Ohio River Valley Water Sanitation Commission

POLLUTION CONTROL STANDARDS

for Discharges to the Ohio River

~~2015~~ ____Revision

Notice of Requirements

You are hereby notified that, having considered all the evidence presented at public hearings, the Ohio River Valley Water Sanitation Commission, at its regularly held meeting on ~~October 8, 2015~~______, acting in accordance with and pursuant to the authority contained in Article VI of the Ohio River Valley Water Sanitation Compact, adopted and promulgated, subject to revision as changing conditions require, Pollution Control Standards ~~2015~~ Revision for the modification or treatment of all sewage from municipalities or other political subdivisions, public or private institutions, corporations or watercraft, and for the modification or treatment of all industrial wastes discharged or permitted to flow into the Ohio River from the point of confluence of the Allegheny and Monongahela Rivers at Pittsburgh, Pennsylvania, designated as Ohio River mile point 0.0 to Cairo Point, Illinois, located at the confluence of the Ohio and Mississippi Rivers, and being 981.0 miles downstream from Pittsburgh, Pennsylvania.

Under the terms and provisions of the Ohio River Valley Water Sanitation Compact, all sewage from municipalities or other political subdivisions, public or private institutions, corporations or watercraft and all industrial wastes discharged or permitted to flow into the Ohio River will be required to be modified or treated to the extent specified in the standards established as above set forth.

To the extent that Pollution Control Standards ~~2013~~ 2015 Revision, which were established by Commission action October ~~10~~8, ~~2013~~2015, have been amended or restated by virtue of Pollution Control Standards ~~2015~~____, the Pollution Control Standards ~~2013~~ 2015 Revision, including any definitions and application procedures appended to or incorporated therein, are rescinded.

Richard Harrison, P.E.
Executive Director and Chief Engineer

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APPENDICES

Ohio River Valley Water Sanitation Commission

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CHAPTER 1: GENERAL PROVISIONS

1.1 AUTHORITY AND PURPOSE

The Ohio River Valley Water Sanitation Compact (the Compact) was signed in 1948 by the Governors of the States of Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia, following the consent of the United States Congress and enactment of the Compact into law by the legislatures of the eight states. The Compact created the Ohio River Valley Water Sanitation Commission (the Commission) as a body corporate with powers and duties set forth in it for the purpose of abating water pollution within the Compact District. Article I of the Compact mandates that all waters in the District be placed and maintained in a satisfactory, sanitary condition, available for certain beneficial uses. It is the mission of the Commission to ensure protection of these uses and to preserve the waters for other legitimate purposes.

The Compact grants the Commission authority to carry out its mission. Article VI states that "the guiding principle of this Compact shall be that pollution by sewage or industrial wastes originating within a signatory State shall not injuriously affect the various uses of the interstate waters." Minimum requirements for the treatment of sewage and industrial waste then are established in Article VI, as well as the authority of the Commission to require higher degrees of treatment where they are determined to be necessary after investigation, due notice, and hearing. Article VI concludes by authorizing the Commission to "adopt, prescribe, and promulgate rules, regulations and standards for administering and enforcing the provisions of this article."

Article IX of the Compact grants the Commission authority to issue orders, after investigation and hearing, for the purpose of achieving compliance with its standards. Any court of general jurisdiction or any United States District Court in the signatory states may be used by the Commission in order to enforce such orders.

It is the policy of the Commission to rely on the member states for the primary enforcement of its standards. Each of the member states is authorized to do so under the legislation that enabled its membership in the Compact. Each of the member states is authorized to administer the federal/state National Pollutant Discharge Elimination System (NPDES) as established in Section 402 of the Federal Clean Water Act. ~~Sections 301(b)(1)(C) and 510 of the Federal Act require that permits issued under that system incorporate applicable standards promulgated by an interstate agency wherever they are~~

more stringent than comparable state or federal standards. The NPDES permits are therefore the primary means by which the Commission's Standards are implemented and enforced.

