FINAL P

CANADIAN ENVIRONMENTAL LAW ASSOCIATION
L'ASSOCIATION CANADIENNE DU DROIT DE L'ENVIRONNEMENT

Comparison of the Guidelines for Canadian Drinking Water Quality to Provincial Guidelines and Standards and to Selected International Guidelines and Standards

Prepared for the Office of the Auditor General by the Canadian Environmental Law Association
Researcher, Anne Wordsworth

January 2005

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ındings:

UMMARY:

ılmost all the provinces and territories use the Guidelines for Canadian Drinking Water Quality (the Guidelines), although there is a wide ange in the way they apply them.

Alberta and Nova Scotia accept all the health-related microbiological, physical and chemical parameters of the current Guidelines document, and make reference to the Guidelines for Canadian Drinking Water Quality in their legislation as being the maximum and interim maximum acceptable levels for contaminants in drinking water. Both provinces have established the Guidelines as legally enforceable standards. Alberta has been the most rigorous in using the Guidelines to set binding standards for drinking water, adopting the radiological parameters of the Guidelines as well as all health-related microbiological, physical and chemical parameters. Nova Scotia has limited its legislation to the microbiological, physical and chemical parameters. For these two provinces, there are no deviations from the Guideline values.

Ontario and Quebec have also used the Guidelines to establish a comprehensive list of drinking water standards, which are specified in their drinking water regulations. However, Ontario and Quebec (unlike Alberta and Nova Scotia) have used the specific numerical values from the Guidelines for the contaminants listed in their regulations, rather than referring to the Guideline document itself. Unlike Alberta and Nova Scotia, they do not reference the Guidelines for Canadian Drinking Water Quality in their regulation, although the values are, in most cases, the same. This means that, if a federal guideline were added or revised, Ontario and Quebec would have to change a specific value for that parameter in their regulations to conform to the Guideline value. For Ontario and Quebec, the Guidelines, which are adopted in the regulations, are legally binding.

In the case of several parameters, Quebec has adopted values that are not the same as the federal Guidelines. For total trihalomethanes (THM), Quebec has adopted a more protective standard of 0.08 milligrams per litre (the federal guideline is 0.10). Quebec has the same THM standard now adopted in the United States. Quebec has also established different criteria for turbidity, and with respect to disinfection, Quebec requires the almost total elimination of *Giardia, Cryptosporidium* and viruses. Quebec has adopted several specific radioactive parameters, but has not adopted the comprehensive list of radioactive parameters from the federal Guidelines. As well, Quebec has included Gross Alpha and Gross Beta as radiological standards for drinking water, in addition to the specific radioactive parameters. Gross Alpha and Gross Beta are not listed in the federal guidelines.

l the Guidelines for Canadian Drinking Water Quality have been adopted by Ontario as drinking water standards, including the standards r radiological substances. Ontario is the only province, other than Alberta, that has adopted all the radiological parameters in the Guidelines ıd made them legally enforceable standards. In addition, Ontario has set standards for a number of parameters that are not identified in the uidelines for Canadian Drinking Water Quality. These include Alachlor, Chlordane, Heptachlor and heptachlor expoxide, DDT, Lindane, DMA (nitrosodimethylamine), PCBs, Prometryne, Temephos, Triallate, 2,4,5-T and Dioxin.

)ther provinces have been more selective in the number of guidelines that they have chosen to adopt as legally enforceable standards. ;askatchewan and the Northwest and Nunavut Territories have adopted legally enforceable limits for a smaller subset of contaminants based ›n the Guidelines.

Saskatchewan under its Water Regulations has established standards for 39 chemical parameters, in addition to microbiological standards and standards for radiological parameters (Gross Alpha and Gross Beta like Quebec). The values for these 39 chemical parameters are identical to the values set by the Guidelines for Canadian Drinking Water Quality.

The Northwest and Nunavut Territories have established values identical to the Guidelines for Canadian Drinking Water Quality for only half of their 20 legislated standards for chemical parameters. Of the 10 other chemical standards in their legislation, the Northwest Territories and Nunavut have set standards for four parameters for which there are no federal guidelines. These are Alkyl benzene sulfonate, Carbon chloroform extract, Phenols and Silver. In addition, they have established standards, which are higher than the values in the Guidelines for Arsenic, Cadmium, Fluoride and Lead, and values lower than the Guidelines for Cyanide and Sulphate. The Northwest Territories and Nunavut also have a standard for Turbidity that is higher than the federal guidelines, and have adopted different criteria for microbiological and radiological characteristics of drinking water in their legislation.

The Yukon Territory, in its draft revised drinking water regulation, proposes to adopt a number of the Guidelines for Canadian Drinking Water Quality. It lists several parameters in Schedule B for which drinking water must be routinely tested, and which must not exceed the Canadian Drinking Water Guidelines. Schedule B also includes several parameters not listed in the Guidelines that are generally included in a "drinking water package" offered by most laboratories. These include Alkalinity, Calcium, Magnesium and Potassium. Although the Yukon Territory does not include parameters for all the federal guidelines in its Regulation, it does state that if there is a reason to suspect the presence of other substances in drinking water that are not specified in the regulation, then these contaminants should be monitored and should meet the criteria of the Guidelines for Canadian Drinking Water Quality. This regulation, however, is not yet finalized.

British Columbia had regulated the physical and chemical parameters set by the federal Guidelines in the original drinking water regulation (Schedules B and C) under its Drinking Water Protection Act. However, those Schedules were rescinded. Now, only the microbiological standards (Schedule A) are legally enforceable. These are comparable to the Guidelines for Canadian Drinking Water Quality but not

entical. The Ministry of Health Services of British Columbia refers to the Guidelines for Canadian Drinking Water Quality to assess inking water quality, as well as the guidelines and standards set by other organizations such as the World Health Organization, the U.S. nvironmental Protection Agency and the Ontario Ministry of the Environment.

ther provinces such as Manitoba, Prince Edward Island, New Brunswick and Newfoundland and Labrador use the Guidelines for Canadian rinking Water Quality only as objectives for assessing drinking water quality. Manitoba, however, has provisions under its Drinking Water afety Act for establishing regulations for drinking water standards. Draft regulations are being finalized now for consultation. Prince dward Island suggests only five guidelines for health-based contaminants to determine the acceptability of drinking water. Both Jewfoundland and New Brunswick monitor a limited number of contaminants for which there are federal guidelines. The two provinces eport regularly on exceedences of the Guideline values in their water testing programs. Newfoundland makes all drinking water monitoring nformation publicly available on its website. However, none of these provinces currently have legally enforceable provincial drinking water standards.

The following descriptions of the provinces (in alphabetical order) outline in more detail drinking water legislation, and the way in which each province applies the Guidelines for Canadian Drinking Water Quality within its legislation or policies.

Alberta

Drinking water is regulated by Alberta Environment under the Environmental Protection and Enhancement Act. The Environmental Protection and Enhancement Act provides powers to Alberta Environment for the regulation of waterworks systems which supply drinking water. The Potable Water Regulation makes the health-related parameters of the Canadian Drinking Water Guidelines legal requirements for drinking water systems in Alberta. The government requires that the physical, chemical, microbiological and radiological quality of potable water meet the limits in the latest edition of the Guidelines for Canadian Drinking Water Quality.

Section 6 of The Potable Water Regulation (Alta. Reg. 277/2003), “Potable Water Quality”, specifically requires that:

6 (1) The physical, microbiological, chemical and radiological characteristics of the potable water in a waterworks system must be maintained to meet as a minimum:

(a) the applicable Maximum Acceptable Concentration or Interim Maximum Acceptable Concentration specified in the Guidelines for Canadian Drinking Water Quality, published by Health Canada, as amended or replaced from time to time, for the parameters

listed in the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, published by the Department, as amended or replaced from time to time, and

(b) any additional or other limits established by the Director in an approval or a code of practice."

ɿe Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, Operating and Monitoring Requirements ıd Guidelines – Waterworks Systems, requires under 9.1.3 Operations that "...the treated water shall, at a minimum, meet the health related ɔncentration limits for substances listed in the "Guidelines for Canadian Drinking Water Quality (GCDWQ)."

3ritish Columbia

In May 2003, the provincial government of British Columbia introduced an amended Drinking Water Protection Act and Drinking Water Protection Regulation. In the original Drinking Water Regulation introduced in 2001, three Schedules in the regulation established the Guidelines for Canadian Drinking Water as standards for drinking water in B.C. However, in Sept. 2001 the provincial government rescinded Schedules B and C of the Safe Drinking Water Regulation that contained health-related chemical standards and additional chemical and physical standards. The government retained only Schedule A, which contains limited microbiological standards (fecal coliform, E. coli, and total coliform).

Eliminating health-related chemical and physical standards was contrary to the advice of the Drinking Water Review Panel that reviewed the Act and reported in February 2002. This Panel recommended in their final report the creation of province-wide tap-water standards, and recommended the appointment of an expert working group to consider the Canadian guidelines and standards used in other jurisdictions, and to develop an appropriate set of science-based minimum standards for B.C. and a monitoring schedule.

Currently, Part 2 – Drinking Water Supply, of the Drinking Water Protection Act, Chapter 9, says that:

Subject to the regulations, a water supplier must provide, to the users served by its water supply system, drinking water from the water supply system that:

(a) is potable water, and

(b) meets any additional requirements established by the regulations or by its operating permit (Section 6).

The government of British Columbia refers primarily to the Guidelines for Canadian Drinking Water Quality in assessing drinking water quality. However, they also refer to the guidelines and standards of other jurisdictions, including the Ontario Ministry of the Environment,

e United States Environmental Protection Agency and the World Health Organization, as well as to emerging information from published ticles.

Ianitoba

n 2002, Manitoba enacted the Drinking Water Safety Act and established the Office of Drinking Water as part of Manitoba Conservation (the nvironment ministry of Manitoba), following the recommendations of its Drinking Water Advisory Committee.

Not all sections of the Drinking Water Safety Act are currently in force, and some aspects of drinking water are still subject to the older Public Health Act. The Drinking Water Safety Act has provisions for establishing regulations "specifying drinking water quality standards" (Section 39 (1) (d)). However, there are no regulations established yet under this section. Two regulations are being finalised for consultation: The Drinking Water Safety Regulation and The Drinking Water Standards Regulation. As of February 1, 2005, they have not been released.

They will replace the two regulations under the Public Health Act that are currently in force with respect to drinking water – "Water Supplies Regulation" and "Water Works, Sewerage and Sewage Disposal Regulation" under the Public Health Act. Currently, Manitoba only requires that "the quality of water for domestic purposes, in any residence, business, or industry shall meet accepted standards of potability subject to the approval of the medical officer of health or the minister." (Section 2, "Water Supplies Regulation", Public Health Act).

The Office of Drinking Water states that "with respect to water quality goals, the Office of Drinking Water adopts Health Canada's Guidelines for Canadian Drinking Water Quality". However, these guidelines are used to assess the quality of drinking water supplies and are not currently legally enforceable standards in Manitoba. Furthermore, Manitoba tests only for bacterial and chemical quality of drinking water. The Office of Drinking Water does not refer to the radiological parameters in the Guidelines.

New Brunswick

New Brunswick has put in place the Clean Water Act and the Potable Water Regulation to protect drinking water. The Department of Health and Wellness has responsibility for monitoring drinking water quality, while the Department of the Environment and Local Government has responsibility for testing some municipal water supplies.

ɪe Potable Water Regulation requires regular testing of public water supplies and wells. Well owners must submit samples of their drinking ater supply for testing to the province within a year of digging a new well. In the case of a public water supply, the Potable Water egulation requires:

(1) An owner of a public water supply system shall
    (a) have a sampling plan that is approved by the Minister of Health and Wellness,
    (b) ensure that the water in the system is collected and tested in accordance with the sampling plan.

The Potable Water Regulation does not have specific standards that drinking water supplies are required to meet.

The government states that there are various guidelines used in protecting the Province's water, including the Guidelines for Canadian Drinking Water Quality. However, it is not clear how the guidelines are used and applied, only that they are used as a benchmark for judging the quality of drinking water samples. The Department of Environment and Local Government does 60 per cent of the tests on municipal water supplies, the rest being done by other laboratories. Of those tested by the Department, between 4 and 8 per cent of the *pre-treatment* samples have exceeded certain federal Guidelines since 1994, although they do not say which federal guidelines have been exceeded.

Newfoundland and Labrador

The Newfoundland and Labrador Dept. of Environment, in partnership with municipal governments, monitors tap water quality of public water supplies for selected physical parameters and major ions and for selected nutrients and metals. These monitoring results are reported on its website and indicate which parameters exceeded the "Guidelines for Canadian Drinking Water Quality". Bacteriological standards are based on the Guidelines for Canadian Drinking Water Quality.

There are no legally binding provincial standards for chemical and physical parameters. Newfoundland and Labrador use the chemical and physical guidelines specified in the Guidelines for Canadian Drinking Water Quality, 6th Edition, 1996 or as revised, as provincial objectives. Newfoundland states that "chemical and physical guidelines as specified in the Guidelines for Canadian Drinking Water Quality, as revised, shall be considered as objectives which are applicable to the province of Newfoundland and Labrador... If it is determined that water quality criteria are exceeded, priority should be given to meeting the Guideline objectives taking into account costs, the degree of exceedance and local factors."

Testing is not required for all parameters for which there are federal Guidelines. Newfoundland and Labrador have a list of the minimum chemical and physical parameters which must be monitored. They include those parameters that are included in standard chemical analysis

d metal scan packages. This list also includes several parameters for which there are no maximum acceptable concentrations in the ıidelines. These are required for "normal operational evaluation". They include: Ammonia, Calcium, Conductivity, Hardness, Magnesium, ›tassium and Total Organic Carbon. The government of Newfoundland has not set any guidelines or maximum acceptable levels for these ırameters.

lova Scotia

n October 2000, Nova Scotia put into effect the "Water and Wastewater Facility Regulations" (Reg. 140/2000) under the Environment Act. ?ublic drinking water supply owners must register their water supplies under a process monitored by Nova Scotia Environment and Labour. The Water and Wastewater Facility Regulations state that: "An owner shall ensure that the microbiological, physical and chemical characteristics of a public drinking water supply do not exceed the maximum acceptable concentration (MAC) and interim maximum acceptable concentration (IMAC) for substances listed in the Guidelines for Canadian Drinking Water Quality" (Section 18).

In effect, Nova Scotia like Alberta has made the Guidelines regulated standards, with the exception of the extensive list of radiological limits suggested by the federal Guidelines. However, in its "Guidelines for Monitoring Public Drinking Water Supplies" Nova Scotia sets out a table of minimum parameters to be monitored, similar to the monitoring done of public water supplies by Newfoundland and Labrador. These include the inorganic and physical parameters that are included in standard general chemical analysis and metal scan packages available at most laboratories. An owner is only obliged to monitor for other substances if there is reason to suspect the presence of other substances not listed in the table.

Ontario

After the seven deaths at Walkerton from contaminated water, Ontario replaced its drinking water guidelines with legally binding standards. Subsequently, in 2002 the government passed the Safe Drinking Water Act, and under the new Act, established the Ontario Drinking Water-Quality Standards (O.Reg. 169/03). This regulation now sets out all legally enforceable standards for drinking water contaminants in the province. The Regulation sets out specific numerical limits for drinking water parameters, including microbiological, chemical and radiological standards. The drinking water standards generally reflect the Guidelines for Canadian Drinking Water Quality, although additional standards for which there are no federal guidelines have been set for several pesticides and a number of other high profile contaminants such as PCBs and dioxin.

. addition, the Safe Drinking Water Act includes a provision for the Ontario Minister of the Environment to establish an Advisory Council to ake recommendations on new or revised drinking water standards not under consideration by the Federal-Provincial-Territorial Committee ı drinking water standards. In May 2004, the Minister set up the Advisory Council on Drinking Water Quality and Testing Standards. This ouncil has a mandate to review scientific and technical documentation of proposed standards, to do public consultation, to undertake lditional consultation to clarify issues, and to consider and make recommendations on adopting standards for contaminants that are not ırrently being considered through the federal-provincial process for developing Canada-wide drinking water guidelines (Media Release, linistry of the Environment, May 12, 2004).

rince Edward Island

rince Edward Island has no legislation governing drinking water. It recommends a limited number of the Guidelines for Canadian Drinking Vater Quality as criteria for assessing the acceptability of drinking water. These include guidelines for chemical and physical characteristics.

uebec

uebec has generally adopted all the health-related microbiological, organic and inorganic Guidelines for Canadian Drinking Water Quality s standards under the "Regulation respecting the Quality of Drinking Water", under the Environment Quality Act. Like Ontario, the arameters and the maximum concentrations are explicitly listed in Annex 1- Standards of Quality of Drinking Water under the Regulation ıpdated to November 2004).

nnex 1 sets out standards for microbiological parameters, inorganic substances, organic substances, radioactive substances, pH and ırbidity. With respect to the federal guidelines for radiological substances, Quebec has adopted only a selected number of radiological arameters as standards for drinking water in the province, compared to Ontario where all the federal Guidelines for radioactive parameters re established as legal limits in the Ontario drinking water regulation. However, Quebec has adopted radiological standards for gross Alpha nd gross Beta parameters.

uebec has also deviated from the federal Guidelines by adopting a lower standard for total Trihalomethanes, different criteria for Turbidity nd by specifying in its regulation the treatment standard that must be met for Cryptosporidium, Giardia and Viruses.

askatchewan

or Saskatchewan, legally enforceable standards have been set under The Water Regulations, 2002, of The Environmental Management and 'rotection Act, 2002. Section 29 in Division 5, Part V, of The Water Regulations state that "the minister may adopt all or any part of the Guidelines for Canadian Drinking Water Quality, Sixth Edition, Health Canada, 1996, as amended from time to time for purposes of this Division." To adopt all or part of the guidelines, the Minister must publish a notice in the Gazette.

The Regulations set out the standards for microbiological quality of drinking water and turbidity, and Table 2 of the Regulations sets out the standards for chemicals related to health, the radiological screening parameters and pesticides, and their maximum acceptable concentrations. There are 39 health related chemicals and pesticides. The maximum acceptable concentrations in Saskatchewan's regulations are adopted from the Guidelines, but not all Guideline values are adopted as standards e.g. Diazinon. The pesticides for which standards have been set in Saskatchewan are the pesticides commonly used in that province.

For radioactivity, if samples exceed Gross Alpha or Gross Beta concentrations in the Table, then Part 5 of the Guidelines for Canadian Drinking Water Quality apply. The aesthetic objectives (AO) are only objectives for drinking water quality in Saskatchewan, and are not legally enforceable requirements.

Northwest Territories

Northwest Territories has established standards for microbiological, physical, chemical and radiological contaminants under the Public Water Supply Regulations (R.R.N.W.T. 1990, c.P-23) of the Public Health Act. Section 10 establishes the microbiological standards for drinking water in the Northwest Territories. Section 11 (Physical Characteristics) and Section 12 (Chemical Characteristics) of the Public Water Supply Regulations, establish the maximum limits for physical and chemical parameters, and Section 13 establishes Radioactive Characteristics. These Regulations include the amendments made by R-015-2004.

There is no reference to the Guidelines for Canadian Drinking Water Quality in the Public Water Supply Regulations, and the Northwest Territories has not applied the Guidelines for many of their drinking water standards. Of the 20 standards for physical and chemical

ıarameters, ten are identical to the Guideline values. With respect to the other 10 parameters, there are standards for four parameters that are ıot included in the Guidelines -- Alkyl benzene sulfonate, Carbon chloroform extract, Phenols and Silver. In addition, for 5 parameters -- \rsenic, Cadmium, Cyanide, Fluoride and Lead, the Northwest Territories has set values which are higher than the Guidelines and for two ›arameters - Sulphate and Cyanide, the values in the Regulation are lower. Their criteria for microbiological standards, Turbidity and ₹adiological quality of drinking water also differ from the Canadian Guidelines.

Yukon Territory

The Yukon government drafted guidelines for new regulations to protect drinking water after the incidents at Walkerton, Ontario, and North Battleford, Saskatchewan. Two documents, the "Public Drinking Water Systems Regulation" and the "Bulk Delivery of Drinking Water Regulation" have both been sent out for public consultation in 2003, but no final regulations appear to have been issued.

The draft revised "Public Drinking Water Systems Regulation" (Section 42 (1)) requires monitoring for:

(a) bacteriological quality,
(b) general chemical and physical quality, as outlined in Schedule B,
(c) turbidity, where the water source is a surface water supply or well under the direct influence of surface water; and,
(d) trihalomethanes
(e) other organisms and/or substances as may be required by a health officer.

The owner of the drinking water supply must ensure that monitoring results for microbiological, chemical and physical characteristics do not exceed the acceptable concentrations for health-related parameters as set out by the Guidelines for Canadian Drinking Water Quality (Section 44 (1)). Section 42 (2) requires that owners monitor for other substances only "if there is a reason to suspect the presence of other substances in the drinking water, not listed in subsection (1)". If these are monitored, then their concentrations must meet the health-related criteria of the Guidelines for Canadian Drinking Water Quality. The Yukon government does not refer to any radiological parameters.

Schedule B of the "Public Drinking Water Systems Regulation" shows the substances routinely used to monitor the chemical and physical quality of drinking water offered in a drinking water sampling package by most laboratories. No specific values are assigned to these parameters. In any monitoring program, the results should not exceed the Guidelines for Canadian Drinking Water Quality, according to the proposed regulation.

ınavut Territory

ınavut has continued the Northwest Territories Public Health Act and Public Water Supply Regulations, which are now the Nunavut statute d regulations governing drinking water. Like Northwest Territories, Nunavut has standards for microbiological, physical, chemical and diological contaminants under the Public Water Supply Regulations (R.R.N.W.T. 1990, c.P-23) of the Public Health Act.

ıere is no reference to the Guidelines for Canadian Drinking Water Quality in the Public Water Supply Regulations. Of the 20 standards for ıysical and chemical parameters, 10 are identical to the Guideline values. With respect to the other 10 parameters, there are standards for ur parameters that are not included in the Guidelines -- Alkyl benzene sulfonate, Carbon chloroform extract, Phenols and Silver. In ldition, for 5 parameters --Arsenic, Cadmium, Cyanide, Fluoride and Lead, Nunavut, like the Northwest Territories, has values which are gher than the Guidelines and for two parameters - Sulphate and Cyanide, the values in the Regulation are lower. Their criteria for ıicrobiological standards, Turbidity and Radiological quality of drinking water also differ from the Canadian Guidelines.

ıETHODOLOGY

'he comparisons of the federal Guidelines for Canadian Drinking Water Quality to provincial guidelines and standards and to the United ;tates Safe Drinking Water Act standards and the World Health Organization Guidelines for Drinking Water Quality, are set out in four ables. In all Tables, bold highlighting has been used to identify those values for parameters that differ from the Guidelines, or parameters for vhich there are currently no Canadian guidelines. In each table, the complete list of Canadian Guidelines for microbiological criteria for lrinking water are presented first, followed by chemical and physical parameters, and then radionuclides. Footnotes are used where further larification or explanations are necessary.

'able 1 compares the federal Guidelines to the drinking water criteria, guidelines and standards used in the first 5 provinces by alphabetical rder. At the end of this table, the federal Guidelines proposed for consultation are listed.

'able 2 compares the federal Guidelines to the drinking water criteria, guidelines and standards used in the other 5 provinces by alphabetical rder.

'able 3 compares the federal Guidelines to the drinking water criteria, guidelines and standards used by the 3 territorial governments. This able does not include the complete list of radionuclides for which there are Canadian guidelines because the Territories have used different riteria for defining radioactive characteristics of drinking water.

ıble 4 compares the federal Guidelines to the standards adopted by the United States under its Safe Drinking Water Act, and to the ıidelines for Drinking Water of the World Health Association. Table 4.1 sets out the complete list of Guidelines for Canadian Drinking 'ater Quality, and illustrates where the United States and the World Health Organization have or have not established guidelines for these ırameters. Where different criteria or values are used by the United States or the WHO, these are highlighted in bold. This Table includes ıicrobiological, physical and chemical parameters. It also includes a list of the proposed Canadian guidelines and compares values adopted y the United States or the WHO. Table 4.2 sets out all the chemical and physical parameters for which the U.S. and the WHO have set uidelines but for which Canada has not (except for microbiological criteria which are covered in Table 4.1). Table 4.3 illustrates the ifferences between the United States, the WHO and Canada with respect to the standards and guidelines set for radiological characteristics of rinking water.

Table 1

Comparison of Federal Guidelines for Canadian Drinking Water Quality

to the Guidelines and Standards of the Provinces of

Alberta, British Columbia, Manitoba, New Brunswick and Newfoundland

ıble 1: Comparison of Federal Guidelines for Canadian Drinking Water Quality to the Guidelines and Standards of the Provinces Alberta, British Columbia, Manitoba, New Brunswick and Newfoundland

ameter	Canada (Maximum Acceptable Concentration)	Alberta[1]	British Columbia[2]	Manitoba[3]	New Brunswick[4]	Newfoundland[5]
ıcroorganisms:						
coli	0[6]	0	No detectable E. coli per 100 ml; **No detectable fecal coliform bacteria in 100 ml**[7]	0		0
ɔtal coliforms	No coliforms detectable per 100 mL (with descriptive	No coliforms detectable per 100 mL (with descriptive	No detectable total coliform bacteria per 100 mL for 1 sample in a 30 day	No coliforms detectable per 100 mL (with descriptive		No coliforms detectable per 100 mL (with descriptive

[1] Alberta has legislated that the microbiological, physical, chemical and radiological quality of potable water must meet the health related concentration limits in the latest edition of Health Canada's Guidelines for Canadian Drinking Water Quality.
[2] British Columbia has established legally enforceable standards only for microbiological parameters. The Guidelines for Canadian Drinking Water Quality are primarily used as a reference to determine drinking water quality in British Columbia.
[3] Manitoba says it has adopted the federal Guidelines but they are not legally binding. However, Manitoba is about to release a drinking water standards regulation for public consultation that will contain numerical drinking water standards.
[4] New Brunswick states that various guidelines are used in protecting the Province's water including the Guidelines for Canadian Drinking Water Quality. However, they are used to assess drinking water quality, rather than being applied as legally enforceable standards.
[5] Newfoundland has no provincial standards but the provincial government does regular testing for the parameters that are listed, and they accept the federal Guidelines as objectives for maximum concentrations. Newfoundland's bacteriological guidelines are based on the Guidelines for Canada Drinking Water Quality, 6th edition, as revised.
[6] The federal guidelines for the bacteriological quality of water systems under review. The current guideline states that:
"Drinking water that fulfills the following conditions is considered to conform to this MAC:
1. No sample should contain *Escherichia coli*...If E. coli is confirmed, the appropriate agencies should be notified, a boil water advisory should be issued and corrective actions taken.
2. No consecutive samples from the same site or not more than 10% of samples from the distribution system in a given calendar month should show the presence of total coliform bacteria."
[7] **Bold** is used to indicate where provinces have adopted criteria or values that are not the same as the federal Guidelines for Drinking Water Quality.

ameter	Canada (Maximum Acceptable Concentration)	Alberta[1]	British Columbia[2]	Manitoba[3]	New Brunswick[4]	Newfoundland[5]
	criteria)[8] Under review (R)[9]	criteria)	period; For more than 1 sample in a 30 day period, at least 90 per cent of samples have no detectable total coliform bacteria per 100 ml, and no sample has more than 10 per 100 ml	criteria)		criteria)
yptosporidium	Under review (R)					
iardia	Under review (R)	**TT**[10]				
iruses (enteric)	Under review (R)	**TT**				
hemical and Physical Parameters (all values are expressed in mg/L unless otherwise stated):						
ldicarb	0.009	0.009		0.009		
ldrin + Dieldrin	0.0007	0.0007		0.0007		
luminum[11]	0.1			0.1		tests
mmonia						tests[12]
ntimony	0.006 (IMAC)[13]	0.006 (IMAC)		0.006 (IMAC)		0.006 (IMAC)
rsenic	0.025 (R)[14]	0.025		0.025		0.025

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[8] See footnote 7 for criteria.
[9] (R) indicates that the current Canadian drinking water guideline is under review.
[10] Accomplished through treatment technology. Although these are not formally adopted as standards, Alberta requires surface waters to have filtration and disinfection to achieve 3-log reduction of Giardia and 4-log reduction of viruses.
[11] A health-based guideline for aluminum has not been established. Operational guidance values of less than 100 micrograms/L total aluminum for conventional treatment plants and less than 200 micrograms/L total aluminum for other types of treatment systems are recommended.
[12] Newfoundland and Labrador test for Ammonia, Bromide, Magnesium, Conductivity, Hardness, Calcium, Potassium and Total Organic Carbon, for which there are no federal guidelines. Nor does the province set guidelines for these parameters. However, they consider them important for normal operational evaluation.
[13] Interim Maximum Acceptable Concentration
[14] The proposed guideline for arsenic is 0.005 Maximum Acceptable Concentration.

ameter	Canada (Maximum Acceptable Concentration)	Alberta[1]	British Columbia[2]	Manitoba[3]	New Brunswick[4]	Newfoundland[5]
azine + metabolites	0.005	0.005		0.005		
nphos-methyl	0.02	0.02		0.02		
ium	1.0	1.0		1.0		1.0
ıdiocarb	0.04	0.04		0.04		
ızene	0.005	0.005		0.005		
nzo(a)pyrene (PAHs)	0.00001	0.00001		0.00001		
ron	5.0	5.0		5.0		5.0
omate	0.01 (IMAC)	0.01 (IMAC)		0.01 (IMAC)		
omide						tests
omoxynil	0.005	0.005		0.005		
ıdmium	0.005	0.005		0.005		0.005
alcium						tests
arbaryl	0.09	0.09		0.09		
arbofuran	0.09	0.09		0.09		
arbon tetrachloride	0.005	0.005		0.005		
hloramines	3.0	3.0		3.0		
hloride	≤250 (AO)			≤250 (AO)		250 (AO)
hlorpyrifos	0.09	0.09		0.09		
hromium	0.05	0.05		0.05		0.05
olour	≤15 TCU	≤15 TCU		≤15 TCU		15 TCU
onductivity						tests
opper	≤1.0 (AO)			≤1.0 (AO)		1.0 (AO)
yanazine	0.01	0.01		0.01		
yanide	0.2	0.2		0.2		
yanobacterial toxins (as ıicrocystin-LR)	0.0015	0.0015		0.0015		
)iazinon	0.02	0.02		0.02		
)icamba	0.12	0.12		0.12		
,2-Dichlorobenzene / o-Dichlorobenzene	0.2	0.2		0.2		

ameter	Canada (Maximum Acceptable Concentration)	Alberta[1]	British Columbia[2]	Manitoba[3]	New Brunswick[4]	Newfoundland[5]
-Dichlorobenzene / p-:hlorobenzene	0.005	0.005		0.005		
-Dichloroethane	0.005	0.005		0.005		
-Dichloroethylene nylidene chloride)	0.014	0.014		0.014		
chloromethane	0.05	0.05		0.05		
l-Dichlorophenol	0.9	0.9		0.9		
l-Dichlorophenoxy-etic acid (2,4-D)	0.1	0.1		0.1		
clofop-methyl	0.009	0.009		0.009		
imethoate	0.02	0.02		0.02		
inoseb	0.01	0.01		0.01		
iquat	0.07	0.07		0.07		
iuron	0.15	0.15		0.15		
thylbenzene	≤0.0024 (AO)			≤0.0024 (AO)		
uoride	1.5	1.5		1.5		1.5
lyphosate	0.28	0.28		0.28		
ardness						tests
on	≤0.3 (AO)			≤0.3 (AO)		0.3 (AO)
ead	0.01	0.01		0.01		0.01
lagnesium						tests
lalathion	0.19	0.19		0.19		
langanese	≤0.05 (AO)			≤0.05 (AO)		0.05 (AO)
lercury	0.001	0.001		0.001		
lethoxychlor	0.9	0.9		0.9		
letolachlor	0.05	0.05		0.05		
letribuzin	0.08	0.08		0.08		
lonochlorobenzene	0.08	0.08		0.08		
litrate	45 (equivalent to 10 mg/L as nitrate-nitrogen)	45 (equivalent to 10 mg/L as nitrate-nitrogen)		45 (equivalent to 10 mg/L as nitrate-nitrogen)		10 (as nitrate-nitrogen)

ımeter	Canada (Maximum Acceptable Concentration)	Alberta[1]	British Columbia[2]	Manitoba[3]	New Brunswick[4]	Newfoundland[5]
ite	Should not exceed 3.2 mg/L if measured separately as nitrite	should not exceed 3.2 mg/L if measured separately as nitrite		Should not exceed 3.2 mg/L if measured separately as nitrite		
rilotriacetic acid (NTA)	0.4	0.4		0.4		
our	Inoffensive (AO)			Inoffensive (AO)		
:aquat (as dichloride)	0.01	0.01		0.01		
rathion	0.05	0.05		0.05		
ntachlorophenol	0.06	0.06		0.06		
I	6.5 – 8.5 (AO)			6.5 – 8.5 (AO)		6.5 – 8.5 (AO)
ıorate	0.002	0.002		0.002		
cloram	0.19	0.19		0.19		
otassium						tests
elenium	0.01	0.01		0.01		0.01
mazine	0.01	0.01		0.01		
odium	≤200 (AO)			≤200 (AO)		200 (AO)
ulphate	≤500 (AO)			≤500 (AO)		500 (AO)
ulphide	≤0.05 (AO)			≤0.05 (AO)		
aste	Inoffensive (AO)			Inoffensive (AO)		
emperature	≤15 degrees C (AO)			≤15 degrees C (AO)		
erbufos	0.001	0.001		0.001		
etrachloroethylene	0.03	0.03		0.03		
,3,4,6-Tetrachlorophenol	0.1	0.1		0.1		
oluene	≤0.024 (AO)			≤0.024 (AO)		
otal Dissolved Solids	≤500 (AO)			≤500 (AO)		500 (AO)
otal Organic Carbon OOC)						tests
richloroethylene[15]	0.05 (R)	0.05		0.05		

[15] The proposed guideline for trichloroethylene is 0.005 mg/L

Parameter	Canada (Maximum Acceptable Concentration)	Alberta[1]	British Columbia[2]	Manitoba[3]	New Brunswick[4]	Newfoundland[5]
2,4,6-Trichlorophenol	0.005	0.005		0.005		
Trifluralin	0.045	0.045		0.045		
Trihalomethanes	0.10 (R)	0.10		0.10		0.10
Turbidity	1 NTU[16]	1 NTU		1 NTU		1 NTU
Uranium	0.02 (IMAC)	0.02 (IMAC)		0.02 (IMAC)		0.02
Vinyl Chloride	0.002	0.002		0.002		
Xylenes (total)	≤0.3 (AO)			≤0.3 (AO)		
Zinc	≤5.0 (AO)			≤5.0 (AO)		5.0 (AO)
Radionuclides (all values are expressed in becquerels per litre unless otherwise stated):						
Natural Radionuclides:						
Lead-210	0.1	0.1				
Radium-224	2	2				
Radium-226	0.6	0.6				
Radium-228	0.5	0.5				
Thorium-228	2	2				
Thorium-230	0.4	0.4				
Thorium-232	0.1	0.1				
Thorium-234	20	20				
Uranium-234	4	4				
Uranium-235	4	4				
Uranium-238	4	4				
Artificial Radionuclides:						
Cesium-134	7	7				
Cesium-137	10	10				
Iodine-125	10	10				
Iodine-131	6	6				
Molybdenum-99	70	70				
Strontium-90	5	5				

[16] NTU = nephelometric turbidity unit

Parameter	Canada (Maximum Acceptable Concentration)	Alberta[1]	British Columbia[2]	Manitoba[3]	New Brunswick[4]	Newfoundland[5]
Nitrite	Should not exceed 3.2 mg/L if measured separately as nitrite	should not exceed 3.2 mg/L if measured separately as nitrite		Should not exceed 3.2 mg/L if measured separately as nitrite		
Nitrilotriacetic acid (NTA)	0.4	0.4		0.4		
Odour	Inoffensive (AO)			Inoffensive (AO)		
Paraquat (as dichloride)	0.01	0.01		0.01		
Parathion	0.05	0.05		0.05		
Pentachlorophenol	0.06	0.06		0.06		
PH	6.5 – 8.5 (AO)			6.5 – 8.5 (AO)		6.5 – 8.5 (AO)
Phorate	0.002	0.002		0.002		
Picloram	0.19	0.19		0.19		
Potassium						tests
Selenium	0.01	0.01		0.01		0.01
Simazine	0.01	0.01		0.01		
Sodium	≤200 (AO)			≤200 (AO)		200 (AO)
Sulphate	≤500 (AO)			≤500 (AO)		500 (AO)
Sulphide	≤0.05 (AO)			≤0.05 (AO)		
Taste	Inoffensive (AO)			Inoffensive (AO)		
Temperature	≤15 degrees C (AO)			≤15 degrees C (AO)		
Terbufos	0.001	0.001		0.001		
Tetrachloroethylene	0.03	0.03		0.03		
2,3,4,6-Tetrachlorophenol	0.1	0.1		0.1		
Toluene	≤0.024 (AO)			≤0.024 (AO)		
Total Dissolved Solids	≤500 (AO)			≤500 (AO)		500 (AO)
Total Organic Carbon (DOC)						tests
Trichloroethylene[15]	0.05 (R)	0.05		0.05		

[15] The proposed guideline for trichloroethylene is 0.005 mg/L

Parameter	**Canada (Maximum Acceptable Concentration)**	**Alberta[1]**	**British Columbia[2]**	**Manitoba[3]**	**New Brunswick[4]**	**Newfoundland[5]**
Tritium	7000	7000				
Secondary Radionuclides:						
Natural Radionuclides						
Beryllium-7	4000	4000				
Bismuth-210	70	70				
Polonium-210	0.2	0.2				
Artifical Radionculides:						
Americium-241	0.2	0.2				
Antimony-122	50	50				
Antimony-124	40	40				
Antimony-125	100	100				
Barium-140	40	40				
Bromine-82	300	300				
Calcium-45	200	200				
Calcium-47	60	60				
Carbon-14	200	200				
Cerium-141	100	100				
Cesium-144	20	20				
Cerium-131	2000	2000				
Cesium-136	50	50				
Chromium-51	3000	3000				
Cobalt-57	40	40				
Cobalt-58	20	20				
Cobalt-60	2	2				
Gallium-67	500	500				
Gold-198	90	90				
Indium-111	400	400				
Iodine-129	1	1				
Iron-55	300	300				
Iron-59	40	40				

Parameter	Canada (Maximum Acceptable Concentration)	Alberta[1]	British Columbia[2]	Manitoba[3]	New Brunswick[4]	Newfoundland[5]
Manganese-54	200	200				
Mercury-197	400	400				
Mercury-203	80	80				
Neptunium-239	100	100				
Niobium-95	200	200				
Phosphorus-32	50	50				
Plutonium-238	0.3	0.3				
Plutonium-239	0.2	0.2				
Plutonium-240	0.2	0.2				
Plutonium-241	10	10				
Rhodium-105	300	300				
Rubidium-81	3000	3000				
Rubidium-86	50	50				
Ruthenium-103	100	100				
Ruthenium-106	10	10				
Selenium-75	70	70				
Silver-108m	70	70				
Silver-110m	50	50				
Silver-111	70	70				
Sodium-22	50	50				
Strontium-85	300	300				
Strontium-89	40	40				
Sulphur-35	500	500				
Technetium-99	200	200				
Technetium-99m	7000	7000				
Tellurium-129m	40	40				
Tellurium-131m	40	40				
Tellurium-132	40	40				
Thallium-201	2000	2000				
Ytterbium-169	100	100				
Yttrium-90	30	30				

Parameter	Canada (Maximum Acceptable Concentration)	Alberta[1]	British Columbia[2]	Manitoba[3]	New Brunswick[4]	Newfoundland[5]
Yttrium-91	30	30				
Zinc-65	40	40				
Zirconium-95	100	100				
Consultation Guidelines[17] (expressed in mg/L unless otherwise stated):						
Arsenic	0.005					
Bacteriological						
Bromodichloromethane	0.016					
Chloral hydrate	No guideline proposed					
Chlorite Chlorate	1.0 1.0					
Methyl tertiary-butyl ether (MTBE)	0.015 (AO)					
Haloacetic Acids						
Trihalomethanes	0.1					
Trichloroethylene	0.005					

[17] These guidelines are identified as proposed "Consultation Guidelines" in the Summary of Guidelines for Canadian Drinking Water Quality. Because they are proposed, they would not be considered to be accepted maximum or interim maximum acceptable concentrations by the provinces.

Table 2

Comparison of the Federal Guidelines for Canadian Drinking Water Quality

to the Guidelines and Standards for the Provinces of

Nova Scotia, Ontario, Prince Edward Island, Quebec and Saskatchewan

Table 2: Comparison of the Guidelines for Canadian Drinking Water Quality to the Guidelines and Standards of Nova Scotia, Ontario, Prince Edward Island, Quebec and Saskatchewan

Parameter	Canada MAC[18]	Nova Scotia[19]	Ontario[20]	Prince Edward Island[21]	Quebec[22]	Saskatchewan[23]
Microorganisms:						
E. coli	0	0	Not detectable for E. Coli; Not detectable for fecal coliforms	See below	0 ("must be free from …fecal coliform bacteria, E. coli bacteria, enterecocci bacteria and coliphage viruses")	0 organisms detectable per 100 mL for fecal coliforms or E. Coli
Total coliforms	No coliforms detectable per 100 mL (with descriptive criteria)[24] (R)[25]	No coliforms detectable per 100 mL (with descriptive criteria)	Not detectable	<10 coliform bacteria present, but not sufficient to regard water unfit for drinking, water should be	Not more than 10 total coliforms per 100 mL water; at least 90 per cent of samples must be free of total	0 organisms detectable per 100 mL[26]

[18] Maximum Acceptable Concentration
[19] Nova Scotia requires that the "microbiological, physical and chemical characteristics of a public drinking water supply" meet the Guidelines for Canadian Drinking Water Quality, but they do not require that drinking water supplies meet the maximum acceptable concentrations for radiological substances. In addition, owners of public water supplies are only required to monitor for a small number of inorganic and physical parameters, and not for all the parameters listed in the Guidelines for Canadian Drinking Water Quality.
[20] Ontario Regulation 169/03, "Ontario Drinking-Water Quality Standards" establishes legally enforceable drinking-water quality standards for Ontario under the Safe Drinking Water Act, 2002.
[21] These maximum acceptable concentration and aesthetic objectives are offered by Prince Edward Island as guidelines for interpreting drinking water quality.
[22] Quebec has set legally enforceable standards under its "Regulation Respecting the Quality of Drinking Water".
[23] Saskatchewan has set legally enforceable requirements for drinking water quality, set out in The Water Regulations, 2002, for bacteriological parameters, turbidity, chemical, pesticide and radiological parameters. Chemical standards will be phased in for excising watersystems with systems serving more than 5,000 people required to meet the standards by December 5, 2008. Where parameters are marked (AO), they are aesthetic objectives only and not legal standards.

Parameter	Canada MAC[18]	Nova Scotia[19]	Ontario[20]	Prince Edward Island[21]	Quebec[22]	Saskatchewan[23]
				resampled >10 or any faecal, water is not fit for human consumption; drinking water should be boiled or an alternate source secured	coliform bacteria over 30 days (where 21 samples or more are collected)	
Heterotrophic plate count			**500 colonies/mL**[27]		**not more than 500 bacteria/mL**	
Total coliform membrane filter analysis			**200 colonies/100 mL**		**not more than 200 colonies per membrane**	**<200 colonies per 100 mL or no overgrowth**
Cryptosporidium	(R)				**treatment must eliminate 99 per cent of oocysts**[28]	**TT**[29]
Giardia	(R)	**TT**[30]	**TT**[31]		**treatment must eliminate at least 99.9 per cent of cysts**	**TT**

[24] No consecutive samples from the same site or not more than 10% of samples from the distribution system in a given calendar month should show the presence of total coliform bacteria.
[25] (R) indicates that the guideline is under review.
[26] The Water Regulations, 2002, Part V, Division 5, Section 32
[27] **Bold** indicates where provinces have adopted criteria or values for microbiological parameters that are not the same as the federal Guidelines for Canadian Drinking Water Quality.
[28] Regulation respecting the Quality of Drinking Water, Chapter 2, Section 5.
[29] Saskatchewan requires under the Water Regulations, 2002, that any other type of surface water filtration technology, that is not chemically assisted, membrane filtration or slow sand or diatomaceous earth filtration, the filtration must achieve a 3-log reduction of Giardia lamblia and Crytosporidium parvum, and a 4-log reduction of viruses (Part V, Division 5, Section 33, ss. 2(d))
[30] Nova Scotia as part of the province's Drinking Water Strategy requires public water systems to achieve 3-log reduction of giardia and 4-log reduction of viruses.
[31] Ontario requires a 4-log reduction or inactivation of viruses through the chlorination procedures of the Drinking Water Standards.

Parameter	**Canada MAC[18]**	**Nova Scotia[19]**	**Ontario[20]**	**Prince Edward Island[21]**	**Quebec[22]**	**Saskatchewan[23]**
Viruses (enteric)	(R)	**TT**	**TT**		**treatment must eliminate at least 99.99 per cent of viruses**	**TT**
Chemical and Physical Parameters (all values are expressed in mg/L unless otherwise stated):						
Alachlor			**0.005**[32]			
Aldicarb	0.009	0.009	0.009		0.009	
Aldrin + Dieldrin	0.0007	0.0007	0.0007		0.0007	
Alkalinity (as CaCO3)						**500 (AO)**
Aluminum	0.1	0.1				
Antimony	0.006 (IMAC)	0.006 (IMAC)	0.006		0.006	
Arsenic	0.025 (R)[33]	0.025	0.025		0.025	0.025 (IMAC)
Atrazine + metabolites	0.005	0.005	0.005		0.005	0.005 (IMAC)
Azinphos-methyl	0.02	0.02	0.02		0.02	
Barium	1.0	1.0	1.0		1.0	1.0
Bendiocarb	0.04	0.04	0.04		0.04	
Benzene	0.005	0.005	0.005		0.005	0.005
Benzo(a)pyrene (PAHs)	0.00001	0.00001	0.00001		0.00001	0.00001
Boron	5.0	5.0	5.0		5.0	5.0 (IMAC)
Bromate	0.01 (IMAC)	0.01 (IMAC)	0.01		0.01	
Bromoxynil	0.005	0.005	0.005		0.005	0.005 (IMAC)
Cadmium	0.005	0.005	0.005	0.005	0.005	0.005
Carbaryl	0.09	0.09	0.09		0.09	
Carbofuran	0.09	0.09	0.09		0.09	0.09
Carbon tetrachloride	0.005	0.005	0.005		0.005	0.005
Chloramines	3.0	3.0	3.0		3.0	
Chloride	≤250 (AO)	≤250 (AO)		<=250 (AO)		250 (AO)

[32] In Tables 1, 2 and 3 parameters shown in **bold** indicate parameters for which the provinces or territories have set guidelines where no federal guideline has been established. Numerical values shown in **bold** also indicate where the provinces and territories have set values for maximum acceptable concentrations of a contaminant that are not identical to the federal guideline.

[33] The proposed guideline for arsenic is 0.005 Maximum Acceptable Concentration

Parameter	Canada MAC[18]	Nova Scotia[19]	Ontario[20]	Prince Edward Island[21]	Quebec[22]	Saskatchewan[23]
Chlordane (total)		-	**0.007**			
Chlorpyrifos	0.09	0.09	0.09		0.09	0.09
Chromium	0.05	0.05	0.05	0.05	0.05	0.05
Colour	≤15 TCU	≤15 TCU				15 ACU (AO)
Copper	≤1.0 (AO)	≤1.0 (AO)		≤1.0 (AO)		1 (AO)
Cyanazine	0.01	0.01	0.01		0.01	
Cyanide	0.2	0.2	0.2		0.2	0.2
Cyanobacterial toxins (as microcystin-LR)	0.0015	0.0015	0.0015			
Diazinon	0.02	0.02	0.02		0.02	
Dicamba	0.12	0.12	0.12		0.12	0.12
1,2-Dichlorobenzene / o-Dichlorobenzene	0.2	0.2	0.2		0.2	0.2
1,4-Dichlorobenzene / p-Dichlorobenzene	0.005	0.005	0.005		0.005	0.005
DDT + metabolites	-	-	**0.03**			
1,2-Dichloroethane	0.005	0.005	0.005		0.005	0.005 (IMAC)
1,1-Dichloroethylene (vinylidene chloride)	0.014	0.014	0.014		0.014	0.014
Dichloromethane	0.05	0.05	0.05		0.05	0.05
2,4-Dichlorophenol	0.9	0.9	0.9		0.9	0.9
2,4-Dichlorophenoxy-acetic acid (2,4-D)	0.1	0.1	0.1		0.1	0.1 (IMAC)
Diclofop-methyl	0.009	0.009	0.009		0.009	0.009
Dimethoate	0.02	0.02	0.02		0.02	0.02 (IMAC)
Dinoseb	0.01	0.01	0.01		0.01	
Dioxin and furan			**0.000000015**			
Diquat	0.07	0.07	0.07		0.07	
Diuron	0.15	0.15	0.15		0.15	
Ethylbenzene	≤0.0024 (AO)	≤0.0024 (AO)				0.0024 (AO)
Fluoride	1.5	1.5	1.5		1.5	1.5
Glyphosate	0.28	0.28	0.28		0.28	

Parameter	**Canada MAC**[18]	**Nova Scotia**[19]	**Ontario**[20]	**Prince Edward Island**[21]	**Quebec**[22]	**Saskatchewan**[23]
Hardness (as CaCO3)				≤200 (AO)		**800 (AO)**
Heptachlor + Heptachlor Epoxide		-	**0.003**			
Iron	≤0.3 (AO)	≤0.3 (AO)		≤0.3 (AO)		0.3 (AO)
Lead	0.01	0.01	0.01	0.01	0.01	0.01
Lindane (total)	-		**0.004**			
Magnesium						**200 (AO)**
Malathion	0.19	0.19	0.19		0.19	0.19
Manganese	≤0.05 (AO)	≤0.05 (AO)		≤0.05 (AO)		0.05 (AO)
Mercury	0.001	0.001	0.001		0.001	0.001
Methoxychlor	0.9	0.9	0.9		0.9	
Metolachlor	0.05	0.05	0.05		0.05	
Metribuzin	0.08	0.08	0.08		0.08	
Monochlorobenzene	0.08	0.08	0.08		0.08	0.08
Nitrate	45 (equivalent to 10 mg/L as nitrate-nitrogen)	45 (equivalent to 10 mg/L as nitrate-nitrogen)	10 (as nitrogen)	10 (as nitrate-nitrogen)		45
Nitrite	should not exceed 3.2 mg/l if measured separately as nitrite	should not exceed 3.2 mg/l if measured separately as nitrite	1 (as nitrogen)		1 (as nitrogen)	
Nitrate + nitrite (as nitrogen)			10		10	
Nitrilotriacetic acid (NTA)	0.4	0.4	0.4		0.4	
Nitrosodimethylamine (NDMA)	-	-	**0.000009**			
Odour	Inoffensive (AO)	Inoffensive (AO)				Inoffensive (AO)
Paraquat	0.01	0.01	0.01		0.01	
Parathion	0.05	0.05	0.05		0.05	
Pentachlorophenol	0.06	0.06	0.06		0.06	0.06
PH	6.5 – 8.5 (AO)	6.5 – 8.5 (AO)		6.5-8.5 (AO)	6.5 - 8.5	**6.5-9.0 (AO)**

Parameter	**Canada MAC[18]**	**Nova Scotia[19]**	**Ontario[20]**	**Prince Edward Island[21]**	**Quebec[22]**	**Saskatchewan[23]**
Phorate	0.002	0.002	0.002		0.002	
Picloram	0.19	0.19	0.19		0.19	0.19 (IMAC)
PCBs		-	**0.003**			
Prometryne		-	**0.001**			
Selenium	0.01	0.01	0.01		0.01	0.01
Simazine	0.01	0.01	0.01		0.01	
Sodium	≤200 (AO)	≤200 (AO)		≤200 (AO)		**300 (AO)**
Sulphate	≤500 (AO)	≤500 (AO)		≤500 (AO)		500 (AO) (Sulphate as H2S 0.05)
Sulphide	≤0.05 (AO)	≤0.05 (AO)				
Taste	Inoffensive (AO)	Inoffensive (AO)				Inoffensive (AO)
Temephos			**0.28**			
Temperature	≤15 degrees C (AO)	≤15 degrees C (AO)		≤15 degrees C (AO)		<=15 degrees C (AO)
Terbufos	0.001	0.001	0.001		0.001	
Tetrachloroethylene	0.03	0.03	0.03		0.03	
2,3,4,6-Tetrachlorophenol	0.1	0.1	0.1		0.1	0.1
Toluene	≤0.024 (AO)	≤0.024 (AO)				0.024 (AO)
Total Dissolved Solids	≤500 (AO)	≤500 (AO)		≤500 (AO)		**1500 based on summation of ions** (AO)
Triallate			**0.23**			
Trichloroethylene	0.05 (R)	0.05	0.05		0.05	0.05
2,4,6-Trichlorophenol	0.005	0.005	0.005		0.005	0.005
2,4,5-T		-	**0.28**			
Trifluralin	0.045	0.045	0.045		0.045	0.045 (IMAC)
Trihalomethanes	0.10 (R)	0.10	0.10		**0.8**	0.1 (IMAC)
Turbidity	1 NTU	1 NTU	1 NTU		**less than or equal to 5 NTU; in**	never to exceed 1.0 NTU for

Parameter	Canada MAC[18]	Nova Scotia[19]	Ontario[20]	Prince Edward Island[21]	Quebec[22]	Saskatchewan[23]
					addition, turbidity must not exceed 0.5 NTU in more than 5 per cent of samples in 30 days (with criteria)	surface water with chemically assisted filtration, never to exceed 0.3 NTU for surface water with membrane filtration; never to exceed 3.0 NTU for surface water with sand or earth filtration; no standard for groundwater
Uranium	0.02 (IMAC)	0.02 (IMAC)	0.02		0.02	0.02
Vinyl Chloride	0.002	0.002	0.002		0.002	0.002
Xylenes (total)	≤0.3 (AO)	≤0.3 (AO)				0.3 (AO)
Zinc	≤5.0 (AO)	≤5.0 (AO)		≤5.0 (AO)		5 (AO)
Radionuclides (values are expressed in becquerels per litre unless otherwise stated):						
Gross Alpha					**0.1**	**0.1**
Gross Beta					**1.0**	**0.11**
Natural Radionuclides:						
Lead-210	0.1		0.1			
Radium-224	2		2.0			
Radium-226	0.6		0.6		0.6	
Radium-228	0.5		0.5			
Thorium-228	2		2.0			
Thorium-230	0.4		0.4			
Thorium-232	0.1		0.1			
Thorium-234	20		20			
Uranium-234	4		4			

Parameter	Canada MAC[18]	Nova Scotia[19]	Ontario[20]	Prince Edward Island[21]	Quebec[22]	Saskatchewan[23]
Uranium-235	4		4			
Uranium-238	4		4			
Artificial Radionuclides:						
Cesium-134	7		7			
Cesium-137	10		10		10	
Iodine-125	10		10			
Iodine-131	6		6		6	
Molybdenum-99	70		70			
Strontium-90	5		5		5	
Tritium	7000		7000		7000	
Secondary Radionuclides:						
Natural Radionuclides						
Beryllium-7	4000		4000			
Bismuth-210	70		70			
Polonium-210	0.2		0.2			
Artifical Radionculides:						
Americium-241	0.2		0.2			
Antimony-122	50		50			
Antimony-124	40		40			
Antimony-125	100		100			
Barium-140	40		40			
Bromine-82	300		300			
Calcium-45	200		200			
Calcium-47	60		60			
Carbon-14	200		200			
Cerium-141	100		100			
Cerium-144	20		20			
Cesium-131	2000		2000			

Parameter	Canada MAC[18]	Nova Scotia[19]	Ontario[20]	Prince Edward Island[21]	Quebec[22]	Saskatchewan[23]
Cesium-136	50		50			
Chromium-51	3000		3000			
Cobalt-57	40		40			
Cobalt-58	20		20			
Cobalt-60	2		2			
Gallium-67	500		500			
Gold-198	90		90			
Indium-111	400		400			
Iodine-129	1		1			
Iron-55	300		300			
Iron-59	40		40			
Manganese-54	200		200			
Mercury-197	400		400			
Mercury-203	80		80			
Neptunium-239	100		100			
Niobium-95	200		200			
Phosphorus-32	50		50			
Plutonium-238	0.3		0.3			
Plutonium-239	0.2		0.2			
Plutonium-240	0.2		0.2			
Plutonium-241	10		10			
Rhodium-105	300		300			
Rubidium-81	3000		3000			
Rubidium-86	50		50			
Ruthenium-103	100		100			
Ruthenium-106	10		10			
Selenium-75	70		70			
Silver-108m	70		70			
Silver-110m	50		50			

Parameter	Canada MAC[18]	Nova Scotia[19]	Ontario[20]	Prince Edward Island[21]	Quebec[22]	Saskatchewan[23]
Silver-111	70		70			
Sodium-22	50		50			
Strontium-85	300		300			
Strontium-89	40		40			
Sulphur-35	500		500			
Technetium-99	200		200			
Technetium-99m	7000		7000			
Tellurium-129m	40		40			
Tellurium-131m	40		40			
Tellurium-132	40		40			
Thallium-201	2000		2000			
Ytterbium-169	100		100			
Yttrium-90	30		30			
Yttrium-91	30		30			
Zinc-65	40		40			
Zirconium-95	100		100			

Table 3

Comparison of the Federal Guidelines for Canadian Drinking Water Quality

to the Guidelines and Standards of

the Territorial Governments of Canada

Table 3: Comparison of Federal Guidelines for Canadian Drinking Water Quality to the Guidelines and Standards of the Territorial Governments of Canada

Parameter	Canada MAC[34]	Northwest Territories	Yukon Territory[35]	Nunavut Territory
Microorganisms:				
E. coli	0		0	
Total coliforms	No coliforms detectable per 100 mL (with descriptive criteria)[36] (R)[37]	**the arithmetic mean of the most probable numbers of coliforms for all samples (multitube fermentation technique) in 1 month shall not exceed 1/100mL (with descriptive criteria)[38]**	No coliforms detectable per 100 mL (with descriptive criteria)	**the arithmetic mean of the most probable numbers of coliforms for all samples (multitube fermentation technique) in 1 month shall not exceed 1/100mL[39]**
Total coliform membrane filter analysis		**arithmetical mean coliform density of all samples in 1 month shall not exceed 1/100 mL[40]**		**arithmetical mean coliform density of all samples in 1 month shall not exceed 1/100 mL**
Cryptosporidium	(R)			

[34] Maximum Acceptable Concentration

[35] The values given for drinking water parameters in the Yukon are based on the Revised Draft Guidelines for the "Public Drinking Water Systems Regulation", April 2004. They are not yet regulated standards.

[36] No consecutive samples from the same site or not more than 10% of samples from the distribution system in a given calendar month should show the presence of total coliform bacteria.

[37] (R) denotes guideline is under review.

[38] The regulation says that, if the most probable number of coliforms for either type of sampling technique is 9 or greater, then additional samples shall be taken...until the results from at least 2 consecutive samples show the water to be of satisfactory quality (Section 10 (2)).

[39] Ibid.

[40] As in the previous two Tables, **bold** is used in Table 3 to indicate where the Territories have adopted criteria, standards for parameters or values for standards that are different from the Guidelines for Canadian Drinking Water Quality.

Parameter	Canada MAC[34]	Northwest Territories	Yukon Territory[35]	Nunavut Territory
Giardia lamblia	(R)			
Viruses (enteric)	(R)			
Physical and Chemical Parameters (values expressed in milligrams per litre unless otherwise stated):				
Aldicarb	0.009			
Aldrin + Dieldrin	0.0007			
Alkyl benzene sulfonate		**0.5**		**0.5**
Alkalinity (as CaCO3)			tests[41]	
Aluminum	0.1		0.1	
Antimony	0.006			
Arsenic	0.025 (proposed 0.005)	**0.05**	0.025	**0.05**
Atrazine + N-dealkylated metabolites	0.005			
Azinphos-methyl	0.02			
Barium	1.0	1.0	1.0	1.0
Bendiocarb	0.04			
Benzene	0.005			
Benzo(a)pyrene (PAHs)	0.00001			
Boron	5.0		5.0	
Bromate	0.01			
Bromoxynil	0.005			
Cadmium	0.005	**0.01**	0.005	**0.01**
Calcium			tests	
Carbaryl	0.09			
Carbofuran	0.09			
Carbon Chloroform Extract		**0.2**		**0.2**
Carbon tetrachloride	0.005			
Chloramines	3.0			

[41] Under Schedule B of Yukon's Public Drinking Water Regulation, there is a list of substances generally included in the package of drinking water testing done by laboratories. These include several substances for which there are no Canadian guidelines and no maximum acceptable concentrations identified in the regulation – Conductivity, Hardness, Total Alkalinity, Calcium, Magnesium and Potassium.

Parameter	**Canada MAC**[34]	**Northwest Territories**	**Yukon Territory**[35]	**Nunavut Territory**
Chloride	<250 (AO)	250	<250	250
Chlorpyrifos	0.09			
Chromium	0.05	0.05	0.05	0.05
Colour	≤15 TCU	15 TCU	≤15 TCU	15 TCU
Copper	≤1.0 (AO)	1.0	≤1.0	1.0
Cyanazine	0.01			
Cyanide	0.2	**0.01**		**0.01**
Cyanobacterial toxins (as microcystin-LR)	.0015			
Diazinon	0.02			
Dicamba	0.12			
1,2-Dichlorobenzene / o-Dichlorobenzene	0.2			
1,4-Dichlorobenzene / p-Dichlorobenzene	0.005			
1,2-Dichloroethane	0.005			
1,1-Dichloroethylene (vinylidene chloride)	0.014			
Dichloromethane	0.05			
2,4-Dichlorophenol	0.9			
2,4-Dichlorophenoxy-acetic acid (2,4-D)	0.1			
Diclofop-methyl	0.009			
Dimethoate	0.02			
Dinoseb	0.01			
Diquat	0.07			
Diuron	0.15			
Ethylbenzene	≤0.0024 (AO)			
Fluoride	1.5	**1.7**	1.5	**1.7**
Glyphosate	0.28			
Hardness			tests	
Iron	≤0.3 (AO)	0.3		0.3

Parameter	**Canada MAC**[34]	**Northwest Territories**	**Yukon Territory**[35]	**Nunavut Territory**
Lead	0.01	**0.05**	0.01	**0.05**
Magnesium			tests	
Malathion	0.19			
Manganese	≤0.05 (AO)	0.05		0.05
Mercury	0.001		0.001	
Methoxychlor	0.9			
Metolachlor	0.05			
Metribuzin	0.08			
Monochlorobenzene	0.08			
Nitrate	45.0 (equivalent to 10.0 mg/L as nitrate-nitrogen)	45.0	45.0	45.0
Nitrite	should not exceed 3.2 mg/l if determined separately		should not exceed 3.2 mg/l if determined separately	
Nitrilotriacetic acid (NTA)	0.4			
Odour	Inoffensive (AO)	**3 threshold odour number**		**3 threshold odour number**
Paraquat	0.01			
Parathion	0.05			
Pentachlorophenol	0.06			
Phenols		**0.001**		**0.001**
Phorate	0.002			
Picloram	0.19			
PH	6.5 – 8.5 (AO)			
Potassium			tests	
Selenium	0.01	0.01	0.01	0.01
Silver		**0.05**		**0.05**
Simazine	0.01			
Sodium	≤200 (AO)		≤200	
Sulphate	≤500 (AO)	**250**	≤500	**250**
Sulphide	≤.05 (AO)			
Taste	Inoffensive (AO)			
Temperature	≤15 degrees C (AO)			
Terbufos	0.001			

Parameter	Canada MAC[34]	Northwest Territories	Yukon Territory[35]	Nunavut Territory
Tetrachloroethylene (perchloroethylene)	0.030			
2,3,4,6-Tetrachlorophenol	0.1			
Toluene	≤0.024 (AO)			
Total Dissolved Solids	≤500 (AO)	500	≤500	500
Trichloroethylene	0.05 (proposed 0.005) (R)			
2,4,6-Trichlorophenol	0.005			
Trifluralin	0.045			
Trihalomethanes	0.10 (R)		0.10	
Turbidity	1 NTU	**5 units**	1 NTU	**5 units**
Uranium	0.02		0.02	
Vinyl Chloride	0.002			
Xylenes (total)	≤0.3 (AO)			
Zinc	≤5.0 (AO)	5.0	≤5.0	5.0
Radioactive Substances:[42]				
Radioactivity		**no intake in addition to other sources greater than radiation protection guidance of the Radiation Protection Division**		**no intake in addition to other sources greater than radiation protection guidance of the Radiation Protection Division**

[42] The complete list of Canadian guidelines for radiological substances is not listed here because neither the Yukon, Northwest or Nunavut Territories have adopted these as guidelines or standards. For the complete list, see Radiological Parameters in Tables 1 and 2. Northwest and Nunavut Territories have criteria for radioactive characteristics of water but they have not adopted drinking water guidelines for any specific radioactive substance. There is a general reference to a maximum limit in the "Public Water Supply Regulations". The Yukon Territory has no reference to radiological substances in its "Public Drinking Water Systems Regulation". Owners of drinking water supplies must ensure that microbiological, chemical and physical characteristics of certain chemicals do not exceed the Guidelines for Canadian Drinking Water. An owner is only obligated to monitor for other substances, such as radiological substances, "if there is a reason to suspect the presence of other substances in the drinking water" (Section 42(2)).

Table 4

Comparison of the Federal Guidelines for Canadian Drinking Water Quality

to the Standards of the United States

and the Guidelines of the World Health Organization

Table 4: Comparison of the Federal Guidelines for Canadian Drinking Water Quality to the Standards of the United States Environmental Protection Agency and the Guidelines of the World Health Organization

Parameter[43]	**Canada mg/L MAC**[44]	**United States Environmental Protection Agency MCL**[45]	**World Health Organization**[46] **(WHO)**
4.1 - Microbiological, Chemical and Physical Guidelines for Canadian Drinking Water Quality compared to the Standards of the United States and the Guidelines of the World Health Organization[47]			
Microorganisms:			
E. coli	0	**see total coliforms**[48]	0/100mL[49]
Total coliforms	No coliforms detectable per 100 mL (with descriptive criteria)	**maximum 5.0% samples total coliform-positive per month including fecal coliform and *E.***	0/100mL[51]

[43] In Table 4.1, numerical values for parameters or criteria highlighted in **bold** indicate where the parameter value or criteria set by the U.S. or the WHO differ from the Guidelines for Canadian Drinking Water Quality. Chemical or physical parameter names highlighted in **bold** indicate where the United States and the World Health Organization have not established a value for a parameter that is listed in the Guidelines for Canadian Drinking Water Quality. Table 4.2 identifies chemical and physical parameters for which the United States and WHO have set standards or guidelines, and Canada has not. Table 4.3 identifies radiological parameters established by the Guidelines for Canadian Drinking Water Quality and compares them to the values and guidelines established by the United States and WHO. Parameters highlighted in **bold** indicate where Canada has set a guideline, and the WHO and the United States have not. Values for parameters highlighted in **bold** indicate differences in the values established by the WHO or the United States from the Canadian Guidelines.

[44] Maximum Acceptable Concentration.

[45] All values for the United States National Primary Drinking Water Regulations are expressed as Maximum Contaminant Levels (MCL), the highest level of a contaminant that is allowed in drinking water. They are legally enforceable standards unless identified as (S). All parameters marked (S) refer to the U.S. National Secondary Drinking Water Regulations, which are non-enforceable guidelines for contaminants with cosmetic or aesthetic effects in drinking water. They may be adopted as standards by individual states.

[46] The values established by the World Health Organization for drinking water are found in the "Guidelines for Drinking-water Quality", Third Edition, World Health Organization, Geneva, 2004. Canada participates in the process of development of these guidelines.

[47] Table 4.1 shows all microbiological, chemical and physical parameters of the Guidelines for Canadian Drinking Water, and illustrates where the United States and WHO have established guidelines and where they have not.

[48] See footnote 43.

[49] Although *E.Coli* is the more precise indicator of fecal pollution, the count of thermotolerant coliform bacteria is considered an acceptable alternative to the WHO.

[50] For water systems that collect fewer than 40 samples/month, no more than 1 sample can be total coliform-positive per month. Every sample that has total coliform must be analyzed for either fecal coliforms or *E.Coli*. If 2 consecutive samples are positive for total coliforms and one is positive for *E.Coli*, the system is in acute violation of the MCL.

Parameter[43]	**Canada mg/L MAC**[44]	**United States Environmental Protection Agency MCL**[45]	**World Health Organization**[46] **(WHO)**
	(under review)	*Coli* (with descriptive criteria)[50]	
Heterotrophic plate count		**>500 colonies/mL**	
Legionella		**TT with no set limit, but controlled if *Giardia* and viruses are removed/inactivated**	Health-based targets based on treatment technologies
Cryptosporidium	(under review)	**TT**[52] **with 99% removal**	Health-based targets based on treatment technologies
Giardia lamblia	(under review)	**TT with 99.9% removal/ inactivation**	Health-based targets based on treatment technologies
Viruses (enteric)	(under review)	**TT with 99.99% removal / inactivation**	Health-based targets based on treatment technologies
Chemical and Physical Parameters (values are expressed in milligrams per litre unless otherwise stated):			
Aldicarb	0.009		**0.01**
Aldrin + Dieldrin	0.0007		**0.00003**
Aluminum	0.1	**0.05 to 0.2** (S)[53]	0.1 (A)[54]
Antimony	0.006	0.006	**0.02**
Arsenic	0.025 (proposed 0.005)	**0.05** (will be 0.01 as of 01/23/06)	**0.01** (P)[55]
Atrazine + N-dealkylated metabolites	0.005	**0.003**	**0.002**
Azinphos-methyl	0.02		
Barium	1.0	**2.0**	**0.7**
Bendiocarb	0.04		
Benzene	0.005	0.005	**0.01**

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[51] Total coliform bacteria counts are not considered acceptable indicators of the sanitary quality of water supplies by the WHO where many bacteria occur in untreated supplies.
[52] TT is Treatment Technique, a required process intended to reduce the level of a contaminant in drinking water.
[53] All parameters marked (S) are used to refer to the U.S. National Secondary Drinking Water Regulations which are non-enforceable guidelines regulating contaminants with cosmetic or aesthetic effects in drinking water
[54] All parameter values marked (A) denotes the acceptability aspects of drinking water identified by the WHO in Chapter 10, WHO Guidelines for Drinking Water-Quality, Third Edition, 2004
[55] P (Provisional guideline value) is used where health effects information is limited, where there is greater uncertainty over effects, where recommended health-based guideline is below the level that can be achieved through practical treatment methods, or where disinfection is likely to result in the guideline being exceeded

Parameter[43]	**Canada mg/L MAC**[44]	**United States Environmental Protection Agency MCL**[45]	**World Health Organization**[46] **(WHO)**
Benzo(a)pyrene (PAHs)	0.00001	**0.0002**	**0.0007**
Boron	5.0		**0.5**
Bromate	0.01	0.01	0.01
Bromoxynil	0.005		
Cadmium	0.005	0.005	**0.003**
Carbaryl	0.09		
Carbofuran	0.09	**0.04**	**0.007**
Carbon tetrachloride	0.005	0.005	**0.004**
Chloramines	3.0	**4.0** (MRDL)[56]	
Chloride	<250 (AO)	250 (S)	250 (A)
Chlorpyrifos	0.09		**0.03**
Chromium	0.05	**0.1**	0.05 (P)
Colour	≤15 TCU	15 color units (S)	15 TCU (A)
Copper	≤1.0 (AO)	**TT** action level = 1.3 (also 1 as (S))	**2.0**
Cyanazine	0.01		**0.0006**
Cyanide	0.2	0.2	**0.07**
Cyanobacterial toxins (as microcystin-LR)	.0015		**0.001** (P)
Diazinon	0.02		
Dicamba	0.12		
1,2-Dichlorobenzene / o-Dichlorobenzene	0.2	**0.6**	**1**
1,4-Dichlorobenzene / p-Dichlorobenzene	0.005	**0.075**	**0.3**
1,2-Dichloroethane	0.005	0.005	**0.03**
1,1-Dichloroethylene (vinylidene chloride)	0.014	**0.007**	
Dichloromethane	0.05	**0.005**	**0.02**
2,4-Dichlorophenol	0.9		

[56] MRDL = Maximum Residual Disinfectant Level

Parameter[43]	**Canada mg/L MAC**[44]	**United States Environmental Protection Agency MCL**[45]	**World Health Organization**[46] **(WHO)**
2,4-Dichlorophenoxy-acetic acid (2,4-D)	0.1	**0.07**	**0.03**
Diclofop-methyl	0.009		
Dimethoate	0.02		**0.006**
Dinoseb	0.01	**0.007**	
Diquat	0.07	**0.02**	
Diuron	0.15		
Ethylbenzene	≤0.0024 (AO)	**0.7**	**0.3**
Fluoride	1.5	**4.0** (also 2 for (S))	1.5
Glyphosate	0.28	**0.7**	
Iron	≤0.3 (AO)	0.3 (S)	0.3 (A)
Lead	0.01	TT[57] 0.015 (action level)	0.01
Malathion	0.19		
Manganese	≤0.05 (AO)	0.05 (S)	**0.4**
Mercury	0.001	**0.002**	0.001
Methoxychlor	0.9	**0.04**	**0.02**
Metolachlor	0.05		**0.01**
Metribuzin	0.08		
Monochlorobenzene	0.08		
Nitrate	45.0 (equivalent to 10.0 mg/L as nitrate-nitrogen)	10.0 (as nitrogen)	**50.0** (as nitrogen)
Nitrite	should not exceed 3.2 mg/l if determined separately	1.0 (as nitrogen)	**3 – short term exposure** **0.2 (P) – long term exposure**
Nitrilotriacetic acid (NTA)	0.4		**0.2**
Odour	Inoffensive (AO)	**3 threshold odour (S)**	Should be acceptable (A)
Paraquat	0.01		
Parathion	0.05		
Pentachlorophenol	0.06	**0.001**	**0.009** (P)
Phorate	0.002		

[57] TT = regulation by treatment technology

Parameter[43]	**Canada mg/L MAC**[44]	**United States Environmental Protection Agency MCL**[45]	**World Health Organization**[46] **(WHO)**
Picloram	0.19	**0.5**	
PH	6.5 – 8.5 (AO)	6.5 – 8.5 (S)	**Preferably <8 for effective disinfection with chlorine (A)**
Selenium	0.01	**0.05**	0.01
Simazine	0.01	**0.004**	**0.002**
Sodium	≤200 (AO)		
Sulphate	≤500 (AO)	**250** (S)	
Sulphide	≤.05 (AO)		
Taste	Inoffensive (AO)		Should be acceptable (A)
Temperature	≤15 degrees C (AO)		
Terbufos	0.001		
Tetrachloroethylene	0.030	**0.005**	
2,3,4,6-Tetrachlorophenol	0.1		
Toluene	≤0.024 (AO)	**1.0**	**0.7**
Total Dissolved Solids	≤500 (AO)	500 (S)	**1000 (A)**
Trichlorethylene	0.05 (proposed 0.005)	**0.005**	
2,4,6-Trichlorophenol	0.005		**0.2**
Trifluralin	0.045		**0.02**
Trihalomethanes	0.10 (under review)	**0.08**	**the sum of the ratio of the concentration of each to its respective guideline value should not exceed 1**
Turbidity	1 NTU	must not exceed 0.3 NTU in 95% of daily samples in one month; may never exceed 1 NTU	**5 NTU (A)**
Uranium	0.02	**0.03**	**0.015** (P)
Vinyl Chloride	0.002	0.002	**0.0003**
Xylenes (total)	≤0.3 (AO)	**10**	**0.5**
Zinc	≤5.0 (AO)	5 (S)	**4.0 (A)**
Proposed Canadian Guidelines for Parameters (in consultation):			
Arsenic	0.005	**0.010** (as of 01/23/06)	**0.01** (P)

Parameter[43]	Canada mg/L MAC[44]	United States Environmental Protection Agency MCL[45]	World Health Organization[46] (WHO)
Bacteriological			
Bromodichloromethane (BDCM)	0.016		**0.06**
Chloral hydrate	No guideline proposed		**0.01** (P)
Chlorite Chlorate	1.0 1.0	1.0 (Chlorite)	**0.7** **0.7**
Methyl tertiary-butyl ether (MTBE)	0.015 (AO)		
Haloacetic Acids	proposed guideline pending	**.060**	
Trihalomethanes	0.1	**0.8**	
Trichloroethylene	0.005	0.005	

4.2 - Guidelines or Standards for Chemical or Physical Parameters Adopted by the United States Environmental Protection Agency or WHO that are not in Canadian Guidelines:

Chemical and Physical Parameters (values expressed in milligrams per litre unless otherwise stated):

Acrylamide		TT	0.0005
Alachlor		0.002	0.02
Asbestos (fiber > 10 micrometers)		7 million fibres/L	
Beryllium		0.004	
Bromodichloromethane	0.016 (proposed – see above)		0.06
Bromoform			0.1
Chlordane (total)	-	0.002	0.0002
Chlorine		4.0 (MRDL)	5
Chlorine Dioxide		0.8 (MRDL)	
Chlorobenzene		0.1	
Chloroform			0.2
Chlorotoluron			0.03
Corrosivity		non-corrosive (S)	
Cyanogen chloride			0.07
Dalapon		0.2	
2.4 -DB			0.09

Parameter[43]	**Canada mg/L MAC**[44]	**United States Environmental Protection Agency MCL**[45]	**World Health Organization**[46] **(WHO)**
DDT + metabolites	-		0.001
Dibromoacetonitrile			0.07
Dibromochloromethane			0.1
1,2-Dibromo-3-chloropropane (DBCP)		0.0002	0.001
1,2-Dibromoethane			0.0004 (P)
Dichloroacetate			0.05
Dichloroacetonitrile			0.02 (P)
1,1-Dichloroethene			0.03
1.2-Dichloroethene			0.05
cis-1,2-Dichloroethylene		0.07	
trans-1,2-Dichloroethylene		0.1	
1,2-Dichloropropane		0.005	0.04 (P)
1,3-Dichloropropene			0.02
Dichlorprop			0.1
Di(2-ethylhexyl) adipate		0.4	
Di(2-ethylhexyl) phthalate		0.006	0.008
Dioxin (2,3,7,8-TCDD)		0.00000003	
Edetic Acid (EDTA)			0.6
Endothall		0.1	
Endrin		0.002	0.0006
Epichlorohydrin		TT	0.0004 (P)
Ethylene dibromide		0.00005	
Foaming Agents		0.5 (S)	
Fenoprop			0.009
Formaldehyde			0.9
Heptachlor + Heptachlor Epoxide	-	heptachlor: 0.0004 heptachlor expoxide: 0.0002	
Hexachlorobenzene		0.001	
Hexachlorobutadiene			0.0006
Hexachlorocyclopentadiene		0.05	
Isoproturon			0.009

Parameter[43]	Canada mg/L MAC[44]	United States Environmental Protection Agency MCL[45]	World Health Organization[46] (WHO)
Lindane (total)		0.0002	0.002
MCPA			0.002
Mecoprop			0.01
Molinate			0.006
Molybdenum			0.07
Monochloramine			3
Monochloroacetate			0.02
Nickel			0.02
Oxamyl (Vydate)		0.2	
Pendimethalin			0.02
Polychlorinated Biphenyls		0.0005	
Pyriproxyfen			0.3
Silver		0.10 (S)	
Styrene		0.1	0.02
Terbuthylazine			0.007
Tetrachloroethene			0.04
Thallium		0.002	
Toxaphene		0.003	
Trichloroacetate			0.2
Trichloroethene			0.07 (P)
2,4,5-T			0.009
2,4,5-T P (Silvex)	-	0.05	
1,2,4-Trichlorobenzene		0.07	
1,1,1-Trichloroethane		0.2	
1,1,2-Trichloroethane		0.005	
4.3 Radiological Parameters (values expressed in becquerels per litre unless otherwise stated):[58]			

[58] There are 78 guidelines for radiological parameters under the Guidelines for Canadian Drinking Water Quality. The World Health Organization has established guidance levels for radionuclides in drinking water that includes 191 radionuclides. This comparison includes only the radionuclides for which there are Canadian

Parameter[43]	**Canada mg/L MAC[44]**	**United States Environmental Protection Agency MCL[45]**	**World Health Organization[46] (WHO)**
Radionuclides[59]:			
Alpha Particles		**15 picocuries per Litre[60]**	
Beta particles and photon emitters		**4 millirems per year**	
Radium 226 and Radium 228 (combined)		**5 picocuries per Litre**	
Uranium		**0.03 milligrams per litre**	
Natural Radionuclides:			
Lead-210[61]	0.1		0.1
Radium-224	2		**1**
Radium-226	0.6		**1**
Radium-228	0.5		**0.1**
Thorium-228	2		**1**
Thorium-230	0.4		**1**
Thorium-232	0.1		**1**
Thorium-234	20		**100**
Uranium-234	4		**10**
Uranium-235	4		**1**
Uranium-238	4		**10**
Artificial Radionuclides:			
Cesium-134	7		**10**
Cesium-137	10		10
Iodine-125	10		10
Iodine-131	6		**10**
Molybdenum-99	70		**100**

guidelines. The complete list is found in Table 9.3 of the World Health Organization's Guidelines for Drinking Water Quality, 3rd Edition, 2004 (page 203), appended to this report.

[59] The Guidelines for Canadian Drinking Water Quality have a list of radiological parameters. These U.S. standards for radionuclides are not as detailed as the federal guidelines.

[60] The United States has different parameters for which it has set standards.

[61] Of the 78 guidelines for radionuclides under the Canadian Guidelines, there are 6 for which the WHO has not established a guideline value. Of the 72 radionuclides for which both Canada and the WHO have established guidelines, the Canadian Guideline values for only 10 radionuclides are identical to the WHO guidelines.

Parameter[43]	**Canada mg/L MAC**[44]	**United States Environmental Protection Agency MCL**[45]	**World Health Organization**[46] **(WHO)**
Strontium-90	5		**10**
Tritium	7000		
Secondary Radionuclides:			
Natural Radionuclides:			
Beryllium-7	4000		**10,000**
Bismuth-210	70		**100**
Polonium-210	0.2		**0.1**
Artificial Radionuclides:			
Americium-241	0.2		**1**
Antimony-122	50		**100**
Antimony-124	40		**100**
Antimony-125	100		100
Barium-140	40		**100**
Bromine-82	300		**100**
Calcium-45	200		**100**
Calcium-47	60		**100**
Carbon-14	200		**100**
Cerium-141	100		100
Cerium-144	20		**10**
Cesium-131	2000		**1000**
Cesium-136	50		**100**
Chromium-51	3000		**10,000**
Cobalt-57	40		**1000**
Cobalt-58	20		**100**
Cobalt-60	2		**100**
Gallium-67	500		
Gold-198	90		**100**
Indium-111	400		**1000**
Iodine-129	1		**1000**
Iron-55	300		**1000**
Iron-59	40		**100**
Manganese-54	200		**100**

Parameter[43]	**Canada mg/L MAC**[44]	**United States Environmental Protection Agency MCL**[45]	**World Health Organization**[46] **(WHO)**
Mercury-197	400		**1000**
Mercury-203	80		**100**
Neptunium-239	100		100
Niobium-95	200		**100**
Phosphorus-32	50		**100**
Plutonium-238	0.3		**1**
Plutonium-239	0.2		**1**
Plutonium-240	0.2		**1**
Plutonium-241	10		10
Rhodium-105	300		**1000**
Rubidium-81	3000		
Rubidium-86	50		**100**
Ruthenium-103	100		100
Ruthenium-106	10		10
Selenium-75	70		**100**
Silver-108m	70		
Silver-110m	50		**100**
Silver-111	70		**100**
Sodium-22	50		**100**
Strontium-85	300		**100**
Strontium-89	40		**100**
Sulphur-35	500		**100**
Technetium-99	200		**100**
Technetium-99m	7000		
Tellurium-129m	40		**100**
Tellurium-131m	40		**100**
Tellurium-132	40		**100**
Thallium-201	2000		**1000**
Ytterbium-169	100		
Yttrium-90	30		**100**
Yttrium-91	30		**100**
Zinc-65	40		**100**

Parameter[43]	**Canada mg/L MAC**[44]	**United States Environmental Protection Agency MCL**[45]	**World Health Organization**[46] **(WHO)**
Zirconium-95	100		100

References:

Health Canada. Guidelines for Canadian drinking water quality, 6th ed. Ottawa: 1996

Health Canada. Summary of Guidelines for Canadian drinking water quality (contains new or revised guidelines since the 1996 edition). http://www.hc-sc.gc.ca/hecs-sesc/water/publications/drinking_water_quality_guidelines/toc.htm, accessed January 2005

United States. *National Primary Drinking Water Regulations*, 40 CFR vol 1 (7-1-00 edition), part 141

United States. Environment Protection Agency. Current drinking water standards. http://www.epa.gov/safewater/mcl.html,accessed January 2005.

World Health Organization. Guidelines for Drinking Water Quality (extracted from: Guidelines for drinking water quality, 3rd ed., vol. 1, Annex 4, Chemical Summary Tables, pages 488-493, available at http://www.who.int/water_sanitation_health/dwq/en/, accessed January 2005

Report of the Walkerton Inquiry, Part Two. Chapter 5, Drinking Water Quality Standards, pages 148 – 182

Alberta Environment. Alberta's Drinking Water Program, including the Environmental Protection and Enhancement Act and Alberta's Potable Water Regulation. http://www3.gov.ab.ca/env/water/dwq/dwprogram.html, accessed January 2005

Alberta's Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems can be found at: http://www3.gov.ab.ca/env/protenf/publications/drainagesec9.pdf, accessed January 2005

British Columbia Ministry of Health Services, Public Health Protection, Drinking Water Program (contains links to the Drinking Water Protection Act and the Drinking Water Protection Regulation B.C. Reg 200/2003) http://www.healthservices.gov.bc.ca/protect/water.html, accessed January 2005

British Columbia Drinking Water Protection Regulation http://www.qp.gov.bc.ca/statreg/reg/D/200_2003.htm, accessed January 2005

British Columbia Ministry of Water, Land and Air Protection, Water, Air and Climate Change Branch, Water Quality, British Columbia Approved Water Quality Guidelines (Criteria) 1988 Edition. http://wlapwww.gov.bc.ca/wat/wq/BCguidelines/approved.html, accessed January 2005

Manitoba Water Stewardship, Office of Drinking Water. Regulatory Information. Acts and Regulations, Approvals Requirements. http://www.gov.mb.ca/waterstewardship/odw/reg-info/acts-regs/index.html, accessed January 2005
The Drinking Water Safety Act is available at http://web2.gov.mb.ca/laws/statutes/ccsm/d101e.php

Manitoba Wildlands Water Information. Manitoba Initiatives. http://manitobawildlands.org/water_mb.htm, accessed January 2005.

New Brunswick, Department of the Environment and Local Government, Air, Land and Water –Reporting to New Brunswickers on Environmental Progress, November 2003. http://www.gnb.ca/0009/0369/0010/0006-e.pdf accessed January 2005.
New Brunswick Department of the Environment and Local Government Water Related programs and information at http://www.gnb.ca/0009/0003-e.asp, accessed January 2005.

Newfoundland and Labrador Dept. of Environment and Conservation, Drinking Water Quality Data (contains links to sampling of sources of drinking water). http://www.gov.nf.ca/env/env/waterres/Surfacewater/Drinking/DrinkingWater.asp accessed January 2005

Newfoundland.and Labrador Dept. of Environment and Conservation, "Source to Tap – Water Supplies in Newfoundland and Labrador", May 2001. http://www.gov.nf.ca/env/SourceToTap/SourceToTap/Report.asp, accessed January 2005

Nova Scotia Environment and Labour, Water and Wastewater, Overview of the New Public Drinking Water Supply Program. http://www.gov.ns.ca/enla/rmep/overview.htm

Nova Scotia Environment and Labour, Water and Wastewater Facility Regulations. http://www.gov.ns.ca/just/regulations/REGS/envwaste.htm, accessed January 2005

Ontario Ministry of Environment, Safe Drinking Water Act, 2002, Ontario Regulation 169/03, Ontario Drinking Water Quality Standards. http://www.e-laws.gov.on.ca/DBLaws/Regs/English/030169_e.htm, accessed January 2005

Prince Edward Island Environment and Land, Info PEI: Water Quality Interpretation. http://www.gov.pe.ca/infopei/onelisting.php3?number=43878, accessed January 2005

Environnement Quebec, Quebec Environment Quality Act, Regulation respecting the quality of Drinking Water. http://www.menv.gouv.qc.ca/eau/potable/brochure-en/, accessed January 2005

Saskatchewan Environment, Saskatchewan's Drinking Water Quality Standards and Objectives Summarized. http://www.se.gov.sk.ca/environment/protection/water/Drinking_Water_Standards_post.pdf, accessed January 2005

Saskatchewan Environment, The Water Regulations, 2002. http://www.se.gov.sk.ca/environment/protection/water/e10-21r1.pdf, accessed January 2005

Northwest Territories, Public Health Act, Public Water Supply Regulations. http://www.canlii.org/nt/laws/regu/p-23/20041110/whole.html, accessed January 2005

Government of the Northwest Territories, "Managing Drinking Water Quality in the Northwest Territories – A Preventive Framework and Strategy, December 2003. http://www.pws.gov.nt.ca/pdf/WaterAndSanitation/WaterFramework.pdf, accessed January 2005

Yukon Department of Health and Social Services, Yukon's Public Drinking Water, http://www.hss.gov.yk.ca/prog/eh/water.html, accessed January 2005

Yukon Department of Health and Social Services, Revised Draft Guideline for Public Drinking Water Systems Regulation. http://www.hss.gov.yk.ca/pdf/waterd-rev0404.pdf, accessed January 2005

Appendix I – World Health Organization's Guidance levels for radionuclides in drinking-water

To be faxed

Comparison of the Guidelines for Canadian Drinking Water Quality to Provincial Guidelines and Standards and to Selected International Guidelines and Standards

Appendix A
World Health Organization Guidelines for Drinking Water Quality - Radionuclides

Background Materials for Comparison Table

1. Canada
2. Alberta
3. British Columbia
4. Manitoba
5. New Brunswick
6. Newfoundland and Labrador
7. Nova Scotia
8. Ontario
9. Prince Edward Island
10. Quebec
11. Saskatchewan
12. The Territories
13. US Environmental Protection Agency
14. World Health Organization

Supplementary Materials

15. Guidelines for Canadian Drinking Water Quality Supporting Documents
16. Newfoundland and Labrador Discussion Paper on Application Of Drinking Water Quality Standards for Institutional and Commercial Water Supplies
17. Chapter 5 Part Two Report of the Walkerton Inquiry Drinking Water Quality Standards

Appendix I

Table 9.2 Dose coefficients for ingestion of radionuclides by adult members of the public

Category	Radionuclide	Dose coefficient (mSv/Bq)
Natural uranium series	Uranium-238	4.5×10^{-5}
	Uranium-234	4.9×10^{-5}
	Thorium-230	2.1×10^{-4}
	Radium-226	2.8×10^{-4}
	Lead-210	6.9×10^{-4}
	Polonium-210	1.2×10^{-3}
Natural thorium series	Thorium-232	2.3×10^{-4}
	Radium-228	6.9×10^{-4}
	Thorium-228	7.2×10^{-5}
Fission products	Caesium-134	1.9×10^{-5}
	Caesium-137	1.3×10^{-5}
	Strontium-90	2.8×10^{-5}
	Iodine-131	2.2×10^{-5}
Other radionuclides	Tritium	1.8×10^{-8}
	Carbon-14	5.8×10^{-7}
	Plutonium-239	2.5×10^{-4}
	Americium-241	2.0×10^{-4}

naturally occurring radionuclides or those arising from human activities that might be found in drinking-water supplies (IAEA, 1996; ICRP, 1996).

9.3 Guidance levels for radionuclides in drinking-water

The guidance levels for radionuclides in drinking-water are presented in Table 9.3 for radionuclides originating from natural sources or discharged into the environment as the result of current or past activities. These levels also apply to radionuclides released due to nuclear accidents that occurred more than 1 year previously. The activity concentration values in Table 9.3 correspond to an RDL of 0.1 mSv/year from each radionuclide listed if their concentration in the drinking-water consumed during the year does not exceed these values. The associated risk estimate was given at the beginning of this chapter. However, for the first year immediately after an accident, generic action levels for foodstuffs apply as described in the International Basic Safety Standards (IAEA, 1996) and other relevant WHO and IAEA publications (WHO, 1988; IAEA, 1997, 1999).

The guidance levels for radionuclides in drinking-water were calculated by the following equation:

$$GL = IDC/(h_{ing} \cdot q)$$

where:

GL = guidance level of radionuclide in drinking-water (Bq/litre),
IDC = individual dose criterion, equal to 0.1 mSv/year for this calculation,
h_{ing} = dose coefficient for ingestion by adults (mSv/Bq),
q = annual ingested volume of drinking-water, assumed to be 730 litres/year.

Table 9.3 Guidance levels for radionuclides in drinking-water

Radionuclides	Guidance level (Bq/litre)[a]	Radionuclides	Guidance level (Bq/litre)[a]	Radionuclides	Guidance level (Bq/litre)[a]
^{3}H	10 000	^{93}Mo	100	^{140}La	100
^{7}Be	10 000	^{99}Mo	100	^{139}Ce	1000
^{14}C	100	^{96}Tc	100	^{141}Ce	100
^{22}Na	100	^{97}Tc	1000	^{143}Ce	100
^{32}P	100	^{97m}Tc	100	^{144}Ce	10
^{33}P	1 000	^{99}Tc	100	^{143}Pr	100
^{35}S	100	^{97}Ru	1000	^{147}Nd	100
^{36}Cl	100	^{103}Ru	100	^{147}Pm	1000
^{45}Ca	100	^{106}Ru	10	^{149}Pm	100
^{47}Ca	100	^{105}Rh	1000	^{151}Sm	1000
^{46}Sc	100	^{103}Pd	1000	^{153}Sm	100
^{47}Sc	100	^{105}Ag	100	^{152}Eu	100
^{48}Sc	100	^{110m}Ag	100	^{154}Eu	100
^{48}V	100	^{111}Ag	100	^{155}Eu	1000
^{51}Cr	10 000	^{109}Cd	100	^{153}Gd	1000
^{52}Mn	100	^{115}Cd	100	^{160}Tb	100
^{53}Mn	10 000	^{115m}Cd	100	^{169}Er	1000
^{54}Mn	100	^{111}In	1000	^{171}Tm	1000
^{55}Fe	1 000	^{114m}In	100	^{175}Yb	1000
^{59}Fe	100	^{113}Sn	100	^{182}Ta	100
^{56}Co	100	^{125}Sn	100	^{181}W	1000
^{57}Co	1 000	^{122}Sb	100	^{185}W	1000
^{58}Co	100	^{124}Sb	100	^{186}Re	100
^{60}Co	100	^{125}Sb	100	^{185}Os	100
^{59}Ni	1 000	^{123m}Te	100	^{191}Os	100
^{63}Ni	1 000	^{127}Te	1000	^{193}Os	100
^{65}Zn	100	^{127m}Te	100	^{190}Ir	100
^{71}Ge	10 000	^{129}Te	1000	^{192}Ir	100
^{73}As	1 000	^{129m}Te	100	^{191}Pt	1000
^{74}As	100	^{131}Te	1000	^{193m}Pt	1000
^{76}As	100	^{131m}Te	100	^{198}Au	100
^{77}As	1 000	^{132}Te	100	^{199}Au	1000
^{75}Se	100	^{125}I	10	^{197}Hg	1000
^{82}Br	100	^{126}I	10	^{203}Hg	100
^{86}Rb	100	^{129}I	1000	^{200}Tl	1000
^{85}Sr	100	^{131}I	10	^{201}Tl	1000
^{89}Sr	100	^{129}Cs	1000	^{202}Tl	1000
^{90}Sr	10	^{131}Cs	1000	^{204}Tl	100
^{90}Y	100	^{132}Cs	100	^{203}Pb	1000
^{91}Y	100	^{134}Cs	10	^{206}Bi	100
^{93}Zr	100	^{135}Cs	100	^{207}Bi	100
^{95}Zr	100	^{136}Cs	100	^{210}Bi[b]	100
^{93m}Nb	1 000	^{137}Cs	10	^{210}Pb[b]	0.1
^{94}Nb	100	^{131}Ba	1000	^{210}Po[b]	0.1
^{95}Nb	100	^{140}Ba	100	^{223}Ra[b]	1
^{224}Ra[b]	1	^{235}U[b]	1	^{242}Cm	10
^{225}Ra	1	^{236}U[b]	1	^{243}Cm	1
^{226}Ra[b]	1	^{237}U	100	^{244}Cm	1
^{228}Ra[b]	0.1	^{238}U[b,c]	10	^{245}Cm	1

continued

Table 9.3 *Continued*

Radionuclides	Guidance level (Bq/litre)	Radionuclides	Guidance level (Bq/litre)	Radionuclides	Guidance level (Bq/litre)
$^{227}Th^{b}$	10	^{237}Np	1	^{246}Cm	1
$^{228}Th^{b}$	1	^{239}Np	100	^{247}Cm	1
^{229}Th	0.1	^{236}Pu	1	^{248}Cm	0.1
$^{230}Th^{b}$	1	^{237}Pu	1000	^{249}Bk	100
$^{231}Th^{b}$	1 000	^{238}Pu	1	^{246}Cf	100
$^{232}Th^{b}$	1	^{239}Pu	1	^{248}Cf	10
$^{234}Th^{b}$	100	^{240}Pu	1	^{249}Cf	1
^{230}Pa	100	^{241}Pu	10	^{250}Cf	1
$^{231}Pa^{b}$	0.1	^{242}Pu	1	^{251}Cf	1
^{233}Pa	100	^{244}Pu	1	^{252}Cf	1
^{230}U	1	^{241}Am	1	^{253}Cf	100
^{231}U	1 000	^{242}Am	1000	^{254}Cf	1
^{232}U	1	^{242m}Am	1	^{253}Es	10
^{233}U	1	^{243}Am	1	^{254}Es	10
$^{234}U^{b}$	10			^{254m}Es	100

[a] Guidance levels are rounded according to averaging the log scale values (to 10^n if the calculated value was below 3×10^n and above $3 \times 10^{n-1}$).
[b] Natural radionuclides.
[c] The provisional guideline value for uranium in drinking-water is 15 µg/litre based on its chemical toxicity for the kidney (see section 8.5).

The higher age-dependent dose coefficients calculated for children (accounting for the higher uptake and/or metabolic rates) do not lead to significantly higher doses due to the lower mean volume of drinking-water consumed by infants and children. Consequently, the recommended RDL of committed effective dose of 0.1 mSv/year from 1 year's consumption of drinking-water applies independently of age.

9.4 Monitoring and assessment for dissolved radionuclides

9.4.1 Screening of drinking-water supplies

The process of identifying individual radioactive species and determining their concentration requires sophisticated and expensive analysis, which is normally not justified, because the concentrations of radionuclides in most circumstances are very low. A more practical approach is to use a screening procedure, where the total radioactivity present in the form of alpha and beta radiation is first determined, without regard to the identity of specific radionuclides.

Screening levels for drinking-water below which no further action is required are 0.5 Bq/litre for gross alpha activity and 1 Bq/litre for gross beta activity. The gross beta activity screening level was published in the second edition of the Guidelines and, in the worse case (radium-222), would lead to a dose close to the guidance RDL of 0.1 mSv/year. The screening level for gross alpha activity is 0.5 Bq/litre (instead of the former 0.1 Bq/litre), as this activity concentration reflects values nearer the radionuclide-specific guidance RDL.

9.4.2 Strategy for assessing drinking-water

If either of the screening levels is exceeded, then the specific radionuclides producing this activity should be identified and their individual activity concentrations measured. From these data, an estimate of committed effective dose for each radionuclide should be made and the sum of these doses determined. If the following additive formula is satisfied, no further action is required:

$$\frac{C_i}{GL_i} \leq 1$$

where:

C_i = the measured activity concentration of radionuclide i, and
GL_i = the guidance level value (see Table 9.3) of radionuclide i that, at an intake of 2 litres/day for 1 year, will result in a committed effective dose of 0.1 mSv/year.

Where the sum exceeds unity for a single sample, the RDL of 0.1 mSv would be exceeded only if the exposure to the same measured concentrations were to continue for a full year. *Hence, such a sample does not in itself imply that the water is unsuitable for consumption* but should be regarded as an indication that further investigation, including additional sampling, is needed. Gross beta and gross alpha activity screening has to be repeated first, then radionuclide-specific analysis conducted only if subsequently measured gross values exceed the recommended practical screening values (1 Bq/litre and 0.5 Bq/litre, respectively).

The application of these recommendations is summarized in Figure 9.2.

The gross beta measurement includes a contribution from potassium-40, a beta emitter that occurs naturally in a fixed ratio to stable potassium. Potassium is an essential element for humans and is absorbed mainly from ingested food. Potassium-40 does not accumulate in the body but is maintained at a constant level independent of intake. The contribution of potassium-40 to beta activity should therefore be subtracted following a separate determination of total potassium. The specific activity of potassium-40 is 30.7 Bq/g of potassium. However, not all the radiation from potassium-40 appears as beta activity. The beta activity of potassium-40 is 27.6 Bq/g of stable potassium, which is the factor that should be used to calculate the beta activity due to potassium-40.

9.4.3 Remedial measures

If the RDL of 0.1 mSv/year is being exceeded on aggregate, then the options available to the competent authority to reduce the dose should be examined. Where remedial measures are contemplated, any strategy considered should first be justified (in the sense that it achieves a net benefit) and then optimized in accordance with the recommendations of ICRP (1989, 1991) in order to produce the maximum net benefit.

SUMMARY OF GUIDELINES FOR CANADIAN DRINKING WATER QUALITY

Membership of the Federal-Provincial-Territorial Committee on Drinking Water and Secretariat

Provincial and Territorial Representatives		
Alberta	Department of Environment	Mr. Karu Chinniah
British Columbia	Ministry of Health Services	Mr. Barry Boettger
Manitoba	Department of Water Stewardship	Mr. Don Rocan
New Brunswick	Department of Health and Wellness	Mr. Ivan Brophy
Newfoundland and Labrador	Department of Environment and Conservation	Mr. Martin Goebel
Northwest Territories	Department of Health and Social Services	Mr. Duane Fleming
Nova Scotia	Department of Environment and Labour	Ms. Judy MacDonald
Nunavut Territory	Department of Health and Social Services	Mr. Bruce Trotter
Ontario	Ministry of Environment	Ms. Patricia Lachmaniuk
Prince Edward Island	Department of Environment and Energy	Mr. George Somers
Québec	Ministère de l'Environnement	Ms. Hélène Tremblay
Saskatchewan	Department of the Environment	Mr. Sam Ferris
Yukon Territory	Department of Health and Social Services	Ms. Patricia Brooks
Federal Representatives		
Health Canada		Dr. John Cooper
Environment Canada		Mr. Doug Spry
Liaison Officers		
Dr. Jim Popplow	Federal–Provincial–Territorial Committee on Health and the Environment	

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Mr. Tim Macaulay	Canadian Advisory Council on Plumbing
Committee Secretary	
Health Canada (Water Quality and Health Bureau, Safe Environments Programme, Healthy Environments and Consumer Safety Branch) Mr. David Green	

* MAC = maximum acceptable concentration; IMAC = interim maximum acceptable concentration.
** Refer to note 1 in Table 2.
*** Refer to section on Summary of Guidelines for Microbiological Parameters.

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Last updated 2004-10-19

PACIFIC/YUKON
WATER QUALITY
MONITORING PROGRAM

Environment Canada Environnement Canada

Français What's New About Us	Contact Us Your Environment	Help Information / Publications	Search Weather	Ca EC
Monitoring Programs	Data Online	Guidelines	Publications	Or

Home

Water Quality
Regional
National
International

Resource Information
Monitoring How-To
Schools and Kids
Research and Assessment
Maps and Data
Legislation
Journals
Environmental Programs
Water Quality Guidelines

Water Quality Concerns
Drinking Water
Pesticides and Toxics
Climate Change
Pollution

Online Resources

EN
FR

Water Resource Information: Guidelines or Safe Levels

National guidelines published by the Federal Gove Canada:

Canadian Council of Ministers of the Environment (CCME) Water Qu
EN FR
Guidelines for Canadian water quality developed by CCME's Water Q Group. Documents on the guideline development process are also av

Guidelines or objectives published by Canadian pr governments:

BRITISH COLUMBIA

British Columbia Ministry of Water, Land and Air Protection EN
A searchable database of technical reports, trend reports, and guideli quality in British Columbia.

Alberta

Alberta Environment EN
Links to PDF versions of guidelines for various water-related topics, i water quality.

Saskatchewan Environment EN
A PDF version of Saskatchewan's new regulations under the Environ Management Protection Act. Includes a table of the maximum accepti of many pollutants.

Manitoba Conservation EN

Provides links to download "Manitoba Water Quality Standards, Objec Guidelines", a PDF document.

Ontario

Ontario Ministry of Agriculture and Food EN

Provides a table showing the legislation and guidelines in place to pr aspects of water quality, their use to public landowners, and the mini for each piece of legislation.

Québec

Environnement Quebec FR

Includes Quebec guidelines for the protection of aquatic life, birds an recreational activites, and esthetics. ***Currently available in French o***

Prince Edward Island

Prince Edward Island EN

Prince Edward Island's water quality guidelines are based on Health Guidelines for Canadian Drinking Water Quality. They include aestheti maximum acceptable concentrations.

Newfoundland EN

Newfoundland follows Health Canada's Guidelines for Canadian Drinki Monitoring data for a number of physical and chemical parameters ar well as listings of those values that exceeded the Guidelines.

Nova Scotia EN

Nova Scotia also follows Health Canada's Guidelines for Canadian Dr Quality. This site contains information about Nova Scotia's new Public Supply Program as well as other guidelines related to drinking water monitoring.

Guidelines or objectives published by governmenta governmental national agencies:

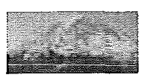
Canadä

Environment Canada - Environmental Quality Guidelines EN FR
A summary of the current guidelines for Canadian drinking water qua the supporting documents that were used to establish many of the cł and microbiological guidelines.

Canadä

Health Canada – Drinking Water Guidelines EN FR
A summary of the current guidelines for Canadian drinking water qua the supporting documents that were used to establish many of the cł and microbiological guidelines.

US Environmental Protection Agency (EPA) EN
An extensive listing of rules, regulations, and policy documents relate in the United States. Most documents are available in PDF or HTML



Washington State Department of Ecology EN
The Washington State Department of Ecology provides surface water for general water use, toxic and radioactive substances, and for the ן drinking water and aquatic life.

World Health Organization (WHO) Guidelines for Drinking Water Poli
Provides an overview of the WHO guidelines for drinking water qualit summary tables with guideline levels for inorganic and organic constit bacteriological quality, pesticides, disinfectants, and radioactive pollutaı

Water Quality in the European Union: Bathing Water EN
Presents the original (1976) European legislation for the protection of lake water for swimming, as well as the current (2002) proposal for ε directive.

Water Quality in the European Union: Water Policy EN
Provides links to water policy sites related to river basin managemen industrial pollution, agriculture, and drinking water.

New Zealand Ministry for the Environment EN
A Government of New Zealand site providing links to a number of gu
and PDF documents related to many aspects of water quality.

Japan Ministry of the Environment EN
A listing of water quality standards and monitoring guidelines for 48 s
considered to be dangerous or potentially dangerous to human health
environment.

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SUMMARY OF GUIDELINES FOR CANADIAN DRINKING WATER QUALITY

New, Revised and Reaffirmed Guidelines

New, revised and reaffirmed guidelines for chemical, physical and microbiological parameters are presented in Table 1.

Table 1 - New, Revised and Reaffirmed Guidelines* for Chemical, Physical and Microbiological Parameters since the Publication of the Sixth Edition of the *Guidelines for Canadian Drinking Water Quality*

Parameter	Guideline (mg/L)	Previous guideline (mg/L)	Year approved
Chemical and Physical Parameters			
Aluminum	0.1**	None	1998
Antimony	IMAC 0.006	None	1997
Bromate	IMAC 0.01	None	1998
Cyanobacterial toxins (as Microcystin-LR)	0.0015	None	2002
Fluoride	MAC 1.5	MAC 1.5	1996
Formaldehyde	None required - see Table 3	None	1997
Uranium	IMAC 0.02	MAC 0.1	1999
Microbiological Parameters			
Bacteria	***		Ongoing
Protozoa	***		Ongoing

Viruses	***	Ongoing

* MAC = maximum acceptable concentration; IMAC = interim maximum acceptable concentration.
** Refer to note 1 in Table 2.
*** Refer to section on Summary of Guidelines for Microbiological Parameters.

Table 2 - Consultation Guidelines

Parameter	**Proposed Guideline* (mg/L)**		**Consultation Concludes**
	MAC	**AO**	
Arsenic	0.005		Fall/Winter 2004
Bacteriological (4 documents)	old		Jan. 13, 2005
Bromodichloromethane (BDCM)**	0.016 new		Jan. 7, 2005
Chloral hydrate	NGP new		Fall/Winter 2004
Chlorite Chlorate	1.0 1.0 new		Fall/Winter 2004
Methyl tertiary-butyl ether (MTBE)	new	0.015	Fall/Winter 2004
Haloacetic Acids (HAAs)	new		TBD
Trihalomethanes (THMs)	0.1 old		Jan. 7, 2005
Trichloroethylene (TCE)	0.005 old		April 5, 2004

* MAC = Maximum Acceptable Concentration;
AO = Aesthetic Objective;
NGP = No Guideline Proposed.
** Refer to Trihalomethane document.

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SUMMARY OF GUIDELINES FOR CANADIAN DRINKING WATER QUALITY

Summary of Guidelines for Microbiological Parameters

Bacteria (Under Review)

The maximum acceptable concentration (MAC) for bacteriological quality of public, semi-public, and private drinking water systems is no coliforms detectable per 100 mL. However, because coliforms are not uniformly distributed in water and are subject to considerable variation in public health significance, drinking water that fulfills the following conditions is considered to conform to this MAC:

Public Drinking Water Supply Systems

1. No sample should contain *Escherichia coli. E. coli* indicates recent faecal contamination and the possible presence of enteric pathogens that may adversly affect human health. If *E. coli* is confirmed, the appropriate agencies should be notified, a boil water advisory should be issued, and corrective actions taken.

2. No consecutive samples from the same site or not more than 10% of samples from the distribution system in a given calendar month should show the presence of total coliform bacteria. The ability of total coliforms to indicate the presence of faecal pollution is less reliable than *E. coli*. However, this group of bacteria is a good indicator of quality control. The presence of total coliforms does not necessarily require the issuance of a boil water advisory but corrective actions should be taken.

Semi-public and Private Drinking Water Supply Systems

1. No sample should contain *E. coli*. As stated above, the presence of *E. coli* indicates faecal contamination and the possible presence of enteric pathogens; therefore the water is unsafe to drink. If *E. coli* is detected, a boil water advisory should be issued and corrective actions taken.

2. No sample should contain total coliform bacteria. In non-disinfected well water, the presence of total coliform bacteria in the absence of *E. coli* indicates the well is prone to surface water infiltration and therefore at risk of faecal contamination. In disinfected water systems, the presence of total coliform bacteria indicates a failure in the disinfection process. In both disinfected and non-disinfected systems, total coliform detection may also indicate the presence of biofilm in the well or plumbing system. The degree of response to the presence of total coliform bacteria, in the absence of *E. coli*, may be site specific and can vary between jurisdictions.

Protozoa (Under Review)

Numerical guidelines for the protozoa *Giardia* and *Cryptosporidium* are not proposed at this time. Routine methods available for the detection of protozoan cysts and oocysts suffer from low recovery rates and do not provide any information on their viability or human infectivity. Nevertheless, until better monitoring data and information on the viability and infectivity of cysts and oocysts present in drinking water are available, measures to reduce the risk of illness as much as possible should be implemented. If viable, human-infectious cysts or oocysts are present or suspected to be present in source waters or if *Giardia* or *Cryptosporidium* has been responsible for past waterborne outbreaks in a community, a treatment regime and a watershed or wellhead protection plan (where feasible) or other measures known to reduce the risk of illness should be implemented.

Viruses (Under Review)

Numerical guidelines for human enteric viruses are not proposed at this time. There are more than 120 types of human enteric viruses, many of which are non-culturable. Testing is complicated, expensive, not available for all viruses, and beyond the capabilities of most laboratories involved in routine water quality monitoring. The best means of safeguarding against the presence of human enteric viruses are based upon the application of adequate treatment and the absence of faecal indicator organisms, such as *Escherichia coli*.

Boil Water Advisories

General guidance on the issuing and rescinding of boil water advisories is provided. In the event of an advisory, a rolling boil for 1 minute is considered adequate.

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SUMMARY OF GUIDELINES FOR CANADIAN DRINKING WATER QUALITY

Summary of Guidelines for Chemical and Physical Parameters

Parameters with Guidelines

Guidelines for all chemical and physical parameters, including all new, revised and reaffirmed maximum acceptable concentrations (MACs), interim maximum acceptable concentrations (IMACs) and aesthetic objectives (AOs), are listed in Table 3. For more information on the drinking water guideline for any particular compound, please refer to the Supporting Documentation for the parameter of concern.

Table 3. Summary of Guidelines for Chemical and Physical Parameters

Parameter	Maximum Acceptable Concentration (mg/L)	Aesthetic Objectives (mg/L)	Reason / Comment
aldicarb	0.009		
aldrin + dieldrin	0.0007		
aluminum [1]			
antimony	0.006 [2]		
arsenic	0.025		
atrazine + metabolites	0.005		
azinphos-methyl	0.02		
barium	1.0		
bendiocarb	0.04		
benzene	0.005		

benzo[a]pyrene	0.00001	
boron	5	
bromate	0.01	
bromoxynil	0.005	
cadmium	0.005	
carbaryl	0.09	
carbofuran	0.09	
carbon tetrachloride	0.005	
chloramines (total)	3.0	
chloride		≤250
chlorpyrifos	0.09	
chromium	0.05	
colour		≤15 TCU [4]
copper [2]		≤1.0
cyanazine	0.01	
cyanide	0.2	
cyanobacterial toxins (as microcystin-LR) [3]	0.0015	
diazinon	0.02	
dicamba	0.12	
dichlorobenzene, 1,2- [5]	0.20	≤0.003
dichlorobenzene, 1,4- [5]	0.005	≤0.001
dichloroethane, 1,2-	0.005	

dichloroethylene, 1,1-	0.014	
dichloromethane	0.05	
dichlorophenol, 2,4-	0.9	≤0.0003
dichlorophenoxyacetic acid, 2,4- (2,4-D)	0.1	
diclofop-methyl	0.009	
dimethoate	0.02	
dinoseb	0.01	
diquat	0.07	
diuron	0.15	
ethylbenzene		≤0.0024
fluoride [6]	1.5	
glyphosate	0.28	
iron		≤0.3
lead [3]	0.010	
malathion	0.19	
manganese		≤0.05
mercury	0.001	
methoxychlor	0.9	
metolachlor	0.05	
metribuzin	0.08	
monochlorobenzene	0.08	≤0.03
nitrate [7]	45	
nitrilotriacetic acid	0.4	

(NTA)		
odour		Inoffensive
paraquat (as dichloride)	0.01 [8]	
parathion	0.05	
pentachlorophenol	0.06	≤0.030
pH		6.5-8.5 [9]
phorate	0.002	
picloram	0.19	
selenium	0.01	
simazine	0.01	
sodium [10]		≤200
sulphate [11]		≤500
sulphide (as H_2S)		≤0.05
taste		Inoffensive
temperature		≤15°C
terbufos	0.001	
tetrachloroethylene	0.03	
tetrachlorophenol, 2,3,4,6-	0.1	≤0.001
toluene		≤0.024
total dissolved solids (TDS)		≤500
trichloroethylene	0.05	
trichlorophenol, 2,4,6-	0.005	≤0.002
trifluralin	0.045	

trihalomethanes (total) [12]	0.1	
turbidity	1 NTU[13]	≤5 NTU [13,14]
uranium	0.02	
vinyl chloride	0.002	
xylenes (total)		≤0.3
zinc [2]		≤5.0

Notes:

1. A health-based guideline for aluminum in drinking water has not been established. However, water treatment plants using aluminum-based coagulants should optimize their operations to reduce residual aluminum levels in treated water to the lowest extent possible as a precautionary measure. *Operational guidance values* of less than 100 µg/L total aluminum for conventional treatment plants and less than 200 µg/L total aluminum for other types of treatment systems are recommended. Any attempt to minimize aluminum residuals must not compromise the effectiveness of disinfection processes or interfere with the removal of disinfection by-product precursors.

2. Because first-drawn water may contain higher concentrations of metals than are found in running water after flushing, faucets should be thoroughly flushed before water is taken for consumption or analysis.

3. The guideline is considered protective of human health against exposure to other microcystins (total microcystins) that may also be present.

4. TCU = true colour unit.

5. In cases where total dichlorobenzenes are measured and concentrations exceed the most stringent value (0.005 mg/L), the concentrations of the individual isomers should be established.

6. It is recommended, however, that the concentration of fluoride be adjusted to 0.8–1.0 mg/L, which is the optimum range for the control of dental caries.

7. Equivalent to 10 mg/L as nitrate–nitrogen. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L.

8. Equivalent to 0.007 mg/L for paraquat ion.

9. No units.

10. It is recommended that sodium be included in routine monitoring programmes, as levels may be of interest to authorities who wish to prescribe sodium-restricted diets for their patients.

11. There may be a laxative effect in some individuals when sulphate levels

exceed 500 mg/L.

12. The IMAC for trihalomethanes is expressed as a running annual average. It is based on the risk associated with chloroform, the trihalomethane most often present and in greatest concentration in drinking water. The guideline is designated as interim until such time as the risks from other disinfection by-products are ascertained. The preferred method of controlling disinfection by-products is precursor removal; however, any method of control employed must not compromise the effectiveness of water disinfection.

13. NTU = nephelometric turbidity unit.

14. At the point of consumption.

Parameters without Guidelines

Since 1978, some chemical and physical parameters have been identified as not requiring a numerical guideline. Table 4 lists these parameters.

The reasons for parameters having no numerical guideline include the following:

- currently available data indicate no health risk or aesthetic problem (e.g., calcium);
- data indicate the compound, which may be harmful, is not registered for use in Canada (e.g., 2,4,5-TP) or is not likely to occur in drinking water at levels that present a health risk (e.g., silver); or
- the parameter is composed of several compounds for which individual guidelines may be required (e.g., pesticides [total]).

Table 4. Summary List of Parameters without Guidelines

Parameter	Parameter
ammonia	mirex
asbestos	phenols
calcium	phthalic acid esters (PAE)
chlordane (total isomers)	polycyclic aromatic hydrocarbons (PAH) [2]
dichlorodiphenyltrichloroethane (DDT) + metabolites	radon
endrin	resin acids
formaldehyde	silver
gasoline	tannin
hardness [1]	temephos
heptachlor + heptachlor epoxide	total organic carbon
lignin	toxaphene

lindane	triallate
magnesium	trichlorophenoxyacetic acid, 2,4,5- (2,4,5-T)
methyl-parathion	trichlorophenoxypropionic acid, 2,4,5- (2,4,5-TP)

Notes:

1. Public acceptance of hardness varies considerably. Generally, hardness levels between 80 and 100 mg/L (as $CaCO_3$) are considered acceptable; levels greater than 200 mg/L are considered poor but can be tolerated; those in excess of 500 mg/L are normally considered unacceptable. Where water is softened by sodium ion exchange, it is recommended that a separate, unsoftened supply be retained for culinary and drinking purposes.

2. Other than benzo[a]pyrene.

SUMMARY OF GUIDELINES FOR CANADIAN DRINKING WATER QUALITY

Summary of Guidelines for Radiological Parameters

In setting dose guidelines for radionuclides in drinking water, it is recognized that water consumption contributes only a portion of the total radiation dose and that some radionuclides present are natural in origin and therefore cannot be excluded. Consequently, maximum acceptable concentrations (MACs) for radionuclides in drinking water have been derived based on a committed effective dose of 0.1 mSv* from one year's consumption of drinking water. This dose represents less than 5% of the average annual dose attributable to natural background radiation.

To facilitate the monitoring of radionuclides in drinking water, the reference level of dose is expressed as an activity concentration, which can be derived for each radionuclide from published radiological data. The National Radiological Protection Board has calculated dose conversion factors (DCFs) for radionuclides based on metabolic and dosimetric models for adults and children. Each DCF provides an estimate of the 50-year committed effective dose resulting from a single intake of 1 Bq** of a given radionuclide.

The MACs of radionuclides in public water supplies are derived from adult DCFs, assuming a daily water intake of 2 L, or 730 L/year, and a maximum committed effective dose of 0.1 mSv, or 10% of the International Commission on Radiological Protection limit on public exposure:

$$\mathrm{MAC\ (Bq/L)} = \frac{1 \times 10^{-4}\ \mathrm{(Sv/year)}}{730\ \mathrm{(L/year)} \times \mathrm{DCF\ (Sv/Bq)}}$$

* Sievert (Sv) is the unit of radiation dose. It replaces the old unit, rem (1 rem = 0.01 Sv).

** Becquerel (Bq) is the unit of activity of a radioactive substance, or the rate at which transformations occur in the substance. One becquerel is equal to one transformation per second and is approximately equal to 27 picocuries (pCi).

When two or more radionuclides are found in drinking water, the following relationship should be satisfied:

$$\frac{c_1}{\mathrm{MAC}_1} + \frac{c_2}{\mathrm{MAC}_2} + \ldots \frac{c_i}{\mathrm{MAC}_i} \leq 1$$

where c_i and MAC_i are the observed and maximum acceptable concentrations,

respectively, for each contributing radionuclide.

MACs for radionuclides that should be monitored in water samples are listed in Table 5. If a sample is analysed by gamma-spectroscopy, additional screening for radionuclides that may be present under certain conditions can be performed. MACs for these radionuclides are given in Table 6. MACs for a number of additional radionuclides, both natural and artificial, can be found in the sixth edition of the guidelines booklet.

Water samples may be initially screened for radioactivity using techniques for gross alpha and gross beta activity determinations. Compliance with the guidelines may be inferred if the measurements for gross alpha and gross beta activity are less than 0.1 Bq/L and 1 Bq/L, respectively, as these are lower than the strictest MACs. Sampling and analyses should be carried out often enough to accurately characterize the annual exposure. If the source of the activity is known, or expected, to be changing rapidly with time, then the sampling frequency should reflect this factor. If there is no reason to suppose that the source varies with time, then the sampling may be done annually. If measured concentrations are consistent and well below the reference levels, this would be an argument for reducing the sampling frequency. On the other hand, the sampling frequency should be maintained, or even increased, if concentrations are approaching the reference levels. In such a case, the specific radionuclides should be identified and individual activity concentrations measured.

Table 5. Primary List of Radionuclides - Maximum Acceptable Concentrations

Radionuclide		Half-life $t_{½}$	DCF (Sv/Bq)	MAC (Bq/L)
Natural Radionuclides				
Lead-210	^{210}Pb	22.3 years	1.3×10^{-6}	0.1
Radium-224	^{224}Ra	3.66 days	8.0×10^{-8}	2
Radium-226	^{226}Ra	1600 years	2.2×10^{-7}	0.6
Radium-228	^{228}Ra	5.76 years	2.7×10^{-7}	0.5
Thorium-228	^{228}Th	1.91 years	6.7×10^{-8}	2
Thorium-230	^{230}Th	7.54×10^{4} years	3.5×10^{-7}	0.4
Thorium-232	^{232}Th	1.40×10^{10} years	1.8×10^{-6}	0.1
Thorium-234	^{234}Th	24.1 days	5.7×10^{-9}	20
Uranium-234	^{234}U	2.45×10^{5} years	3.9×10^{-8}	4*
Uranium-235	^{235}U	7.04×10^{8} years	3.8×10^{-8}	4*
Uranium-238	^{238}U	4.47×10^{9} years	3.6×10^{-8}	4*
Artificial Radionuclides				

Cesium-134	^{134}Cs	2.07 years	1.9×10^{-8}	7
Cesium-137	^{137}Cs	30.2 years	1.3×10^{-8}	10
Iodine-125	^{125}I	59.9 days	1.5×10^{-8}	10
Iodine-131	^{131}I	8.04 days	2.2×10^{-8}	6
Molybdenum-99	^{99}Mo	65.9 hours	1.9×10^{-9}	70
Strontium-90	^{90}Sr	29 years	2.8×10^{-8}	5
Tritium**	^{3}H	12.3 years	1.8×10^{-11}	7000

* The activity concentration of natural uranium corresponding to the chemical guideline of 0.02 mg/L is about 0.5 Bq/L.

** Tritium is also produced naturally in the atmosphere in significant quantities.

Table 6. Secondary List of Radionuclides - Maximum Acceptable Concentrations (MACs)

Radionuclide		Half-life $t^{1/2}$	DCF (Sv/Bq)	MAC (Bq/L)
Natural Radionuclides				
Beryllium-7	^{7}Be	53.3 days	3.3×10^{-11}	4000
Bismuth-210	^{210}Bi	5.01 days	2.1×10^{-9}	70
Polonium-210	^{210}Po	138.4 days	6.2×10^{-7}	0.2
*Artificial Radionuclides***				
Americium-241	^{241}Am	432 years	5.7×10^{-7}	0.2
Antimony-122	^{122}Sb	2.71 days	2.8×10^{-9}	50
Antimony-124	^{124}Sb	60.2 days	3.6×10^{-9}	40
Antimony-125	^{125}Sb	2.76 years	9.8×10^{-10}	100
Barium-140	^{140}Ba	12.8 days	3.7×10^{-9}	40
Bromine-82	^{82}Br	35.3 hours	4.8×10^{-10}	300
Calcium-45	^{45}Ca	165 days	8.9×10^{-10}	200
Calcium-47	^{47}Ca	4.54 days	2.2×10^{-9}	60
Carbon-14	^{14}C	5730 years	5.6×10^{-10}	200

Cerium-141	^{141}Ce	32.5 days	1.2×10^{-9}	100
Cerium-144	^{144}Ce	284.4 days	8.8×10^{-9}	20
Cesium-131	^{131}Cs	9.69 days	6.6×10^{-11}	2000
Cesium-136	^{136}Cs	13.1 days	3.0×10^{-9}	50
Chromium-51	^{51}Cr	27.7 days	5.3×10^{-11}	3000
Cobalt-57	^{57}Co	271.8 days	3.5×10^{-9}	40
Cobalt-58	^{58}Co	70.9 days	6.8×10^{-9}	20
Cobalt-60	^{60}Co	5.27 years	9.2×10^{-8}	2
Gallium-67	^{67}Ga	78.3 hours	2.6×10^{-10}	500
Gold-198	^{198}Au	2.69 days	1.6×10^{-9}	90
Indium-111	^{111}In	2.81 days	3.9×10^{-10}	400
Iodine-129	^{129}I	1.60×10^{7} years	1.1×10^{-7}	1
Iron-55	^{55}Fe	2.68 years	4.0×10^{-10}	300
Iron-59	^{59}Fe	44.5 days	3.1×10^{-9}	40
Manganese-54	^{54}Mn	312.2 days	7.3×10^{-10}	200
Mercury-197	^{197}Hg	64.1 hours	3.3×10^{-10}	400
Mercury-203	^{203}Hg	46.6 days	1.8×10^{-9}	80
Neptunium-239	^{239}Np	2.35 days	1.2×10^{-9}	100
Niobium-95	^{95}Nb	35.0 days	7.7×10^{-10}	200
Phosphorus-32	^{32}P	14.3 days	2.6×10^{-9}	50
Plutonium-238	^{238}Pu	87.7 years	5.1×10^{-7}	0.3
Plutonium-239	^{239}Pu	2.41×10^{4} years	5.6×10^{-7}	0.2
Plutonium-240	^{240}Pu	6560 years	5.6×10^{-7}	0.2
Plutonium-241	^{241}Pu	14.4 years	1.1×10^{-8}	10

Rhodium-105	^{105}Rh	35.4 hours	5.4×10^{-10}	300
Rubidium-81	^{81}Rb	4.58 hours	5.3×10^{-11}	3000
Rubidium-86	^{86}Rb	18.6 days	2.5×10^{-9}	50
Ruthenium-103	^{103}Ru	39.2 days	1.1×10^{-9}	100
Ruthenium-106	^{106}Ru	372.6 days	1.1×10^{-8}	10
Selenium-75	^{75}Se	119.8 days	2.1×10^{-9}	70
Silver-108m	^{108m}Ag	127 years	2.1×10^{-9}	70
Silver-110m	^{110m}Ag	249.8 days	3.0×10^{-9}	50
Silver-111	^{111}Ag	7.47 days	2.0×10^{-9}	70
Sodium-22	^{22}Na	2.61 years	3.0×10^{-9}	50
Strontium-85	^{85}Sr	64.8 days	5.3×10^{-10}	300
Strontium-89	^{89}Sr	50.5 days	3.8×10^{-9}	40
Sulphur-35	^{35}S	87.2 days	3.0×10^{-10}	500
Technetium-99	^{99}Tc	2.13×10^{5} years	6.7×10^{-10}	200
Technetium-99m	^{99m}Tc	6.01 hours	2.1×10^{-11}	7000
Tellurium-129m	^{129m}Te	33.4 days	3.9×10^{-9}	40
Tellurium-131m	^{131m}Te	32.4 hours	3.4×10^{-9}	40
Tellurium-132	^{132}Te	78.2 hours	3.5×10^{-9}	40
Thallium-201	^{201}Tl	3.04 days	7.4×10^{-11}	2000
Ytterbium-169	^{169}Yb	32.0 days	1.1×10^{-9}	100
Yttrium-90	^{90}Y	64 hours	4.2×10^{-9}	30
Yttrium-91	^{91}Y	58.5 days	4.0×10^{-9}	30
Zinc-65	^{65}Zn	243.8 days	3.8×10^{-9}	40

Zirconium-95	^{95}Zr	64.0 days	1.3×10^{-9}	100

* The activity concentration of natural uranium corresponding to the chemical guideline of 0.1 mg/L (see separate criteria summary on uranium in the Supporting Documentation) is about 2.6 Bq/L.

** Tritium and ^{14}C are also produced naturally in the atmosphere in significant quantities.

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VIROLOGICAL QUALITY OF DRINKING WATER - DOCUMENT FOR PUBLIC COMMENT

Appendix I: Virological Quality of Provincial/Territorial Water Supplies and Costs of Treatment for Supplies Contaminated by Viruses

The provinces and territories were surveyed regarding the potential costs associated with implementing the new guideline for virological quality. Their comments are summarized in the following table.

Province/Territory	Comments
Alberta	It is a requirement in Alberta that public waterworks systems on surface waters have filtration and disinfection to achieve 3-log reduction of giardia and 4-log reduction of viruses, and public waterworks systems on groundwaters have disinfection to maintain residual chlorine in the distribution system. Once Health Canada's guidelines for viruses is approved by CEOH, Alberta will formally adopt them as standards and all groundwater systems will be required to achieve at least 4-log reduction of viruses. Financial impact to municipalities will be minimum as all of the facilities already have chlorination system in place. Dosage and contact time, however, must be adjusted to achieve the CT required for 4-log reduction of viruses. This is not a big task as the CT required for 4-log reduction of viruses is in the order of 5 to 10 at temperatures greater than 5 deg celcius and pH < 9.
British Columbia	Treatment of surface water or groundwater believed to contain pathogens is mandatory in British Columbia under the Drinking Water Protection Act. Due diligence to achieve compliance with the act will achieve viral control as indicated in the proposed guideline. In excess of 300 smaller water supply systems

	are currently in violation of the microbiological standard and require either improved treatment capability or operation. Costs associated with improvements in equipment or operation are expected, but will not driven by adoption of a new national guideline.
Manitoba	Manitoba's Public Health Act requires that all public water systems be chlorinated. When brought into force, the new Drinking Water Safety Act will require utilities to achieve 4 log reduction of viruses through a combination of treatment and disinfection. Though most utilities will be able to achieve 4 log inactivation of viruses through adjustment of disinfectant concentration and time (Ct) some will require process modifications to achieve adequate reduction of viruses. The financial impact to specifically address viruses is expected to be minimal.
New Brunswick	Approximately 25% of New Brunswick public water systems are supplied by surface water. Several other systems are supplied by groundwater considered to be under the influence of surface water. Five of these systems incorporate both filtration and chlorine disinfection. New Brunswick does have legislated watershed and wellfield protection programs in place to maintain high quality source water. In terms of viral inactivation, a 4-log reduction for most systems will have to be achieved solely through chlorine disinfection (Ct).
Newfoundland	With respect to the multi-barrier approach, I believe the disinfection standard that we have in NL will achieve a 2 or 3 log inactivation of viruses. However, if the target is for a further log reduction (4 log inactivation of viruses), disinfection alone is not going to achieve it. Further treatment (e.g., coagulation and filtration) will be necessary to get greater log inactivation/ reduction of viruses.
Northwest Territories	The proposed new guideline for viruses may not result in significant costs or implications beyond those already identified to meet the new proposed turbidity guideline. Those costs are currently estimated at approximately $15M to $36M depending on the filtration technology used. However, if a second disinfection process in addition to chlorination is required to meet a

	4 log inactivation of viruses, then there could be additional costs and implications associated with this proposed new guideline.
Nova Scotia	It is a requirement in Nova Scotia that public water systems on surface water, and groundwater under the direct influence of surface water (GUDI) supplies, achieve 3-log reduction of giardia and 4-log reduction of viruses. Public water systems on groundwater must achieve 4-log reduction of viruses. This is being implemented as part of the province's Drinking Water Strategy. The proposed new guideline for viruses will have no regulatory or financial impact above those already identified.
Nunavut Territory	No information provided.
Ontario	The proposed new CDWG for viruses will have no implications for Ontario as we already require minimum 4-log reduction/inactivation of viruses. Reference is Ontario Drinking Water Standards, Procedure B13-3 "Chlorination of Potable Water Supplies in Ontario".
Prince Edward Island	In PEI, the assessment of microbiological quality of water is likely to be based solely on measurement of total coliform bacteria and E. coli. From this perspective, I cannot see how the provisions for the virus document will have any direct or measurable cost. However, the potential presence of viruses is being considered in the development of our requirements for well field protection. While these requirements have not been finalized or approved, the delineation of well field protection zones for prevention of microbiological contamination will be based a 250 day capture zone, reflecting a presumed effective maximum life span for most viruses in a groundwater environment. If we were only considering bacteria, we probably have opted for a much smaller 60 day capture zone (based on the conventional wisdom of a maximum life span for bacteria in groundwater of some 50 - 60 days). There is an opportunity cost to relating to the restrictions one might place on land use withing these well field protection zones, and by extending the size of these zones (ie. 250 day capture zone vs. a 60 day capture zone) this opportunity cost would presumably be higher. As you can probably imagine, it would be very difficult to attach a dollar figure to these opportunity costs -they are likely to be highly subjective, and also highly site specific. In closing, it would be fair to suggest that there are costs associated with considering the viral quality of water in PEI, however it would be extremely difficult

	to put a dollar value on these costs.
Quebec	In the province of Quebec, the regulation already contains the obligation of 4 log-removal and/or inactivation of viruses for surface water and contaminated groundwater. This obligation is carried out by recognition of treatment technology performances in the design and construction of drinking water plants. Compulsory follow-up of treatment performances as well as distributed water quality insure the appropriate removal. Thus, the approval of the document on Viruses will have no regulatory or economic impact.
Saskatchewan	Saskatchewan Environment (SE) does not have any exposure data on enteric viruses in drinking water. However, SE anticipates that very few, if any, water systems will be impacted by the proposed guidelines. In Saskatchewan, minimum treatment requirements for ground and surface water supplies are disinfection and chemically assisted filtration, respectively. If a new treatment or a "black-box" technology is used, 4-log reduction/ activation of viruses is required. Boil Water Advisories have been issued for communities that lack minimum water treatment.
Yukon Territory	The proposed new guideline for viruses will not result in significant costs or implications for the Yukon Territory considering other existing or proposed guideline values (e.g., turbidity).

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Last Review/Updated: June 3, 2002

Alberta's Drinking Water Program

Alberta has a long history of providing safe drinking water to Albertans. Potable water is regulated by Alberta Environment under the environmental Protection and Enhancement Act (EPEA) and the Potable Water Regulation. The Potable Water Regulation makes the health-related parameters of the Canadian Drinking Water Guidelines legal requirements for drinking water treatment systems in Alberta.

- Environmental Protection & Enhancement Act (EPEA)
- Potable Water Regulation

The province's drinking water program adopts the multi-barrier approach, and includes the following key elements:

- Watershed Assessment and Protection
- Legislation and Regulations supported by scientifically defensible design and performance standards and approvals
- Treatment facilities and Infrastructure using state-of-the-art technology
- Operator Training and Certification
- Drinking Water Monitoring/Risk Assessments
- Appropriate Compliance Action (Regulatory Approach)
- Consumer Confidence (Education, Communication & Database availability)

Alberta Government

Last Reviewed/Updated: February 22, 2002

Potable Water Regulation (AR 122/93)

January 1997

The *Environmental Protection and Enhancement Act* (EPEA) provides powers to Alberta Environment for the regulation of waterworks systems which supply potable water.

Background

Matters related to potable water in Alberta have been regulated by Alberta Environment through the use of the Clean Water Act and related regulations. This legislation has dealt not only with potable water quality, but also with requirements for facilities supplying potable water.

Overview

Alberta's environmental laws have been consolidated and updated by EPEA. Part 7 of the Act deals with potable water, its quality and the systems which supply it.

The Potable Water Regulation enables Alberta Environment to regulate the operation of waterworks systems and establish standards for such facilities and their operators. This regulation also establishes requirements for potable water quality, including matters such as disinfection and fluoridation. This regulation replaces the following legislation:

- Clean Water Act;
- Clean Water (General) Regulations;
- Clean Water (Municipal Plants) Regulations; and
- Fluoridation Regulations.

Regulatory Details

References in the Potable Water Regulation have been changed from the Clean Water Act definition of "municipal plant" to clarify the approval mandate of Alberta Environment in relation to Alberta Labour and Alberta Health, who also have program responsibilities related to potable water. Specific definitions are used for the various owners of waterworks systems as follows:

- municipalities;
- municipal developments (unincorporated, multi-owner co-op developments);
- industrial developments (potable water plants owned by industries for the use of their on-site staff);
- regional services commissions;
- privately owned developments but excludes single family dwellings or farms); and
- private utilities.

Transitional provisions are included in this regulation to facilitate and accommodate the implementation of new standards and design requirements to be imposed by this regulation at existing waterworks systems.

Certain activities previously requiring approval under clean water legislation have been exempted, and will require a letter of authorization only under the new Act and Regulations. These include the extension or replacement of watermains to service new subdivisions, new or expanded treated water reservoirs, trial experiments to test the use of new water treatment chemicals and certain small waterworks systems with limited treatment of groundwater supplies.

Requirements to disinfect water supplies from a waterworks system are outlined in this regulation. All supplies must be disinfected in accordance with standards and guidelines, unless the Director provides time for the waterworks system to come into compliance. Approvals for waterworks systems must contain terms and conditions for disinfection, including frequency, levels of disinfecting agents and contact times for disinfectants.

This regulation requires that a waterworks system must at all times comply with minimum potable water treatment design requirements as outlined in *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage System* (published by Alberta Environment). The regulation also requires that the physical, chemical, microbiological and radiological quality of the potable water meet the health related concentration limits in the latest edition of the *Guidelines for Canadian Drinking Water Quality* as established by Health and Welfare Canada. The Director has been given discretion to specify the time periods within which a waterworks system must meet any changes in concentration limits, in order to phase in any new or more stringent standards. A duty created by this regulation is the requirement to immediately report any failure or shutdown of disinfection equipment to the Director and the local board of health.

Certain provisions have been added to the Potable Water Regulation respecting fluoridation. Included are requirements that the addition of fluoride and the design of fluoridation equipment be done in accordance with *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems* (published by Alberta Environment), and that any discontinuation of the application of fluoride in order to replace or repair equipment be reported immediately to the Director and the local board of health.

The owner of a waterworks system is required by this regulation to notify the Director of the names of certified operators in direct supervision of the operation of the facility. The Director has been given power to issue certificates to operate waterworks systems or wastewater systems, with conditions attached.

The Potable Water Regulation has enhanced provisions for certification of operators of waterworks systems and wastewater systems. Certain operators of waterworks systems or wastewater systems require a certificate as outlined in the *Water and Wastewater Operator's Certificate Guidelines* (published by Alberta Environment). The Guidelines have been amended to allow for "conditional certificates" where circumstances (for example, small and very basic water supply systems) do not dictate the application of the normal certification requirements.

This regulation refers to the Water and Wastewater Operator's Certificate Guidelines for renewal of certificates and requirements for renewal applications, as well as requirements to ensure continuing validity of these certificates.

The Director has been given the ability to request resubmission of water samples or submission of water samples at a greater frequency if, in the Director's opinion, the initial water sample is unsatisfactory.

For more information, please call:

Alberta Environment
Air and Water Approvals Division
(780) 427-5883

Alberta >> Statutes and Regulations >> Alta. Reg. 277/2003 >> Complete text

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(no amdt)
ALBERTA REGULATION 277/2003
Environmental Protection and Enhancement Act
POTABLE WATER REGULATION
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Interpretation

1(1) In this Regulation and, in the case of the definitions referred to in clauses (g), (h), (k) and (l), for the purposes of the Act,

(a) "Act" means the Environmental Protection and Enhancement Act;

(b) "approved laboratory" means a laboratory approved by the Director;

(c) "certified operator" means a person who holds a valid certificate of qualification of the appropriate level issued under section 15;

(d) "Director" means the person designated by Ministerial Order as Director for the purposes of this Regulation;

(e) "hamlet" means an unincorporated community that has been designated as a hamlet in accordance with the Municipal Government Act;

(f) "high quality groundwater" means groundwater that

(i) does not require treatment to comply with the applicable physical, chemical and radiological Maximum Acceptable Concentration or Interim Maximum Acceptable Concentration, except for fluoride, specified in the Guidelines for Canadian Drinking Water Quality, published by Health Canada, as amended or replaced from time to time, for the parameters listed in the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, published by the Department, as amended or replaced from time to time,

(ii) contains a concentration of naturally occurring fluoride of less than or equal to 2.4 milligrams per litre, and

(iii) is not under the direct influence of surface water;

(g) "industrial development" means any development on the site of a plant referred to in section 2 of the Schedule of Activities in the Act;

(h) "municipal development" means a development that consists of 2 or more lots but does not include a city, town, specialized municipality, village, summer village, settlement as defined in the Metis Settlements Act, hamlet, privately owned development or industrial development;

(i) "owner" with respect to a waterworks system means

(i) the local authority of a city, town, specialized municipality, village, summer village or settlement as defined in the Metis Settlements Act in which the waterworks system is located;

(ii) for a hamlet,

(A) a cooperative, as defined in the Cooperatives Act, formed by the individual lot owners served by the hamlet's waterworks system, or

(B) if no cooperative exists, the local authority of the municipal district, improvement district, specialized municipality or special area in which the hamlet's waterworks system is located;

(iii) for a municipal development,

(A) the local authority of the municipal district, improvement district, specialized municipality or special area in which the municipal development's waterworks system is located,

(B) the owner of a private utility, or

(C) where neither (A) nor (B) applies, the collection of individual lot owners located in a municipal development that is served by the waterworks system;

(iv) for a privately owned development, the owner of the privately owned development;

(v) for a waterworks system owned by a regional services commission, the regional services commission that owns the waterworks system;

(vi) for a waterworks system that is a private utility, the owner of the private utility;

(vii) for an industrial development, the owner of the industrial development in which the waterworks system is located;

(viii) for a waterworks system that is a watering point, the owner of the watering point;

(j) "person responsible for a waterworks system" means

(i) the owner of the waterworks system,

(ii) the operator of the waterworks system,

(iii) the local authority that contracts to obtain potable water from the waterworks system,

(iv) the local authority that grants a franchise for the supply of potable water by the waterworks system,

(v) the approval holder or registration holder, as the case may be, for the waterworks system,

(vi) any successor, assignee, executor or administrator, receiver, receiver-manager or trustee of a person referred to in subclause (i), (ii), (iii), (iv) or (v), and

(vii) any person who acts as the principal or agent of a person referred to in subclause (i), (ii), (iii), (iv), (v) or (vi);

(k) "privately owned development" means a recreational development, school, mobile home park, restaurant, motel, community hall, work camp, holiday trailer park, campsite, picnic site, information centre or other similar development, including such a development owned or operated by the Government, that is on a parcel of land that is not subdivided, but does not include

(i) a single family dwelling, or

(ii) a farmstead;

(l) "private utility" means a waterworks system that is owned and operated by a person other than a person referred to in clause (i)(i), (ii), (iii)(A) and (C), (iv), (v), (vii) and (viii), but does not include a waterworks system that services only a single family dwelling or a farmstead;

(m) "professional engineer" means a professional engineer or registered professional technologist (engineering) under the Engineering, Geological and Geophysical Professions Act;

(n) "service connection" means the potable water service line from a water distribution main to the property being serviced, but for the purposes of section 5, means the potable water service line from a water distribution main to a building;

(o) "water distribution system" means a system of pipes, valves, fittings and appurtenances, including associated pressure reducing stations, that is used to convey potable water in a waterworks system to a service connection;

(p) "water treatment plant" means the physical components of the waterworks system that are used to produce potable water including components associated with the management of any wastes generated during treatment;

(q) "watering point" means a waterworks system that provides potable water in bulk to the public.

