CARICOM REGIONAL STANDARD

Guidelines for Recreational Water Quality

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REGIONAL TECHNICAL COMMITTEE REPRESENTATION

The preparation of this standard was carried out under the supervision of the Regional Technical Committee for Recreational Water Quality which, at the time of developing this standard, comprised the following persons:

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Foreword

This guideline document has been prepared to set levels of quality and safety for recreational water of riverine and coastal origin within CARICOM member states. Citizens and visitors of these territories enjoy recreational activities in and around water and similarly such recreational activities are major components of the tourism product. As such, it is of paramount importance that water and its environs used for recreational purposes meet health and safety requirements to prevent physical injury and illness and disease outbreaks among persons utilizing the water and surroundings.

The purpose of the guideline is to establish criteria for:

a) ensuring safety of users of recreational waters;
b) types of use and methods of ensuring compliance;
c) regulating usage of recreational waters;
d) promoting economic and ecological sustainability of recreational waters;
e) facilitating quality control of recreational waters.

In so doing, a legislative framework for a safe, protected, healthy and sustainable recreational water environment would be established.

Potential health hazards vary according to the type of water and activity. In general, the more contact there is with the water the better the water quality must be. The guidelines define physical (including aesthetic), chemical and microbiological limits on water quality for three main categories of recreational activity i.e. primary contact recreation, secondary contact recreation and passive recreation.

Health hazards include contact with physical contaminants, exposure to the elements, microbiological pollution, chemical pollution and exposure to toxic algae and their products. The greatest potential risk is posed by microbial contamination of waters by organisms such as bacteria, viruses and algae.

The guidelines proposed have given consideration to meeting the requirements of the Land Based Sources (LBS) of Marine Pollution Protocol to which most CARICOM member states have signed as a party. In so doing, it is expected that all concerned will pay particular attention to the extent of water pollution from land based sources.

Although the guidelines are intended to be applied at designated and classified water bodies, this does not mean that water quality can be allowed to deteriorate at unclassified water bodies.

Water-based recreational activities are popular in members states. Although not all countries have an extensive coastline, there are highly localised pressures on accessible areas, particularly around major urban areas and hotels. Increasingly, freshwater bodies (for example waterfalls) are being developed and managed for recreational purposes and are also becoming subject to these same pressures.

Water-quality guidelines are necessary to protect human health during recreational activities such as swimming and boating, and to preserve the aesthetic appeal of water bodies. Such guidelines are used in monitoring and managing a range of physical, microbial and chemical characteristics that determine whether a body of water is suitable for recreational use.

Use of recreational waters can adversely affect health. For example, gastroenteritis can be caused by swallowing water containing disease-causing organisms (pathogens). However, any potential adverse effects must be weighed against the enormous benefits to health and well being of recreational water use and the positive impacts on local economies that rely on water-associated recreational activities (WHO 2003).

In preparing this document guidance was obtained by study of the following documents:

a) World Health Organisation. 2003. Guidelines for Safe Recreational Water Environment. Volume 1, Coastal and Fresh Waters. Geneva;

b) Federal Provincial Working Group on Recreational Water Quality. Parts 1 & 2. 1992. Guidelines for Canadian Recreational Water Quality. Canada;

c) Australian Government. National Health and Medical Research Council, 2008. Guidelines for Managing Risks in Recreational Waters. Australia;

d) Standards for Recreational Water Quality. 2007. David Kay and John Fawell: Foundation for Water Research. U.K;

e) Tasmania Public Health Act. 1997. Recreational Water Quality Guidelines 2007. Issued by Director of Public Health;

f) Report of the Expert Scientific Workshop on Critical Research Needs for the Development of New or Revised Recreational Water Quality Criteria. 2007. US Environmental Protection Agency. Virginia;

g) List of Prohibited Concentrations, 2004. Government of Barbados; and

h) The Water Pollution Rules, 2001. Government of Trinidad and Tobago.

1 Scope

1.1 These guidelines prescribe requirements for recreational water quality and apply to a range of public and private recreational water environments, such as coastal, estuarine waters and fresh water bodies in CARICOM member states.

1.2 These guidelines also apply to any artificially constructed flow-through impoundment using water from sources described previously.

1.3 Swimming pools are subject to specific management practices and regulations intended to protect public health (for example disinfection standards) and are not covered by these guidelines.

1.4 These guidelines are set for three main categories of recreational activity:

a) primary contact recreation – where the body can be fully immersed and there is the potential to swallow water, and one is in direct contact with the water

EXAMPLE Swimming, diving, surfing

b) secondary contact recreation. There is direct contact with the water but the chance of swallowing water is unlikely or limited

EXAMPLE Boating, fishing, wading

c) passive recreation- no contact with the water and includes scenic appreciation, walking, picnicking, some sports, etc.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Guidelines for Drinking-water Quality, World Health Organisation (WHO) 1998, 2006;

Standard Methods for the Examination of Water and Wastewater, 21st Edition, American Public Health Association, 2005

3 Definitions

For the purpose of these guidelines the following expressions have the meaning stated:

3.1
aesthetic
appreciative of, responsive to the beauty in nature. The aesthetic value of recreational water areas implies freedom from visible materials that will settle to form objectionable

deposits, floating debris, oil, scum and other matter, substances producing objectionable colour, odour, taste or turbidity, and substances and conditions that produce undesirable aquatic life. Other components of the aquatic ecosystem and surrounding land should be present, for example, trees, other plants, birds, mammals, fish, and insects.

3.2
algae
a large group of diverse unicellular and multicellular aquatic plants that occur in both fresh water and seawater

3.3
algal bloom
a sudden increase in the number of algae in a water body to levels that cause visible discolouration of the water

3.4
Best Available Technology
the most accurate and available methods of detection

3.5
Cartagena Convention
Convention for the protection and development of the marine environmental of the wider Caribbean region

3.6
Class I waters
waters in the Cartagena Convention area that, due to inherent or unique environmental characteristics or fragile biological or ecological characteristics or human use, are particularly sensitive to the impacts of domestic wastewater. Class I waters include, but are not limited to:

a) waters containing coral reefs, seagrass beds, or mangroves;
b) critical breeding, nursery or forage areas for aquatic and terrestrial life;
c) areas that provide habitat for species protected under the Protocol Concerning Specially Protected Areas and Wildlife to the Convention (the SPAW Protocol);
d) protected areas listed in the SPAW Protocol; and
e) waters used for recreation.

3.7
catchment
area of land that collects rainfall and contributes to a recreational water body

EXAMPLE Streams, rivers, beaches

3.8
domestic wastewater

all discharges from households, commercial facilities, hotels, septage and any other entity, that include the following:

a) toilet flushing (black water);
b) showers, wash basins, kitchens and laundries (grey water); or
c) small industries, provided their composition and quantity are compatible with treatment in a domestic wastewater system.

NOTE Small quantities of industrial waste or processed wastewater may also be found in domestic wastewater.

3.9
eutrophication
degradation of water quality due to enrichment by nutrients such as nitrogen and phosphorus, resulting in excessive algal growth and decay and often with low dissolved oxygen in the water.

3.10
factor
the broad groupings of attributes associated with recreational water quality. These are: Physical characteristics, Aesthetic aspects, Chemical characteristics, Microbial quality, Dangerous aquatic organisms, and Nuisance factors

3.11
hazard
a biological, chemical, physical or radiological agent that has the potential to cause harm

3.12
indicator organisms
non-pathogenic microorganisms used to indicate the degree of faecal contamination. They are generally present in far greater numbers than pathogenic microorganisms and are easy to isolate, identify and enumerate. These organisms include coliforms (total coliforms, thermotolerant coliforms and *Escherichia coli*), intestinal enterococci, bacteriophages and clostridia

3.13
National Authority
an agency, public authority or person managing or in control of waters declared for recreational use

3.14
nonpoint source pollution
water pollution affecting a water body from diffuse sources, such as polluted runoff from agricultural areas draining into it, or wind borne debris blowing out to sea

3.15

nuisance
something that can cause harm or is annoying, unpleasant, or obnoxious

3.16
pathogen
an agent that causes infection or disease, especially a microorganism such as a bacterium, a protozoan or a virus

3.17
point source pollution
single identifiable localized source of pollution

EXAMPLE Discharge from a factory.

