

The Indiana Department of Environmental Management (IDEM) is providing notice of its intent to revise Indiana's Aquatic Life and Human Health Ambient Water Quality Criteria (WQC) for metals. Revisions to criteria reflect updates to National Recommended Water Quality Criteria (NRWQC) at Section 304(a) of the Clean Water Act. This review is being conducted to evaluate the need to update or revise these criteria in order to remain consistent with State and Federal laws and to ensure that Indiana's WQC for metals continue to reflect the best available science and support sound water quality management policies to improve and protect the water resources of the state. Based on the latest scientific knowledge, updated criteria for metals may become more or less stringent than current criteria.

Aquatic Life criteria for metals are expressed in terms of the dissolved metal in the water column. The recommended dissolved water quality criteria are calculated by using the aquatic life criteria expressed in terms of total recoverable metal, and multiplying it by a conversion factor. Proposed revisions are presented in Tables 1 -4.

Proposed updates to the Human Health metals criteria are presented in Table 5.

Table 1: Water quality criteria for the protection of aquatic life for waters outside of the Great Lakes Basin. All proposed criteria are presented as dissolved metals. Current criteria are expressed as dissolved metals except for mercury which is expressed as total recoverable metal.

Metal	Current Aquatic Life Criteria (µg/L)		Proposed Aquatic Life Criteria (µg/L)	
	Acute	Chronic	Acute	Chronic
Arsenic (III)	360	190	339.8	147.9
Cadmium	$(e^{(1.128 [\ln(\text{hardness})]-3.828)}) \times 1.136672 - [(\ln \text{hardness})(0.041838)]$	$(e^{(0.7852 [\ln(\text{hardness})]-3.490)}) \times 1.101672 - [(\ln \text{hardness})(0.041838)]$	$(e^{(1.0166 [\ln(\text{hardness})]-3.924)}) \times 1.136672 - [(\ln \text{hardness})(0.041838)]$	$(e^{(0.7409 [\ln(\text{hardness})]-4.719)}) \times 1.101672 - [(\ln \text{hardness})(0.041838)]$
Chromium (III)	$(e^{(0.819 [\ln(\text{hardness})]+3.688)}) \times 0.316$	$(e^{(0.8190 [\ln(\text{hardness})]+1.561)}) \times 0.860$	$(e^{(0.819 [\ln(\text{hardness})]+3.7256)}) \times 0.316$	$(e^{(0.819 [\ln(\text{hardness})]+0.6848)}) \times 0.860$
Chromium (VI)	16 X 0.982	11 X 0.962	16.02 X 0.982	10.98 X 0.962
Copper	$(e^{(0.9422 [\ln(\text{hardness})]-1.464)}) \times 0.960$	$(e^{(0.8545 [\ln(\text{hardness})]-1.465)}) \times 0.960$	$(e^{(0.9422 [\ln(\text{hardness})]-1.700)}) \times 0.960$	$(e^{(0.8545 [\ln(\text{hardness})]-1.702)}) \times 0.960$
Lead	$(e^{(1.273 [\ln(\text{hardness})]-1.460)}) \times 1.46203 - [(\ln \text{hardness})(0.145712)]$	$(e^{(1.273 [\ln(\text{hardness})]-4.705)}) \times 1.46203 - [(\ln \text{hardness})(0.145712)]$	$(e^{(1.273 [\ln(\text{hardness})]-1.005)}) \times 1.46203 - [(\ln \text{hardness})(0.145712)]$	$(e^{(1.273 [\ln(\text{hardness})]-4.003)}) \times 1.46203 - [(\ln \text{hardness})(0.145712)]$
Mercury (Total)	2.4	0.012	No proposed national criterion	No proposed national criterion
Mercury (Dissolved)	No current criterion	No current criterion	1.7 X 0.85	0.91 X 0.85
Nickel	$(e^{(0.8460 [\ln(\text{hardness})]+3.3612)}) \times 0.998$	$(e^{(0.8460 [\ln(\text{hardness})]+1.1645)}) \times 0.997$	$(e^{(0.846 [\ln(\text{hardness})]+2.255)}) \times 0.998$	$(e^{(0.846 [\ln(\text{hardness})]+0.0584)}) \times 0.997$
Selenium	130	35	No proposed national criterion	5
Silver	$(e^{(1.72 [\ln(\text{hardness})]-6.52)/2}) \times 0.85$	No current criterion	$(e^{(1.72 [\ln(\text{hardness})]-6.59)}) \times 0.85$	No proposed national criterion
Zinc	$(e^{(0.8473 [\ln(\text{hardness})]+0.8604)}) \times 0.978$	$(e^{(0.8473 [\ln(\text{hardness})]+0.7614)}) \times 0.986$	$(e^{(0.8473 [\ln(\text{hardness})]+0.884)}) \times 0.978$	$(e^{(0.8473 [\ln(\text{hardness})]+0.884)}) \times 0.986$

These equations can be used to calculate numeric criteria at any water hardness. "e" = the base e exponential function; "ln H" = the natural logarithm of the water hardness.

