

Assessment of potential recreational swimming locations in the Blue Mountains City Council local government area

Purpose

This report has been prepared by NSW Government Beachwatch Program to assist Blue Mountains City Council with the assessment of potential recreational swimming locations in the local government area.

This assessment is based on microbial risks in Chapter 5 of the National Health and Medical Research Council Guidelines for Managing Risks in Recreational Waters (NHMRC 2008). To assess potential swimming locations, it is recommended that all risks outlined in the NHMRC 2008 guidelines are considered before determining whether an area is suitable for swimming.

Assessment process

Recreational water quality at seven potential swimming sites was categorised using a combination of sanitary inspection (identification and rating of potential pollution sources at a site) and microbial water quality assessment.

Beachwatch field officers visited seven potential swimming sites with council officers to complete sanitary inspections. The sanitary inspection is an assessment of the area's susceptibility to potential faecal contamination sources. The overall sanitary inspection category (in Table 1) is the sum of the risks from all identified sources. A breakdown of the sources identified is shown on the individual site pages. Please note this information is estimated and may change as more information is available, particularly with more details of sewage overflows and chokes in the catchments.

Applying NHMRC 2008 Guidelines to fresh water environments

NHMRC recommend applying NHMRC 2008 guideline values derived for coastal waters, to fresh waters, in the absence of suitable epidemiological studies examining the health risks in freshwater environments. It is not possible to directly derive the microbial assessment categories for fresh water swimming sites due to lack of data.

However, there may be differences in the illness rates of seawater swimmers and freshwater swimmers at a given indicator bacterial density. This is likely due to the more rapid die-off of indicator bacteria than of the pathogens in sea water compared to fresh water. As a result, applying the NHMRC 2008 guideline values to sites in the Blue Mountains City Council local government area is likely to result in a conservative assessment and may overestimate the health risk to freshwater users.

Council officers collected water samples from each site mostly on a weekly basis from November 2018 to March 2019. Samples were tested for enterococci, as an indicator of faecal contamination. At some sites, additional enterococci data was included in the assessment from water samples collected during 2014 to 2018. The enterococci data was used to determine the microbial assessment category, based on a modified 95th percentile using the Enterotester Tool. This tool calculates a modified 95th percentile, taking into account the distribution of the data, and recommends a minimum of 65 samples for optimum results. Between 31 and 68 samples were included in the analysis for potential swimming sites in the Blue Mountains City Council local government area, with four sites having less than the recommended number. Therefore, results presented in this report are provisional.

Water quality in response to rainfall was assessed by analysing bacteria levels and total rainfall in the previous 24 hours. This assessment has not considered the impact of rainfall in the previous two to three days. Analysing the relationship between bacteria levels and 48- and 72-hour rainfall totals may provide further understanding of the impacts of rainfall and associated stormwater,

and how long it takes for a swimming site to recover after a pollution event.

More information about the Sanitary Inspection and Microbial Assessment is attached in the 'How to read this report' document.

Provisional results

The preliminary results for sites in the Blue Mountains City Council local government area are outlined in Table 1. For this assessment the Beach Suitability Grades are considered provisional due to limited bacterial data and sanitary inspection information available. While the information is limited, this assessment provides an indication of sites with greater potential for swimming, and sites where water quality is more susceptible to faecal contamination.

Two sites were graded Good: Wentworth Falls Lake – Beach and Jellybean Pool (Glenbrook Creek). Swimming at these sites in dry weather (when there has been no rainfall in the previous 24 hours) is frequently within the safe swimming limits.

Wentworth Falls Lake - Jetty was graded Poor. While water was mostly suitable for swimming during dry weather conditions, (with 63% of dry weather samples within the safe swimming limit), elevated enterococci levels were often recorded following light rainfall.

Two locations in Glenbrook Lagoon were graded Poor; Glenbrook Lagoon – Ramp and Glenbrook Lagoon – Beach. Water quality at these sites is susceptible to faecal contamination following light rainfall. Despite this, water quality was mostly suitable for swimming during dry weather, with 90% and 78% of dry weather samples within the safe swimming limit at Glenbrook Lagoon – Ramp and Glenbrook Lagoon – Beach respectively.

Megalong Creek was graded Poor. Water quality at this site was above the safe

swimming limit for almost all samples collected during the assessment period, during both wet and dry weather conditions.

Minnehaha Falls recorded elevated results most of the time during dry and wet weather conditions. Swimming was sometimes suitable in dry weather and after light rain. Several significant sources of faecal contamination are likely impacting water quality at this site, including stormwater, upstream river sources and sewer chokes.

The 95th percentile value for Megalong Creek, Wentworth Falls Lake – Jetty, Glenrock Lagoon - Beach and Jellybean Pool are greater than the bacteria levels recorded at the swimming location but have been modified by the Enterotester tool to derive probabilities of illness taking into account the distribution of the data.

Continued monitoring will provide a clearer understanding of recreational water quality at these sites.

Additional information

Refer to the 'How to read this report' attachment for more information about Beach Suitability Grades, Sanitary Inspections, Microbial Assessment and for explanation of the graphs, charts and information bars used on the following pages of this report.

Table 1: Sanitary Inspection Category, Microbial Assessment Category and Beach Suitability Grades for Blue Mountain City Council sites.

Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Megalong Creek	Freshwater	Moderate	D	Poor
Minnehaha Falls	Freshwater	High	D	Very Poor
Wentworth Falls Lake - Jetty	Freshwater	Moderate	C	Poor
Wentworth Falls Lake - Beach	Freshwater	Moderate	B	Good
Glenbrook Lagoon - Ramp	Freshwater	Moderate	C	Poor
Glenbrook Lagoon - Beach	Freshwater	Moderate	C	Poor
Jellybean Pool (Glenbrook Creek)	Freshwater	Moderate	B	Good

Note: The Beach Suitability Grades are Provisional due to limited sanitary inspection and bacterial data to complete the assessment.

