

## 2. Microbiological water quality indicators and guidelines

### 2.1 Background

Water contaminated by human or animal excreta may contain a diverse range of pathogenic (disease-causing) micro-organisms such as bacteria, viruses, and protozoa (e.g., salmonella, campylobacter, cryptosporidium, giardia, etc). These organisms may pose a health hazard when the water is used for recreational activities such as swimming. The most common illness from swimming in contaminated water is gastroenteritis, but recent evidence shows that respiratory illness and skin infections are also quite common. In most cases, the ill-health effects from exposure to contaminated water are minor and short-lived, although the potential for more serious diseases such as Hepatitis A, Giardiasis, Cryptosporidiosis, Campylobacteriosis, and Salmonellosis can not be discounted.

In 2003 the Ministry for the Environment (MfE) and the Ministry of Health (MoH) finalised microbiological water quality guidelines for recreational waters which are based on an assessment of the risk from exposure to contaminated water. These guidelines use bacteriological indicators associated with the gut of warm blooded animals to assess the risk of faecal contamination and therefore the potential presence of harmful pathogens<sup>1</sup>. The indicators used are:

- Freshwater (including estuarine waters): *Escherichia coli* (*E. coli*)
- Marine waters: Enterococci
- Recreational shellfish-gathering waters: Faecal coliforms

Compliance with the MfE/MoH (2003<sup>2</sup>) microbiological water quality guidelines (from this point on referred to as *the recreational water quality guidelines*) should ensure that people using water for contact recreation are not exposed to significant health risks. The guideline values are outlined Sections 3 (fresh waters) and 4 (marine waters) of this report. In essence, the guidelines are "trigger" values to help water managers determine when management intervention is required. The "trigger" values underpin a three-tier management framework analogous to traffic lights (Table 2.1).

**Table 2.1: Three-tier management framework for recreational waters advocated by MfE/MoH (2003).**

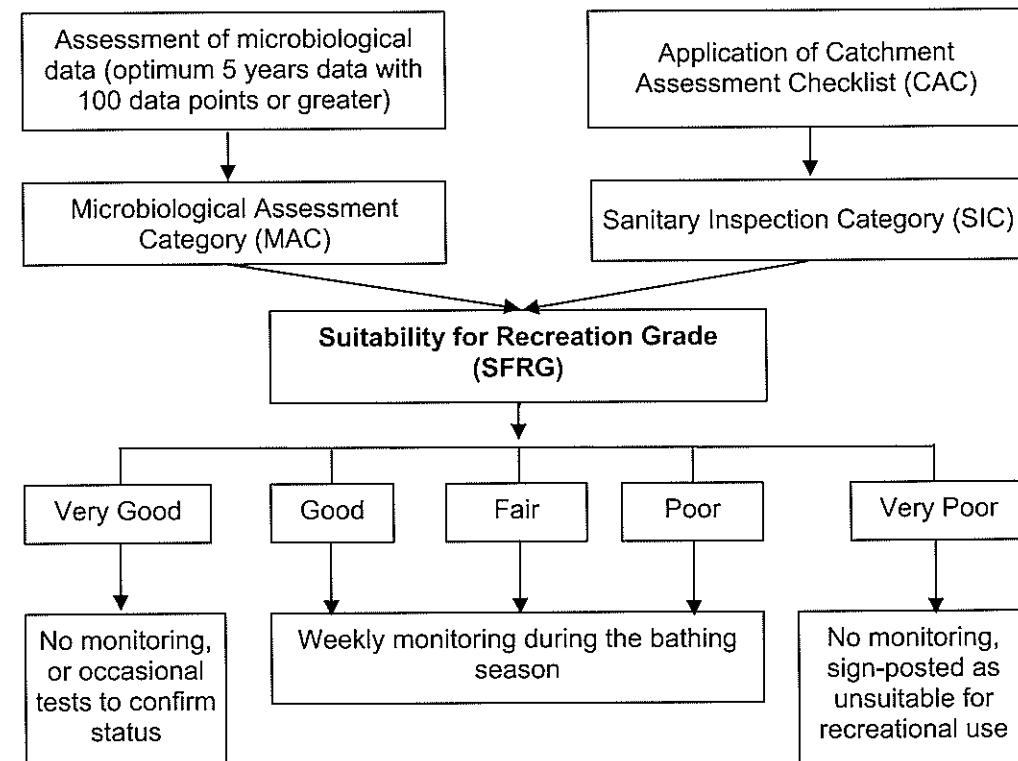
Mode	Management Response
Green/Surveillance	Routine monitoring
Amber/Alert	Increased monitoring, investigation of source and risk assessment
Red/Action	Closure, public warnings, increased monitoring and investigation of source