Table 2: Calculated values for dissolved metals at a hardness of 100 mg/L. Criteria values for other hardness may be calculated per the equations in Table 1.

Metal	Current Aquatic Life Criteria (µg/L)		Proposed Aquatic Life Criteria (µg/L)	
	Acute	Chronic	Acute	Chronic
Cadmium	3.7 (less stringent than proposed criterion)	1.0 (less stringent than proposed criterion)	2.0 (more stringent than current criterion)	0.25 (more stringent than current criterion)
Chromium (III)	550 (more stringent than proposed criterion)	180 (less stringent than proposed criterion)	570 (less stringent than current criterion)	74 (more stringent than current criterion)
Copper	17 (less stringent than proposed criterion)	11 (less stringent than proposed criterion)	13 (more stringent than current criterion)	9 (more stringent than current criterion)
Lead	65 (more stringent than proposed criterion)	2.5 (more stringent than proposed criterion)	102 (less stringent than current criterion)	5.0 (less stringent than current criterion)
Nickel	1400 (less stringent than proposed criterion)	160 (less stringent than proposed criterion)	470 (more stringent than current criterion)	52 (more stringent than current criterion)
Silver	1.7 (more stringent than proposed criterion)	No current criterion	3.2 (less stringent than current criterion)	No proposed national criterion
Zinc	110 (more stringent than proposed criterion)	100 (more stringent than proposed criterion)	120 (less stringent than current criterion)	120 (less stringent than current criterion)

Table 3: Water quality criteria for the protection of aquatic life for waters of the Great Lakes Basin. All proposed criteria are presented as dissolved metals. Current criteria are expressed as dissolved metals.

Metal	Current Aquatic Life Criteria (µg/L)		Proposed Aquatic Life Criteria (µg/L)	
	Acute	Chronic	Acute	Chronic
Cadmium	$(e^{(1.128 [\ln(\text{hardness})]-3.6867)}) \times 1.136672 - [(\ln \text{hardness})(0.041838)]$	$(e^{(0.7852 [\ln(\text{hardness})]-2.715)}) \times 1.101672 - [(\ln \text{hardness})(0.041838)]$	$e^{(1.0166 [\ln(\text{hardness})]-3.924)} \times 1.136672 - [(\ln \text{hardness})(0.041838)]$	$e^{(0.7409 [\ln(\text{hardness})]-4.719)} \times 1.101672 - [(\ln \text{hardness})(0.041838)]$
Lead	No current criterion	No current criterion	$(e^{(1.273 [\ln(\text{hardness})]-1.005)}) \times 1.46203 - [(\ln \text{hardness})(0.145712)]$	$(e^{(1.273 [\ln(\text{hardness})]-4.003)}) \times 1.46203 - [(\ln \text{hardness})(0.145712)]$

The equations can be used to calculate numeric criteria at any water hardness up to 400 mg/l CaCO₃. "e" = the base e exponential function. "ln H" = the natural logarithm of the water hardness. The criteria at a water hardness of 400 mg/l CaCO₃ are used for water hardnesses above 400 mg/l CaCO₃.

Table 4: Calculated values for dissolved metals at a hardness of 100 mg/L. Criteria values for other hardness may be calculated per the equation presented in Table 3.

Metal	Current Aquatic Life Criteria (µg/L)		Proposed Aquatic Life Criteria (µg/L)	
	Acute	Chronic	Acute	Chronic
Cadmium	3.7 (less stringent than proposed criterion)	1.0 (less stringent than proposed criterion)	2.0 (more stringent than current criterion)	0.25 (more stringent than current criterion)
Lead	No current criterion	No current criterion	102	5.0

Table 5: Water quality criteria for the protection of human health for waters outside of the Great Lakes Basin.

Metal	Current Human Health Criteria for the consumption of Water + Organism (µg/L)	Current Human Health Criteria for the consumption of Organism Only (µg/L)	Proposed Human Health Criteria for the consumption of Water + Organism (µg/L)	Proposed Human Health Criteria for the consumption of Organism Only (µg/L)
Antimony	146	45,000	5.6	640
Arsenic (III)	0.022	0.175	0.018	0.14
Cadmium*	10	No current criterion	No proposed national criterion	No proposed national criterion
Chromium (III)*	170,000	3,433,000	No proposed national criterion	No proposed national criterion
Chromium (VI)*	50	No current criterion	No proposed national criterion	No proposed national criterion
Copper**	No current criterion	No current criterion	1300	No proposed national criterion
Lead*	50	No current criterion	No proposed national criterion	No proposed national criterion
Manganese**	No current criterion	No current criterion	50	100
Mercury*	0.14	0.15	No proposed national criterion	No proposed national criterion
Methylmercury**	No current criterion	No current criterion	0.3	0.3
Nickel	13.4	100	610	4600
Selenium	10	No current criterion	170	4200
Silver*	50	No current criterion	No proposed national criterion	No proposed national criterion
Thallium	13	48	0.24	0.47
Zinc**	No current criterion	No current criterion	7400	26,000

* Criteria to be deleted from the proposed table

**Criteria to be added to the proposed table