

Chapter 4: Environmental and sustainable development conditions specific to the various Olympic disciplines



4.4 Aquatic sports

4.4.1 Pool-based aquatic sports

4.4.1.1 General

Pool-based aquatic sports are composed of four disciplines: swimming, synchronised swimming, diving and water polo.

All these disciplines are highly dependent on the quality of the water in which they are practised. The risks of contamination from this water concern chiefly the swimmers themselves, but also the environment of the area where the swimming pool is located. To protect the health and safety of the users of pools for public and competition or training use, those in charge of the pools must comply with the legislation of the country concerned. Most countries have this kind of legislation, but in those which do not, the criteria of the World Health Organisation (WHO) should be respected (see bibliography). The criteria to be monitored are both bacteriological and chemical, and swimmers may be contaminated either through contact or through ingestion. Particular attention should be paid to the quality of testing methods and the reliability of the results obtained.

Some facts

- Swimming is one of the four Olympic disciplines that have been included in all editions of the modern Olympic Games since 1896.
- The lower the water temperature, the higher its oxygen concentration can be, and thus its self-cleaning capacity.
- Contrary to other chemical components, water does not reach its maximum density in solid form, but at 5°C. This is why ice floats on water.
- In seawater, several types of pathogenic bacteria survive for a shorter time than in fresh water.
- Under certain conditions, swimmers may be regarded as boats. For example, if you wish to swim across the Panama Canal, you will have to pay a fee based on your height, exactly as if you were a cargo ship!

4.4.1.2. An environment-friendly approach to pool-based aquatic sports

For swimming pools, there are two main aspects to respect for the environment: preserving swimmers' health and saving water and energy.

a) Water quality criteria to protect swimmers.

The criteria to be considered under the terms of the national legislation in different countries and the WHO rules (see bibliography) are more or less consistent. By way of example, here is a list of the most important parameters to be considered and the values which should be respected:

Physical parameters

Transparency:	See the bottom of the pool clearly
Temperature:	For competitions, and depending on each event, the International Swimming Federation (FINA) stipulates the following temperatures: <ul style="list-style-type: none"> ● At least 26°C for diving, synchronised swimming and water polo ● between 25°C and 28°C for swimming events

Chemical parameters

PH:	Between 7 and 8
Detergents, oils:	No foam or visible film on the surface

IOC Guide on Sport, Environment and Sustainable Development

Toxic substances: The levels of cyanides, nitrates, phosphates, pesticides, phenols and heavy metals like arsenic, cadmium, chrome IV, lead or mercury should not be higher than the limits for drinking water.

Bacteriological parameters

Total bacteria: Less than 100/ml
 Total coliforms: Less than 10/ml
 Faecal coliforms: None
 Pathogenic germs: No pathogenic germs of these types: *Pseudomonas aeruginosa*, *Legionella*, *Mycobacterium* and *Staphylococci* in 95% of the samples analysed

Residual disinfectant

The main disinfection methods are direct chlorination or by using hypochlorite, adding sodium chlorocyanurate and ozonation.

Active free chlorine: Between 0.5 and 3mg/l

Total chlorine: Between 1 and 3.5mg/

Chlorocyanurate: Between 1 and 5mg of chlorine per litre

Disinfection using chlorine products must take place at least one hour before the swimmers arrive, with the renewal system functioning.

Ozone: If ozone disinfection is used, this is performed outside the pool, and there must be no ozone left in the water when it reaches the pool.

By-products of disinfection

The reaction of disinfectants with organic matter may produce by-products such as chloroform (for which the concentration should not exceed 50 micrograms per litre) and trihalomethane (for which the concentration should not exceed 10 micrograms per litre).

Pool maintenance

Water renewal:
 For 50m pools, every 3 to 4 hours
 For pools up to 25m, every 2 to 3 hours
 For diving pools, every 4 to 8 hours

Emptying pools: At least twice a year

b) Preserving water quality and maintaining premises

In a public pool, the main risk of bacterial contamination comes from the bathers themselves. They should therefore respect the hygiene rules intended to avoid contamination of the pool, i.e. take a shower and use the footbaths with disinfectant. Wearing swimming caps in the water is also advisable.