3.18
recreational use class
Type of use based on degree of physical contact with recreational water body. These are:

a) primary contact recreation: recreation in which the whole body or the face and trunk are frequently immersed or the face is frequently wet by spray, and where it is likely that some water will be swallowed or inhaled, or come into contact with ears, nasal passages, mucous membranes or cuts in the skin (eg swimming, diving, surfing or whitewater canoeing).
b) secondary contact recreation: recreation in which only the limbs are regularly wet and in which greater contact (including swallowing water) is unusual (eg boating, fishing, wading), and including occasional and inadvertent immersion through slipping or being swept into the water by a wave.
c) passive recreation: recreation in which there is normally no contact with the water (eg angling from shore), or where water is incidental to the activity (such as sunbathing on a beach).

3.19
recreational water
any public or privately controlled natural water body whether coastal, riverine or estuarine (e.g. rivers, waterfalls, sea, mineral bath) and its source and the immediate environments used for recreational purposes including, but not limited to, bathing, swimming, snorkelling, scuba diving, boating, fishing, wind surfing, skiing, for medicinal/therapeutic purposes, for social activities (e.g. picnicking, public partying) for religious activities and relaxation.

3.20
risk
the likelihood of a hazard causing harm in exposed populations in a specified timeframe, including the magnitude of that harm

3.21
turbidity

degree of cloudiness of water

4 General requirements

Waters used for recreational purposes are classified as Class I Waters.

Waters used for recreational purposes should be sufficiently free from microbiological, physical, and chemical hazards to ensure that there is negligible risk to the health and safety of the user. The determination of the risk of disease or harm from microbiological, physical, or chemical hazards is based on a number of factors, including the following:

a) environmental health assessments;

b) epidemiological evidence;

c) indicator organism limits; and

d) presence of pathogens.

The public, relevant agencies and other interested parties should be notified by the appropriate authority when a beach or body of water is not suitable for recreational use. This warning shall involve, among other things, placing one or more signs in conspicuous places along the shoreline of the recreational water body.

The decision to post a warning to users of recreational areas or to close an area for public use should be made by the Chief Medical Health Officer or other appropriate national authority in accordance with existing legislation. This decision will be based on an assessment of existing hazards using available information on the factors listed above.

NOTE It is recommended that users of recreational areas should not swim within 24 hours of heavy rain at beaches and within 3 days in estuaries or rivers

4.1 Discharges into Class I Waters

Wastewater that discharges into or adversely affects Class I waters shall be treated by a new or existing domestic wastewater system whose effluent achieves the following effluent limitations (Table 1) based on a monthly average:

Table 1 - Effluent Limits for Discharges into Class I Waters including Recreational Waters

Parameter	Effluent limit
Total Suspended Solids (TSS)	30 mg/l [a]
Biochemical Oxygen Demand (BOD)	20 mg/l
pH	5-10 pH units
Fats, Oil and Grease	15 mg/l
Faecal Indicators[1] Faecal Coliform OR a. *E. coli* b. enterococci	 200 mpn/100 ml 126 organisms/100ml 35 organisms/100 ml
Floatables	not visible
NOTE 1 Parties may meet effluent limitations either for faecal coliform or for *E. coli* (freshwater) and for enterococci (saline water).	
[a] Does not include algae from treatment ponds	

4.1.1 Phosphates and nitrates

In addition to the requirements of Table 1 above, the following measures shall be met for domestic wastewater that discharges into Class 1 waters:

4.1.1.1 Total nitrogen (inorganic and organic) shall not exceed 5mg/l (based on 50:1 dilution with nutrient removal.)

4.1.1.2 Total phosphorous (inorganic and organic) shall not exceed1mg/l (based on 50:1 dilution with nutrient removal.

4.2 Environmental health assessments

An annual environmental health assessment should be carried out prior to the bathing season on the watershed or the area from which water flows to a recreational area, as well as on the recreational area itself. The survey should identify all potential sources of contamination and physical hazards that could affect the recreational area. The survey shall include, but not be limited to, the following:

a) the risk of inadequately treated sewage, faecal matter, or chemical substances entering the water, from either a discharge or a spill;

b) knowledge of all outfalls or drainage in the area that may contain sewage, including urban storm water and agricultural waste or runoff;

c) an inspection of the area for physical hazards;

d) an assessment of the seasonal variability of hazards, the density of bathers, the water temperature, the frequency of change or circulation of the water, changes in water depth, and the occurrence of algal blooms;

e) the fluctuation of water quality with rainfall (wet and dry conditions);

f) a reporting mechanism to ensure that health authorities are informed of any malfunction or change to a local/community, private, or industrial waste treatment facility that might cause a deterioration of the water quality of a bathing area.

NOTE Annex B provides a suggested checklist for making an environmental health assessment of a recreational area.

4.2.1 As part of an annual environmental health assessment, consideration should be given to other sources of pollution including:

a) non-domestic and district wastewater systems;

b) industrial discharges;

c) agricultural pollution;

d) yacht and small boat pollution; and

e) recreational water user pollution.

4.3 Epidemiological evidence

The health authorities responsible for making recommendations for a recreational area should, wherever possible, establish surveillance for bather illness or injuries. This can be established by comprehensive epidemiological studies or by formal and informal reporting from physicians and hospital emergency departments. This surveillance will be increased if there have been reports of suspected illness or injuries. The water quality may be considered impaired and appropriate recommendations made as a result of this surveillance.

4.4 Indicator organism limits

An indicator organism or organisms should be chosen by the health authority in consultation with laboratory microbiologists. It is recommended that one of the following indicator organisms be used for routine monitoring of recreational water quality – enterococci, *Escherichia coli*, or faecal coliforms.

The choice of indicator organism and of enumeration procedures will be determined according to:

a) whether the water is marine (salt), fresh, or estuarine (variable salinity)

b) the presence of turbidity, which may interfere with microbiological methods

c) any known correlation of illness with levels of indicator organisms

d) the proportion of faecal coliforms in the area that are *E. coli*, if faecal coliforms are used as indicator organisms

e) local experience of monitoring with a particular organism.

Clauses 5.4.2 – 5.4.4 recommend the limits for each organism and the criteria to assist in the choice of that organism for routine monitoring. Guidelines for sampling and microbiological methods are also presented.

The decision to carry out routine microbiological monitoring of a recreational area will be made by the responsible agency and this should be based on the usage of the area, the environmental health assessment, and epidemiological evidence.

4.5 Presence of pathogens

Tests for pathogenic organisms may be carried out when there have been reports of illnesses of specific etiology, when there is suspected illness of undetermined cause, or when levels of an indicator organism demonstrate a continuous suspected hazard. The tests will help to determine the source of contamination

EXAMPLE Sewage pollution, agricultural or urban runoff, bather origin.

The health authorities should take action when pathogenic organisms are identified in sufficient quantity or frequency to be considered a hazard. Such pathogenic organisms may be *Aeromonas spp., Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Shigella spp*., *Salmonella spp., Campylobacter spp., Giardia spp*., human viruses, and toxic phytoplankton. An appropriate response should be based on the knowledge of the source of the organism and the probability of the hazard being temporary or continuous.

5 Detailed requirements

5.1 Physical characteristics

5.1.1 Recreational water bodies and adjacent areas should be free of physical hazards, such as floating or submerged objects, or other exposed objects that may lead to injury. Wave action, swirls and currents also pose a risk to safety and should be considered. Where permanent hazards exist, for example, rips and sandbars or artificial objects (such as moorings and wrecks) appropriate warning signs should be clearly displayed.

5.1.2 Where there is multi-use of a water body such as for bathing, boating, skiing, etc., there should be clearly demarcated areas for bathing and other activities.

5.1.3 Areas adjacent to water bodies such as beaches or river banks should also be reasonably free of litter and other solid contaminating material and residues of oil, grease and other such material.

5.1.2 Water temperature

5.1.2.1 Maximum limits

The temperature of natural waters is an important factor governing the character and extent of recreational activities, primarily in the warmer months. Scientific evidence suggests that prolonged immersion in water warmer than 34ºC to 35°C is hazardous to humans.

NOTE 1 The degree of hazard varies with the water temperature, immersion time and the metabolic rate of the swimmer.