These standards set forth the uses to be protected in the Ohio River (Chapter 2) as established in the Compact, establish water quality criteria to assure that those uses will be achieved (Chapter 3), and set wastewater discharge requirements (Chapter 5) needed to attain the water quality criteria. The standards also recognize the rights of individual states to adopt and apply more stringent regulations.

Specific wastewater discharge requirements are established in these regulations and must be incorporated into discharge permits issued under the authority of the NPDES or state discharge permitting programs when they are more stringent than:

1) applicable U.S. EPA technology-based effluent guidelines required under Sections 301, 304, 306, and 307 of the Federal Clean Water Act, or

2) any state treatment requirements, effluent standards, or water quality-based effluent limits.

In the absence of promulgated Federal effluent guidelines pursuant to Sections 301, 304, 306, and 307 of the Clean Water Act, the Compact signatory states have the responsibility to establish effluent limitations to be included in any discharge permit, consistent with the standards contained herein using best professional judgment on a case-by-case basis.Because all states are mandated by the federal Clean Water Act to adopt and submit for USEPA approval a program that addresses designated uses, free from mandates, wastewater discharge requirements, water quality standards, mixing zones, and more, the Commission has concluded that the requirements of the Compact are being satisfied by member state programs implementing the federal Clean Water Act. The Commission has also concluded that all of its member states are implementing programs approved under the federal Clean Water Act for the safe and satisfactory uses of the Ohio River as public and industrial water supplies after reasonable treatment, suitable for recreational usage, capable of maintaining fish and other aquatic life, and that therefore the requirement of the Compact are being satisfied by member states through these programs.

Given the fact that all member states are implementing approved programs under the federal Clean Water Act, the Commission will discontinue the triennial review process of updating the PCS rules. By proceeding under this approach the Commission is confident that public will have the full and complete protection of the federal Clean Water Act and the oversight of USEPA and the states without the redundancy of the current PCS program.

The standards set forth in this document are intended to be the mandatory requirements to be applied to the Ohio River as established in the Compact.

1.2 DEFINITIONS

A. "Acute Criteria" means the highest concentrations of toxic substances to which organisms can be exposed for a brief period of time (as measured by approved short-term exposure tests) without causing mortality or other unacceptable effects.

B. "Biological Integrity" means the ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to those best attainable given eco-regional attributes and the modified habitat types of the river.

C. "Chronic Criteria" means the highest concentrations of toxic substances to which organisms can be exposed indefinitely without causing long-term harmful effects on growth and/or reproduction or other unacceptable effects (as measured by approved long-term exposure tests).

D. "Combined Sewer Overflow" means a discharge from a sewer system designed to convey sanitary wastewaters and storm water through a single-pipe system to a treatment facility, at a point in the system prior to the treatment facility.

E. "Compact," as used in these regulations, means the Ohio River Valley Water Sanitation Compact and is an agreement entered into by and between the states of Indiana, West Virginia, Ohio, New York, Illinois, Kentucky, Pennsylvania, and Virginia, which pledges each to the other of the signatory states faithful cooperation in the control of existing and future pollution of the waters in the Ohio River Basin. This Compact created the Ohio River Valley Water Sanitation Commission.

F. "Cooling Water" means water used as a heat transfer medium for once through cooling or cooling tower blow down to which no industrial wastes, toxic wastes, residues from potable water treatment plants, untreated sewage, or other wastes, exclusive of antifouling agents approved by the appropriate regulatory agencies, are added prior to discharge.

G. "Contact Recreation" means recreational activities where the human body may come in direct contact with water of the Ohio River.

H. "Dry Weather Flow Conditions" means flow conditions within a combined sewer system resulting from one or more of the following: flows of domestic sewage, ground water infiltration, commercial and industrial wastewater, and any non-precipitation event related flows. Other non-precipitation event related flows that are included in dry weather flow conditions will be decided by the permitting agency based on site specific conditions.

