PREVENTATIVE RISK MANAGEMENT OF RECREATIONAL WATER QUALITY; NEW AUSTRALIAN GUIDELINES

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The Department of Environment, Climate Change and Water (DECCW) has adopted the new National Health and Medical Research Council (NHMRC*) Guidelines for Managing Risks in Recreational Waters* (NHMRC 2008). The primary aim of the new guidelines is to protect human health. The guidelines advocate a preventative risk management approach with focus on assessing, managing and reducing risks and mean a number of changes to the Beachwatch Programs. This paper highlights the changes to the national guidelines and outlines the adoption of these elements into the Beachwatch Programs. This paper draws largely on the Beachwatch training manual 2009 *Assessment and Management of Microbial Risks in Recreational Waters (*DECC 2009*)*.

Introduction

In February 2008, the National Health and Medical Research Council endorsed the new *Guidelines for Managing Risks in Recreational Water* (NHMRC 2008), which supersede the *Australian Guidelines for Use of Recreational Water* (NHMRC 1990) and the *Australian Water Quality Guidelines for Fresh and Marine Waters* (ANZECC 1992), on which the Beachwatch guidelines are based.

The new guidelines represent a major revision of the previous guidelines by focusing on the assessment and management of hazards to minimise health risks. Under the new guidelines, recreational water quality at swimming sites is no longer reported as percentage compliance based on microbial data, but classified from 'Very poor' to 'Very good' using a matrix based on sanitary inspection and microbial assessment categories.

This approach provides information on possible sources of pollution and numerical data on the likely level of faecal pollution. It also allows beaches to be graded according to their suitability for swimming. By incorporating consequence into the beach classification, beach managers are also able to determine the risk of a public health event occurring at each swimming site and prioritise management actions accordingly.

Beachwatch Programs will implement changes to the monitoring and reporting protocols, in line with the requirements of the new NHMRC guidelines, over the 2009–2010 reporting period, as recommended by NSW Health.

NHMRC (2008) *Guidelines for Managing Risks in Recreational Waters*

The NHMRC *Guidelines for Managing Risks in Recreational Waters* supersedes the previous NHMRC guidelines *Australian Guidelines for Recreational Water Use* (1990). The NHMRC 2008 guidelines are based on World Health Organisation (WHO) *Guidelines for Safe Recreational Water Environments* (WHO 2003) and combines international best practice with an understanding of Australian waters. The adoption of

the guidelines by Beachwatch focuses on chapter 5 of the NHMRC guidelines '*Microbial Quality of Recreational Waters'*.

Microbial Water Quality Assessment

Faecal Indicator Bacteria

The NHMRC 2008 guidelines promote Enterococci as the single preferred indicator for assessing risks for microbial contamination. Epidemiological studies have found a clear dose-response relationship between enterococci and illness in swimmers making it a better indicator of the health risks associated with recreational waters. In addition when Enterococci is analysed using the Australian Standard method: AS/NZS 4276.9:2007 results are available within 26 hours allowing for real time management of swimming sites.

From 1 May 2009, Beachwatch will no longer monitor for faecal coliforms, but will use enterococci as the faecal indicator, as required by the new NHMRC guidelines and advocated by the World Health Organisation (NHMRC 2008, WHO 2003).

Microbial Assessment Categories

Microbial water quality monitoring collects information on levels of faecal contamination over time and is one component in assessing a swimming area's suitability as a recreational swimming site.

The NHMRC guidelines specify a need for 100 sample points to be collected over a maximum of 5 years. Samples should be collected during the bathing season or when the water body is used for swimming.

The Microbial Assessment Category (MAC) is determined from the 95th percentile of a dataset of at least 100 data points. The four categories (A to D) relate to levels of risk determined from key epidemiological studies (see Table 1).

