VTWQS –Appendix C
Water Quality Criteria for the Protection of Human Health and Aquatic Biota

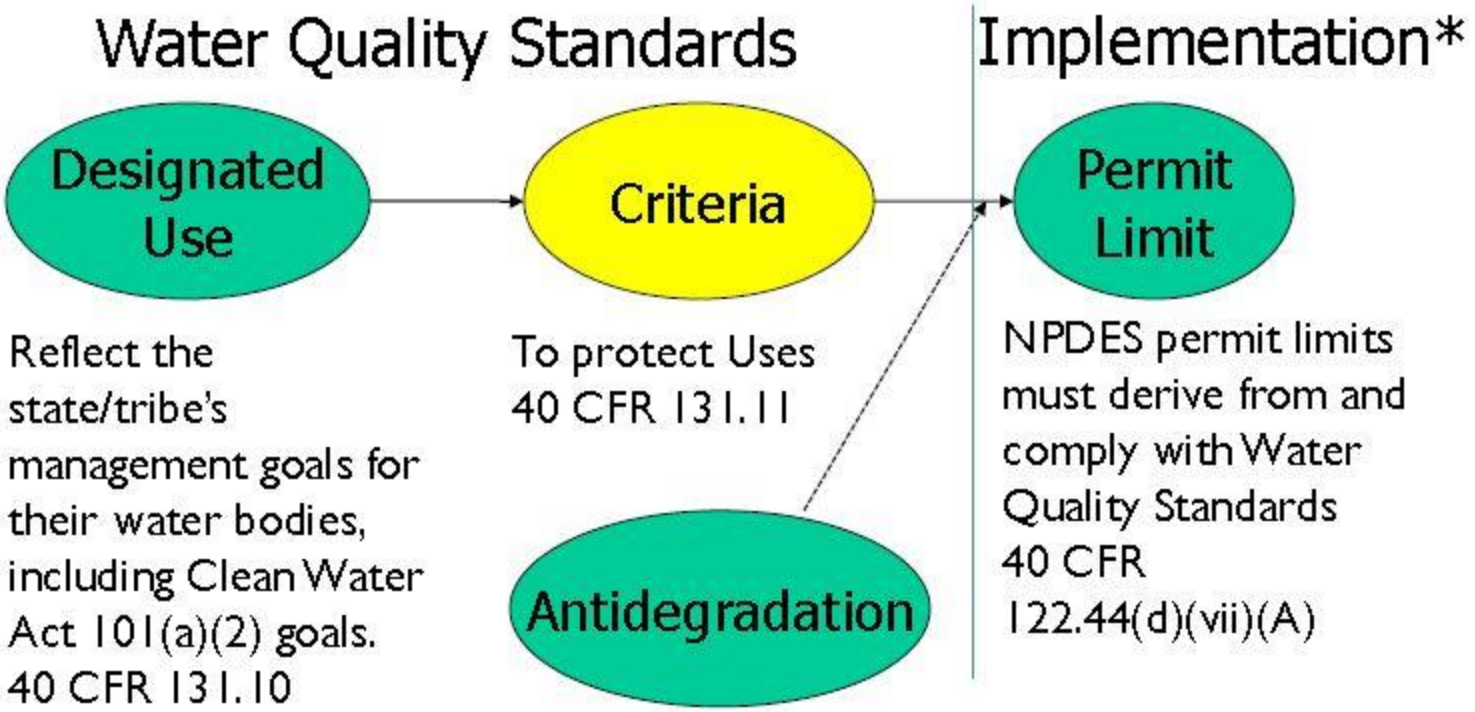
Human Health Criteria for Consumption of Water& Organism and Organism Only

Aquatic Biota Criteria: Acute and Chronic Criteria

Water Quality Criteria Requirements (40 CFR 131.11)

- States/Tribes must adopt Criteria to:
  - Protect the Designated Uses, as part of their Water Quality Standards;
  - Support the most sensitive use;
  - Be based on a sound, scientific rationale; and
  - Include sufficient parameters to protect Designated Use.
- Criteria provide a regulatory basis for implementation and management actions like NPDES permit limits.

Water Quality Standards Schematic (cont.)