I. "Early Life Stages" of fish means the pre-hatch embryonic period, the post-hatch free embryo or yolk-sac fry, and the larval period, during which the organism feeds. Juvenile fish, which are anatomically rather similar to adults, are not considered an early life stage.

J. "Industrial Wastes" means any liquid, gaseous, or solid materials, waste substances or combination thereof other than cooling water as herein defined, resulting from any process or operation including storage and transportation, manufacturing, commercial, agricultural, and government operations.

K. "Mixing Zone" means that portion of the water body receiving a discharge where effluent and receiving waters are not totally mixed and uniform with the result that the zone is not representative of the receiving waters and may not meet all ambient water quality standards or other requirements of any signatory state applicable to the particular receiving waters. All applicable water quality criteria must be met at the edge of the mixing zone.

L. "Net Discharge" is determined by excluding the amount of a pollutant in the intake water when determining the quality of a discharge if both the intake and discharge are from and to the same body of water.

M. "96 hour LC_{50}" as used in these regulations, means the concentration of a substance that kills 50 percent of the test organisms within 96 hours. The test organisms shall be representative important species indigenous to the Ohio River or standard test organisms.

N. The "Ohio River," as used in these regulations, extends from the point of confluence of the Allegheny and Monongahela rivers at Pittsburgh, Pennsylvania, designated as Ohio River mile point 0.0 to Cairo Point, Illinois, located at the confluence of the Ohio and Mississippi Rivers, 981.0 miles downstream from Pittsburgh.

O. "Ohio River Valley Water Sanitation Commission" (the Commission) means a body corporate created by authority of the Compact and is the operating agency established to implement the Compact. It consists of three representatives of each signatory state and three representatives of the federal government.

P. "Other Wastes" means any waste other than sewage, cooling water, residues from potable water treatment plants, industrial wastes or toxic wastes which, if discharged to the Ohio River, could cause or contribute to any violations of these regulations, or of any water quality standards of any signatory state, or which may be deleterious to the designated uses. Other wastes include, but are not limited to: garbage, refuse, decayed wood, sawdust, shavings, bark and other wood debris and residues resulting from secondary processing, sand, lime cinders, ashes, offal, night soil, silt, oil, tar, dyestuffs, acids, chemicals, heat or other materials and substances not sewage or industrial wastes which may cause or might reasonably be expected to cause or contribute to the pollution of the Ohio River.

Q. "Persistent Substances" means those substances that have a half-life for degradation under natural environmental conditions of more than four days. All other substances are non-persistent.

R. "Pollution" means the human-made or human-induced alteration of the chemical, physical, biological and radiological integrity of the waters of the Ohio River.

S. "Public Water System" means a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. As this relates to Chapter 3.3.C (Total Ammonia Nitrogen), the source water of the public water system is the Ohio River or ground water under the direct influence of the Ohio River.

T. "Reasonable Treatment" means, for the purposes of these standards, the conventional drinking water treatment processes of mixing, flocculation, sedimentation, filtration, and disinfection.

U. "Representative Aquatic Species" means those species of aquatic life whose protection and propagation will assure the sustained presence of a balanced indigenous community. Such species are representative in the sense that maintenance of suitable water quality conditions will assure the overall protection and sustain propagation of the balanced, indigenous community.

V. "Residues from Potable Water Treatment Plants" means those wastes emanating from processes used in water purification. Such processes may include sedimentation, chemical coagulation, filtration, iron and manganese removal, softening, and disinfection.

W. "Sewage" means water-carried human or animal wastes from such sources as residences; industrial, commercial, or government establishments; public or private institutions; or other places. For the purposes of these standards, the mixture of sewage with industrial wastes, toxic wastes, or other wastes, shall be subject to treatment requirements for those types of wastes, but shall also be regarded as sewage.

