

**MAINTENANCE AND MONITORING OF WATER
QUALITY IN PUBLIC SPAS**

**INFORMATION SHEET
ON BEST OPERATING PRACTICES**

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Maintenance and Monitoring of Water Quality in Public Spas

Information Sheet on Best Operating Practices

Purpose

This information sheet is intended for operators of public spas (whirlpool baths and hot tubs) subject to the *Regulation respecting water quality in swimming pools and other artificial pools* (RWQSPAP) of Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP). **It is important to read this regulation to ensure compliance with all its requirements.**

This detailed information sheet summarizes best operating practices for maintaining water quality in these facilities. It describes measures to help operators of public spas ensure water quality in these facilities and prevent the transmission of infectious diseases. Some of these requirements are stricter than those set out in the regulation. This is due to the particularities of managing water quality in spas based on the experts consulted and the current practices in other jurisdictions.

This document does not cover emergency equipment (telephones, first aid kits, etc.) or a number of other requirements to consider in ensuring public safety in spas. Aspects related to the safety and construction of these facilities fall under the jurisdiction of Régie du bâtiment du Québec (RBQ). If you have any questions about these issues, we recommend you read the regulations administered by that agency.

Spas Are Different from Other Bathing Facilities

Badly maintained spas are subject to the proliferation of microorganisms that can cause health problems to bathers and people nearby. For this reason it is crucial to ensure good water quality. High water temperatures (35 to 40 °C), low volumes of water per bather, and a heavy bather load are favorable conditions that promote the development and proliferation of pathogenic microorganisms. These same conditions make adequate disinfection of the water more difficult.

Types of Spas Covered

This information sheet covers public spas (whirlpool baths and hot tubs) open to the general public or restricted groups and private spas open exclusively to building or mobile home park residents and their guests. These spas are typically run by tourism establishments, sports centers, water parks, schools, or not-for-profit organizations. They may also be operated by provincial or municipal authorities.

Water Quality in Spas

Four key factors are important in maintaining water quality at all times in these facilities:

- 1- Water treatment/recirculation/replacement and spa maintenance
- 2- Water quality monitoring, inspection of premises, and daily record keeping
- 3- Bather compliance with hygiene and usage rules
- 4- Operator training

The risk of bacterial contamination is low when best facility maintenance practices are applied and free chlorine residual, pH, filtration, and physico-chemical parameters are monitored. The following key factors are important in maintaining a safe and comfortable environment for users:

- Adequate filtration and disinfection
- Recirculation of pool water to ensure proper distribution of disinfectant
- Frequent addition of fresh water
- Cleaning and disinfection of pool walls and filters at regular intervals
- Hygiene and ventilation of the premises

Users also play an important role in minimizing the risk of contamination. Showering with soap and warm water before entering the spa, keeping the premises clean, and applying certain prevention measures limit contamination of the water and bathing area.

1- Water Treatment/Recirculation/Replacement and Spa Maintenance

Special attention should be paid to spa design. Operators should check with their supplier to make sure that the equipment's design criteria ensure that the water is safe for bathers (efficient filters of the right size, chemical injection point, etc.). The operator must also ensure that the facility can handle the various recommended maintenance and operational procedures designed to ensure safe pool water. The operator should schedule replacement of equipment parts (e.g., pumps) before they break down.

The supervisor must post for operators and monitors the procedures recommended by the Workplace Hazardous Materials Information System (WHMIS) for using and storing chemicals.

The supervisor must draw up written instructions describing the procedures to follow in emergency situations that require pool closure and the application of remedial measures, as well as a communications plan so the supervisor or monitor can report operational problems in an efficient manner.

Water Treatment

Efficient continuous filtration and adequate water recirculation in the pool reduce the amount of harmful particles in the water and make the disinfection process more effective. Both these processes are essential for maintaining water quality in the spa.