NOTE 2 Water ranging in temperature from 26 ºC to 30 °C is comfortable for most swimmers throughout prolonged periods of moderate physical exertion.

5.2 Aesthetic aspects

5.2.1 Recreational water bodies should be aesthetically acceptable to recreational users.

5.2.2 The water should be free from visible materials that may settle to form objectionable deposits:

a) floating debris;

b) oil, scum and other matter;

c) substances producing objectionable colour, odour, taste or turbidity; and

d) substances and conditions or combinations thereof that produce undesirable aquatic life.

5.2.3 Various aesthetic components of the aquatic ecosystem and surrounding land should be present, for example, trees, other plants, birds, mammals, fish, and insects all play a role in the natural beauty of a recreational area.

5.2.4. Turbidity

Maximum limits

A limit of 50 Nephelometric Turbidity Units (NTU) is suggested.

5.2.4.2 Colour

Maximum limits

An objective for the colour of recreational water largely depends on the preferences of users, and is difficult to quantify. However, it is desirable that the colour of recreational waters shall not be:

a) so intense or so dark as to impede users in estimating depth, seeing subsurface hazards easily and, for people concerned with their safety, in detecting users in difficulty; and

b) altered by anthropogenic activities.

5.2.4.3 Oil and grease

Maximum limits
Oil or petrochemicals should not be present in concentrations that:

a) can be detected as a visible film, sheen, or discoloration on the surface;

b) can be detected by odour;

c) can form deposits on shorelines and bottom sediments that are detectable by sight or odour.

5.2.4.4 Odour

Recreational water, whether riverine, estuarine or coastal and its surroundings beach users, can be subjected to objectionable smells associated with sewage effluent, decaying organic matter such as vegetation, dead animals or fish, and discharged diesel oil or petrol.

Odour thresholds and their association with concentrations of different pollutants in the recreational water environment have not been determined. The presence of dissolved oxygen in the water body will be important in preventing the formation of undesirable amounts of odorous hydrogen sulphide.

Objectionable odours shall not be detected in recreational water and its surroundings.

5.2.4.5 Litter

A variety of litter types may end up in recreational waters and the surroundings. The sources of such litter may be riverine (including torrents), storm-water run-off or marine and material discarded by users of the recreational water area.

Recreational water and its surroundings should be reasonably free of litter. An assessment of the likely source of litter should be undertaken and programmes established to control litter from source.

There should be bins for disposal of litter in designated recreational water areas.

NOTE Although not litter, large accumulations of seaweed and algae are likely to be an aesthetic problem (both in visual impact and odour). If associated with flying or biting insects such accumulations may also be a nuisance.

5.3 Chemical Characteristics

5.3.1 Chemical contaminants can enter surface waters or be deposited on-shore from both natural and anthropogenic sources. These may be either point sources, such as an industrial outfall or a natural spring, or non-point (diffuse) sources, such as runoff from land. In most cases, there will be significant dilution or attenuation of contaminants, depending on circumstances. In all cases, chemical contamination must be assessed on a local basis.

5.3.2 Assessment of exposure to chemicals

5.3.2.1 In general, the potential risks from chemical contamination of recreational waters will be very much smaller than the potential risk from other hazards, apart from toxins produced by marine and freshwater cyanobacteria and algae or other exceptional circumstances. It is unlikely that recreational water users will come into contact with sufficiently high concentrations of most contaminants to suffer adverse effects from a single exposure. Even repeated (chronic) exposure is unlikely to result in adverse effects at the concentrations of contaminants typically found in water and with the exposure patterns of most recreational water users.

However, it remains important to ensure that chemical hazards and any potential human health risks associated with them are recognised and controlled and that users can be reassured about their personal safety.

5.3.2.2 For recreational water users, the dangers of chemical contamination will depend on the particular circumstances of the local area. Where a water body used for recreational purposes receives significant wastewater discharges, its chemical composition and dilution or dispersion should be taken into consideration.

5.3.2.3 The potential for chemical contamination of groundwater in urban areas and subsequently impact on recreational waterways should be considered when investigating the sources or risks of chemical hazards occurring in recreational waters.

5.3.2.4 Exposure is a key issue in determining the risk of toxic effects from chemicals in recreational waters and this varies with different recreational activities. The frequency, extent and likelihood of exposure are crucial parts of assessing the risk from a contaminant. Routes of exposure are outlined in Table 2.

Table 2 – Routes of exposure of chemicals

Routes of Exposure	Comments

Direct surface contact	The most frequent routes are absorption through skin, eyes and mucous membranes. Wetsuits, used for long periods in the water, trap water against the skin and can enhance the absorption of chemicals through the skin and the development of skin irritation or allergy.
Inhalation	Inhalation is important in circumstances where there is a significant amount of spray, such as in waterskiing.
Ingestion	Ingestion is likely during immersion or partial immersion activities. Very young children are likely to ingest proportionally greater amounts of water than adults when bathing, swimming or playing in the water. However, data on the quantities of water ingested during water sports are difficult to obtain.
NOTE Many substances of concern have low solubility in water and may accumulate in sediments. This is of concern if the sediment is disturbed and re-suspended or if recreational users are in close contact with the sediment. However, in general, this is likely to make only a minor contribution to overall exposure.	

5.3.3 Qualitative assessment of chemical contaminants in recreational water

5.3.3.1 There should be an inspection of the recreational water area which will reveal any obvious sources of chemical contamination, such as outfalls. These are a problem if they are easily accessible or if the effluent does not receive immediate and significant dilution.

Information on past industrial activity in the area and upstream will indicate the likely presence of contaminated sediments. It will also identify possible contamination.

5.3.3.2 Site inspection of industrial facilities should be considered to monitor discharges. Elements to be noted in a site inspection are:

a) amounts of chemicals used and their uses in industrial processes;

b) water use and the quantity used;

c) sanitary conditions of the facility, including the condition of the floor; and

d) effectiveness of wastewater treatment processes.

NOTE 1 Useful sources of information on chemicals likely to be present within a catchment are outlined in Annex C.

NOTE 2 In general, significant contamination by naturally occurring contaminants is less likely than contamination by industrial, agricultural and community/local pollution but there may be circumstances where small recreational water bodies containing water from mineral-rich strata could contain high concentrations of some substances. Such waters, however, are more likely to contain metals, such as iron, that may give rise to aesthetic degradation of the water.

5.3.3.4 The pattern and type of recreational use of the water need to be carefully considered to determine the degree of recreational users' contact with the water and whether there is a significant risk of ingestion.

5.3.4 Quantitative assessment of chemical contaminants in recreational water

5.3.4.1 If it is probable that contamination is occurring and there is significant exposure of users, chemical analysis will be required to support a quantitative risk assessment. Care should be taken in designing the sampling programme to account for variations in time and water movement.

5.3.4.2 The quantitative risk assessment should consider the expected exposure in terms both of dose and of frequency of exposure.

5.3.4.3. The basis for any guidelines or standard considered necessary should be transparent to prevent occasional or trivial exceedances from unnecessarily undermining users' confidence.

5.3.5 Measures of chemical quality of recreational water

The following measures of chemical quality of recreational water listed below should be considered:

5.3.5.1 pH

Both alkaline and acidic waters may cause eye irritation. Consequently, the pH of the waters used for total body contact recreation should be in the pH range of 6.5 to 8.5. If the water has a very low buffering capacity, pH values from 5.0 to 9.0 should be acceptable.

5.3.5.2 Dissolved oxygen

Dissolved oxygen will not have a direct effect on users, but it will influence microbial activity and the chemical oxidation state of various metals, such as iron. Low oxygen concentrations allow the growth of nuisance organisms causing taste and odour problems and also result in the formation of undesirable amounts of hydrogen sulphide. These factors are not a human health concern but may give rise to aesthetic issues.

Recreational water should have dissolved oxygen content greater than 80%.

5.3.5.3 Nitrates

Recreational waters shall not exceed a nitrate/nitrite content of 9.8µg N/l.

NOTE The mass of the nitrogen in a litre rather than the mass of the atoms to which they are attached e.g. oxygen in nitrates.

5.3.5.4 Phosphates (Filterable reactive)

Recreational waters shall not exceed a phosphate content of 2.48µg P/l.

