



Environmental quality criteria for toxic algae in marine recreational water

As part of the Office of the Environmental Protection Authority (OEPA) 2013 review of the Cockburn Sound State Environmental Policy 2005 (now the '[State Environmental \(Cockburn Sound\) Policy 2015](#)'^[2]), the Department of Health, Western Australia (WA Health) has developed in collaboration with the OEPA, and other stakeholders, Environmental Quality Criteria (EQC) for toxic algae in marine recreational water as detailed in this document.

Understanding the Water Quality Management Framework

The Water Quality Management Framework adopted by the OEPA for protecting environmental values in marine waters is based upon the opposite diagram.

This diagram denotes in cascading order of management: **Environmental Values (EV)** i.e. the core principle areas, then **Environmental Quality Objectives (EQO)** i.e. what specifically is to be achieved or maintained within the marine environment. The **Level of ecological protection** is then assigned as either, high, medium or low.

Most importantly from this factsheet's perspective is the **Environmental Quality Criteria (EQC)**, which levels can assist to determine whether the **EQO's** and **EV's** are met.

Water Quality Management Framework



Understanding Environmental Quality Criteria, Guidelines and Standards

Environmental Quality Criteria (EQC) Defined

EQC are established to provide environmental quality benchmarks against which environmental quality and the performance of environmental management can be measured. EQC are generally quantitative and are usually described numerically.

Environmental Quality Guidelines (EQG) Defined

EQG are threshold numerical values or narrative statements which if met, indicate that there is a high degree of certainty that the associated EQO has been achieved. If the EQG is not met, then there is uncertainty as to whether the associated EQO has been achieved, and a more detailed assessment against an 'Environmental Quality Standard' (EQS) is triggered. This assessment is risk-based and investigative in nature.

Environmental Quality Standards (EQS) Defined

EQS are threshold numerical values or narrative statements that indicate a level beyond which, there is a significant risk that the associated EQO has not been achieved and a management response is triggered. The response would normally focus on identifying the cause/source of the exceedance and eradicating or reducing the contaminant of concern.

Environmental Quality Guidelines (EQG)

Development of EQG for toxic algae

Historical numerical environmental quality guidelines (EQG) for toxic algae have primarily been developed for fresh inland waters. In the absence of any known numerical guidelines for marine waters, the EQG for toxic algae detailed below, which includes numerical values, are generally indicative and conservative and are thus designed to protect public health.

This EQG for toxic algae is based upon an understanding that recreational contact and exposure to potentially toxic algae at these levels, is likely to pose a low-level public health risk; whereby certain exposed individuals may experience more mild health effects causing temporary discomfort or difficulty e.g. skin or respiratory irritation.

WA Health will maintain a watching brief for potentially toxic algae species of concern within marine recreational water, and for any reports of human health illness/disease that may be attributable and update this EQG if required.

EQG for toxic algae in marine recreational water

- A.** The phytoplankton cell count* from a single site, should not:
- Exceed 10,000 cells/mL, or;
 - Detect 'WA Health watch list' ([Table 1](#)) species or exceed their trigger levels. #
- B.** There should be no reports of skin, eye or respiratory irritation or potential algal poisoning in swimmers *considered by a medical practitioner as potentially resulting from toxic algae.*

* Phytoplankton cell counts include cyanobacteria and eukaryotic organisms.

Exceedance of 'WA Health watch list' (Table 1) trigger levels, should trigger re-sampling of the site within 72 hours of identification of the exceedance for assessment against EQS A.

Monitoring requirements when EQG exceeded

If phytoplankton water sampling results identify 'WA Health watch list' ([Table 1](#)) species or exceed their trigger levels, re-sampling (within 72 hours of trigger level exceedance identification), and a visual assessment for algal scum (refer also to [Table 2](#)) within the defined recreational area is recommended.