Table 1 Microbial assessment categories

Category	95th %ile of enterococci (cfu/100ml)	Basis of derivation	Estimation of probability
A	≤ 40	No illness seen in most epidemiological studies	GI* illness risk: <1% AFRI** risk: <0.3%
B	40 – 200	Upper threshold is above the threshold of illness transmission reported in most studies	GI illness risk: 1-5% AFRI risk: 0.3– 1.9%
C	201 – 500	Represents a substantial elevation in the probability of adverse health outcomes	GI illness risk: 5-10% AFRI risk: 1.9–3.9%
D	> 500	Above this level there may be significant risk of high levels of illness transmission	GI illness risk: >10% AFRI risk: >3.9%

* GI = gastrointestinal

** AFRI = acute febrile respiratory illness

Sanitary Inspection

The aim of the sanitary inspection is to identify all sources of faecal contamination which could affect a swimming location and assess the risks to public health posed by these sources. It is a qualitative assessment of bacterial water quality at the site, and should, to some degree, correlate with the bacterial water quality results obtained from sampling. Through the assessment process beaches are categorised to reflect the level of risk of exposure to faecal contamination. There are five categories (Very low, Low, Moderate, High and Very high) which are to be reviewed annually.

The first step in carrying out a sanitary inspection is to define the swimming area and catchment. A range of information must be collected including; site type (ocean, estuarine, freshwater etc.), catchment area and land use, site description, level of flushing, rainfall impacts, activities at location, groups of users e.g. children, elderly, tourists etc. and number of users.

The sanitary inspection identifies all sources of pollution with the emphasis on identifying human sources as these pose the greatest risk to human health. Desktop study, field inspections, reconnaissance surveys and interviews are the main sources of information for the sanitary inspection. The main sources of faecal pollution assessed are:

- Bather shedding
- Toilet facilities
- Sewage treatment plant outfall
- Sewage treatment plant bypasses and overflows
- Sewage overflows
- On-site sewage disposal systems
- Wastewater reuse
- Stormwater
- River discharge
- Rivers with sewage discharge
- Lagoons
- Boats
- Animals

In the context of the sanitary inspection risk is defined as; risk of a public health event occurring or more specifically as an occasion when a pollution source could cause enterococci levels in excess of the illness threshold of 200cfu/100mL at a swimming site. Likelihood of a public health event occurring must be assessed for each pollution source. Likelihood descriptors will vary for different sources of pollution but will be largely based on their estimated frequency as described in Table 2.

Table 2 Qualitative descriptions of likelihood

Likelihood	Descriptor
Rare	event occurs only in exceptional circumstances; less than once every five years or more
Unlikely	event occurs infrequently; once in a five year period
Possible	event occurs occasionally; once or twice each bathing season
Likely	event occurs with some regularity; three or four times each bathing season
Almost certain	event occur frequently; several times each month

Weather conditions, particularly rainfall can impact on both site use and pollution sources. To take weather into account, weather condition definitions are derived for each site, based on:

1. The amount of rainfall necessary to trigger 'wet weather' sources of pollution. This defines the starting point of the wet weather condition.
2. The level of flushing or tidal movement at the site. This defines the end point of the wet weather condition.

As such each pollution source is identified as occurring in the dry weather condition, the wet weather condition or both. Despite this the overall risk classification for a site is determined from all identified pollution sources, irrespective of weather conditions. Knowing the weather condition and weather influence on pollution sources provides additional knowledge and tools to be used when managing the swimming site and/or investigating pollution abatement controls.

Beachwatch Programs is currently carrying out sanitary inspections for 130 swimming locations in the Sydney, Hunter and Illawarra regions using information sourced from local governments, Sydney Water, Hunter Water and a number of other stakeholders. The sanitary inspections will be completed by 1st May 2010.

Sanitary Inspection Categories

The sanitary inspection category is the overall risk posed by all identified sources of faecal contamination at a site and is categorized as Very low, Low, Moderate, High or Very high.