Megalong Creek

Beach grade:

P



The site is a group of pools along a 150 metre stretch of Megalong creek, adjacent to Old Ford Camping Reserve.

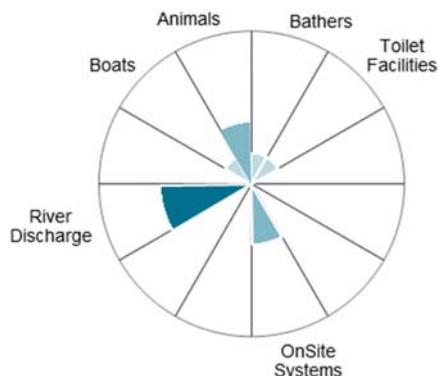
The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions, with potential faecal contamination from upstream sources in the river.

Enterococci levels increased with increasing rainfall, and generally remained above the safe swimming limit across all rainfall categories.

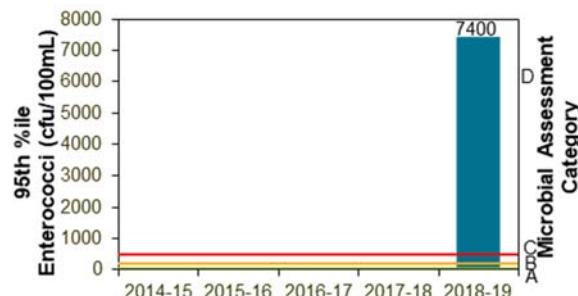
The site has been monitored since 2014.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Freshwater	Dec 2014 to Mar 2019	4%	58	Provisional

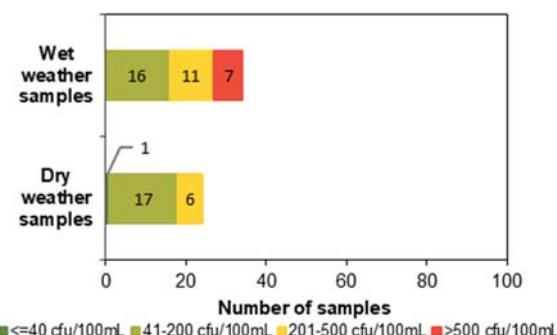
Sanitary inspection: Moderate



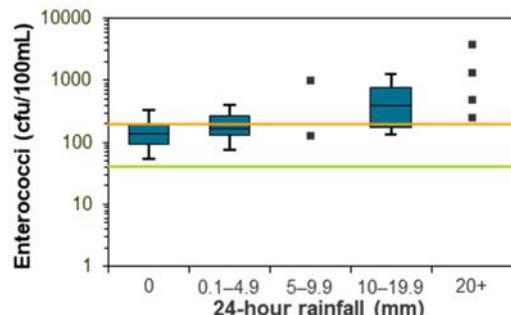
Microbial Assessment Category: D



Dry and wet weather water quality



Water quality in response to rainfall



Minnehaha Falls



Beach grade:



The site is a small, shallow pool in Yosemite creek, at the edge of the Blue Mountains National Park and is located upstream of the popular Minnehaha Falls. The walking track to the falls has been closed since 2018 for safety reasons and remained closed during the sampling season.

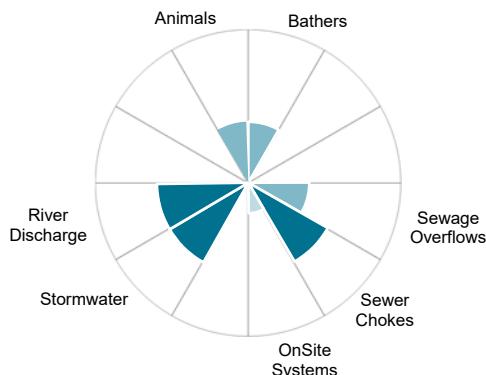
The Beach Suitability Grade of Very Poor indicates microbial water quality is very susceptible to faecal pollution with many potential sources of faecal contamination. Swimming should be avoided at all times.

Enterococci levels increased with increasing rainfall, regularly exceeding the safe swimming limit across all rainfall categories.

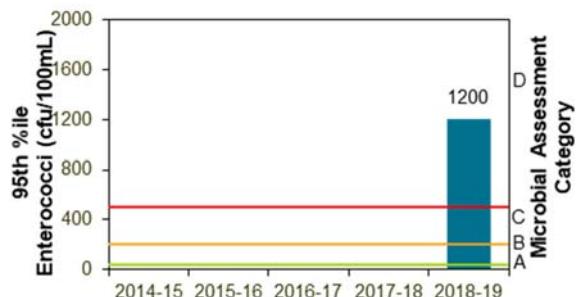
The site has been monitored since 2014.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Freshwater	Dec 2014 to Mar 2019	33%	43	Provisional