<sup>1</sup> Indicator bacteria are monitored because individual pathogenic organisms are often present in very low numbers, can be hard to detect, and the analytical tests are expensive.

<sup>2</sup> The guidelines were published in June 2002 and updated in June 2003.

## 2.2 Beach grading

In recent years there has been a move away from the sole use of quantitative “guideline” values of bacteriological indicators to assess the risk of faecal contamination and therefore the potential presence of pathogens. Instead, the MfE/MoH (2003) guidelines advocate a risk-based approach to managing recreational waters. This involves combining a qualitative assessment of the susceptibility of a recreational site to faecal contamination, and direct measurements of appropriate bacteriological indicators at the site to generate a “Suitability for Recreation Grade” (SFRG) for the site (Figure 2.1).



**Figure 2.1: Overview of the bathing site grading process and surveillance requirements.**

(Source: after MfE/MoH (2003), p. C3)

The SFRG describes the general condition of the water at a site at any given time, based on both microbiological risk and indicator bacteria counts. This grade helps determine whether on-going monitoring is required, and provides the basis for advising people whether or not the water at a site is suitable for recreational use from a public health perspective. The risk of becoming sick from contact with the water at a site increases as the grading shifts from “very good” to “very poor”. Conditions affecting water quality will vary the most for the middle range of grades (“good”, “fair”, and “poor”). For example, the water at “good” sites will usually comply with the guidelines, but events such as high rainfall can increase the risk of microbiological contamination (e.g., via run-off from low-intensity land). Consequently, weekly water quality monitoring at these middle-range sites is recommended during the bathing season (Table 2.2).