Risks are cumulative, so to determine an overall risk for the site, the risks from all pollution sources are added together. The overall likelihood is determined by summing the likelihoods for each pollution source. Each likelihood based on it's frequency of occurrence has been assigned a value as displayed in Table 3. For animal derived sources of faecal pollution the risk is considered to be lower than human sources of faecal pollution and the numerical value has been adjusted to reflect this. The numerical likelihood values assigned to animal derived sources are presented in Table 4.

Table 3 Likelihood values and categories for human derived pollution

Likelihood	Event frequency	Value	Category range
Rare	1 in 10 bathing seasons	0.1	<0.2
Unlikely	1 in 5 bathing seasons	0.2	0.2 to <1
Possible	1 per bathing season	1	1 to < 3
Likely	3 per bathing season	3	3 to < 12
Almost certain	12 per bathing season	12	12 or greater

Table 4 Likelihood values for animal derived sources

Likelihood	Value
Rare	0.1
Unlikely	0.1
Possible	0.2
Likely	1
Almost certain	1

Once the overall total numerical likelihood has been calculated by summing individual likelihoods the Sanitary Inspection Category is determined using Table 5.

Table 5 Sanitary Inspection category

SANITARY INPECTION CATEGORY	TOTAL NUMERICAL LIKELIHOOD
Very low	0 – 0.19
Low	0.2 – 0.99
Moderate	1 – 2.99
High	3 – 11.99
Very high	>12

Beach suitability grades and general advisories

Beach suitability grades use a combination of the sanitary inspection and microbial assessment to rate the appropriateness of a swimming site for primary contact recreation. Swimming locations are graded from 'Very good' to 'Very poor' according to the beach classification matrix in Table 6. Where information from the sanitary survey and water quality sampling do not correlate, 'follow up' is indicated and requires a review of both components.

Table 6 Beach suitability grade matrix

BEACH CLASSIFICATION MATRIX		Microbial assessment category (MAC)			
		A (≤ 40)	**B (41 - 200)**	**C (201 - 500)**	**D (> 500)**
Sanitary inspection category (SIC)	**Very low**	Very good	Very good	Follow up	Follow up
	Low	Very good	Good	Follow up	Follow up
	Moderate	Good	Good	Poor	Poor
	High	Good	Fair	Poor	Very poor
	Very high	Follow up	Fair	Poor	Very poor

The beach classifications are a long team assessment of the susceptibility of a beach to faecal pollution. The beach suitability grades are described in the table below (Table 7) and provide advice on when to swim and when swimming should be avoided. In addition, general advice can be provided to cover certain situations which may increase

the likelihood of pollution at the swimming site. For example, avoid swimming if the lagoon is open or avoid swimming near stormwater drains.

Table 7 Beach suitability grade definitions and general advisories

Very Good		Site has consistently excellent water quality with few potential sources of faecal contamination present. Water is considered safe for swimming at all times.
Good		Generally good water quality with few potential faecal pollution sources. Water is considered safe for swimming most of the time. The water body may be susceptible to pollution during heavy rain and swimming should be avoided at these times.
Fair		Water body is occasionally susceptible to faecal pollution, usually triggered by rainfall. Swimming should be avoided during and following rainfall for one day at ocean beaches and up to three days in harbour swimming sites.
Poor		Water body is susceptible to faecal pollution, particularly after rain. Swimming should be avoided during and for up to three days after rainfall or if there are signs of pollution such as discoloured water, fast flowing or strong smelling drains or street litter floating in the water or on the tide line.
Very Poor		Water body is very susceptible to faecal pollution with many potential pollution sources. Water quality results indicate this location is not suitable for swimming most of the time and should be avoided.

Beachwatch monitors recreational water quality to provide the community with information on suitability of swimming sites and allow the public to make informed decisions about where and when to swim. The minimum level of reporting required by the NHMRC 2008 guidelines is an annual beach classification. For Beachwatch and councils participating in the Beachwatch Partnership Program (BPP) this information is reported in the State of the Beach report issued after 1 October each year.