X. "Substantially Complete Removal" means removal to the lowest practicable level attainable with current technology.

Y. "Toxic Wastes" means wastes containing substances or combinations of substances in concentrations which might reasonably be expected to cause death, disease, behavioral abnormalities, genetic mutations, physiological malfunctions, including those in reproduction, or physical deformations in fish, other aquatic life, wildlife, livestock, or humans.

Z. "Wastewater" means sewage and/or industrial wastes as herein defined.

1.~~3~~ 2 GENERAL CONDITIONS

A. General

The minimum conditions which these standards are intended to achieve in the receiving waters are as follows:

1. Freedom from anything that will settle to form objectionable sludge deposits which interfere with designated water uses.

2. Freedom from floating debris, scum, oil, and other floating material in amounts sufficient to be unsightly or deleterious.

3. Freedom from materials producing color or odors to such a degree as to create unaesthetic conditions or a nuisance.

4. Freedom from substances in concentrations which are toxic or harmful to humans, animals, or fish and other aquatic life; which would in any manner adversely affect the flavor, color, odor, or edibility of fish and other aquatic life, wildlife, or livestock; or which are otherwise detrimental to the designated uses specified in Chapter 2.

1.~~4~~ 3 LIMITATIONS

Nothing contained in these regulations shall be construed to limit the powers of any state signatory to the Compact to promulgate more stringent criteria, conditions, and restrictions to further lessen or prevent the pollution of waters within its jurisdiction.

1.~~5~~ 4 SEVERABILITY CLAUSE

Should any one or more of the Pollution Control Standards hereby established or should any one or more provisions of the regulations herein contained be held or determined to be invalid, illegal or unenforceable, for any reason whatsoever, all other standards and other provisions shall remain effective.

~~1.6 VARIANCES~~

~~A. The Commission may grant a variance from the provisions of Chapter 5 or Chapter 4.F of these standards, provided that the uses set forth in Chapter 2 are maintained and that the water quality criteria set forth in Chapter 3 are met. The~~

permittee shall submit an application which includes, but is not limited to, the following:

1. The specific reasons for the variance.

2. Information on alternatives considered, including elimination of the discharge.

3. The effluent limitations that the discharger believes can be met by the highest level of treatment achievable.

4. A demonstration that the uses set forth in Chapter 2 and the water quality criteria set forth in Chapter 3 will be maintained.

5. Variances granted pursuant to this section will be included in Appendix F of these standards.

B. The Commission may require additional information that it deems relevant to its decision making process, including, but not limited to, the NPDES permitting state regulation that would allow the requested variance absent the ORSANCO standard.

C. The Commission will provide opportunity for public comment in its consideration of any variance request.

D. A variance may be granted for a period not to exceed five years; the applicant may apply for a variance renewal prior to the expiration of the permit.

1.7 SITE SPECIFIC CRITERIA

Alternative site-specific criteria for the constituents listed herein may be approved if they are demonstrated to be appropriate to the satisfaction of the Commission. Such demonstrations shall utilize methods contained in the Water Quality Standards Handbook (U.S. EPA publication EPA823-B94005A, August 1994), or other methods approved by the U.S. EPA.

CHAPTER 2: DESIGNATED USES

2.1 USES AS ESTABLISHED BY THE OHIO RIVER VALLEY WATER SANITATION COMPACT

The Ohio River, as hereinbefore defined, has been designated by the Compact as available for safe and satisfactory use as public and industrial water supplies after reasonable treatment, suitable for recreational usage, capable of maintaining fish and other aquatic life, and adaptable to such other uses as may be legitimate. It is the purpose of these Pollution Control Standards to safeguard the waters of the Ohio River for these designated uses. No degradation of the water quality of the Ohio River that would interfere with or become injurious to these uses shall be permitted.

2.2 DEFINITION / CLARIFICATION OF USES

For the purposes of these Standards, water quality criteria to protect the uses stated above shall be developed, adopted and presented as follows:

A. Aquatic life protection criteria shall assure water quality conditions capable of maintaining fish and other aquatic life.

