

CRITERIA FOR MANAGING CONTAMINATED SITES IN BRITISH COLUMBIA

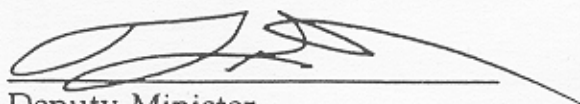
Prepared pursuant to Section 20.1(1)
of the *Waste Management Act*

Approved:



Director of Waste Management

95-7-14
Date



Deputy Minister

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Date

1.0 Introduction

This document presents BC Environment criteria for managing contaminated sites in British Columbia. These are to be used to develop site-specific management goals and limits for contaminants in soil and water, where chemicals from spills and industrial releases have caused contamination and pose risks to human health, to the environment and to the safety of infrastructure such as underground services.

Under the former National Contaminated Sites Remediation Program (NCSRP), the Canadian Council of Ministers of the Environment (CCME) issued "Interim Canadian Environmental Quality Criteria for Contaminated Sites". In keeping with the policy of using comprehensive and current criteria to manage contaminated sites in British Columbia, the CCME interim criteria are being updated and adopted for use by BC Environment's contaminated sites program. Accordingly, the draft of this paper known as CMCS6, which has been used as ministry policy since November 1989, is now superseded. This policy document, as may be amended from time to time, will be ministry policy until cancelled or until regulations under the *Waste Management Act* establish legal standards for contaminated sites.

2.0 Background

2.1 Definitions

In order to protect human health and the environment from substances of concern at sites, benchmarks are needed so regulatory agencies can assess the extent of the risks and the adequacy of any remedial measures that are proposed and carried out. These benchmarks can take a number of forms, including criteria and standards. The following definitions are used in this paper:

Criteria: numerical limits or narrative statements intended as guidance for the protection, maintenance, and improvement of specific uses of soil and water. Criteria are usually provided as concentrations of substances in soil and water, but may also be formulated in terms of levels of risk.

Standards: legally enforceable numerical limits or narrative statements, such as in a permit, regulation, statute, contract or other legally binding document, which have been adopted or adapted from criteria.

The criteria in this document may have a number of different uses. For example, they may be used to establish remediation goals for specific sites. The following defines the two general types of criteria used in this policy:

Numerical criteria: concentrations of substances providing a basis for defining when a site is a contaminated site and for establishing site-specific remediation goals.

Risk-based criteria: levels of risk set to protect the public from unacceptable health impacts.

Remediation goals relate to the need for site remediation (with respect to specified land and water uses) which could take the form of site cleanup, contaminant containment, a change in use or other form of mitigation. After site cleanup, remediation goals can also be used to verify that the residual levels of substances of concern are acceptable.

2.2 General Use of Criteria

The BC criteria for contaminated sites are generally intended to serve as benchmarks related to the protection of human health and the environment with respect to current or future uses of soil and water at contaminated sites. These benchmarks may be used in a variety of ways:

- indicators of the environmental quality at a site;
- indicators of human health and environmental risks for a site;
- guidance for determining when a site is contaminated;
- guidance for determining when site remediation, risk assessment or risk management are necessary;
- guidance for determining when site remediation is performed to acceptable levels, i.e. verification of adequacy of site cleanup;
- the basis for establishing site-specific management goals;
- the basis for developing legally enforceable standards; and
- guidance for evaluating the acceptability of off-site deposit of soil, in conjunction with disposal or deposit site assessment.

2.3 Information Requirements

In establishing remediation goals for a site, the types and levels of substances of concern, the environmental media that are involved and the intended land and water uses must be known. Ministry staff should be consulted about requirements for site characterization at the outset of any investigation. Determining in advance acceptable sampling, sample preparation, sample handling, statistical and chemical analytical methods is important. As well, the ministry must be provided accurate information about the current and intended use of the land and water for a site.

