BLIGH TANNER

Water Quality Guidelines for Public Aquatic Facilities

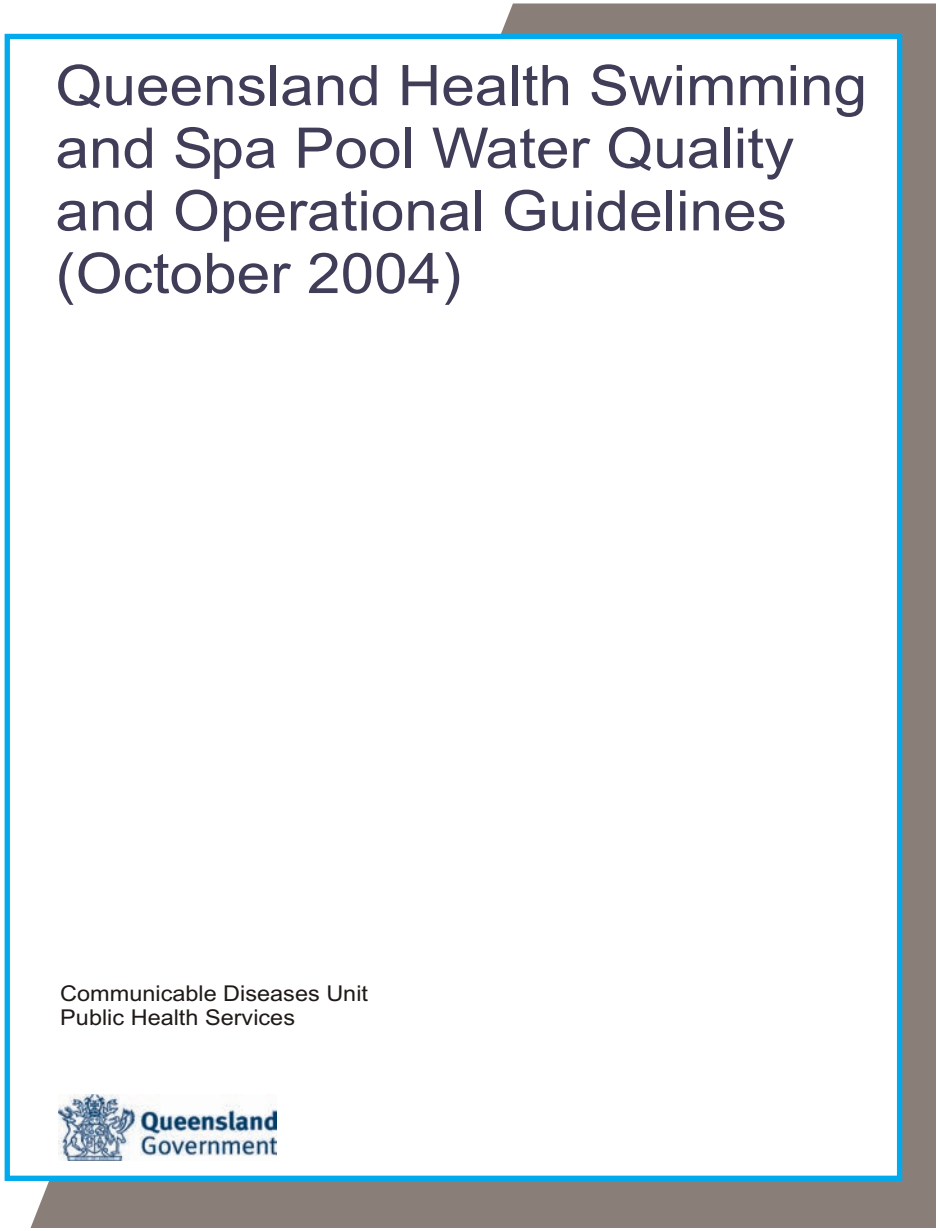
For public access swimming pools spa pools, splash pads and water play areas

Presentation Structure

- **Why change?**
  - changing industry
  - public health risks
- **What has changed?**
- **What is the same?**

Why Change?