** NPDES is just one example of implementation*

Priority Pollutants

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health for the consumption of		FR Cite / Source
			CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	CMC [1] (acute) (µg/L)	CCC [1] (chronic) (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
1	Antimony	7440360					5.6 B	640 B	65 FR 66443
2	Arsenic	7440382	340 A,D,K	150 A,D,K	69 A,D,bb	36 A,D,bb	0.018 C,M,S	0.14 C,M,S	65 FR 31682 57 FR 60848
3	Beryllium	7440417					Z		65 FR 31682
4	Cadmium	7440439	2.0 D,E,K,bb	0.25 D,E,K,bb	40 D,bb	8.8 D,bb	Z		EPA 822R-01-001 65 FR 31682
5a	Chromium (III)	16065831	570 D,E,K	74 D,E,K			Z Total		EPA 820B-96-001 65 FR 31682
5b	Chromium (VI)	18540299	16 D,K	11 D,K	1,100 D,bb	50 D,bb	Z Total		65 FR 31682
6	Copper	7440508	Freshwater criteria calculated using the BLM mm - See Document (epa.gov/waterscience/criteria/copper/)		4.8 D,cc,ff	3.1 D,cc,ff	1,300 U		EPA-822-R-07-001 65 FR 31682 72 FR 7983
7	Lead	7439921	65 D,E,bb,gg	2.5 D,E,bb,gg	210 D,bb	8.1 D,bb			65 FR 31682
8a	Mercury	7439976	1.4 D,K,hh	0.77 D,K,hh	1.8 D,ee,hh	0.94 D,ee,hh			62 FR 42160
8b	Methylmercury	22967926						0.3 mg/kg J	EPA 823R-01-001
9	Nickel	7440020	470 D,E,K	52 D,E,K	74 D,bb	8.2 D,bb	610 B	4,600 B	65 FR 31682
10	Selenium	7782492	L,R,T	5.0 T	290 D,bb,dd	71 D,bb,dd	170 Z	4200	62 FR 42160 65 FR 31682 65 FR 66443

Aquatic Life Criteria: Components

Question: What is an Aquatic Life Criterion?

Answer: The highest instream concentration of a toxicant to which organisms can be exposed for a period of time without causing an unacceptable adverse effect.

Question: What is it intended to protect?

Answer: Aquatic animals (e.g., fish, invertebrates, crustaceans) and plants from acute and chronic exposure to a toxicant or condition.

Aquatic Life Criteria: Components

Question: Are there "defaults" for these components of an Aquatic Life Criterion?

Answer: **Magnitude** (how much):

- No. The concentration is based on toxicity testing.

Duration (how long):

- For acute exposure, 1-24 hour averaging period
- For chronic exposure, 4 day averaging period.

Frequency (how often):

- Once every 3 years, for both acute and chronic criteria.

Water Quality Criteria

- A numeric value (e.g., magnitude, duration, and frequency) or narrative statement.
  - Example numeric: "To protect Aquatic Life, Dissolved Zinc shall not exceed ***90 micrograms per liter*** as a ***one hour average*** more than ***once every three years***."
    Magnitude
    Duration
    Frequency
  - Example narrative: "To protect all Designated Uses, there shall be no toxic materials in toxic amounts.
- Represent a level of water quality that supports a particular use
- EPA Publishes Water Quality Criteria recommendations under Section 304(a) of the Clean Water Act (also known as "EPA's 304(a) criteria recommendations")

Aquatic Life Criteria: Components

Question: What are the data requirements to calculate an Aquatic Life Criterion?

Answer: Acute and chronic test data from 8 taxonomically different families of organisms.

MINIMUM DATASET FOR FRESHWATER CRITERIA DERIVATION

SALMONID

SECOND FISH FAMILY

CHORDATA

PLANKTONIC CRUSTACEAN

BENTHIC CRUSTACEAN

INSECT

ROTIFERA, ANNELIDA, MOLLUSCA

OTHER INSECT OR MOLLUSCA

Human Health Criteria

Background

- A Human Health AWQC is the highest concentration of a pollutant in water that is not expected to pose a significant risk to human health.
- EPA publishes two types of human health criteria:
  - Protection from ingesting water and aquatic organisms
  - Protection from ingesting aquatic organisms only

Equations for Deriving AWQC

- Noncancer Effects:

$$AWQC = RfD \cdot RSC \cdot \left(\frac{BW}{DI + \sum_{i=2}^{4} \left(FI_i \cdot BAF_i \right)} \right)$$

- Cancer Effects:
  - Nonlinear

$$AWQC = \frac{POD}{UF} \cdot RSC \cdot \left(\frac{BW}{DI + \sum_{i=2}^{4} \left(FI_i \cdot BAF_i \right)} \right)$$

- Cancer Effects:
  - Linear

$$AWQC = RSD \cdot \left(\frac{BW}{DI + \sum_{i=2}^{4} \left(FI_i \cdot BAF_{i_3} \right)} \right)$$

National Recommended Water Quality Criteria: 2002 Human Health Criteria Calculation Matrix

This document contains information regarding the calculation of the human health criteria contained in the document entitled, National Recommended Water Quality Criteria: 2002.