2.4 Specific Approaches and Applications

BC Environment has adopted two approaches and corresponding types of criteria for managing contaminated sites in British Columbia. The first approach uses numerical substance concentration criteria (numerical criteria) to determine when a site is contaminated, when site remediation is needed, and when site remediation has been properly completed. The second approach involves site-specific risk assessment and risk management. Potential health risks posed by substances are calculated and are then compared to levels of risk that are considered technically achievable and publicly acceptable.

The numerical criteria approach is applied in situations where contaminants may be removed so that remaining substances have concentrations less than the applicable numerical criteria. It addresses both human health and environmental impacts.

The risk-based criteria approach is applied in situations where there are potential human health impacts, and exposure to substances of concern can be reduced to acceptable levels by containment, removal or another form of risk management. In contrast to the numerical criteria approach, it can be applied where all contaminants cannot be removed, for example, due to physical or financial constraints. In its present form, quantitative risk assessment can best be used to address public health issues associated with contaminated sites. If the risk-based criteria approach is used in managing a site, a qualitative environmental impact assessment is also required. At sites where risk management is used to mitigate potential human health impacts, the numerical criteria approach may still be required to address potential environmental effects identified in the environmental impact assessment.

Either of these two approaches is acceptable for a particular site. If the first approach is chosen, the numerical criteria shall be adopted directly as remediation goals. If the second approach is chosen, quantitative human health risk assessment and qualitative environmental impact assessment shall be used.

3.0 Criteria

Numerical criteria for soil are presented in Table 1 for five specific land uses: agricultural (AL), urban park (PL), residential (RL), commercial (CL) and industrial (IL). Remediation criteria for water used for aquatic life (AW), irrigation (IW), livestock watering (LW), and drinking water for humans (DW) are presented in Table 2. The criteria for water in Table 2 apply to both surface water and groundwater.

3.1 Numerical Criteria Used in Defining a Contaminated Site

If the concentration of a substance at a site for a current or specified land or water use exceed the numerical criteria for that substance in Table 1 or 2, a site is considered a contaminated site.

3.2 Numerical Criteria Used in Defining Remediation Goals

If a numerical criterion for a substance is adopted directly as a remediation goal, and if the concentration of that substance exceeds the remediation goal for the current or specified land or water use, then site remediation is normally required. Where it is not feasible to remediate a site to satisfy a remediation goal due to technological or other constraints, risk and environmental impact assessment and the implementation of risk management measures can still be used.

3.3 Application of Numerical Soil Criteria to Soil Relocation

Separate ministry policies and procedures for soil relocation are described in the document "Landfill Disposal and Relocation of Excavated Soil in British Columbia: Interim Guidelines and Policies".

3.4 Application of Numerical Soil Criteria to Sediments

The numerical criteria for soil are *not intended to be used* to guide the assessment or remediation of *in situ* sediments, sediments that are underwater. However, they may be used to assess and manage sediments which have been deposited on land.

3.5 Application of Water Criteria to Discharges

The numerical criteria for water are *not intended to be used* to determine the acceptability for discharge of water from a site through works, as described in section 7.0. The BC Environment document "Standards for Water-Based Discharges from the Pacific Place Site" is a useful reference for developing guidance on, and standards for water-based discharges for a specific site.

3.6 Application of Water Criteria to Adjacent Sites

The numerical criteria for water apply to substances both on the site on which they reside and to adjacent and nearby sites to which they might flow or migrate.

4.0 Risk-based Criteria Approach

Where the risk-based approach is chosen, exposures to a substance of concern at a site must be reduced so that the human lifetime cancer risk due to exposure to that substance is less than or equal to seven in one million. For a noncarcinogenic substance, exposures must be reduced so that the predicted daily intake of a substance of concern will be less than or equal to the acceptable daily intake established by the ministry (hazard index is less than or equal to one).

