

Appendix F

Water Quality Standards and Nutrient Criteria

F.1 NUTRIENT CRITERIA

Tables F-1 and F-2 summarize nutrient criteria for total nitrogen and total phosphorus, water quality criteria for ammonia and dissolved oxygen, and guidelines for BOD and solids. EPA has developed criteria for each of the aggregate nutrient ecoregions for total phosphorus, total nitrogen, chlorophyll a, and turbidity. Criteria for these different parameters are presented for rivers/streams and lakes/reservoirs for each ecoregion in Tables F-1 and F-2, respectively. A range has also been included in these tables to present the minimum and maximum values for each parameter.

Table F-1
Nutrient Criteria for Rivers and Streams by Ecoregion

	Ecoregions for Rivers & Streams													
<i>Parameter</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>	<i>11</i>	<i>12</i>	<i>14</i>	<i>Range</i>
TP Fg/L	47.00	10.00	21.88	23.00	67.00	76.25	33.00	10.00	36.56	128*	10.00	40.00	31.25	10.00 – 128
TN mg/L	0.31	0.12	0.38	0.56	0.88	2.18	0.54	0.38	0.70	0.76	0.31	0.90	0.71	0.12 – 2.18

Source: USEPA, 2000b. (Updated table from USEPA, 2002.)

Note: *This value appears inordinately high and may either be a statistical anomaly or reflects a unique conditions. In any case, further regional investigation is indicated to determine the sources, i.e., measurement error, notational error, statistical error, statistical anomaly, natural enriched conditions, or cultural impacts.

Table F-2
Nutrient Criteria for Lakes and Reservoirs by Ecoregion

	Ecoregions for Lakes & Reservoirs												
<i>Parameter</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>11</i>	<i>12</i>	<i>13</i>	<i>14</i>	<i>Range</i>
TP Fg/L	8.75	17.00	20.00	33.00	37.5	14.75	8.00	20.00	8.00	10.00	17.50	8.00	8.00 – 37.50
TN mg/L	0.10	0.40	0.44	0.56	1.68	0.66	0.24	0.36	0.46	0.52	1.27	0.32	0.10 – 1.68

Source: USEPA, 2000b. (Updated table from USEPA, 2002.)

F.2 AMMONIA CRITERIA

Water quality criteria for ammonia are expressed as the Criteria Maximum Concentration (CMC or acute criterion) and the Criteria Continuous Concentration (CCC or chronic criterion). These values, which were finalized by EPA in 1999, are intended to be protective to aquatic life. The CMC and CCC are expressed in terms of milligrams ammonia nitrogen per liter (mg N/L) and they vary with pH. For the CMC, based on differences in species acute sensitivity, different CMC values were derived for waters where salmonids (e.g., trout and salmon) are present and waters where salmonids are not present. For the CCC, no substantial differences between salmonid and non-salmonid chronic sensitivity were apparent and consequently, the CCC does not vary with the type of fish present. Criteria concentrations for a few example pH values are shown in Table F-3. Refer to the *1999 Update of Ambient Water Quality Criteria for Ammonia* for the computational formula and for other example pH values between 6.5 and 9.0 (USEPA, 1999).

Table F-3
CMC and CCC (mg N/L) at a Few Example pH Values

pH	CMC (salmonids present)	CMC (salmonids absent)	CCC
6.5	32.5	48.8	3.48
7.0	24.0	36.1	3.08
7.5	13.3	19.9	2.28
8.0	5.60	8.40	1.27
8.5	2.13	3.20	0.57
9.0	0.88	1.32	0.25

Source: USEPA, 1999.

F.3 DISSOLVED OXYGEN CRITERIA

National criteria for ambient dissolved oxygen concentrations for the protection of freshwater aquatic life are presented in Table F-4. The criteria are derived from production impairment estimates found in the criteria document, which are based on growth data and information on temperature, disease,

and pollutant stresses. Each criterion may be viewed as an estimate of the threshold concentration below which detrimental effects are expected (USEPA, 1986).

Criteria for coldwater fish are intended to apply to waters containing species of the family Salmonidae or other coldwater or coolwater fish deemed by the user to be closer to salmonids in sensitivity than to most warmwater species. The criteria for warmwater fish are necessary for protecting early life stages of warmwater fish as sensitive as channel catfish and to protect other life stages of fish as sensitive as largemouth bass (USEPA, 1986).

Table F-4
Water Quality Criteria for Ambient Dissolved Oxygen Concentration

	Coldwater Criteria		Warmwater Criteria	
	Early Life Stages ^{1,2}	Other Life Stages	Early Life Stages ²	Other Life Stages
30 Day Mean (mg/L)	n/a ³	6.5	n/a	5.5
7 Day Mean (mg/L)	9.5 (6.5)	n/a	6.0	n/a
7 Day Mean Minimum (mg/L)	n/a	5.0	n/a	4.0
1 Day Minimum ^{4,5} (mg/L)	8.0 (5.0)	4.0	5.0	3.0

¹ These are water column concentrations recommended to achieve the required intergravel DO concentrations shown in parentheses. The 3-mg/L differential is discussed in the criteria document. For species that have early life stages exposed directly to the water column, the figures in parentheses apply.

² Includes all embryonic and larval stages and all juvenile forms to 30-days following hatching.

³ n/a = not applicable.

⁴ For highly manipulatable discharges, further restrictions apply (see page 37 of the dissolved oxygen criteria document).

⁵ All minima should be considered as instantaneous concentrations to be achieved at all times.

Source: USEPA, 1986.

