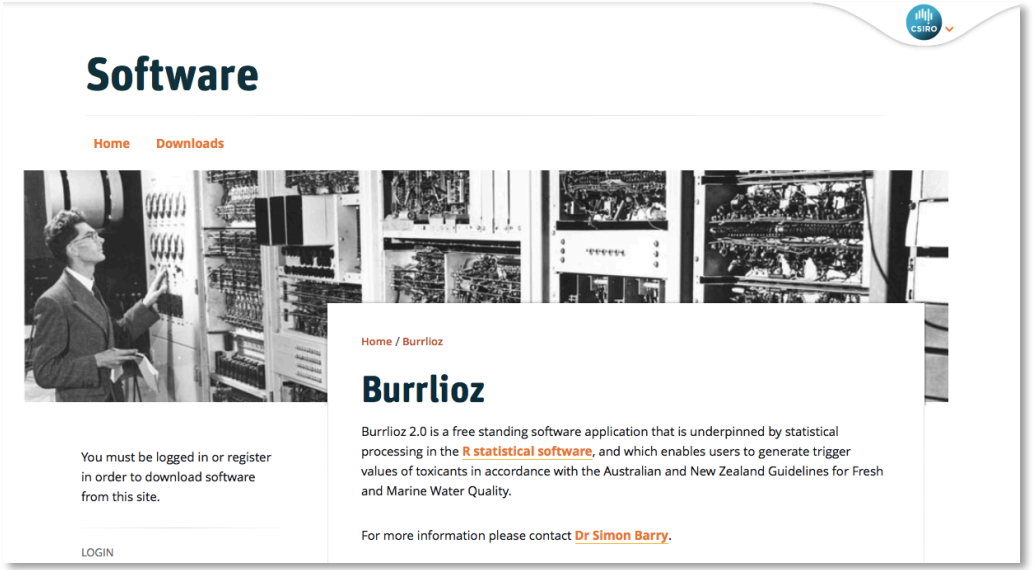
Current revision – toxicants

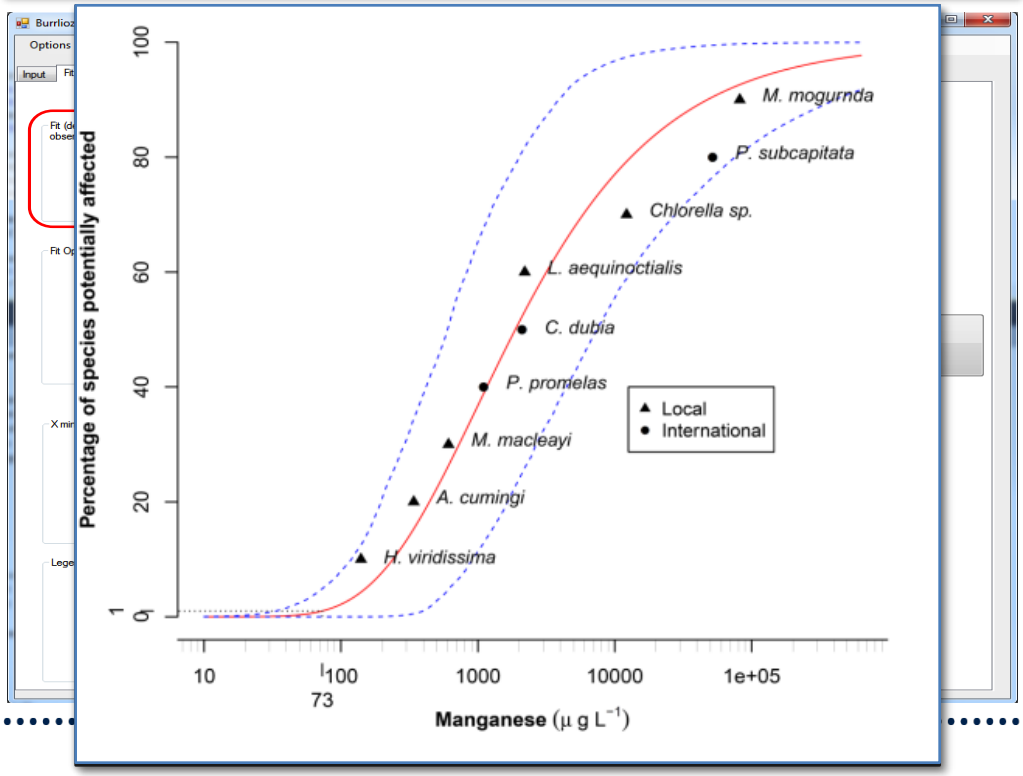
1. Revised GV derivation method
2. **Updated GV derivation software – Burrlioz 2.0**
3. Derivation of GVs for selected high priority GVs