Quantitative risk assessment for human health is well developed, but it is not yet well developed for environmental protection. Procedures for the assessment of environmental risks are being developed. In the interim, the ministry requires the performance of qualitative environmental impact assessments to follow CCME guidance in the document "Framework for Ecological Risk Assessment at Contaminated Sites in Canada". The assessment will evaluate and document any ecological health concerns which may occur. If ecological health concerns are identified, the ministry will require the implementation of appropriate risk management measures.

5.0 Criteria for Other Substances and Media

5.1 Substances Not Listed in Tables 1 and 2

Tables 1 and 2 contain criteria for a wide variety of potential soil and water contaminants. While they represent many substances found at sites, other substances may be encountered for which criteria will have to be established. The ministry will either develop these criteria, or provide guidance on their development on a case-by-case basis. The ministry should be consulted for further detail.

5.2 Air

Volatile chemical compounds may contaminate soil and water, evaporate, and pose a health risk through air exposure. Air criteria may be formulated in levels corresponding to various human health risks, or in terms of acceptable ambient air concentrations of chemicals. The risk-based criteria are those provided in Section 4.0, while criteria for substance concentrations in air will be provided by the ministry, where required, on a chemical by chemical basis.

5.3 *In Situ* Sediments

The assessment and remediation of *in situ* sediments shall be based on criteria issued by the CCME in its document "Interim Sediment Quality Assessment Values".

5.4 Marine Water

The assessment and remediation of marine waters shall be based on the most recent edition of the BC Environment document "Approved and Working Criteria for Water Quality".

6.0 Background Levels of Substances

In the event that background levels of substances in soil and/or water found at a site exceed the criteria described in Sections 3.0 to 5.0, the criteria will be set at background concentrations if the numerical criteria approach is used. If risk-based criteria approach is used, risk levels resulting from background concentrations of substances in soil and/or water will be adopted. Contaminated media shall not be used as a reference for background levels. The ministry should be contacted for advice on establishing background levels of substances associated with a site.

7.0 Release of Contaminants from a Site

The criteria provided in this document are primarily intended to apply to ambient soil and water remaining on a site and being used on the site. However, contaminated water, soil, air and sediments may be released from a site by a number of means, for example by:

- collection and discharge of surface water or groundwater through works;
- sediment transport by natural processes such as tidal action;
- surface erosion by wind and runoff;
- emission of volatile organic chemicals from contaminated soils;
- excavation and redeposit of soils; and
- flow of groundwater into surface waters.

The criteria in this document are not intended to be the sole benchmarks for situations where contaminants are released or deposited elsewhere. Additional factors such as the off-site loading of contaminants, off-site impacts, whether the discharge is from a point- or non-point source, and applicable policy and regulatory requirements such as those of the Special Waste Regulation need to be assessed on a site-specific basis.

Table 1
Soil Numerical Criteria

8.0 Special Waste Criteria

Where special waste contaminants are handled or treated, the Special Waste Regulation under the *Waste Management Act* will apply to the management of these wastes.

9.0 Choice of Indicator Compounds

The indicator compounds used for a contaminated site will sometimes be those for which numerical criteria appear in Tables 1 and 2. However, exhaustive chemical analysis for all substances for which numerical criteria appear in Tables 1 and 2 is not necessarily required. Often consideration of a site's historical use will suggest that a different or smaller set of potential substances of concern exists. In these latter circumstances, the ministry should be consulted for guidance regarding the choice of indicator compounds.

