Water Quality Guidance for Open Water Events and Training Sessions

BRITISH TRIATHLON

ROYAL LIFE SAVING SOCIETY UK

Contents

Introduction

There is always a greater risk of infection or illness caused by microorganisms when swimming in open water compared to a chemically treated swimming pool. However, with a basic understanding of the environment and some venue specific research supported by appropriate water quality monitoring and testing it is possible to mitigate the risks and introduce simple precautions to help protect swimmers.

This guidance aims to help organisers identify the most appropriate monitoring programme particularly where a venue is not already subject to routine water quality testing. It covers both venues that host one-off or infrequent events and venues where regular swimming or triathlon take place.

If you require further support or advice in relation to water quality at your venue please contact the British Triathlon events team on 01509 226162 or e-mail events@britishtriathlon.org

Researching Venues

Researching venues being considered for open water swimming at an early stage of the planning process is an essential part of establishing suitability and potentially saving both time and money.

Discussions with landowners and/or venue operators should be a priority but it may prove necessary to approach other organisations such as the relevant local authority or the Environment Agency.

Environmental Consideration

Water quality is influenced by many factors. When researching a venue important things to research include:

- What type of water is it – still water, river or sea?
  REASON: The type of water dictates what types of microorganisms may be present. It also helps identify what testing may be appropriate
- If it is still water is it stagnant or is there a feed/draw off, underwater spring or any form of aeration?
  REASON: The risk level is likely to be greater in stagnant water
- Are there any obvious signs of pollution e.g. dead fish, oil films on the water, presence of rubbish along the banks and/or in the water?
  REASON: The pollutant pose a direct risk to swimmers or an indirect risk if, for example, it attracts disease-carrying animals and insects
- Is there an unpleasant odour?
  REASON: Unpleasant odours may indicate a problem with water quality caused by pollution or decomposition
- Are there any sewage outlets that feed directly into the water or which might do so in flood conditions?
  REASON: Raw sewage contains enterobacteria (from inside the gut) that can pose a significant risk to swimmers
- Are there any tributaries or storm drains feeding into the venue?
  REASON: If there are tributaries and/or storm drains feeding in to the venue then there is a greater potential for the water quality to be affected particularly in flood conditions
- Is there any farmland close to the venue?
  REASON:
  Arable - the use of fertilisers may increase the level of nutrients in the water (run off during heavy rainfall) promoting the growth of microorganisms
  Animal - during periods of heavy rainfall in particular farm run off may include animal waste
- Are there any signs of bird flock presence and/or animal access points?
  REASON: Bird and animal waste may contain pathogenic microorganisms
- Is there a sediment/silt bottom?
  REASON: Some microorganisms live in the sediment/silt and can be released when the water is disturbed

Historical Data & Experience

If possible, gather historical data and information on the following:

- Water temperature over the open water season – this can help identify the most likely time for algal blooms to appear and therefore the best time to stage an event to minimise risk
- Frequency, duration and magnitude of any problems. For example, algal blooms – which can tend to follow an annual cycle
- Results of any previous water quality testing that may have taken place at the venue

What should you monitor?

Bacteria

Open water contains many microorganisms. Infections and illness due to contact with open water are generally mild however more serious outcomes can be experienced with faecally polluted water. These include gastrointestinal infections and infections of the upper respiratory tract, eyes, ears, nose and skin.

Bacterial testing is used to monitor the presence of organisms that are found in faeces and therefore indicate the potential presence of pathogens. There is a European water quality standard, EC 2006/7, for designated bathing waters (where swimming and other water sports regularly take place) which are regularly tested, typically fortnightly. The water quality is classed as **Excellent, Good, Sufficient** or **Poor** based on the number of (microbial) colony forming units per 100ml (cfu/100ml). Swimming should not take place in **Poor** quality water. The standards differ for inland water and coastal water.

Whilst EC 2006/7 is normally used for water that is tested regularly and where there is a statistical analysis of the number of samples* the guidance values, illustrated in a simplified version below, are still considered most appropriate for one-off or occasional testing.

**which produces the apparent anomalies in the numbers in the tables*

EC Bathing Water Directive 2006/7/EC				
Rating	**Excellent**	**Good**	**Sufficient**	**Poor (Fail)**
Escherichia coli (cfu/100 ml)	**<500**	**<1000**	**<900**	**>900**
Intestinal enterococci (cfu/100 ml)	**<200**	**<400**	**<330**	**>330**

Inland Waters

EC Bathing Water Directive 2006/7/EC				
Rating	**Excellent**	**Good**	**Sufficient**	**Poor (Fail)**
Escherichia coli (cfu/100 ml)	**<250**	**<500**	**<500**	**>500**
Intestinal enterococci (cfu/100 ml)	**<100**	**<200**	**<185**	**>185**

Coastal Water

Weil's Disease

What is it?
Weil's Disease (Leptospirosis) is an acute bacterial infection caught through water-borne contact with infected animal urine –typically rodents, cattle or swine. It is associated with fresh water not salt water.