B. Human health protection criteria shall assure water quality conditions that allow safe and satisfactory use as public and industrial water supplies after reasonable treatment as defined in Chapter 1.2.T; are suitable for contact recreation as defined in Chapter 1.2.G during those months when the river is otherwise suitable for such activities; and allow safe consumption of fish.

C. Taste and odor protection criteria shall assure water quality conditions that allow safe and satisfactory use as public and industrial water supplies after reasonable treatment as defined in Chapter 1.2.T without unaesthetic conditions such as taste or odor.

CHAPTER 3: WATER QUALITY CRITERIA

3.1 WATER QUALITY CRITERIA SUMMARY

The frequency and duration values for the acute, chronic, human health (carcinogen and non-carcinogen) and fish consumption criteria contained in the existing Pollution Control Standards, where not specified, shall be consistent with the design assumptions utilized in development of the criteria.

The following table is a summary of all applicable criteria:

Pollutant	Human Health		Aquatic Life		All Other Uses (e.g. Taste & Odor)
	Carcinogenic (ug/L)	Non-Carcinogenic (ug/L)	Acute (ug/L)	Chronic (ug/L)	
Acenaphthene		670[A,B]	-	-	-
Acrolein		190	-	-	-
Acrylonitrile	0.051[A,C]	-	-	-	-
Aldrin	0.000049[A,C]	-	-	-	-
alpha-BHC	0.0026[A,C]	-	-	-	-

Pollutant	Human Health		Aquatic Life		All Other Uses (e.g. Taste & Odor)
	Carcinogenic (ug/L)	Non-Carcinogenic (ug/L)	Acute (ug/L)	Chronic (ug/L)	
alpha-Endosulfan		62[A]	-	-	-
Ammonia		1.0 mg/L[D]	7.3[E]	1.0[E]	-
Anthracene		8300[A]	-	-	-
Antimony		5.6[A]			
Arsenic		0.010 mg/L	340[F]	150[F]	-
Asbestos		7,000,000 fibers/L[G]	-	-	-
Barium		1.0 mg/L	-	-	-
Benzene	2.2[A,C]	-	-	-	-
Benzidine	0.000086[A,C]	-	-	-	-
Benzo(a) Anthracene	0.0038[A,C]	-	-	-	-
Benzo(a) Pyrene	0.0038[A,C]	-	-	-	-
Benzo(b) Fluoranthene	0.0038[A,C]	-	-	-	-
Benzo(k) Fluoranthene	0.0038[A,C]	-	-	-	-
beta-BHC	0.0091[A,C]	-	-	-	-
beta-Endosulfan		62[A]-	-	-	-
Bis(2-Chloroethyl) Ether	0.03[A,C]	-	-	-	-
Bis(2-Chloroisopropyl) Ether		1400[A]	-	-	-
Bis(2-Ethylhexyl)Phthalate	1.2[A,C]	-	-	-	-
Bromoform	4.3[A,C]	-	-	-	-
Butylbenzyl Phthalate		1500[A]	-	-	-
Cadmium	-	-	2.01[H]	0.25[H]	-
Carbon Tetrachloride	0.23[A,C]	-	-	-	-
Chlordane	0.0008[A,C]	-	-	-	-
Chloride			-	-	250 mg/L
Chlorobenzene		130[B,I]	-	-	-
Chlorodibromomethane	0.4[A,C]	-	-	-	-
Chloroform	5.7[C,J]	-	-	-	-
Chromium III	-	-	570[H]	74.1[H]	-
Chromium VI	-	-	15.712[F]	10.582[F]	-
Chrysene		0.0038[A,C]	-	-	-
Copper		1300[B]	13.4[H]	8.96[H]	-
Cyanide		140[K]	-	-	-
Cyanide (free)	-	-	22[L]	5.2[L]	-
Dibenzo(a,h) Anthracene	0.0038[A,C]	-	-	-	-
Dichlorobromomethane	0.55[A,C]	-	-	-	-
Dieldrin	0.000052[A,C]	-	-	-	-
Diethyl Phthalate		17000[A]	-	-	-
Dimethyl Phthalate		270000	-	-	-
Di-n-Butyl Phthalate		2000[A]	-	-	-