**Table 2.2: Description of Suitability for Recreation Grades.**

SFRG	Definition	Recommendation
Very Good	There may be some indirect run-off from low intensity agricultural/urban/rural/bush catchments, but there are likely to be no significant sources of faecal contamination.	Considered satisfactory for swimming at all times, and therefore may not require monitoring on a regular basis.
Good	On occasions (such as after high rainfall) there may be an increased risk of contamination from run-off. Such sites receive run-off from one or more of the following sources which may contain animal or human faecal material: <ul style="list-style-type: none"> <li>• River discharges impacted by tertiary treated wastewater, combined sewer overflows, sewer overflows, intensive agricultural/rural catchments, significant feral/bird/animal populations.</li> <li>• River discharges impacted by; run-off from low-intensity agricultural/urban/rural catchment.</li> <li>• Direct discharges from stormwater not contaminated by sewage, boat moorings or marinas.</li> <li>• Direct discharges from low-intensity agriculture.</li> </ul>	Satisfactory for swimming most of the time. Exceptions may include following rainfall. Such beaches are monitored regularly throughout the summer season and warning signs will be erected if water quality deteriorates.
Fair	Events such as high rainfall increase the risk of contamination levels from run-off. Such sites receive run-off from one or more of the following sources which may contain animal or human faecal material: <ul style="list-style-type: none"> <li>• River discharges impacted by tertiary treated wastewater, combined sewer overflows, sewer overflows, intensive agricultural/rural catchments, significant feral bird/animal populations.</li> <li>• River discharges impacted by; run-off from low-intensity agricultural/urban/rural catchment.</li> <li>• Direct discharges from stormwater not contaminated by sewage, boat moorings or marinas.</li> <li>• Direct discharges from low-intensity agriculture.</li> </ul>	Generally satisfactory for swimming, though there may be potential sources of faecal material. Caution should be taken during periods of high rainfall, and swimming should be avoided if water is discoloured. Sites are monitored weekly throughout the summer season and warning signs erected if water quality deteriorates.
Poor	These sites receive run-off from one or more of the following sources which may contain animal or human faecal material: <ul style="list-style-type: none"> <li>• Tertiary treated wastewater.</li> <li>• Urban stormwater, intensive agriculture, unrestricted stock access, dense bird populations.</li> <li>• Low-intensity agriculture, marinas or boat moorings, urban stormwater not contaminated by sewage.</li> <li>• River discharges containing untreated/primary/secondary treated wastewater or on-site waste treatment systems.</li> <li>• River discharges impacted by tertiary treated wastewater, combined sewer overflows, intensive agricultural/rural catchments, feral bird/animal populations.</li> </ul>	Generally not okay for swimming, as indicated by historical water quality results. Swimming should be avoided, particularly by the very young, the very old and those with compromised immunity. Permanent warning signs may be erected at these sites, although councils may monitor these sites weekly and post temporary warnings.
Very Poor	These sites receive run-off from one or more of the following sources which may contain animal or human faecal material: <ul style="list-style-type: none"> <li>• Untreated/primary/secondary treated wastewater.</li> <li>• On-site waste treatment systems.</li> <li>• Tertiary treated wastewater.</li> <li>• Urban stormwater, intensive agriculture, unrestricted stock access, dense bird populations.</li> <li>• River discharges containing untreated/primary/secondary treated wastewater or on-site waste treatment systems.</li> </ul>	Avoid swimming, as there are direct discharges of faecal material. Permanent signage will be erected at the beach stating that swimming is not recommended.

Source: adapted from pp. H20-21, MfE/MoH (2003)

The two components providing a SFRG for the water at an individual site are:

- the Sanitary Inspection Category (SIC), which is a measure of the susceptibility of the water body to faecal contamination based on a Catchment Assessment Checklist (CAC); and
- the Microbiological Assessment Category (MAC), which is a measure of the actual water quality over time based on bacteriological test results.

### 2.2.1 Sanitary Inspection Category (SIC)

The SIC allows the principal source of faecal contamination (e.g., sewage overflows, stormwater discharges, agricultural runoff, wildlife, etc.) to be identified and assigns a category (value) according to risk. This value is “very high”, “high”, “moderate”, “low”, or “very low”, and is found for a specific water body by use of a SIC flow chart. The information for using the flow chart comes from a Catchment Assessment Checklist (CAC). The CAC includes a summary of key catchment characteristics such as land use and land cover, water uses (e.g., marina, boat ramp), the prevailing wind direction and total annual rainfall, together with an assessment of microbiological hazards that may affect water quality in the recreational area. The list of hazards to consider for freshwater and marine areas are summarised in Table 2.3, together with the SIC value associated with each hazard. The SIC value assigned to the *primary* microbiological hazard influencing water quality at a site is used in the determination of the SFRG for that site.

The Greater Wellington Regional Council completed CACs for the majority of the 76 marine recreational water quality monitoring sites in 2002, along with preliminary CACs for the 23 freshwater monitoring sites. The microbiological hazard component of the CACs are revisited and updated in this report. Information for the assessment was drawn from a range of sources including site inspections, aerial photographs, sewerage/stormwater reticulation maps, resource consent information, pollution incident records, Regional Public Health, Wairarapa Public Health, and environmental health officers and engineers at selected territorial authorities.

### 2.2.2 Microbiological Assessment Category (MAC)

The MAC is determined from the 95<sup>th</sup> percentile value in an existing or collected set of microbiological water quality data. The MfE/MoH (2003) state that ideally there should be 100 data points or greater, collected over the previous five years, although it is feasible to consider grading with a minimum of 20 data points collected over one full bathing season. The grading is considered interim until five years of data have been collected. Five years of data are available for the majority of the sites monitored in the Wellington region.