The water must be filtered and recirculated according to the manufacturer's recommendations. As a general rule, the water in the entire pool must be recirculated at least every 30 minutes, but if the spa is being used intensively, the water must be recirculated every five minutes. The filtration and disinfection system must remain in operation at all times (day and night) except if the spa is closed for a prolonged period or maintenance operations or repairs require these systems to be shut down.

It is also necessary to backwash and rinse the filters to ensure their effectiveness and prevent them from clogging up. It is important to follow the manufacturer's recommendations in this regard. Certain situations in particular call for filter backwashes, for example when pressure gauges before and after the filters show an important pressure differential, in cases of high pressure readings, when the water is cloudy, or if the turbidity standard is exceeded.

It is also important to check the automatic chemical injection systems several times a day, as well as the amount of chemicals in the injection tanks.

Information on Disinfectants

Disinfectant effectiveness decreases more rapidly when the number of bathers is high. For this reason, it is important to regularly measure disinfectant level in the water when there is a heavy bather load.

Devices are available that automatically and continuously measure the residual concentration of disinfectant in the spa in real time; it is called continuous monitoring. Some systems automatically add disinfectant. Although these systems are effective, concentrations should also be measured manually to validate the continuous measurements and ensure that the water is properly disinfected.

Chlorinated products are very effective in controlling bacteria in this type of pool. Salt systems (NaCl), which are in fact chlorine generators, are also very popular at the moment. These systems generate chlorine by salt electrolysis (sodium chloride). All standards specified in the *Regulation respecting water quality in swimming pools and other artificial pools* must be met when using these systems, including those pertaining to free chlorine residual and pH.

Bromine is also used as a disinfectant in spas. However, it loses its effectiveness when exposed to UV radiation from the sun. A larger quantity of bromine is required to match

the disinfecting capacity of chlorine. Bromine is less irritating than chlorine but is more likely to cause skin allergies.

“Chloramines” are undesirable substances produced by the interaction between chlorine and organic matter in the spa. Their disinfecting capacity is very low. Chloramines are usually responsible for the chlorine odor spa users complain about. Chloramines disperse into the surrounding air and can cause eye irritation, coughing, etc. The measures described in previous sections on water replacement and treatment, maintaining free chlorine residual concentrations, and equipment maintenance are all good ways to minimize the presence of chloramines.

“Bromamines” may also form when bromine is used. Unlike “chloramines”, “bromamines” maintain the same disinfecting power as bromine and are included in total bromine values.

Ozone is another substance that can be used to disinfect spa water. However, as ozone is toxic, it must not remain in the water because it may contaminate the surrounding air. So, the ozone must be removed from the water before additional disinfection methods are used to provide residual disinfection. The spa water thus gains its residual disinfecting capacity through the use of another disinfectant like chlorine at the concentrations specified in the regulation.

Draining the Spa and Adding Fresh Water

Frequently draining some of the spa water and adding fresh water on a daily basis is indispensable for ensuring water quality in these facilities. Adding fresh water prevents excessive accumulation of chemicals and contaminants generated by bathers. As a general rule, at least 30 liters of water a day per bather must be replaced. This partial drainage once a day can represent 20 to 50 % of the spa’s total water volume. The spa may need to be fully drained and filled with fresh water daily if the spa is being used intensively.

A heavy bather load and the presence of algae are also factors that influence the frequency with which water should be replaced. Heavy bather loads speed up water quality degradation. A water meter should be installed to measure and record the amount of fresh water added daily to the spa.

Preventive Shock Treatment

A preventive chlorine shock treatment applied when the spa is closed to the public disinfects the water in the pool and the various spa components (e.g., tubing), and reduces the amount of undesirable substances like chloramines that can affect user comfort and health. Shock treatment consists of keeping the chlorine concentration at 10 mg/L or more for one to four hours. It can be applied on a weekly or daily basis depending on water quality in the spa and how frequently water is replaced. Whenever the shock treatment is completed, the operator must always check that the water meets the standards

presented in Table 1 before reopening the spa to the public. However, under no circumstances can shock treatment be used to replace the other products normally used for regular spa maintenance. The operator should check that the equipment can handle frequent disinfection measures.

