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Regulations and Standards
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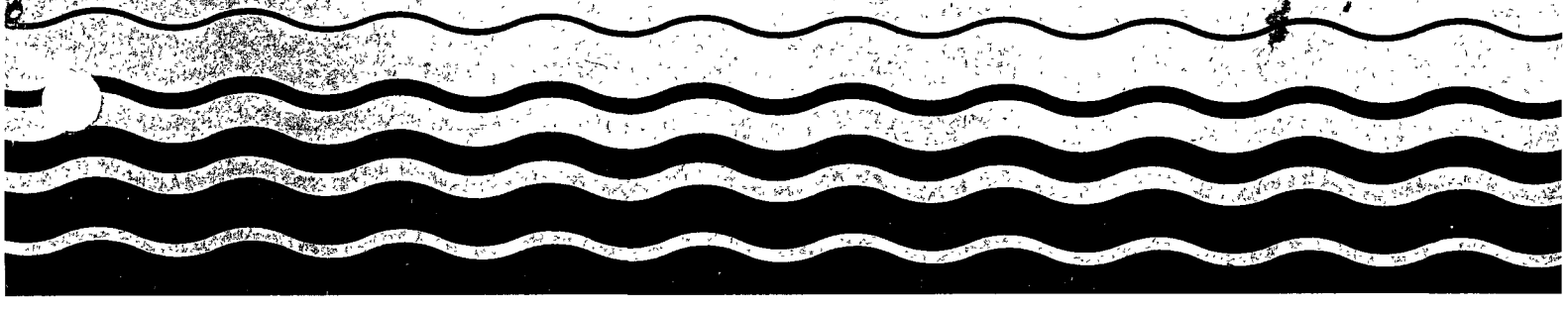
EPA

Other Elements

Water Quality Standards Criteria Summaries: A Compilation of State/Federal Criteria



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The reader should consult the water quality standards of a particular State for exact regulatory language applicable to that State. Copies of State water quality standards may be obtained from the State's Water Pollution Control Agency or its equivalent.

Additional information may also be obtained from the:

Standards Branch
Criteria and Standards Division (WH-585)
Office of Water Regulations and Standards
U.S. Environmental Protection Agency
Washington, D.C. 20460
202-475-7315

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INTRODUCTION

This digest is compiled to provide general information to the public as well as to Federal, State, and local officials. It contains excerpts from the individual Federal-State water quality standards establishing pollutant specific criteria for interstate surface waters. The water quality standards program is implemented by the U. S. Environmental Protection Agency where responsibility for providing water quality recommendations, approving State-adopted standards for interstate waters, evaluating adherence to the standards, and overseeing enforcement of standards compliance, has been mandated by Congress.

Standards, a nationwide strategy for surface water quality management, contain three major elements: the use (recreation, drinking water, fish and wildlife propagation, industrial, or agricultural) to be made of the navigable water; criteria to protect these uses; and an antidegradation statement to protect existing high quality waters, from degradation by the addition of pollutants. Guidance for the development of standards by individual States is contained in two EPA documents entitled Water Quality Standards Handbook (1983) and Quality Criteria for Water (1986).

This digest summarizes eight elements which are usually incorporated into State Water Quality Standards. These are: barium, beryllium, boron, chlorine, manganese, nickel, selenium and silver. The presence of any of these elements in water is not unusual because of their wide industrial application. Many of these elements also occur in natural waters as a result of leaching from mineral deposits and various mining operations. Toxic effects attributed to these elements are as varied as the uses to which they are applied. Some are even essential nutrients in very minute concentrations. Nevertheless, EPA has succeeded in demonstrating water associated environmental problems with these elements.

The 1986 Quality Criteria for Water recommends the following:

Barium	1 mg/l	for domestic water supply (health)
Beryllium	130 ug/l	acute toxicity to freshwater aquatic life
	5.3 ug/l	chronic toxicity to freshwater aquatic life
	3.7 ng/l	water and aquatic organism ingestion (human health)
	64.1 ng/l	aquatic organism consumption only (human health)
Boron	750 ug/l	for long-term irrigation on sensitive crops
Chlorine	11 ug/l	chronic - freshwater aquatic organisms and their uses
	19 ug/l	acute - freshwater aquatic organisms and their uses
	7.5 ug/l	chronic - saltwater aquatic organisms and their uses
	13 ug/l	acute - saltwater aquatic organisms and their uses
Manganese	50 ug/l	for domestic water supplies (welfare)
	100 ug/l	for protection of consumers of marine molluscs

Nickel	Protection of Freshwater Aquatic Life:	
	$e^{(0.76[\ln(\text{hardness})]+1.06)}$	24-hour average
	$e^{(0.76[\ln(\text{hardness})]+4.02)}$	maximum at any time
	Protection of Saltwater Aquatic Life:	
	7.1 ug/l	24-hour average
	140 ug/l	maximum at any time
	632 ug/l	water and aquatic organism ingestion (human health)
	4.77 mg/l	aquatic organism consumption only (human health)
Selenium	Protection of Freshwater Aquatic Life:	
	35 ug/l	24-hour average
	260 ug/l	maximum at any time
	Protection of Saltwater Aquatic Life:	
	54 ug/l	24-hour average
	410 ug/l	maximum at any time
	10 ug/l	human health
Silver	$e^{(1.72[\ln(\text{hardness})]-6.52)}$	maximum for freshwater aquatic life
	2.3 ug/l	maximum for saltwater aquatic life
	50 ug/l	human health

Since water quality standards are revised from time to time, following procedures set forth in the Clean Water Act, individual entries in this digest may be superseded. This digest will be updated periodically. Because this publication is intended for use only as a general information reference, the reader needs to refer to the current approved water quality standards to obtain the latest information for special purposes and applications. These can be obtained from the State water pollution control agencies or the EPA Regional Offices.

