GUIDELINES FOR

CANADIAN RECREATIONAL WATER QUALITY

SUMMARY DOCUMENT

Health Canada Santé Canada

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TABLE OF CONTENTS

INTRODUCTION

The *Guidelines for Canadian Recreational Water Quality* include the following six technical documents.

1. Understanding and managing risks in recreational waters

2. Indicators of fecal contamination

3. Cyanobacteria and their toxins

4. Microbiological pathogens and other biological hazards

5. Microbiological sampling and analysis

6. Physical, aesthetic and chemical characteristics

These documents apply to natural recreational waters defined as untreated natural fresh, marine or estuarine bodies of water used for recreational purposes such as lakes, rivers, and human-made systems (for example, artificial lakes). They don't apply to constructed recreational water facilities like swimming pools or splash parks. The categories for recreational water activities are: primary contact activities (such as swimming, wading, windsurfing and waterskiing) and secondary contact activities (such as canoeing, boating or fishing). Primary and secondary contact activities involve different levels of exposure. Depending on the water quality, some areas may only be suitable for secondary contact activities.

Participating in either primary or secondary contact recreational water activities always involves some level of risk. Public health decisions should balance health risks with the enjoyment and exercise that comes from these activities. If the level of risk is too high, the authorities may issue an advisory.

The *Guidelines for Canadian Recreational Water Quality* guideline technical documents recommend a preventive risk management approach as the best way to keep risk low. Here, readers will find the key information from the six guideline technical documents; however, the individual guideline technical documents should be consulted for the most current and complete information.

1.0 UNDERSTANDING AND MANAGING RISKS IN RECREATIONAL WATERS

The best strategy for protecting public health from risks associated with recreational water activities is a preventive risk management approach incorporating multiple areas of management (for example, source protection, hazard assessment and prioritization, monitoring, hazard control, communication, consultation, and training). This approach requires the cooperation of all stakeholders. Management strategies that rely on microbial water quality monitoring alone are not sufficient to protect public health.

An environmental health and safety survey (EHSS) is recommended as the foundation for designing and implementing an effective risk management plan. It assesses existing and potential water quality hazards (biological, chemical and physical) and reviews all aspects of a beach's operation. It can be used to support risk management decisions and to develop and maintain effective beach monitoring programs. An EHSS should be conducted on an annual basis, just before the start of the swimming season. Shortened surveys may also be carried out throughout the swimming season to help interpret monitoring results.

Using the data from the EHSS, a well-structured and documented monitoring plan should be developed. Monitoring is essential for assessing and communicating information on the quality of recreational waters. A monitoring program may include routine sampling or sampling for specific hazards. In general, recreational areas used for primary contact activities are monitored for fecal indicators (such as *E. coli* or enterococci) at a minimum frequency of one sampling event per week during the swimming season. Each sampling event may require the collection of multiple samples to represent the water quality throughout the entire swimming area. This could include the use of composite sampling. Less frequent monitoring may be possible under certain circumstances, such as at beaches in remote locations or in areas where primary contact recreational activities are not a regular occurrence. Monitoring for specific hazards will vary depending on the identified risks. For cyanobacteria and their toxins, criteria can be used to help evaluate the risk of bloom formation and the level of human exposure that may occur. Areas that are at greater risk for cyanobacteria impacts may need a cyanobacteria management plan in place.

Other tools are also available to supplement EHSS and water quality assessment activities. Fecal source tracking can help understand sources of fecal contamination. As feces from humans and ruminant animals have been shown to be of greater concern than other animal sources, this information can help assess public health risks and help target appropriate risk management barriers. Quantitative microbial risk assessment (QMRA) can also be used to assess public health risks. It uses exposure conditions and dose-response models to provide risk estimates. Predictive water quality modelling is a tool that can be used to inform public health decisions regarding the suitability of water quality for recreational activities. This type of modelling uses mathematical approaches to predict whether a water quality target (such as *E. coli* or enterococci guideline values) may be exceeded. Predictive models are designed to make same day predictions, even on weekends, so they overcome some of the limitations associated with current monitoring approaches. However, not all beaches are good candidates for predictive models. A significant limitation to all of these tools (fecal source tracking, QMRA, predictive modelling) is that they require a high level of technical expertise and a significant amount of data, which may not be available for many recreational water areas.