(2) This Regulation only applies to waterworks systems referred to in Schedule 1, Division 5 and Schedule 2, Division 5 of the Activities Designation Regulation, including additions, replacements, extensions and modifications referred to in the Notes in those Divisions.

Duty to comply with Regulation

2 Except where this Regulation provides otherwise, a person responsible for a waterworks system shall comply with this Regulation.

Water treatment requirements

3 A waterworks system must be

(a) designed,

(b) operated, and

(c) maintained

to achieve under all normal and foreseeable operating conditions all water quality requirements specified in this Regulation, an approval or the applicable code of practice.

Design standards

4(1) A waterworks system must be designed so that it meets as a minimum

(a) the standards and design requirements set out in the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, published by the Department, as amended or replaced from time to time, or

(b) any other standards and design requirements specified by the Director.

(2) The design of a waterworks system or a portion of a waterworks system must be stamped and signed by the professional engineer who designed the system or portion of the system.

(3) Where

(a) a waterworks system is operating on the date this Regulation comes into force and does not meet the standards and design requirements referred to in subsection (1)(a), or

(b) a waterworks system does not meet a change made to the standards and design requirements referred to in subsection (1)(a) made after the date this Regulation comes into force,

subsection (1)(a) does not apply to the waterworks system until the date specified by the Director in a notice in writing given to a person responsible for the waterworks system.

(4) A person who receives a notice under subsection (3) shall comply with the notice in accordance with its terms.

Extension, replacement or modification

5(1) Prior to commencing

(a) an extension of a water distribution system,

(b) a replacement of a portion of a water distribution system, or

(c) a modification of potable water storage,

the registration holder or approval holder, as the case may be, shall inform the Director in writing of the intent to undertake the extension, replacement or modification.

(2) The information referred to in subsection (1) must contain at least the following, where applicable:

(a) the registration or approval number for the waterworks system as issued under the Act;

(b) the location of the proposed extension, replacement or modification;

(c) written confirmation, stamped and signed by a professional engineer, that the increased water flow associated with the extension is within the design capacity of the existing water distribution system;

(d) written confirmation, stamped and signed by a professional engineer, that the increased water demand associated with the extension is within the design capacity of the authorized waterworks system providing potable water to the water distribution system;

(e) any other information required by the Director.

(3) No person shall commence

(a) the extension of a water distribution system,

(b) the replacement of a portion of a water distribution system, or

(c) the modification of potable water storage,

where

(d) the waterworks system design does not comply with the design standards set out in the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, published by the Department, as amended or replaced from time to time, or

(e) the water distribution system will service a portion of a city, town, specialized municipality, village, summer village, settlement area as defined in the Metis Settlements Act, hamlet, privately owned development, municipal development or industrial development that is not serviced by a wastewater system in respect of which a current approval or registration has been issued under the Act,

unless that person has obtained written authorization of the Director.

(4) On request, the registration holder or approval holder, as the case may be, shall immediately provide to the Director or inspector any engineering drawings, specifications or other information regarding any aspect of the extension of a water distribution system, the replacement of a portion of a water distribution system or the modification of potable water storage.

Potable water quality

6(1) The physical, microbiological, chemical and radiological characteristics of the potable water in a waterworks system must be maintained to meet as a minimum

(a) the applicable Maximum Acceptable Concentration or

Interim Maximum Acceptable Concentration specified in the Guidelines for Canadian Drinking Water Quality, published by Health Canada, as amended or replaced from time to time, for the parameters listed in the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, published by the Department, as amended or replaced from time to time, and

(b) any additional or other limits established by the Director in an approval or a code of practice.

(2) Where

(a) a waterworks system is operating on the date this Regulation comes into force and does not meet the limits referred to in subsection (1)(a), or

(b) a waterworks system does not meet a change made to the limits referred to in subsection (1)(a) made after the date this Regulation comes into force,

subsection (1)(a) does not apply to the waterworks system until the date specified by the Director in a notice in writing given to a person responsible for the waterworks system.

(3) A person who receives a notice under subsection (2) shall comply with the notice in accordance with its terms.

Performance standards

7(1) A waterworks system must meet at least the minimum waterworks performance standards set out in the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, published by the Department, as amended or replaced from time to time.

(2) Where

(a) a waterworks system is operating on the date this Regulation comes into force and does not meet the standards referred to in subsection (1), or

(b) a waterworks system does not meet a change made to the standards referred to in subsection (1) made after the date this Regulation comes into force,

subsection (1) does not apply to the waterworks system until the date specified by the Director in a notice in writing given to a person responsible for the waterworks system.

(3) A person who receives a notice under subsection (2) shall comply with the notice in accordance with its terms.

Addition of treatment chemicals

8 No person shall use or permit the use of a chemical for the treatment of water unless

(a) the chemical is listed as a direct or indirect additive in Standard 60 or Standard 61, published by the National Standards Institute and National Sanitation Foundation (ANSI/NSF), as amended or replaced from time to time,

(b) the chemical is listed in the approval, or

(c) the person has obtained written authorization of the Director for use of the chemical.

Operation and maintenance requirements

9(1) The equipment and controls for

(a) filtration,

(b) disinfection, and

(c) all other required treatment

in a waterworks system must be operated in a manner that achieves the potable water quality required by this Regulation, an approval or a code of practice.

(2) In order to ensure continuous operation at a water treatment plant,

(a) spare parts that are required to maintain the equipment used for disinfection of water or that are critical components of the waterworks system must be reasonably available, or

(b) a back up water treatment system must be installed and maintained in operating condition.

Conservation and responsible use

10 A waterworks system must be designed and operated so as to conserve and ensure the responsible use of water.

Malfunction reports

11 Any failure or shut-down of the equipment used for disinfection must be reported immediately

(a) to the Director, and

(b) to the appropriate Regional Health Authority.

Fluoridation

12 Where fluoride is added to a waterworks system, the

(a) application of fluoride,

(b) monitoring of fluoride,

(c) reporting of fluoride,

(d) design of the fluoridation equipment, and

(e) operation of the fluoridation equipment

must be in accordance with the requirements specified in the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, published by the Department, as amended or replaced from time to time.

Prohibitions re: waterworks system

13(1) Subject to section 8 or except where permitted by an approval, no person shall use or permit the use of any chemical or any commercial product in circumstances such that the chemical or commercial product may come into contact with water in any part of a waterworks system.

(2) No person shall cause or permit any connection in a waterworks system that allows a substance that may cause an adverse effect to enter into the waterworks system.

Certified operator required

14(1) At all times, the operation of the

(a) water treatment plant, and

(b) water distribution system

in a waterworks system must be performed by, or under the direction of, a person who holds a valid certificate of qualification at the applicable level as set out in an approval or the applicable code of practice.

(2) A person responsible for a waterworks system shall at no time permit the number of certified operators available to operate or direct the operation of the water treatment plant or water distribution system to fall below the applicable number as set out in an approval or the applicable code of practice.

(3) A person responsible for a waterworks system shall notify the Director in writing

(a) forthwith of the names of all certified operators referred to in this section, and

(b) within 30 days of any change of certified operators referred to in this section.

Certification of operators

15(1) The Director may issue the following kinds of certificate of qualification:

(a) water treatment operator certificate of qualification;

(b) water distribution operator certificate of qualification

at any level described in the Water and Wastewater Operator's Certification Guidelines, published by the Department, as amended or replaced from time to time, to persons who meet the requirements of subsection (2).

(2) An applicant for any level of certificate of qualification referred to in subsection (1) must

(a) apply to the Director on a form acceptable to the Director,

(b) meet the qualification requirements as set out in the guidelines referred to in subsection (1) for that level of certificate of qualification, and

(c) be at least 18 years of age.

(3) An applicant for renewal of any level of certificate of qualification referred to in subsection (1) must meet the qualifications for renewal set out in, and make the application in accordance with, the guidelines referred to in subsection (1).

Returns and reports

16(1) A person responsible for a waterworks system shall submit returns and reports respecting the construction, operation or reclamation of the system

(a) as required in an approval or the applicable code of practice, or

(b) as required by the Director, by a notice in writing.

(2) A person who receives a notice under subsection (1)(b) shall comply with the notice in accordance with its terms.

Sampling

17(1) A person responsible for a waterworks system shall

(a) obtain water samples, and

(b) submit the samples for physical, microbiological, radiological or chemical analysis by an approved laboratory,

in accordance with an approval, the applicable code of practice or a notice in writing from the Director.

(2) With respect to any sample required to be taken pursuant to this Regulation, an approval, the applicable code of practice or a notice in writing from the Director,

(a) sample collection,

(b) sample preservation,

(c) sample storage,

(d) sample handling, and

(e) sample analysis

must be conducted in accordance with

(f) the Standard Methods for the Examination of Water and Wastewater, published by the American Public Health Association, the American Waterworks Association and the Water Environment Federation, as amended or replaced from time to time,

(g) the Methods Manual for Chemical Analysis of Water and Wastes, published by the Alberta Research Council, as amended or replaced from time to time, or

(h) a method authorized in writing by the Director.

(3) Unless the Director specifies otherwise in an approval, the minimum number of water samples to be obtained for analysis of bacteriological quality must be

(a) obtained in accordance with the Guidelines for Canadian Drinking Water Quality, published by Health Canada, as amended or replaced from time to time, and

(b) evenly distributed through the sampling period.

(4) Where, in the Director's opinion, a sample or analysis is unsatisfactory, the Director may require a person responsible for a waterworks system

(a) to resubmit the same sample for analysis or reanalyze the same sample,

(b) to take and analyze additional samples, or

(c) to take and analyze samples at a greater frequency.

(5) A person responsible for a waterworks system shall comply

(a) with a notice under this section in accordance with its terms, and

(b) with the Director's requirements under subsection (4).

Repeal

18 The Potable Water Regulation (AR 122/93) is repealed.

Review

19 In compliance with the ongoing regulatory review initiative, this Regulation must be reviewed on or before September 30, 2011 and not less frequently than every 10 years after that date.

Coming into force

20 This Regulation comes into force on October 1, 2003.

9.0 OPERATING AND MONITORING REQUIREMENTS AND GUIDELINES - WATERWORKS SYSTEMS

9.1 System Operations

9.1.1 General

The proper operation and maintenance of waterworks system is essential to ensure ongoing sustained production and delivery of the best quality drinking water that is both wholesome and protective of public health. It is therefore imperative that programs and activities such as good operator training, emergency response planning, corrective action measures, cross-connection controls, etc. are in place to ensure a reliable and well operated waterworks system.

9.1.2 Reliability

1. The waterworks system should provide an adequate quantity of safe drinking water in a reliable manner at all times. In determining whether a proposed public water system or an expansion or modification of an existing system is capable of providing an adequate quantity of water, the owner should consider the immediate as well as the reasonably anticipated future needs of the system's consumers.

2. The owner should ensure that the system is operated, maintained and has appropriate backup facilities to protect against failures of the power supply, treatment process, equipment, or structure. Security measures should assure the safety of water source, water treatment processes, water storage facilities and the distribution system.

3. Water pressure at the customer's property line should be maintained at the approved design pressure under maximum hourly design flow conditions. The minimum distribution pressure during peak demand design flow should be 150 kPa.

9.1.3 Operations

1. The waterworks system shall be managed and operated in accordance with the EPEA approval for the facility. The facility shall meet the minimum performance requirements for treatment of components outlined in Sections 2.2 and 2.3 of this document; the treated water shall, at a minimum, meet the health related concentration limits for substances listed in the "Guidelines for Canadian Drinking Water Quality (GCDWQ)."

2. The owner should ensure the development and implementation of an emergency response plan as part of the operations program. The plan should include:

   i) General procedures for routine or major emergencies within the waterworks system; and

   ii) A contingency plan for facilities becoming inoperable in a major emergency.

3. The plant shall be operated within its design capacity to supply treated water.

4. The owner shall not establish nor maintain a bypass to divert water around any feature of a treatment process unless the bypass has been approved by AEP.

5. The owner shall take preventative or corrective action as directed by AEP when results of an inspection conducted by AEP or monthly returns indicate conditions which are currently or may become a detriment to system operations.

6. The owner shall protect waterworks systems from contamination due to cross-connections.

   Further, the owner should develop and implement a cross-connection control program. The scope and complexity of the program should be directly related to the size of the system and the potential public health risk.

   When an existing cross-connection poses a potential health or system hazard, the owner shall shut off water service until the cross-connection has been eliminated or controlled by the installation of a proper backflow prevention assembly.

9.1.4 Facility Classification and Operator Requirements

9.1.4.1 Facility Classification

On recommendation from Water and Wastewater Operator Certification Advisory Committee, Alberta Environmental Protection will classify all waterworks facilities. Facility classification may also be reviewed upon request by the owner or authorized representative. The classification of Water Distribution (WD) systems is based upon the population served by the facilities while the classification of Water Treatment (WT) facilities is based upon a range of points as shown in Tables 9.1(a).

9.1.4.2 Requirement For Having Certified Operators

In accordance with AEPEA, day to day operations of waterworks systems should be supervised by one or more persons who hold a valid certificate of qualification for the type and class of facility concerned. The Approval for each facility will state the required number of certified operators and their required level of certification.

Exempted from **these** requirements are:

1. Hamlets that:

   i) utilize a groundwater source with no treatment for health parameters;
   ii) have less than 15 service connections; or
   iii) have less than three kilometres of water distribution system;

2. "Privately owned developments" as defined in the regulations; and

3. Any other systems as determined by AEP.

TABLE 9.1(a)

WATER TREATMENT PLANTS (WT) CLASSIFICATION

ITEM	POINTS
Size	
Maximum population served, peak day (1 pt/10,000 or part of)	1 - 5
Design flow (avg.day) or peak month's production flow (avg.day), whichever is larger (1 pt/5,000 m^3/day)	1 - 5
Water supply source	
Groundwater	3
Surface Water	5
Variation in raw water quality (slight to extreme)*	0 - 10*
Treatment	
Aeration	2
Packed tower aeration	6
pH adjustment	4
Stability or corrosion control	4
Taste and odour control	4
Colour control	4
Iron or iron/manganese removal (includes filtration)	10
Ion exchange softening	10
Chemical precipitation softening (total process)	20
Solids Contact Clarification (includes coag/floc)	14
Coagulant addition	4
Flocculation	6
Sedimentation	5
Filtration (rapid sand)	10
Filtration (pressure or slow sand)	6
Fluoridation	5
Disinfection	5
On site generation of disinfectant	5
Special processes (not otherwise included)	15
In-plant treatment of plant sludge	6
Laboratory control	
Bacteriological/biological*	0 - 10*
Chemical/physical*	0 - 10*

NOTE: Each unit process should have points assigned only once, i.e. for a plant using oxidation, precipitation and filtration for iron removal, add ten (10) points for the iron removal only and nothing for filtration.

* See Table 9.1(b)

TABLE 9.1(b)

WATER TREATMENT PLANT CLASSIFICATION POINT GUIDE

ITEM	POINTS
Variation in raw water quality	0 - 10
Suggested point values are:	
Little or no variation	0
Raw water quality (other than turbidity) varies enough to require treatment changes approximately 10 percent of the time	2
Raw water quality (turbidity) varies severely enough to require pronounced and/or very frequent treatment changes.	5
Raw water quality subject to periodic serious industrial/municipal/agricultural waste pollution	10
Laboratory Control by plant personnel Bacteriological/Biological (complexity)	0 - 10
The key concept is to credit bacti/bio lab work done on-site by plant personnel.	
Suggested point values are:	
Lab work done outside the plant	0
Membrane filter procedures	3
Use of fermentation tubes or any dilution method: fecal coliform determination	5
Biological identification	7
Virus/parasite studies or similarly complex work conducted on site	10
Chemical/Physical (complexity)	0 - 10
The key concept is to credit chemical/physical lab work done on-site by plant personnel.	
Suggested point values are:	
Lab work done outside the plant	0
Push button or colorimetric methods for simple tests such as chlorine residual, pH, - up to	3
Additional procedures such as titration, jar tests, alkalinity, hardness - up to	5
More advanced determinations such as numerous inorganics - up to	7
Highly sophisticated instrumentation such as atomic absorption and gas chromatography	10

Table 9.2 summarizes the classification system. The classification system is based on the "degree of difficulty to operate" a facility. The Alberta system is similar to many used across Canada and the United States

TABLE 9.2

FACILITY CLASSIFICATION SYSTEM

FACILITY	BASED UPON	I	II	III	IV
WD*	Population Served	1500 or fewer	1501-15,000	15,001-50,000	50,001 or more
WT**	Range of Points [Table 9.1a)]	30 or fewer	31-55	56-75	76 or more

Notes: AEP may adjust the classification of a facility if the point system does not reflect the actual complexity of that facility.

WD - Water Distribution
WT - Water Treatment

Water transmission and storage may be part of either water treatment or water distribution, but alone, it is not considered to be either water treatment or water distribution.

* Simple "in-line" treatment (such as shock chlorination) or in-line booster pumping is considered an integral part of the distribution system.

** A groundwater supply with only chlorination is considered a distribution system and not a water treatment plant.

9.1.4.3 Responsibility of Operators

It is the responsibility of certified operators to know and understand the terms and conditions in the operating Approval for their facility. It is also their responsibility to understand the certification requirements for operators of their facilities as indicated by the Approval or by the Certification Guidelines.

It is necessary that the chief operator ensures current certification for operators as required by the Approval or by the Certification Guidelines. It is also important that each facility has a contingency plan so that certified operator requirements are met in cases of planned absences (eg., vacation), unplanned absences (eg., illness), or change of staff (eg., retirement).

Certified operators are also responsible to establish or understand contingency plans for each facility that ensure that the Approval requirements, with respect to certified operators, are met at all times. This is important during normal operation or in the cases of planned absences (eg. vacation), unplanned absences (eg. illness), or change of staff (eg. retirement).

9.1.4.4 Responsibility of Facility Owners

It is the legal responsibility of the owner or manager of each facility to be aware of the requirements of the Approval and to ensure that the requirements are met. The Approval issued by AEP will designate the minimum number and level of certification of key operations personnel. It is important that facility owners or managers develop an internal program so that substitute or replacement personnel are available when necessary.

9.1.4.5 Facility Staffing Requirements: Certified Operators

For Class I facilities, there must be a certified Small Systems or Level I (or higher) operator in charge of the day to day operation of that facility. A back-up certified operator is recommended.

For Class II facilities, there must be a certified Level II (or higher) operator in charge of the day to day operation of that facility. It is recommended that an assistant operator with Level I or II certification be available.

For Class III facilities serving a population under 1,500, there must be a certified Level III (or higher) operator in charge of the day to day operation.

For Class III facilities serving a population under 1,500 - 10,000, there must be a certified Level III (or higher) operator in charge of the day to day operation. There must also be at least one other operator certified at Level I or higher.

For Class III facilities serving a population of 10,000 - 50,000, there must be a certified Level III (or higher) operator in charge of the day to day operation. There must also be at least one other operator certified at Level II or higher.

For Class III facilities serving a population over 50,000, there must be a certified Level III (or higher) operator in charge of the day to day operation. There must also be another operator certified at Level II or higher to act in the absence of the charge operator and at least one other operator certified at Level I or higher. There must be at least one certified operator (any level) for each shift when shift operation is required.

For Class IV facilities serving a population up to 200,000, there must be a Level IV operator in charge of the day to day operation. There must also be two Level III (or higher) operators to act in the absence of the Level IV operator. There must be at least one Level II or higher certified operator for each shift when shift operation is required.

For Class IV facilities serving a population over 200,000, there must be a certified Level IV operator in charge of the day to day operation. There must be at least one other certified Level IV operator to act in the absence of the charge operator. There must be a third operator who is certified at either Level III or IV and there must be at least one Level II (or higher) certified operator for each shift when shift operation is required.

9.2 System Monitoring

9.2.1 General

Establishing reasonable and appropriate monitoring requirements for waterworks facilities is a key factor in ensuring safe drinking water. AEP considers monitoring to fall into one of the following general categories:

1. Operational monitoring
2. Treatment Performance and Compliance monitoring
3. Follow-up or issue oriented monitoring.

Types of monitoring are discussed in detail in the next few sections.

9.2.1.1 Sampling Procedures and Analytical Methods

The owner should ensure that:

1. - Collection and preservation of samples and all analytical procedures are in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater," as published by the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation; or

   - by a method outlined in the most recent edition of the "Methods Manual for Chemical Analysis of Water and Wastes" or "Methods Manual for Chemical Analysis of Trace Organics and Pesticides in Environmental Samples," published by Alberta Environmental Protection; or

   - by an alternative method approved by AEP.

2. - Collection, preservation and the analysis of samples are performed by a laboratory approved by AEP.

9.2.1.2 Approval of Analytical Procedures

Owners should ensure that laboratories obtain approval from AEP for the use of any analytical procedures not included in the "Standard Methods."

The laboratory would be required to follow a protocol established by AEP for the approval of analytical procedures not included in the "Standard Methods."

9.2.2 Operational Monitoring

Operational monitoring and associated reporting requirements would be established on a site-specific basis. The nature of the water supply source, the type of treatment system employed and the size/capabilities of the owner are all considered when establishing operational monitoring requirements. Operational monitoring requirements are established both for specific process control purposes, and to ensure that a facility receives good operational attention on a regular basis.

Table 9.3 outlines the operational monitoring requirements that would apply to waterworks systems.

9.2.3 Treatment Performance and Compliance Monitoring

One of the issues created by comprehensive and ever-expanding drinking water quality guidelines is the frequency at which drinking waters should be sampled and which parameters should be analyzed to determine performance of the treatment and compliance with the guidelines. In Alberta, treatment performance and compliance monitoring requirements for municipal waterworks systems are partially established by AEPEA.

The Potable Water Regulation 122/93 requires bacteriological quality monitoring in accordance with the Guidelines for Canadian Drinking Water Quality, and physical, microbiological, radiological and chemical quality monitoring at least once per year for well water supplies and twice per year for surface water supplies. The regulation also indicates that AEP may specify the physical, microbiological, radiological and chemical parameters necessary for the analysis of water samples. This section outlines the specific parameters that have to be monitored, including the sampling location and monitoring frequency.

9.2.3.1 Bacteriological

1. Sampling Location

   Bacteriological samples should be collected from representative points after treatment and throughout the distribution system after the first service connection. Ideally, the owner should prepare a Coliform Monitoring Plan to include at a minimum, a system map or diagram showing the locations of:

   i) Water source
   ii) Storage, treatment and pressure regulation facilities
   iii) Distribution system
   iv) Pressure zones
   v) Coliform sample collection sites

   The owner should revise or expand the plan at any time the plan no longer ensures representative monitoring of the system, and keep the Coliform Monitoring Plan on file and make it available to AEP for inspection upon request.

2. Monitoring Frequency

   The number of required routine coliform samples to determine compliance should be in accordance with the GCDWQ, or as directed by AEP.

3. Invalid Samples

When a coliform sample is determined invalid by the laboratory, the municipality should:

i) Not include the sample in the determination of monitoring compliance; and
ii) Collect and submit for coliform analysis, an additional drinking water sample from the same location as each invalid sample within twenty-four hours of notification by the laboratory or AEP.

4. Compliance Criteria

Compliance criteria for bacteriological quality shall be in accordance with GCDWQ.

9.2.3.2 Inorganic Chemical and Physical

1. Parameters to be monitored

A complete inorganic chemical and physical analysis should consist of the primary and secondary inorganic chemical and physical substances.

i) The primary inorganic chemical and physical substances are those substances with MACs in the GCDWQ and which are known to cause adverse effects on health. Primary chemical and physical substances are arsenic, barium, boron, cadmium, chromium, cyanide, fluoride, lead, mercury, nitrate and nitrite (as N), selenium, and turbidity.

ii) The secondary inorganic chemical and physical substances are those substances with AOs in the GCDWQ with limits below those considered to constitute a health hazard; and the parameters without guidelines identified in the GCDWQ. The secondary chemical and physical substances are ammonia, asbestos, calcium, chloride, colour, copper, hardness, iron, magnesium, manganese, pH, silver, sulphate, total dissolved solids, total organic carbon and zinc.

For specific systems, AEP, at its discretion, may revise the list of primary and secondary inorganic chemicals and physical substances to be monitored.

2. Sampling Location

i) Inorganic chemical and physical samples should be collected from a point representative of each source, after treatment, and prior to entry to the distribution system. The point of collection should be designated as "Sampling Location" and confirmed by AEP.

TABLE 9.3

OPERATIONAL MONITORING REQUIREMENTS

Parameter	Point of Measurement	Requirement/Objective	Minimum Monitoring
Raw water turbidity	Before addition of any chemical or treatment process	None	See Section 9.2.3.3
Treated water turbidity	Immediately after filtration before entering the clearwater tank	See Section 2.2.1(1)	See Section 9.2.3.3
Raw water flows	Entering the treatment plant	Not to exceed treatment plant's design capacity	Once per day for total daily flow
Treated water flows	Entering the clearwater tank or the distribution system	None	Once per day for total daily flow
Raw water Giardia levels	Entering the treatment plant	None	Quarterly
Raw water pH	Before addition of any chemical	None	Once per day using grab sampling
Raw water iron and manganese	Before addition of any chemical	None	Once per week using grab sampling
Chemicals used	Feed point	The chemical dosage should not exceed the recommended maximum concentration authorized by AEP	Volume/Weight/ Concentration of chemicals used daily or weekly
Treated water pH	Entering the distribution system	6.5-8.5 (exceptions are acceptable if disinfection is not compromised)	Once per day using grab sampling
Turbidity within distribution system	Random location throughout the distribution system	Not to exceed 5 NTU	Once per week using grab sampling
Treated water iron	Immediately after filtration before entering the clearwater tank	Not to exceed 0.3 mg/l	Five times per week, twenty-four hours apart using grab sampling
Treated water manganese	Immediately after filtration before entering the clearwater tank	Not to exceed 0.05 mg/l	Five times per week, twenty-four hours apart using grab sampling

Notes:
1. Monitoring of these parameters is not required during the calendar days the treatment plant is not operated or during statutory or civic holidays.
2. Raw and treated water turbidity monitoring are also required from a compliance point of view.
3. Raw water Giardia levels will be based on the geometric mean of a minimum of 4 quarterly samples, or as determined by AEP
4. Raw water flow rates should be reported in m^3/s and the total daily flows should be reported in m^3/d.
5. Specified monitoring for iron and manganese is required only for plants treating for these parameters.

ii) For multiple sources or wellfields within a single system, which are blended prior to entry into the distribution system, the owner may identify an "Alternate Sampling Location" based on the following:

a) Source vulnerability;
b) Individual source characteristics;
c) Previous water quality information; and
d) Any other information

Each sample must be taken at the same point unless conditions make another sampling point more representative of the water produced by the treatment plant.

iii) When the owner provides treatment for one or more inorganic chemical and physical contaminants, AEP may require the owner to sample before and after treatment. The "Source Sampling Location" for raw water supply should be confirmed by AEP. For groundwater supply requiring treatment, each well should be sampled at the source.

3. Monitoring Frequency

i) The frequency of monitoring conducted to determine compliance with the MACs and AOs for the primary and secondary inorganic chemical and physical substances respectively, should be once per year for groundwater supplies and twice per year, once in the summer and once in the winter for surface water supplies at each designated "Sampling Location" or "Alternate Sampling Location."

For groundwater requiring treatment, one additional sample would be required at each "Source Sampling Location."

ii) Where the results of sampling for the primary inorganic chemical and physical substances indicate that MACs have been exceeded, AEP would require that one additional confirmation sample be collected as soon as possible (but not to exceed two weeks) after the initial sample results are received.

iii) Systems which exceed the MACs for the primary inorganic chemical and physical substances in confirmation samples, should monitor quarterly beginning in the next quarter after the violation occurred, or as directed by AEP. The owner may revert back to the frequencies specified in sub-section 9.2.3.2(3)(i) above, provided that the system is reliably and consistently producing water below the MACs. AEP would make this determination based on a minimum of two quarterly samples for groundwater systems, and a minimum of four quarterly samples for surface water systems.

4. Compliance

i) For systems which are monitoring annually, the system is out of compliance, if the level of a substance at any sampling point is greater than the MAC. If a confirmation sample is required by AEP, the determination of compliance will be based on the average of the two samples.

ii) For systems which are conducting monitoring at a frequency greater than annual, compliance with the MACs is determined by a running annual average at any sampling point. If the average at any sampling point is greater than the MAC, then the system is out of compliance. Any sample below the detection limit should be calculated at zero for the purpose of determining the annual average.

9.2.3.3 Turbidity

1. Source Turbidity Monitoring

   i) Owners on surface water systems using conventional, direct or in-line filtration should measure source turbidity at least once per day on a representative sample collected before the addition of any chemicals.

   ii) Grab sampling or continuous turbidity monitoring and recording may be used to meet the requirement specified in (i) of this sub-section.

   iii) Owners who measure turbidity continuously should record measurements at equal intervals, at least every four hours. Daily turbidity would be the arithmetic average of all the turbidity measurements in one calendar day.

2. Treated Water Turbidity Monitoring

   i) The owners should:

      a) continuously monitor turbidity on representative samples on each individual filter effluent and on the system's combined filter effluent, prior to clearwater tank; and

      b) record continuous turbidity measurements at equal intervals, at least every four hours. Daily turbidity would be the arithmetic average of all the turbidity measurements in one calendar day.

   ii) Municipalities using slow sand filtration may reduce treated water turbidity monitoring to one grab sample per day with AEP approval. Reduced turbidity monitoring would be allowed only if the owner can demonstrate that a reduction in monitoring will not endanger the health of consumers served by the water system.

3. Validation

   Municipalities that continuously monitor turbidity using an in-line analyzer must establish a QA/QC program, consisting of analytical procedures in the "Standard Methods," to validate the measurements obtained from continuous monitoring.

4. Compliance

   System compliance for turbidity is detailed under the Performance Standards in Section 2.2.1(1).

9.2.3.4 Fluoride

1. Where fluoridation is practiced, the municipalities should:

   i) Measure the raw water fluoride concentration, at least once a week on a representative sample collected before the addition of any chemicals. A grab sample may be used for this purpose;

   ii) Once a month, collect a representative sample of raw water before the addition of any chemical and forward it to an independent laboratory for the measurement of fluoride concentration;

   iii) Measure the treated water fluoride concentration continuously at equal intervals, every four hours or at least once per day on a representative sample entering the distribution system;

   iv) Once a month, collect a representative sample of treated water entering the distribution system and forward it to an independent laboratory for the measurement of fluoride concentration;

   v) Measure the total daily volume of water to which fluoride is added;

   vi) Measure the total daily weight of fluoride added to the water;

   vii) Measure the total daily weight of fluoride in the feeding equipment; and

   viii) Measure the total daily weight of fluoride in stock.

2. Validation

   See section 9.2.3.3(3)

3. Compliance

   System compliance for fluoride ion concentration in drinking water is outlined under the Performance Standards in Section 2.5.

9.2.3.5 Trihalomethanes

1. Sampling Location and Monitoring Frequency

   i) Owners on a surface water source, serving a population of ten thousand or more and providing water treated with chlorine should monitor as follows:

      a) Owners should collect four samples per treatment plant every three months. The samples should be taken within a twenty-four hour period. One of the samples should be taken from the extreme end of the distribution system and three samples from representative locations in the distribution system. The samples should be analyzed for total trihalomethanes (TTHM). After one year of monitoring, AEP may reduce the monitoring frequency to one sample every three months per treatment plant if the TTHM levels are less than 100 μg/L.

The sample should be taken at the extreme end of the distribution system.

b) Owners on Regional Systems should collect one water sample every six months. The sample should be taken at the extreme end of the distribution system and analyzed for TTHM.

ii) Owners on a surface water source, serving a population of less than ten thousand, and providing water treated with chlorine should monitor as follows:

a) Owners should collect one water sample per treatment plant every three months for one year. The sample should be taken at the extreme end of the distribution system and analyzed for TTHM. After the first year, the monitoring may be reduced to once every three years, if TTHM levels are less than 100 µg/L.

b) Owners on Regional Systems should collect one water sample every three months for one year at the extreme end of the distribution system and analyze for TTHM. After the first year, the monitoring may be reduced to once every three years, if TTHM levels are less than 100 µg/L.

iii) TTHM monitoring requirements for groundwater systems will be determined on a site specific basis.

2. Compliance

Compliance with the MAC is determined by a running average of all samples taken during any twelve month period. If the average exceeds the MAC, then the system is out of compliance.

9.2.3.6 Organic Chemicals and Pesticides

1. Parameters to be Monitored

Municipalities serving a population of ten thousand or more would undertake monitoring for organic chemicals and pesticides. Parameters to be monitored should include all the organic chemicals and pesticides (used in Alberta only) that are listed in the GCDWQ. They are:

atrazine, benzene, benzo(a)pyrene, bromoxynil, carbaryl, carbon tetrachloride, chlorpyrifos, cyanazine, diazinon, dicamba, dichlorobenzene 1, 2-, dichlorobenzene 1.4-, dichlorethane 1, 2-, dichloromethane, dichlorphenol, 2, 4-, 2, 4-D, demethoate, ethylbenzene, glyphosate, lindane, malathion, monochlorobenzene, pentachlorophenol, phorate, picloram, tetrachlorophenol 2, 3, 4, 6-, toluene, triallate, trichloroethylene, trichlorophenol 2, 4, 6- and trifluralin.

The need for organic chemicals and pesticide monitoring by municipalities serving a population of less than ten thousand will be determined by AEP on a site-specific basis.

For specific systems, AEP, at its discretion, may revise the list of organic chemicals and pesticides to be monitored.

2. Sampling Location

Sampling locations for organic chemicals and pesticides should be the same locations as for inorganic chemical and physical samples. See Section 9.2.3.2(2) for details.

3. Monitoring Frequency

i) The frequency of monitoring conducted to determine compliance with the MACs for organic chemicals and pesticides should be once per year in the summer for groundwater supplies, and twice per year, once in early spring (March-April) and once in the summer (May-September) for surface water supplies, at each designated "Sampling Location" or "Alternate Sampling Location."

For groundwater requiring treatment, one additional sampling would be required at the "Source Sampling Location."

ii) Where the results of sampling for the parameters in subsection 9.2.3.6(1) indicate that MACs have been exceeded, AEP will require that one additional confirmation sample be collected, as soon as possible (but not to exceed two weeks) after the initial sample results are received.

iii) Systems which exceed the MACs in confirmation samples should monitor quarterly at each sampling point which resulted in violation, or as directed by AEP. AEP may decrease the quarterly monitoring requirement to what is specified in subsection 9.2.3.6(3)(i), provided it has determined that the system is reliably and consistently below the MACs. This determination will be based on a minimum of two quarterly samples for groundwater systems, and a minimum of four quarterly samples for surface water systems.

iv) If monitoring shows that the system is reliably and consistently below the MACs for three consecutive years, AEP may allow surface water systems to be monitored annually, and groundwater systems to be monitored once in three years.

4. Compliance

Compliance requirements for organic chemicals and pesticides are the same as for inorganic chemical and physical parameters, as detailed in section 9.2.3.2(4).

9.2.3.7 Disinfection (See Also Section 4.1.5.1)

1. Determination of disinfectant contact time (T_{10})

i) The owner should calculate T_{10} at maximum hourly flow.

ii) For pipelines, T_{10} is calculated by dividing the internal volume of the pipe by the maximum hourly flow rate through that pipe.

iii) For all other systems components, tracer studies or empirical methods should be used to determine T_{10}.

iv) The owner should use the T_{10} value determined by tracer studies or other methods as T on all CT Calculations.

v) Tracer studies

a) The owner should conduct field tracer studies on all systems components for which similar contact times are not documented.

b) Ideally, three tracer studies should be done for different flow conditions at various depths of clearwater tanks.

c) The tracer studies should be conducted in accordance with good engineering practices using methods acceptable to AEP.

vi) Empirical Methods

Empirical methods may be used to calculate T_{10}, if the owner can demonstrate that system components have configuration similar to components on which tracer studies have been conducted. See Appendix C for illustration of typical baffling conditions in reservoirs.

2. Establishing the Level of Reduction

i) AEP will establish the level of disinfection (log reduction) to be provided by the municipality.

ii) The required level of reduction will be based on source quality and expected levels of Giardia cyst and virus reduction achieved by the systems filtration process. Regardless of the reduction credit allowed for filtration, minimum requirements for disinfection alone would be 0.5 log reduction of Giardia cysts and 2 log reduction of viruses.

iii) Based on periodic review, AEP may adjust, as necessary, the level of disinfection the owner should provide to protect the public health.

iv) For systems not meeting the turbidity requirements outlined in Sections 2.2.1(1) and 2.2.2, AEP may grant reduced filtration credit or no filtration credit, as per Section 2.2.4(3).

3. Monitoring the Level of Reduction and Removal

i) Each day the system is in operation, the municipality should determine the total level of reduction of Giardia cysts and viruses.

ii) The owner should determine the total level of reduction based on:

a) Giardia cyst and virus reduction credit granted by AEP for filtration; and

b) Level of reduction of Giardia cysts and viruses achieved through disinfection.

iii) At least once per day, the owner should monitor the following to determine the level of reduction achieved through disinfection:

a) Temperature of the disinfected water at each residual disinfectant concentration sampling point used for CT calculations; and

b) If using chlorine, pH of the disinfected water at each chlorine residual disinfectant concentration sampling point used for CT calculations.

iv) Each day during peak hourly flow (based on historical information), the owner should:

a) Ascertain the filled capacity/depth of the clearwater tank;

b) Determine the disinfectant contact time, T, based on clearwater tank capacity/depth, to the point at which C is measured.

v) The owner should measure the disinfectant concentration, C, of the water at the point for which T is calculated.

For systems serving more than five thousand (>5000) people, the owner should continuously monitor, at equal intervals and at least ever four hours, and record the residual disinfectant concentration. The lowest recorded value for C should be used in the CT calculations.

For systems serving less than five thousand (<5000) people, a grab sample may be collected at the maximum hourly flow to determine the C for CT calculations.

The C measurement point should be located before or at the first customer.

vi) Validation

See section 9.2.3.3(3)

4. Determining the Level of Reduction

Each day the system serves water to the public, the owner should determine:

The total reduction ratio $\frac{(CT_{actual.})}{(CT_{required})}$

CT_{actual} values should be determined using the monitored values of C and T as outlined in subsection 9.2.3.7(3). If C and T values are monitored more frequently, the lowest CT values calculated should be used in determining the level of reduction. $CT_{required}$ values should be referenced from Appendix A or Appendix B.

5. Determining Compliance with the Required Level of Reduction

   The system will be considered in compliance with the reduction requirement when the total reduction ratio is greater than 1. The reduction ratio may be less than 1 for a maximum of one day a month.

6. Monitoring the residual disinfectant concentration entering the distribution system, at a point immediately downstream of the clearwater tank.

   i) Systems serving more than five thousand (>5000) people.

      a) The owner should continuously monitor and record the residual disinfectant concentration of water entering the distribution system and report the lowest value each day.

      b) If the continuous monitoring equipment fails, the owner should measure the residual disinfectant concentration on grab samples collected at least every four hours at the entry to the distribution system.

   ii) Systems serving five thousand or less ($\leq$5000) people.

      a) The owner should collect grab samples or use continuous monitoring and recording to measure the residual disinfectant concentration entering the distribution system.

      b) Owners choosing to take grab samples collect:

         - Samples at the following minimum frequencies

Population Served	Number/day
< 500	1
501 - 1,000	2
1,001 - 2,500	3
2,501 - 5,000	4

         - At least one of the grab samples at peak hourly flow; and the remaining samples evenly spaced over the time the system is disinfecting water that will be delivered to the public.

7. Monitoring residual disinfectant concentrations within the distribution system.

   i) The owner should measure the residual disinfectant concentration at representative points within the distribution system once daily or as otherwise approved by AEP.

   ii) At a minimum, the owner should measure the residual disinfectant concentration within the distribution system at the same time and location that a routine or repeat coliform sample is collected.

8. Determining compliance with the required level of residual disinfectant.

   See section 2.2.3 for compliance with residual disinfectant requirements.

9.2.4 Issue Oriented and Follow-Up Monitoring

1. General

   i) Follow-up action by the owner may be required when the system does not meet the minimum potable water quality stipulated in Section 2.1 or the minimum performance requirements for treatment stipulated in Sections 2.2 and 2.3. Follow-up and corrective actions for specific parameters are discussed later in this section.

   ii) When a violation of MAC or minimum performance requirements for treatment occurs, the municipality should:

      a) Notify AEP in accordance with section 9.4;

      b) Determine the cause of the contamination or operational problems; and

      c) Take action as directed by AEP.

2. Bacteriological

   i) When coliform bacteria are present in any sample, or if a sample contains either more than 500 HPC colonies per millilitre, or more than 200 background colonies on a total coliform membrane filter, the municipality should ensure that the following actions are taken:

      a) The sample is analyzed for fecal coliform or E.coli;

      b) Repeat samples are collected in accordance with (ii) of this subsection; and

      c) The cause of the coliform/colonies presence is determined and corrected.

   ii) Repeat Samples

      a) The owner should collect and submit for analysis a set of repeat samples (consisting of three repeat samples for every sample in which the presence of coliform/colonies is detected.

      b) The three repeat samples should be collected as follows:

         - At the site of previous sample with a coliform/colonies presence;
         - Within 5 active services upstream of the site of sample with a coliform/colonies presence; and
         - Within 5 active services downstream of the site of sample with a coliform/colonies presence.

c) All samples in a set of repeat samples should be collected on the same day of notification by the laboratory of a coliform/colonies presence, and submitted for analysis within twenty-four hours.

d) When repeat samples have coliform/colonies present, the owner should contact AEP and collect one additional set of repeat samples for each sample where a coliform/colonies presence was detected. The procedure should be continued until the problem is corrected.

iii) Corrective Actions

If coliform/colonies are detected in treated water, corrective action should be taken immediately in consultation with AEP, and should as a minimum include:

a) Increasing disinfectant dosage

b) Flushing water mains

c) Using an alternative source.

3. Disinfectant

i) When the total inactivation ratio is less than 1, the owner should:

a) Stop water production until the ratio is restored back to 1;

b) Notify AEP in accordance with section 9.4; and

c) Undertake corrective actions established in consultation with AEP.

ii) If the residual disinfectant concentration entering the distribution system, measured as free or combined chlorine, is less than 0.2 mg/L, the owner should:

a) Take immediate actions(usually increasing disinfectant dosage or cleaning clearwater tank);

b) Increase the monitoring frequency until the residual meets the specified limit; and

c) Notify AEP in accordance with section 9.4.

iii) If the residual disinfectant concentration within the distribution system is less than 0.05 mg/L, the owner should:

a) Take immediate actions (usually flushing) to obtain the residual; and

b) Increase the monitoring frequency until the residual is detectable.

4. Fluoride

   i) The fluoridation system should be shut down if the owner is unable to test fluoride concentrations.

   ii) If the daily fluoride residual varies outside the range of 0.8 mg/L +/- 0.2 mg/L, the owner should:

      a) Resample and check calculated dosage;

      b) Adjust and recalibrate the feed rate; and

      c) Take a sample to verify that proper fluoride residual levels have been obtained.

   iii) If the fluoride residual levels exceed 1.5 mg/L or if the fluoride residual levels vary 0.8 mg/L +/- 0.2 mg/L on two consecutive days, the owner should:

      a) Resample and check calculated dosage;

      b) Notify AEP in accordance with Section 9.4; and

      b) Undertake corrective actions established in consultation with AEP.

5. Turbidity

   i) If treated water turbidity entering the clearwater tank exceeds 0.5 NTU, the owner should:

      a) Notify AEP in accordance with section 9.4; and

      b) Undertake corrective actions established in consultation with AEP.

6. Inorganic physical, organic, and pesticides

   Inorganic, physical, organic and pesticides follow-up monitoring should be conducted in accordance with the procedures outlined in section 9.2.3.2 and 9.2.3.6.

9.3 Record Keeping

All records should bear the signature of the operator in responsible charge of the water system or his or her representative. Owners should keep these records available for inspection by AEP and should send the records to AEP if requested.

The owners should keep the following records and water quality analyses:

1. Bacteriological and turbidity analysis results should be kept for five years.

2. Chemical analysis results should be kept for as long as the system is in operation.

3. Records of daily source meter readings should be kept for ten years.

4. Other records of operation and analyses required by AEP should be kept for three years.

5. Actual laboratory reports may be kept or data may be transferred to tabular summaries, provided the following information is included:

   i) The date, place and time of sampling, and the name of the person collecting the sample;

   ii) Identification of the sample type (routine distribution system sample, repeat sample, source or treated water sample, or other special purpose sample);

   iii) Date of analysis;

   iv) Laboratory and person responsible for performing analysis;

   v) The analytical method used; and

   vi) The results of the analysis.

6. Records of action taken by the system to correct violations of drinking water standards (MAC), including names and addresses of persons who discovered the contravention. For each violation, copies of public notifications should be kept for three years after the last corrective action taken.

7. Copies of project reports, construction documents and related drawings, inspection reports and approvals should be kept for the life of the facility.

8. Where applicable, daily records including:

   i) Information on level of inactivation of Giardia cysts and viruses achieved through disinfection:

      a) Temperature at each residual concentration sampling point;
      b) pH if using chlorine;
      c) peak flow;
      d) Filled capacity/depth of clearwater tank;
      e) Disinfectant contact time T, and corresponding concentration C;
      f) Inactivation ratio.

   ii) Residual disinfectant concentration entering the distribution system, and at representative points within the distribution system;

   iii) Fluoride level;

   iv) Water treatment plant performance including, but not limited to:

      - Type of chemicals used and quantity;
      - Amount of water treated; and
      - Results of analyses.

v) Turbidity;

vi) Source meter readings; and

vii) Other information as specified by AEP.

All records referred to in this section should be made available at any time upon the request of an inspection or investigator as appointed under DPEA.

9.4 Reporting

1. Reporting requirements shall be in accordance with the operating approval for that facility, issued by AEP.

2. Unless otherwise specified in this section, the owner should report to AEP within forty-eight hours:

   i) The violation of a MAC

   ii) The failure to comply with minimum performance requirements for treatment; and

   iii) The failure to comply with the compliance monitoring requirements.

3. The owner should notify AEP when:

   i) Coliform is present in a sample, within ten days of notification by the laboratory;

   ii) A coliform MAC violation is determined in a sample, within twenty-four hours of determining the violation; and

   iii) Fecal coliform or E. coli is present in a sample, by the end of the business day in which the municipality is notified by the laboratory.

4. On discovering the following contravention, the owner should notify AEP by the end of the business day or during the next working day if discovered after normal close of business day:

   i) when the total disinfectant inactivation ratio is less than 1;

   ii) when treated water turbidity exceeds the specified limits;

   iii) when residual disinfectant concentration entering the distribution system, measured as free or combined chlorine is below 0.2 mg/L;

   iv) when the fluoride residual levels exceed 1.5 mg/L or when the fluoride residual levels vary outside 0.8 mg/L +/- 0.2 mg/L on two consecutive days; and

   v) when the application of fluoride is discontinued in order to repair or replace equipment.

5. The owner should compile and submit an annual report on or before February 28 of the following year in which the information was collected. The report should include the following:

   i) A monthly summary of all operational and compliance monitoring for that particular facility, as identified by AEP;

   ii) A summary of approval contraventions and remedial measures taken; and

   iii) A summary of any permanent upgrading works undertaken during the year.

Message

anne@cela.ca

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Message 6 of 513 **(New)**

From: "Boettger, Barry HLTH:EX" <Barry.Boettger@gems7.gov.bc.ca>
To: "'anne@cela.ca'" <anne@cela.ca>
Date: 15 Dec 2004, 06:52:17 PM
Subject: RE:

We refer primarily to the Canadian Guidelines for Drinking Water Quality. We will also refer to guidelines and standards set by other organisations such as WHO, EPA, Ontario Environment, etc. The BC approved water quality guidelines are not used for evaluating drinking water - where they reference water use, they generally do draw from the national guidelines, but apply to water sources, rather than treated water.

We have also referred directly to emerging information from published articles - in 1998 a supplier was required to make changes to their treatment regime in response largely to published literature still not incorporated into any guideline.

Many guidelines incorporate large uncertainty factors and it is important to look at the rationale behind a guideline and determine whether a parameter is acceptable rather than whether or not it meets a guideline - in some cases periodic excedance of a guideline does not have an attendant unacceptable health risk - in other cases (i.e. arsenic), where the guideline is based on treatment capability, a level below the guideline may not be "safe" where an alternative supply can be obtained rather than relying on treatment that has limited capability to reduce a contaminant to a de minimus risk level.

Regards,

Barry Boettger,
Provincial Drinking Water Officer,
Office of the Provincial Health Officer

4-2 1515 Blanshard Street,
Victoria, British Columbia V8W 3C8

mailto:Barry.Boettger@gems7.gov.bc.ca
Phone: (250) 952-1572 Fax: (250) 952-1362
Cell: (250) 217-9135

-----Original Message-----

From: anne@cela.ca [mailto:anne@cela.ca]
Sent: Monday, December 13, 2004 3:14 PM
To: Boettger, Barry HLTH:EX
Subject:

Dear Barry,
I am doing research on different provincial standards for drinking water. I

know B.C. has microbiological standards under the Drinking Water Act. However, I would like to know what guidelines or standards are used to assess the quality of drinking water for other parameters? Are the 1998 B.C. Approved Water Quality Guidelines (Criteria)used for this? Are these guidelines based on the Canadian Drinking Water Quality Guidelines?
Thanks in advance,

Anne Wordsworth
Research Associate
Canadian Environmental Law Asssocation
416 960 2884 ext. 221

Message 6 of 513 **(New)**

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WATER QUALITY

British Columbia Approved Water Quality Guidelines (Criteria) 1998 Edition

Prepared pursuant to Section 2(e) of the *Environment Management Act*, 1981

Original signed by Don Fast
Assistant Deputy Minister
Environment and Lands HQ Division
September 11, 1998

Updated: August 24, 2001

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<u>References</u>

Introduction

Welcome to British Columbia's Approved Guidelines (Criteria) Report for 1998.

The following questions and answers will introduce you to the British Columbia Water Quality Guidelines (Criteria) Report — 1998. They will explain what the report is and guide you through its use. This report is revised periodically to incorporate new information. The authors invite your comments and suggestion on any errors and omissions in the guidelines cited here.

Why do we have an *Approved Water Quality Guidelines (Criteria) Report — 1998*?

Water quality guidelines are developed in order that water quality data can be assessed and site-specific water quality objectives can be prepared. They provide the benchmarks for the assessment of water quality and setting water quality objectives. In general, water quality problems are non-existent if the substance concentration is lower than the guideline(s). However, if the substance concentration exceeds its guideline, an assessment of the water quality is desirable.

What are the *Approved Water Quality Guidelines (Criteria)* and what do they protect?

Tables 2 through 30 list guidelines that have been developed by the Ministry of Environment, Lands and Parks (now called Ministry of Water, Land and Air Protection). They have been approved by the province and, as noted above, will be used to assess water quality in BC. Approved guidelines are given to protect six major water uses: Drinking Water, Aquatic Life (freshwater and marine), Wildlife, Recreation and Aesthetics, Agriculture (Irrigation and Livestock Watering), and Industrial (e.g., Food Processing Industry).

Why does Table 1 look different from the other tables in the report?

Table 1 lists guidelines for drinking water (at the point of consumption) and recreational waters. These guidelines, designed to protect human health, are the responsibility of Health and Welfare Canada. The list of substances considered by Health Canada is broader than that considered by the Province (Tables 2 through 31) and reflects a Canadian perspective.

Drinking water guidelines as stated in Tables 2 through 31 are, in some cases, for raw waters before treatment and should not be confused with those in Table 1.

Who can use this report?

Traditionally, water quality professionals such as consultants have used this report. We are hoping that members of the public, especially those associated with local stewardship groups, will use this new "user-friendly" edition of the report to evaluate water quality data that they collect.

How do you define water quality guidelines?

Water quality guidelines apply province-wide and are safe levels of substances for the protection of a given water use, including drinking water, aquatic life, recreation and agricultural uses. In aquatic environments, water quality includes the physical, chemical and biological quality of the water, sediment and biota. These guidelines are being developed by the province substance by substance, starting with those most urgently needed for water quality assessments and objectives.

What are water quality objectives?

Water quality objectives are a refinement of the province-wide guidelines that are adapted to protect the most sensitive water use at a specific location, taking local circumstances into account. As suggested above, they have their basis in the water quality guidelines plus the site characteristics that may influence the toxic action of the substance of concern.

I have seen other references to similar reports issued by the ministry in the past. Are those reprots still valid?

As indicated above, this report is revised periodically to incorporate new information. Sections from the earlier versions that are still useful have been included in this 1998 report. The 1998 version supersedes the following documents:

1. ***Preliminary Working Criteria for Water Quality,*** October 1982.
2. ***Working Criteria for Water Quality,*** April 1985.
3. ***Approved and Working Criteria for Water Quality,*** April 1987, March 1989, May 1991, February 1994, and April 1995.

A second report, ***A Compendium of Water Quality Guidelines from other Jurisdictions for use in BC*** will be released subsequent to this report.

Which water quality guidelines have been developed by the ministry?

Water quality guidelines for the following substances have been approved:

Substance	Table Number	Substance	Table Number
Algae	3	Nitrogen (nitrate, nitrite and ammonia)	4, 5, 16, 21, 22
Aluminum	6, 7	Nutrients (phosphorous) and algae	3
Benthic sedimentation	2	Organic carbon	33
Chlorine	19	Oxygen (dissolved)	18
Chlorophenols	26, 27	PAHs (polycyclic aromatic hydrocarbons)	24, 25
Coliforms	8	Particulate matter (suspended solids and turbidity)	2
Colour	32	PCBs (polychlorinated biphenyls)	23
Copper	9	pH	28
Cyanide	10	Phosphorous	3
Ethylbenzene	35	Polychlorinated biphenyls (PCBs)	23
Fluoride	20	Polycyclic aromatic hydrocarbons (PAHs)	24, 25
Lead	11, 12	Selenium	41
Manganese	38	Silver	29
Mercury	13, 14	Sulphate	37

Methyl tertiary-butyl ether (MTBE)	40	Suspended solids	2
Microbiological indicators	8	Temperature	42, 43
Molybdenum	15	Toluene	36
MTBE (methyl tertiary-butyl ether)	40	Total gas pressure	30
Nitrate	16	Turbidity	2
Nitrite	16, 17	Zinc	34

Which water quality guidelines are currently being developed by the ministry?

Guidelines for the following substances are being developed or reviewed:

Substance
• Aluminum (update) • Barium • Berylium • Boron • Cadmium • Chlorate • Chromium • Disopropanolamine (DIPA) • Dioxins and furans • Iron • Phenol • Sulfolane • Xylene

Which other tools does the ministry have to help one assess water quality?

In addition to this report and the forthcoming ***Compendium*** report, the ministry has developed several tools that can be used to assess water quality. For instance, the ***Principles*** document, the ***User's Guide***, and the ***Deriving Site-Specific Objectives*** reports (see below) outline the process that can be used to develop site-specific water quality objectives. The ***Status Report*** indicates the state of water quality for waterbodies in BC based on available data. The ministry has also developed manuals that will help in designing and implementing monitoring programs, and interpreting water quality data. Titles of the completed reports are listed below:

- *Principles for Preparing Water Quality Objectives in British Columbia. 1986*
- *Developing Water Quality Objectives in British Columbia-A User's Guide. 1996*
- *British Columbia Water Quality Status Report. 1996*
- *Lake and Stream Bottom Sediment Sampling Manual. 1997*
- *Freshwater Biological Sampling Manual. 1997*
- *Ambient Fresh Water and Effluent Sampling Manual. 1997*
- *Guidelines for Designing and Implementing a Water Quality Monitoring Program in*

British Columbia. 1998

- *Guidelines for Interpreting Water Quality Data. 1998*
- *Methods for Deriving Site-Specific Objectives in British Columbia and Yukon, 1997*

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Tables of Recommended Guidelines

Table 1. Water Quality Guidelines for Drinking and Recreational Water Uses

Substance	Water Use	Guidelines
Aldicarb (total) -aldicarb, aldicarb sulfoxide, aldicarb sulfone	Drinking	9 μg/L (maximum)
Aldrin + Dieldrin (total)	Drinking	0.7 μg/L (maximum)
Aluminum	Drinking	see Tables 6 and 7 for approved criteria
Aluminum	Recreation	see Tables 6 and 7 for approved criteria
Antimony	Drinking	6 μg/L (proposed interim maximum)
Arsenic	Drinking	25 μg/L (interim maximum)
Atrazine and its metabolites	Drinking	9 μg/L (interim maximum)
Azinphos-methyl	Drinking	20 μg/L (maximum)
Barium	Drinking	1 mg/L (maximum)
Bendiocarp	Drinking	40 μg/L (maximum)
Benzene	Drinking	5 μg/L (maximum)
Benzo[a]pyrene	Drinking	0.01 μg/L (maximum)
Boron	Drinking	5 mg/L (maximum)
Bromoxnyl	Drinking	5 μg/L (interim maximum)
Cadmium (total)	Drinking	5 μg/L (maximum)
Carbaryl	Drinking	90 μg/L (maximum)
Carbon tetrachloride	Drinking	5 μg/L (maximum)
Carbofuran	Drinking	90 μg/L (maximum)
Chloramines	Drinking	3 mg/L (maximum)
Chlordane	Drinking	7 μg/L (maximum)
Chloride (dissolved)	Drinking	less than or equal to 250 mg/L (aesthetic objective)
Chlorophyll a (approved BC criterion)	Drinking	2 to 2.5 μg/L (lakes, summer average)
Chlorpyrofos	Drinking	90 μg/L (maximum)

Chromium (total)	Drinking	50 μg/L (maximum)	
Clarity (as secchi disc visibility)	Recreation	1.2 m (minimum)	
Colour (true)	Drinking	less than or equal to 15 TCU (aesthetic objective)	
Colour (true)	Recreation	should not impede visibility in swimming areas	
Conductivity (specific)	Drinking	700 μS/cm(maximum)	
Copper	Drinking	less than or equal to 1 mg/L (aesthetic objective)	
Cyanazine	Drinking	10 μg/L (interim maximum)	
Cyanide	Drinking	200 μg/L (maximum)	
1,2-Dichlorobenzene	Drinking	200 μg/L (maximum)	0.2
1,2-Dichlorobenzene	Drinking	less than or equal to 3 μg/L (aesthetics objective)	.003
Dichlorodiphenyltrichloroethane (DDT+ metabolites)	Drinking	30 μg/L (interim maximum)	.03
2,4-Dichlorophenoxy acetic acid (2,4-D)	Drinking	100 μg/L (interim maximum)	.1
Diazinon	Drinking	20 μg/L (maximum)	.02
Dicamba	Drinking	120 μg/L (interim maximum)	
1,4-Dichlorobenzene	Drinking	5 μg/L (maximum)	
1,4-Dichlorobenzene	Drinking	less than or equal to 1 μg/L (aesthetics objective)	
1,2-Dichloroethane	Drinking	5 μg/L (interim maximum)	.005
1,1-Dichloroethylene	Drinking	14 μg/L (maximum)	
Dichloromethane	Drinking	50 μg/L (maximum)	
2,4-Dichlorophenol	Drinking	900 μg/L (maximum)	
2,4-Dichlorophenol	Drinking	0.3 μg/L (aesthetic objective)	
Diclofop-methyl	Drinking	9 μg/L (maximum)	
Dimethoate	Drinking	20 μg/L (interim maximum)	
Dinoseb	Drinking	10 μg/L (maximum)	
Diquat	Drinking	70 μg/L (maximum)	
Diuron	Drinking	150 μg/L (maximum)	
Ethylbenzene	Drinking	2.4 μg/L (aesthetic objective)	
Ethylbenzene	Recreation	2.4 μg/L (aesthetic objective)	
Fluoride (total)	Drinking	1.5 mg/L (maximum)	
Glyphosate	Drinking	280 μg/L (interim maximum)	
Hardness (total dissolved)	Drinking	80 to 100 mg/L as CaCO3 is acceptable over 200 mg/L as CaCO3 is poor but can be tolerated over 500 mg/L as CaCO3 is normally unacceptable	200 ug/l
Heptachlor + heptachlor epoxide	Drinking	3 μg/L (maximum)	= .2

Heptachlorocyclohexane	Drinking	see Lindane
Iron	Drinking	less than or equal to 0.3 mg/L (aesthetic objective)
Lead	Drinking	10 µg/L (maximum)
Lindane (hexachlorocyclohexane)	Drinking	4 µg/L (maximum)
Magnesium (dissolved)	Drinking	100 mg/L, taste threshold for sensitive people 500 mg/L, taste threshold for average people over 700 mg/L, laxative effects for everyone
Malathion	Drinking	190 µg/L (maximum)
Manganese	Drinking	less than or equal to 50 µg/L (aesthetic objective)
Mercury	Drinking	1 µg/L (maximum)
Methoxychlor	Drinking	900 µg/L (maximum)
Methyl tertiary-butyl ether (MTBE)	Drinking	0.02 mg/L (maximum)
Methyl tertiary-butyl ether (MTBE)	Recreation	0.02 mg/L (maximum)
Metolachlor	Drinking	50 µg/L (interim maximum)
Metribuzin	Drinking	80 µg/L (maximum)
Microbiological indicators	Drinking	10 total coliforms/100 mL 0 fecal coliforms/100 mL
Microbiological indicators	Recreation	2000 E. coli/L (geometric mean, fresh water) 350 enterococci/L (geometric mean, marine water) (resample at 4000 E. coli or 700 enterococci)
Monochlorobenzene	Drinking	80 µg/L (maximum) less than or equal to 30 µg/L (aesthetic objective)
MTBE (Methyl tertiary-butyl ether)	Drinking	0.02 mg/L (maximum)
MTBE (Methyl tertiary-butyl ether)	Recreation	0.02 mg/L (maximum)
Nitrate	Drinking	45 mg/L (maximum) 10 mg/L as NO3 nitrogen
Nitrilotriacetic acid	Drinking	400 µg/L (maximum)
Odour	Drinking	inoffensive (aesthetic objective)
Oil and grease	Recreation	not detectable by sight or smell
Paraquat dichloride	Drinking	10 µg/L (interim maximum) (7 µg/L for the paraquat ion)
pH	Drinking	6.5 to 8.5 (aesthetic objective
pH	Recreation	6.5 to 8.5 (aesthetic objective
pH	Recreation	5.0 to 9.0 (buffering capacity)
phorate	Drinking	2 µg/L (maximum)

Picloram	Recreation	190 µg/L (interim maximum)
Selenium	Drinking	10 µg/L (maximum)
Simazine	Drinking	10 µg/L (interim maximum)
Sodium	Drinking	less than or equal to 200 mg/L (aetshetic objective) 20 mg/L alert level for people on sodium restricted diets
Solids (floatable or settleable)	Recreation	none
Sulphate	Drinking	less than or equal to 500 mg/L (aesthetic objective)
Sulphide (as H2S)	Drinking	50 µg/L (aesthetic objective)
Taste	Drinking	inoffensive (aesthetic objective)
Temephos	Drinking	280 µg/L (interim maximum)
Temperature	Drinking	15 degrees Celcius maximum (aesthetic objective)
Temperature	Recreation	30 degrees Celcius maximum
Terbufos	Drinking	1 µg/L (interim maximum)
Tetrachoroethylene	Drinking	30 µg/L (maximum)
2,3,4,6-Tetrachlorophenol	Drinking	100 µg/L (maximum) less than or equal to 1 µg/L (aesthetic objective)
Toluene	Drinking	less than or equal to 24 µg/L (aesthetic objective)
Total dissolved solids	Drinking	less than or equal to 500 mg/L (aesthetic objective)
Triallate	Drinking	230 µg/L (maximum)
Trichloroethylene	Drinking	50 µg/L (maximum)
2,4,6-Trichlorophenol	Drinking	5 µg/L (maximum) less than or equal to 2 µg/L (aesthetic objective)
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)	Drinking	280 µg/L (maximum) less than or equal to 20 µg/L (aesthetic objective)
Trifluralin	Drinking	45 µg/L (interim maximum)
Triralomethanes	Drinking	100 µg/L (interim maximum)
Turbidity	Drinking	1 NTU (maximum) less than or equal to 5 NTU (aesthetic objective)
Turbidity	Recreation	50 NTU (maximum)
Uranium	Drinking	100 µg/L (maximum)
Vinyl chloride	Drinking	2 µg/L (maximum)
Xylenes (total)	Drinking	less than or equal to 300 µg/L (aesthetic objective)

Zinc	Drinking	less than or equal to 5 mg/L (aesthetic objective)

1. From Health and Welfare Canada, References 21, 22, 23, 24 and 25.

2. From British Columbia Ministry of Water, Land and Air Protection,

References 40, 42 and 43.

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Table 2: Summary of Water Quality Guidelines for Turbidity, Suspended and Benthic Sediments

Water Use	**Maximum Induced Turbidity - NTU or % of background**	**Maximum Induced Suspended Sediments - mg/L or % of background**	**Streambed Substrate Composition**
Drinking Water - raw untreated	1 NTU when background is less than or equal to 5	No Guideline	No Guideline
Drinking Water - raw treated	5 NTU when background is less than or equal to 50 ——— 10% when background is greater than 50	No Guideline	No Guideline
Recreation and Aesthetics	Maximum 50 NTU ——— secchi disc visible at 1.2m	No Guideline	No Guideline
Aquatic Life - fresh - marine - estuarine	8 NTU in 24 hours when background is less than or equal to 8 ——— mean of 2 NTU in 30 days when background is less than or equal to 8	25 mg/L in 24 hours when background is less than or equal to 25 ——— mean of 5 mg/L in 30 days when background is less than or equal to 25	fines not to exceed -10% as less than 2mm -19% as less than 3mm -25% as less than 6.35mm at salmonid spawning sites
Aquatic Life - fresh - marine - estuarine	8 NTU when background is between 8 and 80 ———	25 mg/L when background is between 25 and 250 ———	Geometric mean diameter not less than 12mm ———

	10% when background is greater than or equal to 80	10% when background is greater than or equal to 250	Fredle number not less than 5 mm
Terrestrial Life - wildlife - livestock water Irrigation Industrial	10 NTU when background is less than or equal to 50 ——— 20% when background is greater than or equal to 50	20 mg/L when background is less than or equal to 100 ——— 20% when background is greater than or equal to 100	No Guideline

This table has been updated since the print document was published in 1998.

References 1, 32.

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Table 3. Summary of Water Quality Criteria for Nutrients and Algae

Water Use	Phosphorous µg/L (total)	Chlorophyll *a* mg/m^2
Drinking Water - lakes	10 µg/L (maximum)	None proposed
Aquatic Life - streams	None proposed	100 mg/m^2 (maximum)
Aquatic Life - lakes (salmonids are the predominant fish species)	5 to 15 µg/L (inclusive)	None proposed
Recreation - streams	None proposed	50 mg/m^2
Recreation - lakes	10 µg/L (maximum)	None proposed

1. Total phosphorous in lakes is either the spring overturn concentration, if the residence time of the epilimnetic water is greater than 6 months, or the mean epilimnetic growing season concentration, if the residence time of the

epilimnetic water is less than 6 months

2. Chlorophyll a criteria in streams apply to naturally growing periphytic algae.

Reference 2.

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Table 4. Average 30-day Concentration of Total Ammonia Nitrogen for Protection of Aquatic Life (mg/L of Nitrogen)

Temperature (T) in degrees Celcius

pH	T=0.0	T=1.0	T=2.0	T=3.0	T=4.0	T=5.0	T=6.0
6.5	2.08	2.05	2.02	1.99	1.97	1.94	1.92
6.6	2.08	2.05	2.02	1.99	1.97	1.94	1.92
6.7	2.08	2.05	2.02	1.99	1.97	1.94	1.92
6.8	2.08	2.05	2.02	1.99	1.97	1.94	1.92
6.9	2.08	2.05	2.02	1.99	1.97	1.94	1.92
7.0	2.08	2.05	2.02	1.99	1.97	1.94	1.92
7.1	2.08	2.05	2.02	1.99	1.97	1.94	1.92
7.2	2.08	2.05	2.02	1.99	1.97	1.94	1.92
7.3	2.08	2.05	2.02	1.99	1.97	1.94	1.92
7.4	2.08	2.05	2.02	2.00	1.97	1.94	1.92
7.5	2.08	2.05	2.02	2.00	1.97	1.95	1.93
7.6	2.09	2.05	2.03	2.00	1.97	1.95	1.93
7.7	2.09	2.05	2.03	2.00	1.98	1.95	1.93
7.8	1.78	1.75	1.73	1.71	1.69	1.67	1.65
7.9	1.50	1.48	1.46	1.44	1.43	1.41	1.39
8.0	1.26	1.24	1.23	1.21	1.20	1.18	1.17
8.1	1.00	0.989	0.976	0.963	0.952	0.942	0.932
8.2	0.799	0.788	0.777	0.768	0.759	0.751	0.743
8.3	0.636	0.628	0.620	0.613	0.606	0.599	0.594
8.4	0.508	0.501	0.495	0.489	0.484	0.479	0.475
8.5	0.405	0.400	0.396	0.381	0.387	0.384	0.380
8.6	0.324	0.320	0.317	0.313	0.310	0.308	0.305
8.7	0.260	0.257	0.254	0.251	0.249	0.247	0.246
8.8	0.208	0.206	0.204	0.202	0.201	0.200	0.198
8.9	0.168	0.166	0.165	0.163	0.162	0.161	0.161

9.0	0.135	0.134	0.133	0.132	0.132	0.131	0.131

Temperature (T) in degrees Celcius

pH	T=7.0	T=8.0	T=9.0	T=10.0	T=11.0	T=12.0	T=13.0
6.5	1.90	1.88	1.86	1.84	1.82	1.81	1.80
6.6	1.90	1.88	1.86	1.84	1.82	1.81	1.80
6.7	1.90	1.88	1.86	1.84	1.83	1.81	1.80
6.8	1.90	1.88	1.86	1.84	1.83	1.81	1.80
6.9	1.90	1.88	1.86	1.84	1.83	1.81	1.80
7.0	1.90	1.88	1.86	1.84	1.83	1.81	1.80
7.1	1.90	1.88	1.86	1.84	1.83	1.81	1.80
7.2	1.90	1.88	1.86	1.85	1.83	1.81	1.80
7.3	1.90	1.88	1.86	1.85	1.83	1.82	1.80
7.4	1.90	1.88	1.87	1.85	1.83	1.82	1.80
7.5	1.91	1.88	1.87	1.85	1.83	1.82	1.81
7.6	1.91	1.89	1.87	1.85	1.84	1.82	1.81
7.7	1.91	1.89	1.87	1.86	1.84	1.83	1.81
7.8	1.63	1.62	1.60	1.59	1.57	1.56	1.55
7.9	1.38	1.36	1.35	1.34	1.33	1.32	1.31
8.0	1.16	1.15	1.14	1.13	1.12	1.11	1.10
8.1	0.922	0.914	0.906	0.899	0.893	0.887	0.882
8.2	0.736	0.730	0.724	0.718	0.714	0.709	0.706
8.3	0.588	0.583	0.579	0.575	0.571	0.568	0.566
8.4	0.471	0.467	0.464	0.461	0.458	0.456	0.455
8.5	0.377	0.375	0.372	0.370	0.369	0.367	0.366
8.6	0.303	0.301	0.300	0.298	0.297	0.297	0.296
8.7	0.244	0.243	0.242	0.241	0.241	0.240	0.240
8.8	0.197	0.197	0.196	0.196	0.196	0.196	0.196
8.9	0.160	0.160	0.160	0.160	0.160	0.161	0.161
9.0	0.131	0.131	0.131	0.131	0.132	0.132	0.133

Temperature (T) in degrees Celcius

pH	T=14.0	T=15.0	T=16.0	T=17.0	T=18.0	T=19.0	T=20.0
6.5	1.78	1.77	1.64	1.52	1.41	1.31	1.22
6.6	1.78	1.77	1.64	1.52	1.41	1.31	1.22
6.7	1.78	1.77	1.64	1.52	1.41	1.31	1.22
6.8	1.78	1.77	1.64	1.52	1.42	1.32	1.22
6.9	1.78	1.77	1.64	1.52	1.42	1.32	1.22

7.0	1.79	1.77	1.64	1.52	1.42	1.32	1.22
7.1	1.79	1.77	1.65	1.53	1.42	1.32	1.23
7.2	1.79	1.78	1.65	1.53	1.42	1.32	1.23
7.3	1.79	1.78	1.65	1.53	1.42	1.32	1.23
7.4	1.79	1.78	1.65	1.53	1.42	1.32	1.23
7.5	1.80	1.78	1.66	1.54	1.43	1.33	1.23
7.6	1.80	1.79	1.66	1.54	1.43	1.33	1.24
7.7	1.80	1.79	1.66	1.54	1.44	1.34	1.24
7.8	1.54	1.53	1.42	1.32	1.23	1.14	1.07
7.9	1.31	1.30	1.21	1.12	1.04	0.970	0.904
8.0	1.10	1.09	1.02	0.944	0.878	0.818	0.762
8.1	0.878	0.874	0.812	0.756	0.704	0.655	0.611
8.2	0.703	0.700	0.651	0.606	0.565	0.527	0.491
8.3	0.564	0.562	0.523	0.487	0.455	0.424	0.396
8.4	0.453	0.452	0.421	0.393	0.367	0.343	0.321
8.5	0.366	0.365	0.341	0.318	0.298	0.278	0.261
8.6	0.296	0.296	0.277	0.259	0.242	0.227	0.213
8.7	0.241	0.241	0.226	0.212	0.198	0.186	0.175
8.8	0.197	0.198	0.185	0.174	0.164	0.154	0.145
8.9	0.162	0.163	0.153	0.144	0.136	0.128	0.121
9.0	0.134	0.135	0.128	0.121	0.114	0.108	0.102

1. The average of the measured values must be less than the average of the corresponding individual values.

2. Each measured value is compared to the corresponding individual values.

3. No more than one in five of the measured values can be greater than 1.5 x the corresponding criteria values.

Referemce 3.

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9.0	0.135	0.134	0.133	0.132	0.132	0.131	0.131

Temperature (T) in degrees Celcius

pH	T=7.0	T=8.0	T=9.0	T=10.0	T=11.0	T=12.0	T=13.0
6.5	1.90	1.88	1.86	1.84	1.82	1.81	1.80
6.6	1.90	1.88	1.86	1.84	1.82	1.81	1.80
6.7	1.90	1.88	1.86	1.84	1.83	1.81	1.80
6.8	1.90	1.88	1.86	1.84	1.83	1.81	1.80
6.9	1.90	1.88	1.86	1.84	1.83	1.81	1.80
7.0	1.90	1.88	1.86	1.84	1.83	1.81	1.80
7.1	1.90	1.88	1.86	1.84	1.83	1.81	1.80
7.2	1.90	1.88	1.86	1.85	1.83	1.81	1.80
7.3	1.90	1.88	1.86	1.85	1.83	1.82	1.80
7.4	1.90	1.88	1.87	1.85	1.83	1.82	1.80
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8.7	0.244	0.243	0.242	0.241	0.241	0.240	0.240
8.8	0.197	0.197	0.196	0.196	0.196	0.196	0.196
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6.9	1.78	1.77	1.64	1.52	1.42	1.32	1.22

7.0	1.79	1.77	1.64	1.52	1.42	1.32	1.22
7.1	1.79	1.77	1.65	1.53	1.42	1.32	1.23
7.2	1.79	1.78	1.65	1.53	1.42	1.32	1.23
7.3	1.79	1.78	1.65	1.53	1.42	1.32	1.23
7.4	1.79	1.78	1.65	1.53	1.42	1.32	1.23
7.5	1.80	1.78	1.66	1.54	1.43	1.33	1.23
7.6	1.80	1.79	1.66	1.54	1.43	1.33	1.24
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Drinking Water Program

NEW New Drinking Water Legislation Now in Force

The Drinking Water Program provides expert advice to Health Authorities, and develops legislation, guidelines and policies on drinking water.

Drinking Water Protection Plan

A safe and dependable supply of drinking water is critical for the health of all British Columbians, now and in the future. To deliver on its commitment, the provincial government has consulted across jurisdictions and ministries to establish a comprehensive framework for the protection of drinking water and public health. Consultations with the public, water quality experts, and the managers of water supply and sources ensure the continued integrity of BC's network of private and public systems.

British Columbia's Drinking Water Action Plan will ensure that:

- leadership and accountability exist in the drinking water system;
- drinking water is protected from source to tap in the most effective manner possible;
- small drinking water systems have adequate checks and balances to ensure ongoing quality and supply; and,
- the system produces safe and affordable drinking water.

British Columbia is committed to improving and protecting the province's drinking water system.

New Drinking Water Legislation Now in Force

The amended *Drinking Water Protection Act* and regulations came into force on May 16, 2003, replacing the Safe Drinking Water Regulation under the *Health Act*. These new measures governing drinking water from "source to tap" will better protect the health and safety of British Columbians.

Update: Tougher Rules Safeguard Province's Drinking Water

Drinking Water Protection Act

Drinking Water Protection Regulation

Drinking Water Speech - April 28, 2003 (PDF 36Kb)

NEW Letter To All Drinking Water Suppliers In B.C.(PDF 21.9KB)

The Drinking Water Protection Act requires water suppliers to have microbiological samples analysed by a laboratory which has been approved by the Provincial Health Officer.

NEW List of Approved Water Testing Laboratories

Drinking Water Protection Act Compliance Tools

NEW Drinking Water Source-to-Tap Screening Tool

Other Information on Drinking Water

White Paper:	Drinking Water Protection Act - White Paper on Draft Regulations (April 2003)
Action Plan:	Action Plan for Safe Drinking Water in British Columbia (2002)
Opinion-Editorial:	Safe Drinking Water Vital for B.C. Communities (June 21, 2002)
News Release:	New Action Plan to Deliver Safer Drinking Water (June 19, 2002)
Backgrounder:	Ensuring Safe Drinking Water (June 19, 2002)
Transcript:	Open Cabinet Meeting (June 19, 2002)
Presentation to Cabinet:	Action Plan for Safe Drinking Water in B.C. (June 19, 2002) (PDF 23K)
Cabinet Submission:	Safe Drinking Water (June 19, 2002) (PDF 60K)
News Release:	Drinking Water Review Panel Releases Final Report (February 13, 2002)(PDF 23K) Backgrounder (PDF 40K)
News Release:	Drinking Water Legislation to Be Reviewed (September 25, 2001; Ministry of Water, Land and Air Protection)

The lessons of other provinces and the recommendations of recent, independent reviews are also key considerations for safeguarding water quality and strengthening protection measures. Recent reviews include:

- Drinking Water Review Panel's Final Report: Panel Review of British Columbia's Drinking Water Protection Act (2002)

(PDF 198K)
- Summary: Public Input to the Drinking Water Review Panel (PDF 210K)
- Provincial Health Officer's report, Drinking Water Quality in British Columbia: The Public Health Perspective (2002)
- British Columbia Auditor General's report, Protecting Drinking Water Sources (1999)

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Information on Drinking Water

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Services

Environmental Health Protection Programs are administered locally by Medical Health Officers and Environmental Health Officers, who are responsible for direct service delivery in BC's Health Authorities.

Medical Health Officers and Environmental Health Officers provide surveillance and monitoring of activities and premises which may affect the public's health. They also administer and enforce provincial legislation related to environmental health, and provide interventions to minimize health and safety hazards.

For more information on services in your community, look in the blue pages of your local telephone directory under public or community health, or view a list of Health Authorities.

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Contact Information:

Ministry of Health Services
E-mail: Health Protection Planning
Phone: (250) 952-1469
Fax: (250) 952-1713

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Last Revised: June 03, 2004

Colin Hansen
Min of Health Services

Apr 28/02

- One of the tenets our government is applying across the board is making sure each piece of legislation is backed by a good business case.
- That includes drinking water protection.
- And we put in place the various measures to enhance drinking water protection because they protect public health – not because an interest group with a certain agenda lobbied for this.
- Through these parameters, we are making sure British Columbians enjoy safe, clean, healthy drinking water in a way that is as effective, efficient and reliable as possible.

MEASURES NOT IMPLEMENTED

- I should point out that we heard some suggestions in the consultations that we are choosing not to implement.
- For example, some of the stakeholders we heard from wanted comprehensive, mandatory treatment requirements, including filtration.
- Others asked us to introduce mandatory prescriptions around chemical levels that follow the national guidelines.
- You won't see either of these when the amended Act and regulations come into force.
- These prescriptive measures simply were not consistent with our outcome-based focus.
- What we will be doing, however, is putting into place a system where the new Drinking Water Officers can tailor individualized requirements to a specific water system, on a case-by-case basis.
- This gives drinking water officials the ability to respond in the most appropriate way to any potential risks to human health for a specific water system, and it allows the law to be applied in appropriate ways in a broad range of situations.
- Overall, the changes you will see when the new Drinking Water Protection Act and regulations come into force are an increase in the basic expectations around assessment, certification, monitoring and reporting on water quality.

PRINCIPLES OF ACTION PLAN

- This enhanced drinking water protection system was crafted around eight principles, which formed the basis of our action plan for safe drinking water.
- I'd like now to give you an idea of what you can expect when the new measures come into effect through the Drinking Water Protection Act and regulations.
- I'll do that within the context of these eight principles, but you will notice that in many cases, measures overlap, and could fall within any number of the principles.
- Again, this leads us back to the whole idea of a source-to-tap, multi-barrier system, whose development we approached in a very interconnected or integrated way.

B.C. Reg. 200/2003
O.C. 508/2003

Deposited May 16, 2003

Drinking Water Protection Act

DRINKING WATER PROTECTION REGULATION

Contents

Definitions

1 In this regulation, **"Act"** means the *Drinking Water Protection Act.*

Standards for potable water

2 The prescribed water quality standards for potable water are set out in Schedule A.

Domestic water system

3 The following are excluded from the definition of **"domestic water system"** in the Act:

(a) equipment, works and facilities constructed, operated or maintained under

(i) a licence, as defined in the *Water Act*, for conservation, power or storage purposes, or

(ii) a permit issued under the *Water Act*;

(b) a reservoir relating to a licence or permit referred to in paragraph (a);

(c) equipment for dispensing bottled water.

Prescribed water supply systems

4 For the purposes of sections 8, 9, 10, 11 and 22 (1) (b) of the Act, all water supply systems, as defined in section 1 of the Act, are prescribed.

Treatment

5 (1) In this section:

"ground water" means ground water as defined in section 1 of the *Water Act*;

"surface water" means water from a source which is open to the atmosphere and includes streams, lakes, rivers, creeks and springs.

(2) For the purposes of section 6 (b) of the Act, drinking water from a water supply system must be disinfected if the water originates from

(a) surface water, or

(b) ground water that, in the opinion of a drinking water officer, is at risk of containing pathogens.

Construction permits

6 (1) A drinking water officer who is a professional engineer, or who is working under the direction of a professional engineer, may issue a construction permit to a person after receiving an application in a form satisfactory to the drinking water officer.

(2) A person does not require a construction permit under subsection (1) if the person is undertaking

(a) emergency repairs to a water supply system, or

(b) activities referred to in section 7 (1) of the Act in respect of a water supply system that is a tank truck or vehicle water tank.

(3) The drinking water officer referred to in subsection (1) may delegate a power or duty under section 7 of the Act to a professional engineer or to a person working under the direction of a professional engineer.

(4) A valid and subsisting construction permit that was issued under section 2 of the Safe Drinking Water Regulation, B.C. Reg. 230/92, before the repeal of that regulation is deemed to be a construction permit issued under this regulation and remains valid until its expiration date unless earlier surrendered, suspended or cancelled.

Operating permits

7 (1) A drinking water officer may issue an operating permit to a water supplier after receiving an application in a form satisfactory to the drinking water officer.

(2) An operating permit is not transferable.

(3) A valid and subsisting operating permit that was issued under section 4 of the Safe Drinking Water Regulation, B.C. Reg. 230/92, before the repeal of that regulation is deemed to be an operating permit issued under this regulation and remains valid until its expiration date unless earlier surrendered, suspended or cancelled.

Water monitoring analysis

8 (1) A water supplier must transport water samples to a laboratory in accordance with the procedures established by a drinking water officer.

(2) For the purposes of section 11 (1) of the Act, a water supplier must monitor for the following parameters at the frequencies set out in Schedule B of this regulation:

(a) total coliform bacteria;

(b) fecal coliform bacteria or *Escherichia coli*.

(3) Despite subsection (2), a drinking water officer may establish different sampling frequencies for a water supplier.

(4) A laboratory carrying out monitoring analyses for the parameters referred to in subsection (2) must be approved in writing by the Provincial health officer.

Immediate reporting standard

9 (1) Subject to subsection (2), immediate reporting is required under section 12 of the Act if the water quality standards in Schedule A are not met for the fecal coliform bacteria or *Escherichia coli* parameters.

(2) Immediate reporting is not required if a water sample that failed to meet the immediate reporting standard

(a) was collected from a location in the water supply system before the water is treated for the removal or inactivation of pathogens,

(b) is not used for domestic purposes, or

(c) is water for which a public advisory to boil for drinking water has been issued.

Public notification

10 If water provided by a domestic water system is not or may not be potable water, the owner of a public premises that is served by the domestic water system must do both of the following:

(a) notify the public that the water is not potable water by posting a sign at every sink or drinking water fountain accessible to the public;

(b) if normal business practices provide an opportunity, verbally advise any person who may use the domestic water system for a domestic purpose that the water is not potable water.

Time limits for publication

11 For the purposes of section 15 (b) of the Act, a water supplier must prepare and make public, within 6 months of the end of the calendar year, an annual report of the results of the monitoring required by this regulation, its operating permit or the drinking water officer.

Qualification standards for persons operating water supply systems

12 (1) In this section, **"Environmental Operators Certification Program"** means the program of classification and certification for water supply system operators established in British Columbia by the Environmental Operators Certification Program Society.

(2) Subject to subsections (3) and (5), a person is qualified to operate, maintain or repair a water supply system if the person is certified by the Environmental Operators Certification Program for the class of system as classified under the Environmental Operators Certification Program.

(3) Subsection (2) applies as follows:

(a) on January 1, 2005 if the water supply system is classified as level 1 or level 2 or requires a small system certification;

(b) on January 1, 2006 if the water supply system is classified as level 3.

(4) Despite subsection (3), an operating permit may establish a different date on which subsection (2) applies to a water supply system.

(5) Subsection (2) does not apply to a person with specialist knowledge immediately relevant to maintenance or repair of a water supply system and who works under the direct supervision of a person certified by the Environmental Operators Certification Program.

Emergency response and contingency plan

13 (1) In this section, **"public health inspector"** means a public health inspector as defined in the *Health Act*.

(2) A water supplier must include the following in an emergency response and contingency plan:

(a) the names and telephone numbers of

(i) the management personnel for the water supply system,

(ii) the drinking water officer, medical health officer and public health inspector, and

(iii) other agencies and officials specified by the drinking water officer;

(b) the persons referred to in paragraph (a) to be contacted in each type of emergency or abnormal operational circumstance;

(c) the steps to follow in the event of an emergency or abnormal operational circumstance;

(d) protocols to follow respecting public notice if an immediate reporting standard is not met.

(3) A water supplier must

(a) make the emergency response and contingency plan accessible to the staff of the water supplier, and

(b) provide a copy of the emergency response and contingency plan to the drinking water officer.

(4) A water supplier must make a summary of the emergency response and contingency plan accessible to the users served by its water supply system.

(5) A water supplier must not include in the summary referred to in subsection (4) any information that may reasonably pose a risk to the water supply system.

Well floodproofing

14 For the purposes of section 16 of the Act, the owner or operator of a well that provides drinking water and that is identified in an assessment as being at risk of flooding must floodproof the well by constructing, equipping and maintaining the well in a manner which precludes the entry of flood water into the well and protects the well against damage from flood debris, ice, erosion and scour.

Assessment response plan

15 For the purposes of section 22 (3) of the Act, an assessment response plan must include provisions to identify, eliminate and prevent cross connections with non-potable water sources.

Schedule A
Water Quality Standards for Potable Water

(sections 2 and 9)

Parameter: **Standard:**

Fecal coliform bacteria	No detectable fecal coliform bacteria per 100 ml
Escherichia coli	No detectable *Escherichia coli* per 100 ml
Total coliform bacteria	
(a) 1 sample in a 30 day period	No detectable total coliform bacteria per 100 ml
(b) more than 1 sample in a 30 day period	At least 90% of samples have no detectable total coliform bacteria per 100 ml and no sample has more than 10 total coliform bacteria per 100 ml

Schedule B
Frequency of Monitoring Samples for Prescribed Water Supply Systems

(section 8)

Population Served by the Prescribed Water Supply System:	Number of Samples Per Month:
less than 5 000	4
5 000 to 90 000	1 per 1 000 of population
more than 90 000	90 plus 1 per 10 000 of population in excess of 90 000

Note: *this regulation repeals B.C. Reg. 230/92.*

[Provisions of the *Drinking Water Protection Act*, S.B.C. 2001, c. 9, relevant to the enactment of this regulation: section 48]

Tap Water Standards

The DWPA, as passed in April 2001, included amendments to the Safe Drinking Water Regulation (SDWR), which are pursuant to the *Health Act*. The SDWR included three schedules (A, B and C) that set the *Guidelines For Canadian Drinking Water* as standards for drinking water in BC. On Sept.5, 2001, the provincial government rescinded Schedules B and C, which contain health-related chemical standards and additional chemical and physical standards (respectively), leaving in place Schedule A, which contains microbiological standards (fecal coliform, E. coli, and total coliform).

The DWPA contemplates the creation of tap water standards for water supply systems through an operating permit; it does not enable province-wide tap water standards. The *Safe Drinking Water Regulation (SDWR)* already allows the Ministry of Health Services to set site-specific standards but this power is rarely used.

Province-wide tap water standards are used in other provinces in Canada (i.e., Alberta, Ontario, Quebec and Nova Scotia) and internationally (e.g., USA, UK, European Union and the World Health Organization). In comparison to these other jurisdictions, the standards included in Schedules A, B and C of the April 2001 version of the SDWR are generally less stringent.

The Panel believes that a set of minimum province-wide standards is required to give British Columbians confidence that drinking water has the same safeguards throughout the province. The definition of potable water must also be changed to provide a clearer objective for drinking water in the province.

Recommendation 10: Enable Tap Water Standards

a) **Enable the creation of province-wide tap-water standards, including appropriate physical, chemical and biological parameters, and require appropriate monitoring.**

b) **Appoint an expert working group to consider the Canadian guidelines and standards used in other jurisdictions, and develop an appropriate set of science-based minimum standards for British Columbia and a schedule outlining the appropriate frequency of monitoring.**

c) **Allow for a transition period for implementation of the standards to give purveyors time to change any operations or equipment that may be needed to meet the new standards and to secure funding for the improvements.**

d) **Allow for local standards to supplement or add to province-wide standards.**

e) **Ensure that the tap water standards are enforced.**

Recommendation 11: Redefine "Potable Water"

Define potable water in the Act as, "water that does not contain micro-organisms or any other substances at concentrations that present a potential danger to human health". Standards set through regulation must be consistent with this definition.

Water Treatment and Distribution Standards

Some of the biggest risks to safe drinking water in British Columbia come from microbiological organisms such as bacteria, viruses, and protozoa (particularly *Giardia* and *Cryptosporidium*). Protozoa, which pose the greatest risk to human health from waterborne contamination in BC, are very difficult to measure or monitor in water, making tap-water standards ineffective as a shield against these parasites.

The Provincial Health Officer (2001) concluded, "...setting and implementing treatment standards would minimize the health risks that British Columbians face from waterborne contaminants." Treatment standards set a minimum level of treatment by specifying required reductions (i.e., number of logarithmic reductions) in the concentration of pathogens found in drinking water.

The *Drinking Water Protection Act* provides an option for water treatment standards through the use of terms and conditions on operating permits, but not province-wide standards. Some submissions to the Panel stressed that source protection alone is not enough and that more attention to treatment options and the need for minimum, province-wide treatment standards is required in the Act.

There were also submissions stressing that the best quality treated water is still not safe at the tap if it passes through a faulty distribution system where contamination can occur. The multi-barrier approach to drinking water management recognizes all three stages of drinking water: the source, treatment and distribution. So far, distribution is not adequately safeguarded in the legislation.

The Panel believes that province-wide treatment and distribution standards are a vital component of the multi-barrier approach to safeguarding drinking water. Treatment standards are particularly essential given the risk of illness due to the presence of *Giardia* and *Cryptosporidium* in some BC drinking water sources.

Recommendation 12: Enable Water Treatment and Distribution Standards

a) **Enable the creation of drinking water treatment standards and water distribution standards to protect the public from health hazards associated with drinking water.**

Message

anne@cela.ca

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Message 2 of 489 **(New)**

From: "Chaput, Eve (WSD)" <EChaput@gov.mb.ca>
To: "'anne@cela.ca'" <anne@cela.ca>
Date: 10 Dec 2004, 06:02:30 PM
Subject: DWSA regs-reply

Anne - replies to your questions.

1. Are the draft regulations available yet or do you have an estimated time for when they will be made public?
A. The regs have gone to Dept of Justice
We are looking at a time period between January & February 2005 for fialization.
2. Will they contain numerical drinking water standards?
A. Yes

Eve Chaput
Office of Drinking Water
Water Stewardship
1007 Century Street
Winnipeg, MB R3H 0W4
* (204) 945-5762
E (204) 945-1365
* echaput@gov.mb.ca <mailto:echaput@gov.mb.ca>

-----Original Message-----
From: anne@cela.ca [SMTP:anne@cela.ca]
Sent: Thursday, December 09, 2004 5:28 PM
To: Chaput, Eve (WSD)
Subject: Re: Anne i was not clear the two regulations are not finalized yet at tached are websites

Dear Eve,
Thanks very much for that. Are the draft regulations available yet or do you have an estimated time for when they will be made public? Will they contain numerical drinking water standards?
Best regards,
Anne Wordsworth

Caput, Eve (WSD) writes:
> Drinking Water Safety Act: (Assented to August 9, 2002) is the latest
> version
>

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>
> Anne, I probably was not clear -
> The Drinking Water Safety Regulation and
> The Drinking Water Standards Regulation ?
> Are Not finalized yet.
>
>
> http://web2.gov.mb.ca/laws/statutes/ccsm/d101e.php
<http://web2.gov.mb.ca/laws/statutes/ccsm/d101e.php>
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<http://web2.gov.mb.ca/laws/statutes/ccsm/d101e.php> >
> C.C.S.M.c. D101
> (Assented to August 9, 2002)
> This is the Drinking Water Safety Act - showing what is not
proclaimed yet
> Sections are noted at end of document :
>
> Coming into force
> 44 This Act comes nito force on a day fiex by proclamation
> Note: S.M. 2002, c. 36, except sections 3.7 to 10, 20 to 25
and 30,
> was
> proclaimed in force January 30, 2004
>

> ---------
> http://web2.gov.mb.ca/laws/statutes/2002/c03602e.php
<http://web2.gov.mb.ca/laws/statutes/2002/c03602e.php>
> <http://web2.gov.mb.ca/laws/statutes/2002/c03602e.php
<http://web2.gov.mb.ca/laws/statutes/2002/c03602e.php> >
> <<The Drinking Water Safety Act.url>>
>
> Two regulations are currently being finalised for consultation:
> The Drinking Water Safety Regulation and
> The Drinking Water Standards Regulation
>
> They will replace the following two regulations under the Public
Health Act
> that are currently in force.
>
> http://web2.gov.mb.ca/laws/regs/pdf/p210-330.88r.pdf
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Message 2 of 489 **(New)**

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Updated to: December 8, 2004
Search this document

C.C.S.M. c. D101

The Drinking Water Safety Act

Table of Contents

(Assented to August 9, 2002)

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of Manitoba, enacts as follows:

INTERPRETATION

Definitions
1(1) In this Act,

"director" means a director designated under subsection 6(1); (« directeur »)

"domestic purposes" means the use of water for

(a) personal hygiene, drinking, preparing food or washing dishes or other items that come into contact with food, or

(b) other purposes prescribed by regulation; (« fins domestiques »)

"drinking water officer" means a person appointed as a drinking water officer under subsection 6(2); (« agent du Service de l'eau potable »)

"laboratory" means

(a) a laboratory accredited in accordance with the regulations, or

(b) a testing facility approved by the director and operated in accordance with the regulations; (« laboratoire »)

"medical officer" means a medical officer of health appointed under *The Public Health Act*; (« médecin hygiéniste »)

"minister" means the minister appointed by the Lieutenant Governor in Council to administer this Act; (« ministre »)

"non-potable system" means a well, or a device or structure or an assemblage of devices and structures, used or intended to be used for the production or delivery of non-potable water;

(« réseau d'eau non potable »)

"owner", in relation to a water system, includes a person who is

(a) responsible for the ongoing operation of the water system, or

(b) in charge of managing that operation,

and if the water system or part of it is owned by more than one person or is jointly owned, includes all of those owners; (« propriétaire »)

"person" includes a corporation, partnership, limited partnership, syndicate, trustee, joint venture, and an association of persons; (« personne »)

"personal health information" and **"personal information"** mean personal health information and personal information as defined in *The Freedom of Information and Protection of Privacy Act*; (« renseignements médicaux personnels » ou « renseignements personnels »)

"prescribed" means prescribed by the regulations;

"private water supplier" means an owner of a private water system; (« fournisseur d'un service d'eau privé »)

"private water system" means a water system that

(a) supplies water only to one private residence, or

(b) despite supplying water to commercial premises or to more than one private residence, is designated under clause 2(a) as a private water system; (« réseau privé d'alimentation en eau »)

"public water supplier" means an owner of a public water system; (« fournisseur d'un service d'eau public »)

"public water system" means a water system that

(a) has 15 or more service connections, or

(b) has fewer than 15 service connections, but is designated under clause 2(b) as a public water system; (« réseau public d'alimentation en eau »)

"semi-public water supplier" means an owner of a semi-public water system; (« fournisseur d'un service d'eau semi-public »)

"semi-public water system" means a water system that is not a public water system or a private water system; (« réseau semi-public d'alimentation en eau »)

"water supplier" means a person who is an owner of a water system; (« fournisseur d'un service d'eau»)

"water system" means a well, or a device or structure or an assemblage of devices and structures, used or intended to be used for the production, treatment, storage or delivery of potable water for domestic purposes. (« réseau d'alimentation en eau »)

Reference to "Act" includes regulations
1(2) A reference to "this Act" includes the regulations made under this Act.

Director may designate system as private or public
2 After consulting with a medical officer about the potential risk to public health, the director may

(a) designate a water system that provides water to commercial premises or to more than one private residence as a private water system; or

(b) designate a water system that has fewer than 15 service connections as a public water system.

3 Not yet proclaimed.

OFFICE OF DRINKING WATER

Office of Drinking Water established
4(1) The Office of Drinking Water is hereby established.

Purpose
4(2) The purpose of the Office of Drinking Water is to

(a) administer and enforce this Act and the regulations, licences, permits, advisories and orders made under it;

(b) provide guidance, technical expertise and up-to-date information and educational materials about drinking water safety to water suppliers and the public; and

(c) communicate with government departments and agencies, including federal, provincial and local governments, and with other persons, to share expertise and to facilitate co-operative efforts in drinking water programs and policies.

Annual report
5 Within six months after the end of the government's fiscal year, the director must prepare and submit to the minister a report about the Office's activities during that fiscal year. The minister must lay a copy of the report before the Legislative Assembly within 15 days after receiving it if the Assembly is sitting or, if it is not, within 15 days after the next sitting begins.

Designation of director
6(1) The minister may designate one or more persons as a director for the purpose of this Act.

Appointment of drinking water officers
6(2) The minister may appoint any person, or a class of persons, as a drinking water officer.

7 to 10 Not yet proclaimed.

DRINKING WATER SAFETY ORDERS

Drinking water safety orders
11(1) Subject to subsection (4), the director, a medical officer or a drinking water officer may make a drinking water safety order under this section if he or she reasonably believes that

(a) water obtained from a water system is, may be or may become a risk to the health of persons; and

(b) an order is necessary to investigate, prevent, remedy, mitigate or otherwise deal with the risk.

Order may be directed to any person
11(2) A drinking water safety order may be directed to any person.

Requirements of an order
11(3) A drinking water safety order may require the person to whom it is directed to do anything, or refrain from doing anything, that the person issuing the order considers necessary to investigate, prevent, remedy, mitigate or otherwise deal with the risk, including one or more of the following:

(a) investigate the situation, or undertake tests, examinations, analyses, monitoring or recording, and provide the person issuing the order with any information that he or she requires;

(b) construct, alter, install, replace, remove, reconstruct, repair or do any other work

(i) in relation to a water system or to any other thing, or

(ii) in an area of the environment;

(c) cleanse, disinfect or destroy any thing specified in the order;

(d) stop delivery of water from the water system;

(e) provide users of the water system with an alternate supply of water for domestic purposes;

(f) stop any activity, or remove or remediate any contaminant or other material that is adversely affecting or may adversely affect the source of water for a water system.

Approval of medical officer required
11(4) The director or a drinking water officer must obtain the approval of a medical officer before making a drinking water safety order that

(a) affects the availability of potable water to users of a water system;

(b) requires the water supplier to provide an alternate supply of potable water; or

(c) addresses an issue relating to the safety of water currently being obtained from the water system.

Immediate issuance of order
11(5) Despite subsection (4), if in the time necessary for the director or a drinking water officer to obtain the approval of a medical officer the health risk to users of the water system could increase, the director or drinking water officer may make an order described in that subsection without obtaining that approval. But a person who makes an order in this manner must notify a medical officer of the circumstances of the order as soon as is practicable.

Medical officer may revoke or amend order
11(6) Upon receiving notice under subsection (5), a medical officer may revoke or amend the order.

Order may require standards to be exceeded
11(7) An order may be made under this section or under section 12 or 13 even if it imposes requirements on a water supplier that are more stringent than the drinking water quality standards specified in the regulations.

Director may revoke or amend order
12 The director may, by order, revoke or amend an order made under section 11 by a drinking water officer.

Order to water supplier to hire interim operator
13(1) If the prerequisites for an order under subsection 11(1) are met, the minister may, in addition to any order that may have been made under section 11 or 12, order a water supplier to enter into an agreement or arrangement with another person to take control of, operate and manage a water system or any part of a water system for a specified period, at the water supplier's expense and in accordance with the terms and conditions of the order.

Interim operator to comply with licence and Act
13(2) A person who takes control of all or part of a water system under an agreement or arrangement described in subsection (1) is bound by the operating licence for that water system, and, except as specified in an order under subsection (1), is for all other purposes of this Act deemed to be a water supplier for that water system.

Financial terms and conditions
13(3) In addition to any other terms and conditions that may be included, an order under subsection (1) may contain terms and conditions respecting

(a) the indemnification by a person of another person in relation to costs incurred as a result of an agreement or arrangement described in that subsection;

(b) the requirement of a person to provide financial security to another person in the form of insurance, a letter of credit, a bond or other form of security satisfactory to the minister.

GENERAL PROVISIONS ABOUT ORDERS

Order may contain terms and conditions
14(1) An order issued under this Act may include terms and conditions if the person issuing the order considers that they are necessary to provide for

(a) the safety of water obtained from a water system; or

(b) effective environmental management.

Order may specify deadline
14(2) An order issued under this Act may specify the time within which or the date by which the person to whom it is directed must comply with the order.

Action if order not complied with
15(1) If a person to whom an order has been directed under section 10, 11, 12 or 13 fails to comply with it, unless a stay of the order has been granted under subsection 16(3),

(a) the director may, with the approval of a medical officer, suspend, cancel or refuse to renew the operating licence for the water system; or

(b) the director or a medical officer may take, or cause to be taken, any action that he or she considers necessary to carry out the order.

Order to pay costs
15(2) If action is taken under clause (1)(b), the director or a medical officer may order the person to whom the order was directed to pay the costs of taking that action.

APPEALS TO THE MINISTER

Appeal of director's decision or order
16(1) A person directly affected by

(a) a decision of the director under section 2;

(b) a decision of the director under section 7 or 8, or under the regulations, resulting in the issuance, renewal or refusal to issue or renew a permit or licence, the terms and conditions of a permit or licence, or the amendment, suspension or cancellation of a permit or licence; or

(c) an order made under section 10, 11 or 12;

may, by written notice to the minister within 14 days after the decision or the making of the order, or such further time as the minister allows, appeal the decision or order to the minister.

Content of notice of appeal
16(2) A notice of appeal must state the reasons for the appeal and the facts relied upon.

Stay of decision or order
16(3) An appeal of a decision or order does not stay the decision or order pending the appeal, unless the minister orders a stay.

Minister's power on appeal
16(4) As soon as is reasonably practicable after receiving a notice of appeal, the minister must consider the appeal and

(a) confirm, vary or rescind the decision or order being appealed;

(b) make any decision or order that could have been made;

(c) refer the matter back to the director for reconsideration in accordance with directions given by the minister; or

(d) refer the matter to the Clean Environment Commission established under *The Environment Act* for its advice and recommendations, before making a decision or order under clause (a), (b) or (c).

Notice of decision or order
16(5) Within seven days after making a decision or order under subsection (4), the minister must give notice of it to the appellant.

BOIL WATER ADVISORIES

Boil water advisory
17(1) A boil water advisory may be issued by

(a) a medical officer; or

(b) with the approval of a medical officer, by thedirector or a drinking water officer;

if the person issuing the advisory reasonably believes that water from a water system is or may be unsafe for domestic purposes unless it is boiled or otherwise disinfected.

Approval not needed
17(2) Despite subsection (1), if in the time necessary for the director or a drinking water officer to obtain the approval of a medical officer the health risk to users of the water system could increase, the director or drinking water officer may issue an advisory without obtaining that approval. But a person who issues an advisory in this manner must notify a medical officer of the circumstances of the advisory as soon as is practicable.

Content of advisory
17(3) A boil water advisory must advise users of the water system that, until further notice, the water is or may be unsafe and must be boiled or otherwise disinfected before it is used for any domestic purpose. The advisory may contain any other information or specify any other action to be taken by users or water suppliers that the person issuing the advisory considers appropriate.

Notice of advisory
17(4) The person who issues a boil water advisory may give notice of the advisory, or require the water supplier to give notice of the advisory, to users of the water system by any method the person issuing the advisory considers appropriate, which may include one or more of the following:

(a) delivering copies of the advisory to users;

(b) publishing the advisory in a newspaper distributed in the user area;

(c) broadcasting the advisory on a radio or television station received in the user area;

(d) posting copies of the advisory in publicly accessible locations in the user area;

(e) a method prescribed by regulation.

Termination of advisory
17(5) When a medical officer believes that water from the water system is safe for domestic purposes without being boiled or otherwise disinfected he or she must terminate the boil water advisory and give notice of the termination to the water supplier.

Water not to be provided contrary to advisory
18(1) No person who knows or ought reasonably to know of the existence of a boil water advisory shall provide to any other person

(a) water for domestic purposes; or

(b) a food or beverage containing or prepared with water;

if the water was obtained from a water system that is subject to the boil water advisory, unless the person providing the water, food or beverage has taken the action specified in the advisory.

Exemption for private residences
18(2) Subsection (1) does not apply to a person who provides water, food or a beverage in the person's residence to a member of his or her family or to a guest.

Recovery of costs re boil water advisory
19(1) The director or a medical officer may require the water supplier in relation to a water system for which a boil water advisory has been issued to pay the costs incurred by the government in

(a) giving notice under subsection 17(4); or

(b) sampling, testing or analyzing water from the water system to determine whether a boil water advisory should be issued or terminated.

Order for cost recovery
19(2) If a water supplier does not pay the costs as required under subsection (1), the director may issue an order to the water supplier to pay the costs.

20 to 25 Not yet proclaimed.

DRINKING WATER QUALITY DATABASE

Director may establish and maintain database
26(1) The director may establish and maintain a provincial drinking water quality database to assist in monitoring and tracking drinking water analyses, and in identifying drinking water quality trends and risks.

Information may be entered in database
26(2) The director may enter any information received under this Act, and any other relevant information, in the database. This information may include personal information and proprietary or confidential information.

Sharing information with other bodies
26(3) For the purpose of preventing, controlling or dealing with risks to public health, the director may provide information from the database to any of the following:

(a) a medical officer or a drinking water officer;

(b) a government department or government agency;

(c) a municipality, local government district, school division or school district established under *The Public Schools Act*, regional health authority or other local authority established by or under an enactment;

(d) a band as defined in the *Indian Act* (Canada);

(e) a department or agency of the government of Canada or of another province or territory of Canada, or the government or an agency of the government of a foreign country or of a state, province or territory of a foreign country.

Personal, proprietary and confidential information
26(4) The information referred to in subsection (3) may include personal information, and proprietary or confidential information.

Public reports
26(5) The director may, on a periodic basis, issue public reports summarizing information contained in the database.

ENTRY AND INSPECTION

Inspection authority—director and medical officer
27(1) When reasonably required to administer or determine compliance with this Act, the director or a medical officer may enter and inspect any place or premises, other than a dwelling, at any reasonable time.

Entry into dwelling with consent
27(2) Despite subsection (1), the director or a medical officer may enter and inspect a dwelling with the consent of the owner or occupant.

Warrant for entry into dwelling
27(3) On application by the director or a medical officer, a justice may at any time issue a warrant authorizing the director, a medical officer and any other person named in the warrant to enter and inspect a dwelling, if the justice is satisfied there are reasonable grounds to believe that

(a) entry to the dwelling is necessary for the purpose of administering or determining compliance with this Act; and

(b) in respect of the dwelling,

(i) entry has been refused or there are reasonable grounds to believe that entry will be refused,

(ii) the occupant is temporarily absent, or

(iii) the dwelling is unoccupied.

Conditions
27(4) A warrant may be made subject to any conditions that may be specified in it.

Entry into dwelling in exigent circumstances
27(5) The director or a medical officer may enter and inspect a dwelling without a warrant if the conditions for obtaining a warrant under subsection (3) exist but, because of exigent circumstances, it would not be practical to obtain a warrant.

Entry into premises in public health emergency
27(6) Where the director or a medical officer reasonably believes there is an immediate risk to the health of persons, he or she may

(a) enter and inspect any place or premises, including a dwelling, at any time and without a warrant; and

(b) exercise any of his or her powers under this Act for the purpose of preventing, controlling or dealing with the risk.

Inspection authority—drinking water officer
27(7) A drinking water officer

(a) has the same powers as the director and a medical officer under subsections (1), (2) and (3); and

(b) has the same powers as the director and a medical officer under subsections (5) and (6) if

(i) the director or a medical officer has authorized the drinking water officer to exercise the powers, or

(ii) the drinking water officer reasonably believes that immediate action is necessary and there is no time to locate the director or a medical officer.

Assistance to officials
27(8) In exercising a power under this section, the director, a medical officer or a drinking water officer may use such force or obtain such assistance from a peace officer or other person as he or she considers necessary.

Additional inspection powers
28(1) In addition to the powers referred to in section 27, when reasonably required to administer or determine compliance with this Act, the director, a medical officer or a drinking water officer may

(a) make any inspection, investigation, examination, test, analysis or inquiry that he or she considers necessary;

(b) detain or cause to be detained any vehicle or container that is used as a bulk water hauler;

(c) require any substance, thing, solid, liquid, gas, plant, animal or other organism to be produced for inspection, examination, testing or analysis;

(d) seize or take samples of any substance, thing, solid, liquid, gas, plant, animal or other organism;

(e) subject to subsection (2), require any person to

(i) provide information, including personal information, personal health information or proprietary or confidential information, or

(ii) produce any document or record, including a document or record containing personal information, personal health information or proprietary or confidential information, for examination or copying, or to retain as evidence; or

(f) take photographs or videotapes of a place or premises, or any condition, process, substance, thing, solid, liquid, gas, plant, animal or other organism located at or in it.

Personal health information
28(2) Despite subsection (1), only a medical officer or a person authorized by a medical officer may require the production of personal health information or a document or record containing personal health information.

Use of data processing system and copying equipment
28(3) In carrying out an inspection under this Act, the director, a medical officer or a drinking water officer may

(a) use a data processing system at the place where the records, documents or things are kept to examine any data contained in or available to the system;

(b) reproduce, in the form of a printout or other intelligible output, any record from the data contained in or available to a data processing system in the place; and

(c) use any copying equipment at the place to make copies of any record or document.

Assistance to officials
28(4) A person who has custody or control of a record, document or thing referred to in subsection (1) must give the director, medical officer or drinking water officer

(a) all reasonable assistance to enable the director, medical officer or drinking water officer to carry out his or her duties; and

(b) any information he or she may reasonably require.

Cost recovery
29(1) The director, medical officer or drinking water officer may require a public water supplier or a semi-public water supplier to pay the costs of testing, sampling or analysis under subsection 28(1).

Order for cost recovery
29(2) If a water supplier does not pay the costs as required under subsection (1), the director may issue an order to the water supplier to pay the costs.

30 Not yet proclaimed.

OFFENCES AND PENALTIES

Offences
31(1) A person is guilty of an offence who

(a) contravenes a provision of this Act, or fails to comply with a provision of any order, licence or permit issued under this Act;

(b) makes a false statement to the director, a medical officer, a drinking water officer or any other person acting under the authority of this Act;

(c) provides a false statement in an application, record or any other document given or required under this Act; or

(d) hinders, obstructs or interferes with or attempts to hinder, obstruct or interfere with the director, a medical officer, a drinking water officer or any other person acting under the authority of this Act.

Continuing offence
31(2) When a contravention of this Act or an order, licence or permit issued under this Act continues for more than one day, the person is guilty of a separate offence for each day the contravention continues.

Directors and officers of corporations
31(3) If a corporation commits an offence under this Act, a director or officer of the corporation who authorized, permitted or acquiesced in the commission of the offence is also guilty of the offence.

Penalties for individuals
31(4) Except as provided in subsection (5), a person who is guilty of an offence under this Act is liable on summary conviction,

(a) for a first offence, to a fine of not more than $50,000. or imprisonment for a term of not more than six months, or both; and

(b) for each subsequent offence, to a fine of not more than $100,000. or imprisonment for a term of not more than one year, or both.

Penalties for corporations
31(5) A corporation that is guilty of an offence under this Act is liable on summary conviction,

(a) for a first offence, to a fine of not more than $500,000.; and

(b) for each subsequent offence, to a fine of not more than $1,000,000.

Limitation period
31(6) A prosecution for an offence under this Act may be commenced not more than one year after the day on which evidence sufficient to justify a prosecution for the offence came to the knowledge of the director, a medical officer or a drinking water officer; and the certificate of the director, medical officer or drinking water officer as to the day on which the evidence came to his or her knowledge is

evidence of that date.

Admissibility of certificate in evidence
32(1) A certificate or report purporting to have been signed by a laboratory analyst stating that he or she has analyzed a sample of water or other substance and stating the results of the analysis is admissible in evidence in any prosecution for an offence under this Act without proof of the signature or official character of the analyst who signed the certificate or report, and in the absence of any evidence to the contrary, is proof of the statements contained in the certificate or report, as the case may be.

Service of certificate on party
32(2) No certificate or report or any copy or extract of a certificate or report referred to in subsection (1) shall be received in evidence unless the party intending to produce it has served on the party against whom it is intended to be produced, at least seven days prior to the date fixed for the hearing, a notice of the intention together with a duplicate of the certificate or report.

REPORTING OF VIOLATIONS

Persons may report suspected violation
33(1) Any person who reasonably believes that a violation of this Act has occurred or may occur, may report the circumstances leading to that belief to a medical officer, the director or a drinking water officer.

If information personal or confidential
33(2) A person may make a report under subsection (1) even if

(a) it requires the disclosure of personal information or personal health information; or

(b) the information on which the person's belief is based is proprietary or confidential information.

Protection from liability
33(3) No action or other proceeding may be brought against a person for providing information in good faith under this section.

Adverse employment action prohibited
33(4) No employer shall take adverse employment action against an employee because that person provided information in good faith under this section.

No interference or harassment
33(5) No person shall interfere with or harass a person who provides information under this section.

GENERAL PROVISIONS

Appealing amount of costs
34 A person to whom an order under subsection 15(2), 19(2) or 29(2) is directed may appeal the amount of the costs, and section 16 applies to the appeal, with the necessary changes.

Enforcing cost-recovery order
35 An order to pay costs under subsection 15(2), 19(2) or 29(2) may be filed in the Court of Queen's Bench and enforced as if it were an order of the Court.

Serving documents
36 Any document required to be served or given under this Act is validly served or given

(a) when it is given personally to the person it is required to be served upon or given to or, in the case of a corporation, to an agent, director, officer or employee of the corporation; or

(b) if giving it to a person as described in clause (a) is not reasonable or possible in the circumstances,

(i) when it is sent to the person's address as shown in the records of the director, by registered mail, fax, electronic mail or any other type of mail or communication that provides confirmation of delivery, or

(ii) alternatively, in the case of an order that relates to a place or premises, when it is posted in a visible location on or at the place or premises.

Protection from liability
37 No action for damages or other proceeding lies or may be brought personally against any person acting under the authority of, or engaged in the administration or enforcement of, this Act

(a) for anything done or omitted in good faith in the performance or exercise, or intended performance or exercise, of a duty or power under this Act; or

(b) for any neglect or default in the performance or exercise, or intended performance or exercise, in good faith of a duty or power under this Act.

Act binds the Crown
38 This Act binds the Crown.

REGULATIONS

Regulations
39(1) The Lieutenant Governor in Council may make regulations

(a) respecting the accreditation of laboratories;

(b) respecting the approval of testing facilities by the director, and their operation;

(c) prescribing uses of water for the purpose of the definition of "domestic purposes" in section 1;

(d) specifying drinking water quality standards;

(e) respecting the adoption, development, application, implementation and revision of drinking water quality guidelines and objectives;

(f) respecting the issuance, amendment, renewal, suspension and cancellation of permits to construct or alter water systems, including design and construction requirements to be met by applicants;

(g) respecting the issuance, amendment, renewal, suspension or cancellation of operating licences for water systems;

(h) respecting the manner in which assessments of water system infrastructure and water supply sources are to be conducted;

(i) prescribing methods of giving notice of boil water advisories;

(j) respecting disinfection requirements for water systems;

(k) respecting testing for disinfection residuals, including the prescribing of time intervals for the performing of such tests;

(l) prescribing requirements respecting records of tests for disinfection residuals, including the manner in which they are to be made and retained;

(m) respecting tests and analyses to be performed on water systems, including prescribing the types of tests and analyses to be performed;

(n) respecting the manner in which prescribed tests and analyses in relation to water systems are to be performed, and when they are to be performed;

(o) respecting the form in which and time by which laboratories are to submit results of analyses to the director;

(p) respecting the manner in which laboratories are to notify water suppliers of analyses that indicate a risk or possible risk to users of the water system;

(q) prescribing matters about which public water suppliers and semi-public water suppliers must make and retain records;

(r) respecting obligations on water suppliers to make and maintain written records, and to provide periodic reports to the director or a drinking water officer;

(s) respecting information that water suppliers are required to make publicly available and the manner in which information is to be made available, including requirements for the posting of permits, licenses, orders and advisories issued under this Act;

(t) respecting the siting, construction, maintenance, decommissioning, sealing, abandonment and use of water from wells constructed for domestic purposes;

(u) respecting sources of water used in the production of pre-packaged water for consumptive purposes, including the approval of sources by the director and the monitoring of sources;

(v) respecting water used for bulk distribution for consumptive purposes;

(w) respecting the protection of drinking water sources, groundwater recharge zones and areas adjacent to drinking water sources;

(x) respecting fees payable for permits and operating licences applied for, issued, amended or renewed under this Act or the regulations;

(y) respecting the costs of bacteriological and other prescribed analyses, including cost-sharing programs;

(z) respecting costs that are payable by a person with respect to the monitoring of, or the review of a person's obligation to monitor, the quality of water in relation to water provided for domestic purposes;

(aa) respecting costs that are payable by a person in respect of the review of a report on an assessment conducted under section 9;

(bb) respecting the construction, alteration and operation of non-potable systems;

(cc) respecting vehicles and containers used as bulk water haulers;

(dd) defining any word or phrase used but not defined in this Act;

(ee) respecting any other matter the Lieutenant Governor in Council considers necessary or advisable to carry out the purposes of this Act.

Regulation may apply to all or part of province

39(2) A regulation, or any provision of a regulation, may apply to all or a part of the province only, and may apply specifically to one or more particular water systems.

40 to 42NOTE: These sections contained consequential amendments to other Acts that are now included in those Acts.

C.C.S.M. reference

43 This Act may be referred to as Chapter D101 of the *Continuing Consolidation of the Statutes of Manitoba*.

Coming into force

44 This Act comes into force on a day fixed by proclamation.

NOTE: S.M. 2002, c. 36, except sections 3, 7 to 10, 20 to 25 and 30, was proclaimed in force January 30, 2004.

Message

anne@cela.ca

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From: "Chaput, Eve (WSD)" <EChaput@gov.mb.ca>
To: "'Anne@CELA.Ca'" <Anne@CELA.Ca>
Date: 09 Dec 2004, 10:44:16 PM
Subject: Anne i was not clear the two regulations are not finalized yet at tached are websites

---

Drinking Water Safety Act: (Assented to August 9, 2002) is the latest version

---

Anne, I probably was not clear -
The Drinking Water Safety Regulation and
The Drinking Water Standards Regulation ?
Are Not finalized yet.

http://web2.gov.mb.ca/laws/statutes/ccsm/d101e.php
<http://web2.gov.mb.ca/laws/statutes/ccsm/d101e.php>
C.C.S.M.c. D101
(Assented to August 9, 2002)
This is the Drinking Water Safety Act - showing what is not proclaimed yet
Sections are noted at end of document :

Coming into force
44 This Act comes nito force on a day fiex by proclamation
Note: S.M. 2002, c. 36, except sections 3.7 to 10, 20 to 25 and 30, was
proclaimed in force January 30, 2004

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http://web2.gov.mb.ca/laws/statutes/2002/c03602e.php
<http://web2.gov.mb.ca/laws/statutes/2002/c03602e.php>
<<The Drinking Water Safety Act.url>>

Two regulations are currently being finalised for consultation:
The Drinking Water Safety Regulation and
The Drinking Water Standards Regulation

They will replace the following two regulations under the Public Health Act that are currently in force.

http://web2.gov.mb.ca/laws/regs/pdf/p210-330.88r.pdf
<http://web2.gov.mb.ca/laws/regs/pdf/p210-330.88r.pdf>

http://web2.gov.mb.ca/laws/regs/pdf/p210-331.88r.pdf
<http://web2.gov.mb.ca/laws/regs/pdf/p210-331.88r.pdf>

Attachment: The Drinking Water Safety Act.url (0.1K)

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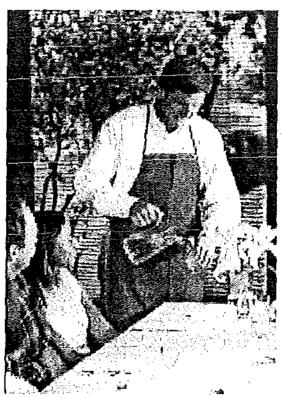

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For general inquiries please contact: (204) 945-5762

Office of Drinking Water
1007 Century Street
Winnipeg, Manitoba R3H 0W4
Facsimile: (204) 945-1365

Central Office of Drinking Water Staff:

Don Rocan, P.Eng.
Manager
DRocan@gov.mb.ca

- Responsibilities: management of the Office of Drinking Water, provincial representative on the Federal-Provincial-Territorial Committee on Drinking Water.

Eve Chaput
Administrative Assistant
EChaput@gov.mb.ca
Telephone: (204) 945-5762

Charles Conyette, P.Eng., M.PI.
Special Projects Engineer
Cconyette@gov.mb.ca
Telephone: (204) 945-5802

- Responsibilities: regulatory review of environmental assessment project proposals under The Environment Act, development of regulatory documents, special projects.

Morley Smith, MNRM
Supervisor, Field Operations
MSmith@gov.mb.ca
Telephone: (204) 945-7014

- Responsibilities: management of the field inspection and monitoring activities of the regional Drinking Water Officers, provision of technical assistance regarding the operation and monitoring of drinking water systems, water treatment plant inspections.

Scott Davies, C.E.T.
Drinking Water Officer
ScDavies@gov.mb.ca
Telephone: (204) 945-6279

- Responsibilities: provision of technical assistance regarding the operation and monitoring of drinking water systems, water treatment plant inspections, development of data management system, special projects.

Kim Barlishen, P.Eng.
Environmental Engineer
KBarlishen@gov.mb.ca
Telephone: (204) 945-5936

- Responsibilities: engineering reviews and regulatory approval of wastewater collection system, and water supply, water conveyance, water treatment and water distribution projects.

Mohammad Rahman, M.Sc.
Drinking Water Officer
MRahman@gov.mb.ca
Telephone: (204) 945-5949

- Responsibilities: engineering reviews, development of data management system.

Ed Chorniuk, B.Sc.
Echorniuk@gov.mb.ca
Telephone: (204) 945-8315

- Responsibilities: management of laboratory water testing contracts and water analysis data, provision of technical assistance regarding water

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About Us

The drinking water unit was established to enhance the existing program for the assessment of water infrastructure, and the monitoring of water plants and operators, and to provide assistance to water system owners and operators.

Our mandate is to:

- Coordinate the activities of the province's drinking water program.
- Provide guidance, technical expertise, information and education materials.
- Ensure water suppliers provide safe, adequate and aesthetically pleasing water.

The Office of Drinking Water carries out its mandate through a range of activities including:

- Inspection of water systems;
- Provision of technical advice regarding water system design, operation and monitoring;
- Review of project proposals, drawings and reports;
- Collection, management and interpretation of drinking water quality data;
- Development of technical guidelines, fact sheets and information bulletins;
- Delivery of presentations to municipal, professional and public groups;
- Participation in committees and organizations such as the Western Canada Section of the American Water Works Association, and the Federal-Provincial-Territorial Committee on Drinking Water.

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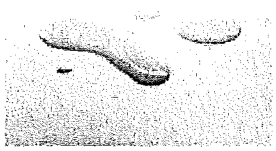
Office of Drinking Water



Water System Data

Drinking water systems in Manitoba are classified into three (3) categories for regulatory and monitoring purposes:

- Public water systems are those systems with 15 or more service connections, or those that have been designated as such.
- Semi-public water systems are those systems which are not public water systems or private water systems.
- Private systems are those which supply water to only one private residence, or those which have been designed as such.

There are approximately 400 public water systems in Manitoba, 45% of which rely on surface water as their source of supply, and 55% on groundwater. Approximately 80% of the population of Manitoba are serviced by public water systems. Surface water is the source of drinking water for 85% of public water system customers. The major population centers of the province rely on surface water sources. There are a growing number of regional water supply systems servicing rural areas. Semi-public water systems are currently being inventoried. An initial estimate is that there are approximately 1,500 semi-public and 35,000 private water systems in Manitoba.

Public water systems have been regulated under the Manitoba Public Health Act. Public water supplies are tested for bacteriological and chemical quality. Both public and semi-public water systems will be required to meet certain design, operational and monitoring requirements under the new Drinking Water Safety Act. A mandatory certification program has been established for operators of water and wastewater systems in Manitoba to ensure they have the training they need to operate these systems. The construction, operation and monitoring of private water systems remain the responsibility of the system owner. Regional Drinking Water Officers are available to provide technical assistance to water system owners and operators.

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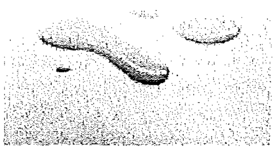

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Boil Water Advisories

Boil Water Advisories are issued for a water system or a water source by a Medical Officer of Health (Manitoba Health) due to a confirmed or suspected bacteriological quality problem. Affected residents and businesses are notified in the event an advisory is issued and provided with instructions on precautionary measures.

Fact sheets are available through the Manitoba Health web site which provide information on recommended actions when a Boil Water Advisory is issued

To obtain a copy of the current listing of Manitoba communities under a Boil Water Advisor, please contact:

Office of Drinking Water
1007 Century Street
Winnipeg, Manitoba R3H 0W4
Telephone: (204) 945-5762
Facsimile: (204) 945-1365

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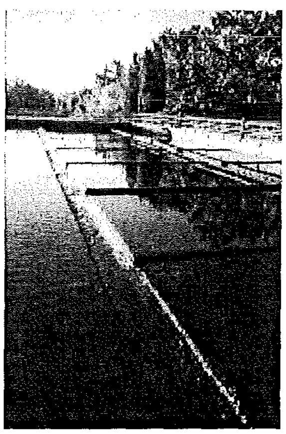

Acts & Regulations

The Drinking Water Safety Act received Royal Assent August 9, 2002 and was proclaimed January 30, 2004, with the exception of section 3, sections 7 through 10, sections 20 through 25, and section 30. Regulations are currently being drafted pursuant to the Act.

http://web2.gov.mb.ca/laws/statutes/2002/c03602e.php

Until the Drinking Water Safety Act is in force (supported by enforceable regulations), the Office of Drinking Water operates under the Public Health Act and its associated regulations related to drinking water and water protection:

http://web2.gov.mb.ca/laws/statutes/ccsm/p210e.php

The Public Health Act addresses a range of issues. The regulations directly related to water systems are as follows:

Protection of Water Sources Regulation (326/88R)

- Relates to the protection of surface water and groundwater resources from contamination.

http://web2.gov.mb.ca/laws/regs/pdf/p210-326.88r.pdf

Water Supplies Regulation (330/88R)

- Relates to water disinfection and monitoring.

http://web2.gov.mb.ca/laws/regs/pdf/p210-330.88r.pdf

Water Works, Sewerage, and Sewage Disposal Regulation (331/88R)

- Relates to the approval requirements for new construction or modifications to existing systems.

http://web2.gov.mb.ca/laws/regs/pdf/p210-331.88r.pdf

Other Pertinent Legislation

Manitoba Plumbing Code

http://web2.gov.mb.ca/laws/regs/pdf/b093-161.98.pdf

The Environment Act

http://web2.gov.mb.ca/laws/statutes/ccsm/e125e.php

Water and Wastewater Facility Operators Regulation (77/2003)

http://web2.gov.mb.ca/laws/regs/pdf/e125-077.03.pdf

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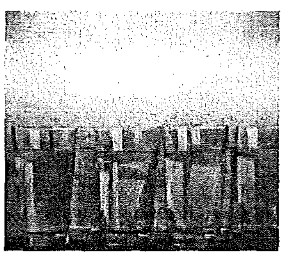

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Approvals Requirements

Approval requirements will change as the Drinking Water Safety Act is enforced. A permit will be required for the construction or alteration of a public or a semi-public water system, and a licence will be required for the operation of a public or semi-public water system.

Owners and operators of semi-public water systems are encouraged to contact this Office regarding water system construction or upgrading plans.

The Office of Drinking Water applies the Recommended Standards for Water Works (commonly known as The Ten State Standards) developed by the Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers fro water system design, AWWA standards, and best practices. Backflow prevention should be done in accordance with the WCS AWWA Cross Connection Control Manual or CSA B64.10-01 Manual for the Selection and Installation of Backflow Prevention Devices. We look for NSF certification for water chemicals and components. With respect to water quality goals, the Office of Drinking Water adopts Health Canada's Guidelines for Canadian Drinking Water Quality.

Permit for Construction/Alteration:

Section 7 of the Drinking Water Safety Act sets out the requirement for public and semi-public water systems to obtain a permit prior to the commencement of construction or alteration of a water system. The permit may contain terms or conditions for project implementation. Specific requirements for such submissions will be addressed in the forthcoming regulations.

Operating Licence:

Section 8 of the Drinking Water Safety Act sets out the requirements for public and semi-public water systems to obtain an operating licence in order to operate their water system. The operating licence may contain terms and conditions for system operation such as monitoring and reporting. Specific requirements for such submissions will be addressed in the forthcoming regulations.

During the transition period:

The Office of Drinking Water, on behalf of Manitoba Health, administers the portions of the Public Health Act related to the approval of new or altered wastewater (sewer) collection systems, and water supply, water conveyance, water treatment and water distribution systems.

Under the current regulatory system, the following information should be provided for review prior to the construction/alteration of a public water system:

- A set of stamped engineering design plans,
- A set of construction specifications, and
- A design brief which includes a project description, schedule and location

map.

Additional information is requested if required to complete the review. The focus of the review is on public health related concerns. If all public health concerns appear to have been addressed, a Certificate of Approval for construction and operation is issued for the proposed works.

Owners and operators of semi-public water systems are encouraged to submit system designs or alterations for review by this Office.

Review Criteria

The Office of Drinking Water applies the Recommended Standards for Water Works (commonly known as The Ten State Standards) developed by the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers for water system design, AWWA standards, and best practices. Backflow prevention should be done in accordance with the WCS AWWA Cross Connection Control Manual or CSA B64.10-01 Manual for the Selection and Installation of Backflow Prevention Devices. We look for NSF certification for water chemicals and treatment units. With respect to water quality goals, the Office of Drinking Water adopts Health Canada's Guidelines for Canadian Drinking Water Quality.

The Ten State Standards are available from Health Education Services:

http://www.hes.org/

AWWA Standards are available through the AWWA web site:

http://www.awwa.org/bookstore/Category.cfm?cat=ALLSTD

The NSF (National Sanitation Foundation) certifies drinking water chemicals and treatment units:

http://www.nsf.org/programs/

A summary of the Guidelines for Canadian Drinking Water Quality is available through Health Canada:

http://www.hc-sc.gc.ca/hecs-sesc/water/pdf/summary.pdf

Other Project Approval Requirements

In addition to Public Health Act or Drinking Water Safety Act approval, certain projects may require a licence pursuant to The Environment Act and the Classes of Development Regulation (164/88). The types of project that may be involved include sewage lagoons, wastewater treatment plants, water impoundments, and water treatment plants which will be discharging wastewater to a surface water system.

http://web2.gov.mb.ca/laws/regs/pdf/e125-164.88.pdf

The withdrawal of water from an aquifer through a groundwater well or from a surface water through an intake requires a Water Rights Licence pursuant to The Water Rights Act when water usage exceeds 25,000 L/day (5500 Imperial gallons/day).

The Water Branch - Water Licensing:

http://www.gov.mb.ca/conservation/watres/water_licensing.html

The Water Rights Act:

http://web2.gov.mb.ca/laws/statutes/ccsm/w080e.php

The Manitoba Workplace Safety and Health Division has guidelines and bulletins which address safe workplace issues including chemical storage and eyewash station design:

http://www.gov.mb.ca/labour/safety/publication/index.html

Manitoba Transportation & Government Services must be contacted for provincial road or highway pipe crossings. It may also be necessary to contact railways, and other utilities.

http://www.gov.mb.ca/tgs/regional.html

Federal guidelines are available regarding the design of fish screens on surface water intake structures:

http://www.dfo-mpo.gc.ca/Library/223669.pdf

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Manitoba

Drinking Water Quality Monitoring

All Public water supplies are tested for both bacterial and chemical quality. Manitoba Conservation personnel review all data to ensure compliance with the Guidelines for Canadian Drinking Water Quality and Provincial legislation.
Subsidized Bacterial Testing: On May 9, the Ministers of Health and Conservation announced that the Manitoba government would reinstate subsidized bacterial testing of private and semi-public drinking water systems on a yearly basis. Availability of this data will eventually permit the regulation of the many small systems providing drinking water to the public as well as the general 'health' of the water sources serving individual homes.
The ministers announced that the province would now cover 70 per cent of the cost of bacterial water testing for private and semi-public water supplies. The water-testing program for private and semi-public water systems is expected to be available to approximately 30,000 Manitoba homeowners and 1,500 semi-public water system owner/operators.

Groundwater Monitoring Activities: The Manitoba Rural Groundwater Quality Initiative was established under the Livestock Stewardship Initiative. A rural groundwater quality surveillance program was initiated in September 1999. This program is being conducted throughout agriculture regions of Manitoba to help gain a better understanding of rural ground water quality. Activities being performed as part of the program include private well sampling and the establishment of 32 sentinel (observation) wells.
The sentinel wells are in areas where substantial nitrate contamination was detected during the sampling program of the private, rural wells. Water quality sampling of sentinel wells is currently being conducted to determine quality of groundwater in aquifers located away from farmyard areas. Additional wells of this type will be constructed in various aquifers over the remainder of the program.
Initial sampling of approximately 1,000 private, rural wells was conducted throughout the agriculture regions of Manitoba. To date, approximately 800 wells have been sampled. Samples are being collected randomly, on a basis of one per 36 square mile township in the Eastern, Central, Red River, and Western regions of the province. Samples have been analyzed for routine water chemistry, nutrients and bacteria.

- Drinking Water Systems
  A list of facilities currently monitored in Manitoba is attached.

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Operation & Monitoring

Section 20 of the Drinking Water Safety Act refers to the requirement for disinfection and record keeping for public and semi-public drinking water systems. Section 21 of the Drinking Water Safety Act refers to the requirement for routine sampling and analysis for public and semi-public water systems. Section 25 of the Drinking Water Safety Act mandates that written operational records be made and retained. Specific requirements regarding sampling, monitoring and reporting will be addressed in the forthcoming regulations.

During the transition period:

Under the Public Health Act, chlorine residual and bacteriological monitoring is required for all public water systems. The responsibilities of water system owners/operators are explained in the following document:

- Guidelines for Public Water Systems: Chlorine Residual Testing and Reporting, and Bacteriological Water Sampling, Submission and Interpretation.

  Guidelines for Public Water Systems (2.1 Mb PDF)

Please contact your regional Drinking Water Officer if you have any questions regarding water system monitoring.

Semi-public water system owners/operators should discuss water system monitoring with their regional Drinking Water Officer, as these systems will be regulated under the Drinking Water Safety Act.

Inspections:

Officer of Drinking Water staff carry out periodic inspections of water systems to evaluate design, operational and monitoring issues, and provide advice regarding corrective measures. Sections 27 and 28 of the Drinking Water Safety Act refer to the entry and inspection powers for provincial personnel.

Drinking water standards for public and semi-public water systems will be set out in forthcoming regulations; additional system-specific standards may also be stipulated in an operating licence. The Office of Drinking Water adopts the Guidelines for Canadian Drinking Water Quality:

http://www.hc-sc.gc.ca/hecs-sesc/water/pdf/summary.pdf

Operator certification:

The Environmental Approvals Branch of Manitoba Conservation is responsible for management of the new water and wastewater facility operators certification program. The program involves education, examination and experience requirements. New regulations have been developed pursuant to The Environment Act.

Please visit their web site for further information:

http://www.gov.mb.ca/conservation/envapprovals/

Water and Wastewater Facility Operators Regulation (77/2003):

http://web2.gov.mb.ca/laws/regs/pdf/e125-077.03.pdf

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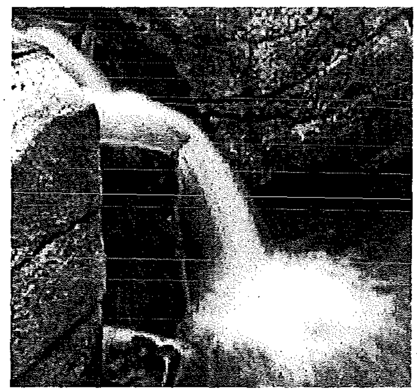


In 1989, the Government of Manitoba began a process to develop water policies and in 1990, it released the document entitled Applying Manitoba's Water Policies. These policies were used again for the review that led to the Manitoba Water Strategy 2003.

In April 2003, the Government of Manitoba released the Manitoba Water Strategy following a 2-year process led by a government-appointed Steering Committee and multi-stakeholder Advisory Committee. The process followed the release of the government-drafted October 2001 discussion paper entitled Water: *A Proposed Strategic Plan for Manitoba. The Manitoba Water Strategy 2004* can be viewed by visiting the Water Branch website. Further information is available through the Manitoba public registry system (File No. 4705.00).

View the April 21, 2003 Manitoba Government news release
View or download the Steering Committee report

Manitoba Wildlands has reviewed the documents in the lead-up to Manitoba's Water Strategy.
Download Summary Comparison: Manitoba Water Strategy Documents (DOC)
View Manitoba's Water Strategy

In June 1999, the Manitoba Government released the Report of the Consultation on Sustainable Development Implementation (COSDI). Among other recommendations, the report calls for integrated large are planning based on watershed boundaries. The Government of Manitoba formally endorsed this report and adopted its recommendations as government policy in July 2000.

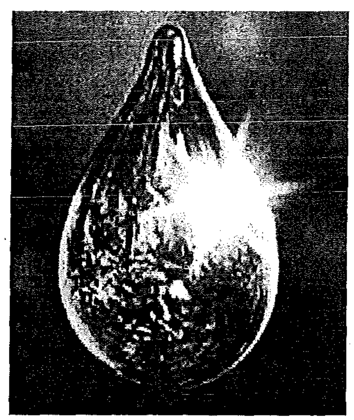
The Manitoba Department of Water Stewardship was created in November 2003 and comprised of water-related sub departments/branches from Manitoba Conservation such as the Water Branch, the Office of Drinking Water, and the Fisheries Branch. Water-related entities such as the Manitoba Water Services Board, The Winnipeg Floodway Authority, and the Lake Winnipeg Stewardship Board are also part of this department.

According to the Manitoba Government website, the Water Stewardship Department was created "to ensure that [Manitoba's] water resources are managed in a coordinated way that promotes sustainable economic development while protecting these vital resources for future generations."

View the November 4, 2003 Manitoba Government press release

In March 2004, the department released draft legislation for the proposed Water Protection Act. Please see 'Water Quality & Protection' (below) for more information.

Water Quality & Protection



On April 20, 2000, the Government of Manitoba released a draft discussion paper in a new process to revise the existing Manitoba Surface Water Quality Objectives. The process aims to develop Manitoba Water Quality Standards, Objectives, and Guidelines. Following a round of public comments, the government released a second draft on February 1, 2001. Following a second round of public comments, the government released a Final Draft on November 22, 2002 and initiated a third round of public comments. The process remains at the Final Draft stage. Copies of each draft including public comments at each round can be viewed at any of the public registry locations (File No. 4519.00).

View the November 22, 2002 Final Draft of the Manitoba Water Quality Standards, Objectives, and Guidelines

In April 2000, the Government of Manitoba began a process to develop a Nutrient Management Strategy. Further information can be viewed at any of the public registry locations (File No. 4518.00).

Download the Draft Nutrient Management Strategy 2002 (PDF 192KB)

In October 2000, the Government of Manitoba announced the start of a 3-year Assiniboine River Study. The study is ongoing. This is part of a decade long sequence of Assiniboine River Studies.