Spa Maintenance

It is recommended that spas should be completely emptied at least once a week. After draining the water, the bottom, walls, gutters, pipes, and prefilters should be cleaned, disinfected, and rinsed with a chlorine solution or as per the manufacturer's instructions. Some plumbing parts (e.g., the jets) can be hard to access and deserve special attention during cleaning. A preventive shock treatment can be performed before the spa is completely drained in order to disinfect all parts. The filters should be cleaned, unclogged, and disinfected as per the manufacturer's instructions. Draining the spa is also a good opportunity for inspecting the condition of the various parts.

When spas are provided with rental buildings (cottages, condos, etc.), the spa must be drained, cleaned, disinfected, refilled, and drained again at least once after each rental period. The equipment, including inside the pipes, must be completely dry before it is stored.

Incidents involving Vomit or Feces and Other Unsafe Situations

Certain conditions require the immediate closure, complete drainage, cleaning, and disinfection of the pool. Cleaning procedures and the list of unsafe situations that require the complete drainage, cleaning, and disinfection of the pool should be available from the operator.

Shock treatment should not be used as the sole method of disinfection after incidents involving vomit or feces in a spa. When such situations occur, completely draining, cleaning, and disinfecting the spa is the safest way to decontaminate it.

In such cases the operator must immediately evacuate the pool. The recirculation system must be stopped and as much solid matter as possible must be removed immediately from the pool using a portable sieve and disposed of in a sanitary manner. Afterwards, the operator must then completely drain the spa and clean, disinfect and rinse the bottom, walls, gutters, accessible plumbing, and prefilters. The filters must then be cleaned, unclogged, and disinfected. Superchlorinating the water after refilling the pool is recommended to disinfect inaccessible plumbing parts. The filtration and recirculation system must therefore be turned on during the superchlorination operation. Superchlorination procedures recommended for incidents involving loose stools is to maintain free chlorine residual at 20 mg/L for at least 13 hours at pH 7.5 or less. If vomit, solid feces, or blood are present, the free chlorine residual concentration must be kept at 2 mg/L for 30 minutes at pH 7.5 or less. During superchlorination, the water must be kept

at a temperature equal to or higher than 25 °C (77 °F). The pool cannot be reopened to the public until the standards for the various parameters set out in the *Regulation respecting water quality in swimming pools and other artificial pools* are met. Apart from the presence of vomit or feces, a number of other situations can also require the immediate closure, cleaning, and disinfection of the spa and its various parts.

Other unsafe situations require that the spa be closed immediately and certain remedial measures taken. The spa can be reopened only once measures to correct the situation have been completed. The person in charge should have a checklist of these situations.

The following are some examples of unsafe situations :

- Water temperature that is too high
- Inadequate water clarity, presence of foam, scum, or a greasy film on the water surface
- Presence of feces or vomit in the water
- Technical problems affecting water filtration and recirculation
- Substandard pH or turbidity values
- Low concentrations of residual disinfectant (< 0.8 mg/L of free chlorine residual or total bromine) in the water that cannot be immediately corrected
- Excess disinfectant (> 5 mg/L of free chlorine or total bromine)
- Chloramine concentrations above 1 mg/L for more than 24 hours
- Confirmation by a laboratory of the presence of pathogenic agents in a second water sample
- Notification that a bather has fallen ill after using the spa
- Any malfunction of the drain covers or suction system or any other problem that could threaten user safety
- Any other incident or condition that poses a health or safety risk

Maximum Number of Bathers

It is very important to always respect the maximum number of bathers permitted in the spa at any given time. This information, which is usually supplied by the manufacturer, must be placed where users can see it. As a general rule, there should be no more than one bather per square meter of the pool, but the manufacturer's recommendations may be stricter. Following this rule and showering with soap and warm water before entering the spa limits water quality degradation.