REFERENCES

5 California Water Quality Standards by River Basins, ca. 1975

For more detailed information on selected basins, sub-basins and stretches of streams and coastal areas refer to California State Water Quality Standards.

12 Idaho Department of Health and Welfare Rules and Regulations, Title 1, Chapter 2, "Water Quality Standards and Wastewater Treatment Requirements", 1980.

25 Missouri Water Quality Standards, 10 CSR 20-7.031, Rule of Department of Natural Resources: Division 20 - Clean Water Commission.

31 Water Quality Standards for Interstate and Intrastate Streams in New Mexico, State of New Mexico Water Quality Control Commission, 1988.

33 State of North Carolina Administrative Code Section: 15 NCAC 2B .0200 - Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina.

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43 Texas Surface Water Quality Standards, Texas Water Commission, Rule Change, 1988.

44 Utah Standards of Quality for Waters of the State, Wastewater Disposal Regulations: Part II, State of Utah Department of Health: Division of Environmental Health, 1988.

48 Water Quality Standards, West Virginia Legislative Rules, State Water Resources Board, 1985.

51 Water Quality Standards for American Samoa, 1984, p. 19.

52 Water Quality Standards of the District of Columbia, Chapter 42, Department of Consumer and Regulatory Affairs, 1985, Section 4206.1.

53 Revised Guam Water Quality Standards, Guam Environmental Protection Agency, 1984, p. 13.

54 Commonwealth of Northern Mariana Islands Marine and Fresh Water Quality Standards, Commonwealth Register, Vol. 8 No. 5, 1986, p. 4467.

55 Puerto Rico Water Quality Standards Regulation, Environmental Quality Board, 1983.

56 Marine and Fresh Water Quality Standard Regulations, Trust Territory, 1986, pp. 8-10.

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24 Page 821:1003, October 25, 1985

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28 Pages 841:1025, 1065-1066, June 29, 1984, 841:1075, February 22, 1985

30 Pages 851:1018-1019, April 11, 1986

32 Pages 861:1016, 1023-1024, 1027, 1032-1036, November 29, 1985

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35 Pages 876:1011, May 24, 1985, 876:1023, December 27, 1985

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37 Pages 886:1006-1047, May 9, 1986

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42 Pages 916:0542, September 7, 1984, 916:1002, April 28, 1978

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52 Pages 741:1003-1004, March 28, 1986

State and Water Use	Other Elements Criteria Values	
Alabama[1]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Alaska[2]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Fresh & Salt Water Uses: Aquaculture, Growth and Propagation of Fish, Shellfish, other Aquatic Life, and Wildlife incl. Seabirds, Waterfowl and Furbearers	Chlorine (total residual):	2.0 ug/l for salmonid fish 10.0 ug/l for other organisms
Arizona[3]		
All	Beryllium	Not specified
	Chlorine	Not specified
	Nickel	Not specified
Domestic - Recreation	Barium	1.000 S mg/l (S = filterable residue)
	Boron	No standard
	Manganese	No standard
	Selenium	0.010 S mg/l
	Silver	0.050 S mg/l
Aquatic Life and Wildlife	Barium	No standard
	Boron	No standard
	Manganese	No standard
	Selenium	0.050 T mg/l (T = total residues)
	Silver	0.050 S mg/l
Agricultural Irrigation	Barium	No standard
	Boron	1.000 T mg/l

State and Water Use	Other Elements	Criteria Values
	Manganese	10.000 T mg/l
	Selenium	0.020 T mg/l
	Silver	No standard
Agricultural Livestock Watering	Barium	No standard
	Boron	No standard
	Manganese	No standard
	Selenium	0.050 T mg/l
	Silver	No standard
West Fork of the Little Colorado River above Government Springs	Selenium	0.002 mg/l total
	Silver	0.02 mg/l dissolved
Oak Creek and Its West Fork	Silver	25 ug/l dissolved
All Effluent Dominated Waters	Boron	No standard
	Manganese	No standard
	Selenium	0.05 T mg/l
	Silver	0.05 D mg/l (D = dissolved)
Arkansas[4]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
California[5]		
All	Barium	1.0 mg/l
	Beryllium	(see specific Basin Plans)
	Boron	varies from stream to stream: 0-0.5 mg/l
	Chlorine	(see specific Basin Plans)
	Manganese	(see specific Basin Plans)
	Nickel	(see specific Basin Plans)
	Selenium	0.01 mg/l
	Silver	(see specific Basin Plans)
Colorado[6]		
Aquatic Life (1)(3)(4)	Manganese	Chronic = $1000(\text{tot rec})$
	Nickel	Acute = $1/2e^{(0.76[\ln(\text{hardness})]+4.02)}$
		Chronic = $e^{(0.76[\ln(\text{hardness})]+1.06)}$

State and Water Use	Other Elements Criteria Values	
	Selenium	Acute = 135 µg/l Chronic = 17 µg/l
	Silver	Acute = $1/2e^{(1.72[\ln(\text{hardness})]-6.52)}$ Chronic = $e^{(1.72[\ln(\text{hardness})]-9.06)}$ Chr(Trout) = $e^{(1.72[\ln(\text{hardness})]-10.51}$
	Chlorine	0.003 mg/l 1-day avg. (tot. residual)
Agriculture (2)	Manganese	200 µg/l 30-day avg.
	Nickel	200 µg/l 30-day avg.
	Selenium	20 µg/l 30-day avg.
	Boron	0.75 mg/l 30-day avg.
Drinking Water Supply (2)	Manganese	50(dis) µg/l 1-day avg.
	Selenium	10 µg/l 1-day avg.
	Silver	50 µg/l 1-day avg.
All	Except where authorized by permits, BMP's or plans of operation approved by the Division, State waters shall be free from substances attributable to human-caused point source or nonpoint source discharges in amounts, concentrations or combinations which are harmful to beneficial uses or toxic to humans, animals, plants, or aquatic life.	