Download the Assiniboine River Study (PDF 352KB)

Water Protection Act

On March 4, 2004, Honourable Steve Ashton introduced Bill 22 The Water Protection Act to the Manitoba Legislature where the Bill had First Reading. The purpose of the legislation will be to provide improved protection for Manitoba's water resources and aquatic ecosystems.

It includes provisions;

- to allow establish and implement water quality standards, objectives and guidelines;
- to establish water quality management zones and to regulate activities within those zones;
- to prohibit and otherwise regulate harmful non-native species;
- to allow water conservation programs to be established;
- to require preparation of watershed management plans, for adoption in local development plans;
- to allow for declaration of a serious water shortage, and for the taking of action to address such shortages.

View Bill 22 The Water Protection Act

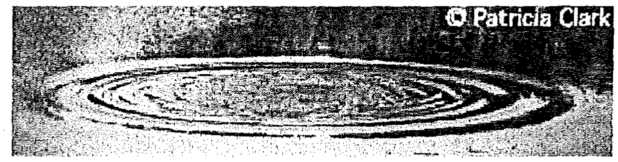
Second Reading of Bill 22 took place on June 2, 2004, and members of the Legislative Assembly voted to accept the principle of the Bill. Bill 22 is now in the Committee Review stage.

View the status of Bill 22 in the Manitoba Legislative Process

Presentations by members of the public to the legislative committee for review of Bill 22 took place September 13, 2004. A wide range of common concerns were expressed during citizen presentations to the legislative review committee. Clarity of definitions, intent, and coordination with exiting legislation concerning water were issues consistently raised in public submissions. The lack of funding, sufficient staff, and capacity for watershed planning, enabled by the Bill concerned several presenters.

View Manitoba Wildlands' presentation to the Bill 22 legislative review committee.
View Glen Koroluk's presentation, provided as a private citizen.

Clean Environment Commission (CEC)



In February 2002, the CEC releases its Report on Public Hearings for the Simplot Potato Processing Plant and the City of Portage la Prairie Water Pollution and Control Facility Alterations. Further information can be viewed at any of the public registry locations (File No. 4655.00).

Download the CEC Report on Simplot (PDF 404KB)

On Sept. 16, 2002 a valve broke at a Pollution Control Centre in the City of Winnipeg, resulting in 427 million cubic meters of untreated, unfiltered sewage (enough to fill 57 Olympic-size swimming pools) being dumped into the Red River. As a result of the spill, in late 2002 the Government of Manitoba convened Clean Environment Commission (CEC) hearings to examine the City of Winnipeg's Wastewater Treatment System. In the fall of 2003, the CEC released its report on the City of Winnipeg's Wastewater Collection and Treatment Systems Investigation. Further information is available through the public registry system (File No. 4864.00).

Environment Canada also investigated the spill and its effects, and in May of 2004 announced that it was charging the City of Winnipeg under the section of the Fisheries Act that protects fish-bearing waters from "the deposit of any substance that is deleterious to fish and aquatic life." The City of Winnipeg is pleading 'not guilty' to the charges, which carry a maximum penalty of $300,000. In October 2004, the court date was moved into November.

The total cost to the City of Winnipeg to upgrade wastewater treatment systems so that such spills will not occur in the future is estimated to be $750,000,000. Controversy exists regarding the ability of the city to carry this cost, when the upgrade to the wastewater treatment system will be done, and whether the Government of Manitoba will assist the City with the work. The CEC recommended that Winnipeg accelerate its intended capital works schedule.

View the CEC - Brandon Wastewater Treatment Plant/Maple Leaf Foods Inc. Plant Review
Download the Interim CEC Report on the City of Winnipeg Wastewater Treatment System (PDF 488KB)
Download the Final CEC Report on the City of Winnipeg Wastewater Treatment System (PDF 740KB)

Lake Winnipeg

In 1998, in response to increasing rates of Lake Winnipeg eutrophication, a number of Manitoba scientists established the Lake Winnipeg Research Consortium (LWRC). The purpose of the LWRC is to initiate and coordinate scientific research on Lake Winnipeg.

On February 18, 2003, the Government of Manitoba released the Lake Winnipeg Action Plan. The 6-point Action Plan included the establishment of the Lake Winnipeg Stewardship Board (LWSB) to identify further actions necessary to reduce nitrogen and phosphorous to pre-1970 levels in the lake, subject to further findings of the Nutrient Management Strategy. On July 18, 2003, the Government of Manitoba announced the appointment of Lake Winnipeg Stewardship Board members. The LWSB first met in August 2003 and meets monthly.

During summer and fall 2004 the LWSB is seeking comments regarding the eutrohpication of Lake Winnipeg, both causes and steps needed to reduce the nutrient load on the lake. Comments are due by December 2004 and a report to the Minister of Water Stewardship will be made by year's end. For information about providing public comments, follow the website like below.

Visit the LWSB website
View February 18, 2003 Manitoba Government news release

Manitoba Wildlands provided comments to the LWSB board in the first week of November 2004. The work products include: a formal letter of comments; an attachment that lists several recent public review and hearings reports concerning the Lake Winnipeg, and Red River basins; a summary of Dr. Patricia Chambers' presentation to Manitoba's Clean Environment Commission hearings regarding Simplot (Dr. Chambers is an aquatic expert with Canada's National Research Council); and a citizens' statement of expectations regarding water source protection in Ontario. Manitoba Wildlands recommended that the LWSB establish a set of principles for the future of Lake Winnipeg, and review all existing reports and recommendations regarding nutrient loading in order to endorse and recommend immediate action on those recommendations not acted on.

Download the Manitoba Wildlands Formal Comments
Download the Manitoba Wildlands Formal Comments Attachment of Reports & Review
Download the Summary of Dr. Chambers' presentation to CEC regarding Simplot
Download the Ontario Source Water Protection Statement of Expectations

Water Quantity & Use

In the winter of 1997, the Government of Manitoba initiated public consultations on drainage and issued a 1998 report entitled Land Drainage Review: Summary and Recommendations.

In December 1998, the Government of Manitoba initiated public consultations on water use and allocation and issued a January 2000 report entitled Water Use and Allocation: Summary and Conclusions.

Download the Water Use and Allocation: Summary and Conclusions Report (PDF 292KB)

In the year 2000, the Government of Manitoba enacted legislation banning bulk water removal from the province. View the Water Resources Conservation and Protection Act

On August 22, 2001, the Shoal Lake Watershed Working Group released a document entitled Shoal Lake Watershed Management Plan: Recommended Strategies & Actions for Maintaining Ecological Integrity & Environmental Quality, Sustaining Watershed Communities & Resources, and Guiding Future Development. Shoal Lake, located primarily in the traditional territories of a number of First Nations in Ontario, is the source of the City of Winnipeg's water supply.

Drinking Water

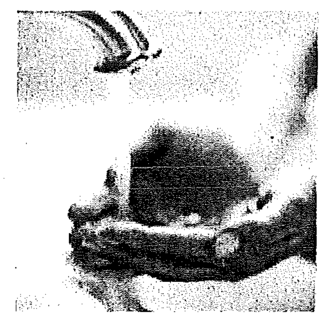
In 2002, the Government of Manitoba enacted the Drinking Water Safety Act and established the Office of Drinking Water. These measures followed the establishment of the Drinking Water Advisory Committee (June 2000) and a report recommending improvements in tracking and reporting to ensure the safety of Manitoba's drinking water supplies (November 2000).

View the Drinking Water Safety Act

Boil orders for drinking water are frequent in Manitoba. Spring run-off can affect wells. Inspection and reporting standards have been updated. Safe drinking water is often at risk for First Nation and Aboriginal communities in northern Manitoba. Often jurisdictional confusion between Indian and Northern Affairs Canada and Manitoba cause delays and risk to human health when water borne illness presents itself in these communities.

Trans-Boundary Initiatives

Top



Canada and the United States are signatory to several water treaties and agreements. Treaties and Conventions include the 1909 Boundary Waters Treaty, the 1925 Lake of the Woods Convention and Protocol, the 1940 Rainy Lake Convention, the 1950 Niagara River Water Diversion Treaty, the 1961 Columbia River Treaty and Protocol (1964), and the 1984 Skagit River Treaty.

Other Agreements include the St. Lawrence Seaway Project (1952), the Great Lakes Water Quality Agreement (1972, 1978, 1987), the Water Supply and Flood Control in the Souris River Basin (1989), and the Great Lakes Charter of 1985, which includes the Great Lakes Annex 2001.

Great Lakes Annex 2001

The Great Lakes Annex 2001 was developed to update the Great Lakes regional water management system and ensure the Great Lakes are protected, conserved, restored, and improved for future generations. The Great Lakes are the drinking water source for one third of Canadians. In July 2004, the draft implementing agreement for the Great Lakes Annex 2001 was released by the Great Lakes Governors and Premiers (Wisconsin, Ohio, Illinois, Michigan, Indiana, New York, Minnesota, Pennsylvania, Ontario, and Quebec). The draft implementing agreement is subject to a 90-day public hearings process on both sides of the border.

Controversy over the draft implementing agreement for the Great Lakes Annex 2001 exists; critics suggest that the agreement fails to restrict how much water can be withdrawn from the Great Lakes, and leaves the door open for long distance water removals and water exports. The draft agreement also does not distinguish between water uses inside the water basin and water uses outside the Great Lakes ecosystem. Other critics have labeled the draft Great Lakes Annex 2001 implementing agreement a complex water-taking permit program, as opposed to a resource-based conservation standard that would keep the water where it belongs: in the basin.

View Manitoba Wildlands August 18, 2004 news item: proposed Great Lakes Annex Implementation Agreements
View Manitoba Wildlands September 29, 2004 news item: proposed Great Lakes Annex Implementation Agreements
View the Council of Great Lakes Governors for the Great Lakes Water Management Initiative

View other analysis of the draft Great Lakes Annex 2001 Implementing Agreements:

View the Council of Canadians web page on the Great Lakes Annex
Download Report - Program on Water Issues, Munk Centre for International Studies, University of Toronto (PDF)
Download Report - The Canada Institute, Woodrow Wilson International Centre for Scholars (PDF)
Download Submission by the Sierra Club of Canada to the Ontario Ministry of Natural Resources (PDF)
View the Walter & Duncan Gordon Foundation - Water Issues

1909 Boundary Waters Treaty

The 1909 Boundary Waters Treaty serves as the basis for Canada/US trans-boundary water issues. This treaty gave rise to the creation of the Canada/US International Joint Commission (IJC). The IJC serves as an independent bi-national organization created to help resolve disputes relating to the use and quality of boundary waters. The IJC has created a number of bilateral boards for investigative, monitoring and surveillance functions. Manitoba-relevant Boards are:

- International Souris River Board (ISRB): The ISRB was established by the IJC to assist in preventing/resolving disputes relating to the trans-boundary waters of the Souris River basin. In creating the ISRB, the IJC combined the responsibilities of the International Souris River Board of Control and the Souris River aspects of the International Souris-Red Rivers Engineering Board.

- International Red River Board (IRRB): The IRRB was established by the IJC to assist in preventing/resolving disputes relating to the trans-boundary waters of the Red

River basin. In creating the IRRB, the IJC combined the responsibilities of the International Souris-Red Rivers Engineering Board and the International Red River Pollution Board.

- The IJC established the International Red River Basin Task Force to undertake an examination of flooding issues and provide recommendations to minimize further flood damages along the Red River. The Task Force released a final report in November 2000 entitled Living With the Red - A report to the Governments of Canada and the United States on Reducing Flood Impacts in the Red River Basin.
- In addition to IJC established bodies, the Red River Basin Commission was established in 2002 to address land and water issues in a basin-wide context. It formed as a result of a merger between The Red River Basin Board, The International Coalition, and the Red River Water Resources Council. Recent US/Manitoba flooding of the Red River, especially in 1997 showed the need for a joint commission.

Provincial Trans-Boundary Initiatives

In 1948, the governments of Saskatchewan, Alberta, Manitoba and Canada created the Prairie Provinces Water Board (PPWB). The PPWB recommends best use of water and water allocations between the provinces. In 1969, the four parties signed the Master Agreement on Apportionment (MAA). The MAA outlines a formula where Alberta and Saskatchewan are entitled to each take up to one half of the natural flow of water originating within its boundaries and one half of the flow entering the province (Manitoba is entitled to the balance). The PPWB has three permanent committees: Committee on Hydrology; Committee on Water Quality, pursuant to the Agreement on Water Quality signed in 1992 and attached to the MAA as Schedule E; and the Committee on Groundwater.

The Walter and Duncan Gordon Foundation makes the Manitoba Wildlands Water page possible.

Citation: Potable Water Regulation - Clean Water Act, N.B. Reg. 93-203
Version available as of 2004-11-04 (Last update on CanLII: 2004-11-04)
URL: http://www.canlii.org/nb/laws/regu/1993r.203/20041104/whole.html
Enabling Statute:Clean Water Act, S.N.B. 1989, c. C-6.1
Information about this text
Consolidation: December 31, 2000

NEW BRUNSWICK

REGULATION 93-203

under the

CLEAN WATER ACT

(O.C. 93-979)

Filed December 21, 1993

Under section 40 of the *Clean Water Act*, the Lieutenant-Governor in Council makes the following Regulation:

1

This Regulation may be cited as the *Potable Water Regulation - Clean Water Act*.

2

In this Regulation

"Act" means the *Clean Water Act*;

"Provincial Analytical Services" means the laboratory that is operated by the Department of the Environment and Local Government for the testing of water;

"regulated water supply system" means a water supply system that is owned or operated by a municipality or the Crown in right of the Province;

"sampling plan" means a plan for collecting and testing water in a regulated

water supply system;

"voucher" means a voucher issued under subsection 3(1).

2000, c.26, s.47; 2000-47

3

(1) The Minister shall issue to a person who bores, drills, digs or redrills a well a voucher that permits the owner of the well to have a sample of water from the well tested for the presence of inorganic substances and micro-organisms at the Provincial Analytical Services.

3

(2) Every person who bores, drills, digs or redrills a well shall, before commencing the work, give a voucher to the owner of the well for a fee of one hundred and thirty-two dollars which includes a fee of one hundred and ten dollars for testing a sample of water from the well for the presence of inorganic substances and micro-organisms at the Provincial Analytical Services.

3

(3) Every person who bores, drills, digs or redrills a well shall, on completion of the work, attach a well identifier tag that is provided by the Minister

(a)

to a portion of the well that is above the land surface, or

(b)

to any other portion of the well with the prior written approval of the Minister.

3

(4) Except with the prior written approval of the Minister, no person shall remove a well identifier tag referred to in subsection (3) that is attached to a well.

3

(5) A well identifier tag attached to a well under subsection (3) shall bear an identifier number that is the same as the identifier number on the water well driller's report for the well.

4

(1) Every person who bores, drills, digs or redrills a well shall, when giving a voucher to the owner of the well under subsection 3(2), sign and date the voucher.

4

(2) A voucher shall

(a)

be valid for a period of twelve months commencing on the date on which it is given to the owner of the well under subsection 3(2), and

(b)

have an identifier number that is the same as the identifier number on the water well driller's report for the well and the well identifier tag.

5

(1) The owner of a well to whom a voucher has been given under subsection 3(2) shall redeem it within twelve months after the date on which it is given by submitting

(a)

the voucher to an office of the Department of the Environment and Local Government or the Department of Health and Wellness, and

(b)

a sample of water from the well to the Provincial Analytical Services in accordance with the instructions provided by the Minister.

5

(2) If the owner of a well to whom a voucher has been given does not redeem it within twelve months after the date on which it is given, the Minister or the Minister of Health and Wellness may take a sample of water from the well and have it tested at the Provincial Analytical Services at the expense of the owner.

5

(3) The Provincial Analytical Services shall on completion of a test of a sample of water from a well referred to in subsection (1) or (2) notify the Minister of Health and Wellness of the results of the test.

5

(4) If a test of a sample of water from a well referred to in subsection (1) or (2) establishes that the water does not pose a significant health risk, the Minister of Health and Wellness shall send by ordinary mail a letter informing the owner of the well of the results of the test.

5

(5) If a test of a sample of water from a well referred to in subsection (1) or (2) establishes that the water poses a significant health risk, the Minister of Health and Wellness shall within three working days after receiving the results of the test send by prepaid registered mail a letter informing the owner of the well of the results.

2000, c.26, s.47

6

The results of a test of a sample of water from a well are confidential and shall not be disclosed by the Minister, the Minister of Health and Wellness or any person employed by the Department of the Environment and Local Government or the Department of Health and Wellness to a person other than the owner of the well unless

(a)

the person requesting the results has obtained the written consent of the owner, or

(b)

the disclosure is in an aggregate form and does not identify the individual well from which the sample was taken.

2000, c.26, s.47

7

(1) An owner of a regulated water supply system shall

(a)

have a sampling plan that is approved by the Minister of Health and Wellness, and

(b)

ensure that the water in the system is collected and tested in accordance with the sampling plan.

7

(2) If an owner of a regulated water supply system does not have an approved sampling plan, the Minister of Health and Wellness may make a sampling plan for the system.

2000, c.26, s.47; 2000-47

8

(1) A sampling plan shall be on a form provided by the Minister of Health and Wellness and shall include the following information:

(a)

the frequency with which the samples of water are to be collected from the regulated water supply system for the purpose of testing;

(b)

a list of the substances that the regulated water supply system is to be tested for;

(c)

a description of each location in the regulated water supply system where the samples of water are to be collected;

(d)

the name or title of the position of the person who is to collect the samples of water and a description of the relevant training of that person;

(e)

the name and address of the laboratory that is to perform the testing;

(f)

the date that the sampling of the water is to commence; and

(g)

any other information that that Minister considers necessary.

8

(2) An owner of a regulated water supply system may make written application to the Minister of Health and Wellness to amend the sampling plan that applies to that system.

8

(3) The Minister of Health and Wellness may approve or reject an application by an owner referred to in subsection (2).

8

(4) If the Minister of Health and Wellness approves an application to amend a sampling plan under subsection (3), the amendment shall take effect on the date of the approval.

8

(5) The Minister of Health and Wellness may amend a sampling plan without the consent of an owner of the regulated water supply system to which the plan applies if that Minister gives the owner written reasons for the amendment before making the amendment.

8

(6) If the Minister of Health and Wellness amends a sampling plan under subsection (5), the amendment shall take effect on the date that Minister makes the amendment.

8

(7) The Minister of Health and Wellness may on request by any person provide a copy of a sampling plan.

2000, c.26, s.47; 2000-47

9

(1) An owner of a regulated water supply system shall ensure that the water in the system is tested in accordance with the sampling plan that applies to that system at a laboratory that

(a)

is accredited by the Canadian Association of Environmental Analytical Laboratories,

(b)

is certified by the Canadian Association of Environmental Analytical Laboratories to perform the testing required of that system in its sampling plan, or

(c)

is acceptable to the Minister of Health and Wellness.

9

(2) If an owner of a regulated water supply system submits the water for testing at a laboratory other than the Provincial Analytical Services, the laboratory shall transmit the results from the tests to the Minister of Health and Wellness in a manner that is acceptable to that Minister.

9

(3) If an owner of a regulated water supply system does not have the water tested in accordance with subsection (1), the Minister or the Minister of Health and Wellness may take samples of water from the regulated water supply system in accordance with the sampling plan which applies to that system and have the samples tested at the Provincial Analytical Services at the expense of the owner.

2000, c.26, s.47; 2000-47

10

If a sample of water has been submitted for testing to the Provincial Analytical Services, the Province may test the sample for substances other than the

substances for which it was submitted for testing and shall bear the costs of the additional testing.

11 ***This Regulation comes into force on January 1, 1994.***

N.B.

This Regulation is consolidated to December 31, 2000.

Key DELG Land-related Web Addresses:
Environmental Impact Assessment: http://www.gnb.ca/0009/0377/0002/index-e.html
Land Use Planning: http://www.gnb.ca/0009/0136/0001/0010-e.html
Technical Guidelines: http://www.gnb.ca/0009/0009-e.asp
Waste-related Education Materials: http://www.gnb.ca/0009/0010-e.asp

Other Land-related Web Addresses:
Atlantic Risk-Based Corrective Action: http://www.atlanticrbca.com/eng/right.html
District Planning Commissions: http://www.gnb.ca/0009/0136/0001/0002-e.html
Environment Canada: http://www.ec.gc.ca/wastes_e.html
NB Department of Justice: Acts and Regulations: http://www.gnb.ca/0062/acts/acts-e.asp
NB Solid Waste Association: http://www.nbsolidwaste.com/

WATER

Department of the Environment and Local Government (DELG) Contacts:

Drinking Water Protection	Sustainable Planning Branch	Tel: (506) 453-2862
Municipal Water Treatment and Distribution	Stewardship Branch	Tel: (506) 453-7945
Regional Water Planning Officers	Regional Services Branch	Tel: (506) 453-2182
Water Classification	Sustainable Planning Branch	Tel: (506) 453-2862
Water Quantity (policy)	Policy and Planning Branch	Tel: (506) 457-7811
Water Quantity (science)	Sciences and Reporting Branch	Tel: (506) 457-4844
Water Testing	Analytical Services Branch	Tel: (506) 453-2477

Compliance and Enforcement:
Contact your nearest DELG Regional Office: Bathurst (506) 547-2092, Miramichi (506) 778-6032, Moncton (506) 856-2374, Saint John (506) 658-2558, Fredericton (506) 444-5149, Grand Falls (506) 473-7744.

Key NB Water-related Education Materials:
Educational Services Branch Tel: (506) 453-3700 / E-mail: Information-elg-egl@gnb.ca

- A Coastal Areas Protection Policy for NB
- Facts on Water
- Healthy Riparian Areas
- How to Chlorinate Your Well Water
- Hydrologic Cycle Poster
- A Guide to NB's Water Classification Regulation
- A Guide to NB's Watershed Protected Area Designation Order
- A Guide to NB's Wellfield Protected Area Designation Order
- Water Conservation
- An Overview of NB's Wellfield Protected Area Designation Order
- Your Well Water - A Safety Checklist

Key DELG Water-related Web Addresses:
NB Water-related Programs and Information: http://www.gnb.ca/0009/0003-e.asp
Water-related Education Materials: http://www.gnb.ca/0009/0010-e.asp
New Brunswick's Watershed Protection Program:
http://www.gnb.ca/0009/0371/0004/index.htm
New Brunswick's Wellfield Protection Program:
http://www.gnb.ca/0009/0371/0001/index.html
Well Construction and Well Water Testing: http://www.gnb.ca/0009/0373/0001/0009-e.html

Other Water-related Web Addresses:
Atlantic Canada Water Works Association: http://www.canfish.com/awwa/index.html
Environment Canada: http://www.ec.gc.ca/water_e.html
NB Department of Justice: Acts and Regulations: http://www.gnb.ca/0062/acts/acts-e.asp
NB Wetlands Conservation Policy: http://www.gnb.ca/0078/reports/wetlands/index-e.asp

New Nouveau Brunswick CANADA

News Release *Communications New Brunswick*

Environment and Local Government

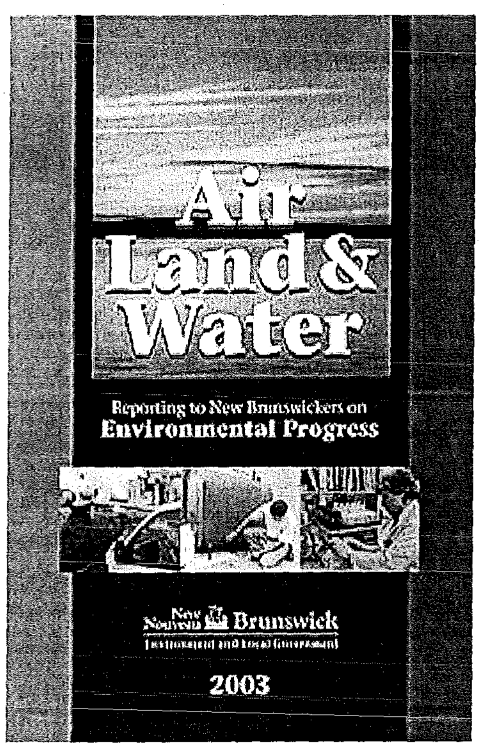
Province releases first Report on Environmental Progress (03/11/12)

NB 1048

Nov. 12, 2003

FREDERICTON (CNB) - New Brunswick's first Report on Environmental Progress, *Air, Land and Water - Reporting to New Brunswickers on Environmental Progress*, was released today by Environment and Local Government Minister Brenda Fowlie.

"I am pleased that government has taken the initiative to report on the environmental progress that has been accomplished over the last 30 years," Fowlie said. "This report will raise the level of awareness among New Brunswickers about the general environmental conditions in the province, and it will inform them of the efforts being taken on their behalf to protect and preserve our environment."



(Large image.) Windows Media Player *Video : (Original) (Translation) Audio : (Original) (Translation) - (more audio/video)*

The publication reports on air quality, land planning and management, and water quality. It summarizes a number of the monitoring and auditing activities conducted by staff of the department. It documents, for example, a decrease in various air emissions, a trend toward improved protection of large petroleum storage tanks, and the quality of municipal water supplies.

To measure the status of a particular aspect of the environment, the report uses environmental indicators, which are statistical measurements usually based on recognized standards and guidelines. These indicators present information about areas where progress has been made and where more effort may be needed.

"While this report shows there has been much progress, it also demonstrates that New Brunswick faces both existing and future environmental challenges," Fowlie said. "This report provides a measuring stick by which we can gauge our progress as we develop new tools to improve environmental management."

The report is intended to be produced every two years, and future reports may examine trends among the indicators presented this year, and/or expand to include additional subject areas. Feedback is welcome both in terms of content as well as how the information is presented. New Brunswickers are invited to fill out the comment form that is enclosed in each printed copy, or available as part of the web-based version of the report.

Copies of *Air, Land and Water - Reporting to New Brunswickers on Environmental Progress* are available at all Environment and Local Government offices as well as through the department's Educational Services Branch. An electronic version is also available online at: http://www.gnb.ca/0009/0369/0010/index-e.asp.

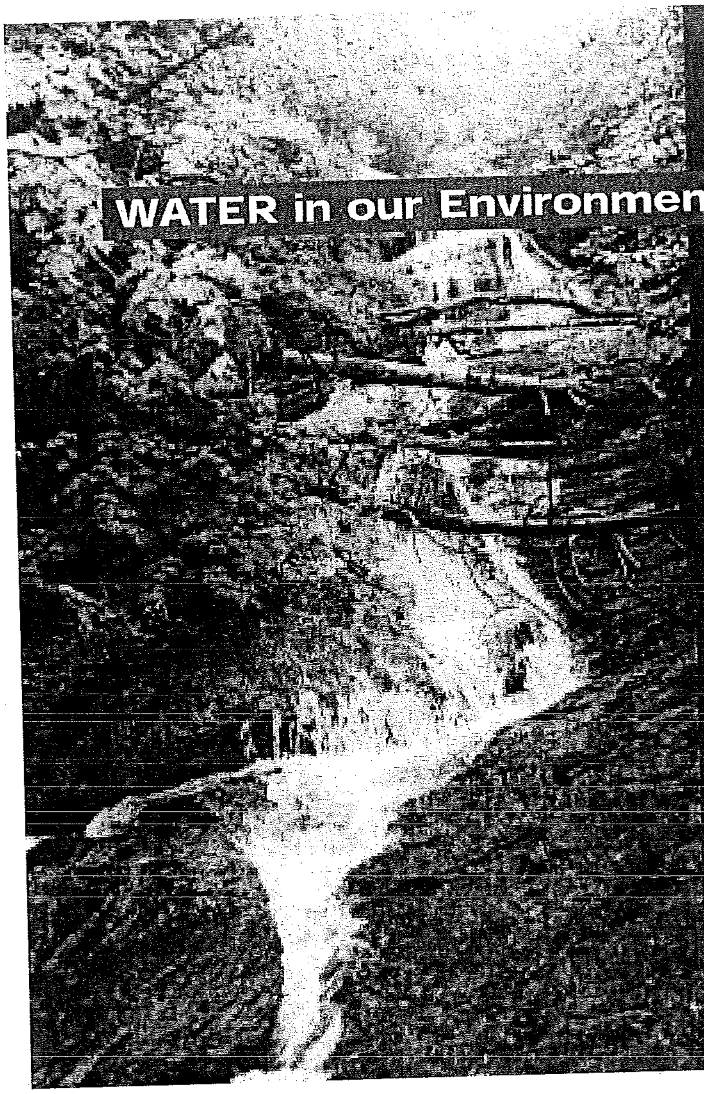
03/11/12

MEDIA CONTACT: Christelle Léger, communications, Environment and Local Government, 506-453-3700.

03/11/12

Editorial/Web Services
Communications New Brunswick
Fredericton, N.B. CANADA
e-mail: wwwcnb@gnb.ca

WATER in our Environment



Water is one of Earth's most precious resources and is as important to New Brunswickers as it is to people elsewhere.

A safe supply of drinking water is essential to our health, just as clean water sustains many other living things. For a broad variety of other uses, we also depend on a reliable supply of water in our households, institutions, businesses and industries. The recreational opportunities offered by our lakes and rivers are a traditional and valued part of the New Brunswick lifestyle as well as a significant benefit to tourism in the province.

We know water is important; so how do we protect it? From an environmental protection standpoint, water quality is determined by various chemical, biological and physical components. In order to understand these components it is important that we know how water behaves in the natural environment.

When precipitation falls to earth, a percentage of the water will evaporate back into the atmosphere. Some will be taken up by soil and vegetation and a further portion will flow overland as runoff into streams, lakes and rivers. This is called surface water. Some of the precipitation makes its way down through the earth to be stored underground, within layers of sand and gravel, or along rock fractures. It is from these underground waters, commonly referred to as "aquifers" that we pump out groundwater from drilled wells.

Drinking water supplies come from one of these two main sources - either bodies of surface water, or from wells fed by groundwater. Nearly 300,000 people in New Brunswick municipalities depend on water from a surface watershed area. Another 150,000 rely on a municipal wellfield fed by groundwater, while the remaining 300,000 New Brunswickers depend on privately-owned domestic groundwater wells.

While there is a variety of naturally-occurring elements or substances that can affect water quality, such as arsenic and bacteria, it is our own activities as humans that have the greatest impact on water quality. Many land use activities have the potential to contaminate our drinking water supplies and the water resources on which aquatic life depends.

If we are to benefit from and enjoy safe and reliable water supplies for generations to come, we will need to continue to focus on correcting past practices and in strategically addressing future activities to ensure minimal impact to the environment.

The following pages provide an overview of approaches to water protection and sustainability, as well as some key water-related findings that report on New Brunswick's progress to date.

Air Land & Water
New Brunswick

Approaches to Water Quality Protection - Water-related Legislation

The *Clean Water Act* and its various regulations provide a framework for water protection in New Brunswick. The Potable Water Regulation governs drinking water and sets requirements established jointly by the departments of the Environment and Local Government, and Health and Wellness. This Regulation requires regular testing of public water supplies, and testing by domestic well owners when new wells are constructed or an existing well is reconstructed. The Well Water Regulation, in turn, outlines procedures that must be followed by both those who drill wells, and by domestic well owners.

An approval is required under the Water Quality Regulation to discharge 'used' water or any substance into a body of water as part of an industrial process. Approvals are also issued for the construction and operation of water and wastewater facilities.

The Watershed and Wellfield Protected Areas Designation Orders identify the allowable activities in designated drinking water supply areas. The Water Classification Regulation is a mechanism for applying water quality goals to the province's lakes and rivers.

ENVIRONMENTAL INDICATORS - *DRINKING WATER*

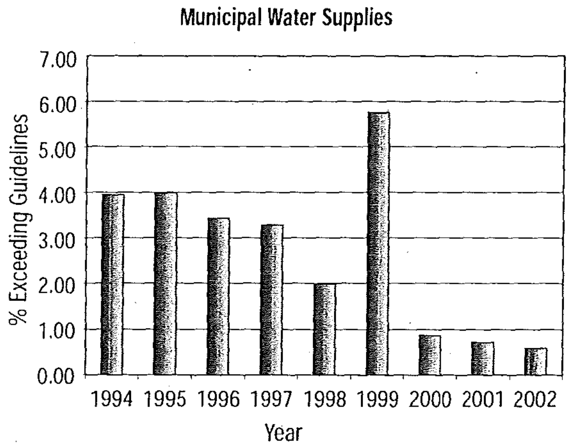
INDICATOR 1 - Percentage of Post-Treatment Tests for Municipal Water Supplies Exceeding Guidelines for Canadian Drinking Water Quality

Municipal drinking water in New Brunswick is tested before and after treatment, as required by the Potable Water Regulation under the *Clean Water Act.* Mandatory reporting of test results to the Department of Health and Wellness since 1994 has ensured that all test results are reviewed from a health and safety perspective.

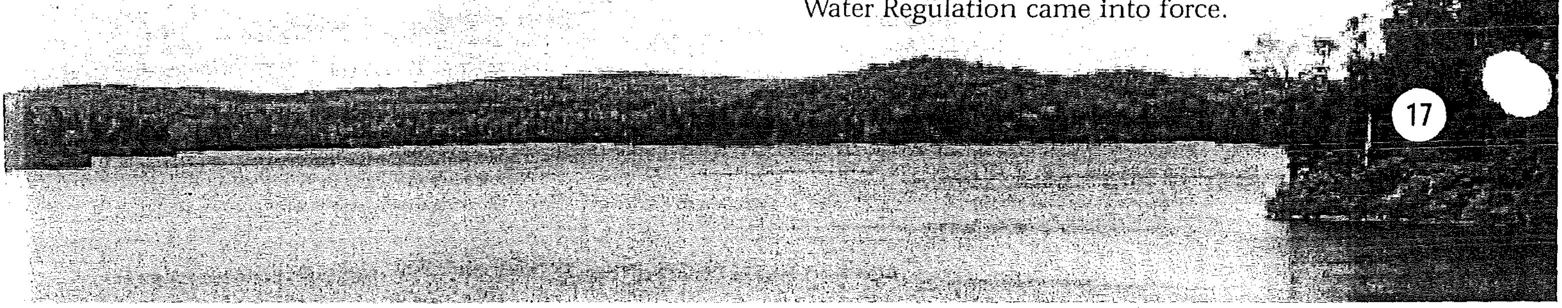
The Department of the Environment and Local Government laboratory tests approximately 60% of municipal water supplies in the Province. The remaining systems are tested by other laboratories. Of the tests analyzed by the department, the percentage of pre-treatment samples that exceed Canadian guidelines has ranged from 4 to 8% since 1994. The tests analyzed following water treatment, show a decrease in these exceedances to 1 to 4% with one exception. Higher numbers in 1999 were the result of intensive sampling in one municipality during an episode of poor water quality.

Most exceedances relate to manganese and pH that have 'aesthetic' guidelines, (appearance, smell etc.) rather than health guidelines.

The chart below shows the percentage of all at-the-tap post treatment exceedances from 1994-2002 of those tests analyzed by the Department. It does not reflect tests performed by other laboratories.



The percentage of samples exceeding key health-related guidelines (such as total coliforms and E. coli) has decreased significantly since 1994, when the Potable Water Regulation came into force.



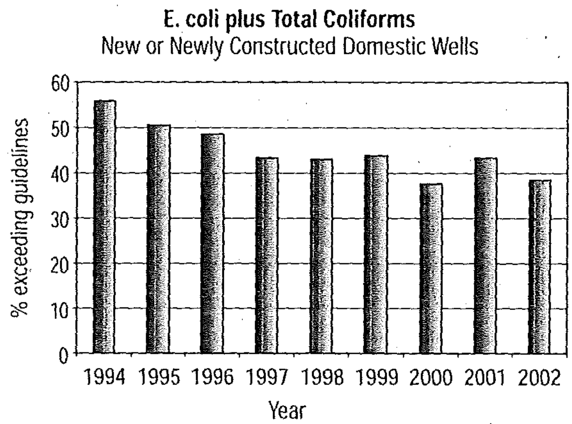
INDICATOR 2 - Percentage of New Private Wells Exceeding Guidelines for Canadian Drinking Water Quality for Total Coliforms or E. coli.

In New Brunswick, when we construct or reconstruct a private well, the Potable Water Regulation requires that we take a water sample for testing. The sample is analyzed for the presence of about 30 chemical substances, and bacteria (both total coliforms and E. coli).

The presence of total coliforms or E. coli bacteria indicates the possible presence of more harmful bacteria that may cause illness. When guidelines for total coliform and E. coli bacteria are exceeded, the Department of Health and Wellness advises homeowners on ways to remedy the situation.

Of the monitoring carried out by the Provincial Government, results show that in a given year, as much as 40 % of new or newly-constructed private wells are contaminated with total coliform bacteria, and an average of 3% with E. coli. These combined exceedances are illustrated on the chart (at right).

It is important to note that it is common for a new well to show contamination in its first test. Many of these and other instances of contamination are quickly corrected following disinfection using chlorine, and a second test generally shows improvement.



Testing shows similar percentages of exceedances among older wells. Reasons include well construction practices, proximity to bacterial sources (e.g. septic tanks), old or malfunctioning wells and distribution (piping) systems, as well as seasonal changes in groundwater levels.

Through educational efforts and advisory services, the department encourages proper well maintenance and regular testing by all private well owners.

Did You Know?

There are various guidelines used in protecting the Province's water:

- The guidelines for drinking water (from the tap) are published by Health Canada, under the title **"Guidelines for Canadian Drinking Water Quality"**.
- **Guidelines for surface waters are set under the Canadian Council of Ministers of the Environment.** There are separate guidelines according to use: recreational, aquatic life, and agricultural.
- The national guidelines for aquatic protection are called the **"Canadian Water Quality Guidelines for the Protection of Aquatic Life"**.

Approaches to Water Quality Protection - Water Quality Testing

The Provincial Laboratory, operated by the Department of the Environment and Local Government, tests samples from both drinking and non-drinking water sources. Where drinking water is concerned, the laboratory compiles water test results and transmits them to the Department of Health and Wellness, the agency with which it shares responsibility for overseeing the quality of New Brunswick's drinking water. All privately operated laboratories are also required to submit test results for public water supplies to the Department of Health and Wellness.

Approaches to Water Quality Protection - Surface Water Quality Monitoring

In New Brunswick, both drinking water and non-drinking water sources are monitored. Drinking water supplied by a surface water supply such as a lake within a drinking water watershed is monitored, as well as water at a specific location such as the intake of a municipal water system. This monitoring is carried out to determine if there have been changes in water quality and if so, why, as well as to aid the Province in determining when public health advisories should be issued.

The monitoring of non-drinking water is aimed at evaluating the ability of a body of water to support aquatic life. To monitor a water body or watershed as a whole, many samples may be taken over a period of time and at a number of locations. Monitoring is a fundamental aspect of water planning, assessing the general health of an ecosystem, and in recognizing and understanding long-term trends in water quality. In more immediate circumstances, it also indicates when protective steps may be required to address a problem.

ENVIRONMENTAL INDICATORS - *OTHER WATER RESOURCES*

INDICATOR 1 - Quality of Major River Systems as Measured by Annual Average Dissolved Oxygen, Nitrates, and pH

For many years, the Province has operated one primary monitoring station at strategic locations on major river systems* in New Brunswick. These stations measure key components of water quality, including dissolved oxygen, nitrates and pH.

Dissolved oxygen (D.O.), which natural waters obtain from the air and aquatic plants, is crucial to water-dwelling life and therefore an important indicator of water quality. To protect aquatic life, D.O. concentrations should be at least 5.5 milligrams per litre, and to protect critical stages of development in some species, at least 9.5 milligrams per litre.

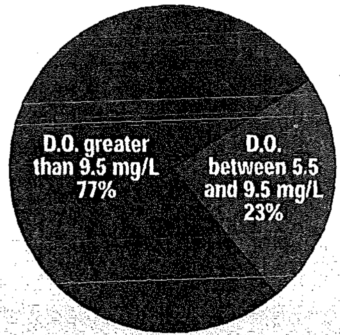
Nitrate is an important nutrient and can be a useful indicator in measuring human influences on a body of water. In New Brunswick, surface waters generally contain much less than 1 milligram of nitrate per litre, with 67% having values of less than 0.1 milligram per litre.

In common terms, pH is a measurement of acidity or alkalinity and is expressed using a scale of 0-14 pH units. In natural waters, the pH should be between 6.6 and 9.0 units in order to protect aquatic life. Note that pH values less than 6.5 are less desirable than higher values.

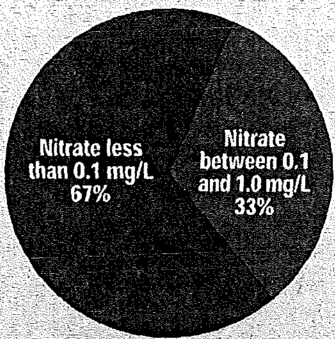
The chart opposite shows the levels of D.O., nitrates and pH from 1991-2000 in New Brunswick's major river systems. Over 90% of the tests for these components meet Canadian Water Quality Guidelines for the Protection of Aquatic Life.

* Major River Systems: Bouctouche, Kennebecasis, Lepreau, Magaguadavic, Nepisiguit, North Branch Oromocto, Northwest and Southwest Miramichi, Petitcodiac, Restigouche, Saint John (two sites), St. Croix, Tabusintac, Upsalquitch.

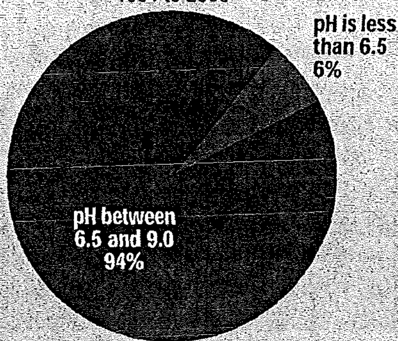
Dissolved Oxygen (D.O.)
1991 to 2000



Nitrate
1991 to 2000



pH
1991 to 2000



INDICATOR 2 - Proportion of Water Used by Major Sectors

New Brunswick's fresh water is used for many purposes, including drinking water, irrigation, and industrial processes. While it may seem that the province has an abundant supply of fresh water, there is ultimately a finite amount available for present and future use.

This, coupled with the relationship between water quantity and quality, makes tracking water usage important.

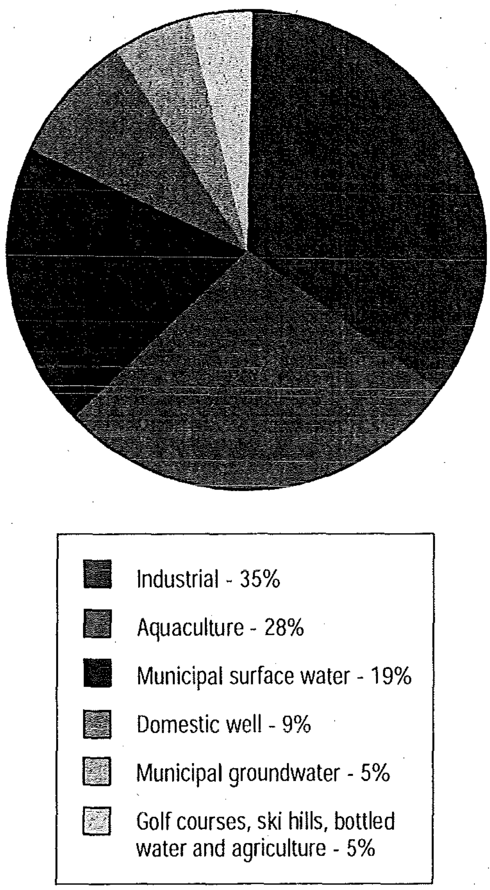
The Department of the Environment and Local Government requires many industrial operators to monitor the amounts of effluents being released from their facilities, which among other information, gives a sense of the amount of water being used given the high water content in effluent.

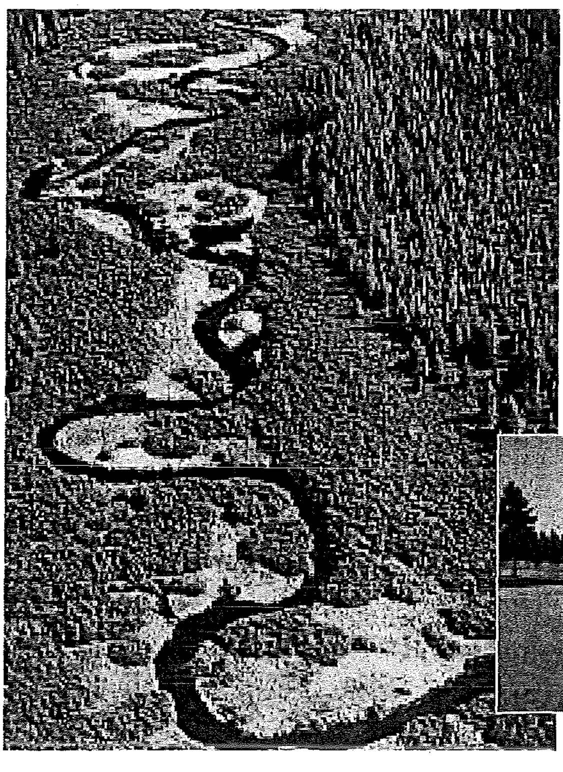
On a national level, New Brunswick has joined the Federal Government and a number of other provinces and territories in agreeing to prohibit the removal of bulk water from Canada's major drainage basins.

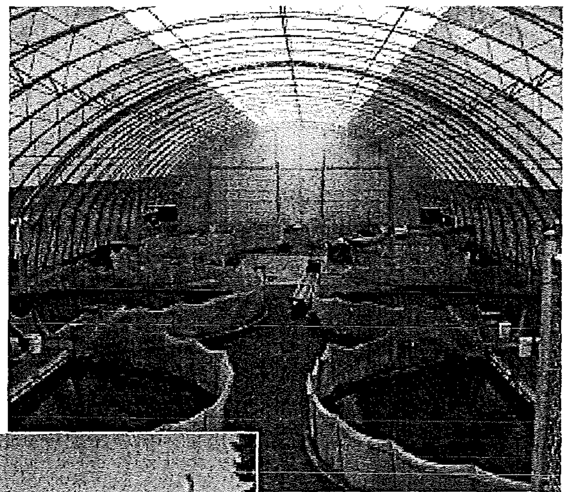
The Province has also begun work to initiate discussion on water quantity issues in New Brunswick.

The chart at right shows the proportion of water used by major sectors in 2001, by percentage, based on reported and other available data.

Water Use in New Brunswick







Approaches to Water Quality Protection - Compliance and Enforcement

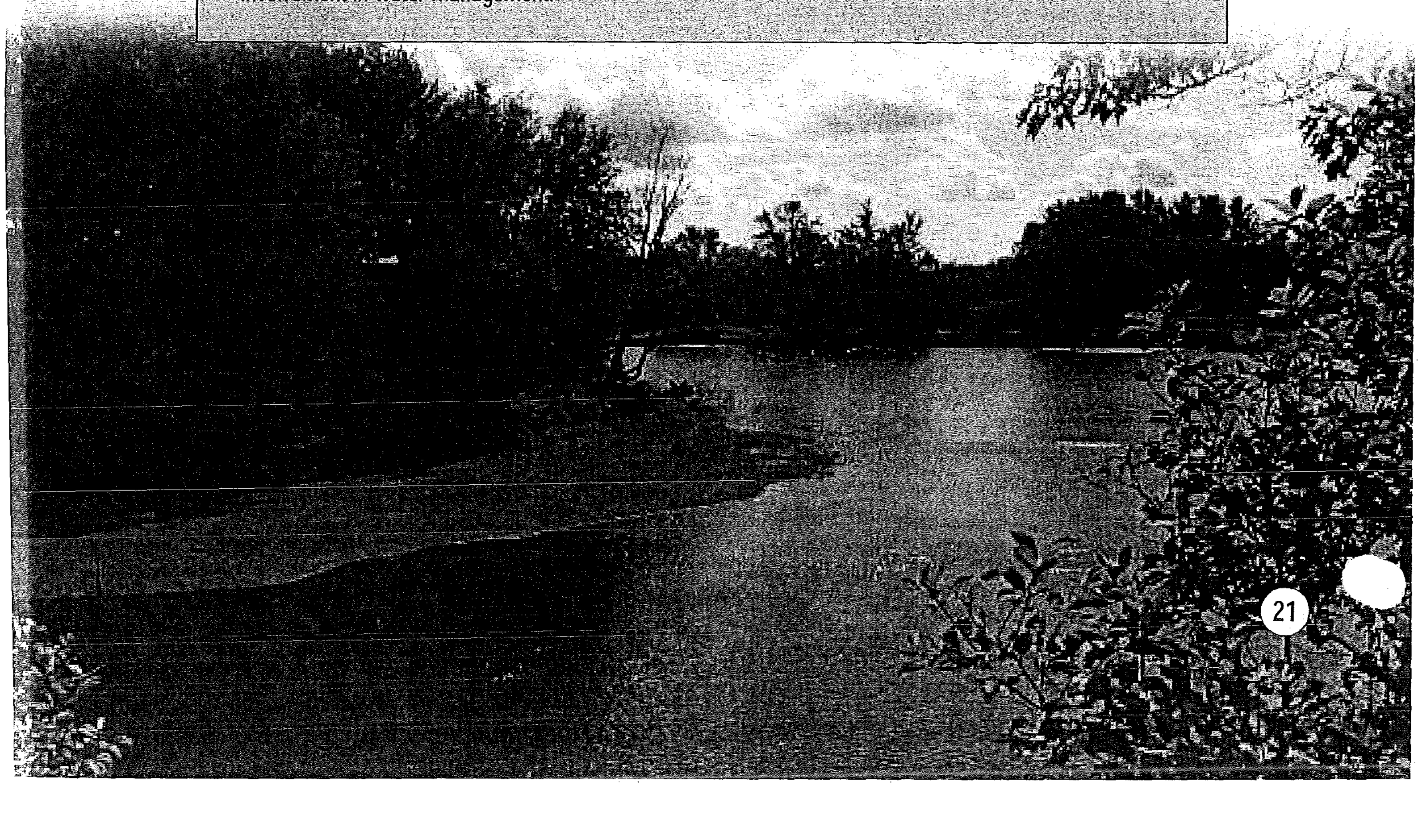
The Department of the Environment and Local Government's approach to issues of non-compliance tends to follow two distinct and complementary paths - direct response, and continuing response. If, for example, an activity taking place in a designated drinking water watershed were prohibited by the legislation, the Department's inspection staff would respond to determine the extent of the violation and to apply the appropriate remedy to bring the activity into compliance. The Department's water planning staff, in turn, develop opportunities to make users of that watershed aware of the restrictions on activities in the area both as a preventive measure, and as a follow-up to instances of non-compliance.

As a further means of achieving protection, the Department issues operating approvals for municipal water supply systems. In addition, a certification program has been established for those who are responsible for managing these municipal systems. By setting precise standards for operation in legislation, additional checks and balances have been added to the Department's compliance tool kit.

Approaches to Water Quality Protection - Public Education and Involvement

As with other environmental subjects, public awareness and understanding of the threats to both drinking water and other water resources are important aspects of effective management and protection. The Department has identified the owners of private wells and other drinking water supplies as key audiences for enhanced education activities. The Department has developed education materials, web pages, and information display programs specifically geared to well owners. This effort has been further enhanced by the addition of water planning staff in each of the department's six regions, whose responsibilities include community-based public awareness around water planning and protection.

Individuals and community-based groups have long been involved in the development of local water quality goals and the actions aimed at achieving them. For example, there are a number of active community watershed groups whose participation in provincial water classification and other environmental studies includes monitoring programs. This, coupled with interest from the business and industrial sectors, cottage owners' associations and environmental groups is encouraging greater local involvement in water management.



Your Well Water

A Safety Checklist

Many New Brunswickers depend on drilled, dug, or spring-fed domestic wells for drinking water, along with other household uses, and so it's important to know what you can do to ensure the safety of your well water supply...

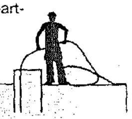
New Brunswick
Environment and Local Government

Maintaining Your Well

Wells are supplied by aquifers, or underground reserves, which are generally protected by the overlying soil. However, well water can be affected by improperly maintained or damaged well casings. That's why regular maintenance is so important.

The checklist:

- Periodically inspect parts of the well for problems such as:
  - cracked, corroded, or damaged well casings, pumps, or pipes
  - broken or missing well cap
- Slope the area around the well to drain surface runoff away from the well.
- Disinfect drinking water wells at least once per year, or after long periods of non-use with chlorine or bleach. (Instructional brochure available from the Department of the Environment and Local Government.)
- Have the well tested once a year for coliform bacteria. Tests for compounds such as nitrates, arsenic, and fluoride should be conducted at least every two years.
- Any new well construction, modification, or decommissioning of must be carried out by a licensed water well contractor.
- Avoid mixing or using pesticides, fertilizers, degreasers, fuels, and other pollutants near the well, and never dispose of hazardous materials in a septic system.
- Do not dispose of wastes in dry wells or in abandoned wells.
- Avoid housing pets near your well and keep the area free of pet waste.
- Do not cut off the well casing below the land surface, and if this has already occurred, have the casing extended to 30 cm above ground level.



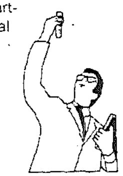
- Pump and inspect septic systems as often as recommended by the Department of Health and Wellness.

Testing Your Well Water

Well water should be tested for the presence of bacteria regularly and for chemical contamination if it is suspected. In addition to regular tests, well water should be tested immediately if there is any change in its clarity, colour, odour or taste, or if there has been a significant change or new development on the surrounding land. If at any time, you have any doubt as to the safety of your private water supply, you should have it tested as soon as possible. Through regular assessment and testing of drinking water, the safety of your well water can be verified.

The checklist:

- Sample your well water when the probability of contamination is greatest: early spring just after the thaw, after an extended dry spell, following heavy rains or after lengthy periods of non-use.
- Carefully follow all instructions for taking a sample and use an accredited or certified bacteria testing laboratory to have the sample analyzed.
- Seek advice for both testing and any corrective action from the Departments of Environment and Local Government, or Health and Wellness.



How To Collect a Well Water Sample for Bacteria Testing

The sampling kit provided by the Department of Environment and Local Government contains a small clear plastic bottle that holds approximately 100mL of water. There will also be information to fill out and submit with your sample. *Please note that sampling kits are also available for testing the presence of chemicals in well water.*

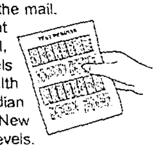
The Checklist:

- Read the sampling instructions carefully before taking a sample.
- Remove the tap screen or any other devices attached to the tap spout.
- Turn on the cold water tap in your kitchen or bathroom and run the water for at least 5 minutes to flush the lines. Be careful not to touch the faucet where the water is coming out.

- Reduce the flow of water to about 500mL (2 cups) per minute. (If needed, use a measuring cup to help determine the rate of flow.)
- The clear plastic bottle is sterile when you receive it. To avoid contaminating the bottle and your sample, do not touch the mouth of the bottle or inside of the cap. The bottle also contains a preservative to help maintain the sample, so do not rinse the bottle out before filling it.
- Fill the bottle directly from, but not touching the faucet to just above the 100mL mark, and place the cap securely on the bottle.
- Keep the sample cool and return it to the same place you received your kit within 24 hours of when you took the sample.
- Fill out the forms to be submitted with your sample, including your full name, address and your Property Identification Number (PID) which is on your property tax form, or you can call Service New Brunswick at 1-888-762-8600 to find out your PID.

The Results of Your Well Water Test for Bacteria

Well water samples analyzed at the Provincial Laboratory are tested for two primary sources of bacteria: total coliforms which occur naturally in soil and in the intestines of humans and animals, and Escherichia coli, or E. coli which are found only in the intestines of humans and animals. The results of your well water test will be sent to you in the mail. This information tells you what the results were for your well, and what the acceptable levels are for bacteria, under Health Canada's Guidelines for Canadian Drinking Water Quality and New Brunswick's Health Advisory Levels.



To ensure a safe and enjoyable water supply, it is important to learn about the steps you can take to prevent contamination, assess your water quality, and act when there are problems. We're here to help, so please contact us if you have any questions, or require additional information.

The Sustainable Planning Branch
Department of the Environment & Local Government
Tel: 457-4846
Fax: 457-7823
E-mail: well-puits@gnb.ca

Or contact
Your Regional Public Health Office

Ground Water Supply Sources

FACTS ON WATER. . .

WELL CONSTRUCTION AND WELL WATER TESTING

BACKGROUND:

Thousands of New Brunswick families, living in smaller towns and rural areas, rely on individual wells for drinking water.

These wells, in turn, depend on natural groundwater reserves or "aquifers". The quality of the water they produce is always influenced by naturally occurring minerals beneath the ground surface. As well, a variety of man made substances and other aspects of our modern lifestyle can affect the quality of well water.

WELL CONSTRUCTION PLANNING:

It is important to plan the location of the well to reduce the risk of influence from other site features such as roads and septic systems. The New Brunswick "Water Well Regulation" specifies well location set back distances from structures, and potential contaminant sources. These are shown in Table 1.

TABLE 1

SOURCE	REQUIRED SETBACK DISTANCE DUG WELL	REQUIRED SETBACK DISTANCE DRILLED WELL
Building	2 m	2 m
Road	10 m	10 m
Cesspool	30 m	30 m
Leaching Field	30 m	25 m
Septic Tank	30 m	15 m
Sewer Line	3 m	3 m

WELL DRILLING REQUIREMENTS:

The New Brunswick "Clean Water Act" requires that all new well construction, deepening of existing wells, and well abandonment must be carried out by a licensed New Brunswick Water Well Contractor and licensed well driller.

A well driller or a well drilling company is not responsible for guaranteeing well water quality or quantity to the homeowner. They must however, comply with the minimum well construction and location requirements as specified in the "Water Well Regulation" under the "Clean Water Act". The driller is also required to provide a detailed Water Well Driller's Report to the homeowner and the Department of the Environment and Local Government once the well is complete. It is strongly recommended by the Department, and the New Brunswick Groundwater Association, that the homeowner sign a formal legal agreement with the contractor chosen, so both parties understand the process prior to work commencing.

WATER QUALITY TEST:

Mandatory testing for water quality of all newly drilled or redrilled wells in NB was introduced under the "Potable Water Regulation " in September of 1994.

WHAT IS INVOLVED WITH A WATER TEST:

The standard tests required under the "Potable Water Regulation" analyse the water for both inorganic and bacteriological substances. "Inorganic" testing examines a variety of components such as: hardness, alkalinity, calcium, chloride, copper, fluoride, iron, potassium, magnesium, manganese, sodium, nitrite, lead, sulphate, antimony, arsenic, boron and zinc. Bacteriological testing looks for the presence of total coliform and faecal coliform, which are substances typically associated with decaying natural organic matter or discharges from sewage disposal systems.

HOW DOES THE TEST GET DONE:

- The basic well water test costs $122.00 +HST, and the cheque is to be made payable to the Minister of Finance. Prior to well construction, the well contractor will collect the fee from the well owner; and in exchange will provide a Well Water Testing Voucher.
- The contractor will attach a sequentially numbered permanent identification tag to the completed well. This well tag number is also recorded on the testing voucher along with the NB GIS property Identification number.
- Well owners can obtain sampling kits from local Department of Health, Environment or Services NB offices.
- When the well construction and plumbing is completed and the well has experienced some normal usage, the well owner is responsible to collect the samples. This sampling is mandatory, and must be done within 12 months of the well construction. The samples and the voucher are then returned to the office where the bottles were picked up.
- The samples are then forwarded to Department of the Environment and Local Government Analytical Services Laboratory for analysis.
- The results of the analysis are interpreted by Department of Health and Community Services and returned to the well owner by mail.

- The Department of the Environment and Local Government maintains a province wide groundwater data base, containing records of the well water quality information along with the "Water Well Drillers Report".
- Making sure well water is safe for human consumption is a top priority. The objective of the "Water Well Regulation" and the "Potable Water Regulation" is to prevent drinking water problems in New Brunswick as well as to protect the water resource.

FURTHER INFORMATION:

Additional information and assistance can be obtained by contacting NBDOELG Environmental Quality Staff:

Fredericton Phone: 457 - 4844 Fax: 457 - 2265	Michelle Paul-Elias Sustainable Planning Branch (20 McGloin St., E3A 5T8) P. O. Box 6000 Fredericton, NB, E3B 5H1

OR:

A Department of the Environment and Local Government Regional Office in your area:

BATHURST Office:547-2092 Fax: 547-7655	Regional Services & Enforcement Br. 159 Main St., Suite 202 Bathurst, N. B. E2A 1A6
FREDERICTON Office:444-5149 Fax: 453-2893	Regional Services & Enforcement Br. 565 Priestman Street, Suite 103 Priestman Centre Fredericton, N. B., E3B 5X8
MIRAMICHI Office:778-6032 Fax: 778-6796	Regional Services & Enforcement Br. 316 Dalton Avenue Miramichi, N.B. E1V 3N9
MONCTON Office: 856-2374 Fax: 856-2370	Regional Services & Enforcement Br. 428 Collishaw Street Moncton, N.B. E1C 3C7

SAINT JOHN
Office: 658-2558
Fax: 658-3046

Regional Services & Enforcement Br.
8 Castle Street
Saint John, N. B. E2L 3B8

GRAND FALLS
Office: 473-7744
Fax: 475-2510

Regional Services & Enforcement Br.
65 Broadway Blvd.
Grand Falls, N. B. E3Z 2J6

Regional Boundaries of the New Brunswick Department of Environment and Local Government

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FRANÇAIS BACK

Drinking Water Quality Data

The Department of Environment in partnership with municipal governments monitors source and tap water quality of public water supplies on a regular basis. The collected data is used to ensure compliance with the "Guidelines for Canadian Drinking Water Quality" and to take appropriate measures to address emerging drinking water quality issues. The data is provided to the public on a regular basis through this web page.

The data below is for all sampling carried out up to June 30, 2004.

These documents are in Adobe PDF format and, if you have an older browser, may require the free Adobe Acrobat Reader to view and print. Click on the hyperlinks below to download each document for viewing and printing.

Due to the large number of parameters included these documents are best printed on legal (8.5" x 14") paper in landscape orientation.

Detection Limit
The detection limit is the lowest concentration of a substance that can be determined with confidence. Prior to March 31, 2004 analytical results less than the detection limit were reported as half of the detection limit. After March 31, 2004 analytical results less than the detection limit are reported as zero. If you wish to know the detection limit of a particular parameter, please click here to see an Adobe PDF document which lists the various labs, associated parameters and detection limits that have been used during this sampling program. The Department is working to develop better tools to deal with less than detection limit data for statistical analysis and public reporting.

Source Water Quality

All source water data from the Spring 2004 Sampling Season only

- Physical Parameters and Major Ions (pdf)
- Nutrients and Metals (pdf)
- List of all samples showing which parameters exceeded the "Guidelines for Canadian Drinking Water Quality"

All source water data from the Winter 2004 Sampling Season only

- Physical Parameters and Major Ions (pdf)
- Nutrients and Metals (pdf)
- List of all samples showing which parameters exceeded the "Guidelines for Canadian Drinking Water Quality"

All source water data from the Fall 2003 Sampling Season only

- Physical Parameters and Major Ions (pdf)

- Nutrients and Metals (pdf)
- List of all samples showing which parameters exceeded the "Guidelines for Canadian Drinking Water Quality"

All source water data from the Summer 2003 Sampling Season only

- Physical Parameters and Major Ions (pdf)
- Nutrients and Metals (pdf)
- List of all samples showing which parameters exceeded the "Guidelines for Canadian Drinking Water Quality"

Tap Water Quality

All tap water data from the Spring 2004 Sampling Season only

- Physical Parameters and Major Ions (pdf)
- Nutrients and Metals (pdf)
- List of all samples showing which parameters exceeded the "Guidelines for Canadian Drinking Water Quality"

All tap water data from the Winter 2004 Sampling Season only

- Physical Parameters and Major Ions (pdf)
- Nutrients and Metals (pdf)
- List of all samples showing which parameters exceeded the "Guidelines for Canadian Drinking Water Quality"

All tap water data from the Fall 2003 Sampling Season only

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- List of all samples showing which parameters exceeded the "Guidelines for

Canadian Drinking Water Quality"

For additional information on drinking water quality or any other water resources related topics please contact us.

Return to Water Resources Home Page

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what stds

Department of Environment & Conservation
Water Resources Management Division

Tap Water Quality for Public Water Supplies
Nutrients and Metals

Serviced Area(s)	Source Name	Sample Date	Ammonia	DOC	Nitrate(ite)	Kjeldahl Nitrogen	Total Phosphorus	Aluminum	Antimony	Arsenic	Barium	Cadmium	Chromium	Copper	Iron	Lead	Magnesium
		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Guidelines for Canadian Drinking Water Quality				10				0.006	0.025	1.0	0.005	0.05	1.0	0.3	0.01	
	Aesthetic (A) Parameter or Contaminant (C)				C				C	C	C	C	C	A	A	C	
Admirals Beach																	
Admiral's Beach	2 Well Fields	Aug 19, 2004	LTD	LTD	LTD	0.080	0.060	LTD	LTD	0.004	0.050	LTD	0.00200	0.041	LTD	LTD	8.000
Badger																	
Badger	Well Field, 2 wells on standby	Aug 23, 2004	0.060	LTD	0.130	0.140	0.020	LTD	LTD	LTD	LTD	LTD	LTD	0.225	0.030	LTD	LTD
Baine Harbour																	
Baine Harbour	Dug	Aug 23, 2004	0.050	LTD	0.230	0.150	0.060	0.020	LTD	LTD	LTD	LTD	LTD	0.005	LTD	LTD	2.000
Barachois Brook																	
Barachois Brook	Drilled, one well on stand by	Sep 06, 2004	0.070	LTD	LTD	0.160	0.080	LTD	LTD	0.003	LTD	LTD	0.00100	0.001	0.020	LTD	3.000
Bay St. George South																	
Heatherton	#1 Well Heatherton	Sep 07, 2004	0.070	2.5	LTD	0.120	0.050	LTD	LTD	0.001	0.010	LTD	0.00100	0.001	0.520	LTD	16.000
Highlands	#2 Well Highlands	Sep 07, 2004	0.160	LTD	LTD	0.270	0.040	LTD	LTD	LTD	0.020	LTD	0.00200	0.002	0.020	LTD	19.000
Highlands	Pumphrey Well Highlands	Sep 07, 2004	0.050	LTD	LTD	0.130	0.110	LTD	LTD	LTD	0.110	LTD	0.00300	0.001	0.060	LTD	15.000
Jeffrey's	#1 Well Jeffery's	Sep 07, 2004	0.190	LTD	LTD	0.350	0.070	LTD	LTD	0.003	0.040	LTD	0.00100	LTD	0.010	LTD	15.000
Jeffrey's	#2 Well Jeffery's	Sep 07, 2004	0.110	5.6	LTD	0.190	0.050	LTD	LTD	LTD	0.170	LTD	0.00100	LTD	0.010	LTD	9.000
Lock Leven	#6 Well Loch Leven	Sep 07, 2004	0.030	LTD	0.220	LTD	0.070	LTD	LTD	LTD	0.170	LTD	0.00300	LTD	0.010	LTD	17.000
McKay's	#7 Well McKay's	Sep 07, 2004	0.140	2.5	LTD	0.230	0.080	LTD	LTD	0.006	0.090	LTD	0.00100	LTD	0.260	LTD	17.000
McKay's	Lions Club Well	Sep 07, 2004	0.130	0.9	LTD	0.180	0.060	LTD	LTD	0.001	0.050	LTD	0.00200	LTD	0.210	LTD	19.000
Robinson's	#1 Well Robinson's	Sep 07, 2004	0.030	1.8	LTD	0.150	0.090	LTD	LTD	0.009	0.300	LTD	0.00100	0.006	0.160	LTD	10.000
St. David's	#9 Well St. David's	Sep 07, 2004	0.130	3.6	LTD	0.180	0.060	LTD	LTD	0.002	0.190	LTD	0.00200	LTD	1.060	LTD	6.000
St. Fintan's	#1 Well St. Fintan's	Sep 07, 2004	LTD	0.6	LTD	LTD	0.080	LTD	LTD	0.003	0.140	LTD	0.00100	0.006	0.060	LTD	13.000
St. Fintan's	#2 Well St. Fintan's	Sep 07, 2004	0.090	LTD	0.940	0.200	0.080	LTD	LTD	LTD	0.140	LTD	0.00300	0.001	LTD	LTD	16.000
Bishop's Falls																	
Bishop's Falls	Northern Arm Lake	Aug 31, 2004	0.190	2.5	LTD	0.230	LTD	0.050	LTD	LTD	LTD	LTD	LTD	0.045	0.040	LTD	LTD
Black Duck																	

Manganese	Mercury	Nickel	Selenium	Uranium	Zinc
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
0.05	0.001		0.01	0.02	5.0
A	C		C	C	A
LTD	LTD	LTD	LTD	LTD	LTD
0.030	LTD	LTD	LTD	LTD	LTD
LTD	LTD	LTD	LTD	LTD	LTD
LTD	LTD	LTD	LTD	LTD	LTD
0.290	LTD	LTD	LTD	0.0020	LTD
0.020	LTD	LTD	LTD	LTD	LTD
0.250	LTD	LTD	LTD	LTD	LTD
0.050	LTD	LTD	LTD	0.0020	LTD
0.020	LTD	LTD	LTD	LTD	LTD
LTD	LTD	LTD	LTD	LTD	LTD
0.070	LTD	LTD	LTD	0.0010	LTD
0.030	LTD	LTD	LTD	LTD	LTD
0.030	LTD	LTD	LTD	LTD	LTD
0.520	LTD	LTD	LTD	LTD	LTD
0.010	LTD	LTD	LTD	LTD	LTD
LTD	LTD	LTD	LTD	LTD	LTD
LTD	LTD	LTD	LTD	LTD	LTD

Section 4 Drinking Water Quality Monitoring and Reporting

Monitoring water quality at the source, within a treatment plant, and in the distribution system, is an important requirement to assess the effectiveness of the multi-barrier approach, as well as to ensure the safety of drinking water. However, it should be noted that monitoring is of little value if the multi-barrier approach is not in place.

Currently, the routine monitoring of drinking water quality in this province is a joint responsibility between the Department of Environment and the Department of Government Services and Lands. The Department of Environment is responsible for chemical monitoring of source and tap water quality while the Department of Government Services and Lands is responsible for microbiological monitoring of tap water quality.

It should be noted that Newfoundland and Labrador is one of two provinces in Canada which has assumed the responsibility for drinking water quality monitoring and reporting of data to the public. In the eight remaining provinces, this responsibility has been assigned to the municipal governments. In those provinces, the municipal governments are responsible for drinking water quality monitoring and reporting of the data to the provincial regulatory agency (Ministry / Department of Environment).

4.1 Sampling Location and Frequency

There are no provincial legislative requirements relating to sampling frequency. The provincial drinking water quality monitoring program is based on the sampling frequency for microbiological and chemical monitoring as outlined in the Guidelines for Canadian Drinking Water Quality (GCDWQ). Based on site-specific issues and problems, appropriate modifications are made to the recommended sampling frequency.

4.1.1 Chemical and Physical Parameters

Samples for physical and chemical analysis are generally taken from the source water (lake, pond, river, reservoir, well or spring) and from the distribution system. The distribution system samples are taken at a point significantly beyond the point at which treated water enters the distribution system. Additional sampling locations may be identified if profiling or benchmarking data is required for any of the parameters. All sampling is done using grab samples. Tap water samples are generally collected after running the tap water for five minutes. Chemical sampling is generally carried out for inorganic parameters, trihalomethanes (THMs) and haloacetic acids (HAAs). Organic sampling for both source and tap water is carried out if there are any known sources of organic contamination or

concern in a given area. Plant operators may be required to sample for operational parameters (aluminum, pH, fluoride, colour, residual chlorine and turbidity).

Samples are generally collected semi-annually with the exception of Trihalomethanes (THMs) and Haloacetic Acid (HAA) samples which are collected on a seasonal basis. If there are any known or emerging site-specific water quality issues, sampling frequency for inorganic parameters is also changed from semi-annually to seasonal. The main emphasis of the sampling is on tap water quality, as the Guidelines for Canadian Drinking Water Quality are developed for tap water quality. However, source water quality is also monitored on a selective basis in order to assess the impact of land use activities, effectiveness of buffer zones and other environmental controls, THM pre-cursor levels, and comparison between source and tap water quality.

The monitoring program is limited to public water supplies only and currently there is no legislative requirement for the monitoring of institutional, commercial and private supplies.

There are no provincial standards for chemical and physical parameters. The province uses the chemical and physical guidelines as specified in the *Guidelines for Canadian Drinking Water Quality*, 6th Edition, 1996, or as revised, as provincial objectives. The guidelines note that the maximum acceptable concentration (MAC) can be achieved by available water treatment methods at reasonable cost and it must also be reliably measurable by available analytical methods. If it is determined that water quality criteria are exceeded, priority should be given to meeting the guideline objectives taking into account costs, the degree of exceedence and local factors. A summary of the Guidelines for Canadian Drinking Water Quality is included in **Appendix 4.1**.

Recommended Quality Assurance and Quality Control (QA and QC) protocols are followed throughout the sampling period.

4.1.2 Microbiological Parameters

The details of microbiological monitoring of drinking water quality are included in Section 4.3.

In addition to the information presented in Section 4.3 the Department of Environment's Guidelines for the Design, Construction and Operation of Water and Sewage Systems also require the following to ensure the microbiological safety of drinking water:

1. All public water supply systems must be continuously disinfected.

Appendix 1.1

Water Supply Systems

Legislation and Policy Guidelines

TITLE	DESCRIPTION	DATE
Memorandum of Understanding: Dept. of Health & Community Services, Health & Community Services Boards, Health Labrador Corporation, Grenfell Regional Health Services and the Dept. of Government Services and Lands	Clarifies the responsibilities of the Government Service Centre in relation to the inspection / investigation programs that the GSC carries out under the authority of Health and Community Services legislation. For example, the bacteriological analysis of public water supplies. The MOU also requires the use of the International Association for Food Protection publication **Procedures to Investigate Waterborne Illness**, 2nd Edition, 1996 for the investigation of illnesses alleged to be waterborne related.	July 16 1999
Temporary Facilities Policy	Temporary facilities must have a satisfactory source of water.	April, 1994
Standards of Accepted Practice for the Location, Design and Construction of Private Sewage Disposal Systems	GSC/Health document that provides the information stated in the title plus setback distances for sewage systems from water supplies and water-bodies and information on dug well construction.	1996

Policy Guidelines for Land and Water Related Developments in Protected Water Supply Areas	Prohibits (e.g., discharging of sewage) or regulates (e.g., residential development)various activities in protected water supply areas.	
Memorandum of Understanding Between the Dept. of Environment and the GSC, Dept. of Government Services & Lands	One of the specific duties described in the MOU is for the Government Service Centre to review plans, specifications and reports for water and sewer systems for commercial facilities, construction camps, issue Certificates of Approval as appropriate and to monitor those facilities.	1998

Department of Municipal and Provincial Affairs

TITLE	DESCRIPTION	DATE
	LEGISLATION	
Municipalities Act	The *Municipalities Act* gives municipalities(councils) the authority to construct, acquire, establish, own and operate public water supply systems, subject to the *Environment Act* and *Regulations* under the *Act*. The *Municipalities Act* gives municipalities the authority to alter or divert water courses for the purpose of improving the watercourse or the water supply, subject to the *Environment Act* and *Regulations* under the *Act*. Under the Municipalities Act a person in a municipality shall not make or use a new water supply or system except in accordance with the written permission from the council. Council shall not give permission without the written approval of the Department of Health and Community Services and the Department of Environment & Labour	1999
Department of Municipal Affairs Act	This *Act* gives the Department of Municipal and Provincial Affairs the right to construct, operate or take over a water supply system.	

Standards for Chemical and Physical Monitoring of Drinking Water

Objective:

To help ensure that consumers of water provided by a public drinking water supply have clean and safe drinking water. Chemical and physical guidelines as specified in the *Guidelines for Canadian Drinking Water* Quality 6th Edition, 1996, as revised, shall be considered as objectives which are applicable to the Province of Newfoundland and Labrador. The *Guidelines* note that the maximum acceptable concentration (MAC) can be achieved by available water treatment methods at reasonable cost and it must also be reliably measurable by available analytical methods. If it is determined that water quality criteria are exceeded, priority should be given to meeting the *Guideline* objectives taking into account costs, the degree of excedence and local factors.

Standards - Chemical and Physical Parameters:

The following standards for routine chemical and physical water quality monitoring are applicable in the Province of Newfoundland and Labrador. The minimum parameters to be monitored are shown in the table below. This table does not include all parameters in the *Guidelines* rather only those included in standard chemical analysis and metal scan packages. Some parameters are without MAC but are required for normal operational evaluation. The collected samples are to be analysed by accredited laboratories. If there is reason to suspect the presence of certain substances in a water supply system, additional parameters may be added as required by the Department of Environment.

N.B.

Alkalinity

Chemical Parameters	
Aluminum ✓	Iron
Ammonia ✓	Lead
Antimony ✓	Magnesium
Arsenic ✓	Nitrate
Barium ✓	Potassium
Boron ✓	Selenium
Cadmium ✓	Sodium
Calcium ✓	Sulphate
Chloride ✓	Total Organic Carbon/DOC

Chromium	Trihalomethanes
Copper	Uranium
Fluoride	Zinc
Hardness	
Physical Parameters	
Colour	Total Dissolved Solids
Conductivity	Turbidity
pH	

Standards - Sampling Location and Frequency

Samples for chemical and physical parameters shall be taken from the source water (lake, pond, river, reservoir, well or spring) and from the distribution system. The distribution system samples shall be taken at a point significantly beyond the point at which treated water enters the distribution system. Additional sampling locations may be identified if profiling/bench marking data is required for any of the parameters. All sampling shall be done by taking grab samples.

Samples are to be collected semi-annually with the exception of trihalomethane samples which are to be collected for each season of the year. Plant operators may be required to sample for operational parameters (aluminum, pH, fluoride, colour, residual chlorine, temperature and turbidity) on a weekly or bi-weekly basis.

It is essential that results of chemical and physical monitoring are provided to the operator of the water supply system and that the operator make those results available to the consumers. Where results show that the water exceeds the MAC or any aesthetic objectives, the water supply owner / operator shall develop an action plan in consultation with appropriate authorities for addressing non-compliance issues.

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Surface Water

Safety of Drinking Water in Newfoundland and Labrador
Questions and Answers

How do the various levels of government in Newfoundland and Labrador ensure the safety of drinking water?

Both provincial and municipal governments have some level of responsibility in ensuring the safety of Newfoundland and Labrador's drinking water. The provincial government, in cooperation with municipal governments protects source water quality through the watershed protection program. Under a partnership program with municipal governments, the provincial government monitors drinking water quality on a regular basis in order to ensure compliance with the "*Guidelines for Canadian Drinking Water Quality*" and to deal with emerging issues on a pro-active basis. The Department of Environment provide the drinking water quality data along with a brief interpretation to municipal governments on a regular basis. The Department is an active member of the Federal-Provincial Subcommittee on Drinking Water (DWS) which is responsible for the development of the *Guidelines for Canadian Drinking Water Quality.*

How can I obtain a copy of the current Canadian drinking water quality guidelines?

Contact the Department of Environment or check Health Canada's web site http://www.hc-sc.gc.ca/waterquality for a summary table of the current guidelines. Information on the development of these Guidelines can also be found on Health Canada's web site.

What are chlorination disinfection by-products and how are they formed?

Chlorination disinfection by-products (CDBPs) are chemical compounds that form when water containing natural organic matter (the decay products of living things such as leaves, human and animal wastes, etc.) is chlorinated. Chlorine disinfection of water can lead to the formation of a number of chlorination by-products of which trihalomethanes (THMs) are only one subgroup. Among the many chlorination by-products, THMs are most often present and in the greatest concentration in drinking water and as such are used as indicators of total disinfection by-product formation.

Why is drinking water chlorinated?

Chlorination is necessary for two reasons. First, almost all sources of surface water contain microbiological organisms, which have to be removed in order to prevent the outbreak of waterborne diseases such as typhoid fever and cholera. Second, once the treated water leaves the treatment plant, it may travel through water mains and pipes sometimes at significant distances, before it reaches it's destination. During this time, it is necessary to maintain a residual level of disinfectant in the water to ensure no possible regrowth of microorganisms. Without adequate disinfection, the health risks from microorganisms far outweigh the risks from THMs.

What is the current Canadian drinking water guideline for THMs?

The current Canadian drinking water quality guideline for THMs is 100 parts per billion (ppb) or micrograms per litre (m g/l). The guideline is based on an annual running average of quarterly samples to account for seasonal variations. THM levels are generally highest in the summer and lowest in the winter.

What are the health effects associated with THMs?

The Federal-Provincial Subcommittee on Drinking Water established the current guideline for THMs in 1993. The guideline is based on the risk of cancer reported in animal studies of chloroform, the THM most often present and in greatest concentration in drinking water. Since then, new epidemiological (human) studies had been published which reported associations between THMs and bladder and colon cancer, and adverse pregnancy outcomes including miscarriage, birth defects and low birth weight. In response to these new findings Health Canada, in its role as Secretariat to the DWS, established a multi-stakeholder task group in 1998 to oversee a comprehensive update of health risk information on THMs and to develop recommendations for controlling the risks.

Which public water supplies have the highest/lowest levels of THMs?

Levels of THMs are generally highest in treated water from sources with high organic matter content, such as rivers and lakes. Lower levels of THMs are usually found when the source water is groundwater.

THM levels can vary within single water supply depending on the season, water temperatures, amount of natural organic matter in water, pH, amount of chlorine added, point of chlorination, time in distribution system, and other factors such as treatment processes used.

What are the alternate disinfectants?

Alternate disinfectants include chloramine, chlorine dioxide and ozone. Each of these alternate disinfectants have their own advantages and disadvantages regarding handling and storage, disinfection by-product formation and cost. The use of chlorine is, however, essential to maintain the required residual in the water distribution system in order to ensure microbiologically safe water.

What is being done to reduce the levels of THMs in municipal drinking water in Newfoundland and Labrador?

The government of Newfoundland and Labrador in consultation with municipal governments has developed a three-phase approach to deal with this issue. The first phase is data collection through THM surveys, the second phase deals with data assessment and identification of remediation methods and the third phase will be the implementation of mitigation measures where necessary. It must be emphasized that any changes made to water treatment practices must not

compromise the effectiveness of disinfection.

The government of Newfoundland and Labrador is also actively participating, with its provincial colleagues of the DWS in the *Chlorinated Disinfection By-Products Task Group* that is overseeing a coordinated effort to estimate the health risks from THMs and to develop risk management recommendations.

Should I stop drinking my tap water?

Tap water provided by municipal governments is generally safe and regularly monitored by the provincial government for physical, chemical and bacteriological quality. You do not need to stop drinking tap water unless you are have been advised to do so by the provincial or municipal governments.

Are there risks from CDBPs through showering, bathing or swimming?

While showering, bathing or swimming in chlorinated water may result in significant exposure to CDBPs through breathing in vapors and absorption through the skin, the health risks of prolonged exposure to CDBPs from these sources are currently unknown. Research is in progress to better understand the contribution of inhalation and skin absorption from showering in overall exposure to CDBPs.

How can I reduce exposure to THMs?

Consumers wishing to reduce their exposure to chlorination disinfection by-products can use a filter containing activated carbon certified to the NSF Standard 53 for THM removal. If a filter device is used it should be properly maintained because such devices can become sources of bacterial contamination in water. Although blending and boiling water will remove volatile (meaning easily evaporated) CDBPs such as THMs, they do not eliminate or necessarily reduce the health risks of other CDBPs that may not evaporate easily. As such, blending and boiling of water are not recommended by Health Canada as methods for reducing chlorination disinfection by-products.

Health Canada laboratories are currently testing a range of carbon filters and other treatment methods to see if they are able to remove most CDBPs. The results will be made public within a year.

How can I obtain information about my drinking water quality?

Contact your Town Council office or call the Department of Environment at:

- (709) 729-2563 (Eastern)
- (709) 292-4285 (Central)
- (709) 637-2367 (Western and Labrador)

June 8, 2000

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Water Res St Johns 709-729-2563

Environment and Conservation Government of Newfoundland & Labrador

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Standards for Bacteriological Quality of Drinking Water

Objective:

To reduce the risk of enteric illnesses that may be attributed to public water supplies, the following standards are applicable in the Province of Newfoundland and Labrador. If any of the criteria are exceeded, corrective action should be taken in the affected area immediately.

Standards - Bacteriological:

Bacteriological standards are based on *Guidelines for Canadian Drinking Water Quality* 6th Edition, 1996 as revised, and shall be considered generally applicable to the Province of Newfoundland and Labrador. The *Guideline* notes that the maximum acceptable concentration (MAC) for the bacteriological quality of public, semi-public and private drinking water systems is no coliforms detectable per 100 mL. However, because coliforms are not uniformly distributed in water and are subject to considerable variation in public health significance, drinking water that fulfils the following conditions is considered to conform to this MAC:

1. No sample should contain *Escherichia coli (E.coli)*.
2. No consecutive samples from the same site or no more than 10% of the samples from each distribution system in a given sample set should show the presence of total coliforms.

Standards - Sampling:

The number of bacteriological samples to be taken is based on the following:

No distribution system or very small system serving less than 100 people	1 sample per month
Distribution systems serving:	
Less than 5,000 population	4 samples per month
5,000 to 90,000	1 sample per 1,000 population per month
more than 90,000	90 plus one sample per additional 10,000 population per month

Standards - Disinfection:

Continuous disinfection is required for community and public facility water systems. Chlorine is the most common chemical used for disinfection, and where used:

1. All water entering the distribution system or public facility, after a minimum 20 minute contact time, shall contain a residual disinfectant concentration of free chlorine of at least 0.3 mg/L, or equivalent CT value;
2. A detectable free chlorine residual must be maintained in all areas in the distribution system.

Water systems which are primarily disinfected by means **other than chlorination**, must be provided with a sufficient residual disinfectant as determined to be appropriate for that system.

Rev: April 9, 2002

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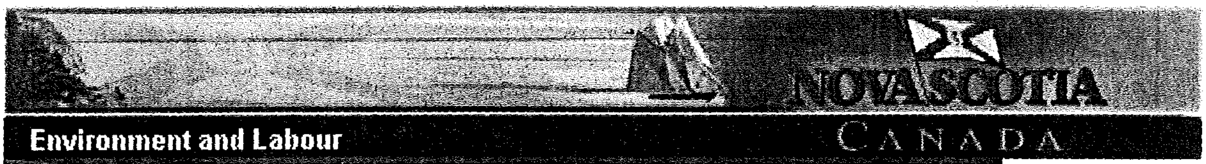

Water and Wastewater

Overview of the New Public Drinking Water Supply Program

Background

The Public Drinking Water Supply Program has recently gone through significant changes which clearly define and outline specific liabilities, roles, and responsibilities of the public drinking water supply owners and the Province.

Historically, this program was delivered by the Department of Health under the *Health Act* and carried out by Nova Scotia Environment and Labour. Municipal water sampling for bacteria and chlorine residual were completed by Health Inspectors on a weekly basis. Samples were submitted to local hospital labs for results.

A pilot project for the new "Municipal Water Supply Program" was successfully developed and implemented in Annapolis County on April 1, 1997. Municipal water utility operators collected bacteria samples on a weekly basis and tested chlorine residuals on a daily basis. The operators' thorough knowledge of the water distribution system resulted in an immediate response to potential problems and a significant reduction in "boil advisories". Nova Scotia Environment and Labour carried out an auditing role throughout this pilot project.

This pilot demonstrated that drinking water protection is a shared responsibility involving owner, municipal, and provincial governments. The pilot was adopted by Nova Scotia Environment and Labour and instituted province-wide on April 1, 1998. The Department then expanded the program to include all public drinking water supplies with the development of *Guidelines for Monitoring Public Drinking Water Supplies.* The guidelines were then incorporated into regulation through amendments to the *Water and Wastewater Facility Regulations.*

CHANGES OCCURRING

The amended Water and Wastewater Facility Regulations and the accompanying Guidelines for Monitoring Public Drinking Water Supplies both came into effect on October 1, 2000. The regulations include "what" needs to be done, and the guidelines include "how" to comply with the regulations.

Beginning October 1, 2000, Nova Scotia public drinking water supply owners are required to begin registering their water supply under a process structured and monitored by Nova Scotia Environment and Labour.

Public drinking water supply owners include those who own or operate a public drinking water system with at least 15 service connections or serving 25 or more individuals at least 60 days of the year. Municipal supplies and commercial or non-profit facilities which are not on municipal water supplies are included, as well as restaurants, schools, nursing homes, and campgrounds.

REGULATIONS AND GUIDELINES

The **regulations** require public drinking water supply owners to test their water supplies on a regular basis, to inform their customers and Nova Scotia Environment and Labour if there are problems, and to take corrective action to address any problems which may be identified.

All water supplied must meet health based *Guidelines for Canadian Drinking Water Quality* published by Health Canada.

The guidelines for monitoring public drinking water supplies call for:

- regular and frequent testing of water
- micro-biological and chemical testing to be conducted by approved laboratories
- suppliers to meet stringent water quality standards
- prescribed action to be taken if problems arise
- clear requirements for the immediate, person-to-person communication of reports of potentially unsafe water situations to Nova Scotia Environment and Labour, the local Medical Officer of Health, and the water supply owner

Routine monitoring by the water supply owner will ensure a more proactive approach to detecting and resolving any problems. Nova Scotia Environment and Labour plays an important role in this process through auditing and enforcement.

Municipalities and the public have had input into the new guidelines and regulations, via a thorough public consultation process.

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Water and Wastewater Facility Regulations

made under Sections 66 and 110 of the
Environment Act
S.N.S. 1994-95, c. 1
O.I.C. 95-299 (April 11, 1995), N.S. Reg. 60/95
as amended up to O.I.C. 2000-413 (August 11, 2000, effective October 1, 2000), N.S. Reg. 140/2000

Citation

1 These regulations may be cited as the "Water and Wastewater Facility Regulations".

Interpretation

2 In these regulations

(a) "Act" means the Environment Act;

(b) "Administrator" means a person appointed by the Minister for the purpose of the Act, and includes an acting Administrator;

(c) "Association of Boards of Certification" or "ABC" means the organization that is recognized by the Province for recommending standards and guidelines for the classification of potable water supply and wastewater systems and for the certification of operators;

(d) "Atlantic Canada Water and Wastewater Voluntary Certification Board" means the Board established by the Atlantic Canada Water and Wastewater Association to classify a wastewater treatment facility or a water treatment facility and certify the operators of these facilities;

(e) "continuing education unit" or "CEU" means 10 hours of participation in a recognized continuing education program;

(f) "Department" means the Department of Environment and Labour;

(g) "direct responsible charge" or "DRC" means the direct charge of the operations at a water or wastewater treatment facility, which includes

(i) at a treatment plant that does not have shift operations, active, daily, on-site charge of the operation, and

(ii) at a treatment plant that does have shift operations, active, daily, on-site direction and supervision of operation duties;

(h) "extension" means an increase in size of a facility or the volume of wastewater received by a facility;

(i) "facility" means a wastewater collection facility, a wastewater treatment facility, a water distribution facility, or a water treatment facility;

(j) "facility classification certificate" means a certificate issued by the Minister or an Administrator that prescribes the classification of a water treatment facility, water distribution facility, wastewater treatment facility, wastewater collection facility, or a combination of these facilities;

(k) "Minister" means the Minister of Environment and Labour;

(l) "modification" means an alteration to a facility whereby a new structure or equipment is added or an existing structure or equipment is eliminated and the alterations do not change the purpose or function of the facility;

(m) "Operator Certification Certificate" means a certificate of qualification issued by an Administrator under these regulations;

(n) "wastewater" means sewage derived principally from a residential or non-industrial operation, but does not include industrial process wastewater regulated under the Activities Designation Regulations;

(o) "wastewater collection facility" means a publicly or privately owned facility for the collection or transmission of wastewater;

(p) "wastewater treatment facility" means a publicly or privately owned facility for the treatment and disposal of wastewater, but does not include an on-site sewage disposal system;
Clause 2(p) amended: O.I.C. 2000-413, N.S. Reg. 140/2000.

(q) "water distribution facility" means a publicly or privately owned facility for the production, collection, storage and transmission of potable water;

(r) "water treatment facility" means a publicly or privately owned facility for the treatment of potable water, but does not include water treatment equipment used in private residences or a bottled water treatment facility.
Clause 2(r) amended: O.I.C. 2000-413, N.S. Reg. 140/2000.

Administrator
3 The Minister may appoint an Administrator to administer these regulations.

Part I - Facility classifications

Classification application

4 (1) Subject to subsection 5(3), every owner, operator or person responsible for a facility located in the Province at the effective date of these regulations shall have the facility classified under Section 5 of these regulations on or before January 1, 1996.

(2) A facility that is newly constructed after the effective date of these regulations shall be classified prior to the facility being put into operation.

(3) An application to have a facility classified under subsection (1) shall be on a form approved from time to time by the Minister or an Administrator.

Facility classification

5 (1) For the purposes of facility classification,

(a) the classification system for a treatment, distribution and collection facility shall be as prescribed in Table 1 of Schedule "A" to these regulations;

(b) the point system classification and guidelines for water treatment facilities shall be as prescribed in Table 2 of Schedule "A" to these regulations; and

(c) the point system classification and guidelines for wastewater treatment facilities shall be as prescribed in Table 3 of Schedule "A" to these regulations.

(2) A facility that was classified prior to the effective date of these regulations by

(a) the Atlantic Canada Water and Wastewater Classification Board; or

(b) under the Water and Wastewater Facility Classification Regulations made by Order in Council 92-60 dated January 21, 1992,

shall be deemed to be classified under these regulations at the equivalent class level.

(3) A facility classification certificate shall be issued by an Administrator upon payment of a fee prescribed by the Minister.

(4) Where a modification or extension of a facility is made or to be made after a facility classification certificate is issued under subsection (3), notice shall be given to an Administrator that provides details of the modifications or extensions made or to be made.

(5) Within 30 days of receipt of the notice provided under subsection (4), the Administrator shall advise the holder of the facility classification certificate in writing whether the original classification needs to be changed.

(6) If the original classification needs to be changed under subsection (5), a new facility classification certificate shall be issued by an Administrator upon payment of a fee prescribed by the Minister.

Part II - Operator certification

Operator certification requirement

6 (1) Subject to subsection 14(2), every owner of a facility located in the Province that is constructed and operational at the effective date of these regulations shall place the responsibility for operation, repair and maintenance of the facility under the direct responsible charge of an operator who has received full certification under these regulations.
Subsection 6(1) amended: O.I.C. 97-463, N.S. Reg. 83/97.
[Note: Subsection 14(2) repealed: O.I.C. 2000-413, N.S. Reg. 140/2000.]

(2) Every owner of a facility located in the Province that is constructed after the effective date of these regulations shall place the responsibility for operation, repair and maintenance of the facility after it is put into operation under the direct responsible charge of an operator who has received full certification under these regulations.

(3) An operator described in subsections (1) or (2) shall hold a valid Operator Certification Certificate of a classification rating that is equivalent to or greater than the classification rating assigned to the facility.

(4) An operator who has been certified by the Atlantic Canada Water and Wastewater Voluntary Certification Board prior to the effective date of these regulations shall be deemed to be certified under these regulations at the same class level at which the operator was certified.

(5) An operator who has been certified by the ABC or a certification agency equivalent to the ABC outside of the Province and who produces information requested by an Administrator may be certified by an Administrator under these regulations.

Operator certification certificate
7 (1) Any person who applies to qualify for an Operator Certification Certificate as an operator of a facility under these regulations shall submit to an Administrator an application on a form approved by the Minister or an Administrator.

(2) An applicant shall satisfy the education and experience requirements prescribed in Table 1 of Schedule "B" of these regulations and, except for a Class I level, must already be certified at the next lower class to be eligible to write an examination.

(3) Education and operating experience required under subsection (2) may be substituted within the limits prescribed in Table 2 of Schedule "B".

(4) In order to be certified to operate a particular type of facility that is issued a classification rating under Part I of these regulations, an applicant shall write an examination and achieve a pass mark established by the Minister or an Administrator.

(5) The Minister or an Administrator shall issue an Operator Certification Certificate to an applicant who satisfies the requirements of these regulations.

(6) An Operator Certification Certificate shall be on a form approved from time to time by the Minister or an Administrator.

(7) A person who holds a valid Operator Certification Certificate to operate a water treatment facility or wastewater treatment facility at the effective date of these regulations, shall, unless the certificate prescribes otherwise, be deemed to be certified under these regulations at an equal classification level to operate the collection or distribution components of the facility.

Part III - Financial Assistance

Definitions
8 In this Part,

(a) "flow gauging and wastewater characterization study" means a report prepared by a professional engineer which identifies important design criteria such as flow rates and variations in wastewater composition;

(b) "infiltration and inflow study" means a report prepared by a professional engineer which identifies extraneous flow contributions into a sewer system, assesses the need for a sewer rehabilitation program, and provides cost estimates and an implementation schedule program for the recommended rehabilitation;

(c) "pre-design study" means a report prepared by a professional engineer which presents cost effective options for an acceptable sewage collection and treatment strategy;

(d) "receiving water study" means a report which identifies the dilution and assimilative capacity of a watercourse for receiving wastewater and establishes effluent requirements to meet Provincial water quality objectives;

(e) "wastewater works" means any works for the collection, transmission, treatment and disposal of wastewater or any part of any such works.
Section 8 added: O.I.C. 97-463, N.S. Reg. 83/97.

Municipal sewage studies that qualify
9 A study on municipal wastewater works that qualifies for financial assistance under these regulations includes

(a) a pre-design study;

(b) a flow gauging and wastewater characterization study;

(c) an infiltration and inflow study;

(d) receiving water study; or

(e) any combination or part of the above.
Section 9 added: O.I.C. 97-463, N.S. Reg. 83/97.

Proposals
10 (1) A proposal for a study described in Section 9 shall contain a detailed description of

(a) the methodology to be followed in meeting study objectives;

(b) the project team to be retained by the consultant;

(c) the costs of the project; and

(d) a study schedule.

(2) A proposal shall be evaluated using the standard consultant evaluation form provided by the Department.
Section 10 added: O.I.C. 97-463, N.S. Reg. 83/97.

Review of application
11 After reviewing an application for financial assistance, the Minister or an Administrator may

(a) approve the application in whole or part;

(b) reject the application; or

(c) request more information.
Section 11 added: O.I.C. 97-463, N.S. Reg. 83/97.

Technical steering committee
12 (1) Where an Administrator considers it appropriate, a technical steering committee shall be established to guide the study described in Section 9 and to provide recommendations to the applicant.

(2) Where an Administrator considers it appropriate, the technical steering committee may include technical representation from a municipality, the Department, and other regulatory or funding agencies.
Section 12 added: O.I.C. 97-463, N.S. Reg. 83/97.

Payment of assistance
13 (1) Where the Minister or an Administrator has approved an application for financial assistance respecting a study, the Minister or an Administrator may advance progress payments to the applicant prior to the completion of the project in amounts which shall not exceed 50% of the approved financial assistance.

(2) Any request for a progress payment under subsection (1) shall be accompanied by appropriate invoices to justify the expenditures claimed.

(3) Upon completion of the project, the Minister or an Administrator may pay the remainder of the approved financial assistance to the applicant provided that

(a) the applicant has completed the study to the satisfaction of an Administrator; and

(b) appropriate invoices have been submitted to the Administrator to justify the expenditures claimed.
Section 13 added: O.I.C. 97-463, N.S. Reg. 83/97.

Part IV - Monitoring Public Drinking Water Supplies

14 In this Part

(a) "guidelines" means the most recent version of the Department's *Guidelines for Monitoring Public Drinking Water Supplies*, as amended from time to time;

(b) "*Guidelines for Canadian Drinking Water Quality*" means the most recent version of the guidelines published by Health Canada, as amended from time to time;

(c) "owner" means a person who owns, operates or maintains a water works system;

(d) "public drinking water supply" means a water works system for the provision to the public of piped water for human consumption where the system has at least 15 service connections or serves 25 or more individuals per day at least 60 days of the year;

(e) "water works system" means a water supply system where water is furnished or offered by an owner for human consumption, including its source, intake, treatment, storage, transmission and distribution.
Original Section 8 renumbered 14: O.I.C. 97-463, N.S. Reg. 83/97; replaced: O.I.C. 2000-413, N.S. Reg. 140/2000.

15 No person shall own, operate or maintain a public drinking water supply without first registering the public drinking water supply with the Department on a form approved from time to time by the Minister or an Administrator.
Section 15 added: O.I.C. 2000-413, N.S. Reg. 140/2000.

16 (1) An owner shall monitor a public drinking water supply for

(a) microbiological quality;

(b) general chemical and physical quality;

(c) disinfection residual, where an owner is using a disinfection system;

(d) source and treated water turbidity, where an owner is using chemically assisted filtration;

(e) fluoride concentrations, where an owner is using fluoridation; and

(f) other substances as may be required by the Minister or an Administrator.

(2) An owner shall ensure that the samples collected pursuant to subsection (1) are tested in the manner and with the frequency set out in the guidelines or as required by the Minister or an Administrator.

(3) An owner shall record the results of the tests performed pursuant to subsection (2) and forward them to an Administrator in accordance with the Department guidelines or as required by the Minister or an Administrator.
Section 16 added: O.I.C. 2000-413, N.S. Reg. 140/2000.

17 An owner shall notify the Minister or an Administrator immediately upon becoming aware of

(a) the owner's public drinking water supply not meeting the bacteriological and chemical criteria set out in the *Guidelines for Canadian Drinking Water Quality*;

(b) an ~~incidence~~ [incident] of raw water contamination;

(c) evidence of an outbreak of waterborne illness;

(d) suspected cross-connection or negative pressure; or

(e) ineffective disinfection due to high turbidity, equipment malfunctions or high chlorine demand,

and shall take corrective action as set out in the guidelines or as may be required by the Minister or an Administrator.
Section 17 added: O.I.C. 2000-413, N.S. Reg. 140/2000.

18 An owner shall ensure that the microbiological, physical and chemical characteristics of a public drinking water supply do not exceed the maximum acceptable concentration (MAC) and interim maximum acceptable concentration (IMAC) for substances listed in the *Guidelines for Canadian Drinking Water Quality*.
Section 18 added: O.I.C. 2000-413, N.S. Reg. 140/2000.

Schedule "A"

Table 1 - Classification

1 Facility Classification

(a) Wastewater treatment facilities and water treatment facilities shall be classified according to the following points system:

30 points or less	Class I Facility
31-55 points	Class II Facility
56-75 points	Class III Facility
76 points or more	Class IV Facility

(b) Points shall be assigned to each facility according to Table 2 for water treatment facilities and Table 3 for wastewater treatment facilities.

2 Water Distribution Facility Classification
Distribution shall be classified as follows according to the population served:

500 - 1500	Class I Facility
1501 - 15 000	Class II Facility
15 001 - 50 000	Class III Facility
50 001 or more	Class IV Facility

Section 2 replaced: O.I.C. 2000-413, N.S. Reg. 140/2000.

3 Wastewater Collection Facility Classification

Collection facilities shall be classified as follows according to the population served:

1500 or less	Class I Facility
1501 - 15 000	Class II Facility
15 001 - 50 000	Class III Facility
50 001 or more	Class IV Facility

Section 3 added: O.I.C. 2000-413, N.S. Reg. 140/2000.

Table 2 - Water Treatment Facilities

With respect to classifying water treatment facilities:

(a) A groundwater supply with only disinfection is considered a distribution system and not a water treatment facility.

Clause (a) amended: O.I.C. 2000-413, N.S. Reg. 140/2000.

(b) Each unit process should have points assigned only once. For example, for a facility using oxidation, precipitation and filtration for iron removal, add 10 points for the iron removal only and nothing for filtration.

(c) The point rating scale for a water treatment facility is as follows:

Item	Points
1. Size	
(a) Maximum population served, peak day*	1 point per 10 000 persons or any fraction thereof
(b) Design flow average day or peak month's average day, whichever is larger*	1 point per 4.546 million litres (1 million imperial gallons day or any fraction thereof

Clause (c), Item 1 replaced: O.I.C. 2000-413, N.S. Reg. 140/2000.

Item	Points
2. Water supply source	
(a) Groundwater	3
(b) Surface water	5
(c) Average raw water quality**	
(i) Little or no variation	0
(ii) Raw water quality (other than turbidity) varies enough to require treatment changes approximately 10% of the time	2
(iii) Raw water quality (turbidity) varies severely enough to require pronounced or very frequent treatment changes	5
(iv) Raw water quality subject to periodic serious industrial waste pollution	10
3. Aeration	2
4. Packed tower aeration	6
5. pH Adjustment	4

6. Stability or corrosion control	4
7. Taste and odour control	8
8. Colour control	4
9. Iron or iron manganese removal	10
10. Ion exchange softening	10
11. Chemical precipitation softening	20
12. Coagulation	4
13. Flocculation	6
14. Sedimentation	5
15. Upflow clarification	14
16. Filtration	10
17. Fluoridation	5
18. Disinfection***	
(a) No disinfection	0
(b) Chlorination or comparable	5
(c) On-site generation of disinfectant	5
19. Special processes (including reverse osmosis electrodialysis)	15
20. In-plant treatment of plant sludge	6
21. Laboratory control****	
(a) Bacteriological/biological	
(i) Lab work done outside the facility	0
(ii) Membrane filter procedures	3
(iii) Use of fermentation tubes or any dilution method; fecal coliform determination	5
(iv) Biological identification	7
(v) Viral studies or similarly complex work conducted on-site	10
(b) Chemical/physical	
(i) Lab work done outside the facility	0
(ii) Push button or colormetric methods for simple tests, such as chlorine residual, pH	3
(iii) Additional procedures such as titration jar tests, alkalinity, hardness	5
(iv) Highly sophisticated instrumentation such as atomic absorption and gas chromatography	10

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* Maximum of 10 points

** The key concept is the variation or change in the quality of the raw water source with point values ranging from 0 to 10.

*** For disinfectants such as ozone, chlorine dioxide or chloramine, assign 5 points for chlorination or comparable and 5 points for on-site generation of disinfectant.

**** The key concept is to credit laboratory analyses done on-site by facility personnel with point values ranging from 0 to 20.

Table 3 - Wastewater Treatment Facilities

With respect to classifying wastewater treatment facilities:

(a) A wastewater system with only collection, lift stations and chlorination is considered a collection system and not a wastewater treatment facility.

(b) Each unit process should have points assigned only once.

(c) The point rating scale for wastewater treatment facilities is as follows:

Item	Points
1. Size	
(a) Maximum population served, peak day*	1 point per 10 000 persc or any fraction thereof
(b) Design flow average day or peak month's average day, whichever is larger*	1 point per 3.785 millio litres (1 million gallons) day or any fraction ther
2. Variation in raw waste**	
(a) Variations do not exceed those normally or typically expected	0
(b) Recurring deviations or excessive variations of 100 to 200% in strength and/or flow	2
(c) Recurring deviations or excessive variations of more than 200% in strength and/or flow	4
(d) Raw wastes subject to toxic waste discharges	6
3. Facility pumping of main flow	3
4. Screening, comminution	3
5. Grit removal	3
6. Chemical pretreatment (except chlorination, enzymes)	4
7. Equalization	1
8. Primary clarifiers	5
9. Imhoff tanks	5
10. Bio-filtration with secondary clarifiers	10
11. Activated sludge with secondary clarifiers, including extended aeration and oxidation ditches	15
12. Stabilization ponds without aeration	5
13. Stabilization ponds with aeration	8
14. Polishing ponds for advanced waste treatment	2
15. Chemical/physical advanced waste treatment without secondary treatment	15
16. Chemical/physical advanced waste treatment following secondary treatment	10
17. Biological or chemical/biological advanced waste treatment	12

18. Ion exchange for advanced waste treatment	10
19. Reverse osmosis, electrodialysis for advanced waste treatment	15
20. Advanced waste treatment chemical recovery, carbon regeneration	4
21. Solids conditioning	2
22. Solids thickening	5
23. Anaerobic digestion of solids	10
24. Aerobic digestion of solids	6
25. Evaporative sludge drying	2
26. Mechanical dewatering of solids	8
27. Solids reduction (including incineration, wet oxidation)	12
28. On-site landfill for solids	2
29. Solids composting	10
30. Disinfection	
(a) No disinfection	0
(b) Chlorination or comparable	5
(c) On-site generation of disinfection	5
31. Effluent discharge	
(a) Post aeration	4
(b) Receiving stream sensitivity***	
(i) "effluent limited segment" in the U.S. EPA terminology; secondary treatment is adequate	0
(ii) More than secondary treatment is adequate	2
(iii) "water quality limited segment" in U. S. EPA terminology; stream conditions are very critical (dry run, for example) and a very high degree of treatment is required	3
(iv) Direct recycle and reuse	6
(v) Land disposal - evaporation	2
(vi) Subsurface	4
32. Laboratory control****	
(a) Bacteriological/biological	
(i) Lab work done outside the facility	0
(ii) Membrane filter procedures	3
(iii) Use of fermentation tubes or any dilution method; fecal coliform determination	5
(iv) Biological identification	7
(v) Viral studies or similarly complex work conducted on-site	10
(b) Chemical/physical	
(i) Lab work done outside the facility	0
(ii) Push-button or visual methods for simple tests such as pH, residual chlorine settleable solids	3
(iii) Additional procedures such as DO, COD,	5

	BOD, gas analysis, titrations, solids, volatile content	
(iv)	More advanced determinations, such as specific constituents, nutrients, total oils, phenols	7
(v)	Highly sophisticated instrumentation, such as atomic absorption and gas chromatography	10

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* Maximum of 10 points.

** The key concept is frequency or intensity of deviation or excessive variation from normal or typical fluctuations. The deviation can be in terms of strength, toxicity, shock loads, inflow/infiltration with point values ranging from 0 to 6.

*** The key concept is the degree of dilution provided under low flow conditions with point values ranging from 0 to 6.

**** The key concept is to credit laboratory analyses done on-site by facility personnel with point values ranging from 0 to 20.

Schedule "B"

Table 1 - Operator Certification Education and Experience Requirements

1 Class I

(a) **Education** - Grade 12 high school diploma, general equivalency diploma (GED), or equivalent education; and

(b) **Experience** - one year of acceptable operating experience of a Class I or higher facility.

2 Class II

(a) **Education** - Grade 12 high school diploma, GED, or equivalent education; and

(b) **Experience** - three years of acceptable operating experience of a Class I or higher facility.

3 Class III

(a) **Education** - Grade 12 high school diploma, GED, or equivalent education;

(b) **Post Secondary Education** - two years or 90 CEUs (continuing education units)* of post high school training or education in the water or wastewater field, engineering, or related science; and

(c) **Experience** - four years of acceptable operating experience of a Class II or higher facility, including 2 years of direct responsible charge.

4 Class IV

(a) **Education** - Grade 12 high school diploma, GED, or equivalent education;

(b) **Post Secondary Education** - four years or 180 CEUs* of post secondary training or education in water or wastewater field engineering, or related science; and

(c) **Experience** - four years of acceptable operating experience of a Class III or higher facility, including 2 years of direct responsible charge.

* 45 CEUs = 1 year post secondary education.

Table 2 - Operator Certification Substitutions

Education substitutions (short on experience)

Education or training	**May be substituted for**	**Limit**
Post secondary (1 year)	Operating or DRC experience (1 year)	50% experience requirement
Specialized operator training 45 CEU	Operating or DRC experience (1 year)	50% experience requirement

Note:

- For a Class I Facility a minimum operating experience of 1 year is required.
- 45 CEUs = 1 year post secondary education.
- Regardless of education available for substitution, 50% of any experience requirement (both Operating and DRC) for a Class II, III or IV Facility must be met in or by actual on-site operating experience in the appropriate type of facility or system.
- Education applied for operation experience substitutions cannot be utilized for an education requirement.
- Post secondary education must be in the environment field to be credited.

Operating experience substitutions (short on education)

Experience	**May be substituted for**	**Limit**
Operating or DRC experience (1 year)	Grade school (Grade 1 to 8) (2 years)	None
Operating or DRC experience (1 year)	High school (Grade 9 to 12), GED or equivalent (1 year)	None
In Class III, DRC (only) experience in Class II or higher (1 year)	Post secondary (1 year)	1 year substitute
In Class IV, DRC (only) experience in Class III or higher (1 year)	Post secondary (1 year)	1 year substitute
Specialized operator training 45 CEUs	Post secondary (1 year)	None

Note:

- Operating experience applied for education substitutions cannot be utilized for an operating experience requirement.
- For a Class I and II Facility there is no limit to substitution of experience for education.
- Qualified DRC experience can be substituted for post secondary education in a Class III or IV Facility only, but is limited to 1 year only.
- Experience should be obtained under the supervision of a certified operator.

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Nova Scotia

Guidelines for Monitoring Public Drinking Water Supplies

1.0 Preface

The purpose of these guidelines is to assist an owner of a public drinking water supply with developing and implementing an acceptable water quality monitoring program. The objective is to ensure that consumers of water provided by a public drinking water supply in Nova Scotia have safe drinking water. It is also recognized that a monitoring program should be part of a comprehensive water supply protection program and be used to assist with maintaining and optimizing water treatment operations.

These guidelines apply to a public drinking water supply as defined herein and include municipal, commercial, industrial, institutional, and privately owned water supplies. **It should be noted that these guidelines are considered to be minimum requirements and any conditions to an operating approval that the facility has or may require will always take precedence.**

2.0 Definitions

Public Drinking Water Supply (water supply) means a water works system for the provision to the public of piped water for human consumption where the system has at least 15 service connections or serves 25 or more individuals per day at least 60 days of the year.

Water Works System means a water supply system where water is furnished or offered by an owner for human consumption, including its source, intake, treatment, storage, transmission and distribution.

Owner means a person who owns, operates or maintains a water works system;

Safe Drinking Water means water that meets health related criteria for substances specified in the most recent Guidelines for Canadian Drinking Water Quality published by Health Canada, as amended from time to time.

Water Quality Committee means an ad hoc committee appointed at the discretion of the Medical Officer of Health (MOH) to address water quality deficiencies that require a boil water advisory. In addition to the MOH and representatives from the Nova Scotia Department of the Environment, the committee may include an owner, a representative from a water quality laboratory and other experts as required.

3.0 Roles and Responsibilities

3.1 Public Drinking Water Supply Owner

An owner is responsible for delivering safe drinking water to the consumer. This responsibility includes routine monitoring of the public drinking water supply, informing the consumer and the Nova Scotia Department of the Environment (NSDOE) if water quality fails to meet the criteria set out in the Guidelines for Canadian Drinking Water Quality and correcting any deficiencies which may result. The owner is also responsible for contacting NSDOE as soon as he/she becomes aware of any problem such as equipment malfunction which may result in unsafe water being supplied to the consumer. The owner shall have contingency plans in place to deal with poor water quality or a prolonged interruption in the supply of water.

3.2 Nova Scotia Department of the Environment (NSDOE)

NSDOE has been designated as the lead agency to take such measures as are reasonable to provide access to safe, adequate and reliable public water supplies (*Environment Act*, Section 104(c)). To carry out this mandate, NSDOE issues approvals to construct and operate water distribution and water treatment facilities, classifies facilities, requires certified operators, audits facilities and ensures water quality monitoring programs are carried out and appropriate action is taken to address any problems that may arise. When a water supply owner fails to notify consumers that a public health risk exists, NSDOE will cause a public notification to be issued. NSDOE may assist with non-routine or site specific monitoring.

3.3 Medical Officer of Health (MOH)

The MOH provides advice to the Ministers of Health and the Environment, the owner, NSDOE and the public regarding public health concerns associated with drinking water supplies. The MOH may issue orders to protect the public health, including the issuance of boil water advisories.

3.4 Water Quality Laboratory (lab)

The lab conducts analysis of samples following procedures defined in the latest edition of "Standard Methods for the Examination of Water and Wastewater", published jointly by the American Public Health Association, the American Water Works Association and the Water Pollution Control Federation, or an alternative method acceptable to NSDOE. The lab also participates in quality control and certification programs as required to ensure accurate analysis results. All sample analyses are to be performed by a laboratory acceptable to NSDOE.

4.0 Routine Monitoring for Microbiological Quality

4.1 Parameters

An owner shall monitor all public drinking water supplies for total coliform and fecal coliform bacteria. Coliform bacteria are indicator organisms used to determine the efficiency of treatment and the integrity of the water works system. They are surrogates for less abundant and more difficult to detect human pathogens. Fecal coliforms, such as *E. Coli*, are a sub-group of total coliforms that may be used as a screen for fecal contamination. Thus, the presence of coliform organisms in treated water indicates that barriers are ineffective and there is an increased chance for waterborne pathogens to follow the same pathway. However, the absence of coliforms does not guarantee safe water and the presence of coliforms does not necessarily indicate an immediate hazard. Generally the presence of total coliforms indicates that treatment is not effective or that there is a secondary contamination in the water works system such as cross connection or biofilm. The presence of fecal coliforms indicates ineffective treatment and recent fecal contamination.

An owner shall ensure that all samples collected for routine bacteriological monitoring are tested for the presence of total and fecal coliform organisms using methods listed in the latest edition of "Standard Methods for the Examination of Water and Wastewater". However, it is recommended that the samples be analyzed using the presence/absence (P/A) method which permits both total coliform and fecal coliform organisms to be determined simultaneously.

4.2 Sample Frequency, Number and Location

4.2.1 Approved Water Supplies

An Approved Water Supply is a Public Drinking Water Supply that requires an approval under the *Activities Designation Regulations* made pursuant to the *Environment Act.*

An owner of such a drinking water supply shall sample the water supply routinely. The minimum number of bacteriological samples an owner shall collect from a water works system is set out in the most recent version of the Guidelines for Canadian Drinking Water Quality and shown in the following table:

Population Served	**Minimum # of Samples per Month**
up to 5,000	4
5,000 to 90,000	1 per 1,000 population
more than 90,000	90 + (1 per 10,000 population)

In many cases the number of samples necessary to obtain an accurate representation of a water works system will exceed these minimums. The sampling locations shall be chosen to be representative of the water works system and include central and peripheral locations. Buildings with prolonged periods of low or no use of water should be avoided as sampling locations. For systems using surface water supplies, at least one water sample per week shall be collected from the point where the treated water enters the water works system. Sampling frequency from the system shall be at least weekly.

The MOH or NSDOE may alter the frequencies, locations, numbers and parameters to be monitored depending on local conditions, analytical results or changes to the Guidelines for Canadian Drinking Water Quality.

4.2.2 Registered Water Supplies

Public drinking water supplies which do not require an approval must be registered with the Department under the *Water and Wastewater Facility Regulations* made pursuant to the *Environment Act.*

An owner of such a drinking water supply shall sample the water supply quarterly. Where a water supply is not in operation year round, at least one of the samples is to be collected prior to start up.

The MOH or NSDOE may alter the frequencies, locations, numbers and parameters to be monitored depending on local conditions, analytical results or changes to the Guidelines for Canadian Drinking Water Quality.

4.3 Sample Collection and Preservation

All samples shall be collected and transported according to the standard procedures outlined in APPENDIX A.

4.4 Reporting of Sample Results

1) An owner shall ensure that results of all routine samples collected are sent from the lab to the owner. An owner shall record summaries of routine sample results in a uniform manner and make them available to NSDOE upon request. The owner shall maintain records of sample results, including the original lab receipts, for a minimum of two years from the collection date.

2) Whenever the presence of coliforms is detected, the owner shall ensure that the lab immediately notifies the water supply owner and NSDOE. The owner shall notify NSDOE immediately and forward the results to NSDOE. Receipt of any results sent electronically must be confirmed by telephone. If the local NSDOE office cannot be contacted for any reason, the environmental emergencies number is to be called at 1-800-565-1633.

3) Upon receipt of positive sample results, the owner shall comply with Section 7.0 of this Guideline, "Corrective Actions to be Taken When Bacteria Are Present". Depending on the particular circumstances, advice may be sought from the MOH.

4) If the results indicate deficiencies that may require a boil advisory (see Section 8.1), the owner shall notify and work cooperatively with the NSDOE and the MOH. The NSDOE and the MOH may appoint a water quality committee to address the problem.

4.5 Resampling Procedure

The owner shall resample all locations showing coliforms present as soon as possible within 24 hours of receiving the results. Depending on the circumstances, the NSDOE may require that the owner collect additional samples throughout the water works system. The owner shall make arrangements with the lab to ensure the samples are analysed when received.

All resamples shall be analysed by the P/A method (Colilert) for a 24-28 hour result to confirm whether total or fecal coliforms are present. When more than one sample in a set is positive for total coliforms, the samples shall be reanalysed by an acceptable method that will enumerate the number of coliforms present.

4.6 Compliance

An owner shall ensure that the drinking water meets the bacteriological quality requirements as set out in the "Guidelines for Canadian Drinking Water Quality".

Currently, the guidelines state that:

1) No sample should contain more than 10 total coliform organisms per 100 ml, none of which should be *Escherichia coli* or thermotolerant coliforms; or

2) No consecutive sample from the same site should show the presence of coliform organisms; and

3) For community drinking water supplies:

   a) not more than one sample from a set of samples taken from the community on a given day should show the presence of coliform organisms; and

b) not more than 10% of the samples based on a minimum of 10 samples should show the presence of coliform organisms.

5.0 Routine Monitoring for Chemical and Physical Quality

5.1 Parameters

The owner shall monitor for general chemical and physical quality. The minimum parameters to be monitored are shown in the following table and include inorganic and physical parameters with recommended limits in the Guidelines for Canadian Drinking Water Quality and some with no guidelines at the present time. These parameters are included in standard general chemical analysis and metal scan packages available at most labs.

aluminum	colour	pH
ammonia	conductivity	potassium
antimony	copper	selenium
arsenic	fluoride	sodium
barium	hardness	sulphate
boron	iron	total dissolved solids
cadmium	lead	total organic carbon
calcium	magnesium	turbidity
chloride	manganese	uranium
chromium	nitrate	zinc

5.2 Sample Frequency, Number and Location

An owner shall monitor a surface water supply at least annually. An owner shall monitor a groundwater supply at least once every two years. On each occasion two samples shall be collected, one sample from the raw water source and one sample from a point after treatment. The same sample points shall be used each year.

If there is reason to suspect the presence of other substances not listed above in a public drinking water supply, an owner shall monitor for these substances to ensure that their concentrations are below the acceptable limits. The MOH or NSDOE may alter the frequencies, locations, numbers and parameters to be monitored depending on local conditions, analytical results or changes to the Guidelines for Canadian Drinking Water Quality.

5.3 Sample Collection and Preservation

An owner shall collect and transport samples according to the standard procedures outlined in APPENDIX B.

5.4 Reporting of Sample Results

An owner shall ensure that the results of samples for chemical and physical quality are sent from the lab to the owner. An owner shall make the results available to NSDOE upon request. The owner shall maintain records of sample results for a minimum of ten years from the collection date.

Where results indicate that a Maximum Acceptable Concentration (MAC) or an Interim Maximum Acceptable Concentration (IMAC) has been exceeded, the owner shall notify NSDOE immediately and forward the results to NSDOE. Receipt of any results sent electronically must be confirmed by telephone. The owner shall collect a confirmation sample for that parameter(s) as soon as possible after the initial results are received.

5.5 Compliance

Any public drinking water supply in which the level of a substance exceeds the Maximum Acceptable Concentration (MAC) or the Interim Maximum Acceptable Concentration (IMAC) for that parameter, as given in the most recent version of the Guidelines for Canadian Drinking Water Quality, is considered to be out of compliance. The water supply owner, in consultation with NSDOE and the MOH, shall develop an action plan for addressing such non-compliance issues.

6.0 Daily Operational Monitoring

6.1 Disinfection Residual

An owner using a disinfection system shall monitor daily for disinfection residual. A disinfection residual should be continuously maintained throughout the entire water works system. Where a chlorine disinfection system is being used, the goal for free chlorine residual at distant points in a water works system should be a minimum 0.2 mg/L. Higher chlorine residuals may be required by NSDOE depending on other characteristics of the system but should not exceed 4 mg/L at any time.

Daily disinfection residuals should be recorded in a uniform manner and made available to NSDOE upon request.

6.2 Turbidity

An owner using chemically assisted filtration shall measure source and treated water turbidity at least once per day. An owner shall record daily turbidity measurements in a uniform manner and make them available to NSDOE upon request.

6.3 Fluoride

An owner using fluoridation shall monitor daily for fluoride concentrations at a representative location within the water works system. At no time should fluoride concentrations exceed 1.5 mg/L with an optimum range between 0.8 and 1.0 mg/L. An owner shall record daily fluoride measurements in a uniform manner and make them available to NSDOE upon request.

7.0 Corrective Actions to be Taken When Bacteria Are Present

An owner shall contact NSDOE immediately upon receipt of any total or fecal coliform positive sample results and discuss any potential causes for the bad samples. When corrective action is to involve increased sampling (resampling) and/or weekend or public holiday monitoring, the lab is to be notified immediately.

7.1 No E.coli Present and Less than 10% Samples Positive for Total Coliforms

Where there are no *E.coli* (or fecal coliforms) present and less than 10% of samples test positive for total coliforms, the owner shall

1) Resample at least the coliform positive locations as soon as possible;
2) Check disinfection residual;
   a) If there is inadequate residual throughout the system, increase disinfection;
   b) If there is no, or very low, disinfection residual at distant ends of the system, flush water mains and increase disinfection if necessary.

7.2 With *E.coli* (or fecal coliforms) present or more than 10% of samples positive for total coliforms

Where fecal coliforms are present in any sample, or total coliforms incidence is greater than 10% of the samples based on a minimum of 10 samples (two or more positives in a set of less than 10 samples), the owner shall initiate a boil water advisory and shall immediately contact NSDOE who will notify the MOH. NSDOE, the MOH and the owner shall consider on a case by case basis one or more of the following actions:

1) Resample at all regular sampling locations. Additional locations for sample collection may be added when deemed necessary;
2) Enumerate coliforms in samples to assess degree of contamination and possible point of entry;
3) Evaluate effectiveness of treatment and treatment plant:
   - Determine if the disinfection equipment is working properly.
   - Collect additional sample(s) of water leaving treatment plant to see if it is properly disinfected (dosage/contact time).
   - Test for heterotrophic plate counts of raw and treated water and stressed coliform.
   - Analyse turbidity of water entering the water works system;
4) Evaluate integrity of the water works system for:
   - cross connections
   - repairs, construction, etc.
   - loss of pressure;
5) Consider determining the species of coliforms retrieved from the water works system;
6) Survey doctor offices, hospital laboratories, etc. for increase in the incidence of waterborne gastrointestinal illness;
7) Review past history of the system and possibility of biofilm episode (see Appendix C).

8.0 Boil Water Advisories

8.1 Deficiencies That Require a Boil Water Advisory

1) Water that does not meet the Guidelines for Canadian Drinking Water Quality requirements for bacteriological quality;
2) Lack of disinfection (equipment breakdown, emergency water supply from unchlorinated source, etc.), failure of key water treatment process, or loss of pressure;
3) Fecal contamination of drinking water evidenced by fecal coliform positive samples;
4) Suspected cross connection or negative pressure;

5) Ineffective disinfection due to high turbidity, temporary equipment malfunctions, high chlorine demand, etc. evidenced by coliform positive water leaving the treatment plant and generally poor bacteriological water quality;
6) Other circumstances which in the opinion of the NSDOE or the MOH constitutes a risk to public health (eg. *Giardia*, *Cryptosporidium* contamination, etc.);
7) Evidence of outbreak of waterborne illness (the risk to young children, elderly and immuno-compromised people should be considered in a decision);
8) A serious incidence of raw water contamination.

8.2 Boil Water Advisory Protocol and Communication Plan

8.2.1 Introduction

Where one or more of the conditions described in Section 8.1 exist, the owner shall initiate the boil water advisory and contact NSDOE and the MOH as soon as possible. In the event that NSDOE or the MOH is aware of a potential serious health risk, NSDOE or the MOH will advise the water supply owner to initiate the boil water advisory.

During the boil water advisory there should be frequent communication between the MOH, NSDOE staff and the owner.

8.2.2 Procedure for Notification of Boil Water Advisory

1) The owner will inform consumers in a manner and frequency acceptable to NSDOE and the MOH.
2) If the owner fails to notify the consumers, NSDOE or the MOH will take appropriate steps to notify the consumers.

8.2.3 Suggested Wording for Boil Water Advisory

"Due to water quality problems and the possibility of unsafe water, consumers are advised to boil all water for at least 2 minutes before drinking, making ice cubes, washing foods, brushing teeth or any other activity requiring human consumption. This is to be done until further notice". (See APPENDIX D for recommended press release).

This advisory should be placed in the local newspaper daily, if possible, and hourly on the local radio station for the duration of the advisory. In the case of an immediate serious public health threat other methods of notification, such as door to door contact, may be necessary.

8.2.4 Follow up Communication Plan for Boil Water Advisory

After a boil water advisory has been issued, the owner shall keep the general public informed about the status of the advisory. A telephone hot line may be put in place by the owner during the boil water advisory. The hot line should be staffed for extended hours as needed. Prepared fact sheets can be made available by NSDOE to the press and the public (See APPENDIX E).

Some businesses, institutions, manufacturing plants or health care facilities may have special requirements when a boil water advisory is in effect. (See APPENDIX F). There may be circumstances where these facilities should be contacted to assure compliance with the precautions.

8.3 Removing the Boil Water Advisory

The boil water advisory may be removed by the MOH in consultation with NSDOE and the owner. Under normal circumstances the boil water advisory will be removed when

a) the Guidelines for Canadian Drinking Water Quality for coliform bacteria are met for 2 consecutive sets of samples separated by a minimum of 24 hours,

b) the deficiencies which led to the boil water advisory are corrected, and

c) sufficient finished water displacement has occurred in the water works system to eliminate potentially contaminated water.

These guidelines are in effect as of the 1st day of October, 2000.

DATED at Halifax, in the County of Halifax, Province of Nova Scotia, the 6th day of September, 2000.

Kevin McNamara
Acting Deputy Minister of Environment

APPENDIX A

Sample Collection and Preservation - Microbiological Quality

1) Sterile microbiological sampling containers, containing sodium thiosulphate (to neutralize chlorine), should be used to collect all samples.

2) Sample containers should be kept clean and free from contamination before and after collecting the sample. They should not be opened prior to collecting the sample.

3) At locations at which the sample must be collected from a tap, inspect the outside of the faucet. If water leaks around the outside of the faucet, select a different sampling site. Remove any aerators, strainers, hose attachments, mixing type faucets, and purification devices from the tap.

4) Run the cold water for at least three minutes before sample collection.

5) Reduce the tap flow rate before taking the sample. The flow rate should be low enough to ensure that no splashing occurs as the container is filled. At sampling points where water runs continuously, do not adjust flow rate.

6) Label all bottles and complete the corresponding requisition. All raw water samples are to be noted and analysed for numbers of total and fecal coliforms.

7) Measure chlorine residual. Normally free chlorine residual is measured, however, total chlorine residuals may be required on occasion. In either case, the requisition form is to be marked "F" or "T" indicating free or total chlorine residual.

8) While holding the sample container at the base, remove plastic seal around cap before attempting to open the bottle. The cap is removed with the free hand, care being exercised not to touch the edge or the bottom of the cap or top or neck of bottle. If the cap is found to be loose or cracked, if it contains no seal, if the seal pulls away from the cap, if the bottle appears dirty, or if there are any other conditions which places the quality of the bottle in doubt, the bottle is to be rejected and a proper container used. Care is to be exercised to prevent breathing on the cap or bottle. The cap is to be held in one hand during the entire bottle filling operation; it is not to be laid down.

9) Sampling points will not normally be flamed. In some circumstances the tap can be flamed or disinfected at the sampler's discretion.

10) The sampling container is to be filled to the "fill line" leaving enough air space in the container to allow for mixing by shaking in the lab. The cap is carefully replaced.

11) Samples shall be transported to an approved water quality laboratory within 24 hours. Samples shall be kept in a refrigerator or cooler with ice packs until delivered to the lab.

APPENDIX B

Sample Collection and Preservation - Chemical and Physical Quality

Container

- For most basic parameters, use a clean polyethylene bottle available from the local hospital or water quality laboratory. For additional or specialized parameters, discuss the requirements with the laboratory or a trained professional before sampling.
- Label the bottle with water supply owner's name, address, location of the water source, date, and time.
- Make sure all information on the requisition is filled out completely.

Flush the System

- If the sample is to be taken from a tap or pump, run the cold water tap 10 minutes, if possible. This will help to remove stagnant water that may have artificially elevated metal concentrations from the distribution system.

Collect the Sample

- Rinse the bottle and cap 2 to 3 times.
- Turn flow volume down so that water runs gently.
- Sample for sensitive parameters (organics, metals) first. Filtration and preservation may be necessary for metals, depending on the purpose of sampling.
- Fill bottle to top (overflow) and cap tightly with no air gap.

Storage and Transport

- Refrigerate the sample immediately or place in a cooler and store at 4^{o}C in the dark.
- Transport the sample to the laboratory as soon as possible, preferably within 24 hours.

APPENDIX C

The Growth of Biofilm In a Water works System

Introduction

Biofilm refers to organic or inorganic surface deposits in a water works system consisting of microorganisms, microbial products and debris. Biofilm may occur on interior pipe surfaces, in sediments, inorganic tubercles, suspended particles or virtually any substratum immersed in the aquatic environment. Biofilm may be evenly distributed or occur as sporadic random patches on the surface.

Public Health Significance

Portions of a biofilm lining the interior of a water pipe may be periodically sloughed off into the passing water thereby seeding it with microorganisms contained in the biofilm. If such bacteria are coliforms, the occupancy must be considered a public health concern until it is proven that a treatment failure or contamination has not occurred. It is difficult to distinguish between a true biofilm event and an unexplained coliform occurrence. Determination of coliform contamination due to biofilm is usually a negative conclusion; that is, there are no observable coliforms in the treatment plan effluent, no identified breakdown in treatment barriers, no apparent cross-connection or other contamination of the water works system (breaks, construction, etc.). While a true coliform biofilm event may not in itself signal a public health risk it may mask a real contamination event and therefore must be viewed with concern. The onus is on the owner to show that these coliform occurrences are a result of biofilm release into the water supply.

Characteristic of a Situation Where Biofilm May be the Cause of Bacteria Counts Within a Water Works System

- No coliforms are detected in treatment plant effluent.
- Coliform bacteria persist in a water works system samples despite the maintenance of a disinfectant residual.
- Seasonal increase in coliform densities with highest recovery in warm summer months, decreasing in the fall.
- The duration of the coliform episode is prolonged for years.
- Growth of heterotrophic bacteria (HPC) frequently occurs before coliforms are detected.
- Coliform growth occurs as randomized pattern in the water works system.
- Some predominant coliform species can be identified, such as *Klebsiella*, *Entrobacter* or *Citrobacter*.
- Coliform occurrence persist despite proper operation and maintenance practices being carried out, including: consistently maintaining positive pressure in the water works system, implementing aggressive cross-connection control, thoroughly flushing and disinfecting pipes after construction and repair, providing efficient treatment.

APPENDIX D

Draft Press Release for Boil Water Advisory
(Revise as necessary to fit specific circumstances)

Due to apparent contamination of the ________________ public drinking water supply and the possibility of unsafe water, consumers are advised to boil all water for at least 2 minutes before drinking, making ice cubes, washing foods, brushing teeth or any other activity requiring human consumption. This is to be done until further notice.

The water utility is doing all it can to determine the cause of the problem and to remedy it as quickly as possible. The water utility, the Nova Scotia Department of the Environment and the Medical Officer of Health are continuing to monitor the water quality closely and are working in close consultation.

Fact sheets on water usage when a boil water advisory is in effect are available from the water utility or the local office of the Nova Scotia Department of the Environment.

For further information regarding this notice call:

APPENDIX E

Fact Sheet on Domestic Water Usage When a Boil Advisory is in Effect

Disinfecting Water

Water can be disinfected in a number of ways including boiling or adding household bleach which contains chlorine. Please see the table below for the details on disinfecting water.

	Method	Amount	Time
Boiling	Bring water to a rapid boil and continue to boil for at least 2 minutes		boil for at least 2 minutes
Adding Bleach	Use household bleach (5.25% sodium hypochlorite)		
	a) for washing dishes in the sink	a capful (10 ml) of bleach per sink of water	mix and let sit for 1 minute before use
	b) for bathing in the bathtub	3 ounces (85 ml) of bleach per standard tub	mix and let sit for 10 minutes
	c) for whirlpool tubs	follow manufacturers instructions	

Only boiled water should be used for:

- drinking
- use in formulas or mixing juice or other drinks
- making ice cubes

Only disinfected water (boiled or bleached) should be used for:

- washing and bathing
- washing dishes
- humidifiers
- washing food that will be consumed uncooked such as fruit or vegetables

Note: Showering is not recommended if water contains fecal coliforms.

It is not necessary to use disinfected water for:

- laundry
- washing floors and other household cleaning

Point of use treatment units on the consumers tap or water line cannot be depended upon to adequately disinfect water.

APPENDIX F

Users That Must Take Particular Precautions During A Boil Advisory

Restaurants

It is necessary to boil water

- All drinking water
- Soft drink post-mix machines
- Ice cubes and any ice products (shaved or block ice) used in food or drinks.
- Washing any food that would not be cooked
- Vending machines that use water that does not reach boiling temperatures as part of their design

It is not necessary to boil water for:

- Soft drink pre-mix machines
- Cooking and baking
- Coffee machines which achieve boiling temperatures as part of their design

Food Production

- Dairy Plants - The contaminated water must not contact products following the pasteurization procedure and water used in clean-in-place procedures and in cleaning of product related equipment must be properly chlorinated.

- Bottling Plants - Pre-superchlorination and chorine removal must be a part of production procedure.

- Ice Making - It is prohibited to make ice for domestic purposes or for cooling or preservation of food from water that is likely to make the ice impure or is liable to produce disease.

Hospitals, Schools, Special Care Facilities, Dental or Physician Clinics, Etc.

- Boil water or use alternate potable water supply in all applications of tap water intended for consumption or treatment procedures where a risk of infection is possible. Assess all water usage in consultation with infection control personnel.

Water Vending Outlets (Includes Wine and Beer Vending)

- Assess each system individually.

Appendix G

REGISTRATION FORM
For Public Drinking Water Supplies

OWNER: **(Please Print)**

Business Name:		
Owner First Name:	Middle Initial:	Last Name:
Home Phone: ( )	Business Phone: ( )	Other Phone ( )
Fax Number: ( )	E-mail:	
Civic Address:	Community:	
Mailing Address:	Town:	
County:	Province:	Postal Code:

CONTACT:

First Name:	Middle Initial:	Last Name:
Home Phone: ( )	Business Phone: ( )	Other Phone ( )
Fax Number: ( )	E-mail:	
Civic Address:	Community:	
Mailing Address:	Town:	
County:	Province:	Postal Code:

SITE INFORMATION:

Name of Facility:		Phone No.	
Type of Facility:			
Population Served:		Number of Connections:	
Demand (Litres/Day):			
Civic No.		Street Name:	
Community:		County:	
PID No.	Map No. 1:50000	Easting	Northing:

WATER SOURCE: For wells please attach copy of well log

Source of Water:	Well Log No.

TREATMENT EQUIPMENT:

Type:	Capacity/Size:	Age:

FOR OFFICE USE ONLY: (CLASSIFICATION)

Classification of Facility	**Operator Certification:**
No. of days of operation:	**Type of Facility Served:**

Owner's Signature ______________________________ **Date:** ______________________________

Media Backgrounder

May 12, 200

ADVISORY COUNCIL ON DRINKING WATER QUALITY AND TESTING STANDARDS

The Advisory Council on Drinking Water Quality and Testing Standards will make recommendations to the Minister of the Environment on matters related to provincial drinking water standards.

Council members are from key professional organizations with expertise in the areas of microbiology, engineering, utility operations and public health and a record of interest and accomplishment in areas related to drinking water. The council will contribute to ensuring Ontario's standard for drinking water quality and testing are consistent with the most up-to-date information and practices, and that the standards-setting process i transparent with increased public input.

The Advisory Council has a mandate to:

- review scientific and technical documentation of proposed standards;
- consult and provide feedback to the public;
- undertake additional consultation to clarify and address issues; and
- consider and make recommendations on adopting standards for contaminants that are not currently being considered through the federal-provincial process for developing Canada-wide drinking water guidelines.

The Advisory Council will first focus on the following priorities:

- replacing the total coliform test with an E. coli test;
- the desirability of a turbidity limit that is lower than the limit specified in the federal- provincial guidelines;
- treatment standards for protozoa based on source water quality; and
- reviewing Ontario's standards for disinfection by-products.

Through the Advisory Council, the McGuinty government is implementing six recommendations (Recommendations 25 to 29 and 31) regardin an advisory council and standards made by Commissioner O'Connor in Part Two of the Walkerton Inquiry report.

–30 –

Contact:
Art Chamberlain
Minister's Office
(416) 314-5139

John Steele
Ministry of the Environment
(416) 314-6666

Date: Fri, 14 May 2004 09:43:04 -0400
To: (Recipient list suppressed)
From: Ontario Environment Network <oen@oen.ca>
Subject: MOE: MCGUINTY GOVERNMENT TAKES FURTHER ACTION TO PROTECT ONTARIOÆS DRINKING WATER

News Release
For immediate release
May 12, 2004

MCGUINTY GOVERNMENT TAKES FURTHER ACTION TO PROTECT ONTARIO'S DRINKING WATER
New advisory council to make recommendations on water quality and testing

TORONTO— The McGuinty government is further protecting Ontario's drinking water by establishing an Advisory Council on Drinking Water Quality and Testing Standards, Environment Minister Leona Dombrowsky announced today.

"Our people's health is our most precious resource. We share a responsibility to protect it from harm," said Dombrowsky. "The Advisory Council will help us ensure that Ontario's standards for drinking water quality and drinking water tests are among the most stringent in the world. Our citizens deserve no less."

The Advisory Council will be chaired by Jim Merritt, a former Assistant Deputy Minister with the Ministry of the Environment.

W members drawn from key professional organizations with expertise in areas related to drinking water, the council will make recommendations to the Minister of the Environment on provincial drinking water standards and other measures to improve the safety and quality of Ontario's drinking water supply.

The establishment and mandate of the Advisory Council satisfy six specific recommendations made by the O'Connor Commission.

In response to concerns raised by rural municipalities, public health officials and small privately-run systems across the province, the minister also announced proposed changes to the Drinking Water Systems Regulation. These proposed changes extend the deadline for some systems to install treatment equipment to December 31, 2004 and will allow the ministry to consult on further changes to the regulation to make compliance more feasible for small waterworks.

"The previous government didn't consider the effects of the drinking water regulation on rural Ontario," Dombrowsky said. "We will meet with affected stakeholders over the next few months to come up with solutions that will m the regulation more workable for rural drinking water systems while protecting public health and meeting our commitment to implement all of the O'Connor Commission's recommendations."

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Media Backgrounder
May 12, 2004

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The Advisory Council has a mandate to:

review scientific and technical documentation of proposed standards;
consult and provide feedback to the public;
undertake additional consultation to clarify and address issues; and
consider and make recommendations on adopting standards for contaminants that are not currently being considered through the federal-provincial process for developing Canada-wide drinking water guidelines.
Tl \dvisory Council will first focus on the following priorities:

replacing the total coliform test with an E. coli test;
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treatment standards for protozoa based on source water quality; and
reviewing Ontario's standards for disinfection by-products.
Through the Advisory Council, the McGuinty government is implementing six recommendations (Recommendations 25 to 29 and 31) regarding an advisory council and standards made by Commissioner O'Connor in Part Two of the Walkerton Inquiry report.

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Media Backgrounder
May 12, 2004

PROPOSED AMENDMENTS TO DRINKING WATER SYSTEMS REGULATION (O. Reg. 170/03)

The Drinking Water System Regulation (O.Reg. 170/03) was implemented in Ju 2003 to address recommendations of the O'Connor Commission. The ministry has heard from rural municipalities and operators of non-municipal drinking water systems about its impact on their ability to continue to provide services to their clients.

The Ministry of the Environment has proposed amendments to the Drinking Water Systems Regulation which respond to these concerns and give the ministry time to consult over the summer months with rural municipalities and operators of non-municipal drinking water systems, medical officers of health and health officials on making the regulation more workable. The government remains committed to providing safe, clean drinking water, and is prepared to look at workable solutions towards achieving that goal.