NOTE The mass of the phosphorous in a litre rather than the mass of the atoms to which they are attached, e.g. oxygen in phosphates.

5.3.5.5 Total nitrogen (inorganic and organic)

Recreational waters shall not exceed total nitrogen content of 100µg/l.

5.3.5.6 Total phosphorous (inorganic and organic)

Recreational waters shall not exceed a total phosphorous content of 15µg/l.

5.3.5.7 Chemical contaminants

The requirements for chemical contaminants in recreational waters should be addressed as follows.

a) **Guideline values**

There are no specific rules that can easily be applied to calculate guideline values for chemical contaminants in recreational waters. It is noted however, that the WHO Guidelines for Drinking-water Quality (WHO, 1998, 2006) can provide a starting point for deriving values that could be used to make a screening level risk assessment under specific circumstances.

It is further recommended that a simple screening approach be that a substance occurring in recreational water at a concentration ten times that stipulated in the WHO Guidelines for Drinking Water – WHO, 1998, 2006 – may merit further consideration.

b) **Inorganic contaminants**

Most recreational exposure to inorganic contaminants will be by ingestion, with dermal contact and inhalation contributing little to exposure. Screening values for the ingestion of inorganic contaminants in recreational waters can be calculated from the WHO *Guidelines for Drinking-water Quality* (WHO, 1998, 2006). However, if the corresponding value for a particular inorganic contaminant is exceeded, this does not necessarily imply that a problem exists. A specific evaluation of the contaminant should be undertaken, taking into consideration local circumstances and conditions of the recreational water area. These could include, for example:

1) the characteristics of the typical recreational water user;
2) the degree of water contact of the recreational water activities carried out;
3) effects of winds/currents/tides on contaminant concentration; and
4) the chemical form of the inorganic contaminant.

c) **Organic contaminants**
There are many organic contaminants that can be present in surface waters as a consequence of industrial and agricultural activity. Many of these substances will primarily be associated with sediments and particulate matter. Skin absorption from contact with sediment is a possibility but for most recreational purposes, the extent of contact is likely to be small. However, consideration should be given to the likelihood of sediment being disturbed and the possibility of ingestion by some groups, such as infants and small children.

NOTE Some small chlorinated molecules, for example chloroform or tri- and tetrachloroethene, and hydrocarbons, for example toluene have been shown to be absorbed through skin from water.

As with inorganic contaminants, the WHO *Guidelines for Drinking-water Quality* (WHO,1998, 2006) can be used as a basis for screening the potential risk from specific organic chemicals.

NOTE A list of chemicals of interest is given in Annex E.

5.3.6 Management of chemicals

5.3.6.1 When potential sources of contamination are known to exist upstream of the recreational area, further tests should be required and a quantitative risk assessment implemented. Management strategies should focus on catchment protection. For example, planning should address:

a) the prevention or reduction of existing or future nitrogen pollution from agricultural sources through safer storage and spreading of animal manure and fertilisers, to prevent eutrophication in seas, rivers and lakes; and

b) improved protection of soils against erosion through codes of good practice and action programmes.

5.3.6.2 The guideline values provided in Annex D are directly applicable to drinking water quality and should only be regarded as an initial guide to the quality of recreational water. Local circumstances should be taken into consideration in determining the best action based on the status of recreational water, or in assessing priorities for action, including monitoring.

5.3.7 Monitoring of chemicals

Monitoring for chemicals should focus only on those of concern in the water body. While regular monitoring for a large number of chemical contaminants may not be justified, there may be instances where local knowledge or accidental spills justify increased surveillance.

In areas where pesticides are used, monitoring should take into consideration those chemicals being used to ensure that management practices address all potential chemical contaminants in recreational water. Sediments often concentrate chemical

contaminants and should be included in the monitoring process because contact in shallow water is likely.

Monitoring of priority chemicals or indicators of chemical contamination should be more frequent for water from unprotected or partially protected catchments, or water that may be contaminated with industrial discharges or effluent, compared to water from protected catchments. The analyses required will be determined by knowledge of the potential contaminants.

5.4 Microbial quality

5.4.1 Recreational waters may be contaminated by direct human contact and by waterborne pollutants from external sources including sewage, storm water and agricultural runoff). Preventive risk management practices should be adopted to ensure that designated recreational waters are protected against direct contamination with fresh faecal material, particularly of human or domesticated animal origin.

To categorise recreational water by its microbial quality, a combination of sanitary inspection and microbial water-quality assessment shall be used as it provides information on possible sources of pollution and numerical data on the likely level of faecal pollution. It should involve the following steps:

a) initial assessment of the water quality of the water body and sanitary status, including source waters;

b) definition of categorisation and audit parameters for major environmental conditions likely to be encountered and the trigger values by which different conditions are distinguished;

c) classification of overall suitability according to intended use and scale of use;

d) definition of access restrictions by environmental conditions;

e) ongoing management, involving:

   1) periodic sanitary survey and water-quality auditing to ensure that the suitability classification is valid;
   2) frequent activities in sanitary assurance and reactive management to ensure that the access allowed is appropriate to the current environmental conditions or to alter the access status in response to changes in environmental conditions (where improved conditions are desirable);

   3) proactive management to upgrade the water body's suitability classification (or classification system) and to assess the appropriateness of changes in suitability classification; and

4) management support activities, such as data management and development of sanitary survey and complaints response systems.

The results of the categorisation based on sanitary inspection and microbial water quality assessment should be used to:

a) classify water bodies in order to support informed personal choice;

b) provide on-site guidance to users on relative microbial safety;

c) assist in the identification and promotion of effective management interventions; and

d) provide a basis for regulatory requirements and an assessment of compliance with them.

5.4.2 Indicator organisms for fresh and marine waters

5.4.2.1 The best indicators of the presence of enteric pathogens in faecal pollution sources should have the following properties:

a) be present in faecal-contaminated waters when enteric pathogens are present but in greater numbers;

b) be incapable of growth in the aquatic environment but capable of surviving longer than pathogens;

c) be equally or more resistant to disinfection than pathogens;

d) be easily and accurately enumerated;

e) be applicable to all types of natural recreational waters;

EXAMPLE Fresh, estuarine, and marine.

f) be absent from non-polluted waters and exclusively associated with animal and human faecal wastes;

g) density of indicator should be directly correlated with the degree of faecal contamination;

h) density of indicator should be quantitatively related to swimming associated illnesses.

Escherichia coli, enterococci, and, to a lesser degree, faecal coliforms are currently considered the best faecal indicators. Maximum acceptable concentrations of these indicator organisms are provided below.

NOTE The presence of *Streptococcus iniae* which is a good indicator of fish health should be considered for environmental and aesthetic reasons.

5.4.2.2 Indicator organisms for fresh waters

5.4.2.2.1 *Escherichia coli* and faecal coliforms

Maximum Limits
The geometric mean of at least 5 samples, taken during a period not to exceed 30 days, should not exceed 2000 *E. coli*/L (200 E.coli/100mL). Re-sampling should be performed when any sample exceeds 4000 *E. coli*/L (400 E.coli/100mL).

When previous analyses have shown that more than 90 per cent of the faecal coliforms are *E. coli*, either faecal coliform or *E. coli* may be determined. When less than 90 percent of the faecal coliforms are *E. coli*, only *E. coli* shall be determined.

5.4.2.3 Indicator organisms for marine waters

5.4.2.3.1 Enterococci

Maximum limits
The geometric mean of at least five samples, taken during a period not to exceed 30 days, should not exceed 350 enterococci/L (35 enteroccocci/100 mL). Resampling should be performed when any sample exceeds 700 enterococci/L. However, if it can be demonstrated that *E. coli* or faecal coliforms can adequately demonstrate the presence of faecal contamination in marine waters, then the *E. coli* or faecal coliform maximum limit for fresh waters may be used. If there is any doubt, samples should be examined for both sets of indicators for extended periods to determine if a positive relationship exists.

5.4.3 Coliphages

Bacteriophages are virus-like entities that invade bacterial cells. Coliphage is the general name applied to bacteriophages that attack bacteria of the coliform group.

No limits on coliphages have been established at this time. Monitoring and epidemiological studies are required to determine the levels of coliphages in water and the health effects associated with swimming in water containing coliphages.