Pollutant	Human Health: Carcinogenic (ug/L)	Human Health: Non-Carcinogenic (ug/L)	Aquatic Life: Acute (ug/L)	Aquatic Life: Chronic (ug/L)	All Other Uses (e.g. Taste & Odor)
Dissolved Oxygen	-	-	> 4.0 mg/L[M]	> 5.0 mg/L[M]	-
E. Coli	-	130 CFU/100mL (GM)[R]; 240 CFU/100mL[S]	-	-	
Endosulfan Sulfate		62[A]	-	-	-
Endrin		0.059	-	-	-
Endrin Aldehyde		0.29[A]	-	-	-
Ethylbenzene		530	-	-	-
Fecal Coliform		2,000 CFU/100mL[N]	-	-	
Fluoride		1.0 mg/L	-	-	-
Fluoranthene		130[A]	-	-	-
Fluorene		1100[A]	-	-	-
gamma-BHC (Lindane)		0.98	-	-	-
Heptachlor	0.000079[A,C]	-	-	-	-
Heptachlor Epoxide	0.000039[A,C]	-	-	-	-
Hexachlorobenzene	0.00028[A,C]	-	-	-	-
Hexachlorobutadiene	0.44[A,C]	-	-	-	-
Hexachlorocyclopentadiene		40[B]-	-	-	-
Hexachloroethane	1.4[A,C]	-	-	-	-
Ideno(1,2,3-cd) Pyrene	0.0038[A,C]	-	-	-	-
Isophorone	35[A,C]	-	-	-	-
Lead	-	-	64.6[H]	2.52[H]	-
Mercury		0.000012mg/L	1.45[F]	0.774[F]	-
Methyl Bromide		47[A]	-	-	-
Methylene Chloride	4.6[A,C]	-	-	-	-
Methylmercury		0.3 mg/kg[O]	-	-	-
Nickel		610[A]	469[H]-	52[H]-	-
Nitrite Nitrate Nitrogen		10 mg/L	-	-	-
Nitrite Nitrogen		1 mg/L	-	-	-
Nitrobenzene		17[A]	-	-	-
N-Nitrosodimethylamine	0.00069[A,C]	-	-	-	-
N-Nitrosodi-n-Propylamine	0.005[A,C]	-	-	-	-
N-Nitrosodiphenylamine	3.3[A,C]	-	-	-	-
Pentachlorophenol	0.27[A,C]	-	-	-	-
pH	-	-	-	>6.0 and <9.0	-
Phenol	21000[A,B]	-	-	-	
Phenolics		-	-	-	0.005 mg/L
Polychlorinated Biphenyls	0.000064[A,C,P]	-	-	-	-