A detection or exceedance of 'WA Health watch list' ([Table 1](#)) species/trigger levels should also increase the monitoring frequency preferably to weekly sampling and visual assessment for algal filaments or scum. Increased monitoring shall continue until, two consecutive all-clear results are achieved i.e. samples and the visual assessment does not trigger the EQG or EQS criteria.

Note: Visual assessment of the water body shall be undertaken at a time of day that generally experiences calmer water conditions for that season. This might for example occur when known prevailing winds are not blowing or as strong as what typically might be expected. In general, morning conditions tend to provide calmer wind and weather conditions.

The resample shall be analysed to determine both algal groups and species counts. Biovolumes are also recommended, especially for cyanobacterial species. The results of this analysis shall be reported to WA Health, who will advise regarding any potential impacts that detection or exceedance may pose to recreational water users and activities.

Environmental Quality Standards (EQS)

Development of EQS for toxic algae

Historical numerical EQS for toxic algae have primarily been developed for inland/fresh waters. In the absence of any known numerical guidelines for marine waters, the EQS for toxic algae referred to below, which includes numerical values, is designed to indicate when recreational exposure to potentially toxic algae is likely to pose a medium to high level of public health risk.

A medium to high public health risk level is considered to occur when an increased number of people, who undertake either primary/direct, or secondary/indirect water contact recreation, experience more pronounced health compromising effects e.g. severe intense skin and respiratory reactions, gastrointestinal or other illness, as a result of exposure to toxic algae.

EQS for toxic algae in marine recreational water

- A.** The phytoplankton cell count* from a single site should not:
 - Exceed 50,000 cells/mL, or;
 - Exceed 'WA Health watch list' ([Table 1](#)) action levels.
- B.** The presence of algal scums+ ^[1] - Refer also to 'WA Health watch list' ([Table 1](#)) action levels for algal filaments or scums.
- C.** There should be no confirmed incidences by report from a medical practitioner, of skin, eye or respiratory irritation, caused by toxic algae or of algal poisoning in swimmers.

* Phytoplankton cell counts includes cyanobacteria and eukaryotic organisms.

+ **Algal Scum:** dense accumulation of algal cells at or near the surface of the water forming a layer of distinct discolouration (green, blue, brown or red) ^[3].

Management actions when EQS exceeded

If an EQS is exceeded, the exceedance should be referred to WA Health for confirmation/advice as to the appropriate management actions required to be implemented. If the exceedance involves:

- a potentially toxic algal species at an elevated level, or;
- if algal scums are present at moderate to high risk levels (See [Table 2](#)), as determined/confirmed by WA Health.

The relevant management action will likely include:

- Erection of warning signs;
- Issue of a press release, and;
- Ongoing monitoring at increased frequency, including;
 - Weekly to fortnightly sampling, and;
 - Daily visual assessment of algal bloom location, movement, density and coverage.

Upon exceedance of an EQS, sampling shall be undertaken at regular durations (fortnightly at a minimum and more frequently for more significant situations/events).

Note: Weekly sampling at a minimum is recommended when a health warning/press release has been issued.

Sampling shall be undertaken for the duration of the exceedance/detection event, to determine whether toxic species continue to be present at potentially harmful concentrations.

Sample analysis should include cell counts and biovolumes for each potentially toxic species.

Phytoplankton Sampling Methodology

The recommended water sampling methodology for phytoplankton in recreational water is as follows:

1. Select a suitable access point e.g. open water, shoreline, bridge or weir.
2. Collect a minimum of 3 x 1.5-2m depth tube/hosepipe samples over the representative recreational area.

Note: Sampling on different sides of a stationary boat is acceptable. When sampling, ensure that the 5-20cm benthic (bottom) layer is avoided.

3. Mix the collected samples into a large container (at least 25-50L of sample is required).
4. Collect 2 composite samples from bucket (1 fixed sample and 1 fresh sample).