The proposed amendments, affecting both municipal and privately-run drinking water systems, are as follows:

The treatment deadlines will be extended from July 1, 2004 to December 31, 2004 for surface water systems in the three categories listed below, as long as the system does not serve a designated facility (i.e. school or health/social care facility):
non-municipal year-round residential systems (i.e., mobile home parks, subdivisions, condos/apartments)
large non-municipal – non-residential systems (i.e., systems serving hotels, resorts and campgrounds with less than 6 hook-ups)
large municipal – non-residential systems (large community centres and recreational facilities, for example, capable of supplying water at a rate greater than 2.9 litres of per second)

The treatment deadline for groundwater water systems in the three categories listed above remains December 31, 2005.
Small municipal – non-residential systems (i.e., systems serving small community centres and town halls not capable of supplying 2.9 litres of water per second) would be allowed to post signs until December 31, 2004 rather than conduct tests required by the regulation. Signs would state that the water has not been tested or treated for drinking water purposes.
Small non-municipal non-residential systems (i.e., motels, resorts and restaurants not capable of supply 2.9 litres of water per second) would receive a deadline extension to June 1, 2005 to notify the ministry of their intention to comply, apply for relief from treatment or post warning notices.
As well, changes have been proposed to the sequence of corrective actions for some adverse test results to better provide for the immediate correction of the problem, and to the definition of 'food premises' to be clear that systems that do not serve the public, such as food manufacturers, are not included in the regulation.
The majority of systems will continue to have to meet tough standards, sample and test, use accredited laboratories for microbiological and chemical testing, provide immediate notification of any adverse test results and are subject to tough penalties for non-compliance.

The proposed amendments have been posted to the Environmental Bill of Rights Registry for a 30-day public comment period which ends June 11, 2004.

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Media Backgrounder

May 12, 2004

MEMBERS OF ADVISORY COUNCIL ON DRINKING WATER QUALITY AND TESTING STANDARDS

Jim Merritt (Chair)
M Merritt is an independent consultant on environmental services, municipal infrastructure and water management. He is a former Assistant Deputy Minister of the Operations Division at the Ontario Ministry of the Environment. Mr. Merritt led the establishment of the Ontario Clean Water Agency and served as Vice President of Operations and Vice President of Information and Technology.

Dr. Robert Andrews
Dr. Andrews is a professor in the department of Civil Engineering at the University of Toronto. He is a past co-recipient of the National Science and Engineering Research Council Synergy Award for University-Industry Partnership. He is a past appointee to the Council of Research Managers — Great Lakes International Joint Commission. Dr. Andrews is a member of the American Water Works Association. He currently serves on the AWWA Disinfection Committee, and on the Ontario Water Works Association's Treatment Committee. He has published technical reports on E.coli occurrence, UV disinfection, Disinfection By-products, among other issues.

Dr. Ronald W. Brecher
Dr. Brecher is Principal and Secretary/Treasurer of GlobalTox International Consultants — a Canadian corporation that assesses the impact of toxic cl ical exposures on human health. He is an Adjunct Professor, Faculty of Environmental Studies at the University of Waterloo and Associated Graduate Faculty, Department of Biomedical Sciences at the University of Guelph. From 1994-2002, he was the director of the Children's Groundwater Institute. He is a past recipient of the Natural Sciences and Engineering Research Council's Industrial Research Fellowship. He is a past member of the Science and Policy Advisory Board of the American Council of Science and Health.

Michele Giddings
Ms. Giddings is the Manager, Water Quality and Health Bureau, Healthy Environments & Consumer Safety Branch, Health Canada. She is Health Canada's representative on the Federal/Provincial/Territorial Committee on Drinking Water. She is currently co-coordinator of the Disinfectants and Disinfection By-products Working Group for the World Health Organization's Guidelines for Drinking Water Quality. Ms. Giddings has developed a number of drinking water guidelines for Health Canada and WHO.

Rod Holme
Mr Holme is former Vice President for Water and Waste water division of E Tech Canada and is currently an independent consultant on drinking water. He is Past President of American Water Works Association and Chair of the Joint Committee on Water Regulations for the Ontario Water Works Association and the Ontario Municipal Water Association. He has extensive experience in technical and project management in municipal water supply.

Dr. Peter Huck
Dr. Huck is a Professor in the Department of Civil Engineering, NSERC Chair in Water Treatment and University Research Chair at the University of Waterloo. He has undertaken extensive research in water quality and treatment in areas such as the robustness of water treatment systems, membrane and UV treatment, the removal of Cryptosporidium pathogen loadings in watersheds, among other topics.

Dr. Alexander Hukowich
Dr. Hukowich is the Associate Medical Officer of Health, Haliburton, Kawartha, Pine Ridge Health Unit and the appointed coroner for Northumberland County. He also serves as Chair of the Association of Local Public Health Authorities'Advocacy Committee. He represents the Association of Local Public Health Authorities.

Dr. Marilyn Lee
Dr. Marilyn Lee is a board member of the Environmental Health Foundation of Canada. She is a professor in the School of Occupational and Public Health, Ryerson Polytechnic University, where she teaches courses on water quality, food hygiene, food pathogens, parasitology, pest control, and infection control.

Dr. Harold Richardson
Dr Richardson is the managing director of the Laboratory Proficiency Testing Program of the Ontario Medical Association. He also serves as the Vice chair of the National Committee on Medical Laboratory Quality Systems of the Canadian Standards Association. He is a former chair of the Medical Microbiology and Infectious Diseases program, and past president of the Canadian Association of Medical Microbiologists. Dr. Richardson represents the Ontario Medical Association.

Dr. Ken Roberts
Dr. Roberts has over 30 years' experience in the field of drinking water treatment engineering and groundwater management. He currently works for XCG Consultants Ltd. Prior to joining XCG, he served in a number of water-quality-related positions in the Ontario Ministry of the Environment and Energy. Dr. Roberts is a member of the American Water Works Association and the AWWA's Research Foundation.

John Rudnickas
Mr. Rudnickas is the Manager of Water Quality for the City of Toronto. A chemist by training, he has extensive experience in all aspects of quality assurance/quality control in a large drinking water system. He is responsible for the management of the City of Toronto's accredited and licensed laboratory for drinking water testing. He is a member of the Ontario Water Works Association and is on the Water Quality Committee of the Canadian Water and Wastewater Association. He is also a member of the American Water Works Association.

Dr. Mark Servos

Dr. Servos is the Scientific Director of the Canadian Water Network, a national network of Centres of Excellence involving 30 universities across Canada. He is a professor in the Department of Biology, at the University of Waterloo, where his research focuses on risk assessment and risk management of emerging water quality issues such as endocrine disruption ar ˙ ɔharmaceuticals in the environment. He is the former Project Chief for the Priority Substances Exposure Project for the National Water Research Institute. He is a former member of the board of directors of the Society of Environmental Toxicology and Chemistry and the International Association of Great Lakes Research.

Dr. Lesbia F. Smith

Dr. Smith is Assistant Professor at the University of Toronto and Institute of Environment and Health, McMaster University. Dr. Smith holds a medical degree, specializing in internal medicine and hematology/oncology. She is the former head of the Environmental health and Toxicology Unit of the Public Health Branch of the Ontario Ministry of Health. Dr. Smith has carried out research in the areas of ecological and human health risk assessment of surface waters, linkages between non-bladder cancers and THMs, linkages between aluminum in drinking water and the incidence of Alzheimer's disease.

Robert Walton

Robert Walton is Director of Public Works for the County of Oxford. He is the former Manager of Water and Wastewater Services. Prior to joining the C ty of Oxford, Mr. Walton worked as a consulting engineer. Mr. Walton is a member of the Ontario Municipal Water Association and has served on the Drinking Water Committee of the Association of Municipalities of Ontario. He represents the Ontario Municipal Water Association.

Chiefs of Ontario

A representative will be named in the near future.

-30 -

Contact:
Art Chamberlain
Minister's Office
(416) 314-5139
John Steele
Ministry of the Environment
(416) 314-6666

WINDOW TO A GREENER WORLD
The Ontario Environmental Directory, Environmental Search Guide, and Environmental 'Portal of Portals' are now on-line! THE place to start for environmental research, communication a[illegible] action. http://www.oen.ca/dir/

Ontario Environment Network
P.O. Box 1412, Station Main
North Bay, ON P1B 8K6
t: 705-840-2888 f: 705-840-5862
<oen@oen.ca>
http://www.oen.ca

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Français

Safe Drinking Water Act, 2002

ONTARIO REGULATION 169/03

Amended to O. Reg. 17/04

ONTARIO DRINKING-WATER QUALITY STANDARDS

Notice of Currency:* This document is up to date.

*This notice is usually current to within two business days of accessing this document. For more current amendment information, see the Table of Regulations (Legislative History).

This is the English version of a bilingual regulation.

Standards

1. The standards set out in Schedules 1, 2 and 3 are prescribed as drinking-water quality standards for the purposes of the Act. O. Reg. 169/03, s. 1.

Deemed compliance

2. (1) A person who, pursuant to section 10 of the Act or otherwise, has an obligation to ensure that water meets a standard set out in Schedule 1, 2 or 3 shall be deemed not to have contravened the obligation if, in circumstances where the water does not meet the standard, the person immediately contacts the medical officer of health and takes such other steps as are directed by the medical officer of health. O. Reg. 169/03, s. 2 (1).

(2) Despite subsection (1), the owner or operating authority of a drinking-water system that provides water that does not meet a standard set out in Schedule 1, 2 or 3 shall be deemed not to have contravened paragraph 1 of subsection 11 (1) of the Act only if the owner or operating authority ensures that the appropriate corrective action is taken under Schedule 17 or 18 to Ontario Regulation 170/03 (Drinking-Water Systems). O. Reg. 169/03, s. 2 (2).

3. Omitted (provides for coming into force of provisions of the English version of this Regulation). O. Reg. 169/03, s. 3.

SCHEDULE 1
MICROBIOLOGICAL STANDARDS

Item	Microbiological Parameter	Standard (expressed as a maximum)
1.	*Escherichia coli* (E. coli)	Not detectable
2.	Fecal coliforms	Not detectable
3.	Total coliforms	Not detectable
4.	General bacteria population expressed as background colony counts on	200 colony forming units (CFU) per 100 millilitres

	the total coliform membrane filter	
5.	General bacteria population expressed as colony counts on a heterotrophic plate count	500 colony forming units (CFU) per millilitre

O. Reg. 169/03, Sched. 1.

SCHEDULE 2
CHEMICAL STANDARDS

Item	Chemical Parameter	Standard (expressed as a maximum concentration in milligrams per litre)
1.	Alachlor	0.005
2.	Aldicarb	0.009
3.	Aldrin + Dieldrin	0.0007
4.	Antimony	0.006
5.	Arsenic	0.025
6.	Atrazine + N-dealkylated metabolites	0.005
7.	Azinphos-methyl	0.02
8.	Barium	1.0
9.	Bendiocarb	0.04
10.	Benzene	0.005
11.	Benzo(a)pyrene	0.00001
12.	Boron	5.0
13.	Bromate	0.01
14.	Bromoxynil	0.005
15.	Cadmium	0.005
16.	Carbaryl	0.09
17.	Carbofuran	0.09
18.	Carbon Tetrachloride	0.005
19.	Chloramines	3.0
20.	Chlordane (Total)	0.007
21.	Chlorpyrifos	0.09
22.	Chromium	0.05
23.	Cyanazine	0.01
24.	Cyanide	0.2
25.	Diazinon	0.02
26.	Dicamba	0.12
27.	1,2-Dichlorobenzene	0.2
28.	1,4-Dichlorobenzene	0.005
29.	Dichlorodiphenyltrichloroethane (DDT) + metabolites	0.03
30.	1,2-dichloroethane	0.005
31.	1,1-Dichloroethylene (vinylidene chloride)	0.014
32.	Dichloromethane	0.05

33.	2,4-Dichlorophenol	0.9
34.	2,4-Dichlorophenoxy acetic acid (2,4-D)	0.1
35.	Diclofop-methyl	0.009
36.	Dimethoate	0.02
37.	Dinoseb	0.01
38.	Dioxin and Furan	0.000000015 [a]
39.	Diquat	0.07
40.	Diuron	0.15
41.	Fluoride	1.5
42.	Glyphosate	0.28
43.	Heptachlor + Heptachlor Epoxide	0.003
44.	Lead	0.01
45.	Lindane (Total)	0.004
46.	Malathion	0.19
47.	Mercury	0.001
48.	Methoxychlor	0.9
49.	Metolachlor	0.05
50.	Metribuzin	0.08
51.	Microcystin LR	0.0015
52.	Monochlorobenzene	0.08
53.	Nitrate (as nitrogen)	10.0
54.	Nitrite (as nitrogen)	1.0
55.	Nitrate + Nitrite (as nitrogen)	10.0
56.	Nitrilotriacetic Acid (NTA)	0.4
57.	N-Nitrosodimethylamine (NDMA)	0.000009
58.	Paraquat	0.01
59.	Parathion	0.05
60.	Pentachlorophenol	0.06
61.	Phorate	0.002
62.	Picloram	0.19
63.	Polychlorinated Biphenyls (PCB)	0.003
64.	Prometryne	0.001
65.	Selenium	0.01
66.	Simazine	0.01
67.	Temephos	0.28
68.	Terbufos	0.001
69.	Tetrachloroethylene (perchloroethylene)	0.03
70.	2,3,4,6-Tetrachlorophenol	0.1
71.	Triallate	0.23
72.	Trichloroethylene	0.05
73.	2,4,6-Trichlorophenol	0.005
74.	2,4,5-Trichlorophenoxy acetic acid (2,4,5-T)	0.28
75.	Trifluralin	0.045
76.	Trihalomethanes	0.100 [b]

77.	Uranium	0.02
78.	Vinyl Chloride	0.002

Footnotes:

[a] Total toxic equivalents when compared with 2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin).

[b] This standard is expressed as a running annual average.

O. Reg. 169/03, Sched. 2; O. Reg. 268/03, s. 1.

SCHEDULE 3
RADIOLOGICAL STANDARDS

Item	Radiological Parameter	Standard (expressed as a maximum in becquerels per litre)
Natural Radionuclides		
1.	Beryllium-7	4000.0
2.	Bismuth -210	70.0
3.	Lead-210	0.1
4.	Polonium-210	0.2
5.	Radium-224	2.0
6.	Radium-226	0.6
7.	Radium-228	0.5
8.	Thorium-228	2.0
9.	Thorium-230	0.4
10.	Thorium-232	0.1
11.	Thorium-234	20.0
12.	Uranium-234	4.0
13.	Uranium-235	4.0
14.	Uranium-238	4.0
Artificial Radionuclides		
15.	Americium-241	0.2
16.	Antimony-122	50.0
17.	Antimony-124	40.0
18.	Antimony-125	100.0
19.	Barium-140	40.0
20.	Bromine-82	300.0
21.	Calcium-45	200.0
22.	Calcium-47	60.0
23.	Carbon-14	200.0
24.	Cerium-141	100.0
25.	Cerium-144	20.0
26.	Cesium-131	2000.0
27.	Cesium-134	7.0

28.	Cesium-136	50.0
29.	Cesium-137	10.0
30.	Chromium-51	3000.0
31.	Cobalt-57	40.0
32.	Cobalt-58	20.0
33.	Cobalt-60	2.0
34.	Gallium-67	500.0
35.	Gold-198	90.0
36.	Indium-111	400.0
37.	Iodine-125	10.0
38.	Iodine-129	1.0
39.	Iodine-131	6.0
40.	Iron-55	300.0
41.	Iron-59	40.0
42.	Manganese-54	200.0
43.	Mercury-197	400.0
44.	Mercury-203	80.0
45.	Molybdenum-99	70.0
46.	Neptunium-239	100.0
47.	Niobium-95	200.0
48.	Phosphorus-32	50.0
49.	Plutonium-238	0.3
50.	Plutonium-239	0.2
51.	Plutonium-240	0.2
52.	Plutonium-241	10.0
53.	Rhodium-105	300.0
54.	Rubidium-81	3000.0
55.	Rubidium-86	50.0
56.	Ruthenium-103	100.0
57.	Ruthenium-106	10.0
58.	Selenium-75	70.0
59.	Silver-108m	70.0
60.	Silver-110m	50.0
61.	Silver-111	70.0
62.	Sodium-22	50.0
63.	Strontium-85	300.0
64.	Strontium-89	40.0
65.	Strontium-90	5.0
66.	Sulphur-35	500.0
67.	Technetium-99	200.0
68.	Technetium-99m	7000.0
69.	Tellurium-129m	40.0
70.	Tellurium-131m	40.0
71.	Tellurium-132	40.0
72.	Thallium-201	2000.0
73.	Tritium	7000.0
74.	Ytterbium-169	100.0

75.	Yttrium-90	30.0
76.	Yttrium-91	30.0
77.	Zinc-65	40.0
78.	Zirconium-95	100.0

Notes:

Radionuclide concentrations that exceed the standard may be tolerated for a short period, as long as the annual average concentrations remain below the standard and the restriction (see immediately below) for multiple radionuclides is met.

Restrictions for multiple radionuclides: If two or more radionuclides are present, the following relationship, based on International Commission on Radiological Protection (ICRP) Publication 26, must be satisfied and, if not satisfied, the standard shall be considered to have been exceeded:

$$\frac{c_1}{C_1} + \frac{c_2}{C_2} + \cdots\cdots \frac{c_i}{C_i} \leq 1$$

where

c_1, c_2 and c_i are the observed concentrations, and C_1, C_2 and C_i are the maximum acceptable concentrations for each contributing radionuclide.

O. Reg. 169/03, Sched. 3.

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Français

InfoPEI

Drinking Water Strategy

Where can I find information about the Drinking Water Strategy?

The Drinking Water Strategy is an action plan to ensure PEI drinking water stays ***clear from the ground to the glass***. The strategy uses a multi-barrier approach to protecting drinking water, focusing on source protection, system design and operation, and monitoring and reporting. These three elements are the foundation of a 10-point strategy which is termed *"10 Points to Purity"*.

The first five points in the *"10 Points to Purity"* relate to private supplies. In PEI, 57 per cent of the population depend on private wells for their drinking water and approximately 40 per cent have onsite sewage disposal systems for wastewater treatment. A high proportion of drinking water quality problems can be directly related to the condition of wells or onsite sewage disposal systems. The second five points in the "10 points to purity" relate to municipal supplies. They are designed to ensure that Islanders who rely on a central water supply system for their drinking water can have confidence in the quality of that water.

1. We will invest in public information materials on planning, construction and maintenance of wells and sewage disposal systems and installation of treatment devices. By fall, 2001.
2. We will expand the current Homeowner's Kit encouraging homeowners to keep records for well construction, pump specifications, logs of water sampling and equipment repair. By fall, 2001.
3. We will invest in a field manual for technical staff to use in site suitability assessment for sewage disposal systems. By fall, 2001.
4. We will revise regulations governing water wells and sewage disposals systems, emphasizing safety, proper grouting, setbacks from possible sources of contamination, and replacement of antiquated and failing septic tanks. By spring, 2002.
5. We will update the site assessment handbook for use by developers in water and sewer servicing. By spring, 2002.
6. We will develop water monitoring and public reporting regulations for central water supply and wastewater treatment systems. By spring, 2002.
7. We will develop Standards and Guidelines for supply, storage, distribution and maintenance of water systems. By fall, 2002.
8. We will enforce mandatory certification for water supply and wastewater operators. By spring, 2003.
9. We will achieve full accreditation by the Standards Council of Canada for the Provincial Water Microbiology and Chemistry Laboratories. By spring, 2003.
10. We will work with municipalities and land owners in development of a strategy for municipal wellfield protection. By spring, 2004.

For More Information

Toll-free: 1-866-368-5044
Website: Drinking Water Strategy Website

Contact

- News Releases
- Feedback
- Print Friendly View

Charlottetown

Jones Building

Young, Jim (Director)

Somers, George (Drinking Water Management Section Manager)

Prince Edward Island

- Legislation
- 1. Public information materials
- 2. Homeowner's kit for wells
- 3. A technical field manual
- 4. Regulations governing water wells and sewage disposal systems
- 5. Site Assessment Handbook for developers
- 6. Water monitoring and public reporting regulations
- 7. Standards and Guidelines
- 8. Operator certification
- 9. Accreditation of Laboratories
- 10. Strategy for municipal wellfield protection

P.E.I.'s Drinking Water Strategy

The title of the Drinking Water Strategy is "10 Points to Purity", and these 10 points highlight areas for improvement in the protection of both private and public water supplies, keeping PEI's groundwater "Clear from the Ground to the Glass".

- P.E.I.'s Drinking Water Strategy – "10 Points to Purity"
  The Drinking Water Strategy takes a multi-barrier approach to protecting drinking water, focusing on source protection, system design and operation, and monitoring and reporting. The Drinking Water Strategy "10 Points to Purity" includes the following elements:

  Private Supplies
  1. Public Information materials
  2. Homeowner's Kit for wells
  3. A technical field manual
  4. Regulations governing water wells and sewage disposal systems
  5. Site Assessment Handbook for developers

  Municipal Supplies
  6. Water monitoring and public reporting regulations
  7. Standards and Guidelines
  8. Certification for water supply and wastewater operators
  9. Accreditation of Laboratories
  10. Strategy for municipal wellfield protection.

- Where can I find information about the Drinking Water Strategy?
  The Drinking Water Strategy is an action plan to ensure PEI drinking water stays clear from the ground to the glass.

Morley Foy 902 368·5036
mmfoy@gov.pe.ca

Gen. 902 368·5044

InfoPEI

Water Quality Interpretation

Water Quality Interpretation

A water supply can be considered unacceptable for drinking purposes based on bacterial analysis; the chemical characteristics of the water such as chlorides, iron and hardness; or the physical characteristics such as odour, taste and colour.

The following report indicates the criteria for drinking water quality according to Health Canada's Guidelines for Canadian Drinking Water Quality. The following are notes relating to the guidelines.

a. Maximum Acceptable Concentration: Drinking water that continually contains a substance at a concentration greater than the maximum acceptable concentration will contribute significantly to consumers' exposure to that substance and may, in some instances, be capable of inducing harmful effects on health.

b. Aesthetic Objective: These apply to certain substances or characteristics of drinking water which can affect its acceptance by consumers or interfere with good water supply practices. The objective concentrations are below that considered to constitute a health hazard.

c. Coliform bacteria are absent. Water is considered in compliance with the coliform MAC.

   If coliform bacteria present:

< 10	Bacteria present, but not sufficient to regard water unfit for drinking. The water should be re-sampled and the source inspected.
> 10 or any faecal	Water is not considered fit for human consumption. Drinking water should be boiled or an alternate source secured. The water should be re-sampled and appropriate remedial action taken.

d. < = less than or equal to.

e. Lead value may be expressed in mg/L or mg/L depending on the type of analysis conducted.

f. An acceptable limit for sodium depends on a person's allowable daily intake. If youare on a low sodium diet, see your physician or appropriate health authority.

g. Public acceptance of hardness varies considerably. Generally, hardness levels between 80 and 100 mg/L (as CaCO3) are considered acceptable; levels greater than 200 mg/L are considered poor, but can be tolerated; those in excess of 500 mg/L are normally considered unacceptable.

Guideline for Drinking Water Quality (from GCDWQ, Health Canada 1996)

Parameter	Maximum Acceptable Concentration [a] (mg/L)	Aesthetic Objective [b] (mg/L)
Coliforms (total or faecal)	0 [c]	
Alkalinity Total		
Ammonia (NH_4-N)		
Cadmium	0.005	
Calcium		

will develop Stds + Guidelines for supply, storage, distn + maintenance

- News Releases
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Chloride		<= 250 [d]
Chromium	0.05	
Copper		<= 1.0
Iron		<= 0.3
Lead	0.01(10ug/L) [e]	
Magnesium		
Manganese		<= 0.05
Nitrate (NO_3-N)	10.0	
pH		6.5 to 8.5
Phosphorous		
Potassium		
Sodium	[f]	<= 200
Sulphate		<= 500
Temperature		<= 15°C
Total Dissolved Solids		<= 500
Total Hardness (as $CaCO_3$)		<= 200 [g]
Zinc		<= 5.0

This document is also available as a PDF file.

Contact

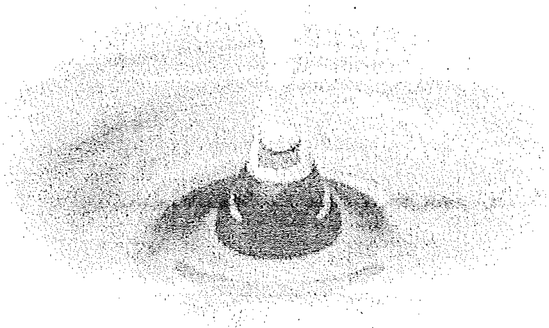
Charlottetown

Jones Building

Mutch, James (Hydrogeologist)

Regulation respecting the quality of drinking water

Highlights



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10 - Schedule I

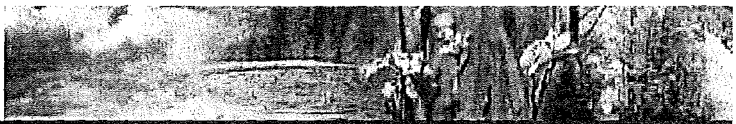
This is different from Regulation

10.1 - Parameters respecting inorganic substances

Table 5 - Parameters respecting inorganic substances

Inorganic substances	Maximum concentration (mg/L)
Arsenic (As)	0.025
Barium (Ba)	1
Boron (B)	5

Environnement Québec



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Wastewaters
Watersheds

Regulation respecting the quality of drinking water

Highlights

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10 - Schedule I

This is different from Regulation

10.1 - Parameters respecting inorganic substances

Table 5 - Parameters respecting inorganic substances

Inorganic substances	Maximum concentration (mg/L)
Arsenic (As)	0.025
Barium (Ba)	1
Boron (B)	5

Glyphosate	280
Malathion	190
Methoxychlor	900
Metolachlor	50
Metribuzin	80
Paraquat (in dichlorides)	10
Parathion	50
Phorate	2
Picloram	190
Simazine	10
Terbufos	1
Trifluralin	45
Other organic substances	**Maximum concentration (μ g/L)**
Benzene	5
Benzo(a)pyrene	0.01
Vinyl chloride	2
1,1-dichloroethylene	14
1,2-dichlorobenzene	200
1,4-dichlorobenzene	5
1,2-dichloroethane	5
Dichloromethane	50
2,4-dichlorophenol	900
Monochlorobenzene	80
Pentachlorophenol	60
Tetrachloroethylene	30
2,3,4,6-tetrachlorophenol	100
Carbon tetrachloride	5
2,4,6-trichlorophenol	5
Trichloroethylene	50
Total trihalomethanes	Yearly average: 80

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10.3 - Definitions of target groups

Enterprise: means any establishment where a commercial, industrial, agricultural, professional or institutional activity is carried out, excluding educational institutions, houses of detention, health and social services institutions and tourist facilities. Sawmills, aluminum smelters, forest camps, convenience stores and garages are designated

as enterprises.

Educational institution: means any institution providing elementary and secondary education and governed by the Education Act (R.S.Q., chapter I-13.3) or by the Education Act for Cree, Inuit and Naskapi Native Persons (R.S.Q., chapter I-14), a private educational institution governed by the Act respecting private education (R.S.Q., chapter E-9.1), an institution whose curriculum is subject to an international agreement within the meaning of the Act respecting the Ministère des Relations internationales (R.S.Q., chapter M-25.1.1), a general and vocational college or a university, a research institute, an academy or educational institution whose operation expenses are paid for by more than half on the budget voted by the National Assembly. For the purposes of this Regulation, child care centres, day care centres, stop-over centres and nursery schools governed by the Act respecting childcare centres and childcare services (R.S.Q., chapter C-8.2) are deemed to be educational institutions.

House of detention: means any establishment used for the detention of persons and governed by the Act respecting correctional services (R.S.Q., chapter S-4.01).

Health and social services institution: means any health and social services institution governed by the Act respecting health services and social services (R.S.Q., chapter S-4.2) or by the Act respecting health services and social services for Cree Native persons (R.S.Q., chapter S-5). For the purposes of this Regulation, any other facility where accommodation services are provided to the elderly or any clientele entrusted by a public establishment governed by one or the other of the aforementioned institution is deemed to be a health and social service institution. Hospitals, local community service centres (CLSC) and senior citizens home are designated as health and social services institutions.

Tourist facility: means any establishment that, for payment, offers the public accommodation, restaurant or camping services. For the purposes of this Regulation, "tourist facility" also includes tourist information offices, roadside rest areas and recreational facilities accessible to the public. Outfitters, campgrounds, inns and restaurants are designated as tourist facilities.

Person in charge of a distribution system: means the owner or operator of a system.

Distribution system: means mains or a system of mains used for supplying drinking water to human beings. In the case of an immovable connected to a waterworks system, any mains supplying that immovable and located downstream from the stop valve serving the immovable shall be excluded. Municipal networks, mobile parks and smaller private networks are designated as distribution systems.

10.4 - Glossary

Enterococci bacteria: bacteria that are naturally present in the digestive tract of people and animals. They are used as indicators of fecal contamination.

Facultatively aerobic or anaerobic heterotrophic bacteria (AAHB): a total count of the bacteria present in water. Counts exceeding 500/ml harm growth and prevent the counting of coliform bacteria. Such concentrations are abnormal in water that is properly treated and distributed in a properly maintained system since they indicate the absence or insufficiency of free residual chlorine.

Chloramination: a disinfection method that consists of mixing chlorine with ammonia to generate chloramines, whose disinfectant power is lower than chlorine but which are more stable, thereby permitting better penetration of the biofilm present throughout distribution mains. Chloramination does not produce THMs.

Fecal coliforms: bacteria of fecal origin that are used as indicators of pollution or contamination by microorganisms likely to be pathogens.

Total coliforms: bacteria used as indicators of pollution or microbiological contamination.

Atypical colonies: Bacterial colonies that are not metallic green in colour in coliform counts using the membrane filtration method and in coliform growth when there are more than 200/100 ml.

Residual disinfectant: chemical agent used to disinfect; remains a certain time after being applied.

Continuous disinfection: treatment that destroys pathogenic microorganisms in a given environment on an ongoing basis.

Water designed for human consumption: water designed for individual or collective household use (drinking water, water for cleaning, washing clothes, watering lawns and gardens).

Escherichia coli: type of bacteria belonging to the coliform group. Their presence indicates recent contamination by fecal matter and the possible presence of pathogenic microorganisms.

Membrane filtration: water monitoring process performed using a filter made of a synthetic membrane.

Pathogenic organism: microorganism that can cause illness or disease.

pH: measure of a liquid's or soil's acidity or alkalinity.

THM (Trihalomethanes): volatile organic compounds resulting from the chlorination of water.

Turbidity: the condition of turbid or cloudy water. Turbidity is

expressed in nephelometric turbidity units.

Coliphage virus: Type of virus that infects mainly E. coli bacteria used as an indicator of possible fecal contamination.

Québec

Latest version available
Updated to 9 November 2004

c. Q-2, r.18.1.1

Regulation respecting the quality of drinking water

Environment Quality Act

(R.S.Q., c. Q-2, s. 31, pars. *e*, *h*.1 and *h*.2, ss. 45, 45.2, par. *a*, s. 46, pars. *a*, *b*, *d*, *m*, *o*, *o*.1 and *o*.2, s. 87, pars. *a* and *b*, ss. 109.1and 124.1)

CHAPTER I
GENERAL

1. For the purposes of this Regulation,

(1) "enterprise" means any establishment where a commercial, industrial, agricultural, professional or institutional activity is carried on, excluding educational institutions, houses of detention, health and social services institutions and tourist establishments;

(2) "educational institution" means any institution providing preschool, elementary or secondary education and governed by the Education Act (R.S.Q., c. I-13.3) or by the Education Act for Cree, Inuit and Naskapi Native Persons (R.S.Q., c. I-14), a private educational institution governed by the Act respecting private education (R.S.Q., c. E-9.1), an institution whose instructional program is the subject of an international agreement within the meaning of the Act respecting the Ministère des Relations internationales (R.S.Q., c. M-25.1.1), a general and vocational college, a university, a research institute, a superior school or an educational institution of which more than one-half of the operating expenditures are paid out of the appropriations voted by the National Assembly. For the purposes of this Regulation, childcare centres, day care centres, stop-over centres and nursery schools governed by the Act respecting childcare centres and childcare services (R.S.Q., c. C-8.2) are deemed to be educational institutions;

(3) "house of detention" means any establishment used for the detention of persons and governed by the Act respecting correctional services (R.S.Q., c. S-4.01);

(4) "health and social services institution" means any health and social services institution governed by the Act respecting health services and social services (R.S.Q., c. S-4.2) or by the Act respecting health services and social services for Cree Native persons (R.S.Q., c. S-5). For the purposes of this Regulation, any other place where lodging services are provided for senior citizens or for any users entrusted by a public institution governed by any of the aforementioned acts is also a health and social services institution;

(5) "tourist establishment" means any establishment which offers to the public, in return for payment, sleeping accommodations, restaurant services or camping sites. For the purposes of this Regulation, tourist information offices, rest areas and leisure establishments open to the public are deemed to be tourist establishments;

(6) "person in charge of a distribution system" means the owner or operator of a system; and

(7) "distribution system" means mains or a system of mains used for supplying drinking water to human beings. In the case of an immovable connected to a waterworks system, any mains supplying that immovable and located downstream from the shut-off valve serving the immovable shall be excluded.

O.C. 647-2001, s. 1.

2. The provisions of this Regulation do not apply to water whose use or distribution is governed by the Food Products Act (R.S.Q., c. P-29).

O.C. 647-2001, s. 2.

3. Drinking water must, where it is put at the disposal of a user, comply with the standards of quality defined in Schedule 1.

O.C. 647-2001, s. 3.

CHAPTER II
FILTRATION AND DISINFECTION

4. The provisions of this Chapter do not apply to a distribution system that supplies only:

(1) one residence;

(2) one or several enterprises;

(3) one residence and one or several enterprises.

O.C. 647-2001, s. 4.

5. Water supplied by a distribution system must have undergone, before being supplied, a continuous filtration and disinfection treatment if it comes in whole or in part from surface water or from groundwater whose microbiological quality is likely to be altered by surface water because of the non-permeability of collection or storage facilities.

The treatment prescribed by this section must be able to eliminate at least 99.99 % of viruses, 99.9 % of *Giardia* cysts and 99 % of *Cryptosporidium* oocysts.

Notwithstanding the foregoing, the filtration treatment is not mandatory where raw water that supplies the distribution system meets the following conditions:

(1) its turbidity is lower than or equal to 5 NTU (nephelometric turbidity unit), subject to the provisions of subparagraph 2 below;

(2) during at least 90 consecutive days, one sample of water per week is collected and, in at least 90 % of those samples,

- the turbidity of water is lower than 1 NTU;

- its content in total organic carbon is lower than or equal to 3 mg/L; and

- less than 20 fecal coliform bacteria and less than 100 total coliforms per 100 millilitres of water collected are counted;

(3) the quality of that water is not likely to be altered by contaminants from wastewater collection or treatment systems, or from agricultural activities such as the storing or spreading of livestock waste.

O.C. 647-2001, s. 5.

6. Any continuous disinfection treatment facility of water supplied by a distribution system must, if it comes from groundwater, be able to eliminate at least 99.99 % of viruses.

O.C. 647-2001, s. 6.

7. Water supplied by a distribution system must, if it comes from groundwater for which the analyses carried out pursuant to section 13 or 39 revealed the presence of fecal contamination, have undergone, before being supplied, a continuous disinfection treatment.

O.C. 647-2001, s. 7.

8. Where the water supplied by a distribution system is continuously chlorinated, it shall, at the outlet of the treatment facility or, where that facility has a disinfected water reservoir, at the outlet of that reservoir, have a content of free residual chlorine of at least 0.3 mg/L.

If disinfection is carried out by means of a process other than chlorination, that process shall, under the same conditions, provide a residual disinfection potential at least equivalent to that which would be obtained by chlorination.

The provisions of this section do not apply to a distribution system that supplies only one building.

O.C. 647-2001, s. 8.

9. Any distribution system that supplies disinfected water must be equipped with standby equipment to ensure disinfection in case of emergency, particularly if the main treatment facility breaks down.

O.C. 647-2001, s. 9.

CHAPTER III
QUALITY CONTROL OF DRINKING WATER

DIVISION I
WATER SUPPLIED BY DISTRIBUTION SYSTEMS

10. The provisions of this Division do not apply to a distribution system that supplies 20 persons or less.

They do not apply to a distribution system that supplies only one or several enterprises.

O.C. 647-2001, s. 10.

§ 1. Bacteriological control

11. The person in charge of a distribution system must, for the control of total coliform bacteria and fecal coliform bacteria or *Escherichia coli* bacteria, collect or have samples of the water supplied collected according to the frequency determined in the following table:

[Q-2R18.1.1#01 see 2002 G.O. 2, 1670]

Users	Minimum number of samples to collect or to have collected per month
21 to 1 000 persons	2
1 001 to 8 000 persons	8
8 001 to 100 000 persons	1 per 1 000 persons
100 001 persons and more exceeding 100 000 persons	100 + 1 per group of 10 000 persons

The samples to be collected pursuant to the first paragraph must be collected from the tap of different users, after the water has run for at least 5 minutes on the same day of sampling. In addition, the water thus collected must not have undergone treatment by means of an individual device.

Where possible, those samples shall be spread in equal numbers over each of the weeks in the month; if the number of samples is less than 4, they shall be collected at an interval of at least 7 days.

O.C. 647-2001, s. 11; O.C. 301-2002, s. 1.

12. At least 50 % of the samples prescribed by section 11 must be collected at the outermost limits of the distribution system and have as its object the analysis of facultatively aerobic or anaerobic heterotrophic bacteria, in addition to total coliform bacteria and fecal coliform bacteria or *Escherichia coli* bacteria.

The provisions of this section do not apply to a distribution system that supplies only one building.

O.C. 647-2001, s. 12.

13. Where the water supplied by a distribution system comes in whole or in part from non-disinfected and vulnerable groundwater, the person in charge of the distribution system is also bound, to control *Escherichia coli* bacteria, enterococci bacteria and coliphage viruses, to collect or have at least one sample of raw water that supplies the distribution system collected every month.

For the purposes of this section, groundwater is considered vulnerable where the following conditions are met:

(1) after the assessment according to the DRASTIC method, that groundwater has a vulnerability number greater than 100 within the perimeters of the protected supply area of the collection site, established on the basis of a migration time of groundwater of 550 days for a virological protection and 200 days for a bacteriological protection;

(2) within the aforementioned protection perimeters, there are works or activities likely to alter the microbiological quality of that water.

O.C. 647-2001, s. 13.

§ 2. Physical and chemical control

Control of inorganic substances

14. The person in charge of a distribution system must, for the control of inorganic substances referred to in Schedule 1 (excluding nitrates, chloramines, bromates and antimony), collect or have at least one sample of the water supplied collected annually between July 1st and October 1st.

He must also, for the control of nitrates, collect or have at least one sample of the water supplied collected annually during each of the quarters beginning respectively on January 1st, April 1st, July 1st and October 1st, with a minimum interval of 2 months between samplings.

O.C. 647-2001, s. 14.

15. Where the water supplied by a distribution system is subject to ozonation, the person in charge of the system must, to control bromates, collect or have at least one sample of the water supplied collected annually between July 1st and October 1st.

If the water supplied is disinfected with chloramines, the person in charge of the distribution system must also collect or have at least one sample of the water collected for the purposes of measuring, during the sampling, the concentration of chloramines and enter the results in the analysis report prescribed by the Minister of the Environment.

O.C. 647-2001, s. 15.

16. The sampling methods provided for in the second paragraph of section 11 shall apply to the samples prescribed under sections 14 and 15, which must be collected at the central point of the distribution system.

O.C. 647-2001, s. 16.

17. For each of the samples collected pursuant to the second paragraph of section 14, the person in charge of the distribution system must, at the time of the sampling, measure the pH of the water and enter the results in the analysis report prescribed by the Minister of the Environment.

O.C. 647-2001, s. 17.

Control of organic substances

18. . The person in charge of a distribution system that supplies chlorinated water must, for the control of trihalomethanes referred to in Schedule 1, collect or have at least one sample of the water supplied collected annually, during each of the quarters beginning respectively on January 1st, April 1st, July 1st and October 1st, with a minimum interval of 2 months between samplings.

Notwithstanding the preceding paragraph, if the aforementioned system supplies only a tourist establishment, a health and social services institution, an educational institution or a house of detention, the person in charge of the system is bound to make only one sampling of the water supplied per year, between July 1st and October 1st to control trihalomethanes.

O.C. 647-2001, s. 18.

19. The person in charge of a distribution system that supplies more than 5 000 persons must, for the control of organic substances referred to in Schedule 2, collect or have at least one sample of the water supplied collected annually during each of the quarters beginning on January 1st, April 1st, July 1st and October 1st, with a minimum interval of 2 months between samplings.

O.C. 647-2001, s. 19.

20. The sampling methods provided for in the second paragraph of section 11 shall apply to the samples prescribed under sections 18 and 19, which must be collected at the outermost limits of the distribution system.

O.C. 647-2001, s. 20.

Control of turbidity

21. The person in charge of a distribution system must, for turbidity control purposes, collect or have at least one sample of the water supplied collected per month.

The sampling methods provided for in the second paragraph of section 11 shall apply to the samples prescribed above, which must be collected at the central point of the distribution system.

O.C. 647-2001, s. 21.

§ 3. Disinfection control

22. Any continuous disinfection treatment facility of the water supplied by a distribution system must be equipped with a continuous measuring device of the free residual disinfectant, installed at the outlet of the facility or, where the facility has a disinfected water reservoir, at the outlet of that reservoir; the device must be equipped with an alarm system in case of breakdown or defect of the facility or noncompliance with the prescriptions of section 8.

It must also, if the water supplied is subject to an ultraviolet radiation disinfection treatment, be equipped with a safety device designed to indicate any reduction of the intensity of lamps below the required level.

In addition, any disinfection treatment facility that treats water supplied by a distribution system referred to in section 5 must be equipped with a continuous measuring device of the turbidity of the water installed after each filter or, in the absence of filtration, at the outlet of that facility; the device must be equipped with an alarm system in case of noncompliance with the prescriptions of this Regulation related to turbidity.

The owner or operator of the disinfection treatment facility must enter daily in a register, for each 4-hour period, the lowest content of free residual disinfectant measured during that period, a measure of the flow rate of the water as well as, in the case referred to in the third paragraph, a measure of the turbidity. He must also measure daily, and enter in the register, the pH and water temperature in a sample collected at the outlet of the treatment facility or, where the facility has a disinfected water reservoir, at the outlet of that reservoir. The date on which those measures were taken and the names of the persons who took them must also appear in the register. The register shall be preserved and kept at the disposal of the Minister of the Environment for at least 5 years.

The provisions of the first, third and fourth paragraphs do not apply to a distribution system that supplies only a health and social services institution, an educational institution, a house of detention or a tourist establishment.

O.C. 647-2001, s. 22.

23. The person in charge of a distribution system that supplies disinfected water must, during each sampling carried out pursuant to section 11, measure the quantity of free residual disinfectant in a water sample collected for that purpose and enter the result in the analysis report prescribed by the Minister of the Environment.

The provisions of this section do not apply to a distribution system that supplies only one building.

O.C. 647-2001, s. 23.

24. Where the analysis of a sample of disinfected water coming from a distribution system referred to in section 5 and collected pursuant to section 21 shows that the turbidity of that water exceeds 0.5 NTU (nephelometric turbidity unit), the person in charge of the distribution system is bound, as soon as he is informed, either

- to check, using the register constituted under section 22, the measures of turbidity carried out during the period of 30 consecutive days that preceded the sampling or, if he is not the owner or operator of the treatment facility, request that the owner or operator do the aforementioned checking which must be done without delay; or

- to notify the Minister of the Environment of that excess and to check if the disinfection treatment has the effectiveness required by section 5, second paragraph, where he is exempted from the obligations prescribed by the first, third and fourth paragraphs of section 22.

O.C. 647-2001, s. 24.

25. Where the analysis of a disinfected water sample coming from a distribution system referred to in section 6 and collected pursuant to section 21 shows that the turbidity of the water exceeds 1 NTU (nephelometric turbidity unit), the person in charge of that system must, as soon as he is informed thereof, notify the Minister of the Environment of that excess and check if the disinfection treatment has the effectiveness required by section 6.

O.C. 647-2001, s. 25.

DIVISION II
WATER SUPPLIED BY TANK TRUCK

26. The provisions of Division I are applicable, mutatis mutandis, to drinking water supplied by tank truck to more than 20 persons. Thus, the owner or operator of a tank truck is bound by the same obligations as those devolving upon the person in charge of a distribution system under the aforementioned provisions. The samples prescribed by those provisions shall be collected at the outlet of the tank ; section 12 does not apply to the water supplied by tank truck.

O.C. 647-2001, s. 26.

27. Drinking water supplied by tank truck must have undergone a chlorination treatment before being put at the disposal of a user.

In addition, the water contained in the tank must at all times have a concentration of free residual chlorine equal to or greater than 0.2 mg/L.

O.C. 647-2001, s. 27.

28. The owner or operator of a tank truck who supplies drinking water must, at least once a day, measure the quantity of free residual chlorine in a water sample collected at the outlet of the tank.

In addition, he shall keep an up-to-date register in which the date and results of the measurements prescribed above are entered along with the names of the persons who took them. That data shall be preserved and kept at the disposal of the Minister for a minimum period of 5 years

O.C. 647-2001, s. 28.

29. The tank of a vehicle used to supply drinking water may not be used to transport other materials likely to contaminate that water.

O.C. 647-2001, s. 29.

DIVISION III
METHODS, ANALYSES AND RESULTS

30. The water samples prescribed by the provisions of this Regulation must be collected and preserved in accordance with the methods described in the document entitled Methods for Taking and Preserving Samples for the Application of the Regulation respecting the quality of drinking water and published by the Ministère de l'Environnement.

Anyone who collects or has a water sample collected pursuant to this Regulation must certify that the sampling and preservation of that sample complies with the requirements prescribed under the Regulation. That certification shall be preserved and kept at the disposal of the Minister of the Environment for at least 5 years.

O.C. 647-2001, s. 30.

31. The water samples collected pursuant to subparagraph 2 of the third paragraph of section 5, sections 11 to 14, the first paragraph of section 15, sections 18 to 21, 26, 27, 39, 40 and 42 shall be sent, for analysis purposes, to laboratories accredited by the Minister of the Environment under section 118.6 of the Environment Quality Act. The analysis reports prescribed by the Minister shall also be sent with those samples.

O.C. 647-2001, s. 31.

32. The water samples collected pursuant to the second paragraph of section 15, section 17, the fourth paragraph of section 22, section 23 and the first paragraph of section 28 must be analysed in accordance with the methods described in the Standard Methods for the Examination of Water and Wastewater published by the American Water Works Association, the Water Environment

Federation and the American Public Health Association.

The person who carries out the analysis of one of those samples shall certify that the analysis complies with the aforementioned methods; that certification shall be preserved and kept at the disposal of the Minister of the Environment, for at least 5 years.

O.C. 647-2001, s. 32.

33. The laboratory shall send to the Minister of the Environment, by electronic means and on the record prescribed by the Minister, the results of the analyses of the water samples referred to in section 31 and the data entered in the analysis reports received under that section, within 10 days of the sampling in the case of samples for the control of microorganisms, free residual disinfectant or turbidity or, in the case of samples for the control of other parameters, within 60 days of the sampling.

O.C. 647-2001, s. 33.

CHAPTER IV
NONCOMPLIANCE OF WATER WITH THE STANDARDS OF QUALITY

34. The provisions of the second paragraph of section 35 and sections 36 to 41 do not apply to a distribution system that supplies only one residence.

O.C. 647-2001, s. 34.

35. The laboratory that analyses a water sample must immediately inform the person in charge of the distribution system in question or, as the case may be, the owner or operator of the tank truck, of any result revealing that the water at the disposal of a user does not comply with any of the standards of quality defined in Schedule 1 or contains total coliform bacteria.

The laboratory must immediately inform the Minister of the Environment and the public health director of the region in question of any result showing noncompliance with a standard of quality defined in Schedule 1.

O.C. 647-2001, s. 35.

36. Where the water at the disposal of a user does not comply with any of the standards of quality established in Schedule 1, the person in charge of the distribution system or, as the case may be, the owner or operator of the tank truck from where the water comes must, as soon as he is informed thereof, notify the Minister of the Environment and the public health director of the region in question of the measures taken to remedy the situation and, where applicable, to protect the users from any risks involved.

If the water contains fecal coliform bacteria or *Escherichia coli* bacteria, the person in charge of the distribution system or the owner or operator of the tank truck is also bound to notify the users in question, as soon as he is informed thereof, through the media or by forwarding individual written notices, that the water at their disposal is unfit for consumption and that precautions must be taken, in particular, boiling the water for at least one minute before drinking it. If, among the users in question, there are health and social services institutions or educational institutions, they must be notified individually. The Minister of Agriculture, Fisheries and Food, responsible under the Food Products Act for protecting the health and safety of consumers, must also be notified thereof as soon as possible.

The notices to be given to users shall be given at least once every 2 weeks and until it is shown, in accordance with section 39, that the water supplied is free from total coliform bacteria and complies with the standards of quality determined in Schedule 1 with respect to other analysed microorganisms. The person in charge of the distribution system or the owner or operator of the tank truck must send immediately to the Minister of the Environment and to the public health director a written notice stating that the notices to be given to users were given according to the methods prescribed.

For the purposes of this section, `users in question´ means, in the case of a distribution system, all those persons who, considering the hydraulic features of the system, are likely to be supplied with contaminated water.

O.C. 647-2001, s. 36.

37. Where another distribution system is connected to his system and where users of that system are also likely to be supplied with contaminated water, or a tank truck is supplied with drinking water directly by his system, the person in charge of the distribution system referred to in the first or second paragraph of section 36 must also immediately notify the person in charge of that other system or, as the case may be, the owner or operator of the vehicle of the problem.

O.C. 647-2001, s. 37.

38. The person in charge of an educational institution, a health and social services institution or a tourist establishment supplied by a distribution system or by a tank truck that was subject to a notice given pursuant to the second paragraph of section 36 must, as soon as he is informed that the water at the disposal of users is unfit for consumption, post a notice everywhere in the institution where the water is made available for consumption purposes and interrupt any water service from drinking fountains supplied with contaminated water.

If the distribution system or the tank truck that is subject to a notice given pursuant to the second paragraph of section 36 supplies a house of detention or an enterprise, the person in charge of that house or enterprise must, as soon as he is aware of the notice, notify the users thereof within the house or enterprise.

O.C. 647-2001, s. 38.

39. Where the analysis of a sample collected from a distribution system or tank truck shows that the water contains *Escherichia coli* bacteria or that it does not comply with one of the parameters set out in Schedule 1 respecting other bacteria, the person in charge of the distribution system or the owner or operator of the vehicle is bound to collect or have the minimum number of samples of the water supplied collected, during 2 consecutive days, as provided for in the table below for bacteriological control purposes.

[Q-2R18.1.1#02 see G.O. 2, 2647]

Users in question	Minimum number of samples to collect or to have collected per day
5000 persons or less	4
5001 to 20 000 persons	1 per 1000 persons

20 001 persons and more	20

In the case of disinfected water, he must also measure in each of the collected samples the quantity of free residual disinfectant and enter the result of those measures in the report prescribed by the Minister.

In the case of non-disinfected water for which analyses revealed the presence of fecal coliform bacteria or *Escherichia coli* bacteria, at least 2 samples of raw groundwater that supplies the system must be collected per day during 2 consecutive days, for the purposes of checking the presence of *Escherichia coli* bacteria and enterococci bacteria.

The sampling methods provided for in the second paragraph of section 11 shall apply to the sampling prescribed by the first paragraph. Where the person in charge of the distribution system or the owner or operator of the tank truck from which the water sample comes does not have access by road to an accredited laboratory, the sampling prescribed by this section may be carried out during the same day provided that there is an interval of at least 2 hours between each sampling. The water samples collected under this section may not be taken into account for the purposes of the sampling prescribed by section 11.

Water supplied by the distribution system or tank truck referred to in the first paragraph may be considered as complying again with the bacteriological parameters indicated in Schedule 1 only if the analysis of the samples collected under that paragraph has shown a complete absence of total coliform bacteria and compliance of the water with the aforementioned parameters regarding other analyzed bacteria.

O.C. 647-2001, s. 39.

40. Where the analysis of a sample collected in a distribution system or a tank truck shows that the water does not comply with any of the parameters set out in Schedule 1 respecting organic substances (excluding trihalomethanes) or inorganic substances, radioactive substances or activities, pH or turbidity, the person in charge of the distribution system or the owner or operator of the vehicle is bound to collect or have at least one sample of the water supplied collected during 2 consecutive days to control those parameters.

Water supplied by that distribution system or vehicle may be considered as complying again with the aforementioned parameters only if the analysis of the samples collected has shown that compliance.

The sampling methods provided for in the second paragraph of section 11 shall apply to the samples prescribed by the first paragraph of this section, which must be collected in the central part of the distribution system. The provisions of the fourth paragraph of section 39 shall also apply, *mutatis mutandis*. Finally, the water samples collected under this section may not be taken into account for the purposes of the sampling prescribed by sections 14, 15 and 21.

O.C. 647-2001, s. 40.

41. As soon as the water supplied by a distribution system or tank truck that was subject to a notice given pursuant to section 36 is in compliance again with the standards of quality set out in Schedule 1, the person in charge of the system or the owner or operator of the vehicle shall so inform any person or institution that had to be notified by him under that section, following the same methods as those prescribed by that section.

O.C. 647-2001, s. 41.

42. If he has reasons to suspect that the water supplied does not comply with the standards of quality set out in Schedule 1, the person in charge of the distribution system or, as the case may be, the owner or operator of the tank truck is bound to take as soon as possible the appropriate measures to check adequately the quality of that water.

O.C. 647-2001, s. 42.

CHAPTER V
COMPETENCE REQUIRED

43. The provisions of this Chapter do not apply to a distribution system or tank truck that supplies only:

(1) one residence;

(2) one or several enterprises;

(3) one residence and one or several enterprises.

O.C. 647-2001, s. 43.

44. Only competent persons may be in charge of the operation of a distribution system, a collection facility of water supplied by that system and a filtration or disinfection treatment facility of that water.

Within the meaning of this section, "competent persons" means persons who hold a diploma, certificate or other attestation issued in matters of drinking water purification or treatment recognized by the Minister of Education or by Emploi-Québec or by the Minister responsible therefor. The attestations issued for the purposes of this section, excluding the diplomas obtained from the Minister of the Environment, shall be renewed every 5 years.

The competence obligation prescribed by this section also applies to persons who supply drinking water by tank truck.

O.C. 647-2001, s. 44.

CHAPTER VI
PENAL

45. Any person, in contravention of section 3, who puts at the disposal of a user drinking water that does not comply with the standards of quality set out in Schedule 1 is liable

(1) to a fine of 1 000 $ to 20 000 $ in the case of a natural person;

(2) to a fine of 2 000 $ to 40 000 $ in the case of a legal person.

O.C. 647-2001, s. 45.

46. In the case of a contravention of any of the provisions of sections 5 to 9, 24, 27, 29, 36, 42 and 44, the owner or operator of the distribution system, disinfection treatment facility or tank truck, as the case may be, is liable to the fines provided for in section 45.

The person who enters false or inaccurate data in the register or report referred to in sections 22, 23, 28 and 39 or who omits to enter therein the data prescribed by those sections is liable to the same fines.

O.C. 647-2001, s. 46.

47. Any offence against section 35 or 38 makes the offender liable to the fines provided for in section 45.

O.C. 647-2001, s. 47.

48. Any person who commits an offence against the provisions of this Regulation and not covered by sections 45 to 47 is liable

(1) to a fine of 500 $ to 10 000 $ in the case of a natural person; and

(2) dto a fine of 1 000 $ to 20 000 $in the case of a legal person.

O.C. 647-2001, s. 48.

49. . In the case of a subsequent offence, the fines provided for in sections 45 to 48 shall be doubled.

O.C. 647-2001, s. 49.

CHAPTER VII
MISCELLANEOUS AND FINAL

50. This Regulation applies in particular to immovables included in reserved areas and agricultural zones established under the Act respecting the preservation of agricultural land and agricultural activities (R.S.Q., c. P-41.1).

O.C. 647-2001, s. 50.

51. Omitted.

O.C. 647-2001, s. 51.

52. *Amendment integrated into chapters F-4.1, r. 1.001.1, P-29, r. 1, P-30, r. 14.1 and Q-2, r. 7.*

O.C. 647-2001, s. 52.

53. The distribution systems the water supplied by which on the 28 June 2001 comes in whole or in part from surface water and is not subject to any treatment including flocculation, slow filtration or membrane filtration shall be exempt from the application of the provisions of section 5

- until 28 June 2005 where they supply less than 50 000 persons ;

- until 28 June 2007 where they supply 50 000 persons or more.

The persons in charge of those systems will have to, however, no later than 28 June 2002, provide the Minister of the Environment with a description of the measures that will be implemented, accompanied by an implementation schedule, in order to guarantee that those systems will meet the requirements contemplated in section 5 no later than the expiry of the period of exemption provided for in the first paragraph.

The exemption from which a distribution system benefits under the first paragraph will cease however to apply if the system is subject to a notice given pursuant to the second paragraph of section 36.

O.C. 647-2001, s. 53; O.C. 301-2002, s. 2.

54. The Minister of the Environment must, no later than on 15 June 2006, and thereafter every 5 years, draw up a report to the Government on the implementation of this Regulation, in particular on the opportunity to change the standards of quality of drinking water considering the scientific and technical knowledge of the time.

That report shall be available to the public no less than 15 days after it has been sent to the Government.

O.C. 647-2001, s. 54.

55. This Regulation comes into force on 28 June 2001, except section 44 which will take effect on 1 December 2005.

O.C. 647-2001, s. 55; O.C. 301-2002, s. 3; O.C. 586-2004, s. 1.

ANNEXE 1

STANDARDS OF QUALITY OF DRINKING WATER

1. Microbiological parameters

(a) Water collected for microbiological analysis purposes must be free from pathogenic organisms and indicator organisms of fecal contamination, such as fecal coliform bacteria, *Escherichia coli*bacteria, enterecocci bacteria and coliphage viruses;

(b) Water must not contain more than 10 total coliforms per 100 millilitres of water collected where a technique is used to count them;

(c) Where, pursuant to section 11, 21 water samples or more are collected over a period of 30 consecutive days, at least 90 % of the samples must be free from total coliform bacteria;

(d) Where, pursuant to section 11, less than 21 water samples are collected over a period of 30 consecutive days, only one of the samples may contain total coliform bacteria;

(e) Water must not contain more than 200 atypical colonies per membrane where the membrane filtration technique is used to count total coliforms;

(f) Water must not contain bacteria in such quantity that they may not be identified nor counted where the membrane filtration technique is used to count total coliforms and fecal coliform bacteria in 100 millilitres of water collected;

(g) Water must not contain more than 500 facultatively aerobic or anaerobic heterotrophic bacteria per millilitre of water collected, after incubation at 35 °C for 48 hours.

2. Parameters respecting inorganic substances

Water must not contain inorganic substances in a concentration greater than those indicated in the table below:

[Q-2R18.1.1#03 see 2001 G.O. 2. 2650]

Inorganic substances	Maximum concentration (mg/L)
Antimony	0.006
Arsenic (As)	0.025
Barium (Ba)	1
Boron (B)	5
Bromates	0.010
Cadmium (Cd)	0.005
Chloramines	3
Cyanides (CN)	0.2
Fluorides (F)	1.5
Lead (Pb)	0.01
Nitrates + nitrites (expressed as N)	10
Nitrites (expressed as N)	1
Mercury (Hg)	0.001
Selenium (Se)	0.01
Total chromium (Cr)	0.05
Uranium (U)	0.02

3. Parameters respecting organic substances

Water must not contain organic substances in a concentration greater than those indicated in the following tables:

[Q-2R18.1.1#04 see 2001 G.O. 2, 2650]

Pesticides	Maximum concentration (μg/L)
Aldicarb and its metabolites	9
Aldrin and dieldrin	0.7
Atrazine and its metabolites	5

Azinphos-methyl	20
Bendiocarb	40
Bromoxynil	5
Carbaryl	90
Carbofuran	90
Chlorpyrifos	90
Cyanazine	10
Diazinon	20
Dicamba	120
2,4-dichlorophenoxyacetic acid (2,4-D)	100
Diclofop-methyl	9
Dimethoate	20
Dinoseb	10
Diquat	70
Diuron	150
Glyphosate	280
Malathion	190
Methoxychlor	900
Metolachlor	50
Metribuzin	80
Paraquat in (dichlorides)	10
Parathion	50
Phorate	2
Picloram	190
Simazine	10
Terbufos	1
Trifluralin	45

Other organic substances	Maximum concentration ($\mu g/L$)

Benzene	5
Benzo(a)pyrene	0.01
Carbon tetrachloride	5
1,1-dichloroethylene	14
1,2-dichlorobenzene	200
1,4-dichlorobenzene	5
1,2-dichloroethane	5
Dichloromethane	50
2,4-dichlorophenol	900
Monochlorobenzene	80
Nitrilotriacetic acid (NTA)	400
Pentachlorophenol	60
Tetrachloroethylene	30
2,3,4,6-tetrachlorophenol	100
2,4,6-trichlorophenol	5
Trichloroethylene	50
Vinyl chloride	2

Other organic substances	Maximum annual average concentration (μg/L)
Total trihalomethanes (chloroform, bromodichloromethane, chlorodibromomethane and bromoform)	80

4. Parameters respecting radioactive substances

Water must not contain radioactive substances in a concentration greater than those indicated in the following table:

[Q-2R18.1.1#05 see 2001 G.O. 2, 2651

Radioactive substances or activities	Maximum concentration (Bq/L)
Cesium-137	10
Gross alpha activity	0.1

Gross beta activity	1
Iodine-131	6
Radium-226	0.6
Strontium-90	5
Tritium	7000

5. Parameters respecting pH

The pH of water must not be greater than 8.5 nor less than 6.5.

6. Parameters respecting turbidity

The turbidity of water must be less than or equal to 5 NTU (nephelometric turbidity units).

In addition, in the case of filtered or disinfected water, the turbidity must not exceed 0.5 NTU in more than 5 % of the measures entered in the register pursuant to section 22 over a period of 30 consecutive days ; notwithstanding the preceding, the limit of 0.5 NTU will be either increased to 1 NTU if filtration is carried out by means of a slow filtration process or with diatomaceous earth, or decreased to 0.1 NTU if it is carried out by means of a membrane filtration process.

O.C. 647-2001, sch. 1.

SCHEDULE 2

(s.19)

ORGANIC SUBSTANCES

[Q-2R18.1.1#06 see 2001 G.O. 2, 2651]

Pesticides
Atrazine and its metabolites
Azinphos-methyl
Bromoxynil
Carbaryl
Carbofuran
Chlorpyrifos
Cyanazine
Diazinon

Dicamba
2,4-dichlorophenoxyacetic acid (2,4-D)
Dimethoate
Diquat
Diuron
Glyphosate
Malathion
Methoxychlor
Metolachlor
Metribuzin
Paraquat (in dichlorides)
Parathion
Phorate
Picloram
Simazine
Terbufos
Trifluralin
Other organic substances
Benzene
Benzo(a)pyrene
Carbon tetrachloride
1,1-dichloroethylene
1,2-dichlorobenzene
1,4-dichlorobenzene
1,2-dichloroethane
Dichloromethane
2,4-dichlorophenol
Monochlorobenzene
Pentachlorophenol
Tetrachloroethylene

2,3,4,6-tetrachlorophenol
2,4,6-trichlorophenol
Trichloroethylene
Vinyl chloride

O.C. 647-2001, sch. 2.

O.C. 647-2001, 2001 G.O. 2, 2641
O.C. 301-2002, 2002 G.O. 2, 1669
O.C. 586-2004, 2004 G.O. 2, 2023

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table Concentration (MAC)

aximum Acceptable
entration (IMAC)

tic Objective (AO)

l Color Unit (ACU)

ric Turbidity Unit (NTU)

ns per Litre (mg/L)

Filtration - When monthly source water ave[illegible] is less than 1.5 NTU	measurements or 95% time if continu[illegible] monitoring employed	consecutive hours if c[illegible]tinuous monitoring employed	
Surface water[1,2]: Membrane Filtration	Less than 0.1 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	No stated standard	Never to exceed 0.3 NTU
Surface water[1,2]: Slow Sand or Diatomaceous Earth Filtration	Less than 1.0 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	Not to exceed 1.0 NTU for more than 12 consecutive hours if continuous monitoring employed	Never to exceed 3.0 NTU
Groundwater[3]	Less than 1.0 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	No stated standard	No stated standard - see permit

[1] Includes surface waters and groundwater under the influence of surface water. [2] Turbidity value measured from each filter effluent. [3] Turbidity value for water entering the distribution system. Other requirements apply for novel surface water treatment technologies.

Chemical Health/Pesticides/Radiological

These include a range of substances that are known or suspected to cause adverse effects on health. These values have been derived to safeguard health on the basis of life long consumption. Compliance with chemical standards is immediate for newly constructed waterworks. Existing waterworks producing water for human consumptive use will be required to meet the standards by December 5, 2010 for systems serving a population of less than 5,000 and by December 5, 2008 for systems serving a population of 5,000 or more.

Chemical - Health Category			Chemical Pesticides (commonly used in Saskatchewan)			Radiological[6]	
Parameter	MAC (mg/L)	IMAC (mg/L)	Parameter	MAC (mg/L)	IMAC (mg/L)	Screening Parameter	Concentration Becquerels Per litre (Bq/L)
Arsenic		0.025	Atrazine		0.005	Gross alpha	0.1
Barium	1		Bromoxynil		0.005	Gross beta	0.11
Benzene	0.005		Carbofuran	0.09			
Benzo(a)pyrene	0.00001		Chlorpyrifos	0.09			
Boron		5.0	Dicamba	0.12			
Cadmium	0.005		2,4-D[5]		0.1		
Carbon tetrachloride	0.005		Diclofop-methyl	0.009			
Chromium	0.05		Dimethoate		0.02		
Cyanide	0.2		Malathion	0.19			
Dichlorobenzene, 1,2	0.2		Pentachlorophenol	0.06			
Dichlorobenzene, 1,4	0.005		Picloram		0.19		
Dichloroethane, 1,2		0.005	Trifluralin		0.045		
Dichloroethylene, 1,1	0.014						
Dichloromethane	0.05						
Dichlorophenol, 2,4	0.9						

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C' mical Health/Pestic s/Radiological

T se include a range of substances that are known or suspected to cause adverse effects on health. These values have been derived to safeguard health on the basis of life long consumption. Compliance with chemical standards is immediate for newly constructed waterworks. Existing waterworks producing water for human consumptive use will be required to meet the standards by December 5, 2010 for systems serving a population of less than 5,000 and by December 5, 2008 for systems serving a population of 5,000 or more.

Chemical - Health Category			**Chemical Pesticides (commonly used in Saskatchewan)**			**Radiological**[6]	
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Arsenic		0.025	Atrazine		0.005	Gross alpha	0.1
Barium	1		Bromoxynil		0.005	Gross beta	0.11
Benzene	0.005		Carbofuran	0.09			
Benzo(a)pyrene	0.00001		Chlorpyrifos	0.09			
Boron		5.0	Dicamba	0.12			
Cadmium	0.005		2,4-D[5]		0.1		
Carbon tetrachloride	0.005		Diclofop-methyl	0.009			
Chromium	0.05		Dimethoate		0.02		
Cyanide	0.2		Malathion	0.19			
Dichlorobenzene, 1,2	0.2		Pentachlorophenol	0.06			
Dichlorobenzene, 1,4	0.005		Picloram		0.19		
Dichloroethane, 1,2		0.005	Trifluralin		0.045		
Dichloroethylene, 1,1	0.014						
Dichloromethane	0.05						
Dichlorophenol, 2,4	0.9						
Fluoride[1]	1.5						
Lead[2]	0.01						
Mercury	0.001						
Monochlorobenzene	0.08						
Nitrate[3] as NO_3	45						
Selenium	0.01						
Tetrachlorophenol, 2,3,4,6	0.1						
Trichloroethylene	0.05						
Trichlorophenol, 2,4,6	0.005						
Trihalomethanes (THM)[4]		0.1					
Uranium	0.02						
Vinyl Chloride	0.002						

[1] Maximum allowable concentration of naturally occurring fluoride in a treated drinking water intended or used for human consumptive use.
[2] Faucets should be thoroughly flushed before sample is collected.
[3] Nitrate levels in excess of 45 mg/L (10 mg/L as nitrate-nitrogen) may cause adverse health effects in infants less than six months old. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L.
[4] Based on an annual average of 4 seasonal samples.
[5] 2,4 Dichlorophenoxyacetic acid

[6] Water samples may be initially screened for radioactivity using gross alpha and gross beta activity determinations. Compliance with the standards may be inferred if the measurements for gross alpha and gross beta activity are less than 0.1 Bq/L and 1 Bq/L, respectively, as these are lower than the strictest MACs. If these values are exceeded then Part 5 of the *Guidelines for Canadian Drinking Water Quality*, Sixth Edition, Health Canada, 1996, as amended from time to time, applies.

Objectives

Objectives apply to certain characteristics of, or substances found in water for human consumptive or hygienic use. The presence of these substances will affect

Dichloromethane	0.05	
Dichlorophenol, 2,4	0.9	
Fluoride[1]	1.5	
Lead[2]	0.01	
Mercury	0.001	
Monochlorobenzene	0.08	
Nitrate[3] as NO_3	45	
Selenium	0.01	
Tetrachlorophenol, 2,3,4,6	0.1	
Trichloroethylene	0.05	
Trichlorophenol, 2,4,6	0.005	
Trihalomethanes (THM)[4]		0.1
Uranium	0.02	
Vinyl Chloride	0.002	

[1] Maximum allowable concentration of naturally occurring fluoride in a treated drinking water intended or used for human consumptive use.
[2] Faucets should be thoroughly flushed before sample is collected.
[3] Nitrate levels in excess of 45 mg/L (10 mg/L as nitrate-nitrogen) may cause adverse health effects in infants less than six months old. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L.
[4] Based on an annual average of 4 seasonal samples.
[5] 2,4 Dichlorophenoxyacetic acid

[6] Water samples may be initial radioactivity using gross alpl activity determinations. Com standards may be inferred if for gross alpha and gross be than 0.1 Bq/L and 1 Bq/L, re: are lower than the strictest M values are exceeded then Pa *Guidelines for Canadian Drin.* Sixth Edition, Health Canada, from time to time, applies.

Objectives

Objectives apply to certain characteristics of, or substances found in water for human consumptive or hygienic use. The presence of these subst the acceptance of water by consumers and/or interfere with the practice of supplying good quality water. Compliance with drinking water objectiv mandatory as these objectives are in the range where they do not constitute a health hazard. However, these substances may represent a health people if found in excessive concentrations. The Aesthetic Objectives for several parameters (including hardness as $CaCO_3$, magnesium, sodium dissolved solids) consider regional differences in drinking water quality.

Physical

Parameter	AO
Color	15 ACU
Odor	Inoffensive
PH	6.5 to 9.0
Taste	Inoffensive
Temperature	$\leq 15^{\circ}C$

Total Dissolved Solids (TDS): For the purposes of Saskatchewan Environment's drinking water quality objectives, TDS are based on summation of ions.

Summation of Ions: $Cl + SO_4 + Ca + Mg + K + Na + NO_3 + CO_3 + HCO_3 =$ TDS calculation

Chemical

Parameter	AO (mg/L)
Alkalinity (as $CaCO_3$)	500
Chloride	250
Copper	1
Ethylbenzene	0.0024
Hardness (as $CaCO_3$)	800
Iron	0.3
Magnesium	200
Manganese	0.05
Sodium[1]	300
Sulphate[2]	500
Sulphate (as H_2S)	0.05
Total Dissolved Solids	1500
Toluene	0.024
Xylenes	0.3
Zinc	5

[1] Sodium: It is sodium be inc monitoring pr levels may be authorities wh sodium-restri patients.
[2] Sulphate: The effect in some sulphate level

Saskatchewan Environment

EPB207 / 2002

Saskatchewan's Drinking Water Quality Standards and Objectives (summarized)

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Standards

Standards are legally enforceable requirements for drinking water quality and are set out in *The Water Regulations, 2002*.

Bacteriological Standards: Effective immediately, standards include:

- total coliform levels of zero organisms detectable per 100 millilitre (mL);
- fecal coliform levels of zero organisms detectable per 100 mL; and
- background bacteria levels on a total coliform or a fecal coliform membrane filtration plate of less than 200 colonies per 100 mL or no overgrowth.

Turbidity Standards: Turbidity is an important indicator of water treatment process efficiency from both health and aesthetic perspectives. Compliance with turbidity standards is immediate for newly constructed waterworks. Existing waterworks producing water for human consumptive use will be required to meet the standards by December 5, 2008 for systems serving a population of less than 5,000 and by December 5, 2006 for systems serving a population of 5,000 or more.

Source/Treatment	Routine Standard	Continuous Monitoring Time Duration Maximum	Absolute Maximum
Surface water[1,2]: Chemically Assisted Filtration - When monthly source water average is 1.5 NTU or more	Less than 0.3 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	Not to exceed 0.3 NTU for more than 12 consecutive hours if continuous monitoring employed	Never to exceed 1.0 NTU
Surface water[1,2]: Chemically Assisted Filtration - When monthly source water average is less than 1.5 NTU	Less than 0.2 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	Not to exceed 0.2 NTU for more than 12 consecutive hours if continuous monitoring employed	Never to exceed 1.0 NTU
Surface water[1,2]: Membrane Filtration	Less than 0.1 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	No stated standard	Never to exceed 0.3 NTU
Surface water[1,2]: Slow Sand or Diatomaceous Earth Filtration	Less than 1.0 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	Not to exceed 1.0 NTU for more than 12 consecutive hours if continuous monitoring employed	Never to exceed 3.0 NTU
Groundwater[3]	Less than 1.0 NTU, 95% of discrete measurements or 95% time if	No stated standard	No stated standard - see permit

The Water Regulations, 2002

being

Chapter E-10.21 Reg 1 (effective December 5, 2002).

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CHAPTER E-10.21 REG 1

The Environmental Management and Protection Act, 2002

PART I
Title, Interpretation and Application

Title

1 These regulations may be cited as *The Water Regulations, 2002.*

Interpretation

2(1) In these regulations:

(a) **"accredited"** means attainment of the Standards Council of Canada, National Standards System, General Requirements for the Competence of Testing and Calibration Laboratories, (ISO/IEC17025-1999) CAN-P-4D, March 2002, including but not limited to attaining the parameters necessary to undertake the reports required by Part V or by a permit to operate a waterworks issued for the purposes of subsection 21(1) of the Act;

(b) **"Act"** means *The Environmental Management and Protection Act, 2002*;

(c) **"approved"** means approved by the minister in writing;

(d) **"basin"** means a natural or artificially created space or structure that has a shape and character that permits sewage or industrial waste to be treated or retained;

(e) **"BOD_5"** means a five-day biochemical oxygen demand at 20 degrees centigrade;

(f) **"$CBOD_5$"** means a five-day carbonaceous biochemical oxygen demand at 20 degrees centigrade;

(g) **"chemical feeder"** means a device for dispensing a chemical at a predetermined rate for the treatment of water in a waterworks, sewage works or industrial effluent works;

(h) **"collection system"** means a system of pipes, conduits, drains, mains, manholes and appurtenances used for collecting and conveying sewage;

(i) **"design flow"** means the amount of water that is designed to be treated by a water treatment facility or wastewater treatment facility based on standard engineering design parameters and capacities;

(j) **"distribution system"** means that portion of a waterworks, including water pipes, storage reservoirs, valves, hydrants and associated components, that is designed or used to convey water for human consumptive use or hygienic use to a service connection, but does not include tank fill drop tubes, surface piping or hoses attached to a well;

(k) **"drinking water"** means potable water;

(l) **"effluent"** means any waste that is discharged from a sewage works or an industrial effluent works;

(m) **"existing"** means in existence on the date that these regulations come into force and, with respect to waterworks, includes waterworks mentioned in subsection 31(4);

(n) **"facultative lagoon"** means a lagoon or treatment pond with an aerobic upper section and an anaerobic bottom section that allows both aerobic and anaerobic processes to occur simultaneously;

(o) **"free chlorine residual"** means that portion of the total residual chlorine remaining in water that will react chemically and biologically as hypochlorous acid or hypochlorite ion;

(p) **"ground water treatment plant"** means a water treatment facility that draws all of its water supply from ground water that is beyond the direct influence of surface water;

(q) **"human consumptive use"** means a use of water for human consumption, including the following uses and applications:

(i) drinking;

(ii) cooking and food preparation;

(iii) oral hygiene;

(r) **"hygienic use"** means a use of water for hygienic purposes by humans, including the following uses and applications:

(i) bathing and personal hygiene, but not including swimming;

(ii) showering;

but does not include a human consumptive use;

(s) **"lagoon"** means one or more open basins or reservoirs designed to treat or store sewage or industrial waste;

(t) **"mechanical treatment facility"** means a wastewater treatment facility the processes of which are controlled primarily by mechanical means;

(u) **"municipal sewage works"** means a sewage works that is owned or operated by a municipality or by another person on behalf of a municipality;

(v) **"municipal waterworks"** means a waterworks that is owned or operated by a municipality or by another person on behalf of a municipality;

(w) **"municipal well"** means a well that is owned or operated by a municipality or by another person on behalf of a municipality;

(x) **"permittee"** means the person to whom a permit for a works, or a permit with respect to an activity mentioned in section 35 or 36 of the Act, is issued or continued pursuant to the Act or these regulations;

(y) **"pipes"** means closed conduits and all appurtenances attached to those conduits;

(z) **"potable water"** means water that is intended for human consumption or a human consumptive use;

(aa) **"primary basins"** means the basins designed for treatment in a facultative lagoon;

(bb) **"pump house"** means a facility in a waterworks containing one or more pumps and their appurtenances that are designed to pump water in or into the waterworks;

(cc) **"pumping station"** means a facility in a sewage works or industrial effluent works containing one or more pumps and their appurtenances that are designed to pump sewage in or into the sewage works or industrial waste in or into the industrial effluent works;

(dd) **"sanitary sewer"** means a system of conduits, drains, mains and pipes in a sewage works that is intended to convey sewage exclusively or principally;

(ee) **"secondary treatment process"** means a treatment process for sewage or industrial waste that consists of primary treatment and biological treatment and that may also consist of physical treatment or chemical treatment;

(ff) **"service connection"** means a pipe that connects a main with premises;

(gg) **"storm sewer"** means a system of conduits, drains, mains, manholes, basins and pipes intended to convey storm water exclusively or principally;

(hh) **"surface water treatment plant"** means a water treatment facility that draws all or part of its water supply from a surface water body source;

(ii) **"total chlorine residual"** means the chlorine concentration remaining in water as free chlorine residual plus combined chlorine;

(jj) **"upset condition"** means any abnormal conditions, anomalies or interruptions in the treatment process or the distribution system within a waterworks that may have any adverse effect on the quality of water supplied to consumers;

(kk) **"wastewater treatment facility"** means those components of a sewage works or industrial effluent works that modify or hold sewage or industrial waste;

(ll) **"water pipeline"** means all or a portion of a waterworks, distribution system or extended network of pipes that:

(i) is owned by a person or association other than a municipality;

(ii) is intended or used to provide water for human consumptive use or hygienic use; and

(iii) serves one or more of, or any combination of, permanent residences, seasonal residences, acreages, farmsteads, trailer courts, commercial buildings, industrial buildings or other, similar facilities;

(mm) **"water treatment facility"** means those components of a waterworks that are used to filter or condition water for the purpose of rendering the water acceptable for human consumptive use or hygienic use;

(nn) **"works"** means industrial effluent works, sewage works or waterworks.

(2) For the purposes of the Act and in these regulations, **"person"** includes an authority, organization or agency.

(3) For the purposes of these regulations, water beneath the surface of the ground is considered under the direct influence of surface water if that water, in the opinion of the minister, exhibits:

(a) a significant occurrence of insects or other macro-organisms, algae or large diameter pathogens, including *Giardia lamblia* and *Cryptosporidium*; or

(b) significant and relatively rapid shifts in water characteristics, including turbidity, temperature, conductivity or pH factors, that closely correlate to climatological or surface water conditions.

13 Dec 2002 cE-10.21 Reg 1 s2.

Interpretation of "watercourse" and other terms used principally in Division 3 of Part IV of the Act

3(1) For the purposes of clause 2(cc) and section 36 of the Act and in these regulations, **"watercourse"** includes a stream, creek, river, gully, valley floor, drainage ditch or any other channel, including any artificial channel, in which water flows either permanently or intermittently.

(2) For the purposes of section 36(1)(a) of the Act and in these regulations, **"alter or cause to be altered"** does not include:

(a) excavation and replacement of existing culverts but only if the excavation or replacement:

(i) is commenced and completed under dry conditions;

(ii) results in the culvert pipe being installed parallel to the natural channel;

(iii) results in the culvert pipe being installed below the natural channel bed by a depth equivalent to at least 20% of the culvert diameter; and

(iv) incorporates, in the opinion of the minister, adequate erosion control measures at the inlet and outlet end of the culvert to prevent washout and damage to the bed or boundary;

(b) directional boring or direct ploughing for the placement of utility lines, but only if all of the boring or ploughing work is commenced and completed under dry or frozen conditions; or

(c) cultivation of intermittent watercourses that have been continuously cultivated without interruption commencing on or before the date these regulations come into force.

(3) For the purposes of section 36(1)(b) of the Act and in these regulations:

(a) **"add"** includes the addition of sand, gravel or rock if that material is added for the purposes of excavating or replacing a culvert in the circumstances mentioned in clause (2)(a);

(b) **"remove"** does not include:

(i) removal of beaver dams or beaver houses by use of hand tools or dynamite;

(ii) removal of beaver dams by mechanical means, but only if:

(A) the removal does not result in the alteration of the bed, bank or boundary, including noticeable impact to the soil caused by equipment; and

(B) the material removed is placed in a way that it cannot be washed back into the watercourse.

(4) For the purposes of section 36(1)(c) of the Act and in these regulations, **"remove vegetation"** does not include:

(a) cutting, mowing, haying or swathing, but only if all that work is commenced and completed under dry or frozen conditions;

(b) grazing or watering of livestock, but only if the activity does not result in exposed soil, stream bank slumping or erosion;

(c) burning of vegetation or plant material, but only if the burning does not occur between May 1st and August 1st of each year;

(d) harvesting Crown timber in accordance with an approved plan prepared with respect to a licence issued pursuant to *The Forest Resources Management Act*;

(e) cutting or removal of vegetation by hand tools or hydro-axing for the maintenance of existing utility lines, road allowances, ditches designed for the purpose of moving urban storm water or drainage ditches that are licenced or exempted under *The Drainage Control Regulations*, but only if all that work is commenced and completed under dry or frozen conditions; or

(f) removal of vegetation or plant material if that removal is for the purposes of excavating or replacing a culvert in the circumstances mentioned in clause (2)(a).

(5) In subsections (2) to (4):

(a) **"dry conditions"** means, with respect to soil, that the soil in the affected area is dry enough that vehicles or equipment used would not make a noticeable impact on the soil;

(b) **"frozen conditions"** means, with respect to soil, that the soil in the affected area is frozen solid enough that vehicles or equipment used would not make a noticeable impact on the soil;

(c) **"intermittent watercourse"** means a watercourse that normally does not experience year-round flow, and includes ephemeral streams that are usually inundated during spring snow melt or following a heavy rain event;

(d) **"mowing"** means cutting of vegetation, usually for hay or maintenance purposes, but does not include hydro-axing or use of other machines primarily designed to cut brush or trees.

13 Dec 2002 cE-10.21 Reg 1 s3.

Interpretation of "person responsible for a waterworks or sewage works"

4(1) For the purposes of section 18 of the Act and in these regulations, **"person responsible for a waterworks or sewage works"** means the permittee of the waterworks or sewage works and includes:

(a) any successor, assignee, executor, administrator, receiver, receiver-manager or trustee of the permittee; and

(b) any principal or agent of a permittee or of a person mentioned in clause (a).

(2) For the purposes of subsections 32(2) of the Act, **"person responsible for a waterworks"** includes, in addition to the persons mentioned in subsection (1), a permittee whose permit has been suspended or cancelled or whose permit has expired.

(3) For the purposes of subsections 32(3) of the Act, **"person responsible for a sewage works"** includes, in addition to the persons mentioned in subsection (1), a permittee whose permit has been suspended or cancelled or whose permit has expired.

13 Dec 2002 cE-10.21 Reg 1 s4.

Guidelines adopted

5(1) For the purposes of these regulations, the following guidelines, as amended from time to time, are adopted:

(a) the *Guidelines for Sewage Works Design*, EPB 203 as issued by the department and dated November, 2002;

(b) the *Municipal Drinking Water Quality Monitoring Guidelines*, EPB 202, as issued by the department and dated November, 2002;

(c) a *Guide to Waterworks Design*, EPB 201, as issued by the department and dated November, 2002.

(2) The minister shall cause the guidelines adopted pursuant to this section to be made available to the public in any manner that the minister considers likely to bring them to the public's attention, including causing them to be posted on the department's Internet website.

13 Dec 2002 cE-10.21 Reg 1 s5.

PART II
Exemptions from Requirement to obtain a Permit under Part IV of the Act

Exempt discharges and works

6(1) For the purposes of subsection 21(2) of the Act, all sewage works that are not municipal sewage works and that have a design flow of effluent that is 18 cubic metres or less per 24-hour period are exempt from the requirement to have a permit pursuant to section 21 of the Act.

(2) The following discharges are exempt from the requirements of clause 35(1)(a) of the Act:

(a) a discharge from a sewage works that is not a municipal sewage works and that has a design flow of effluent that is 18 cubic metres or less per 24-hour period;

(b) a discharge from pipes in a collection system owned or operated by a municipality if the pipes are located under the surface of the property on which the premises served by the collection system are located;

(c) a discharge from piping fixtures comprising the plumbing within a building or structure;

(d) a discharge from one of the following industrial effluent works:

(i) a facility that is operated for the disposal of salt water, sediment or other wastes from oil or gas well operation or development;

(ii) a facility that collects, stores or contains industrial waste in a building or the underground works of a mine if the industrial waste is not subsequently disposed of into the environment;

(iii) a facility that handles or treats waste from abattoirs unless the design flow of effluent from the facility exceeds 18 cubic metres per 24-hour period;

(iv) a drainage works as defined in *The Saskatchewan Watershed Authority Act*;

(e) a discharge from an intensive livestock operation;

(f) a discharge from a waterworks or sewage works for which a permit pursuant to Division 2 of Part IV of the Act has been issued.

(3) The construction, extension, alteration, installation or operation of the following industrial effluent works is exempt from the requirements of clause 35(1)(c) of the Act:

(a) a facility that is operated for the disposal of salt water, sediment or other wastes from oil or gas well operation or development;

(b) a facility that collects, stores or contains industrial waste in a building or the underground works of a mine if the industrial waste is not subsequently disposed of into the environment;

(c) a facility that handles or treats waste from abattoirs unless the design flow of effluent from the facility exceeds 18 cubic metres per 24-hour period;

(d) a facility that handles or treats livestock waste from intensive livestock operations;

(e) a facility that is a drainage works as defined in *The Saskatchewan Watershed Authority Act*;

(f) a facility for the disposal of industrial waste into deep well formations if the disposal is approved pursuant to *The Oil and Gas Conservation Act* and the regulations pursuant to that Act;

(g) a pollutant control facility, as defined in *The Mineral Industry Environmental Protection Regulations, 1996*, that is regulated by those regulations.

13 Dec 2002 cE-10.21 Reg 1 s6.

PART III
Permits under Division 3 of Part IV of the Act

Requirements for applications for permits

7(1) In this section:

(a) **"aquatic guidelines"** means a *Guide to Aquatic Nuisances and their Control*, EPB 47, as issued by the department and dated November, 2002;

(b) **"standards"** means the *Industrial Works Construction Application Standards*, as issued by the department and dated November, 2002.

(2) For the purposes of this Division, the following, as amended from time to time, are adopted:

(a) a *Guide to Aquatic Nuisances and their Control*, EPB 47, as issued by the department and dated November, 2002;

(b) the *Industrial Works Construction Application Standards*, as issued by the department and dated November, 2002.

(3) The minister shall cause the aquatic guidelines and standards adopted pursuant to this section to be made available to the public in any manner that the minister considers likely to bring them to the public's attention, including causing them to be posted on the department's Internet website.

(4) A person who applies for a permit pursuant to Division 3 of Part IV of the Act shall:

(a) file a written application with the minister in a form satisfactory to the minister;

(b) provide the information and materials required by:

(i) in the case of a permit required by clause 35(1)(b) of the Act, the aquatic guidelines;

(ii) in the case of a permit required by clause 35(1) (a) or (c) of the Act, the standards;

(iii) in the case of a permit required by section 36 of the Act, section 8 of these regulations; and

(c) provide any other information or materials that the minister may reasonably request.

13 Dec 2002 cE-10.21 Reg 1 s7.

Application for permit to alter shoreline, etc.

8 If a person applies for a permit required by section 36 of the Act, the person shall provide the following information and materials:

(a) information respecting the fish and wildlife species, vegetative cover, landforms, soil types and water bodies that the minister considers as likely to be affected by the activity that the applicant proposes to undertake;

(b) a location plan or site map for the land where the proposed activity is to take place showing:

(i) who is the registered owner of the land; and

(ii) any proposed development, including any proposed access roads, rights of way, stream crossings and borrow pits and the location and description of all stockpiles of materials and work camps, drawn to scale;

(c) if the permit applied for is to authorize construction, the details regarding construction materials to be used and a construction schedule, including the proposed date for commencing construction, the duration of construction and the completion of construction in or near water;

(d) proposed measures to mitigate or prevent any potential impact of the proposed activity on aquatic and riparian habitats, including erosion and sediment control plans;

(e) plans for restoring the environment after the proposed activity has been completed, including replacing or restoring vegetation;

(f) any additional information and materials that the minister may reasonably request.

13 Dec 2002 cE-10.21 Reg 1 s8.

Decision respecting permits

9(1) If the minister receives an application and the information and material required by this Part, the minister shall:

(a) either:

(i) if the minister is satisfied that the Act and these regulations have been complied with and that it is not contrary to the public interest to do so, issue a permit; or

(ii) refuse to issue a permit; and

(b) notify the applicant of the decision.

(2) On issuing a permit, the minister may impose any terms and conditions on the permit that the minister considers appropriate.

(3) Every permittee shall inform every employee, helper or agent of the permittee of the contents, terms and conditions of the permittee's permit before that employee, helper or agent performs any work pursuant to the permit.

(4) No permittee shall fail to:

(a) comply with any term or condition contained in the permit; or

(b) ensure that any employee, helper or agent complies with any term or condition contained in the permit.

13 Dec 2002 cE-10.21 Reg 1 s9.

Notification to minister of completion by permittee of construction, etc., authorized by permit

10 On completion of the construction, extension or alteration of the industrial effluent works for which a permit is issued, the permittee shall:

(a) notify the minister in writing of the completion; and

(b) if requested to do so by the minister, supply the minister with plans showing the works as actually constructed, extended or altered.

13 Dec 2002 cE-10.21 Reg 1 s10.

Amendment, suspension, cancellation of permits

11(1) In this section, **"permittee"** means a permittee who is governed by a permit issued pursuant to section 9.

(2) A permittee may apply to the minister to cancel, amend or alter the permit.

(3) On receipt of an application pursuant to subsection (2) and if the minister considers it appropriate to do so, the minister may cancel, amend or alter the permit.

(4) The minister may cancel, amend, alter or suspend any permit issued pursuant to section 9, in whole or in part, if:

(a) the permittee fails to comply with any term or condition of the permit or has contravened the Act, these regulations or any order made pursuant to the Act or these regulations;

(b) the permittee makes any false or misleading statement in any application, information, materials or plans supplied pursuant to the Act or these regulations in support of an application for a permit;

(c) the permit was issued as a result of a clerical or administrative error or mistake;

(d) unauthorized changes or alterations are made to the activity or works governed by the permit; or

(e) the minister is satisfied that it is in the public interest to do so.

(5) Subject to subsection (8), before the minister does any of the things mentioned in subsection (4), the minister shall give the permittee:

(a) written notice of the minister's intention to cancel, amend, alter, or suspend the permit, and the reasons for doing so; and

(b) an opportunity to make written representations to the minister, within 30 days after the written notice mentioned in clause (a) is served, as to why the permit should not be cancelled, amended, altered, or suspended.

(6) The minister is not required to give an oral hearing to any person to whom a notice has been given pursuant to subsection (5).

(7) After receiving the representations mentioned in subsection (5), the minister shall issue a written decision and shall serve the decision on the person who made the representations.

(8) If the minister considers that it is necessary to protect human health or public safety, the minister may immediately cancel, amend, alter or suspend any permit issued pursuant to section 9 without complying with subsection (5) but, if the minister does so, the minister shall give the permittee:

(a) written notice of the minister's action as soon as is practicable; and

(b) an opportunity to make written representations to the minister, within 30 days after the written notice mentioned in clause (a) is served, requesting the minister to reconsider the decision to cancel, amend, alter or suspend.

(9) The minister is not required to give an oral hearing to any person to whom a notice has been given pursuant to subsection (8).

(10) After receiving the representations mentioned in subsection (8), the minister shall issue a written decision and shall serve the decision on the person who made the representations.

(11) If the minister cancels, amends, alters or suspends a permit issued pursuant to section 9, the minister:

(a) may issue any additional order that the minister considers appropriate requiring any repair, restoration or remediation of the environment; and

(b) in an order mentioned in clause (a), shall specify the period within which the order must be complied with.

(12) No person to whom an order pursuant to subsection (11) is directed shall fail to comply with that order.

13 Dec 2002 cE-10.21 Reg 1 s11.

PART IV
Water Pollution Control

DIVISION 1
Interpretation, Compliance and Permits

Interpretation and compliance

12(1) In this Part, **"permittee"** means a person to whom a permit has been issued pursuant to this Part for a sewage works or industrial effluent works and includes:

(a) any successor, assignee, executor, administrator, receiver, receiver-manager or trustee of the permittee; and

(b) any principal or agent of a permittee or of a person mentioned in clause (a).

(2) Every permittee:

(a) shall comply with this Part; and

(b) shall cause the sewage works or industrial effluent works, as the case may be, to conform with this Part.

13 Dec 2002 cE-10.21 Reg 1 s12.

Applications for sewage works permit

13(1) In this section, **"guidelines"** means a *Guide for Sewage Works Design*, EPB 203, adopted pursuant to section 5.

(2) A person who applies for a permit for a sewage works pursuant to Division 2 of Part IV of the Act shall:

(a) file a written application with the minister in a form satisfactory to the minister; and

(b) provide the information and materials required by the guidelines.

13 Dec 2002 cE-10.21 Reg 1 s13.

DIVISION 2
Operational Matters

No interconnection between sanitary sewers and storm sewers

14 No permittee shall cause any sanitary sewers and storm sewers to be interconnected in a manner that permits sewage in the sanitary sewer to be discharged through the storm sewer.

13 Dec 2002 cE-10.21 Reg 1 s14.

Pumping stations

15(1) A pumping station that is a part of a sewage works or industrial effluent works must have mechanically forced air ventilation.

(2) A water outlet or any of its component parts that may come in contact with sewage or industrial waste in a sewage works or industrial effluent works must be equipped with a backflow prevention device that, in the opinion of the minister, is effective.

13 Dec 2002 cE-10.21 Reg 1 s15.

Wastewater treatment facilities

16(1) This section applies to wastewater treatment facilities.

(2) Wastewater treatment facilities must be operated so as to produce effluent that meets the requirements set out in the permittee's permit, these regulations and any other relevant regulations made pursuant to the Act.

(3) Unless otherwise set out in the permittee's permit, all wastewater treatment facilities in a sewage works must include:

(a) a secondary treatment process that produces effluent with no more than:

(i) 30 milligrams per litre of BOD_5 or $CBOD_5$; and

(ii) 30 milligrams per litre of total suspended solids; or

(b) facultative lagoons designed in accordance with subsection (4).

(4) Unless otherwise set out in the permittee's permit, all facultative lagoons must be designed to have:

(a) a minimum of two basins operating in series;

(b) primary basins with a surface area sufficient to ensure that a BOD_5 loading of not greater than 30 kilograms per hectare per day will be applied; and

(c) a combined storage capacity in all basins, other than the primary basins, of at least 180 days of sewage flow into the basins for the service connections and population to be served by the sewage works.

13 Dec 2002 cE-10.21 Reg 1 s16.

Report required re any upset conditions

17(1) In this section, **"upset condition"** means any abnormal conditions, anomalies or interruptions in the treatment process or the collection system within the sewage works or industrial effluent works that could adversely affect the quality of effluent discharged into the environment.

(2) Every permittee and every employee, agent or contractor engaged by a permittee shall immediately report to the minister any known or anticipated upset condition, bypass condition or event at or affecting a sewage works or industrial effluent works that could adversely affect the quality of effluent discharged to the environment.

13 Dec 2002 cE-10.21 Reg 1 s17.

Disinfection of effluent

18(1) In the permittee's permit, the minister may require the permittee to disinfect any effluent from the sewage works or industrial effluent works.

(2) Every permittee and every employee, agent or contractor engaged by a permittee shall immediately report to the minister any instance where:

(a) disinfection equipment required by the permittee's permit fails; or

(b) the level of disinfection required by the permittee's permit is not achieved or not anticipated to be achieved.

13 Dec 2002 cE-10.21 Reg 1 s18.

Required testing of sewage works and industrial effluent works

19 Every permittee shall:

(a) cause tests to be conducted and information to be collected as required in the permittee's permit;

(b) cause operational records or logs to be maintained, including information respecting:

(i) maintenance work and any failure of treatment components;

(ii) types, dosages and total amounts of chemicals or other substances added to the sewage or industrial waste;

(iii) dates of discharge of sewage or industrial waste and the volumes of discharge;

(iv) locations from which samples for any tests are taken; and

(v) the results of any tests conducted on the samples taken pursuant to subclause (iv);

(c) promptly make available the operational records or logs mentioned in clause (b) and the results of the tests conducted and the information collected pursuant to clause (a) to the minister or to the public as required by the permit or requested by the minister; and

(d) promptly provide the minister with any additional information that the minister may reasonably request respecting the operation of the permittee's sewage works or industrial effluent works.

13 Dec 2002 cE-10.21 Reg 1 s19.

PART V
Waterworks

DIVISION 1
Application of Part and Exemptions

Application of Part

20(1) This Part applies to the following waterworks that supply water for a human consumptive use or hygienic use:

(a) all municipal waterworks;

(b) all municipal wells that are connected to a distribution system;

(c) all water pipelines connected to a municipal waterworks, regardless of volume of water supplied or number of service connections;

(d) all water pipelines, not otherwise connected to a municipal waterworks, serving 15 or more service connections;

(e) all waterworks, other than those mentioned in clauses (a) to (d), with a design flow exceeding 18 cubic metres in any 24-hour period.

(2) This Part does not apply to the following:

(a) pipes in a distribution system owned or operated by a permittee if the pipes are located under the surface of the property on which the premises served by the distribution system are located;

(b) piping fixtures comprising the plumbing within a building.

13 Dec 2002 cE-10.21 Reg 1 s20.

Certain works designated as waterworks

21 The waterworks mentioned in subsection 20(1) are designated as waterworks for the purposes of clause 2(gg) of the Act and these regulations.

13 Dec 2002 cE-10.21 Reg 1 s21.

DIVISION 2
Requirements for Suppliers of Water for Hygienic Use

Requirements for municipal waterworks and wells

22(1) This section applies to the following waterworks that are governed by this Part:

(a) municipal waterworks;

(b) municipal wells that are connected to a distribution system.

(2) If authorized by the permittee's permit to supply water for hygienic use, the permittee must comply with the following requirements:

(a) the water must be produced, stored, managed, conveyed and monitored in accordance with the requirements set out in this Part for water intended or used for hygienic use;

(b) a source of water that is suitable and safe for human consumption must be provided by alternative means to the consumers of water from the waterworks;

(c) in the case of source water drawn from a surface water source or a ground water source under the direct influence of surface water, the water must be disinfected to meet the standards set out in subsection 30(6);

(d) if the waterworks draws source water from a ground water source that is beyond the direct influence of surface water:

(i) the water must be disinfected to meet the standards set out in subsection 30(6); or

(ii) the permittee must satisfy the minister that 90% of routine bacteriological samples of water from the waterworks have met the requirements of subclause 32(1)(a)(i) over any period of one year.

13 Dec 2002 cE-10.21 Reg 1 s22.

Requirements for other waterworks

23(1) This section applies to the following waterworks that are governed by this Part:

(a) water pipelines connected to a municipal waterworks regardless of volume of water supplied or number of service connections;

(b) water pipelines, not otherwise connected to a municipal waterworks or distribution system, serving 15 or more service connections;

(c) waterworks, other than those mentioned in section 22 or in clauses (a) and (b), with a design flow exceeding 18 cubic metres in any 24-hour period.

(2) If authorized by the permittee's permit to supply water for hygienic use, the permittee must comply with the following requirements:

(a) the water must be produced, stored, managed, conveyed and monitored in accordance with the requirements set out in this Part for water intended or used for hygienic use;

(b) in the case of source water drawn from a surface water source or a ground water source under the direct influence of surface water, the water must be disinfected to meet the standards set out in subsection 30(6); and

(c) in the case of a waterworks drawing source water from a ground water source that is beyond the direct influence of surface water:

(i) the water must be disinfected to meet the standards set out in subsection 30(6); or

(ii) the permittee must satisfy the minister that 90% of routine bacteriological samples of water from the waterworks have met the requirements of subclause 32(1)(a)(i) over any period of one year.

(3) No person shall supply water to consumers for hygienic use unless:

(a) the person is a permittee who is in compliance with section 22 or this section; and

(b) the water is from a waterworks, well or pipeline that meets the requirements of this section.

13 Dec 2002 cE-10.21 Reg 1 s23.

DIVISION 3
Information and Materials for Waterworks Permits

Information and materials for waterworks permits

24(1) In this section, **"guidelines"** means a *Guide to Waterworks Design*, EPB 201, adopted pursuant to section 5.

(2) A person who applies for a permit for a waterworks pursuant to Division 2 of Part IV of the Act shall:

(a) file a written application with the minister in a form satisfactory to the minister; and

(b) provide the information and materials required by the guidelines.

13 Dec 2002 cE-10.21 Reg 1 s24.

DIVISION 4
Operation of Facilities Associated with Waterworks

Water wells

25(1) In this section, **"approved person"** means a person who holds an approval pursuant to *The Saskatchewan Watershed Authority Act* to construct, extend, alter or operate a well that is used as a source of water in a waterworks.

(2) Every approved person shall ensure that the well:

(a) has a durable well casing;

(b) is constructed of new materials; and

(c) is constructed and maintained to prevent the entry of surface water, dirt or other material into the well casing.

(3) If the water is used or is intended to be used as a source of water for a human consumptive use or a hygienic use, the approved person shall ensure that the well is cleaned and disinfected:

(a) during drilling operations;

(b) after the well has been completely constructed but before use; and

(c) each time after:

(i) a new pump has been installed; or

(ii) maintenance or repairs have been carried out on a well or pump that is connected to the well.

13 Dec 2002 cE-10.21 Reg 1 s25.

Water pipes

26(1) Subject to subsections (2) and (3), no permittee shall install:

(a) a water pipe in a trench with a sewer pipe; or

(b) a sewer pipe in a trench with a water pipe.

(2) If the minister is satisfied that it is in the public interest to do so, the minister may authorize a permittee in the permit to install a water pipe in a trench with a sewer pipe if:

(a) the lowest portion of the water pipe is placed at least 600 millimetres above the highest portion of the sewer pipe in a vertical plane;

(b) the water pipe is horizontally separated from the sewer pipe by at least 300 millimetres; and

(c) the sewer pipe is not under internal pressure.

(3) Subsection (1) does not apply to a service connection if the sewer pipe is not under internal pressure and is not located above the water pipe.

(4) The permittee of a water pipe used to supply water intended for a human consumptive use or hygienic use shall cause the water pipe to be cleaned, disinfected and pressure tested before the commencement of its use.

13 Dec 2002 cE-10.21 Reg 1 s26.

Water storage reservoirs

27(1) This section applies to reservoirs used to store water intended or used for human consumptive use or hygienic use.

(2) Every permittee shall ensure that every reservoir that is part of the permittee's waterworks:

(a) has a watertight cover;

(b) is maintained in a state that is, in the opinion of the minister, of good repair; and

(c) otherwise complies with this section.

(3) All manholes providing access to an underground or ground level reservoir must be at least 150 millimetres above the grade of the surrounding area and the grade must be sloped away from the reservoir to prevent flooding by surface run-off.

(4) All manholes providing access to a reservoir must:

(a) be equipped with a tight-fitting cover designed to prevent entry of water; and

(b) if the reservoir is located outdoors, be kept locked at all times except when being used by persons authorized by the permittee to enter the reservoir.

(5) All pipes that pass through a reservoir must be constructed and maintained to prevent contaminants from entering the water storage reservoir.

(6) An opening or pipe used to ventilate a reservoir must:

(a) be designed to prevent the entry of birds, rodents, rain water or foreign matter; and

(b) be screened.

13 Dec 2002 cE-10.21 Reg 1 s27.

Water treatment facilities and pump houses

28 Every permittee whose waterworks supplies water intended or used for human consumptive use or hygienic use shall ensure that:

(a) the floor of every water treatment facility or pump house is designed so that drainage occurs only into the floor drains or sumps in the water treatment facility or the pump house;

(b) every drain line that connects a treatment component in a water treatment facility to a sanitary sewer has a trap that contains water at all times;

(c) all pipes that connect the discharge pipe from a treatment component in a water treatment facility or pump house to a sanitary sewer are equipped with a backflow prevention device that is, in the opinion of the minister, effective;

(d) every water treatment facility or pump house is equipped with a meter that records the volume of water passing through the water treatment facility or pump house;

(e) every chemical feeder in a water treatment facility or pump house is equipped with a device that is capable of adjusting the rate of chemical applied; and

(f) every water treatment facility and pump house is maintained in a clean and orderly condition satisfactory to the minister.

13 Dec 2002 cE-10.21 Reg 1 s28.

DIVISION 5
Operation of Waterworks

Adoption of drinking water guidelines

29(1) In this Division and in Division 6, **"drinking water guidelines"** means all or that part of the *Guidelines for Canadian Drinking Water Quality*, Sixth Edition, Health Canada, 1996, as amended from time to time, that the minister adopts pursuant to subsection (2).

(2) The minister may adopt all or any part of the *Guidelines for Canadian Drinking Water Quality*, Sixth Edition, Health Canada, 1996, as amended from time to time, for the purposes of this Division.

(3) If the minister adopts all or any part of the *Guidelines for Canadian Drinking Water Quality*, Sixth Edition, Health Canada, 1996, as amended from time to time, the minister shall cause a notice of the adoption to be published in the Gazette.

(4) No permittee shall fail to comply with the drinking water guidelines.

(5) If there is a conflict between a standard set out in the drinking water guidelines, a standard set out in Table 2 in the Appendix and a standard set out in the permittee's permit, the permittee shall comply with the more stringent standard.

13 Dec 2002 cE-10.21 Reg 1 s29.

Chemical treatment standards for water

30(1) In this section, **"standards"** means "Drinking Water Treatment Chemicals – Health Effects", NSF/ANSI 60-2002 and dated June 28, 2002.

(2) For the purposes of this section, "Drinking Water Treatment Chemicals – Health Effects", NSF/ANSI 60-2002 and dated June 28, 2002, as amended from time to time, is adopted.

(3) No person shall use a chemical to treat water intended or used for human consumptive use or hygienic use unless:

(a) the chemical is listed in accordance with the standards;

(b) that person provides evidence to the minister that the chemical is equivalent to a chemical listed in the standards; or

(c) the chemical is an approved chemical.

(4) No permittee shall cause the operation of a distribution system, or portion of a distribution system, that is new, altered, extended or repaired to commence operation until it has been disinfected.

(5) Every permittee of a waterworks supplying water for human consumptive use shall cause continuous disinfection by chlorination, or other approved means, of the water entering a distribution system and of the water throughout the distribution system.

(6) Unless otherwise set out in the permit, every permittee shall cause to be maintained:

(a) a free chlorine residual of not less than 0.1 milligrams per litre in the water entering a distribution system; and

(b) a total chlorine residual of not less than 0.5 milligrams per litre or a free chlorine residual of not less than 0.1 milligrams per litre in the water throughout the distribution system.

(7) If a permittee applies fluoride to water, the permittee shall ensure that equipment used to apply the fluoride to water in the waterworks is operated in a manner that will maintain control of chemical dosages that is, in the opinion of the minister, proper.

13 Dec 2002 cE-10.21 Reg 1 s30.

Standards for constituents in water – new or altered waterworks

31(1) In this section, **"alter"** means, with respect to a waterworks, a change in the water source or water treatment process used by the waterworks.

(2) Subject to subsection (3), every permittee of a waterworks that is constructed, commissioned or altered after the coming into force of these regulations shall ensure that water from the waterworks meets the following standards before the permittee supplies water to its consumers:

(a) the standards set out in Table 2 in the Appendix and the standards set out in the permittee's permit;

(b) the standards for microbiological characteristics specified in section 32, and that section applies with any necessary modification for the purposes of this section;

(c) the turbidity, protozoan and viral standards specified in section 33.

(3) Subsection (2) does not apply to a waterworks for which all or any part of the construction design plans have been submitted to the minister on or before the day that these regulations come into force.

(4) Waterworks mentioned in subsection (3) are deemed to be existing waterworks for the purposes of these regulations.

13 Dec 2002 cE-10.21 Reg 1 s31.

Standards for microbial and bacteriological constituents in water – existing waterworks

32(1) On the coming into force of these regulations, every permittee of an existing waterworks supplying water intended or used for human consumptive use or hygienic use shall cause to be maintained throughout the distribution system water that has:

(a) the following levels, unless otherwise set out in the permittee's permit:

(i) total coliform levels of zero organisms detectable per 100 millilitres;

(ii) fecal coliform levels of zero organisms detectable per 100 millilitres; and

(iii) background bacteria levels on a total coliform or a fecal coliform membrane filtration plate of less than 200 organisms per 100 millilitres or no overgrowth; or

(b) if permitted by the permittee's permit, no presence of total coliform or *Escherichia coli* as determined:

(i) if required by the permit authorizing the operation of the waterworks, in the case of microbiological constituents by initial field presence/absence tests that meet specification 9223 in *Standard Methods for the Examination of Water and Wastewater*, 20th edition, 1998, as issued by the American Public Health Association, as amended from time to time; or

(ii) by any other approved method.

(2) For the purposes of this section, specification 9223 in *Standard Methods for the Examination of Water and Wastewater*, 20th edition, 1998 as issued by the American Public Health Association, as amended from time to time, is adopted.

13 Dec 2002 cE-10.21 Reg 1 s32.

Water turbidity standards – water for human consumptive use

33(1) In this section, **"NTU"** means Nephelometric Turbidity Units.

(2) Subject to subsections (3) and (4), unless otherwise set out in the permittee's permit, every permittee of a waterworks supplying water intended or used for human consumptive use shall cause the following applicable water turbidity, protozoan and viral standards to be maintained:

(a) in the case of a surface water treatment plant employing chemically assisted filtration:

(i) if the monthly average of daily source water turbidity is greater than or equal to 1.5 NTU, the water turbidity levels from each filter must:

(A) not exceed 0.3 NTU:

(I) in at least 95% of the discrete measurements made for each calendar month; or

(II) if continuous turbidity monitoring is employed, at least 95% of the time for each calendar month;

(B) if continuous turbidity monitoring is employed, not exceed 0.3 NTU for more than 12 consecutive hours; and

(C) not exceed 1.0 NTU at any time;

(ii) if the monthly average of daily source water turbidity is less than 1.5 NTU, the water turbidity levels from each filter must:

(A) not exceed 0.2 NTU:

(I) in at least 95% of the discrete measurements made for each calendar month; or

(II) if continuous turbidity monitoring is employed at least 95% of the time each calendar month;

(B) if continuous turbidity monitoring is employed, not exceed 0.2 NTU for more than 12 consecutive hours; and

(C) not exceed 1.0 NTU at any time;

(b) in the case of a surface water treatment plant employing membrane filtration, water turbidity levels from each filter must:

(i) be less than or equal to 0.1 NTU:

(A) in at least 95% of the discrete measurements made for each calendar month; or

(B) if continuous turbidity monitoring is employed, at least 95% of the time each calendar month; and

(ii) not exceed 0.3 NTU at any time;

(c) in the case of slow sand filtration or diatomaceous earth filtration, the water turbidity levels from each filter must:

(i) not exceed 1.0 NTU:

(A) in at least 95% of the discrete measurements made for each calendar month; or

(B) if continuous turbidity monitoring is employed, at least 95% of the time each calendar month;

(ii) if continuous turbidity monitoring is employed, not exceed 1.0 NTU for more than 12 consecutive hours; and

(iii) not exceed 3.0 NTU at any time;

(d) in the case of any surface water filtration technology, other than those mentioned in clause (a), (b) or (c), that is used in combination with disinfection, protozoan and viral levels for the water must reliably achieve, to the satisfaction of the minister, at least:

(i) a 3-log reduction of *Giardia lamblia* and *Cryptosporidium parvum*; and

(ii) a 4-log reduction of viruses;

(e) in the case of a ground water treatment plant, for water entering the distribution system or water pipelines, turbidity levels must not exceed 1.0 NTU:

(i) in at least 95% of the discrete measurements made for each calendar month; or

(ii) at least 95% of the time each calendar month if continuous turbidity monitoring is employed.

(3) For the purposes of clause (2)(d), the permittee must demonstrate to the satisfaction of the minister that the levels mentioned in that clause are being achieved through pilot studies or other approved means.

(4) In the case of existing waterworks supplying water intended or used for human consumptive use serving:

(a) a population of less than 5 000 persons, the turbidity, protozoan and viral standards prescribed in subsection (2) must be complied with within six years after the date that these regulations come into force; or

(b) a population of 5 000 or more persons, the turbidity, protozoa and viral standards prescribed in subsection (2) must be complied with within four years after the date that these regulations come into force.

13 Dec 2002 cE-10.21 Reg 1 s33.

Chemical standards – water for human consumptive use supplied by existing waterworks

34(1) Subject to subsections (2) and 29(5), the permittee of an existing waterworks supplying water intended or used for human consumptive use shall cause drinking water to be maintained to a standard that meets:

(a) the standards set out in Table 2 in the Appendix; and

(b) the standards set out in the permittee's permit.

(2) For the purposes of subsection (1), the requirements prescribed by that subsection must be shown to have been met through monitoring requirements that are set out in the permittee's permit authorizing the operation of the waterworks.

(3) In the case of existing waterworks supplying water intended or used for human consumptive use serving:

(a) a population of less than 5 000 persons, the drinking water quality requirements prescribed in subsection (1) must be complied with within eight years after the date that these regulations come into force; or

(b) a population of 5 000 or more persons, the drinking water quality requirements prescribed in subsection (1) must be complied with within six years after the date that these regulations come into force.

13 Dec 2002 cE-10.21 Reg 1 s34.

Assessment and audit of water – water for human consumptive use

35(1) Subject to subsections (2) to (5), the permittee of a waterworks supplying water intended or used for human consumptive use shall ensure that an independent engineering assessment of the following respecting the waterworks is conducted at least once every five years:

(a) the waterwork's performance;

(b) the waterwork's condition;

(c) the waterwork's capacity;

(d) the waterwork's functionality;

(e) the waterwork's processes;

(f) the waterwork's optimization;

(g) the waterwork's sustainability;

(h) the waterwork's maintenance.

(2) An assessment conducted pursuant to this section must be conducted in accordance with the standards developed by the minister.

(3) The first assessment required pursuant to subsection (1) must be completed by December 31, 2005.

(4) An assessment is to be done at the sole expense of the permittee of the waterworks.

(5) The permittee of a waterworks supplying water intended or used for human consumptive use shall report the findings of an independent assessment required by this section to the minister within 90 days after the completion of the assessment.

13 Dec 2002 cE-10.21 Reg 1 s35.

Required notices – water for hygienic use

36 If a waterworks is intended to supply water for hygienic use, the permittee of the waterworks shall ensure that:

(a) at least twice every year, the owner of every service connection is notified in writing respecting the restrictions on water use;

(b) at least once every year, the owner of every service connection is supplied with self-adhesive advisory labels that:

(i) are acceptable to the minister; and

(ii) are to be attached adjacent to taps within the structure so as to advise users that the water is not safe for human consumption;

(c) the waterworks, standpipes, fill pipes and other publicly accessible water sources found on the distribution system are continuously posted with a notice that the water is not safe for human consumption; and

(d) the minister is advised at least once each year as to all measures taken to advise users that the water is not safe for human consumption.

13 Dec 2002 cE-10.21 Reg 1 s36.

What is required if unusual operational anomalies, etc.

37(1) Every permittee of a waterworks and every employee, agent or contractor engaged by a permittee shall immediately report to the minister any known or anticipated upset condition, bypass condition or events at or affecting a waterworks that could adversely affect the quality of water produced by the waterworks.

(2) The persons mentioned in subsection (1) shall immediately report to the minister any instance where:

(a) disinfection equipment fails; or

(b) the level of disinfection required by section 30 is not achieved or is not anticipated to be achieved.

13 Dec 2002 cE-10.21 Reg 1 s37.

DIVISION 6
Water Samples and Tests

Accredited laboratory

38(1) Subject to subsections (2) and (3), on and after March 31, 2004, an accredited laboratory must perform any analysis pursuant to this Division in accordance with the parameters for which it has been accredited.

(2) For the purposes of this Division, if an accredited laboratory is not specifically accredited to perform an analysis required by this Division:

(a) the minister may approve any analytical protocols and procedures that the minister considers necessary to ensure that water is properly tested; and

(b) the accredited laboratory performing analysis pursuant to this Division shall perform the analysis in accordance with the analytical protocols and procedures authorized pursuant to clause (a).

(3) If the minister approves any analytical protocols and procedures pursuant to subsection (2), the minister shall cause those protocols and procedures to be made available to the public in any manner that the minister considers likely to bring them to the public's attention, including causing them to be posted on the department's Internet website.

13 Dec 2002 cE-10.21 Reg 1 s38.

Testing, test results and notice of test results

39(1) Every permittee of a waterworks shall:

(a) cause water samples to be taken regularly during the operation of the waterworks to test for bacteria and chlorine, and for any other constituents that the permittee's permit requires to be monitored, at those locations and times and at a frequency:

(i) specified in the permittee's permit; or

(ii) as directed by an order made pursuant to the Act; and

(b) subject to subsections (2) and (3), submit the water samples taken pursuant to clause (a) for analysis to an accredited laboratory.

(2) A water sample taken for the purposes of analysis pursuant to subclause 32(1)(b)(i) may be submitted to an accredited laboratory or to any approved laboratory.

(3) A permittee may perform tests on water samples taken for the purposes of analysis for on-site total chlorine residuals, free chlorine residuals or turbidity monitoring and need not submit those water samples for testing to an accredited laboratory.

(4) If the results of any sample test taken pursuant to subsection (1) show that the level of any bacteria or any other constituent in the treated water exceeds the level or range set out in these regulations, the permittee shall:

(a) in the case a test result showing the presence of total coliforms, fecal coliforms, *Escherichia coli* or 200 or more organisms per 100 millilitres as an overgrowth of background bacteria, conduct any additional testing in accordance with the *Bacteriological Follow-up Protocol for Waterworks Regulated by Saskatchewan Environment*, EPB 205, dated November 2002 as issued by the department;

(b) in the case of any other constituent that exceeds a level set out in these regulations, conduct any additional testing at the times and frequencies and in the manner directed by the minister.

(5) For the purposes of this section, the *Bacteriological Follow-up Protocol for Waterworks Regulated by Saskatchewan Environment*, EPB 205, dated November 2002 as issued by the department, as amended from time to time, is adopted.

(6) If the minister considers it to be necessary, the minister may direct a permittee to conduct any further sampling and testing, in addition to that conducted pursuant to subsection (1), to monitor:

(a) the quality of the water in the waterworks; or

(b) the efficacy of the treatment process.

(7) Subject to subsection (8), any laboratory that conducts any analysis of water samples from a waterworks shall, within seven days after the date of completion of the analysis, report the results of the analysis to:

(a) the permittee of the waterworks; and

(b) the minister.

(8) If a sample submitted in accordance with subsection (1) or (6) shows the presence of total coliforms, fecal coliforms, *Escherichia coli* or 200 or more organisms per 100 millilitres as an overgrowth of background bacteria, the laboratory that conducted the analysis shall:

(a) notify the minister in accordance with the *Bacteriological Follow-up Protocol for Waterworks Regulated by Saskatchewan Environment* mentioned in subsection (5); and

(b) within 72 hours after obtaining the result, send a written copy of the result to the permittee who submitted the samples and to the minister.

(9) On being notified pursuant to subsection (8), the permittee of the waterworks shall:

(a) immediately notify the minister of the measures the permittee has taken and intends to take to remedy the situation in relation to the testing results;

(b) notify consumers served by the waterworks of the measures mentioned in clause (a) in the manner and within the time that is directed by the minister in accordance with the *Bacteriological Follow-up Protocol for Waterworks Regulated by Saskatchewan Environment* mentioned in subsection (5); and

(c) take any other action in relation to the results of testing and quality of water that the minister may direct to protect human health or public safety.

13 Dec 2002 cE-10.21 Reg 1 s39.

Required testing after completion, alteration, extension or repair

40 Every permittee of a waterworks supplying water for human consumptive use or hygienic use shall cause samples of water from any part of the waterworks, including the distribution system or portion of the distribution system, that is new, altered, extended or repaired to be analysed for bacteria in a laboratory as soon as possible after the completion of the new waterworks or the alteration, extension or repair.

13 Dec 2002 cE-10.21 Reg 1 s40.

Fluoride in potable water

41(1) If fluoride is applied to potable water, the permittee of a waterworks shall submit samples of water from the waterworks to an accredited laboratory for fluoride analysis.

(2) The samples mentioned in subsection (1) must be taken at the locations and times and in the frequency and manner set out in the permit.

13 Dec 2002 cE-10.21 Reg 1 s41.

Operational records to be kept

42(1) Every permittee of a waterworks shall cause operational records or logs to be maintained, including records of the following:

(a) the total water pumped into the distribution system on a daily basis or the total raw water used;

(b) the types, dosages and total amounts of chemicals applied to the water for treatment;

(c) the locations from which samples for any tests conducted by the permittee of the waterworks were taken in accordance with the permittee's permit and the name of the person who conducted the sampling or testing and the results of those tests;

(d) any departures from normal operating procedures that may have occurred and the time and date that they occurred;

(e) any instructions that were given during operation of the waterworks to depart from normal operating practices and the name of the person who gave the instructions;

(f) any upset condition or bypass condition, the time and date of the upset condition or bypass condition and measures taken to notify others and resolve the upset condition or bypass condition;

(g) any condition of low disinfectant levels, the time, date and location of occurrence and measures taken to restore disinfectant levels to required values;

(h) the dates and results of calibrating any metering equipment and testing instruments; and

(i) the dates and types of maintenance performed on equipment and any actions taken to ensure the normal operations of the waterworks.

(2) Every permittee of a waterworks shall cause the operational records or logs mentioned in subsection (1) to be recorded and maintained in the following manner:

(a) operational records or logs must be made in chronological order, with the dates, times and testing locations clearly indicated;

(b) entries in an operational record or log must only be made by the permittee;

(c) any person making an entry in an operational record or log must do so in a manner that allows the person to be unambiguously identified as the maker of the entry;

(d) operational records or logs must be maintained for at least five years;

(e) any anomalies or instances of missing entries in an operational record or log must be accompanied by explanatory notes;

(f) operational records or logs must only contain data or information that is actually observed or produced;

(g) operational records or logs must not contain default values generated manually or by automated means;

(h) operational records or logs maintained pursuant to clause (d) must be made available promptly on request of the minister.

13 Dec 2002 cE-10.21 Reg 1 s42.

Water assurance and quality control policy and record keeping – water for human consumptive use

43(1) On and after December 31, 2003, every permittee of a waterworks supplying water intended or used for human consumptive use shall have in place a written quality assurance and quality control policy that is satisfactory to the minister.

(2) On and after December 31, 2003, every permittee of a waterworks shall review the records and logs kept pursuant to section 42 on a monthly basis to ensure that operating parameters and water quality parameters applicable to the operation of the waterworks are being achieved.

(3) If a review of the records and logs mentioned in subsection (2) indicates that the quality of water from the waterworks has been adversely affected, the permittee shall report the findings to the minister as soon as is reasonably practicable after the review has been done.

13 Dec 2002 cE-10.21 Reg 1 s43.

Annual notice to consumers

44(1) At least once each year, every permittee of a waterworks supplying water intended or used for human consumptive use or hygienic use shall provide consumers supplied by the waterworks with a notification of:

(a) the quality of water produced or supplied by the waterworks in comparison with the levels set out in these regulations; and

(b) the permittee's compliance with sample submission requirements described in the permittee's permit.

(2) As soon as possible after complying with subsection (1), the permittee shall provide the minister with written notice of the permittee's compliance.

13 Dec 2002 cE-10.21 Reg 1 s44.

PART VI
Certification

DIVISION 1
Interpretation and Application of Part

Interpretation of Part

45 In this Part:

(a) **"board"** means the Operator Certification Board continued pursuant to section 47;

(b) **"certificate"** means a certificate issued to an operator by the board pursuant to section 66 and includes a certificate issued to an operator in training;

(c) **"operator"** means a person who adjusts, inspects or evaluates a process that controls the effectiveness or efficiency of sewage works or waterworks and includes:

(i) a person who adjusts or directs the flow, pressure or quality of the water within sewage works or waterworks; and

(ii) an operator in training.

13 Dec 2002 cE-10.21 Reg 1 s45.

Application of Part

46(1) This Part applies to:

(a) municipal waterworks that produce or supply water intended or used for human consumptive use;

(b) municipal sewage works;

(c) municipal wells that are connected to a distribution system and that produce or supply water intended or used for human consumptive use;

(d) waterworks that produce or supply water intended or used for human consumptive use, in addition to municipal waterworks, having a design flow exceeding 18 cubic metres over any 24-hour period;

(e) sewage works, in addition to municipal sewage works, having a design flow of sewage exceeding 18 cubic metres over any 24-hour period;

(f) all water pipelines connected to a municipal waterworks, regardless of volume of water supplied or number of service connections; and

(g) all water pipelines, not otherwise connected to a municipal waterworks, serving 15 or more service connections.

(2) This Part does not apply to a waterworks producing or supplying water intended or used for hygienic use.

13 Dec 2002 cE-10.21 Reg 1 s46.

DIVISION 2
Operator Certification Board

Board continued

47 The Operator Certification Board is continued as a corporation.

13 Dec 2002 cE-10.21 Reg 1 s47.

Membership of board

48(1) The board consists of at least three but not more than seven persons appointed by the minister who, in the minister's opinion, have experience with waterworks or sewage works.

(2) Each member of the board:

(a) holds office at pleasure for a term not exceeding three years that is specified in the appointment;

(b) is eligible for reappointment; and

(c) continues in office until a successor is appointed.

(3) Members of the board are entitled to:

(a) remuneration at a rate determined by the board; and

(b) reimbursement for expenses in accordance with the rates paid to members of the public service in Saskatchewan.

(4) If a member of the board dies or resigns, the person ceases to be a member of the board on the date of death or on the date that a written resignation is received by the board, as the case may be.

(5) If the office of a member of the board becomes vacant, the minister may:

(a) appoint another person for the remainder of the term of the person who vacated the office; or

(b) appoint another person for the term mentioned in subsection (2).

(6) A vacancy in the office of a member of the board does not impair the power of the remaining members of the board to act.

13 Dec 2002 cE-10.21 Reg 1 s48.

Board of directors and chairperson

49(1) A board of directors consisting of the members of the board shall manage the business and affairs of the board.

(2) The members of the board shall designate from amongst their number a chairperson and a vice-chairperson.

(3) The vice-chairperson shall exercise the powers and perform the duties of the chairperson whenever the chairperson is absent or otherwise unable to act.

13 Dec 2002 cE-10.21 Reg 1 s49.

Board not an agent of the Crown

50 The board is not an agent of the Crown in right of Saskatchewan.

13 Dec 2002 cE-10.21 Reg 1 s50.

Head office

51 The head office of the board is to be situated at any place within Saskatchewan that the board may designate.

13 Dec 2002 cE-10.21 Reg 1 s51.

Meetings

52 The board may meet at any time and place and in a manner that it considers necessary or desirable for the proper conduct of its business.

13 Dec 2002 cE-10.21 Reg 1 s52.

Responsibilities of board

53 The board is responsible for the following:

(a) receiving and reviewing applications for certificates pursuant to this Part;

(b) issuing certificates to applicants whom the board considers qualified.

13 Dec 2002 cE-10.21 Reg 1 s53.

Powers of board

54 The board may:

(a) accept any funds;

(b) enter into contracts or agreements that it considers expedient or desirable in the exercise of its powers or the performance of its responsibilities pursuant to this Part;

(c) charge fees within the range set out in section 64 for the certification of operators, for renewal of certificates and for matters respecting certification and certificates and collect and expend those fees;

(d) employ any staff necessary to carry out its responsibilities or the intent of this Part;

(e) attach any terms and conditions to a certificate that the board considers appropriate;

(f) issue or renew or refuse to issue or renew a certificate;

(g) cancel or amend a certificate to correct a clerical or other similar error;

(h) amend, suspend or cancel a certificate in accordance with section 69;

(i) appoint any advisory committees that it considers necessary for the efficient conduct of the affairs and business of the board, including appointing persons to an advisory committee who are not members of the board;

(j) enter into reciprocity agreements with other jurisdictions respecting operator certification standards;

(k) make bylaws governing its business and operations that it considers appropriate;

(l) generally do and authorize the doing of any things that it considers incidental or conducive to the exercise of its powers or the performance of its responsibilities pursuant to this Part.

13 Dec 2002 cE-10.21 Reg 1 s54.

Borrowing powers

55(1) The board may borrow any amount of money that it considers will be required to fund the operations of the board or to fulfil the responsibilities of the board.

(2) The board may provide any guarantee or security that it considers appropriate respecting a loan.

13 Dec 2002 cE-10.21 Reg 1 s55.

No Crown guarantee for loans by board

56 No loan made pursuant to section 55 is to be guaranteed by the Minister of Finance, and the Government of Saskatchewan is not liable for the repayment of that loan or any interest, principal or premium respecting that loan.

13 Dec 2002 cE-10.21 Reg 1 s56.

Investments of board

57 The board may:

(a) invest any part of the capital or operating money of the board in any security or class of securities authorized for investment of money in the general revenue fund pursuant to *The Financial Administration Act, 1993*; and

(b) dispose of the investments in any manner, on any terms and conditions and in any amount that the board considers appropriate.

13 Dec 2002 cE-10.21 Reg 1 s57.

Fiscal year of board

58 The fiscal year of the board is the period commencing on April 1 in one year and ending on March 31 in the following year.

13 Dec 2002 cE-10.21 Reg 1 s58.

Audit

59 The board shall appoint an auditor, at the board's expense, who shall audit the board's records, accounts and financial statements:

(a) annually; and

(b) at any other times the board or the minister may direct.

13 Dec 2002 cE-10.21 Reg 1 s59.

Annual report

60(1) In each year, not later than June 30, the board shall provide an annual report to the minister for the previous year that includes:

(a) the number of applications for certification and for certification renewals, certifications and renewals granted, certifications and renewals denied and hearings by the board;

(b) the total number of operators with valid certificates, their names, their level of certification and their places of employment;

(c) an annual audited financial statement; and

(d) any other information that the minister may request.

(2) An annual report mentioned in subsection (1) is a public document.

(3) Subject to subsection (5), the board may publish or distribute a copy of its records and information, including the following information with respect to each certified operator:

(a) his or her name;

(b) his or her level of certification;

(c) his or her place of employment;

(d) his or her certificate number;

(e) the date of issue or upgrading of his or her certificate;

(f) the date of expiry of his or her certificate.

(4) The board may publish or distribute the information mentioned in subsection (3) in any manner and any time that the board considers necessary or appropriate.

(5) The board may not publish or disclose any record or information, other than the information specifically mentioned in clauses (3)(a) to (f), that is personal in nature or that could disclose an individual's education, test marks or work history.

13 Dec 2002 cE-10.21 Reg 1 s60.

DIVISION 3
Standards to be met by Operators to obtain Certificates

Standards adopted

61(1) In this section and in section 62:

(a) **"standards"** means the *Saskatchewan Water and Wastewater Works Operator Certification Standards, 2002*, EPB 139/02/2M, as amended from time to time, and as issued by the department, respecting the training and qualifications of operators and the classification of facilities as adopted pursuant to this section;

(b) **"wastewater collection facilities"** means that part of a sewage works that includes the collection system and pumping stations;

(c) **"wastewater treatment facilities"** means those components of a sewage works that modify or hold sewage;

(d) **"water distribution facilities"** means that part of a waterworks that:

(i) includes the distribution system and pump houses; and

(ii) only treats water by means of chemical addition;

(e) **"water treatment facilities"** means those components of a waterworks that are used to filter or condition water for the purpose of rendering the water acceptable for human consumptive use.

(2) For the purposes of this Part:

(a) the *Saskatchewan Water and Wastewater Works Operator Certification Standards, 2002*, EPB 139/02/2M, as amended from time to time, and as issued by the department, respecting the training and qualifications of operators and the classification of facilities is adopted; and

(b) the board shall base its decision whether to issue or renew or refuse to issue or renew a certificate, or to amend, suspend or cancel a certificate, on the standards mentioned in clause (a).

(3) The minister shall cause the standards adopted pursuant to this section to be made available to the public in any manner that the minister considers likely to bring them to the public's attention, including causing them to be posted on the department's Internet website.

13 Dec 2002 cE-10.21 Reg 1 s61.

Classification of facilities

62(1) For the purposes of this Part, waterworks and sewage works are to be divided into the following types of facilities in accordance with the standards:

(a) water distribution facilities;

(b) water treatment facilities;

(c) wastewater collection facilities;

(d) wastewater treatment facilities.

(2) The minister may classify a waterworks or sewage works mentioned in subsection (1) in accordance with the standards.

(3) A waterworks or sewage works classified by the minister before the coming into force of this Part retains the classification it had on the date that these regulations come into force until it is reclassified pursuant to the standards.

(4) If the minister considers it appropriate, the minister may reclassify a waterworks or sewage works in accordance with the standards.

13 Dec 2002 cE-10.21 Reg 1 s62.

DIVISION 4
Certificates

Minimum certificates that operators must hold

63 On and after July 15, 2005, every municipality and permittee of a waterworks or sewage works governed by this Part shall ensure that the operation, repair and maintenance of those works is under the direction of an operator who holds at least the corresponding certificate for the classification of those works that is set out in the standards.

13 Dec 2002 cE-10.21 Reg 1 s63.

Application for certificate or renewal

64(1) A person who wishes to obtain a certificate shall:

(a) apply to the board in a form acceptable to the board;

(b) provide evidence satisfactory to the board that the applicant has the necessary training, education and experience for certification as set out in the standards;

(c) pay the fee that the board may charge pursuant to subsection (3);

(d) provide any information and materials that the board may reasonably require to assess the application; and

(e) comply with any other requirements that may be set by the board.

(2) A person who wishes to renew a certificate shall:

(a) pay the fee that the board may charge pursuant to subsection (3);

(b) provide any information and materials that the board may reasonably require to assess the application; and

(c) comply with any other requirements that may be set by the board.

(3) The board may charge a fee in an amount that it considers necessary to recover its costs in reviewing an application and issuing a certificate to a maximum of $125 for each year that the certificate applied for may be issued.

(4) Any fee charged pursuant to this section is non-refundable.

(5) Notwithstanding subsection (2), a certificate issued to an operator in training is not renewable.

13 Dec 2002 cE-10.21 Reg 1 s64.

Board may investigate applicant

65 The board may investigate an applicant or request any information that it considers necessary respecting an application for a certificate or the renewal of a certificate.

13 Dec 2002 cE-10.21 Reg 1 s65.

Issuance or refusal of certificate

66(1) Within 90 days after receiving an application for a certificate, the board shall:

(a) if it is satisfied that the applicant has met the requirements of the standards and has complied with these regulations, issue or renew a certificate to the applicant;

(b) if it is not satisfied of the matters set out in clause (a), notify the applicant that a certificate will not be issued and provide the applicant with written reasons for not issuing a certificate; or

(c) if the board considers it necessary, notify the applicant that further information is required to assess the application.

(2) An applicant who is not issued a certificate, or whose certificate is not renewed, may, within 30 days after being notified pursuant clause (1)(b), make written representations to the board to have the board reconsider its decision, and the board shall consider those representations in determining whether or not a certificate should be issued or renewed.

13 Dec 2002 cE-10.21 Reg 1 s66.

Term of certificate and application to upgrade

67(1) A certificate issued or renewed by the board expires on the date set out in the certificate which is not to be later than two years from the date of issue or renewal.

(2) The holders of a certificate may apply to have the holder's certificate upgraded to a higher level of certification before the holder's certificate expires.

(3) Sections 64 to 66 apply, with any necessary modification, to an application to upgrade a holder's certificate.

13 Dec 2002 cE-10.21 Reg 1 s67.

Additional information re renewal of certificate

68 On and after July 15, 2005, in addition to the requirements set out in clause 66(1)(a), an applicant who wishes to have his or her certificate renewed must satisfy the board that the applicant has obtained 5.0 contact hours, 0.5 Continuing Education Unit or 0.67 credit hours per year of training in an area that the board considers to be an appropriate field since the date that the applicant's certificate was issued or last renewed.

13 Dec 2002 cE-10.21 Reg 1 s68.

Amendment, cancellation, suspension of certificate

69(1) Subject to subsection (2), the board may amend or cancel a certificate, or suspend a certificate for a stated period, if the board is satisfied that:

(a) the certificate was obtained by fraud, deceit or the submission of an application containing inaccurate information;

(b) the person holding the certificate has been discharged from employment in a facility for gross negligence or for incompetence in the performance of his or her duties; or

(c) the person holding the certificate has placed the environment or human health or public safety at risk.

(2) Before taking any action pursuant to subsection (1), the board shall provide the person holding the certificate with:

(a) reasonable notice of its intended action, including written reasons; and

(b) an opportunity to make written representations to the board.

(3) The board is not required to give an oral hearing to any person to whom notice has been sent pursuant to subsection (2).

13 Dec 2002 cE-10.21 Reg 1 s69.

PART VII
Administrative Penalties

Provisions for which an administrative penalty may be imposed

70 For the purposes of section 77 of the Act, the provisions of the Act and these regulations listed in Table 1 of the Appendix are prescribed as provisions for which the minister may impose an administrative penalty if they are contravened.

13 Dec 2002 cE-10.21 Reg 1 s70.

Amount of administrative penalty

71(1) Subject to subsections (2) and (3), the amount of an administrative penalty that may be assessed for each contravention is to be determined in accordance with the range set out in the following Base Penalty Table:

Base Penalty Table

Type of Contravention	Potential for Adverse Effect		
	Major	Moderate	Minor
Major	$5,000	$3,500	$2,500
Moderate	$3,500	$2,500	$1,500
Minor	$2,500	$1,500	$1,000

(2) In establishing an administrative penalty, the minister may consider the significance of the contravention by assessing the following factors:

(a) the potential impact on the environment and on human health and public safety;

(b) whether or not there was any mitigation relating to the contravention;

(c) whether or not steps have been taken to prevent reoccurrence of the contravention;

(d) whether or not the person who receives the notice of administrative penalty has been assessed a prior administrative penalty or has a prior conviction for an offence respecting a contravention of the Act and these regulations;

(e) whether or not the person who receives the notice of administrative penalty has derived any economic benefit from the contravention;

(f) any other factors that, in the opinion of the minister, are relevant.

(3) The maximum administrative penalty that may be assessed for each contravention is $5,000.

13 Dec 2002 cE-10.21 Reg 1 s71.

PART VIII
General

Information submitted to the minister deemed to be public information

72(1) All information, data, test results and records submitted to the minister pursuant to a permit, the Act or these regulations is deemed to be public information.

(2) The minister may disclose to the public any of the information, data, test results and records mentioned in subsection (1) at any times and in any manner that the minister considers appropriate.

13 Dec 2002 cE-10.21 Reg 1 s72.

Application fees for Division 2 – Part IV permits

73 For the purposes of clause 22(d) of the Act, the prescribed fee is $49 for each notice or certificate respecting the permit that, in the opinion of minister, must be registered pursuant to sections 25 and 27 of the Act.

13 Dec 2002 cE-10.21 Reg 1 s73.

Required contents of easements

74 For the purposes of clause 27(2)(b) of the Act, every easement must contain the following information and provisions:

(a) the name of the person proposing to construct, extend, alter or operate the waterworks or sewage works that is the subject of the easement;

(b) the nature and extent of the construction, extension, alteration or operation of the waterworks or sewage works that is the subject of the easement;

(c) the name of the registered owner of the land on which the waterworks or sewage works that is the subject of the easement is to be constructed, extended, altered or operated and, if different, the name of the registered owner of the land affected by the waterworks or sewage works that is the subject of the easement;

(d) the legal description of the lands mentioned in clause (c);

(e) a provision that:

(i) grants an easement by the registered owners of the lands affected by the waterworks or sewage works that is the subject of the easement;

(ii) conveys a right to use the land for the purposes and to the extent required to construct, alter, extend or operate the waterworks or sewage works that is the subject of the easement; and

(iii) states that the easement runs with the land and is binding on the present and subsequent registered owners of the lands affected by waterworks or sewage works that is the subject of the easement and their heirs, executors, administrators and assigns.

13 Dec 2002 cE-10.21 Reg 1 s74.

PART IX
Repeal and Coming into Force

R.R.S. c.E-10.2 Reg 2 repealed

75 *The Water Pollution Control and Waterworks Regulations* are repealed.

13 Dec 2002 cE-10.21 Reg 1 s75.

Coming into force

76 These regulations come into force on the day on which they are filed with the Registrar of Regulations.

13 Dec 2002 cE-10.21 Reg 1 s76.

APPENDIX

Table 1
Provisions respecting which Administrative Penalty May Be Imposed
[*Section 71*]

Provisions of the Act

subsection 23(5)

Provisions of these Regulations

clause 18(2)(a)
clause 19(a)
clauses 26(1)(a)(b)
clause 27(2)(a)
subsection 27(3)
clauses 27(4)(a)(b)
clauses 28(a)(b)(d)(e)
subsections 30(5) and (6)
subclauses 32(1)(a)(i)(ii)(iii)
paragraph 33(2)(a)(i)(C)
paragraph 33(2)(a)(ii)(C)
subclause 33(2)(b)(ii)
subclause 33(2)(c)(iii)
clause 36(c)
clauses 39(1)(a)(b)
clauses 42(1)(a)(b)(c)(d)(e)(f)(g)(h)(i)
clauses 42(2)(a)(b)(c)(d)(e)(f)(g)
subsection 44(1)
section 63

13 Dec 2002 cE-10.21 Reg 1.

Table 2
[Section 31 and subsection 34(1)]

Chemical – Health Category

Parameter	**Maximum Acceptable Concentration (mg/L)**	**Interim Maximum Acceptable Concentration (mg/L)**
Arsenic		0.025
Barium	1	
Benzene	0.005	
Benzo(a)pyrene	0.00001	
Boron		5.0
Cadmium	0.005	
Carbon tetrachloride	0.005	
Chromium	0.05	
Cyanide	0.2	
Dichlorobenzene, 1,2	0.2	
Dichlorobenzene, 1,4	0.005	
Dichloroethane, 1,2		0.005
Dichloroethylene, 1,1	0.014	
Dichloromethane	0.05	
Dichlorophenol, 2,4	0.9	
Fluoride[1]	1.5	
Lead[2]	0.01	
Mercury	0.001	
Monochlorobenzene	0.08	
Nitrate[3] as NO_3	45	
Selenium	0.01	
Tetrachlorophenol, 2,3,4,6	0.1	
Trichloroethylene	0.05	
Trichlorophenol, 2,4,6	0.005	
Trihalomethanes (THM)[4]		0.1
Uranium	0.02	
Vinyl Chloride	0.002	

[1] Maximum allowable concentration of naturally occurring fluoride in treated drinking water intended or used for human consumptive use.