**Table 2.3: Microbiological hazards and associated SIC grades for marine and fresh waters.**

	Microbiological Hazards – Fresh Waters	SIC†
	<i>Is water quality affected by:</i>	
1	Direct discharge of sewage or animal wastes	Very High
2	Stormwater with potential sewage contamination	High
3	Urban stormwater protected from sewage ingress	Moderate
4	Private sewage disposal systems discharge (septic tanks)	Very High
5	Communal sewage disposal with primary or secondary treatment	Very High
6	Communal sewage disposal with tertiary treatment	High
7	Intensive agricultural land use and potential for direct run-off	High
8	Focal points of drainage from low intensity land use	Moderate
9	Unrestricted stock access to waterways	High
10	Dense birdlife near the area	High
11	Water craft mooring or use of area	Moderate
12	Faecal contamination from feral animals (e.g., forest or bush run-off)	Low
13	Stream/drain/wetland discharging into/upstream of site	(refer to 14-20)
	<i>If rivers/streams/drains are present, are these affected by:</i>	
14	Discharges of human or animal effluent	High
15	Urban stormwater with potential sewage contamination	Moderate
16	Urban stormwater protected from sewage ingress*	Moderate**
17	Communal sewage disposal with tertiary treatment	Moderate
18	Intensive agricultural land use and potential for direct run-off	Moderate
19	Focal points of drainage from low intensity land use	Low
20	Faecal contamination from feral animals (e.g., forest or bush run-off)	Very Low
	<i>Other influences to consider:</i>	
	Does rainfall trigger contamination?	
	Does microbiological water quality exceed guidelines?	
	Have illnesses been notified from this area?	
	<b>Microbiological Hazards – Marine Waters</b>	<b>SIC</b>
	<i>Is the beach water quality affected by:</i>	
1	Direct discharge of sewage or animal wastes	Very High
2	Urban stormwater with potential sewage contamination	High
3	Urban stormwater protected from sewage ingress	Moderate
4	Private sewage disposal systems discharge (septic tanks)	Very High
5	Communal sewage disposal with primary or secondary treatment	Very High
6	Communal sewage disposal with tertiary treatment	High
7	Intensive agricultural land use and potential for direct run-off	High
8	Dense birdlife near the beach	Moderate
9	Water craft mooring or use of area	High
10	Focal points of drainage from low intensity land use*	Low**
11	River/stream/drain discharging near the beach	(refer to 12-17)
	<i>If rivers/streams/drains are present, are these affected by:</i>	
12	Discharges of human or animal effluent	High
13	Urban stormwater with potential sewage contamination	Moderate
14	Urban stormwater protected from sewage ingress*	Moderate**
15	Intensive agricultural land use and potential for direct run-off	Moderate
16	Faecal contamination from feral animals (e.g., forest or bush run-off)	Very Low
17	Focal points of drainage from low intensity land use	Low
	<i>Other influences to consider:</i>	
	Does water quality change with currents, tide or wind?	
	Does rainfall trigger contamination?	
	Does microbiological water quality exceed guidelines?	
	Have illnesses been notified from this area?	

† Only applies if hazard identified as being the primary factor influencing water quality at the site

\* Represents an additional hazard considered by Greater Wellington Regional Council

\*\* Estimated SIC value

### 2.2.3 Cautionary notes

- The MfE/MoH (2003) recreational water quality guidelines do not cover toxic algal blooms, which in certain places and under certain conditions, may pose a significant risk to contact recreation. Such blooms have occurred in recreational waters in the Wellington region in the past. For example, Milne and Wyatt (2006) reported on the presence of benthic cyanobacteria blooms in several Wellington rivers over the 2005/2006 summer.
- A lot of illness associated with contact with potentially contaminated waters will not come to medical attention, so the true burden of illness is likely to be significantly underestimated (Bokkerink<sup>3</sup>, pers. comm., 2006).

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<sup>3</sup> Stephen Bokkerink, RPH Environmental Health Protection Officer