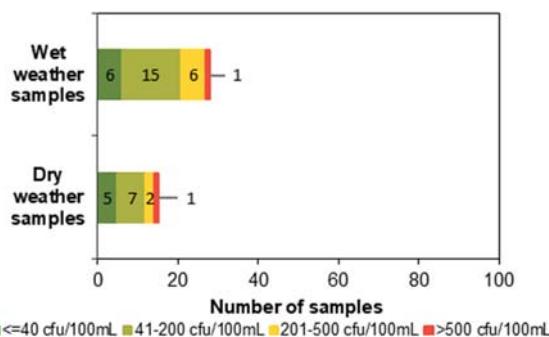
Sanitary inspection: High



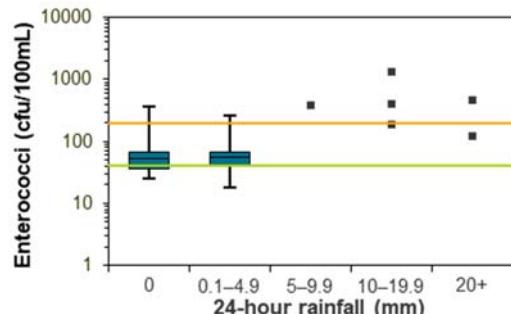
Microbial Assessment Category: D



Dry and wet weather water quality



Water quality in response to rainfall



Wentworth Falls Lake - Jetty

P

Beach grade:



The site is located adjacent to a small jetty and is a broad shallow area on the south-eastern shore of Wentworth Falls Lake, next to playground and reserve.

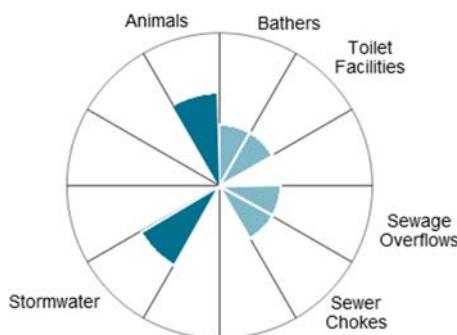
The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions, with potential faecal contamination from stormwater and animals.

Enterococci levels increased slightly with increasing rainfall, often exceeding the safe swimming limit across all rainfall categories.

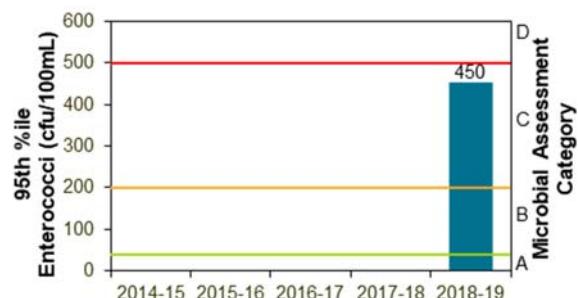
The site has been monitored since 2014.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Freshwater	Dec 2014 to Mar 2019	63%	68	Provisional

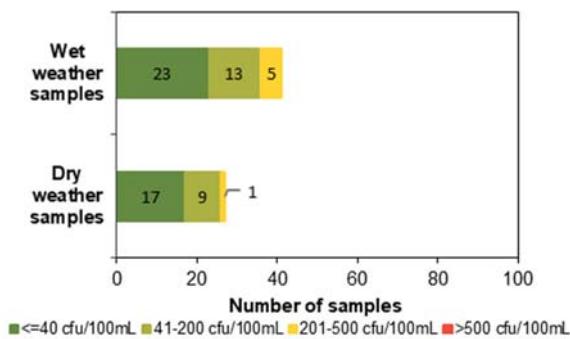
Sanitary inspection: Moderate



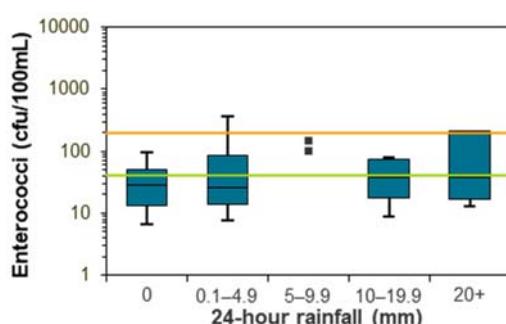
Microbial Assessment Category: C



Dry and wet weather water quality



Water quality in response to rainfall



Wentworth Falls Lake - Beach

Beach grade:

G



The site is shallow and located in a small cleared area on the northern shore of Wentworth Falls Lake. Access is along a small trail through adjoining bushland.

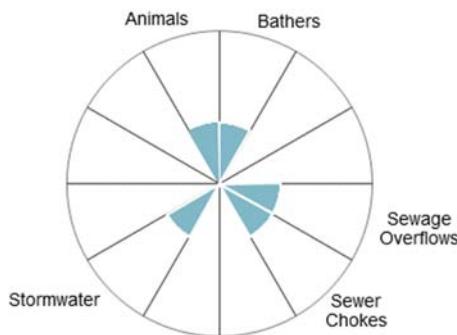
The Beach Suitability Grade of Good indicates microbial water quality is suitable for swimming most of the time but can be susceptible to pollution after rain, with several sources of potential minor faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit after light rain and often after 10mm or more of rainfall.

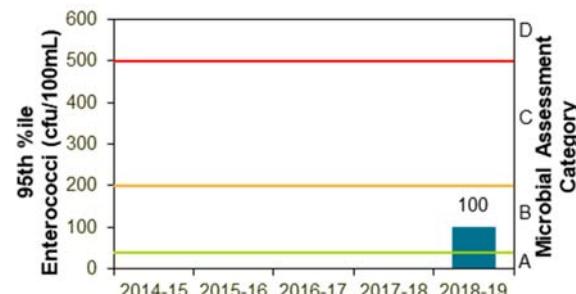
The site has been monitored since 2014.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Freshwater	Dec 2014 to Mar 2019	96%	67	Provisional