Pollutant	Human Health		Aquatic Life		All Other Uses (e.g. Taste & Odor)
	Carcinogenic (ug/L)	Non-Carcinogenic (ug/L)	Acute (ug/L)	Chronic (ug/L)	
Pyrene		830[A] -	-	-	-
combined radium 226 and radium 228	4 pCi/L	-	-	-	-
gross total alpha	15 pCi/L	-	-	-	-
total gross beta	50 pCi/L	-	-	-	-
total gross strontium 90	8 pCI/L	-	-	-	-
Selenium	170[I]	-	-	5[L]	-
Silver	0.05 mg/L	-	3.22[H]	-	-
Sulfate		-	-	-	250 mg/L
Temperature		110 Deg F	See table Chapter 3.2.C.		
Tetrachloroethylene	0.69[C]	-	-	-	-
Thallium		0.24	-	-	-
Toluene		1300[I]	-	-	-
Total dissolved solids	-	-	-	-	500 mg/L[D]
Toxaphene	0.00028[A,C]	-	-	-	-
Trichloroethylene	2.5[C]	-	-	-	-
Vinyl Chloride	0.025[C,Q]	-	-	-	-
Zinc		7400[B]	117[H]	118[H]	-
1,1,2,2-Tetrachloroethane	0.17[A,C]	-	-	-	-
1,1,2-Trichloroethane	0.59[A,C]	-	-	-	-
1,1-Dichloroethylene		330	-	-	-
1,2,4-Trichlorobenzene		35	-	-	-
1,2-Dichlorobenzene		420	-	-	-
1,2-Dichloroethane	0.38[A,C]	-	-	-	-
1,2-Dichloropropane	0.5[A,C]	-	-	-	-
1,2-Diphenylhydrazine	0.036[A,C]	-	-	-	-
1,2-Trans-Dichloroethylene		140[I]	-	-	-
1,3-Dichlorobenzene		320	-	-	-
1,3-Dichloropropene	0.34[C]	-	-	-	-
1,4-Dichlorobenzene		63	-	-	-
2,3,7,8-TCDD (Dioxin)	0.000000005[C]	-	-	-	-
2,4,6-Trichlorophenol	1.4[A,C]	-	-	-	-
2,4-Dichlorophenol		77[A,B]	-	-	-
2,4-Dimethylphenol		380[A]	-	-	-
2,4-Dinitrophenol		69[A]	-	-	-
2,4-Dinitrotoluene	0.11[C]	-	-	-	-
2-Chloronaphthalene		1000[A] -	-	-	-
2-Chlorophenol		81[A,B]	-	-	-
2-Methyl-4,6-Dinitrophenol		13	-	-	-
3,3-Dichlorobenzidine	0.021[A,C]	-	-	-	-

Pollutant	Human Health		Aquatic Life		All Other Uses (e.g. Taste & Odor)
	Carcinogenic (ug/L)	Non-Carcinogenic (ug/L)	Acute (ug/L)	Chronic (ug/L)	
4,4'-DDD	0.00031[A,C]	-	-	-	-
4,4'-DDE	0.00022 [A,C]	-	-	-	-
4,4'-DDT	0.00022[A,C]	-	-	-	-

[A] This criterion has been revised to reflect The U.S. EPA's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of May 17, 2002. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.
[B] The organoleptic effect criterion is more stringent than the value for priority toxic pollutants.
[C] This criterion is based on carcinogenicity of 10^{-6} risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10^{-5}, move the decimal point in the recommended criterion one place to the right).
[D] Criteria applies at drinking water intakes.
[E] Criteria dependant on pH and temp, see formulas Sec. 3.2.E and 4-day avg. rule, Appendix A1-A5. Criteria shown at pH 7.0, most restrictive temperature, and unionid mussels present.
[F] Presented in the dissolved form.
[G] This criterion for asbestos is the Maximum Contaminant Level (MCL) developed under the Safe Drinking Water Act (SDWA).
[H] Presented in the dissolved form and shown at Hardness 100, specific formulas in Sec. 3.2. F.
[I] U.S. EPA has issued a more stringent MCL. Refer to drinking water regulations (40 CFR 141) or Safe Drinking Water Hotline (1-800-426-4791) for values.
[J] Although a new RfD is available in IRIS, the surface water criteria will not be revised until the National Primary Drinking Water Regulations: Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) is completed, since public comment on the relative source contribution (RSC) for chloroform is anticipated.
[K] This recommended water quality criterion is expressed as total cyanide, even though the IRIS RFD we used to derive the criterion is based on free cyanide. The multiple forms of cyanide that are present in ambient water have significant differences in toxicity due to their differing abilities to liberate the CN-moiety. Some complex cyanides require even more extreme conditions than refluxing with sulfuric acid to liberate the CN-moiety. Thus, these complex cyanides are expected to have little or no 'bioavailability' to humans. If a substantial fraction of the cyanide present in a water body is present in a complexed form (e.g., Fe4[Fe(CN)6]3), this criterion may be over conservative.
[L] Criteria shown to be applied in total recoverable form.
[M] Dissolved oxygen minimum 5.0 mg/L April 15 – June 15.
[N] Criteria based on 5-sample per month geometric mean.
[O] This fish tissue residue criterion for methylmercury is based on a total fish consumption rate of 0.0175 kg/day.
[P] This criterion applies to total PCBs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses).
[Q] This recommended water quality criterion was derived using the cancer slope factor of 1.4 (LMS exposure from birth).
[R] Criteria based on 90 day geometric mean.
[S] Not to be exceeded in greater than 25% of the samples during 90 day period.

