

## ANNEX 1

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<sup>1</sup> In chapter 11, selected bibliographical references are included at the end of each microbial fact sheet. In chapter 12, principal references are provided at the end of each chemical fact sheet.

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## GUIDELINES FOR DRINKING-WATER QUALITY

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19. *Contributors to the chemical substantiation document on:*
  - i. Aluminium
  - ii. Boron
  - iii. Nickel
  - iv. Nitrate and Nitrite
  - v. Cyanobacterial Toxins: Microcystin-LR
  - vi. Edetic Acid (EDTA)
  - vii. Polynuclear aromatic hydrocarbons
  - viii. Cyanazine
  - ix. 1,2-Dichloropropane (1,2-DCP)
  - x. Pentachlorophenol
  - xi. Terbutylazine (TBA)
  - xii. Trihalomethanes

GUIDELINES FOR DRINKING-WATER QUALITY

xiii.	<i>1,1,1-Trichloroethane</i>
xiv.	<i>1,2-Dibromoethane</i>
xv.	<i>1,2-Dichloroethane</i>
xvi.	<i>Di(2-ethylhexyl)adipate</i>
xvii.	<i>2-Phenylphenol</i>
xviii.	<i>2,4-Dichlorophenoxyacetic acid</i>
xix.	<i>Acrylamide</i>
xx.	<i>Aldicarb</i>
xxi.	<i>Aldrin and Dieldrin</i>
xxii.	<i>Antimony</i>
xxiii.	<i>Arsenic</i>
xxiv.	<i>Barium</i>
xxv.	<i>Bentazone</i>
xxvi.	<i>Bromate</i>
xxvii.	<i>Brominated Acetic Acids</i>
xxviii.	<i>Cadmium</i>
xxix.	<i>Carbofuran</i>
xxx.	<i>Carbon Tetrachloride</i>
xxxi.	<i>Monochloramine</i>
xxxii.	<i>Chlordane</i>
xxxiii.	<i>Monochloroacetic acid</i>
xxxiv.	<i>Chlorite and Chlorate</i>
xxxv.	<i>Chlorpyrifos</i>
xxxvi.	<i>Copper</i>
xxxvii.	<i>DDT and its Derivatives</i>
xxxviii.	<i>Dimethoate</i>
xxxix.	<i>Diquat</i>
xl.	<i>Endosulfan</i>
xli.	<i>Endrin</i>
xlII.	<i>Epichlorohydrin</i>
xlIII.	<i>Fenitrothion</i>
xlIV.	<i>Fluoride</i>
xlV.	<i>Glyphosate and AMPA</i>
xlVI.	<i>Halogenated Acetonitriles</i>
xlVII.	<i>Heptachlor and Heptachlor Epoxide</i>
xlVIII.	<i>Hexachlorobenzene</i>
xlIX.	<i>Hexachlorobutadiene</i>
l.	<i>Lindane</i>
li.	<i>Malathion</i>
lii.	<i>Manganese</i>
liii.	<i>Methoxychlor</i>
liV.	<i>Methyl Parathion</i>

ANNEX 2. CONTRIBUTORS TO THE DEVELOPMENT OF THE THIRD EDITION

- lv. *Monochlorobenzene*
- lvi. *MX*
- lvii. *Dialkyltins*
- lviii. *Parathion*
- lix. *Permethrin*
- lx. *Propanil*
- lxi. *Pyriproxifen*
- lxii. *Sulfate*
- lxiii. *Inorganic Tin*
- lxiv. *Toluene*
- lxv. *Trichlorobenzenes*
- lxvi. *Uranium*
- lxvii. *Vinyl Chloride*
- lxviii. *Trichloroacetic Acid*
- lxix. *Dichloroacetic Acid*
- 20. *Provision of comments on drafts of the Guidelines for Drinking-water Quality (3rd edition)*
- 21. *Contributor to Guidelines for Drinking-water Quality (2nd edition), Addendum, Microbiological Agents in Drinking-water*
  - i. *Aeromonas*
  - ii. *Enteric Hepatitis Viruses*
  - iii. *Legionella*
  - iv. *Protozoan Parasites (Cryptosporidium, Giardia, Cyclospora)*
  - v. *Vibrio cholerae*
- 22. *Participant in Final Task Force Meeting for 3rd Edition of Guidelines on Drinking-water Quality, Geneva, Switzerland, 31 March – 4 April 2003*
- 23. *Contributor to the background document “Safe, Piped Water: Managing Microbial Water Quality in Piped Distribution Systems.”*
- 24. *Contributor to the background document “Water Treatment and Pathogen Control: Process Efficiency in Achieving Safe Drinking-water.”*
- 25. *Contributor to the background document “Water Safety Plans.”*
- 26. *Contributor to the background document “Quantifying Public Health Risk in the WHO Guidelines for Drinking-Water Quality: A Burden of Disease Approach.”*
- 27. *Contributor to the background document “Protecting Groundwaters for Health – Managing the Quality of Drinking-water Sources.”*
- 28. *Contributor to the background document “Hazard Characterization for Pathogens in Food and Water: Guidelines.”*
- 29. *Contributor to the background document “Toxic Cyanobacteria in Water.”*

## ANNEX 3

# Default assumptions

### A3.1 Drinking-water consumption and body weight

Global data on the consumption of drinking-water are limited. In studies carried out in Canada, the Netherlands, the United Kingdom and the USA, the average daily per capita consumption was usually found to be less than 2 litres, but there was considerable variation between individuals. As water intake will vary with climate, physical activity and culture, the above studies, which were conducted in temperate zones, can give only a limited view of consumption patterns throughout the world. At temperatures above 25°C, for example, there is a sharp rise in fluid intake, largely to meet the demands of an increased sweat rate (ICRP, 1992; see also Howard & Bartram, 2003).