Footnotes:

(1) Metals for aquatic life use are stated as dissolved unless otherwise specified.

(2) Metals for agriculture and domestic uses are stated as total recoverable unless otherwise specified.

(3) Hardness values to be used in equations are in mg/l as calcium carbonate. The hardness values used in calculating the appropriate metal standard should be based on the lower 95 per cent confidence limit of the mean hardness value at the periodic low flow criteria as determined from a regression analysis of site-specific data. where insufficient site-specific data exists to define the mean hardness value at the periodic low flow criteria, representative regional data shall be used to perform the regression analysis. where a regression analysis is not appropriate, a site-specific method should be used. In calculating a hardness value, regression analyses should not be extrapolated past the point that data exist.

(4) Both acute and chronic numbers adopted as stream standards are levels not to be exceeded more than once every three years on the average.

State and Water Use	Other Elements	Criteria Values
Connecticut[7]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Delavare[8]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Florida[9]		
Potable Water Supply (Class I)	Barium	1 mg/l
	Beryllium	0.011 mg/l in waters with hardness ≤ 150 mg/l of $CaCO_3$ 1.10 mg/l in harder waters
	Chlorine	0.01 mg/l (total residual)
	Nickel	0.1 mg/l
	Selenium	0.01 mg/l
	Silver	0.07 ug/l
Shellfish Propagation or Harvesting (Class II)	Chlorine	0.01 mg/l
	Manganese	0.1 mg/l
	Nickel	0.1 mg/l
	Selenium	0.025 mg/l
	Silver	0.05 ug/l
Recreation-Propagation and Management of Fish and Wildlife (Class III)	Beryllium	0.011 mg/l in waters with hardness ≤ 150 mg/l of $CaCO_3$ 1.10 mg/l in harder waters (in predominantly fresh waters)
	Chlorine	0.01 mg/l (total residual)
	Nickel	0.1 mg/l
	Selenium	0.025 mg/l
	Silver	0.07 ug/l in predominantly fresh waters 0.05 ug/l in predominantly marine waters
Agriculture (Class IV)	Beryllium	0.1 mg/l in waters with hardness ≤ 150 mg/l $CaCO_3$ 0.5 mg/l in harder waters

State and Water Use	Other Elements Criteria Values	
	Boron	0.75 mg/l
	Nickel	0.1 mg/l
Georgia[10]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Hawaii[11]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Idaho[12]		
All	Beryllium	Not specified
	Boron	Not specified
	Manganese	Not specified
	Nickel	Not specified
Domestic Water Supply	Barium	1.000 mg/l
	Selenium	0.010 mg/l
	Silver	0.050 mg/l
Wastewaters Discharged Into Surface Waters	Chlorine (total residual): The wastewater must not affect the receiving water outside the mixing zone so that:	
	i. If the receiving water is designated for cold water biota, its total chlorine residual concentration exceeds two one-thousandth (0.002) mg/l.	
	ii. If the receiving water is designated for warm water biota and not cold water biota, its total chlorine residual concentrations exceeds one one-hundredth (0.01) mg/l.	

State and Water Use	Other Elements Criteria Values	
Illinois[13]		
General Use	Barium	5.0 mg/l
	Beryllium	Not specified
	Boron	1.0 mg/l
	Chlorine	Not specified
	Manganese	1.0 mg/l
	Nickel	1.0 mg/l
	Selenium	1.0 mg/l
	Silver	0.005 mg/l
Public and Food Processing Water Supply	Barium	1.0 mg/l
	Manganese	0.15 mg/l
	Selenium	0.01 mg/l
Secondary Contact and Indigenous Aquatic Life	Barium	5.0 mg/l
	Manganese	1.0 mg/l
	Nickel	1.0 mg/l
	Selenium	1.0 mg/l
	Silver	0.1 mg/l
Unnamed Tributary of Wood River Creek	(a) This section applies to the unnamed tributary of Wood River Creek which enters Wood River Creek 4700 feet above the confluence of Wood River Creek with the Mississippi River from a point 450 feet above the confluence of the unnamed tributary and Wood River Creek to said confluence, and in Wood River Creek from said confluence to the confluence of Wood River Creek and the Mississippi River.	
	(b) Such waters shall meet the following standard instead of the boron standard of Section 302.208(General Use):	
	15 mg/l	
Effluent Standards	No person shall cause or allow the concentration of the following constituents in any effluent to exceed the following levels, subject to the averaging rules contained in Section 304.104(a):	
	Barium	2.0 mg/l
	Manganese	1.0 mg/l
	Nickel	1.0 mg/l
	Silver	0.1 mg/l
Indiana[14]		
All	Beryllium	Not specified
	Boron	Not specified
	Manganese	Not specified