5.4.4 Pathogenic organisms

Pathogens may also be present in recreational water and its surroundings such as beach sand.

The routine monitoring of recreational waters for pathogens is not recommended. Analysis for particular pathogens should be carried out based on epidemiological or other evidence of their presence. An environmental health assessment should also be carried out in conjunction with sampling as part of the investigation to identify the source.

Attention should be paid to the following pathogens:

5.4.4.1 *Pseudomonas aeruginosa*

Levels of *P. aeruginosa* are influenced by sewage or urban drainage sources. *Pseudomonas aeruginosa* is typically isolated from fresh recreational waters in low numbers. The levels of *P. aeruginosa* in a bathing area are influenced by density of bathers, especially individuals that are infected with *P. aeruginosa* or are carriers.

Maximum limits
No numerical limit is proposed. However, it is recommended that *Pseudomonas aeruginosa* be used as a parameter to assist in interpreting the results of sanitary and microbiological surveys.

5.4.4.2 *Staphylococcus aureus*

Staphylococcus aureus is responsible for boils, ear infections, and other purulent infections. There may be a relationship between bather numbers and staphylococci levels in the water,

Maximum limits
No limits are specified for *Staphylococcus aureus*. Sampling for this pathogen should be carried out when there is epidemiological or other evidence of its presence in the water or in order to assess the hazards of excessive utilization of the water with possible person-to-person transfer of pathogens.

5.4.4.3 *Salmonella*

Maximum Limits
No limit is proposed for *Salmonella* concentrations in recreational waters. Instead, it is recommended that *Salmonella* should be used as a parameter to assist regulatory agencies in interpreting the results of sanitary and microbiological surveys and in determining the health risk involved in using waters for recreation. Because virtually all *Salmonella* species are pathogenic, a health hazard exists when *Salmonella* can be consistently isolated from a bathing area.

5.4.4.4 Shigella

Maximum limits
Shigella can be considered as a support parameter to aid regulatory agencies in determining the health risk involved in using waters for recreation.

No maximum limits are specified for *Shigella* in bathing areas. Sampling for these organisms in waters used for recreation should be carried out when there is epidemiological or other evidence of their presence in the water or in order to assess the hazards of excessive utilization of the water with possible person-to-person transfer of pathogens. A health hazard exists if these organisms can be consistently isolated

from a bathing area.

NOTE The methods for the isolation of *Shigella* have not been standardized, and routine enumeration is not practical.

5.4.4.5 *Aeromonas*

As water appears to be the natural habitat of *Aeromonas*, this organism should not be used as an indicator of faecal pollution or as a sanitary indicator for bathing areas. *Aeromonas* may be pathogenic, but sampling of recreational water should be considered for epidemiological investigations only.

Maximum limits
No maximum limit has been proposed for ***Aeromonas*** in bathing areas.

5.4.4.6 *Campylobacter jejuni*

Water is potentially an important reservoir of the thermophilic *Campylobacter* and is an established vehicle for the transmission of *Campylobacter* to man and domestic animals. The use of a standard indicator of faecal pollution should be helpful in determining potential health hazards related to *Campylobacter* spp. as well as other bacterial intestinal pathogens.

Maximum limits
No limits are specified for *Campylobacter jejuni* in recreational waters. Sampling for this pathogen should be conducted when there is epidemiological or other evidence of its presence in the water. Sampling should also be considered to assess the hazards of excessive utilization of the water with possible person-to-person transfer of pathogens.

5.4.4.7 Viruses

Viruses are known to be pathogenic in low numbers. Concentration and enumeration steps are too detailed to make routine monitoring practical.

Maximum limits
No limits are specified for viruses in recreational waters. Sampling for viruses should be conducted when there is epidemiological or other evidence of their presence in the water or in order to assess the hazards of excessive utilization of the water with possible person-to-person transfer of pathogens.

5.4.4.8 Toxic phytoplankton

Phytoplankton can become a hazard and a nuisance in recreational waters, especially when they concentrate at the water surface in blooms either as a result of a natural phenomenon or through cultural eutrophication. The presence of certain species in a freshwater community, usually blue-green algae, is often a sensitive indicator of recreational water quality.

Maximum limits
No limits are specified for toxic phytoplankton in recreational waters. However, water containing a blue-green or turquoise scum is indicative of an algal bloom. Such waters should be avoided because of reduced clarity and the possible presence of algal toxins.

Sampling recreational waters for toxic phytoplankton should be considered only for epidemiological investigations.

5.4.4.9 Protozoa

A large number of pathogenic parasites can occur in the aquatic environment. Of potential importance are two protozoa (*Giardia and Cryptosporidium*), and one helminth (*Schistosoma*).

Giardia is one of the most common pathogenic intestinal protozoans. The ingestion of a few (10 to 100) viable cysts can cause a diarrheal illness (giardiasis). Transmission can be from person to person or via food or water. *Giardia* are more resistant to chlorination than indicator organisms, pathogenic bacteria and viruses.

Cryptosporidium, a newly recognized pathogenic protozoan, may be as important as *Giardia*. The ingestion of low levels of viable oocysts can also result in a diarrheal illness known as cryptosporidiosis. Like *Giardia, Cryptosporidium* can also be transmitted from person to person or via food or water and like Giardia is resistant to chlorination.

Schistosoma spp. are digenetic trematodes (also known as flukes or flatworms). The larvae (cercariae), released in water by infected aquatic snails, must enter the skin of a susceptible host to complete their life cycle.

Prevention of schistosomiasis can be assured only by complete avoidance of aquatic sports in areas where the disease has been a problem. An acceptable alternative might be the elimination of the molluscan hosts, using approved molluscicides.

Maximum limits
No limits are specified for pathogenic protozoa in recreational waters.

5.5 Dangerous aquatic organisms

Recreational water bodies should be reasonably free of, or protected from, venomous organisms such as jelly fish, sea urchins, sponges. Where risks associated with dangerous aquatic organisms are known, appropriate warning signs should be clearly displayed.

5.6 Nuisance factors

5.6.1 The bathing area should be as free as possible from nuisance organisms that could affect swimmers. It is impossible to have natural areas "free" from nuisance organisms, so no limits can be quantified.

Recreational areas should not be developed if there is an excessive growth of aquatic plants where entanglement could occur, thus causing a hazard to water-related recreational activities. Measures should be taken to remove the plants from areas used for swimming.

5.6.2 The presence of horses on beaches presents a risk of physical injury, and poses a health hazard with regard beach/sand/sediment microbial contamination from faecal matter. Local legislation pertaining to the presence of horses on beaches shall apply.

5.6.3 The presence of dogs in recreational water areas including beaches or surroundings of freshwater bodies poses a risk to human health if contact is made with animal excreta. There should be restricted access for dogs in recreational water areas or owners should be obligated to remove such excreta. The public shall also be made aware of the threat posed to human health by dogs.

5.6.4 Other nuisance organisms

Some plant and animal species could be a nuisance to fresh, estuarine or costal recreational water users if present in large numbers and should be absent from areas intended for development as recreational waters, areas or beaches.

EXAMPLE Mussels, biting insects, floating or rooted aquatic plants, phytoplankton, and growths such as sewage fungus.

Consideration should be given to the presence of large numbers of midges and aquatic worms, which can tolerate polluted, especially organically enriched conditions as caused by sewage for example. This would indicate that the water quality was probably not good enough for recreational use.

6 Microbial sampling and analysis

The sampling and analytical methods described are typical and are adapted from the Guidelines for Canadian Recreational Water Quality.

The Chief Medical Health Officer or other appropriate national authority in accordance with the existing legislation shall initiate sampling and analysis activities.

6.1 Sampling

In recreational water quality investigations, sampling should provide aliquots that are representative of the microbiological properties of the area. Sampling should be conducted:

a) during peak bathing season, the rainy season when runoff is at its peak and the dry season when concentrations of contaminants in effluents may increase due to decreased volume of the riverine receiving waters; and

b) when recreational waters are suspected as a source of waterborne disease.

NOTE Regular sampling may not be necessary as historical data, combined with an annual environmental health assessment, may indicate that only occasional sampling is necessary. However, if a deterioration of water quality has occurred, then routine monitoring of the area should be carried out. Such an approach will allow health officials to concentrate their resources on beaches of questionable quality.