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
arsenic (total)	0.5	10	10	100	100
barium (total)	5	50	50	500	500
bismuth (total)	200	400	400	2000	2000
cadmium	375	500	500	1000	1000
chromium	0.5	2	2	10	10
cobalt	5	10	10	40	40
copper	150	100	100	500	500
fluorine	1	2	2	10	10
gold	20	20	20	40	40
mercury (elemental)	500				
molybdenum	1	50	30	30	30
nickel	5	50	50	500	500
potassium	200	200	200	1000	1000
silver	600	500	500	1000	1000
selenium	0.05	0.5	0.5	3	3
tin	0.1	1	1	10	10
vanadium	0.1	1	1	10	10
zinc	0.1	1	1	10	10
Monocyclic Aromatic Hydrocarbons (MAHs)					
benzene	0.1	3	3	50	50
chlorobenzene	0.1	3	3	50	50
1,2-dichlorobenzene	0.1	3	3	50	50
1,3-dichlorobenzene	0.1	3	3	50	50
1,4-dichlorobenzene	0.1	3	3	50	50
ethylbenzene	0.1	3	3	50	50
styrene	0.1	3	3	50	50
toluene	0.1	3	3	50	50
xylene	0.1	3	3	50	50

Table 1
Soil Numerical Criteria¹

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V	COLUMN VI
Substance	Agricultural (AL)	Urban Park (PL)	Residential (RL)	Commercial (CL)	Industrial (IL)
Inorganic Substances					
antimony	20	20	20	40	40
arsenic	20	30	30	50	50
barium	750	500	500	2000	2000
beryllium	4	4	4	8	8
boron (hot water soluble)	2				
cadmium	3	5	5	20	20
chromium (+6)	8	8	8		
chromium (total)	750	250	250	800	800
cobalt	40	50	50	300	300
copper	150	100	100	500	500
cyanide (free)	0.5	10	10	100	100
cyanide (total)	5	50	50	500	500
fluoride (total)	200	400	400	2000	2000
lead	375	500	500	1000	1000
mercury	0.8	2	2	10	10
molybdenum	5	10	10	40	40
nickel	150	100	100	500	500
selenium	2	3	3	10	10
silver	20	20	20	40	40
sulphur (elemental)	500				
thallium	1				
tin	5	50	50	300	300
vanadium	200	200	200		
zinc	600	500	500	1500	1500
Monocyclic Aromatic Hydrocarbons (MAHs)					
benzene	0.05	0.5	0.5	5	5
chlorobenzene	0.1	1	1	10	10
1,2-dichlorobenzene	0.1	1	1	10	10
1,3-dichlorobenzene	0.1	1	1	10	10
1,4-dichlorobenzene	0.1	1	1	10	10
ethylbenzene	0.1	5	5	50	50
styrene	0.1	5	5	50	50
toluene	0.1	3	3	30	30
xylene	0.1	5	5	50	50

Soil Numerical Criteria¹

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V	COLUMN VI
Substance	Agricultural (AL)	Urban Park (PL)	Residential (RL)	Commercial (CL)	Industrial (IL)
Polycyclic Aromatic Hydrocarbons (PAHs)					
benzo[a]anthracene	0.1	1	1	10	10
benzo[a]pyrene	0.1	1	1	10	10
benzo[b]fluoranthene	0.1	1	1	10	10
benzo[k]fluoranthene	0.1	1	1	10	10
dibenz[a,h]anthracene	0.1	1	1	10	10
indeno(1,2,3-c,d)pyrene	0.1	1	1	10	10
naphthalene	0.1	5	5	50	50
phenanthrene	0.1	5	5	50	50
pyrene	0.1	10	10	100	100
Phenolic Substances					
nonchlorinated ² (each)	0.1	1	1	10	10
chlorophenols ³ (each)	0.05	0.5	0.5	5	5
Chlorinated Hydrocarbons					
chlorinated aliphatics ⁴ (each)	0.1	5	5	50	50
chlorobenzenes ⁵ (each)	0.05	2	2	10	10
hexachlorobenzene	0.05	2	2	10	10
hexachlorocyclohexane	0.01				
PCBs ⁶	0.5	5	5	50	50
PCDDs and PCDFs ⁷	0.00001	0.001	0.001		
Miscellaneous Organic Substances					
nonchlorinated aliphatics (each)	0.3				
phthalic acid esters (each)	30				
quinoline	0.1				
thiophene	0.1				