The operator is also advised to set up a schedule of five-minute breaks in spa usage when traffic is high to ensure that free chlorine residual levels are maintained. This could involve, for example, three 15 minute bathing periods per hour alternating with five-minute break periods. Users should be made aware of this rule.

2- Monitoring Water Quality, Inspecting Premises, and Keeping Daily Records

Monitoring the physico-chemical parameters of the water, using disinfectants and other products properly, and following proper treatment and maintenance procedures are the basic keys to maintaining water quality in spas. The following table presents the main physico-chemical parameters to monitor and the recommended analysis frequency for each. Most of these parameters are subject to a requirement in the *Regulation respecting water quality in swimming pools and other artificial pools*. The table also provides additional information on their importance.

Physico-Chemical Monitoring of Water Quality in Spas¹ - Main Physico-Chemical Parameters for Which the *Regulation respecting water quality in swimming pools and other artificial pools* Prescribes Standards

PARAMETER	STANDARDS	FREQUENCY	IMPORTANCE
Residual Disinfectant* Free chlorine Total bromine	2.0 to 3.0 mg/L 3.0 to 5.0 mg/L	Before opening the pool, after closing, and every three hours during operation	Helps eliminate pathogenic microorganisms
pH*	7.2 to 7.8	Before opening the pool, after closing, and halfway through the opening period	pH between 7.2 and 7.5 increases effectiveness of disinfectants
Clarity* (transparency)	The operator must be able to see the drain at the bottom of the pool (still water).	Before opening the pool, after closing, and halfway through the opening period	Provides a quick indication of water safety
Temperature*	35 to 40 °C (95 to 104 °F)	Before opening the pool, after closing, and halfway through the opening period	To ensure bather safety and comfort, the temperature should never exceed 40°C (104°F)
Chloramines* Outdoor spas Indoor spas	≤1.0 mg/L ≤0.5 mg/L	Before opening the pool, after closing, and halfway through the opening period	Limits amount of undesirable substances produced by the interaction between chlorine and perspiration, urine, etc. that can cause eye and skin irritation, respiratory symptoms, etc.
Alkalinity*	60 to 150 mg/L CaCO ₃	Once a week	Stabilizes pH and increases the effectiveness of disinfectants
Oxidation-Reduction Potential (ORP)	>750 mV	Before opening the pool, after closing, and halfway through the opening period	Directly measures the oxidizing activity of water disinfected with chlorine or bromine
Turbidity* Outdoor pools Indoor pools	≤1.0 UTN ≤1.0 UTN	Once every two weeks Once every four weeks	Another indicator of water quality degradation
Cyanuric acid Outdoor pools	≤60 mg/L	At least once a week	Prevents accumulation of cyanuric acid that reduces the disinfecting capacity of chlorine. Keep below 30 mg/L

*: Parameter for which the regulation prescribes a sampling frequency

¹: The regulation requires that operator monitor fecal coliform bacteria or *Escherichia coli* once every two weeks for outdoor pools and once every four weeks for indoor pools.

In outdoor spas, cyanuric acid is another parameter to check when stabilized chlorine is used as a disinfectant (chlorine is available in both free and stabilized forms). Cyanuric acid makes chlorine more resistant to UV radiation from the sun. However, it also has a tendency to accumulate in the water and reduce chlorine's effectiveness. Stabilized chlorine is prohibited in covered and even partially covered spas, and it is not recommended for use in outdoor spas. However, if it is used in outdoor spas, cyanuric acid concentration should be measured at least once a week. The *Regulation respecting water quality in swimming pools and other artificial pools* sets the maximum allowable concentration of cyanuric acid at 60 mg/L. However, cyanuric acid concentrations should be kept below 30 mg/L. Partial draining of the spa is the only way to reduce the amount of cyanuric acid in the water.