6.1.1 Sampling locations

Most bodies of water used for recreational purposes frequently lack homogeneity with respect to their microbiological properties, thus making multi-point sampling necessary. The sites should be selected on the basis of information gathered during the environmental health assessment. The sites chosen should be representative of the water quality throughout the whole bather exposure area. The selection of sites should pay particular attention to site-specific conditions that may influence the levels and distribution of indicator organisms and pathogens.

The sampling sites should include points of greatest bather activity as well as peripheral points subject to external faecal pollution. Natural or artificial streams discharging storm water and sewage can give certain sections of a body of water very different microbiological qualities from the body at large. The degree of heterogeneity can also be affected by rainfall, wind velocity and direction, and tides. In larger bodies, the contribution of local events is somewhat diminished by the large volumes of water involved.

The collection of subsurface samples at wading depth should be considered where the water has been stirred up either by bather activity or by the person collecting the sample.

6.1.2 Frequency of sampling

Samples should be collected at random intervals and at times of greatest user activity as well as at times when maximum faecal contamination can be expected.

EXAMPLE Periods of storm water runoff and high onshore winds that upwell bottom sediments.

If concentrations of faecal indicator bacteria fluctuate cyclically, for example effluent discharges at regular intervals or tidal variations, then samples should be collected during all phases of the cycle in addition to periods of high bather density.

The minimum recommended sampling frequency for each season (wet and dry), for routine investigations is five samples in not more than 30 days from each sampling

location. At beaches with higher bather densities or at those known to have poor water quality, or in cases of suspected waterborne diseases associated with bathing, then the sampling frequency should be increased.

Occasional sampling should be adequate in areas that historically have had acceptable water quality. However, if information gathered prior to the bathing season indicates that the water quality may have deteriorated, then routine monitoring should be initiated.

When analyses indicate that a single sample contains more than 4000 *Escherichia coli* or faecal coliforms/L or more than 700 enterococci/L, resampling of the area is required. The number of samples collected and their location should be sufficient to indicate the possible sources of contamination.

6.1.3 Sampling procedures for water

Samples for microbiological examination should be collected in sterile, 200 mL to 500mL environmental sensitive containers. When sampling is done by hand, the bottle should be held near the base with one hand, the cap removed, and the bottle mouth plunged downward into the water. The bottle is tilted slightly upward to displace the air, then pushed forward against the current away from the hand and/or sampling platform (if used) to avoid contamination.

The sampling depth should be 15 cm to 30 cm below the surface in both deep and shallow waters. When collecting is done with a sampling pole, the bottle should be fitted into the holder in the recommended manner, the cover removed, and the sample collected, upstream away from the collector, by simulating the scooping motion of the hand-collected sample.

With either method, a small amount of sample should be poured out, leaving an airspace to allow for proper mixing prior to analysis. The cap should be replaced and the bottle labelled and stored in an ice chest. The samples must be collected and processed individually. Composite samples are not acceptable.

6.1.4 Sampling procedures for sediments

When evidence indicates that bathing beaches could be the source of waterborne diseases among bathers, sediment sampling and analysis for suspected pathogens are also recommended. Many investigations have demonstrated that pollution indicator bacteria and pathogenic bacteria survive for extended periods in sediments.

Sediment samples should be collected using sterile, 250mL to 500mL wide-mouth jars, observing the same precautions used with water sampling to ensure aseptic collection. In shallow waters, the jars are pushed along the bottom, collecting the material at the sediment-water interface, until half full. The excess water is poured off, and the sample is stored as described above. In deeper waters, sediment samplers used for collecting benthic invertebrates can also be used. When sediments are brought to the surface, a

sub-sample is aseptically transferred from the centre of the material to the sterile jar.

6.1.5 Sample preservation and storage

Water and sediment samples should be maintained at 1ºC to 5°C and processed ideally within 6 to 24 hours after collection. For transport to the laboratory, the sample bottles should be placed in an insulated ice chest containing melting ice or freezer packs. To prevent the possibility of contamination, total immersion of the bottles in the water should be avoided. The samples should never be frozen. If freezer packs are used, the samples should be protected from direct contact to avoid freezing. Storage in the dark under these conditions (or at 4ºC to 5°C in a refrigerator) minimizes die-off and multiplication for at least 24 hours after collection.

6.2 Methods for microbiological analysis

6.2.1 *Escherichia coli* and faecal coliforms

The 21st edition of Standard Methods for the Examination of Water and Wastewater (American Public Health Association, 2005) contains two official methods for the determination of faecal coliforms: the multiple tube fermentation or most probable number (MPN) procedure, and the membrane filtration (MF) technique.

6.2.2 Enterococci

Enterococci in marine and freshwater recreational areas are usually enumerated by the MF technique described by the U.S. Environmental Protection Agency (1985). Highly turbid waters and those directly influenced by chlorinated sewage should be examined by an MPN method, using azide dextrose broth followed by confirmation with Pfizer selective enterococcus agar (American Public Health Association 1989).

6.2.3 *Pseudomonas aeruginosa*

A variety of enumeration procedures for *Pseudomonas aeruginosa* in natural waters is available. An MF technique and medium (mPA), that is more efficient and accurate than the MPN methods in use, have been described. However, if turbid waters or sediments are examined, the MPN method must be employed. This procedure requires extended incubation periods and confirmation of presumptive positive tubes.

6.2.4 *Staphylococcus aureus*

The American Public Health Association (2005) lists a MPN method for enumeration of *Staphylococcus aureus* from waters. An MF technique designed to count *S. aureus* in swimming pools was also found useful for recreational waters.

6.2.5 *Salmonella and Shigella*

Many methods are available for the isolation of *Salmonella and Shigella* from water and sediments using concentration and enrichment techniques followed by identification

procedures or detection by fluorescent antibody techniques (Environment Canada 1978; American Public Health Association 2005). MPN and MF techniques for the quantitative determination of *Salmonella* have also been described (American Public Health Association, 2005).

6.2.6 *Aeromonas*

Many media and methods have been proposed for the isolation and enumeration of aeromonas. The methods presented in the Standard Methods for the Examination of Water and Wastewater, 21 edition, 2005 represent a compromise. MPN and MF methods of enumeration are described.

6.2.7 *Campylobacter jejuni*

Water collection, isolation and identification procedures are described in Standard Methods for the Examination of Water and Wastewater, 21st edition, 2005.

6.2.8 Viruses and coliphages

The development of methods for the concentration of viruses from large volumes of water (Wallis *et al*. 1972; Payment *et al*. 1976; Sobsey *et al*. 1980; Gerba and Goyal 1982; Block and Schwartzbrod 1982; Gerba 1983; Payment and Trudel 1988) and their detection by highly sensitive methods (Payment and Trudel 1985; Margolin *et al*. 1986) now allow the virological analysis of surface waters. The methodology for concentration and isolation of viruses in large volumes of water has been standardized to some extent (American Public Health Association 1989), so that monitoring of recreational waters is possible if epidemiological data indicate a need.

There are now available some rather simple, quick, and inexpensive procedures for the monitoring of coliphages and bacteriophages in water. One of the most sensitive procedures for enumerating coliphages from water or effluents is described in Standard Methods for the Examination of Water and Wastewater (American Public Health Association 2005) using *E. coli* (ATCC 13706) as host.

6.2.9 Toxic phytoplankton

The presence of potentially toxic blue-green species can be determined microscopically, but this technique cannot distinguish toxic from non-toxic strains because the strains look alike. Rapid chemical analyses using reversed-phase, high performance liquid chromatography (Harada *et al*. 1988), HPLC and internal surface reverse-phase columns (Meriluoto and Eriksson 1988) and high performance, thin-layer chromatography (Jamel Al-Layl *et al*. 1988) have been proposed, for toxins that affect the liver from *Microcystis aeruginosa* and *Anabaena flos-aquae* to replace the previous, more time- consuming methodology using gel filtration (Krishnamurthy *et al*. 1986).

The standard mouse bioassay (Bishop *et al*. 1959; Elleman *et al*. 1978) provides a rapid general assessment of the presence and toxicity of hepatotoxins.

7 Designation of recreational waters

7.1 A body of water and its surroundings whether, riverine, estuarine or coastal may be designated as a recreational water body further classified for primary, secondary or passive recreational use based on the criteria set out below in Table 3.