What are the symptoms?
Infection can lead to a number of flu-like symptoms including fever, a short-lived rash, headaches and nausea. In more severe cases it can be potentially life-threatening. Symptoms can take up to 3 weeks to appear. It is also important is to watch for anyone getting a mild illness, recovering and then about a week later feeling very ill again.

Testing
Laboratory analysis of water samples to detect the presence of the bacteria is not included within EC 2006/7 and therefore a specific request for testing would need to be requested if organisers are concerned. However, Weil's Disease is rare in the UK and testing is more likely to be considered when a swimmer(s) has a confirmed case and is able to highlight where and when they have been swimming.

Action
Organisers should make swimmers aware that there are risks associated with swimming in open water and provide advice on basic precautions they can take to minimise the risks. They should also highlight symptoms and recommend seeking medical advice.

Blue Green Algae

Blue Green Algae is the common name for Cyanobacteria. There are many species of which almost 50 can create a health risk when present as dense scums or blooms through direct contact or ingestion of toxins released when the cells die. Mild symptoms can include upset stomach, vomiting, diarrhoea, allergic reaction and fatigue but more serious cases can lead to organ failure.

Visual monitoring is used to detect the presence of algal blooms and laboratory analysis of water samples is used to detect the presence of blue green algae. The laboratory analysis identifies the number of algal cells per millilitre of water.

The World Health Organisation provides guidance values for health protection where blue green algae are present based on three categories – Relatively Low, Moderate and High – and recommends that swimming is discouraged at the moderate level and prohibited at the high level.

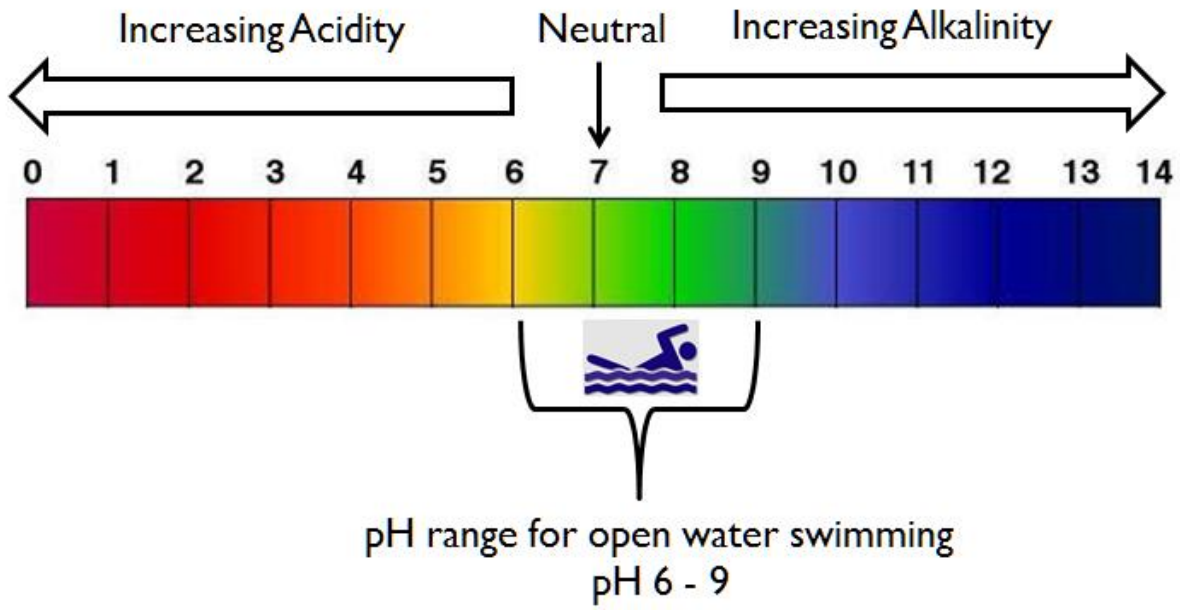
No. Cells/ml	<20,000	>20,000 - < 100,000	> 100,000
Rating	Relatively Low	Moderate (Warning Threshold)	High

WHO Guidance Levels

It is important to understand that the WHO guidance values are not species specific and given that not all species are toxic further investigation may be advisable where moderate ratings are recorded. The Environment Agency does provide species-specific values that provide a warning of the potential for bloom formation and advises that once a venue is free from surface scums/blooms and when two consecutive samples, taken at weekly intervals, indicate results below the warning threshold immersion sports can resume.

pH

pH is a numeric scale (from 0 to 14) based on hydrogen ion concentration, used to identify whether a solution is acidic or alkaline. A pH of 7 indicates neutrality, a pH below 7 indicates acidity and above 7 alkalinity. The pH of human skin and eyes is around 7 which is why the pH of swimming pools is maintained in the range of 7.2 – 7.6. For open water swimming it is advised that the pH range should fall within 6 to 9 to prevent potential health issues.



