Summary of Guidelines for Canadian Drinking Water Quality

Prepared by the
Federal–Provincial Subcommittee on Drinking Water
of the
Federal–Provincial Committee
on Environmental and Occupational Health

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Membership of the Federal–Provincial Subcommittee on Drinking Water and Secretariat

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Summary of Guidelines for Microbiological Parameters

The maximum acceptable concentration (MAC) for coliforms in drinking water is zero organisms detectable per 100 mL. Because coliforms are not uniformly distributed in water and are subject to considerable variation in enumeration, drinking water that fulfils the following conditions is considered to be in compliance with the coliform MAC:

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.

If up to 10 total coliform organisms per 100 mL are detected from a single sample, or if the sample contains either more than 500 heterotrophic plate count (HPC) colonies per millilitre or more than 200 background colonies on a total coliform membrane filter (i.e., overgrowth), the water should be resampled.

Numerical guidelines for viruses and protozoa are not proposed at this time. It is desirable, however, that no human enteric viruses or viable protozoa (e.g., *Giardia*) be detected. General guidance on the issuing and rescinding of boil water advisories is also available.

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 1. For more information on the drinking water guideline for any particular compound, please refer to the latest edition of the *Guidelines for Canadian Drinking Water Quality* or to the Supporting Documentation for the parameter of concern.

Table 1
Summary of Guidelines for Chemical and Physical Parameters

Parameter	MAC (mg/L)	IMAC (mg/L)	AO (mg/L)
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	

Parameter	MAC (mg/L)	IMAC (mg/L)	AO (mg/L)
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 [3]
copper [2]			≤1.0
cyanazine		0.01	
cyanide	0.2		
diazinon	0.02		
dicamba	0.12		
dichlorobenzene, 1,2- [4]	0.20		≤0.003
dichlorobenzene, 1,4- [4]	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 [5]	1.5		
glyphosate		0.28	
iron			≤0.3
lead [2]	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 [6]	45		
nitrilotriacetic acid (NTA)	0.4		
odour			Inoffensive
paraquat (as dichloride)		0.01 [7]	
parathion	0.05		
pentachlorophenol	0.06		≤0.030

Parameter	MAC (mg/L)	IMAC (mg/L)	AO (mg/L)
pH			6.5–8.5 [8]
phorate	0.002		
picloram		0.19	
selenium	0.01		
simazine		0.01	
sodium [9]			≤200
sulphate [10]			≤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) [11]		0.1	
turbidity	1 NTU [12]		≤5 NTU [12,13]
uranium	0.1		
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. TCU = true colour unit.
4. 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.
5. 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.
6. 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.
7. Equivalent to 0.007 mg/L for paraquat ion.
8. No units.
9. 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.
10. There may be a laxative effect in some individuals when sulphate levels exceed 500 mg/L.
11. 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.
12. NTU = nephelometric turbidity unit.
13. 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 2 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 2
Summary List of Parameters without Guidelines

Parameter	Parameter
ammonia	pesticides (total)
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)
mirex	

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 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.

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

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:

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

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

$$\frac{c_1}{MAC_1} + \frac{c_2}{MAC_2} + \ldots \frac{c_i}{MAC_i} \leq 1$$

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 3. If a sample is analyzed 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 4. 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.

* 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).

Table 3
Primary List of Radionuclides – Maximum Acceptable Concentrations

Radionuclide		Half-life $t_{1/2}$	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 0.1 mg/L is about 2.6 Bq/L.
** Tritium is also produced naturally in the atmosphere in significant quantities.

Table 4
Secondary List of Radionuclides – Maximum Acceptable Concentrations

Radionuclide		Half-life $t_{1/2}$	DCF (Sv/Bq)	MAC (Bq/L)
Artificial Radionuclides				
Antimony-125	^{125}Sb	2.76 years	9.8×10^{-10}	100
Cerium-141	^{141}Ce	32.5 days	1.2×10^{-9}	100
Cerium-144	^{144}Ce	284.4 days	8.8×10^{-9}	20
Cobalt-60	^{60}Co	5.27 years	9.2×10^{-8}	2
Iron-59	^{59}Fe	44.5 days	3.1×10^{-9}	40
Manganese-54	^{54}Mn	312.2 days	7.3×10^{-10}	200
Niobium-95	^{95}Nb	35.0 days	7.7×10^{-10}	200
Ruthenium-103	^{103}Ru	39.2 days	1.1×10^{-9}	100
Ruthenium-106	^{106}Ru	372.6 days	1.1×10^{-8}	10
Zinc-65	^{65}Zn	243.8 days	3.8×10^{-9}	40
Zirconium-95	^{95}Zr	64.0 days	1.3×10^{-9}	100