Management of beach sand is also an important part of a preventive risk management approach. Beach sands can contain many types of microorganisms, including various human pathogens and fecal indicator organisms. These microorganisms can impact the microbial quality of adjacent shallow waters if there are disturbances of the beach sand (for example, through wave action, rain-mediated run-off or swimmer activities). Beach users can also be exposed to these microorganisms through direct contact as they often spend more time on the beach than in the water, and children routinely play in the sand at the water's edge. It is possible to monitor beach sand for fecal indicator organisms, but it is difficult, as concentrations of microorganisms are highly variable over small distances. The relationship between fecal indicator concentrations in beach sands and human health risks is also not well characterized. The best approach to minimize the risks associated with beach sands is to apply numerous management strategies. Beach grooming and cleaning can help minimize fecal contamination and reduce its transport to swimming areas. Various barriers (such as restricting pet access or installing animal-proof refuse containers) can also help limit beach sand contamination. Beach users can also do their part by properly disposing of litter, using available facilities for hygiene practices, and complying with beach regulations or codes of conduct.

The public also need access to information on the recreational water areas they are visiting, including any existing water quality hazards and the steps they can take to protect themselves. Information can be communicated to the public in numerous ways, such as through posted signs, printed materials, or various media sources. Improving public awareness and understanding of water quality can have many benefits, including a reduction in illnesses and injuries.

2.0 INDICATORS OF FECAL CONTAMINATION

For many recreational water areas, pathogenic microorganisms introduced into the water through human and animal fecal wastes are a concern. Routine testing for these pathogens is impractical. Instead, risk management approaches include routine monitoring for fecal indicator organisms. Elevated numbers of fecal indicator organisms signal fecal contamination and an increased risk of illness. The source of the fecal contamination has an impact on the level of risk. Feces from humans and ruminant animals represent a higher level of risk to human health than feces from other sources (for example, non-ruminant animals or birds). Responsible authorities are encouraged to identify the sources of fecal contamination impacting a recreational water area to aid in public health decisions and to inform remediation prioritization to improve water quality.

2.1 Primary contact activities

The fecal indicator guideline values recommended in this guideline technical document are beach action values (BAV). Both culture-based methods (*E. coli* and enterococci) and polymerase chain reaction (PCR)-based methods (enterococci) can be used for analysis (Table 1).

Table 1. Fecal indicator guideline values.

Indicator	BAV (Culture-based)	BAV (PCR-based)
E. coli—fresh water	≤ 235 *E. coli* cfu/100 mL	N/A
Enterococci—marine and fresh water	≤ 70 enterococci cfu/100 mL	< 1000 enterococci cce/100 mL

BAVs inform day-to-day beach management decisions. If *E. coli* or enterococci concentrations exceed the established BAVs, this should trigger actions. The actions required will depend on site-specific considerations, such as the sources of fecal contamination and the extent of the exceedance. Actions may include immediate resampling of the site(s), issuing a swimming advisory, and conducting a shortened EHSS. Other approaches, such as using predictive beach water quality models, may also trigger beach management actions. Recreational waters that have a very low risk of human or ruminant fecal contamination may benefit from the development of alternative guideline values.

In addition to day-to-day decisions, fecal indicator monitoring data can help determine a location's overall suitability for recreation. Summarizing fecal indicator data using geometric means is recommended for looking at water quality trends. It can also be compared to the geometric mean associated with the water quality distribution used in the calculation of the BAVs. Recreational water areas where the *E. coli* and enterococci geometric mean concentrations are consistently higher than 126 cfu/100mL and 35 cfu/100mL (or 470 cce/100mL), respectively, may represent a greater level of risk to human health and may not be suitable for primary contact recreation.