Chapter 4: Environmental and sustainable development conditions specific to the various Olympic disciplines



Figure 40: Swimmers may be contaminated both through contact and through ingestion.

The water in pools must be renewed and filtered within a given period which depends on their size. Particular attention should be paid to the clogging of filters. When the flow rate of filters drops below 70% of new ones, they must be changed. Pools must be emptied and disinfected at least twice a year.

The air in covered pools must be correctly renewed. If the water is disinfected with a chlorine-based product, as chlorine is heavier than air, it can accumulate at ground level and cause breathing problems for the swimmers. The same is true of ozone. Because of the heat and humidity, the aeration or air conditioning systems are particularly vulnerable to the development of pathogenic bacteria like legionella. They therefore need to be checked and sterilised regularly.

For open-air pools, it is advisable to provide a surface water drainage system for the surrounding area, to avoid contamination of the pool water after rainfall. This is particularly important in tropical countries, where there are violent rain showers.

Rules of conduct for preserving pool water quality

For the user

- Use the hygiene equipment before swimming (showers and footbaths) and wear a swimming cap;
- Wash your swimming trunks every time before or after swimming;
- Protect any injuries using a waterproof plaster or bandage;
- Do not spit, blow your nose or urinate in the pool;
- Do not throw anything into the pool that is not needed for swimming.

For the operator

- Respect the official guidelines on water quality or, where there are none, use the WHO criteria;

IOC Guide on Sport, Environment and Sustainable Development

- Check the active free chlorine content of the pool each day by using a simple analysis system;
- Have all the water quality parameters checked regularly by a Best Laboratory Practice-certified laboratory, or one with the ISO 17025 label or any other relevant standard;
- Respect the water renewal guidelines for pools;
- Regularly check the clogging of water filters and change them when necessary;
- For indoor pools, have the aeration systems checked and disinfected regularly to avoid the growth of legionella-type bacteria;
- After each event, return the pool premises to their initial condition by clearing up and where possible sorting solid waste, cleaning and disinfecting the toilets and checking the functioning of the waste water evacuation system. Do the same in changing rooms with the heating, air conditioning and air evacuation systems.

4.4.1.3 Environmental impact of pools, their use and aquatic sports events

The main source of environmental pollution caused by pools is the evacuation of untreated water into the ground or an aquatic environment. Before changing pool water, the water must be cleaned to remove all traces of disinfectant. For chlorine, this can be done by adding a product to eliminate active chlorine or by allowing the concentration of active chlorine to reduce naturally, which generally happens over several days.

A pool also generates large quantities of waste water from the heavy use of the changing facilities by swimmers. This water must also be cleaned before being emptied into the natural aquatic environment.

Another big impact, in terms of sustainable development, is caused by the consumption of energy. In countries with cold or temperate climates, large amounts of energy are used to heat the water, operate pumps and filters and provide lighting. All equipment which uses energy should be maintained regularly to ensure the best possible energy efficiency. A series of photovoltaic cells or a passive solar heating system on the roof of a covered pool can provide a significant part of this energy.

Environmental responsibility of pool operators

- Make best use of and maintain the water renewal and filtering system so as to consume as little water as possible;
- Never use waste water from the pool for watering plants without first removing the chlorine;
- Clean the changing room water used by swimmers before returning this to the environment;
- Maintain the energy-consuming installations to ensure optimum energy use, and use solar energy;
- Use and manage chemical water treatment products in accordance with the safety and environmental protection rules.

Responsibility of those involved in pool-based swimming events

For the organiser

- For covered pools, choose those with good thermal insulation to avoid heating-related energy losses and ensure that there is no asbestos in the insulating material used;
- Choose pools with renewable energy systems such as wind, geothermal or solar energy systems;
- Promote and provide a convenient public transport system for travelling to the event;
- Offer the public an adequate number of toilet and waste collection facilities which are well maintained and allow for waste water to be treated and solid waste to be recycled or destroyed without risk to the environment;
- Inform users of the rules of conduct to be observed: keep the toilets clean, save water and collect rubbish.