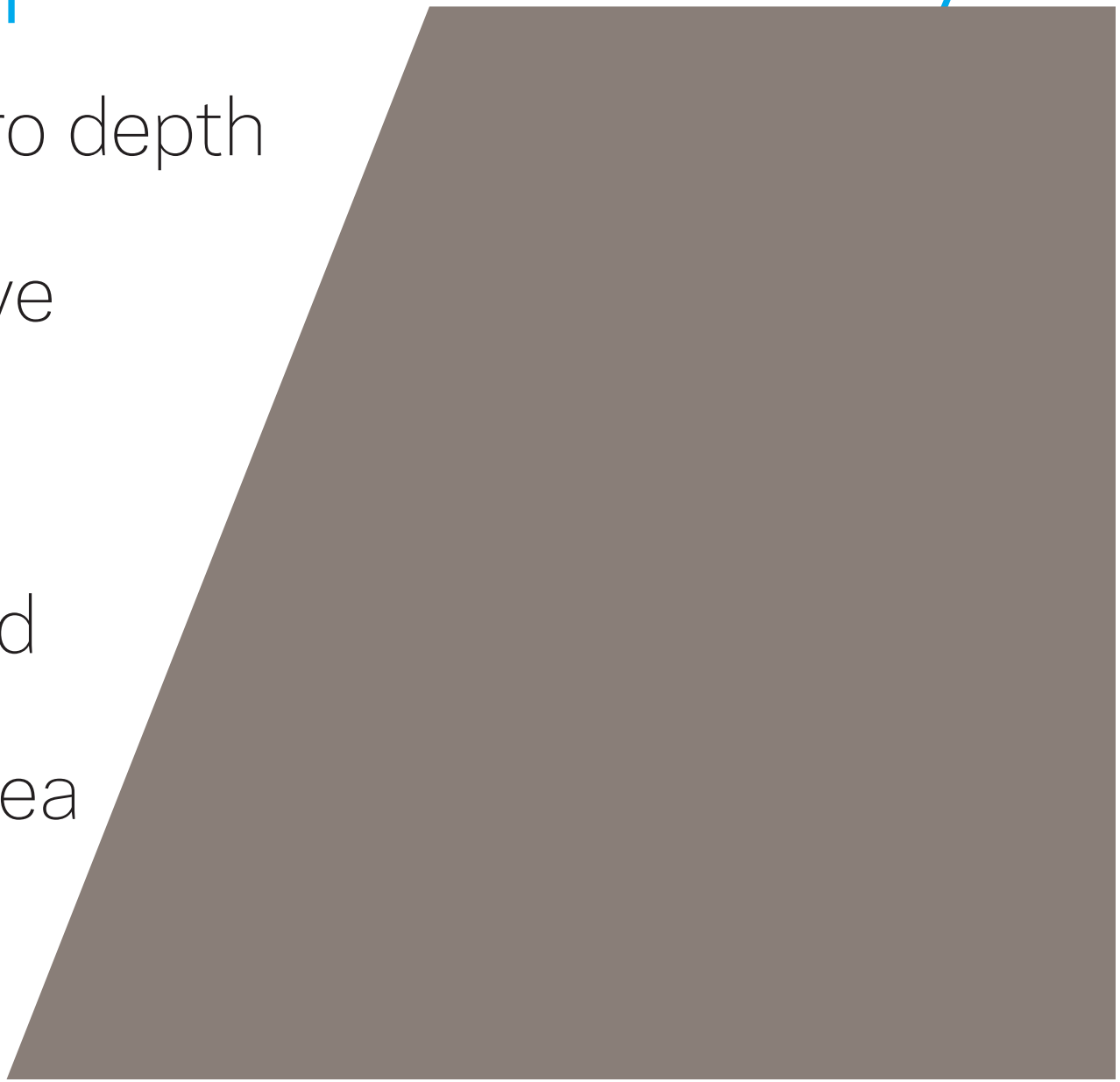
- Industry has changed in past 12 years
- Interstate guidance is relied upon
- Comm Games should increase tourism - good time for increased focus