Other fecal indicators have been widely discussed and a summary can be found in the guideline technical document.

2.2 Secondary contact activities

Secondary contact recreational water activities (for example, canoeing, kayaking, or fishing) involve different exposures from those associated with primary contact uses. Secondary contact activities usually result in a lower ingestion of water and therefore a lower risk of gastrointestinal illness. For recreational water areas that are used solely for secondary contact activities, responsible authorities may choose to develop secondary contact guidelines. The suggested approach for determining a secondary contact value is to apply a direct multiplier to the primary contact guideline value. This multiplier is based on the assumed ratio difference in the volume of water generally consumed during primary and secondary contact activities. The calculated value represents a risk management decision.

3.0 CYANOBACTERIA AND THEIR TOXINS

Cyanobacteria blooms are a public health concern as they can contain harmful cyanotoxins and contact with bloom material can cause skin irritation and gastrointestinal illness. In Canada, there are many rivers and lakes that are used for recreational activities. Monitoring all of them for cyanobacteria blooms is not feasible or recommended. Instead, responsible authorities can use criteria to identify the areas that are at greater risk for bloom formation. This information is then used to prioritize areas for monitoring and to determine a monitoring approach (for example, what to monitor and how often). This monitoring should be included as part of the overall risk management plan for a recreational water area.

Guideline values have been developed for planktonic cyanobacteria and cyanobacterial toxins. The guidelines are divided into (1) direct measures for cyanotoxins and (2) indicators of the potential presence of cyanotoxins (Table 2).

Table 2. Guideline values for planktonic cyanobacteria and cyanobacterial toxins.

	Parameter	Guideline value
Direct measure for cyanotoxins (health-based value)	Total microcystins	10 µg/L
Indicators of the potential presence of cyanotoxins	Total cyanobacteria cells	50 000 cells/mL
	Total cyanobacterial biovolume	4.5 mm^3/L
	Total chlorophyll *a*	33 µg/L

The total microcystins guideline value is a health-based value. It protects against the accidental ingestion of harmful quantities of microcystins in water and against the potential harmful effects after exposure to cyanobacterial material. The total microcystins health-based value is considered protective for all Canadians. Other cyanotoxins, such as anatoxin-a, saxitoxin, and cylindrospermopsin, have more limited information available, and guideline values have not been established in this document. The remaining guideline parameters are indicators of the potential presence of cyanotoxins. Total cyanobacteria cells and total cyanobacterial biovolume are measures of planktonic cyanobacteria

biomass and total chlorophyll *a* is a measure of total phytoplankton biomass. These guideline values are derived based on relationships with total microcystins. If these values are exceeded, total microcystins, if present, may be at levels above the health-based value and concentrations of cyanobacterial material may be at levels that are harmful to human health.

Management plans for planktonic blooms can include visual monitoring and monitoring for indicators and cyanotoxins. Visual monitoring of waterbodies can include inspections for surface blooms, jar tests, or Secchi depth measurements. It can also include reports from the general public about potential cyanobacteria issues. It may be difficult to tell if a bloom is cyanobacteria or other phytoplankton. There are publications available that provide visual examples. However, determining if these blooms contain toxins can only be done by laboratory analysis. Indicator and cyanotoxin monitoring may include the parameters for which there are guideline values (Table 2) or other parameters (for example, phycocyanin, anatoxins, or saxitoxins). The types and frequency of monitoring will vary between locations. This flexibility in cyanobacteria management should help responsible authorities address some of the monitoring challenges associated with cyanobacteria and their toxins while continuing to protect public health.