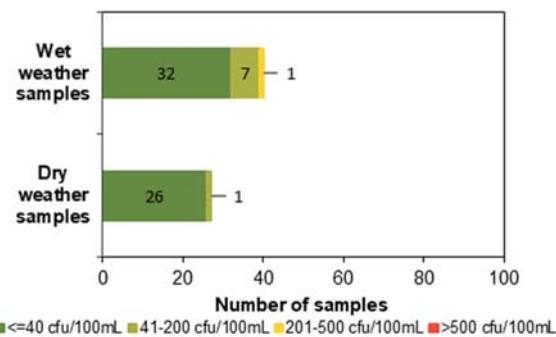
Sanitary inspection: Moderate



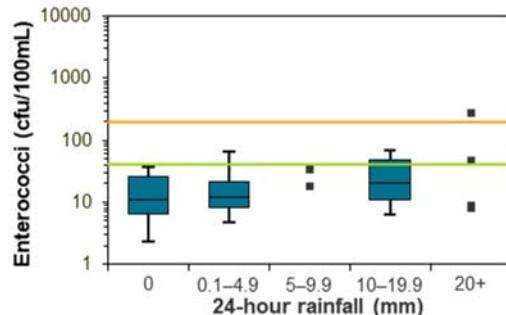
Microbial Assessment Category: B



Dry and wet weather water quality



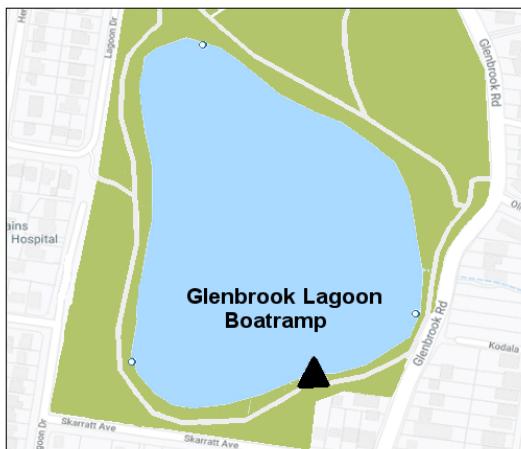
Water quality in response to rainfall



Glenbrook Lagoon - Ramp

P

Beach grade:



The site is located at a rock-lined clearing amongst reeds on the southern bank of Glenbrook Lagoon.

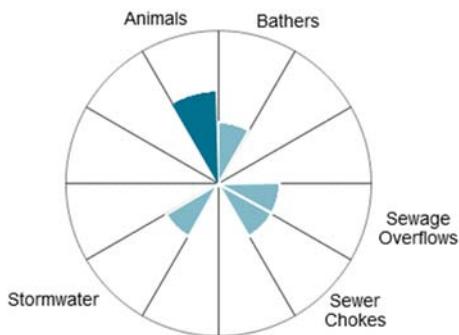
The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions, with several sources of potential faecal contamination including animals.

Enterococci levels increased with increasing rainfall, occasionally exceeding the safe swimming limit after no rain, and often after light rainfall.

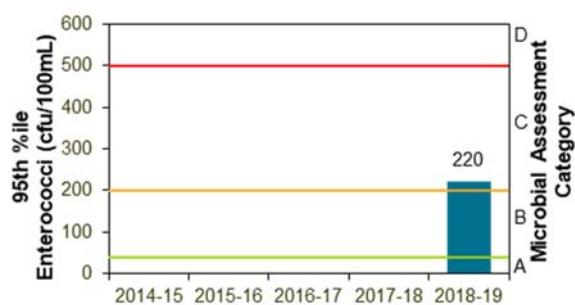
The site has been monitored since 2014.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Freshwater	Dec 2014 to Mar 2019	90%	66	Provisional

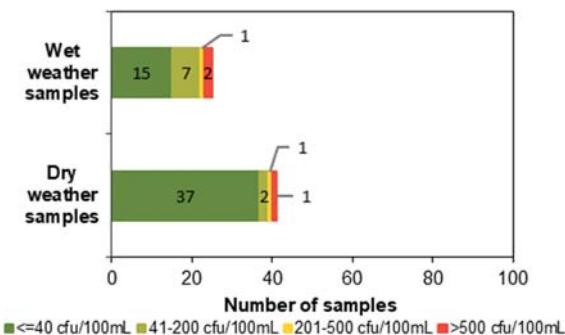
Sanitary inspection: Moderate



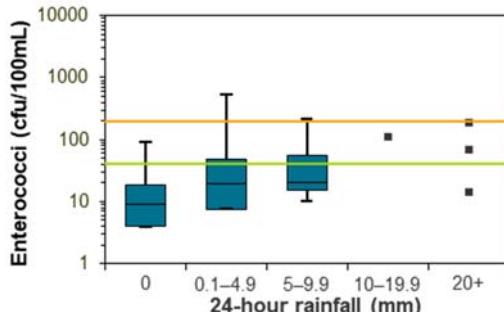
Microbial Assessment Category: C



Dry and wet weather water quality



Water quality in response to rainfall



Glenbrook Lagoon - Beach

P

Beach grade:



The site is a small beach area backed by bushland on the northern shore of Glenbrook Lagoon. The site is located about 150 metres along trail from the carpark.

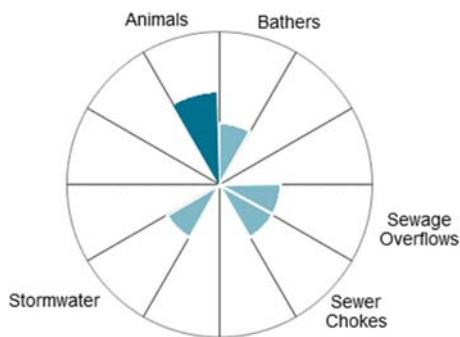
The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions, with potential faecal contamination from several potential sources including animals.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit after no rain, and regularly after light rain.