State and Water Use	Other Elements	Criteria Values
Ohio River Main Stem and the Interstate Portion Of The Wabash River	Barium	1.0 mg/l
	Selenium	0.01 mg/l
	Silver	0.05 mg/l
Lake Michigan and Contiguous Harbor Areas	Barium	not to exceed 1000 ug/l at any time
	Selenium	not to exceed 10 ug/l at any time
	Silver	not to exceed 50 ug/l at any time
Natural Spawning, Rearing or Imprinting Areas;Migration Routes for Salmonid Fishes	Nickel (max)	$e^{(0.76(\ln(\text{hardness}^*))+4.02)}$ ug/l
	(24-hr ave)	$e^{(0.76(\ln(\text{hardness}^*))+1.06)}$ ug/l
	Selenium (max)	260 ug/l
	(24-hr ave)	35 ug/l
	Silver (max)	$e^{(1.72(\ln(\text{hardness}^*))-6.52)}$ ug/l
	Chlorine (max)	19 ug/l
	(24-hr ave)	11.0 ug/l
	*Hardness in mg/l $CaCO_3$	

Iowa[15]

All	Beryllium	Not specified
	Boron	Not specified
	Manganese	Not specified
	Nickel	Not specified
Wildlife, Fish, Aquatic And Semiaquatic Life, Secondary Contact (Class B)	Barium	1.0 mg/l
	Selenium	0.1 mg/l
	Chlorine	25 ug/l (total residual)
Potable Water Supply (Class C)	Barium	1.0 mg/l
	Selenium	0.01 mg/l
	Silver	0.05 mg/l

Kansas[16]

All	Barium	Not specified
	Beryllium	Not specified
	Manganese	Not specified
Aquatic Life	Chlorine - There shall be no detectable concentrations of total residual chlorine in surface waters as detected by method 408C (Amperometric) or 408D (DPD-FAS), which are hereby adopted by reference, and are found in the 16th edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association, 1985).	

State and Water Use	Other Elements Criteria Values	
	Nickel	hardness range (mg/l $CaCO_3$)
	0.056 mg/l	< 150
	0.130 mg/l	150-250
	0.192 mg/l	251-400
	0.324 mg/l	> 400
	Selenium	0.035 mg/l
	Silver	0.00012 mg/l
	Zinc	0.047 mg/l
Agricultural Irrigation	Boron	0.75 mg/l
	Selenium	0.2 mg/l
	Silver	0.2 mg/l
Agricultural Livestock	Boron	5 mg/l
	Silver	0.05 mg/l
Kentucky[17]		
All	Boron	Not specified
	Nickel	Not specified
Warmwater Aquatic Habitat	Beryllium	11 ug/l soft water 1100 ug/l hard water
	Chlorine	10 ug/l (total residual)
Coldwater Aquatic Habitat	Beryllium	11 ug/l soft water 1100 µg/l hard water
	Chlorine	The total residual chlorine shall not exceed two (2) ug/l as an instream value.
Domestic Water Supply	Barium	1 mg/l
	Manganese	0.05 mg/l
	Selenium	0.01 mg/l
	Silver	0.05 mg/l
Louisiana[18]		
All	Covered by general criteria for toxic substances.	
	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified

State and Water Use	Other Elements Criteria Values	
Maine[19]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Maryland[20]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Natural Trout Waters (Class III)	Chlorine	The use of chlorine or chlorine compounds is prohibited in the treatment of wastewaters discharged into the waters of this State designated as Class III unless: (i) The volume of treated sewage discharged from the sewage treatment facilities is less than 1 percent of the 7 day, 10 year low flow; or (ii) Matching federal funds are not available to convert existing publicly owned treatment works from chlorine to another disinfectant. (iii) When an exception occurs, the total residual chlorine shall be less than .002 mg/l in the surface waters.
Recreational Trout Waters (Class IV)	Chlorine	Total residual chlorine concentrations shall be less than .002 mg/l in the surface waters.
Massachusetts[21]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified

State and Water Use	Other Elements	Criteria Values
Michigan[22]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Minnesota[23]		
All	Beryllium	Not specified
	Nickel	Not specified
Domestic (Classes A, B, C, & D)	Barium	1 mg/l
	Manganese	0.05 mg/l
	Selenium	0.01 mg/l
	Silver	0.05 mg/l
Fisheries & Recreation (Classes A, B, & C)	Chlorine	0.005 mg/l (total residual)*
Agriculture and Wildlife (Class A)	Boron	0.5 mg/l
Mississippi[24]		
All	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
Public Water Supply	Barium	1.0 mg/l
	Selenium	0.01 mg/l
	Silver	0.05 mg/l
Missouri[25]		
Effluent Limitations for: Losing Stream; Wild and Scenic Rivers and Ozark National Scenic Riverways and	Chlorine - Where chlorine is used as a disinfectant, the effluent shall be dechlorinated except when the discharge is: A. Into an unclassified stream at least one (1) mile from a Water Quality Standard classified stream;	

* Applies to conditions of continuous exposure, where continuous exposure refers to chlorinated effluents which are discharged for more than a total of two hours in any 24 hour period.

State and Water Use	Other Elements Criteria Values
Drainage Thereto; all water, except those in (1)(A)1.,2.,3.,4.,5. and 6.	B. Into a flowing stream where the seven (7)-day Q_{10} flow is equal to or greater than fifty (50) times the effluent flow.
Effluent Limitations for Subsurface Waters	If aquifer recharges surface water designated for Aquatic Life protection:

Barium	1000 ug/l
Beryllium	5 ug/l
Boron	2000 ug/l
Chlorine	10 ug/l (total residual)
Manganese	50 ug/l
Nickel	100 ug/l
Selenium	10 ug/l
Silver	5 ug/l

When aquifer does not recharge surface water designated for Aquatic Life protection:

Barium	1000 ug/l
Beryllium	100 ug/l
Boron	2000 ug/l
Chlorine	Not specified
Manganese	50 ug/l
Nickel	200 ug/l
Selenium	10 ug/l
Silver	50 ug/l