[2] Faucets should be thoroughly flushed before sample is collected.

[3] Nitrate levels in excess of 45 mg/L (10 mg/L as nitrate-nitrogen) may cause adverse health effects in infants less than six months old.

[4] Based on an annual average of 4 seasonal samples.

Radiological*

Screening Parameter	**Concentration Becquerels per litre**
Gross alpha	0.1
Gross beta	0.11

* Radiological – Water samples may be initially screened for radioactivity using gross alpha and gross beta activity determinations. Compliance with the standards may be inferred if the measurements for gross alpha and gross beta activity are less than 0.1 Bq/L (becquerels per litre) and 1 Bq/L, respectively, as these are lower than the strictest Maximum Acceptable Concentrations. If these values are exceeded then Part 5 of the *Guidelines for Canadain Drinking Water Quality*, Sixth Edition, Health Canada, 1996, as amended from time to time, apply.

Chemical – Pesticides*

Parameter	**Maximum Acceptable Concentration (mg/L)**	**Interim Maximum Acceptable Concentration (mg/L)**
Atrazine		0.005
Bromoxynil		0.005
Carbofuran	0.09	
Chlorpyrifos	0.09	
Dicamba	0.12	
2,4-D**		0.1
Diclofop-methyl	0.009	
Dimethoate		0.02
Malathion	0.19	
Pentachlorophenol	0.06	
Picloram		0.19
Trifluralin		0.045

* Pesticides commonly used in Saskatchewan

** 2,4 Dichlorophenoxyacetic acid

13 Dec 2002 cE-10.21 Reg 1.

REGINA, SASKATCHEWAN
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Saskatchewan's Drinking Water Quality Standards and Objectives (summarized)

Standards and objectives can be applied to water for both hygienic use and human consumption. In general, standards are mandatory for systems that supply water for human consumptive use. For systems that supply water for hygienic use, only bacteriological standards apply. Both systems should also strive to achieve the water quality objectives.

Explanation of Terms

Maximum Acceptable Concentration (MAC)

Interim Maximum Acceptable Concentration (IMAC)

Aesthetic Objective (AO)

Apparent Color Unit (ACU)

Nephelometric Turbidity Unit (NTU)

Milligrams per Litre (mg/L)

Standards

Standards are legally enforceable requirements for drinking water quality and are set out in *The Water Regulations, 2002*.

Bacteriological Standards: Effective immediately, standards include:

- total coliform levels of zero organisms detectable per 100 millilitre (mL);
- fecal coliform levels of zero organisms detectable per 100 mL; and
- background bacteria levels on a total coliform or a fecal coliform membrane filtration plate of less than 200 colonies per 100 mL or no overgrowth.

Turbidity Standards: Turbidity is an important indicator of water treatment process efficiency from both health and aesthetic perspectives. Compliance with turbidity standards is immediate for newly constructed waterworks. Existing waterworks producing water for human consumptive use will be required to meet the standards by December 5, 2008 for systems serving a population of less than 5,000 and by December 5, 2006 for systems serving a population of 5,000 or more.

Source/Treatment	Routine Standard	Continuous Monitoring Time Duration Maximum	Absolute Maximum
Surface water[1,2]: Chemically Assisted Filtration - When monthly source water average is 1.5 NTU or more	Less than 0.3 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	Not to exceed 0.3 NTU for more than 12 consecutive hours if continuous monitoring employed	Never to exceed 1.0 NTU
Surface water[1,2]: Chemically Assisted Filtration - When monthly source water average is less than 1.5 NTU	Less than 0.2 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	Not to exceed 0.2 NTU for more than 12 consecutive hours if continuous monitoring employed	Never to exceed 1.0 NTU
Surface water[1,2]: Membrane Filtration	Less than 0.1 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	No stated standard	Never to exceed 0.3 NTU
Surface water[1,2]: Slow Sand or Diatomaceous Earth Filtration	Less than 1.0 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	Not to exceed 1.0 NTU for more than 12 consecutive hours if continuous monitoring employed	Never to exceed 3.0 NTU
Groundwater[3]	Less than 1.0 NTU, 95% of discrete measurements or 95% time if continuous monitoring employed	No stated standard	No stated standard - see permit

[1] Includes surface waters and groundwater under the influence of surface water. [2] Turbidity value measured from each filter effluent. [3] Turbidity value for water entering the distribution system
Other requirements apply for novel surface water treatment technologies.

Chemical Health/Pesticides/Radiological

These include a range of substances that are known or suspected to cause adverse effects on health. These values have been derived to safeguard health on the basis of life long consumption. Compliance with chemical standards is immediate for newly constructed waterworks. Existing waterworks producing water for human consumptive use will be required to meet the standards by December 5, 2010 for systems serving a population of less than 5,000 and by December 5, 2008 for systems serving a population of 5,000 or more.

Chemical - Health Category

Parameter	MAC (mg/L)	IMAC (mg/L)
Arsenic		0.025
Barium	1	
Benzene	0.005	
Benzo(a)pyrene	0.00001	
Boron		5.0
Cadmium	0.005	
Carbon tetrachloride	0.005	
Chromium	0.05	
Cyanide	0.2	
Dichlorobenzene, 1,2	0.2	
Dichlorobenzene, 1,4	0.005	
Dichloroethane, 1,2		0.005
Dichloroethylene, 1,1	0.014	
Dichloromethane	0.05	
Dichlorophenol, 2,4	0.9	
Fluoride[1]	1.5	
Lead[2]	0.01	
Mercury	0.001	
Monochlorobenzene	0.08	
Nitrate[3] as NO_3	45	
Selenium	0.01	
Tetrachlorophenol, 2,3,4,6	0.1	
Trichloroethylene	0.05	
Trichlorophenol, 2,4,6	0.005	
Trihalomethanes (THM)[4]		0.1
Uranium	0.02	
Vinyl Chloride	0.002	

Chemical Pesticides (commonly used in Saskatchewan)

Parameter	MAC (mg/L)	IMAC (mg/L)
Atrazine		0.005
Bromoxynil		0.005
Carbofuran	0.09	
Chlorpyrifos	0.09	
Dicamba	0.12	
2,4-D[5]		0.1
Diclofop-methyl	0.009	
Dimethoate		0.02
Malathion	0.19	
Pentachlorophenol	0.06	
Picloram		0.19
Trifluralin		0.045

[1] Maximum allowable concentration of naturally occurring fluoride in a treated drinking water intended or used for human consumptive use.
[2] Faucets should be thoroughly flushed before sample is collected.
[3] Nitrate levels in excess of 45 mg/L (10 mg/L as nitrate-nitrogen) may cause adverse health effects in infants less than six months old. Where nitrate and nitrite are determined separately, levels of nitrite should not exceed 3.2 mg/L
[4] Based on an annual average of 4 seasonal samples.
[5] 2,4 Dichlorophenoxyacetic acid

Radiological[6]

Screening Parameter	Concentration Becquerels Per litre (Bq/L)
Gross alpha	0.1
Gross beta	0.11

[6] Water samples may be initially screened for radioactivity using gross alpha and gross beta activity determinations. Compliance with the standards may be inferred if the measurements for gross alpha and gross beta activity are less than 0.1 Bq/L and 1 Bq/L, respectively, as these are lower than the strictest MACs. If these values are exceeded then Part 5 of the *Guidelines for Canadian Drinking Water Quality*, Sixth Edition, Health Canada, 1996, as amended from time to time, applies

Objectives

Objectives apply to certain characteristics of, or substances found in water for human consumptive or hygienic use. The presence of these substances will affect the acceptance of water by consumers and/or interfere with the practice of supplying good quality water. Compliance with drinking water objectives is not mandatory as these objectives are in the range where they do not constitute a health hazard. However, these substances may represent a health risk to some people if found in excessive concentrations. The Aesthetic Objectives for several parameters (including hardness as $CaCO_3$, magnesium, sodium and total dissolved solids) consider regional differences in drinking water quality.

Physical

Parameter	AO
Color	15 ACU
Odor	Inoffensive
PH	6.5 to 9.0
Taste	Inoffensive
Temperature	$\leq 15°C$

Total Dissolved Solids (TDS): For the purposes of Saskatchewan Environment's drinking water quality objectives, TDS are based on summation of ions.

Summation of Ions: $Cl + SO_4 + Ca + Mg + K + Na + NO_3 + CO_3 + HCO_3$ = TDS calculation

Chemical

Parameter	AO (mg/L)
Alkalinity (as $CaCO_3$)	500
Chloride	250
Copper	1
Ethylbenzene	0.0024
Hardness (as $CaCO_3$)	800
Iron	0.3
Magnesium	200
Manganese	0.05
Sodium[1]	300
Sulphate[2]	500
Sulphide (as H_2S)	0.05
Total Dissolved Solids	1500
Toluene	0.024
Xylenes	0.3

[1] Sodium: It is recommended sodium be included in routine monitoring programmes. Sodium levels may be of interest to authorities who wish to prescribe sodium-restricted diets to their patients.
[2] Sulphate: There may be a laxative effect in some individuals when

Drinking Water Quality in the Territories

May 2003

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The territorial governments are responsible for ensuring safe drinking water in all communities including First Nations and Inuit.

Drinking water quality monitoring responsibilities and 'boil water' advisories reside with the Territorial Governments and INAC. Environmental health and surveillance programs were transferred when the federal government devolved certain health services to the Government of the Northwest Territories (NWT) in 1988 and to the Yukon Territorial Government (YTG) in 1997 and Nunavut in 1999.

After the 1997 YTG devolution Health Canada continues to provide funding for the promotion of drinking water safety to Yukon First Nations. Health Canada also provides financial support to YTG to provide drinking water testing supplies to Yukon First Nations communities.

Upon request, HC provides scientific support and expertise for First Nations and Inuit communities in the territories and to territorial governments.

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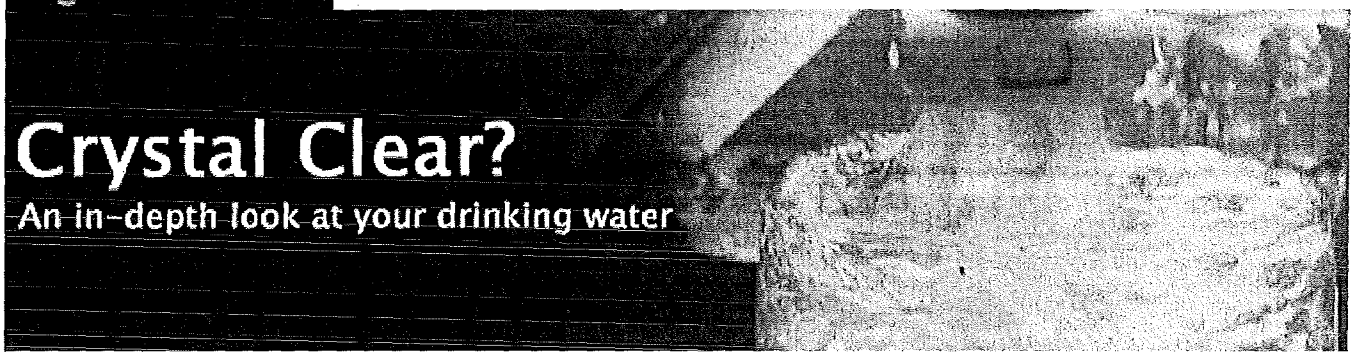

Main > Nunavut

YUKON
N.W.T.
NUNAVUT

Cambridge Bay
Gjoa Haven
Iqaluit
Kugluktuk
Rankin Inlet

Nunavut

There are 28 communities in Nunavut, with a total population of 27,039.

CBC North sampled water quality in the following communities; Cambridge Bay, Gjoa Haven, Iqaluit, Kugluktuk, Rankin Inlet.

Results by community

	Bacterial	Metals	THMs	Turbidity	Hardness
Cambridge Bay	high bacteria count	normal	normal	acceptable	very hard
Gjoa Haven	below guidelines	normal	normal	acceptable	very hard
Iqaluit	below guidelines	normal	normal	acceptable	soft
Kugluktuk	some coliforms found	normal	normal	acceptable	soft
Rankin Inlet	below guidelines	normal	normal	acceptable	hard
Testing information: Click here					

You can see how the results are affecting your community, plus stories and information, by clicking on the name.

CBC collected water in the communities above, meeting sampling guidelines, and forwarded the samples to Norwest Labs in Edmonton within 48 hours of collection. Norwest Labs is a certified and accredited water testing facility. Click here for more information.

Media

AUDIO:

Qulliq host Joanna A' conversation with re| Bell about Nunavut's infrastructure. (runs

Patricia Bell looks at the results from Nun water in most comm found to be good en((runs 1:30)

Interview with Bruce Environmental Health 5:38)

Norwest Lab's Antho talks about Nunavut' results. (run 8:28)

INUKTITUT AUDIO:

Joanna Awa, host of Quilliq, talks to reporter Karliin Aaria Nunavut's test result

Joanna Awa, host of Qullig, discusses CB(Northern water serie Salome Awa. (runs 7

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Resources

PDF:

Guidelines for Canad
Water Quality

EXTERNAL LINK:

Norwest Labs of Edm

Environment Canada

Health Canada

First Nations and Inu

BACKGROUNDER:

Inside Walkerton

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(b) changes or repairs are required to such public water supply.

(3) Nothing in these regulations shall be deemed to revoke anything contained in a building code or regulation applicable to a public water supply in any area of the Territories, but where there is a conflict between these regulations and a building code or regulation, these regulations shall apply.

Approval

3. No person shall construct, make a structural alteration or add to a public water supply system unless approval has first been obtained in accordance with these regulations.

Inspection

4. (1) The Medical Health Officer or a Health Officer may, at any reasonable time, enter any premises of a public water supply and examine the premises and anything in the premises that is used in connection with the operation of the public water supply.

(2) Where, in the opinion of the Medical Health Officer or a Health Officer, any provision of these regulations is not being observed, he or she may make such recommendations or issue such directives to the operator as he or she deems to be necessary in that connection.

(3) Where the operation of a public water supply does not comply with these regulations, the Medical Health Officer or Health Officer shall make a report to the Chief Medical Health Officer and shall furnish a copy of the report to the operator, specifying the violation or violations of these regulations together with recommendations for their correction.

Closure and Appeal

5. (1) Where, in the opinion of the Chief Medical Health Officer, the water is dangerous to the health of the consumers, he or she may order closure of the public water supply.

(2) The operator may appeal in writing to the Commissioner within 48 hours after receiving a closure order under subsection (1) and the Commissioner shall either revoke or confirm the order.

PART II

WATER SOURCES, WATER TREATMENT, CHLORINATION AND FLUORIDATION

Surface Water Sources

6. No surface water source shall be approved for use in a public water supply unless

(a) the quantity of water is sufficient to permit reasonable quality control of the water having regard to the estimated demand that the source is required to fill;

(b) it is practicable to convert the water from the source into finished water having regard to natural and man-made conditions affecting the quality of water.

7. (1) The quantity of water available in a surface water source shall be adequate to supply the water demand, including the fire demand, of the community using the surface water source, including a reasonable surplus for anticipated growth.

(2) Where a surface water source is impounded and when it is necessary to estimate the quantity of water to meet the demand of a community, required allowance shall be made for all losses including water released, losses due to evaporation and seepage, loss of capacity due to siltation and ice and unavailable water stored below the bottom intake opening.

8. Where a surface water source is approved for use in a public water supply nothing which may adversely affect the quality of the raw water may be done on the watershed without approval by the Chief Medical Health Officer.

Water Quality

Bacteriological Characteristics

9. Samples of water shall be submitted to a laboratory for bacteriological analysis as directed by the Medical Health Officer. Where practical, it is desirable that there should be a minimum number of samples of treated water a month submitted for bacteriological examination according to the following table:

Population	**Number of samples a month**
up to 500	1
501 to 2500	2
2501 to 3500	3
3501 to 4000	4
4001 to 4800	5
4801 to 5500	6
5501 to 6500	7

10. (1) Where the multitube fermentation technique is used, the arithmetical mean of the most probable numbers of coliforms for all standard samples examined a month shall not exceed 1 for each 100 ml. When the membrance filter technique is used, the arithmetical mean coliform density of all standard samples shall not exceed 1 for each 100 ml.

(2) If the most probable number of coliforms when the multitube fermentation technique is used, or the coliform density when the membrance filter technique is used, is nine or greater, then additional samples shall be taken. These should be submitted one after another as soon as reasonably possible in view of the logistics of transportation and the laboratory facilities until the results obtained from at least two consecutive samples show the water to be of satisfactory quality.

Physical Characteristics

11. (1) The frequency and manner of sampling shall be determined by the Chief Medical Health Officer. Under normal circumstances, samples should be collected daily by the operator who should record the results.

(2) Drinking water should contain no impurity which would cause offence to the sense of sight, taste or smell. The following limits should not be exceeded:

Turbidity 5 units

Colour 15 units

Threshold odour number 3

Chemical Characteristics

12. (1) The frequency and manner of sampling shall be determined by the Chief Medical Health Officer. Under normal circumstances, analyses for substances listed below need be made no more often than once in two years.

(2) Drinking water shall not contain impurities in concentrations which may be hazardous to the public health. It should not be excessively corrosive to the water supply system. Substances used in its treatment shall not remain in the water in concentrations greater than required by good practice.

(3) Substances which may have deleterious physiological effect, or for which physiological effects are not known, shall not be introduced onto the system in a manner which would permit them to reach the consumer. The following chemical substances should not be present in a water supply in excess of the listed concentrations where, in the judgment of the Chief Medical Health Officer, other more suitable supplies are or can be made available:

Maximum

Substances

concentration - mg/l

Alkyl benzene

sulfonate (ABS) 0.5

Arsenic (As) 0.05

Chloride (Cl) 250

Copper (Cu) 1

Carbon chloroform

extract (CCE) 0.2

Cyanide (CN) 0.01

Fluoride (F) 1.7

Iron (Fe) 0.3

Manganese (Mn) 0.05

Nitrate (NO3) 45

Phenols 0.001

Sulfate (SO4) 250

Total dissolved solids 500

Zinc (Zn) 5

Barium (Ba) 1

Cadmium (Cd) 0.01

Chromium

(hexovalent) (Cr6) 0.05

Lead (Pb) 0.05

Selenium (Se) 0.01

Silver (Ag) 0.05.

Radioactive Characteristics

13. (1) The frequency of sampling and analysis for radioactivity shall be determined by the Chief Medical Health Officer in consultation with the Radiation Protection Bureau of the Department of National Health and Welfare, or its successors, after consideration of the likelihood of significant amounts being present.

(2) The effects of human radiation exposure are viewed as harmful and any unnecessary exposure to ionizing radiation should be avoided. Approval of water supplies containing radioactive materials shall be based upon the judgment that the radioactivity intake from such water supplies when added to that from all other sources is not likely to result in an intake greater than the radiation protection guidance recommended by the Radiation Protection Division of the Department of National Health and Welfare, or its successors.

Water Treatment Plants

14. (1) The design of water treatment plants shall be adequate to provide the treatment of the raw water which is required to produce finished water.

(2) Filters shall be of the gravity type unless otherwise approved by the Chief Medical Health Officer.

(3) Heating facilities of a safe type should be provided in buildings which will be occupied by personnel, and should be adequate for comfort, as well as for protection of the equipment.

(4) The buildings shall be well-ventilated by means of windows and doors, roof ventilators or other means. All rooms, compartments, pits and other enclosures below the grade floor, which must be entered and in which an unsafe atmosphere may develop, or where excessive heat may be built up by equipment, shall have adequate forced ventilation. The equipment should be capable of producing at least six complete turnovers of air an hour. Rooms containing equipment or piping should be adequately heated, ventilated and, if necessary, dehumidified to prevent injurious condensation. Where practicable, ventilation should be supplemented by insulation of the building, equipment and piping. Switches which control the forced ventilation shall be located in order to be conveniently manipulated from outside such compartments.

(5) Buildings shall be adequately lighted throughout by means of natural light or by artificial lighting facilities, or both. Control switches, where needed, shall be conveniently placed at the entrance to each room or compartment. All electric wiring and equipment shall be of a type listed by the Canadian Standards Association Testing Laboratories and installed in accordance with the CSA Standard C22.1 - 1986 Canadian Electrical Code - Part I - Safety Standard for Electrical Installation and those of the Government of the Northwest Territories and local government authorities.

(6) Where lavatory and toilet facilities are provided at the water treatment plant, wastes shall be safely disposed of, without danger of contaminating the water and preferably they shall be discharged directly into an approved sewer.

Chlorination

15. (1) Drinking water shall be chlorinated or receive other bactericidal treatment as approved by the Chief Medical Health Officer in all cases when the supply is obtained from a surface source, and in the case of a groundwater source if the water may be subject to contamination in the well or in storage reservoirs or mains. Additional chlorination may be required if there is reasonable possibility for contamination subsequent to the original disinfection.

(2) Chlorination equipment shall have a maximum feed capacity at least 50% greater than the highest dosage required to provide a free chlorine residual.

(3) Dependable feed equipment, either of the gas feed or positive displacement solution feed type, shall be used for adding chlorine. Automatic proportioning of the chlorine dosage to the rate of flow of the water treated shall be provided at all treatment plants where the rate of flow varies without manual adjustment of pumping rates. In the selection and design of equipment, care should be taken to ensure that there is sufficient dilution of chlorine in the water whenever there is contact with piping, valves or fittings which are corrodible.

(4) All chlorination equipment should be installed in duplicate, in order to provide standby units for ensuring uninterrupted operation. In addition, spare parts consisting of at least the commonly expendable parts such as glassware, rubber fittings, hose clamps, and gaskets should be provided for effecting emergency repairs. In some cases, satisfactory emergency chlorinators may consist of discontinued equipment if it is operable and adequately sized.

(5) Where gas feed chlorinators are employed, a scale shall be provided for weighing the chlorine cylinders serving each operating chlorinator. Preferably, weigh scales for 68 kg cylinders should be recessed in the floor, and the recess provided with a drain.

(6) Where a powdered hypochlorite is used, solutions should be prepared in a separate tank. The clear liquid should be siphoned to the solution storage tank from which it is drawn by the hypochlorinator. A second tank is not

required when chlorine is supplied as a solution.

(7) Where gas chlorine is used, there shall be a canister-type respirator with a full face mask in a location handy to the operator. The canister shall be specifically designed to protect against chlorine and a new one should be obtained each time one is used.

(8) Safety chains should be used to retain 68 kg cylinders of chlorine gas, either in storage or on weigh scales, in a safe upright position.

(9) Gas chlorine equipment, including chlorinators, weigh scales and chlorine cylinders, shall be located in an isolated building, room or rooms. In larger installations, the storage and scale facilities should be in a room separated from the chlorinators. The construction of the room or rooms should be of fire resistant material and have concrete floors.

(10) Areas containing chlorine or chlorinator equipment shall be clearly marked "DANGER! CHLORINE STORAGE" or "DANGER! CHLORINE FEED EQUIPMENT" as applicable.

(11) There should be two or more exits if the distance of travel to the nearest exit exceeds 4.5 m.

(12) There should be continuous mechanical ventilation at the rate of three air changes an hour. Alternatively there should be screened openings to the outdoors with a size of 0.02% of the floor area

(a) within 150 mm of the floor, and

(b) near the ceiling.

(13) In addition, there should be emergency mechanical ventilation sufficient to produce 30 air changes an hour taking suction at floor level. The switch for the emergency fan should be located outside the chlorinator room. It should be posted with a sign warning that 10 minutes should elapse after starting the fan before entering the room.

(14) The temperature in the storage and scale room should never be higher and preferably slightly lower than that in the chlorinator room. The gas lines between the scales, chlorinators and injectors should not be located on an outside wall or in a location where low temperatures may be encountered.

16. (1) The application of chlorine shall be sufficient to provide 0.2 mg/l of residual free chlorine after a thorough mixing of the chlorine and water and 20 minutes of contact time after the mixing. Notwithstanding the foregoing, the Chief Medical Health Officer may decide on another chlorine residual for particular local circumstances.

(2) The chlorine residual test is performed on a sample of the plant or pipeline effluent, after it has been held for 20 minutes, unless it is certain that there has already been a chlorine contact time of 20 minutes.

(3) Where bacterial counts in the distribution system are high, the minimum requirements for chlorine residual should be increased.

(4) Where possible, a chlorine residual should be maintained in all active parts of the distribution system.

(5) There shall be a minimum total chlorine contact period of 20 minutes in the pipeline and reservoirs, before the first consumption by any person of the treated water.

(6) There shall be a permanent standard chlorine residual comparator test kit at each water plant where chlorination is undertaken.

(7) Whenever it is necessary to pump unchlorinated water which might not be potable into the distribution system the Chief Medical Health Officer or in his or her absence a responsible Health Officer, shall be notified immediately. After the emergency, the water mains and service lines shall be disinfected as stated in section 22.

Fluoridation

17. (1) Fluoridation is recommended for community water supplies. Before the equipment is ordered, the fluorides concentration in the raw water shall be checked to be sure of the need for fluorides.

(2) The fluorides feed rate shall be proportioned to the water flow rate. Where a pump supplies water at approximately a constant rate, a suitable fluoridator is a type which operates simultaneously with the pump. The pumping variation should be less than 10% from the mean.

(3) The sampling point should be a tap located on a line before the point where interfering substances (alum, chlorine, polyphosphates and other such substances) are added. The application point for the fluorides should be far enough ahead of this to ensure thorough mixing. Usually a distance equivalent to 10 pipe diameters would be sufficient for this purpose.

(4) If such an arrangement is not practical in view of the existing plant layout, then accurate tests may be made following neutralization in the case of chlorine and removal by distillation in the case of aluminum (from alum) and phosphates. The operator should make appropriate adjustments in the readings of his or her tests.

(5) The concentration of fluorides in the finished water shall be within the range of 1.2 and 1.6 mg/l. The optimum proportion is 1.4 mg/l.

(6) The following control procedures are required and all results should be recorded:

(a) the operator should make daily tests to determine the fluorides concentration in the treated water. In some installations there will be instantaneous variations in the fluorides concentration at the sampling tap due to the briefly intermittent discharge characteristics of some fluorides feeders. To compensate for these variations a large bottle of water should be drawn as the source of samples for testing;

(b) on a weekly basis duplicate samples of the water to be tested should be submitted to a laboratory designated by the Chief Medical Health Officer. The laboratory analyses will establish the accuracy of the plant operator's field tests and his or her ability to properly control the treatment. When this criteria has been attained, duplicate samples should be submitted on a monthly basis only;

(c) as a daily routine, the chemical dosage should be calculated based on the consumption of fluorides and volume of water treated.

(7) Protection to the skin and lungs of the operator handling the fluoride chemical shall be maintained as follows:

(a) if the equipment is not of a type which prevents the dust entering the air when the fluorides chemical is being replaced, then the equipment should be in a separate room with suitable exhaust venting from the floor level to the outside atmosphere. A vacuum cleaner in which disposable bags are used would be a suitable alternative, and it could also be used in cleaning the room. The bags should be either buried at the nuisance grounds or washed out

in the sewer;

(b) respirator, cloth cap, rubber gloves, rubber apron and goggles should be used at all times when handling the dry chemical, and these should be stored outside the fluoridation room;

(c) the operator should not smoke while handling the dry powder;

(d) instructions should be posted instructing the staff to observe the points contained in this section.

PART III

PUMPING STATIONS, RESERVOIRS AND DISTRIBUTION SYSTEMS

Pumping Stations

18. (1) The design of pumping stations shall be based on the provision to ensure maintenance of the sanitary quality of the water pumped through it, and to facilitate cleanliness, continuity and ease of operation. Subsurface pits, subterranean piping and connections and inaccessible installations should be avoided.

(2) The location should be chosen so that there will be adequate control over every external factor (such as usage of surrounding areas) which might contribute to the impairment of the sanitary quality of the water.

(3) The wet wells and pump reservoirs which are part of pumping stations shall conform with section 19.

Equalizing Reservoirs, Elevated Tanks, Standpipes and Pressure Tanks for Finished Water

19. (1) The most up-to-date standards should be followed where applicable in the design of reservoirs and other tanks.

(2) The locations, size and type of reservoir, tank or standpipe should be integrated with the distribution system, ground elevations and effective pressures, type and capacity of supply, economics of pumping and construction, consumer use and terrain. The design to be desired should give uniform pressures during the day with no pressure drop below 140 kPa.

(3) Reservoirs shall have watertight covers or roofs which exclude birds, animals, insects and excessive dust.

(4) There shall be locks on access manholes, fencing and other precautions in order to prevent trespassing, vandalism or sabotage.

(5) Steps should be taken to prevent an excessive build-up of ice which would damage the reservoir.

(6) There shall be consideration of public health safety in the location of ground level reservoirs. The bottom should be above the groundwater table and preferably above any possible flooding.

(7) Where the bottom of a reservoir is below the normal ground surface, separation from possible sources of contamination shall be provided as follows:

(a) 46 m from any septic tank, sewage lift station, sewage disposal point, sewage disposal field or other similar source of contamination;

(b) 8 m from any sewer pipe and preferably 30 m;

(c) for all other sources of contamination as far as appears to be reasonable in view of local conditions and the type of construction.

(8) Tops of ground level reservoirs shall be not less than 600 mm above the normal ground surface, and shall be a minimum of 1.2 m above any possible flood level.

(9) The area surrounding ground level reservoirs shall be graded to prevent surface water from standing against the structure.

(10) There shall be footing drains around the reservoir, which should be drained by gravity if possible. There should be a means of observing the volume of flow from the footing drains.

(11) The maximum variation of working levels in storage reservoirs which float on a distribution system should not exceed 9 m.

(12) Water level controls or telemetering equipment should be provided in reservoirs on the distribution system where there is an appreciable variation in level.

(13) Water level control switches or telemetering equipment should be provided, with warning or alarms in appropriate places about the community, so that high and low water levels may be immediately reported.

(14) Overflows on structures shall have free fall discharges that are in plain view, and should be designed so that they will not freeze.

(15) A manhole on a reservoir or tank shall be framed so that there is a raised lip around the edge. The lip shall be at least 100 mm high, and preferably 150 mm, and the join between the lip and the roof shall be watertight. It shall be fitted with a watertight cover which overlaps the lip of the manhole and extends down around the frame at least 50 mm. The cover shall be hinged at one side and shall be provided with a locking device.

(16) The roof of the structure should be well drained. The downspout pipes of the roof drain shall not enter the reservoir or connect to the overflow from the reservoir. There shall be no parapets or construction which will tend to pool the water or snow on the roof.

(17) Valve stems or similar projections through the roof shall be designed with a wall sleeve, elevated at least 100 mm above the roof top, set in a curbed opening, or welded to the cover plate. The opening must be covered by an overlapping, turned-down hood, welded to the valve stem.

(18) Vents, overflows, finial decorations and warning lights shall be so constructed as to exclude dust, birds, animals and insects. There shall be no direct connection between an overflow and any drain or sewer. A ground level vent must terminate in an inverted U construction, the opening of which is at least 600 mm above the ground surface.

(19) Unsafe water shall not be stored adjacent to a finished water compartment when only a single wall separates the two.

(20) Reservoirs should be drainable to the ground surface in such a manner as to preclude contamination by

surface water and access by animals. There shall be no direct connection to a sewer or storm. Alternatively, a reservoir should be drained by pumping from a sump at a lower level than the bottom. A manhole should be located directly above the sump, to permit servicing of the pump intake and to allow dewatering with a portable pump.

(21) Interior surfaces of all steel reservoirs shall be protected by paints or other protective coatings or cathodic protection according to practices recommended by the American Water Works Association or the Canadian Standards Association.

(22) There should be periodical disinfection in order to ensure a continued source of finished water.

Water Mains

20. (1) Pipes and pipe packing and jointing materials shall have been manufactured in conformity with the latest standard specifications issued by the American Water Works Association or the Canadian Standards Association. Plastic pipe shall be approved by and bear the seal of the Canadian Standards Association. Selection of the pipe material and design shall be made after giving consideration to the possible deleterious action of the soils and water which will be surrounding the pipe, the water to be distributed and possible electrolytic action on the metal parts.

(2) Steps should be taken to prevent freezing, which could damage the mains.

(3) The minimum working pressure during the flow in outlying parts of the distribution system should be 140 kPa.

(4) If water hydrants are installed, the supply of water shall be adequate to provide water for the fire pumps and regular use, and at the same time maintain adequate positive pressure in all parts of the system.

(5) The dead-end of a main should have a fire hydrant or blow-off connected for flushing purposes. No flushing device shall be connected directly to any sewer.

(6) Water mains shall be laid a minimum of 3 m from sewers which run in the same direction. Where it is clearly very difficult to comply with this regulation, then

(a) the bottom of the water main shall be at least 450 mm higher than the top of the sewer, and

(b) the water main shall rest on undisturbed soil.

(7) When a water main must cross a sewer, the bottom of the water main shall be laid at least 450 mm above the top of the sewer. The vertical separation shall be maintained for that portion of the water main located within 3 m of the sewer, the 3 m to be measured as the normal distance from the water main to the sewer.

(8) When it is impossible to achieve the condition as stated in subsections (6) and (7) then both the water main and the sewer shall be constructed of Class 150 pressure-type pipes. There shall be adequate support on each side of the crossing for both pipes so that there will be no stresses in either pipe caused by one pipe settling on the other. Pipe sections shall be centred at the crossing so that there is a maximum distance from the crossing to all joints. Both pipes shall be pressure tested to assure that there are no leaks.

(9) Where water and sewer pipes are contained in a utilidor, there shall be adequate provision for drainage in order to prevent contamination of the water supply during repairs and breakdowns.

(10) Water mains which run below the surface of a stream or other surface water body shall be of special construction with flexible watertight joints. Valves shall be provided at both ends of the water crossing so that the

section can be isolated for test or repair. The valves shall be easily accessible and not subject to flooding. Taps shall be made for testing and locating leaks.

(11) Water mains which cross under railways shall conform to the standards and requirements of those regulations established by the National Transportation Agency cited as Pipe Crossings Under Railways Regulations.

(12) Drains from hydrant barrels shall not be connected to sanitary sewers or storm drains. Where practicable hydrant barrels should be drained to the ground surface, or to dry wells provided exclusively for that purpose and a means provided for pumping out.

(13) There shall be no physical connections between the distribution system and any pipes, pumps or tanks which are connected to a sewer system or storm drain or are supplied from any source that is not approved.

Water Haulage Tanks

21. (1) Water haulage tanks should be constructed so as to exclude birds, animals, insects and dust.

(2) There shall be a manhole cover on a tank, conveniently located for entering for purposes of cleaning the interior. The opening shall be made so that there is a water-tight raised lip around the edge, a minimum of 50 mm high. It shall be fitted with a water-tight cover.

(3) There shall be a drain opening in the bottom of a tank so that the tank may be drained completely and flushed easily.

(4) Each tank shall be provided with convenient clean storage space for the hoses, and the ends of the hoses shall be protected from contamination.

Disinfection of New or Repaired Works

22. (1) Before disinfection is attempted, all surfaces should be thoroughly cleaned. Pipelines should be flushed with potable water until turbidity-free water is obtained at all ends. Reservoirs should be flushed with water and brushed if necessary to obtain clean surfaces.

(2) New, repaired or altered waterworks and pipelines shall be disinfected according to the American Water Works Association Standards, or as follows:

(a) all surfaces should be in contact with chlorine solution with a final strength of 10 or 50 mg/l of available chlorine after a contact period of 24 or two hours respectively. The higher value may be tested using chlorine testing papers;

(b) if it is necessary to conserve water and chemical, reservoirs may be disinfected by spraying all surfaces with a chlorine solution having a starting strength of 250 mg/l available chlorine. Special protective clothing and self contained or air-supplied type respirators should be used by personnel performing the spray procedure; or

(c) when surface conditions are not ideal, such as may be encountered in used works, special disinfection procedures will be required. This could include the maintenance of a chlorine residual for an extended period of time.

Records

23. (1) Accurate records shall be maintained of raw water quality, finished water quality and amounts of chemicals used.

(2) As-built construction plans shall be maintained and shall be amended to include additions, extensions and renovations.

Government of Yukon department of HEALTH AND SOCIAL SERVICES

Yukon's Public Drinking Water

The Yukon Government is committed to ensuring safe drinking water for all its residents and visitors. It has drafted guidelines for new regulations that reflect source to tap protection of public drinking water systems and bulk water delivery systems.

- **Revised** Public Drinking Water Systems Regulation (April/04) (PDF, 184 KB)
- **Revised** Bulk Delivery of Drinking Water Regulation (April/04) (PDF, 97 KB)

Contact Us:

Environmental Health
Health and Social Services
Government of Yukon
Box 2703
#2 Hospital Road
Whitehorse, Yukon
Canada Y1A 2C6

Phone: (867) 667-8391
Toll free (In Yukon): 1-800-661-0408, local 8391
Fax: (867) 667-8322
environmental.health@gov.yk.ca

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Yukon Government

Government of Yukon

department of HEALTH AND SOCIAL SERVICES

Contact Us:

Department of Health and Social Services
Government of Yukon
Box 2703
Whitehorse, Yukon
Canada Y1A 2C6

Phone: (867) 667-3673
Toll free (In Yukon): 1-800-661-0408, local 3673
Fax: (867) 393-3096
hss@gov.yk.ca

Yukon Government

environmental.health
@gov.yk.ca

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FALL CONSULTATION WILL DETERMINE HIGH QUALITY WATER STANDARDS

WHITEHORSE – The Yukon government wants to insure safe drinking water and it is starting a public consultation process this fall to ensure safe water for everyone, Health and Social Services Minister Peter Jenkins announced today.

Environmental Health Services will consult owners of public drinking water systems and bulk water delivery systems on guidelines that will lead to new regulations for these systems in the Yukon. The guidelines will be used to draft regulations to govern the training of operators, the monitoring and testing of water, and the operation and maintenance of systems, and enforcement.

"We have been working with operators and owners to date," said Jenkins, "and many practices outlined in these proposed guidelines, such as water testing, are already being done. We believe the owners and operators share our ultimate goal of clean, safe water."

Yukon residents will receive a householder through the mail that describes Yukon's multi-barrier approach to ensure safe drinking water from source-to-tap. Residents can use the information as their starting point for sending in written comments to the Environmental Health Services (EHS) unit by Tuesday, October 7.

"It is important that the public know we are working very hard to develop standards that ensure higher quality drinking water throughout the Yukon. In light of what happened in North Battleford, Saskatchewan and Walkerton, Ontario, people want assurances that their drinking water is safe. We intend to give them peace of mind about their water," the minister said.

The department will turn its attention to regulating the semi-public drinking water systems serving restaurants or care facilities after new regulations are in place for public and bulk water delivery systems. The current Eating and Drinking Places Regulations allow Environmental Health Officers to monitor drinking water quality at restaurants and lodges.

In addition to the householder, there are two technical papers on the proposed guidelines available by calling EHS at (867) 667-8391, or on line at . Copies can also be picked up at Environmental Health Services, #2 Hospital Road, or at the Yukon government's information desk in the main administration building on Second Avenue.

-30-

Contact:
Pat Living
Communications Specialist
Health and Social Services
(867) 667-3673

Peter Carr
Cabinet Communications Advisor
Cabinet Office
(867) 667-8688

Revised (April/04) Draft Guidelines for New Regulation - Part 2 of

Title

Public Drinking Water Systems Regulation

Preamble

Legislative and policy framework is an important component in Yukon's multi-barrier approach to safe drinking water. This Regulation outlines who is responsible for each aspect of the drinking water system from *Source-to-Tap*, and gives criteria for the protection, operation and maintenance of a public drinking water system.

Definitions

1. In this regulation:

"competent person" means a person who

(a) is qualified because of their knowledge, training and experience to perform an activity;

(b) is familiar with the provisions of this Regulation that apply to the activity; and

(c) has knowledge of any potential or actual risk to health or safety that may or is created by the activity in relation to the water system for which they have all or some responsibility for.

"drinking water" means water destined for

(a) drinking;

(b) preparing food, infant formulas, juices and ice;

(c) washing fruits and vegetables;

(d) cooking;

(e) dental hygiene;

(f) body washing; and/or

(g) hand washing.

"*Guidelines for Canadian Drinking Water Quality*" means the most recent version of the *Guidelines for Canadian Drinking Water Quality*, published by Health Canada, as amended from time to time.

"*Guidelines for Water Well Construction*" means the most recent version of the *Guidelines for Water Well Construction*, published by the Canadian Ground Water Association.

"facility class" is a ranking which describes the complexity of a public drinking water system as assessed by the B.C. Environmental Operators Certification Program or any other certification recognized by the *Association of Boards of Certification.*

"health and safety risk" means a condition that is or is likely to cause disease, injury and/or illness in humans.

"health officer" means a medical health officer or health officer appointed under the *Public Health and Safety Act.*

"laboratory" means a laboratory that is accredited for analysis of that parameter, by a certification body approved by the Standards Council of Canada.

"operator" means a person who has direct responsibility for the on-site operation and maintenance of a drinking water system, and includes back-up operator(s).

"operators certification certificate" means a certificate issued by the B.C. Environmental Operators Certification Program or any other certification recognized by the *Association of Boards of Certification.*

"owner" includes any person, firm, corporation, or agent who owns, operates or maintains a public drinking water system; and is identified as the owner in the application and on the permit.

"professional engineer" means a person who is registered and licenced to practice engineering under the provisions of the Yukon *Engineering Profession Act.*

"public drinking water system" means

(a) any drinking water system which has

(i) 15 or more service connections to a piped distribution system, or

(ii) 5 or more delivery sites on a trucked distribution system; or

(b) a water system designated as a public drinking water system by a health officer;

and includes the water source, any infrastructure (e.g., well, pumphouse, water treatment plant, storage tank, reservoir, water delivery truck) and/or distribution system (piped or trucked).

"safe drinking water" means drinking water that meets the health-related criteria set out in the *Guidelines for Canadian Drinking Water Quality*, and does not pose a health or safety risk to its users.

"*Standard Methods for the Examination of Water and Wastewater*" means the most recent edition of *Standard Methods for the Examination of Water and Wastewater*, published jointly by the American Public Health Association, American Water Works Association and Water Environment Federation.

"*substantial modifications*" means significantly altering the operation or practice of a public drinking water system.

"well under the direct influence of surface water" means a well that

(a) does not have a watertight casing to a depth of at least 6 m below ground;

(b) obtains water from an infiltration gallery;

(c) exhibits evidence of surface water influence or contamination (e.g., insect parts, high turbidity, surface water organism, such as *Giardia*); and/or

(d) has been classified as being under the direct influence of surface water based on hydrogeological evidence.

Application

2. (1) This Regulation applies to public drinking water systems in all municipalities and in all health districts established under the *Public Health and Safety Act.*

2. (2) If there is a conflict between a provision of the Regulation and a bylaw of a municipality, then this Regulation governs.

3. This Regulation does not apply to the manufacture of bottled water, or drinking water obtained from a vending machine.

General

4. The owner of a public drinking water system is responsible for supplying and delivering safe drinking water to users, and shall provide drinking water as set out in this Regulation.

5. The owner is responsible for the maintenance and upgrade of the public drinking water system, as necessary, for the purpose of providing safe drinking water to its users.

Drinking Water Protection

6. (1) A medical health officer may require an owner to prepare an assessment and response plan for the water source, in relation to the public drinking water system, that will

(a) identify, inventory and assess risks to the drinking water source, including land use and other activities or conditions that may adversely affect or threaten the water source;

(b) identify measures (e.g., public education, changes to land use, increase in monitoring, selection of a new water source) that can be taken to address risks; and

(c) outline an implementation plan to manage risks to the drinking water source for those measures that will be taken by the owner.

6. (2) A medical health officer may require the owner to

(a) review and revise the assessment response plan; and

(b) implement measures to manage risks to the water source in relation to the public drinking water system.

7. No person shall introduce into a public drinking water system or its watershed, or do or cause any other thing to be done or to occur, if this will result or is likely to create a health or safety risk to the users.

8. An owner upon selecting a drinking water source shall consider a source that is

(a) most likely to produce drinking water of a quality that meets the *Guidelines for Canadian Drinking Water Quality*; and

(b) is least likely to be subject to municipal, industrial and agricultural contamination, and/or other types of contamination resulting from animal or human activities within the watershed.

9. An owner that obtains drinking water from a ground water source shall

(a) unless otherwise determined based on results of a comprehensive hydrogeological study, ensure that the drinking water well is located a minimum distance of

 (i) 60 m from any part of a sewage disposal system, or other potential sources of pollution that may pose a health and safety risk;

 (ii) 120 m from a solid waste site or dump, and cemetery; and

 (iii) 300 m from a sewage lagoon or pit.

(b) have a hydrogeological study performed to determine the minimum separation distances to sources of pollution outlined in section 9.(a) for drinking water well in a bedrock aquifer;

(c) use only a drilled well,

(i) located and constructed in accordance with criteria that meets or exceeds those outlined in the *Guidelines for Well Water Construction*, and

(ii) certified by an independent professional engineer.

10. A health officer may require the owner to conduct or cause to conduct a hydrological or hydrogeological study

(i) to determine if a well is under the direct influence of surface water, or

(ii) to identify existing or potential sources of contamination for ground water or surface water sources.

11. An owner shall ensure that the decommissioning or abandonment of a drinking water well is done in accordance with criteria, outlined in the *Guidelines for Water Well Construction*.

12. An owner of a drinking water well, which is maintained for future use, shall ensure that the well is capped in a manner sufficient to prevent entry of any substance which might adversely affect the quality of water in the well.

13. If a public drinking water system (or part thereof) is shut down such that the piped distribution system becomes depressurized or chlorine residual concentrations fall below those expected during normal operation, the owner shall ensure that measures are taken to ensure the safety of the drinking water prior to reuse of the system (or affected part).

14. An owner shall ensure that the infrastructure protecting the wellhead, pumphouse, storage tank and/or water treatment plant is designed and secured so as to prevent the unauthorized access by humans or entrance by animals.

15. The design, operation and maintenance of a water delivery truck that is part of a trucked distribution system of a public drinking water supply shall comply with provisions set out in the *Bulk Delivery of Drinking Water Regulation*.

Approval to Construct or Modify

16. The owner shall submit to Environmental Health Services, two complete sets of plans to construct or substantially modify (e.g., change in the method of disinfection, installation of new drinking water storage tank) a public drinking water system

(a) under the seal of a Professional Engineer; and

(b) to include

(i) A map which shows the location of the water system, including Global Positioning Co-ordinates for proposed well location(s) or water intake(s) and potential sources of contamination to the ground water well(s) or surface water intake,

(ii) location of buildings, roads and other infra-structures within 150 metres from the actual or proposed site of the drinking water source,

(iii) detailed design drawings and specifications,

(iv) facility class,

(v) proposed well driller (if applicable),

(vi) information on water source and its protection, infrastructure and distribution system,

(vii) water quality data,

(viii) method of treatment (if applicable),

(ix) identification of potential users,

(x) provisions for record keeping, and

(xi) any other information required by a health officer.

17. No person shall construct a public drinking water system without approval from a health officer.

18. A health officer may allow construction of a public drinking water system that does not conform to the requirements of this Regulation, if such variance does not present a health or safety risk to its users.

19. Once a public drinking water system has been constructed or substantially modified, the owner shall submit to Environmental Health Services

(i) a well log (if applicable),

(ii) one time only, the analysis of biological (e.g., bacteriological), chemical, physical and radiological parameters (full suite, as outlined in the *Guidelines for Canadian Drinking Water Quality*) of the drinking water after treatment for newly constructed systems, and at the direction of the health officer for modified systems, and

(iii) any additional analysis or information required by a health officer.

Permit to Operate

20.(1) No person shall operate a public drinking water system without first obtaining a written permit from a health officer.

20.(2) If the public drinking water system commenced operation before the enactment of the Regulation and is not in compliance with subsection (1), the owner is required to comply within six months.
21.(1) The owner shall make application for a permit to operate a public drinking water system, and submit the application to Environmental Health Services, Yukon Government.

21. (2) No later than six weeks after receipt of application, a health officer shall notify the owner whether the application for a permit to operate has been approved, denied or deferred.

21. (3) If denied or deferred, the health officer shall provide a reason in writing for the decision.

22. (1) Notwithstanding section 21, an application for a permit to operate a drinking water system is not required for a change in the name of a public drinking water system.

22. (2) Further to subsection (1), a permit fee will not be required for amending the name of the public drinking water system on the permit to operate.

23.(1) A permit shall be issued, if the application complies with provisions set out in this Regulation, and any requirements prescribed by a health officer.

23.(2) No permit shall be issued where

(a) a public drinking water system does not conform to the requirements of the *Public Health and Safety Act* and its Regulations, or any other Act or Regulation;

(b) use of the public drinking water system would be detrimental to the health or safety of its users;

(c) the quality of the drinking water does not meet the criteria set out in this Regulation;

(d) the proposed treatment for drinking water source does not provide assurance of its safety;

(e) a public drinking water system is under a boil water advisory/order; or

(f) a public drinking water system is under a health officer's order and the owner has not complied with the terms of the order.

24. A permit to operate a public drinking water system remains valid unless

(a) there is a change in the owner;

(b) the permit is revoked or suspended by a health officer; or

(c) the public drinking water system ceases to operate.

25. A health officer may amend, revoke or suspend a permit to operate a public drinking water system.

26. Fees for permits and other documents or services arc payable as set out in Schedule A.

27. A health officer may allow an operation of a public drinking water system that does not conform to the requirements of this Regulation, if such variance does not present a health or safety risk to users.

Engineering Assessment

28.(1) The owner shall ensure that, every five years, an engineering assessment of the public drinking water system be performed under the seal of an independent professional engineer; and the date of initial assessment shall be determined by the health office, taking into consideration previous engineering assessments for the public drinking water system and the owner's operational and maintenance schedules.

28.(2) The regular engineering assessment shall identify any existing or potential public health risks; and include observations, comments and prioritized recommendations on the

(i) water source and its watershed,

(ii) infrastructure (i.e., pumping, storage and treatment facilities),

(iii) distribution system(s), and

(iv) any other factors identified by a health officer.

29. The owner shall ensure that an engineering assessment of the public drinking water system (or part of) be performed when there is a substantial modification to the public drinking water system.

30. In addition to engineering assessments outlined in sections 28 and 29, a health officer may require the owner to conduct, or cause to be conducted an engineering assessment of the public drinking water system's water source, infrastructure or distribution system at any time, if the health officer reasonably believes that

(i) the water source, infrastructure or distribution system presents or may present a health and safety risk to its users, or

(ii) the public drinking water system has been substantially altered.

Annual Report

31. The owner shall submit an annual report to Environmental Health Services within three months of the time period specified in the terms and conditions of the permit to operate a public drinking water system.

32. A report shall include, but is not limited to

(a) for the period covered,

(i) summary of any assessments, inspections, reports, orders or notices,

(ii) summary of the results of tests done as set out in this Regulation,

(iii) description of any mitigating or corrective action taken with respect to deficiencies identified in 32.(a)(i),

(iv) explanation(s) of why any recommended mitigating or corrective measure were not acted upon

(v) description of overall system modifications, and

(vi) update on operator training and certification; and

(b) contingency plans arising from an assessment or previous reports.

Operator Training

33.(1) An owner of a public drinking water system shall ensure that the operator holds a valid operator certification certificate of a classification rating that is equivalent to or greater than facility class assigned to a water system.

33.(2) If the public drinking water system commenced operation before the enactment of the Regulation and is not in compliance with subsection (1), the owner is required to comply within two years of the enactment of the Regulation.

34. An owner shall ensure that any activity (e.g., maintenance, sampling, testing, and inspections), in relation to the public drinking water system he or she is responsible for, is performed by a competent person.

Disinfection and Treatment

35. An owner of a public drinking water system must disinfect the system's water supply in accordance with this Regulation.

36.(1) The owner of a public drinking water system that obtains water from a surface water source or uses a well under the direct influence of surface water, shall ensure provision of treatment consisting of filtration and disinfection, or other treatment capable of producing safe drinking water.

36.(2) If the public drinking water system commenced operation before the enactment of the Regulation and is not in compliance with subsection (1), the owner

(a) is required to comply with subsection (1) within five years of the enactment of the Regulation;

(b) shall, within six months, deliver to a health officer a written notice describing the action proposed in order to achieve compliance and setting out a timetable for the action; and

(c) shall commence construction within three years of the enactment of the Regulations.

37. Subsequent to section 36, the owner shall verify that the method of treatment consistently produces safe drinking water.

38. The owner of a public drinking water system shall ensure that

(a) no water enters a piped distribution system or plumbing unless it has been treated with chlorination or another treatment that is as effective as chlorination to achieve disinfection that persists in the distribution system; and

(b) the free chlorine residual concentration throughout the distribution system is no less than 0.2 mg/L, or as prescribed by a health officer.

39. The owner of a public drinking water system that includes a trucked distribution system shall ensure that no water enters the water tank unless it has been treated with chlorination and has a free chlorine residual concentration of no less than 0.4 mg/L at the point of loading.

40. Where chorine disinfection is required, the owner shall ensure that

(a) drinking water is tested, as set out in Schedule C, with a suitable chlorine test kit in accordance with manufacturer's directions; and

(b) a record is made of the date and time the drinking water sample was tested, the name of the person who performed the test and the results of the test.

41. Where the public drinking water system has a piped distribution system, the owner shall test for free chlorine residual concentrations from representative points in the distribution system.

Sampling and Analysis

42.(1) An owner shall ensure that drinking water from the public drinking water system is monitored for

(a) bacteriological quality;

(b) general chemical and physical quality, as outlined in Schedule B;

(c) turbidity, where the water source is a surface water supply or well under the direct influence of surface water; and

(d) trihalomethanes (THMs)

(e) other organisms and/or substances, as may be required by a health officer.

42.(2) If there is a reason to suspect the presence of other substances in the drinking water, not listed in subsection (1), the owner shall monitor for these substances to ensure that their concentration meets the health-related criteria set out in the *Guidelines for Canadian Drinking Water Quality*; and report such to Environmental Heath Services.

43. In regards to parameters outlined in section 42, an owner shall ensure water samples are

(a) collected, stored and transported in accordance with the *Standard Methods for the Examination of Water and Wastewater*, or as per instructions from the laboratory performing the analysis; and

(b) collected according to the sampling requirements

   (i) outlined in Schedule C, or

   (ii) as prescribed by a health officer.

44.(1) An owner shall ensure that microbiological, chemical and physical characteristics of those parameters set out in section 43 do not exceed the acceptable concentration for any health-related parameter set out in the *Guidelines for Canadian Drinking Water Quality*.

44.(2) An owner shall ensure that the laboratory performing analysis of the parameter outlined in subsection (1), immediately notifies Environmental Health Services of any result that exceeds the acceptable concentration for any health-related parameter set out in the *Guidelines for Canadian Drinking Water Quality*.

Notification and Corrective Action

45. (1) An owner shall notify a health officer immediately upon becoming aware that

(a) the owner's public drinking water system is not meeting the health-related criteria set out in the *Guidelines for Canadian Drinking Water Quality*;

(b) an incident of raw water contamination has occurred or is suspected;

(c) disinfection is rendered ineffective due to high turbidity or high chlorine demand; or

(d) equipment failures have resulted in a contravention of the any section of the Regulation.

45.(2) If notice is required under subsection (1), the owner shall take corrective action as necessary to mitigate a health or safety risk to system users, and/or corrective action as directed by a health officer.

Boil Water Advisory or Order

46. A boil water order may be issued by a health officer to the owner of a public drinking water system, upon reasonable belief that the drinking water from the water system is or may present a health or safety risk to users unless the water is boiled.

47. A boil water order issued verbally by a health officer, must be put in writing and delivered to the owner, as soon as practicable after its issuance.

48. The health officer may rescind a boil water advisory or order when it has been determined that the drinking water from the system does not present a health or safety risk to users, and the public drinking water system is operating in compliance with the Regulation.

49. The health officer may give notice of the boil water advisory or order or its rescinding; or require the owner to give said notice to users of the public drinking water system by any method the health officer considers appropriate.

50. No person who knows or ought to reasonably know of the existence of a boil water advisory or order shall provide to any other person drinking water or food or beverage containing or prepared with water, if the water was obtained from a public drinking water system that is subject to the boil water advisory or order, unless action(s) specified have been taken that would mitigate the health and safety risk.

Emergency Response and Contingency Plan

51.(1) An owner must have a written response and contingency plan to be implemented in the event of an emergency or abnormal operational circumstances affecting its public drinking water system.

51.(2) If the water system commenced operation before the enactment of the Regulation and is not in compliance with subsection (1), the owner is required to comply within one year of the enactment of the Regulation.

52. The owner shall ensure that the emergency response and contingency plan is reviewed at least once a year and updated, as necessary.

53. The emergency response and contingency plan must include, but is not limited to

(a) list of contacts, such as medical health officer, health officers, system operators, agencies to be contacted in the event of any kind of emergency, repair people, alternate water suppliers and users;

(b) list of potential emergency situations and potential corrective actions for each;

(c) method of communication and posting of notices;

(d) map of system;

(e) equipment operations, such as procedures for switching to alternate power supplies; and

(f) other relevant information.

54. An owner shall ensure the availability of a back-up operator, equipment, and supplies to be used in the event of an emergency or abnormal operational circumstances.

55. An owner shall ensure that equipment, manuals and written procedures are available, and located so as to be accessible.

Record Keeping

56. An owner must ensure written and electronic records (to include reports and plans) relating to the construction, operation, inspection, maintenance, sampling, testing, operator training and other related matters are made, retained for a minimum of six years, and appropriately located and accessible.

57. Notwithstanding section 56,

(a) chemical and physical analysis reports are to be retained for a minimum of fifteen years; and

(b) well installation or drilling logs are kept for the duration of the life of the drinking water well.

58. The owner shall ensure that records are available to a health officer immediately upon request in the event of an emergency; or otherwise, within seven days.

Public Information

59. The owner shall ensure that assessments, annual reports, and sampling and testing results pertaining to the water system will be made available for inspection by any member of the public during normal working hours.

60. The owner shall permit Environmental Health Services to post or release information on their water systems that was collected by Regulation to any member of the public.

Enforcement

61. Where in the opinion of a health officer a health or safety risk exists or likely to be created, the owner shall take such corrective measures as the health officer deems necessary.

62. A health officer may request any documentation; or conduct or have the owner conduct inspections, assessments, sampling, testing, as he or she deems necessary to determine whether a public drinking water system is located, constructed, installed, operated, maintained and used in accordance to this Regulation.

63. A health officer may order closure of a public drinking water system, if the system is or is likely to present a health or safety risk to users, and or is not in compliance with the Regulation.

64. A health officer may rescind the closure order on a public drinking water system, when it has been determined that the drinking water from the system does not present a health or safety risk to users, and is in compliance with the Regulation.

Schedule A - Fees

Issue of permit to operate a public drinking water system	$450.00
Document search and copies per system	$ 50.00

Schedule B – General Chemical and Physical Parameters

The following substances are routinely used to monitor the chemical and physical quality of drinking water, and are generally included in a "drinking water package" offered by most laboratories.

Physical Tests
Colour
Conductivity
Total Dissolved Solids
Hardness ($CaCO_3$)
Turbidity

Total Dissolved Anions
Total Alkalinity
Chloride
Fluoride
Sulphate

Nutrients
Nitrate Nitrogen
Nitrite Nitrogen

Total Metals*
Aluminium
Arsenic
Barium
Boron
Cadmium
Calcium
Chromium
Copper
Lead
Magnesium
Mercury
Potassium
Selenium
Sodium
Uranium
Zinc

*The concentration of a metal is to be determined by using the total metals test method, as set out in *Standard Methods for the Examination of Water and Wastewater*.

Schedule C – Public Drinking Water System Sampling Requirements

<table>
<tr><td>Bacteriological includes analysis for both

• Total Coliforms

• Escherichia coli (E. coli) or thermotolerant coliforms</td><td>For public drinking water systems serving:

<u>over 3000 users</u>, once a week:
• one sample from the raw water source(s)
• one sample from point at which treated water enters the distribution system (e.g., for a trucked distribution system, this would be the fill-point)
• two samples from piped distribution system for water systems and over the period of a month, an additional twelve representative water samples from the distribution system

<u>501 to 3000 users</u>, once a week:
• one sample from the raw water source(s)
• one sample from point at which treated water enters the distribution system (e.g., for a trucked distribution system, this would be the fill-point)
• two samples from piped distribution system for water systems and over the period of a month, an additional four representative water samples from the distribution system

<u>500 users or less</u>, twice a month
• one sample from the raw water source(s)
• one sample from point at which treated water enters the distribution system (e.g., for a trucked distribution system, this would be the fill-point)
• two samples from piped distribution system for water systems and over the period of a month, an additional two representative water samples from the distribution system

in a ground water source, each well is to be tested</td></tr>
<tr><td>Chemical and Physical Parameters</td><td><u>annually</u>

in a ground water source, each well is to be tested</td></tr>
<tr><td>Turbidity

- on-site monitoring equipment or test kit</td><td>for surface water sources and wells subject to surface water contamination
• continuous monitoring for water systems serving over 3000 users
• 2 samples per day for all others analysis performed on-site

taken from water on each filter effluent line</td></tr>
<tr><td>Trihalomethanes (THMS)</td><td><u>annually</u> - water system using a ground water source

<u>quarterly</u> – water system using surface water or a well under the direct influence of surface water</td></tr>
<tr><td>Chlorine Residual Concentrations

- on-site monitoring equipment or test kit</td><td>• continuous monitoring at site of treatment for water systems serving over 3000 users

• minimum daily for all others, and

• at the time and at the site when taking a water sample for bacteriological analysis</td></tr>
</table>

Revised (April/04) Draft Guidelines for new regulation - Part 1?

Title

Bulk Delivery of Drinking Water Regulation

Preamble

Legislative and policy framework is an important component in Yukon's multi-barrier approach to safe drinking water. This Regulation outlines who is responsible for each aspect of the trucked distribution system / bulk delivery of drinking water, and gives criteria for the construction, operation and maintenance of a water delivery truck.

Definitions

1. In this regulation:

"bulk delivery" means transportation of drinking water in a container which is fixed to a transportation vehicle, and which is filled at the source and emptied at one or more destinations.

"competent person" means a person who

(a) is qualified because of their knowledge, training and experience to perform an activity;

(b) is familiar with the provisions of this Regulation that apply to the activity; and

(c) has knowledge of any potential or actual risk to health or safety that may or is created by the activity in relation to the water system for which they have all or some responsibility for.

"drinking water" means water destined for

(a) drinking;

(b) preparing food, infant formulas, juices and ice;

(c) washing fruits and vegetables;

(d) cooking;

(e) dental hygiene;

(f) body washing; and/or

(g) hand washing.

"*Guidelines for Canadian Drinking Water Quality*" means the most recent version of the *Guidelines for Canadian Drinking Water Quality*, published by Health Canada, as amended from time to time.

"health and safety risk" means a condition that is or is likely to cause disease, injury and/or illness in humans.

"health officer" means a medical health officer or health officer appointed under the *Public Health and Safety Act.*

"laboratory" means a laboratory that is accredited for analysis of that parameter, by a certification body approved by the Standards Council of Canada.

“operator” means a person who has direct responsibility for the on-site operation and maintenance of a trucked distribution system, and includes back-up operator(s).

“operators certification certificate” means a certificate issued by the B.C. Environmental Operators Certification Program or any other certification recognized by the *Association of Boards of Certification*.

“owner” includes any person, firm, corporation, or agent who owns, operates or maintains a trucked distribution system for drinking water; and is identified as the owner in the application and on the permit.

“professional engineer” means a person who is registered and licenced to practice engineering under the provisions of the Yukon *Engineering Profession Act*.

“safe drinking water” means drinking water that meets the health-related criteria set out in the *Guidelines for Canadian Drinking Water Quality*, and does not pose a health or safety risk to its users.

“trucked distribution system” includes the water source, any infrastructure (e.g., well, water treatment system,) and/or one or more water delivery truck(s) that are owned, operated and maintained by the same owner.

“water delivery truck” means a vehicle constructed or modified and used for the purpose of bulk delivery of drinking water.

“water tank” means the container which is mounted on the water delivery truck for the purpose of containing drinking water in bulk during delivery.

Application

2.(1) This Regulation applies in all municipalities and in all health districts established under the *Public Health and Safety Act*.

2.(2) If there is a conflict between a provision of the Regulation and a bylaw of a municipality, then this Regulation governs.

3. This Regulation applies to a trucked distribution system

(a) that provides the bulk delivery of drinking water to five or more delivery sites, or

(b) which is designated as a trucked distribution system by a health officer.

General

4. The owner is responsible for delivering safe drinking water to consumers.

5. Drinking water transported in water delivery trucks shall only be obtained from

(a) a public drinking water system permitted under the *Public Drinking Water Systems Regulation*; and/or

(b) a drinking water system that is permitted under the *Bulk Delivery of Drinking Water Regulation*.

6. A drinking water system as outlined in section 5.(b) must comply with the same provisions applicable to a public drinking water system permitted under the *Public Drinking Water Systems Regulation*.

7. The owner is responsible for the maintenance and upgrade of the components of a trucked distribution system, as necessary, for the purpose of providing safe drinking water to its users.

8. A water delivery truck for the bulk delivery of drinking water shall not be used for any other purpose, except with the prior written approval of a health officer.

Permit to Operate

9.(1) No person shall operate a trucked distribution system for drinking water without first obtaining a written permit from a health officer.

9.(2) If the trucked distribution system commenced operation before the enactment of the Regulation and is not in compliance with subsection (1), the owner is required to comply within six months.

9.(3) This section does not apply to water delivery trucks that are part of the trucked distribution system of a public drinking water system permitted under the *Public Drinking Water Systems Regulation.*

10.(1) The owner shall make application for a permit to operate a trucked distribution system for drinking water and submit such to Environmental Health Services, Yukon Government.

10.(2) Should the trucked distribution system include a drinking water system, then the application must also include all information and documentation that would be required for the permitting of a public drinking water system.

11. A permit to operate a trucked distribution system remains valid unless

(a) there is a change in the

(i) owner, or

(ii) name of the trucked distribution system;

(b) the permit is revoked or suspended by a health officer; or

(c) the trucked distribution system ceases to operate.

12.(1) A permit shall be issued, if the application complies with provisions set out in this Regulation, and any requirements prescribed by a health officer.

12.(2) No permit shall be issued where

(a) a trucked distribution system does not conform to the requirements of the *Public Health and Safety Act* and its Regulations, or any other Act or Regulation;

(b) use of the drinking water would be detrimental to the health or safety of its users;

(c) the quality of the drinking water does not meet the criteria set out in this Regulation; or

(d) a trucked distribution system is under a health officer's order, and the owner has not complied with the terms of the order.

13. A health officer may revoke or suspend a permit to operate a public drinking water system.

14. Fees for permits and other documents or services are payable as set out in the Schedule A.

15. A health officer may allow the operation of a trucked distribution system that does not conform to the requirements of this Regulation, if such variance does not present a health or safety risk to users.

Engineering Assessment

16. The owner shall ensure that an engineering assessment for each water delivery truck is prepared under the seal of an independent professional engineer upon initial application for a permit to operate; and thereafter for any additional water delivery trucks.

17. The engineering assessment shall identify any existing or potential public health risks; and include observations, comments and recommendations on all relevant aspects of the operation.

18. An owner shall submit all engineering assessments required by this Regulation to Environmental Health Services, in duplicate.

19. In addition to the engineering assessment required under section 16, a health officer may require the owner to conduct, or cause to be conducted, an engineering assessment at any time, if the health officer reasonably believes that

(a) the use of a water delivery truck presents or may present a risk to the safety of the drinking water obtained from the water system; or

(b) a water delivery truck has been substantially modified (e.g., water tank replacement).

Operator Training

20.(1) An owner shall ensure that the operator holds a valid operator certification certificate for the bulk delivery of drinking water.

20.(2) If the trucked distribution system commenced operation before the enactment of the Regulation and is not in compliance with subsection (1), the owner is required to comply within two years of the enactment of the Regulation.

21. An owner shall ensure that any activity (e.g., maintenance, sampling, testing, inspections, delivery) in relation to the water delivery truck(s) and/or drinking water system he or she is responsible for, is performed by a competent person.

Water Tank

22. Every water delivery truck shall be equipped with a stainless steel tank or other material (e.g., aluminum, plastic, fibreglass) suitable for transporting drinking water.

23. For water tanks that require an internal coating, the owner shall ensure the proper composition, application and maintenance of the coating.

24. Every water tank mounted on a water delivery truck shall be equipped with sufficient access ports fitted with water tight lids to allow for inspection and cleaning.

25. The lids noted in section 24 shall be lockable or otherwise be secured to prevent unauthorized entry and tampering.

26. Water tank vents shall be suitably designed to prevent the entrance of contaminants.

27. The water tank is to be clearly labeled with the words "DRINKING WATER", in weather-resistant, bold letters, and sized to allow for easy identification at a minimum distance of 30 m (100 ft.).

Equipment

28. Every water delivery truck is to be equipped with a clean, lockable compartment for containing and protecting hoses, nozzles and related couplers and fittings from contamination.

29. All water delivery trucks are to be designed to prevent backflow of water from the truck into the water source.

30.(1) All equipment on a water delivery truck which is in contact with drinking water, including but not limited to hoses, valves, couplers, fittings, nozzles and pumps, shall be constructed of materials that are suitable (e.g., corrosive resistant) for drinking water use; and shall be maintained in a clean and sanitary condition.

30.(2) No equipment which is installed on a water delivery truck and which is in contact with drinking water shall have been previously used for any purpose incompatible with the conveyance of drinking water.

Operation and Maintenance

31. At least once every six months, all internal areas of the water tank and all water delivery equipment on the water delivery truck shall be cleaned and disinfected.

32. Immediately prior to commencing the first delivery of each day, the hose compartment, delivery hose nozzle and/or coupler shall be disinfected.

33. Should the water delivery nozzle and/or coupler come into contact with the ground or any other source of contamination, it shall immediately be cleaned and disinfected.

34. Disinfection shall be carried out when a water tank

(a) has not been in use for greater than 30 days;

(b) when any part of the tank or related water delivery equipment has been repaired or replaced; or

(c) when the sanitation of the tank and/or delivery system is known or suspected to have been compromised.

35. Drinking water shall not be retained in a water delivery truck longer than 24 hours after the time of loading, upon which time any remaining water in the tank shall be drained; and shall not be used for drinking water.

36. Where an owner of a trucked distribution system is also involved in the transportation of sewage, different personnel are to be used for the bulk delivery of drinking water than those transporting sewage, except with the prior written approval of a health officer.

37. An owner shall ensure the availability of equipment and supplies to be used in the event of an emergency or abnormal operational circumstances.

38. An owner shall ensure that equipment, manuals and written procedures are available and accessible.

Chlorination and Testing

39. All drinking water shall be chlorinated and shall have a free chlorine residual concentration of no less than 0.4 milligrams per litre (mg/L) at the time of loading into the water delivery truck and a free chlorine residual concentration of no less than 0.2 mg/L at the time of delivery.

40. The owner shall ensure that

(a) each water delivery truck is equipped with an approved chlorine test kit; and

(b) a free residual chlorine test is performed in accordance with accompanying manufacturer directions.

41.(1) The owner shall ensure that a record is made that shows the

(a) location of the source of each load of water;

(b) date and time at which the water was loaded and by whom;

(c) address, date, time and volume of each delivery and by whom;

(d) free residual chlorine concentration in the water at time of loading;

(e) free residual chlorine concentration in the water of the first and last delivery site of each tank load;

(f) date, time and location of each equipment disinfection; and

(g) the name of the person making the measurements and recording the information.

41.(2) Notwithstanding subsection (1)(d) and (1)(e) the testing for free residual chlorine levels may be reduced to no less than once per day, if the owner provides data/documentation to the satisfaction of a health officer which demonstrates consistency in meeting free residual chlorine levels prescribed in section 39.

Sampling and Analysis

42.(1) The owner shall ensure that water samples from the fill line and water truck delivery hose are submitted to a laboratory for bacteriological analysis when a water truck

(a) is first put into use;

(b) has not been in use for greater than 30 days; and

(c) biweekly (twice a month) when in regular use, or as prescribed by a health officer.

42.(2) Subsequent to subsection (1), when a water delivery truck is first put into use or has not been in use for a month, the owner shall ensure that the water delivery truck is not used to distribute drinking water until test results from water samples are satisfactory and approval to operate is given by a health officer.

43. An owner shall ensure water samples for bacteriological analysis are collected, stored and transported as per instructions from the laboratory performing the analysis.

44. An owner shall ensure that the laboratory performing the bacteriological analysis immediately notifies Environmental Health Services of any result that exceeds the maximum acceptable concentration set out in the *Guidelines for Canadian Drinking Water Quality.*

Storage of the Water Delivery Truck

45(1) When a water delivery truck is stored in a garage or similar structure, it and any related drinking water delivery equipment should be kept in a completely enclosed bay or compartment (e.g., floor to ceiling partition designed to prevent contaminants from being transported between the equipment), so as to be physically separated from any source of contamination, including any sewage transporting equipment.

45.(2) When not in use, a water delivery truck should be stored in a secure area designed to prevent the entry of unauthorized persons.

45.(3) If the trucked distribution system commenced operation before the enactment of the Regulation and is not in compliance with subsection (1) and/or (2); the requirement to comply will vary based on potential health and safety risks, not to exceed two years from the enactment of the Regulation.

46. When not in use, being cleaned or drained dry,

(a) delivery hoses should be capped at both ends, and

(b) delivery hoses and related couplers fittings and nozzles shall be placed in the hose compartment.

Notification and Corrective Action

47.(1) An owner shall notify a health officer immediately upon becoming aware that its trucked distribution system is not meeting criteria set out in this Regulation, and/or is or may become a health and safety risk to users.

47.(2) If notice is required under subsection (1), the owner shall take corrective action, as necessary, to mitigate a health or safety risk to system users, and/or corrective action as directed by a health officer.

48. The health officer may give notice of a boil water advisory or order or its rescinding; or require the owner to give said notice to users of the trucked distribution water system by any method the health officer considers appropriate.

Record Keeping

49. An owner must ensure written and electronic records (to include reports and plans) relating to the construction, operation, inspection, maintenance, sampling, testing, and other related matters for a trucked distribution system are made, retained for a minimum of six years, and appropriately located.

50. The owner shall ensure that records are available to a health officer immediately upon request in the event of an emergency; or otherwise, within seven days.

Public Information

51. The owner shall ensure that assessments, reports, sampling and testing results pertaining to the trucked distribution system will be made available for inspection by any member of the public, during normal working hours.

52. The owner shall permit Environmental Health Services to post or release information on their trucked distribution system that was collected by Regulation to any member of the public.

Enforcement

53. Where in the opinion of a health officer a health or safety risk exists or likely to be created, the owner shall take such correct measures as the health officer deems necessary.

54. A health officer may request any documentation; or conduct or have the owner conduct inspections, assessments, sampling, testing, as he or she deems necessary to determine whether a trucked distribution system is located, constructed, installed, operated, maintained and used in accordance to this Regulation.

55 A health officer may order closure of a trucked distribution system, if the system is or is likely to present a health or safety risk to users, and or is not in compliance with the Regulation.

56. The health officer may rescind the closure order on a trucked distribution system, when it has been determined that the drinking water from the system does not present a health or safety risk to users, and/or is in compliance with the Regulation.

Schedule A - Fees

Issue of permit to operate a trucked distribution system that includes the operation of a drinking water system	$450.00
Issue of permit to operate a trucked distribution system	$150.00
Document search and copies per system	$ 50.00

BARRIERS	ACTIONS			[illegible]
	COMPLETED	IN PROGRESS	FUTURE WORK	
1 Community Water Licensing	About two thirds of all NWT communities with a water supply system now have the required water licenses	Work is progressing towards having all communities with up-to-date water licenses	Studies associated with the water licensing process will be undertaken as required	Communities working with Water Boards, MACA and Federal Govn't
2 Testing of Source Water Quality	PW&S has committed to ensuring that source water quality is tested annually	A centralized tracking and monitoring system for source water quality is being developed	Data will be reviewed and analyzed for trends on an ongoing basis	PW&S, H&SS, and Communities
3 Coordinated Watershed Decision Making	An inter-departmental committee consisting of senior representatives from RWED, PW&S, MACA and H&SS has been formed	An inter-jurisdictional committee will be established to develop a source protection strategy	The Federal Government is working towards transferring the responsibility for water resource management to the GNWT and the Water Boards	Federal Government, RWED, MACA, Water Boards, and Communities
	Water Boards currently monitor development through the water license approval process and send information on development applications to all stakeholders The NWT and the Yukon have signed a *Transboundary Water Management Agreement*	Watershed areas for all public drinking water sources in the NWT will be identified Emergency response plans are being developed Communities will be assisted in developing by-laws that help protect watershed areas Additional *Transboundary Water Management Agreements* are being negotiated	Watershed protection measures will be implemented for all NWT public drinking water sources Watershed management strategies will be developed	Federal Government, MACA, RWED, H&SS, PW&S, Water Boards, Aboriginal Organizations and Communities
4 Effective Legislation	*Public Water Supply Regulations* under the *Public Health Act* (NWT) *Area Development Act* (NWT) *Mackenzie Valley Resource Management Act* (Federal) *Northwest Territories Waters Act* and *Regulations* (Federal)	The *Public Health Act* and the *Public Water Supply Regulations* are being updated to reflect best practices	The effectiveness of revised legislation will be monitored by stakeholders	Justice, PW&S, H&SS, RWED, Federal Government, and Communities
5 Public Education	A need has been identified for improved public education on the protection of drinking water sources	Education / promotional materials will be developed to inform the public of its role in source protection and water conservation	Education campaigns will be ongoing and updated regularly based on need	Federal Government, RWED, and Communities

BARRIERS	ACTIONS			AGENCIES
	COMPLETED	IN PROGRESS	FUTURE WORK	
1 Testing and Monitoring of Treated Water Quality	Daily, monthly and annual water sampling procedures have been developed	Roles and responsibilities for water sampling are being clarified Resource requirements are being identified	Refinement of the sampling process will occur in response to changes in legislation, technology and best practices	H&SS, PW&S, and Communities
2 Public Access to Water Quality Data	A community water quality database has been developed and is publicly accessible on the GNWT website	The on-line database will be expanded to include three years of water quality data for all communities	The on-line database will be updated on an ongoing basis	PW&S, H&SS and Communities
3 Incident Tracking and Reporting	Environmental Health Officers keep records of all 'boil water' advisories RWED and the Water Boards track spills of hazardous materials	An online database to report incidents of negative water quality and measures taken to correct these situations is being developed	The on-line incident reporting database will be updated on a regular basis	PW&S, H&SS and Communities
4 Public Reporting on NWT Drinking Water Quality	The need for regular public reporting of water quality issues has been identified	A report format is being developed and a first annual report will be published in 2004	A report on NWT water quality will be published annually	MACA, RWED, and PW&S
5 Assessment of Water Treatment Infrastructure and Operations	Comprehensive infrastructure and water supply reviews are complete in a majority of communities	Infrastructure and operational reviews are being used to identify short term corrective action and long term planning requirements	Operational and infrastructure reviews will be updated on an on-going basis	MACA, PW&S, H&SS, and Communities
6 Public Education	There is a need to improve public awareness of the quality of drinking water and the roles and responsibilities of various stakeholders	Public education material is being developed and will be distributed	Education campaigns will be on-going and updated regularly	H&SS, MACA, Federal Government and Communities

WEB LINK TO NWT WATER QUALITY DATABASE

http://aurora.gov.nt.ca/waterq/waterq_main_menu.asp

Citation: PUBLIC WATER SUPPLY REGULATIONS, R.R.N.W.T. 1990, c. P-23
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Enabling Statute:PUBLIC HEALTH ACT, R.S.N.W.T. 1988, c. P-12

PUBLIC HEALTH ACT	LOI SUR LA SANTÉ PUBLIQUE
PUBLIC WATER SUPPLY REGULATIONS	**RÈGLEMENT SUR LE SERVICE D'EAU PUBLIC**
R.R.N.W.T. 1990,c.P-23	R.R.T.N.-O. 1990, ch. P-23
INCLUDING AMENDMENTS MADE BY	**MODIFIÉ PAR**
R-015-2004	R-015-2004

This consolidation is not an official statement of the law. It is an office consolidation prepared by Legislation Division, Department of Justice, for convenience of reference only. The authoritative text of regulations can be ascertained from the *Revised Regulations of the Northwest Territories, 1990* and the monthly publication of Part II of the *Northwest Territories Gazette.*

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PUBLIC HEALTH ACT

PUBLIC WATER SUPPLY REGULATIONS

INTERPRETATION

1. In these regulations,

"Act" means the *Public Health Act*; (*Loi*)

"approval" or "approved" means approval or approved in writing by the Chief Medical Health Officer or his or her authorized representative; (*approbation* et *approuvé*)

"finished water" means water that in the opinion of the Chief Medical Health Officer is treated and ready for human consumption; (*eau finie*)

"Health Officer" means a person who is appointed under the Act to act as a Health Officer; (*agent de la santé*)

"Medical Health Officer" means the Medical Health Officer for the area in which the water supply is located; (*médecin-hygiéniste*)

"operator" means the operator or owner of any public water supply; (*exploitant*)

"public water supply" means any water supply system which serves or supplies water, by any means whatsoever, either exclusively or partly for human consumption to more than five customers

LOI SUR LA SANTÉ PUBLIQUE

RÈGLEMENT SUR LE SERVICE D'EAU PUBLIC

DÉFINITIONS

1. Les définitions qui suivent s'appliquent au présent règlement.

«agent de la santé» La personne nommée à ce titre en vertu de la Loi. (*Health Officer*)

«approbation» Approbation écrite du médecinhygiéniste en chef ou son représentant autorisé. (*approval*)

«approuvé» Approuvé par écrit par le médecin-hygiéniste en chef ou son représentant autorisé. (*approved*)

«citerne de transport d'eau» Citerne montée sur un véhicule et servant au transport et à la livraison d'eau destinée aux besoins domestiques. (*water haulage tank*)

«coffrage d'un réseau de distribution aérien» Coffrage ou compartiment dans lequel sont acheminées au moins deux des conduites suivantes : conduites d'eau, canalisations d'égouts et tuyauteries de chauffage à eau chaude ou à vapeur. (*utilidor*)

«eau brute» Eau non traitée. (*raw water*) and includes the plant for the treatment of water; (*service d'eau public*)

"raw water" means untreated water; (*eau brute*)

"surface water source" includes all tributary streams, drainage basins, lakes and reservoirs above a water supply intake which may affect a public water supply; (*source d'eaux de surface*)

"utilidor" means a boxing which contains more than one of the following: water pipes, sewers and hot water or steam heating pipes; (*coffrage d'un réseau de distribution aérien*)

"water haulage tank" means a tank that is mounted on a vehicle for haulage and delivery of water for domestic purposes. (*citerne de transport d'eau*)

«eau finie» Eau qui a été traitée et qui est propre à la consommation, de l'avis du médecin-hygiéniste en chef. (*finished water*)

«exploitant» L'exploitant ou le propriétaire de tout service d'eau public. (*operator*)

«Loi» La *Loi sur la santé publique*. (*Act*)

«médecin-hygiéniste» La personne nommée à ce titre en vertu de la Loi. (*Medical Health Officer*)

«service d'eau public» Tout système d'aqueduc dont l'eau est destinée exclusivement ou en partie à l'alimentation humaine et qui dessert plus de cinq clients, y compris les installations de traitement de l'eau. (*public water supply*)

«source d'eaux de surface» S'entend notamment de tout tributaire, bassin hydrographique, lac ou réservoir dont le niveau est plus élevé que celui d'une prise d'eau, et qui peut affecter le service d'eau public. (*surface water source*)

PART I

APPLICATION, APPROVAL AND INSPECTION

Application

2. (1) Subject to subsection (2), these regulations apply to every public water supply.

(2) These regulations do not apply to a water supply system that was constructed before the establishment of these regulations, but these regulations apply where

(a) in the opinion of a Medical Health Officer such a system becomes a health hazard; or

(b) changes or repairs are required to such public water supply.

PARTIE I

APPLICATION, APPROBATION ET INSPECTION

Application

2. (1) Sous réserve du paragraphe (2), le présent règlement s'applique à tout service d'eau public.

(2) Est soustrait à l'application du présent règlement le système d'aqueduc construit avant l'entrée en vigueur du présent règlement sauf si, selon le cas :

a) de l'avis d'un médecin-hygiéniste, ce système présente un danger pour la santé;

b) des modifications ou des réparations doivent y être apportées.

(3) Nothing in these regulations shall be deemed to revoke anything contained in a building code or regulation applicable to a public water supply in any area of the Territories, but where there is a conflict between these regulations and a building code or regulation, these regulations shall apply.

Approval

3. No person shall construct, make a structural alteration or add to a public water supply system unless approval has first been obtained in accordance with these regulations.

Inspection

4. (1) The Medical Health Officer or a Health Officer may, at any reasonable time, enter any premises of a public water supply and examine the premises and anything in the premises that is used in connection with the operation of the public water supply.

(2) Where, in the opinion of the Medical Health Officer or a Health Officer, any provision of these regulations is not being observed, he or she may make such recommendations or issue such directives to the operator as he or she deems to be necessary in that connection.

(3) Where the operation of a public water supply does not comply with these regulations, the Medical Health Officer or Health Officer shall make a report to the Chief Medical Health Officer and shall furnish a copy of the report to the operator, specifying the violation or violations of these regulations together with recommendations for their correction.

Closure and Appeal

5. (1) Where, in the opinion of the Chief Medical Health Officer, the water is dangerous to the health of the consumers, he or she may order closure of the public water supply.

(2) The operator may appeal in writing to the Minister within 48 hours after receiving a closure order under subsection (1) and the Minister shall either revoke or confirm the order.

(3) Le présent règlement n'a pas pour effet de révoquer toute disposition d'un code du bâtiment ou d'un règlement applicable aux services d'eau publics de tout secteur des territoires. Cependant, en cas d'incompatibilité entre le présent règlement et un code du bâtiment ou un autre règlement, le présent règlement a préséance.

Approbation

3. Il est interdit de construire un système d'aqueduc, d'en modifier la structure ou d'en ajouter une partie sans obtenir une approbation préalable en conformité avec le présent règlement.

Inspection

4. (1) Le médecin-hygiéniste ou l'agent de la santé peut, à toute heure raisonnable, pénétrer dans tout local d'un service d'eau public et inspecter le local ainsi que tout objet dans le local servant à l'exploitation du service d'eau public.

(2) Lorsque, de l'avis du médecin-hygiéniste ou de l'agent de la santé, une disposition du présent règlement n'est pas respectée, il peut faire les recommandations ou donner les directives à l'exploitant qu'il juge nécessaires à cet égard.

(3) Lorsqu'un service d'eau public n'est pas exploité en conformité avec le présent règlement, le médecin-hygiéniste ou l'agent de la santé présente au médecin-hygiéniste en chef un rapport faisant état des infractions relevées et des dispositions correctives recommandées et remet une copie du rapport à l'exploitant.

Fermeture et appel

5. (1) Le médecin-hygiéniste en chef peut ordonner la fermeture d'un service d'eau public s'il estime que l'eau fournie présente un danger pour la santé des consommateurs.

(2) Dans les 48 heures suivant la réception de l'ordre de fermeture visée au paragraphe (1), l'exploitant peut en appeler par écrit devant le ministre. Celui-ci peut révoquer ou confirmer

R-015-2004,s.2.

PART II

WATER SOURCES, WATER TREATMENT,

CHLORINATION AND FLUORIDATION

Surface Water Sources

6. No surface water source shall be approved for use in a public water supply unless

(a) the quantity of water is sufficient to permit reasonable quality control of the water having regard to the estimated demand that the source is required to fill;

(b) it is practicable to convert the water from the source into finished water having regard to natural and man-made conditions affecting the quality of water.

7. (1) The quantity of water available in a surface water source shall be adequate to supply the water demand, including the fire demand, of the community using the surface water source, including a reasonable surplus for anticipated growth.

(2) Where a surface water source is impounded and when it is necessary to estimate the quantity of water to meet the demand of a community, required allowance shall be made for all losses including water released, losses due to evaporation and seepage, loss of capacity due to siltation and ice and unavailable water stored below the bottom intake opening.

8. Where a surface water source is approved for use in a public water supply nothing which may adversely affect the quality of the raw water may be done on the watershed without approval by the Chief Medical Health Officer.

Water Quality Bacteriological Characteristics

9. Samples of water shall be submitted to a laboratory for bacteriological analysis as directed

l'ordre. R-015-2004, art. 2.

PARTIE II

SOURCES D'EAU, TRAITEMENT DE L'EAU,

CHLORATION ET FLUORATION

Sources d'eaux de surface

6. L'utilisation d'une source d'eaux de surface dans un service d'eau public n'est approuvée que si :

a) l'eau existe en quantité suffisante pour permettre un contrôle raisonnable de la qualité de l'eau, compte tenu de la demande;

b) il est possible de transformer l'eau de cette source en eau finie, compte tenu des conditions naturelles ou artificielles de la source pouvant affecter la qualité de l'eau.

7. (1) La quantité d'eau disponible dans une source d'eaux de surface doit être suffisante pour combler les besoins de la collectivité visée, y compris les besoins en eau d'incendie. Il est également tenu compte d'un surplus raisonnable en prévision de l'accroissement de la population.

(2) Lorsqu'une source d'eaux de surface est retenue et qu'il faut évaluer la quantité d'eau qui répond à la demande de la collectivité, il faut notamment tenir compte des pertes causées par les déversements, l'évaporation, l'infiltration, l'envasement et la formation de glace ainsi que l'eau non disponible qui se situe sous le niveau de l'ouverture de la prise d'eau.

8. Lorsque l'utilisation d'une source d'eaux de surface est approuvée aux fins d'un service d'eau public, toute intervention sur le bassin hydrographique susceptible d'affecter la qualité de l'eau reçoit préalablement l'approbation du médecin-hygiéniste en chef.

Caractéristiques bactériologiques et qualité de l'eau

9. Selon les directives du médecin-hygiéniste, des échantillons d'eau sont soumis en laboratoire by the Medical Health Officer. Where practical, it is desirable that there should be a minimum number of samples of treated water a month submitted for bacteriological examination according to the following table:

à des analyses bactériologiques. Si cela est pratique, un minimum d'échantillons d'eau traitée est soumis à des analyses bactériologiques à tous les mois, en conformité avec le tableau suivant :

Population	Number of samples a month
up to 500	1
501 to 2500	2
2501 to 3500	3
3501 to 4000	4
4001 to 4800	5
4801 to 5500	6
5501 to 6500	7

Population	Nombre d'échantillons par mois
jusqu'à 500	1
de 501 à 2500	2
de 2501 à 3500	3
de 3501 à 4000	4
de 4001 à 4800	5
de 4801 à 5500	6
de 5501 à 6500	7

10. (1) Where the multitube fermentation technique is used, the arithmetical mean of the most probable numbers of coliforms for all standard samples examined a month shall not exceed 1 for each 100 ml. When the membrance filter technique is used, the arithmetical mean coliform density of all standard samples shall not exceed 1 for each 100 ml.

10. (1) Dans le cas où la technique de fermentation en tubes multiples est utilisée, la moyenne arithmétique du nombre le plus probable de coliformes dans tous les échantillons analysés ne peut dépasser un coliforme par 100 ml. Dans le cas où la technique de la membrane filtrante est utilisée, la moyenne arithmétique des concentrations de coliformes de tous les échantillons ne peut dépasser un coliforme par 100 ml.

(2) If the most probable number of coliforms when the multitube fermentation technique is used, or the coliform density when the membrance filter technique is used, is nine or greater, then additional samples shall be taken. These should be submitted one after another as soon as reasonably possible in view of the logistics of transportation and the laboratory facilities until the results obtained from at least two consecutive samples show the water to be of satisfactory quality.

(2) Si le nombre le plus probable de coliformes, dans le cas de la technique de fermentation en tubes multiples, ou la concentration de coliformes, dans le cas de la technique de la membrane filtrante, est de neuf ou plus, des échantillons supplémentaires sont prélevés. Ces derniers sont acheminés aux fins d'analyses l'un après l'autre, aussitôt que raisonnablement possible compte tenu des moyens de transport et de la disponibilité des laboratoires, jusqu'à ce que les résultats obtenus sur deux échantillons consécutifs démontrent une qualité d'eau satisfaisante.

Physical Characteristics

11. (1) The frequency and manner of sampling shall be determined by the Chief Medical Health Officer. Under normal circumstances, samples should be collected daily by the operator who should record the results.

(2) Drinking water should contain no impurity which would cause offence to the sense of sight, taste or smell. The following limits should not be exceeded:

Turbidity	5 units
Colour	15 units
Threshold odour number	3

Chemical Characteristics

12. (1) The frequency and manner of sampling shall be determined by the Chief Medical Health Officer. Under normal circumstances, analyses for substances listed below need be made no more often than once in two years.

(2) Drinking water shall not contain impurities in concentrations which may be hazardous to the public health. It should not be excessively corrosive to the water supply system. Substances used in its treatment shall not remain in the water in concentrations greater than required by good practice.

(3) Substances which may have deleterious physiological effect, or for which physiological effects are not known, shall not be introduced onto the system in a manner which would permit them to reach the consumer. The following chemical substances should not be present in a water supply in excess of the listed concentrations where, in the judgment of the Chief Medical Health Officer, other more suitable supplies are or can be made available:

Caractéristiques physiques

11. (1) La fréquence et la méthode d'échantillonnage sont fixées par le médecin-hygiéniste en chef. Dans les circonstances normales, les échantillons sont prélevés quotidiennement par l'exploitant et les résultats obtenus sont consignés dans un registre.

(2) L'eau potable ne devrait pas contenir d'impuretés susceptibles d'en troubler la limpidité ou de lui donner un goût ou une odeur désagréable. Les limites suivantes ne devraient pas être dépassées :

turbidité	5 unités
couleur	15 unités
seuil de perception olfactive	3

Caractéristiques chimiques

12. (1) La fréquence et la méthode d'échantillonnage sont fixées par le médecin-hygiéniste en chef. Dans les circonstances normales, les analyses pour mesurer le dosage dans l'eau des substances chimiques mentionnées ci-après ne sont nécessaires qu'une fois tous les deux ans.

(2) L'eau potable ne doit pas contenir d'impuretés en concentrations susceptibles de présenter un danger pour la santé du public. Elle ne devrait pas présenter un risque de corrosion excessive du système d'aqueduc. Les concentrations dans l'eau potable de substances utilisées pour le traitement de celle-ci ne doivent pas être supérieures à celles recommandées en pratique.

(3) Les substances pouvant avoir des effets nocifs sur la santé ou dont les effets sur la santé sont inconnus ne doivent pas être introduits dans le système d'aqueduc de manière à ce qu'elles atteignent le consommateur. Les substances chimiques suivantes ne devraient pas être présentes dans une réserve d'eau en concentrations supérieures à celles indiquées dans le tableau ci-après si, de l'avis du médecin-hygiéniste en chef, d'autres sources d'approvisionnement plus convenables peuvent

être disponibles :

Substances	Maximum concentration - mg/l	Substances	Concentration maximale-mg/l
Alkyl benzene sulfonate (ABS)	0.5	Alkyl benzène sulfonale (ABS)	0,5
Arsenic (As)	0.05	Arsenic (As)	0,05
Chloride (Cl)	250	Chlorures (Cl)	250
Copper (Cu)	1	Cuivre (Cu)	1
Carbon chloroform extract (CCE)	0.2	Produit d'une extraction chloroformique sur charbon (ECC)	0,2
Cyanide (CN)	0.01	Cyanures (CN)	0,01
Fluoride (F)	1.7	Fluorures (F)	1,7
Iron (Fe)	0.3	Fer (Fe)	0,3
Manganese (Mn)	0.05	Manganèse (Mn)	0,05
Nitrate (NO_3)	45	Nitrate (NO_3)	45
Phenols	0.001	Phénols	0,001
Sulfate (SO_4)	250	Sulfate (SO_4)	250
Total dissolved solids	500	Matières totales dissoutes	500
Zinc (Zn)	5	Zinc (Zn)	5
Barium (Ba)	1	Barym (Ba)	1
Cadmium (Cd)	0.01	Cadmium (Cd)	0,01
Chromium (hexovalent) (Cr^6)	0.05	Chrome (hexavalent)(Cr^6)	0,05

Lead (Pb)	0.05	Plomb (Pb)	0,05
Selenium (Se)	0.01	Sélénium (Se)	0,01
Silver (Ag)	0.05.	Argent (Ag)	0,05 .

Radioactive Characteristics

13. (1) The frequency of sampling and analysis for radioactivity shall be determined by the Chief Medical Health Officer in consultation with the Radiation Protection Bureau of the Department of National Health and Welfare, or its successors, after consideration of the likelihood of significant amounts being present.

(2) The effects of human radiation exposure are viewed as harmful and any unnecessary exposure to ionizing radiation should be avoided. Approval of water supplies containing radioactive materials shall be based upon the judgment that the radioactivity intake from such water supplies when added to that from all other sources is not likely to result in an intake greater than the radiation protection guidance recommended by the Radiation Protection Division of the Department of National Health and Welfare, or its successors.

Water Treatment Plants

14. (1) The design of water treatment plants shall be adequate to provide the treatment of the raw water which is required to produce finished water.

(2) Filters shall be of the gravity type unless otherwise approved by the Chief Medical Health Officer.

(3) Heating facilities of a safe type should be provided in buildings which will be occupied by personnel, and should be adequate for comfort, as well as for protection of the equipment.

(4) The buildings shall be well-ventilated by means of windows and doors, roof ventilators or other means. All rooms, compartments, pits and other enclosures below the grade floor, which must be entered and in which an unsafe atmosphere may develop, or where excessive heat may be built up by equipment, shall have adequate forced ventilation. The equipment

Radioactivité

13. (1) La fréquence de l'échantillonnage et des analyses aux fins de déterminer le taux de radioactivité est fixée par le médecin-hygéniste en chef après avoir consulté le Bureau de la radioprotection du ministère de la Santé nationale et du Bien-être social, ou le service qui lui aura succédé, après avoir considéré les probabilités d'une irradiation importante de l'eau.

(2) Les effets dus à l'irradiation des personnes sont considérés comme nocifs et toute exposition inutile à un rayonnement ionisant devrait être évitée. L'approbation d'une réserve d'eau contenant des substances radioactives est basée sur la radio-concentration de l'eau qui, une fois ajoutée à celle des autres sources d'eau, ne doit pas atteindre un total supérieur à la norme établie par la Division de la radioprotection du ministère de la Santé nationale et du Bien-être social, ou le service qui lui aura succédé.

Installations de traitement de l'eau

14. (1) Les installations de traitement de l'eau sont conçues de façon à pouvoir fournir à l'eau brute le traitement nécessaire pour la transformer en eau finie.

(2) Les filtres utilisés sont des filtres à gravité sauf si le médecin-hygiéniste en chef approuve un autre genre de filtre.

(3) Dans les bâtiments abritant du personnel, des installations de chauffage sécuritaires devraient être fournies afin d'assurer le confort des occupants et la protection de l'équipement.

(4) Les bâtiments sont largement ventilés au moyen de fenêtres, de portes, de ventilateurs de toit ou autrement. Les locaux, compartiments, fosses et autres enceintes accessibles situés sous le niveau du rez-de-chaussée et où une atmosphère malsaine peut se former ou encore où une quantité excessive de chaleur produite par l'équipement peut s'accumuler doivent être

should be capable of producing at least six complete turnovers of air an hour. Rooms containing equipment or piping should be adequately heated, ventilated and, if necessary, dehumidified to prevent injurious condensation. Where practicable, ventilation should be supplemented by insulation of the building, equipment and piping. Switches which control the forced ventilation shall be located in order to be conveniently manipulated from outside such compartments.

desservis par un système adéquat de ventilation par air pulsé. L'équipement devrait pouvoir effectuer au moins six renouvellements d'air complets par heure. Les locaux abritant de l'équipement ou de la tuyauterie devraient être chauffés, aérés et, au besoin, déshumidifiés pour empêcher la condensation nuisible. Si possible, la ventilation devrait être complétée par l'isolation du bâtiment, de l'équipement et de la tuyauterie. Les interrupteurs de commande du système de ventilation par air pulsé sont placés de manière à pouvoir être facilement manœuvrés depuis l'extérieur des compartiments desservis.

(5) Buildings shall be adequately lighted throughout by means of natural light or by artificial lighting facilities, or both. Control switches, where needed, shall be conveniently placed at the entrance to each room or compartment. All electric wiring and equipment shall be of a type listed by the Canadian Standards Association Testing Laboratories and installed in accordance with the CSA Standard C22.1 -1986 Canadian Electrical Code - Part I - *Safety Standard for Electrical Installation* and those of the Government of the Northwest Territories and local government authorities.

(5) Les bâtiments sont adéquatement et complètement éclairés au moyen d'un éclairage naturel, d'installations d'éclairage artificiel, ou des deux. Les interrupteurs de commande nécessaires sont placés à un endroit pratique, à l'entrée de chaque local ou compartiment. Le câblage et l'équipement électriques doivent être d'un genre approuvé par les laboratoires d'essai de l'Association canadienne de normalisation et installés en conformité avec la norme de l'ACNOR numéro C22.1, Code canadien de l'électricité 1986, partie I, *Norme de sécurité relative aux installations électriques* et les normes fixées par le gouvernement des Territoires du Nord-Ouest ou les administrations locales.

(6) Where lavatory and toilet facilities are provided at the water treatment plant, wastes shall be safely disposed of, without danger of contaminating the water and preferably they shall be discharged directly into an approved sewer.

(6) Lorsque des installations sanitaires sont aménagées dans une station de traitement de l'eau, les eaux usées sont évacuées d'une manière ne présentant aucun danger de contamination de l'eau et, de préférence, elles sont évacuées directement dans un égout approuvé.

Chlorination

Chloration

15. (1) Drinking water shall be chlorinated or receive other bactericidal treatment as approved by the Chief Medical Health Officer in all cases when the supply is obtained from a surface source, and in the case of a groundwater source if the water may be subject to contamination in the well or in storage reservoirs or mains. Additional chlorination may be required if there is reasonable possibility for contamination subsequent to the original disinfection.

15. (1) Lorsque l'approvisionnement provient d'une source d'eaux de surface, l'eau potable est chlorée ou autrement traitée avec des substances bactéricides suite à l'approbation du médecin-hygiéniste en chef. Dans le cas d'une source d'eau souterraine, ces traitements sont requis si l'eau est susceptible d'être contaminée dans les puits, les réservoirs de retenue ou dans les conduites d'amenée. S'il existe une possibilité raisonnable que l'eau soit contaminée après une première désinfection, il peut être nécessaire de procéder à une seconde chloration.

(2) Chlorination equipment shall have a maximum feed capacity at least 50% greater than the highest dosage required to provide a free

(2) L'équipement de chloration a une capacité maximale d'alimentation au moins 50 % supérieure à la dose maximale requise pour

chlorine residual.

obtenir un résidu de chlore libre.

(3) Dependable feed equipment, either of the gas feed or positive displacement solution feed type, shall be used for adding chlorine. Automatic proportioning of the chlorine dosage to the rate of flow of the water treated shall be provided at all treatment plants where the rate of flow varies without manual adjustment of pumping rates. In the selection and design of equipment, care should be taken to ensure that there is sufficient dilution of chlorine in the water whenever there is contact with piping, valves or fittings which are corrodible.

(3) Des appareils fiables, soit du type à alimentation du chlore à l'état gazeux ou du type à alimentation du chlore en solution à l'aide de pompes volumétriques, sont utilisés pour l'ajout du chlore. Dans le cas des installations de traitement dont le débit d'eau varie sans que le taux de pompage ne puisse être réglé manuellement, des appareils permettant le dosage automatique proportionnel au débit d'eau sont utilisés. Lorsque l'eau chlorée doit entrer en contact avec des tuyaux, des soupapes ou des raccords susceptibles de se corroder, les appareils choisis ou conçus devraient permettre une dilution suffisante du chlore dans l'eau.

(4) All chlorination equipment should be installed in duplicate, in order to provide standby units for ensuring uninterrupted operation. In addition, spare parts consisting of at least the commonly expendable parts such as glassware, rubber fittings, hose clamps, and gaskets should be provided for effecting emergency repairs. In some cases, satisfactory emergency chlorinators may consist of discontinued equipment if it is operable and adequately sized.

(4) Tout équipement de chloration devrait être installé en double de façon à ce que des installations de secours puissent assurer un fonctionnement ininterrompu. De plus, des pièces de rechange pour les pièces généralement non réutilisables tels la verrerie, les raccords en caoutchouc, les colliers de serrage et les joints d'étanchéité statiques devraient être prévues pour les réparations d'urgence. Dans certains cas, des chlorateurs désuets, mais en bon état et de taille appropriée peuvent être utilisés comme appareils de secours.

(5) Where gas feed chlorinators are employed, a scale shall be provided for weighing the chlorine cylinders serving each operating chlorinator. Preferably, weigh scales for 68 kg cylinders should be recessed in the floor, and the recess provided with a drain.

(5) Lorsque des chloronomes sont utilisés, une balance permet de peser les bouteilles de chlore reliées à chaque chloronome. Les balances pour bouteilles de 68 kg sont de préférence encastrées dans le plancher et les cavités sont munies d'un tuyau d'écoulement.

(6) Where a powdered hypochlorite is used, solutions should be prepared in a separate tank. The clear liquid should be siphoned to the solution storage tank from which it is drawn by the hypochlorinator. A second tank is not required when chlorine is supplied as a solution.

(6) Lorsque de l'hypochlorite en poudre est utilisé, la solution devrait être préparée dans un réservoir distinct. La solution devrait être siphonnée à un réservoir de stockage et ensuite aspirée par le chlorateur. Un second réservoir n'est pas requis lorsque le chlore est fourni sous forme de solution. (7) Where gas chlorine is used, there shall be a canister-type respirator with a full face mask in a location handy to the operator. The canister shall be specifically designed to protect against chlorine and a new one should be obtained each time one is used.

(7) Lorsque du chlore à l'état gazeaux est utilisé, un respirateur à boîte filtrante muni d'un masque complet est placé à la portée de l'opérateur. La boîte filtrante est spécialement conçue pour assurer une protection contre le chlore et devrait être remplacée après chaque utilisation.

(8) Safety chains should be used to retain 68 kg cylinders of chlorine gas, either in storage or on weigh scales, in a safe upright position.

(9) Gas chlorine equipment, including chlorinators, weigh scales and chlorine cylinders, shall be located in an isolated building, room or rooms. In larger installations, the storage and scale facilities should be in a room separated from the chlorinators. The construction of the room or rooms should be of fire resistant material and have concrete floors.

(10) Areas containing chlorine or chlorinator equipment shall be clearly marked "DANGER! CHLORINE STORAGE" or "DANGER! CHLORINE FEED EQUIPMENT" as applicable.

(11) There should be two or more exits if the distance of travel to the nearest exit exceeds 4.5 m.

(12) There should be continuous mechanical ventilation at the rate of three air changes an hour. Alternatively there should be screened openings to the outdoors with a size of 0.02% of the floor area

(a) within 150 mm of the floor, and

(b) near the ceiling.

(13) In addition, there should be emergency mechanical ventilation sufficient to produce 30 air changes an hour taking suction at floor level. The switch for the emergency fan should be located outside the chlorinator room. It should be posted with a sign warning that 10 minutes should elapse after starting the fan before entering the room.

(14) The temperature in the storage and scale room should never be higher and preferably slightly lower than that in the chlorinator room. The gas lines between the scales, chlorinators and injectors should not be located on an outside wall or in a location where low temperatures may be

(8) Des chaînes de sécurité devraient être utilisées pour retenir les bouteilles de chlore de 68 kg en position verticale, tant en entrepôt que sur les balances.

(9) L'équipement de chloration au chlore gazeux, y compris les chloronomes, les balances et les bouteilles de chlore, est situé dans un bâtiment isolé ou dans un ou plusieurs locaux détachés, de préférence construits en matériaux qui résistent au feu et dotés d'un plancher en béton. Dans les installations plus importantes, l'entrepôt et les balances devraient se situer dans un local séparé des chloronomes.

(10) Dans les aires renfermant du chlore ou de l'équipement de chloration, sont visiblement affichés les messages suivants : «DANGER! ENTREPOSAGE DE CHLORE» ou «DANGER! ÉQUIPEMENT DE CHLORATION».

(11) Il devrait y avoir deux sorties ou plus afin que la distance à franchir pour se rendre jusqu'à la sortie la plus rapprochée ne soit jamais supérieur à 4,5 m.

(12) Il devrait y avoir un système de ventilation mécanique assurant trois renouvellements d'air par heure. À défaut d'une telle installation, il devrait y avoir des ouvertures grillagées donnant à l'extérieur, d'une superficie correspondant à 0,02 % de celle du plancher, et situées aux endroits suivants :

a) à au plus 150 mm du plancher;

b) près du plafond.

(13) Il devrait également y avoir un système de ventilation mécanique de secours, à aspiration au niveau du plancher, capable d'assurer 30 renouvellements d'air par heure. L'interrupteur de commande du ventilateur de secours devrait être situé à l'extérieur du local des chlorateurs et être surmonté d'un avis indiquant d'attendre 10 minutes après la mise en marche du ventilateur avant d'entrer dans le local.

(14) La température dans la salle d'entreposage et des balances ne devrait jamais être supérieure à celle qui prévaut dans la salle des chlorinateurs; elle devrait, de préférence, être légèrement inférieure à cette dernière. Les conduites de gaz entre les balances, les

encountered.

16. (1) The application of chlorine shall be sufficient to provide 0.2 mg/l of residual free chlorine after a thorough mixing of the chlorine and water and 20 minutes of contact time after the mixing. Notwithstanding the foregoing, the Chief Medical Health Officer may decide on another chlorine residual for particular local circumstances.

(2) The chlorine residual test is performed on a sample of the plant or pipeline effluent, after it has been held for 20 minutes, unless it is certain that there has already been a chlorine contact time of 20 minutes.

(3) Where bacterial counts in the distribution system are high, the minimum requirements for chlorine residual should be increased.

(4) Where possible, a chlorine residual should be maintained in all active parts of the distribution system.

(5) There shall be a minimum total chlorine contact period of 20 minutes in the pipeline and reservoirs, before the first consumption by any person of the treated water.

(6) There shall be a permanent standard chlorine residual comparator test kit at each water plant where chlorination is undertaken.

(7) Whenever it is necessary to pump unchlorinated water which might not be potable into the distribution system the Chief Medical Health Officer or in his or her absence a responsible Health Officer, shall be notified immediately. After the emergency, the water mains and service lines shall be disinfected as stated in section 22.

Fluoridation

17. (1) Fluoridation is recommended for community water supplies. Before the equipment is ordered, the fluorides concentration in the raw water shall be checked to be sure of the need for fluorides.

chlorinateurs et les injecteurs ne devraient pas être acheminées le long d'un mur extérieur ou à un endroit où règne une basse température.

16. (1) La quantité de chlore à ajouter dans l'eau doit être suffisante pour que la concentration de résidu de chlore libre, après un parfait mélange du chlore et de l'eau et un temps de contact de 20 minutes suivant ce mélange, soit de 0,2 mg/l. Malgré ce qui précède, le médecin-hygiéniste en chef peut modifier cette exigence en cas de circonstances locales particulières.

(2) La détermination du taux de chlore résiduel est effectuée sur un échantillon d'un effluent de la station de traitement ou d'une canalisation après une période d'attente de 20 minutes, à moins qu'il ne soit établi qu'il y ait déjà eu un temps de contact de 20 minutes.

(3) Lorsque la numération bactérienne dans le réseau de distribution est élevée, la concentration de chlore résiduel minimale devrait être augmentée.

(4) Si possible, une certaine concentration de chlore résiduel devrait être maintenue dans toutes les parties actives du réseau de distribution.

(5) Il doit y avoir un temps de contact total de chlore de 20 minutes dans les canalisations et les réservoirs avant que toute personne puisse consommer l'eau traitée.

(6) Toute station de traitement de d'eau qui effectue la chloration est dotée en permanence d'une trousse standard du type comparateur pour effectuer les dosages de chlore résiduel.

(7) Lorsqu'il est nécessaire d'acheminer dans un réseau de distribution de l'eau non chlorée et possiblement non potable, le médecin-hygiéniste en chef ou, en son absence, un agent de la santé compétent, en est immédiatement avisé. Une fois l'urgence satisfaite, les conduites principales et les conduites de branchement sont désinfectées de la manière prévue à l'article 22.

Fluoruration

17. (1) Il est recommandé de procéder à la fluoruration des réserves d'eau d'une collectivité. Avant de commander l'équipement, une vérification de la concentration de fluorures dans l'eau est effectuée pour s'assurer de la nécessité

(2) The fluorides feed rate shall be proportioned to the water flow rate. Where a pump supplies water at approximately a constant rate, a suitable fluoridator is a type which operates simultaneously with the pump. The pumping variation should be less than 10% from the mean.

(3) The sampling point should be a tap located on a line before the point where interfering substances (alum, chlorine, polyphosphates and other such substances) are added. The application point for the fluorides should be far enough ahead of this to ensure thorough mixing. Usually a distance equivalent to 10 pipe diameters would be sufficient for this purpose.

(4) If such an arrangement is not practical in view of the existing plant layout, then accurate tests may be made following neutralization in the case of chlorine and removal by distillation in the case of aluminum (from alum) and phosphates. The operator should make appropriate adjustments in the readings of his or her tests.

(5) The concentration of fluorides in the finished water shall be within the range of 1.2 and 1.6 mg/l. The optimum proportion is 1.4 mg/l.

(6) The following control procedures are required and all results should be recorded:

(a) the operator should make daily tests to determine the fluorides concentration in the treated water. In some installations there will be instantaneous variations in the fluorides concentration at the sampling tap due to the briefly intermittent discharge characteristics of some fluorides feeders. To compensate for these variations a large bottle of water should be drawn as the source of samples for testing;

(b) on a weekly basis duplicate samples of the water to be tested should be submitted to a laboratory designated by the Chief Medical Health

de la fluoruration.

(2) Le taux d'alimentation en fluorures est proportionnel au débit d'eau. Lorsque le débit d'eau fourni par la pompe est à peu près constant, le fluorateur idéal est celui qui agit selon le fonctionnement de la pompe. Le débit d'eau fourni par la pompe ne devrait pas s'écarter de plus de 10 % de la moyenne.

(3) Le point d'échantillonnage devrait se trouver en amont de l'endroit où sont ajoutées certaines substances (alum, chlore, phosphates et autres substances du genre) venant modifier la composition de l'eau. Le point d'introduction des fluorures dans le réseau devrait être encore plus en amont pour que les fluorures puissent être parfaitement dispersés dans l'eau. À cette fin, une distance équivalant à 10 diamètres de conduite est habituellement suffisante.

(4) Si un tel aménagement n'est pas pratique en raison de la disposition actuelle des lieux, des essais précis peuvent être menés après neutralisation du chlore et enlèvement par distillation de l'alum et des phosphates. Les ajustements nécessaires devraient alors être apportés à la lumière des résultats de tels essais.

(5) La concentration de fluorures dans l'eau finie se situe entre 1,2 et 1,6 mg/l, la concentration optimale étant de 1,4 mg/l.

(6) Les mécanismes de contrôle ci-après décrits sont obligatoires et les résultats devraient être consignés dans un registre :

a) des essais quotidiens sont faits pour déterminer la concentration de fluorures dans l'eau traitée. Dans certaines installations, des variations instantanées dans la concentration de fluorures peuvent être décelées à la prise d'échantillon, en raison des brèves interruptions de débit des fluorateurs à fonctionnement intermittent. Pour éviter que les résultats de l'essai ne soient faussés, une grosse bouteille d'eau devrait être prélevée comme échantillon;

b) chaque semaine, un double de chaque échantillon d'eau prélevé aux fins d'analyses devrait être soumis à

Officer. The laboratory analyses will establish the accuracy of the plant operator's field tests and his or her ability to properly control the treatment. When this criteria has been attained, duplicate samples should be submitted on a monthly basis only;

(c) as a daily routine, the chemical dosage should be calculated based on the consumption of fluorides and volume of water treated.

(7) Protection to the skin and lungs of the operator handling the fluoride chemical shall be maintained as follows:

(a) if the equipment is not of a type which prevents the dust entering the air when the fluorides chemical is being replaced, then the equipment should be in a separate room with suitable exhaust venting from the floor level to the outside atmosphere. A vacuum cleaner in which disposable bags are used would be a suitable alternative, and it could also be used in cleaning the room. The bags should be either buried at the nuisance grounds or washed out in the sewer;

(b) respirator, cloth cap, rubber gloves, rubber apron and goggles should be used at all times when handling the dry chemical, and these should be stored outside the fluoridation room;

(c) the operator should not smoke while handling the dry powder;

(d) instructions should be posted instructing the staff to observe the points contained in this section.

PART III

un laboratoire désigné par le médecin-hygiéniste en chef pour que puissent être vérifiées la précision des essais faits à la station et l'aptitude de l'exploitant à contrôler adéquatement le traitement de l'eau. Une fois cette précision et cette aptitude établies, le double des échantillons ne devrait être soumis qu'une fois par mois;

c) tous les jours, le dosage de fluorures est calculé sur la base de la quantité de fluorures utilisée par rapport au volume d'eau traitée.

(7) La protection de la peau et des poumons de la personne qui manipule les fluorures est assurée par le respect des directives suivantes :

a) si l'équipement ne permet pas d'empêcher la dispersion des particules chimiques dans l'air au moment de la remise en place des fluorures, l'équipement devrait être installé dans une salle distincte desservie par un ventilateur d'extraction convenable, aspirant l'air au niveau du sol et l'évacuant à l'extérieur. Une bonne solution de rechange serait un aspirateur avec sacs jetables, lequel pourrait également être utilisé pour l'entretien de la salle. Les sacs usés devraient être enfouis à un endroit prévu à cette fin ou leur contenu chassé dans l'égout;

b) lors de la manipulation de la poudre chimique, le respirateur, la casquette de toile, les gants, le tablier de caoutchouc ainsi que les lunettes de sécurité devraient être utilisés en tout temps et devraient être entreposés à l'extérieur de la salle de fluoration;

c) la personne qui manipule la poudre sèche ne devrait pas fumer;

d) des directives portant sur les points traités au présent article devraient être affichées.

PARTIE III

PUMPING STATIONS, RESERVOIRS AND DISTRIBUTION SYSTEMS

Pumping Stations

18. (1) The design of pumping stations shall be based on the provision to ensure maintenance of the sanitary quality of the water pumped through it, and to facilitate cleanliness, continuity and ease of operation. Subsurface pits, subterranean piping and connections and inaccessible installations should be avoided.

(2) The location should be chosen so that there will be adequate control over every external factor (such as usage of surrounding areas) which might contribute to the impairment of the sanitary quality of the water.

(3) The wet wells and pump reservoirs which are part of pumping stations shall conform with section 19.

Equalizing Reservoirs, Elevated Tanks, Standpipes and Pressure Tanks for Finished Water

19. (1) The most up-to-date standards should be followed where applicable in the design of reservoirs and other tanks.

(2) The locations, size and type of reservoir, tank or standpipe should be integrated with the distribution system, ground elevations and effective pressures, type and capacity of supply, economics of pumping and construction, consumer use and terrain. The design to be desired should give uniform pressures during the day with no pressure drop below 140 kPa.

(3) Reservoirs shall have watertight covers or roofs which exclude birds, animals, insects and excessive dust.

(4) There shall be locks on access manholes, fencing and other precautions in order to prevent trespassing, vandalism or sabotage.

STATIONS DE POMPAGE, RÉSERVOIRS ET RÉSEAUX DE DISTRIBUTION

Stations de pompage

18. (1) Les stations de pompage sont conçues de manière à préserver la qualité de l'eau qui y est pompée et à favoriser l'entretient ainsi que la simplicité et la continuité de son fonctionnement. Elle devrait comporter le moins possible de fosses et de canalisations souterraines ainsi que d'installations inaccessibles.

(2) L'emplacement devrait être choisi en fonction de la possibilité de contrôler convenablement les facteurs externes (telle l'utilisation faite des secteurs attenants) pouvant contribuer à la dégradation de la qualité de l'eau.

(3) Les bâches d'aspiration et les réservoirs qui font partie intégrante des stations de pompage sont conformes à l'article 19.

Réservoirs d'équilibre, châteaux d'eau, réservoirs au sol et réservoirs sous pression pour l'eau finie

19. (1) Les normes applicables les plus récentes sont respectées dans la conception des réservoirs et des citernes.

(2) L'emplacement, la dimension et la sorte de réservoir, de citerne ou de réservoir au sol devraient être déterminés en fonction de l'utilisation de l'eau, du réseau de distribution, des accidents de terrain, de la contrainte effective, du type et de la capacité de la réserve d'eau, de la rentabilité d'une installation de pompage et sa construction ainsi que du genre de terrain. Les réservoirs devraient être conçus pour permettre de maintenir des pressions constantes durant la journée, sans chutes sous les 140 kPa.

(3) Les réservoirs doivent être munis d'un couvercle ou d'un toit étanche qui empêche les oiseaux, les animaux, les insectes et la poussière de pénétrer à l'intérieur.

(4) Des serrures sont installées sur les trous d'homme d'accès, ainsi que sur les clôtures et d'autres mesures sont prises pour décourager les intrusions, ainsi que les actes de vandalisme et de

sabotage.

(5) Steps should be taken to prevent an excessive build-up of ice which would damage the reservoir.

(5) Des mesures devraient être prises pour empêcher l'accumulation excessive de glace pouvant endommager les réservoirs.

(6) There shall be consideration of public health safety in the location of ground level reservoirs. The bottom should be above the groundwater table and preferably above any possible flooding.

(6) L'emplacement des réservoirs au niveau du sol est déterminé en tenant compte de la santé et de la sécurité du public. Le fond des réservoirs devrait se situer au-dessus de la nappe phréatique et, de préférence, au dessus de tout niveau possible de crue.

(7) Where the bottom of a reservoir is below the normal ground surface, separation from possible sources of contamination shall be provided as follows:

(a) 46 m from any septic tank, sewage lift station, sewage disposal point, sewage disposal field or other similar source of contamination;

(b) 8 m from any sewer pipe and preferably 30 m;

(c) for all other sources of contamination as far as appears to be reasonable in view of local conditions and the type of construction.

(7) Les réservoirs dont le fond se trouve au-dessus du niveau normal du sol doivent être installés à une certaine distance de toute source de contamination possible, à savoir, selon le cas :

a) à une distance de 46 m d'une fosse septique, d'une station de relevage des eaux usées, d'un point de rejet des eaux usées, d'un champ d'épuration ou de toute autre source de contamination similaire;

b) à une distance de 8 m et de préférence 30 m de toute conduite d'égout;

c) à une distance raisonnable de toute autre source de contamination, compte tenu des conditions locales et du type de construction.

(8) Tops of ground level reservoirs shall be not less than 600 mm above the normal ground surface, and shall be a minimum of 1.2 m above any possible flood level.

(8) Le dessus des réservoirs au niveau du sol est situé à au moins 600 mm au-dessus du niveau normal du sol et à au moins 1,2 m au-dessus de tout niveau de crue possible.

(9) The area surrounding ground level reservoirs shall be graded to prevent surface water from standing against the structure.

(9) Autour des réservoirs au niveau du sol, le terrain est régalé en pente pour empêcher que les eaux de surface ne stagnent contre les réservoirs.

(10) There shall be footing drains around the reservoir, which should be drained by gravity if possible. There should be a means of observing the volume of flow from the footing drains.

(10) Des drains de semelle, si possible à écoulement par gravité, sont posés autour des réservoirs. Un dispositif devrait être prévu pour observer le débit d'eau dans les drains.

(11) The maximum variation of working levels in storage reservoirs which float on a distribution system should not exceed 9 m.

(11) La variation maximale du niveau utile des réservoirs de stockage incorporés à un réseau de distribution ne devrait pas être supérieure à 9 m.

(12) Water level controls or telemetering equipment should be provided in reservoirs on the distribution system where there is an appreciable variation in level.

(12) Lorsque la variation du niveau est importante, les réservoirs devraient être munis de régulateurs de niveau d'eau ou d'équipement de télémesure.

(13) Water level control switches or telemetering equipment should be provided, with warning or alarms in appropriate places about the community, so that high and low water levels may be immediately reported.

(13) Des interrupteurs reliés aux régulateurs de niveau ou d'équipement de télémesure sont prévus, avec avertisseurs ou signaux d'alarme placés à des endroits stratégiques de la collectivité, afin que les niveaux d'eau trop hauts ou trop bas soient signalés immédiatement.

(14) Overflows on structures shall have free fall discharges that are in plain view, and should be designed so that they will not freeze.

(14) Les déversoirs des réservoirs sont du type à déversement libre et sont à l'épreuve du gel.

(15) A manhole on a reservoir or tank shall be framed so that there is a raised lip around the edge. The lip shall be at least 100 mm high, and preferably 150 mm, and the join between the lip and the roof shall be watertight. It shall be fitted with a watertight cover which overlaps the lip of the manhole and extends down around the frame at least 50 mm. The cover shall be hinged at one side and shall be provided with a locking device.

(15) Le contour des trous d'homme sur les réservoirs ou les citernes est muni d'un collet. Le collet mesure 100 mm et de préférence 150 mm de haut, et le joint entre le collet et le toit est étanche. Un couvercle étanche recouvre complètement le collet et est muni d'un rebord d'au moins 50 mm qui tombe sur les parois du réservoir.

(16) The roof of the structure should be well drained. The downspout pipes of the roof drain shall not enter the reservoir or connect to the overflow from the reservoir. There shall be no parapets or construction which will tend to pool the water or snow on the roof.

(16) Le toit des réservoirs devrait être muni des éléments nécessaires à l'écoulement des eaux de pluie. Les tuyaux de descente reliés à l'avaloir ne sont pas acheminés à l'intérieur des réservoirs ni raccordés au déversoir. Le toit ne doit pas être muni de parapets ou d'autres constructions pouvant causer l'accumulation de l'eau ou de la neige.

(17) Valve stems or similar projections through the roof shall be designed with a wall sleeve, elevated at least 100 mm above the roof top, set in a curbed opening, or welded to the cover plate. The opening must be covered by an overlapping, turned-down hood, welded to the valve stem.

(17) Les tiges de soupape ou les autre éléments faisant sailli sur le toit des réservoirs sont protégés par un manchon s'élevant à une hauteur d'au moins 100 mm au-dessus du toit. Les manchons sont soudés au couvercle ou passent par une ouverture à collet. Les ouvertures sont recouvertes d'un capuchon rabattu qui chevauche la tige en saillie et qui est soudé à celle-ci.

(18) Vents, overflows, finial decorations and warning lights shall be so constructed as to exclude dust, birds, animals and insects. There shall be no direct connection between an overflow and any drain or sewer. A ground level vent must terminate in an inverted U construction, the opening of which is at least 600 mm above the ground surface.

(18) Les évents, les déversoirs, les éléments décoratifs et les feux avertisseurs sont construits de manière à empêcher l'introduction de la poussière, des oiseaux, des animaux et des insectes. Les déversoirs ne sont pas directement raccordés aux drains ou aux canalisations d'égout. Tout évent situé près du sol doit se terminer en forme de U renversé, l'ouverture placée à une hauteur d'au moins 600 mm au-dessus du niveau du sol.

(19) Unsafe water shall not be stored adjacent to a finished water compartment when only a single wall separates the two.

(19) L'eau de mauvaise qualité ne doit pas être stockée dans un compartiment voisin d'un compartiment d'eau finie lorsqu'une seule paroi sépare les deux compartiments.

(20) Reservoirs should be drainable to the ground surface in such a manner as to preclude contamination by surface water and access by animals. There shall be no direct connection to a sewer or storm. Alternatively, a reservoir should be drained by pumping from a sump at a lower level than the bottom. A manhole should be located directly above the sump, to permit servicing of the pump intake and to allow dewatering with a portable pump.

(20) Le contenu des réservoirs devraient être évacué à la surface du sol sans qu'il y ait risque d'intrusion d'animaux ou risque de contamination par des eaux de surface. Les réservoirs ne sont pas directement raccordés à un égout sanitaire ou pluvial. À défaut, ils devraient être vidés au moyen d'une pompe installée dans un puisard situé à un niveau inférieur à celui du fond du réservoir. Le puisard devrait être muni d'un trou d'homme pour permettre l'entretien de la prise et l'assèchement du puissard au moyen d'une pompe portative.

(21) Interior surfaces of all steel reservoirs shall be protected by paints or other protective coatings or cathodic protection according to practices recommended by the American Water Works Association or the Canadian Standards Association.

(21) Les parois intérieures des réservoirs en acier sont protégées par une peinture ou d'autres revêtements de protection ou encore une protection cathodique en conformité avec les pratiques recommandées par l'American Water Works Association ou l'Association canadienne de normalisation.

(22) There should be periodical disinfection in order to ensure a continued source of finished water.

(22) Afin que l'alimentation en eau finie soit continue, les réservoirs devraient être désinfectés périodiquement.

Water Mains

Conduites d'eau principales

20. (1) Pipes and pipe packing and jointing materials shall have been manufactured in conformity with the latest standard specifications issued by the American Water Works Association or the Canadian Standards Association. Plastic pipe shall be approved by and bear the seal of the Canadian Standards Association. Selection of the pipe material and design shall be made after giving consideration to the possible deleterious action of the soils and water which will be surrounding the pipe, the water to be distributed and possible electrolytic action on the metal parts.

20. (1) Les tuyaux ainsi que les matériaux de jointement et d'obturation utilisés doivent être fabriqués en conformité avec les normes récentes prescrites par l'American Water Works Association ou l'Association canadienne de normalisation. Les tuyaux en plastique sont approuvés par l'Association canadienne de normalisation et en portent l'étiquette. La conception et les matériaux de fabrication des tuyaux sont choisis en tenant compte de l'effet possiblement nuisible du sol et de l'eau qui entoureront le tuyau, de l'eau qui est distribuée et de la possibilité d'une réaction électrolytique avec les pièces métalliques.

(2) Steps should be taken to prevent freezing, which could damage the mains.

(2) Les conduites d'eau principales devraient être protégées contre le gel.

(3) The minimum working pressure during the flow in outlying parts of the distribution system should be 140 kPa.

(3) La pression de service minimale dans les parties périphériques du réseau de distribution devrait être de 140 kPa.

(4) If water hydrants are installed, the

(4) Si le réseau de distribution comporte des

(12) Water level controls or telemetering equipment should be provided in reservoirs on the distribution system where there is an appreciable variation in level.

(12) Lorsque la variation du niveau est importante, les réservoirs devraient être munis de régulateurs de niveau d'eau ou d'équipement de télémesure.

(13) Water level control switches or telemetering equipment should be provided, with warning or alarms in appropriate places about the community, so that high and low water levels may be immediately reported.

(13) Des interrupteurs reliés aux régulateurs de niveau ou d'équipement de télémesure sont prévus, avec avertisseurs ou signaux d'alarme placés à des endroits stratégiques de la collectivité, afin que les niveaux d'eau trop hauts ou trop bas soient signalés immédiatement.

(14) Overflows on structures shall have free fall discharges that are in plain view, and should be designed so that they will not freeze.

(14) Les déversoirs des réservoirs sont du type à déversement libre et sont à l'épreuve du gel.

(15) A manhole on a reservoir or tank shall be framed so that there is a raised lip around the edge. The lip shall be at least 100 mm high, and preferably 150 mm, and the join between the lip and the roof shall be watertight. It shall be fitted with a watertight cover which overlaps the lip of the manhole and extends down around the frame at least 50 mm. The cover shall be hinged at one side and shall be provided with a locking device.

(15) Le contour des trous d'homme sur les réservoirs ou les citernes est muni d'un collet. Le collet mesure 100 mm et de préférence 150 mm de haut, et le joint entre le collet et le toit est étanche. Un couvercle étanche recouvre complètement le collet et est muni d'un rebord d'au moins 50 mm qui tombe sur les parois du réservoir.

(16) The roof of the structure should be well drained. The downspout pipes of the roof drain shall not enter the reservoir or connect to the overflow from the reservoir. There shall be no parapets or construction which will tend to pool the water or snow on the roof.

(16) Le toit des réservoirs devrait être muni des éléments nécessaires à l'écoulement des eaux de pluie. Les tuyaux de descente reliés à l'avaloir ne sont pas acheminés à l'intérieur des réservoirs ni raccordés au déversoir. Le toit ne doit pas être muni de parapets ou d'autres constructions pouvant causer l'accumulation de l'eau ou de la neige.

(17) Valve stems or similar projections through the roof shall be designed with a wall sleeve, elevated at least 100 mm above the roof top, set in a curbed opening, or welded to the cover plate. The opening must be covered by an overlapping, turned-down hood, welded to the valve stem.

(17) Les tiges de soupape ou les autre éléments faisant sailli sur le toit des réservoirs sont protégés par un manchon s'élevant à une hauteur d'au moins 100 mm au-dessus du toit. Les manchons sont soudés au couvercle ou passent par une ouverture à collet. Les ouvertures sont recouvertes d'un capuchon rabattu qui chevauche la tige en saillie et qui est soudé à celle-ci.

(18) Vents, overflows, finial decorations and warning lights shall be so constructed as to exclude dust, birds, animals and insects. There shall be no direct connection between an overflow and any drain or sewer. A ground level vent must terminate in an inverted U construction, the opening of which is at least 600 mm above the ground surface.

(18) Les évents, les déversoirs, les éléments décoratifs et les feux avertisseurs sont construits de manière à empêcher l'introduction de la poussière, des oiseaux, des animaux et des insectes. Les déversoirs ne sont pas directement raccordés aux drains ou aux canalisations d'égout. Tout évent situé près du sol doit se terminer en forme de U renversé, l'ouverture placée à une hauteur d'au moins 600 mm au-dessus du niveau du sol.

(19) Unsafe water shall not be stored adjacent to a finished water compartment when only a single wall separates the two.

(19) L'eau de mauvaise qualité ne doit pas être stockée dans un compartiment voisin d'un compartiment d'eau finie lorsqu'une seule paroi sépare les deux compartiments.

(20) Reservoirs should be drainable to the ground surface in such a manner as to preclude contamination by surface water and access by animals. There shall be no direct connection to a sewer or storm. Alternatively, a reservoir should be drained by pumping from a sump at a lower level than the bottom. A manhole should be located directly above the sump, to permit servicing of the pump intake and to allow dewatering with a portable pump.

(20) Le contenu des réservoirs devraient être évacué à la surface du sol sans qu'il y ait risque d'intrusion d'animaux ou risque de contamination par des eaux de surface. Les réservoirs ne sont pas directement raccordés à un égout sanitaire ou pluvial. À défaut, ils devraient être vidés au moyen d'une pompe installée dans un puisard situé à un niveau inférieur à celui du fond du réservoir. Le puisard devrait être muni d'un trou d'homme pour permettre l'entretien de la prise et l'assèchement du puissard au moyen d'une pompe portative.

(21) Interior surfaces of all steel reservoirs shall be protected by paints or other protective coatings or cathodic protection according to practices recommended by the American Water Works Association or the Canadian Standards Association.

(21) Les parois intérieures des réservoirs en acier sont protégées par une peinture ou d'autres revêtements de protection ou encore une protection cathodique en conformité avec les pratiques recommandées par l'American Water Works Association ou l'Association canadienne de normalisation.

(22) There should be periodical disinfection in order to ensure a continued source of finished water.

(22) Afin que l'alimentation en eau finie soit continue, les réservoirs devraient être désinfectés périodiquement.

Water Mains

Conduites d'eau principales

20. (1) Pipes and pipe packing and jointing materials shall have been manufactured in conformity with the latest standard specifications issued by the American Water Works Association or the Canadian Standards Association. Plastic pipe shall be approved by and bear the seal of the Canadian Standards Association. Selection of the pipe material and design shall be made after giving consideration to the possible deleterious action of the soils and water which will be surrounding the pipe, the water to be distributed and possible electrolytic action on the metal parts.

20. (1) Les tuyaux ainsi que les matériaux de jointement et d'obturation utilisés doivent être fabriqués en conformité avec les normes récentes prescrites par l'American Water Works Association ou l'Association canadienne de normalisation. Les tuyaux en plastique sont approuvés par l'Association canadienne de normalisation et en portent l'étiquette. La conception et les matériaux de fabrication des tuyaux sont choisis en tenant compte de l'effet possiblement nuisible du sol et de l'eau qui entoureront le tuyau, de l'eau qui est distribuée et de la possibilité d'une réaction électrolytique avec les pièces métalliques.

(2) Steps should be taken to prevent freezing, which could damage the mains.

(2) Les conduites d'eau principales devraient être protégées contre le gel.

(3) The minimum working pressure during the flow in outlying parts of the distribution system should be 140 kPa.

(3) La pression de service minimale dans les parties périphériques du réseau de distribution devrait être de 140 kPa.

(4) If water hydrants are installed, the

(4) Si le réseau de distribution comporte des

supply of water shall be adequate to provide water for the fire pumps and regular use, and at the same time maintain adequate positive pressure in all parts of the system.

(5) The dead-end of a main should have a fire hydrant or blow-off connected for flushing purposes. No flushing device shall be connected directly to any sewer.

(6) Water mains shall be laid a minimum of 3 m from sewers which run in the same direction. Where it is clearly very difficult to comply with this regulation, then

(a) the bottom of the water main shall be at least 450 mm higher than the top of the sewer, and

(b) the water main shall rest on undisturbed soil.

(7) When a water main must cross a sewer, the bottom of the water main shall be laid at least 450 mm above the top of the sewer. The vertical separation shall be maintained for that portion of the water main located within 3 m of the sewer, the 3 m to be measured as the normal distance from the water main to the sewer.

(8) When it is impossible to achieve the condition as stated in subsections (6) and (7) then both the water main and the sewer shall be constructed of Class 150 pressure-type pipes. There shall be adequate support on each side of the crossing for both pipes so that there will be no stresses in either pipe caused by one pipe settling on the other. Pipe sections shall be centred at the crossing so that there is a maximum distance from the crossing to all joints. Both pipes shall be pressure tested to assure that there are no leaks.

(9) Where water and sewer pipes are contained in a utilidor, there shall be adequate provision for drainage in order to prevent

prises d'eau, la réserve d'eau est suffisante pour répondre à la demande régulière et à une demande ponctuelle en eau d'incendie, et pour maintenir une pression positive adéquate dans toutes les parties du réseau.

(5) L'impasse d'une conduite principale devrait être raccordée à un poteau d'incendie ou à un robinet d'évacuation aux fins de rinçage. Aucun dispositif de rinçage n'est raccordé directement à un égout.

(6) Les conduites d'eau principales sont installées à une distance d'au moins 3 m de toute canalisation d'égout parrallèle. S'il est trop difficile de se conformer à cette règle, les règles suivantes s'appliquent :

a) la partie inférieure d'une conduite d'eau principale doit se situer à au moins 450 mm de la partie supérieure d'une canalisation d'égout située au-dessous;

b) la conduite d'eau principale repose sur un sol non remanié.

(7) Lorsqu'une conduite d'eau principale croise une canalisation d'égout, la partie inférieure de la conduite d'eau doit se situer à au moins 450 mm de la partie supérieure de la canalisation d'égout qui se situe au-dessous. Cette distance s'applique pour toute partie de la conduite d'eau comprise dans un rayon de 3 m de la canalisation d'égout, cette distance de 3 m étant la distance normale entre la conduite d'eau et la canalisation d'égout.

(8) S'il est impossible de respecter les dispositions des paragraphes (6) et (7), alors la conduite d'eau principale et la canalisation d'égout sont fabriquées de tuyaux sous pression de catégorie 150. Chacune des deux canalisations est soutenue de part et d'autre du croisement afin qu'aucune des deux n'exerce une pression sur l'autre. Les sections des tuyaux sont centrées de manière à ce que les joints de chacune des canalisations se situent à égale distance de part et d'autre du point d'intersection entre les deux canalisations. L'étanchéité des canalisations est vérifiée au moyen d'un essai sous pression.

(9) Lorsque des canalisations d'eau et d'égout sont acheminées dans le coffrage d'un réseau de distribution aérien, des dispositions

contamination of the water supply during repairs and breakdowns.

sont prises pour l'évacuation du coffrage afin d'éviter les risques de contamination des réserves d'eau lors d'un bris ou d'une réparation.

(10) Water mains which run below the surface of a stream or other surface water body shall be of special construction with flexible watertight joints. Valves shall be provided at both ends of the water crossing so that the section can be isolated for test or repair. The valves shall be easily accessible and not subject to flooding. Taps shall be made for testing and locating leaks.

(10) Les conduites d'eau principales qui passent sous un ruisseau ou tout cours d'eau de surface sont de construction particulière et munies de joints flexibles et étanches. Des robinets sont installés aux deux extrémités du tronçon qui se retrouve sous le cours d'eau afin qu'il soit possible d'isoler ce dernier aux fins d'essai ou de réparation. Les robinets sont faciles d'accès et ne sont pas susceptibles d'être submergés. Des prises d'essai sont prévues pour la détection des fuites.

(11) Water mains which cross under railways shall conform to the standards and requirements of those regulations established by the National Transportation Agency cited as *Pipe Crossings Under Railways Regulations*.

(11) Les conduites d'eau principales qui passent sous un chemin de fer sont conformes aux normes et exigences du *Règlement sur le passage de conduits sous les chemins de fer* de l'Office nationale des transports.

(12) Drains from hydrant barrels shall not be connected to sanitary sewers or storm drains. Where practicable hydrant barrels should be drained to the ground surface, or to dry wells provided exclusively for that purpose and a means provided for pumping out.

(12) Les tuyaux d'écoulement des poteaux d'incendie ne sont pas raccordés directement à un égout sanitaire ou à un collecteur d'eaux pluviales. Si possible, les poteaux d'incendie devraient être évacués à la surface du sol ou dans un puits sec prévu à cette seule fin muni d'un dispositif de pompage.

(13) There shall be no physical connections between the distribution system and any pipes, pumps or tanks which are connected to a sewer system or storm drain or are supplied from any source that is not approved.

(13) Les conduites, les pompes et les réservoirs raccordés à un réseau d'égouts ou à un collecteur d'eaux pluviales ou alimentés à partir d'une source non approuvée ne sont raccordés d'aucune manière au réseau de distribution.

Water Haulage Tanks

Citernes de transport d'eau

21. (1) Water haulage tanks should be constructed so as to exclude birds, animals, insects and dust.

21. (1) Les citernes de transport d'eau sont construites de manière à empêcher l'introduction des oiseaux, des animaux, des insectes et de la poussière.

(2) There shall be a manhole cover on a tank, conveniently located for entering for purposes of cleaning the interior. The opening shall be made so that there is a water-tight raised lip around the edge, a minimum of 50 mm high. It shall be fitted with a water-tight cover.

(2) Les citernes sont munies d'un trou d'homme avec couvercle étanche, placé de manière à faciliter l'accès à l'intérieur aux fins de nettoyage. L'étanchéité est assurée par un collet d'au moins 50 mm de hauteur sur le contour du trou d'homme.

(3) There shall be a drain opening in the bottom of a tank so that the tank may be drained completely and flushed easily.

(3) Un trou d'évacuation est pratiqué au fond des citernes afin qu'elles puissent être vidées complètement et rincées facilement.

(4) Each tank shall be provided with convenient clean storage space for the hoses, and

(4) Chaque citerne comporte un espace de rangement pour tuyaux souples qui est propre et

the ends of the hoses shall be protected from contamination.

convenable. Les extrémités des tuyaux souples qui y sont rangées sont protégées contre toute contamination.