This document provides: cancer potency factors (q1*s); reference doses (RfDs); relative source contributions (RSCs); fish intake values; and equations used to derive the human health criteria in the aforementioned compilation.

This document is not a regulation and cannot substitute for the Clean Water Act or Environmental Protection Agency (EPA) regulations. Thus, the criteria in the calculation matrix cannot impose legally binding requirements on EPA, states, authorized tribes or the regulated community.

Appendix C: Water Quality Criteria for the Protection of Human Health and the Aquatic Biota

Criteria are in micrograms per liter (µg/l - parts per billion) unless indicated otherwise.

Compound	FR Cite/Source	CAS Number	Protection of Human Health			Protection of Aquatic Biota	
			Tox Class	Consumption of Water & Organisms	Consumption of Organisms Only	Maximum Allowable Concentration - Acute Criteria*	Average Allowable Concentration - Chronic Criteria*
Toxic Metals							
Antimony	65FR66443	7440360	TT	5.6 ~~14~~	640 ~~4,300~~	---	---
Arsenic	65FR31682	7440382	A	0.02[9]	1.5[9]	340 ~~360~~	150 ~~150~~
Cadmium **	65FR31682	7440439	TT	---	---	1.03 ~~1.74~~	0.15 ~~0.62~~
Chromium (VI)*	65FR31682	18540299	TT	---	---	16	11
Chromium (III) **	EPA820/B-96-001	16065831	TT	---	---	322 ~~311~~	42 ~~101~~
Copper **	65FR31682	7440508	TT	---	---	7.0 ~~8.8~~	4.95 ~~6.24~~
Cyanide	EPA820/B-96-001 68FR75510	57125	TT	140 ~~700~~	140 ~~220,000~~	22 ^	5.2 ^
Iron *	EPA 440/5-86-001	7439896	TT	300 (added)	---	---	1,000
Lead **	65FR31682	7439921	TT	---	---	30.1	1.17
Mercury	62FR42160 EPA 440/5-86-001	7439976	TT/BC	~~0.14~~	~~0.15~~	1.4 ** ~~2.4~~	0.012 (1986)
Methylmercury (added)	EPA823-R-01-001	22967926	---	---	0.3 mg/kg [1]	---	---
Nickel **	65FR31682	7440020	TT	610	4,600	260 ~~786~~	25 ~~87.4~~
Selenium	62FR42160 65FR31682 65FR66443	7782492	TT	170 (added)	4200 (added)	i. ~~20~~	5
Silver **	65FR31682	7440224	TT	---	---	1.02 ~~1.05~~	---

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			Tox Class	Consumption of Water & Organisms	Consumption of Organisms Only	Maximum Allowable Concentration - Acute Criteria*	Average Allowable Concentration - Chronic Criteria*
Thallium	68FR75510	7440280	TT	0.24 ~~1.7~~	0.47 ~~6.3~~	---	---
Zinc **	65FR31682	7440666	TT	---	---	~~65.13~~ ~~63.5~~	~~65.6~~ ~~58.0~~
Volatile Organic Compounds							
Acrolein	74FR27535 74FR46587	107028	TT	6 ~~320~~	9 ~~780~~	3 (added)	3 (added)
Acrylonitrile	65FR66443	107131	C	0.051^ ~~0.059~~	0.25^ ~~0.66~~	---	---
Benzene	IRIS 01/15/00 65FR66443	71432	A	2.2^ ~~1.2~~	51^ ~~71~~	---	---
Bromoform	65FR66443	75252	C	4.3^	140^ ~~360~~	---	---
Carbon Tetrachloride	65FR66443	56235	C	0.23^ ~~0.25~~	1.6^ ~~4.4~~	---	---
Chlorodibromomethane	65FR66443	124481	C	0.40^ ~~0.41~~	13^ ~~34~~	---	---
Chloroform	62FR42160	67663	C	5.7	470	---	---
Dichlorobromomethane	65FR66443	75274	C	0.55^ ~~0.27~~	17^ ~~22~~	---	---
1,2-Dichloroethane	65FR66443	107062	C	0.38^	37^ ~~99~~	---	---
1,1-Dichloroethylene	68FR75510	75354	C	330 ~~0.057~~	7,100 ~~3.2~~	---	---
1,2-Dichloropropane (added)	65FR66443	78875	---	0.50^	15^	---	---
1,3-Dichloropropylene	68FR75510	542756	TT	0.34 ~~10~~	21 ~~1,700~~	---	---
Ethylbenzene	68FR75510	100414	TT	530 ~~3,100~~	2,100 ~~29,000~~	---	---
Methyl Bromide	65FR66443	74839	TT	47^ ~~48~~	1,500^ ~~4,000~~	---	---