The site has been monitored since 2016.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Freshwater	Jan 2016 to Mar 2019	78%	55	Provisional

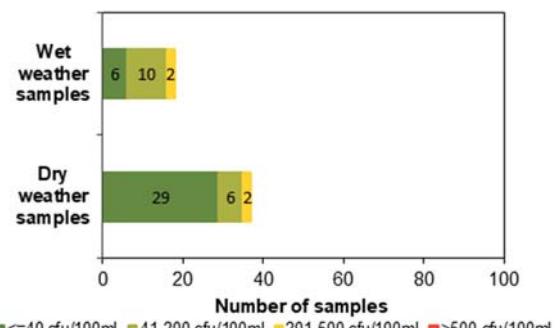
Sanitary inspection: Moderate



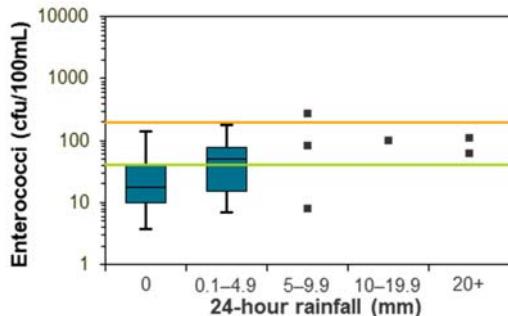
Microbial Assessment Category: C



Dry and wet weather water quality



Water quality in response to rainfall

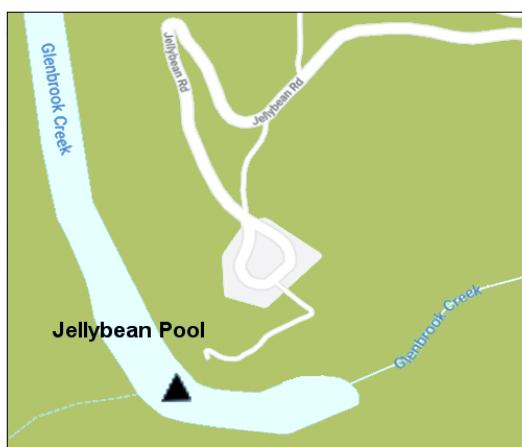


■<=40 cfu/100mL ■41-200 cfu/100mL ■201-500 cfu/100mL ■>500 cfu/100mL

Jellybean Pool (Glenbrook Creek)

Beach grade:

G



The site is a large pool along Glenbrook Creek at the bottom of a small canyon. The area is surrounded by Blue Mountains National Park.

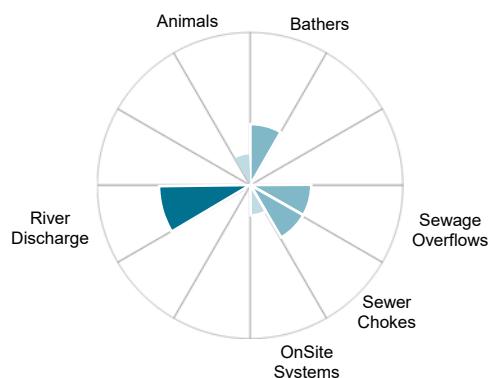
The Beach Suitability Grade of Good indicates microbial water quality is suitable for swimming most of the time but can be susceptible to pollution after rain, with several sources of potential faecal contamination including upstream river sources.

Enterococci levels had little response to rainfall, but often exceeded the safe swimming limit after little or no rain.

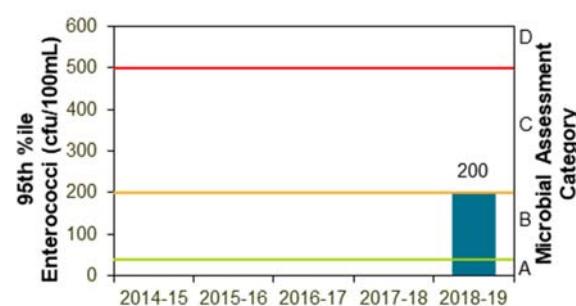
The site has been monitored since 2017.

Site type	Assessment period	Dry weather samples suitable for swimming	Water samples	Beach grade status
Freshwater	Nov 2017 to Mar 2019	65%	31	Provisional

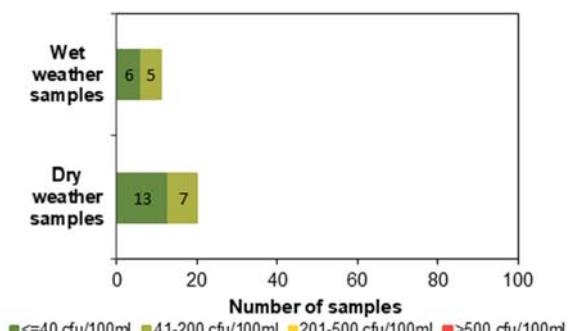
Sanitary inspection: Moderate



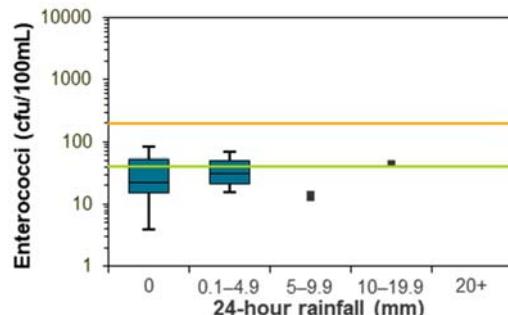
Microbial Assessment Category: B



Dry and wet weather water quality



Water quality in response to rainfall



How to read this report

Beach Suitability Grades

Beach Suitability Grades provide an assessment of the suitability of a swimming location for recreation over time and are based on a combination of sanitary inspection (identification and rating of potential pollution sources at a beach) and microbial assessment (water quality measurements gathered over previous years). There are five grades ranging from Very Good to Very Poor:

Very Good

Location has generally excellent microbial water quality and very few potential sources of faecal pollution. Water is considered suitable for swimming almost all of the time

Good

Location has generally good microbial water quality and water is considered suitable for swimming most of the time. Swimming should be avoided during and for up to one day following heavy rain at ocean beaches and up to three days at estuarine sites

Fair

Microbial water quality is generally suitable for swimming, but because of the presence of significant sources of faecal contamination, extra care should be taken to avoid swimming during and for up to three days following rainfall or if there are signs of pollution such as discoloured water or odour or debris in the water

Poor

Location is susceptible to faecal pollution and microbial water quality is not always suitable for swimming. During dry weather conditions, ensure that the swimming location is free of signs of pollution, such as discoloured water, odour or debris in the water, and avoid swimming at all times during and for up to three days following rainfall

Very Poor

Location is very susceptible to faecal pollution and microbial water quality may often be unsuitable for swimming. It is generally recommended to avoid swimming at these sites almost all of the time

Some of the Beach Suitability Grades in this report are **provisional**, as the information required for the analysis is incomplete due to limited bacterial data or limited information on potential pollution sources in a beach catchment.

The guidelines

The National Health and Medical Research Council's *Guidelines for managing risks in recreational water*¹ were adopted for use in New South Wales in May 2009. These guidelines have been adopted in all Australian states and territories and are supported by guidance notes developed by the Department of Health Western Australia².

¹NHMRC 2008, *Guidelines for managing risks in recreational water*, National Health and Medical Research Council, Australian Government Publishing Service, Canberra, ACT.

²Department of Health, Western Australia 2007, *Microbial quality of recreational water guidance notes in support of chapter 5 of the National Health and Medical Research Council guidelines for managing risks in recreational water, 2006*, Department of Health, Western Australia and The University of Western Australia, October 2007. Available at [ww2.health.wa.gov.au/Articles/A_E/Environmental-waters-publications](http://www2.health.wa.gov.au/Articles/A_E/Environmental-waters-publications). Accessed on 28/06/18.

Enterococci

The national guidelines advocate the use of enterococci as the single preferred faecal indicator in marine waters.

These bacteria are excreted in faeces and are rarely present in unpolluted waters. Enterococci have shown a clear dose-response relationship to disease outcomes in marine waters in the northern hemisphere. In accordance with the guidelines, Beachwatch tests for enterococci only. The enterococci density in water samples is analysed in the laboratory using method AS/NZS 4276.9:2007.

AS/NZS 4276.9:2007, Water microbiology Method 9: Enterococci – Membrane filtration method (ISO 7899-2:2000, MOD), Standards Australia International Ltd, Sydney and Standards New Zealand, Wellington.

Enterococci are measured in colony forming units per 100mL of sample (cfu/100mL).

Beach Suitability Grades are determined by using the following matrix:

		Microbial Assessment Category			
		A	B	C	D
Sanitary Inspection Category	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

Using the Beach Suitability Grade classification matrix, sites assigned a moderate Sanitary Inspection Category can only be rated as Good or Poor with no option of Fair grades. This can create the impression of a large change in water quality when in fact there need only be a slight increase in bacterial counts to push it over the threshold, with no significant increase in the risk to public health.

Microbial Assessment Category (MAC)

There are four Microbial Assessment Categories (A to D) and these are determined from the 95th percentile of an enterococci dataset of at least 100 data points. Each MAC is associated with a risk of illness determined from epidemiological studies. The risks of illness shown below are not those associated with a single data point but are the overall risk of illness associated with an enterococci dataset with that 95th percentile (Wyer et al 1999).

Risk of illness associated with Microbial Assessment Categories

Category	Enterococci (cfu/100mL)	Illness risk*
A	≤ 40	GI illness risk: <1% AFR illness risk: <0.3%
B	41–200	GI illness risk: 1–5% AFR illness risk: 0.3–1.9%
C	201–500	GI illness risk: >5–10% AFR illness risk: >1.9–3.9%
D	>500	GI illness risk: >10% AFR illness risk: >3.9%

* GI = gastrointestinal illness; AFR = acute fever and rash

Calculating the MAC

The 95th percentile is a useful statistic for summarising the distribution of enterococci data at a site. It embodies elements of both the location of the distribution (how high/low the enterococci counts are) and the scale of the distribution (how variable the enterococci counts are).

The 95th percentile values for each of the four Microbial Assessment Categories were determined by the World Health Organization using enterococci data collected from swimming locations across Europe. These values will represent different probabilities of illness if the distribution of enterococci data from swimming locations in New South Wales differs from the European distribution.

In recognition of this issue, Dr Richard Lugg (Department of Health, Western Australia) has developed a Microsoft® Excel tool for calculating a modified 95th percentile that takes into account the distribution of data. This tool has been used to calculate the 95th percentile values presented in this report and has been adopted for use by other state governments in Australia.

The tool can be downloaded from:

http://ww2.health.wa.gov.au/Articles/A_E/Environmental-waters-publications under *Forms and templates* [accessed 28/06/18].

Sanitary Inspection Category (SIC)

More information about the **sanitary inspection** process is available at:
www.environment.nsw.gov.au/topics/water/beaches/reporting-beach-water-quality/guidelines/sanitary-inspection.