Soil Numerical Criteria¹

Footnotes

¹All values in µg/g unless otherwise stated

²Nonchlorinated phenolic substances include

2,4-dimethylphenol
2,4-dinitrophenol
2-methyl 4,6-dinitrophenol
nitrophenol (2-, 4-)
phenol
cresol

³Chlorophenols include

chlorophenol isomers (ortho, meta, para)
dichlorophenols (2,6-, 2,5-, 2,4-, 3,5-, 2,3-, 3,4-)
trichlorophenols (2,4,6-, 2,3,6-, 2,4,5-, 2,3,5-, 2,3,4-, 3,4,5-)
tetrachlorophenols (2,3,5,6-, 2,3,4,5-, 2,3,4,6-)
pentachlorophenol

⁴Aliphatic chlorinated hydrocarbons include

chloroform
dichloroethane (1,1-, 1,2-), dichloroethene (1,1-, 1,2-)
dichloromethane
1,2-dichloropropane, 1,3-dichloropropane (cis and trans)
1,1,2,2-tetrachloroethane, tetrachloroethene
carbon tetrachloride
trichloroethane (1,1,1-, 1,1,2-) trichloroethene

⁵Chlorobenzenes include

all trichlorobenzene isomers, all tetrachlorobenzene isomers, pentachlorobenzene

⁶Polychlorinated biphenyls (PCBs) include mixtures 1242, 1248, 1254 and 1260.

⁷Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) expressed in 2,3,7,8-TCDD equivalents. NATO International Toxicity Equivalency Factors (I-TEFs) for congeners and isomers of PCDDs and PCDFs are as follows:

Congener	I-TEF	Congener	I-TEF
2,3,7,8-T ₄ CDD	1.0	2,3,7,8-T ₄ CDF	0.1
1,2,3,7,8-P ₅ CDD	0.5	2,3,4,7,8-P ₅ CDF	0.5
1,2,3,4,7,8-H ₆ CDD	0.1	1,2,3,7,8-P ₅ CDF	0.05
1,2,3,7,8,9-H ₆ CDD	0.1	1,2,3,4,7,8-H ₆ CDF	0.1
1,2,3,6,7,8-H ₆ CDD	0.1	1,2,3,7,8,9-H ₆ CDF	0.1
1,2,3,4,6,7,8-H ₇ CDD	0.01	1,2,3,6,7,8-H ₆ CDF	0.1
O ₈ CDD	0.001	2,3,4,6,7,8-H ₆ CDF	0.1
		1,2,3,4,6,7,8-H ₇ CDF	0.01
		1,2,3,4,7,8,9-H ₇ CDF	0.01
		O ₈ CDF	0.001