Chapter 4: Environmental and sustainable development conditions specific to the various Olympic disciplines



For the swimmers

- Behave impeccably in terms of fair play and respect for the environment (do not leave litter, such as water bottles or packaging).

For the public

- Whenever possible, travel to the competition venue by public transport, bicycle or on foot;
- Respect the rules of conduct on use of the toilet facilities and disposing of rubbish, particularly packaging and empty bottles.

4.4.1.4 Special waste, toxic products and sources of pool pollution

The disinfecting products used in pools are dangerous and toxic. They should be stored in special well-ventilated premises, never underground, well away from the areas frequented by the pool users. Chlorine is a suffocating gas which can cause serious respiratory damage.

Hypochlorites should be stored in such a way as to ensure they are never in contact with acid, which would release chlorine. Hypochlorite dust can cause lesions of the liver. Only people specially trained in handling and using these products should have access to these storage premises. A detailed register of operations with these products should be kept.

4.4.1.5 Other aspects of pool-based aquatic sports linked to sustainable development

In many countries affected by drought, pools must not be a factor which aggravates the lack of water that may affect the local population. In these regions, water must be used chiefly for drinking, preparing food, hygiene and agriculture. A responsible attitude which respects sustainable development means not filling swimming pools until these basic needs are met. At the same time, the waste water from pools, once dechlorinated, can be used to water ornamental and vegetable gardens.

Knowing how to swim may save a person's life, but swimming is also a particularly relaxing way of ensuring the harmonious development of the body, whatever the age of the swimmer. For this reason, particularly among people with sedentary occupations, it is important to facilitate access to swimming pools, lessons and clubs.

4.4.2 Open-water aquatic sports

4.4.2.1 General

The swimming part of the triathlon and open-water swimming, which is not an Olympic discipline, generally take place in natural aquatic environments which are also used by many recreational swimmers. For this reason, close attention should be paid to the environmental conditions of these areas.

While the aquatic conditions of pools depend totally on human influence, those for open-water swimming depend on the local environmental conditions. Open-water swimming thus depends on the quality of the natural water areas, whether these are rivers, lakes or coasts. It should be noted also that some water areas, while not polluted, are not suitable for swimming or even bathing, because they are dangerous. This may be due to currents which are too strong or the presence of dangerous parasites or animals.

4.4.2.2 Open-water swimming which respects the environment

With open-water swimming, respect for the environment means conditions which allow this sport to be practised without damaging the natural environment. Not all countries have legislation on water quality for open-water swimming.

IOC Guide on Sport, Environment and Sustainable Development

What is more, the quality of this water depends very much on a number of local climate conditions, as in addition to the chemical and bacteriological aspects there are other biotic factors to be considered, such as parasites, harmful vegetation and dangerous animals. It is also necessary to consider the quality of the banks or shores, particularly the sand on beaches.



Figure 41: Open-water swimming depends very much on the quality of the water. A scene from the swimming part of the triathlon at the 2004 Olympic Games in Athens.

There may be contamination of bathing and open-water swimming sites due to the bacteria present in human and animal excrement, particularly intestinal enterococcus, coliforms like *Escherichia coli*, salmonella and enteroviruses. These bacteria have various effects, chiefly gastroenteritis.

Depending on the climate, natural water areas contain several types of pathogenic micro-organisms. *Vibrio*-type bacteria may be present in natural water areas without this being due to human influence. They may cause damage to the liver, the most dangerous being *Vibrio cholerae*, which can result in death by dehydration.

Some algae and cyanobacteria produce toxins which may have an effect directly, or more likely through eating infected fish or shellfish. This is particularly true of ciguatera in tropical waters. These toxins have a paralysing or neurotoxic effect and may cause gastroenteritis. In fresh water, particularly lakes and ponds, cyanobacterial plankton form during periods of algae growth due to eutrophication. This phenomenon is the result of too high a concentration of fertilisers in the water. These fertiliser elements (fertiliser, nitrates and phosphates) mainly come from agricultural fertiliser, detergents and waste water. In addition to the toxic effects of the cyanobacteria, the growth of algae is followed by a period of decomposition which makes the water foul-smelling. The only way of avoiding such algae growth is to limit the amount of fertiliser which enters the water.