Disinfection of New or Repaired Works

Désinfection des ouvrages neufs ou remis en état

22. (1) Before disinfection is attempted, all surfaces should be thoroughly cleaned. Pipelines should be flushed with potable water until turbidity-free water is obtained at all ends. Reservoirs should be flushed with water and brushed if necessary to obtain clean surfaces.

22. (1) La désinfection devrait être précédée d'un nettoyage à fond de toutes les surfaces des ouvrages visés. Les canalisations devraient être rincées avec de l'eau potable jusqu'à ce que de l'eau parfaitement limpide en ressorte aux extrémités. Les réservoirs devraient être rincés avec de l'eau et leurs surfaces brossées au besoin.

(2) New, repaired or altered waterworks and pipelines shall be disinfected according to the American Water Works Association Standards, or as follows:

(a) all surfaces should be in contact with chlorine solution with a final strength of 10 or 50 mg/l of available chlorine after a contact period of 24 or two hours respectively. The higher value may be tested using chlorine testing papers;

(b) if it is necessary to conserve water and chemical, reservoirs may be disinfected by spraying all surfaces with a chlorine solution having a starting strength of 250 mg/l available chlorine. Special protective clothing and self contained or air-supplied type respirators should be used by personnel performing the spray procedure; or

(c) when surface conditions are not ideal, such as may be encountered in used works, special disinfection procedures will be required. This could include the maintenance of a chlorine residual for an extended period of time.

(2) Les canalisations et autres ouvrages d'adduction et de distribution d'eau, nouveaux, modifiés, ou remis en état, sont désinfectés en conformité avec les normes de l'American Water Works Association ou les exigences suivantes :

a) toutes les surfaces devraient être mises en contact avec une solution de chlore présentant une concentration finale de chlore actif de 10 ou 50 mg/l pour une période de 24 ou de 2 heures, respectivement. La valeur la plus élevée peut être vérifiée au moyen d'un papier détecteur de chlore;

b) s'il est nécessaire d'économiser l'eau et les produits chimiques, les réservoirs peuvent être désinfectés en pulvérisant sur toutes ses surfaces une solution de chlore présentant une concentration initiale de chlore actif de 250 mg/l. Le personnel responsable de ces travaux devrait porter des vêtements de protection particuliers ainsi que des respirateurs à adduction d'air ou à alimentation en air autonome;

c) lorsque l'état des surfaces n'est pas idéal, comme dans le cas des ouvrages usagés, des méthodes de désinfection particulières sont nécessaires. Ainsi, il pourrait être nécessaire de maintenir, pour une période prolongée, un résidu de chlore dans l'eau.

Records

Registres

23. (1) Accurate records shall be maintained of raw water quality, finished water quality and amounts of chemicals used.

23. (1) Les données concernant la qualité de l'eau brute, la qualité de l'eau finie et les quantités de produits chimiques utilisés sont consignées de façon précise dans des registres.

(2) As-built construction plans shall be maintained and shall be amended to include additions, extensions and renovations.

(2) Les ajouts, prolongements et rénovations sont indiqués au fur et à mesure sur les dessins d'exécution des installations en place.

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Drinking Water and Health Basics

Frequently Asked Questions

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Priority Rulemakings

QUICK LINKS

Priority Rulemakings

Regulatory Infrastructure

Additional Information

Adobe Acrobat Reader is required to view PDF documents. The most recent version of the Adobe Acrobat Reader EXIT disclaimer is available as a free download. An Adobe Acrobat plug-in for assisted technologies is also available.

- Arsenic
  The Safe Drinking Water Act requires EPA to revise the existing 50 parts per billion (ppb) standard for arsenic in drinking water. EPA is implementing a 10 ppb standard for arsenic.
- Ground Water Rule
  EPA is proposing a rule which specified the appropriate use of disinfection in ground water and addresses other components of ground water systems to assure public health protection.
- Lead and Copper
  EPA estimates that approximately 20 percent of human exposure to lead is attributable to lead in drinking water.
- Microbials & Disinfection Byproducts
  A major challenge for water suppliers is how to balance the risks from microbial pathogens and disinfection byproducts. This paragraph includes development of the Long Term 2 Enhanced Surface Water Treatment Rule and Stage 2 Disinfectants and Disinfection Byproducts Rule.
- MTBE
  MTBE (methyl-t-butyl ether) is a member of a group of chemicals commonly known as fuel oxygenates. MTBE replaces the use of lead as an octane enhancer since 1979.
- Radionuclides
  EPA has updated its standards for radionuclides in drinking water.
- Radon
  Radon is a naturally-occurring radioactive gas that may cause cancer, and may be found in drinking water and indoor air.
- Unregulated Contaminant Monitoring Rule
  EPA uses data generated by the UCMR to evaluate and prioritize contaminants on the Drinking Water Contaminant Candidate List, a list of contaminants EPA is considering for possible new drinking water standards.

Regulatory Infrastructure

- Analytical Methods for Drinking Water
  An analytical method is a procedure used to analyze a sample in order to determine the identity and concentration of a specific sample component. Many government agencies, universities and consensus methods organizations develop analytical methods.
- Laboratory Certification
  Laboratories analyzing drinking water compliance samples must be

certified by U.S. EPA or the State. They must analyze performance evaluation samples, use approved methods and States also require periodic on-site audits.

- National Contaminant Occurrence Database
  The NCOD was developed to satisfy statutory requirements set by Congress in the 1996 Safe Drinking Water Act amendments. The purpose of the database is to support EPA's decisions related to identifying contaminants for regulation and subsequent regulation development.
- Occurrence and Contaminant Selection
  EPA is required to establish a list of contaminants to aid in priority-setting for the Agency's drinking water program. EPA has divided contaminants among those which are priorities for additional research, those which need additional occurrence data, and those which are priorities for consideration in rulemaking.
- Six Year Review of Standards
  EPA is required to review each national primary drinking water regulation promulgated by the Agency at least every six years.
- Treatment Technology
  The mission of the treatment technology team is to identify and/or develop high quality, cost-effective treatment technologies to meet regulation development and program implementation objectives and deadlines.

Additional Information

- Research
  Links to the National Center for Environmental Assessment (NCEA) home page.
- Current Standards (MCLs)
  EPA sets standards that, when combined with protecting ground water and surface water, are critical to ensuring safe drinking water. EPA works with its regional offices, states, tribes and its many partners to protect public health through implementing the Safe Drinking Water Act.
- Drinking Water and Health
  The U.S. has one of the safest water supplies in the world. Now you have a way to find information about your drinking water if it comes from a public water supplier.
- Meeting Summaries
  Read summaries of public meetings related to Safe Drinking Water Act implementation.
- Partnership for Safe Water
  The Partnership for Safe Water is a unique cooperative effort between EPA and its stakeholders. The Partnership encourages and assists U.S. water suppliers to voluntarily enhance their water systems' performance.
- Perchlorate
  EPA has released for public review and comment its revised draft toxicity assessment on perchlorate, which is the primary ingredient of solid rocket propellant.
- Sulfate
  Sulfate is a substance that occurs naturally in drinking water. Health concerns regarding sulfate in drinking water have been raised because of reports that diarrhea may be associated with the ingestion of water containing high levels of sulfate.

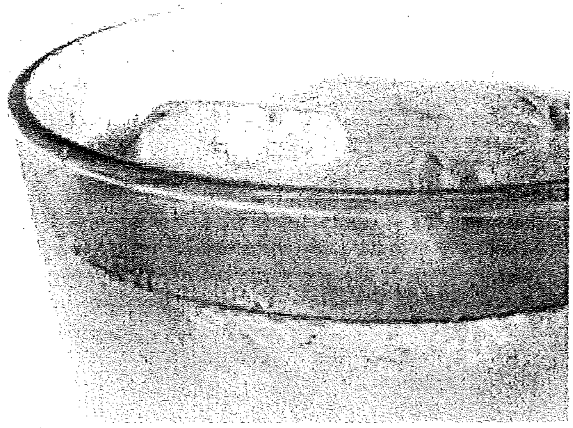
Last updated on Thursday, July 8th, 2004
URL: http://www.epa.gov/safewater/standards.html

Last updated on Thursday, July 8th, 2004
URL: http://www.epa.gov/safewater/standards.html

List of Drinking Water Contaminants & MCLs

National Primary Drinking Water Regulations

National Primary Drinking Water Regulations (NPDWRs or primary standards) are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. Vist the list of regulated contaminants with links for more details.



- **List of Contaminants & their Maximum Contaminant Level (MCLs)**
- Setting Standards for Safe Drinking Water to learn about EPA's standard-setting process
- EPA's Regulated Contaminant Timeline (PDF File)
- National Primary Drinking Water Regulations EXIT disclaimer - The complete regulations regarding these contaminants availible from the Code of Federal Regulations Website

National Secondary Drinking Water Regulations

National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

- **List of National Secondary Drinking Water Regulations**
- National Secondary Drinking Water Regulations EXIT disclaimer - The complete regulations regarding these contaminants availible from the Code of Federal Regulations Website.

Unregulated Contaminants

This list of contaminants which, at the time of publication, are not subject to any proposed or promulgated national primary drinking water regulation (NPDWR), are known or anticipated to occur in public water systems, and may require regulations under SDWA. For more information

check out the list, or vist the Drinking Water Contaminant Candidate List (CCL) website.

- **List of Unregulated Contaminants**
- Drinking Water Contaminant Candidate List (CCL) Website
- Unregulated Contaminant Monitoring Rule (UCMR)

List of Contaminants & their MCLs

EPA 816-F-02-013
July 2002

Microorganisms | Disinfectants | Disinfection Byproducts | Inorganic Chemicals | Organic Chemicals | Radionuclides

- The links provided below are to either Consumer Fact Sheet, Rule Implementation websites, or PDF files
- Alaphabetical Version of this chart in PDF format (EPA 816-F-03-016 June 2003 - 396 K PDF FILE)

Microorganisms

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Cryptosporidium	zero	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and fecal animal waste
Giardia lamblia	zero	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste
Heterotrophic plate count	n/a	TT[3]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment
Legionella	zero	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems
Total Coliforms (including fecal coliform and *E. Coli*)	zero	5.0%[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment; as well as feces; fecal coliforms and *E. coli* only come from human and animal fecal waste.
Turbidity	n/a	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are	Soil runoff

			present). Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	
Viruses (enteric)	zero	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste

Disinfection Byproducts

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Bromate	zero	0.010	Increased risk of cancer	Byproduct of drinking water disinfection
Chlorite	0.8	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection
Haloacetic acids (HAA5)	n/a[6]	0.060	Increased risk of cancer	Byproduct of drinking water disinfection
Total Trihalomethanes (TTHMs)	none[7] ---------- n/a[6]	0.10 ---------- 0.080	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection

Disinfectants

Contaminant	MRDLG[1] (mg/L)[2]	MRDL[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Chloramines (as Cl_2)	MRDLG=4[1]	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes
Chlorine (as Cl_2)	MRDLG=4[1]	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes
Chlorine dioxide (as ClO_2)	MRDLG=0.8[1]	MRDL=0.8[1]	Anemia; infants & young children: nervous system effects	Water additive used to control microbes

Inorganic Chemicals

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water

Antimony	0.006	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
Arsenic	0[7]	0.010 as of 01/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass & electronicsproduction wastes
Asbestos (fiber >10 micrometers)	7 million fibers per liter	7 MFL	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits
Barium	2	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Beryllium	0.004	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries
Cadmium	0.005	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints
Chromium (total)	0.1	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits
Copper	1.3	TT[8]; Action Level=1.3	Short term exposure: Gastrointestinal distress Long term exposure: Liver or kidney damage People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits
Cyanide (as free cyanide)	0.2	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories
Fluoride	4.0	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge

				from fertilizer and aluminum factories
Lead	zero	TT[8]; Action Level=0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits
Mercury (inorganic)	0.002	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands
Nitrate (measured as Nitrogen)	10	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Nitrite (measured as Nitrogen)	1	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Selenium	0.05	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines
Thallium	0.0005	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories

Organic Chemicals

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Acrylamide	zero	TT[9]	Nervous system or	Added to water during

			blood problems; increased risk of cancer	sewage/wastewater treatment
Alachlor	zero	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops
Atrazine	0.003	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops
Benzene	zero	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills
Benzo(a)pyrene (PAHs)	zero	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines
Carbofuran	0.04	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa
Carbon tetrachloride	zero	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities
Chlordane	zero	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide
Chlorobenzene	0.1	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories
2,4-D	0.07	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops
Dalapon	0.2	0.2	Minor kidney changes	Runoff from herbicide used on rights of way
1,2-Dibromo-3-chloropropane (DBCP)	zero	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards

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o-Dichlorobenzene	0.6	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories
p-Dichlorobenzene	0.075	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories
1,2-Dichloroethane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
1,1-Dichloroethylene	0.007	0.007	Liver problems	Discharge from industrial chemical factories
cis-1,2-Dichloroethylene	0.07	0.07	Liver problems	Discharge from industrial chemical factories
trans-1,2-Dichloroethylene	0.1	0.1	Liver problems	Discharge from industrial chemical factories
Dichloromethane	zero	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories
1,2-Dichloropropane	zero	0.005	Increased risk of cancer	Discharge from industrial chemical factories
Di(2-ethylhexyl) adipate	0.4	0.4	Weight loss, liver problems, or possible reproductive difficulties.	Discharge from chemical factories
Di(2-ethylhexyl) phthalate	zero	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories
Dinoseb	0.007	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables
Dioxin (2,3,7,8-TCDD)	zero	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories
Diquat	0.02	0.02	Cataracts	Runoff from herbicide use
Endothall	0.1	0.1	Stomach and intestinal problems	Runoff from herbicide use
Endrin	0.002	0.002	Liver problems	Residue of banned

				insecticide
Epichlorohydrin	zero	TT[9]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals
Ethylbenzene	0.7	0.7	Liver or kidneys problems	Discharge from petroleum refineries
Ethylene dibromide	zero	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries
Glyphosate	0.7	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use
Heptachlor	zero	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide
Heptachlor epoxide	zero	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor
Hexachlorobenzene	zero	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories
Hexachlorocyclopentadiene	0.05	0.05	Kidney or stomach problems	Discharge from chemical factories
Lindane	0.0002	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens
Methoxychlor	0.04	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock
Oxamyl (Vydate)	0.2	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes
Polychlorinated biphenyls (PCBs)	zero	0.0005	Skin changes; thymus gland problems; immune deficiencies;	Runoff from landfills; discharge of waste chemicals

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			reproductive or nervous system difficulties; increased risk of cancer	
Pentachlorophenol	zero	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories
Picloram	0.5	0.5	Liver problems	Herbicide runoff
Simazine	0.004	0.004	Problems with blood	Herbicide runoff
Styrene	0.1	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills
Tetrachloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners
Toluene	1	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories
Toxaphene	zero	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle
2,4,5-TP (Silvex)	0.05	0.05	Liver problems	Residue of banned herbicide
1,2,4-Trichlorobenzene	0.07	0.07	Changes in adrenal glands	Discharge from textile finishing factories
1,1,1-Trichloroethane	0.20	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories
1,1,2-Trichloroethane	0.003	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories
Trichloroethylene	zero	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories
Vinyl chloride	zero	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories
Xylenes (total)	10	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories

Radionuclides

Contaminant	MCLG[1] (mg/L)[2]	MCL or TT[1] (mg/L)[2]	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
Alpha particles	none[7] ---------- zero	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation
Beta particles and photon emitters	none[7] ---------- zero	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation
Radium 226 and Radium 228 (combined)	none[7] ---------- zero	5 pCi/L	Increased risk of cancer	Erosion of natural deposits
Uranium	zero	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits

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Notes

[1] Definitions:
Maximum Contaminant Level (MCL) - The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
Maximum Contaminant Level Goal (MCLG) - The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
Maximum Residual Disinfectant Level (MRDL) - The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
Maximum Residual Disinfectant Level Goal (MRDLG) - The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
Treatment Technique - A required process intended to reduce the level of a contaminant in drinking water.

[2] Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million.

[3] EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- Cryptosporidium (as of1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99% removal.
- *Giardia lamblia:* 99.9% removal/inactivation
- Viruses: 99.99% removal/inactivation
- *Legionella:* No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter.
- Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, Cryptosporidium removal requirements, updated watershed control requirements for unfiltered systems).
- Filter Backwash Recycling; The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

[4] more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli* if two consecutive TC-positive samples, and one is also positive for *E.coli* fecal coliforms, system has an acute MCL violation.

[5] Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

[6] Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L). Chloroform is regulated with this group but has no MCLG.
- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L). Monochloroacetic acid, bromoacetic acid, and dibromoacetic acid are regulated with this group but have no MCLGs.

[7] MCLGs were not established before the 1986 Amendments to the Safe Drinking Water Act. Therefore, there is no MCLG for this contaminant.

[8] Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

[9] Each water system must certify, in writing, to the state (using third-party or manufacturer's certification) that when acrylamide and epichlorohydrin are used in drinking water systems, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows:

- Acrylamide = 0.05% dosed at 1 mg/L (or equivalent)
- Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent)

National Secondary Drinking Water Regulations

National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

- For more information, read Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals.

Contaminant	Secondary Standard
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

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Stage 1 Disinfectants and Disinfection Byproducts Rule

EPA 815-F-98-010
December 1998

- **Read the Federal Register Notice About the Rule (HTML)**

In the past 25 years, the Safe Drinking Water Act (SDWA) has been highly effective in protecting public health and has also evolved to respond to new and emerging threats to safe drinking water. Disinfection of drinking water is one of the major public health advances in the 20th century. One hundred years ago, typhoid and cholera epidemics were common through American cities; disinfection was a major factor in reducing these epidemics.

However, the disinfectants themselves can react with naturally-occurring materials in the water to form unintended byproducts which may pose health risks. In addition, in the past ten years, we have learned that there are specific microbial pathogens, such as *Cryptosporidium*, which can cause illness and is resistant to traditional disinfection practices.

Amendments to the SDWA in 1996 require EPA to develop rules to balance the risks between microbial pathogens and disinfection byproducts (DBPs). It is important to strengthen protection against microbial contaminants, especially *Cryptosporidium*, and at the same time, reduce potential health risks of DBPs. The Stage 1 Disinfectants and Disinfection Byproducts Rule and Interim Enhanced Surface Water Treatment Rule, announced in December 1998, are the first of a set of rules under the 1996 SDWA Amendments. This fact sheet focuses on the Stage 1 Disinfectants and Disinfection Byproducts Rule. A separate fact sheet focuses on the Interim Enhanced Surface Water Treatment Rule (EPA 815-F-98-009).

PUBLIC HEALTH CONCERNS

While disinfectants are effective in controlling many microorganisms, they react with natural organic and inorganic matter in source water and distribution systems to form DBPs. Results from toxicology studies have shown several DBPs (e.g., bromodichloromethane, bromoform, chloroform, dichloroacetic acid, and bromate) to be carcinogenic in laboratory animals. Other DBPs (e.g., chlorite, bromodichloromethane, and certain haloacetic acids) have also been shown to cause adverse reproductive or developmental effects in laboratory animals. Several epidemiology studies have suggested a weak association between certain cancers (e.g., bladder) or reproductive and developmental effects, and exposure to chlorinated surface water. More than 200 million people consume water that has been disinfected. Because of the large population exposed, health risks associated with DBPs, even if small, need to be taken seriously.

WHO MUST COMPLY WITH THE RULE?

The Stage 1 Disinfectants and Disinfection Byproducts Rule applies to all community and nontransient noncommunity water systems that treat their water with a chemical disinfectant for either primary or residual treatment.

WHAT DOES THE RULE REQUIRE?

The Stage 1 Disinfectant and Disinfection Byproduct Rule updates and supersedes the 1979 regulations for total trihalomethanes. In addition, it will reduce exposure to three disinfectants and many disinfection byproducts.

The rule establishes maximum residual disinfectant level goals (MRDLGs) and maximum residual disinfectant levels (MRDLs) for three chemical disinfectants - chlorine, chloramine and chlorine dioxide (see Table 1). It also establishes maximum contaminant level goals (MCLGs) and maximum contaminant levels (MCLs) for total trihalomethanes, haloacetic acids, chlorite and bromate (see Table 1).

Table 1

MRDLGs, MRDLs, MCLGs and MCLs for Stage 1 Disinfectants and Disinfection Byproducts Rule

DISINFECTANT RESIDUAL	MRDLG (mg/L)	MRDL (mg/L)	COMPLIANCE BASED ON
Chlorine	4 (as Cl_2)	4.0 (as Cl_2)	Annual Average
Chloramine	4 (as Cl_2)	4.0 (as Cl_2)	Annual Average
Chlorine Dioxide	0.8 (as ClO_2)	0.8 (as ClO_2)	Daily Samples
DISINFECTION BYPRODUCTS	**MCLG (mg/L)**	**MCL (mg/L)**	**COMPLIANCE BASED ON**
Total trihalomethanes (TTHM)[1]	N/A	0.080	Annual Average
- Chloroform	***		
- Bromodichloromethane	0		
- Dibromochloromethane	0.06		
- Bromoform	0		
Haloacetic acids (five) (HAA5)[2]	N/A	0.060	Annual Average
- Dichloroacetic acid	0		
- Trichloroacetic acid	0.3		
Chlorite	0.8	1.0	Monthly Average
Bromate	0	0.010	Annual Average

N/A - Not applicable because there are individual MCLGs for TTHMs or HAAs

1-Total trihalomethanes is the sum of the concentrations of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

2-Haloacetic acids (five) is the sum of the concentrations of mono-, di-, and trichloroacetic acids and mono- and dibromoacetic acids.

*** EPA removed the zero MCLG for chloroform from its National Primary Drinking Water Regulations, effective May 30, 2000, in accordance with an order of the U.S. Court of Appeals for the District of Columbia Circuit.

Water systems that use surface water or ground water under the direct influence of surface water and use conventional filtration treatment are required to remove specified percentages of organic materials, measured as total organic carbon (TOC), that may react with disinfectants to form DBPs (See Table 2). Removal will be achieved through a treatment technique (enhanced coagulation or enhanced softening) unless a system meets alternative criteria.

Table 2

Required Removal of Total Organic Carbon by Enhanced Coagulation and Enhanced Softening for Subpart H Systems Using Conventional Treatment[1]

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0-60	>60-120	>120[2]
>2.0-4.0	35.0%	25.0%	15.0%
>4.0-8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

[1]Systems meeting at least one of the alternative compliance criteria in the rule are not required to meet the removals in this table.

[2]Systems practicing softening must meet the TOC removal requirements in the last column to the right.

WHAT ARE THE COMPLIANCE DEADLINES?

Large surface water systems are required to comply with the Stage 1 Disinfectants and Disinfection Byproducts Rule and Interim Enhanced Surface Water Treatment Rule by January 2002. Ground water systems and small surface water systems must comply with the Stage 1 Disinfectants and Disinfection Byproducts Rule by January 2004.

WHAT ARE THE COSTS AND BENEFITS OF THE RULE?

EPA estimates that implementation of the Stage 1 Disinfectants and Disinfection Byproducts Rule will result in:

· As many as 140 million people receiving increased protection from DBPs.

· 24 percent national average reduction in TTHM levels.

· Reduction in exposure to the major DBPs from use of ozone (bromate) and chlorine dioxide (chlorite).

The total annual cost of the rule is about $700 million. EPA believes that the benefits exceed the costs of the Stage 1 Disinfectants and Disinfection Byproducts Rule. An estimated 116 million households are affected by the Stage 1 Disinfectants and Disinfection Byproducts Rule. EPA estimates that 95 percent of the households will incur additional costs of less than $1 per month on their water bills. An additional four percent will pay between $1 and $10 per month more, and one percent are expected to incur increased water bills of $10 to $33 per month, if they choose to install treatment. However, many of these systems may chose less costly non-treatment options, such as consolidation. The majority of households incurring the highest costs are small systems serving less than 10,000 people that have never been regulated for DBPs.

WHAT TECHNICAL INFORMATION WILL BE AVAILABLE ON THE RULE?

A series of guidance manuals supports the Interim Enhanced Surface Water Treatment Rule and the Stage 1 Disinfectants/Disinfection Byproducts Rule. The manuals aid EPA, State agencies and affected public water systems in implementing the two interrelated rules, and will help to ensure that implementation among these groups is consistent. These manuals are available on the Internet at http://www.epa.gov/safewater/mdbp/implement.html and may be ordered from the Safe Drinking Water Hotline, 1 (800) 426-4791.

Drinking Water Priority Rulemaking: Microbial and Disinfection Byproduct Rules

Existing Rules
Interim Trihalomethanes Rule ~ Total Coliform Rule
Surface Water Treatment Rule ~ Information Collection Rule
Interim Enhanced Surface Water Treatment Rule
Stage 1 Disinfectants & Disinfection Byproducts Rule
Filter Backwash Recycling Rule
Long Term 1 Enhanced Surface Water Treatment Rule

Future Rules
Ground Water Rule
Long Term 2 Enhanced Surface Water Treatment Rule/Stage 2 Disinfectants & Disinfection Byproducts Rule

Guidance & implementation documents for these rules

Disinfection of drinking water is one of the major public health advances in the 20th century. One hundred years ago, typhoid and cholera epidemics were common throughout American cities. Disinfection was a major factor in reducing these epidemics, and it is an essential part of drinking water treatment today. However, the disinfectants themselves can react with naturally-occurring materials in the water to form unintended organic and inorganic byproducts which may pose health risks.

Over the past ten years, we have also learned that there are specific microbial pathogens, such as *Cryptosporidium*, that are highly resistant to traditional disinfection practices. In 1993, *Cryptosporidium* caused 400,000 people in Milwaukee to experience intestinal illness. More than 4,000 were hospitalized, and at least 50 deaths have been attributed to the disease. There have also been cryptosporidiosis outbreaks in Nevada, Oregon, and Georgia over the past several years.

A major challenge for water suppliers is how to balance the risks from microbial pathogens and disinfection byproducts. It is important to provide protection from these microbial pathogens while simultaneously ensuring decreasing health risks to the population from disinfection byproducts (DBPs). The 1996 Safe Drinking Water Act (SDWA) Amendments require EPA to develop rules to achieve these goals.

Schedule of M-DBP Rules

November 1998 -- Final Rule	Interim Enhanced Surface Water Treatment Rule & Stage 1 Disinfection Byproduct Rule
Early 2001 -- Final Rule	Filter Backwash Recycling Rule
Early 2001 -- Final Rule	Long Term 1 Enhanced Surface Water Treatment Rule
Summer 2003 -- Proposed Rule	Stage 2 Disinfection Byproduct Rule & Long Term 2 Enhanced Surface Water Treatment Rule
December 2003 -- Final Rule	Ground Water Rule

Public Health Concerns

Most Americans drink tap water that meets all existing health standards all the time. These new rules will further strengthen existing drinking water standards and thus increase protection for many water systems.

EPA's Science Advisory Board concluded in 1990 that exposure to microbial contaminants such as bacteria, viruses, and protozoa (e.g., *Giardia lamblia* and *Cryptosporidium*) was likely the greatest remaining health risk management challenge for drinking water suppliers. Acute health effects from exposure to microbial pathogens are documented and associated illness can range from mild to moderate cases lasting only a few days to more severe infections that can last several weeks and may result in death for those with weakened immune systems.

In addition, while disinfectants are effective in controlling many microorganisms, they react with natural organic and inorganic matter in source water and distribution systems to form potentially harmful DBPs. Many of these DBPs have been shown to cause cancer and reproductive and developmental effects in laboratory animals. More than 200 million people consume water that has been disinfected. Because of the large population exposed, health risks associated with DBPs, even if small, need to be taken seriously.

Existing Regulations

- Microbial Contaminants: The Surface Water Treatment Rule, promulgated in 1989, applies to all public water systems using surface water sources or ground water sources under the direct influence of surface water. It establishes maximum contaminant level goals (MCLGs) for viruses, bacteria and *Giardia lamblia*. It also includes treatment technique requirements for filtered and unfiltered systems that are specifically designed to protect against the adverse health effects of exposure to these microbial pathogens. The Total Coliform Rule, revised in 1989, applies to all PWSs and establishes a maximum contaminant level (MCL) for total coliforms.
- Disinfection Byproducts: In 1979, EPA set an interim MCL for total trihalomethanes of 0.10 mg/l as an annual average. This applies to any community water system serving at least 10,000 people that adds a disinfectant to the drinking water during any part of the treatment process.

Information Collection Rule

To support the M-DBP rulemaking process, the Information Collection Rule required large public water systems serving at least 100,000 people to monitor and collect data on microbial contaminants, disinfectants and disinfection byproducts for 18 months. The data provide EPA with information about disinfection byproducts, disease-causing microorganisms, including *Cryptosporidium*, and engineering data to control these contaminants. Drinking Water Microbial and Disinfection Byproduct Information collected for the ICR is available in EPA's Envirofacts Warehouse.

Interim Enhanced Surface Water Treatment Rule & Stage 1 Disinfectants and

Disinfection Byproducts Rule

EPA finalized the Interim Enhanced Surface Water Treatment Rule and Stage 1 Disinfectants and Disinfection Byproducts Rule in November 1998, as required by the 1996 Amendments to the Safe Drinking Water Act, Section 1412(b)(2)(C). The final rules resulted from formal regulatory negotiations with a wide range of stakeholders that took place in 1992-93 and 1997. On Jan 16, 2001, EPA published final revisions to the IESWTR and Stage 1DBPR (read online) ~ (PDF).

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Interim Enhanced Surface Water Treatment Rule

The Interim Enhanced Surface Water Treatment Rule applies to systems using surface water, or ground water under the direct influence of surface water, that serve 10,000 or more persons. The rule also includes provisions for states to conduct sanitary surveys for surface water systems regardless of system size. The rule builds upon the treatment technique requirements of the Surface Water Treatment Rule with the following key additions and modifications:

- Maximum contaminant level goal (MCLG) of zero for *Cryptosporidium*
- 2-log *Cryptosporidium* removal requirements for systems that filter
- Strengthened combined filter effluent turbidity performance standards
- Individual filter turbidity monitoring provisions
- Disinfection profiling and benchmarking provisions
- Systems using ground water under the direct influence of surface water now subject to the new rules dealing with *Crypdosporidium*
- Inclusion of *Cryptosporidium* in the watershed control requirements for unfiltered public water systems
- Requirements for covers on new finished water reservoirs
- Sanitary surveys, conducted by states, for all surface water systems regardless of size

The Interim Enhanced Surface Water Treatment Rule, with tightened turbidity performance criteria and required individual filter monitoring, is designed to optimize treatment reliability and to enhance physical removal efficiencies to minimize the *Cryptosporidium* levels in finished water. In addition, the rule includes disinfection benchmark provisions to assure continued levels of microbial protection while facilities take the necessary steps to comply with new DBP standards.

Stage 1 Disinfectants and Disinfection Byproducts Rule

The final Stage 1 Disinfectants and Disinfection Byproducts Rule applies to community water systems and non-transient non-community systems, including those serving fewer than 10,000 people, that add a disinfectant to the drinking water during any part of the treatment process.

The final Stage 1 Disinfectants and Disinfection Byproducts Rule includes the following key provisions:

- Maximum residual disinfectant level goals (MRDLGs) for chlorine (4 mg/L), chloramines (4 mg/L), and chlorine dioxide (0.8 mg/L);
- Maximum contaminant level goals (MCLGs) for four trihalomethanes (chloroform (zero), bromodichloromethane (zero), dibromochloromethane (0.06 mg/L), and bromoform (zero)), two haloacetic acids (dichloroacetic

acid (zero) and trichloroacetic acid (0.3 mg/L)), bromate (zero), and chlorite (0.8 mg/L); EPA subsequently removed the zero MCLG for chloroform from its National Primary Drinking Water Regulations, effective May 30, 2000, in accordance with an order of the U.S. Court of Appeals for the District of Columbia Circuit.

- MRDLs for three disinfectants (chlorine (4.0 mg/L), chloramines (4.0 mg/L), and chlorine dioxide (0.8 mg/L));
- **MCLs for total trihalomethanes** - a sum of the four listed above **(0.080 mg/L)**, haloacetic acids (HAA5) (0.060 mg/L)- a sum of the two listed above plus monochloroacetic acid and mono- and dibromoacetic acids), and two inorganic disinfection byproducts (chlorite (1.0 mg/L)) and bromate (0.010 mg/L)); and
- A treatment technique for removal of DBP precursor material.

The terms MRDLG and MRDL, which are not included in the SDWA, were created during the negotiations to distinguish disinfectants (because of their beneficial use) from contaminants. The final rule includes monitoring, reporting, and public notification requirements for these compounds. This final rule also describes the best available technology (BAT) upon which the MRDLs and MCLs are based.

Filter Backwash Recycling Rule

The Filter Backwash Recycling Rule (FBRR) requires public water systems (PWSs) to review their backwash water recycling practices to ensure that they do not compromise microbial control. Under the FBRR, recycled filter backwash water, sludge thickener supernatant, and liquids from dewatering processes must be returned to a location such that all processes of a system's conventional or direct filtration including coagulation, flocculation, sedimentation (conventional filtration only) and filtration, are employed. Systems may apply to the State for approval to recycle at an alternate location. The Filter Backwash Rule applies to all public water systems, regardless of size.

Long Term 1 Enhanced Surface Water Treatment Rule

While the Stage 1 Disinfectants and Disinfection Byproducts Rule rule applies to systems of all sizes, the Interim Enhanced Surface Water Treatment Rule only applies to systems serving 10,000 or more people. The Long Term 1 Enhanced Surface Water Treatment Rule, promulgated in January 2002, will strengthen microbial controls for small systems i.e., those systems serving fewer than 10,000 people. The rule will also prevent significant increase in microbial risk where small systems take steps to implement the Stage 1 Disinfectants and Disinfection Byproducts Rule.

EPA believes that the rule will generally track the approaches in the Interim Enhanced Surface Water Treatment Rule for improved turbidity control, including individual filter monitoring and reporting. The rule will also address disinfection profiling and benchmarking. The Agency is considering what modifications of some large system requirements may be appropriate for small systems.

Future M-DBP Rules

Ground Water Rule

EPA has proposed a Ground Water Rule that specifies the appropriate use of disinfection while addressing other components of ground water systems to ensure public health protection. There are more than 158,000 public ground water systems. Almost 89 million people are served by community ground water systems, and 20 million people are served by non-community ground water systems. Ninety-

nine percent (157,000) of ground water systems serve fewer than 10,000 people. However, systems serving more than 10,000 people serve 55% (more than 60 million) of all people who get their drinking water from public ground water systems. The Ground Water Rule will be promulgated summer 2001.

Long Term 2 Enhanced Surface Water Treatment Rule (LT2)

- LT2 Homepage

Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2)

- Stage 2 Homepage

More Information

- Surface Water Treatment Rules Training Materials
- Is tap water safe for those with weakened immune systems? Guidance from the EPA and Centers for Disease Control and Prevention on *Cryptosporidium*. (Also in Spanish)
- E. Coli in drinking water (fact sheet)
- Partnership for Safe Water: A unique cooperative effort that encourages and assists United States water suppliers to voluntarily enhance their water systems performance, for greater control of *Cryptosporidium*, *Giardia* and other microbial contaminants.
- Microbiology web site maintained by the Microbiological & Chemical Exposure Assessment Research Division of the National Exposure Research Laboratory
- EPA's Office of Research and Development: Research Plans and Strategies, including microbial pathogens and disinfection byproducts in drinking water
- Related Meeting Summaries
- Stage 1 Microbial/Disinfection Byproduct Federal Advisory Committee Agreement In Principle
- Health Effects Data Available on Disinfectants and Disinfection Byproducts: March 31, 1998 Notice of Data Availability
- Data Available on Microbials and Disinfection Byproducts: November 3, 1997 Notices of Data Availability

3rd Edition 2004

Water for Health

WHO's Guidelines for Drinking-Water Quality

World Health Organization

Water Quality and Human Health

The quality of drinking-water is a universal health concern. Water is essential for life, but it can and does transmit disease in countries in all continents – from the poorest to the wealthiest.

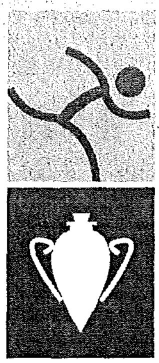
> ***Access to safe water is a fundamental human need and therefore a basic human right.***
>
> ***Kofi Annan, United Nations Secretary-General.***

Ensuring good quality water for the poor is an effective, health protective measure. Reductions of around a third of cases of diarrhoeal disease in children have been reported by projects that assisted poor households in treating water in the home and protecting against recontamination.

Although safe drinking-water is available daily to millions, especially in the industrialized countries, improvements are needed to prevent incidents such as the outbreak of cryptosporidiosis in Milwaukee (USA) which affected 400,000 people, and an *E. coli* O157 and *Campylobacter* outbreak in Walkerton (Canada) which infected more than 2,000 people and killed seven.

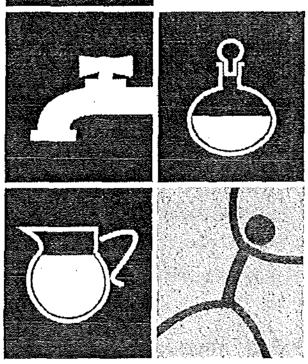
Chemicals in drinking-water also continue to feature in the headlines:

- Arsenic continues to be a major public health issue in Bangladesh and has become increasingly recognized in countries as diverse as the USA and Viet Nam.
- The presence of naturally-occurring fluoride in the groundwater in some of the least developed countries, which has largely been ignored, severely affects tens of millions of people with crippling effects.
- Toxic cyanobacteria in water have been headline news in California, USA, and are of increasing concern elsewere.
- Disaster relief workers, while trying to restore supplies of safe drinking-water, sometimes struggle with unclear guidance on the safety of emergency disinfectants.



WHO and Water

The World Health Organization (WHO) was set up in 1948 with the objective of promoting *'the attainment by all peoples of the highest possible level of health'*. WHO has a wide range of functions, which include promoting (in co-operation with other specialized agencies) the improvement of nutrition, housing, sanitation, recreation, economic or working conditions with a bearing on health, and other aspects of environmental hygiene.



One of the main roles of WHO is to establish international norms to protect human health. Since 1958, as part of its activities on drinking-water and health, the Organization has published – at around ten-year intervals – several editions of *International Standards for Drinking-Water* and, subsequently, *Guidelines for Drinking-Water Quality*.

Titles of WHO's Water-related Guidelines

- Guidelines for Drinking-water Quality
- Guidelines for Safe Use of Wastewater and Excreta in Agriculture and Aquaculture
- Guidelines for Safe Recreational Water Environments
  Vol. 1. Coastal and freshwater
  Vol. 2. Swimming pools and spas
- Guide to Ship Sanitation
- Guide to Sanitation on Aircraft

Guidelines, not Standards?

In 1982, WHO shifted its focus from 'International Standards' to 'Guidelines'. The main reason for not promoting international standards for drinking-water quality is the advantage provided by the use of a risk-benefit approach (quantitative or qualitative) to the establishment of national standards and regulations. The idea is that application of the *Guidelines* to different countries should take account of the sociocultural, environmental and economic circumstances particular to those countries.

When WHO changed its terminology from 'International Standards' to 'Guidelines', it did so in order to recognize the different roles of risk assessment and risk management. 'Risk assessment' reports on what is known about specific health risks, while 'risk management' describes the actions to control the risks.

Work on risk assessment is best informed by pooling information, for instance from many countries. In contrast, risk management involves applying this information to control local risks under local circumstances, although it may benefit from sharing experience in effective approaches.

The water quality priorities that promise most benefit to health vary from place to place. For instance, arsenic and fluoride are not a problem everywhere, but can be a major health issue where they occur.

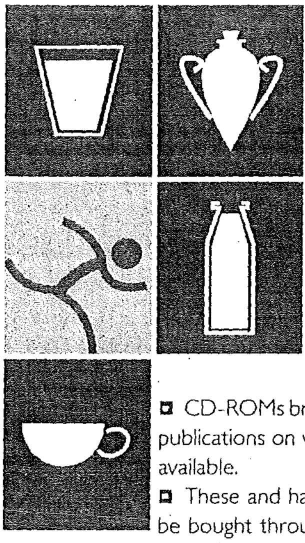
Who uses the Guidelines?

The *Guidelines* are addressed to water and health regulators, policy-makers, and their advisors, mainly to assist them in the development of national standards. The *Guidelines* are also used by many others as a source of information on water quality and health and on effective management approaches.

The *Guidelines for Drinking-Water Quality* are recognized as the UN system's position on drinking-water quality. The European Commission and Japan use the *Guidelines* as the 'scientific point of departure' for their drinking-water directive and drinking-water quality standards, respectively; the Australian Drinking Water Guidelines are based on the WHO *Guidelines*, while the United States Environmental Protection Agency (USEPA) and Canada actively observe and participate in the process of development of the WHO *Guidelines*.

Many developing countries use the *Guidelines* directly or indirectly in setting national standards.

The *Guidelines* are often used where guidelines or standards are unavailable and are also referred to in the food standards



developed by the Codex Alimentarius Commission (for instance, for mineral water and bottled water).

Finding the Guidelines

- The text of most of the *Guidelines* and information on their updating are available on the Internet: http://www.who.int/water_sanitation_health/GDWQ/index.html
- CD-ROMs bringing together most of WHO's publications on water, sanitation and health are available.
- These and hard copies of the *Guidelines* can be bought through WHO sales agents, the list of which is available at: http://www.who.int/dsa/cat97/zsale.htm or from WHO Heaquarters:

WHO, Marketing and Dissemination
CH-1211 Geneva 27, Switzerland
Tel: +41 22 791 24 76, Fax: +41 22 791 48 57
E-mail: bookorders@who.int

Dates of publication of the Guidelines for Drinking-Water Quality

- 1984: Volume 1 (Summary, first edition)
- 1985: Volume 2 (Supporting information, first edition)
- 1987: Volume 3 (Community supplies, first edition)
- 1993: Volume 1 (Summary, second edition)
- 1996: Volume 2 (Supporting information, second edition)
- 1997: Volume 3 (Community supplies, second edition
- 1998: Addendum to Vol. 1 (Selected chemicals)
- 1999: Addendum to Vol. 2 (Selected chemicals)
- 2000: Toxic Cyanobacteria in Water (Supporting document)
- 2002: Addendum on microbial aspects
- 2004: Third edition
- Thereafter: Continuous 'rolling revision', with expanded use of electronic publication

The *Guidelines* today

The third edition of the *Guidelines* deals with infectious diseases (microbes), hazardous chemicals, radiological hazards, and acceptability aspects.

The approach to microbial hazards advocates protection of water sources and treatment according to source quality and disinfection, with monitoring, of control measures plus verification testing for faecal indicators to ensure that targets are met.

For hazardous chemicals, exhaustive chemical-by-chemical reviews are prepared and lead to 'Guideline Values' representing concentrations that should be safe even with lifelong consumption.

Significant improvements are included in the third edition in response to new information and developments in risk assessment and management for chemicals and microbes.

Updating the Guidelines

The pace of development – in wa
ing of water and health – has ac

the *Guidelines* up to date when information and knowledge are moving so quickly is a major challenge.

As a result, since 1994 WHO has been carrying out a process of ongoing 'rolling revision' to update the *Guidelines*.

Most of the work concerns either developing and substantiating the recommendations in the *Guidelines*, or of supporting 'guidance' on good practice to assist in implementing programmes and projects on drinking-water quality.

Since 2001, information on the process and on individual areas of work and their progress has been put on the Internet.

There are around 100 lines of work in the rolling revision. For further information, see: http://www.who.int/water_sanitation_health/GDWQ/index.html for the workplan and documents avaible for review. Some of the lines of work are close to completion and others have a development programme that will extend over several years.

Making sure that the *Guidelines* are of the highest quality is a priority. Phases of peer review and public domain review have been built into the rolling revision process as key elements of the approach to ensure quality and relevance.

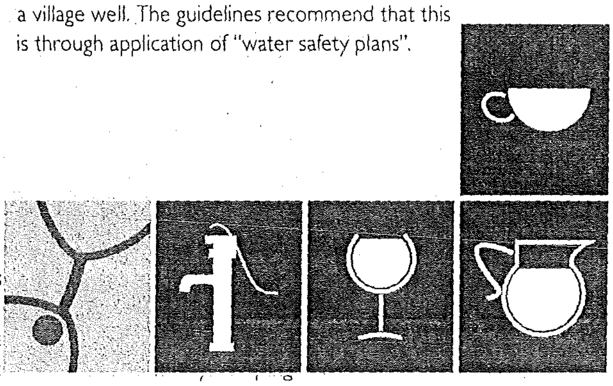
Ensuring that the right subjects are included in the rolling revision is also an important part of the future strategy. New proposals are considered at intervals and access to the process is promoted through the Internet.

Managing water-borne disease properly — How can water safety be ensured?

Analytical monitoring has increasingly become the focus of assuring water quality. However, by the time results are available the water has generally been supplied and may have been consumed. For microbial hazards in particular, adverse health effects may be unavoidable by the time a problem has been detected. The cost of analyses and, in some circumstances, lack of laboratory facilities may be additional constraints.

The third edition of the *Guidelines* is placing more emphasis on preventive management of water safety.

Comprehensive management of water quality, from catchment to consumer, is the most valuable preventive approach in the provision of safe drinking-water. This approach can be applied to any type of water supply – from a complex piped supply in a major city through to a village well. The guidelines recommend that this is through application of "water safety plans".



WHO

ANNEX 4

Chemical summary tables

Table A4.1 Chemicals excluded from guideline value derivation

Chemical	Reason for exclusion
Amitraz	Degrades rapidly in the environment and is not expected to occur at measurable concentrations in drinking-water supplies
Beryllium	Unlikely to occur in drinking-water
Chlorobenzilate	Unlikely to occur in drinking-water
Chlorothalonil	Unlikely to occur in drinking-water
Cypermethrin	Unlikely to occur in drinking-water
Diazinon	Unlikely to occur in drinking-water
Dinoseb	Unlikely to occur in drinking-water
Ethylene thiourea	Unlikely to occur in drinking-water
Fenamiphos	Unlikely to occur in drinking-water
Formothion	Unlikely to occur in drinking-water
Hexachlorocyclohexanes (mixed isomers)	Unlikely to occur in drinking-water
MCPB	Unlikely to occur in drinking-water
Methamidophos	Unlikely to occur in drinking-water
Methomyl	Unlikely to occur in drinking-water
Mirex	Unlikely to occur in drinking-water
Monocrotophos	Has been withdrawn from use in many countries and is unlikely to occur in drinking-water
Oxamyl	Unlikely to occur in drinking-water
Phorate	Unlikely to occur in drinking-water
Propoxur	Unlikely to occur in drinking-water
Pyridate	Not persistent and only rarely found in drinking-water
Quintozene	Unlikely to occur in drinking-water
Toxaphene	Unlikely to occur in drinking-water
Triazophos	Unlikely to occur in drinking-water
Tributyltin oxide	Unlikely to occur in drinking-water
Trichlorfon	Unlikely to occur in drinking-water

WHO

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Tributyltin oxide	Unlikely to occur in drinking-water
Trichlorfon	Unlikely to occur in drinking-water

Table A4.2 Chemicals for which guideline values have not been established

Chemical	Reason for not establishing a guideline value
Aluminium	Owing to limitations in the animal data as a model for humans and the uncertainty surrounding the human data, a health-based guideline value cannot be derived; however, practicable levels based on optimization of the coagulation process in drinking-water plants using aluminium-based coagulants are derived: 0.1 mg/litre or less in large water treatment facilities, and 0.2 mg/litre or less in small facilities
Ammonia	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Asbestos	No consistent evidence that ingested asbestos is hazardous to health
Bentazone	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Bromochloroacetate	Available data inadequate to permit derivation of health-based guideline value
Bromochloroacetonitrile	Available data inadequate to permit derivation of health-based guideline value
Chloride	Not of health concern at levels found in drinking-water[a]
Chlorine dioxide	Guideline value not established because of the rapid breakdown of chlorine dioxide and because the chlorite provisional guideline value is adequately protective for potential toxicity from chlorine dioxide
Chloroacetones	Available data inadequate to permit derivation of health-based guideline values for any of the chloroacetones
Chlorophenol, 2-	Available data inadequate to permit derivation of health-based guideline value
Chloropicrin	Available data inadequate to permit derivation of health-based guideline value
Dialkyltins	Available data inadequate to permit derivation of health-based guideline values for any of the dialkyltins
Dibromoacetate	Available data inadequate to permit derivation of health-based guideline value
Dichloramine	Available data inadequate to permit derivation of health-based guideline value
Dichlorobenzene, 1,3-	Toxicological data are insufficient to permit derivation of health-based guideline value
Dichloroethane, 1,1-	Very limited database on toxicity and carcinogenicity
Dichlorophenol, 2,4-	Available data inadequate to permit derivation of health-based guideline value
Dichloropropane, 1,3-	Data insufficient to permit derivation of health-based guideline value
Di(2-ethylhexyl)adipate	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Diquat	Rarely found in drinking-water, but may be used as an aquatic herbicide for the control of free-floating and submerged aquatic weeds in ponds, lakes and irrigation ditches
Endosulfan	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Fenitrothion	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Fluoranthene	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Glyphosate and AMPA	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Hardness	Not of health concern at levels found in drinking-water[a]
Heptachlor and heptachlor epoxide	Occurs in drinking-water at concentrations well below those at which toxic effects may occur

continued

Table A4.2 ***Continued***

Chemical	Reason for not establishing a guideline value
Hexachlorobenzene	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Hydrogen sulfide	Not of health concern at levels found in drinking-water[a]
Inorganic tin	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Iodine	Available data inadequate to permit derivation of health-based guideline value, and lifetime exposure to iodine through water disinfection is unlikely
Iron	Not of health concern at concentrations normally observed in drinking-water, and taste and appearance of water are affected below the health-based value
Malathion	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Methyl parathion	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Monobromoacetate	Available data inadequate to permit derivation of health-based guideline value
Monochlorobenzene	Occurs in drinking-water at concentrations well below those at which toxic effects may occur, and health-based value would far exceed lowest reported taste and odour threshold
MX	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Parathion	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Permethrin	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
pH	Not of health concern at levels found in drinking-water[b]
Phenylphenol, 2- and its sodium salt	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Propanil	Readily transformed into metabolites that are more toxic; a guideline value for the parent compound is considered inappropriate, and there are inadequate data to enable the derivation of guideline values for the metabolites
Silver	Available data inadequate to permit derivation of health-based guideline value
Sodium	Not of health concern at levels found in drinking-water[a]
Sulfate	Not of health concern at levels found in drinking-water[a]
Total dissolved solids (TDS)	Not of health concern at levels found in drinking-water[a]
Trichloramine	Available data inadequate to permit derivation of health-based guideline value
Trichloroacetonitrile	Available data inadequate to permit derivation of health-based guideline value
Trichlorobenzenes (total)	Occurs in drinking-water at concentrations well below those at which toxic effects may occur, and health-based value would exceed lowest reported odour threshold
Trichloroethane, 1,1,1-	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Zinc	Not of health concern at concentrations normally observed in drinking-water[a]

[a] May affect acceptability of drinking-water (see chapter 10).
[b] An important operational water quality parameter.

Table A4.3 Guideline values for chemicals that are of health significance in drinking-water

Chemical	Guideline value[a] (mg/litre)	Remarks
Acrylamide	0.0005[b]	
Alachlor	0.02[b]	
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	0.01[b] (A, T)	
Bromodichloromethane	0.06[b]	
Bromoform	0.1	
Cadmium	0.003	
Carbofuran	0.007	
Carbon tetrachloride	0.004	
Chloral hydrate (trichloroacetaldehyde)	0.01 (P)	
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	0.2	
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
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	
1,2-Dibromo-3-chloropropane	0.001[b]	
1,2-Dibromoethane	0.0004[b] (P)	
Dichloroacetate	0.05 (T, D)	
Dichloroacetonitrile	0.02 (P)	
Dichlorobenzene, 1,2-	1 (C)	

continued

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Table A4.3 ***Continued***

Chemical	Guideline value (mg/litre)	Remarks
Dichlorobenzene, 1,4-	0.3 (C)	
Dichloroethane, 1,2-	0.03[b]	
Dichloroethene, 1,1-	0.03	
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	
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
Formaldehyde	0.9	
Hexachlorobutadiene	0.0006	
Isoproturon	0.009	
Lead	0.01	
Lindane	0.002	
Manganese	0.4 (C)	
MCPA	0.002	
Mecoprop	0.01	
Mercury	0.001	For total mercury (inorganic plus organic)
Methoxychlor	0.02	
Metolachlor	0.01	
Microcystin-LR	0.001 (P)	For total microcystin-LR (free plus cell-bound)
Molinate	0.006	
Molybdenum	0.07	
Monochloramine	3	
Monochloroacetate	0.02	
Nickel	0.02 (P)	
Nitrate (as NO_3^-)	50	Short-term exposure
Nitrilotriacetic acid (NTA)	0.2	
Nitrite (as NO_2^-)	3	Short-term exposure
	0.2 (P)	Long-term exposure
Pendimethalin	0.02	
Pentachlorophenol	0.009[b] (P)	
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)	

Table A4.3 Guideline values for chemicals that are of health significance in drinking-water

Chemical	Guideline value[a] (mg/litre)	Remarks
Acrylamide	0.0005[b]	
Alachlor	0.02[b]	
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	0.01[b] (A, T)	
Bromodichloromethane	0.06[b]	
Bromoform	0.1	
Cadmium	0.003	
Carbofuran	0.007	
Carbon tetrachloride	0.004	
Chloral hydrate (trichloroacetaldehyde)	0.01 (P)	
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	0.2	
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
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	
1,2-Dibromo-3-chloropropane	0.001[b]	
1,2-Dibromoethane	0.0004[b] (P)	
Dichloroacetate	0.05 (T, D)	
Dichloroacetonitrile	0.02 (P)	
Dichlorobenzene, 1,2-	1 (C)	

continued

41

Table A4.3 ***Continued***

Chemical	**Guideline value (mg/litre)**	**Remarks**
Trichloroacetate	0.2	
Trichloroethene	0.07 (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
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.

is aimed at highlighting common or recurrent problems, the objective at a regional level is to assign a degree of priority to individual interventions. It is therefore important to derive a relative measure of health risk. While this information cannot be used on its own to determine which systems should be given immediate attention (which would also require the analysis of economic, social, environmental and cultural factors), it provides an extremely important tool for determining regional priorities. It should be a declared objective to ensure that remedial action is carried out each year on a predetermined proportion of the systems classified as high risk.

At the regional level, it is also important to monitor the improvement in (or deterioration of) both individual drinking-water supplies and the supplies as a whole. In this context, simple measures, such as the mean sanitary inspection score of all systems, the proportion of systems with given degrees of faecal contamination, the population with different levels of service and the mean cost of domestic consumption, should be calculated yearly and changes monitored.

In many developing and developed countries, a high proportion of small-community drinking-water systems fail to meet requirements for water safety. In such circumstances, it is important that realistic goals for progressive improvement are agreed upon and implemented. It is practical to classify water quality results in terms of an overall grading for water safety linked to priority for action, as illustrated in Table 5.2.

Grading schemes may be of particular use in community supplies where the frequency of testing is low and reliance on analytical results alone is especially inappropriate. Such schemes will typically take account of both analytical findings and results of the sanitary inspection through schema such as illustrated in Figure 5.1.

Combined analysis of sanitary inspection and water quality data can be used to identify the most important causes of and control measures for contamination. This is important to support effective and rational decision-making. For instance, it will be important to know whether on-site or off-site sanitation could be associated with contamination of drinking-water, as the remedial actions required to address either source of contamination will be very different. This analysis may also identify other factors associated with contamination, such as heavy rainfall. As the data will be non-parametric, suitable methods for analysis include chi-square, odds ratios and logistic regression models.

Table 5.2 Categorization of drinking-water systems based on compliance with performance and safety targets (see also table 7.7)

	Proportion (%) of samples negative for *E. coli*		
		Population size:	
Quality of water system	**<5000**	**5000–100 000**	**>100 000**
Excellent	90	95	99
Good	80	90	95
Fair	70	85	90
Poor	60	80	85

Table 7.7 Guideline values for verification of microbial quality[a] (see also table 5.2)

Organisms	Guideline value
All water directly intended for drinking	
E. coli or thermotolerant coliform bacteria[b,c]	Must not be detectable in any 100-ml sample
Treated water entering the distribution system	
E. coli or thermotolerant coliform bacteria[b]	Must not be detectable in any 100-ml sample
Treated water in the distribution system	
E. coli or thermotolerant coliform bacteria[b]	Must not be detectable in any 100-ml sample

[a] Immediate investigative action must be taken if *E. coli* are detected.
[b] Although *E. coli* is the more precise indicator of faecal pollution, the count of thermotolerant coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests must be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of water supplies, particularly in tropical areas, where many bacteria of no sanitary significance occur in almost all untreated supplies.
[c] It is recognized that in the great majority of rural water supplies, especially in developing countries, faecal contamination is widespread. Especially under these conditions, medium-term targets for the progressive improvement of water supplies should be set.

guidelines values should be used and interpreted in conjunction with the information contained in these Guidelines and other supporting documentation.

A consequence of variable susceptibility to pathogens is that exposure to drinking-water of a particular quality may lead to different health effects in different populations. For guideline derivation, it is necessary to define reference populations or, in some cases, to focus on specific sensitive subgroups. National or local authorities may wish to apply specific characteristics of their populations in deriving national standards.

7.5 Methods of detection of faecal indicator bacteria

Analysis for faecal indicator bacteria provides a sensitive, although not the most rapid, indication of pollution of drinking-water supplies. Because the growth medium and the conditions of incubation, as well as the nature and age of the water sample, can influence the species isolated and the count, microbiological examinations may have variable accuracy. This means that the standardization of methods and of laboratory procedures is of great importance if criteria for the microbial quality of water are to be uniform in different laboratories and internationally.

International standard methods should be evaluated under local circumstances before being adopted. Established standard methods are available, such as those of the ISO (Table 7.8) or methods of equivalent efficacy and reliability. It is desirable that established standard methods be used for routine examinations. Whatever method is chosen for detection of *E. coli* or thermotolerant coliforms, the importance of "resuscitating" or recovering environmentally damaged or disinfectant-damaged strains must be considered.

Table 7.8 International Organization for Standardization (ISO) standards for detection and enumeration of faecal indicator bacteria in water

ISO standard	Title (water quality)
6461-1:1986	Detection and enumeration of the spores of sulfite-reducing anaerobes (clostridia) — Part 1: Method by enrichment in a liquid medium
6461-2:1986	Detection and enumeration of the spores of sulfite-reducing anaerobes (clostridia) — Part 2: Method by membrane filtration
7704:1985	Evaluation of membrane filters used for microbiological analyses
7899-1:1984	Detection and enumeration of faecal streptococci – Part 1: Method by enrichment in a liquid medium
7899-2:1984	Detection and enumeration of faecal streptococci – Part 2: Method by membrane filtration
9308-1:1990	Detection and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive *Escherichia coli* – Part 1: Membrane filtration method
9308-2:1990	Detection and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive *Escherichia coli* – Part 2: Multiple tube (most probable number) method

Table 9.2 Dose coefficients for ingestion of radionuclides by adult members of the public

Category	Radionuclide	Dose coefficient (mSv/Bq)
Natural uranium series	Uranium-238	4.5×10^{-5}
	Uranium-234	4.9×10^{-5}
	Thorium-230	2.1×10^{-4}
	Radium-226	2.8×10^{-4}
	Lead-210	6.9×10^{-4}
	Polonium-210	1.2×10^{-3}
Natural thorium series	Thorium-232	2.3×10^{-4}
	Radium-228	6.9×10^{-4}
	Thorium-228	7.2×10^{-5}
Fission products	Caesium-134	1.9×10^{-5}
	Caesium-137	1.3×10^{-5}
	Strontium-90	2.8×10^{-5}
	Iodine-131	2.2×10^{-5}
Other radionuclides	Tritium	1.8×10^{-8}
	Carbon-14	5.8×10^{-7}
	Plutonium-239	2.5×10^{-4}
	Americium-241	2.0×10^{-4}

naturally occurring radionuclides or those arising from human activities that might be found in drinking-water supplies (IAEA, 1996; ICRP, 1996).

9.3 Guidance levels for radionuclides in drinking-water

The guidance levels for radionuclides in drinking-water are presented in Table 9.3 for radionuclides originating from natural sources or discharged into the environment as the result of current or past activities. These levels also apply to radionuclides released due to nuclear accidents that occurred more than 1 year previously. The activity concentration values in Table 9.3 correspond to an RDL of 0.1 mSv/year from each radionuclide listed if their concentration in the drinking-water consumed during the year does not exceed these values. The associated risk estimate was given at the beginning of this chapter. However, for the first year immediately after an accident, generic action levels for foodstuffs apply as described in the International Basic Safety Standards (IAEA, 1996) and other relevant WHO and IAEA publications (WHO, 1988; IAEA, 1997, 1999).

The guidance levels for radionuclides in drinking-water were calculated by the following equation:

$$GL = IDC/(h_{ing} \cdot q)$$

where:

GL = guidance level of radionuclide in drinking-water (Bq/litre),
IDC = individual dose criterion, equal to 0.1 mSv/year for this calculation,
h_{ing} = dose coefficient for ingestion by adults (mSv/Bq),
q = annual ingested volume of drinking-water, assumed to be 730 litres/year.

Table 9.3 Guidance levels for radionuclides in drinking-water

Radionuclides	Guidance level (Bq/litre)[a]	Radionuclides	Guidance level (Bq/litre)[a]	Radionuclides	Guidance level (Bq/litre)[a]
^{3}H	10 000	^{93}Mo	100	^{140}La	100
^{7}Be	10 000	^{99}Mo	100	^{139}Ce	1000
^{14}C	100	^{96}Tc	100	^{141}Ce	100
^{22}Na	100	^{97}Tc	1000	^{143}Ce	100
^{32}P	100	^{97m}Tc	100	^{144}Ce	10
^{33}P	1 000	^{99}Tc	100	^{143}Pr	100
^{35}S	100	^{97}Ru	1000	^{147}Nd	100
^{36}Cl	100	^{103}Ru	100	^{147}Pm	1000
^{45}Ca	100	^{106}Ru	10	^{149}Pm	100
^{47}Ca	100	^{105}Rh	1000	^{151}Sm	1000
^{46}Sc	100	^{103}Pd	1000	^{153}Sm	100
^{47}Sc	100	^{105}Ag	100	^{152}Eu	100
^{48}Sc	100	^{110m}Ag	100	^{154}Eu	100
^{48}V	100	^{111}Ag	100	^{155}Eu	1000
^{51}Cr	10 000	^{109}Cd	100	^{153}Gd	1000
^{52}Mn	100	^{115}Cd	100	^{160}Tb	100
^{53}Mn	10 000	^{115m}Cd	100	^{169}Er	1000
^{54}Mn	100	^{111}In	1000	^{171}Tm	1000
^{55}Fe	1 000	^{114m}In	100	^{175}Yb	1000
^{59}Fe	100	^{113}Sn	100	^{182}Ta	100
^{56}Co	100	^{125}Sn	100	^{181}W	1000
^{57}Co	1 000	^{122}Sb	100	^{185}W	1000
^{58}Co	100	^{124}Sb	100	^{186}Re	100
^{60}Co	100	^{125}Sb	100	^{185}Os	100
^{59}Ni	1 000	^{123m}Te	100	^{191}Os	100
^{63}Ni	1 000	^{127}Te	1000	^{193}Os	100
^{65}Zn	100	^{127m}Te	100	^{190}Ir	100
^{71}Ge	10 000	^{129}Te	1000	^{192}Ir	100
^{73}As	1 000	^{129m}Te	100	^{191}Pt	1000
^{74}As	100	^{131}Te	1000	^{193m}Pt	1000
^{76}As	100	^{131m}Te	100	^{198}Au	100
^{77}As	1 000	^{132}Te	100	^{199}Au	1000
^{75}Se	100	^{125}I	10	^{197}Hg	1000
^{82}Br	100	^{126}I	10	^{203}Hg	100
^{86}Rb	100	^{129}I	1000	^{200}Tl	1000
^{85}Sr	100	^{131}I	10	^{201}Tl	1000
^{89}Sr	100	^{129}Cs	1000	^{202}Tl	1000
^{90}Sr	10	^{131}Cs	1000	^{204}Tl	100
^{90}Y	100	^{132}Cs	100	^{203}Pb	1000
^{91}Y	100	^{134}Cs	10	^{206}Bi	100
^{93}Zr	100	^{135}Cs	100	^{207}Bi	100
^{95}Zr	100	^{136}Cs	100	^{210}Bi[b]	100
^{93m}Nb	1 000	^{137}Cs	10	^{210}Pb[b]	0.1
^{94}Nb	100	^{131}Ba	1000	^{210}Po[b]	0.1
^{95}Nb	100	^{140}Ba	100	^{223}Ra[b]	1
^{224}Ra[b]	1	^{235}U[b]	1	^{242}Cm	10
^{225}Ra	1	^{236}U[b]	1	^{243}Cm	1
^{226}Ra[b]	1	^{237}U	100	^{244}Cm	1
^{228}Ra[b]	0.1	^{238}U[b,c]	10	^{245}Cm	1

continued

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The guidance levels for radionuclides in drinking-water were calculated by the following equation:

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where:

GL = guidance level of radionuclide in drinking-water (Bq/litre),
IDC = individual dose criterion, equal to 0.1 mSv/year for this calculation,
h_{ing} = dose coefficient for ingestion by adults (mSv/Bq),
q = annual ingested volume of drinking-water, assumed to be 730 litres/year.

Table 9.3 *Continued*

Radionuclides	Guidance level (Bq/litre)	Radionuclides	Guidance level (Bq/litre)	Radionuclides	Guidance level (Bq/litre)
^{227}Th[b]	10	^{237}Np	1	^{246}Cm	1
^{228}Th[b]	1	^{239}Np	100	^{247}Cm	1
^{229}Th	0.1	^{236}Pu	1	^{248}Cm	0.1
^{230}Th[b]	1	^{237}Pu	1000	^{249}Bk	100
^{231}Th[b]	1 000	^{238}Pu	1	^{246}Cf	100
^{232}Th[b]	1	^{239}Pu	1	^{248}Cf	10
^{234}Th[b]	100	^{240}Pu	1	^{249}Cf	1
^{230}Pa	100	^{241}Pu	10	^{250}Cf	1
^{231}Pa[b]	0.1	^{242}Pu	1	^{251}Cf	1
^{233}Pa	100	^{244}Pu	1	^{252}Cf	1
^{230}U	1	^{241}Am	1	^{253}Cf	100
^{231}U	1 000	^{242}Am	1000	^{254}Cf	1
^{232}U	1	^{242m}Am	1	^{253}Es	10
^{233}U	1	^{243}Am	1	^{254}Es	10
^{234}U[b]	10			^{254m}Es	100

[a] Guidance levels are rounded according to averaging the log scale values (to 10^n if the calculated value was below 3×10^n and above $3 \times 10^{n-1}$).
[b] Natural radionuclides.
[c] The provisional guideline value for uranium in drinking-water is 15 μg/litre based on its chemical toxicity for the kidney (see section 8.5).

The higher age-dependent dose coefficients calculated for children (accounting for the higher uptake and/or metabolic rates) do not lead to significantly higher doses due to the lower mean volume of drinking-water consumed by infants and children. Consequently, the recommended RDL of committed effective dose of 0.1 mSv/year from 1 year's consumption of drinking-water applies independently of age.

9.4 Monitoring and assessment for dissolved radionuclides

9.4.1 Screening of drinking-water supplies

The process of identifying individual radioactive species and determining their concentration requires sophisticated and expensive analysis, which is normally not justified, because the concentrations of radionuclides in most circumstances are very low. A more practical approach is to use a screening procedure, where the total radioactivity present in the form of alpha and beta radiation is first determined, without regard to the identity of specific radionuclides.

Screening levels for drinking-water below which no further action is required are 0.5 Bq/litre for gross alpha activity and 1 Bq/litre for gross beta activity. The gross beta activity screening level was published in the second edition of the Guidelines and, in the worse case (radium-222), would lead to a dose close to the guidance RDL of 0.1 mSv/year. The screening level for gross alpha activity is 0.5 Bq/litre (instead of the former 0.1 Bq/litre), as this activity concentration reflects values nearer the radionuclide-specific guidance RDL.

9.4.2 Strategy for assessing drinking-water

If either of the screening levels is exceeded, then the specific radionuclides producing this activity should be identified and their individual activity concentrations measured. From these data, an estimate of committed effective dose for each radionuclide should be made and the sum of these doses determined. If the following additive formula is satisfied, no further action is required:

$$\sum_i \frac{C_i}{GL_i} \leq 1$$

where:

C_i = the measured activity concentration of radionuclide i, and
GL_i = the guidance level value (see Table 9.3) of radionuclide i that, at an intake of 2 litres/day for 1 year, will result in a committed effective dose of 0.1 mSv/year.

Where the sum exceeds unity for a single sample, the RDL of 0.1 mSv would be exceeded only if the exposure to the same measured concentrations were to continue for a full year. *Hence, such a sample does not in itself imply that the water is unsuitable for consumption* but should be regarded as an indication that further investigation, including additional sampling, is needed. Gross beta and gross alpha activity screening has to be repeated first, then radionuclide-specific analysis conducted only if subsequently measured gross values exceed the recommended practical screening values (1 Bq/litre and 0.5 Bq/litre, respectively).

The application of these recommendations is summarized in Figure 9.2.

The gross beta measurement includes a contribution from potassium-40, a beta emitter that occurs naturally in a fixed ratio to stable potassium. Potassium is an essential element for humans and is absorbed mainly from ingested food. Potassium-40 does not accumulate in the body but is maintained at a constant level independent of intake. The contribution of potassium-40 to beta activity should therefore be subtracted following a separate determination of total potassium. The specific activity of potassium-40 is 30.7 Bq/g of potassium. However, not all the radiation from potassium-40 appears as beta activity. The beta activity of potassium-40 is 27.6 Bq/g of stable potassium, which is the factor that should be used to calculate the beta activity due to potassium-40.

9.4.3 Remedial measures

If the RDL of 0.1 mSv/year is being exceeded on aggregate, then the options available to the competent authority to reduce the dose should be examined. Where remedial measures are contemplated, any strategy considered should first be justified (in the sense that it achieves a net benefit) and then optimized in accordance with the recommendations of ICRP (1989, 1991) in order to produce the maximum net benefit.

Guidelines for Drinking-Water Quality

The Guidelines: contents (Third edition)

Microbial Aspects

Pathogens of concern; system risk assessment; safe management practices; safety management plans; surveillance; and guideline requirements.

Application of the Guidelines to:

- Emergencies
- Bottled water
- Desalinated water
- Travellers
- Health care facilities, schools
- Food production and processing

Chemical Safety

More than 100 chemical-by-chemical reviews covering health effects, occurrence, technical and analytical achievability and derived Guideline Values, where appropriate.
Overall management approach for chemicals, by source type.

Acceptability Aspects

Radiological Aspects

2.1.1

3

Guidelines: associated texts

Key chemicals

- Arsenic
- Fluoride
- Nitrate/nitrite

Monitoring

- Identifying priority chemicals
- Community supplies
- Monitoring in urban areas

Management

- Materials and chemicals ('additives')
- Groundwater
- Spills and exceedences
- Managing surface water quality
- Managing groudwater quality

Managing microbial safely

- Treatment efficiency
- Water quality in piped distribution systems
- Household treatment and management
- Role of H_2S, HPC testing
- Water Safety Plans
- Hazard characterization in food and water

Others

- Toxic cyanobacteria in water
- Desalination
- Legionella management

What about those who don't have piped drinking-water?

Most of the world's population does not have access to piped water (see Table).

	Number with no access (millions)	Access to improved sources (millions)	Access through household connections
1990	1126 (21%)	1981 (38%)	2159 (41%)
2000	1099 (18%)	2110 (35%)	2846 (47%)

Source: Global water supply and sanitation assessment 2000 report. WHO/UNICEF/WSSCC, 2000.

To contribute effectively to health protection the *Guidelines* have to be relevant to the way people get their water, including:

- vendor-provided water, protected wells and springs, rainwater catchment, tubewells fitted with hand pumps;
- complex piped supplies, small community piped supplies;
- emerging types of supply such as desalinated water and bottled/packaged water; as well as
- special situations such as water supply in emergencies and in health care facilities.

From the first edition, the *Guidelines* have given special consideration to small community supplies through Volume 3. In the third edition, the *Guidelines* contain guidance on their application to a wider range of different circumstances (see box overleaf)

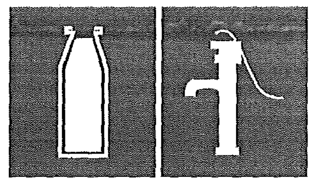
A framework for safe drinking-water

The key activities required in actively controlling water safety:

- Health-based targets, set by national authorities.
- Checking whether systems are capable of delivering safe drinking-water through a 'system assessment' from catchment to consumer. This requires developing an understanding of occurrence, control and treatment of the different microbes (and other contaminants) in a particular water supply. To support these assessments, detailed characterizations of microbial hazards and critical reviews of control measures are prepared.
- Systematic monitoring for safe management achieved through monitoring of control measures by simple, frequently applied methods, building on 'sanitary inspection' and the multiple barrier principle in water supply practice.
- Ensuring water safety plans are in place documenting the assessment and monitoring plans, management and communication procedures for both 'normal' and 'incident' circumstances.
- Ensuring independent oversight 'surveillance', often through auditing-type approaches.

Managing chemical quality better: learning from mistakes

As for microbial quality, emphasis on preventive approaches has been proposed for the third edition of the *Guidelines*. Again, system-based risk assessments will be required. In the past this has not been done effectively, as demonstrated by the disastrous series of events in Bangladesh.



In trying to tackle infectious disease transmission through changing drinking-water sources from surface water to groundwater, millions ended up drinking water that contained high levels of arsenic – with severe health effects of a magnitude that is still not fully understood.

Many lessons are still being learned about arsenic – which occurs in drinking-water in countries worldwide – and hopefully the same mistake will not be repeated elsewhere.

But looking towards the future, we have to ask what will be 'tomorrow's arsenic'? Monitoring for all of the chemicals that might be a health risk is simply not possible in many countries, but there are some fairly simple ways to 'rule out' some chemicals and to prioritize others using readily available information. Guidance on identifying chemicals that should be included in making assessments and in monitoring is being developed to accompany the *Guidelines*.

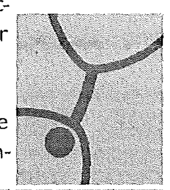
More guidance on managing the biggest chemical problems

There are a limited number of chemical hazards in drinking-water that cause widespread health effects. The 'big issues' are probably arsenic and fluoride. But guidance on managing them is not readily available in the countries and regions where the problems are greatest.

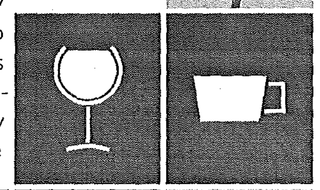
Work is progressing towards publication of guidance on arsenic and fluoride. Some chemicals such as lead, are of concern because of multiple routes of exposure and guidance is also in preparation.

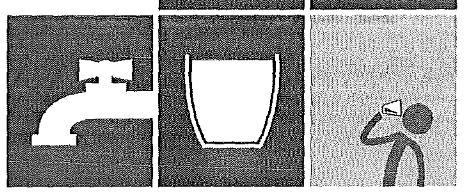
Drinking-water safety in emergencies

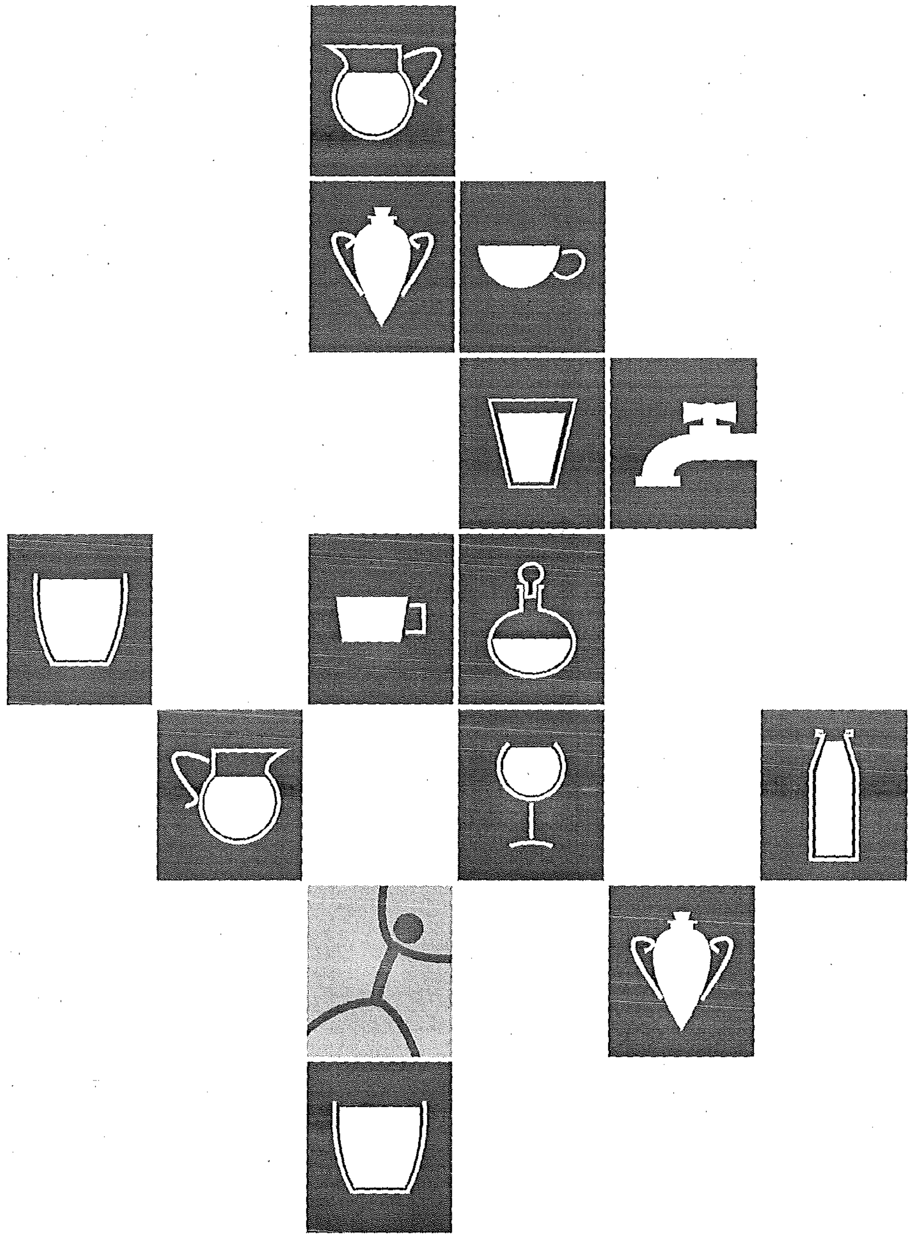
Emergencies – accidental and deliberately induced – may lead to contamination of drinking-water supplies. Public concern about drinking-water safety may be a major issue even where the actual risk is low. If a sufficient quantity of toxic or infectious material contaminates a drinking-water supply, it may lead to actual health effects.



The preventive management approach of the third edition of the *Guidelines* can support planning for prevention and early detection of, and response to contamination events. Work is in hand to provide more guidance on drinking-water quality in emergencies and to include this in the *Guidelines*.







World Health Organization

WHO
Documentation Centre
Protection of the Human Environment
CH-1211 Geneva 27, Switzerland
Tel: +41 22 791 38 72
Fax: +41 22 791 43 21
E-mail: phedoc@who.int

Guidelines for Drinking-water Quality

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Contents

Preface

Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection.

The importance of water, sanitation and hygiene for health and development has been reflected in the outcomes of a series of international policy forums. These have included health-oriented conferences such as the International Conference on Primary Health Care, held in Alma-Ata, Kazakhstan (former Soviet Union), in 1978. They have also included water-oriented conferences such as the 1977 World Water Conference in Mar del Plata, Argentina, which launched the water supply and sanitation decade of 1981–1990, as well as the Millennium Declaration goals adopted by the General Assembly of the United Nations (UN) in 2000 and the outcome of the Johannesburg World Summit for Sustainable Development in 2002. Most recently, the UN General Assembly declared the period from 2005 to 2015 as the International Decade for Action, "Water for Life."

Access to safe drinking-water is important as a health and development issue at a national, regional and local level. In some regions, it has been shown that investments in water supply and sanitation can yield a net economic benefit, since the reductions in adverse health effects and health care costs outweigh the costs of undertaking the interventions. This is true for major water supply infrastructure investments through to water treatment in the home. Experience has also shown that interventions in improving access to safe water favour the poor in particular, whether in rural or urban areas, and can be an effective part of poverty alleviation strategies.

In 1983–1984 and in 1993–1997, the World Health Organization (WHO) published the first and second editions of the *Guidelines for Drinking-water Quality* in three volumes as successors to previous WHO International Standards. In 1995, the decision was made to pursue the further development of the Guidelines through a process of rolling revision. This led to the publication of addenda to the second edition of the Guidelines, on chemical and microbial aspects, in 1998, 1999 and 2002; the publication of a text on *Toxic Cyanobacteria in Water*; and the preparation of expert reviews on key issues preparatory to the development of a third edition of the Guidelines.

In 2000, a detailed plan of work was agreed upon for development of the third edition of the Guidelines. As with previous editions, this work was shared between WHO Headquarters and the WHO Regional Office for Europe (EURO). Leading the process of the development of the third edition were the Programme on Water Sanitation and Health within Headquarters and the European Centre for Environment and Health, Rome, within EURO. Within WHO Headquarters, the Programme on Chemical Safety provided inputs on some chemical hazards, and the Programme on Radiological Safety contributed to the section dealing with radiological aspects. All six WHO Regional Offices participated in the process.

This revised Volume 1 of the Guidelines is accompanied by a series of publications providing information on the assessment and management of risks associated with microbial hazards and by internationally peer-reviewed risk assessments for specific chemicals. These replace the corresponding parts of the previous Volume 2. Volume 3 provides guidance on good practice in surveillance, monitoring and assessment of drinking-water quality in community supplies. The Guidelines are also accompanied by other publications explaining the scientific basis of their development and providing guidance on good practice in implementation.

This volume of the *Guidelines for Drinking-water Quality* explains requirements to ensure drinking-water safety, including minimum procedures and specific guideline values, and how those requirements are intended to be used. The volume also describes the approaches used in deriving the guidelines, including guideline values. It includes fact sheets on significant microbial and chemical hazards. The development of this third edition of the *Guidelines for Drinking-water Quality* includes a substantive revision of approaches to ensuring microbial safety. This takes account of important developments in microbial risk assessment and its linkages to risk management. The development of this orientation and content was led over an extended period by Dr Arie Havelaar (RIVM, Netherlands) and Dr Jamie Bartram (WHO).

Since the second edition of WHO's *Guidelines for Drinking-water Quality*, there have been a number of events that have highlighted the importance and furthered understanding of various aspects of drinking-water quality and health. These are reflected in this third edition of the Guidelines.

These Guidelines supersede those in previous editions (1983–1984, 1993–1997 and addenda in 1998, 1999 and 2002) and previous International Standards (1958, 1963 and 1971). The Guidelines are recognized as representing the position of the UN system on issues of drinking-water quality and health by "UN-Water," the body that coordinates amongst the 24 UN agencies and programmes concerned with water issues. This edition of the Guidelines further develops concepts, approaches and information in previous editions:

- Experience has shown that microbial hazards continue to be the primary concern in both developing and developed countries. Experience has also shown the value of a systematic approach towards securing microbial safety. This edition includes significantly expanded guidance on ensuring microbial safety of drinking-water, building on principles – such as the multiple-barrier approach and the importance of source protection – considered in previous editions. The Guidelines are accompanied by documentation describing approaches towards fulfilling requirements for microbial safety and providing guidance to good practice in ensuring that safety is achieved.

- Information on many chemicals has been revised. This includes information on chemicals not considered previously; revisions to take account of new scientific information; and, in some cases, lesser coverage where new information suggests a lesser priority.
- Experience has also shown the necessity of recognizing the important roles of many different stakeholders in ensuring drinking-water safety. This edition includes discussion of the roles and responsibilities of key stakeholders in ensuring drinking-water safety.
- The need for different tools and approaches in supporting safe management of large piped supplies versus small community supplies remains relevant, and this edition describes the principal characteristics of the different approaches.
- There has been increasing recognition that only a few key chemicals cause large-scale health effects through drinking-water exposure. These include fluoride and arsenic. Other chemicals, such as lead, selenium and uranium, may also be significant under certain conditions. Interest in chemical hazards in drinking-water was highlighted by recognition of the scale of arsenic exposure through drinking-water in Bangladesh and elsewhere. The revised Guidelines and associated publications provide guidance on identifying local priorities and on management of the chemicals associated with large-scale effects.
- WHO is frequently approached for guidance on the application of the *Guidelines for Drinking-water Quality* to situations other than community supplies or managed utilities. This revised edition includes information on application of the Guidelines to several specific circumstances and is accompanied by texts dealing with some of these in greater detail.

The *Guidelines for Drinking-water Quality* are kept up to date through a process of rolling revision, which leads to periodic release of documents that may add to or supersede information in this volume.

The Guidelines are addressed primarily to water and health regulators, policy-makers and their advisors, to assist in the development of national standards. The Guidelines and associated documents are also used by many others as a source of information on water quality and health and on effective management approaches.

Acknowledgements

The preparation of the current edition of the *Guidelines for Drinking-water Quality* and supporting documentation covered a period of eight years and involved the participation of over 490 experts from 90 developing and developed countries. The contributions of all who participated in the preparation and finalization of the *Guidelines for Drinking-water Quality*, including those individuals listed in Annex 2, are gratefully acknowledged.

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Microbial aspects working group

Ms T. Boonyakarnkul, Department of Health, Thailand (*Surveillance and control*)
Dr D. Cunliffe, SA Department of Human Services, Australia (*Public health*)
Prof. W. Grabow, University of Pretoria, South Africa (*Pathogen-specific information*)
Dr A. Havelaar, RIVM, The Netherlands (Working Group coordinator; *Risk assessment*)
Prof. M. Sobsey, University of North Carolina, USA (*Risk management*)

Chemical aspects working group

Mr J.K. Fawell, United Kingdom (*Organic and inorganic constituents*)
Ms M. Giddings, Health Canada (*Disinfectants and disinfection by-products*)
Prof. Y. Magara, Hokkaido University, Japan (*Analytical achievability*)
Dr E. Ohanian, EPA, USA (*Disinfectants and disinfection by-products*)
Dr P. Toft, Canada (*Pesticides*)

Protection and control working group

Dr I. Chorus, Umweltbundesamt, Germany (*Resource and source protection*)
Dr J. Cotruvo, USA (*Materials and additives*)
Dr G. Howard, DfID, Bangladesh, and formerly Loughborough University, United Kingdom (*Monitoring and assessment*)
Mr P. Jackson, WRc-NSF, United Kingdom (*Treatment achievability*)

The WHO coordinators were:

Dr J. Bartram, Coordinator, Programme on Water Sanitation and Health, WHO Headquarters, and formerly WHO European Centre for Environmental Health

Mr P. Callan, Programme on Water Sanitation and Health, WHO Headquarters, on secondment from National Health and Medical Research Council, Australia

Ms C. Vickers acted as a liaison between the Working Groups and the International Programme on Chemical Safety, WHO Headquarters.

Ms Marla Sheffer of Ottawa, Canada, was responsible for the editing of the Guidelines. Mr Hiroki Hashizume provided support to the work of the Chemical Aspects Working Group. Ms Mary-Ann Lundby, Ms Grazia Motturi and Ms Penny Ward provided secretarial and administrative support throughout the process and to individual meetings.

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Acronyms and abbreviations used in text

AAS	atomic absorption spectrometry
AD	Alzheimer disease
ADI	acceptable daily intake
AES	atomic emission spectrometry
AIDS	acquired immunodeficiency syndrome
AMPA	aminomethylphosphonic acid
BaP	benzo[*a*]pyrene
BDCM	bromodichloromethane
BMD	benchmark dose
bw	body weight
CAC	Codex Alimentarius Commission
CAS	Chemical Abstracts Service
CICAD	Concise International Chemical Assessment Document
CSAF	chemical-specific adjustment factor
Ct	product of disinfectant concentration and contact time
DAEC	diffusely adherent *E. coli*
DALY	disability-adjusted life-year
DBCM	dibromochloromethane
DBCP	1,2-dibromo-3-chloropropane
DBP	disinfection by-product
DCB	dichlorobenzene
DCP	dichloropropane
DDT	dichlorodiphenyltrichloroethane
DEHA	di(2-ethylhexyl)adipate
DEHP	di(2-ethylhexyl)phthalate
DNA	deoxyribonucleic acid

EAAS	electrothermal atomic absorption spectrometry
EAEC	enteroaggregative *E. coli*
EBCT	empty bed contact time
EC	electron capture
ECD	electron capture detector
EDTA	edetic acid; ethylenediaminetetraacetic acid
EHC	Environmental Health Criteria monograph
EHEC	enterohaemorrhagic *E. coli*
EIEC	enteroinvasive *E. coli*
ELISA	enzyme-linked immunosorbent assay
EPEC	enteropathogenic *E. coli*
ETEC	enterotoxigenic *E. coli*
EURO	WHO Regional Office for Europe
FAAS	flame atomic absorption spectrometry
FAO	Food and Agriculture Organization of the United Nations
FD	fluorescence detector
FID	flame ionization detector
FPD	flame photodiode detector
GAC	granular activated carbon
GAE	granulomatous amoebic encephalitis
GC	gas chromatography
GL	guidance level (used for radionuclides in drinking-water)
GV	guideline value
HACCP	hazard analysis and critical control points
HAd	human adenovirus
HAstV	human astrovirus
HAV	hepatitis A virus
Hb	haemoglobin
HCB	hexachlorobenzene
HCBD	hexachlorobutadiene
HCH	hexachlorocyclohexane
HEV	hepatitis E virus
HIV	human immunodeficiency virus
HPC	heterotrophic plate count
HPLC	high-performance liquid chromatography
HRV	human rotavirus
HuCV	human calicivirus
HUS	haemolytic uraemic syndrome

IAEA	International Atomic Energy Agency
IARC	International Agency for Research on Cancer
IC	ion chromatography
ICP	inductively coupled plasma
ICRP	International Commission on Radiological Protection
IDC	individual dose criterion
IPCS	International Programme on Chemical Safety
ISO	International Organization for Standardization
JECFA	Joint FAO/WHO Expert Committee on Food Additives
JMPR	Joint FAO/WHO Meeting on Pesticide Residues
K_{ow}	octanol/water partition coefficient
LI	Langelier Index
LOAEL	lowest-observed-adverse-effect level
MCB	monochlorobenzene
MCPA	4-(2-methyl-4-chlorophenoxy)acetic acid
MCPP	2(2-methyl-chlorophenoxy) propionic acid; mecoprop
metHb	methaemoglobin
MMT	methylcyclopentadienyl manganese tricarbonyl
MS	mass spectrometry
MX	3-chloro-4-dichloromethyl-5-hydroxy-2(5H)-furanone
NAS	National Academy of Sciences (USA)
NOAEL	no-observed-adverse-effect level
NOEL	no-observed-effect level
NTA	nitrilotriacetic acid
NTP	National Toxicology Program (USA)
NTU	nephelometric turbidity unit
P/A	presence/absence
PAC	powdered activated carbon
PAH	polynuclear aromatic hydrocarbon
PAM	primary amoebic meningoencephalitis
PCP	pentachlorophenol
PCR	polymerase chain reaction
PD	photoionization detector
PMTDI	provisional maximum tolerable daily intake
PT	purge and trap
PTDI	provisional tolerable daily intake

PTWI	provisional tolerable weekly intake
PVC	polyvinyl chloride
QMRA	quantitative microbial risk assessment
RDL	reference dose level
RIVM	Rijksinstituut voor Volksgezondheid en Milieu (Dutch National Institute of Public Health and Environmental Protection)
RNA	ribonucleic acid
SI	Système international d'unités (International System of Units)
SOP	standard operating procedure
SPADNS	sulfo phenyl azo dihydroxy naphthalene disulfonic acid
TBA	terbuthylazine
TCB	trichlorobenzene
TCU	true colour unit
TD_{05}	tumorigenic $dose_{05}$, the intake or exposure associated with a 5% excess incidence of tumours in experimental studies in animals
TDI	tolerable daily intake
TDS	total dissolved solids
THM	trihalomethane
TID	thermal ionization detector
UF	uncertainty factor
UNICEF	United Nations Children's Fund
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USA	United States of America
US EPA	United States Environmental Protection Agency
UV	ultraviolet
UVPAD	ultraviolet photodiode array detector
WHO	World Health Organization
WHOPES	World Health Organization Pesticide Evaluation Scheme
WQT	water quality target
WSP	water safety plan
YLD	years of healthy life lost in states of less than full health, i.e., years lived with a disability
YLL	years of life lost by premature mortality

7
Microbial aspects

The greatest risk from microbes in water is associated with consumption of drinking-water that is contaminated with human and animal excreta, although other sources and routes of exposure may also be significant.

This chapter focuses on organisms for which there is evidence, from outbreak studies or from prospective studies in non-outbreak situations, of disease being caused by ingestion of drinking-water, inhalation of droplets or contact with drinking-water; and their control.

7.1 Microbial hazards associated with drinking-water

Infectious diseases caused by pathogenic bacteria, viruses and parasites (e.g., protozoa and helminths) are the most common and widespread health risk associated with drinking-water. The public health burden is determined by the severity of the illness(es) associated with pathogens, their infectivity and the population exposed.

Breakdown in water supply safety may lead to large-scale contamination and potentially to detectable disease outbreaks. Other breakdowns and low-level, potentially repeated contamination may lead to significant sporadic disease, but is unlikely to be associated with the drinking-water source by public health surveillance.

Quantified risk assessment can assist in understanding and managing risks, especially those associated with sporadic disease.

7.1.1 Waterborne infections

The pathogens that may be transmitted through contaminated drinking-water are diverse. Table 7.1 and Figure 7.1 provide general information on pathogens that are of relevance for drinking-water supply management. The spectrum changes in response to variables such as increases in human and animal populations, escalating use of wastewater, changes in lifestyles and medical interventions, population movement and travel and selective pressures for new pathogens and mutants or recombinations of existing pathogens. The immunity of individuals also varies considerably, whether acquired by contact with a pathogen or influenced by such factors as age, sex, state of health and living conditions.

Table 7.1 Waterborne pathogens and their significance in water supplies

Pathogen	Health significance	Persistence in water supplies[a]	Resistance to chlorine[b]	Relative infectivity[c]	Important animal source
Bacteria					
Burkholderia pseudomallei	Low	May multiply	Low	Low	No
Campylobacter jejuni, C. coli	High	Moderate	Low	Moderate	Yes
Escherichia coli – Pathogenic[d]	High	Moderate	Low	Low	Yes
E. coli – Enterohaemorrhagic	High	Moderate	Low	High	Yes
Legionella spp.	High	Multiply	Low	Moderate	No
Non-tuberculous mycobacteria	Low	Multiply	High	Low	No
Pseudomonas aeruginosa[e]	Moderate	May multiply	Moderate	Low	No
Salmonella typhi	High	Moderate	Low	Low	No
Other salmonellae	High	May multiply	Low	Low	Yes
Shigella spp.	High	Short	Low	Moderate	No
Vibrio cholerae	High	Short	Low	Low	No
Yersinia enterocolitica	High	Long	Low	Low	Yes
Viruses					
Adenoviruses	High	Long	Moderate	High	No
Enteroviruses	High	Long	Moderate	High	No
Hepatitis A	High	Long	Moderate	High	No
Hepatitis E	High	Long	Moderate	High	Potentially
Noroviruses and Sapoviruses	High	Long	Moderate	High	Potentially
Rotavirus	High	Long	Moderate	High	No
Protozoa					No
Acanthamoeba spp.	High	Long	High	High	No
Cryptosporidium parvum	High	Long	High	High	Yes
Cyclospora cayetanensis	High	Long	High	High	No
Entamoeba histolytica	High	Moderate	High	High	No
Giardia intestinalis	High	Moderate	High	High	Yes
Naegleria fowleri	High	May multiply[f]	High	High	No
Toxoplasma gondii	High	Long	High	High	Yes
Helminths					
Dracunculus medinensis	High	Moderate	Moderate	High	No
Schistosoma spp.	High	Short	Moderate	High	Yes

Note: Waterborne transmission of the pathogens listed has been confirmed by epidemiological studies and case histories. Part of the demonstration of pathogenicity involves reproducing the disease in suitable hosts. Experimental studies in which volunteers are exposed to known numbers of pathogens provide relative information. As most studies are done with healthy adult volunteers, such data are applicable to only a part of the exposed population, and extrapolation to more sensitive groups is an issue that remains to be studied in more detail.

[a] Detection period for infective stage in water at 20 °C: short, up to 1 week; moderate, 1 week to 1 month; long, over 1 month.

[b] When the infective stage is freely suspended in water treated at conventional doses and contact times. Resistance moderate, agent may not be completely destroyed.

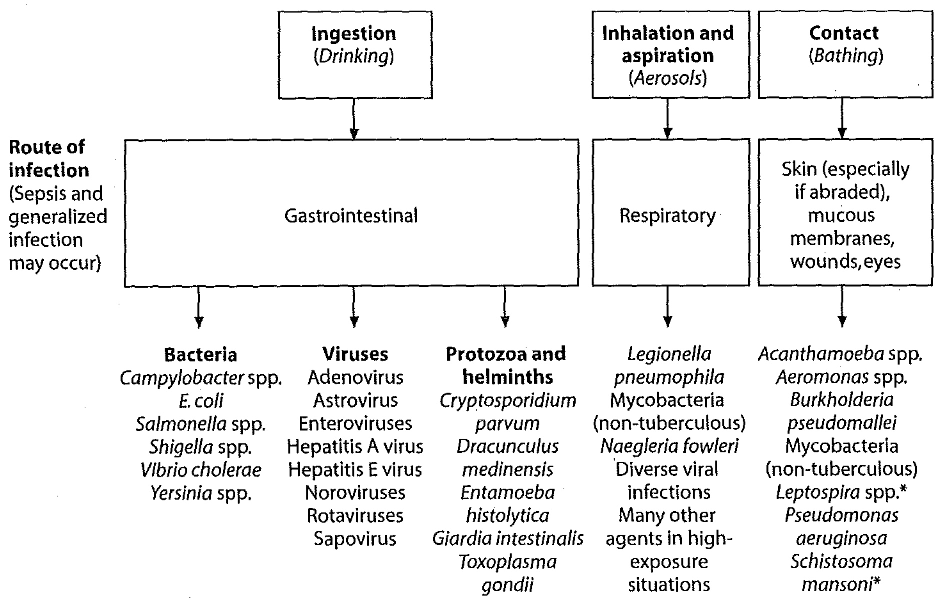
[c] From experiments with human volunteers or from epidemiological evidence.

[d] Includes enteropathogenic, enterotoxigenic and enteroinvasive.

[e] Main route of infection is by skin contact, but can infect immunosuppressed or cancer patients orally.

[f] In warm water.

For pathogens transmitted by the faecal–oral route, drinking-water is only one vehicle of transmission. Contamination of food, hands, utensils and clothing can also play a role, particularly when domestic sanitation and hygiene are poor. Improvements in the quality and availability of water, in excreta disposal and in general hygiene are all important in reducing faecal–oral disease transmission.



* Primarily from contact with highly contaminated surface waters.

Figure 7.1 Transmission pathways for and examples of water-related pathogens

> Infectious diseases caused by pathogenic bacteria, viruses, protozoa and helminths are the most common and widespread health risk associated with drinking-water.

Drinking-water safety is not related only to faecal contamination. Some organisms grow in piped water distribution systems (e.g., *Legionella*), whereas others occur in source waters (guinea worm *Dracunculus medinensis*) and may cause outbreaks and individual cases. Some other microbes (e.g., toxic cyanobacteria) require specific management approaches, which are covered elsewhere in these Guidelines (see section 11.5).

Certain serious illnesses result from inhalation of water droplets (aerosols) in which the causative organisms have multiplied because of warm temperatures and the presence of nutrients. These include legionellosis and Legionnaires' disease, caused by *Legionella* spp., and those caused by the amoebae *Naegleria fowleri* (primary amoebic meningoencephalitis [PAM]) and *Acanthamoeba* spp. (amoebic meningitis, pulmonary infections).

Schistosomiasis (bilharziasis) is a major parasitic disease of tropical and subtropical regions that is transmitted when the larval stage (cercariae), which is released by infected aquatic snails, penetrates the skin. It is primarily spread by contact with water. Ready availability of safe drinking-water contributes to disease prevention by reducing the need for contact with contaminated water resources – for example, when collecting water to carry to the home or when using water for bathing or laundry.

It is conceivable that unsafe drinking-water contaminated with soil or faeces could act as a carrier of other parasitic infections, such as balantidiasis (*Balantidium coli*) and certain helminths (species of *Fasciola*, *Fasciolopsis*, *Echinococcus*, *Spirometra*, *Ascaris*, *Trichuris*, *Toxocara*, *Necator*, *Ancylostoma*, *Strongyloides* and *Taenia solium*). However, in most of these, the normal mode of transmission is ingestion of the eggs in food contaminated with faeces or faecally contaminated soil (in the case of *Taenia solium*, ingestion of the larval cysticercus stage in uncooked pork) rather than ingestion of contaminated drinking-water.

Other pathogens that may be naturally present in the environment may be able to cause disease in people with impaired local or general immune defence mechanisms, such as the elderly or the very young, patients with burns or extensive wounds, those undergoing immunosuppressive therapy or those with acquired immunodeficiency syndrome (AIDS). If water used by such persons for drinking or bathing contains sufficient numbers of these organisms, they can produce various infections of the skin and the mucous membranes of the eye, ear, nose and throat. Examples of such agents are *Pseudomonas aeruginosa* and species of *Flavobacterium*, *Acinetobacter*, *Klebsiella*, *Serratia*, *Aeromonas* and certain "slow-growing" (non-tuberculous) mycobacteria (see the supporting document *Pathogenic Mycobacteria in Water*; section 1.3).

Most of the human pathogens listed in Table 7.1 (which are described in more detail in chapter 11) are distributed worldwide; some, however, such as those causing outbreaks of cholera or guinea worm disease, are regional. Eradication of *D. medinensis* is a recognized target of the World Health Assembly (1991).

It is likely that there are pathogens not shown in Table 7.1 that are also transmitted by water. This is because the number of known pathogens for which water is a transmission route continues to increase as new or previously unrecognized pathogens continue to be discovered (see WHO, 2003a).

7.1.2 Persistence and growth in water

While typical waterborne pathogens are able to persist in drinking-water, most do not grow or proliferate in water. Microorganisms like *E. coli* and *Campylobacter* can accumulate in sediments and are mobilized when water flow increases.

After leaving the body of their host, most pathogens gradually lose viability and the ability to infect. The rate of decay is usually exponential, and a pathogen will become undetectable after a certain period. Pathogens with low persistence must rapidly find new hosts and are more likely to be spread by person-to-person contact or poor personal hygiene than by drinking-water. Persistence is affected by several factors, of which temperature is the most important. Decay is usually faster at higher temperatures and may be mediated by the lethal effects of UV radiation in sunlight acting near the water surface.

The most common waterborne pathogens and parasites are those that have high infectivity and either can proliferate in water or possess high resistance to decay outside the body.

Viruses and the resting stages of parasites (cysts, oocysts, ova) are unable to multiply in water. Conversely, relatively high amounts of biodegradable organic carbon, together with warm temperatures and low residual concentrations of chlorine, can permit growth of *Legionella*, *V. cholerae*, *Naegleria fowleri*, *Acanthamoeba* and nuisance organisms in some surface waters and during water distribution (see also the supporting document *Heterotrophic Plate Counts and Drinking-water Safety*; section 1.3).

Microbial water quality may vary rapidly and widely. Short-term peaks in pathogen concentration may increase disease risks considerably and may also trigger outbreaks of waterborne disease. Results of water quality testing for microbes are not normally available in time to inform management action and prevent the supply of unsafe water.

7.1.3 Public health aspects

Outbreaks of waterborne disease may affect large numbers of persons, and the first priority in developing and applying controls on drinking-water quality should be the control of such outbreaks. Available evidence also suggests that drinking-water can contribute to background rates of disease in non-outbreak situations, and control of drinking-water quality should therefore also address waterborne disease in the general community.

Experience has shown that systems for the detection of waterborne disease outbreaks are typically inefficient in countries at all levels of socioeconomic development, and failure to detect outbreaks is not a guarantee that they do not occur; nor does it suggest that drinking-water should necessarily be considered safe.

Some of the pathogens that are known to be transmitted through contaminated drinking-water lead to severe and sometimes life-threatening disease. Examples include typhoid, cholera, infectious hepatitis (caused by hepatitis A virus [HAV] or HEV) and disease caused by *Shigella* spp. and *E. coli* O157. Others are typically associated with less severe outcomes, such as self-limiting diarrhoeal disease (e.g., Norovirus, *Cryptosporidium*).

The effects of exposure to pathogens are not the same for all individuals or, as a consequence, for all populations. Repeated exposure to a pathogen may be associated with a lower probability or severity of illness because of the effects of acquired immunity. For some pathogens (e.g., HAV), immunity is lifelong, whereas for others (e.g., *Campylobacter*), the protective effects may be restricted to a few months to years. On the other hand, sensitive subgroups (e.g., the young, the elderly, pregnant women and the immunocompromised) in the population may have a greater probability of illness or the illness may be more severe, including mortality. Not all pathogens have greater effects in all sensitive subgroups.

Not all infected individuals will develop symptomatic disease. The proportion of the infected population that is asymptomatic (including carriers) differs between pathogens and also depends on population characteristics, such as prevalence of

immunity. Carriers and those with asymptomatic infections as well as individuals developing symptoms may all contribute to secondary spread of pathogens.

7.2 Health-based target setting

7.2.1 Health-based targets applied to microbial hazards

General approaches to health-based target setting are described in section 2.1.1 and chapter 3.

Sources of information on health risks may be from both epidemiology and risk assessment, and typically both are employed as complementary sources.

Health-based targets may also be set using a health outcome approach, where the waterborne disease burden is believed to be sufficiently high to allow measurement of the impact of interventions – i.e., to measure reductions in disease that can be attributed to drinking-water.

Risk assessment is especially valuable where the fraction of disease that can be attributed to drinking-water is low or difficult to measure directly through public health surveillance or analytical epidemiological studies.

Data – from both epidemiology and risk assessment – with which to develop health-based targets for many pathogens are limited, but are increasingly being produced. Locally generated data will always be of great value in setting national targets.

For the control of microbial hazards, the most frequent form of health-based target applied is performance targets (see section 3.2.2), which are anchored to a tolerable burden of disease. WQTs (see section 3.2.3) are typically not developed for pathogens, because monitoring finished water for pathogens is not considered a feasible or cost-effective option.

7.2.2 Risk assessment approach

In many circumstances, estimating the effects of improved drinking-water quality on health risks in the population is possible through constructing and applying risk assessment models.

QMRA is a rapidly evolving field that systematically combines available information on exposure and dose–response to produce estimates of the disease burden associated with exposure to pathogens. Mathematical modelling is used to estimate the effects of low doses of pathogens in drinking-water on populations and subpopulations.

Interpreting and applying information from analytical epidemiological studies to derive health-based targets for application at a national or local level require consideration of a number of factors, including the following:

- Are specific estimates of disease reduction or indicative ranges of expected reductions to be provided?
- How representative of the target population was the study sample in order to ensure confidence in the reliability of the results across a wider group?

- To what extent will minor differences in demographic or socioeconomic conditions affect expected outcomes?

Risk assessment commences with problem formulation to identify all possible hazards and their pathways from source(s) to recipient(s). Human exposure to the pathogens (environmental concentrations and volumes ingested) and dose–responses of these selected organisms are then combined to characterize the risks. With the use of additional information (social, cultural, political, economic, environmental, etc.), management options can be prioritized. To encourage stakeholder support and participation, a transparent procedure and active risk communication at each stage of the process are important. An example of a risk assessment approach is described in Table 7.2 and outlined below.

Problem formulation and hazard identification

All potential hazards, sources and events that can lead to the presence of these hazards (i.e., what can happen and how) should be identified and documented for each component of the drinking-water system, regardless of whether or not the component is under the direct control of the drinking-water supplier. This includes point sources of pollution (e.g., human and industrial waste discharge) as well as diffuse sources (e.g., those arising from agricultural and animal husbandry activities). Continuous, intermittent or seasonal pollution patterns should also be considered, as well as extreme and infrequent events, such as droughts and floods.

The broader sense of hazards focuses on hazardous scenarios, which are events that may lead to exposure of consumers to specific pathogenic microorganisms. In this, the hazardous event (e.g., peak contamination of source water with domestic wastewater) may be referred to as the hazard.

Representative organisms are selected that, if controlled, would ensure control of all pathogens of concern. Typically, this implies inclusion of at least one bacterial pathogen, virus and protozoan.

Table 7.2 Risk assessment paradigm for pathogen health risks

Step	Aim
1. Problem formulation and hazard identification	To identify all possible hazards associated with drinking-water that would have an adverse public health consequence, as well as their pathways from source(s) to consumer(s)
2. Exposure assessment	To determine the size and nature of the population exposed and the route, amount and duration of the exposure
3. Dose–response assessment	To characterize the relationship between exposure and the incidence of the health effect
4. Risk characterization	To integrate the information from exposure, dose–response and health interventions in order to estimate the magnitude of the public health problem and to evaluate variability and uncertainty

Source: Adapted from Haas *et al.* (1999).

Exposure assessment

Exposure assessment involves estimation of the number of pathogenic microbes to which an individual is exposed, principally through ingestion. Exposure assessment is a predictive activity that often involves subjective judgement. It inevitably contains uncertainty and must account for variability of factors such as concentrations of microorganisms over time, volumes ingested, etc.

Exposure can be considered as a single dose of pathogens that a consumer ingests at a certain point of time or the total amount over several exposures (e.g., over a year). Exposure is determined by the concentration of microbes in drinking-water and the volume of water consumed.

It is rarely possible or appropriate to directly measure pathogens in drinking-water on a regular basis. More often, concentrations in source waters are assumed or measured, and estimated reductions – for example, through treatment – are applied to estimate the concentration in the water consumed. Pathogen measurement, when performed, is generally best carried out at the location where the pathogens are at highest concentration (generally source waters). Estimation of their removal by sequential control measures is generally achieved by the use of surrogates (such as *E. coli* for enteric bacterial pathogens).

The other component of exposure assessment, which is common to all pathogens, is the volume of unboiled water consumed by the population, including person-to-person variation in consumption behaviour and especially consumption behaviour of at-risk groups. For microbial hazards, it is important that the unboiled volume of drinking-water, both consumed directly and used in food preparation, is used in the risk assessment, as heating will rapidly inactivate pathogens. This amount is lower than that used for deriving chemical guideline values and WQTs.

The daily exposure of a consumer can be assessed by multiplying the concentration of pathogens in drinking-water by the volume of drinking-water consumed. For the purposes of the Guidelines, unboiled drinking-water consumption is assumed to be 1 litre of water per day.

Dose–response assessment

The probability of an adverse health effect following exposure to one or more pathogenic organisms is derived from a dose–response model. Available dose–response data have been obtained mainly from studies using healthy adult volunteers. Several subgroups in the population, such as children, the elderly and immunocompromised persons, are more sensitive to infectious disease; currently, however, adequate data are lacking to account for this.

The conceptual basis for the infection model is the observation that exposure to the described dose leads to the probability of infection as a conditional event. For infection to occur, one or more viable pathogens must have been ingested. Furthermore, one or more of these ingested pathogens must have survived in the host's body. An important concept is the single-hit principle (i.e., that even a single organism may

be able to cause infection and disease, possibly with a low probability). This concept supersedes the concept of (minimum) infectious dose that is frequently used in older literature (see the supporting document *Hazard Characterization for Pathogens in Food and Water*; section 1.3).

In general, well dispersed pathogens in water are considered to be Poisson distributed. When the individual probability of any organism to survive and start infection is the same, the dose–response relation simplifies to an exponential function. If, however, there is heterogeneity in this individual probability, this leads to the beta-Poisson dose–response relation, where the "beta" stands for the distribution of the individual probabilities among pathogens (and hosts). At low exposures, such as would typically occur in drinking-water, the dose–response model is approximately linear and can be represented simply as the probability of infection resulting from exposure to a single organism (see the supporting document *Hazard Characterization for Pathogens in Food and Water*; section 1.3).

Risk characterization

Risk characterization brings together the data collected on pathogen exposure, dose–response, severity and disease burden.

The probability of infection can be estimated as the product of the exposure by drinking-water and the probability that exposure to one organism would result in infection. The probability of infection per day is multiplied by 365 to calculate the probability of infection per year. In doing so, it is assumed that different exposure events are independent, in that no protective immunity is built up. This simplification is justified for low risks only.

Not all infected individuals will develop clinical illness; asymptomatic infection is common for most pathogens. The percentage of infected persons that will develop clinical illness depends on the pathogen, but also on other factors, such as the immune status of the host. Risk of illness per year is obtained by multiplying the probability of infection by the probability of illness given infection.

The low numbers in Table 7.3 can be interpreted to represent the probability that a single individual will develop illness in a given year. For example, a risk of illness for *Campylobacter* of 2.5×10^{-4} per year indicates that, on average, 1 out of 4000 consumers would contract campylobacteriosis from drinking-water.

To translate the risk of developing a specific illness to disease burden per case, the metric DALYs is used. This should reflect not only the effects of acute end-points (e.g., diarrhoeal illness) but also mortality and the effects of more serious end-points (e.g., Guillain-Barré syndrome associated with *Campylobacter*). Disease burden per case varies widely. For example, the disease burden per 1000 cases of rotavirus diarrhoea is 480 DALYs in low-income regions, where child mortality frequently occurs. However, it is only 14 DALYs per 1000 cases in high-income regions, where hospital facilities are accessible to the great majority of the population (see the supporting document *Quantifying Public Health Risk in the WHO Guidelines for Drinking-water*

Table 7.3 Linking tolerable disease burden and source water quality for reference pathogens: example calculation

River water (human and animal pollution)		*Cryptosporidium*	*Campylobacter*	Rotavirus[a]
Raw water quality (C_R)	Organisms per litre	10	100	10
Treatment effect needed to reach tolerable risk (PT)	*Percent reduction*	*99.994%*	*99.99987%*	*99.99968%*
Drinking-water quality (C_D)	Organisms per litre	6.3×10^{-4}	1.3×10^{-4}	3.2×10^{-5}
Consumption of unheated drinking-water (V)	Litres per day	1	1	1
Exposure by drinking-water (E)	Organisms per day	6.3×10^{-4}	1.3×10^{-4}	3.2×10^{-5}
Dose–response (r)	Probability of infection per organism	4.0×10^{-3}	1.8×10^{-2}	2.7×10^{-1}
Risk of infection ($P_{inf,d}$)	Per day	2.5×10^{-6}	2.3×10^{-6}	8.5×10^{-6}
Risk of infection ($P_{inf,y}$)	Per year	9.2×10^{-4}	8.3×10^{-4}	3.1×10^{-3}
Risk of (diarrhoeal) illness given infection ($P_{ill\|inf}$)		0.7	0.3	0.5
Risk of (diarrhoeal) illness (P_{ill})	Per year	6.4×10^{-4}	2.5×10^{-4}	1.6×10^{-3}
Disease burden (db)	DALYs per case	1.5×10^{-3}	4.6×10^{-3}	1.4×10^{-2}
Susceptible fraction (f_s)	Percentage of population	100%	100%	6%
Disease burden (DB)	DALYs per year	1×10^{-6}	1×10^{-6}	1×10^{-6}
Formulas:	$C_D = C_R \times (1 - PT)$ $E = C_D \times V$ $P_{inf,d} = E \times r$			

[a] Data from high-income regions. In low-income regions, severity is typically higher, but drinking-water transmission is unlikely to dominate.

Quality; section 1.3). This considerable difference in disease burden results in far stricter treatment requirements in low-income regions for the same source water quality in order to obtain the same risk (expressed as DALYs per year). Ideally, the default disease burden estimates in Table 7.3 should be adapted to specific national situations. In Table 7.3, no accounting is made for effects on immunocompromised persons (e.g., cryptosporidiosis in HIV/AIDS patients), which is significant in some countries. Section 3.3.3 gives more information on the DALY metric and how it is applied to derive a reference level of risk.

Only a proportion of the population may be susceptible to some pathogens, because immunity developed after an initial episode of infection or illness may provide lifelong protection. Examples include HAV and rotaviruses. It is estimated that in developing countries, all children above the age of 5 years are immune to rotaviruses because of repeated exposure in the first years of life. This translates to an

average of 17% of the population being susceptible to rotavirus illness. In developed countries, rotavirus infection is also common in the first years of life, and the illness is diagnosed mainly in young children, but the percentage of young children as part of the total population is lower. This translates to an average of 6% of the population in developed countries being susceptible.

The uncertainty of the risk estimate is the result of the uncertainty and variability of the data collected in the various steps of the risk assessment. Risk assessment models should ideally account for this variability and uncertainty, although here we present only point estimates (see below).

It is important to choose the most appropriate point estimate for each of the variables. Theoretical considerations show that risks are directly proportional to the arithmetic mean of the ingested dose. Hence, arithmetic means of variables such as concentration in raw water, removal by treatment and consumption of drinking-water are recommended. This recommendation is different from the usual practice among microbiologists and engineers of converting concentrations and treatment effects to log-values and making calculations or specifications on the log-scale. Such calculations result in estimates of the geometric mean rather than the arithmetic mean, and these may significantly underestimate risk. Analysing site-specific data may therefore require going back to the raw data rather than relying on reported log-transformed values.

7.2.3 Risk-based performance target setting

The process outlined above enables estimation of risk on a population level, taking account of source water quality and impact of control. This can be compared with the reference level of risk (see section 3.3.2) or a locally developed tolerable risk. The calculations enable quantification of the degree of source protection or treatment that is needed to achieve a specified level of acceptable risk and analysis of the estimated impact of changes in control measures.

Performance targets are most frequently applied to treatment performance – i.e., to determine the microbial reduction necessary to ensure water safety. A performance target may be applied to a specific system (i.e., allow account to be taken of specific source water characteristics) or generalized (e.g., impose source water quality assumptions on all systems of a certain type or abstracting water from a certain type of source).

Figure 7.2 illustrates the targets for treatment performance for a range of pathogens occurring in the raw water. For example, 10 microorganisms per litre of source water will lead to a performance target of 4.2 logs (or 99.994%) for *Cryptosporidium* or of 5.5 logs (99.99968%) for rotavirus in high-income regions (see also Table 7.4 below). The difference in performance targets for rotavirus in high- and low-income countries (5.5 and 7.6 logs; Figure 7.2) is related to the difference in disease severity by this organism. In low-income countries, the child case fatality rate is relatively high, and, as a consequence, the disease burden is higher. Also, a larger proportion of the

Figure 7.2 Performance targets for selected bacterial, viral and protozoan pathogens in relation to raw water quality (to achieve 10^{-6} DALYs per person per year)

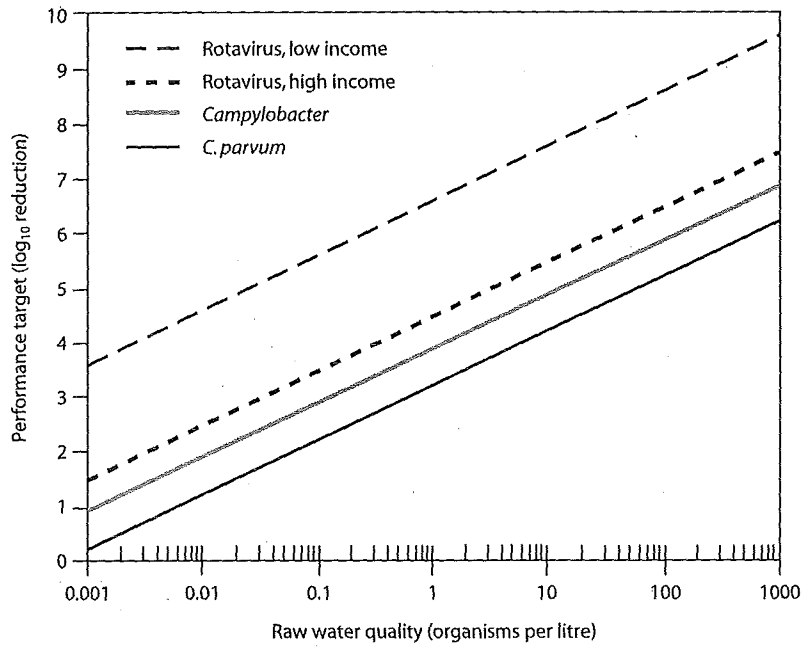


Table 7.4 Health-based targets derived from example calculation in Table 7.3

	Cryptosporidium	Campylobacter	Rotavirus[a]
Organisms per litre in source water	10	100	10
Health outcome target	10^{-6} DALYs per person per year	10^{-6} DALYs per person per year	10^{-6} DALYs per person per year
Risk of diarrhoeal illness[b]	1 per 1600 per year	1 per 4000 per year	1 per 11 000 per year
Drinking-water quality	1 per 1600 litres	1 per 8000 litres	1 per 32 000 litres
Performance target[c]	4.2 $\log_{10}$ units	5.9 $\log_{10}$ units	5.5 $\log_{10}$ units

[a] Data from high-income regions. In low-income regions, severity is typically higher, but drinking-water transmission is unlikely to dominate.
[b] For the susceptible population.
[c] Performance target is a measure of log reduction of pathogens based on source water quality.

population in low-income countries is under the age of 5 and at risk for rotavirus infection.

The derivation of these performance targets is described in Table 7.4, which provides an example of the data and calculations that would normally be used to construct a risk assessment model for waterborne pathogens. The table presents data for representatives of the three major groups of pathogens (bacteria, viruses and protozoa) from a range of sources. These example calculations aim at achieving the reference level of risk of 10^{-6} DALYs per person per year, as described in section 3.3.3. The

data in the table illustrate the calculations needed to arrive at a risk estimate and are not guideline values.

7.2.4 Presenting the outcome of performance target development

Table 7.4 presents some data from Table 7.3 in a format that is more meaningful to risk managers. The average concentration of pathogens in drinking-water is included for information. It is not a WQT, nor is it intended to encourage pathogen monitoring in finished water. As an example, a concentration of 6.3×10^{-4} *Cryptosporidium* per litre (see Table 7.3) corresponds to 1 oocyst per 1600 litres (see Table 7.4). The performance target (in the row "Treatment effect" in Table 7.3), expressed as a percent reduction, is the most important management information in the risk assessment table. It can also be expressed as a log-reduction value. For example, 99.99968% reduction for rotavirus corresponds to $5.5 \log_{10}$ units.

7.2.5 Issues in adapting risk-based performance target setting to national/local circumstances

The choice of pathogens in Table 7.4 was based mainly on availability of data on resistance to water treatment, infectivity and disease burden. The pathogens illustrated may not be priority pathogens in all regions of the world, although amending pathogen selection would normally have a small impact on the overall conclusions derived from applying the model.

Wherever possible, country- or site-specific information should be used in assessments of this type. If no specific data are available, an approximate risk estimate can be based on default values (see Table 7.5 below).

Table 7.4 accounts only for changes in water quality derived from treatment and not source protection measures, which are often important contributors to overall safety, impacting on pathogen concentration and/or variability. The risk estimates presented in Table 7.3 also assume that there is no degradation of water quality in the distribution network. These may not be realistic assumptions under all circumstances, and it is advisable to take these factors into account wherever possible.

Table 7.4 presents point estimates only and does not account for variability and uncertainty. Full risk assessment models would incorporate such factors by representing the input variables by statistical distributions rather than by point estimates. However, such models are currently beyond the means of many countries, and data to define such distributions are scarce. Producing such data may involve considerable efforts in terms of time and resources, but will lead to much improved insight into the actual source water quality and treatment performance.

The necessary degree of treatment also depends on the values assumed for variables (e.g., drinking-water consumption, fraction of the population that is susceptible) that can be taken into account in the risk assessment model. Figure 7.3 shows the effect of variation in the consumption of unboiled drinking-water on the performance targets for *Cryptosporidium parvum*. For example, if the raw water concentration

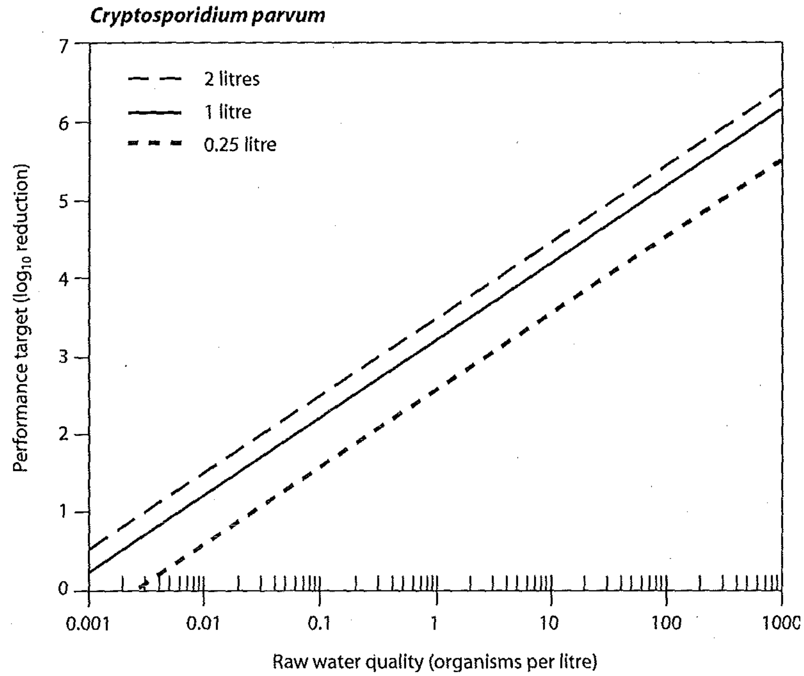


Figure 7.3 Performance targets for *Cryptosporidium parvum* in relation to the daily consumption of unboiled drinking-water (to achieve 10^{-6} DALYs per person per year)

is 1 oocyst per litre, the performance target varies between 2.6 and 3.5 $\log_{10}$ units if consumption values vary between 0.25 and 2 litres per day. Some outbreak data suggest that in developed countries, a significant proportion of the population above 5 years of age may not be immune to rotavirus illness. Figure 7.4 shows the effect of variation in the susceptible fraction of the population. For example, if the raw water concentration is 10 virus particles per litre, the performance target increases from 5.5 to 6.7 if the susceptible fraction increases from 6 to 100%.

7.2.6 Health outcome targets

Health outcome targets that identify disease reductions in a community may be applied to the WSPs developed for specified water quality interventions at community and household levels. These targets would identify expected disease reductions in communities receiving the interventions.

The prioritization of water quality interventions should focus on those aspects that are estimated to contribute more than e.g. 5% of the burden of a given disease (e.g., 5% of total diarrhoea). In many parts of the world, the implementation of a water quality intervention that results in an estimated health gain of more than 5% would

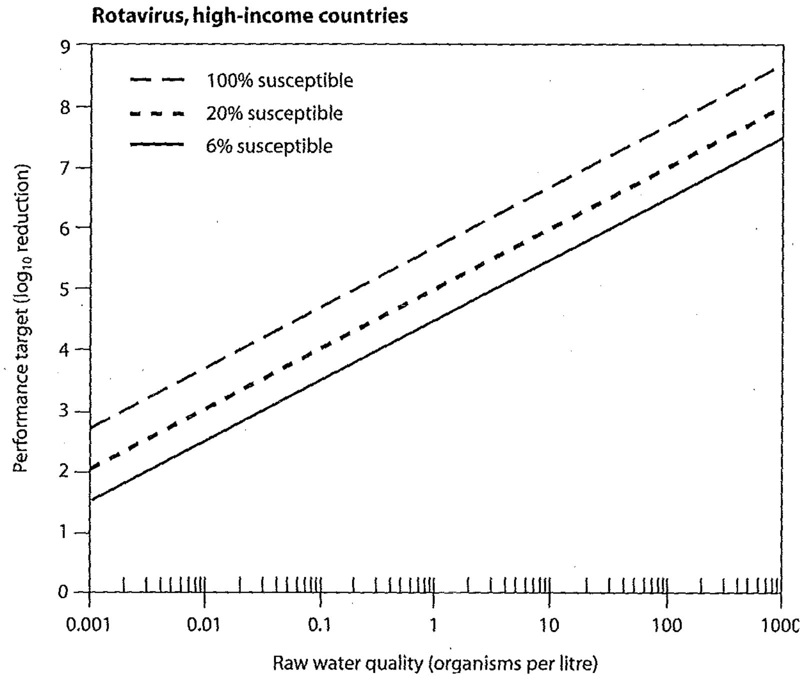


Figure 7.4 Performance targets for rotavirus in relation to the fraction of the population that is susceptible to illness (to achieve 10^{-6} DALYs per person per year)

be considered extremely worthwhile. Directly demonstrating the health gains arising from improving water quality – as assessed, for example, by reduced *E. coli* counts at the point of consumption – may be possible where disease burden is high and effective interventions are applied and can be a powerful tool to demonstrate a first step in incremental water safety improvement.

Where a specified quantified disease reduction is identified as a health outcome target, it may be advisable to undertake ongoing proactive public health surveillance among representative communities rather than through passive surveillance.

7.3 Occurrence and treatment of pathogens

As discussed in section 4.1, system assessment involves determining whether the drinking-water supply chain as a whole can deliver drinking-water quality that meets identified targets. This requires an understanding of the quality of source water and the efficacy of control measures.

An understanding of pathogen occurrence in source waters is essential, because it facilitates selection of the highest-quality source for drinking-water supply, determines pathogen loads and concentrations in source waters and provides a basis for establishing treatment requirements to meet health-based targets within a WSP.

Understanding the efficacy of control measures includes validation (see sections 2.1.2 and 4.1.7). Validation is important both in ensuring that treatment will achieve the desired goals (performance targets) and in assessing areas in which efficacy may be improved (e.g., by comparing performance achieved with that shown to be achievable through well run processes).

7.3.1 Occurrence

The occurrence of pathogens and indicator organisms in groundwater and surface water sources depends on a number of factors, including intrinsic physical and chemical characteristics of the catchment area and the magnitude and range of human activities and animal sources that release pathogens to the environment.

In surface waters, potential pathogen sources include point sources, such as municipal sewerage and urban stormwater overflows, as well as non-point sources, such as contaminated runoff from agricultural areas and areas with sanitation through on-site septic systems and latrines. Other sources are wildlife and direct access of livestock to surface water bodies. Many pathogens in surface water bodies will reduce in concentration due to dilution, settling and die-off due to environmental effects (thermal, sunlight, predation, etc.).

Groundwater is often less vulnerable to the immediate influence of contamination sources due to the barrier effects provided by the overlying soil and its unsaturated zone. Groundwater contamination is more frequent where these protective barriers are breached, allowing direct contamination. This may occur through contaminated or abandoned wells or underground pollution sources, such as latrines and sewer lines. However, a number of studies have demonstrated pathogens and indicator organisms in groundwater, even at depth in the absence of such hazardous circumstances, especially where surface contamination is intense, as with land application of manures or other faecal impacts from intensive animal husbandry (e.g., feedlots). Impacts of these contamination sources can be greatly reduced by, for example, aquifer protection measures and proper well design and construction.

For more detailed discussion on both pathogen sources and key factors determining their fate, refer to the supporting documents *Protecting Surface Waters for Health* and *Protecting Groundwaters for Health* (section 1.3).

Table 7.5 presents estimates of high concentrations of enteric pathogens and microbial indicators in different types of surface waters and groundwaters, derived primarily from a review of published data. High values have been presented because they represent higher-risk situations and, therefore, greater degrees of vulnerability. The table includes two categories of data for rivers and streams: one for impacted sources and one for less impacted sources. More detailed information about these data is published in a variety of references, including several papers cited in Dangendorf et al. (2003).

The data in Table 7.5 provide a useful guide to the concentrations of enteric pathogens and indicator microorganisms in a variety of sources. However, there are a number of limitations and sources of uncertainty in these data, including:

Table 7.5 Examples of high detectable concentrations (per litre) of enteric pathogens and faecal indicators in different types of source waters from the scientific literature

Pathogen or indicator group	Lakes and reservoirs	Impacted rivers and streams	Wilderness rivers and streams	Groundwater
Campylobacter	20–500	90–2500	0–1100	0–10
Salmonella	—	3–58 000 (3–1000)[a]	1–4	—
E. coli (generic)	10 000–1 000 000	30 000–1 000 000	6000–30 000	0–1000
Viruses	1–10	30–60	0–3	0–2
Cryptosporidium	4–290	2–480	2–240	0–1
Giardia	2–30	1–470	1–2	0–1

[a] Lower range is a more recent measurement.

— the lack of knowledge on sampling locations in relation to pollution sources;
— concerns about the sensitivity of analytical techniques, particularly for viruses and protozoa; and
— the lack of knowledge about the viability and human infectivity of *Cryptosporidium* oocysts, *Giardia* cysts and viruses detected in the different studies, because the various methods used are based upon non-culture methods (e.g., microscopy or molecular/nucleic acid analysis).

While the table provides an indication of concentrations that might be present in water sources, by far the most accurate way of determining pathogen loads and concentrations in specific catchments and other water sources is by analysing water quality over a period of time, taking care to include consideration of seasonal variation and peak events such as storms. Direct measurement of pathogens and indicators in the specific source waters for which a WSP and its target pathogens are being established is recommended wherever possible, because this provides the best estimates of microbial concentrations and loads.

7.3.2 Treatment

Waters of very high quality – for example, groundwater from confined aquifers – may rely on source water and distribution system protection as the principal control measures for provision of safe water. More typically, water treatment is required to remove or destroy pathogenic microorganisms. In many cases (e.g., poor-quality surface water), multiple treatment stages are required, including, for example, coagulation, flocculation, sedimentation, filtration and disinfection. Table 7.6 provides a summary of treatment processes that are commonly used individually or in combination to achieve microbial reductions.

The microbial reductions presented in Table 7.6 are for broad groups or categories of microbes: bacteria, viruses and protozoa. This is because it is generally the case that treatment efficacy for microbial reduction differs among these microbial groups due to the inherently different properties of the microbes (e.g., size, nature of protective outer layers, physicochemical surface properties, etc.). Within these microbial groups,

Table 7.6 Reductions of bacteria, viruses and protozoa achieved by typical and enhanced water treatment processes

Treatment process	Enteric pathogen group	Baseline removal	Maximum removal possible
Pretreatment			
Roughing filters	Bacteria	50%	Up to 95% if protected from turbidity spikes by dynamic filter or if used only when ripened
	Viruses	No data available	
	Protozoa	No data available, some removal likely	Performance for protozoan removal likely to correspond to turbidity removal
Microstraining	Bacteria, viruses, protozoa	Zero	Generally ineffective
Off-stream/ bankside storage	All	Recontamination may be significant and add to pollution levels in incoming water; growth of algae may cause deterioration in quality	Avoiding intake at periods of peak turbidity equivalent to 90% removal; compartmentalized storages provide 15–230 times rates of removal
	Bacteria	Zero (assumes short circuiting)	90% removal in 10–40 days actual detention time
	Viruses	Zero (assumes short circuiting)	93% removal in 100 days actual detention time
	Protozoa	Zero (assumes short circuiting)	99% removal in 3 weeks actual detention time
Bankside infiltration	Bacteria	99.9% after 2 m 99.99% after 4 m (minimum based on virus removal)	
	Viruses	99.9% after 2 m 99.99% after 4 m	
	Protozoa	99.99%	
Coagulation/flocculation/sedimentation			
Conventional clarification	Bacteria	30%	90% (depending on the coagulant, pH, temperature, alkalinity, turbidity)
	Viruses	30%	70% (as above)
	Protozoa	30%	90% (as above)
High-rate clarification	Bacteria	At least 30%	
	Viruses	At least 30%	
	Protozoa	95%	99.99% (depending on use of appropriate blanket polymer)
Dissolved air flotation	Bacteria	No data available	
	Viruses	No data available	
	Protozoa	95%	99.9% (depending on pH, coagulant dose, flocculation time, recycle ratio)

Table 7.6 ***Continued***

Treatment process	Enteric pathogen group	Baseline removal	Maximum removal possible
Lime softening	Bacteria	20% at pH 9.5 for 6 h at 2–8 °C	99% at pH 11.5 for 6 h at 2–8 °C
	Viruses	90% at pH < 11 for 6 h	99.99% at pH > 11, depending on the virus and on settling time
	Protozoa	Low inactivation	99% through precipitative sedimentation and inactivation at pH 11.5
Ion exchange			
	Bacteria	Zero	
	Viruses	Zero	
	Protozoa	Zero	
Filtration			
Granular high-rate filtration	Bacteria	No data available	99% under optimum coagulation conditions
	Viruses	No data available	99.9% under optimum coagulation conditions
	Protozoa	70%	99.9% under optimum coagulation conditions
Slow sand filtration	Bacteria	50%	99.5% under optimum ripening, cleaning and refilling and in the absence of short circuiting
	Viruses	20%	99.99% under optimum ripening, cleaning and refilling and in the absence of short circuiting
	Protozoa	50%	99% under optimum ripening, cleaning and refilling and in the absence of short circuiting
Precoat filtration,	Bacteria	30–50%	96–99.9% using chemical pretreatment with coagulants polymers
diatomaceous earth and perlite	Viruses	90%	98% using chemical pretreatment with coagulants or polymers
	Protozoa	99.9%	99.99%, depending on media grade and filtration rate
Membrane filtration – microfiltration	Bacteria	99.9–99.99%, providing adequate pretreatment and membrane integrity conserved	
	Viruses	<90%	
	Protozoa	99.9–99.99%, providing adequate pretreatment and membrane integrity conserved	
Membrane filtration – ultrafiltration,	Bacteria	Complete removal, providing adequate pretreatment and membrane integrity conserved	

continued

Table 7.6 ***Continued***

Treatment process	Enteric pathogen group	Baseline removal	Maximum removal possible
nanofiltration and reverse osmosis	Viruses	Complete removal with nanofilters, with reverse osmosis and at lower pore sizes of ultrafilters, providing adequate pretreatment and membrane integrity conserved	
	Protozoa	Complete removal, providing adequate pretreatment and membrane integrity conserved	
Disinfection			
Chlorine	Bacteria	Ct_{99}: 0.08 mg·min/litre at 1–2 °C, pH 7; 3.3 mg·min/litre at 1–2 °C, pH 8.5	
	Viruses	Ct_{99}: 12 mg·min/litre at 0–5 °C; 8 mg·min/litre at 10 °C; both at pH 7–7.5	
	Protozoa	*Giardia* Ct_{99}: 230 mg·min/litre at 0.5 °C; 100 mg·min/litre at 10 °C; 41 mg·min/litre at 25 °C; all at pH 7–7.5 *Cryptosporidium* not killed	
Monochloramine	Bacteria	Ct_{99}: 94 mg·min/litre at 1–2 °C, pH 7; 278 mg·min/litre at 1–2 °C, pH 8.5	
	Viruses	Ct_{99}: 1240 mg·min/litre at 1 °C; 430 mg·min/litre at 15 °C; both at pH 6–9	
	Protozoa	*Giardia* Ct_{99}: 2550 mg·min/litre at 1 °C; 1000 mg·min/litre at 15 °C; both at pH 6–9 *Cryptosporidium* not inactivated	
Chlorine dioxide	Bacteria	Ct_{99}: 0.13 mg·min/litre at 1–2 °C, pH 7; 0.19 mg·min/litre at 1–2 °C, pH 8.5	
	Viruses	Ct_{99}: 8.4 mg·min/litre at 1 °C; 2.8 mg·min/litre at 15 °C; both at pH 6–9	
	Protozoa	*Giardia* Ct_{99}: 42 mg·min/litre at 1 °C; 15 mg·min/litre at 10 °C; 7.3 mg·min/litre at 25 °C; all at pH 6–9 *Cryptosporidium* Ct_{99}: 40 mg·min/litre at 22 °C, pH 8	

Table 7.6 *Continued*

Treatment process	Enteric pathogen group	Baseline removal	Maximum removal possible
Ozone	Bacteria	Ct_{99}: 0.02 mg·min/litre at 5 °C, pH 6–7	
	Viruses	Ct_{99}: 0.9 mg·min/litre at 1 °C, 0.3 mg·min/litre at 15 °C	
	Protozoa	*Giardia* Ct_{99}: 1.9 mg·min/litre at 1 °C; 0.63 mg·min/litre at 15 °C, pH 6–9 *Cryptosporidium* Ct_{99}: 40 mg·min/litre at 1 °C; 4.4 mg·min/litre at 22 °C	
UV irradiation	Bacteria	99% inactivation: 7 mJ/cm^2	
	Viruses	99% inactivation: 59 mJ/cm^2	
	Protozoa	*Giardia* 99% inactivation: 5 mJ/cm^2 *Cryptosporidium* 99.9% inactivation: 10 mJ/cm^2	

Note: Ct and UV apply to microorganisms in suspension, not embedded in particles or in biofilm.

differences in treatment process efficiencies are smaller among the specific species, types or strains of microbes. Such differences do occur, however, and the table presents conservative estimates of microbial reductions based on the more resistant or persistent pathogenic members of that microbial group. Where differences in removal by treatment between specific members of a microbial group are great, the results for the individual microbes are presented separately in the table.

Non-piped water supplies such as roof catchments (rainwater harvesting) and water collected from wells or springs may often be contaminated with pathogens. Such sources often require treatment and protected storage to achieve safe water. Many of the processes used for water treatment in households are the same as those used for community-managed and other piped water supplies (Table 7.6). The performance of these treatment processes at the household level is likely to be similar to that for baseline removal of microbes, as shown in Table 7.6. However, there are additional water treatment technologies recommended for use in non-piped water supplies at the household level that typically are not used for piped supplies.

Further information about these water treatment processes, their operations and their performance for pathogen reduction is provided in more detail in supporting documents (for piped water supplies: *Water Treatment and Pathogen Control*; for non-piped [primarily household] water supplies: *Managing Water in the Home*; see section 1.3).

7.4 Verification of microbial safety and quality

Pathogenic agents have several properties that distinguish them from other drinking-water contaminants:

- Pathogens are discrete and not in solution.
- Pathogens are often clumped or adherent to suspended solids in water.
- The likelihood of a successful challenge by a pathogen, resulting in infection, depends upon the invasiveness and virulence of the pathogen, as well as upon the immunity of the individual.
- If infection is established, pathogens multiply in their host. Certain pathogenic bacteria are also able to multiply in food or beverages, thereby perpetuating or even increasing the chances of infection.
- Unlike many chemical agents, the dose–response of pathogens is not cumulative.

Faecal indicator bacteria, including *E. coli*, are important parameters for verification of microbial quality (see also section 2.2.1). Such water quality verification complements operational monitoring and assessments of contamination risks – for instance, through auditing of treatment works, evaluation of process control and sanitary inspection.

Faecal indicator bacteria should fulfil certain criteria to give meaningful results. They should be universally present in high numbers in the faeces of humans and other warm-blooded animals, should be readily detectable by simple methods and should not grow in natural water.

The indicator organism of choice for faecal pollution is *E. coli*. Thermotolerant coliforms can be used as an alternative to the test for *E. coli* in many circumstances.

Water intended for human consumption should contain no indicator organisms. In the majority of cases, monitoring for indicator bacteria provides a high degree of safety because of their large numbers in polluted waters.

Pathogens more resistant to conventional environmental conditions or treatment technologies may be present in treated drinking-water in the absence of *E. coli*. Retrospective studies of waterborne disease outbreaks and advances in the understanding of the behaviour of pathogens in water have shown that continued reliance on assumptions surrounding the absence or presence of *E. coli* does not ensure that optimal decisions are made regarding water safety.

Protozoa and some enteroviruses are more resistant to many disinfectants, including chlorine, and may remain viable (and pathogenic) in drinking-water following disinfection. Other organisms may be more appropriate indicators of persistent microbial hazards, and their selection as additional indicators should be evaluated in relation to local circumstances and scientific understanding. Therefore, verification may require analysis of a range of organisms, such as intestinal enterococci, (spores of) *Clostridium perfringens* and bacteriophages.