Table 2
Water Numerical Criteria¹

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V
Substance	Aquatic Life ² (AW)	Irrigation ^{2,3} (IW)	Livestock ² (LW)	Drinking Water ⁴ (DW)
Inorganic Substances				
aluminum	5 @ pH<4.5 7 @ pH=5.0 11 @ pH=5.5 20 @ pH=6.0 50 @ pH>6.0	5000	5000	200
ammonia	131 @ pH=9.0 ⁷ 370 @ pH=8.5 ⁷ 1130 @ pH=8.0 ⁷ 1840 @ pH<7.7 ⁷			
arsenic	50	100	500 ⁵	25
barium	1000			1000
beryllium	5.3	100	100	
boron		500 - 6000 ⁶	5000	5000
cadmium	0.2 @ H ²³ =0-60 (0.01 @ H=30) 0.8 @ H=60-120 (0.03 @ H=90) 1.3 @ H=120-180 (0.05 @ H=150) 1.8 @ H>180 (0.06 @ H=210)	10	20	5
calcium			1000 mg/l	
chloride		100 - 700mg/l ¹⁶		250 mg/l
chlorine	2	1000		
chromium	2	100	1000	50
cobalt	50	50	1000	
copper	2 @ H<50mg/l CaCO ₃ 4 @ H=100mg/l CaCO ₃ 6 @ H=150mg/l CaCO ₃ 8 @ H=200 mg/l	200 ⁶	300	1000
cyanide (WAD) ⁹	5			
cyanide (SAD) ¹⁵				200
fluoride	200 @ H<50mg/l 300 @ H>50mg/l	1000	1000 ^{5,8}	1500
iron	300	5000		300
lead	3 @ H<40 mg/l CaCO ₃ 5 @ H=50mg/l CaCO ₃ 6 @ H=100mg/l CaCO ₃ 11 @ H=180 mg/l	200	100	10
lithium		2500	5000	
manganese	100	200		50
mercury	0.1	1	2	1
molybdenum	1000	10 - 30 ¹⁰	50	
nickel	25 @ H=0.60mg/l CaCO ₃ 65 @ H=60-120mg/l CaCO ₃ 110 @ H=120-180mg/l CaCO ₃ 150 @ H>180mg/l CaCO ₃	200	1000	
nitrate - N (or as N)	40mg/l		10000 ¹¹	10000 ¹¹
nitrate and nitrite (as N)	40mg/l		10000 ¹¹	10000 ¹¹
nitrite - N (or as N)	20 (chloride < 2mg/l) - 60 ¹²		10000	3200
selenium	1	20 ¹³ , 50 ¹⁴	50	10
silver	0.1			
sodium				
sulphate	100 mg/l		1000000	200 mg/l
sulphide as H ₂ S	2			500 mg/l
uranium	300	10	200	100
vanadium		100	100	
zinc	30	1000-5000 ^{14,16}	50000	5000

Water Numerical Criteria¹

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V
Substance	Aquatic Life ² (AW)	Irrigation ^{2,3} (IW)	Livestock ² (LW)	Drinking Water ⁴ (DW)
Monocyclic Aromatic Hydrocarbons (MAHs)				
benzene	300			5
ethylbenzene	700			2.4
toluene	300			24
xylene				300
Polycyclic Aromatic Hydrocarbons (PAHs)				
naphthalene	1			
acenaphthene	6			
fluorene	12			
anthracene	0.1			
phenanthrene	0.3			
acridine	0.05			
fluoranthene	0.2			
pyrene	0.02			
benzo[a]anthracene	0.1			
benzo[a]pyrene	0.01			0.01
Phenolic Substances				
phenols (total)	1			
chlorinated phenols				
monochlorophenol	0.5 - 0.9 ¹⁷		0.1 ⁹	
dichlorophenols	0.12 - 0.35 ¹⁷		0.3 ⁹	0.3
trichlorophenols	0.06 - 0.5 ¹⁷		2 ⁹	2
tetrachlorophenols	0.02 - 0.3 ¹⁷		1 ⁹	1
pentachlorophenol	0.02 - 0.3 ¹⁷		30 ⁹	30
Chlorinated Hydrocarbons				
chlorinated aliphatics				
dichloroethane, 1,2-	100			5
dichloromethane				50
hexachlorobutadiene	0.1			
hexachlorocyclohexane isomers	0.01			
tetrachloroethylene	260			50
trichloroethylene	20			2
vinyl chloride				
chlorinated benzenes				
monochlorobenzene	15			30
dichlorobenzene, 1,2-	2.5			3
dichlorobenzene, 1,3-	2.5			
dichlorobenzene, 1,4-	4			1
trichlorobenzene, 1,2,3-	0.9			
trichlorobenzene, 1,2,4-	0.5			
trichlorobenzene, 1,3,5-	0.65			
tetrachlorobenzene, 1,2,3,4-	0.1			
tetrachlorobenzene, 1,2,3,5-	0.1			
tetrachlorobenzene, 1,2,4,5-	0.15			
pentachlorobenzene	0.03			
hexachlorobenzene	0.0065			
PCBs	0.0001	0.5		
Halogenated Methanes				
carbon tetrachloride				5
trihalomethanes				100
Phthalate Esters				
DBP	4			
DEHP	0.6			
other phthalate esters	0.2			