Chloramines concentration corresponds to the amount of combined chlorine in the water. It is calculated by subtracting the amount of free chlorine residual from total chlorine residual. This amount should be kept equal to or less than 0.5 mg/L and 1 mg/L in indoor and outdoor spas respectively to prevent eye and skin irritation and respiratory symptoms of bathers.

Turbidity indicates the amount of suspended solids in the water. As turbidity increases, water clarity decreases. When turbidity increases, chlorine becomes less effective in destroying microorganisms. According to the World Health Organization (WHO), disinfection is effective when turbidity does not exceed 0.5 NTU.

Failure to comply with standards may result in a number of situations requiring the immediate closure of the spa and the application of remedial measures. Automatic, real-time monitoring of free chlorine residual and pH, supported by manual measurements, makes it possible to better control physico-chemical parameters essential for maintaining water quality. The most effective way to minimize water quality degradation in these facilities is to implement all equipment maintenance measures, including replacing and repairing various parts (e.g., liners) and complying with spa hygiene and usage rules.

Water Temperature

It is essential to control spa water temperature. Water temperature should never exceed 40 °C (104 °F). Exposure to high temperatures can cause discomfort and even fainting and heat stroke. The following people are particularly vulnerable: children age five and under, adults over 65, pregnant women, people with heart problems or high blood pressure, or people who take certain antidepressants or medication for insomnia or poor blood circulation. The spa should have an independent device for keeping water temperature below 40 °C.

Sanitation and Ventilation of Premises

The premises must be kept clean to minimize contamination of spa water. The person in charge must inspect and clean areas around the pools and washroom facilities (toilets, showers, etc.) on a daily basis.

Adequate ventilation is required for indoor spas. Replacing 20 m³ of fresh air/hour/user improves air quality by reducing the amount of chlorination byproducts like chloramines and microorganisms in the air and ensures user comfort.

The spa should be covered and locked when not in use. This reduces the humidity inside the building. It is also a good way to reduce water quality degradation, prevent the accumulation of debris that could affect water quality, reduce evaporation of chemicals, and prevent drowning. Steps should also be taken to prevent access to the spa when the facility is closed (e.g. by installing fences).

Record Keeping

The *Regulation respecting water quality in swimming pools and other artificial pools* requires that the person in charge of a pool must keep a daily log. The log must contain information on the tests carried out on site, as well as the date, number of bathers, chemical dosage, and maintenance activities carried out during the day (backwashes, drainage, refilling, etc.), including steps taken following an incident. The log is also a useful tool during daily inspections to remind the person in charge of the various essential points to check. The day's log, as well as those for the 30 previous days, should be available to users. Logs should be kept for at least two years.

3- Operator Training

Training familiarizes operators with the equipment under their charge, as well as with water treatment, water quality monitoring, and spa maintenance. This ensures maximal spa safety. In some provinces like Ontario, operator training is compulsory or strongly recommended. In Québec, training is available in both French and English. For more information on available courses, contact Association des responsables aquatiques du Québec (ARAQ) at: <http://www.araq.net/fr/index.aspx>.

4- Advice for Users

Users must comply with the operator's instructions about bathing periods and the maximum number of bathers allowed in the spa at any given time. These instructions, included in spa rules, must be placed where they are readily visible to users, ideally at the entrance to the spa. Posting the rules in an obvious place helps remind bathers of the importance of acting carefully and safely. Ministère de la Santé et des Services sociaux (MSSS) has produced a poster entitled *Safe bathing in public hot tubs*. Posting these rules

in changing rooms and near the spas promotes the proper use of these facilities, in terms of both hygiene as well as health and safety. It is a way to educate customers about the role they must play in reducing the risk of outbreaks of recreational water illnesses (RWI). The operator must post these rules and specify the maximum number of bathers allowed in the pool.