Primary contact activities in recreational waters should be avoided where a planktonic bloom has developed, or the guideline value for total microcystins is exceeded. A swimming/contact advisory should be issued as a precaution. Once issued, an advisory should remain in place until the associated health risk has returned to an acceptable level. In areas with a history of reoccurring blooms, advisories may be left in place for the season once a bloom occurs, particularly if the water conditions change quickly or there are limited resources to conduct frequent inspections.

Guideline values have not been developed for benthic cyanobacteria; however, monitoring is still recommended. Benthic cyanobacteria form bottom-covering mats that, under certain environmental conditions, can detach from the underlying surface and accumulate along shores where they present an exposure risk. In clear shallow areas, the presence of benthic mats should be visually assessed. To determine the presence of toxins or toxin producing cyanobacterial species, laboratory analysis is needed. In areas where benthic mats can be reached, individuals should be advised to avoid these areas, including keeping pets away from the impacted areas.

4.0 MICROBIOLOGICAL PATHOGENS AND BIOLOGICAL HAZARDS

Recreational water areas may contain numerous types of microbiological pathogens and other biological hazards. Guideline values have not been established for any of the hazards described in the guideline technical document. Routine monitoring is not recommended due to the challenges associated with the detection of many of these hazards. Testing may be carried out if epidemiological or other types of evidence (for example, visible signs of deterioration) suggest that it may be informative.

Enteric pathogens (the pathogens found in feces) are the most common cause of human illness from recreational water exposures. Non-enteric pathogens (for example, free-living microorganisms that occur in the natural environment, or microorganisms associated with urine or human body surfaces) can also be present in recreational waters. These pathogens are not related to fecal contamination. To reduce the risk of human exposure to both enteric and non-enteric pathogens, a preventive risk management approach should be implemented. This should include routine monitoring for fecal indicator organisms.

Table 3 includes a list of pathogens that may exist in natural fresh, marine, or estuarine bodies of water in Canada. They are not present in all recreational settings, nor are they present on a continuous basis.

Table 3. Pathogens of potential concern in recreational water areas

	Enteric pathogens	Naturally-occurring pathogens	Other pathogens
Bacteria	*Campylobacter* spp. Pathogenic *E. coli* / *Shigella* spp. *Salmonella* spp.	*Aeromonas* spp. *Legionella* spp. *Mycobacterium* spp. *Pseudomonas* spp.	*Leptospira* spp. *Staphylococcus aureus*
Viruses	Adenoviruses Astroviruses Enteroviruses Hepatitis A, E Noroviruses Rotaviruses		
Protozoa	*Cryptosporidium* spp. *Cyclospora* spp. *Entamoeba* spp. *Giardia* spp. *Toxoplasma* spp.	*Acanthamoeba* spp. *Naegleria fowleri*	

Other biological hazards can also affect recreational waters and impact human health. Swimmer's itch (cercarial dermatitis) is caused by parasitic flatworms or "schistosomes" that are free-living species that occur naturally in Canadian surface waters and are not related to fecal contamination. Warning signs should be posted in recreational water areas where cases of swimmer's itch have been reported. Aquatic vascular plants and algae can also present a safety risk to recreational water users and create aesthetic problems for recreational water areas. They can attract animals to the area and provide breeding grounds for a variety of species of insects and bacteria. Improved beach clean-up procedures to remove masses of plants and algal material that have washed up on shorelines can be effective in reducing risks. Actions that involve trying to remove these organisms from natural waters or to treat them using pesticides may be harmful to the aquatic environment and are discouraged. These actions may also be illegal in some jurisdictions. Many other hazards can also interfere with the safe and enjoyable use of recreational waters in Canada (for example jellyfish, leech "bites", sea urchins and mussel shells). The responsible authority should be contacted for further guidance on these subjects where necessary.

5.0 MICROBIOLOGICAL SAMPLING AND ANALYSIS

Monitoring recreational water quality is an important component of a preventive risk management approach. Standard procedures for the collection, transport and analysis of samples are critical to obtain the most accurate assessment of the water quality. All collection procedures and laboratory analyses should be carried out as directed by the responsible authority.