Table 3 - Recreational Use Class and parameter importance

Factor/parameter	Recreational Use Class			Comment
	Primary	Secondary	Passive	
Physical characteristics				
Free of physical hazards in and around water	Major	Major	Major	Signage for permanent physical hazards
Considers wave action, swirls, currents, etc	Major	Minor		
Temperature	Minor			Warning for Sulphur Springs
Demarcated areas for bathing and other such activities	Major			
Aesthetic Aspects				
Colour	Major	Major	Major	
Turbidity	Major	Major	Major	
Oil & grease	Major	Major	Major	
Odour	Major	Major	Major	
Litter	Major	Major	Major	
Chemical				
pH	Major	Minor		
Dissolved oxygen	Major	Major	Major	
Chemical contaminants	Major	Major	Major	Specifics needed for marinas industry agrochemicals metals pesticides
Organic and inorganic	Minor			
Phosphates & Nitrates	Major	Major	Major	
Pesticides	Major			
Other				
Microbial Quality	Major	Major	Major	
Dangerous Aquatic Organisms	Major	Major		Signage as needed
Nuisance Factors	Major	Major	Major	

7.2 When the appropriate national authority has determined that a beach or body of water is not suitable for recreational use, the public should be notified. Normally this involves placing one or more signs in conspicuous places along the beach or

shoreline. These signs should be clear and concise as to the health risk and recommended course of action. They should be written in simple understandable text and symbols. The national authority making the determination should be clearly indicated on the signs. The signs should be left in place only as long as necessary and promptly removed when the health hazard no longer exists.

Annex A
(Informative)

Summary of parameters and limits

Table A.1 – Summary of Parameters and Limits

Parameter	Limits	Comments
PYHSICAL CHARACTERISTICS	▪ Free of physical hazards in and around water; ▪ Surroundings reasonably free of litter, and other contaminating material such as oil, etc	
	Demarcation of bathing and other areas	Necessary in multi-use areas
Temperature	26 -30 °C	
AESTHETIC ASPECTS		
▪ floating debris; ▪ oil, scum and other matter; ▪ substances producing objectionable colour, odour, taste or turbidity; and ▪ substances and conditions or combinations thereof that produce undesirable aquatic life	Not visible	
Colour	Not intense to impede visibility for swimming	
Turbidity	Suggested 50 NTU	
Oil & grease	Not detected as film, sheen or discoloration or by odour on surface, and not detected by sight or odour on shorelines, river banks and sediments	For both fresh and costal areas
Odour	Not detectable	
Litter	Reasonably free	
CHEMICAL CHARACTERITICS	In general assessed on a case by case basis	
pH	▪ 6.5-8.5 ▪ 5.0-9.0 (for water with low buffering capacity	

Parameter	Limits	Comments
Dissolved oxygen	> 80%	
Nitrates	2.48 (µg P/l) [1]	
Phosphates	9.8 (µg N/l) [2]	
Total nitrogen (organic and inorganic)	100 µg/l	
Total phosphorous (organic and inorganic)	15 µg/l	
Pesticides, insecticides, herbicides, fungicides	No limits set	Assessed on a case by case basis using *WHO Guidelines for Drinking-water Quality* as a guide
Other inorganic and organic contaminants	No limits set	Assessed on a case by case basis using *WHO Guidelines for Drinking-water Quality* as a guide
MICROBIAL QUALITY	Ensure that designated recreational waters are protected against direct contamination with fresh faecal material, particularly of human or domesticated animal origin.	Use of risk management practices
Escherichia coli and faecal coliforms	Geometric mean of at least 5 samples, taken during a period not to exceed 30 days, should not exceed 2000 ***E. coli***L(200 E.coli/100mL)**.**	For fresh waters
Enterococci	The geometric mean of at least five samples, taken during a period not to exceed 30 days, should not exceed 350 enterococci/L (35 enteroccocci/100mL).	For marine waters
Coliphages	No limits set	Monitoring and epidemiological studies required to determine health effects
Pseudomonas aeruginosa	No limits set	Parameter to assist in interpreting the results of sanitary and microbiological surveys.
Staphylococcus aureus	No limits set	Sampling done if there is epidemiological or other evidence of its presence
Salmonella	No limits set	Used as a parameter to

Parameter	Limits	Comments
		assist in interpreting the results of sanitary and microbiological surveys; health hazard exists when ***Salmonella*** can be consistently isolated from a bathing area.
Shigella	No limits set	Health hazard exists if these organisms can be consistently isolated from a bathing area.
Aeromonas	No limits set	Sampling of recreational water should be considered for epidemiological investigations only.
Campylobacter jejuni	No limits set	Sampling for this pathogen should be conducted when there is epidemiological or other evidence of its presence in the water.
Viruses	No limits set	Sampling for viruses should be conducted when there is epidemiological or other evidence of their presence in the water or in order to assess the hazards of excessive utilization of the water
Toxic phytoplankton	No limits set	Blue-green or turquoise scum is indicative of an algal bloom and water should not be used. Sampling only for epidemiological investigations.
DANGEROUS AQUATIC ORGANISMS	Reasonably free of, or protected from,	Appropriate warning signs where risks are known
NUISANCE FACTORS	Reasonably free from nuisance organisms	
Horses	No limits	Local legislation shall apply
Dogs	Restricted access	Owner 'obligations' and education on health risks
Other nuisance organisms (midges, aquatic worms,	Absent from areas intended for development as recreational	Presence indicates that the water quality was probably

Parameter	Limits	Comments
etc)	waters/areas/beaches.	not good enough for recreational use.

NOTE 1 The mass of the nitrogen in a litre rather than the mass of the atoms to which they are attached e.g. oxygen in nitrates.

NOTE 2 The mass of the phosphorous in a litre rather than the mass of the atoms to which they are attached, e.g. oxygen in phosphates.

Annex B
(Informative)

Recreational Water/Area Environmental Health Assessment

B.1 General information

B.1.1 Site _____
B.1.2 Body of Water _____

B.1.3 Type of Water: Fresh _____
B.1.4 Coastal/Marine_____
B.1.5 Estuarine_____
B.1.6 Location _____
B.1.7 Owner/Operator _____
B.1.8 Address _____
B.1.8 Phone _____

B.2 Microbiological hazards

As appropriate, consult with Public Health, Environment, and/or Agriculture Departments.

B.2.1 Sewage	**Y**	**N**
Is the water quality likely to be affected by discharges from:		
a) private on-site sewage disposal systems?	___	___
b) communal sewage treatment facilities?	___	___
c) agricultural activities?	___	___

B.2.2 Storm water runoff	**Y**	**N**
Is the water quality likely to be affected by runoff from:	___	___
a) municipal storm drains?	___	___
b) agricultural fields?	___	___
c) natural drainage?	___	___

Note: any of the above with a Yes answer require(s) a Detailed Investigation and Risk Analysis.

B.2.2 Physical hazards

B.2.2.1 Access	**Y**	**N**
a) Is the beach protected from vehicle access?	___	___
b) Is the swimming area protected from water craft access?	___	___

B.2.2.2 Shoreline **Y** **N**

a) Is the shoreline free of large rocks, sharp objects, or other impairments? ___ ___
b) Is the shoreline free of trees and shrubs that may impair visibility? ___ ___

B.2.2.3 Bottom conditions **Y** **N**

a) Does the bottom consist of material that is not easily stirred up? ___ ___
b) Are the slopes gentle? ___ ___
c) Is the bottom free of large rocks, sharp objects, or other obstructions? ___ ___
d) Is the maximum depth of the swimming area less than 4.5 metres? ___ ___
e) Is the bottom free of weeds? ___ ___

B.2.2.4 Water conditions **Y** **N**

a) Is the water elevation constant throughout the season? ___ ___
b) Have lateral and helical currents been assessed as safe? ___ ___
c) Have surf conditions been assessed for potential to create undertows and rips? ___ ___
d) Are there 2.8 square metres to 3.7 square metres of space available per swimmer? ___ ___

NOTE: any of the above with a No answer require(s) a Detailed Investigation and Risk Analysis.