A typical Qld multiuse facility

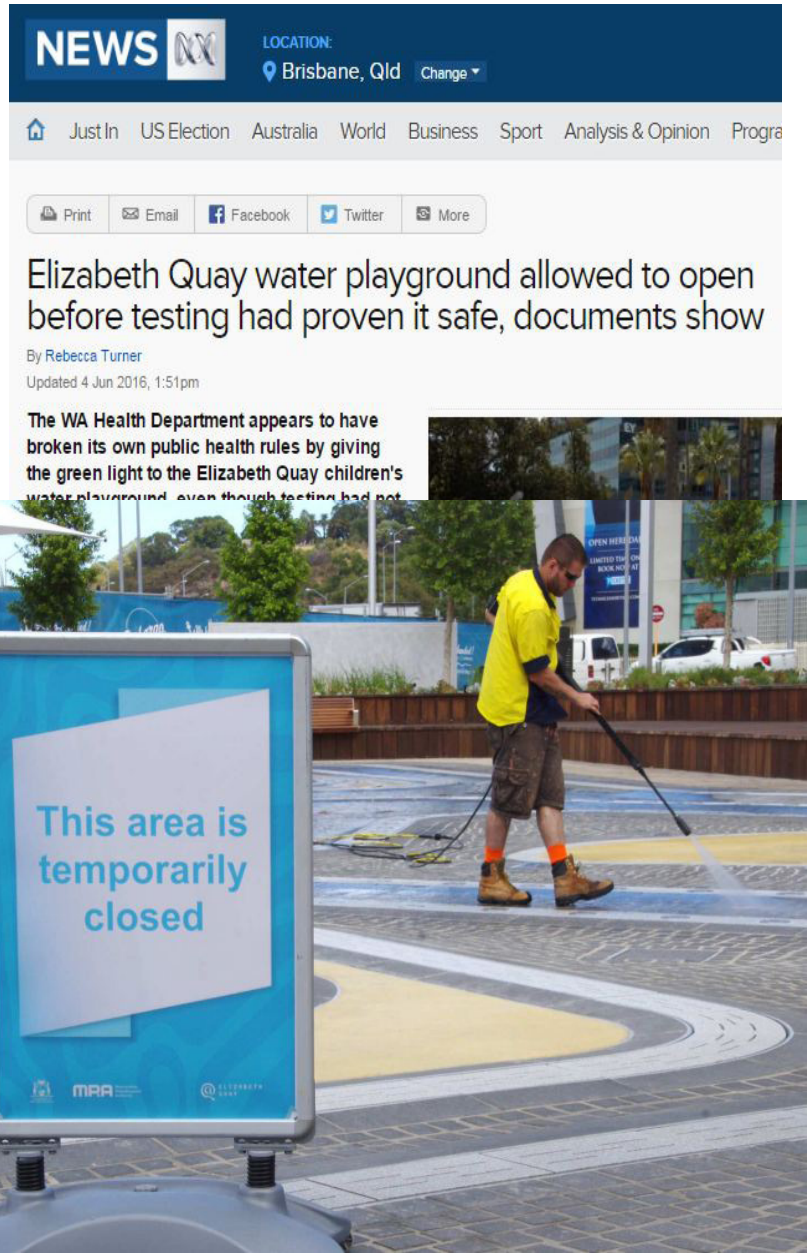
"New" Types of facility

- Splash Pads/ Zero depth
- Toddler interactive
- Water Parks
  - high bather load
  - high surface area to volume



Before

...and after



Images from ABC website

Public Health Risks

- Microbial
  - *Cryptosporidium* and *Giardia (Naeglaria)*
  - *Pseudomonas aeruginosa*
  - other bacteria, viruses and fungii