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Human Health Criteria : Methylmercury Fish Tissue Criterion

Guidance for Implementing the January 2001 Criterion

Fact Sheet; EPA 823-F-20-001; April 2010

Summary

EPA is publishing its final Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion. This document will help protect waters and human health by giving guidance to states, territories, and authorized tribes (states and tribes) for adopting a fish tissue-based methylmercury water quality criterion into their water quality standards and implementing the criterion through other

Methylmercury Fish Tissue Criterion – Footnote (proposed)

This fish tissue residue criterion for methylmercury is used for the purpose of determination of attainment pursuant to these Standards. Fish consumption advisory guidance for mercury in fish taken from the waters of Vermont is developed by the Vermont Department of Health and is available on their website.

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Compound	FR Cite/Source	CAS Number	Protection of Human Health			Protection of Aquatic Biota	
			Tox Class	Consumption of Water & Organisms	Consumption of Organisms Only	Maximum Allowable Concentration - Acute Criteria*	Average Allowable Concentration - Chronic Criteria*
Methylene Chloride	65FR66443	75092	C	4.6 ^ ~~4.7~~	590 ^ ~~1,600~~	---	---
Monochlorobenzene	68FR75510	108907	TT	130 ~~680~~	1,600 ~~21,000~~	---	---
1,1,2,2-Tetrachloroethane	65FR66443	79345	C/BC	0.17 ^	4.0 ^ ~~11~~	---	---
Tetrachloroethylene	65FR66443	127184	C	0.69 ~~0.8~~	3.3 ~~8.85~~	---	---
Toluene	68FR75510	108883	TT	1,300 ~~6,800~~	15,000 ~~200,000~~	---	---
1,2-Trans-Dichloroethylene (added)	68FR75510	156605	---	140	10,000	---	---
1,1,2-Trichloroethane	65FR66443	79005	C	0.55 ^ ~~0.60~~	16 ^ ~~42~~	---	---
Trichloroethylene	65FR66443	75016	C	2.5 ~~2.7~~	30 ~~81~~	---	---
Acid Organic Compounds							
Vinyl Chloride	68FR75510	75014	C	0.025 ~~2~~	2.4 ~~525~~	---	---
2-Chlorophenol (added)	65FR66443	95578	---	81 ^	150 ^	---	---
2,4-Dichlorophenol	65FR66443	120832	TT	77 ^ ~~93~~	290 ^ ~~790~~	---	---
2,4-Dimethylphenol (added)	65FR66443	105679	---	380 ^	850 ^	---	---
2,4 Dinitrophenol	65FR66443	51285	TT	69 ^ ~~70~~	5,300 ^ ~~14,000~~	---	---
2-Methyl-4,6-Dinitrophenol	65FR66443	534521	TT	13 ~~13.4~~	280 ~~765~~	---	---
Pentachlorophenol	65FR31682 65FR66443	87865	C/BC	0.27 ^ ~~0.28~~	3.0 ^ ~~8.2~~	~~exp(1.005 (pH) - 4.86~~ 15 ^	~~exp(1.005 (pH) - 5.13.)~~ 15 ^
Phenol	74FR27535	108952	TT	10,000 ~~21,000~~ ^	860,000 ~~4.6x10^6~~	---	---
Nonylphenol (added)	EPA-822-F05-003	84852153	C/BC	28	6.6		