F.4 BIOCHEMICAL OXYGEN DEMAND

There are no national in-stream criteria for BOD. However, ambient levels for BOD vary by state. EPA has established effluent limitations guidelines for discharges such as wastewater treatment plants. These guidelines are based on the ability of technologies to economically and effectively remove

BOD from waste streams, which can vary depending on location and site-specific considerations. In any case, minimum secondary treatment effluent concentration limits for BOD₅ have been established for wastewater treatment plants. The average value during a 30-day period shall not exceed 30 mg/L and the average 7-day value shall not exceed 45 mg/L (USEPA, 2000a).

Furthermore, BOD (together with dissolved oxygen (DO), fecal coliforms (FC), and total suspended solids (TSS)) has been used as an indicator of the recreational use value of a water body. Changes in the recreational use value of a water body, as indicated by changing values of BOD, DO, FC, and TSS, can then be monetized (USEPA, 2001).

F.5 SOLIDS¹

There are no national water quality criteria for solids. However, many AAP facilities with NPDES permits must control and monitor their discharge levels of solids. In Idaho for example, NPDES permits specify a maximum average of 0.1 mL/L for settleable solids and 5 mg/L for total suspended solids (IDEQ, n.d.). According to the U.S. Army Corps of Engineers *Fisheries Handbook*, streams with silt loads (e.g., settleable solids) averaging between 80 and 4,000 mg/L should not be considered good areas for supporting fresh water fisheries. Additionally, streams with less than 25 mg/L may be expected to support good fresh water fisheries (Bell, 1986). High turbidity can also prove fatal to fish. Fatal turbidity levels for various fish species are presented in Table F-5.

¹ Total suspended solids are the suspended solids in wastewater, effluent, or water bodies, determined by tests for "total suspended non-filterable solids." Settleable solids include material heavy enough to sink to the bottom of a wastewater treatment tank. Silt is sedimentary material composed of fine or intermediate-sized mineral particles. Sediment is defined as soil, sand, and minerals washed from land into water, usually after rain (USEPA, 1998).

Table F-5
Turbidity Levels Fatal to Various Fish Species

Common name of fish	Range of temperature (°C)	Average time of test (days)	Fatal turbidity in mg/L		
			Minimum	Average	Maximum
Golden shiner	20-29	7.1	55,000	166,000	200,000
Mosquito fish	20-28	16.5	120,000	181,500	225,000
Goldfish	24-32	12.0	90,000	197,000	270,000
Green sunfish	20-29	5.5	50,000	166,500	225,000
Black bullhead	22-32	17.0	175,000	222,000	270,000
Red Shiner	22-32	9.0	175,000	183,000	190,000
River carpsucker	24-32	9.6	105,000	165,000	250,000
Largemouth bass	16-32	7.6	52,000	101,000	150,000
Pumpkinseed	16-22	13.0	16,500	69,000	120,000
Orangespotted sunfish	22-32	10.0	100,000	157,000	200,000
Channel catfish	24-32	9.3	—	85,000	—
Blackstrip top-minnow	22-26	19.3	—	175,000	—
Black crappie	28-29	2.0	—	145,000	—
Rock bass	—	3.5	—	38,250	—

Note: 1 ppm is assumed to equal 1 mg/L.

Source: U.S. Army Corps of Engineers *Fisheries Handbook*. Bell, 1986.

F.6 REFERENCES

Bell, M. C. 1986. *Fisheries Handbook of Engineering Requirements and Biological Criteria*. U.S. Army Corps of Engineers, Fish Passage Development and Evaluation Program.

IDEQ (Idaho Division of Environmental Quality). N.d. *Idaho Waste Management Guidelines for Aquaculture Operations*. Idaho Division of Environmental Quality, Boise, ID.

<http://www2.state.id.us/deq/ro_t/tro_water/aquacult_open.htm>. Accessed December 2001.

USEPA (U.S. Environmental Protection Agency). 1986. *Ambient Water Quality Criteria for Dissolved Oxygen*. EPA 440-5-86-003. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 1998. *Terms of the Environment: B*. U.S. Environmental Protection Agency. <<http://www.epa.gov/OCEPAterms/bterms.html>>. Accessed December 2001.

USEPA (U.S. Environmental Protection Agency). 1999. *1999 Update of Ambient Water Quality Criteria for Ammonia*. EPA 822-R-99-014. U.S. Environmental Protection Agency, Office of Water, Washington, DC. <<http://www.epa.gov/ost/standards/ammonia/99update.pdf>>. Accessed February 2002.

USEPA (U.S. Environmental Protection Agency). 2000a. *Progress in Water Quality: An Evaluation of the National Investment in Municipal Wastewater Treatment*. EPA-832-R-00-008. U.S. Environmental Protection Agency <<http://www.epa.gov/OW-OWM.html/wquality/index.htm>>. Accessed February 2002.

USEPA (U.S. Environmental Protection Agency). 2000b. *Summary Table for the Nutrient Criteria Documents*. U.S. Environmental Protection Agency, Office of Water, Washington, DC. <<http://www.epa.gov/waterscience/criteria/nutrient/ecoregions/sumtable.pdf>>. Accessed February 2002.

USEPA (U.S. Environmental Protection Agency). 2001. *Environmental and Economic Benefit Analysis of Proposed Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations*. EPA-821-R-01-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (U.S. Environmental Protection Agency). 2002. *Summary Table for the Nutrient Criteria Documents*. U.S. Environmental Protection Agency, Office of Water, Washington, DC. <<http://www.epa.gov/waterscience/criteria/nutrient/ecoregions/sumtable.pdf>>. Accessed May 2002.