Table 7.7 presents guideline values for verification of microbial quality of drinking-water. Individual values should not be used directly from the tables. The

Table 7.7 Guideline values for verification of microbial quality[a] (see also table 5.2)

Organisms	Guideline value
All water directly intended for drinking	
E. coli or thermotolerant coliform bacteria[b,c]	Must not be detectable in any 100-ml sample
Treated water entering the distribution system	
E. coli or thermotolerant coliform bacteria[b]	Must not be detectable in any 100-ml sample
Treated water in the distribution system	
E. coli or thermotolerant coliform bacteria[b]	Must not be detectable in any 100-ml sample

[a] Immediate investigative action must be taken if *E. coli* are detected.

[b] Although *E. coli* is the more precise indicator of faecal pollution, the count of thermotolerant coliform bacteria is an acceptable alternative. If necessary, proper confirmatory tests must be carried out. Total coliform bacteria are not acceptable indicators of the sanitary quality of water supplies, particularly in tropical areas, where many bacteria of no sanitary significance occur in almost all untreated supplies.

[c] It is recognized that in the great majority of rural water supplies, especially in developing countries, faecal contamination is widespread. Especially under these conditions, medium-term targets for the progressive improvement of water supplies should be set.

guidelines values should be used and interpreted in conjunction with the information contained in these Guidelines and other supporting documentation.

A consequence of variable susceptibility to pathogens is that exposure to drinking-water of a particular quality may lead to different health effects in different populations. For guideline derivation, it is necessary to define reference populations or, in some cases, to focus on specific sensitive subgroups. National or local authorities may wish to apply specific characteristics of their populations in deriving national standards.

7.5 Methods of detection of faecal indicator bacteria

Analysis for faecal indicator bacteria provides a sensitive, although not the most rapid, indication of pollution of drinking-water supplies. Because the growth medium and the conditions of incubation, as well as the nature and age of the water sample, can influence the species isolated and the count, microbiological examinations may have variable accuracy. This means that the standardization of methods and of laboratory procedures is of great importance if criteria for the microbial quality of water are to be uniform in different laboratories and internationally.

International standard methods should be evaluated under local circumstances before being adopted. Established standard methods are available, such as those of the ISO (Table 7.8) or methods of equivalent efficacy and reliability. It is desirable that established standard methods be used for routine examinations. Whatever method is chosen for detection of *E. coli* or thermotolerant coliforms, the importance of "resuscitating" or recovering environmentally damaged or disinfectant-damaged strains must be considered.

Table 7.8 International Organization for Standardization (ISO) standards for detection and enumeration of faecal indicator bacteria in water

ISO standard	Title (water quality)
6461-1:1986	Detection and enumeration of the spores of sulfite-reducing anaerobes (clostridia) — Part 1: Method by enrichment in a liquid medium
6461-2:1986	Detection and enumeration of the spores of sulfite-reducing anaerobes (clostridia) — Part 2: Method by membrane filtration
7704:1985	Evaluation of membrane filters used for microbiological analyses
7899-1:1984	Detection and enumeration of faecal streptococci – Part 1: Method by enrichment in a liquid medium
7899-2:1984	Detection and enumeration of faecal streptococci – Part 2: Method by membrane filtration
9308-1:1990	Detection and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive *Escherichia coli* – Part 1: Membrane filtration method
9308-2:1990	Detection and enumeration of coliform organisms, thermotolerant coliform organisms and presumptive *Escherichia coli* – Part 2: Multiple tube (most probable number) method

Table 9.2 Dose coefficients for ingestion of radionuclides by adult members of the public

Category	Radionuclide	Dose coefficient (mSv/Bq)
Natural uranium series	Uranium-238	4.5×10^{-5}
	Uranium-234	4.9×10^{-5}
	Thorium-230	2.1×10^{-4}
	Radium-226	2.8×10^{-4}
	Lead-210	6.9×10^{-4}
	Polonium-210	1.2×10^{-3}
Natural thorium series	Thorium-232	2.3×10^{-4}
	Radium-228	6.9×10^{-4}
	Thorium-228	7.2×10^{-5}
Fission products	Caesium-134	1.9×10^{-5}
	Caesium-137	1.3×10^{-5}
	Strontium-90	2.8×10^{-5}
	Iodine-131	2.2×10^{-5}
Other radionuclides	Tritium	1.8×10^{-8}
	Carbon-14	5.8×10^{-7}
	Plutonium-239	2.5×10^{-4}
	Americium-241	2.0×10^{-4}

naturally occurring radionuclides or those arising from human activities that might be found in drinking-water supplies (IAEA, 1996; ICRP, 1996).

9.3 Guidance levels for radionuclides in drinking-water

The guidance levels for radionuclides in drinking-water are presented in Table 9.3 for radionuclides originating from natural sources or discharged into the environment as the result of current or past activities. These levels also apply to radionuclides released due to nuclear accidents that occurred more than 1 year previously. The activity concentration values in Table 9.3 correspond to an RDL of 0.1 mSv/year from each radionuclide listed if their concentration in the drinking-water consumed during the year does not exceed these values. The associated risk estimate was given at the beginning of this chapter. However, for the first year immediately after an accident, generic action levels for foodstuffs apply as described in the International Basic Safety Standards (IAEA, 1996) and other relevant WHO and IAEA publications (WHO, 1988; IAEA, 1997, 1999).

The guidance levels for radionuclides in drinking-water were calculated by the following equation:

$$GL = IDC/(h_{ing} \cdot q)$$

where:

GL = guidance level of radionuclide in drinking-water (Bq/litre),
IDC = individual dose criterion, equal to 0.1 mSv/year for this calculation,
h_{ing} = dose coefficient for ingestion by adults (mSv/Bq),
q = annual ingested volume of drinking-water, assumed to be 730 litres/year.

Table 9.3 Guidance levels for radionuclides in drinking-water

Radionuclides	Guidance level (Bq/litre)[a]	Radionuclides	Guidance level (Bq/litre)[a]	Radionuclides	Guidance level (Bq/litre)[a]
^{3}H	10 000	^{93}Mo	100	^{140}La	100
^{7}Be	10 000	^{99}Mo	100	^{139}Ce	1000
^{14}C	100	^{96}Tc	100	^{141}Ce	100
^{22}Na	100	^{97}Tc	1000	^{143}Ce	100
^{32}P	100	^{97m}Tc	100	^{144}Ce	10
^{33}P	1 000	^{99}Tc	100	^{143}Pr	100
^{35}S	100	^{97}Ru	1000	^{147}Nd	100
^{36}Cl	100	^{103}Ru	100	^{147}Pm	1000
^{45}Ca	100	^{106}Ru	10	^{149}Pm	100
^{47}Ca	100	^{105}Rh	1000	^{151}Sm	1000
^{46}Sc	100	^{103}Pd	1000	^{153}Sm	100
^{47}Sc	100	^{105}Ag	100	^{152}Eu	100
^{48}Sc	100	^{110m}Ag	100	^{154}Eu	100
^{48}V	100	^{111}Ag	100	^{155}Eu	1000
^{51}Cr	10 000	^{109}Cd	100	^{153}Gd	1000
^{52}Mn	100	^{115}Cd	100	^{160}Tb	100
^{53}Mn	10 000	^{115m}Cd	100	^{169}Er	1000
^{54}Mn	100	^{111}In	1000	^{171}Tm	1000
^{55}Fe	1 000	^{114m}In	100	^{175}Yb	1000
^{59}Fe	100	^{113}Sn	100	^{182}Ta	100
^{56}Co	100	^{125}Sn	100	^{181}W	1000
^{57}Co	1 000	^{122}Sb	100	^{185}W	1000
^{58}Co	100	^{124}Sb	100	^{186}Re	100
^{60}Co	100	^{125}Sb	100	^{185}Os	100
^{59}Ni	1 000	^{123m}Te	100	^{191}Os	100
^{63}Ni	1 000	^{127}Te	1000	^{193}Os	100
^{65}Zn	100	^{127m}Te	100	^{190}Ir	100
^{71}Ge	10 000	^{129}Te	1000	^{192}Ir	100
^{73}As	1 000	^{129m}Te	100	^{191}Pt	1000
^{74}As	100	^{131}Te	1000	^{193m}Pt	1000
^{76}As	100	^{131m}Te	100	^{198}Au	100
^{77}As	1 000	^{132}Te	100	^{199}Au	1000
^{75}Se	100	^{125}I	10	^{197}Hg	1000
^{82}Br	100	^{126}I	10	^{203}Hg	100
^{86}Rb	100	^{129}I	1000	^{200}Tl	1000
^{85}Sr	100	^{131}I	10	^{201}Tl	1000
^{89}Sr	100	^{129}Cs	1000	^{202}Tl	1000
^{90}Sr	10	^{131}Cs	1000	^{204}Tl	100
^{90}Y	100	^{132}Cs	100	^{203}Pb	1000
^{91}Y	100	^{134}Cs	10	^{206}Bi	100
^{93}Zr	100	^{135}Cs	100	^{207}Bi	100
^{95}Zr	100	^{136}Cs	100	^{210}Bi[b]	100
^{93m}Nb	1 000	^{137}Cs	10	^{210}Pb[b]	0.1
^{94}Nb	100	^{131}Ba	1000	^{210}Po[b]	0.1
^{95}Nb	100	^{140}Ba	100	^{223}Ra[b]	1
^{224}Ra[b]	1	^{235}U[b]	1	^{242}Cm	10
^{225}Ra	1	^{236}U[b]	1	^{243}Cm	1
^{226}Ra[b]	1	^{237}U	100	^{244}Cm	1
^{228}Ra[b]	0.1	^{238}U[b,c]	10	^{245}Cm	1

continued

Table 9.3 ***Continued***

Radionuclides	Guidance level (Bq/litre)	Radionuclides	Guidance level (Bq/litre)	Radionuclides	Guidance level (Bq/litre)
$^{227}Th^{b}$	10	^{237}Np	1	^{246}Cm	1
$^{228}Th^{b}$	1	^{239}Np	100	^{247}Cm	1
^{229}Th	0.1	^{236}Pu	1	^{248}Cm	0.1
$^{230}Th^{b}$	1	^{237}Pu	1000	^{249}Bk	100
$^{231}Th^{b}$	1 000	^{238}Pu	1	^{246}Cf	100
$^{232}Th^{b}$	1	^{239}Pu	1	^{248}Cf	10
$^{234}Th^{b}$	100	^{240}Pu	1	^{249}Cf	1
^{230}Pa	100	^{241}Pu	10	^{250}Cf	1
$^{231}Pa^{b}$	0.1	^{242}Pu	1	^{251}Cf	1
^{233}Pa	100	^{244}Pu	1	^{252}Cf	1
^{230}U	1	^{241}Am	1	^{253}Cf	100
^{231}U	1 000	^{242}Am	1000	^{254}Cf	1
^{232}U	1	^{242m}Am	1	^{253}Es	10
^{233}U	1	^{243}Am	1	^{254}Es	10
$^{234}U^{b}$	10			^{254m}Es	100

[a] Guidance levels are rounded according to averaging the log scale values (to 10^{n} if the calculated value was below 3×10^{n} and above $3 \times 10^{n-1}$).
[b] Natural radionuclides.
[c] The provisional guideline value for uranium in drinking-water is 15 μg/litre based on its chemical toxicity for the kidney (see section 8.5).

The higher age-dependent dose coefficients calculated for children (accounting for the higher uptake and/or metabolic rates) do not lead to significantly higher doses due to the lower mean volume of drinking-water consumed by infants and children. Consequently, the recommended RDL of committed effective dose of 0.1 mSv/year from 1 year's consumption of drinking-water applies independently of age.

9.4 Monitoring and assessment for dissolved radionuclides

9.4.1 Screening of drinking-water supplies

The process of identifying individual radioactive species and determining their concentration requires sophisticated and expensive analysis, which is normally not justified, because the concentrations of radionuclides in most circumstances are very low. A more practical approach is to use a screening procedure, where the total radioactivity present in the form of alpha and beta radiation is first determined, without regard to the identity of specific radionuclides.

Screening levels for drinking-water below which no further action is required are 0.5 Bq/litre for gross alpha activity and 1 Bq/litre for gross beta activity. The gross beta activity screening level was published in the second edition of the Guidelines and, in the worse case (radium-222), would lead to a dose close to the guidance RDL of 0.1 mSv/year. The screening level for gross alpha activity is 0.5 Bq/litre (instead of the former 0.1 Bq/litre), as this activity concentration reflects values nearer the radionuclide-specific guidance RDL.

9.4.2 Strategy for assessing drinking-water

If either of the screening levels is exceeded, then the specific radionuclides producing this activity should be identified and their individual activity concentrations measured. From these data, an estimate of committed effective dose for each radionuclide should be made and the sum of these doses determined. If the following additive formula is satisfied, no further action is required:

$$\sum_i \frac{C_i}{GL_i} \leq 1$$

where:

C_i = the measured activity concentration of radionuclide i, and
GL_i = the guidance level value (see Table 9.3) of radionuclide i that, at an intake of 2 litres/day for 1 year, will result in a committed effective dose of 0.1 mSv/year.

Where the sum exceeds unity for a single sample, the RDL of 0.1 mSv would be exceeded only if the exposure to the same measured concentrations were to continue for a full year. *Hence, such a sample does not in itself imply that the water is unsuitable for consumption* but should be regarded as an indication that further investigation, including additional sampling, is needed. Gross beta and gross alpha activity screening has to be repeated first, then radionuclide-specific analysis conducted only if subsequently measured gross values exceed the recommended practical screening values (1 Bq/litre and 0.5 Bq/litre, respectively).

The application of these recommendations is summarized in Figure 9.2.

The gross beta measurement includes a contribution from potassium-40, a beta emitter that occurs naturally in a fixed ratio to stable potassium. Potassium is an essential element for humans and is absorbed mainly from ingested food. Potassium-40 does not accumulate in the body but is maintained at a constant level independent of intake. The contribution of potassium-40 to beta activity should therefore be subtracted following a separate determination of total potassium. The specific activity of potassium-40 is 30.7 Bq/g of potassium. However, not all the radiation from potassium-40 appears as beta activity. The beta activity of potassium-40 is 27.6 Bq/g of stable potassium, which is the factor that should be used to calculate the beta activity due to potassium-40.

9.4.3 Remedial measures

If the RDL of 0.1 mSv/year is being exceeded on aggregate, then the options available to the competent authority to reduce the dose should be examined. Where remedial measures are contemplated, any strategy considered should first be justified (in the sense that it achieves a net benefit) and then optimized in accordance with the recommendations of ICRP (1989, 1991) in order to produce the maximum net benefit.

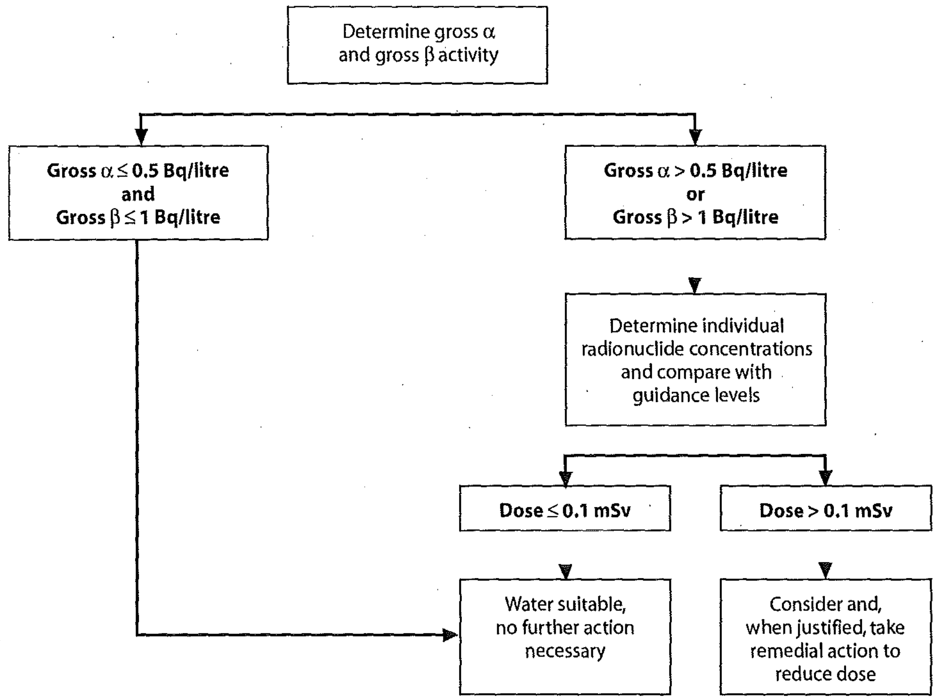


Figure 9.2 Application of screening and guidance levels for radionuclides in drinking-water

9.5 Radon

9.5.1 Radon in air and water

The largest fraction of natural radiation exposure comes from radon, a radioactive gas (see Table 9.1 and Figure 9.1), due to decay of radium contained in rocks and soil as part of the uranium radionuclide chain. The term radon in general refers mostly to radon-222. Radon is present virtually everywhere on Earth, but particularly in the air over land and in buildings.

Underground rock containing natural uranium continuously releases radon into water in contact with it (groundwater). Radon is readily released from surface water; consequently, groundwater normally has much higher concentrations of radon than surface water. The average concentration of radon is usually less than 0.4 Bq/litre in public water supplies derived from surface waters and about 20 Bq/litre from groundwater sources. However, some wells have been identified with higher concentrations, up to 400 times the average, and in rare cases exceeding 10 kBq/litre.

For assessing the dose from radon ingestion, it is important that water processing technology before consumption is taken into account. Moreover, the use of some groundwater supplies for general domestic purposes will increase the levels of radon in the air, thus increasing the dose from inhalation. This dose depends markedly on the form of domestic usage and housing construction (NCRP, 1989). The amount and

10
Acceptability aspects

The most undesirable constituents of drinking-water are those capable of having a direct adverse impact on public health. Many of these are described in other chapters of these Guidelines.

To a large extent, consumers have no means of judging the safety of their drinking-water themselves, but their attitude towards their drinking-water supply and their drinking-water suppliers will be affected to a considerable extent by the aspects of water quality that they are able to perceive with their own senses. It is natural for consumers to regard with suspicion water that appears dirty or discoloured or that has an unpleasant taste or smell, even though these characteristics may not in themselves be of direct consequence to health.

The provision of drinking-water that is not only safe but also acceptable in appearance, taste and odour is of high priority. Water that is aesthetically unacceptable will undermine the confidence of consumers, lead to complaints and, more importantly, possibly lead to the use of water from sources that are less safe.

The appearance, taste and odour of drinking-water should be acceptable to the consumer.

It is important to consider whether existing or proposed water treatment and distribution practices can affect the acceptability of drinking-water. For example, a change in disinfection practice may generate an odorous compound such as trichloramine in the treated water. Other effects may be indirect, such as the disturbance of internal pipe deposits and biofilms when changing between or blending waters from different sources in distribution systems.

The acceptability of drinking-water to consumers is subjective and can be influenced by many different constituents. The concentration at which constituents are objectionable to consumers is variable and dependent on individual and local factors, including the quality of the water to which the community is accustomed and a variety of social, environmental and cultural considerations. Guideline values have not been established for constituents influencing water quality that have no direct link to adverse health impacts.

In the summaries in this chapter and chapter 12, reference is made to levels likely to give rise to complaints from consumers. These are not precise numbers, and problems may occur at lower or higher levels, depending on individual and local circumstances.

It is not normally appropriate to directly regulate or monitor substances of health concern whose effects on the acceptability of water would normally lead to rejection of the water at concentrations significantly lower than those of concern for health; rather, these substances may be addressed through a general requirement that water be acceptable to the majority of consumers. For such substances, a health-based summary statement and guideline value are derived in these Guidelines in the usual way. In the summary statement, this is explained, and information on acceptability is described. In the tables of guideline values (see chapter 8 and Annex 4), the health-based guideline value is designated with a "C," with a footnote explaining that while the substance is of health significance, water would normally be rejected by consumers at concentrations well below the health-based guideline value. Monitoring of such substances should be undertaken in response to consumer complaints.

There are other water constituents that are of no direct consequence to health at the concentrations at which they normally occur in water but which nevertheless may be objectionable to consumers for various reasons.

10.1 Taste, odour and appearance

Taste and odour can originate from natural inorganic and organic chemical contaminants and biological sources or processes (e.g., aquatic microorganisms), from contamination by synthetic chemicals, from corrosion or as a result of water treatment (e.g., chlorination). Taste and odour may also develop during storage and distribution due to microbial activity.

Taste and odour in drinking-water may be indicative of some form of pollution or of a malfunction during water treatment or distribution. It may therefore be an indication of the presence of potentially harmful substances. The cause should be investigated and the appropriate health authorities should be consulted, particularly if there is a sudden or substantial change.

Colour, cloudiness, particulate matter and visible organisms may also be noticed by consumers and may create concerns about the quality and acceptability of a drinking-water supply.

10.1.1 Biologically derived contaminants

There are a number of diverse organisms that may have no public health significance but which are undesirable because they produce taste and odour. As well as affecting the acceptability of the water, they indicate that water treatment and/or the state of maintenance and repair of the distribution system are insufficient.

Actinomycetes and fungi

Actinomycetes and fungi can be abundant in surface water sources, including reservoirs, and they also can grow on unsuitable materials in the water supply distribution systems, such as rubber. They can give rise to geosmin, 2-methyl isoborneol and other substances, resulting in objectionable tastes and odours in the drinking-water.

Animal life[1]

Invertebrate animals are naturally present in many water resources used as sources for the supply of drinking-water and often infest shallow, open wells. Small numbers of invertebrates may also pass through water treatment works where the barriers to particulate matter are not completely effective and colonize the distribution system. Their motility may enable them and their larvae to penetrate filters at the treatment works and vents on storage reservoirs.

The types of animal concerned can be considered, for control purposes, as belonging to two groups. First, there are free-swimming organisms in the water itself or on water surfaces, such as the crustaceans *Gammarus pulex* (freshwater shrimp), *Crangonyx pseudogracilis*, *Cyclops* spp. and *Chydorus sphaericus*. Second, there are other animals that either move along surfaces or are anchored to them (e.g., water louse *Asellus aquaticus*, snails, zebra mussel *Dreissena polymorpha*, other bivalve molluscs and the bryozoan *Plumatella* sp.) or inhabit slimes (e.g., *Nais* spp., nematodes and the larvae of chironomids). In warm weather, slow sand filters can sometimes discharge the larvae of gnats (*Chironomus* and *Culex* spp.) into the water.

Many of these animals can survive, deriving food from bacteria, algae and protozoa in the water or present on slimes on pipe and tank surfaces. Few, if any, water distribution systems are completely free of animals. However, the density and composition of animal populations vary widely, from heavy infestations, including readily visible species that are objectionable to consumers, to sparse occurrences of microscopic species.

The presence of animals has largely been regarded by piped drinking-water suppliers in temperate regions as an acceptability problem, either directly or through their association with discoloured water. In tropical and subtropical countries, on the other hand, there are species of aquatic animal that act as secondary hosts for parasites. For example, the small crustacean *Cyclops* is the intermediate host of the guinea worm *Dracunculus medinensis* (see sections 7.1.1 and 11.4). However, there is no evidence that guinea worm transmission occurs from piped drinking-water supplies. The presence of animals in drinking-water, especially if visible, raises consumer concern about the quality of the drinking-water supply and should be controlled.

Penetration of waterworks and mains is more likely to be a problem when low-quality raw waters are abstracted and high-rate filtration processes are used. Pre-chlorination assists in destroying animal life and in its removal by filtration.

[1] The section was drawn largely from Evins (2004).

Production of high-quality water, maintenance of chlorine residuals in the distribution system and the regular cleaning of water mains by flushing or swabbing will usually control infestation.

Treatment of invertebrate infestations in piped distribution systems is discussed in detail in chapter 6 of the supporting document *Safe, Piped Water* (section 1.3).

Cyanobacteria and algae

Blooms of cyanobacteria and other algae in reservoirs and in river waters may impede coagulation and filtration, causing coloration and turbidity of water after filtration. They can also give rise to geosmin, 2-methyl isoborneol and other chemicals, which have taste thresholds in drinking-water of a few nanograms per litre. Some cyanobacterial products – cyanotoxins – are also of direct health significance (see section 8.5.6).

Iron bacteria

In waters containing ferrous and manganous salts, oxidation by iron bacteria (or by exposure to air) may cause rust-coloured deposits on the walls of tanks, pipes and channels and carry-over of deposits into the water.

10.1.2 Chemically derived contaminants

Aluminium

Naturally occurring aluminium as well as aluminium salts used as coagulants in drinking-water treatment are the most common sources of aluminium in drinking-water. The presence of aluminium at concentrations in excess of 0.1–0.2 mg/litre often leads to consumer complaints as a result of deposition of aluminium hydroxide floc in distribution systems and the exacerbation of discoloration of water by iron. It is therefore important to optimize treatment processes in order to minimize any residual aluminium entering the supply. Under good operating conditions, aluminium concentrations of less than 0.1 mg/litre are achievable in many circumstances. Available evidence does not support the derivation of a health-based guideline value for aluminium in drinking-water (see sections 8.5.4 and 12.5).

Ammonia

The threshold odour concentration of ammonia at alkaline pH is approximately 1.5 mg/litre, and a taste threshold of 35 mg/litre has been proposed for the ammonium cation. Ammonia is not of direct relevance to health at these levels, and no health-based guideline value has been proposed (see sections 8.5.3 and 12.6).

Chloride

High concentrations of chloride give a salty taste to water and beverages. Taste thresholds for the chloride anion depend on the associated cation and are in the range of 200–300 mg/litre for sodium, potassium and calcium chloride. Concentrations in

excess of 250 mg/litre are increasingly likely to be detected by taste, but some consumers may become accustomed to low levels of chloride-induced taste. No health-based guideline value is proposed for chloride in drinking-water (see sections 8.5.4 and 12.22).

Chlorine

Most individuals are able to taste or smell chlorine in drinking-water at concentrations well below 5 mg/litre, and some at levels as low as 0.3 mg/litre. At a residual free chlorine concentration of between 0.6 and 1.0 mg/litre, there is an increasing likelihood that some consumers may object to the taste. The taste threshold for chlorine is below the health-based guideline value (see sections 8.5.4 and 12.23).

Chlorophenols

Chlorophenols generally have very low taste and odour thresholds. The taste thresholds in water for 2-chlorophenol, 2,4-dichlorophenol and 2,4,6-trichlorophenol are 0.1, 0.3 and 2 μg/litre, respectively. Odour thresholds are 10, 40 and 300 μg/litre, respectively. If water containing 2,4,6-trichlorophenol is free from taste, it is unlikely to present a significant risk to health (see section 12.26). Microorganisms in distribution systems may sometimes methylate chlorophenols to produce chlorinated anisoles, for which the odour threshold is considerably lower.

Colour

Drinking-water should ideally have no visible colour. Colour in drinking-water is usually due to the presence of coloured organic matter (primarily humic and fulvic acids) associated with the humus fraction of soil. Colour is also strongly influenced by the presence of iron and other metals, either as natural impurities or as corrosion products. It may also result from the contamination of the water source with industrial effluents and may be the first indication of a hazardous situation. The source of colour in a drinking-water supply should be investigated, particularly if a substantial change has taken place.

Most people can detect colours above 15 true colour units (TCU) in a glass of water. Levels of colour below 15 TCU are usually acceptable to consumers, but acceptability may vary. High colour could also indicate a high propensity to produce by-products from disinfection processes. No health-based guideline value is proposed for colour in drinking-water.

Copper

Copper in a drinking-water supply usually arises from the corrosive action of water leaching copper from copper pipes. Concentrations can vary significantly with the period of time the water has been standing in contact with the pipes; for example, first-draw water would be expected to have a higher copper concentration than a fully flushed sample. High concentrations can interfere with the intended domestic uses of

the water. Copper in drinking-water may increase the corrosion of galvanized iron and steel fittings. Staining of laundry and sanitary ware occurs at copper concentrations above 1 mg/litre. At levels above 5 mg/litre, copper also imparts a colour and an undesirable bitter taste to water. Although copper can give rise to taste, it should be acceptable at the health-based guideline value (see sections 8.5.4 and 12.31).

Dichlorobenzenes

Odour thresholds of 2–10 and 0.3–30 μg/litre have been reported for 1,2- and 1,4-dichlorobenzene, respectively. Taste thresholds of 1 and 6 μg/litre have been reported for 1,2- and 1,4-dichlorobenzene, respectively. The health-based guideline values derived for 1,2- and 1,4-dichlorobenzene (see sections 8.5.4 and 12.42) far exceed the lowest reported taste and odour thresholds for these compounds.

Dissolved oxygen

The dissolved oxygen content of water is influenced by the source, raw water temperature, treatment and chemical or biological processes taking place in the distribution system. Depletion of dissolved oxygen in water supplies can encourage the microbial reduction of nitrate to nitrite and sulfate to sulfide. It can also cause an increase in the concentration of ferrous iron in solution, with subsequent discoloration at the tap when the water is aerated. No health-based guideline value is recommended.

Ethylbenzene

Ethylbenzene has an aromatic odour; the reported odour threshold in water ranges from 2 to 130 μg/litre. The lowest reported odour threshold is 100-fold lower than the health-based guideline value (see sections 8.5.4 and 12.60). The taste threshold ranges from 72 to 200 μg/litre.

Hardness

Hardness caused by calcium and magnesium is usually indicated by precipitation of soap scum and the need for excess use of soap to achieve cleaning. Public acceptability of the degree of hardness of water may vary considerably from one community to another, depending on local conditions. In particular, consumers are likely to notice changes in hardness.

The taste threshold for the calcium ion is in the range of 100–300 mg/litre, depending on the associated anion, and the taste threshold for magnesium is probably lower than that for calcium. In some instances, consumers tolerate water hardness in excess of 500 mg/litre.

Depending on the interaction of other factors, such as pH and alkalinity, water with a hardness above approximately 200 mg/litre may cause scale deposition in the treatment works, distribution system and pipework and tanks within buildings. It will also result in excessive soap consumption and subsequent "scum" formation. On heating, hard waters form deposits of calcium carbonate scale. Soft water, with a hardness of

less than 100 mg/litre, may, on the other hand, have a low buffering capacity and so be more corrosive for water pipes.

No health-based guideline value is proposed for hardness in drinking-water.

Hydrogen sulfide

The taste and odour thresholds of hydrogen sulfide in water are estimated to be between 0.05 and 0.1 mg/litre. The "rotten eggs" odour of hydrogen sulfide is particularly noticeable in some groundwaters and in stagnant drinking-water in the distribution system, as a result of oxygen depletion and the subsequent reduction of sulfate by bacterial activity.

Sulfide is oxidized rapidly to sulfate in well aerated or chlorinated water, and hydrogen sulfide levels in oxygenated water supplies are normally very low. The presence of hydrogen sulfide in drinking-water can be easily detected by the consumer and requires immediate corrective action. It is unlikely that a person could consume a harmful dose of hydrogen sulfide from drinking-water, and hence a health-based guideline value has not been derived for this compound (see sections 8.5.1 and 12.71).

Iron

Anaerobic groundwater may contain ferrous iron at concentrations of up to several milligrams per litre without discoloration or turbidity in the water when directly pumped from a well. On exposure to the atmosphere, however, the ferrous iron oxidizes to ferric iron, giving an objectionable reddish-brown colour to the water.

Iron also promotes the growth of "iron bacteria," which derive their energy from the oxidation of ferrous iron to ferric iron and in the process deposit a slimy coating on the piping. At levels above 0.3 mg/litre, iron stains laundry and plumbing fixtures. There is usually no noticeable taste at iron concentrations below 0.3 mg/litre, although turbidity and colour may develop. No health-based guideline value is proposed for iron (see sections 8.5.4 and 12.74).

Manganese

At levels exceeding 0.1 mg/litre, manganese in water supplies causes an undesirable taste in beverages and stains sanitary ware and laundry. The presence of manganese in drinking-water, like that of iron, may lead to the accumulation of deposits in the distribution system. Concentrations below 0.1 mg/litre are usually acceptable to consumers. Even at a concentration of 0.2 mg/litre, manganese will often form a coating on pipes, which may slough off as a black precipitate. The health-based guideline value for manganese is 4 times higher than this acceptability threshold of 0.1 mg/litre (see sections 8.5.1 and 12.79).

Monochloramine

Most individuals are able to taste or smell monochloramine, generated from the reaction of chlorine with ammonia, in drinking-water at concentrations well below

5 mg/litre, and some at levels as low as 0.3 mg/litre. The taste threshold for monochloramine is below the health-based guideline value (see sections 8.5.4 and 12.89).

Monochlorobenzene

Taste and odour thresholds of 10–20 µg/litre and odour thresholds ranging from 40 to 120 µg/litre have been reported for monochlorobenzene. A health-based guideline value has not been derived for monochlorobenzene (see sections 8.5.4 and 12.91), although the health-based value that could be derived far exceeds the lowest reported taste and odour threshold in water.

Petroleum oils

Petroleum oils can give rise to the presence of a number of low molecular weight hydrocarbons that have low odour thresholds in drinking-water. Although there are no formal data, experience indicates that these may have lower odour thresholds when several are present as a mixture. Benzene, toluene, ethylbenzene and xylenes are considered individually in this section, as health-based guideline values have been derived for these chemicals. However, a number of other hydrocarbons, particularly alkylbenzenes such as trimethylbenzene, may give rise to a very unpleasant "diesel-like" odour at concentrations of a few micrograms per litre.

pH and corrosion

Although pH usually has no direct impact on consumers, it is one of the most important operational water quality parameters. Careful attention to pH control is necessary at all stages of water treatment to ensure satisfactory water clarification and disinfection (see the supporting document *Safe, Piped Water*; section 1.3). For effective disinfection with chlorine, the pH should preferably be less than 8; however, lower-pH water is likely to be corrosive. The pH of the water entering the distribution system must be controlled to minimize the corrosion of water mains and pipes in household water systems. Alkalinity and calcium management also contribute to the stability of water and control its aggressiveness to pipe and appliance. Failure to minimize corrosion can result in the contamination of drinking-water and in adverse effects on its taste and appearance. The optimum pH required will vary in different supplies according to the composition of the water and the nature of the construction materials used in the distribution system, but it is usually in the range 6.5–8. Extreme values of pH can result from accidental spills, treatment breakdowns and insufficiently cured cement mortar pipe linings or cement mortar linings applied when the alkalinity of the water is low. No health-based guideline value has been proposed for pH (see sections 8.5.1 and 12.100).

Sodium

The taste threshold concentration of sodium in water depends on the associated anion and the temperature of the solution. At room temperature, the average taste thresh-

old for sodium is about 200 mg/litre. No health-based guideline value has been derived (see sections 8.5.1 and 12.108).

Styrene

Styrene has a sweet odour, and reported odour thresholds for styrene in water range from 4 to 2600 μg/litre, depending on temperature. Styrene may therefore be detected in water at concentrations below its health-based guideline value (see sections 8.5.2 and 12.109).

Sulfate

The presence of sulfate in drinking-water can cause noticeable taste, and very high levels might cause a laxative effect in unaccustomed consumers. Taste impairment varies with the nature of the associated cation; taste thresholds have been found to range from 250 mg/litre for sodium sulfate to 1000 mg/litre for calcium sulfate. It is generally considered that taste impairment is minimal at levels below 250 mg/litre. No health-based guideline value has been derived for sulfate (see sections 8.5.1 and 12.110).

Synthetic detergents

In many countries, persistent types of anionic detergent have been replaced by others that are more easily biodegraded, and hence the levels found in water sources have decreased substantially. The concentration of detergents in drinking-water should not be allowed to reach levels giving rise to either foaming or taste problems. The presence of any detergent may indicate sanitary contamination of source water.

Toluene

Toluene has a sweet, pungent, benzene-like odour. The reported taste threshold ranges from 40 to 120 μg/litre. The reported odour threshold for toluene in water ranges from 24 to 170 μg/litre. Toluene may therefore affect the acceptability of water at concentrations below its health-based guideline value (see sections 8.5.2 and 12.114).

Total dissolved solids

The palatability of water with a TDS level of less than 600 mg/litre is generally considered to be good; drinking-water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/litre. The presence of high levels of TDS may also be objectionable to consumers, owing to excessive scaling in water pipes, heaters, boilers and household appliances. No health-based guideline value for TDS has been proposed (see sections 8.5.1 and 12.115).

Trichlorobenzenes

Odour thresholds of 10, 5–30 and 50 μg/litre have been reported for 1,2,3-, 1,2,4- and 1,3,5-trichlorobenzene, respectively. A taste and odour threshold concentration of

30 μg/litre has been reported for 1,2,4-trichlorobenzene. A health-based guideline value was not derived for trichlorobenzenes, although the health-based value that could be derived (see sections 8.5.2 and 12.117) exceeds the lowest reported odour threshold in water of 5 μg/litre.

Turbidity

Turbidity in drinking-water is caused by particulate matter that may be present from source water as a consequence of inadequate filtration or from resuspension of sediment in the distribution system. It may also be due to the presence of inorganic particulate matter in some groundwaters or sloughing of biofilm within the distribution system. The appearance of water with a turbidity of less than 5 NTU is usually acceptable to consumers, although this may vary with local circumstances.

Particulates can protect microorganisms from the effects of disinfection and can stimulate bacterial growth. In all cases where water is disinfected, the turbidity must be low so that disinfection can be effective. The impact of turbidity on disinfection efficiency is discussed in more detail in section 4.1.

Turbidity is also an important operational parameter in process control and can indicate problems with treatment processes, particularly coagulation/sedimentation and filtration.

No health-based guideline value for turbidity has been proposed; ideally, however, median turbidity should be below 0.1 NTU for effective disinfection, and changes in turbidity are an important process control parameter.

Xylenes

Xylene concentrations in the range of 300 μg/litre produce a detectable taste and odour. The odour threshold for xylene isomers in water has been reported to range from 20 to 1800 μg/litre. The lowest odour threshold is well below the health-based guideline value derived for the compound (see sections 8.5.2 and 12.124).

Zinc

Zinc imparts an undesirable astringent taste to water at a taste threshold concentration of about 4 mg/litre (as zinc sulfate). Water containing zinc at concentrations in excess of 3–5 mg/litre may appear opalescent and develop a greasy film on boiling. Although drinking-water seldom contains zinc at concentrations above 0.1 mg/litre, levels in tap water can be considerably higher because of the zinc used in older galvanized plumbing materials. No health-based guideline value has been proposed for zinc in drinking-water (see sections 8.5.4 and 12.125).

10.1.3 Treatment of taste, odour and appearance problems

The following water treatment techniques are generally effective in removing organic chemicals that cause tastes and odours:

—aeration (see section 8.4.6);
—activated carbon (GAC or PAC) (see section 8.4.8); and
—ozonation (see section 8.4.3).

Tastes and odours caused by disinfectants and DBPs are best controlled through careful operation of the disinfection process. In principle, they can be removed by activated carbon.

Manganese can be removed by chlorination followed by filtration. Techniques for removing hydrogen sulfide include aeration, GAC, filtration and oxidation. Ammonia can be removed by biological nitrification. Precipitation softening or cation exchange can reduce hardness. Other taste- and odour-causing inorganic chemicals (e.g., chloride and sulfate) are generally not amenable to treatment (see the supporting document *Chemical Safety of Drinking-water*; section 1.3).

10.2 Temperature

Cool water is generally more palatable than warm water, and temperature will impact on the acceptability of a number of other inorganic constituents and chemical contaminants that may affect taste. High water temperature enhances the growth of microorganisms and may increase taste, odour, colour and corrosion problems.

11
Microbial fact sheets

Fact sheets are provided on potential waterborne pathogens as well as on indicator and index microorganisms.

The potential waterborne pathogens include:

— bacteria, viruses, protozoa and helminths identified in Table 7.1 and Figure 7.1, with the exception of *Schistosoma*, which is primarily spread by contact with contaminated surface water during bathing and washing;
— potentially emerging pathogens, including *Helicobacter pylori*, *Tsukamurella*, *Isospora belli* and microsporidia, for which waterborne transmission is plausible but unconfirmed;
— *Bacillus*, which includes the foodborne pathogenic species *Bacillus cereus* but for which there is no evidence at this time of waterborne transmission; and
— hazardous cyanobacteria.

The human health effects caused by waterborne transmission vary in severity from mild gastroenteritis to severe and sometimes fatal diarrhoea, dysentery, hepatitis and typhoid fever. Contaminated water can be the source of large outbreaks of disease, including cholera, dysentery and cryptosporidiosis; for the majority of waterborne pathogens, however, there are other important sources of infection, such as person-to-person contact and food.

Most waterborne pathogens are introduced into drinking-water supplies in human or animal faeces, do not grow in water and initiate infection in the gastrointestinal tract following ingestion. However, *Legionella*, atypical mycobacteria, *Burkholderia pseudomallei* and *Naegleria fowleri* are environmental organisms that can grow in water and soil. Besides ingestion, other routes of transmission can include inhalation, leading to infections of the respiratory tract (e.g., *Legionella*, atypical mycobacteria), and contact, leading to infections at sites as diverse as the skin and brain (e.g., *Naegleria fowleri*, *Burkholderia pseudomallei*).

Of all the waterborne pathogens, the helminth *Dracunculus medinensis* is unique in that it is the only pathogen that is solely transmitted through drinking-water.

The fact sheets on potential pathogens include information on human health effects, sources and occurrence, routes of transmission and the significance of drinking-water as a source of infection. The fact sheets on microorganisms that can be used as indicators of the effectiveness of control measures or as indices for the potential presence of pathogenic microorganisms provide information on indicator value, source and occurrence, application and significance of detection.

11.1 Bacterial pathogens

Most bacterial pathogens potentially transmitted by water infect the gastrointestinal tract and are excreted in the faeces of infected humans and other animals. However, there are also some waterborne bacterial pathogens, such as *Legionella*, *Burkholderia pseudomallei* and atypical mycobacteria, that can grow in water and soil. The routes of transmission of these bacteria include inhalation and contact (bathing), with infections occurring in the respiratory tract, in skin lesions or in the brain.

11.1.1 Acinetobacter

General description

Acinetobacter spp. are Gram-negative, oxidase-negative, non-motile coccobacilli (short plump rods). Owing to difficulties in naming individual species and biovars, the term *Acinetobacter calcoaceticus baumannii* complex is used in some classification schemes to cover all subgroups of this species, such as *A. baumannii*, *A. iwoffii* and *A. junii*.

Human health effects

Acinetobacter spp. are usually commensal organisms, but they occasionally cause infections, predominantly in susceptible patients in hospitals. They are opportunistic pathogens that may cause urinary tract infections, pneumonia, bacteraemia, secondary meningitis and wound infections. These diseases are predisposed by factors such as malignancy, burns, major surgery and weakened immune systems, such as in neonates and elderly individuals. The emergence and rapid spread of multidrug-resistant *A. calcoaceticus baumannii* complex, causing nosocomial infections, are of concern in health care facilities.

Source and occurrence

Acinetobacter spp. are ubiquitous inhabitants of soil, water and sewage environments. *Acinetobacter* has been isolated from 97% of natural surface water samples in numbers of up to 100/ml. The organisms have been found to represent 1.0–5.5% of the HPC flora in drinking-water samples and have been isolated from 5–92% of distribution water samples. In a survey of untreated groundwater supplies in the USA, *Acinetobacter* spp. were detected in 38% of the groundwater supplies at an arithmetic mean density of 8/100 ml. The study also revealed that slime production, a virulence factor for *A. calcoaceticus*, was not significantly different between well water isolates and clinical strains, suggesting some degree of pathogenic potential for strains isolated from groundwater. *Acinetobacter* spp. are part of the natural microbial flora of the skin and occasionally the respiratory tract of healthy individuals.

Routes of exposure

Environmental sources within hospitals and person-to-person transmission are the likely sources for most outbreaks of hospital infections. Infection is most commonly associated with contact with wounds and burns or inhalation by susceptible individuals. In patients with *Acinetobacter* bacteraemia, intravenous catheters have also been identified as a source of infection. Outbreaks of infection have been associated with water baths and room humidifiers. Ingestion is not a usual source of infection.

Significance in drinking-water

While *Acinetobacter* spp. are often detected in treated drinking-water supplies, an association between the presence of *Acinetobacter* spp. in drinking-water and clinical disease has not been confirmed. There is no evidence of gastrointestinal infection through ingestion of *Acinetobacter* spp. in drinking-water among the general population. However, transmission of non-gastrointestinal infections by drinking-water may be possible in susceptible individuals, particularly in settings such as health care facilities and hospitals. As discussed in chapter 6, specific WSPs should be developed for buildings, including hospitals and other health care facilities. These plans need to take account of particular sensitivities of occupants. *Acinetobacter* spp. are sensitive to disinfectants such as chlorine, and numbers will be low in the presence of a disinfectant residual. Control measures that can limit growth of the bacteria in distribution systems include treatment to optimize organic carbon removal, restriction of the residence time of water in distribution systems and maintenance of disinfectant residuals. *Acinetobacter* spp. are detected by HPC, which can be used together with parameters such as disinfectant residuals to indicate conditions that could support growth of these organisms. However, *E. coli* (or, alternatively, thermotolerant coliforms) cannot be used as an index for the presence/absence of *Acinetobacter* spp.

Selected bibliography

Bartram J et al., eds. (2003) *Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health.* WHO Emerging Issues in Water and Infectious Disease Series. London, IWA Publishing.

Bergogne-Berezin E, Towner KJ (1996) *Acinetobacter* as nosocomial pathogens: microbiological, clinical and epidemiological features. *Clinical Microbiology Reviews*, 9:148–165.

Bifulco JM, Shirey JJ, Bissonnette GK (1989) Detection of *Acinetobacter* spp. in rural drinking water supplies. *Applied and Environmental Microbiology*, 55:2214–2219.

Jellison TK, McKinnon PS, Rybak MJ (2001) Epidemiology, resistance and outcomes of *Acinetobacter baumannii* bacteremia treated with imipenem-cilastatin or ampicillin-sulbactam. *Pharmacotherapy*, 21:142–148.

Rusin PA et al. (1997) Risk assessment of opportunistic bacterial pathogens in drinking-water. *Reviews of Environmental Contamination and Toxicology*, 152:57–83.

11.1.2 Aeromonas

General description

Aeromonas spp. are Gram-negative, non-spore-forming, facultative anaerobic bacilli belonging to the family Vibrionaceae. They bear many similarities to the Enterobacteriaceae. The genus is divided into two groups. The group of psychrophilic non-motile aeromonads consists of only one species, *A. salmonicida*, an obligate fish pathogen that is not considered further here. The group of mesophilic motile (single polar flagellum) aeromonads is considered of potential human health significance and consists of the species *A. hydrophila*, *A. caviae*, *A. veronii* subsp. *sobria*, *A. jandaei*, *A. veronii* subsp. *veronii* and *A. schubertii*. The bacteria are normal inhabitants of fresh water and occur in water, soil and many foods, particularly meat and milk.

Human health effects

Aeromonas spp. can cause infections in humans, including septicaemia, particularly in immunocompromised patients, wound infections and respiratory tract infections. There have been some claims that *Aeromonas* spp. can cause gastrointestinal illness, but epidemiological evidence is not consistent. Despite marked toxin production by *Aeromonas* spp. *in vitro*, diarrhoea has not yet been introduced in test animals or human volunteers.

Source and occurrence

Aeromonas spp. occur in water, soil and food, particularly meat, fish and milk. *Aeromonas* spp. are generally readily found in most fresh waters, and they have been detected in many treated drinking-water supplies, mainly as a result of growth in distribution systems. The factors that affect the occurrence of *Aeromonas* spp. in water distribution systems are not fully understood, but organic content, temperature, the residence time of water in the distribution network and the presence of residual chlorine have been shown to influence population sizes.

Routes of exposure

Wound infections have been associated with contaminated soil and water-related activities, such as swimming, diving, boating and fishing. Septicaemia can follow from such wound infections. In immunocompromised individuals, septicaemia may arise from aeromonads present in their own gastrointestinal tract.

Significance in drinking-water

Despite frequent isolation of *Aeromonas* spp. from drinking-water, the body of evidence does not provide significant support for waterborne transmission. Aeromonads typically found in drinking-water do not belong to the same DNA homology groups as those associated with cases of gastroenteritis. The presence of *Aeromonas* spp. in drinking-water supplies is generally considered a nuisance. Entry of aeromonads into distribution systems can be minimized by adequate disinfection. Control measures that can limit growth of the bacteria in distribution systems include treatment to optimize organic carbon removal, restriction of the residence time of water in distribution systems and maintenance of disinfectant residuals. *Aeromonas* spp. are detected by HPC, which can be used together with parameters such as disinfectant residuals to indicate conditions that could support growth of these organisms. However, *E. coli* (or, alternatively, thermotolerant coliforms) cannot be used as an index for the presence/absence of *Aeromonas* spp.

Selected bibliography

Bartram J et al., eds. (2003) *Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health.* WHO Emerging Issues in Water and Infectious Disease Series. London, IWA Publishing.

Borchardt MA, Stemper ME, Standridge JH (2003) *Aeromonas* isolates from human diarrheic stool and groundwater compared by pulsed-field gel electrophoresis. *Emerging Infectious Diseases*, 9:224–228.

WHO (2002) *Aeromonas.* In: *Guidelines for drinking-water quality*, 2nd ed. *Addendum: Microbiological agents in drinking water.* Geneva, World Health Organization.

11.1.3 Bacillus

General description

Bacillus spp. are large (4–10 μm), Gram-positive, strictly aerobic or facultatively anaerobic encapsulated bacilli. They have the important feature of producing spores that are exceptionally resistant to unfavourable conditions. *Bacillus* spp. are classified into the subgroups *B. polymyxa*, *B. subtilis* (which includes *B. cereus* and *B. licheniformis*), *B. brevis* and *B. anthracis.*

Human health effects

Although most *Bacillus* spp. are harmless, a few are pathogenic to humans and animals. *Bacillus cereus* causes food poisoning similar to staphylococcal food poisoning. Some strains produce heat-stable toxin in food that is associated with spore germination and gives rise to a syndrome of vomiting within 1–5 h of ingestion. Other strains produce a heat-labile enterotoxin after ingestion that causes diarrhoea within 10–15 h. *Bacillus cereus* is known to cause bacteraemia in immunocompromised patients as well as symptoms such as vomiting and diarrhoea. *Bacillus anthracis* causes anthrax in humans and animals.

Source and occurrence

Bacillus spp. commonly occur in a wide range of natural environments, such as soil and water. They form part of the HPC bacteria, which are readily detected in most drinking-water supplies.

Routes of exposure

Infection with *Bacillus* spp. is associated with the consumption of a variety of foods, especially rice, pastas and vegetables, as well as raw milk and meat products. Disease may result from the ingestion of the organisms or toxins produced by the organisms. Drinking-water has not been identified as a source of infection of pathogenic *Bacillus* spp., including *Bacillus cereus*. Waterborne transmission of *Bacillus* gastroenteritis has not been confirmed.

Significance in drinking-water

Bacillus spp. are often detected in drinking-water supplies, even supplies treated and disinfected by acceptable procedures. This is largely due to the resistance of spores to disinfection processes. Owing to a lack of evidence that waterborne *Bacillus* spp. are clinically significant, specific management strategies are not required.

Selected bibliography

Bartram J et al., eds. (2003) *Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health*. WHO Emerging Issues in Water and Infectious Disease Series. London, IWA Publishing.

11.1.4 Burkholderia pseudomallei

General description

Burkholderia pseudomallei is a Gram-negative bacillus commonly found in soil and muddy water, predominantly in tropical regions such as northern Australia and south-east Asia. The organism is acid tolerant and survives in water for prolonged periods in the absence of nutrients.

Human health effects

Burkholderia pseudomallei can cause the disease melioidosis, which is endemic in northern Australia and other tropical regions. The most common clinical manifestation is pneumonia, which may be fatal. In some of these areas, melioidosis is the most common cause of community-acquired pneumonia. Cases appear throughout the year but peak during the rainy season. Many patients present with milder forms of pneumonia, which respond well to appropriate antibiotics, but some may present with a severe septicaemic pneumonia. Other symptoms include skin abscesses or ulcers, abscesses in internal organs and unusual neurological illnesses, such as brainstem encephalitis and acute paraplegia. Although melioidosis can occur in healthy children and adults, it occurs mainly in people whose defence mechanisms against infection are impaired by underlying conditions or poor general health associated with poor nutrition or living conditions.

Source and occurrence

The organism occurs predominantly in tropical regions, typically in soil or surface-accumulated muddy water, from where it may reach raw water sources and also drinking-water supplies. The number of organisms in drinking-water that would constitute a significant risk of infection is not known.

Routes of exposure

Most infections appear to be through contact of skin cuts or abrasions with contaminated water. In south-east Asia, rice paddies represent a significant source of infection. Infection may also occur via other routes, particularly through inhalation or ingestion. The relative importance of these routes of infection is not known.

Significance in drinking-water

In two Australian outbreaks of melioidosis, indistinguishable isolates of *B. pseudomallei* were cultured from cases and the drinking-water supply. The detection of the organisms in one drinking-water supply followed replacement of water pipes and chlorination failure, while the second supply was unchlorinated. Within a WSP, control measures that should provide effective protection against this organism include application of established treatment and disinfection processes for drinking-water coupled with protection of the distribution system from contamination, including during repairs and maintenance. HPC and disinfectant residual as measures of water treatment effectiveness and application of appropriate mains repair procedures could be used to indicate protection against *B. pseudomallei.* Because of the environmental occurrence of *B. pseudomallei, E. coli* (or, alternatively, thermotolerant coliforms) is not a suitable index for the presence/absence of this organism.

Selected bibliography

Ainsworth R, ed. (2004) *Safe, piped water: Managing microbial water quality in piped distribution systems.* IWA Publishing, London, for the World Health Organization, Geneva.

Currie BJ (2000) The epidemiology of melioidosis in Australia and Papua New Guinea. *Acta Tropica*, 74:121–127.

Currie BJ et al. (2001) A cluster of melioidosis cases from an endemic region is clonal and is linked to the water supply using molecular typing of *Burkholderia pseudomallei* isolates. *American Journal of Tropical Medicine and Hygiene*, 65:177–179.

Inglis TJJ et al. (2000) Outbreak strain of *Burkholderia pseudomallei* traced to water treatment plant. *Emerging Infectious Diseases*, 6:56–59.

11.1.5 Campylobacter

General description

Campylobacter spp. are microaerophilic (require decreased oxygen) and capnophilic (require increased carbon dioxide), Gram-negative, curved spiral rods with a single unsheathed polar flagellum. *Campylobacter* spp. are one of the most important causes of acute gastroenteritis worldwide. *Campylobacter jejuni* is the most frequently isolated species from patients with acute diarrhoeal disease, whereas *C. coli*, *C. laridis* and *C. fetus* have also been isolated in a small proportion of cases. Two closely related genera, *Helicobacter* and *Archobacter*, include species previously classified as *Campylobacter* spp.

Human health effects

An important feature of *C. jejuni* is relatively high infectivity compared with other bacterial pathogens. As few as 1000 organisms can cause infection. Most symptomatic infections occur in infancy and early childhood. The incubation period is usually 2–4 days. Clinical symptoms of *C. jejuni* infection are characterized by abdominal pain, diarrhoea (with or without blood or faecal leukocytes), vomiting, chills and fever. The infection is self-limited and resolves in 3–7 days. Relapses may occur in 5–10% of untreated patients. Other clinical manifestations of *C. jejuni* infections in humans include reactive arthritis and meningitis. Several reports have associated *C. jejuni* infection with Guillain-Barré syndrome, an acute demyelinating disease of the peripheral nerves.

Source and occurrence

Campylobacter spp. occur in a variety of environments. Wild and domestic animals, especially poultry, wild birds and cattle, are important reservoirs. Pets and other animals may also be reservoirs. Food, including meat and unpasteurized milk, are important sources of *Campylobacter* infections. Water is also a significant source. The occurrence of the organisms in surface waters has proved to be strongly dependent on rainfall, water temperature and the presence of waterfowl.

Routes of exposure

Most *Campylobacter* infections are reported as sporadic in nature, with food considered a common source of infection. Transmission to humans typically occurs by the consumption of animal products. Meat, particularly poultry products, and unpasteurized milk are important sources of infection. Contaminated drinking-water supplies have been identified as a source of outbreaks. The number of cases in these outbreaks ranged from a few to several thousand, with sources including unchlorinated or inadequately chlorinated surface water supplies and faecal contamination of water storage reservoirs by wild birds.

Significance in drinking-water

Contaminated drinking-water supplies have been identified as a significant source of outbreaks of campylobacteriosis. The detection of waterborne outbreaks and cases appears to be increasing. Waterborne transmission has been confirmed by the isolation of the same strains from patients and drinking-water they had consumed. Within a WSP, control measures that can be applied to manage potential risk from *Campylobacter* spp. include protection of raw water supplies from animal and human waste, adequate treatment and protection of water during distribution. Storages of treated and disinfected water should be protected from bird faeces. *Campylobacter* spp. are faecally borne pathogens and are not particularly resistant to disinfection. Hence, *E. coli* (or thermotolerant coliforms) is an appropriate indicator for the presence/absence of *Campylobacter* spp. in drinking-water supplies.

Selected bibliography

Frost JA (2001) Current epidemiological issues in human campylobacteriosis. *Journal of Applied Microbiology*, 90:85S–95S.

Koenraad PMFJ, Rombouts FM, Notermans SHW (1997) Epidemiological aspects of thermophilic *Campylobacter* in water-related environments: A review. *Water Environment Research*, 69:52–63.

Kuroki S et al. (1991) Guillain-Barré syndrome associated with *Campylobacter* infection. *Pediatric Infectious Diseases Journal*, 10:149–151.

11.1.6 Escherichia coli pathogenic strains

General description

Escherichia coli is present in large numbers in the normal intestinal flora of humans and animals, where it generally causes no harm. However, in other parts of the body, *E. coli* can cause serious disease, such as urinary tract infections, bacteraemia and meningitis. A limited number of enteropathogenic strains can cause acute diarrhoea. Several classes of enteropathogenic *E. coli* have been identified on the basis of different virulence factors, including enterohaemorrhagic *E. coli* (EHEC), enterotoxigenic *E. coli* (ETEC), enteropathogenic *E. coli* (EPEC), enteroinvasive *E. coli* (EIEC), enteroaggregative *E. coli* (EAEC) and diffusely adherent *E. coli* (DAEC). More is known about the first four classes named; the pathogenicity and prevalence of EAEC and DAEC strains are less well established.

Human health effects

EHEC serotypes, such as *E. coli* O157:H7 and *E. coli* O111, cause diarrhoea that ranges from mild and non-bloody to highly bloody, which is indistinguishable from haemorrhagic colitis. Between 2% and 7% of cases can develop the potentially fatal haemolytic uraemic syndrome (HUS), which is characterized by acute renal failure and haemolytic anaemia. Children under 5 years of age are at most risk of developing HUS. The infectivity of EHEC strains is substantially higher than that of the other strains. As few as 100 EHEC organisms can cause infection. ETEC produces heat-labile or heat-stable *E. coli* enterotoxin, or both toxins simultaneously, and is an important cause of diarrhoea in developing countries, especially in young children. Symptoms of ETEC infection include mild watery diarrhoea, abdominal cramps, nausea and headache. Infection with EPEC has been associated with severe, chronic, non-bloody diarrhoea, vomiting and fever in infants. EPEC infections are rare in developed countries, but occur commonly in developing countries, with infants presenting with malnutrition, weight loss and growth retardation. EIEC causes watery and occasionally bloody diarrhoea where strains invade colon cells by a pathogenic mechanism similar to that of *Shigella*.

Source and occurrence

Enteropathogenic *E. coli* are enteric organisms, and humans are the major reservoir, particularly of EPEC, ETEC and EIEC strains. Livestock, such as cattle and sheep and, to a lesser extent, goats, pigs and chickens, are a major source of EHEC strains. The latter have also been associated with raw vegetables, such as bean sprouts. The pathogens have been detected in a variety of water environments.

Routes of exposure

Infection is associated with person-to-person transmission, contact with animals, food and consumption of contaminated water. Person-to-person transmissions are particularly prevalent in communities where there is close contact between individuals, such as nursing homes and day care centres.

Significance in drinking-water

Waterborne transmission of pathogenic *E. coli* has been well documented for recreational waters and contaminated drinking-water. A well publicized waterborne outbreak of illness caused by *E. coli* O157:H7 (and *Campylobacter jejuni*) occurred in the farming community of Walkerton in Ontario, Canada. The outbreak took place in May 2000 and led to 7 deaths and more than 2300 illnesses. The drinking-water supply was contaminated by rainwater runoff containing cattle excreta. Within a WSP, control measures that can be applied to manage potential risk from enteropathogenic *E. coli* include protection of raw water supplies from animal and human waste, adequate treatment and protection of water during distribution. There is no indication that the response of enteropathogenic strains of *E. coli* to water treatment and disinfection procedures differs from that of other *E. coli*. Hence, conventional testing for *E. coli* (or, alternatively, thermotolerant coliform bacteria) provides an appropriate index for the enteropathogenic serotypes in drinking-water. This applies even though standard tests will generally not detect EHEC strains.

Selected bibliography

Nataro JP, Kaper JB (1998) Diarrheagenic *Escherichia coli*. *Clinical Microbiology Reviews*, 11:142–201.

O'Connor DR (2002) *Report of the Walkerton Inquiry: The events of May 2000 and related issues. Part 1: A summary*. Toronto, Ontario, Ontario Ministry of the Attorney General, Queen's Printer for Ontario.

11.1.7 Helicobacter pylori

General description

Helicobacter pylori, originally classified as *Campylobacter pylori*, is a Gram-negative, microaerophilic, spiral-shaped, motile bacterium. There are at least 14 species of *Helicobacter*, but only *H. pylori* has been identified as a human pathogen.

Human health effects

Helicobacter pylori is found in the stomach; although most infections are asymptomatic, the organism is associated with chronic gastritis, which may lead to complications such as peptic and duodenal ulcer disease and gastric cancer. Whether the organism is truly the cause of these conditions remains unclear. The majority of *H. pylori* infections are initiated in childhood and without treatment are chronic. The infections are more prevalent in developing countries and are associated with overcrowded living conditions. Interfamilial clustering is common.

Source and occurrence

Humans appear to be the primary host of *H. pylori*. Other hosts may include domestic cats. There is evidence that *H. pylori* is sensitive to bile salts, which would reduce the likelihood of faecal excretion, although it has been isolated from faeces of young children. *Helicobacter pylori* has been detected in water. Although *H. pylori* is unlikely to grow in the environment, it has been found to survive for 3 weeks in biofilms and up to 20–30 days in surface waters. In a study conducted in the USA, *H. pylori* was found in the majority of surface water and shallow groundwater samples. The presence of *H. pylori* was not correlated with the presence of *E. coli*. Possible contamination of the environment can be through children with diarrhoea or through vomiting by children as well as adults.

Routes of exposure

Person-to-person contact within families has been identified as the most likely source of infection through oral–oral transmission. *Helicobacter pylori* can survive well in mucus or vomit. However, it is difficult to detect in mouth or faecal samples. Faecal–oral transmission is also considered possible.

Significance in drinking-water

Consumption of contaminated drinking-water has been suggested as a potential source of infection, but further investigation is required to establish any link with waterborne transmission. Humans are the principal source of *H. pylori*, and the organism is sensitive to oxidizing disinfectants. Hence, control measures that can be applied to protect drinking-water supplies from *H. pylori* include preventing contamination by human waste and adequate disinfection. *Escherichia coli* (or, alternatively, thermotolerant coliforms) is not a reliable index for the presence/absence of this organism.

Selected bibliography

Dunn BE, Cohen H, Blaser MJ (1997) *Helicobacter pylori. Clinical Microbiology Reviews*, 10:720–741.

Hegarty JP, Dowd MT, Baker KH (1999) Occurrence of *Helicobacter pylori* in surface water in the United States. *Journal of Applied Microbiology*, 87:697–701.

Hulten K et al. (1996) *Helicobacter pylori* in drinking-water in Peru. *Gastroenterology*, 110:1031–1035.

Mazari-Hiriart M, López-Vidal Y, Calva JJ (2001) *Helicobacter pylori* in water systems for human use in Mexico City. *Water Science and Technology*, 43:93–98.

11.1.8 Klebsiella

General description

Klebsiella spp. are Gram-negative, non-motile bacilli that belong to the family Enterobacteriaceae. The genus *Klebsiella* consists of a number of species, including *K. pneumoniae*, *K. oxytoca*, *K. planticola* and *K. terrigena*. The outermost layer of *Klebsiella* spp. consists of a large polysaccharide capsule that distinguishes the organisms from other members of the family. Approximately 60–80% of all *Klebsiella* spp. isolated from faeces and clinical specimens are *K. pneumoniae* and are positive in the thermotolerant coliform test. *Klebsiella oxytoca* has also been identified as a pathogen.

Human health effects

Klebsiella spp. have been identified as colonizing hospital patients, where spread is associated with the frequent handling of patients (e.g., in intensive care units). Patients at highest risk are those with impaired immune systems, such as the elderly or very young, patients with burns or excessive wounds, those undergoing immunosuppressive therapy or those with HIV/AIDS infection. Colonization may lead to invasive infections. On rare occasions, *Klebsiella* spp., notably *K. pneumoniae* and *K. oxytoca*, may cause serious infections, such as destructive pneumonia.

Source and occurrence

Klebsiella spp. are natural inhabitants of many water environments, and they may multiply to high numbers in waters rich in nutrients, such as pulp mill wastes, textile finishing plants and sugar-cane processing operations. In drinking-water distribution systems, they are known to colonize washers in taps. The organisms can grow in water distribution systems. *Klebsiella* spp. are also excreted in the faeces of many healthy humans and animals, and they are readily detected in sewage-polluted water.

Routes of exposure

Klebsiella can cause nosocomial infections, and contaminated water and aerosols may be a potential source of the organisms in hospital environments and other health care facilities.

Significance in drinking-water

Klebsiella spp. are not considered to represent a source of gastrointestinal illness in the general population through ingestion of drinking-water. *Klebsiella* spp. detected in drinking-water are generally biofilm organisms and are unlikely to represent a health risk. The organisms are reasonably sensitive to disinfectants, and entry into distribution systems can be prevented by adequate treatment. Growth within distribution systems can be minimized by strategies that are designed to minimize biofilm growth, including treatment to optimize organic carbon removal, restriction of the residence time of water in distribution systems and maintenance of disinfectant residuals. *Klebsiella* is a coliform and can be detected by traditional tests for total coliforms.

Selected bibliography

Ainsworth R, ed. (2004) *Safe, piped water: Managing microbial water quality in piped distribution systems.* IWA Publishing, London, for the World Health Organization, Geneva.

Bartram J et al., eds. (2003) *Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health.* WHO Emerging Issues in Water and Infectious Disease Series. London, IWA Publishing.

11.1.9 Legionella

General description

The genus *Legionella*, a member of the family Legionellaceae, has at least 42 species. Legionellae are Gram-negative, rod-shaped, non-spore-forming bacteria that require L-cysteine for growth and primary isolation. *Legionella* spp. are heterotrophic bacteria found in a wide range of water environments and can proliferate at temperatures above 25 °C.

Human health effects

Although all *Legionella* spp. are considered potentially pathogenic for humans, *L. pneumophila* is the major waterborne pathogen responsible for legionellosis, of which two clinical forms are known: Legionnaires' disease and Pontiac fever. The former is a pneumonic illness with an incubation period of 3–6 days. Host factors influence the likelihood of illness: males are more frequently affected than females, and most cases occur in the 40- to 70-year age group. Risk factors include smoking, alcohol abuse, cancer, diabetes, chronic respiratory or kidney disease and immunosuppression, as in transplant recipients. Pontiac fever is a milder, self-limiting disease with a high attack rate and an onset (5 h to 3 days) and symptoms similar to those of influenza: fever, headache, nausea, vomiting, aching muscles and coughing. Studies of seroprevalence of antibodies indicate that many infections are asymptomatic.

Source and occurrence

Legionella spp. are members of the natural flora of many freshwater environments, such as rivers, streams and impoundments, where they occur in relatively low numbers. However, they thrive in certain human-made water environments, such as water cooling devices (cooling towers and evaporative condensers) associated with air conditioning systems, hot water distribution systems and spas, which provide suitable temperatures (25–50 °C) and conditions for their multiplication. Devices that support multiplication of *Legionella* have been associated with outbreaks of Legionnaires' disease. *Legionella* survive and grow in biofilms and sediments and are more easily detected from swab samples than from flowing water. Legionellae can be ingested by trophozoites of certain amoebae such as *Acanthamoeba*, *Hartmanella* and *Naegleria*, which may play a role in their persistence in water environments.

Routes of exposure

The most common route of infection is the inhalation of aerosols containing the bacteria. Such aerosols can be generated by contaminated cooling towers, warm water showers, humidifiers and spas. Aspiration has also been identified as a route of infection in some cases associated with contaminated water, food and ice. There is no evidence of person-to-person transmission.

Significance in drinking-water

Legionella spp. are common waterborne organisms, and devices such as cooling towers, hot water systems and spas that utilize mains water have been associated with outbreaks of infection. Owing to the prevalence of *Legionella*, the potential for ingress into drinking-water systems should be considered as a possibility, and control measures should be employed to reduce the likelihood of survival and multiplication. Disinfection strategies designed to minimize biofilm growth and temperature control can minimize the potential risk from *Legionella* spp. The organisms are sensitive to disinfection. Monochloramine has been shown to be particularly effective, probably due to its stability and greater effectiveness against biofilms. Water temperature is an important element of control strategies. Wherever possible, water temperatures should be kept outside the range of 25–50 °C. In hot water systems, storages should be maintained above 55 °C, and similar temperatures throughout associated pipework will prevent growth of the organism. However, maintaining temperatures of hot water above 50 °C may represent a scalding risk in young children, the elderly and other vulnerable groups. Where temperatures in hot or cold water distribution systems cannot be maintained outside the range of 25–50 °C, greater attention to disinfection and strategies aimed at limiting development of biofilms are required. Accumulation of sludge, scale, rust, algae or slime deposits in water distribution systems supports the growth of *Legionella* spp., as does stagnant water. Systems that are kept clean and flowing are less likely to support excess growth of *Legionella* spp. Care should also be taken to select plumbing materials that do not support microbial growth and the development of biofilms.

Legionella spp. represent a particular concern in devices such as cooling towers and hot water systems in large buildings. As discussed in chapter 6, specific WSPs incorporating control measures for *Legionella* spp. should be developed for these buildings. *Legionella* are not detected by HPC techniques, and *E. coli* (or, alternatively, thermotolerant coliforms) is not a suitable index for the presence/absence of this organism.

Selected bibliography

Codony F et al. (2002) Factors promoting colonization by legionellae in residential water distribution systems: an environmental case–control survey. *European Journal of Clinical Microbiology and Infectious Diseases*, 21:717–721.

Emmerson AM (2001) Emerging waterborne infections in health-care settings. *Emerging Infectious Diseases*, 7:272–276.

Rusin PA et al. (1997) Risk assessment of opportunistic bacterial pathogens in drinking-water. *Reviews of Environmental Contamination and Toxicology*, 152:57–83.

WHO (in preparation) *Legionella and the prevention of legionellosis*. Geneva, World Health Organization.

11.1.10 Mycobacterium

General description

The tuberculous or "typical" species of *Mycobacterium*, such as *M. tuberculosis*, *M. bovis*, *M. africanum* and *M. leprae*, have only human or animal reservoirs and are not transmitted by water. In contrast, the non-tuberculous or "atypical" species of *Mycobacterium* are natural inhabitants of a variety of water environments. These aerobic, rod-shaped and acid-fast bacteria grow slowly in suitable water environments and on culture media. Typical examples include the species *M. gordonae*, *M. kansasii*, *M. marinum*, *M. scrofulaceum*, *M. xenopi*, *M. intracellulare* and *M. avium* and the more rapid growers *M. chelonae* and *M. fortuitum*. The term *M. avium* complex has been used to describe a group of pathogenic species including *M. avium* and *M. intracellulare*. However, other atypical mycobacteria are also pathogenic. A distinct feature of all *Mycobacterium* spp. is a cell wall with high lipid content, which is used in identification of the organisms using acid-fast staining.

Human health effects

Atypical *Mycobacterium* spp. can cause a range of diseases involving the skeleton, lymph nodes, skin and soft tissues, as well as the respiratory, gastrointestinal and genitourinary tracts. Manifestations include pulmonary disease, Buruli ulcer, osteomyelitis and septic arthritis in people with no known predisposing factors. These bacteria are a major cause of disseminated infections in immunocompromised patients and are a common cause of death in HIV-positive persons.

Source and occurrence

Atypical *Mycobacterium* spp. multiply in a variety of suitable water environments, notably biofilms. One of the most commonly occurring species is *M. gordonae*. Other species have also been isolated from water, including *M. avium*, *M. intracellulare*, *M. kansasii*, *M. fortuitum* and *M. chelonae*. High numbers of atypical *Mycobacterium* spp. may occur in distribution systems after events that dislodge biofilms, such as flushing or flow reversals. They are relatively resistant to treatment and disinfection and have been detected in well operated and maintained drinking-water supplies with HPC less than 500/ml and total chlorine residuals of up to 2.8 mg/litre. The growth of these organisms in biofilms reduces the effectiveness of disinfection. In one survey, the organisms were detected in 54% of ice and 35% of public drinking-water samples.

Routes of exposure

Principal routes of infection appear to be inhalation, contact and ingestion of contaminated water. Infections by various species have been associated with their presence in drinking-water supplies. In 1968, an endemic of *M. kansasii* infections was associated with the presence of the organisms in the drinking-water supply, and the spread of the organisms was associated with aerosols from showerheads. In Rotterdam, Netherlands, an investigation into the frequent isolation of *M. kansasii* from clinical specimens revealed the presence of the same strains, confirmed by phage type and weak nitrase activity, in tap water. An increase in numbers of infections by the *M. avium* complex in Massachusetts, USA, has also been attributed to their incidence in drinking-water. In all these cases, there is only circumstantial evidence of a causal relationship between the occurrence of the bacteria in drinking-water and human disease. Infections have been linked to contaminated water in spas.

Significance in drinking-water

Detections of atypical mycobacteria in drinking-water and the identified routes of transmission suggest that drinking-water supplies are a plausible source of infection. There are limited data on the effectiveness of control measures that could be applied to reduce the potential risk from these organisms. One study showed that a water treatment plant could achieve a 99% reduction in numbers of mycobacteria from raw water. Atypical mycobacteria are relatively resistant to disinfection. Persistent residual disinfectant should reduce numbers of mycobacteria in the water column but is unlikely to be effective against organisms present in biofilms. Control measures that are designed to minimize biofilm growth, including treatment to optimize organic carbon removal, restriction of the residence time of water in distribution systems and maintenance of disinfectant residuals, could result in less growth of these organisms. Mycobacteria are not detected by HPC techniques, and *E. coli* (or, alternatively, thermotolerant coliforms) is not a suitable index for the presence/absence of this organism.

Selected bibliography

Bartram J et al., eds. (2003) *Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health.* WHO Emerging Issues in Water and Infectious Disease Series. London, IWA Publishing.

Bartram J et al., eds. (2004) *Pathogenic mycobacteria in water: A guide to public health consequences, monitoring and management.* Geneva, World Health Organization.

Covert TC et al. (1999) Occurrence of nontuberculous mycobacteria in environmental samples. *Applied and Environmental Microbiology*, 65:2492–2496.

Falkinham JO, Norton CD, LeChevallier MW (2001) Factors influencing numbers of *Mycobacterium avium*, *Mycobacterium intracellulare* and other mycobacteria in drinking water distribution systems. *Applied and Environmental Microbiology*, 66:1225–1231.

Grabow WOK (1996) Waterborne diseases: Update on water quality assessment and control. *Water SA*, 22:193–202.

Rusin PA et al. (1997) Risk assessment of opportunistic bacterial pathogens in drinking-water. *Reviews of Environmental Contamination and Toxicology*, 152:57–83.

Singh N, Yu VL (1994) Potable water and *Mycobacterium avium* complex in HIV patients: is prevention possible? *Lancet*, 343:1110–1111.

Von Reyn CF et al. (1994) Persistent colonization of potable water as a source of *Mycobacterium avium* infection in AIDS. *Lancet*, 343:1137–1141.

11.1.11 Pseudomonas aeruginosa

General description

Pseudomonas aeruginosa is a member of the family Pseudomonadaceae and is a polarly flagellated, aerobic, Gram-negative rod. When grown in suitable media, it produces the non-fluorescent bluish pigment pyocyanin. Many strains also produce the fluorescent green pigment pyoverdin. *Pseudomonas aeruginosa*, like other fluorescent pseudomonads, produces catalase, oxidase and ammonia from arginine and can grow on citrate as the sole source of carbon.

Human health effects

Pseudomonas aeruginosa can cause a range of infections but rarely causes serious illness in healthy individuals without some predisposing factor. It predominantly colonizes damaged sites such as burn and surgical wounds, the respiratory tract of people with underlying disease and physically damaged eyes. From these sites, it may invade the body, causing destructive lesions or septicaemia and meningitis. Cystic fibrosis and immunocompromised patients are prone to colonization with *P. aeruginosa*, which may lead to serious progressive pulmonary infections. Water-related folliculitis and ear infections are associated with warm, moist environments such as swimming pools and spas. Many strains are resistant to a range of antimicrobial agents, which can increase the significance of the organism in hospital settings.

Source and occurrence

Pseudomonas aeruginosa is a common environmental organism and can be found in faeces, soil, water and sewage. It can multiply in water environments and also on the surface of suitable organic materials in contact with water. *Pseudomonas aeruginosa* is a recognized cause of hospital-acquired infections with potentially serious complications. It has been isolated from a range of moist environments such as sinks, water baths, hot water systems, showers and spa pools.

Routes of exposure

The main route of infection is by exposure of susceptible tissue, notably wounds and mucous membranes, to contaminated water or contamination of surgical instruments. Cleaning of contact lenses with contaminated water can cause a form of keratitis. Ingestion of drinking-water is not an important source of infection.

Significance in drinking-water

Although *P. aeruginosa* can be significant in certain settings such as health care facilities, there is no evidence that normal uses of drinking-water supplies are a source of infection in the general population. However, the presence of high numbers of *P. aeruginosa* in potable water, notably in packaged water, can be associated with complaints about taste, odour and turbidity. *Pseudomonas aeruginosa* is sensitive to disinfection, and entry into distribution systems can be minimized by adequate disinfection. Control measures that are designed to minimize biofilm growth, including treatment to optimize organic carbon removal, restriction of the residence time of water in distribution systems and maintenance of disinfectant residuals, should reduce the growth of these organisms. *Pseudomonas aeruginosa* is detected by HPC, which can be used together with parameters such as disinfectant residuals to indicate conditions that could support growth of these organisms. However, as *P. aeruginosa* is a common environmental organism, *E. coli* (or, alternatively, thermotolerant coliforms) cannot be used for this purpose.

Selected bibliography

Bartram J et al., eds. (2003) *Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health.* WHO Emerging Issues in Water and Infectious Disease Series. London, IWA Publishing.

de Victorica J, Galván M (2001) *Pseudomonas aeruginosa* as an indicator of health risk in water for human consumption. *Water Science and Technology*, 43:49–52.
Hardalo C, Edberg SC (1997) *Pseudomonas aeruginosa*: Assessment of risk from drinking-water. *Critical Reviews in Microbiology*, 23:47–75.

11.1.12 Salmonella

General description

Salmonella spp. belong to the family Enterobacteriaceae. They are motile, Gram-negative bacilli that do not ferment lactose, but most produce hydrogen sulfide or gas from carbohydrate fermentation. Originally, they were grouped into more than 2000 species (serotypes) according to their somatic (O) and flagellar (H) antigens (Kauffmann-White classification). It is now considered that this classification is below species level and that there are actually no more than 2–3 species (*Salmonella enterica* or *Salmonella choleraesuis*, *Salmonella bongori* and *Salmonella typhi*), with the serovars being subspecies. All of the enteric pathogens except *S. typhi* are members of the species *S. enterica*. Convention has dictated that subspecies are abbreviated, so that *S. enterica* serovar Paratyphi A becomes *S.* Paratyphi A.

Human health effects

Salmonella infections typically cause four clinical manifestations: gastroenteritis (ranging from mild to fulminant diarrhoea, nausea and vomiting), bacteraemia or septicaemia (high spiking fever with positive blood cultures), typhoid fever / enteric fever (sustained fever with or without diarrhoea) and a carrier state in persons with previous infections. In regard to enteric illness, *Salmonella* spp. can be divided into two fairly distinct groups: the typhoidal species/serovars (*Salmonella typhi* and *S.* Paratyphi) and the remaining non-typhoidal species/serovars. Symptoms of non-typhoidal gastroenteritis appear from 6 to 72 h after ingestion of contaminated food or water. Diarrhoea lasts 3–5 days and is accompanied by fever and abdominal pain. Usually the disease is self-limiting. The incubation period for typhoid fever can be 1–14 days but is usually 3–5 days. Typhoid fever is a more severe illness and can be fatal. Although typhoid is uncommon in areas with good sanitary systems, it is still prevalent elsewhere, and there are many millions of cases each year.

Source and occurrence

Salmonella spp. are widely distributed in the environment, but some species or serovars show host specificity. Notably, *S. typhi* and generally *S.* Paratyphi are restricted to humans, although livestock can occasionally be a source of *S.* Paratyphi. A large number of serovars, including *S.* Typhimurium and *S.* Enteritidis, infect humans and also a wide range of animals, including poultry, cows, pigs, sheep, birds and even reptiles. The pathogens typically gain entry into water systems through faecal contamination from sewage discharges, livestock and wild animals. Contamination has been detected in a wide variety of foods and milk.

Routes of exposure

Salmonella is spread by the faecal–oral route. Infections with non-typhoidal serovars are primarily associated with person-to-person contact, the consumption of a variety of contaminated foods and exposure to animals. Infection by typhoid species is associated with the consumption of contaminated water or food, with direct person-to-person spread being uncommon.

Significance in drinking-water

Waterborne typhoid fever outbreaks have devastating public health implications. However, despite their widespread occurrence, non-typhoidal *Salmonella* spp. rarely cause drinking-water-borne outbreaks. Transmission, most commonly involving *S.* Typhimurium, has been associated with the consumption of contaminated groundwater and surface water supplies. In an outbreak of illness associated with a communal rainwater supply, bird faeces were implicated as a source of contamination. *Salmonella* spp. are relatively sensitive to disinfection. Within a WSP, control measures that can be applied to manage risk include protection of raw water supplies from animal and human waste, adequate treatment and protection of water during distribution. *Escherichia coli* (or, alternatively, thermotolerant coliforms) is a generally reliable index for *Salmonella* spp. in drinking-water supplies.

Selected bibliography

Angulo FJ et al. (1997) A community waterborne outbreak of salmonellosis and the effectiveness of a boil water order. *American Journal of Public Health*, 87:580–584.

Escartin EF et al. (2002) Potential *Salmonella* transmission from ornamental fountains. *Journal of Environmental Health*, 65:9–12.

Koplan JP et al. (1978) Contaminated roof-collected rainwater as a possible cause of an outbreak of salmonellosis. *Journal of Hygiene*, 81:303–309.

11.1.13 Shigella

General description

Shigella spp. are Gram-negative, non-spore-forming, non-motile, rod-like members of the family Enterobacteriaceae, which grow in the presence or absence of oxygen. Members of the genus have a complex antigenic pattern, and classification is based on their somatic O antigens, many of which are shared with other enteric bacilli, including *E. coli*. There are four species: *S. dysenteriae*, *S. flexneri*, *S. boydii* and *S. sonnei*.

Human health effects

Shigella spp. can cause serious intestinal diseases, including bacillary dysentery. Over 2 million infections occur each year, resulting in about 600 000 deaths, predominantly in developing countries. Most cases of *Shigella* infection occur in children under 10 years of age. The incubation period for shigellosis is usually 24–72 h. Ingestion of as few as 10–100 organisms may lead to infection, which is substantially less than the infective dose of most other enteric bacteria. Abdominal cramps, fever and watery diarrhoea occur early in the disease. All species can produce severe disease, but illness due to *S. sonnei* is usually relatively mild and self-limiting. In the case of *S. dysenteriae*, clinical manifestations may proceed to an ulceration process, with bloody diarrhoea and high concentrations of neutrofils in the stool. The production of Shiga toxin by the pathogen plays an important role in this outcome. *Shigella* spp. seem to be better adapted to cause human disease than most other enteric bacterial pathogens.

Source and occurrence

Humans and other higher primates appear to be the only natural hosts for the shigellae. The bacteria remain localized in the intestinal epithelial cells of their hosts. Epidemics of shigellosis occur in crowded communities and where hygiene is poor. Many cases of shigellosis are associated with day care centres, prisons and psychiatric institutions. Military field groups and travellers to areas with poor sanitation are also prone to infection.

Routes of exposure

Shigella spp. are enteric pathogens predominantly transmitted by the faecal–oral route through person-to-person contact, contaminated food and water. Flies have also been identified as a transmission vector from contaminated faecal waste.

Significance in drinking-water

A number of large waterborne outbreaks of shigellosis have been recorded. As the organisms are not particularly stable in water environments, their presence in drinking-water indicates recent human faecal pollution. Available data on prevalence in water supplies may be an underestimate, because detection techniques generally used can have a relatively low sensitivity and reliability. The control of *Shigella* spp. in drinking-water supplies is of special public health importance in view of the severity of the disease caused. *Shigella* spp. are relatively sensitive to disinfection. Within a WSP, control measures that can be applied to manage potential risk include protection of raw water supplies from human waste, adequate treatment and protection of water during distribution. *Escherichia coli* (or, alternatively, thermotolerant coliforms) is a generally reliable index for *Shigella* spp. in drinking-water supplies.

Selected bibliography

Alamanos Y et al. (2000) A community waterborne outbreak of gastro-enteritis attributed to *Shigella sonnei*. *Epidemiology and Infection*, 125:499–503.

Pegram GC, Rollins N, Espay Q (1998) Estimating the cost of diarrhoea and epidemic dysentery in Kwa-Zulu-Natal and South Africa. *Water SA*, 24:11–20.

11.1.14 Staphylococcus aureus

General description

Staphylococcus aureus is an aerobic or anaerobic, non-motile, non-spore-forming, catalase- and coagulase-positive, Gram-positive coccus, usually arranged in grapelike irregular clusters. The genus *Staphylococcus* contains at least 15 different species. Apart from *S. aureus*, the species *S. epidermidis* and *S. saprophyticus* are also associated with disease in humans.

Human health effects

Although *Staphylococcus aureus* is a common member of the human microflora, it can produce disease through two different mechanisms. One is based on the ability of the organisms to multiply and spread widely in tissues, and the other is based on the ability of the organisms to produce extracellular enzymes and toxins. Infections based on the multiplication of the organisms are a significant problem in hospitals and other health care facilities. Multiplication in tissues can result in manifestations such as boils, skin sepsis, post-operative wound infections, enteric infections, septicaemia, endocarditis, osteomyelitis and pneumonia. The onset of clinical symptoms for these infections is relatively long, usually several days. Gastrointestinal disease (enterocolitis or food poisoning) is caused by a heat-stable staphylococcal enterotoxin and characterized by projectile vomiting, diarrhoea, fever, abdominal cramps, electrolyte imbalance and loss of fluids. Onset of disease in this case has a characteristic short incubation period of 1–8 h. The same applies to the toxic shock syndrome caused by toxic shock syndrome toxin-1.

Source and occurrence

Staphylococcus aureus is relatively widespread in the environment but is found mainly on the skin and mucous membranes of animals. The organism is a member of the normal microbial flora of the human skin and is found in the nasopharynx of 20–30% of adults at any one time. Staphylococci are occasionally detected in the gastrointestinal tract and can be detected in sewage. *Staphylococcus aureus* can be released by human contact into water environments such as swimming pools, spa pools and other recreational waters. It has also been detected in drinking-water supplies.

Routes of exposure

Hand contact is by far the most common route of transmission. Inadequate hygiene can lead to contamination of food. Foods such as ham, poultry and potato and egg salads kept at room or higher temperature offer an ideal environment for the multiplication of *S. aureus* and the release of toxins. The consumption of foods containing *S. aureus* toxins can lead to enterotoxin food poisoning within a few hours.

Significance in drinking-water

Although *S. aureus* can occur in drinking-water supplies, there is no evidence of transmission through the consumption of such water. Although staphylococci are slightly more resistant to chlorine residuals than *E. coli*, their presence in water is readily controlled by conventional treatment and disinfection processes. Since faecal material is not their usual source, *E. coli* (or, alternatively, thermotolerant coliforms) is not a suitable index for *S. aureus* in drinking-water supplies.

Selected bibliography

Antai SP (1987) Incidence of *Staphylococcus aureus*, coliforms and antibiotic-resistant strains of *Escherichia coli* in rural water supplies in Port Harcourt. *Journal of Applied Bacteriology*, 62:371–375.

LeChevallier MW, Seidler RJ (1980) *Staphylococcus aureus* in rural drinking-water. *Applied and Environmental Microbiology*, 39:739–742.

11.1.15 Tsukamurella

General description

The genus *Tsukamurella* belongs to the family Nocardiaceae. *Tsukamurella* spp. are Gram-positive, weakly or variably acid-fast, non-motile, obligate aerobic, irregular rod-shaped bacteria. They are actinomycetes related to *Rhodococcus*, *Nocardia* and *Mycobacterium*. The genus was created in 1988 to accommodate a group of chemically unique organisms characterized by a series of very long chain (68–76 carbons), highly unsaturated mycolic acids, *meso*-diaminopimelic acid and arabinogalactan, common to the genus *Corynebacterium*. The type species is *T. paurometabola*, and the following additional species were proposed in the 1990s: *T. wratislaviensis*, *T. inchonensis*, *T. pulmonis*, *T. tyrosinosolvens* and *T. strandjordae*.

Human health effects

Tsukamurella spp. cause disease mainly in immunocompromised individuals. Infections with these microorganisms have been associated with chronic lung diseases, immune suppression (leukaemia, tumours, HIV/AIDS infection) and post-operative wound infections. *Tsukamurella* were reported in four cases of catheter-related bacteraemia and in individual cases including chronic lung infection, necrotizing tenosynovitis with subcutaneous abscesses, cutaneous and bone infections, meningitis and peritonitis.

Source and occurrence

Tsukamurella spp. exist primarily as environmental saprophytes in soil, water and foam (thick stable scum on aeration vessels and sedimentation tanks) of activated sludge. *Tsukamurella* are represented in HPC populations in drinking-water.

Routes of exposure

Tsukamurella spp. appear to be transmitted through devices such as catheters or lesions. The original source of the contaminating organisms is unknown.

Significance in drinking-water

Tsukamurella organisms have been detected in drinking-water supplies, but the significance is unclear. There is no evidence of a link between organisms in water and illness. As *Tsukamurella* is an environmental organism, *E. coli* (or, alternatively, thermotolerant coliforms) is not a suitable index for this organism.

Selected bibliography

Bartram J et al., eds. (2003) *Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health*. WHO Emerging Issues in Water and Infectious Disease Series. London, IWA Publishing.

Kattar MM et al. (2001) *Tsukamurella strandjordae* sp. nov., a proposed new species causing sepsis. *Journal of Clinical Microbiology*, 39:1467–1476.

Larkin JA et al. (1999) Infection of a knee prosthesis with *Tsukamurella* species. *Southern Medical Journal*, 92:831–832.

11.1.16 Vibrio

General description

Vibrio spp. are small, curved (comma-shaped), Gram-negative bacteria with a single polar flagellum. Species are typed according to their O antigens. There are a number of pathogenic species, including *V. cholerae*, *V. parahaemolyticus* and *V. vulnificus*. *Vibrio cholerae* is the only pathogenic species of significance from freshwater environments. While a number of serotypes can cause diarrhoea, only O1 and O139 currently cause the classical cholera symptoms in which a proportion of cases suffer fulminating and severe watery diarrhoea. The O1 serovar has been further divided into "classical" and "El Tor" biotypes. The latter is distinguished by features such as the ability to produce a dialysable heat-labile haemolysin, active against sheep and goat red blood cells. The classical biotype is considered responsible for the first six cholera pandemics, while the El Tor biotype is responsible for the seventh pandemic that commenced in 1961. Strains of *V. cholerae* O1 and O139 that cause cholera produce an enterotoxin (cholera toxin) that alters the ionic fluxes across the intestinal mucosa, resulting in substantial loss of water and electrolytes in liquid stools. Other factors associated with infection are an adhesion factor and an attachment pilus. Not all strains of serotypes O1 or O139 possess the virulence factors, and they are rarely possessed by non-O1/O139 strains.

Human health effects

Cholera outbreaks continue to occur in many areas of the developing world. Symptoms are caused by heat-labile cholera enterotoxin carried by toxigenic strains of *V.*

cholerae O1/O139. A large percentage of infected persons do not develop illness; about 60% of the classical and 75% of the El Tor group infections are asymptomatic. Symptomatic illness ranges from mild or moderate to severe disease. The initial symptoms of cholera are an increase in peristalses followed by loose, watery and mucus-flecked "rice-water" stools that may cause a patient to lose as much as 10–15 litres of liquid per day. Decreasing gastric acidity by administration of sodium bicarbonate reduces the infective dose of *V. cholerae* O1 from more than 10^8 to about 10^4 organisms. Case fatality rates vary according to facilities and preparedness. As many as 60% of untreated patients may die as a result of severe dehydration and loss of electrolytes, but well established diarrhoeal disease control programmes can reduce fatalities to less than 1%. Non-toxigenic strains of *V. cholerae* can cause self-limiting gastroenteritis, wound infections and bacteraemia.

Source and occurrence

Non-toxigenic *V. cholerae* is widely distributed in water environments, but toxigenic strains are not distributed as widely. Humans are an established source of toxigenic *V. cholerae*; in the presence of disease, the organism can be detected in sewage. Although *V. cholerae* O1 can be isolated from water in areas without disease, the strains are not generally toxigenic. Toxigenic *V. cholerae* has also been found in association with live copepods as well as other aquatic organisms, including molluscs, crustaceans, plants, algae and cyanobacteria. Numbers associated with these aquatic organisms are often higher than in the water column. Non-toxigenic *V. cholerae* has been isolated from birds and herbivores in areas far away from marine and coastal waters. The prevalence of *V. cholerae* decreases as water temperatures fall below 20 °C.

Routes of exposure

Cholera is typically transmitted by the faecal–oral route, and the infection is predominantly contracted by the ingestion of faecally contaminated water and food. The high numbers required to cause infection make person-to-person contact an unlikely route of transmission.

Significance in drinking-water

Contamination of water due to poor sanitation is largely responsible for transmission, but this does not fully explain the seasonality of recurrence, and factors other than poor sanitation must play a role. The presence of the pathogenic *V. cholerae* O1 and O139 serotypes in drinking-water supplies is of major public health importance and can have serious health and economic implications in the affected communities. *Vibrio cholerae* is highly sensitive to disinfection processes. Within a WSP, control measures that can be applied to manage potential risk from toxigenic *V. cholerae* include protection of raw water supplies from human waste, adequate treatment and protection of water during distribution. *Vibrio cholerae* O1 and non-O1 have been detected in the absence of *E. coli*, and this organism (or, alternatively, thermotolerant coliforms) is not a reliable index for *V. cholerae* in drinking-water.

Selected bibliography

Kaper JB, Morris JG, Levine MM (1995) Cholera. *Clinical Microbiology Reviews*, 8:48–86.

Ogg JE, Ryder RA, Smith HL (1989) Isolation of *Vibrio cholerae* from aquatic birds in Colorado and Utah. *Applied and Environmental Microbiology*, 55:95–99.

Rhodes JB, Schweitzer D, Ogg JE (1985) Isolation of non-O1 *Vibrio cholerae* associated with enteric disease of herbivores in western Colorado. *Journal of Clinical Microbiology*, 22:572–575.

WHO (2002) *Vibrio cholerae*. In: *Guidelines for drinking-water quality*, 2nd ed. *Addendum: Microbiological agents in drinking water*. Geneva, World Health Organization, pp. 119–142.

11.1.17 Yersinia

General description

The genus *Yersinia* is classified in the family Enterobacteriaceae and comprises seven species. The species *Y. pestis*, *Y. pseudotuberculosis* and certain serotypes of *Y. enterocolitica* are pathogens for humans. *Yersinia pestis* is the cause of bubonic plague through contact with rodents and their fleas. *Yersinia* spp. are Gram-negative rods that are motile at 25 °C but not at 37 °C.

Human health effects

Yersinia enterocolitica penetrates cells of the intestinal mucosa, causing ulcerations of the terminal ilium. Yersiniosis generally presents as an acute gastroenteritis with diarrhoea, fever and abdominal pain. Other clinical manifestations include greatly enlarged painful lymph nodes referred to as "buboes." The disease seems to be more acute in children than in adults.

Source and occurrence

Domestic and wild animals are the principal reservoir for *Yersinia* spp.; pigs are the major reservoir of pathogenic *Y. enterocolitica*, whereas rodents and small animals are the major reservoir of *Y. pseudotuberculosis*. Pathogenic *Y. enterocolitica* has been detected in sewage and polluted surface waters. However, *Y. enterocolitica* strains detected in drinking-water are more commonly non-pathogenic strains of probable environmental origin. At least some species and strains of *Yersinia* seem to be able to replicate in water environments if at least trace amounts of organic nitrogen are present, even at temperatures as low as 4 °C.

Routes of exposure

Yersinia spp. are transmitted by the faecal–oral route, with the major source of infection considered to be foods, particularly meat and meat products, milk and dairy products. Ingestion of contaminated water is also a potential source of infection. Direct transmission from person to person and from animals to humans is also known to occur.

Significance in drinking-water

Although most *Yersinia* spp. detected in water are probably non-pathogenic, circumstantial evidence has been presented to support transmission of *Y. enterocolitica* and *Y. pseudotuberculosis* to humans from untreated drinking-water. The most likely source of pathogenic *Yersinia* spp. is human or animal waste. The organisms are sensitive to disinfection processes. Within a WSP, control measures that can be used to minimize the presence of pathogenic *Yersinia* spp. in drinking-water supplies include protection of raw water supplies from human and animal waste, adequate disinfection and protection of water during distribution. Owing to the long survival and/or growth of some strains of *Yersinia* spp. in water, *E. coli* (or, alternatively, thermotolerant coliforms) is not a suitable index for the presence/absence of these organisms in drinking-water.

Selected bibliography

Aleksic S, Bockemuhl J (1988) Serological and biochemical characteristics of 416 *Yersinia* strains from well water and drinking water plants in the Federal Republic of Germany: lack of evidence that these strains are of public health significance. *Zentralblatt für Bakteriologie, Mikrobiologie und Hygiene B*, 185:527–533.

Inoue M et al. (1988) Three outbreaks of *Yersinia pseudotuberculosis* infection. *Zentralblatt für Bakteriologie, Mikrobiologie und Hygiene B*, 186:504–511.

Ostroff SM et al. (1994) Sources of sporadic *Yersinia enterocolitica* infections in Norway: a prospective case control study. *Epidemiology and Infection*, 112:133–141.

Waage AS et al. (1999) Detection of low numbers of pathogenic *Yersinia enterocolitica* in environmental water and sewage samples by nested polymerase chain reaction. *Journal of Applied Microbiology*, 87:814–821.

11.2 Viral pathogens

Viruses associated with waterborne transmission are predominantly those that can infect the gastrointestinal tract and are excreted in the faeces of infected humans (enteric viruses). With the exception of hepatitis E, humans are considered to be the only source of human infectious species. Enteric viruses typically cause acute disease with a short incubation period. Water may also play a role in the transmission of other viruses with different modes of action. As a group, viruses can cause a wide variety of infections and symptoms involving different routes of transmission, routes and sites of infection and routes of excretion. The combination of these routes and sites of infection can vary and will not always follow expected patterns. For example, viruses that are considered to primarily cause respiratory infections and symptoms are usually transmitted by person-to-person spread of respiratory droplets. However, some of these respiratory viruses may be discharged in faeces, leading to potential contamination of water and subsequent transmission through aerosols and droplets. Another example is viruses excreted in urine, such as polyomaviruses, which could contaminate and then be potentially transmitted by water, with possible long-term health effects, such as cancer, that are not readily associated epidemiologically with waterborne transmission.

11.2.1 Adenoviruses

General description

The family Adenoviridae is classified into the two genera *Mastadenovirus* (mammal hosts) and *Aviadenovirus* (avian hosts). Adenoviruses are widespread in nature, infecting birds, mammals and amphibians. To date, 51 antigenic types of human adenoviruses (HAds) have been described. HAds have been classified into six groups (A–F) on the basis of their physical, chemical and biological properties. Adenoviruses consist of a double-stranded DNA genome in a non-enveloped icosahedral capsid with a diameter of about 80 nm and unique fibres. The subgroups A–E grow readily in cell culture, but serotypes 40 and 41 are fastidious and do not grow well. Identification of serotypes 40 and 41 in environmental samples is generally based on polymerase chain reaction (PCR) techniques with or without initial cell culture amplification.

Human health effects

HAds cause a wide range of infections with a spectrum of clinical manifestations. These include infections of the gastrointestinal tract (gastroenteritis), the respiratory tract (acute respiratory diseases, pneumonia, pharyngoconjunctival fever), the urinary tract (cervicitis, urethritis, haemorrhagic cystitis) and the eyes (epidemic keratoconjunctivitis, also known as "shipyard eye"; pharyngoconjunctival fever, also known as "swimming pool conjunctivitis"). Different serotypes are associated with specific illnesses; for example, types 40 and 41 are the main cause of enteric illness. Adenoviruses are an important source of childhood gastroenteritis. In general, infants and children are most susceptible to adenovirus infections, and many infections are asymptomatic. High attack rates in outbreaks imply that infecting doses are low.

Source and occurrence

Adenoviruses are excreted in large numbers in human faeces and are known to occur in sewage, raw water sources and treated drinking-water supplies worldwide. Although the subgroup of enteric adenoviruses (mainly types 40 and 41) is a major cause of gastroenteritis worldwide, notably in developing communities, little is known about the prevalence of these enteric adenoviruses in water sources. The limited availability of information on enteric adenoviruses is largely due to the fact that they are not detectable by conventional cell culture isolation.

Routes of exposure

Owing to the diverse epidemiology of the wide spectrum of HAds, exposure and infection are possible by a variety of routes. Person-to-person contact plays a major role in the transmission of illness; depending on the nature of illness, this can include faecal–oral, oral–oral and hand–eye contact transmission, as well as indirect transfer through contaminated surfaces or shared utensils. There have been numerous outbreaks associated with hospitals, military establishments, child care centres and schools. Symptoms recorded in most outbreaks were acute respiratory disease, keratoconjunctivitis and conjunctivitis. Outbreaks of gastroenteritis have also been reported. The consumption of contaminated food or water may be an important source of enteric illness, although there is no substantial evidence supporting this route of transmission. Eye infections may be contracted by the exposure of eyes to contaminated water, the sharing of towels at swimming pools or the sharing of goggles, as in the case of "shipyard eye." Confirmed outbreaks of adenovirus infections associated with water have been limited to pharyngitis and/or conjunctivitis, with exposure arising from use of swimming pools.

Significance in drinking-water

HAds have been shown to occur in substantial numbers in raw water sources and treated drinking-water supplies. In one study, the incidence of HAds in such waters was exceeded only by the group of enteroviruses among viruses detectable by PCR-based techniques. In view of their prevalence as an enteric pathogen and detection in water, contaminated drinking-water represents a likely but unconfirmed source of HAd infections. HAds are also considered important because they are exceptionally resistant to some water treatment and disinfection processes, notably UV light irradiation. HAds have been detected in drinking-water supplies that met accepted specifications for treatment, disinfection and conventional indicator organisms. Within a WSP, control measures to reduce potential risk from HAds should focus on prevention of source water contamination by human waste, followed by adequate treatment and disinfection. The effectiveness of treatment processes used to remove HAds will require validation. Drinking-water supplies should also be protected from contamination during distribution. Because of the high resistance of the viruses to disinfection, *E. coli* (or, alternatively, thermotolerant coliforms) is not a reliable index of the presence/absence of HAds in drinking-water supplies.

Selected bibliography

Chapron CD et al. (2000) Detection of astroviruses, enteroviruses and adenoviruses types 40 and 41 in surface waters collected and evaluated by the information collection rule and integrated cell culture-nested PCR procedure. *Applied and Environmental Microbiology*, 66:2520–2525.

D'Angelo LJ et al. (1979) Pharyngoconjunctival fever caused by adenovirus type 4: Report of a swimming pool-related outbreak with recovery of virus from pool water. *Journal of Infectious Diseases*, 140:42–47.

Grabow WOK, Taylor MB, de Villiers JC (2001) New methods for the detection of viruses: call for review of drinking water quality guidelines. *Water Science and Technology*, 43:1–8.

Puig M et al. (1994) Detection of adenoviruses and enteroviruses in polluted water by nested PCR amplification. *Applied and Environmental Microbiology*, 60:2963–2970.

11.2.2 Astroviruses

General description

Human and animal strains of astroviruses are single-stranded RNA viruses classified in the family Astroviridae. Astroviruses consist of a single-stranded RNA genome in a non-enveloped icosahedral capsid with a diameter of about 28 nm. In a proportion of the particles, a distinct surface star-shaped structure can be seen by electron microscopy. Eight different serotypes of human astroviruses (HAstVs) have been described. The most commonly identified is HAstV serotype 1. HAstVs can be detected in environmental samples using PCR techniques with or without initial cell culture amplification.

Human health effects

HAstVs cause gastroenteritis, predominantly diarrhoea, mainly in children under 5 years of age, although it has also been reported in adults. Seroprevalence studies showed that more than 80% of children between 5 and 10 years of age have antibodies against HAstVs. Occasional outbreaks in schools, nurseries and families have been reported. The illness is self-limiting, is of short duration and has a peak incidence in the winter. HAstVs are the cause of only a small proportion of reported gastroenteritis infections. However, the number of infections may be underestimated, since the illness is usually mild, and many cases will go unreported.

Source and occurrence

Infected individuals generally excrete large numbers of HAstVs in faeces; hence, the viruses will be present in sewage. HAstVs have been detected in water sources and in drinking-water supplies.

Routes of exposure

HAstVs are transmitted by the faecal–oral route. Person-to-person spread is considered the most common route of transmission, and clusters of cases are seen in child care centres, paediatric wards, families, homes for the elderly and military establishments. Ingestion of contaminated food or water could also be important.

Significance in drinking-water

The presence of HAstVs in treated drinking-water supplies has been confirmed. Since the viruses are typically transmitted by the faecal–oral route, transmission by drinking-water seems likely, but has not been confirmed. HAstVs have been detected in drinking-water supplies that met accepted specifications for treatment, disinfection and conventional indicator organisms. Within a WSP, control measures to reduce potential risk from HAstVs should focus on prevention of source water contamination by human waste, followed by adequate treatment and disinfection. The effectiveness of treatment processes used to remove HAstVs will require validation. Drinking-water supplies should also be protected from contamination during distribution. Owing to the higher resistance of the viruses to disinfection, *E. coli* (or, alternatively, thermotolerant coliforms) is not a reliable index of the presence/absence of HAstVs in drinking-water supplies.

Selected bibliography

Grabow WOK, Taylor MB, de Villiers JC (2001) New methods for the detection of viruses: call for review of drinking water quality guidelines. *Water Science and Technology*, 43:1–8.

Nadan S et al. (2003) Molecular characterization of astroviruses by reverse transcriptase PCR and sequence analysis: comparison of clinical and environmental isolates from South Africa. *Applied and Environmental Microbiology*, 69:747–753.

Pintó RM et al. (2001) Astrovirus detection in wastewater. *Water Science and Technology*, 43:73–77.

11.2.3 Caliciviruses

General description

The family Caliciviridae consists of four genera of single-stranded RNA viruses with a non-enveloped capsid (diameter 35–40 nm), which generally displays a typical surface morphology resembling cup-like structures. Human caliciviruses (HuCVs) include the genera *Norovirus* (Norwalk-like viruses) and *Sapovirus* (Sapporo-like viruses). *Sapovirus* spp. demonstrate the typical calicivirus morphology and are called classical caliciviruses. Noroviruses generally fail to reveal the typical morphology and were in the past referred to as small round-structured viruses. The remaining two genera of the family contain viruses that infect animals other than humans. HuCVs cannot be propagated in available cell culture systems. The viruses were originally discovered by electron microscopy. Some *Norovirus* spp. can be detected by ELISA using antibodies raised against baculovirus-expressed *Norovirus* capsid proteins. Several reverse transcriptase PCR procedures have been described for the detection of HuCVs.

Human health effects

HuCVs are a major cause of acute viral gastroenteritis in all age groups. Symptoms include nausea, vomiting and abdominal cramps. Usually about 40% of infected individuals present with diarrhoea; some have fever, chills, headache and muscular pain. Since some cases present with vomiting only and no diarrhoea, the condition is also known as "winter vomiting disease." Infections by HuCVs induce a short-lived immunity. The symptoms are usually relatively mild and rarely last for more than 3 days. High attack rates in outbreaks indicate that the infecting dose is low.

Source and occurrence

HuCVs are excreted in faeces of infected individuals and will therefore be present in domestic wastewaters as well as faecally contaminated food and water, including drinking-water supplies.

Routes of exposure

The epidemiology of the disease indicates that person-to-person contact and the inhalation of contaminated aerosols and dust particles, as well as airborne particles of vomitus, are the most common routes of transmission. Drinking-water and a wide variety of foods contaminated with human faeces have been confirmed as major sources of exposure. Numerous outbreaks have been associated with contaminated drinking-water, ice, water on cruise ships and recreational waters. Shellfish harvested from sewage-contaminated waters have also been identified as a source of outbreaks.

Significance in drinking-water

Many HuCV outbreaks have been epidemiologically linked to contaminated drinking-water supplies. Within a WSP, control measures to reduce potential risk from HuCV should focus on prevention of source water contamination by human waste, followed by adequate treatment and disinfection. The effectiveness of treatment processes used to remove HuCV will require validation. Drinking-water supplies should also be protected from contamination during distribution. Owing to the higher resistance of the viruses to disinfection, *E. coli* (or, alternatively, thermotolerant coliforms) is not a reliable index of the presence/absence of HuCVs in drinking-water supplies.

Selected bibliography

Berke T et al. (1997) Phylogenetic analysis of the Caliciviridae. *Journal of Medical Virology*, 52:419–424.

Jiang X et al. (1999) Design and evaluation of a primer pair that detects both Norwalk- and Sapporo-like caliciviruses by RT-PCR. *Journal of Virological Methods*, 83:145–154.

Mauer AM, Sturchler DA (2000) A waterborne outbreak of small round-structured virus, *Campylobacter* and *Shigella* co-infections in La Neuveville, Switzerland, 1998. *Epidemiology and Infection*, 125:325–332.

Monroe SS, Ando T, Glass R (2000) Introduction: Human enteric caliciviruses – An emerging pathogen whose time has come. *Journal of Infectious Diseases*, 181(Suppl. 2):S249–251.

11.2.4 Enteroviruses

General description

The genus *Enterovirus* is a member of the family Picornaviridae. This genus consists of 69 serotypes (species) that infect humans: poliovirus types 1–3, coxsackievirus types A1–A24, coxsackievirus types B1–B6, echovirus types 1–33 and the numbered enterovirus types EV68–EV73. Members of the genus are collectively referred to as enteroviruses. Other species of the genus infect animals other than humans – for instance, the bovine group of enteroviruses. Enteroviruses are among the smallest known viruses and consist of a single-stranded RNA genome in a non-enveloped icosahedral capsid with a diameter of 20–30 nm. Some members of the genus are readily isolated by cytopathogenic effect in cell cultures, notably poliovirus, coxsackievirus B, echovirus and enterovirus.

Human health effects

Enteroviruses are one of the most common causes of human infections. They have been estimated to cause about 30 million infections in the USA each year. The spectrum of diseases caused by enteroviruses is broad and ranges from a mild febrile illness to myocarditis, meningoencephalitis, poliomyelitis, herpangina, hand-foot-and-mouth disease and neonatal multi-organ failure. The persistence of the viruses in chronic conditions such as polymyositis, dilated cardiomyopathy and chronic fatigue syndrome has been described. Most infections, particularly in children, are asymptomatic, but still lead to the excretion of large numbers of the viruses, which may cause clinical disease in other individuals.

Source and occurrence

Enteroviruses are excreted in the faeces of infected individuals. Among the types of viruses detectable by conventional cell culture isolation, enteroviruses are generally the most numerous in sewage, water resources and treated drinking-water supplies. The viruses are also readily detected in many foods.

Routes of exposure

Person-to-person contact and inhalation of airborne viruses or viruses in respiratory droplets are considered to be the predominant routes of transmission of enteroviruses in communities. Transmission from drinking-water could also be important, but this has not yet been confirmed. Waterborne transmission of enteroviruses (coxsackievirus

A16 and B5) has been epidemiologically confirmed for only two outbreaks, and these were associated with children bathing in lake water in the 1970s.

Significance in drinking-water

Enteroviruses have been shown to occur in substantial numbers in raw water sources and treated drinking-water supplies. In view of their prevalence, drinking-water represents a likely, although unconfirmed, source of enterovirus infection. The limited knowledge on the role of waterborne transmission could be related to a number of factors, including the wide range of clinical symptoms, frequent asymptomatic infection, the diversity of serotypes and the dominance of person-to-person spread. Enteroviruses have been detected in drinking-water supplies that met accepted specifications for treatment, disinfection and conventional indicator organisms. Within a WSP, control measures to reduce potential risk from enteroviruses should focus on prevention of source water contamination by human waste, followed by adequate treatment and disinfection. The effectiveness of treatment processes used to remove enteroviruses will require validation. Drinking-water supplies should also be protected from contamination during distribution. Owing to the higher resistance of the viruses to disinfection, *E. coli* (or, alternatively, thermotolerant coliforms) is not a reliable index of the presence/absence of enteroviruses in drinking-water supplies.

Selected bibliography

Grabow WOK, Taylor MB, de Villiers JC (2001) New methods for the detection of viruses: call for review of drinking water quality guidelines. *Water Science and Technology*, 43:1–8.

Hawley HB et al. (1973) Coxsackie B epidemic at a boys' summer camp. *Journal of the American Medical Association*, 226:33–36.

11.2.5 Hepatitis A virus

General description

HAV is the only species of the genus *Hepatovirus* in the family Picornaviridae. The virus shares basic structural and morphological features with other members of the family, as described for enteroviruses. Human and simian HAVs are genotypically distinguishable. HAV cannot be readily detected or cultivated in conventional cell culture systems, and identification in environmental samples is based on the use of PCR techniques.

Human health effects

HAV is highly infectious, and the infecting dose is considered to be low. The virus causes the disease hepatitis A, commonly known as "infectious hepatitis." Like other members of the group enteric viruses, HAV enters the gastrointestinal tract by ingestion, where it infects epithelial cells. From here, the virus enters the bloodstream and reaches the liver, where it may cause severe damage to liver cells. In as many as 90%

of cases, particularly in children, there is little, if any, liver damage, and the infection passes without clinical symptoms and elicits lifelong immunity. In general, the severity of illness increases with age. The damage to liver cells results in the release of liver-specific enzymes such as aspartate aminotransferase, which are detectable in the bloodstream and used as a diagnostic tool. The damage also results in the failure of the liver to remove bilirubin from the bloodstream; the accumulation of bilirubin causes the typical symptoms of jaundice and dark urine. After a relatively long incubation period of 28–30 days on average, there is a characteristic sudden onset of illness, including symptoms such as fever, malaise, nausea, anorexia, abdominal discomfort and eventually jaundice. Although mortality is generally less than 1%, repair of the liver damage is a slow process that may keep patients incapacitated for 6 weeks or longer. This has substantial burden of disease implications. Mortality is higher in those over 50 years of age.

Source and occurrence

HAV occurs worldwide, but the prevalence of clinical disease has typical geographically based characteristics. HAV is excreted in faecal material of infected people, and there is strong epidemiological evidence that faecally contaminated food and water are common sources of the virus. In areas with poor sanitation, children are often infected at a very early age and become immune for life without clinical symptoms of disease. In areas with good sanitation, infection tends to occur later in life.

Routes of exposure

Person-to-person spread is probably the most common route of transmission, but contaminated food and water are important sources of infection. There is stronger epidemiological evidence for waterborne transmission of HAV than for any other virus. Foodborne outbreaks are also relatively common, with sources of infection including infected food handlers, shellfish harvested from contaminated water and contaminated produce. Travel of people from areas with good sanitation to those with poor sanitation provides a high risk of infection. Infection can also be spread in association with injecting and non-injecting drug use.

Significance in drinking-water

The transmission of HAV by drinking-water supplies is well established, and the presence of HAV in drinking-water constitutes a substantial health risk. Within a WSP, control measures to reduce potential risk from HAV should focus on prevention of source water contamination by human waste, followed by adequate treatment and disinfection. The effectiveness of treatment processes used to remove HAV will require validation. Drinking-water supplies should also be protected from contamination during distribution. Owing to the higher resistance of the viruses to disinfection, *E. coli* (or, alternatively, thermotolerant coliforms) is not a reliable index of the presence/absence of HAV in drinking-water supplies.

Selected bibliography

Cuthbert JA (2001) Hepatitis A: Old and new. *Clinical Microbiology Reviews*, 14:38–58.
WHO (2002) Enteric hepatitis viruses. In: *Guidelines for drinking-water quality*, 2nd ed. *Addendum: Microbiological agents in drinking water*. Geneva, World Health Organization, pp. 18–39.

11.2.6 Hepatitis E virus

General description

HEV consists of a single-stranded RNA genome in a non-enveloped icosahedral capsid with a diameter of 27–34 nm. HEV shares properties with a number of viruses, and classification is a challenge. At one stage, HEV was classified as a member of the family Caliciviridae, but most recently it has been placed in a separate family called hepatitis E-like viruses. There are indications of antigenic variation, and possibly even differences in serotypes of the virus, whereas human HAV consists of only one clearly defined serotype. HEV cannot be readily detected or cultivated in conventional cell culture systems, and identification in environmental samples is based on the use of PCR techniques.

Human health effects

HEV causes hepatitis that is in many respects similar to that caused by HAV. However, the incubation period tends to be longer (average 40 days), and infections typically have a mortality rate of up to 25% in pregnant women. In endemic regions, first infections are typically seen in young adults rather than young children. Despite evidence of antigenic variation, single infection appears to provide lifelong immunity to HEV. Global prevalence has a characteristic geographic distribution. HEV is endemic and causes clinical diseases in certain developing parts of the world, such as India, Nepal, central Asia, Mexico and parts of Africa. In many of these areas, HEV is the most important cause of viral hepatitis. Although seroprevalence can be high, clinical cases and outbreaks are rare in certain parts of the world, such as Japan, South Africa, the United Kingdom, North and South America, Australasia and central Europe. The reason for the lack of clinical cases in the presence of the virus is unknown.

Source and occurrence

HEV is excreted in faeces of infected people, and the virus has been detected in raw and treated sewage. Contaminated water has been associated with very large outbreaks. HEV is distinctive, in that it is the only enteric virus with a meaningful animal reservoir, including domestic animals, particularly pigs, as well as cattle, goats and even rodents.

Routes of exposure

Secondary transmission of HEV from cases to contacts and particularly nursing staff has been reported, but appears to be much less common than for HAV. The lower level of person-to-person spread suggests that faecally polluted water could play a much more important role in the spread of HEV than of HAV. Waterborne outbreaks involving thousands of cases are on record. These include one outbreak in 1954 with approximately 40 000 cases in Delhi, India; one with more than 100 000 cases in 1986–1988 in the Xinjiang Uighar region of China; and one in 1991 with some 79 000 cases in Kanpur, India. Animal reservoirs may also serve as a route of exposure, but the extent to which humans contract HEV infection from animals remains to be elucidated.

Significance in drinking-water

The role of contaminated water as a source of HEV has been confirmed, and the presence of the virus in drinking-water constitutes a major health risk. There is no laboratory information on the resistance of the virus to disinfection processes, but data on waterborne outbreaks suggest that HEV may be as resistant as other enteric viruses. Within a WSP, control measures to reduce potential risk from HEV should focus on prevention of source water contamination by human and animal waste, followed by adequate treatment and disinfection. The effectiveness of treatment processes used to remove HEV will require validation. Drinking-water supplies should also be protected from contamination during distribution. Due to the likelihood that the virus has a higher resistance to disinfection, *E. coli* (or, alternatively, thermotolerant coliforms) is not a reliable index of the presence/absence of HEV in drinking-water supplies.

Selected bibliography

Pina S et al. (1998) Characterization of a strain of infectious hepatitis E virus isolated from sewage in an area where hepatitis E is not endemic. *Applied and Environmental Microbiology*, 64:4485–4488.

Van der Poel WHM et al. (2001) Hepatitis E virus sequence in swine related to sequences in humans, the Netherlands. *Emerging Infectious Diseases*, 7:970–976.

WHO (2002) Enteric hepatitis viruses. In: *Guidelines for drinking-water quality*, 2nd ed. *Addendum: Microbiological agents in drinking water.* Geneva, World Health Organization, pp. 18–39.

11.2.7 Rotaviruses and orthoreoviruses

General description

Members of the genus *Rotavirus* consist of a segmented double-stranded RNA genome in a non-enveloped icosahedral capsid with a diameter of 50–65 nm. This capsid is surrounded by a double-layered shell, giving the virus the appearance of a wheel – hence the name rotavirus. The diameter of the entire virus is about 80 nm. *Rotavirus* and *Orthoreovirus* are the two genera of the family Reoviridae typically associated with human infection. Orthoreoviruses are readily isolated by cytopathogenic effect on cell cultures. The genus *Rotavirus* is serologically divided into seven groups, A–G, each of which consists of a number of subgroups; some of these subgroups specifically infect humans, whereas others infect a wide spectrum of animals. Groups A–C are found in humans, with group A being the most important human pathogens. Wild-type strains of rotavirus group A are not readily grown in cell culture, but there are a number of PCR-based detection methods available for testing environmental samples.

Human health effects

Human rotaviruses (HRVs) are the most important single cause of infant death in the world. Typically, 50–60% of cases of acute gastroenteritis of hospitalized children throughout the world are caused by HRVs. The viruses infect cells in the villi of the small intestine, with disruption of sodium and glucose transport. Acute infection has an abrupt onset of severe watery diarrhoea with fever, abdominal pain and vomiting; dehydration and metabolic acidosis may develop, and the outcome may be fatal if the infection is not appropriately treated. The burden of disease of rotavirus infections is extremely high. Members of the genus *Orthoreovirus* infect many humans, but they are typical "orphan viruses" and not associated with any meaningful disease.

Source and occurrence

HRVs are excreted by patients in numbers up to 10^{11} per gram of faeces for periods of about 8 days. This implies that domestic sewage and any environments polluted with the human faeces are likely to contain large numbers of HRVs. The viruses have been detected in sewage, rivers, lakes and treated drinking-water. Orthoreoviruses generally occur in wastewater in substantial numbers.

Routes of exposure

HRVs are transmitted by the faecal–oral route. Person-to-person transmission and the inhalation of airborne HRVs or aerosols containing the viruses would appear to play a much more important role than ingestion of contaminated food or water. This is confirmed by the spread of infections in children's wards in hospitals, which takes place much faster than can be accounted for by the ingestion of food or water contaminated by the faeces of infected patients. The role of contaminated water in transmission is lower than expected, given the prevalence of HRV infections and presence in contaminated water. However, occasional waterborne and foodborne outbreaks have been described. Two large outbreaks in China in 1982–1983 were linked to contaminated water supplies.

Significance in drinking-water

Although ingestion of drinking-water is not the most common route of transmission, the presence of HRVs in drinking-water constitutes a public health risk. There is some evidence that the rotaviruses are more resistant to disinfection than other enteric viruses. Within a WSP, control measures to reduce potential risk from HRVs should focus on prevention of source water contamination by human waste, followed by adequate treatment and disinfection. The effectiveness of treatment processes used to remove HRVs will require validation. Drinking-water supplies should also be protected from contamination during distribution. Due to a higher resistance of the viruses to disinfection, *E. coli* (or, alternatively, thermotolerant coliforms) is not a reliable index of the presence/absence of HRVs in drinking-water supplies.

Selected bibliography

Baggi F, Peduzzi R (2000) Genotyping of rotaviruses in environmental water and stool samples in southern Switzerland by nucleotide sequence analysis of 189 base pairs at the 5' end of the VP7 gene. *Journal of Clinical Microbiology*, 38:3681–3685.

Gerba CP et al. (1996) Waterborne rotavirus: a risk assessment. *Water Research*, 30:2929–2940.

Hopkins RS et al. (1984) A community waterborne gastroenteritis outbreak: evidence for rotavirus as the agent. *American Journal of Public Health*, 74:263–265.

Hung T et al. (1984) Waterborne outbreak of rotavirus diarrhoea in adults in China caused by a novel rotavirus. *Lancet*, i:1139–1142.

Sattar SA, Raphael RA, Springthorpe VS (1984) Rotavirus survival in conventionally treated drinking water. *Canadian Journal of Microbiology*, 30:653–656.

11.3 Protozoan pathogens

Protozoa and helminths are among the most common causes of infection and disease in humans and other animals. The diseases have a major public health and socioeconomic impact. Water plays an important role in the transmission of some of these pathogens. The control of waterborne transmission presents real challenges, because most of the pathogens produce cysts, oocysts or eggs that are extremely resistant to processes generally used for the disinfection of water and in some cases can be difficult to remove by filtration processes. Some of these organisms cause "emerging diseases." In the last 25 years, the most notable example of an emerging disease caused by a protozoan pathogen is cryptosporidiosis. Other examples are diseases caused by microsporidia and *Cyclospora*. As evidence for waterborne transmission of "emerging diseases" has been reported relatively recently, some questions about their epidemiology and behaviour in water treatment and disinfection processes remain to be elucidated. It would appear that the role of water in the transmission of this group of pathogens may increase substantially in importance and complexity as human and animal populations grow and the demands for potable drinking-water escalate.

Further information on emerging diseases is provided in *Emerging Issues in Water and Infectious Disease* (WHO, 2003) and associated texts.

11.3.1 Acanthamoeba

General description

Acanthamoeba spp. are free-living amoebae (10–50 μm in diameter) common in aquatic environments and one of the prominent protozoa in soil. The genus contains some 20 species, of which *A. castellanii*, *A. polyphaga* and *A. culbertsoni* are known to be human pathogens. However, the taxonomy of the genus may change substantially when evolving molecular biological knowledge is taken into consideration. *Acanthamoeba* has a feeding, replicative trophozoite, which, under unfavourable conditions, such as an anaerobic environment, will develop into a dormant cyst that can withstand extremes of temperature (−20 to 56 °C), disinfection and desiccation.

Human health effects

Acanthamoeba culbertsoni causes granulomatous amoebic encephalitis (GAE), whereas *A. castellanii* and *A. polyphaga* are associated with acanthamoebic keratitis and acanthamoebic uveitis.

GAE is a multifocal, haemorrhagic and necrotizing encephalitis that is generally seen only in debilitated or immunodeficient persons. It is a rare but usually fatal disease. Early symptoms include drowsiness, personality changes, intense headaches, stiff neck, nausea, vomiting, sporadic low fevers, focal neurological changes, hemiparesis and seizures. This is followed by an altered mental status, diplopia, paresis, lethargy, cerebellar ataxia and coma. Death follows within a week to a year after the appearance of the first symptoms, usually as a result of bronchopneumonia. Associated disorders of GAE include skin ulcers, liver disease, pneumonitis, renal failure and pharyngitis.

Acanthamoebic keratitis is a painful infection of the cornea and can occur in healthy individuals, especially among contact lens wearers. It is a rare disease that may lead to impaired vision, permanent blindness and loss of the eye. The prevalence of antibodies to *Acanthamoeba* and the detection of the organism in the upper airways of healthy persons suggest that infection may be common with few apparent symptoms in the vast majority of cases.

Source and occurrence

The wide distribution of *Acanthamoeba* in the natural environment makes soil, airborne dust and water all potential sources. *Acanthamoeba* can be found in many types of aquatic environments, including surface water, tap water, swimming pools and contact lens solutions. Depending on the species, *Acanthamoeba* can grow over a wide temperature range in water, with the optimum temperature for pathogenic species being 30 °C. Trophozoites can exist and replicate in water while feeding on bacteria, yeasts and other organisms. Infections occur in most temperate and tropical regions of the world.

Routes of exposure

Acanthamoebic keratitis has been associated with soft contact lenses being washed with contaminated home-made saline solutions or contamination of the contact lens containers. Although the source of the contaminating organisms has not been established, tap water is one possibility. Warnings have been issued by a number of health agencies that only sterile water should be used to prepare wash solutions for contact lenses. The mode of transmission of GAE has not been established, but water is not considered to be a source of infection. The more likely routes of transmission are via the blood from other sites of colonization, such as skin lesions or lungs.

Significance in drinking-water

Cases of acanthamoebic keratitis have been associated with drinking-water due to use of tap water in preparing solutions for washing contact lenses. Cleaning of contact lenses is not considered to be a normal use for tap water, and a higher-quality water may be required. Compared with *Cryptosporidium* and *Giardia*, *Acanthamoeba* is relatively large and is amenable to removal from raw water by filtration. Reducing the presence of biofilm organisms is likely to reduce food sources and growth of the organism in distribution systems, but the organism is highly resistant to disinfection. However, as normal uses of drinking-water lack significance as a source of infection, setting a health-based target for *Acanthamoeba* spp. is not warranted.

Selected bibliography

Marshall MM et al. (1997) Waterborne protozoan pathogens. *Clinical Microbiology Reviews*, 10:67–85.

Yagita K, Endo T, De Jonckheere JF (1999) Clustering of *Acanthamoeba* isolates from human eye infections by means of mitochondrial DNA digestion patterns. *Parasitology Research*, 85:284–289.

11.3.2 Balantidium coli

General description

Balantidium coli is a unicellular protozoan parasite with a length up to 200 μm, making it the largest of the human intestinal protozoa. The trophozoites are oval in shape and covered with cilia for motility. The cysts are 60–70 μm in length and resistant to unfavourable environmental conditions, such as pH and temperature extremes. *Balantidium coli* belongs to the largest protozoan group, the ciliates, with about 7200 species, of which only *B. coli* is known to infect humans.

Human health effects

Infections in humans are relatively rare, and most are asymptomatic. The trophozoites invade the mucosa and submucosa of the large intestine and destroy the host cells when multiplying. The multiplying parasites form nests and small abscesses that break down into oval, irregular ulcers. Clinical symptoms may include dysentery similar to amoebiasis, colitis, diarrhoea, nausea, vomiting, headache and anorexia. The infections are generally self-limiting, with complete recovery.

Source and occurrence

Humans seem to be the most important host of *B. coli*, and the organism can be detected in domestic sewage. Animal reservoirs, particularly swine, also contribute to the prevalence of the cysts in the environment. The cysts have been detected in water sources, but the prevalence in tap water is unknown.

Routes of exposure

Transmission of *B. coli* is by the faecal–oral route, from person to person, from contact with infected swine or by consumption of contaminated water or food. One waterborne outbreak of balantidiasis has been reported. This outbreak occurred in 1971 when a drinking-water supply was contaminated with stormwater runoff containing swine faeces after a typhoon.

Significance in drinking-water

Although water does not appear to play an important role in the spread of this organism, one waterborne outbreak is on record. *Balantidium coli* is large and amenable to removal by filtration, but cysts are highly resistant to disinfection. Within a WSP, control measures to reduce potential risk from *B. coli* should focus on prevention of source water contamination by human and swine waste, followed by adequate treatment. Due to resistance to disinfection, *E. coli* (or, alternatively, thermotolerant coliforms) is not a reliable index for the presence/absence of *B. coli* in drinking-water supplies.

Selected bibliography

Garcia LS (1999) Flagellates and ciliates. *Clinics in Laboratory Medicine*, 19:621–638.

Walzer PD et al. (1973) Balantidiasis outbreak in Truk. *American Journal of Tropical Medicine and Hygiene*, 22:33–41.

11.3.3 Cryptosporidium

General description

Cryptosporidium is an obligate, intracellular, coccidian parasite with a complex life cycle including sexual and asexual replication. Thick-walled oocysts with a diameter of 4–6 µm are shed in faeces. The genus *Cryptosporidium* has about eight species, of which *C. parvum* is responsible for most human infections, although other species can cause illness. *Cryptosporidium* is one of the best examples of an "emerging disease"-causing organism. It was discovered to infect humans only in 1976, and waterborne transmission was confirmed for the first time in 1984.

Human health effects

Cryptosporidium generally causes a self-limiting diarrhoea, sometimes including nausea, vomiting and fever, which usually resolves within a week in normally healthy people, but can last for a month or more. Severity of cryptosporidiosis varies according to age and immune status, and infections in severely immunocompromised people can be life-threatening. The impact of cryptosporidiosis outbreaks is relatively high due to the large numbers of people that may be involved and the associated socioeconomic implications. The total cost of illness associated with the 1993 outbreak in Milwaukee, USA, has been estimated at US$96.2 million.

Source and occurrence

A large range of animals are reservoirs of *C. parvum*, but humans and livestock, particularly young animals, are the most significant source of human infectious organisms. Calves can excrete 10^{10} oocysts per day. Concentrations of oocysts as high as 14 000 per litre for raw sewage and 5800 per litre for surface water have been reported. Oocysts can survive for weeks to months in fresh water. *Cryptosporidium* oocysts have been detected in many drinking-water supplies. However, in most cases, there is little information about whether human infectious species were present. The currently available standard analytical techniques provide an indirect measure of viability and no indication of human infectivity. Oocysts also occur in recreational waters.

Routes of exposure

Cryptosporidium is transmitted by the faecal–oral route. The major route of infection is person-to-person contact. Other sources of infection include the consumption of contaminated food and water and direct contact with infected farm animals and possibly domestic pets. Contaminated drinking-water, recreational water and, to a lesser extent, food have been associated with outbreaks. In 1993, *Cryptosporidium* caused the largest waterborne outbreak of disease on record, when more than 400 000 people were infected by the drinking-water supply of Milwaukee, USA. The infectivity of *Cryptosporidium* oocysts is relatively high. Studies on healthy human volunteers revealed that ingestion of fewer than 10 oocysts can lead to infection.

Significance in drinking-water

The role of drinking-water in the transmission of *Cryptosporidium*, including in large outbreaks, is well established. Attention to these organisms is therefore important. The oocysts are extremely resistant to oxidizing disinfectants such as chlorine, but investigations based on assays for infectivity have shown that UV light irradiation inactivates oocysts. Within a WSP, control measures to reduce potential risk from *Cryptosporidium* should focus on prevention of source water contamination by human and livestock waste, adequate treatment and protection of water during distribution. Because of their relatively small size, the oocysts represent a challenge for removal by conventional granular media-based filtration processes. Acceptable removal requires well designed and operated systems. Membrane filtration processes that provide a direct physical barrier may represent a viable alternative for the effective removal of *Cryptosporidium* oocysts. Owing to the exceptional resistance of the oocysts to disinfectants, *E. coli* (or, alternatively, thermotolerant coliforms) cannot be relied upon as an index for the presence/absence of *Cryptosporidium* oocysts in drinking-water supplies.

Selected bibliography

Corso PS et al. (2003) Cost of illness in the 1993 waterborne *Cryptosporidium* outbreak, Milwaukee, Wisconsin. *Emerging Infectious Diseases*, 9:426–431.

Haas CN et al. (1996) Risk assessment of *Cryptosporidium parvum* oocysts in drinking water. *Journal of the American Water Works Association*, 88:131–136.

Leav BA, Mackay M, Ward HD (2003) *Cryptosporidium* species: new insight and old challenges. *Clinical Infectious Diseases*, 36:903–908.

Linden KG, Shin G, Sobsey MD (2001) Comparative effectiveness of UV wavelengths for the inactivation of *Cryptosporidium parvum* oocysts in water. *Water Science and Technology*, 43:171–174.

Okhuysen PC et al. (1999) Virulence of three distinct *Cryptosporidium parvum* isolates for healthy adults. *Journal of Infectious Diseases*, 180:1275–1281.

WHO (2002) Protozoan parasites (*Cryptosporidium*, *Giardia*, *Cyclospora*). In: *Guidelines for drinking-water quality*, 2nd ed. *Addendum: Microbiological agents in drinking water*. Geneva, World Health Organization, pp. 70–118.

11.3.4 Cyclospora cayetanensis

General description

Cyclospora cayetanensis is a single-cell, obligate, intracellular, coccidian protozoan parasite, which belongs to the family Eimeriidae. It produces thick-walled oocysts of 8–10 μm in diameter that are excreted in the faeces of infected individuals. *Cyclospora cayetanensis* is considered an emerging waterborne pathogen.

Human health effects

Sporozoites are released from the oocysts when ingested and penetrate epithelial cells in the small intestine of susceptible individuals. Clinical symptoms of cyclosporiasis include watery diarrhoea, abdominal cramping, weight loss, anorexia, myalgia and occasionally vomiting and/or fever. Relapsing illness often occurs.

Source and occurrence

Humans are the only host identified for this parasite. The unsporulated oocysts pass into the external environment with faeces and undergo sporulation, which is complete in 7–12 days, depending on environmental conditions. Only the sporulated oocysts are infectious. Due to the lack of a quantification technique, there is limited information on the prevalence of *Cyclospora* in water environments. However, *Cyclospora* has been detected in sewage and water sources.

Routes of exposure

Cyclospora cayetanensis is transmitted by the faecal–oral route. Person-to-person transmission is virtually impossible, because the oocysts must sporulate outside the host to become infectious. The primary routes of exposure are contaminated water and food. The initial source of organisms in foodborne outbreaks has generally not been established, but contaminated water has been implicated in several cases. Drinking-water has also been implicated as a cause of outbreaks. The first report was among staff of a hospital in Chicago, USA, in 1990. The infections were associated with drinking tap water that had possibly been contaminated with stagnant water from a rooftop storage reservoir. Another outbreak was reported from Nepal, where drinking-water consisting of a mixture of river and municipal water was associated with infections in 12 of 14 soldiers.

Significance in drinking-water

Transmission of the pathogens by drinking-water has been confirmed. The oocysts are resistant to disinfection and are not inactivated by chlorination practices generally applied in the production of drinking-water. Within a WSP, control measures that can be applied to manage potential risk from *Cyclospora* include prevention of source water contamination by human waste, followed by adequate treatment and protection of water during distribution. Owing to the resistance of the oocysts to disinfectants, *E. coli* (or, alternatively, thermotolerant coliforms) cannot be relied upon as an index of the presence/absence of *Cyclospora* in drinking-water supplies.

Selected bibliography

Curry A, Smith HV (1998) Emerging pathogens: *Isospora*, *Cyclospora* and microsporidia. *Parasitology*, 117:S143–159.

Dowd SE et al. (2003) Confirmed detection of *Cyclospora cayetanensis*, *Encephalitozoon intestinalis* and *Cryptosporidium parvum* in water used for drinking. *Journal of Water and Health*, 1:117–123.

Goodgame R (2003) Emerging causes of traveller's diarrhea: *Cryptosporidium*, *Cyclospora*, *Isospora* and microsporidia. *Current Infectious Disease Reports*, 5:66–73.

Herwaldt BL (2000) *Cyclospora cayetanensis*: A review, focusing on the outbreaks of cyclosporiasis in the 1990s. *Clinical Infectious Diseases*, 31:1040–1057.

Rabold JG et al. (1994) *Cyclospora* outbreak associated with chlorinated drinking-water [letter]. *Lancet*, 344:1360–1361.

WHO (2002) Protozoan parasites (*Cryptosporidium*, *Giardia*, *Cyclospora*). In: *Guidelines for drinking-water quality*, 2nd ed. *Addendum: Microbiological agents in drinking water.* Geneva, World Health Organization, pp. 70–118.

11.3.5 Entamoeba histolytica

General description

Entamoeba histolytica is the most prevalent intestinal protozoan pathogen worldwide and belongs to the superclass Rhizopoda in the subphylum Sarcodina. *Entamoeba* has a feeding, replicative trophozoite (diameter 10–60 μm), which, under unfavourable conditions, will develop into a dormant cyst (diameter 10–20 μm). Infection is contracted by the ingestion of cysts. Recent studies with RNA and DNA probes demonstrated genetic differences between pathogenic and non-pathogenic *E. histolytica*; the latter has been separated and reclassified as *E. dispar*.

Human health effects

About 85–95% of human infections with *E. histolytica* are asymptomatic. Acute intestinal amoebiasis has an incubation period of 1–14 weeks. Clinical disease results from the penetration of the epithelial cells in the gastrointestinal tract by the amoebic trophozoites. Approximately 10% of infected individuals present with dysentery or colitis. Symptoms of amoebic dysentery include diarrhoea with cramping, lower abdominal pain, low-grade fever and the presence of blood and mucus in the stool. The ulcers produced by the invasion of the trophozoites may deepen into the classic flask-shaped ulcers of amoebic colitis. *Entamoeba histolytica* may invade other parts of the body, such as the liver, lungs and brain, sometimes with fatal outcome.

Source and occurrence

Humans are the reservoir of infection, and there would not appear to be other meaningful animal reservoirs of *E. histolytica*. In the acute phase of infection, patients excrete only trophozoites that are not infectious. Chronic cases and asymptomatic carriers who excrete cysts are more important sources of infection and can discharge up to 1.5×10^7 cysts daily. *Entamoeba histolytica* can be present in sewage and contaminated water. Cysts may remain viable in suitable aquatic environments for several months at low temperature. The potential for waterborne transmission is greater in the tropics, where the carrier rate sometimes exceeds 50%, compared with more temperate regions, where the prevalence in the general population may be less than 10%.

Routes of exposure

Person-to-person contact and contamination of food by infected food handlers appear to be the most significant means of transmission, although contaminated water also plays a substantial role. Ingestion of faecally contaminated water and consumption of food crops irrigated with contaminated water can both lead to transmission of amoebiasis. Sexual transmission, particularly among male homosexuals, has also been documented.

Significance in drinking-water

The transmission of *E. histolytica* by contaminated drinking-water has been confirmed. The cysts are relatively resistant to disinfection and may not be inactivated by chlorination practices generally applied in the production of drinking-water. Within a WSP, control measures that can be applied to manage potential risk from *E. histolytica* include prevention of source water contamination by human waste, followed by adequate treatment and protection of water during distribution. Owing to the resistance of the oocysts to disinfectants, *E. coli* (or, alternatively, thermotolerant coliforms) cannot be relied upon as an index of the presence/absence of *E. histolytica* in drinking-water supplies.

Selected bibliography

Marshall MM et al. (1997) Waterborne protozoan pathogens. *Clinical Microbiology Reviews*, 10:67–85.

11.3.6 Giardia intestinalis

General description

Giardia spp. are flagellated protozoa that parasitize the gastrointestinal tract of humans and certain animals. The genus *Giardia* consists of a number of species, but human infection (giardiasis) is usually assigned to *G. intestinalis*, also known as *G. lamblia* or *G. duodenalis*. *Giardia* has a relatively simple life cycle consisting of a flagellate trophozoite that multiplies in the gastrointestinal tract and an infective thick-walled cyst that is shed intermittently but in large numbers in faeces. The trophozoites are bilaterally symmetrical and ellipsoidal in shape. The cysts are ovoid in shape and 8–12 μm in diameter.

Human health effects

Giardia has been known as a human parasite for 200 years. After ingestion and excystation of cysts, the trophozoites attach to surfaces of the gastrointestinal tract. Infections in both children and adults may be asymptomatic. In day care centres, as many as 20% of children may carry *Giardia* and excrete cysts without clinical symptoms. The symptoms of giardiasis may result from damage caused by the trophozoites, although the mechanisms by which *Giardia* causes diarrhoea and intestinal malabsorption remain controversial. Symptoms generally include diarrhoea and abdominal cramps; in severe cases, however, malabsorption deficiencies in the small intestine may be present, mostly among young children. Giardiasis is self-limiting in most cases, but it may be chronic in some patients, lasting more than 1 year, even in otherwise healthy people. Studies on human volunteers revealed that fewer than 10 cysts constitute a meaningful risk of infection.