Groundwater

If aquifer recharge has an effect on surface water designated for Aquatic Life protection:

Barium	1000 ug/l
Beryllium	5 ug/l
Boron	750 ug/l
Chlorine	10 ug/l (total residual)
Manganese	50 ug/l
Nickel	100 ug/l
Selenium	10 ug/l
Silver	5 ug/l

If aquifer recharge has a negligible effect on surface water designated for Aquatic Life protection:

Barium	1000 ug/l
Beryllium	100 ug/l
Boron	750 ug/l
Chlorine	Not specified
Manganese	50 ug/l
Nickel	200 ug/l
Selenium	10 ug/l
Silver	50 ug/l

State and Water Use	Other Elements Criteria Values	
Aquatic Life	Beryllium	5 ug/l
	Chlorine	10 ug/l (total residual)
	Nickel	100 ug/l
	Selenium	10 ug/l
	Silver	5 ug/l
Irrigation	Beryllium	100 ug/l
	Boron	750 ug/l
Livestock, Wildlife Watering	Nickel	200 ug/l
Coldwater Fishery*	Chlorine	2.0 ug/l (total residual)

* All values for "Aquatic Life" also shall apply, unless values listed here are more stringent.

Drinking Water Supply	Barium	1000 ug/l
	Manganese	50 ug/l
	Selenium	10 ug/l
	Silver	50 ug/l

Montana[26]

All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified

Nebraska[27]

All	Beryllium	Not specified
	Boron	Not specified
	Manganese	Not specified
	Nickel	Not specified
Aquatic Life: Coldwater Habitat (Classes A & B); Warmwater Habitat (Class A)	Chlorine	0.01 mg/l (residual)
Public Drinking Water	Barium	1.0 mg/l
	Selenium	0.01 mg/l
	Silver	0.05 mg/l

State and Water Use	Other Elements Criteria Values		
Nevada[28]			
All	Barium	1.0 mg/l	
	Beryllium	0.011 mg/l	
	Boron	1.0 mg/l	
	Chlorine	0.002 mg/l	
	Manganese	0.05 mg/l	sample mean
		0.20 mg/l	single value
	Nickel	0.1 mg/l	
	Selenium	0.01 mg/l	
	Silver	0.05 mg/l	
Humboldt River			
Irrigation	Boron	1.0 mg/l	
Municipal or Domestic supply	Selenium	0.01 mg/l	
Freshwater Aquatic Life	Selenium	0.260 mg/l	
Irrigation	Selenium	0.02 mg/l	
Watering of Livestock & Propagation of Wildlife	Selenium	0.05 mg/l	
New Hampshire[29]			
All	Barium	Not specified	
	Beryllium	Not specified	
	Boron	Not specified	
	Chlorine	Not specified	
	Manganese	Not specified	
	Nickel	Not specified	
	Selenium	Not specified	
	Silver	Not specified	
New Jersey[30]			
All	Beryllium	Not specified	
	Boron	Not specified	
	Manganese	Not specified	
	Nickel	Not specified	
FW-2	Barium	1000 ug/l	
	Chlorine	3.0 ug/l	(total residual)
	Selenium	10 ug/l	
	Silver	50 ug/l	
All SE, SC	Chlorine	10.0 ug/l	(total residual)

State and Water Use	Other Elements Criteria Values		
New Mexico[31]			
All	Barium	Not specified	
	Beryllium	Not specified	
	Boron	Not specified	
	Manganese	Not specified	
	Nickel	Not specified	
	Selenium	Not specified	
	Silver	Not specified	
Coldwater Fishery	Chlorine	0.003 mg/L (total residual)	
High Quality Cold Water Fishery	Chlorine	0.002 mg/L (total residual)	
New York[32]			
All	Chlorine	Not specified	
AA; AA-s; A; A-s (Human)	Barium	1,000	all units in ug/l
	Manganese	300	
	Selenium	10	
	Silver	50	
AA; AA-s; A; A-s (Aquatic)	Beryllium	11[a] or 1,100[b]	
	Boron	10,000	
	Nickel	[c]	
	Selenium	1.0[d]	
	Silver	0.1[e]	
B; C	Beryllium	11[a] or 1,100[b]	
	Boron	10,000	
	Nickel	[c]	
	Selenium	1.0[d]	
	Silver	0.1[e]	
D	Nickel	[f]	
	Silver	[g]	
SA; SB; SC	Boron	1,000	
	Nickel	7.1	
SD	Nickel	140	
	Silver	2.3	
	Remarks:	[a] - when hardness is ≤ 75 ppm	
		[b] - when hardness is > 75 ppm	
		[c] - exp (0.76[ln(ppm hardness)]+1.06)	
		[d] - all standards except (Human) apply to acid-soluble form	
		[e] - ionic silver	
		[f] - exp (0.76[ln(ppm hardness)]+4.02)	