- Chemical
  - added chemicals
  - disinfection byproducts

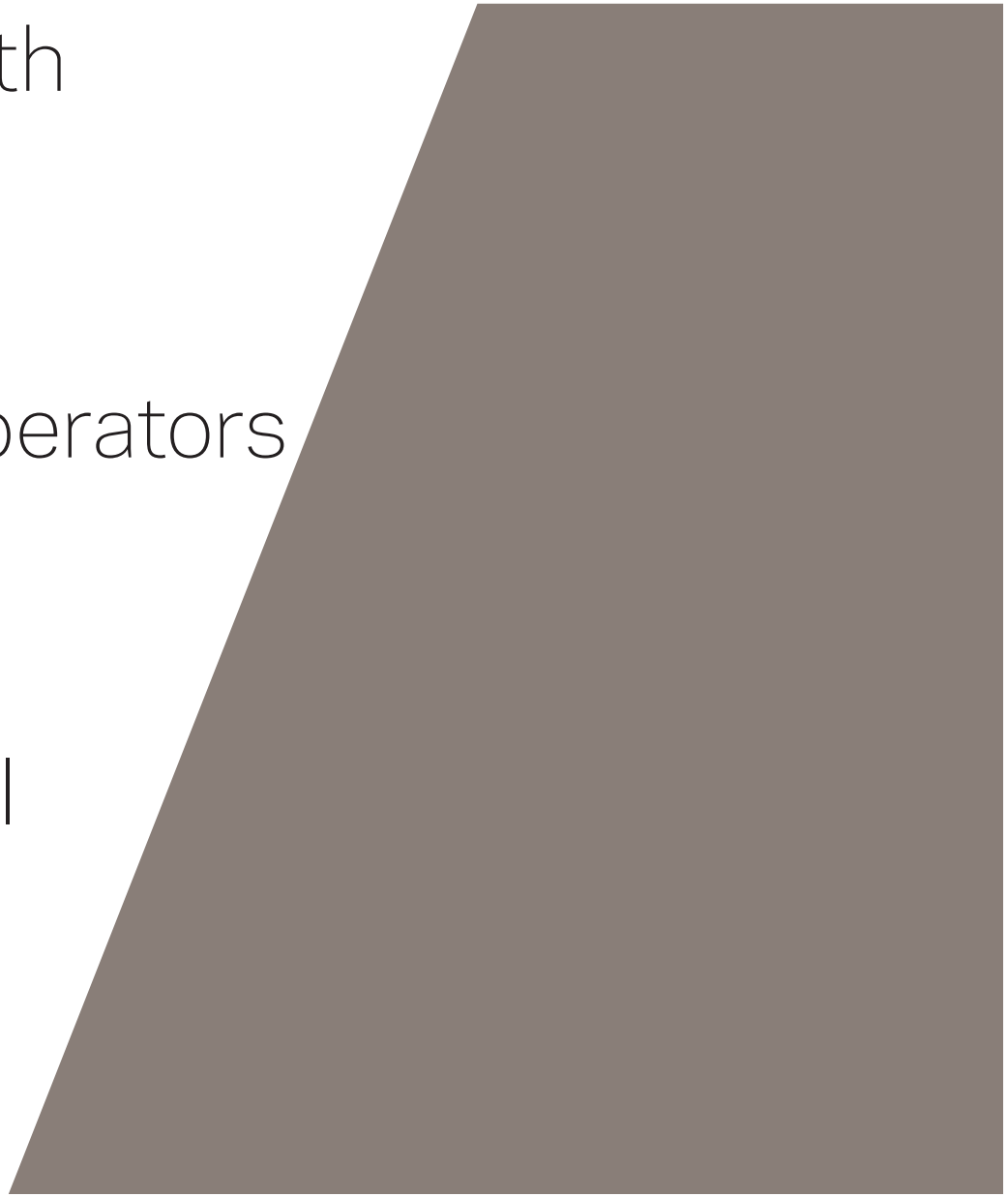
What does an ideal "pool" look like?

An ideal pool would be expected to have:

+ disinfection capable of deactivating bacteria, viruses, and protozoa and maintain a disinfection residual
+ filtration capable of removing protozoan pathogens
+ a turnover time that is capable of rapidly removing contaminants
+ automated monitoring and control of chemical dosing
+ balanced water chemistry, and
+ all bathers should be required to shower before entering the water

What makes an ideal guideline?

- Protects public health
- Leads industry
- Accsessible to all operators
- Simple to follow
  - with enough detail
- Easy to apply



Disinfection

No single disinfectant is ideal

- **UV or ozone are effective for protozoa, but do not have a residual**
- **chlorine and bromine based disinfectants deactivate bacteria and viruses, and are best for maintaining a residual**
- **chlorine (and bromine based disinfectants) are pH dependent (higher pH above 7 = less effective disinfection)**
- **chlorine dioxide is useful for remediation, but not to be used as a primary disinfectant (see MAHC)**
- **hydrogen peroxide not fully assessed by APVMA - so will not be recommended in this guideline**

Complications

+ Isocyanuric acid - reduces chlorine loss to sunlight
  + *but dramatically reduces disinfection effectiveness*
+ more chlorine = better for deactivating pathogens
+ more chlorine = worse for bather comfort
+ pathogens trump comfort

Ideal disinfection strategy

+ Ozone or UV for pathogen deactivation
+ Chlorine (or bromine) for residual protection (no stabilisers)

Disinfection byproducts

- Chloramines should be as low as possible
- Should be possible for modern pools to have < 0.5 mg/L
- Other disinfection byproducts probably carcinogenic, but reducing chlorine increases pathogen risks
  - trihalomethanes, chlorate etc
  - WHO discusses health benefits of swimming vs risks from disinfection byproducts
  - pathogens trump disinfection byproducts

Cryptosporidium/ Giardia

Chlorination (under routine conditons) is ineffective for the deactication of *Crypto/ Giardia*