In developing guidelines for microbial hazard, per capita daily consumption of 1 litre of unboiled water was assumed.

In developing the guideline values for potentially hazardous chemicals, a daily per capita consumption of 2 litres by a person weighing 60 kg was generally assumed. The guideline values set for drinking-water using this assumption do, on average, err on the side of caution. However, such an assumption may underestimate the consumption of water per unit weight, and thus exposure, for those living in hot climates, as well as for infants and children, who consume more fluid per unit weight than adults. The higher intakes, and hence exposure, for infants and children apply for only a limited time, but this period may coincide with greater sensitivity to some toxic agents and less for others. Irreversible effects that occur at a young age will have more social and public health significance than those that are delayed. Where it was judged that this segment of the population was at a particularly high risk from exposure to certain chemicals, the guideline value was derived on the basis of a 10-kg child consuming 1 litre per day or a 5-kg bottle-fed infant consuming 0.75 litre per day. The corresponding daily fluid intakes are higher than for adults on a body weight basis.

### A3.2 Inhalation and dermal absorption

The contribution of drinking-water to daily exposure includes some indirect routes – such as inhalation of particles and droplets containing microbes and volatile

## ANNEX 2. CONTRIBUTORS TO THE DEVELOPMENT

substances, and dermal contact during bathing or showering – as well as direct ingestion.

In most cases, available data are insufficient to permit reliable estimates of exposure by inhalation and dermal absorption of contaminants present in drinking-water. It was not always possible, therefore, to address intake from these routes specifically in the derivation of the guideline values. However, that portion of the total tolerable daily intake (TDI) allocated to drinking-water is generally sufficient to allow for these additional routes of intake (see section 8.2.2). Should there be reason to believe that potential inhalation of volatile compounds and dermal exposure from various indoor water uses (such as showering) are not adequately addressed, authorities could consider taking this into account in setting national standards or guidelines.

## ANNEX 4

# Chemical summary tables

**Table A4.1 Chemicals excluded from guideline value derivation**

<b>Chemical</b>	<b>Reason for exclusion</b>
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

## ANNEX 4. CHEMICAL SUMMARY TABLES

**Table A4.2 Chemicals for which guideline values have not been established**

<b>Chemical</b>	<b>Reason for not establishing a guideline value</b>
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 <sup>a</sup>
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 <sup>a</sup>
Heptachlor and heptachlor epoxide	Occurs in drinking-water at concentrations well below those at which toxic effects may occur

*continued*

GUIDELINES FOR DRINKING-WATER QUALITY

**Table A4.2 Continued**

<b>Chemical</b>	<b>Reason for not establishing a guideline value</b>
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 <sup>a</sup>
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 <sup>b</sup>
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 <sup>a</sup>
Sulfate	Not of health concern at levels found in drinking-water <sup>a</sup>
Total dissolved solids (TDS)	Not of health concern at levels found in drinking-water <sup>a</sup>
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 <sup>a</sup>

<sup>a</sup> May affect acceptability of drinking-water (see chapter 10).

<sup>b</sup> An important operational water quality parameter.

## ANNEX 4. CHEMICAL SUMMARY TABLES

**Table A4.3 Guideline values for chemicals that are of health significance in drinking-water**

<b>Chemical</b>	<b>Guideline value<sup>a</sup> (mg/litre)</b>	<b>Remarks</b>
Acrylamide	0.0005 <sup>b</sup>	
Alachlor	0.02 <sup>b</sup>	
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 <sup>b</sup>	
Benzo[ <i>a</i> ]pyrene	0.0007 <sup>b</sup>	
Boron	0.5 (T)	
Bromate	0.01 <sup>b</sup> (A, T)	
Bromodichloromethane	0.06 <sup>b</sup>	
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 $\geq 0.5$ 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 <sup>b</sup>	
1,2-Dibromoethane	0.0004 <sup>b</sup> (P)	
Dichloroacetate	0.05 (T, D)	
Dichloroacetonitrile	0.02 (P)	
Dichlorobenzene, 1,2-	1 (C)	

*continued*

GUIDELINES FOR DRINKING-WATER QUALITY

**Table A4.3 Continued**

<b>Chemical</b>	<b>Guideline value (mg/litre)</b>	<b>Remarks</b>
Dichlorobenzene, 1,4-	0.3 (C)	
Dichloroethane, 1,2-	0.03 <sup>b</sup>	
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 <sup>b</sup>	
Dichloroprop	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 <sub>3</sub> <sup>-</sup> )	50	Short-term exposure
Nitrilotriacetic acid (NTA)	0.2	
Nitrite (as NO <sub>2</sub> <sup>-</sup> )	3	Short-term exposure
	0.2 (P)	Long-term exposure
Pendimethalin	0.02	
Pentachlorophenol	0.009 <sup>b</sup> (P)	
Pyriproxyfen	0.3	
Selenium	0.01	
Simazine	0.002	
Styrene	0.02 (C)	
2,4,5-T	0.009	
Terbutylazine	0.007	
Tetrachloroethene	0.04	
Toluene	0.7 (C)	

## ANNEX 4. CHEMICAL SUMMARY TABLES

**Table A4.3 Continued**

<b>Chemical</b>	<b>Guideline value (mg/litre)</b>	<b>Remarks</b>
Trichloroacetate	0.2	
Trichloroethene	0.07 (P)	
Trichlorophenol, 2,4,6-	0.2 <sup>b</sup> (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 <sup>b</sup>	
Xylenes	0.5 (C)	

<sup>a</sup> 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.

<sup>b</sup> 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.