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			Tox Class	Consumption of Water & Organisms	Consumption of Organisms Only	Maximum Allowable Concentration - Acute Criteria*	Average Allowable Concentration - Chronic Criteria*
	65FR66443						
Endosulfan Sulfate	65FR66443	1031078	TT	62 ^ ~~0.93~~	89 ^ ~~2.0~~	---	---
Endrin	65FR31682 68FR75510	72208	TT	0.59 ~~0.76~~	0.060 ~~0.81~~	0.086 ~~0.18~~	0.036 ~~0.0023~~
Endrin Aldehyde	65FR66443	7421934	TT	0.29 ^ ~~0.76~~	0.30 ^ ~~0.81~~	---	---
Heptachlor	65FR31682 65FR66443	76448	C	0.000079 ^ ~~0.00021~~	0.000079 ^ ~~0.00021~~	0.52 °	0.0038 °
Heptachlor Epoxide	65FR31682 65FR66443	1024573	C	0.000039 ^ ~~0.00010~~	0.000039 ^ ~~0.00011~~	0.52 °	0.0038 °
Benzene hexachloride-alpha	65FR66443	319846	C/BC	0.0026 ^ ~~0.0035~~	0.0049 ^ ~~0.013~~	---	---
Benzene hexachloride-beta	65FR66443	319857	C/BC	0.0091 ^ ~~0.014~~	0.017 ^ ~~0.046~~	---	---
Benzene hexachloride-gamma (Lindane)	65FR31682 68FR75510	58899	TT/BC	0.98 ~~0.019~~	1.8 ~~0.063~~	0.95 ~~2.0~~	--- ~~0.8~~ (remove)
Malathion *	EPA 440/5-86-001	121755	---	---	---	---	0.1
Parathion *	EPA 440/5-86-001	56382	---	---	---	0.065	0.013
Total PCB's *	65FR31682 65FR66443	53469219	C/BC	0.000064 ^ ~~0.000044~~	0.000064 ^ ~~0.000045~~	---	0.014 °
~~PCB-1242~~	~~65FR31682 65FR66443~~	~~53469219~~	~~C/BC~~	~~0.000064 0.000044~~	~~0.000064 0.000045~~	~~---~~	~~0.014 °~~

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			Tox Class	Consumption of Water & Organisms	Consumption of Organisms Only	Maximum Allowable Concentration - Acute Criteria[a]	Average Allowable Concentration - Chronic Criteria[a]
~~PCB-1254~~	~~65FR31682 65FR66443~~	~~11097691~~	~~C/BC~~	~~0.000064 0.000044~~	~~0.000064 0.000045~~	---	~~0.014~~ [b]
~~PCB-1221~~	~~65FR31682 65FR66443~~	~~11104282~~	~~C/BC~~	~~0.000064 0.000044~~	~~0.000064 0.000045~~	---	~~0.014~~ [b]
~~PCB-1232~~	~~65FR31682 65FR66443~~	~~11141165~~	~~C/BC~~	~~0.000064 0.000044~~	~~0.000064 0.000045~~	---	~~0.014~~ [b]
~~PCB-1248~~	~~65FR31682 65FR66443~~	~~12672296~~	~~C/BC~~	~~0.000064 0.000044~~	~~0.000064 0.000045~~	---	~~0.014~~ [b]
~~PCB-1260~~	~~65FR31682 65FR66443~~	~~11096825~~	~~C/BC~~	~~0.000064 0.000044~~	~~0.000064 0.000045~~	---	~~0.014~~ [b]
~~PCB-1016~~	~~65FR31682 65FR66443~~	~~12674112~~	~~C/BC~~	~~0.000064 0.000044~~	~~0.000064 0.000045~~	---	~~0.014~~ [b]
Dioxin (2,3,7,8-TCDD)	65FR66443	1746016	C/BC	5.0×10^{-9} ~~0.13×10^{-8}~~	5.1×10^{-9} ~~0.14×10^{-8}~~	---	---
Toxaphene	65FR31682 65FR66443	8001352	C/BC	0.00028 [c] ~~0.00073~~	0.00028 [c] ~~0.00075~~	0.73	0.0002
Tributyltin (TBT)	EPA 822-R-03-031	688-73-3	BC	0.46	0.072	0.42	0.0074
Other Substances							
Ammonia [d]	~~EPA822-R-99-014~~ EPA 822-R-13-001	7664417	---	---	---	see EPA April 2013 water quality criteria document for Ammonia	
Asbestos	57FR60848	1332214	A	7 million fibers/L	---	---	---

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Aquatic Life Criteria – Ammonia

2013 Final Ammonia Criteria

You will need Adobe Reader to view some of the files on this page. See EPA's PDF page to learn more.