Management of recreational swimming areas

Management of risks from microbial contamination is a critical component of the NHMRC 2008 guidelines. Knowledge of catchment, pollution sources and receiving waters provides beach managers with a good foundation for investigating pollution incidents and prioritising and implementing pollution abatement measures. By determining the consequence of a public health event at a particular swimming location, beach managers can priorities actions to reduce the risk where most appropriate. The consequence of a public health event at a particular swimming location is determined by how well it fits each of the following definitions (Table 8) based on site use, user groups and economic importance.

Table 8 Qualitative descriptions of consequence

Consequence	Descriptor
Minor	location rarely used on weekdays; occasionally used on weekends and holidays; few people enter the water; not popular with children or elderly; of minimal importance to the local economy.
Moderate	location occasionally used on weekdays; frequently used on weekends and holidays; most people enter the water; often used by children or elderly; of some importance to local economy
Major	location frequently used on weekdays, weekends and holidays; most people enter the water; very popular with children and the elderly; of great importance to the local economy

Risk rating matrix (for management)

The risk rating matrix (for management) can be completed for managers of recreational water bodies to determine the risk of a public health event occurring at the recreational water body (swimming site). Combining the Sanitary Inspection Category (SIC) with the Consequence rating, should enable managers to clearly identify and classify swimming sites using a risk based approach (Table 9). Swimming sites identified to have a 'High' to 'Very high' rating would indicate a higher risk of a public health event occurring at this location. This classification may mean that more urgent actions by management should be taken to reduce and avoid the risk to public health, as opposed to a 'Very low' to 'Low' classification. These classifications could be used to priorities pollution abatements works, and allocate resources between swimming sites by management.

Table 9 risk rating matrix

		CONSEQUENCE		
		Minor	Moderate	Major
SANITARY INSPECTION CATEGORY (SIC)	Very low	Very low	Very low	Low
	Low	Very low	Low	Low
	Moderate	Low	Low	Moderate
	High	Low	Moderate	High
	Very high	Moderate	High	Very high

Management actions to reduce risk to public health

The sanitary inspection, beach suitability grade and management risk rating provides focus and a method for measuring improvements in water quality. Using the sanitary inspection process risk can be reduced in two ways:

1. Reduce the likelihood of a public health event occurring, and
2. Reduce the consequence of a public health event

Actions to reduce likelihood usually require capital expenditure and include:

- relining sewers and stormwater pipes, fixing pumping stations and reducing sewer inputs to reduce the potential for overflows e.g. reusing wastewater;
- using retention tanks or tunnels to control discharge times and provide a buffer during storms;
- transporting sewage to locations distant from recreational areas via piped collection systems or effective outfalls; and
- disinfection

To control cost or guide investments, sources requiring pollution abatement measures can be prioritised according to likelihood with resources focussed on sources rated as Very likely or Likely.

The consequence of a public health event can be greatly reduced by restricting public use of the site during periods of increased risk. This can be through hard solutions like council lifeguards closing beaches when water pollution is clearly visible or through softer solutions like signage and public education. It is recommended that swimming locations rated as Very poor be permanently closed (NHMRC 2008).

Despite having an annual classification it is important to keep an eye out for elevated enterococci results, especially when at abnormal levels for a known site. When detected they should trigger a response to investigate the cause of faecal contamination. If sampling results remain elevated, the source or cause must be identified and appropriate action taken.

Conclusion

With the adoption of the new NHMRC 2008 guidelines by the NSW Government, Beachwatch Programs has revised its monitoring and reporting mechanisms to align with the recent developments for monitoring recreational waters.

The new guidelines provide a holistic approach to monitoring and managing recreational swimming sites. The introduction of catchment investigations through the sanitary inspection is an essential component and provides beach managers with in-depth knowledge of contributing pollution sources and water quality performance at individual sites. This in turn can allow for focused and measurable improvements to water quality being made at a catchment and individual site basis. By communicating the above information to the public through the beach suitability grade the community can make informed choices about where and when to swim and potentially reduce the consequence of public health events from recreational waters.

References

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