Note: 'Fixed' sample refers to the addition of 1mL of iodine preservative 'Lugols solution' per 100mL of sample to assist in sample preservation. If you do not have access to Lugols the laboratory can generally preserve the sample, in this case just send one fresh sample.

5. Submit composite samples for analysis.

Glossary ^[4]

Algae	Comparatively simple chlorophyll-bearing plants, most of which are aquatic and microscopic in size
Cyanobacteria	A division of photosynthetic bacteria, formerly known as blue-green algae that can produce strong toxins.
Eukaryotic organisms	Organisms characterised by the presence of membrane-bound organelles. Opposite to Prokaryotes.
Phytoplankton	Small often microscopic plants suspended in water.

Table 1: WA Health Watch list for potentially toxic algae in marine recreational waters

Algal Group	Algal Genus /Complex	Key Species	Trigger Levels		Action Levels		
			Cell Counts cells/mL	Biovol. Mm/L ³	Cell Counts cells/mL	Biovol. mm/L ³	Visual Observation
Cyanobacteria	<i>Lyngbya</i>	<i>majuscula</i>	Detected ^[1]				Algal filaments - widespread ^[1]
	<i>Trichodesmium</i>	spp.	≥ 5,000	≥ 0.4 ^[1]	≥ 50,000	≥ 4 ^[1]	Algal scums ^[1]
	Other	spp.		≥ 0.4 ^[1]		≥ 4-10 ^[1]	Algal scums ^[1]
Dinoflagellates	<i>Alexandrium</i>	spp.	≥ 1*		≥ 10**		
	<i>Karenia</i>	<i>brevis</i>	≥ 5*		≥ 10**		
	<i>Karenia</i>	spp.	≥ 50*		≥ 100**		
	<i>Pfiesteria</i>	spp.	Detected ^[1]				Algal scums ^[1]
phytoplankton			≥ 10,000		≥ 50,000		

* Repeat sampling, visual observation and/or further investigation of previously sampled waters/adjacent environment is recommended to determine if there is an ongoing or potentially increasing health risk.

** Repeat sampling, regular visual observation of the water body and/or further investigation/analysis (as appropriate) in liaison with WA Health is recommended. WA Health may also issue a public health warning and/or provide other community information/advice, in consideration of the specific situation/context and the monitoring results/event.

Table 2: WA Health risk assessment for algal scum in marine waters

Algal Scum/Filaments Distribution/Characteristic	Algal Scum Location	~Scum Area ≤ 25 m ²	~ Scum Area 25-100 m ²	~ Scum Area > 100 m ²	Risk Level
patchy/sporadic in nature	1. along shoreline at recreational beach/area	Moderate	High	High	
	2. within swimming zone at recreational beach (< 500 m from shoreline)	Low	Moderate	High	
	3. > 500 m offshore	Low	Low	Moderate	
	4. along shoreline or < 500m from shoreline (non-recreational area) e.g. rocky outcrop, boat harbour/marina.	Low	Low	Moderate	
continuous aggregated	1. along shoreline at recreational beach/area	Moderate	High	High	
	2. within swimming zone at recreational beach (< 500 m from shoreline)	Moderate	High	High	
	3. > 500 m offshore	Low	Low	Moderate	
	4. along shoreline or < 500 m from shoreline (non-recreational area) e.g. rocky outcrop, boat harbour/marina.	Low	Low	Moderate	

References

1. National Health and Medical Research Council, *Guidelines for Managing Risks in Recreational Water*. 2008: Canberra. p. 215.
2. Government of Western Australia, *State Environmental (Cockburn Sound) Policy 2015*, Environmental Protection Authority, Editor. 2015: Perth, Western Australia. p. 15.
3. Government of Queensland, *Queensland Harmful Algal Bloom Response Plan*, Department of Health Qld, Editor. 2002, Department of Health Qld, Queensland. p. 13.
4. Australian and New Zealand Environment and Conservation Council and and Agriculture and Resource Management Council of Australia and New Zealand, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* 2000: Canberra, ACT.

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