Captured by filtration

Pool turnover impacts ability to rapidly remove

Shorter turnover times increase the ability for filters to remove *Crypto/ Giardia* from the "pool"

Ideal Filtration

+ Should capture particles < 1 micron
+ Turnover time should be as rapid as possible
+ Backwashes should be frequent enough to prevent filter breakthrough
+ Different pools should have their own plant (not shared)

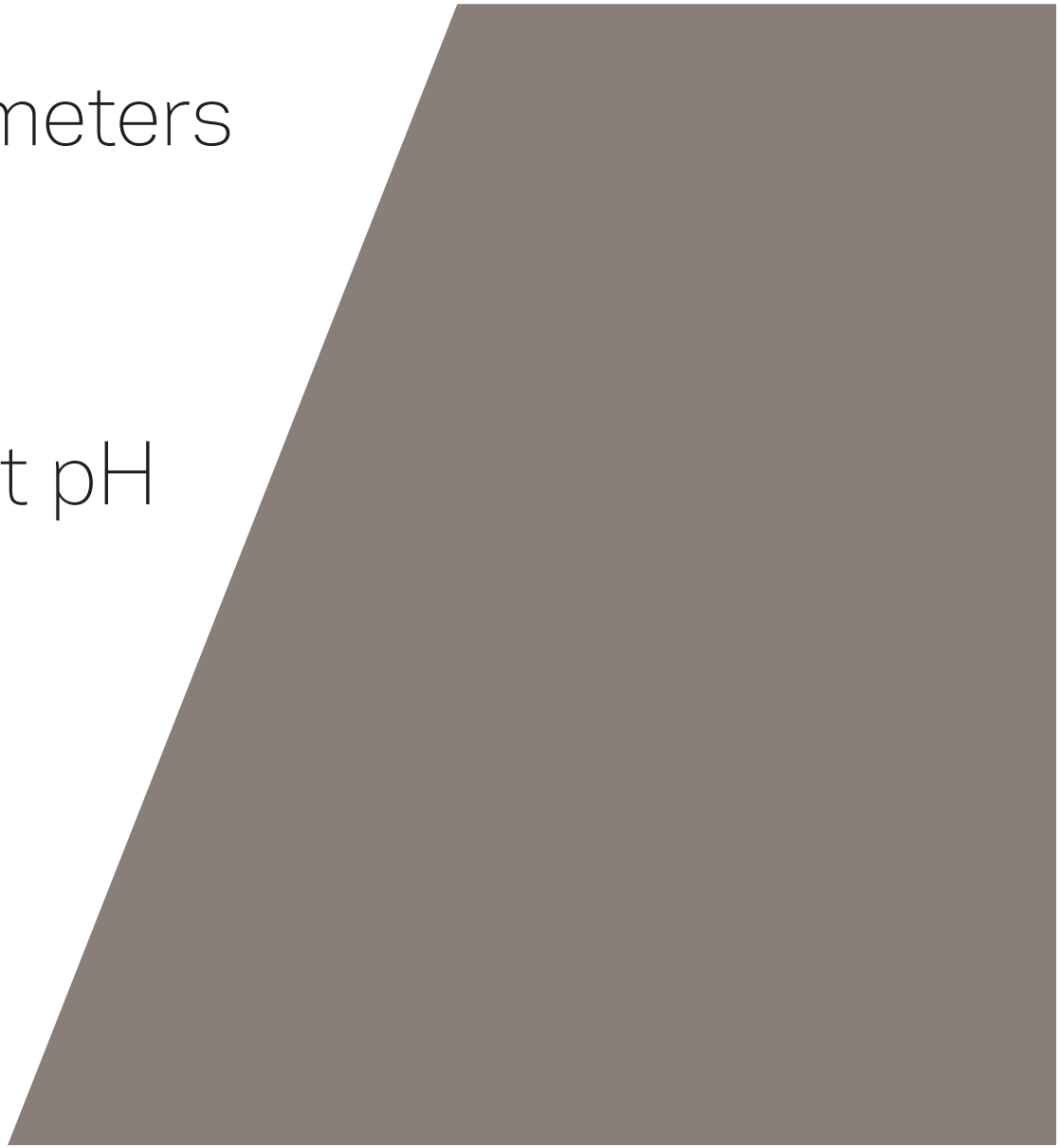

Holiday loading...

What Changes?

- Recommended turnover times
- Monitoring recommendations
- Faecal response protocols
- *Pseudomonas* response
- Risk categorisation
- Chemical levels

What stays the same?