Other aquatic organisms can also be dangerous. In warm regions, surface water encourages the development of mosquitoes which carry parasites. Mosquitoes of the *Anopheles* species carry malaria, while the *Aedes* transmit dengue fever and the *Culex* cause filariasis. While using insecticides is effective, these can lead to serious environmental imbalances, so they should be applied with moderation. For individuals, bathing wearing long clothing and the use of repellent creams or essences may be a good solution.



Chapter 4: Environmental and sustainable development conditions specific to the various Olympic disciplines



In the same regions, various kinds of aquatic snails carry parasites such as *Schistosoma*, which cause bilharzia and schistosomiasis, diseases which lead to anaemia and in some cases even death. In temperate climates, a duck parasite, *trichobilharzia ocellata*, can cause severe itching and types of dermatosis. It is advisable not to swim or bathe in water where these parasites are present. In areas where bird flu is prevalent, one should not swim in water used by wildfowl or birds.

It is also dangerous to bathe in water where there are dangerous animals, such as sharks, piranhas, electric fish, crocodiles, alligators, jellyfish or snakes.

Some countries and the WHO (see bibliography) establish quality criteria for bathing in open water. Below are some indications on the main parameters to take into consideration:

Physical parameters

Aspect:	The site (shore and water) must be free of all types of rubbish such as glass, plastic, paper, remains of food or dead fish. There must be no insects or insect larvae on the surface of the water.
Current:	River or sea currents must be no stronger than one metre per second.
Waves:	Waves or breakers must not be dangerous for children, i.e. less than one metre high.
Dissolved oxygen:	Depending on the water temperature, between 8mg/l (water at 30°C) and 11mg/l (water at 15°C)
Transparency:	At least two metres (but some water which contains large amounts of natural humic acid is not transparent but still suitable for swimming)

Chemical parameters

PH:	Between 6 and 9
Detergents, oils:	No foam or film of oil or diesel visible on the surface.
Toxic substances:	The levels of cyanides, nitrates, phosphates, pesticides, phenols and heavy metals like arsenic, cadmium chrome IV, lead or mercury should not be higher than the limits for drinking water.

Bacteriological parameters

Total coliforms:	Less than 500/ml
Faecal coliforms:	Less than 100/ml
Faecal streptococci:	Less than 100/ml

Biotic parameters

No proliferation of algae	
Cyanobacteria:	Less than 50,000 cells/ml
No risk of parasites	
No dangerous animals in the vicinity	

Official open water competitions organised by the "Fédération Internationale de Natation" (FINA) over 25, 10 and 5 km must be held in sites first approved by it and in conditions in conformity with the FINA rules.

In addition, the beach, particularly sand, and river banks may be contaminated by bathers and animals. Look particularly for the presence of faecal coliforms, staphylococci and microscopic mushrooms. The mechanical cleaning of the sand performed on many tourist beaches is beneficial aesthetically, but has little effect on this type of contamination. Only respect of the rules of hygiene by the users, prohibiting animals and using a towel can provide a solution.

IOC Guide on Sport, Environment and Sustainable Development

Rules of conduct for preserving the environment for open-water bathing and swimming

- Avoid bathing in environmentally sensitive areas: mangroves, coral reefs, bird nesting areas, etc;
- Use sun cream and perfume in moderation;
- Do not spit, blow your nose, defecate or urinate in the water;
- Do not take pets with you;
- Do not throw anything into the water (leftover food, cigarette ends, plastic or paper bags, etc.);
- Wash your swimming trunks before or after bathing;
- Protect any injuries using a waterproof plaster or bandage;
- Take nothing from the environment, for example shells, coral, aquatic plants, seaweed, etc.

4.4.2.3 Impact of open-water swimming events and the necessary facilities

As with all outdoor events, in addition to the sports activity itself, the approach and attitude of the public are important elements to be taken into consideration.