All bathers must use the showers installed near the spas. Showering with soap and warm water before entering the spa removes perspiration, sun cream, beauty products, and other substances from bathers' skin, thus preventing water quality from deteriorating.

Users should wear a watch or use the clock at the spa to monitor the length of time they spend in the spa to ensure compliance with recommendations on bathing periods.

The following is a list of sample rules for spa users:

- ❖ Respect the maximum number of bathers at all times.
- ❖ Shower with soap and warm water before entering the spa. It is also recommended that you shower after using the spa to lower your body temperature.
- ❖ Children under five are not allowed in the spa.
- ❖ Children under 12 must be supervised by an adult.
- ❖ Respect the maximum recommended bathing period: 15 minutes for adults and 10 minutes for children.
- ❖ Do not bathe alone in the absence of a monitor.
- ❖ Do not put your head under water.
- ❖ Tie up long hair and remove jewelry and accessories that could be sucked into drains.
- ❖ Do not block suction drains.
- ❖ Do not use the spa if the drain cover is broken or missing, and advise the person in charge of any defect.
- ❖ Do not eat or drink near the spas.
- ❖ Pregnant women (especially in the first trimester) should avoid spas or consult their doctor beforehand.
- ❖ People with skin lesions (open wounds, eczema, psoriasis, etc.) should avoid spas.
- ❖ People with a contagious illness (e.g., gastroenteritis) should not use the spa.
- ❖ People who have consumed alcohol or medication causing drowsiness should avoid spas.
- ❖ People suffering from a serious illness should consult their doctor before using a spa.
- ❖ Users should report any defects.

5- Disposal of Wastewater

Spa wastewater contains chemicals that are toxic to aquatic organisms. Chlorine, bromine, and cyanuric acid concentrations in spas exceed acute toxicity thresholds for these contaminants. Section 20 of the *Environment Quality Act* requires spa owners to

ensure that waste from their spas does not impair wildlife quality. Under Section 22 of the Act, MDDE must authorize any wastewater release.

Wastewater can be released into the environment if treated beforehand. Dechlorination can be passive or active depending on the volume of water that needs treatment. Passive dechlorination of uncovered spas with the aerators in operation is sometimes enough to reduce concentrations to an acceptable level for the environment. Chemical dechlorination involves the use of sulfites or sulfur dioxide. In the case of bromine, the same method is used for dehalogenation as for dechlorination. It is important to avoid an excess of sulfur in wastewater because it can significantly lower the water's dissolved oxygen content.

The chlorine and bromine content of wastewater must be below detectable levels before it is released. Given cyanuric acid's toxicity for the environment, its use is not recommended.

For additional recommendations, please refer to the document *Position technique sur le rejet d'eaux chlorés dans le milieu aquatique*, available online at:

<http://www.mddep.gouv.qc.ca/eau/eaux-usees/position-tech-eauxchlorees.pdf>.

6- Additional Information

MDDEP is responsible for enforcing the *Regulation respecting water quality in swimming pools and other artificial pools*. In light of this obligation, MDDEP published *Guide d'exploitation des piscines et autres bassins artificiels* in 2007 as a tool to help spa operators. The guide is available in French on the MDDEP website:

<http://www.mddep.gouv.qc.ca/eau/piscine/index.htm>.

Methods for Taking, Preserving, and Analyzing Samples to Monitor the Water Quality of Pools and Other Artificial Reservoirs, DR-09-05, published in 2003 by Centre d'expertise en analyse environnementale du Québec (CEAEQ), describes the sampling procedures and methods of preserving water samples required under the *Regulation respecting water quality in swimming pools and other artificial pools*. An English-language version is available on the MDDEP website at:

http://www.ceaeq.gouv.qc.ca/documents/publications/echantillonnage/piscines_bassinsart_en.pdf.