EPA has published final national recommended water quality criteria for the protection of aquatic life from the toxic effects of ammonia in freshwater. EPA's 2013 ammonia criteria reflect new data on sensitive freshwater mussels and snails, incorporate scientific views EPA received on its draft 2009 criteria, and supercede EPA's previously recommended 1999 ammonia criteria. In addition to the criteria document, EPA has also published supporting information to assist states, territories, and authorized tribes considering adoption of the new recommended criteria into their water quality standards.

- FR Notice | Print Version (PDF) (3 pp, 202K) (August 22, 2013)
- 2013 Final Ammonia Criteria (PDF) (255 pp, 3MB)
- Fact Sheet on 2013 Final Ammonia Criteria (PDF) (3 pp, 599K)
- Flexibilities for States Applying EPA's Ammonia Criteria Recommendations (PDF) (11 pp, 554K)
- Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria (PDF) (15 pp, 200K)

What is the history of EPA's development of ammonia criteria?

EPA first published ammonia criteria for the protection of aquatic life in 1976. The criteria were then updated in 1985 and 1999 to reflect scientific information available at that time. The 1999 recommended aquatic life criteria for ammonia were based on the most sensitive endpoints known at the time: the acute criterion was based on salmonid fish toxicity information, and the chronic criterion was based on bluegill sunfish early life stage toxicity.

In 2003, EPA became aware of new toxicity studies indicating the relative sensitivity of freshwater mussels to ammonia and began to update the 1999 criteria to reflect this new information. In 2009, following external peer review, EPA published draft recommended ammonia criteria, for waters with and without mussels. Since the publication of the draft 2009 ammonia criteria, additional toxicity testing has validated information on the effects of ammonia on sensitive freshwater gill-breathing snail species. In April 2013, EPA finalized the updated ammonia criteria that are applicable nationally, taking into account the latest toxicity information for freshwater species, including unionid mussels and gill-breathing snails. The 2013 criteria incorporate scientific views received on the draft (2009) ammonia criteria and supersede EPA's previously recommended 1999 criteria.

What are the 2013 recommended water quality criteria for ammonia?

EPA recommends an acute criterion magnitude of 17 mg Total Ammonia Nitrogen (TAN) per liter at pH 7 and 20° C for a one-hour average duration, not to be exceeded more than once every three years on average. EPA recommends a chronic criterion magnitude of 1.9 mg TAN/L at pH 7 and 20° C for a 30-day average duration, not to be exceeded more than once every three years on average. In addition, the highest four-

How do the 2013 criteria compare to the previously recommended 1999 criteria and the draft 2009 criteria?

The 2013 ammonia criteria recommendations take into account the latest freshwater toxicity information for ammonia, including toxicity studies for sensitive unionid mussels and gill-breathing snails. These new criteria are based on robust toxicity data available for 69 genera (acute) and 16 genera (chronic). The updated criteria magnitudes are more stringent than the previously recommended 1999 criteria magnitudes (see *Table 1*). The duration components of the 1999, 2009 and 2013 criteria remain the same - a one-hour average duration for the acute criterion and 30-day average duration for the chronic criterion. The frequency component for the acute and chronic criteria remains once in three years on average.

Table 1. Comparison of past and current EPA-recommended aquatic life water quality criteria magnitudes for ammonia. Criteria magnitudes are expressed as total ammonia nitrogen (mg TAN/L) at pH 7 and 20°C.

Criterion Duration	1999 Criteria	2009 Draft Updated Criteria	2013 Final Updated Criteria
Acute (1-hour average)	24	19	17
Chronic (30-day rolling average)	4.5*	0.91*	1.9*
*Not to exceed 2.5 times the criterion continuous concentration as a 4-day average within a 30-day period.			
Criteria frequency: Not to be exceeded more than once in three years on average.			

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			Tox Class	Consumption of Water & Organisms	Consumption of Organisms Only	Maximum Allowable Concentration - Acute Criteria*	Average Allowable Concentration - Chronic Criteria*
Barium * (added)	EPA 440/5-86-001	7440393	---	1,000 (added)	---	---	---
Chlorine *	EPA 440/5-86-001	7782505	---	---	---	19	11
Chloride * (added)	53FR15028	16887006	---	---	---	860,000 (added)	230,000 (added)

Management Implications of proposed changes in Appendix C

- Appendix C used in implementing a number of environmental programs.
- NPDES: Industrial & Municipal discharge permits (wastewater, stormwater, CSOs)
- Waste Management Division – remediation of contaminated sites (clean-up values)
- Impaired waters list with subsequent need for TMDL? (chloride criteria)

PCB Footnote:

This criterion applies to total PCBs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses.)