State and Water Use	Other Elements Criteria Values		
	^{g} - exp (1.72[ln(ppm hardness)]-6.52) Most standards except (Human) apply to acid-soluble form.		
GA	Barium	1.0 mg/l	
	Manganese	0.3 mg/l	
	Selenium	0.02 mg/l	
	Silver	0.05 mg/l	
Effluent Standards for Discharges To Class GA Waters	Barium	2.0 mg/l	
	Manganese	0.6 mg/l	
	Nickel	2.0 mg/l	
	Selenium	0.04 mg/l	
	Silver	0.1 mg/l	
North Carolina[33]			
All	Boron	Not specified	
Fresh Surface Waters	Beryllium	11 ug/l	
	Chlorine	2.0 ug/l	(tot. resid.) for Trout Waters
	Nickel	50 ug/l	or if more stringent, 0.01 of the 96-hour LC50
	Selenium	10 ug/l	or if more stringent, 0.01 of the 96-hour LC50 in streams and rivers
		5 ug/l	in ponds, lakes and reservoirs
	Silver	10 ug/l	
WS-1 Waters	Barium	1.0 mg/l	
	Manganese	50 ug/l	
	Nickel	25 ug/l	or if more stringent, 0.01 of the 96-hour LC50
WS-II Waters	Barium	1.0 mg/l	
	Manganese	50 ug/l	
	Nickel	25 ug/l	or if more stringent, 0.01 of the 96-hour LC50
WS-III Waters	Barium	1.0 mg/l	
	Manganese	50 ug/l	
	Nickel	25 ug/l	or if more stringent, 0.01 of the 96-hour LC50
Tidal Salt Waters	Nickel	50 ug/l	or if more stringent, 0.01 of the 96-hour LC50
	Selenium	10.0 ug/l	or if more stringent, 0.01 of the 96-hour LC50
	Silver	10 ug/l	
Class SA Waters	Manganese	0.1 mg/l	

State and Water Use	Other Elements	Criteria Values
North Dakota[34]		
All	Beryllium	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Silver	Not specified
Classes I, IA, II, and III	Barium	1.0 mg/l (dissolved)
	Boron	.75 mg/l (dissolved)
	Chlorine	.2 mg/l (total residual)
	Selenium	.01 mg/l (total)
Ohio[35]		
All	Boron	Not specified
All Lake Erie Uses	Barium	1.0 mg/l
	Beryllium	1.100 mg/l
	Chlorine	0.002 mg/l (total residual)
	Manganese	0.050 mg/l
	Nickel	0.025 mg/l
	Selenium	0.010 mg/l
	Silver	0.050 mg/l
All Ohio River Uses	Barium	1.0 mg/l
	Selenium	0.01 mg/l
	Silver	0.05 mg/l
Aquatic Life Habitat	Beryllium	water hardness dependent (30-day ave.)
	Chlorine	2 ug/l (total residual) (30-day ave.)
		No chlorine is to be discharged - Seasonal Salmonid
	Nickel	water hardness dependent (30-day ave.)
	Selenium	34 ug/l (30-day ave.)
	Silver	1.3 ug/l (30-day ave.)
		0.06 ug/l (30-day ave.) - Coldwater
Nuisance Prevention	Beryllium	water hardness dependent (max.)
	Nickel	water hardness dependent (max.)
	Selenium	128 ug/l (max.)
	Silver	water hardness dependent (max.)
Public Water Supply	Barium	1.0 ug/l (max.)
	Manganese	50 ug/l (max.)
	Selenium	10 ug/l (max.)
	Silver	50 ug/l (max.)
Agricultural Water Supply	Beryllium	100 ug/l (max.)
	Nickel	200 ug/l (max.)
	Selenium	50 ug/l (max.)

State and Water Use	Other Elements Criteria Values	
Oklahoma[36]		
All	Beryllium	Not specified
	Boron	Not specified
	Manganese	Not specified
Public And Private Water Supplies	Barium	1.00 mg/l
	Selenium	0.010 mg/l
	Silver	0.050 mg/l
Fish And Wildlife	Chlorine	The maximum allowable concentration for total residual chlorine shall not exceed 0.5 mg/l at any time. Total residual chlorine shall include the combined chlorine (as chloramines) plus free chlorine.
	Nickel	A methodology to establish protective criteria for Nickel is being developed. Until further criteria are adopted the 1982 criteria for Nickel remain in effect.
	Selenium	Same as above comment (Nickel).
	Silver	Criteria for silver whose toxicity is extremely dependent on water chemistry are listed by segment. The concentration varies from 1.3 to 50.0 ug/l depending on the segment (see Oklahoma Water Quality Standards Table 1).
Oregon[37]		
All	Beryllium	Not specified
	Chlorine	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
All	Special water quality standard applicable to: North Coast-Lower Columbia Basin, Mid Coast Basin, Umpqua Basin, South Coast Basin, Rogue Basin, Willamette Basin, Sandy Basin, Hood Basin, Deschutes Basin, John Day Basin, Umatilla Basin, Walla Walla Basin, Grande Ronde Basin, Powder Basin, Malheur River Basin, Owyhee Basin, Malheur Lake Basin, Goose and Summer Lakes Basin, and Klamath Basin:	
	Barium	1.0 mg/l
	Boron	0.5 mg/l
	Manganese	0.05 mg/l

State and Water Use	Other Elements Criteria Values		
Pennsylvania[38]			
All	Barium	Not specified	
	Beryllium	Not specified	
	Boron	Not specified	
	Chlorine	Not specified	
	Selenium	Not specified	
	Silver	Not specified	
All	Manganese	1.0 mg/l	
	Nickel	Not to exceed 0.01 of the 96-hour LC50 for representative important species as determined through substantial available literature data or bioassay tests tailored to the ambient quality of the receiving waters.	
Rhode Island[39]			
All	Barium	Not specified	
	Boron	Not specified	
	Chlorine	Not specified	
	Manganese	Not specified	
		minimum data base guidelines	
		R.I.DEM Acute	R.I.DEM Chronic
Fresh Water Aquatic Life	Beryllium	7.5	.17
		U.S.EPA Acute	U.S.EPA Chronic
	Nickel	$e^{(.76[\ln(H)]+4.02)}$	$e^{(.76[\ln(H)]+1.06)}$
	Selenium	260	35 (Selenite)
	Silver	$e^{(1.72[\ln(H)]-6.52)}$	acute/45*
	* - No EPA chronic criterion is available for silver. The chronic value should be determined by dividing the acute value given by the hardness equation by an acute to chronic ratio of 45.		
Saltwater Aquatic Life	Nickel	140	7.1
	Selenium	410	54 (Selenite)
	Silver	2.3	---
		all units in ug/l	