https://research.csiro.au/software/burrlioz/

Burrlioz 2.0 GV derivation software

- For default and site-specific GVs
- Fits log-logistic distribution when n < 8 and Burr Type III when n ≥ 7.
- Calculation of 95% confidence limits (CLs)
- GV and '% species protected' calculators
- Improved graphics functionality
  - Labels and legends
  - Graphics export function
  - Plot 95% CLs





Current revision – toxicants

1. Revised GV derivation method
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3. **Derivation of GVs for selected high priority GVs**

New/revised default GVs for priority toxicants

- Selection based on jurisdictional priorities

Toxicant	Type	Fresh/Marine
Phase 1		
Manganese	Metal	Marine
Nitrate	Non-met inorg	Fresh
Boron	Metal	Fresh
Phase 2		
Chromium (Cr III)	Metal	Fresh
Iron	Metal	Fresh
Iron	Metal	Marine
Chlorine	Non-met inorg	Marine
Ammonia	Non-met inorg	Fresh
Bisphenol-A	Indust Chem	Marine
Bisphenol-A	Indust Chem	Fresh
Triclosan	Indust Chem	Fresh
PFOS	Indust Chem	Fresh
PFOA	Indust Chem	Fresh
Dioxins	Indust Chem	Fresh

Toxicant	Type	Fresh/Marine
Glyphosate	Pesticide	Fresh
MCPA	Pesticide	Fresh
Metsulfuron-methyl	Pesticide	Fresh
Paraquat	Pesticide	Fresh
Picloram	Pesticide	Fresh
Metalochlor	Pesticide	Fresh
Simazine	Pesticide	Fresh
Simazine	Pesticide	Marine
2,4-D	Pesticide	Fresh
Fipronil	Pesticide	Fresh
Mancozeb	Pesticide	Fresh
Permethrin	Pesticide	Fresh
Sulfometuron	Pesticide	Fresh
α-cypermethrin	Pesticide	Fresh

Third party contributed GVs

- Formal process for allowing external parties to contribute GVs where they are a priority to them
- External parties = industry, government, research organisations
- For default GVs, not site-specific GVs
- Must follow the approved GV derivation method
- Formal peer review process
- Details will be available on WQGs website

Toxicant	Contributor
Aluminium (marine)	CSIRO
Uranium (fresh)	ERISS
Manganese (fresh)	ERISS
Fluoride (fresh)	NSW Govt
Carbamazepine (fresh)	CSIRO
Diclofenac (fresh)	CSIRO
Fluoxetine (fresh)	CSIRO
Propranolol (fresh)	CSIRO
Hexazinone (fresh/marine)	Qld Govt
Imidacloprid (fresh/marine)	Qld Govt
Atrazine (fresh/marine)	Qld Govt
Diuron (fresh/marine)	Qld Govt
Tebuthiuron (fresh/marine)	Qld Govt
PFOS (marine)	CRC CARE/GHD
PFOA (marine)	CRC CARE/GHD

Four key messages

1. Significant modifications/improvements to the toxicant GV derivation method and Burrlioz software
    - *Includes flexibility for best professional judgement*
2. New/revised GVs being derived for 28 high priority toxicants
3. Provision for contributed GVs from external parties
    - *~15 already in the queue*
4. Wider engagement on GVs expected mid 2016

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