The pH level can be affected by a number of factors including algal and weed growth, agricultural run-off, waste water from industry, make-up of the bottom/bedrock.

It is advisable to monitor pH particularly at a new venue where swimming has not previously taken place. The pH can be measured simply using a pH meter and should be considered as part of the initial venue research.

When and how often should you test water quality?

The water quality testing regime is likely to differ between venues depending on frequency of use for swimming and the visual monitoring of algal blooms. Considering bacterial and algal testing separately:

Bacteria

Water quality testing provides a snapshot of what is present at the time of testing and therefore can only ever provide an indication of the suitability for swimming. Given the number of factors that can influence water quality it is a rapidly changing picture, particularly in rivers* and following periods of heavy rainfall when run-off and sewage overflows can lead to relatively short periods of elevated faecal pollution.

The timing and frequency of testing (at venues not already tested by a 3rd party) is likely to differ between one-off events and venues hosting regular swims and triathlons. In both cases the testing should be undertaken prior to any swimming taking place but not too long in advance to get the best indication of what is present.

Where swimming regularly takes place a test taken two weeks before the first swim and several times during the season may suffice. For one off events testing should be undertaken in the lead up to the event with a suggested programme of:

Test 1: One month prior to the event – to give an early indication of any problems and provide
sufficient time for contingency plans to be developed

Test 2: Two weeks prior to the event – to give an indication of whether the water quality has
improved or worsened

Test 3: One week prior to the event – to inform the final decision for the swim to take place and
allow sufficient time to implement contingency and inform participants (NOTE: It takes 48
hours for bacterial results to be produced)

*depending on flow rates water quality testing of rivers prior to swimming is likely to have very limited value. Sampling on the day of the swim may have some value if swimmers subsequently experience health issues but given that events typically take place at weekend or in the evening when laboratories are likely to be closed it may not be practically achievable. It is therefore recommended that water quality testing of a river venue is discussed in greater detail with a UKAS accredited testing company.

Blue Green Algae

As the presence of blue green algae (in suspension) does not necessarily pose an issue to public health unless in the form of a bloom or scum it may be acceptable to rely on visual checks and only undertake testing if/when blooms are present in the water body.

However, it is recommended that the water quality testing regime suggested for bacteria is extended to include blue green algae because:

- algal blooms can develop very quickly – sometimes in a matter of hours
- laboratory analysis can provide a warning of the potential for bloom formation and,
- not all blue green algae produce toxins that harmful to humans so it may still be safe to swim even if blooms are present

Who can analyse water samples?

It is the responsibility of the organiser to ensure that water samples are collected and sent for analysis.

It is recommended that the analysis and interpretation of water samples is undertaken by United Kingdom Accreditation Service (UKAS) accredited laboratories as UKAS is the only body recognised by the government to assess against internationally agreed standards. Laboratory analysis can be expensive and costs may vary considerably so it is worth seeking quotes.

The collection of water samples may be undertaken by the organiser following basic guidance to reduce costs. The sample bottles should ideally be provided by the laboratory as they should be sterile and may need to contain preservatives,

With the exception of algal blooms, samples should be taken 30cm below the water surface. Clear bottle may be used for bacterial testing but dark bottles must be used for blue green algae to prevent further photosynthesis during transportation to the lab. Samples should be transported as soon as possible after collection in a cool box so that they arrive at the laboratory on the same day, ideally within a few hours.

How long does it take to get results?

It takes a minimum of 48 hours for bacterial results to be produced because water samples have to be incubated on special growth media for 48 hours to allow colonies of the indicator bacteria to grow if they are present.

Blue green algae results can be produced more quickly because the water is analysed under a microscope directly. Results can be available within 24 hours.

It is important to bear in mind how long it takes for results to be produced when determining the testing regime for a venue so that there is time to interpret the results and, if necessary, inform swimmers of any contingency arrangements.

Where do you sample?

Bacteria

Samples should be collected from multiple, spatially separated sites to give a reflection of the whole area where the swim course is based. This might include swim entry, swim exit, mid-course and/or furthest point of the course. Particular attention should be made to potential points of faecal pollution e.g. sewer overflow, bird roosting sites or where cattle have access to the water's edge.