MSSS has produced a poster describing the main hygiene, safety, and security rules to enforce to minimize the risks associated with bathing in public spas. The poster entitled *Safe bathing in public hot tubs* is available on the MDDEP website at:

http://www.msss.gouv.qc.ca/sujets/santepub/environnement/index.php?eaux_recreatives.

7- Duties

The person in charge of a pool must be vigilant and use all available means to protect water quality by:

- Following the *Regulation respecting water quality in swimming pools and other artificial pools* (standards and analysis schedule) and keeping a daily log
- Ensuring compliance with in-house hygiene rules
- Ensuring compliance with the maximum number of bathers in the spa to help maintain water quality within standard levels
- Keeping the facilities clean
- Properly treating and disinfecting the water
- Closing the pool temporarily if necessary

MDDEP handles complaints arising under the *Regulation respecting water quality in swimming pools and other artificial pools*. The person in charge of the pool must contact a specialized firm for appropriate technical advice on managing water quality.

Users also play an important role in ensuring the safety of these facilities. Users must talk to the person in charge of the pool about any safety or water quality problem in the pool. If users are still not satisfied, they must notify their regional MDDEP office, which will do a follow up of the complaint (www.mddep.gouv.qc.ca/regions/index.htm). If pool users experience symptoms or health problems after bathing, they should contact their family doctor or local CLSC.

References

Brousseau, N., Lévesque, B., Guillemet, T., Gauvin, D., Giroux, J.-P., Cantin, P., Gingras, S., and Laverdière, D. 2009. *Étude de la contamination microbiologique de spas publics au Québec*. Institut national de santé publique du Québec.

Centers for Disease Control. *Hot Tub User information: Protect Yourself from Recreational Water Illnesses and Stay HOT! Healthy Swimming* (online). <http://www.cdc.gov/healthywater/pdf/swimming/resources/hot-tub-user-tips-factsheet.pdf>.

Centers for Disease Control. *Operating Public Hot Tubs*. Healthy Swimming (online). <http://www.cdc.gov/healthywater/pdf/swimming/resources/operating-public-hot-tubs-factsheet.pdf>.

County of San Bernardino, Department of Public Health, California. May 2009. *Fecal accident and vomitus in public swimming pools/spas*. Technical Bulletin No. 13.

Government of Québec. 2007. *Guide d'exploitation des piscines et autres bassins artificiels*. (Online, in French only). <http://www.mddep.gouv.qc.ca/eau/piscine/guide-exploitation.pdf>.

Government of Québec. 2007. *Regulation respecting water quality in swimming pools and other artificial pools*, (Online). http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=3&file=/Q_2/Q2R39_A.htm.

Government of Québec. 2010. *Regulation respecting safety in public baths*, (Online). http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=3&file=/S_3/S3R3_A.htm.

Government of Québec. 2010. *Public Buildings Safety Act* (Online). http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=2&file=/S_3/S3_A.htm.

Government of Ontario. 2006. *Ontario Regulation 428/05. Public Spas*. (Online). http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_050428_e.htm.

Government of South Australia. 2008. *Private Spa Pools: A Maintenance Guide for Owners*. (Online). <http://www.health.sa.gov.au/PEHS/PDF-files/ph-factsheet-spa-pools.pdf>.

Government of South Australia. 1998. *Standard for the Operation of Swimming Pools and Spa Pools in South Australia*.

Health Protection Agency and Health and Safety Executive. 2006. *Management of Spa Pools, Controlling the Risks of Infection.*

République française. Ministère de la Santé et des Sports. July 2010. Direction générale de la Santé. *Guide pour les exploitants relatif à la prévention des risques infectieux et notamment de la légionellose dans les bains à remous (SPAS) à usage collectif et recevant du public.*

State Government of Victoria, Australia, Department of Health. May 2010. *Faecal Accident Policies.*

World Health Organization. 2006. *Guidelines for Safe Recreational Water Environments. Volume 2. Swimming Pools and Similar Environments.*