- Microbiological parameters
- 3 risk categories
- Water balance except pH
- Record keeping



Chemical Water Quality

Types of facility	Parameter	Minimum	Maximum
All	pH	7.2	7.8
	Calcium hardness	150 mg/L	1000 mg/L
	Total Dissolved Solids		1000 mg/L above source water
	Temperature	-	38°C
		Recommended Range	
	Total Alkalinity	80 mg/L	200 mg/L
	Calcium hardness	200 mg/L	400 mg/L
	Langelier Saturation Index	ideally 0 range of -0.5 to 0.5 recommended	

Disinfection levels

Types of disinfection	Parameter	Minimum	Maximum
Chlorine	free chlorine (outdoor facilities)	1 mg/L	
	free chlorine (indoor facilities above 26°C)	2 mg/L	
	free chlorine (spas)	3 mg/L	
	facilities with pH 7.6- 7.8	values indicated above +1 mg/L	
	total chlorine		10 mg/L
	combined chlorine (chloramines)		0.5 mg/L
Stablised chlorine * Not allowable in indoor facilities or spas	isocyanuric acid and other cyanuric acid based stabilisers		30 mg/L
	free chlorine	3 mg/L	
	total chlorine		10 mg/L
	combined chlorine (chloramines)		0.5 mg/L
Bromine	Bromine (outdoor facilities)	2.25 mg/L	9 mg/L
	Bromine (indoor facilities above 26°C)	4.5 mg/L	9 mg/L
	Bromine (spas)	4.5 mg/L	9 mg/L
	Dimethyl hydantoin		200 mg/L

Microbiological Water Quality

Types of facility	Parameter	Acceptable values
All	heterotrophic plate count (HPC)	Less than 100 cfu/mL Exceedences don't necessarily represent a health risk but should trigger an investigation into the performance of the water treatment processes.
	thermotolerant coliforms (or *Escherichia coli*)	0 cfu/100mL or 0 MPN/100mL
	Pseudomonas aeruginosa	0 cfu/100mL or 0 MPN/100mL

Faecal Incidents

+ Principle - Loose stool incidents are commonly associated with protozoan illnesses
+ Cryptosporidium outbreaks are commonly associated with pools
+ 1 oocyst can cause disease
+ infected people can shed 10 000 000 to 100 000 000 oocysts per bowel movement (Jokipii and Jokipii, New Engl J Med, 1986;315:1643)
+ a person who has been ill with diarrhoeal illness in the past 2 weeks is still shedding, and likely contaminates your facility
+ a loose stool incident in an aquatic facility is very likely to be an immediate public health risk

Response Protocol

- Immediately close the facility and any other connected aquatic facility.
- Remove as much of the faecal material as possible using a bucket, scoop or another container that can be discarded or easily cleaned and disinfected.
  - Dispose of faecal material to sanitary sewer.
  - Do not use aquatic vacuum cleaners for removal of contamination unless vacuum waste can be discharged to sewer, and the vacuum equipment can be adequately disinfected.
- Adjust the pH to 7.5 or lower.

Response Protocol

+ Dose the water to achieve a free chlorine contact time of 15,300 mg.min/L (e.g. free chlorine of 20 mg/L for 13 hours or 10 mg/L for 26 hours)
+ Ensure filtration and any secondary disinfection systems operate for the duration of decontamination
+ If possible, add coagulant prior to filtration to enhance filtration
+ Reduce total chlorine to below 10 mg/L
+ Backwash granular filters or replace cartridge filter as appropriate. Precoat filter media should be replaced
+ Ensure chemical balance of the water is acceptable
+ Log the incident and remedial action taken

Response Protocol - stabilised chlorine

+ cyanuric acid dramatically impacts the chlorine contact time to deactivate protozoan pathogens
+ effective remediation may require >10 mg/L chlorine for a week
+ chlorine dioxide is much more effective in this case
+ availability of chlorine dioxide may be an issue for non-SEQ operators - so cannot blanket recommend usage
+ sought industry opinion through consultation - no real solutions put forward
+ option may be to dilute cyanuric acid as much as possible before commencing remediation - advice from specialists probably still required regarding appropriate contact time

Level 9, 269 Wickham St
PO Box 612 Fortitude Valley
QLD 4006, Australia

T +61 7 3251 8555
F +61 7 3251 8599
blightanner@blightanner.com.au
www.blightanner.com.au

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