For the quantification of fecal indicators, standardized culture-based and polymerase chain reaction (PCR)-based methods are available. There are advantages and disadvantages to each type of method. The analytical method employed will depend on factors such as monitoring program requirements, laboratory capability and capacity, beach-specific considerations (for example, source water characteristics) and jurisdictional requirements.

PCR-based methods are also useful for determining which sources of contamination are impacting recreational areas such as human sewage or feces from ruminants, canine, and avian species. They can also be used for informing waterborne illness outbreak investigations.

Routine monitoring for pathogenic microorganisms is not recommended due to the associated complexity and costs. If testing is necessary, it should be conducted by qualified staff in laboratories with proper biosafety level, design, equipment, and procedures.

6.0 PHYSICAL, AESTHETIC AND CHEMICAL CHARACTERISTICS

The physical (Table 4), aesthetic (Table 5) and chemical (Table 6) characteristics of the water and surrounding beach area may affect their suitability for recreational activities. These parameters may not be applicable in all waters. In addition, other site-specific characteristics may need to be considered. When a numerical value can be assigned, guideline values or aesthetic objectives are provided.

Table 4. Physical characteristics that may affect the suitability of an area for recreational activities

Physical Characteristic	Recommendation	Justification
pH	5.0–11.0	pH values outside this range may cause skin and eye irritation. Most natural waters have pH ranges from 4.0 to 9.0, therefore some natural waters may fall outside the recommended pH range.
Dissolved oxygen	Low oxygen conditions are undesirable in recreational water areas as they may cause water quality issues.	Although dissolved oxygen does not directly impact recreational uses, low oxygen conditions may be associated with the growth of organisms that are a nuisance to recreators and other aesthetically objectionable water quality characteristics (for example, odour).
Temperature	Avoid recreating for time-temperature combinations that appreciably increase or decrease core body temperature.	Tolerance to temperatures can vary, therefore no recommended temperature range can be set. Cold water temperatures are more of a concern in Canadian waters. Unprotected immersion in water ≤ 15 °C is considered potentially life-threatening.
Ultraviolet radiation (UVR)	Avoid overexposure to UVR and protect yourself from excessive heat.	Acute UVR overexposure can result in sunburns, and chronic overexposure can cause skin cancers and cataracts. Excessive heat can result in heat illnesses (such as heat exhaustion, heat stroke, or heat cramps). Simple protective measures can help avoid these conditions.
Other hazards	Check for hazards in the water and on the beach, remove hazards or post warnings, when required.	Hazards (for example litter, shells, sharp rocks) and waterbody characteristics (for example strong currents, rough waves, water depth) present a risk of injury.

Table 5. Aesthetic characteristics that may affect the suitability of an area for recreational activities

Aesthetic Characteristic	Recommendation	Justification
Turbidity	<50 nephelometric turbidity units (NTU)	Values below this level should maintain water clarity and ensure aesthetic acceptability.
Clarity	Not significantly decreased compared to background values.	Individuals engaged in primary contact activities need to be able to estimate depth and see subsurface hazards. Secchi depth measurements are useful for determining clarity.
Colour	Should not impede visibility.	Intense colour can impede visibility in areas used for primary contact activities
Oil and grease	None visible.	Extensive visible film, sheen or discoloration on the surface, or detectable by sight or odour as deposits on shorelines and bottom sediments make water aesthetically unattractive. Low levels of contamination are low risk for adverse human health impacts.
Litter	None visible.	Floating debris may be aesthetically unappealing, pose a safety hazard, and may settle to form objectionable deposits.

Table 6. Chemical characteristics that may affect the suitability of an area for recreational activities

Chemical Characteristic	Recommendation	Justification
Organic and inorganic chemicals	Assess on a case-by-case basis, taking local factors into account.	Concentrations of chemical contaminants found in most recreational waters are not sufficient to cause illness. Locations with higher risk should be identified using an EHSS.