Water Numerical Criteria¹

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V
Substance	Aquatic Life ² (AW)	Irrigation ^{2,3} (IW)	Livestock ² (LW)	Drinking Water ⁴ (DW)
Pesticides				
aldicarb	0.15 ^{18,19}	54.9 ²⁰ , 67.5 ²¹	11	9
aldrin and dieldrin	0.004		0.7	0.7
atrazine	2 ¹⁹ , 10 ¹⁸	10	60	5
azinphos-methyl				20
bendiocarb				40
bromoxynil				5
carbaryl				90
carbofuran	1.75		45	90
chlordane	0.006			7
chlorpyrifos				90
cyanazine	2	0.5	10	10
2,4-D	4			100
DDT	0.001			30 ²²
diazinon	0.01		14	20
dicamba				120
diclofop-methyl				9
dimethoate	6.2		3	20
dinoseb				10
diquat				70
diuron				150
endosulfan	0.02			
endrin	0.0023			
glyphosate	65		280	280
heptachlor & heptachlor epoxide	0.01			3
lindane				4
malathion				190
methoxychlor				900
metolachlor	8	28	50	50
metribuzin	1	0.5	80	80
paraquat				10
parathion				50
phorate				2
picloram	29	0.5	190	190
simazine	10	0.5	10	10
2,4,5-T				20
temephos				280
terbufos				1
toxaphene	0.008			
triallate	0.24		230	230
trifluralin	0.1		45	45
Radioactive Substances				
¹³⁷ cesium				50 Bq/l
¹³¹ iodine				10 Bq/l
²²⁶ radium				1 Bq/l
⁹⁰ strontium				10 Bq/l
³ tritium				40000 Bq/l

Water Numerical Criteria¹

Footnotes

¹All values are in ug/l unless otherwise stated.

²For surface water samples, samples must be tested to determine total combined particulate and dissolved substance concentrations. For groundwater samples, samples must be tested to determine dissolved substance concentrations.

³Applies to irrigation of all soil types.

⁴Drinking water criteria are for unfiltered samples obtained at the point of consumption. Heavy metals, metalloids and inorganic ions are expressed as total concentrations (particulate and dissolved) unless otherwise indicated.

⁵Criterion applies where dietary intakes or natural levels are high. Consult Director for further advice.

⁶Criterion varies depending on crop. Consult Director for further advice.

⁷Criterion varies with pH and temperature. 10°C is assumed. Consult Director for further advice.

⁸Criterion varies with type of livestock. Consult Director for further advice.

⁹WAD means weak acid dissociable.

¹⁰Criterion varies with crop, soil drainage and Mo:Cu ratio. Consult Director for further advice.

¹¹Where nitrate and nitrite are present, total nitrate plus nitrite-nitrogen should not exceed this value.

¹²Criterion varies with chloride concentration. Consult Director for further advice.

¹³Criterion for intermittent applications on crops.

¹⁴Criterion for continuous application on crops.

¹⁵SAD means strong acid dissociable.

¹⁶Criterion varies with soil pH. Consult Director for further advice.

¹⁷Criterion varies with pH and substance isomer. Consult Director for further advice.

¹⁸Criterion to protect marine aquatic life.

¹⁹Criterion to protect freshwater aquatic life.

²⁰Criterion to protect crops other than legumes.

²¹Criterion to protect legumes.

²²Includes DDT metabolites.

²³H means water hardness in mg/l CaCO₃.

ERRATUM

The reference to footnote 9 for chlorinated phenols - livestock watering criteria (column IV) is incorrect. Footnote reference should be to footnote 24 below:

²⁴ Criterion to protect against taste and odor concerns.