State and Water Use	Other Elements	Criteria Values
South Carolina[40]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
South Dakota[41]		
All	Beryllium	Not specified
	Boron	Not specified
	Manganese	Not specified
	Nickel	Not specified
Domestic Water Supply	Barium	1 mg/l
	Selenium	0.01 mg/l
	Silver	0.05 mg/l
Fish Life Propagation	Chlorine	0.02 mg/l (total residual)
	The applicable criteria are to be maintained at all times, without exception.	
Tennessee[42]		
All	Beryllium	Not specified
Domestic Water Supply	Nickel	100 ug/l
	Selenium	10 ug/l
	Silver	50 ug/l
Effluent Limitations (Industrial Wastewater Treatment Plants)	Barium	5.0 mg/l
	Boron	500 mg/l
	Chlorine	2.0 mg/l
	Manganese	10.0 mg/l
	Nickel	3.0 mg/l
	Selenium	0.01 mg/l
	Silver	0.05 mg/l
Texas[43]		
All	Chlorine	Chlorine toxicity will be controlled by the development of generic permit limits for final residual chlorine concentration.

State and Water Use	Other Elements Criteria Values	
	Nickel	Acute = $e^{(0.8460[\ln(\text{hardness})]+3.3612)}$ Chronic = $e^{(0.8460[\ln(\text{hardness})]+1.1645)}$
	Selenium	Acute = 260 µg/l Chronic = 35 µg/l
	Silver	Acute = $e^{(1.72[\ln(\text{hardness})]-6.52)}$ Chronic = 0.49 µg/l
All Toxic Material without Specific Numerical Criteria	10) For toxic material for which specific numerical criteria are not listed in the table in §307.6(c)(1) of this title (relating to Toxic Materials), the following provisions shall be applied in accordance with the application procedures of specific numerical criteria, as established in this sections and in §307.8 (relating to Application of Standards): A. concentration of non-persistent toxic material shall not exceed concentrations which are chronically toxic (as determined from appropriate chronic toxicity data or calculated as 0.1 of LC_{50} values) to representative, sensitive aquatic organisms; B. concentrations of persistent toxic materials that do not bioaccumulate shall not exceed ambient concentrations of specific toxics of concern in receiving water, sediment, and/or indigenous biota; C. bioavailability of specific toxics of concern in the effluent.	
Utah[44]		
All	Beryllium Manganese	Not specified Not specified
Domestic Source	Barium Chlorine Selenium Silver	1 mg/l Limits assigned on a case-by-case basis. .01 mg/l .05 mg/l
Agriculture	Selenium	.05 mg/l
Aquatic Wildlife (Class 3A & 3B)	Chlorine Selenium Silver Nickel	.011 µg/l - 4 day avg. .019 µg/l - 1 hour avg. 5.0 µg/l - 4 day avg. 20 µg/l - 1 hour avg. 0.12 µg/l - 4 day avg. 4.1 µg/l - 1 hour avg. (Hardness Depend) 160 µg/l - 4 day avg. 1400 µg/l - 1 hour avg.

State and Water Use	Other Elements	Criteria Values
Aquatic Wildlife (Class 3C)	Chlorine	0.2 µg/l - 1 hour avg.
	Selenium	5.0 µg/l - 4 day avg. 20 µg/l - 1 hour avg.
	Silver	.12 µg/l - 4 day avg. 4.1 µg/l - 1 hour avg.
	Nickel	160 µg/l - 4 day avg. 1400 µg/l - 1 hour avg.
Aquatic Wildlife (Class 3D)	Chlorine	Determined on case-by-case basis.
	Selenium	5.0 µg/l - 4 day avg. 20 µg/l - 1 hour avg.
	Silver	4.1 µg/l - 1 hour avg.
	Nickel	160 µg/l - 4 day avg. 1400 µg/l - 1 hour avg.
Vermont[45]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
Virginia[46]		
All	Beryllium	Not specified
	Boron	Not specified
Public Water Supply	Barium	1.0 mg/l
	Manganese*	0.05 mg/l (soluble)
	Selenium*	0.01 mg/l
	Silver*	0.05 mg/l
Surface Water (Chronic Criteria for the Protection of Aquatic Lige)	Manganese	100 ug/l saltwater
	Nickel**	$e^{0.76(\ln(\text{hardness}))+1.06}$ freshwater
		7.1 ug/l saltwater
	Selenium***	35 ug/l freshwater
		54 ug/l saltwater
	Silver**	$e^{1.72(\ln(\text{hardness}))-6.52}$ x0.01 freshwater
		0.023 ug/l saltwater

* - The numeric standards for the chemicals listed under Public Water Supply above are designed to protect public water supplies for human consumption. The limits established for those chemicals marked with an asterisk (*) may not protect aquatic life.