The aim of a sanitary inspection is to identify all sources of faecal contamination that could affect a swimming location and assess the risk to public health posed by these sources. It is an assessment of the likelihood of bacterial contamination from identified pollution sources and should, to some degree, correlate with the bacterial water quality results obtained from sampling.

The main sources of faecal contamination considered in the sanitary inspection are: bathers, toilet facilities, wastewater treatment plants (WWTP), sewage overflows, sewer chokes, onsite systems, wastewater reuse, stormwater, river discharge, lagoons, boats and animals.

Rivers, lakes and estuaries themselves can be potential sources of faecal contamination to sites located in these waterbodies, with contaminated water from upstream or surrounding areas impacting water quality at the swimming location. This source is captured in river discharge or lagoon category, and shown as the waterbody in the sanitary inspection charts.

Through the sanitary inspection process, beaches are categorised to reflect the overall likelihood of faecal contamination. There are five categories: Very Low, Low, Moderate, High and Very High.



Stormwater at Coogee Beach
Photo: Beachwatch/OEH

Stormwater in urban areas often contains sewage from leakages, overflows or sewer chokes when the sewerage system fails.

Sewage overflows can occur in wet weather when the network has exceeded capacity due to rainwater entering the system. The mix of sewage and rainwater discharges from designated overflow points and drains to waterways, usually via the stormwater system. Overflows from the sewerage system can also occur in dry weather due to mechanical failure or power outage.

Sewer chokes occur due to blockages in the pipes usually due to tree roots, oil, grease or debris. This causes sewage to back up and escape via sewer inspection points, designed overflow structures or cracks in the pipes, then drain to waterways, usually via the stormwater system.

Where there is a known history or evidence of sewage overflows or sewer chokes in the catchment they are identified as sources of potential faecal contamination, particularly if they are located close to the swimming location. In these instances, the risk posed by stormwater is adjusted accordingly to ensure the overall risk to public health is not overestimated.

Explanation of tables

Each region contains tables listing all monitored swimming sites including site type, beach grade and change in grade from the previous year.

The following symbols are used to show the change in beach grade from the previous year:

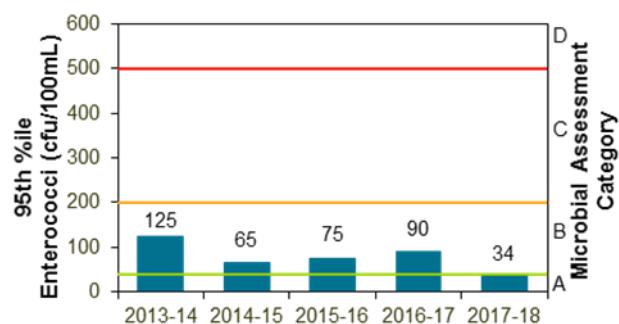
- Stable
- ▲ Improved
- ▼ Declined

A provisional grade indicates the assessment is based on limited data collected during the assessment period and should not be compared to the beach grade from the previous year.

Explanation of graphs, charts, and information bars on beach pages

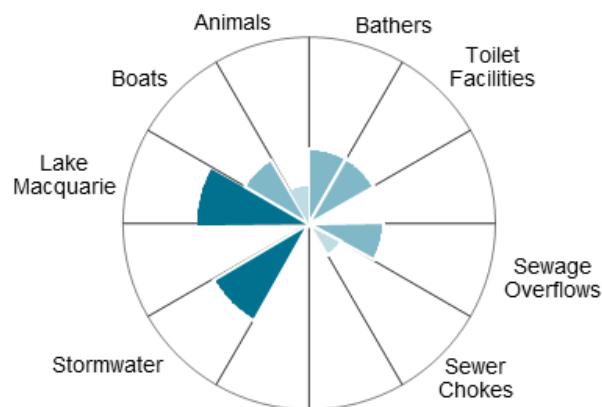
Microbial Assessment Category (MAC) chart

On each beach page, the MACs for the last five years are displayed on a simple bar chart. The bars are labelled with the 95th percentile value for each year and the thresholds dividing the A, B, C and D categories are marked in green, amber and red for reference.



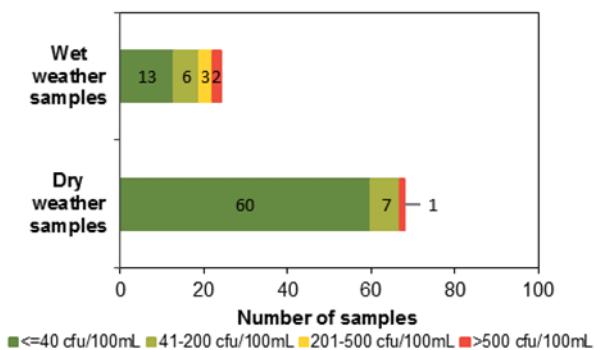
Sanitary Inspection Category (SIC) chart

The results of the sanitary inspection for each swimming location are presented in a radar pie chart. The chart shows the likelihood that each identified pollution source will contribute to faecal contamination at a swimming site, as indicated by the size and colour of the segment, ranging from very low (lightest colour) to very high (darkest colour) as shown below. The sum of these contributions is the overall likelihood, or Sanitary Inspection Category.