Blue Green Algae

Blooms form when the buoyant algal cells accumulate at the surface of water. Winds can then drive the blooms to the leeward shore (the shore with wind blowing towards it) where they can form dense scums. An increase in wind strength or a change of wind direction can break up the scums and re-disperse them within a matter of hours. On this basis it is important to sample water from across the waterbody with a particular focus on sheltered bays, inlets and the leeward shore (at the time of sampling) to get the "worst case scenario".

Visual Checking for Blue Green Algae

It is recommended that visual checks are undertaken weekly from one month prior to an event and throughout the season at venues where there is regular swimming/triathlon. Checks should ideally cover the whole waterbody with a particular focus on leeward shores and sheltered bays. If algal suspensions (green specks suspended under water) or blooms are observed the frequency of checks should be increased and, if not already in place, arrangements made for laboratory analysis of water samples.

Examples of blue green algae

Changing Swim Course

As health problems are associated with ingestion of or contact with toxins in algal blooms it may be possible to change the swim course to avoid blooms. However this approach is not advisable because new blooms can appear very quickly and/or a change in wind direction may move blooms into the swimming area. Relying on weather forecasts for wind direction and speed is not recommended. If there are any doubts swimming should not proceed.

In large bodies of water where the algal blooms may be a significant distance away from the swimming location it may be possible to continue as planned but further advice should be sought.

Are there any treatments available to prevent blue green algae growth or speed up its clearance?

There are a number of treatments available for both the prevention and removal of blue green algae which work by either restricting nutrients to limit growth or by killing the cells - these include the use of barley straw, blue dyes and ultrasound. They can be expensive and depending on the size of the waterbody in particular may have limited impact. Chemical treatments can be controversial because of concerns about any negative impact on plant and animal life.

Coastal Waters

Many beaches and marinas have Blue Flag accreditation. One of the benefits to organisers is that this award includes criteria for water quality and the most important stipulation is that no industrial, waste-water or sewage-related discharges should affect the beach. Water quality testing results have to be displayed at Blue Flag locations and organisers do not necessarily need to undertake independent testing. Blue Flag locations are listed on the website (and mobile phone app)

www.thebeachguide.co.uk/best- beaches/blue_flag.htm

Another useful resource for real-time information on water quality at many coastal locations can be found at the Safer Seas website (and mobile phone app)

www.sas.org.uk/safer-seas-service/

What information & advice should be made available to swimmers?

Whilst it is not possible to guarantee good water quality it is possible to advise swimmers* (and members of the water safety team coming into contact with the water) of the potential risks and provide guidance on simple steps they can take to protect themselves.

*For example – website, competitor information, welfare e-mail, notices posted at the event/session

ADVICE	REASON
Pre Swim	
Cover open wounds	To prevent microbial access to the body
Do not swim if feeling unwell	If the immune system is suppressed by illness you are more susceptible to infection
Post Swim	
Wash hands before eating or drinking (or use sterilising wipes/gels)	To reduce the risk of ingesting pathogenic microbes
Shower in fresh water at the earliest opportunity	To remove all microbes, many of which are able to survive on the skin surface for long periods
Rinse and wash all kit in fresh water before drying thoroughly – including wetsuit, goggles, swimming costume	To remove all microbes and potentially prevent toxin concentration in/on the item that can cause skin irritations and eye infections
Seek medical advice if you feel ill or develop symptoms including rashes for up to 3 weeks following your swim – highlighting that you have been swimming in open water (and where)	It can take up to 3 weeks for the symptoms of Weil's Disease to develop. Sharing information can help identify the source and nature of the problem and the most effective treatment. It can also help identify problems with particular bodies of water

Swimmers may also be advised to use a wide spectrum disinfectant on themselves and their equipment to remove bacteria but they should also be made aware that these are not effective for blue green algae.

A commonly held belief is that carbonated drinks can prevent illness and infection because the acid content of the drink kills bacteria. There is no proof that this works (and indeed the acid content of the stomach is greater than that of the drink) and it should not be relied upon as an effective preventive measure.

Biosecurity

As well as concerns about water quality on the health of swimmers some venue owners/operators have concerns about the potential introduction or spread of invasive, non-native aquatic species which have the potential to impact on fish and other wildlife, restrict navigation and/or clog up propellers. There are a number of ways that these species can be introduced but in relation to swimming the most likely would be from safety craft that have been operating at other venues or potentially from swimmers' wetsuits if they have not been cleaned since being used elsewhere.

Organisers may be required to take preventative measures to minimise the risks – this is known as biosecurity. Further information can be found at www.nonnativespecies.org including details of specific species of concern.

Further Reading