State and Water Use	Other Elements Criteria Values	
	Therefore when a request to classify a stream as a public water supply is received, it will be determined if more stringent limits are needed for those chemicals in order to insure protection of aquatic life.	
	** - total recoverable *** - total inorganic	
Groundwater(All except Cumberland Plateau)	Manganese	0.05 mg/l
Groundwater(Cumberland Plateau)	Manganese	0.01 - 0.5 mg/l
Washington[47]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
West Virginia[48]		
All	Beryllium	Not specified
	Boron	Not specified
Category A	Barium	1.0 mg/l
	Selenium	10 ug/l
Category A & B	Manganese*	1.0 mg/l
	* - Effluent limitations which may result in a concentration up to 2.0 mg/l manganese in the stream are allowable upon demonstration to the Chief by the applicant that such concentration will not have an adverse impact upon designated stream uses. This demonstration is subject to EPA approval and must show either: (1) the stream is supporting designated uses while containing manganese concentrations higher than the applicable criteria, or (2) the stream does not have an aquatic life use to protect. Notwithstanding Series I, Section 4 of the Board's regulations, this demonstration shall be the only demonstration required before the Chief and the Board with respect to water quality related effluent limitations. This exception does not apply to trout waters.	

State and Water Use	Other Elements	Criteria Values
Category B1 & C2	Silver	Water Use Categories B1 & C2: (Public Water Supply and Trout Waters)

Hardness mg/l as $CaCO_3$	Silver Criterion ug/l Total Silver
0 - 50	1
51-100	4
101- 200	12
> 201	24

Category B2	Nickel	50 ug/l
	Chlorine	No chlorinated discharges allowed (total residual)
Category A,B1,B3 & C	Chlorine	10 ug/l as measured by the amperometric or equivalent method (total residual)
	Silver	Water Use Category C1:

Water Hardness mg/l as $CaCO_3$	Total Recoverable Silver ug/l
0 - 50	1
51-100	4
101-200	12
201-300	24
301-400	24
401-500	30
501-600	43

All except B2	Chlorine -	There is a chart located in Section 8 of the West Virginia Water Standards that may be used to derive the criteria instead of the above fixed criteria.

Wisconsin[49]

All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified

Wyoming[50]

All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified

State and Water Use	Other Elements Criteria Values	
	Chlorine	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
American Samoa[51]		
All	Barium	Not specified
	Beryllium	Not specified
	Boron	Not specified
	Manganese	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified
All Fresh Surface Water, Embayments, Open Coastal Water and Oceanic Waters	Chlorine	20 ug/l (total residual) (shall apply as a minimum within the zone of mixing)
District of Columbia[52]		
All	Boron	Not specified
	Manganese	Not specified
Class C (Aquatic Life, Waterfowl, Shore Birds, And Water Oriented Wildlife)	Beryllium	150 ug/l
	Chlorine	0.01 mg/l (total residual)
	Nickel	100 ug/l
	Selenium	0.04 mg/l (total recoverable)
	Silver	1.0 ug/l (dissolved)
Class D (Public Water Supply)	Barium	1.0 mg/l (total recoverable)
	Beryllium	0.0004 ug/l*
	Nickel	13.0 ug/l
	Selenium	0.01 mg/l (total recoverable)
	Silver	50.0 ug/l (dissolved)
	* - A risk factor of 10^{-6} is associated with the criterion, the preferred level is absolutely none.	
Guam[53]		
All	Beryllium	Not specified
	Nickel	Not specified
	Selenium	Not specified
	Silver	Not specified

State and Water Use	Other Elements Criteria Values		
	Maximum Numerical Limit		Application Factor
	Marine	Fresh	
Barium	0.5 mg/l		.05
Boron	5.0 mg/l		.1
Chlorine*	0.01 mg/l	(free,residual)	.1
Manganese	0.02 mg/l		.02

* - Greater amounts of Chlorine may be used to treat a source of drinking water in order to meet the requirements of Subsection II.B.1 of the Revised Guam Water Quality Standards.

Mariana Islands[54]

All

	Maximum Conc. Level		Application Factor
	mg/l	ug/l	
Barium	0.50	500.0	0.05
Beryllium	0.10	100.0	0.01
Boron	5.00	5000.0	0.10
Chlorine*	0.0075	7.5	0.10
Chlorine**	0.011	11.0	0.10
Manganese	0.02	20.0	0.02
Nickel	0.002	2.0	0.02
Selenium	-----	-----	0.01
Silver	0.001	1.0	0.01

* - Chlorine prod. oxidants
** - Chlorine residual (for fresh waters)

Puerto Rico[55]

All	Beryllium	Not specified
	Chlorine	Not specified
	Nickel	Not specified
SB, SC (Coastal Waters)	Barium	1,000.0 ug/l
	Boron	4,800.0 ug/l
	Manganese	100.0 ug/l
	Selenium	10.0 ug/l
	Silver	2.00 ug/l
SD (Surface Waters)	Barium	1,000.0 ug/l
	Boron	1,000.0 ug/l
	Manganese	-----
	Selenium	10.0 ug/l
	Silver	2.00 ug/l

State and Water Use	Other Elements Criteria Values				
Trust Territory[56]					
		Factor	Marine	Class 1	Class 2
All	Barium	0.05	0.5 mg/l	1.0 mg/l	
	Beryllium	0.01	0.1 mg/l	6.8 ug/l	
	Boron	0.1	5.0 mg/l		
	Chlorine*	0.1	7.5 ug/l	10 ug/l	10 ug/l
	Manganese	0.02	0.02 mg/l	50 mg/l	
	Nickel	0.01	0.002mg/l	56 ug/l	56 ug/l
	Selenium	0.01	0.005ug/l	10 ug/l	10 ug/l
	Silver	0.01	1 ug/l	1 ug/l	1 ug/l
	* - Chlorine-produced oxidants				
Virgin Islands[57]					
All	Barium	Not specified			
	Beryllium	Not specified			
	Boron	Not specified			
	Chlorine	Not specified			
	Manganese	Not specified			
	Nickel	Not specified			
	Selenium	Not specified			
	Silver	Not specified			