B.2.2.5 Chemical hazards

Y **N**

Is the water quality likely to be affected by:

a) discharges from industrial sources? ___ ___
b) agricultural drainage? ___ ___
c) water craft mooring or use? ___ ___

NOTE: any of the above with a *Yes* answer require(s) a Detailed Investigation and Risk Analysis.

B.2.2.6 Reporting systems

Y **N**

a) Are there formal mechanisms for the reporting of abnormal waste discharges, spills, treatment bypasses, etc., to the local health authority? ___ ___
b) Is there an illness or injury reporting mechanism in place that would be effective for epidemiological monitoring? ___ ___

B.3 Sampling or posting recommendations

_____
_____
_____
_____
_____

_____ _____
Date of Assessment Responsible Authority

Annex C
(Informative)

Sources of information on chemical usage in local areas

Agriculture	• Farmers' Associations • Government agricultural authorities – Ministry of Agriculture • Local/community government authorities • University extension services (e.g. SALCC, UWI) • Government Environmental Authorities • Natural Resource Management Agencies • General public • Community groups
Extractive industries (e.g. quarrying)	• Government resource management agencies (Ministry of Planning, Ministry of Industry and Commerce) • Local/community government authorities • Government Environmental Authorities • Natural Resource Management Agencies • Natural Resource Management Agencies • NGOs
Manufacturing and processing industries	• Government environmental protection authorities and industry departments (Ministry of Planning, Ministry of Industry and Commerce) • Local/community government authorities • Industry associations (eg Chambers of Commerce, Agriculture) • Government/Private Environmental Authorities • Natural Resource Management Agencies
Contamination from former industrial sites	• Government environmental protection agencies • Local/community government authorities • Historical societies • Government/private Environmental Authorities • General public • Community groups
Natural environment	• Government Department of natural resources (Ministry of Planning) • Local/community government authorities • Government/Private Environmental Authorities • Natural Resource Management Agencies • General public • Community groups

Annex D
(Normative)

Guideline values for chemicals that are of health significance in drinking-water (WHO *Guidelines for Drinking-water Quality- Guidelines for Chemicals)*

Table D.1 – Guideline values for chemicals that are of health significance in drinking-water

Chemical	Guideline value[a](mg/litre)	Remarks
Acrylamide	0.0005[b]	
Alachlor	0.02b	
Aldicarb	0.01	Applies to aldicarb sulfoxide and aldicarb sulfone
Aldrin and dieldrin	0.00003	For combined aldrin plus dieldrin
Antimony	0.02	
Arsenic	0.01 (P)	
Atrazine	0.002	
Barium	0.7	
Benzene	0.01[b]	
Benzo[*a*]pyrene	0.0007[b]	
Boron	0.5 (T)	
Bromate	0.01b (A, T)	
Bromodichloromethane	0.06[b]	
Bromoform	0.1	
Cadmium	0.003	
Carbofuran	0.007	
Carbon tetrachloride	0.004	
Chlorate	0.7 (D)	
Chlordane	0.0002	
Chlorine	5 (C)	For effective disinfection, there should be a residual concentration of free chlorine of ≥0.5 mg/litre after at least 30 min contact time at pH <8.0
Chlorite	0.7 (D)	
Chloroform	0.3	
Chlorotoluron	0.03	
Chlorpyrifos	0.03	
Chromium	0.05 (P)	For total chromium
Copper	2	Staining of laundry and sanitary ware may occur below guideline value

Chemical	Guideline value[a](mg/litre)	Remarks
Cyanazine	0.0006	
Cyanide	0.07	
Cyanogen chloride	0.07	For cyanide as total cyanogenic compounds
2,4-D (2,4-dichlorophenoxyacetic acid	0.03	Applies to free acid
2,4-DB 0.09 DDT and metabolites	0.001	
Di(2-ethylhexyl)phthalate	0.008	
Dibromoacetonitrile	0.07	
Dibromochloromethane	0.1	
Dibromo-3-chloropropane, 1,2-	0.001[b]	
Dibromoethane, 1,2-	0.0004b (P)	
Dichloroacetate	0.05b (T, D)	
Dichloroacetonitrile	0.02 (P)	
Dichlorobenzene, 1,2-	1 (C)	
Dichlorobenzene, 1,4-	0.3 (C)	
Dichloroethane, 1,2-	0.03b	
Dichloroethene, 1,2-	0.05	
Dichloromethane	0.02	
1,2-Dichloropropane (1,2-DCP)	0.04 (P)	
1,3-Dichloropropene	0.02[b]	
Dichlorprop	0.1	
Dimethoate	0.006	
Dioxane, 1,4-	0.05[b]	
Edetic acid (EDTA)	0.6	Applies to the free acid
Endrin	0.0006	
Epichlorohydrin	0.0004 (P)	
Ethylbenzene	0.3 (C)	
Fenoprop	0.009	
Fluoride	1.5	Volume of water consumed and intake from other sources should be considered when setting national standards
Hexachlorobutadiene	0.0006	
Isoproturon	0.009	

Chemical	Guideline value[a](mg/litre)	Remarks
Lead	0.01	
Lindane	0.002	
Manganese	0.4 (C)	
MCPA	0.002	
Mecoprop	0.01	
Mercury	0.006	For inorganic mercury
Methoxychlor	0.02	
Metolachlor	0.01	
Microcystin-LR	0.001 (P)	For total microcystin-LR (free plus cellbound)
Molinate	0.006	
Molybdenum	0.07	
Monochloramine	3	
Monochloroacetate	0.02	
Nickel	0.07	
Nitrate (as NO3-)	50	Short-term exposure
Nitrilotriacetic acid (NTA)	0.2	
Nitrite (as NO2-)	3	Short-term exposure
	0.2 (P)	Long-term exposure
Pendimethalin	0.02	
Pentachlorophenol	0.009[b] (P)	
Permethrin	0.3	Only when used as a larvicide for public health purposes
Pyriproxyfen	0.3	
Selenium	0.01	
Simazine	0.002	
Styrene	0.02 (C)	
2,4,5-T	0.009	
Terbuthylazine	0.007	
Tetrachloroethene	0.04	
Toluene	0.7 (C)	
Trichloroacetate	0.2	
Trichloroethene	0.02 (P)	
Trichlorophenol, 2,4,6-	0.2[b] (C)	
Trifluralin	0.02	
Trihalomethanes		The sum of the ratio of the concentration of each to its respective guideline value should not exceed 1
Uranium	0.015 (P, T)	Only chemical aspects of uranium addressed

Chemical	Guideline value[a](mg/litre)	Remarks
Vinyl chloride	0.0003[b]	
Xylenes	0.5 (C)	

[a] P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited; T = provisional guideline value because calculated guideline value is below the level that can be achieved through practical treatment methods, source protection, etc.; A = provisional guideline value because calculated guideline value is below the achievable quantification level; D = provisional guideline value because disinfection is likely to result in the guideline value being exceeded; C = concentrations of the substance at or below the health based guideline value may affect the appearance, taste or odour of the water, leading to consumer complaints.

[b] For substances that are considered to be carcinogenic, the guideline value is the concentration in drinking-water associated with an upper-bound excess lifetime cancer risk of 10-5 (one additional cancer per 100 000 of the population ingesting drinking-water containing the substance at the guideline value for 70 years).Concentrations associated with upper-bound estimated excess lifetime cancer risks of 10-4 and 10-6 can be calculated by multiplying and dividing, respectively, the guideline value by 10.

Annex E
(Informative)

Other chemicals of interest for consideration

1 Arsenic
2 Chlorine (Total Residual Chlorine)
3 Cyanide (un-ionised Hydrogen Cyanide)
4 Cadmium
5 Chromium III (trivalent)
6 Chromium VI (hexavalent)
7 Copper
8 Lead
9 Mercury (inorganic)
10 Nickel
11 Silver
12 Vanadium
13 Zinc
14 Tributyltin (used for boat cleaning and anti-fouling (bottom) paint).
15 Ethanol
16 1,1,2- trichloroethane
17 1,1,2,2-tetrachloroethylene (perchloroethylene)
18 Benzene
19 Toluene
20 Ethyl benzene
21 Xylenes
22 Naphthalene
23 Polychlorinated Biphenyls (PCBs)
24 Phenol
25 Petroleum and petroleum products
26 Solvents and resins
27 Engine coolant
28 Paint

END OF DOCUMENT