Wet and dry weather water quality chart

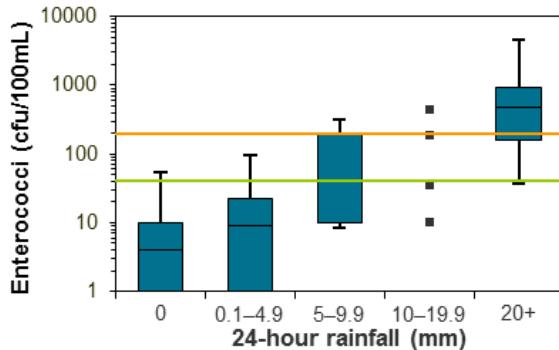
Enterococci levels in wet and dry weather conditions are presented for each swimming location as a bar graph. Dry weather is defined as no rainfall recorded in the previous 24 hours. Each bar is colour coded to show the number of enterococci results up to 40cfu/100mL, between 41 and 200cfu/100mL, between 201 and 500cfu/100mL and greater than 500cfu/100mL. These categories reflect the Microbial Assessment Category thresholds and are coloured on the graph as dark green, light green, amber and red respectively.



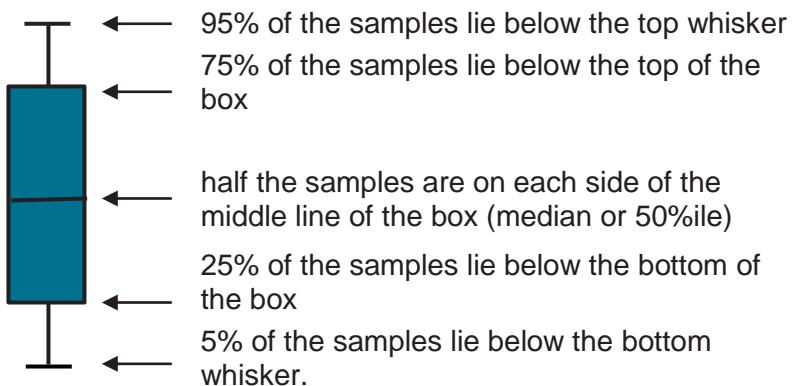
It is expected that swimming sites with lower levels of flushing show some elevated bacterial results in dry weather samples (no rainfall in the previous 24 hours) due to the longer time needed to recover from a rainfall event. At some estuarine and lake/lagoon swimming locations the impacts of stormwater pollution on beach water quality may be detected up to three days after rainfall.

Water quality in response to rainfall

Trends in enterococci levels in response to rainfall are shown using a box plot. For reference, enterococci levels of 40cfu/100mL and 200cfu/100mL are indicated with a green and orange line, respectively. The 40cfu/100mL level is referred to as the 'safe swimming limit'. The enterococci data were obtained from the last five years of monitoring. Rainfall data were obtained from rain gauges situated close to the sample site and are 24-hour totals to 9am on the day of sampling. If there are fewer than five enterococci data points in a rainfall category, individual data points are presented instead of a box plot. At sites where many results are below the detection limit (1cfu/100mL), only the upper portion of the box plots will be visible.



Each part of the box plot represents a significant percentile value of the sample population:



Information bars

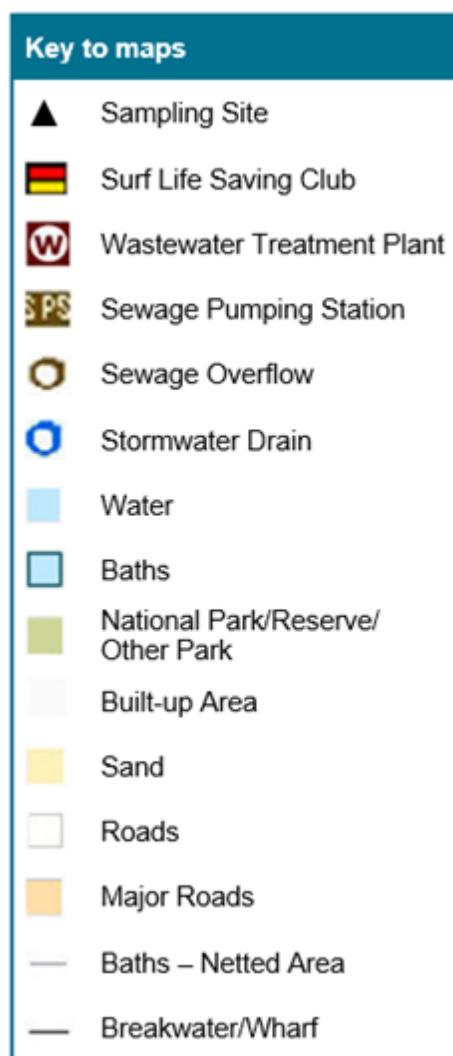
Information bars on each beach page provide a summary of details about the swimming site.

The monitoring period shows the timeframe in which the water samples were collected. The NHMRC guidelines state beach grades should be determined from the most recent 100 water quality results collected within a five-year period. The monitoring period varies between sites depending on sampling frequency.

Dry weather samples suitable for swimming (**dry weather swimmability**) shows the percentage of water samples with enterococci levels below 40cfu/100mL. Dry weather is defined as no rainfall in the previous 24 hours. Swimming sites with lower levels of flushing often have a lower percentage of dry weather samples within the safe swimming limit due to the impacts of rainfall detected up to three days after the event.

Explanation of maps

A map of individual swimming locations is presented on each beach page. The scale of the maps is 1:10,000. Each map shows the location of the sampling site, land use and features such as surf lifesaving clubs. Potential pollution sources such as stormwater drains, sewage pumping stations, wastewater treatment plants, lagoons, rivers and creeks, are shown where accurate data is held.



References

Wyer MD, Kay D, Fleisher JM, Salmon RL, Jones F, Godfree AF, Jackson G and Rogers A 1999, An experimental health related classification for marine waters, *Water Research* 33(3), pp.715–722.