Responsibility of those involved in open-water swimming events

For the organiser

- Choose a competition site which respects the bathing water quality parameters, outside environmentally-sensitive areas: mangroves, coral reef, etc;
- On a river, do not choose a location downstream of a city;
- Ensure that access is prohibited to craft which could hurt the swimmers (motorboats, jet skis, etc.);
- On banks with vegetation, prevent the public from standing on the first five-to-ten metres from the water;
- Promote and provide a convenient public transport system for travelling to the event;
- To move the public, create gravel or geotextile paths on uncleared ground;
- Provide a number of water fountains, mobile toilets and dustbins in line with spectator attendance at the event;
- Display clearly and legibly the rules to be respected both by the competitors and their entourage and by the public;
- Possibly restore to their original state any banks trampled by the public after the competition.

For the swimmers and their entourage

- Obtain information on any risks inherent to the swimming venue;
- Know and respect the safety instructions displayed at the venue;
- Use a towel to lie on the river bank or sand;
- For the boats following the swimmers:
 - choose turbine propulsion rather than propellers, which can injure swimmers;
 - maintain the engine properly to avoid oil and fuel leaks when the engine is operating;
 - do not use tributyltin (TBT)-based anti-fouling paint;
 - near banks, avoid going too close to aquatic bird nesting sites.

For the public

- Whenever possible, travel to the competition venue by public transport, bicycle or on foot;
- Know and respect the rules in force;
- Keep away from the edge of the bank, standing instead on sand or rocks, and avoid walking on riverbank plants;
- Do not leave behind any packaging, rubbish, leftover food, matches, cigarette ends or pieces of glass, and do not light fires.



Chapter 4: Environmental and sustainable development conditions specific to the various Olympic disciplines



4.4.2.4 Special waste, toxic products and sources of pollution linked to open-water swimming

A priori, there are no toxic products linked to open-water swimming. However, a warning should be given about perfume and sun cream products used by swimmers, which are released into the water.

Perfume products use elements known as polycyclic musks, some of which (Galaxolide®, Abbalide®, Tonalide®, Fixolide® and Astralide®), while not poisonous to wildlife, are difficult to biodegrade and accumulate in the food chains, particularly the aquatic food chain. To avoid this, you should not apply perfume before swimming in open water.

Protection against ultraviolet radiation is becoming increasingly indispensable, especially because of the seasonal hole in the ozone layer. However, some products used in these filters (Benzophenone 3, Homosalate, 4-Methylbenzylidene Camphor, Octyl Methocyanamate and Octyl Dimethyl PABA) can accumulate in fish and are suspected of having a sterilising effect, as they disrupt the endocrine system. For this reason, sun creams containing these five molecules should either be avoided or used only after swimming in open water.

4.4.2.5 Other aspects of open-water swimming linked to sustainable development

Open water is the most natural place to learn to swim. It is an excellent way of exploring the aquatic environment, pitting oneself against the forces of nature (waves and currents) and assessing the place of humanity within this world. It is a recreational environment to be enjoyed by all generations. Open-water swimming is also a sport which, being open to all social categories and all ages, enables the various members of society to meet and share a common activity.

4.5 Land-based sports in open-air stadiums

4.5.1 General

Land-based individual and team sports practised in open-air stadiums include athletics, tennis, archery and shooting sport. Team sports are football, baseball and hockey. This chapter also deals with pentathlon and triathlon, even though it also includes disciplines practised indoors and in the natural environment, as well as swimming.

The main environmental aspects of land-based sports practised in open-air stadiums relate to stadium construction, equipment management, event organisation and the conduct of participants and spectators. The other contribution these sports can make to sustainable development concerns their role in helping athletes from the most disadvantaged social backgrounds to be integrated into society or to climb the social ladder.

The popularity and media attention enjoyed by land-based sports played in open-air stadiums means that they can set an important example by promoting the image of sustainable development among the general public.

4.5.2 Athletics

4.5.2.1 General

Apart from the marathon, walking events, cross-country, road events and events in the mountains, most disciplines of athletics take place in stadiums. This chapter looks at the environmental and sustainable development aspects of all the disciplines involved in an athletics competition, whether held in a stadium or in the natural environment, as well as recreational running and walking.

Some facts

- Athletics is one of the four Olympic disciplines that have been included in all editions of the modern Olympic Games, since 1896.