Source and occurrence

Giardia can multiply in a wide range of animal species, including humans, which excrete cysts into the environment. Numbers of cysts as high as 88 000 per litre in raw sewage and 240 per litre in surface water resources have been reported. These cysts are robust and can survive for weeks to months in fresh water. The presence of cysts in raw water sources and drinking-water supplies has been confirmed. However, there is no information on whether human infectious species were present. The currently available standard analytical techniques provide an indirect measure of viability and no indication of human infectivity. Cysts also occur in recreational waters and contaminated food.

Routes of exposure

By far the most common route of transmission of *Giardia* is person-to-person contact, particularly between children. Contaminated drinking-water, recreational water and, to a lesser extent, food have been associated with outbreaks. Animals have been implicated as a source of human infectious *G. intestinalis*, but further investigations are required to determine their role.

Significance in drinking-water

Waterborne outbreaks of giardiasis have been associated with drinking-water supplies for over 30 years; at one stage, *Giardia* was the most commonly identified cause of waterborne outbreaks in the USA. *Giardia* cysts are more resistant than enteric bacteria to oxidative disinfectants such as chlorine, but they are not as resistant as *Cryptosporidium* oocysts. The time required for 90% inactivation at a free chlorine residual of 1 mg/litre is about 25–30 min. Within a WSP, control measures that can be applied to manage potential risk from *Giardia* include prevention of source water contamination by human and animal waste, followed by adequate treatment and disinfection and protection of water during distribution. Owing to the resistance of the cysts to disinfectants, *E. coli* (or, alternatively, thermotolerant coliforms) cannot be relied upon as an index of the presence/absence of *Giardia* in drinking-water supplies.

Selected bibliography

LeChevallier MW, Norton WD, Lee RG (1991) Occurrence of *Giardia* and *Cryptosporidium* species in surface water supplies. *Applied and Environmental Microbiology*, 57:2610–2616.

Ong C et al. (1996) Studies of *Giardia* spp. and *Cryptosporidium* spp. in two adjacent watersheds. *Applied and Environmental Microbiology*, 62:2798–2805.

Rimhanen-Finne R et al. (2002) An IC-PCR method for detection of *Cryptosporidium* and *Giardia* in natural surface waters in Finland. *Journal of Microbiological Methods*, 50:299–303.

Slifko TR, Smith HV, Rose JB (2000) Emerging parasite zoonoses associated with water and food. *International Journal for Parasitology*, 30:1379–1393.

Stuart JM et al. (2003) Risk factors for sporadic giardiasis: a case–control study in southwestern England. *Emerging Infectious Diseases*, 9:229–233.

WHO (2002) Protozoan parasites (*Cryptosporidium, Giardia, Cyclospora*). In: *Guidelines for drinking-water quality*, 2nd ed. *Addendum: Microbiological agents in drinking water.* Geneva, World Health Organization, pp. 70–118.

11.3.7 Isospora belli

General description

Isospora is a coccidian, single-celled, obligate parasite related to *Cryptosporidium* and *Cyclospora*. There are many species of *Isospora* that infect animals, but only *I. belli* is known to infect humans, the only known host for this species. *Isospora belli* is one of the few coccidia that undergo sexual reproduction in the human intestine. Sporulated oocysts are ingested, and, after complete asexual and sexual life cycles in the mucosal epithelium of the upper small intestine, unsporulated oocysts are released in faeces.

Human health effects

Illness caused by *I. belli* is similar to that caused by *Cryptosporidium* and *Giardia*. About 1 week after ingestion of viable cysts, a low-grade fever, lassitude and malaise may appear, followed soon by mild diarrhoea and vague abdominal pain. The infection is usually self-limited after 1–2 weeks, but occasionally diarrhoea, weight loss and fever may last for 6 weeks to 6 months. Symptomatic isosporiasis is more common in children than in adults. Infection is often associated with immunocompromised patients, in whom symptoms are more severe and likely to be recurrent or chronic, leading to malabsorption and weight loss. Infections are usually sporadic and most common in the tropics and subtropics, although they also occur elsewhere, including industrialized countries. They have been reported from Central and South America, Africa and south-east Asia.

Source and occurrence

Unsporulated oocysts are excreted in the faeces of infected individuals. The oocysts sporulate within 1–2 days in the environment to produce the potentially infectious form of the organism. Few data are available on numbers of oocysts in sewage and raw and treated water sources. This is largely because sensitive and reliable techniques for the quantitative enumeration of oocysts in water environments are not available. Little is known about the survival of oocysts in water and related environments.

Routes of exposure

Poor sanitation and faecally contaminated food and water are the most likely sources of infection, but waterborne transmission has not been confirmed. The oocysts are less likely than *Cryptosporidium* oocysts or *Giardia* cysts to be transmitted directly from person to person, because freshly shed *I. belli* oocysts require 1–2 days in the environment to sporulate before they are capable of infecting humans.

Significance in drinking-water

The characteristics of *I. belli* suggest that illness could be transmitted by contaminated drinking-water supplies, but this has not been confirmed. No information is available on the effectiveness of water treatment processes for removal of *I. belli*, but it is likely that the organism is relatively resistant to disinfectants. It is considerably larger than *Cryptosporidium* and should be easier to remove by filtration. Within a WSP, control measures that can be applied to manage potential risk from *I. belli* include prevention of source water contamination by human waste, followed by adequate treatment and disinfection and protection of water during distribution. Owing to the likely resistance of the oocysts to disinfectants, *E. coli* (or, alternatively, thermotolerant coliforms) cannot be relied upon as an index of the presence/absence of *I. belli* in drinking-water supplies.

Selected bibliography

Ballal M et al. (1999) *Cryptosporidium* and *Isospora belli* diarrhoea in immunocompromised hosts. *Indian Journal of Cancer*, 36:38–42.

Bialek R et al. (2002) Comparison of autofluorescence and iodine staining for detection of *Isospora belli* in feces. *American Journal of Tropical Medicine and Hygiene*, 67:304–305.

Curry A, Smith HV (1998) Emerging pathogens: *Isospora*, *Cyclospora* and microsporidia. *Parasitology*, 117:S143–159.

Goodgame R (2003) Emerging causes of traveller's diarrhea: *Cryptosporidium*, *Cyclospora*, *Isospora* and microsporidia. *Current Infectious Disease Reports*, 5:66–73.

11.3.8 Microsporidia

General description

The term "microsporidia" is a non-taxonomic designation commonly used to describe a group of obligate intracellular protozoa belonging to the phylum Microspora. More than 100 microsporidial genera and almost 1000 species have been identified. Infections occur in every major animal group, including vertebrates and invertebrates. A number of genera have been implicated in human infections, including *Enterocytozoon*, *Encephalitozoon* (including *Septata*), *Nosema*, *Pleistophora*, *Vittaforma* and *Trachipleistophora*, as well as a collective group of unclassified microsporidia referred to as microsporidium. Microsporidia are among the smallest eukaryotes. They produce unicellular spores with a diameter of 1.0–4.5 µm and a characteristic coiled polar filament for injecting the sporoplasm into a host cell to initiate infection. Within an infected cell, a complex process of multiplication takes place, and new spores are produced and released in faeces, urine, respiratory secretions or other body fluids, depending on the type of species and the site of infection.

Human health effects

Microsporidia are emerging human pathogens identified predominantly in persons with AIDS, but their ability to cause disease in immunologically normal hosts has been recognized. Reported human infections are globally dispersed and have been documented in persons from all continents. The most common clinical manifestation in AIDS patients is a severe enteritis involving chronic diarrhoea, dehydration and weight loss. Prolonged illness for up to 48 months has been reported. Infections in the general population are less pronounced. *Enterocytozoon* infection generally appears to be limited to intestinal enterocytes and biliary epithelium. *Encephalitozoon* spp. infect a variety of cells, including epithelial and endothelial cells, fibroblasts, kidney tubule cells, macrophages and possibly other cell types. Unusual complications include keratoconjunctivitis, myositis and hepatitis.

Source and occurrence

The sources of microsporidia infecting humans are uncertain. Spores are likely to be excreted in faeces and are also excreted in urine and respiratory secretions. Due to the lack of a quantification technique, there is limited information on the prevalence of microsporidia spores in water environments. However, microsporidia have been detected in sewage and water sources. Indications are that their numbers in raw sewage may be similar to those of *Cryptosporidium* and *Giardia*, and they may survive in certain water environments for many months. Certain animals, notably swine, may serve as a host for human infectious species.

Routes of exposure

Little is known about transmission of microsporidia. Person-to-person contact and ingestion of spores in water or food contaminated with human faeces or urine are probably important routes of exposure. A waterborne outbreak of microsporidiosis has been reported involving about 200 cases in Lyon, France, during the summer of 1995. However, the source of the organism and faecal contamination of the drinking-water supply were not demonstrated. Transmission by the inhalation of airborne spores or aerosols containing spores seems possible. The role of animals in transmission to humans remains unclear. Epidemiological and experimental studies in mammals suggest that *Encephalitozoon* spp. can be transmitted transplacentally from mother to offspring. No information is available on the infectivity of the spores. However, in view of the infectivity of spores of closely related species, the infectivity of microsporidia may be high.

Significance in drinking-water

Waterborne transmission has been reported, and infection arising from contaminated drinking-water is plausible but unconfirmed. Little is known about the response of microsporidia to water treatment processes. One study has suggested that the spores may be susceptible to chlorine. The small size of the organism is likely to make them difficult to remove by filtration processes. Within a WSP, control measures that can be applied to manage potential risk from microsporidia include prevention of source water contamination by human and animal waste, followed by adequate treatment and disinfection and protection of water during distribution. Owing to the lack of information on sensitivity of infectious species of microsporidia to disinfection, the reliability of *E. coli* (or, alternatively, thermotolerant coliforms) as an index for the presence/absence of these organisms from drinking-water supplies is unknown.

Selected bibliography

Coote L et al. (2000) Waterborne outbreak of intestinal microsporidiosis in persons with and without human immunodeficiency virus infection. *Journal of Infectious Diseases*, 180:2003–2008.

Dowd SE et al. (2003) Confirmed detection of *Cyclospora cayetanensis*, *Encephalitozoon intestinalis* and *Cryptosporidium parvum* in water used for drinking. *Journal of Water and Health*, 1:117–123.

Goodgame R (2003) Emerging causes of traveller's diarrhea: *Cryptosporidium*, *Cyclospora*, *Isospora* and microsporidia. *Current Infectious Disease Reports*, 5:66–73.

Joynson DHM (1999) Emerging parasitic infections in man. *The Infectious Disease Review*, 1:131–134.

Slifko TR, Smith HV, Rose JB (2000) Emerging parasite zoonoses associated with water and food. *International Journal for Parasitology*, 30:1379–1393.

11.3.9 Naegleria fowleri

General description

Naegleria are free-living amoeboflagellates distributed widely in the environment. There are several species of *Naegleria*, of which *N. fowleri* is the primary infectious species. *Naegleria* spp. exist as a trophozoite, a flagellate and a cyst stage. The trophozoite (10–20 μm) moves by eruptive pseudopod formation feeding on bacteria and reproduces by binary fission. The trophozoite can transform into a flagellate stage with two anterior flagella. The flagellate does not divide but reverts to the trophozoite stage. Under adverse conditions, the trophozoite transforms into a circular cyst (7–15 μm), which is resistant to unfavourable conditions.

Human health effects

Naegleria fowleri causes primary amoebic meningoencephalitis (PAM) in healthy individuals. The amoeba enters the brain by penetrating the olfactory mucosa and cribiform plate. The disease is acute, and patients often die within 5–10 days and before the infectious agent can be diagnosed. Treatment is difficult. Although the infection is rare, new cases are reported every year.

Source and occurrence

Naegleria fowleri is thermophilic and grows well at temperatures up to 45 °C. It occurs naturally in fresh water of suitable temperature, and prevalence is only indirectly related to human activity, inasmuch as such activity may modify temperature or promote bacterial (food source) production. The pathogen has been reported from many countries, usually associated with thermally polluted water environments such as geothermal water or heated swimming pools. However, the organism has been detected in drinking-water supplies, particularly where water temperature can exceed 25–30 °C. Water is the only known source of infection. The first cases of amoebic meningitis were diagnosed in 1965 in Australia and Florida. Since that time, about 100 cases of PAM have been reported throughout the world.

Routes of exposure

Infection with *N. fowleri* is almost exclusively contracted by exposure of the nasal passages to contaminated water. Infection is predominantly associated with recreational use of water, including swimming pools and spas, as well as surface waters naturally heated by the sun, industrial cooling waters and geothermal springs. In a limited number of cases, a link to recreational water exposure is lacking. The occurrence of PAM is highest during hot summer months, when many people engage in water recreation and when the temperature of water is conducive to growth of the organism. Consumption of contaminated water or food and person-to-person spread have not been reported as routes of transmission.

Significance in drinking-water

Naegleria fowleri has been detected in drinking-water supplies. Although unproven, a direct or indirect role of drinking-water-derived organisms – for example, through use of drinking-water in swimming pools – is possible. Any water supply that seasonally exceeds 30 °C or that continually exceeds 25 °C can potentially support the growth of *N. fowleri*. In such cases, a periodic prospective study would be valuable. Free chlorine or monochloramine residuals in excess of 0.5 mg/litre have been shown to control *N. fowleri*, providing the disinfectant persists through the water distribution system. In addition to maintaining persistent disinfectant residuals, other control measures aimed at limiting the presence of biofilm organisms will reduce food sources and hence growth of the organism in distribution systems. Owing to the environmental nature of this amoeba, *E. coli* (or, alternatively, thermotolerant coliforms) cannot be relied upon as an index for the presence/absence of *N. fowleri* in drinking-water supplies.

Selected bibliography

Behets J et al. (2003) Detection of *Naegleria* spp. and *Naegleria fowleri*: a comparison of flagellation tests, ELISA and PCR. *Water Science and Technology*, 47:117–122.

Cabanes P-A et al. (2001) Assessing the risk of primary amoebic meningoencephalitis from swimming in the presence of environmental *Naegleria fowleri*. *Applied and Environmental Microbiology*, 67:2927–2931.

Dorsch MM, Cameron AS, Robinson BS (1983) The epidemiology and control of primary amoebic meningoencephalitis with particular reference to South Australia. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 77:372–377.

Martinez AJ, Visvesvara GS (1997) Free-living amphizoic and opportunistic amebas. *Brain Pathology*, 7:583–598.

Parija SC, Jayakeerthee SR (1999) *Naegleria fowleri*: a free living amoeba of emerging medical importance. *Communicable Diseases*, 31:153–159.

11.3.10 Toxoplasma gondii

General description

Many species of *Toxoplasma* and *Toxoplasma*-like organisms have been described, but it would appear that *T. gondii* is the only human infectious species. *Toxoplasma gondii* is a coccidian parasite, and the cat is the definitive host. Only cats harbour the parasite in the intestinal tract, where sexual reproduction takes place. The actively multiplying asexual form in the human host is an obligate, intracellular parasite (diameter 3–6 μm) called a tachyzoite. A chronic phase of the disease develops as the tachyzoites transform into slowly replicating bradyzoites, which eventually become cysts in the host tissue. In the natural cycle, mice and rats containing infective cysts are eaten by cats, which host the sexual stage of the parasite. The cyst wall is digested, and bradyzoites penetrate epithelial cells of the small intestine. Several generations of intracellular multiplication lead to the development of micro- and macrogametes. Fertilization of the latter leads to the development of oocysts that are excreted in faeces as early as 5 days after a cat has ingested the cysts. Oocysts require 1–5 days to sporulate in the environment. Sporulated oocysts and tissue-borne cysts can both cause infections in susceptible hosts.

Human health effects

Toxoplasmosis is usually asymptomatic in humans. In a small percentage of cases, flu-like symptoms, lymphadenopathy and hepatosplenomegaly present 5–23 days after the ingestion of cysts or oocysts. Dormant cysts, formed in organ tissue after primary infection, can be reactivated when the immune system becomes suppressed, producing disseminated disease involving the central nervous system and lungs and leading to severe neurological disorders or pneumonia. When these infection sites are involved, the disease can be fatal in immunocompromised patients. Congenital toxoplasmosis is mostly asymptomatic, but can produce chorioretinitis, cerebral calcifications, hydrocephalus, severe thrombocytopenia and convulsions. Primary infection during early pregnancy can lead to spontaneous abortion, stillbirth or fetal abnormality.

Source and occurrence

Toxoplasmosis is found worldwide. Estimates indicate that in many parts of the world, 15–30% of lamb and pork meat is infected with cysts. The prevalence of oocyst-shedding cats may be 1%. By the third decade of life, about 50% of the European population is infected, and in France this proportion is close to 80%. *Toxoplasma gondii* oocysts may occur in water sources and supplies contaminated with the faeces of infected cats. Due to a lack of practical methods for the detection of *T. gondii* oocysts, there is little information on the prevalence of the oocysts in raw and treated water supplies. Details on the survival and behaviour of the oocysts in water environments are also not available. However, qualitative evidence of the presence of oocysts in faecally polluted water has been reported, and results suggest that *T. gondii* oocysts may be as resistant to unfavourable conditions in water environments as the oocysts of related parasites.

Routes of exposure

Both *T. gondii* oocysts that sporulate after excretion by cats and tissue-borne cysts are potentially infectious. Humans can become infected by ingestion of oocysts excreted by cats by direct contact or through contact with contaminated soil or water. Two outbreaks of toxoplasmosis have been associated with consumption of contaminated water. In Panama, creek water contaminated by oocysts from jungle cats was identified as the most likely source of infection, while in 1995, an outbreak in Canada was associated with a drinking-water reservoir being contaminated by excreta from domestic or wild cats. A study in Brazil during 1997–1999 identified the consumption of unfiltered drinking-water as a risk factor for *T. gondii* seropositivity. More commonly, humans contract toxoplasmosis through the consumption of undercooked or raw meat and meat products containing *T. gondii* cysts. Transplacental infection also occurs.

Significance in drinking-water

Contaminated drinking-water has been identified as a source of toxoplasmosis outbreaks. Little is known about the response of *T. gondii* to water treatment processes. The oocysts are larger than *Cryptosporidium* oocysts and should be amenable to removal by filtration. Within a WSP, control measures to manage potential risk from *T. gondii* should be focused on prevention of source water contamination by wild and domesticated cats. If necessary, the organisms can be removed by filtration. Owing to the lack of information on sensitivity of *T. gondii* to disinfection, the reliability of *E. coli* (or, alternatively, thermotolerant coliforms) as an indicator for the presence/absence of these organisms in drinking-water supplies is unknown.

Selected bibliography

Aramini JJ et al. (1999) Potential contamination of drinking water with *Toxoplasma gondii* oocysts. *Epidemiology and Infection*, 122:305–315.

Bahia-Oliveira LMG et al. (2003) Highly endemic, waterborne toxoplasmosis in North Rio de Janeiro State, Brazil. *Emerging Infectious Diseases*, 9:55–62.

Bowie WR et al. (1997) Outbreak of toxoplasmosis associated with municipal drinking water. The BC Toxoplasma Investigation Team. *Lancet*, 350:173–177.

Kourenti C et al. (2003) Development and application of different methods for the detection of *Toxoplasma gondii* in water. *Applied and Environmental Microbiology*, 69:102–106.

11.4 Helminth pathogens

The word "helminth" comes from the Greek word meaning "worm" and refers to all types of worms, both free-living and parasitic. The major parasitic worms are classified primarily in the phylum Nematoda (roundworms) and the phylum Platyhelminthes (flatworms including trematodes). Helminth parasites infect a large number of people and animals worldwide. For most helminths, drinking-water is not a significant route of transmission. There are two exceptions: *Dracunculus medinensis* (guinea worm) and *Fasciola* spp. (*F. hepatica* and *F. gigantica*) (liver flukes). Dracunculiasis and fascioliasis both require intermediate hosts to complete their life cycles but are transmitted through drinking-water by different mechanisms. Other helminthiases can be transmitted through water contact (schistosomiasis) or are associated with the use of untreated wastewater in agriculture (ascariasis, trichuriasis, hookworm infections and strongyloidiasis) but are not usually transmitted through drinking-water.

11.4.1 *Dracunculus medinensis*

Dracunculus medinensis, commonly known as "guinea worm," belongs to the phylum Nematoda and is the only nematode associated with significant transmission by drinking-water.

The eradication of guinea worm infection from the world by 1995 was a target of the International Drinking Water Supply and Sanitation Decade (1981–1990), and the World Health Assembly formally committed itself to this goal in 1991. The Dracunculus Eradication Programme has achieved a massive reduction in the number of cases. There were an estimated 3.3 million cases in 1986, 625 000 cases in 1990 and fewer than 60 000 cases in 2002, with the majority occurring in Sudan. Dracunculiasis is restricted to a central belt of countries in sub-Saharan Africa.

General description

The *D. medinensis* worms inhabit the cutaneous and subcutaneous tissues of infected individuals, the female reaching a length of up to 700 mm, and the male 25 mm. When the female is ready to discharge larvae (embryos), its anterior end emerges from a blister or ulcer, usually on the foot or lower limb, and releases large numbers of rhabditiform larvae when the affected part of the body is immersed in water. The larvae can move about in water for approximately 3 days and during that time can be ingested by many species of *Cyclops* (cyclopoid Copepoda, Crustacea). The larvae penetrate into the haemocoelom, moult twice and are infective to a new host in about 2 weeks. If the *Cyclops* (0.5–2.0 mm) are swallowed in drinking-water, the larvae are released in the stomach, penetrate the intestinal and peritoneal walls and inhabit the subcutaneous tissues.

Human health effects

The onset of symptoms occurs just prior to the local eruption of the worm. The early manifestations of urticaria, erythema, dyspnoea, vomiting, pruritus and giddiness are of an allergic nature. In about 50% of cases, the whole worm is extruded in a few weeks; the lesion then heals rapidly, and disability is of limited duration. In the remaining cases, however, complications ensue, and the track of the worm becomes secondarily infected, leading to a severe inflammatory reaction that may result in abscess formation with disabling pain that lasts for months. Mortality is extremely rare, but permanent disability can result from contractures of tendons and chronic arthritis. The economic impact can be substantial. One study reported an 11% annual reduction in rice production from an area of eastern Nigeria, at a cost of US$20 million.

Source and occurrence

Infection with guinea worm is geographically limited to a central belt of countries in sub-Saharan Africa. Drinking-water containing infected *Cyclops* is the only source of infection with *Dracunculus*. The disease typically occurs in rural areas where piped water supplies are not available. Transmission tends to be highly seasonal, depending on changes in water sources. For instance, transmission is highest in the early rainy season in a dry savannah zone of Mali with under 800 mm annual rainfall but in the dry season in the humid savannah area of southern Nigeria with over 1300 mm annual rainfall. The eradication strategy combines a variety of interventions, including integrated surveillance systems, intensified case containment measures, provision of safe water and health education.

Routes of exposure

The only route of exposure is the consumption of drinking-water containing *Cyclops* spp. carrying infectious *Dracunculus* larvae.

Significance in drinking-water

Dracunculus medinensis is the only human parasite that may be eradicated in the near future by the provision of safe drinking-water. Infection can be prevented by a number of relatively simple control measures. These include intervention strategies to prevent the release of *D. medinensis* larvae from female worms in infected patients into water and control of *Cyclops* spp. in water resources by means of fish. Prevention can also be achieved through the provision of boreholes and safe wells. Wells and springs should be surrounded by cement curbings, and bathing and washing in these waters should be avoided. Other control measures include filtration of water carrying infectious *Dracunculus* larvae through a fine mesh cloth to remove *Cyclops* spp. or inactivation of *Cyclops* spp. in drinking-water by treatment with chlorine.

Selected bibliography

Cairncross S, Muller R, Zagaria N (2002) Dracunculiasis (guinea worm disease) and the eradication initiative. *Clinical Microbiology Reviews*, 15:223–246.

Hopkins DR, Ruiz-Tiben E (1991) Strategies for dracunculiasis eradication. *Bulletin of the World Health Organization*, 69:533–540.

11.4.2 Fasciola spp.

Fascioliasis is caused by two trematode species of the genus *Fasciola*: *F. hepatica*, present in Europe, Africa, Asia, the Americas and Oceania, and *F. gigantica*, mainly distributed in Africa and Asia. Human fascioliasis was considered a secondary zoonotic disease until the mid-1990s. In most regions, fascioliasis is a foodborne disease. However, the discovery of floating metacercariae in hyperendemic regions (including the Andean Altiplano region in South America) indicates that drinking-water may be a significant transmission route for fascioliasis in certain locations.

General description

The life cycle of *F. hepatica* and *F. gigantica* takes about 14–23 weeks and requires two hosts. The life cycle comprises four phases. In the first phase, the definitive host ingests metacercariae. The metacercariae excyst in the intestinal tract and then migrate to the liver and bile ducts. After 3–4 months, the flukes attain sexual maturity and produce eggs, which are excreted into the bile and intestine. Adult flukes can live for 9–14 years in the host. In the second phase, the eggs are excreted by the human or animal. Once in fresh water, a miracidium develops inside. In the third phase, miracidia penetrate a snail host and develop into cercaria, which are released into the water. In the fourth and final phase, cercaria swim for a short period of time until they reach a suitable attachment site (aquatic plants), where they encyst to form metacercariae, which become infective within 24 h. Some metacercariae do not attach to plants but remain floating in the water.

Human health effects

The parasites inhabit the large biliary passages and the gall-bladder. Disease symptoms are different for the acute and chronic phases of the infection. The invasive or acute phase may last from 2 to 4 months and is characterized by symptoms such as dyspepsia, nausea and vomiting, abdominal pain and a high fever (up to 40 °C). Anaemia and allergic responses (e.g., pruritis, urticaria) may also occur. In children, the acute infection can be accompanied by severe symptoms and sometimes causes death. The obstructive or chronic phase (after months to years of infection) may be characterized by painful liver enlargement and in some cases obstructive jaundice, chest pains, loss of weight and cholelithiasis. The most important pathogenic sequelae are hepatic lesions and fibrosis and chronic inflammation of the bile ducts. Immature flukes may deviate during migration, enter other organs and cause ectopic fascioliasis in a range of subcutaneous tissues. Fascioliasis can be treated with triclabendazole.

Source and occurrence

Human cases have been increasing in 51 countries on five continents. Estimates of the numbers of humans with fascioliasis range from 2.4 to 17 million people or even higher, depending on unquantified prevalence in many African and Asian countries.

Analysis of the geographical distribution of human cases shows that the correlation between animal and human fascioliasis occurs only at a basic level. High prevalences in humans are not necessarily related to areas where fascioliasis is a great veterinary problem. Major health problems associated with fascioliasis occur in Andean countries (Bolivia, Peru, Chile, Ecuador), the Caribbean (Cuba), northern Africa (Egypt), Near East (Iran and neighbouring countries) and western Europe (Portugal, France and Spain).

Routes of exposure

Humans can contract fascioliasis when they ingest infective metacercariae by eating raw aquatic plants (and, in some cases, terrestrial plants, such as lettuce, irrigated with contaminated water), drinking contaminated water, using utensils washed in contaminated water or eating raw liver infected with immature flukes.

Significance in drinking-water

Water is often cited as a human infection source. In the Bolivian Altiplano, 13% of metacercariae isolates are floating. Untreated drinking-water in hyperendemic regions often contains floating metacercariae; for example, a small stream crossing in the Altiplano region of Bolivia contained up to 7 metacercariae per 500 ml. The importance of fascioliasis transmission through water is supported by indirect evidence. There are significant positive associations between liver fluke infection and infection by other waterborne protozoans and helminths in Andean countries and in Egypt. In many human hyperendemic areas of the Americas, people do not have a history of eating watercress or other water plants. In the Nile Delta region, people living in houses with piped water had a higher infection risk. Metacercariae are likely to be resistant to chlorine disinfection but should be removed by various filtration processes. For example, in Tiba, Egypt, human prevalence was markedly decreased after filtered water was supplied to specially constructed washing units.

Selected bibliography

Mas-Coma S (2004) Human fascioliasis. In: *Waterborne zoonoses: Identification, causes, and controls*. IWA Publishing, London, on behalf of the World Health Organization, Geneva.

Mas-Coma S, Esteban JG, Bargues MD (1999) Epidemiology of human fascioliasis: a review and proposed new classification. *Bulletin of the World Health Organization*, 77(4):340–346.

WHO (1995) *Control of foodborne trematode infections*. Geneva, World Health Organization (WHO Technical Report Series 849).

11.5 Toxic cyanobacteria

More detailed information on toxic cyanobacteria is available in the supporting document *Toxic Cyanobacteria in Water* (see section 1.3).

General description

Cyanobacteria are photosynthetic bacteria that share some properties with algae. Notably, they possess chlorophyll-a and liberate oxygen during photosynthesis. The first species to be recognized were blue-green in colour; hence, a common term for these organisms is blue-green algae. However, owing to the production of different pigments, there are a large number that are not blue-green, and they can range in colour from blue-green to yellow-brown and red. Most cyanobacteria are aerobic phototrophs, but some exhibit heterotrophic growth. They may grow as separate cells or in multicellular filaments or colonies. They can be identified by their morphology to genus level under a microscope. Some species form surface blooms or scums, while others stay mixed in the water column or are bottom dwelling (benthic). Some cyanobacteria possess the ability to regulate their buoyancy via intracellular gas vacuoles, and some species can fix elemental nitrogen dissolved in water. The most notable feature of cyanobacteria in terms of public health impact is that a range of species can produce toxins.

Human health effects

Many cyanobacteria produce potent toxins, as shown in Table 11.1. Cyanobacterial toxins are also discussed in section 8.5.6. Each toxin has specific properties, with distinct concerns including liver damage, neurotoxicity and tumour promotion. Acute symptoms reported after exposure include gastrointenstinal disorders, fever and irritations of the skin, ears, eyes, throat and respiratory tract. Cyanobacteria do not multiply in the human body and hence are not infectious.

Source and occurrence

Cyanobacteria are widespread and found in a diverse range of environments, including soils, seawater and, most notably, freshwater environments. Some environmental conditions, including sunlight, warm weather, low turbulence and high nutrient levels, can promote growth. Depending on the species, this may result in greenish discol-

Table 11.1 Cyanotoxins produced by cyanobacteria

Toxic species	Cyanotoxin
Potentially *Anabaena* spp.	Anatoxin-a(S), anatoxin-a, microcystins, saxitoxins
Anabaenopsis millenii	Microcystins
Aphanizomenon spp.	Anatoxin-a, saxitoxins, cylindrospermopsin
Cylindrospermum spp.	Cylindrospermopsin, saxitoxins, anatoxin-a
Lyngbya spp.	Saxitoxins, lyngbyatoxins
Microcystis spp.	Microcystins, anatoxin-a (minor amounts)
Nodularia spp.	Nodularins
Nostoc spp.	Microcystins
Oscillatoria spp.	Anatoxin-a, microcystins
Planktothrix spp.	Anatoxin-a, homoanatoxin-a, microcystins
Raphidiopsis curvata	Cylindrospermopsin
Umezakia natans	Cylindrospermopsin

oration of water due to a high density of suspended cells and, in some cases, the formation of surface scums. Such cell accumulations may lead to high toxin concentrations.

Routes of exposure

Potential health concerns arise from exposure to the toxins through ingestion of drinking-water, during recreation, through showering and potentially through consumption of algal food supplement tablets. Repeated or chronic exposure is the primary concern for many of the cyanotoxins; in some cases, however, acute toxicity is more important (e.g., lyngbyatoxins and the neurotoxins saxitoxin and anatoxin). Human fatalities have occurred through use of inadequately treated water containing high cyanotoxin levels for renal dialysis. Dermal exposure may lead to irritation of the skin and mucous membranes and to allergic reactions.

Significance in drinking-water

Cyanobacteria occur in low cell density in most surface waters. However, in suitable environmental conditions, high-density "blooms" can occur. Eutrophication (increased biological growth associated with increased nutrients) can support the development of cyanobacterial blooms (see also section 8.5.6).

Selected bibliography

Backer LC (2002) Cyanobacterial harmful algal blooms (CyanoHABs): Developing a public health response. *Lake and Reservoir Management*, 18:20–31.

Chorus I, Bartram J, eds. (1999) *Toxic cyanobacteria in water: A guide to their public health consequences, monitoring and management.* Published by E & FN Spon, London, on behalf of the World Health Organization, Geneva.

Lahti K et al. (2001) Occurrence of microcystins in raw water sources and treated drinking water of Finnish waterworks. *Water Science and Technology*, 43:225–228.

11.6 Indicator and index organisms

Owing to issues relating to complexity, cost and timeliness of obtaining results, testing for specific pathogens is generally limited to validation, where monitoring is used to determine whether a treatment or other process is effective in removing target organisms. Very occasionally, pathogen testing may be performed to verify that a specific treatment or process has been effective. However, microbial testing included as part of operational and verification (including surveillance) monitoring is usually limited to that for indicator organisms, either to measure the effectiveness of control measures or as an index of faecal pollution.

The concept of using indicator organisms as signals of faecal pollution is a well established practice in the assessment of drinking-water quality. The criteria determined for such indicators were that they should not be pathogens themselves and should:

—be universally present in faeces of humans and animals in large numbers;
—not multiply in natural waters;
—persist in water in a similar manner to faecal pathogens;
—be present in higher numbers than faecal pathogens;
—respond to treatment processes in a similar fashion to faecal pathogens; and
—be readily detected by simple, inexpensive methods.

These criteria reflect an assumption that the same indicator organism could be used as both an index of faecal pollution and an indicator of treatment/process efficacy. However, it has become clear that one indicator cannot fulfil these two roles. Increased attention has focused on shortcomings of traditional indicators, such as *E. coli*, as surrogates for enteric viruses and protozoa, and alternative indicators of these pathogens, such as bacteriophages and bacterial spores, have been suggested. In addition, greater reliance is being placed on parameters that can be used as indicators for the effectiveness of treatments and processes designed to remove faecal pathogens, including bacteria, viruses, protozoa and helminths.

It is important to distinguish between microbial testing undertaken to signal the presence of faecal pathogens or alternatively to measure the effectiveness of treatments/processes. As a first step, the separate terms *index* and *indicator* have been proposed, whereby:

—an *index organism* is one that points to the presence of pathogenic organisms – for example, as an index of faecal pathogens; and
—an *indicator organism* is one that is used to measure the effectiveness of a process – for example, a process indicator or disinfection indicator.

These terms can also be applied to non-microbial parameters; hence, turbidity can be used a filtration indicator.

Further discussion on index and indicator organisms is contained in the supporting document *Assessing Microbial Safety of Drinking Water* (see section 1.3).

11.6.1 Total coliform bacteria

General description

Total coliform bacteria include a wide range of aerobic and facultatively anaerobic, Gram-negative, non-spore-forming bacilli capable of growing in the presence of relatively high concentrations of bile salts with the fermentation of lactose and production of acid or aldehyde within 24 h at 35–37 °C. *Escherichia coli* and thermotolerant coliforms are a subset of the total coliform group that can ferment lactose at higher temperatures (see section 11.6.2). As part of lactose fermentation, total coliforms produce the enzyme β-galactosidase. Traditionally, coliform bacteria were regarded as belonging to the genera *Escherichia*, *Citrobacter*, *Klebsiella* and *Enterobacter*, but the group is more heterogeneous and includes a wider range of genera, such as *Serratia* and *Hafnia*. The total coliform group includes both faecal and environmental species.

Indicator value

Total coliforms include organisms that can survive and grow in water. Hence, they are not useful as an index of faecal pathogens, but they can be used as an indicator of treatment effectiveness and to assess the cleanliness and integrity of distribution systems and the potential presence of biofilms. However, there are better indicators for these purposes. As a disinfection indicator, the test for total coliforms is far slower and less reliable than direct measurement of disinfectant residual. In addition, total coliforms are far more sensitive to disinfection than are enteric viruses and protozoa. HPC measurements detect a wider range of microorganisms and are generally considered a better indicator of distribution system integrity and cleanliness.

Source and occurrence

Total coliform bacteria (excluding *E. coli*) occur in both sewage and natural waters. Some of these bacteria are excreted in the faeces of humans and animals, but many coliforms are heterotrophic and able to multiply in water and soil environments. Total coliforms can also survive and grow in water distribution systems, particularly in the presence of biofilms.

Application in practice

Total coliforms are generally measured in 100-ml samples of water. A variety of relatively simple procedures are available based on the production of acid from lactose or the production of the enzyme β-galactosidase. The procedures include membrane filtration followed by incubation of the membranes on selective media at 35–37 °C and counting of colonies after 24 h. Alternative methods include most probable number procedures using tubes or micro-titre plates and P/A tests. Field test kits are available.

Significance in drinking-water

Total coliforms should be absent immediately after disinfection, and the presence of these organisms indicates inadequate treatment. The presence of total coliforms in distribution systems and stored water supplies can reveal regrowth and possible biofilm formation or contamination through ingress of foreign material, including soil or plants.

Selected bibliography

Ashbolt NJ, Grabow WOK, Snozzi M (2001) Indicators of microbial water quality. In: Fewtrell L, Bartram J, eds. *Water quality: Guidelines, standards and health – Assessment of risk and risk management for water-related infectious disease.* WHO Water Series. London, IWA Publishing, pp. 289–315.

Grabow WOK (1996) Waterborne diseases: Update on water quality assessment and control. *Water SA*, 22:193–202.

Sueiro RA et al. (2001) Evaluation of Coli-ID and MUG Plus media for recovering *Escherichia coli* and other coliform bacteria from groundwater samples. *Water Science and Technology*, 43:213–216.

11.6.2 Escherichia coli and thermotolerant coliform bacteria

General description

Total coliform bacteria that are able to ferment lactose at 44–45 °C are known as thermotolerant coliforms. In most waters, the predominant genus is *Escherichia*, but some types of *Citrobacter*, *Klebsiella* and *Enterobacter* are also thermotolerant. *Escherichia coli* can be differentiated from the other thermotolerant coliforms by the ability to produce indole from tryptophan or by the production of the enzyme β-glucuronidase. *Escherichia coli* is present in very high numbers in human and animal faeces and is rarely found in the absence of faecal pollution, although there is some evidence for growth in tropical soils. Thermotolerant coliform species other than *E. coli* can include environmental organisms.

Indicator value

Escherichia coli is considered the most suitable index of faecal contamination. In most circumstances, populations of thermotolerant coliforms are composed predominantly of *E. coli*; as a result, this group is regarded as a less reliable but acceptable index of faecal pollution. *Escherichia coli* (or, alternatively, thermotolerant coliforms) is the first organism of choice in monitoring programmes for verification, including surveillance of drinking-water quality. These organisms are also used as disinfection indicators, but testing is far slower and less reliable than direct measurement of disinfectant residual. In addition, *E. coli* is far more sensitive to disinfection than are enteric viruses and protozoa.

Source and occurrence

Escherichia coli occurs in high numbers in human and animal faeces, sewage and water subject to recent faecal pollution. Water temperatures and nutrient conditions present in drinking-water distribution systems are highly unlikely to support the growth of these organisms.

Application in practice

Escherichia coli (or, alternatively, thermotolerant coliforms) are generally measured in 100-ml samples of water. A variety of relatively simple procedures are available based on the production of acid and gas from lactose or the production of the enzyme β-glucuronidase. The procedures include membrane filtration followed by incubation of the membranes on selective media at 44–45 °C and counting of colonies after 24 h. Alternative methods include most probable number procedures using tubes or microtitre plates and P/A tests, some for volumes of water larger than 100 ml. Field test kits are available.

Significance in drinking-water

The presence of *E. coli* (or, alternatively, thermotolerant coliforms) provides evidence of recent faecal contamination, and detection should lead to consideration of further action, which could include further sampling and investigation of potential sources such as inadequate treatment or breaches in distribution system integrity.

Selected bibliography

Ashbolt NJ, Grabow WOK, Snozzi M (2001) Indicators of microbial water quality. In: Fewtrell L, Bartram J, eds. *Water quality: Guidelines, standards and health – Assessment of risk and risk management for water-related infectious disease.* WHO Water Series. London, IWA Publishing, pp. 289–315.

George I et al. (2001) Use of rapid enzymatic assays to study the distribution of faecal coliforms in the Seine river (France). *Water Science and Technology*, 43:77–80.

Grabow WOK (1996) Waterborne diseases: Update on water quality assessment and control. *Water SA*, 22:193–202.

Sueiro RA et al. (2001) Evaluation of Coli-ID and MUG Plus media for recovering *Escherichia coli* and other coliform bacteria from groundwater samples. *Water Science and Technology*, 43:213–216.

11.6.3 Heterotrophic plate counts

A substantial review of the use of HPC is available (Bartram et al., 2003).

General description

HPC measurement detects a wide spectrum of heterotrophic microorganisms, including bacteria and fungi, based on the ability of the organisms to grow on rich growth media, without inhibitory or selective agents, over a specified incubation period and at a defined temperature. The spectrum of organisms detected by HPC testing includes organisms sensitive to disinfection processes, such as coliform bacteria; organisms resistant to disinfection, such as spore formers; and organisms that rapidly proliferate in treated water in the absence of residual disinfectants. The tests detect only a small proportion of the microorganisms that are present in water. The population recovered will differ according to the method and conditions applied. Although standard methods have been developed, there is no single universal HPC measurement. A range of media is available, incubation temperatures used vary from 20 °C to 37 °C and incubation periods range from a few hours to 7 days or more.

Indicator value

The test has little value as an index of pathogen presence but can be useful in operational monitoring as a treatment and disinfectant indicator, where the objective is to keep numbers as low as possible. In addition, HPC measurement can be used in assessing the cleanliness and integrity of distribution systems and the presence of biofilms.

Source and occurrence

Heterotrophic microorganisms include both members of the natural (typically non-hazardous) microbial flora of water environments and organisms present in a range of pollution sources. They occur in large numbers in raw water sources. The actual organisms detected by HPC tests vary widely between locations and between consecutive samples. Some drinking-water treatment processes, such as coagulation and sedimentation, reduce the number of HPC organisms in water. However, the organisms proliferate in other treatment processes, such as biologically active carbon and sand filtration. Numbers of HPC organisms are reduced significantly by disinfection practices, such as chlorination, ozonation and UV light irradiation. However, in practice, none of the disinfection processes sterilizes water; under suitable conditions, such as the absence of disinfectant residuals, HPC organisms can grow rapidly. HPC organisms can grow in water and on surfaces in contact with water as biofilms. The principal determinants of growth or "regrowth" are temperature, availability of nutrients, including assimilable organic carbon, lack of disinfectant residual and stagnation.

Application in practice

No sophisticated laboratory facilities or highly trained staff are required. Results on simple aerobically incubated agar plates are available within hours to days, depending on the characteristics of the procedure used.

Significance in drinking-water

After disinfection, numbers would be expected to be low; for most uses of HPC test results, however, actual numbers are of less value than changes in numbers at particular locations. In distribution systems, increasing numbers can indicate a deterioration in cleanliness, possibly stagnation and the potential development of biofilms. HPC can include potentially "opportunistic" pathogens such as *Acinetobacter*, *Aeromonas*, *Flavobacterium*, *Klebsiella*, *Moraxella*, *Serratia*, *Pseudomonas* and *Xanthomonas*. However, there is no evidence of an association of any of these organisms with gastrointestinal infection through ingestion of drinking-water in the general population.

Selected bibliography

Ashbolt NJ, Grabow WOK, Snozzi M (2001) Indicators of microbial water quality. In: Fewtrell L, Bartram J, eds. *Water quality: Guidelines, standards and health – Assessment of risk and risk management for water-related infectious disease.* WHO Water Series. London, IWA Publishing, pp. 289–315.

Bartram J et al., eds. (2003) *Heterotrophic plate counts and drinking-water safety: the significance of HPCs for water quality and human health.* WHO Emerging Issues in Water and Infectious Disease Series. London, IWA Publishing.

11.6.4 Intestinal enterococci

General description

Intestinal enterococci are a subgroup of the larger group of organisms defined as faecal streptococci, comprising species of the genus *Streptococcus*. These bacteria are Gram-positive and relatively tolerant of sodium chloride and alkaline pH levels. They are facultatively anaerobic and occur singly, in pairs or as short chains. Faecal streptococci including intestinal enterococci all give a positive reaction with Lancefield's Group D antisera and have been isolated from the faeces of warm-blooded animals. The subgroup intestinal enterococci consists of the species *Enterococcus faecalis*, *E. faecium*, *E. durans* and *E. hirae*. This group was separated from the rest of the faecal streptococci because they are relatively specific for faecal pollution. However, some intestinal enterococci isolated from water may occasionally also originate from other habitats, including soil, in the absence of faecal pollution.

Indicator value

The intestinal enterococci group can be used as an index of faecal pollution. Most species do not multiply in water environments. The numbers of intestinal enterococci in human faeces are generally about an order of magnitude lower than those of *E. coli*. Important advantages of this group are that they tend to survive longer in water environments than *E. coli* (or thermotolerant coliforms), are more resistant to drying and are more resistant to chlorination. Intestinal enterococci have been used in testing of raw water as an index of faecal pathogens that survive longer than *E. coli* and in drinking-water to augment testing for *E. coli*. In addition, they have been used to test water quality after repairs to distribution systems or after new mains have been laid.

Source and occurrence

Intestinal enterococci are typically excreted in the faeces of humans and other warm-blooded animals. Some members of the group have also been detected in soil in the absence of faecal contamination. Intestinal enterococci are present in large numbers in sewage and water environments polluted by sewage or wastes from humans and animals.

Application in practice

Enterococci are detectable by simple, inexpensive cultural methods that require basic bacteriology laboratory facilities. Commonly used methods include membrane filtration with incubation of membranes on selective media and counting of colonies after incubation at 35–37 °C for 48 h. Other methods include a most probable number technique using micro-titre plates where detection is based on the ability of intestinal enterococci to hydrolyse 4-methyl-umbelliferyl-β-D-glucoside in the presence of thallium acetate and nalidixic acid within 36 h at 41 °C.

Significance in drinking-water

The presence of intestinal enterococci provides evidence of recent faecal contamination, and detection should lead to consideration of further action, which could include further sampling and investigation of potential sources such as inadequate treatment or breaches in distribution system integrity.

Selected bibliography

Ashbolt NJ, Grabow WOK, Snozzi M (2001) Indicators of microbial water quality. In: Fewtrell L, Bartram J, eds. *Water quality: Guidelines, standards and health – Assessment of risk and risk management for water-related infectious disease.* WHO Water Series. London, IWA Publishing, pp. 289–315.

Grabow WOK (1996) Waterborne diseases: Update on water quality assessment and control. *Water SA*, 22:193–202.

Junco TT et al. (2001) Identification and antibiotic resistance of faecal enterococci isolated from water samples. *International Journal of Hygiene and Environmental Health*, 203:363–368.

Pinto B et al. (1999) Characterization of "faecal streptococci" as indicators of faecal pollution and distribution in the environment. *Letters in Applied Microbiology*, 29:258–263.

11.6.5 Clostridium perfringens

General description

Clostridium spp. are Gram-positive, anaerobic, sulfite-reducing bacilli. They produce spores that are exceptionally resistant to unfavourable conditions in water environments, including UV irradiation, temperature and pH extremes, and disinfection processes, such as chlorination. The characteristic species of the genus, *C. perfringens*, is a member of the normal intestinal flora of 13–35% of humans and other warm-blooded animals. Other species are not exclusively of faecal origin. Like *E. coli*, *C. perfringens* does not multiply in most water environments and is a highly specific indicator of faecal pollution.

Indicator value

In view of the exceptional resistance of *C. perfringens* spores to disinfection processes and other unfavourable environmental conditions, *C. perfringens* has been proposed as an index of enteric viruses and protozoa in treated drinking-water supplies. In addition, *C. perfringens* can serve as an index of faecal pollution that took place previously and hence indicate sources liable to intermittent contamination. *Clostridium perfringens* is not recommended for routine monitoring, as the exceptionally long survival times of its spores are likely to far exceed those of enteric pathogens, including viruses and protozoa. *Clostridium perfringens* spores are smaller than protozoan (oo)cysts and may be useful indicators of the effectiveness of filtration processes. Low numbers in some source waters suggest that use of *C. perfringens* spores for this purpose may be limited to validation of processes rather than routine monitoring.

Source and occurrence

Clostridium perfringens and its spores are virtually always present in sewage. The organism does not multiply in water environments. *Clostridium perfringens* is present more often and in higher numbers in the faeces of some animals, such as dogs, than in the faeces of humans and less often in the faeces of many other warm-blooded animals. The numbers excreted in faeces are normally substantially lower than those of *E. coli.*

Application in practice

Vegetative cells and spores of *C. perfringens* are usually detected by membrane filtration techniques in which membranes are incubated on selective media under strict anaerobic conditions. These detection techniques are not as simple and inexpensive as those for other indicators, such as *E. coli* and intestinal enterococci.

Significance in drinking-water

The presence of *C. perfringens* in drinking-water can be an index of intermittent faecal contamination. Potential sources of contamination should be investigated. Filtration processes designed to remove enteric viruses or protozoa should also remove *C. perfringens*. Detection in water immediately after treatment should lead to investigation of filtration plant performance.

Selected bibliography

Araujo M et al. (2001) Evaluation of fluorogenic TSC agar for recovering *Clostridium perfringens* in groundwater samples. *Water Science and Technology*, 43:201–204.

Ashbolt NJ, Grabow WOK, Snozzi M (2001) Indicators of microbial water quality. In: Fewtrell L, Bartram J, eds. *Water quality: Guidelines, standards and health – Assessment of risk and risk management for water-related infectious disease.* WHO Water Series. London, IWA Publishing, pp. 289–315.

Nieminski EC, Bellamy WD, Moss LR (2000) Using surrogates to improve plant performance. *Journal of the American Water Works Association*, 92(3):67–78.

Payment P, Franco E (1993) *Clostridium perfringens* and somatic coliphages as indicators of the efficiency of drinking-water treatment for viruses and protozoan cysts. *Applied and Environmental Microbiology*, 59:2418–2424.

11.6.6 Coliphages

General description

Bacteriophages (phages) are viruses that use only bacteria as hosts for replication. Coliphages use *E. coli* and closely related species as hosts and hence can be released by these bacterial hosts into the faeces of humans and other warm-blooded animals. Coliphages used in water quality assessment are divided into the major groups of somatic coliphages and F-RNA coliphages. Differences between the two groups include the route of infection.

Somatic coliphages initiate infection by attaching to receptors permanently located on the cell wall of hosts. They replicate more frequently in the gastrointestinal tract of warm-blooded animals but can also replicate in water environments. Somatic coliphages consist of a wide range of phages (members of the phage families Myoviridae, Siphoviridae, Podoviridae and Microviridae) with a spectrum of morphological types.

F-RNA coliphages initiate infection by attaching to fertility (F-, sex) fimbriae on *E. coli* hosts. These F-fimbriae are produced only by bacteria carrying the fertility (F-) plasmid. Since F-fimbriae are produced only in the logarithmic growth phase at temperatures above 30 °C, F-RNA phages are not likely to replicate in environments other than the gastrointestinal tract of warm-blooded animals. F-RNA coliphages comprise a restricted group of closely related phages, which belong to the family Leviviridae, and consist of a single-stranded RNA genome and an icosahedral capsid that is morphologically similar to that of picornaviruses. F-RNA coliphages have been divided into serological types I–IV, which can be identified as genotypes by molecular techniques such as gene probe hybridization. Members of groups I and IV have to date been found exclusively in animal faeces, and group III in human faeces. Group II phages have been detected in human faeces and no animal faeces other than about 28% of porcine faeces. This specificity, which is not fully understood, offers a potential tool to distinguish between faecal pollution of human and animal origin under certain conditions and limitations.

Indicator value

Phages share many properties with human viruses, notably composition, morphology, structure and mode of replication. As a result, coliphages are useful models or surrogates to assess the behaviour of enteric viruses in water environments and the sensitivity to treatment and disinfection processes. In this regard, they are superior to faecal bacteria. However, there is no direct correlation between numbers of coliphages and numbers of enteric viruses. In addition, coliphages cannot be absolutely relied upon as an index for enteric viruses. This has been confirmed by the isolation of enteric viruses from treated and disinfected drinking-water supplies that yielded negative results in conventional tests for coliphages.

F-RNA coliphages provide a more specific index of faecal pollution than somatic phages. In addition, F-RNA coliphages are better indicators of the behaviour of enteric viruses in water environments and their response to treatment and disinfection processes than are somatic coliphages. This has been confirmed by studies in which the behaviour and survival of F-RNA coliphages, somatic phages, faecal bacteria and enteric viruses have been compared. Available data indicate that the specificity of F-

RNA serogroups (genotypes) for human and animal excreta may prove useful in the distinction between faecal pollution of human and animal origin. However, there are shortcomings and conflicting data that need to be resolved, and the extent to which this tool can be applied in practice remains to be elucidated. Due to the limitations of coliphages, they are best used in laboratory investigations, pilot trials and possibly validation testing. They are not suitable for operational or verification (including surveillance) monitoring.

Source and occurrence

Coliphages are excreted by humans and animals in relatively low numbers. As a result of their respective modes of replication and host specificity, somatic coliphages are generally excreted by most humans and animals, whereas F-RNA coliphages are excreted by a variable and generally lower percentage of humans and animals. Available data indicate that in some communities, F-RNA phages are detectable in 10% of human, 45% of bovine, 60% of porcine and 70% of poultry faecal specimens. Somatic coliphages have been found to generally outnumber F-RNA phages in water environments by a factor of about 5 and cytopathogenic human viruses by a factor of about 500, although these ratios vary considerably. Sewage contains somatic coliphages in numbers of the order of 10^6–10^8 per litre; in one study, slaughterhouse wastewater was found to contain somatic coliphages in numbers up to 10^{10} per litre. There are indications that they may multiply in sewage, and somatic coliphages may multiply in natural water environments using saprophytic hosts. Somatic phages and F-RNA phages have been detected in numbers up to 10^5 per litre in lake and river water.

Application in practice

Somatic coliphages are detectable by relatively simple and inexpensive plaque assays, which yield results within 24 h. Plaque assays for F-RNA coliphages are not quite as simple, because the culture of host bacteria has to be in the logarithmic growth phase at a temperature above 30 °C to ensure that F-fimbriae are present. Plaque assays using large petri dishes have been designed for the quantitative enumeration of plaques in 100-ml samples, and P/A tests have been developed for volumes of water of 500 ml or more.

Significance in drinking-water

Since coliphages typically replicate in the gastrointestinal tract of humans and warm-blooded animals, their presence in drinking-water provides an index of faecal pollution and hence the potential presence of enteric viruses and possibly also other pathogens. The presence of coliphages in drinking-water also indicates shortcomings in treatment and disinfection processes designed to remove enteric viruses. F-RNA coliphages provide a more specific index for faecal pollution. The absence of coliphages from treated drinking-water supplies does not confirm the absence of pathogens such as enteric viruses and protozoan parasites.

Selected bibliography

Ashbolt NJ, Grabow WOK, Snozzi M (2001) Indicators of microbial water quality. In: Fewtrell L, Bartram J, eds. *Water quality: Guidelines, standards and health – Assessment of risk and risk management for water-related infectious disease.* WHO Water Series. London, IWA Publishing, pp. 289–315.

Grabow WOK (2001) Bacteriophages: Update on application as models for viruses in water. *Water SA*, 27:251–268.

Mooijman KA et al. (2001) Optimisation of the ISO-method on enumeration of somatic coliphages (draft ISO 10705–2). *Water Science and Technology*, 43:205–208.

Schaper M et al. (2002) Distribution of genotypes of F-specific RNA bacteriophages in human and non-human sources of faecal pollution in South Africa and Spain. *Journal of Applied Microbiology*, 92:657–667.

Storey MV, Ashbolt NJ (2001) Persistence of two model enteric viruses (B40-8 and MS-2 bacteriophages) in water distribution pipe biofilms. *Water Science and Technology*, 43:133–138.

11.6.7 Bacteroides fragilis phages

General description

The bacterial genus *Bacteroides* inhabits the human gastrointestinal tract in greater numbers than *E. coli*. Faeces can contain 10^9–10^{10} *Bacteroides* per gram compared with 10^6–10^8 *E. coli* per gram. *Bacteroides* are rapidly inactivated by environmental oxygen levels, but *Bacteroides* bacteriophages are resistant to unfavourable conditions. Two groups of *B. fragilis* phages are used as indicators in water quality assessment. One is a restricted group of phages that specifically uses *B. fragilis* strain HSP40 as host. This group of phages appears unique, because it is found only in human faeces and not in faeces of other animals. The numbers of these phages in sewage appear to be relatively low, and they are almost absent in some geographical areas. The *B. fragilis* HSP40 phages belong to the family Siphoviridae, with flexible non-contractile tails, double-stranded DNA and capsids with a diameter of up to 60 nm. The second group of *Bacteroides* phages used as indicators is those that use *B. fragilis* strain RYC2056 as a host. This group includes a substantially wider spectrum of phages, occurring in the faeces of humans and many other animals. The numbers of these phages in sewage are generally substantially higher than those of *B. fragilis* HSP40 phages.

Indicator value

Bacteroides bacteriophages have been proposed as a possible index of faecal pollution due to their specific association with faecal material and exceptional resistance to environmental conditions. In particular, *B. fragilis* HSP40 phages are found only in human faeces. *Bacteroides fragilis* phage B40-8, a typical member of the group of *B. fragilis* HSP40 phages, has been found to be more resistant to inactivation by chlorine than poliovirus type 1, simian rotavirus SA11, coliphage f2, *E. coli* and *Streptococcus faecalis*. *Bacteroides fragilis* strain RYC2056 phages seem to be likewise relatively resistant to disinfection. Indicator shortcomings of *B. fragilis* phages include relatively low numbers in sewage and polluted water environments. This applies in particular to *B. fragilis* HSP40 phages. Human enteric viruses have been detected in drinking-water supplies that yielded negative results in conventional tests for *B. fragilis* HSP40 phages. Owing to the limitations of *Bacteroides* bacteriophages, they are best used in laboratory investigations, pilot trials and possibly validation testing. They are not suitable for operational or verification (including surveillance) monitoring.

Source and occurrence

Bacteroides fragilis HSP40 phages are excreted by about 10–20% of humans in certain parts of the world; consequently, their numbers in sewage are substantially lower than those of somatic and even F-RNA coliphages. A mean count of 67 *B. fragilis* HSP40 phages per litre in a sewage-polluted river has been reported. In some parts of the world, *B. fragilis* HSP40 phages would appear not to be detectable in sewage at all. Phages using *B. fragilis* RYC2056 as host are excreted in larger numbers and seem to occur more universally. On average, these phages are excreted by more than 25% of humans. In a survey of water environments, *B. fragilis* HSP40 phages have been found to outnumber cytopathogenic enteric viruses on average by only about 5-fold. Theoretically, wastewaters could be expected to contain higher levels of *B. fragilis* phages than those detected. The reason for the discrepancy may be due to failure in maintaining sufficiently anaerobic conditions during the performance of plaque assays. Improvement of detection methods may result in the recording of higher numbers of *B. fragilis* phages in sewage and polluted water environments.

Application in practice

Disadvantages of *B. fragilis* phages are that the detection methods are more complex and expensive than those for coliphages. Costs are increased by the need to use antibiotics for purposes of selection and to incubate cultures and plaque assays under absolute anaerobic conditions. Results of plaque assays are usually available after about 24 h compared with about 8 h for coliphages.

Significance in drinking-water

The presence of *B. fragilis* phages in drinking-water is sound evidence of faecal pollution as well as shortcomings in water treatment and disinfection processes. In addition, the presence of *B. fragilis* HSP40 phages strongly indicates faecal pollution of human origin. However, *B. fragilis* phages occur in relatively low numbers in sewage, polluted water environments and drinking-water supplies. This implies that the absence of *B. fragilis* phages from treated drinking-water supplies does not confirm the absence of pathogens such as enteric viruses and protozoan parasites.

Selected bibliography

Bradley G et al. (1999) Distribution of the human faecal bacterium *Bacteroides fragilis* and their relationship to current sewage pollution indicators in bathing waters. *Journal of Applied Microbiology*, 85(Suppl.):90S–100S.

Grabow WOK (2001) Bacteriophages: Update on application as models for viruses in water. *Water SA*, 27:251–268.

Puig A et al. (1999) Diversity of *Bacteroides fragilis* strains in their capacity to recover phages from human and animal wastes and from fecally polluted wastewater. *Applied and Environmental Microbiology*, 65:1772–1776.

Storey MV, Ashbolt NJ (2001) Persistence of two model enteric viruses (B40-8 and MS-2 bacteriophages) in water distribution pipe biofilms. *Water Science and Technology*, 43:133–138.

Tartera C, Lucena F, Jofre J (1989) Human origin of *Bacteroides fragilis* bacteriophages present in the environment. *Applied and Environmental Microbiology*, 10:2696–2701.

11.6.8 Enteric viruses

General description

The viruses referred to here are a combined group of those that infect the human gastrointestinal tract and are predominantly transmitted by the faecal–oral route. Well known members of this group include the enteroviruses, astroviruses, enteric adenoviruses, orthoreoviruses, rotaviruses, caliciviruses and hepatitis A and E viruses. The enteric viruses cover a wide spectrum of viruses, members of which are a major cause of morbidity and mortality worldwide. Members of the group of enteric viruses differ with regard to structure, composition, nucleic acid and morphology. There are also differences in the numbers and frequency of excretion, survival in the environment and resistance to water treatment processes. Enteric viruses have robust capsids that enable them to survive unfavourable conditions in the environment as well as allowing passage through the acidic and proteolytic conditions in the stomach on their way to the duodenum, where they infect susceptible epithelial cells.

Indicator value

The use of enteric viruses as indicator or index organisms is based on the shortcomings of the existing choices. The survival of faecal bacteria in water environments and the sensitivity to treatment and disinfection processes differ substantially from those of enteric viruses. Monitoring based on one or more representatives of the large group of enteric viruses themselves would, therefore, be more valuable for assessment of the presence of any of the enteric viruses in water and the response to control measures.

Source and occurrence

Enteric viruses are excreted by individuals worldwide at a frequency and in numbers that result in many of these viruses being universally present in substantial numbers in wastewater. However, the prevalence of individual members may vary to a large extent due to variations in rates of infection and excretion. Much higher numbers would be present during outbreaks.

Application in practice

Practical methods are not yet available for the routine monitoring of water supplies for a broad spectrum of enteric viruses. Viruses that are more readily detectable include members of the enterovirus, adenovirus and orthoreovirus groups. These viruses occur in polluted environments in relatively high numbers and can be detected by reasonably practical and moderate-cost techniques based on cytopathogenic effect in cell culture that yield results within 3–12 days (depending on the type of virus). In addition, progress in technology and expertise is decreasing costs. The cost for the recovery of enteric viruses from large volumes of drinking-water has been reduced extensively. Some techniques – for instance, those based on glass wool adsorption–elution – are inexpensive. The cost of cell culture procedures has also been reduced. Consequently, the cost of testing drinking-water supplies for cytopathogenic viruses has become acceptable for certain purposes. Testing could be used to validate effectiveness of treatment processes and, in certain circumstances, as part of specific investigations to verify performance of processes. The incubation times, cost and relative complexity of testing mean that enteric virus testing is not suitable for operational or verification (including surveillance) monitoring. Orthoreoviruses, and at least the vaccine strains of polioviruses detected in many water environments, also have the advantage of not constituting a health risk to laboratory workers.

Significance in drinking-water

The presence of any enteric viruses in drinking-water should be regarded as an index for the potential presence of other enteric viruses, is conclusive evidence of faecal pollution and also provides evidence of shortcomings in water treatment and disinfection processes.

Selected bibliography

Ashbolt NJ, Grabow WOK, Snozzi M (2001) Indicators of microbial water quality. In: Fewtrell L, Bartram J, eds. *Water quality: Guidelines, standards and health – Assessment of risk and risk management for water-related infectious disease.* WHO Water Series. London, IWA Publishing, pp. 289–315.

Grabow WOK, Taylor MB, de Villiers JC (2001) New methods for the detection of viruses: call for review of drinking-water quality guidelines. *Water Science and Technology*, 43:1–8.

12
Chemical fact sheets

The background documents referred to in this chapter may be found on the Water Sanitation and Health website at http://www.who.int/water_sanitation_health/dwq/guidelines/en/.

12.1 Acrylamide

Residual acrylamide monomer occurs in polyacrylamide coagulants used in the treatment of drinking-water. In general, the maximum authorized dose of polymer is 1 mg/litre. At a monomer content of 0.05%, this corresponds to a maximum theoretical concentration of 0.5 μg/litre of the monomer in water. Practical concentrations may be lower by a factor of 2–3. This applies to the anionic and non-ionic polyacrylamides, but residual levels from cationic polyacrylamides may be higher. Polyacrylamides are also used as grouting agents in the construction of drinking-water reservoirs and wells. Additional human exposure might result from food, owing to the use of polyacrylamide in food processing and the potential formation of acrylamide in foods cooked at high temperatures.

Guideline value	0.0005 mg/litre (0.5 μg/litre)
Occurrence	Concentrations of a few micrograms per litre have been detected in tap water.
Basis of guideline derivation	Combined mammary, thyroid and uterine tumours observed in female rats in a drinking-water study, and using the linearized multistage model
Limit of detection	0.032 μg/litre by GC; 0.2 μg/litre by HPLC; 10 μg/litre by HPLC with UV detection
Treatment achievability	Conventional treatment processes do not remove acrylamide. Acrylamide concentrations in drinking-water are controlled by limiting either the acrylamide content of polyacrylamide flocculants or the dose used, or both.
Additional comments	Although the practical quantification level for acrylamide in most laboratories is above the guideline value (generally in the order of 1 μg/litre), concentrations in drinking-water can be controlled by product and dose specification.

GUIDELINES FOR CANADIAN DRINKING WATER QUALITY - SUPPORTING DOCUMENTS

The following documents represent the technical or scientific supporting documentation used by the Federal-Provincial-Territorial Committee on Drinking Water in developing and approving guidelines for contaminants found in drinking water. The documents are criteria summaries prepared by the staff of the Water Quality and Health Bureau of the Safe Environments Programme of Health Canada, or their consultants, following the critical evaluation of available information on exposure, health effects, analytical methodology and treatment technology for each contaminant. These reviews are not exhaustive, but present a brief summary of background data and information considered to be critical for the derivation of the guidelines.

Summary paragraphs of these individual documents are published in the sixth edition of the Guidelines for Canadian Drinking Water Quality.

Health Canada has published Guidelines for Canadian Drinking Water Quality since 1968. The guidelines are prepared by the Federal-Provincial-Territorial Committee on Drinking Water; the Committee is made up of representatives from each province and territory, as well as from Health Canada.

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Last updated 2003-11-21

Discussion Paper on Application of Drinking Water Quality Standards for Institutional and Commercial Water Supplies

Introduction:

Government has made substantial progress in the implementation of the Multi-Barrier Strategic Action Plan (MBSAP) for drinking water safety. This plan refers to the protection of drinking water on a variety of levels. The components of the MBSAP include: source protection, water treatment, operation and maintenance of water supply systems, comprehensive drinking water quality monitoring and reporting, appropriate inspection, abatement and enforcement measures and operator education and training. The primary goal is to ensure that adequate safeguards are in place at each stage of water supply systems to minimize the possibility of pathogens and other contaminants entering the water and, therefore, to ensure the safety of drinking water.

In May 2001, government through the Department of Environment adopted new standards for bacteriological quality of drinking water and the requirements for chlorine residual in distribution systems for all public water supplies. To date, most of the attention on drinking water has focused on those municipal and community water supplies. However, the public also has access to drinking water at commercial facilities such as hotels, restaurants, and community centers and institutional facilities such as hospitals and schools. There are many situations where such facilities do not use a public (municipal) water supply but have their own on-site or private water supply. Historically, there has been limited control exercised over the quality of drinking water at these facilities. It is intended that the new standards will be extended to apply to all locations where the public has access to drinking water.

Commercial and Institutional Facility Water Supplies:

Institutional water supplies are defined as separate water supplies for public schools, hospitals, parks, firehalls that provide water to the public, Newfoundland and Labrador Housing group housing etc., that are not on a public supply.

Commercial water supplies are defined as separate water supplies for private schools, daycare centres, hotels, motels, restaurants, etc., that are not on a public supply.

The Drinking Water Standards:

The *"Standards for Bacteriological Quality of Public Drinking Water Supplies"* and the *"Standards for Chemical and Physical Monitoring of Drinking Water"* are attached to this paper. Owners and operators of commercial and institutional facilities are being consulted on these standards and the implications of applying these standards. The issue is not the safety or the water quality as such. All drinking water in the province must be bacteriologically safe and must meet the same chemical standards regardless of its source. Rather the issue is how to ensure that all drinking water meets the disinfection requirements to an appropriate degree and that sufficient monitoring of water quality takes place to ensure that it meets the provincial standards.

Currently, Environmental Health Officers with the Government Service Centre collect water samples for bacteriological analysis each time they inspect an institution or commercial facility

which obtains its water from a private water supply. The frequency of this sample collection is not sufficient and the majority of supplies are not being adequately disinfected.

It is being proposed that:

1. **Continuous disinfection be mandatory.**
2. **Regular sampling and testing be carried out for bacteriological and chemical quality. Sampling should be conducted monthly for bacteriological sampling, 2 times per year for basic chemical analysis which can be reduced to once per year under certain circumstances.**
3. **All costs associated with the disinfection and water quality monitoring will be bourne by the owner or operator of the facility.**

The provincial Department of Environment, in consultation with the Departments of Health and Community Services, Municipal and Provincial Affairs and Government Services and Lands, is developing an appropriate testing regime for commercial and institutional water supplies to meet drinking water standards. The proposed testing regime will be discussed during the consultations stage. It is being suggested that to meet drinking water standards, institutional and commercial facilities must test their drinking water twice a year, submit the results to Government, and ensure that their drinking water is properly disinfected. It is emphasized that this only applies to commercial and institutional facilities that have a private water supply because as such the water is only being tested to a very limited degree for bacteriological parameters and practically never for chemical, and physical parameters. Public water supplies are monitored for these parameters by the provincial government.

The objective of this discussion paper is to provide information to the commercial and institutional facilities that have a private water supply as to the recommended testing and to receive feedback from these facilities.

What are other jurisdictions in Canada doing about Institutional and Commercial Water Supplies?

In April 2003, a survey of practices in the other provinces and territories in Canada was carried out. While jurisdictions in Canada have varying practices, all have a fundamental requirement that drinking water must meet the *Guidelines for Canadian Drinking Water Quality* or a similar standards through provincial regulations. When it comes to disinfection requirements, practices vary somewhat. Filtration of surface water sources is required in Alberta. Disinfection is required in Yukon, Saskatchewan, Quebec, Ontario, Northwest Territories, Manitoba and British Columbia. In some jurisdictions, groundwater systems that are not under the influence of surface water are exempted from this requirement, ie BC and Yukon. PEI can order disinfection on a case by case basis and in New Brunswick, standby chlorination equipment is required.

Water quality testing at commercial and institutional water supplies is required in all jurisdictions across Canada with the exception of New Brunswick and PEI although it is recommended in PEI. The type of sampling and frequency varies significantly from once per year for bacteriological only to weekly bacteriological sampling and twice per year for chemical sampling. Analysis costs are usually borne by the owner and generally accredited labs must be used for the analysis. Sampling results are reported to various departments depending on the jurisdiction. Details of the survey are available from this department.

How will the Consultation Process work?

Primarily, the purpose of this consultation process is to receive input from the target audience which includes commercial and institutional facilities that have a private water supply. These facilities include hospitals, schools, community centres, hotels/motels and restaurants which are not serviced by a public water supply. Feedback will also be solicited from municipalities, special interest groups, economic development boards and environmental industry associations.

The discussion paper will be mailed to known commercial and institutional facilities, and will also be circulated to such umbrella groups as the Newfoundland and Labrador Health Boards Association, Newfoundland and Labrador School Boards Association and Hospitality Newfoundland and Labrador who will be asked to share the document with their respective members. Officials of the Department of Environment are available for information sessions and/or meetings should further clarification and consultation be required.

The discussion document will be posted on the Department of Environment's website where public comments can be submitted. The department will accept written submissions, phone calls and comments provided by groups listed above or from owners and operators directly. Written submissions may be sent to:

Department of Environment
Drinking Water Safety Technical Group
4th Floor, West Block, Confederation Building
PO Box 8700
St. John's NL A1B 4J6

The deadline for submissions or comments on the discussion paper was April 2, 2004.

The Department of Environment will prepare a report by July 2004 which will summarize information and concerns provided through these consultations. This report will be made available to the target audiences and will be posted on the department's website. It is anticipated the proposed standards can be finalized within a brief timeframe following the consultation process. In determining when the standards would take effect, the department will take into consideration input from the target audiences which referenced the amount of time required to be in compliance with the standards.

For further information or clarification, please contact the Department of Environment at (709) 729-2563.

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Chapter 5 Drinking Water Quality Standards

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Chapter 5 Drinking Water Quality Standards

5.1 Introduction

This chapter is about standards, specifically the drinking water quality standards that are now part of Ontario Regulation 459/00. In discussing these standards, I do not intend to offer recommendations about maximum acceptable concentrations of contaminants but to examine the process by which they are set. There was no information presented at the Inquiry to warrant alarm with respect to existing standards. This Inquiry did not examine individual standards in detail; the purpose of my recommendations regarding the process of setting standards is to provide a vehicle for public review of existing standards, where necessary, and of emerging threats to drinking water safety.

There are many other kinds of standards. Some deal with mechanical, electrical, or plumbing matters, which have a bearing – but not a central one – on matters of drinking water quality. I deal with these standards only incidentally. More important are standards for treatment, monitoring, and laboratory testing, which are dealt with in Chapters 6, 8, and 9. Finally, there are essential standards for attaining consistent high quality in management and operations, which require drinking water quality standards as a base.[1] Quality management is dealt with in Chapter 11.

The failures at Walkerton were not failures of the drinking water quality objectives as such but of the systems that were supposed to ensure they were met. Reviews of outbreaks – see Chapter 3 – suggest that this pattern holds on a larger scale. As was the case in Walkerton, operational, managerial, and regulatory failures can lead to a major breakdown.

In this chapter, I make only a few recommendations. Some are directed toward the cautious approach that should be adopted in setting drinking water quality standards. The remainder are directed toward making the system for setting standards, both at the federal and provincial levels, more transparent. There is reason to have confidence that Ontario's drinking water quality standards are

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[1] Contrasting the two, the executive director of the American Water Works Association said: "[A] table of numbers – whether they are guidelines or strict standards – does not protect public health in and of itself. Meeting the numbers is just part of an effective program. More important to me is whether utilities have continuous quality improvement systems to verify that the entire process of delivering safe drinking water is working as it should": J.W. Hoffbuhr, 2001, "The regulatory paradox," *Journal of the American Water Works Association*, vol. 93, no. 5, p. 8.

essentially based on sound principles of risk assessment and management and that they make due allowance for precaution. Conservative and enforceable water quality standards are an important basis for a multi-barrier approach to water safety, and it is likely true that improvements in management and regulation will yield greater safety benefits than will any general tightening of Ontario's present drinking water quality standards. Nevertheless, new threats will continue to be identified and old ones will be periodically re-evaluated.

I also recommend the establishment of an expert advisory council to advise the Minister of the Environment on setting standards. There are, in particular, two areas where current standards may be obsolete: the use of total coliform as an indicator, and the apparently lax standard for turbidity. These I assign to this expert advisory council to examine, in public, along with the rest of a lengthy agenda. Finally, I have included a description of the contaminants that pose the more serious threats to drinking water and the processes by which drinking water quality standards are set in Canada and elsewhere.

5.2 Setting Drinking Water Quality Standards in Canada

Drinking water quality standards are expressed as maximum acceptable concentration (MAC) limits for certain microbes, chemicals, and physical properties. Where data are insufficient but a hazard is suspected, an interim maximum acceptable concentration (IMAC) limit may be specified. Canada's drinking water quality standards are set in two steps. First, a committee of officials from the federal, provincial, and territorial governments, working without a great deal of public involvement or political oversight, examines toxicological and epidemiological evidence as well as other information and publishes a set of recommended *Guidelines*.[2] Second, provinces and territories decide which of the contaminants and MACs ought to be adopted in their jurisdictions.

Sometimes, as was the case for many years in Ontario, the federal–provincial *Guidelines* were carried over simply as guidelines or objectives by the implementing jurisdictions. In a few provinces, they were given the force of

[2] Federal–Provincial–Territorial Committee on Environmental and Occupational Health, Federal–Provincial Subcommittee on Drinking Water, 1996, *Guidelines for Canadian Drinking Water Quality*, 6th ed. (Ottawa: Health Canada) [hereafter *Guidelines*]. A more updated version of the *Guidelines* can be found at <http://www.hc-sc.gc.ca/ehp/ehd/catalogue/bch_pubs/summary.pdf> [accessed April 30, 2002].

law by being made regulations under appropriate provincial legislation. In Ontario, a version of the *Guidelines* was incorporated as an objective into the Ontario Drinking Water Objectives (ODWO),[3] until shortly after Walkerton, when they were extended and incorporated into law as Ontario Regulation 459/00 under the *Ontario Water Resources Act.*[4]

Recommendation 18: In setting drinking water quality standards, the objective should be such that, if the standards are met, a reasonable and informed person would feel safe drinking the water.

I discussed this goal in more detail in Chapter 3.

Recommendation 19: Standards setting should be based on a precautionary approach, particularly with respect to contaminants whose effects on human health are unknown.

In setting up systems that affect human health, decision makers usually err on the side of safety, regardless of the costs. As discussed in Chapter 3, a refinement to this approach is the precautionary principle, a guide to environmental action that has been recognized in international law and cited approvingly by the Supreme Court of Canada.[5] Precautionary measures include setting standards to account for uncertainties, investments in risk mitigation or alternative technologies, and investments in research.[6] This prudent approach must still consider costs, but as prevention usually costs much less than remediation, the precautionary principle has a role to play in risk management and should be an integral part of decisions affecting the safety of drinking water.

Recommendation 20: Regarding drinking water quality research, I encourage Health Canada and other agencies to adopt as a priority the development of sufficiently detailed definitions of the susceptibility of vulnerable population groups to drinking water contaminant exposures to allow appropriate adjustments in drinking water quality guidelines.

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[3] Ontario, Ministry of the Environment, Water Policy Branch (1994 revision).

[4] R.S.O. 1990, c. O.40.

[5] See *114957 Canada Ltée (Spraytech, Société d'arrosage)* v. *Hudson (Town),* [2001] 2 S.C.R. 241.

[6] Some of the parties in Part 2 made the point explicitly: Sierra Legal Defence Fund, 2001, "A paper on the regulatory approaches to drinking water used in Canada and, selectively, abroad," and "Public submission to the Walkerton Inquiry," vol. 2, Walkerton Inquiry Submission, p. 39; and Canadian Environmental Law Association and Concerned Walkerton Citizens, 2001, "Tragedy on tap: Why Ontario needs a *Safe Drinking Water Act,*" vol. 2, Walkerton Inquiry Submission, pp. 120–121.

Where identifiable groups are susceptible to certain contaminants, quality standards may be made more stringent and/or susceptible people must take measures to protect themselves. Immunocompromised people (e.g., people with AIDS, transplants, or cancer, whose drug regimes suppress immune responses) may need to take special precautions if there is a chance of *Cryptosporidium* in the water.[7] Sometimes it is practical to require general standards to take these problems into account, but at other times, medical advice and individual precautions are necessary.

5.2.1 The Federal–Provincial Subcommittee on Drinking Water

The Federal–Provincial Subcommittee on Drinking Water develops water quality guidelines as recommendations to its parent committee, the Federal–Provincial–Territorial Committee on Environmental and Occupational Health (CEOH),[8] which is composed of senior officials from the health, environment, and labour departments. The subcommittee consists of 14 mid-level managers appointed by the ten provinces, the three territories, and Health Canada. Its members are public servants who typically have regulatory experience in water or public health, but operational experience or professional qualifications in the subject are not prerequisites to appointment. The judgments they make are based on scientific evidence about risks to human health, costs, availability of suitable technologies, and the expressed views of the governments they represent. None of these categories is free of important value judgments.

Although the Walkerton Inquiry is a provincial inquiry, the standards in Ontario principally originate in the work of the federal–provincial subcommittee. Therefore, I consider it appropriate to make recommendations about that process.

Recommendation 21: I suggest that the federal–provincial process for proposing drinking water quality guidelines be refined to provide for greater transparency and public participation.

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[7] In 2001, people drinking Vancouver's unfiltered water were warned to boil it, as a precaution, if they were immunocompromised: see British Columbia, Ministry of Health, Health File #56, February 2000, "Weakened immune systems and water-borne infections" <http://www.hlth.gov.bc.ca/hlthfile/hfile56.html> [accessed April 22, 2002].

[8] Federal–Provincial Subcommittee on Drinking Water, 1999, *Canadian Drinking Water Guidelines Development Process* (Ottawa: Health Canada).

In recent years, the work of the subcommittee has become more visible. A Web site posts summaries of its proceedings. It also posts proposed recommendations and the supporting technical evidence for public comment before they are forwarded to the parent committee.[9] Few comments are received, however. Perhaps interested parties do not understand the process or they may not know where to look for the documentation. Possibly they are unsure where, in this multi-stage federal–provincial process, they may intervene most effectively. The subcommittee may need to become more involved in active outreach.

Transparency and public participation can be advanced in several ways. I suggest that all meeting and future research agendas should be published on the Health Canada Web site, as should the full minutes (not summaries) of the subcommittee's meetings. All the risk assessment research done or commissioned by Health Canada for the subcommittee, including copies of toxicological or epidemiological papers prepared as part of the characterization of specific risks, should be freely available through the Web site. Most important, the subcommittee should document and publish the reasons for its recommendations. It should allow for dissenting or minority opinions.

The Web site should include an up-to-date schedule of scientific and regulation-making work, the subcommittee's members' names with their contact information, and requests for comments about substance or process. All the information needed to facilitate efficient and informed participation by the interested public should be freely available.

In that context, when a matter of broad public interest is being considered for regulatory change, interested parties should be encouraged to attend, write, or make submissions. Specifically, academics, consumer and environmental groups, and water industry experts should be invited to attend on an agenda basis. For more controversial issues, the subcommittee should consider asking Health Canada to undertake research on relevant public values and attitudes. Since the standards-setting process is inherently subjective, the subcommittee should consider the values of Canadians in making its decisions and not limit its considerations to science alone.

At present, a 1996 edition of the resulting *Guidelines* is sold to the public in a

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[9] See <www.hc-sc.gc.ca/ehp/ehd/bch/water_quality.htm> and <www.hc-sc.gc.ca/ehp/ehd/bch/water_quality/consult/intro.htm> [accessed April 30, 2002].

print version. The current *Guidelines* should be made available on the Internet, free of charge.[10]

The CEOH receives recommendations from the subcommittee and in due course either passes them or sends them back for reconsideration. It also approves the subcommittee's plans for the technical and scientific work that underlies new guidelines. It is difficult to assess what value this committee brings to the process, since its proceedings are not public and there is no mechanism for public input. The CEOH does not even have a link on the Health Canada Web page. In my view, it should adopt the same procedures urged on its subcommittee in relation to transparency and public participation with respect to its own work on drinking water guidelines. The CEOH's guidance on the agenda, its reasons for accepting proposed guidelines or sending them back for further consideration, and its plans for drinking-water–related work at all levels, including the international level, should be published on the Health Canada Web site.

The first reason for opening the debate, at all levels, is that many of the decisions are inherently value-laden. Even experts do not always agree on what standards should apply.[11] It is important that the full debate on values should be as public as possible and open to comment from those who have an interest.[12] Some people may object that, if the real decisions lie with the provinces, then that is where the public debate should take place. I agree that more openness is needed at the provincial level, but the federal–provincial guidelines to a large extent set the agenda for provincial decisions, and the process establishing those guidelines should therefore be fully open to the public. In this respect, I urge the CEOH to mirror the improved process suggested for the subcommittee.

A second reason for calling for more transparency at the CEOH level is that there is always the chance that the federal government might decide to use the

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[10] A summary table can be found on <www.hc-sc.gc.ca/ehp/ehd/bch/water_quality.htm> [accessed April 30, 2002].

[11] A pioneering work in this regard is M.F. O'Connor, 1973, "The application of multiattribute scaling procedures to the development of indices of water quality," Report 7339 (Chicago: Center for Mathematical Studies in Business and Economics, University of Chicago); cited in R.L. Keeney and H. Raiffa, 1975, *Decisions with Multiple Objectives: Preferences and Value Tradeoffs* (New York: John Wiley & Sons), pp. 431–432. This work, completed the year before the discovery of disinfection by-products, surveys water professionals and identifies 13 attractive attributes of public water supplies, which cannot all be produced at once. There was no consensus on priorities.

[12] Observers have praised the process for developing air standards in Ontario for its transparency and opportunities for public input; this may serve as a useful precedent.

Guidelines as the basis for enforceable regulations within its own domain. Ontarians whose water may be regulated federally should have the opportunity to make their views known regarding the standards to be applied.

Finally, there is a danger that decisions arrived at without public scrutiny tend toward the lowest common denominator. Standards arrived at after public debate are likely to be more demanding and less skewed by any particular interests and more acceptable to the public because of the process.

Recommendation 22: I suggest that the Federal–Provincial Subcommittee on Drinking Water focus on drinking water quality guidelines. I encourage Health Canada to commit the required scientific support to the federal–provincial process for proposing drinking water quality guidelines.

The Federal–Provincial Subcommittee on Drinking Water already has a full agenda in developing water quality guidelines. The structure, and many of the resources, for carrying out the research and analysis for setting water quality guidelines are now in place. There is a substantial benefit in having the subcommittee focus on the primary task for which it was established and for which it is equipped and qualified.

Health Canada provides the secretariat and all the subcommittee expenses, including travel and research, except for the salaries of the provincial and territorial members. The expenses can be significant. In particular, Health Canada provides the toxicological and epidemiological research that is the primary basis for characterizing public health risks. The speed at which the subcommittee can operate is effectively set by the budget that Health Canada is able to provide for this research. Goff Jenkins, the member from Ontario for many years and the chair for a period of five years, told the Inquiry that there is a considerable amount of research requested by the subcommittee that must be continually deferred for budgetary reasons.[13]

The subcommittee reportedly goes to some length to achieve consensus. This means that any of its 14 members can veto, or at least substantially delay, the passage of a particular recommendation for a guideline. Not all provinces and territories share the same pattern of past investments in treatment facilities, and because new recommendations may entail large expenditures, individual

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[13] G. Jenkins, Walkerton Inquiry (Public Hearing, September 11, 2001), transcript pp. 20–21.

provinces and territories have, from time to time, a financial concern that may cause their members not to approve an otherwise desirable guideline. The danger is that the recommendations to the parent committee, the CEOH, may reflect only the views of the jurisdiction that seeks the least protective standards. I have been informed, for instance, that the turbidity standard would be lower but for the fact that several provinces would have to spend a great deal of money on filtration.[14]

Since the content of the *Guidelines* is non-binding and advisory, it is not necessary that unanimity exist for the recommendations to go forward. A simple, or two-thirds, majority should suffice. It is likely that the removal of the effective consensus rule would lessen the ability of a small number of jurisdictions to hold up progress toward a standard otherwise widely anticipated and accepted.

5.3 Where the Canadian *Guidelines* Apply

Recommendation 23: I encourage the federal government to adopt standards that are as stringent as, or more stringent than, Ontario Regulation 459/00 for all federal facilities, Indian reserves, national parks, military installations, and other lands under federal jurisdiction in Ontario.

The final output of the federal–provincial process is called the *Guidelines for Canadian Drinking Water Quality*, published by Health Canada and now in its sixth edition. The *Guidelines* serve as advice to the provinces and territories, and as the objective in some areas of federal jurisdiction. Alberta, Ontario, and Quebec have adopted versions of the *Guidelines* as provincial regulations. In general, the federal government policy is to apply whichever standard is stricter – the *Guidelines* or the provincial regulation or objective – to installations for which it is responsible. These include First Nations, military installations, and national parks.[15] The *Guidelines* are not regulations, however, and thus do not have the force of law: there are no penalties for a failure to comply with them.

Federal officials are obviously aware of the unenforceability of the *Guidelines* in the federal domain. One step in the right direction has been the incorporation by reference of the *Guidelines* MACs in Part IV of the *Canada Labour Code*.

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[14] G. Jenkins, 2002, personal communication.

[15] J. Weiner, Health Canada, and J. Mills, Environment Canada, 2001, letter to H. Swain, Chair, Research Advisory Panel, Walkerton Inquiry, July 5 [Walkerton Inquiry files]. The federal government's policy and its actions sometimes diverge: see letter to H. Swain in Chapter 15.

This does not, however, require the sampling, testing, or reporting of the results, nor does it allow the prosecution of water suppliers who do not meet the quality standards.

It is important that sound and legally enforceable standards exist regardless of which of the two senior levels of government enacts them. Ontario residents drawing drinking water from areas under federal jurisdiction should not have lower standards than do other residents of the province. In this respect, it is important that this new obligation should carry requirements for sampling, testing, and enforcement that are as stringent as, or more stringent than, those standards established from time to time by Ontario regulations.

5.4 The Province's Responsibility to Implement Standards

Recommendation 24: The provincial government should continue to be the government responsible for setting legally binding drinking water quality standards.

Drinking water quality standards should, as they do now, have the force of law. I commented on this matter in the Part 1 report of this Inquiry.[16] Water quality standards should be set, on the initiative of the Minister of the Environment, by the Lieutenant-Governor-in-Council. The guidelines established from time to time by the federal–provincial subcommittee should be used as a starting point for establishing provincial standards.

For many years, as noted, the federal–provincial recommendations became "guidelines" or "objectives" in Ontario and other jurisdictions. Increased administrative flexibility resulted in weak enforcement. An offender could not be prosecuted for a breach of a guideline. In the 1980s, the MOE began to insert the Ontario Drinking Water Objectives (ODWO), as they then were, into Certificates of Approval. In the wake of Walkerton, the provincial government strengthened the process by incorporating the ODWO in Ontario Regulation 459/00. Now, recommendations from the federal–provincial process are scrutinized by the provincial government and, if found fitting, are added by Order-in-Council to the schedule in the regulation.

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[16] Ontario, Ministry of the Attorney General, 2002, *Report of the Walkerton Inquiry, Part 1: The Events of May 2000 and Related Issues* (Toronto: Queen's Printer), pp. 355–358.

A bill before the Senate, S-18,[17] would require the federal government to regulate drinking water quality standards for the whole of Canada. This is not necessary for the protection of drinking water quality in Ontario, where the Ontario government has already established a standard more stringent than exists in the federal *Guidelines*. A federal enactment of this nature would also imply a willingness to establish a federal inspection and enforcement regime or to negotiate the delegation of those functions to the provinces.

Recommendation 25: In setting drinking water quality standards for Ontario, the Minister of the Environment should be advised by an Advisory Council on Standards.

There are two principal reasons for creating this new body.[18] First, it is reasonable for the provincial government to seek expertise from the general public. The general public provides a broad base from which to draw people highly qualified in the many relevant disciplines. Second, there are benefits in terms of transparency and public access through the use of an advisory council.

Members should be Canadians distinguished in the fields of public health, engineering, microbiology, utility operations, and other related areas, and should be appointed by Order-in-Council for overlapping terms. Relevant professional organizations, notably the Ontario Water Works Association, the Ontario Municipal Water Association, the Aboriginal Water Works Association of Ontario, the Ontario Medical Association, and the Association of Local Public Health Agencies, as well as leading non-governmental organizations with a record of interest and accomplishment in areas related to drinking water, should be solicited for nominations.

A predecessor committee, the Advisory Committee on Environmental Standards, was discontinued in 1996. Such bodies, however, are an excellent mechanism for drawing upon expert members of the community at a relatively low cost in terms of the quality of advice that is available.

The advisory council should establish its own process, solicit public views on proposed regulations, be provided with staff support by the MOE, and make appropriate recommendations to the minister. Recommendations should be

[17] Bill S-18, *An Act to Amend the Food and Drugs Act (Clean Drinking Water)*, 1st Sess., 37th Parl., 2001 (1st reading February 20, 2001).

[18] In subsequent chapters, I recommend that the Advisory Council on Standards also advise the minister with respect to management, treatment, testing, materials, and reporting standards.

made public and should be supported by the council's reasons. The advisory council should also provide advice to the MOE and Health Canada on drinking water research requirements; since this advice should be public, the universities and granting councils may also take note, with a consequent effect on the direction of the national research effort.The advisory council should make full use of the *Environmental Bill of Rights, 1993,*[19] and may decide to hold public hearings on matters of broad public concern. Under the *Environmental Bill of Rights*, the MOE operates a Web site where Ontario government agencies can post proposals with significant environmental impacts for public comment.[20]

5.4.1 Ontario Can Initiate as Well as React

Recommendation 26: The Advisory Council on Standards should have the authority to recommend that the provincial government adopt standards for contaminants that are not on the current federal–provincial agenda.

Although the federal–provincial subcommittee's work is important, it need not be the sole source of suggestions. Relevant work by the World Health Organization, the United States Environmental Protection Agency, and other leading authorities may be helpful, as may the work of public interest groups in Ontario. Recently, for instance, the Sierra Legal Defence Fund drew public attention to a less restrictive guideline for TCE (trichloroethylene) in Canada than exists in the United States.[21] This is the type of issue that the advisory council may wish to address.

check TCE

5.5 Contaminants and Current Standards

The standards in Ontario Regulation 459/00 and the hazards posed by the contaminants they limit are worth examining in some detail. In order of decreasing risk to public health, the hazards fall into four groups. Those that can cause acute, serious, and immediate threats to public health are for the most part pathogens, such as viruses, bacteria, and protozoa. There is then a large class of chemicals that adversely affect public health in the case of long-

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[19] S.O. 1993, c. 28, as amended.

[20] See Environmental Registry Postings for Policies, Acts, Regulations, and Instruments at <www.ene.gov.on.ca/envision/env_reg/er/registry.htm> [accessed April 30, 2002].

[21] M. Mittelstaedt, 2002, "Ottawa urged to curb solvent in tap water," *Globe and Mail*, January 16, p. A9.

term exposure: these are called chronic risks. Third are some standards that relate to the efficient operation of water treatment systems themselves, and finally, there are aesthetic standards for otherwise harmless agents affecting taste, odour, and colour.

5.5.1 Standards for Acute (Microbial) Risk

Standards for microbial risk are the most important and the most difficult to establish. Of the uncounted millions of microbes, only a tiny proportion is harmful to humans and other animals. Many, in fact, are conducive to, or compatible with, good health. Science has identified some, but by no means all, of the harmful ones, and evolutionary processes continue to create new ones. These difficulties are compounded by the serious problems of finding and characterizing microbes (see Chapter 8), so a regulatory dilemma appears.

Globally, the contamination of water by pathogenic organisms poses the most significant threat to the health of humans.[22] Several types of organisms may be implicated in the spread of water-borne illness. Viruses, bacteria, and parasites may all cause disease. A common element among many of them is that mammals (including humans) and sometimes birds are the usual source of the contaminants that may cause disease in humans.[23]

5.5.1.1 *Endemic versus Epidemic Levels of Exposure*

Illnesses that result from pathogenic organisms occur at low levels in the population almost continually. The background level of infection of a given pathogen in a population is referred to as the *endemic* rate of infection. The Inquiry heard evidence that endemic levels of exposure to some important pathogens, such as *Giardia* and *Cryptosporidium,* may be due to low-level exposure through drinking water or through other potential pathways, such as contact with pets, contaminated fruits or vegetables, or undercooked meats.

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[22] L. Ritter et al., 2002, "Sources, pathways, and relative risks of contaminants in water," Walkerton Inquiry Commissioned Paper 10.
[23] D. Krewski et al., 2002, "Managing health risks from drinking water," Walkerton Inquiry Commissioned Paper 7, p. 77.

As much as one-third of the endemic level of exposure to enteric bacteria may be due to the low-level contamination of drinking water.[24]

Endemic exposure is with us all the time, but sometimes large populations are exposed to high concentrations of a pathogen all at once. Such exposure results in an *epidemic* – a large number of cases of the same disease occurring in a population at the same time. Walkerton was an epidemic. The recommendations in this report are cast with a view to reducing both endemic and epidemic exposure to pathogens.

5.5.1.2 *Viruses*

Viruses are tiny (typically 0.02–0.3 μm)[25] organisms consisting of little more than a strand of genetic material and a protein shell.[26] They cannot multiply outside a host, but some may survive long periods in the environment if they are provided with appropriate conditions. Any one of more than 140 enteric viruses may infect people through the digestive system. Some of these viruses cause well-known diseases, including hepatitis and meningitis; they also cause generic symptoms such as diarrhea, fever, and heart disease.[27]

There are no standards for viruses.[28] Historically, this has been justified by the small fraction of the uncountable viruses in nature that are harmful, the poorly known pathways and mechanisms by which most have their effect, and the fact that most are even more easily susceptible to chlorine than are bacteria. Among those tested, most, but not all, are easily inactivated with chlorine.

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[24] P. Payment et al., 1991, "A randomized trial to evaluate the risk of gastrointestinal disease due to the consumption of drinking water meeting current microbiological standards," *American Journal of Public Health*, vol. 81, pp. 703–708.

[25] Krewski et al., p. 53.

[26] American Water Works Association, 1999, *Waterborne Pathogens: Manual of Water Supply Practice,* M48 (Denver: American Water Works Association).

[27] Ibid.; Krewski et al., p. 54.

[28] O. Reg. 459/00 does not mention viruses. The companion O. Reg. 505/01, for "smaller water works serving designated facilities," requires the use of filtration and disinfection equipment capable of 4-log removal or inactivation of viruses. It would be better to specify one or more of the relatively resistant pathogenic viruses because "viruses" as a class have varying susceptibility to treatment.

5.5.1.3 *Bacteria*

Bacteria are small (typically 0.5–1.0 μm) single-celled organisms that are nearly ubiquitous on Earth.[29] Natural water systems contain massive communities of bacteria, most of which are free-living environmental bacteria that have no health consequences for humans. A small subset of the bacteria found in source waters may be of mammalian origin, and an even smaller subset of those is potentially pathogenic in humans.[30] Bacteria are responsible for two of the biggest historical threats to public safety through drinking water: typhoid and cholera. Although these diseases have been largely eradicated in the developed world through the disinfection of public water supplies, they are still threats in many parts of the world. However, as occurred in Walkerton, the potential exists for the bacterial contamination of drinking water to cause serious health problems in North America.

The main reservoirs for pathogenic water-borne bacteria are mammals, including humans and farm animals. Pathogenic bacteria are excreted in large numbers in the feces of mammals and work their way into source waters through surface runoff or infiltration. The ecology and health impacts of pathogenic bacteria are well described elsewhere.[31]

The regulatory requirement is that water should receive a minimum level of treatment: disinfection in the case of groundwater, chemically assisted filtration and disinfection in the case of surface water. "Disinfection" is not defined in the regulation. The Ontario Regulation 459/00 standard for pathogenic bacteria is expressed in terms of a treatment requirement if coliform bacteria, especially *E. coli*, are found in samples.[32] In essence, the operator is to increase the chlorine dose until two successive samples show no bacteria.[33]

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[29] Krewski et al., p. 54.

[30] HDR Engineering Inc., 2001, *Handbook of Public Water Systems* (New York: John Wiley & Sons), p. 87.

[31] American Water Works Association, 1999; the Part 1 report of this Inquiry has information on the two species implicated at Walkerton – *E. coli* O157:H7 and *Campylobacter jejuni:* Ontario, Ministry of the Attorney General, 2002, *Report of the Walkerton Inquiry, Part 1: The Events of May 2000 and Related Issues* (Toronto: Queen's Printer), pp. 49–51.

[32] O. Reg. 459/00, as amended, "Drinking water protection: Larger water works."

[33] The following is included in a list of indicators of adverse water quality: "*Escherichia coli (E. coli)* or fecal coliform is detected in any required sample other than a raw water sample. (Corrective action: Increase the chlorine dose and flush the mains to ensure that a total chlorine residual of at least 1.0 mg/L or a free chlorine residual of 0.2 mg/L is achieved at all points in the affected part(s) of the distribution system. Resample and analyze. Corrective action should begin immediately and

The regulation does not oblige the water provider, even as an objective that will guide the treatment requirements, to supply water that is free of pathogenic bacteria. The regulation for small systems is likewise treatment-based but allows for new technologies by saying they must be demonstrably as good as, or better than, chlorine. Operationally, this is specified as 2-log removal or inactivation of viruses if the source is groundwater, or 4-log removal or inactivation of viruses and 3-log removal or inactivation of *Giardia* if the source is surface water.[34] No inactivation limit is set for pathogenic or other bacteria.

Recommendation 27: The Advisory Council on Standards should consider whether to replace the total coliform test with an *E. coli* test.

For a century and a half, the focus of drinking water treatment has been on bacteria. For most of that time, the approach has been to erect defences against bacteria that are known to cause gastrointestinal disease and to assume that viruses and protozoa would be equally well challenged.[35] Bacteria that spent part of their life cycle in mammalian, especially human, gut were the focus.[36] These bacteria were hard to identify, but one, *E. coli*, was a sure indicator of fecal contamination because of its enormous numbers in feces and because it has no non-fecal source.[37] However, for the better part of a century, it was hard to separate *E. coli* from other bacteria, called coliforms, which shared one specific metabolic process. Thus most standards around the world refer to coliform counts, even though there are many coliform bacteria that never pass near, or through, a mammal's intestine. Recently, better tests specific for *E. coli* have become available. It is now cheaper and quicker to measure directly the species

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continue until *E. coli* and fecal coliforms are no longer detected in two consecutive sets of samples or as instructed by the local Medical Officer of Health.)": O. Reg. 459/00, Schedule 6.

[34] O. Reg. 505/01, "Drinking water protection – Smaller water works serving designated facilities," para. 4(3)(b); <http://www.ene.gov.on.ca/envision/WaterReg/Kit/reg505a.pdf> [accessed April 30, 2002].

[35] Authorities have long considered viruses and protozoa, but only recently have the assumptions about kill rates for *Giardia* and *Cryptosporidia* overturned longstanding practices.

[36] Virtually all the organisms that can cause water-borne gastroenteritis in humans – *Salmonella, Shigella, Campylobacter, E. coli,* and so on, as well as parasites such as *Entamoeba, Giardia, Cryptosporidia* and such viruses as hepatitis A – enter water supplies through fecal contamination.

[37] "By the late 1970s, it was established that *E. coli* was specific and abundant in human and animal feces at an average of approximately 10^9 g^{-1}": S.C. Edberg et al., 2000, "*Escherichia coli*: The best biological drinking water indicator for public health protection," *Journal of Applied Microbiology,* vol. 88, p. 109S.

of interest than the broad family of look-alike bacteria, and it is probably appropriate that regulatory standards should follow.[38]

In testing drinking water, the use of indicator organisms of some sort must remain a reality for the foreseeable future. However, the total coliform test is not efficient because of the number of non-fecal sources that can provide total coliform results.[39] This test may nevertheless have some limited value as a means for monitoring the general condition of a distribution system.

5.5.1.4 *Parasites*

Parasites are the largest of the water-borne pathogens and the leading causes of water-borne illness.[40] Most of them are larger than 3 μm in size. To put the sizes of the three types of pathogen in perspective, if viruses were the size of a marble, bacteria would be about the size of a grapefruit, and most parasites would be as big as beach balls. As with viruses and bacteria, mammals are the principal source of parasites of concern. The main parasites in drinking water are the protozoa *Giardia lamblia* (infection that leads to "beaver fever") and *Cryptosporidium parvum;*[41] several other protozoan parasites and some helminth worm eggs may be conveyed through drinking water. Protozoan parasites cause the usual array of gastrointestinal complaints. As with bacteria and viruses, infection in susceptible population groups can have much more serious health consequences.[42]

Parasites can exist outside their host for extended periods of time. Most, like *Giardia* and *Cryptosporidium,* are excreted from their hosts as cysts – dormant organisms with tough walls, which make them resistant to heat, light, and even disinfection by chlorination.

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[38] Edberg et al.; M. Stevens, N. Ashbolt, and D. Cunliffe, 2001, "Microbial indicators of water quality – An NHMRC discussion paper," National Health and Medical Research Council, Canberra <http://www.health.gov.au/nhmrc/advice/microb.pdf> [accessed April 30, 2002]; J.B. Rose and D.J. Grimes, 2001, *Re-evaluation of Microbial Water Quality: Powerful New Tools for Detection and Risk Management* (Washington: American Academy of Microbiology).
[39] Stevens et al.
[40] American Water Works Association, 1999.
[41] HDR Engineering, p. 87.
[42] Krewski et al., pp. 57–59.

Recommendation 28: No formal maximum contaminant level for protozoa should be established until real-time tests are available. The objective, as with bacterial and viral pathogens, should be zero, and the regulations should so state; but the standard should be a treatment standard, specified in terms of log removal dependent on source water quality.

Only the provincial regulation dealing with smaller water systems, Ontario Regulation 505/01, currently says anything about protozoa, and it refers only to *Giardia*. Yet the incidence of gastrointestinal disease from *Cryptosporidium* and *Giardia* is considerable[43] because there is no practical way of detecting these organisms, or of determining their infectivity if detected, in a reasonable period of time. Small numbers – even as few as ten organisms – can give rise to disease, and a given sample from infected water may or may not contain the microbe. False positives and false negatives are prevalent in current testing methods. Even large and sophisticated operations can make serious errors: Milwaukee experienced an estimated 370,000 cases of cryptosporidiosis in 1993 (initial false negative).[44] Sydney, Australia, spent $50 million battling an epidemic that many experts now believe was merely a monitoring mistake – a series of false positives[45] – and Thunder Bay issued a boil water advisory on the basis of one report of one *Giardia* cyst in treated water.[46]

The United Kingdom has experienced a number of localized outbreaks of cryptosporidiosis, most recently in 1995 and 1997. In the aftermath of privatization, drought, and a failed legal proceeding, the United Kingdom enacted new legislation. Utilities, and their managements and directors, now face the possibility of criminal sanctions if they permit *Cryptosporidium* to contaminate the water system. The U.K. Drinking Water Inspectorate claims that its continuous and risk-based sampling techniques are workable and that storing the sampled water until the lab tests are done can obviate the risk of people drinking contaminated water while testing goes on. Many on this side

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[43] P. Payment, 1999, "Poor efficacy of residual chlorine disinfectant in drinking water to inactivate waterborne pathogens in distribution systems," *Canadian Journal of Microbiology*, vol. 45, pp. 709–715; Payment et al., 1991.
[44] N.J. Hoxie et al., 1997, "Cryptosporidiosis-associated mortality following a massive waterborne outbreak in Milwaukee, Wisconsin," *American Journal of Public Health*, vol. 87, no. 12, pp. 2032–2035; various authors, 1993, "Fatal neglect," *Milwaukee Journal* (special reprint), September 19–26.
[45] J.L. Clancy, 2000, "Sydney's 1998 water quality crisis," *Journal of the American Water Works Association*, vol. 92, no. 3, pp. 55–66.
[46] D.W. Scott, 2002, letter to the Walkerton Inquiry, January 30.

of the Atlantic are skeptical, and a debate continues.[47] In North America, the weight of professional opinion is that the best safeguard against *Cryptosporidium* is provided by filtration rather than direct measurement. This relatively large (>4 μm, for the most part) parasite can be removed through chemically assisted filtration or through the use of membrane filters. More recently, its susceptibility to ultraviolet radiation has led to new treatment possibilities. For the present at least, the preferable approach is that the standard for *Cryptosporidium* should be based upon validated performance criteria for an effective treatment method, rather than specifying the unmeasurable absence of this particular microbe.

5.5.2 Standards for Chronic Risks

An enormous array of chemicals may be present in drinking water sources. Metals such as lead, cadmium, or chromium; organics including benzene, toluene, vinyl chloride, pesticides, herbicides, and some pharmaceuticals; radiological contaminants like radon or uranium; and even the by-products of drinking water disinfection may all be present to one degree or another. Possible sources include industry, landfills, urban runoff, sewage disposal, agriculture, atmospheric transport, and nature itself: cyanotoxin, for example, is produced by blue-green algae. Ontario Regulation 459/00 specifies maximum acceptable concentration (MAC) levels for 54 chemicals, 14 natural radionuclides, and 64 artificial radionuclides. In addition, there are interim maximum acceptable concentrations (IMACs) for another 22 chemicals. Appendix A to this report compares the limits specified in Ontario Regulation 459/00 with those in the federal-provincial *Guidelines* and the standards set by the U.S. Environmental Protection Agency, Australia, and the World Health Organization.

This Inquiry commissioned a team from the Canadian Network of Centres of Excellence in Toxicology to report on the relative risks of various types of potentially toxic contaminants in Ontario drinking water generally.[48] The brief was to quantify, as best as available data allow, the relative risks associated with

[47] At the AWWA annual meeting in June 2001, Michael Rouse, the head of the Drinking Water Inspectorate, defended his position stoutly. He claimed that continuous filter sampling of risky sources, strict chain of control, interim storage, and regulation-induced diligence on the part of privatized utilities had effectively eliminated *Cryptosporidium* from U.K. drinking water, and it was therefore sensible to have a regulation banning the microbe. British water providers also rely on filtration.

[48] L. Ritter et al. There are, of course, specific local contamination concerns, such as the NDMA problem at Elmira, Ontario, which was discussed at the town hall meeting in Kitchener-Waterloo on March 22, 2001.

toxic contaminants that have had demonstrated or potential effects on human health through exposure from drinking water. Some chemicals ranked low on the risk scale simply because scientific information was lacking. Those most likely to repay investment in further research were nitrates and the pesticide atrazine in rural drinking water wells, and lead and disinfection by-products in municipal systems. An expert meeting in April 2001 added fluoride, water treatment chemicals, endocrine-disrupting substances, and pharmaceuticals to the list as chemicals that should receive closer scrutiny.

The current levels are set on the basis of tests of elevated levels of the contaminant in question on laboratory animals – usually rats or mice that have been selected to be especially susceptible to possible effects. A level at which there is no observable adverse effect is determined. At this point, safety factors are entered: an order of magnitude (factor of ten) for interspecies differences in susceptibility, a correction for body mass, perhaps another order of magnitude to ensure that especially susceptible humans are not affected, and so forth. For carcinogenic chemicals, the aim is to strike a standard that would assure less than one statistically expected additional case in a population of 100,000 over a lifetime, a level below the capacity of epidemiological analysis to measure. The final recommendation for a MAC is thus usually explicitly precautionary. Nevertheless, new research sometimes results in a need to rethink a standard, and there will be substances for which, because of scientific uncertainty, further precaution is required.

5.5.2.1 *Chemical Hazards*

Arsenic: A case in point is the current controversy in the United States over arsenic.[49] The old standard, 50 parts per billion (ppb), was a rough rule of thumb struck in 1942 by the U.S. Public Health Service. In recent years, concerns have arisen that the standard is too lax. Congress asked the U.S. Environmental Protection Agency to take action, and the National Academy of Sciences was asked to provide advice. Its view was that a lower level was justified. The controversy was over how low: 20, 10, 5, and 3 ppb were all suggested. The outgoing administration made 10 ppb the limit in January 2001 – a decision that was suspended by the new administration. After an extensive review, the U.S. Environmental Protection Agency reiterated the 10

[49] "Senate supports tougher arsenic standard" <www.safedrinkingwater.com/alerts/alert080201.htm> [accessed August 2, 2001]. The U.S. Environmental Protection Agency's Web site has exhaustive coverage: see <www.epa.gov/safewater/arsenic.html>.

ppb limit, and the administration confirmed it. An issue arises because the expense of achieving arsenic removal at the lower end of the range is large, and some argue that the expected gain in public health is small.[50] We can expect the Federal–Provincial Subcommittee on Drinking Water to take careful note of the U.S. debate and the scientific evidence underlying it and to propose any necessary change to the Canadian *Guidelines* IMAC level of 25 ppb (0.025 mg/L). Ontario is not known to have arsenic problems, even though arsenic is often a by-product of gold mining and occurs elsewhere in groundwater in Canada. Recent news articles have reported elevated levels of arsenic in groundwater in Saskatchewan and Newfoundland. If the proceedings of the subcommittee and the Advisory Council on Standards are open and accessible, as I recommend, the public will be able to participate in the debate as it sees fit.

Arsenic has dominated the debate on inorganic chemicals in recent years. The debate has been driven by the enormous tragedy of water-borne disease arising from groundwater contaminated with arsenic in Bangladesh[51] and by the U.S. political and regulatory agenda.[52] However, a number of other chemicals are being evaluated on a preventive basis, notably hexavalent chromium, boron, vanadium, radium, cyanide, bromate, and perchlorate. These chemicals are usually present, if at all, only in very small concentrations, which poses difficult engineering questions. Ion exchange methods and enhanced membrane treatment are the focal points of much current work. The U.S. Environmental Protection Agency has a formal process in which larger water systems screen for the presence of a long list of suspect chemicals.[53]

Lead: Lead in drinking water sources can occur naturally at low levels (up to 0.04mg/L) as a result of geological deposits. This level can be increased as a

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[50] As an example, at the June 2001 American Water Works Association annual meeting in Washington, there was a lively debate between U.S. EPA officials and local utility operators, encapsulated by one small-town water provider from the U.S. Southwest who noted that the agency's then-proposed standard of 5 ppb would require the expenditure of several thousand dollars per household per year to prevent less than one statistically predicted but empirically unmeasurable cancer in 250 years. He said he did not expect his mayor to agree to make the investment. See also F.J. Frost et al., 2002, "Evaluation of costs and benefits of a lower arsenic MCL," *Journal of the American Water Works Association*, vol. 94, no. 3, pp. 71–80.

[51] The Bangladesh–West Bengal case of naturally occurring arsenic in groundwater is extensively covered on the Internet. See, for example, <www.angelfire.com/ak/medinet.arsenic.html>, <www.unicef.org/arsenic>, and <phys4.Harvard.edu/~wilson/arsenic_project_main.html>.

[52] National Research Council, Subcommittee on Arsenic in Drinking Water, 1999, *Arsenic in Drinking Water* (Washington, DC: National Academy Press), c. 4.

[53] United States Environmental Protection Agency, 2001, "Reference guide for the unregulated contaminant monitoring regulation," EPA 815-R-01-023 (Washington, DC).

result of activities such as mining.[54] However, the principal source of lead in drinking water is lead in the distribution system. Lead piping used to be a common component of drinking water systems, and in many older systems today there remain some lead components. Lead is also much more soluble in soft water than in hard. It is therefore not surprising that there are some instances of elevated lead concentrations in distributed drinking water in Ontario.

Acute effects from lead exposure are rare. Its toxicity almost always occurs as a result of chronic exposure. The effects include a wide variety of physiological complications, including cognitive difficulties, kidney dysfunction, anemia, reproductive problems, and delayed neurological and physiological development. The U.S. Environmental Protection Agency classifies lead as a probable human carcinogen,[55] although a 1982 study by the U.S. National Academy of Sciences[56] concluded there was little evidence of carcinogenicity, mutagenicity, or teratogenicity. The effects of lead are particularly serious in children, where exposure can lead to mental retardation or death. Most exposure to lead, however, occurs through ambient air and food.[57]

Nitrates: Nitrates are found in concentrations exceeding the levels specified in Ontario Regulation 459/00 in many wells in rural Ontario. One study indicated that 14% of Ontario's rural wells contain nitrates in concentrations exceeding the MAC set out in the regulation.[58] Nitrates are also found in treated municipal water, but they rarely exceed provincial standards.[59]

The principal sources of nitrates in water are runoff from fertilized agricultural lands, feedlots, municipal and industrial waste discharges, landfill leachate, and decaying vegetation.[60] Nitrates normally occur in concentrations of less than 2 mg/L in surface water and of up to 20 mg/L in groundwater. They may be found in much higher concentrations in shallow aquifers polluted by sewage

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[54] United States Environmental Protection Agency, 2001.
[55] J. DeZuane, 1997; *Handbook of Drinking Water Quality*, 2nd ed. (New York: John Wiley & Sons), p. 80.
[56] DeZuane, p. 83.
[57] Ibid.
[58] M.J. Goss, D.A.J. Barry, and D.L. Rudolph, 1998, "Contamination in Ontario farmstead domestic wells and its association with agriculture: 1. Results from drinking water wells," *Journal of Contaminant Hydrology*, vol. 32, pp. 267–293; cited in Ritter et al., p. 85.
[59] Ritter et al., p. 69.
[60] HDR Engineering, p. 47.

or the intensive use of fertilizers.[61] Nitrates are highly soluble in water and, as such, are not filtered out as water percolates through the ground.

Nitrate contamination above the regulation's limit of 10 mg/L is most common in agricultural areas,[62] and the presence of nitrates in groundwater is an important indicator of potential contamination from agricultural sources.

Although nitrates do not directly affect human health, they are rapidly reduced to nitrites in the gastrointestinal tract. Nitrites then bind with hemoglobin, the oxygen-carrying molecule of the blood, converting it to methemoglobin, which is not capable of carrying oxygen. In adults this does not appear to have any significant effect, but methemoglobinemia can cause serious problems in young children and lead to "blue baby syndrome," a potentially fatal condition. The difference in susceptibility may be due either to the small amount of nitrate consumed relative to body weight in adults[63] or to the fact that children under three years of age convert all ingested nitrates to nitrites in the gastrointestinal tract, whereas older people convert only about 10%.[64] There is also some indication that nitrates in high concentrations may react with other substances to create potentially carcinogenic compounds (notably nitrosamines), although the U.S. Environmental Protection Agency, one of the leading agencies examining issues of this nature, has yet to make any determination in this matter.

Fluorides: Fluorides are found in fertilizers, chemicals, and aluminum smelting, coal burning, and nuclear power plants.[65] The Federal–Provincial Subcommittee on Drinking Water revisited its guideline in 1996. Two health conditions are associated with excess fluoride. Fluorosis mottles young teeth and, in severe cases, results in enamel erosion and tooth pain, which can impair chewing. Long-term exposure to fluorides may result in skeletal fluorosis, a progressive disease in which bone density increases. Bones become more brittle and joints may stiffen, leading to reduced mobility and skeletal deformation in extreme cases.[66]

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[61] DeZuane, p. 89.
[62] M.J. Goss et al., 2002, "The management of manure in Ontario with respect to water quality," Walkerton Inquiry Commissioned Paper 6, p. 9.
[63] HDR Engineering, pp. 47–48.
[64] DeZuane, p. 89.
[65] Health Canada, "It's your health: Fluorides and human health" <http://www.hc-sc.gc.ca/english/iyh/fluorides.html> [accessed April 30, 2002]; G. Glasser, "Fluorine pollution" <http://home.att.net/~gtigerclaw/fluorine_pollution.html> [accessed April 30, 2002].
[66] Health Canada.

There is a long-standing debate over the fluoridation of water.[67] Most water providers in Ontario add fluoride, where necessary, to maintain the regulation's recommended level of 1.0 ± 0.2 mg/L, "the optimum level for control of tooth decay."[68]

Chemicals Used in Water Treatment: The chemicals used in water treatment (see Chapter 6) can, in large enough quantities, cause health problems of their own. Regulations, and standards such as those set by the U.S. National Sanitation Foundation, provide for the maintenance of chemical doses below adverse health levels. However, accidents happen: in 1998 in Camelford, Cornwall, United Kingdom, 20 tonnes of aluminium sulphate were accidentally dumped into the wrong tank at a treatment works. The consumption of contaminated water affected 20,000 households; the effects ranged from mouth ulcers to vomiting and rashes.[69]

5.5.2.2 *Disinfection By-products*

The chemicals added to water for disinfection can form disinfection by-products (DBPs). Chlorine may react with dissolved organic material in water to form trihalomethanes (THMs) and haloacetic acids.[70] At high-dose levels, some of these chemicals, when fed to mice that are bred to develop cancers easily, are carcinogenic. Clearly, DBPs should be minimized in finished water; equally clearly, doing without disinfection to prevent the occurrence of DBPs is substituting an acute risk for a relatively remote, chronic risk. The Peruvian tragedy of 1991, when officials reduced disinfection in a manner that may have contributed to infecting 320,000 people with cholera, which resulted in 3,000 deaths, shows the importance of keeping risks in proper perspective.[71] The balance of evidence is that Ontario standards for THMs have been set at

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[67] Two examples of the opposing views of fluoridation are at <http://www.fluoridation.com> and <http://www.all-natural.com/fleffect.html>.

[68] O. Reg. 459/00, Schedule 4, note b.

[69] A draft report from the committee investigating the incident is due in 2002: <http://news.bbc.co.uk/hi/english/uk/newsid_1490000/1490142.stm> [accessed April 30, 2002].

[70] Canada, Department of National Health and Welfare, Environmental Health Directorate, Health Protection Branch, 1995, *A National Survey of Chlorinated Disinfection By-Products in Canadian Drinking Water* (Ottawa, Supply and Services Canada), p. 7. See <http://www.hc-sc.gc.ca/ehp/ehd/catalogue/bch_pubs/95ehd197.htm> [accessed April 30, 2002].

[71] C. Anderson, 1991, "Cholera epidemic traced to risk miscalculation," *Nature*, vol. 354, November 28; Pan American Health Organization, 2002, *Cholera: Number of Cases and Deaths in the Americas (1991–2001)* (Washington, DC).

quite safe levels,[72] but the human health effects of other DBPs have yet to be assessed.

In addition to a review of old standards on the basis of new evidence, there is a need to provide a first round of examination for many chemicals, particularly when a standard has been struck on the basis of the precautionary principle, in advance of experimental evidence. Cases in point include bromate, aluminum, and uranium. Ontario should contribute to the national effort, and the Ministry of the Environment (MOE) laboratory, in particular, should have as one of its missions the ability to provide authoritative advice to the provincial government on the scientific basis for standards setting.

A greater level of research effort should be devoted to DBPs of all sorts, not just those arising from chlorination. The economies of scale are considerable, however, and the effort would make the most sense if it were mounted cooperatively by many nations. Human susceptibility to toxic substances is similar everywhere. Canadians need both to contribute to the worldwide effort and to keep fully abreast of the work of others. Given the magnitude of the issue, I am of the view that Canada's contribution is best coordinated by Health Canada, working together with international bodies, leading institutions in other countries, the granting councils, the National Research Council, and the provinces. Not all provinces have the resources to be much more than consumers of this research, but this is certainly not the case with Ontario.

5.5.2.3 *Radiological Hazards*

Most countries specify maximum acceptable concentrations of contaminants or their equivalent in terms of an aggregate radiation exposure. Ontario, following the model of the federal-provincial *Guidelines*, specifies individual limits for a large number of natural and manufactured radionuclides as well as an aggregate limit. See Appendix A to this report.

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[72] S.E. Hrudey, 1999, *Assessment of Human Health Risks in Relation to Exposure to THMs in Drinking Water* (Toronto: Pollution Probe).

5.5.3 Operational Standards

A third group of standards is related to treatment and distribution techniques. For obvious engineering reasons, water should not corrode the materials through which it flows. It should be neither too acidic nor too alkaline. It should not be so efficient an electrolyte that it promotes unwanted galvanic reactions among the metals used in water treatment and distribution systems.

Recommendation 29: The provincial government should seek the advice of the Advisory Council on Standards regarding the desirability of a turbidity limit that is lower than the limit specified in the federal–provincial *Guidelines*.

Turbidity is important because microbes can shelter themselves on, within, or behind (in the case of ultraviolet radiation disinfection) suspended particles. Moreover, to the degree that the particles have an organic origin, their downstream reaction with chlorine will not only reduce the chlorine residual but may also produce unacceptable levels of DBPs. The current standard of 1 NTU[73] is an example of the Federal–Provincial Subcommittee on Drinking Water lagging behind good practice among the better water providers, most of whom now routinely produce water at 0.3 NTU or better. Turbidity by itself has little meaning for public health. Rather, it is the consequences of turbidity that are worrisome: the lower the level, the better.

5.5.4 Aesthetic Standards

Finally, there are purely aesthetic standards. People prefer to avoid the smells associated with summer algal blooms or the tea colour of tannic northern waters. Thus, standards are set for taste, odour, and colour. These standards are not without importance from a public health standpoint: if their tap water is unappealing, people may turn to other, less secure, sources, with consequent increases in public health risk. Furthermore, aesthetic problems can indicate other water quality problems. Foul water is never acceptable.

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[73] "Nephelometric turbidity unit: A unit for expressing the cloudiness (turbidity) of a sample," in J.M. Symons, L.C. Bradley, Jr., and T.C. Cleveland, 2000, *The Drinking Water Dictionary* (Denver: American Water Works Association), p. 495.

5.5.5 Problems in Setting Standards

In the case of drinking water safety, the pure model for setting standards implies that relationships between the amount of exposure to a drinking water contaminant (the dose) and the illness caused (the response) are known. In practice, a number of problems arise; the following are two examples.[74] First, the necessary experiments must usually be performed with animal models, but the differences between these laboratory species and humans can, and have been shown to, lead to wrong conclusions about whether a given contaminant can actually cause a given disease. For instance, chloroform in drinking water is no longer regarded by experts to be a serious cancer risk, after almost 25 years of suspicion.[75] There are also contaminants that distress humans but not the animal models.[76] Second, the laboratory animals must be exposed to high doses of contaminants to ensure that some measurable response (to be used to estimate risk) will occur with a reasonable number of experimental animals. An experimental population of 100 animals at each exposure level, for instance, can only reveal a risk of 1 in 100 or more. Attaining a high degree of statistical certainty may require unrealistically large sample populations when the contaminant is rare or the effect small. Thus the laboratory budget decision itself is an expression of relative values.

These features of dose-response determination inevitably introduce major uncertainties. Obvious ethical considerations preclude deliberate human testing,[77] although epidemiological evidence and accident case histories are sometimes able to provide key inferences about human health risk. An even more serious problem arises when the existence of a causal relationship between exposure and health is unknown – when uncertainty about causation itself

[74] D. Hattis and D. Kennedy, 1986, "Assessing risks from health hazards: An imperfect science," *Technology Review*, May/June, pp. 60–71.

[75] F. Pontius, 2000, "Chloroform: Science, policy and politics," *Journal of the American Water Works Association*, vol. 92, no. 5, p. 12.

[76] Odours and other sensory irritants can be severe sources of human distress, for example, but cannot be assessed by any animal models.

[77] The U.S. Environmental Protection Agency was recently criticized for proposing the use of human experiments in setting pesticide limits. Manufacturers who felt that these more accurate tests would allow higher pesticide doses favoured the move. The agency sent the matter to the National Academy of Science for a report on the ethical and scientific issues involved (*New York Times*, December 15, 2001). Human experimentation is not allowed for these purposes in Canada; drinking water standards will continue to be set by using animal models.

makes uncertainty about the form of the dose-response function pale in comparison.[78]

5.6 Emerging Issues

Ontario has no established system for examining candidates for regulation and does not mention the standard-setting process on its Web site. However, both the Federal–Provincial Subcommittee on Drinking Water and the U.S. Environmental Protection Agency publish priority lists of contaminants that are candidates for regulation.[79] Ontario does, however, have a monitoring program that can help to identify emerging issues. The Drinking Water Surveillance Program (DWSP), undertaken by the MOE Environmental Monitoring and Reporting Branch, Environmental Science and Standards Division, monitors trends and contaminant levels for a wide variety of parameters, improving our knowledge of new contaminants and supporting standards and policy development. The program is not mandatory, but as of 1997, it consisted of 145 municipal waterworks, serving 88% of the population.[80]

5.6.1 New Pathogens

New pathogens arise from time to time. Sometimes a microbe is discovered that has been quietly making people ill for a long time; at other times, a mutant form of an organism emerges. Microbes are continually evolving, just as humans and other animals are continually developing antibodies and other defences against them.[81] Some scientists view the O157:H7 strain of *E. coli* as biologically novel. Cyanobacterial and algal toxins are beginning to receive attention. There is little to be said about this as a matter of public policy, except to emphasize the necessity for a robust, long-term research effort.

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[78] S.E. Hrudey, 1998, "Quantitative cancer risk assessment: Pitfalls and progress," *Issues in Environmental Science and Technology,* vol. 9, pp. 57–90.

[79] See <www.hc-sc.gc.ca/ehp/ehd/bch/water_quality/priority_lst.htm>; <www.epa.gov/safewater/ccl/cclfs.html> [accessed April 30, 2002].

[80] Krewski et al., p. 8.

[81] J. Diamond, 1997, *Guns, Germs and Steel* (New York: Norton); T. McMichael, 2001, *Human Frontiers, Environments and Disease: Past Patterns, Uncertain Futures* (Cambridge: Cambridge University Press). The latter is reviewed in D. Morens, 2001, "Certain diseases, uncertain explanations," *Science*, vol. 294, p. 1658.

Treatment for protozoan pathogens has been a major topic of professional debate in the past few years. This will likely continue. There will be more discussion of water-borne viruses, which as a group are poorly understood. More research is needed, not only to understand the risks they pose to people, but also to gain basic information about their sources and persistence in raw and finished waters.

5.6.2 Chemicals

The case of arsenic has been discussed above. Other chemicals that bear a closer degree of scrutiny for possible regulatory action as drinking water constituents are water-soluble pesticides and herbicides, certain industrial chemicals, nitrates (especially in agricultural areas), and the large family of chemicals, including human and veterinary antibiotics and other pharmaceuticals, that may disrupt endocrine systems in humans and other animals, in addition to other public health concerns.

5.6.2.1 *Pesticides and Herbicides*

Pesticides and herbicides are regulated by Health Canada's Pest Management Regulatory Agency, which follows the classic process of testing the substances on laboratory animals and establishing a human threshold at least an order of magnitude lower than the level at which no effects are observed in the test animals. Some pesticides and herbicides are long-lived and accumulate in the body – a substantial reason for great care. On the other hand, the worst culprits, the bioaccumulative ones, appear to be dangerous precisely because they are soluble in fats and nerve tissue and only sparingly or not at all soluble in water. The likelihood is that Canadians are more exposed to these chemicals directly and through food than through water supplies.

The only pesticide identified by one study as being a potential problem in Ontario drinking water was atrazine, detected "in 6.6 and 10.5% of approximately 1,300 domestic wells sampled in the winter and summer respectively" of Ontario farm wells surveyed in 1998.[82] This is a small number, but it indicates that atrazine may be a health risk in some parts of Ontario.

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[82] Goss et al., 1998, cited in Ritter et al., 2002, p. 74.

Atrazine is a herbicide commonly used on corn and soybeans. The effects of chronic exposure to atrazine are not well documented.[83] However, the U.S. Environmental Protection Agency

> has found atrazine to potentially cause the following health effects when people are exposed to it at levels above the MCL [3 ppb] for relatively short periods of time: congestion of heart, lungs and kidneys; low blood pressure; muscle spasms; weight loss; damage to adrenal glands ... Atrazine has the potential to cause the following effects from a lifetime exposure at levels above the MCL: weight loss, cardiovascular damage, retinal and some muscle degeneration; cancer.[84]

The interim maximum acceptable concentration for atrazine in Ontario is 0.005 mg/L (5 ppb).

5.6.2.2 *Industrial Chemicals*

There is a wide range of industrial chemicals about which relatively little is known, at least insofar as these chemicals may be delivered in water. Lipid-soluble chemicals are not the first concern for water systems for the reasons mentioned above, but chemicals such as NDMA (nitrosodimethylamine),[85] TCE (tetrachloroethylene, used for drycleaning and industrial degreasing), MTBE (methyl-*tert*-butyl-ether, an octane enhancer), and perchlorate (an oxidant for rocket fuels) have all been matters of at least local interest in parts of the United States.[86] The Sierra Legal Defence Fund, as mentioned, has drawn

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[83] DeZuane, pp. 268–269; <http://www.horizononline.com/MSDS_Sheets/968.txt> [accessed April 30, 2002].

[84] United States Environmental Protection Agency, Office of Water, 2002, *Technical Factsheet on Atrazine,* National Primary Drinking Water Regulation, Washington, DC <www.epa.gov/safewater/dwh/t-soc/atrazine.html> [accessed April 30, 2002].

[85] For NDMA, Ontario sets an IMAC of 0.000009 mg/L. NDMA is not mentioned in the federal–provincial *Guidelines,* which illustrates why Ontario needs its own expertise in risk assessment: NDMA is a serious, although localized, matter.

[86] The U.S. EPA's Unregulated Contaminant Monitoring Regulation requires large utilities to assist in identifying candidates for future regulation by screening three lists of possible contaminants. The difference among the lists is the degree to which analytic methods have been developed. United States Environmental Protection Agency, 2001, *Reference Guide for the Unregulated Contaminants Monitoring Regulation,* 815-R-01-023 (Washington, DC: Environmental Protection Agency), s. 1.2.

attention to TCE in the Ottawa River and to the existence of a less restrictive guideline for TCE in Canada than in the United States. The *Guidelines* do not currently have a maximum acceptable concentration for NDMA, MTBE, or perchlorate, but Ontario has an interim maximum acceptable concentration of 0.000009 mg/L for NDMA, and MTBE is on the current priority list for development of a federal–provincial guideline. TCE is subject to a maximum acceptable concentration of 0.05 mg/L in Ontario, but the World Health Organization and the United States have not yet developed a standard. Although rocket fuel intrusions into groundwater are unlikely to become a Canadian concern, the other chemicals may occur in specific locations in Ontario. Elmira, Ontario, is the unfortunate locus of serious groundwater pollution by industrial NDMA, which is water-soluble, able to penetrate skin, and known to be carcinogenic at extremely low doses.[87]

5.6.2.3 *Endocrine-Disrupting Substances*

A large and ill-defined class of pharmaceutical and other chemicals are suspected of disrupting animal endocrine systems.[88] The endocrine system consists of glands and organs that release chemical messages in the form of hormones to other parts of the body. These glands and hormones are fundamental to growth, reproduction, and behaviour. Endocrine-disrupting substances (EDS) either prevent the hormone from being released, block the hormone receptor in a cell, or mimic the hormone. These "could lead to irreversible effects in the organism or its offspring."[89] Some of these chemicals (e.g., the artificial estrogens in birth control pills) pass untransformed through the human body and are not destroyed or sequestered in sewage treatment systems. They thus pass into rivers, lakes, and ultimately oceans. There is some suspicion among fisheries

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[87] S. Bryant, Walkerton Inquiry (Kitchener-Waterloo Town Hall Meeting, March 22, 2001), transcript pp. 197–199; see also E.O. Frind, D.L Rudolph, and J.W. Molson, 2001, "The case for groundwater protection in Ontario: Results of the workshop held at the University of Waterloo, May 1, 2001 – A contribution to the Walkerton Inquiry, Phase II," Walkerton Inquiry Submission.
[88] United States National Academy of Sciences, *Hormonally Active Agents in the Environment* (Washington, DC). See also <www.emcom.ca>, a service of the Institute for Population Health at the University of Ottawa. A recent workshop surveyed the state of research in the United States: P. Weyer, G. Parkin, and D. Riley, 2001, *Endocrine Disruptors and Pharmaceuticals in Drinking Water,* Project 2598 (Denver: American Water Works Association Research Foundation).
[89] M. Servos, G.J. Van Der Kraak, and M. Wade, 2001, "Introductory remarks: Scientific assessment of endocrine disrupting substances in the Canadian environment," *Water Quality Research Journal of Canada*, vol. 36, no. 2, p. 171 (a special issue of the journal dedicated to EDS in Canada).

and aquatic ecosystem scientists that these chemicals, even in minuscule doses, may cause reproductive anomalies in fish.

There are probably tens of thousands of EDS, or hormonally active agents, as the U.S. National Research Council calls them.[90] Some of these are well-known persistent organic chemicals. Although maximum contaminant levels have been established in the United States for several suspected EDS,[91] problems exist on several levels. Some EDS are difficult to detect at the levels required to produce adverse results. Also, their effects in the human body are slow and might not be manifested in the affected individual but in that individual's offspring, and perhaps not until the offspring mature. This slow emergence of symptoms makes the collection of scientific evidence about EDS difficult.

To date, research has mainly focused on estrogen look-alikes. Current research is concentrating on how individual substances might affect various hormonal relationships. This research is being undertaken globally. In Canada, a federal working group has been established whose terms of reference instruct it to "identify knowledge gaps from a Canadian perspective, and anticipate international developments that may influence Canadian policy."[92]

Endocrine-disrupting substances and links with human health will continue to be an area of research, both with regard to the environment as a whole and in the water industry in particular.[93] Water providers must keep up with scientific research and disseminate this information among their employees. Potential risks and treatment should be evaluated on an individual plant basis, as techniques to monitor and remove the substances are developed. Furthermore, treatment plants must communicate with the public regarding both the potential risks and the measures being implemented to mitigate them.[94]

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[90] United States National Research Council, Committee on Hormonally Active Agents in the Environment, 2000, *Hormonally Active Agents in the Environment* (Washington, DC: National Academy Press), c. 2.

[91] American Water Works Association, 2000, *Endocrine Disruptors* <http://www.awwa.org/endocrine> [accessed April 29, 2001].

[92] M. Servos et al., 2001, "A Canadian perspective on endocrine disrupting substances in the environment," *Water Quality Research Journal of Canada*, vol. 36, no. 2, p. 331.

[93] Foundation for Water Research, 1999, *Exposure to Endocrine Disruptors Via Materials in Contact with Drinking Water*, Report No. DWI0809 <http://www.fwr.org/> [accessed May 3, 2002].

[94] R. Rhodes Trussell, 2001, "Endocrine disruptors and the water industry," *Journal of the American Water Works Association*, vol. 93, no. 2, pp. 58–65.

5.7 Standards Setting in Some Other Countries

The Australian Productivity Commission has most helpfully published a detailed comparison of standards-setting processes in Australia, the United States, Canada, New Zealand, England and Wales, France, and the European Union.[95] Following is a summary of some features that may be relevant to the discussion in Ontario.

5.7.1 United States

Drinking water standards are established as part of the *Safe Drinking Water Act*.[96] The standards apply to public water systems that have a minimum of 15 service connections or that supply more than 25 people. The U.S. Environmental Protection Agency is responsible for establishing and implementing these standards, although implementation is usually devolved to the tribal or state level, often with the agency's financial assistance.

Standards can be primary or secondary: primary standards are legally enforceable, whereas secondary standards are a guideline for aesthetic effects that can be made legally enforceable at the state level, if required. Primary standards are applied to contaminants with known or suspected adverse health effects. They may be based on a maximum concentration limit (MCL) approach or a treatment technique approach. They come into effect three to five years after being established. The United States has almost completed a new codification of its primary surface water standard, the Long-Term Stage 2 Enhanced Surface Water Treatment Rule, which will come into effect over the next several years.[97]

Before a standard is set, water problems are identified and prioritized. Substances are identified in a National Drinking Water Contaminant Candidate List (CCL), last published in 1998. On a five-year cycle, substances are prioritized, and five substances are examined in detail to see whether they warrant a primary standard; if so, a standard is drafted. The standard is based on scientific evidence

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[95] Australia, Productivity Commission, 2000 <www.pc.gov.au/research/benchmrk/drink> [accessed April 30, 2002]. For the World Health Organization, the United States, and the state of New York, see DeZuane.

[96] See <www.epa.gov/OGWDW/sdwa/sdwa.html> [accessed April 30, 2002].

[97] M.A. Scharfenaker, 2002, "Draft LT2ESWTR out of the box," *Journal of the American Water Works Association*, vol. 94, no. 2, pp. 24–37.

as well as a broad technological assessment that includes the presence of the contaminant in the environment, risk assessment, detection technology, and removal feasibility, as well as the impacts of the standard and variations of it on health, utilities, and the economy. Within each five-year cycle, 30 unregulated contaminants are identified for monitoring by systems that serve more than 100,000 people. At the end of the cycle, the CCL is updated. Meanwhile, on a six-year cycle, existing standards are revisited and updated as necessary.

A maximum contaminant level goal (MCLG) is established by the U.S. Environmental Protection Agency (U.S. EPA) as an unenforceable guideline. This is the level at which health effects do not, or are not expected to, occur. Since the MCLG is based purely on health, it does not always coincide with technical feasibility. In these cases, the MCL is established as close to the MCLG as possible. If the MCLG is unattainable, a treatment technique standard may be established.

Once a standard has been drafted, an economic analysis is undertaken to ensure that the benefits justify the costs. A standard can be adjusted for certain system types so that the costs are justified by the risk reduction benefits. For all standards except microbial, variances can be granted to systems serving fewer than 3,300 people at a state level, if they cannot afford to comply with a rule and if they install U.S. EPA-approved technology to minimize risks. A state can grant variances to systems serving up to 10,000 people with U.S. EPA approval. Exemption periods from standards can also be granted to find alternative funding sources, but at the end of the period, the system is expected to be in full compliance. There is an obligation for the U.S. EPA, particularly in the case of small systems, to identify point-of-use or point-of-entry and low-cost options, such as modular systems, to attain standards. The U.S. EPA has a duty to identify affordable technologies that reduce contaminant levels and protect public health.

Public input is solicited throughout the standards-setting process. A key platform for this is the National Drinking Water Advisory Council.[98] Public participation is solicited at public meetings and through comments on postings on the Federal

[98] A 15-member committee consisting of five members of the general public, five representatives from private organizations concerned with water hygiene and supply, and five representatives from state and local agencies. Two of the representatives for private organizations have to represent rural systems. The council was formed under the *Safe Drinking Water Act* and advises the U.S. EPA on all matters relating to drinking water: National Drinking Water Advisory Council <http://www.epa.gov/safewater/ndwac/charter.html> [accessed April 30, 2002].

Register. Special meetings are held to obtain input from specific target groups, such as small businesses, minority groups, and low-income communities.

The U.S. system of full public disclosure and wide-open debate, mandated under law, can be studied by Ontarians who are interested in continuously improving standards and performance.

5.7.2 England and Wales

The European Union (EU) has incorporated World Health Organization guidelines into its *Drinking Water Directive 98/83/EC.* Enforcement is through national legislation, which must be established by a certain compliance date. In the United Kingdom, standards beyond those dictated by the EU are developed under the *Water Industry Act* (1991). A regulatory impact statement is required for standards other than those directed by the EU, as in the case for *Cryptosporidium.*

Britain's unique *Cryptosporidium* legislation arose at least in part from a failed legal proceeding (see section 5.5.1.4 of this report). In 1995, about 600 people in a town in South Devon were infected with water-borne *Cryptosporidium.* The Drinking Water Inspectorate prosecuted the water company for the event but was unsuccessful: epidemiological evidence was deemed hearsay. The *Cryptosporidium* legislation came into force in 1999 as the Water Supply (Water Quality) (Amendment) Regulations.[99] Operating agencies must perform a *Cryptosporidium* risk analysis, and if they are found to be at risk, the companies must implement a stringent monitoring program that demands continuous sampling via inline filters. Treated water cannot contain more than 1 oöcyst in 10 L of water. Failing to meet this standard is considered a criminal offence.

This is an interesting approach, but not one I would recommend for Ontario. The standards required for criminal prosecution imply extremely low levels of measurement error and a large investment in documentation, chain of custody, and the like that could better be spent on quality upgrades by water providers and on inspection and enforcement on a civil basis by the MOE.

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[99] See <http://www.dwi.gov.uk/regs/si1524/index.htm> [accessed April 30, 2002].

5.7.3 Australia

In Australia, guidelines are developed at the Commonwealth level. A joint committee of the National Health and Medical Research Council (NHMRC) and the Agriculture and Resource Management Council of Australia and New Zealand established the current version of the guidelines in 1996. Specialist panels under this committee presented reports on micro-organisms, organic and inorganic chemicals, and radiological and physical parameters. The panels included members from universities, the NHMRC, utilities, and private industry. Territories and states are responsible for implementing these guidelines and can adopt them as standards. Various regions adopt different versions of the guidelines.

The guidelines are based on the World Health Organization's 1993 guidelines and "provide a framework for identifying acceptable drinking water quality, emphasising flexibility and community consultation."[100] They are meant to be used as part of the management framework approach to water quality. Multiple barriers are intended to constitute a comprehensive treatment system. From an Ontario perspective, the Australian "rolling revision" process is notable for, among other things, its inclusion of non-governmental people in the process and the provision of a reasoned response to commentary from the public.[101]

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[100] Australia, Productivity Commission, p. 170.
[101] See <www.waterquality.crc.org.au/guideRR.htm> [accessed April 30, 2002].