3.2 AQUATIC LIFE PROTECTION

To protect aquatic life, the following criteria shall be met outside the mixing zone:

A. BIOLOGICAL: The biological integrity of the Ohio River shall be safeguarded, protected, and preserved.

B. DISSOLVED OXYGEN: The average concentration shall be at least 5.0 mg/L for each calendar day; the minimum concentration shall not be less than 4.0 mg/L. During the April 15-June 15 spawning season, a minimum concentration of 5.0 mg/L shall be maintained at all times.

C. TEMPERATURE: Allowable daily maximum stream temperatures are based on the following table (in degrees Fahrenheit), where MP is mile point below Pittsburgh, and Julian Day is the number day of the year (1 – 366):

Julian Day	MP 0 to MP 341	MP 341.1 to MP 606.8	MP 606.9 to MP 981
1 – 49	47.1 – 0.086 * Julian Day	47.2 – 0.024 * Julian Day	50.1 – 0.047 * Julian Day
50 – 166	26.6 + 0.328 * Julian Day	34.1 + 0.311 * Julian Day	34.8 + 0.269 * Julian Day
167 – 181	87	87	87
182 – 243	89	89	89
244 – 258	87	87	87
259 – 366	160.8 – 0.300 * Julian Day	176.7 – 0.346 * Julian Day	164.5 – 0.308 * Julian Day

Monthly averages of the daily maximum allowable stream temperatures (calculated using above criteria) may be used as permitting endpoints in place of daily criteria and are shown in the following table:

Month	MP 0 to MP 341		MP 341.1 to MP 606.8		MP 606.9 to MP 981	
	°F	°C	°F	°C	°F	°C
January	45.7	7.6	46.8	8.2	49.3	9.6
February	43.9	6.6	47.9	8.8	48.6	9.2
March	51.2	10.7	57.4	14.1	55.0	12.8
April	61.2	16.2	66.9	19.4	63.2	17.3
May	71.2	21.8	76.4	24.7	71.4	21.9
June 1-15	78.8	26.0	83.5	28.6	77.6	25.3
June 16-30	87.0	30.6	87.0	30.6	87.0	30.6
July	89.0	31.7	89.0	31.7	89.0	31.7
August	89.0	31.7	89.0	31.7	89.0	31.7
September 1-15	87.0	30.6	87.0	30.6	87.0	30.6
September 16-30	81.0	27.2	84.7	29.3	82.6	28.1
October	74.1	23.4	76.7	24.8	75.5	24.2
November	65.0	18.3	66.2	19.0	66.1	19.0
December	55.8	13.2	55.6	13.1	56.7	13.7

D. pH: No value below 6.0 standard units nor above 9.0 standard units.

E. AMMONIA:

1. Acute Criterion Concentration: The one hour average concentration of total ammonia nitrogen (mg/L) shall not exceed, more than once every three years on the average, the ACC (acute criterion) calculated using the following equations:

i. If unionid mussels are present:

$$ACC = 0.7249 * \left(\frac{0.0114}{1 + 10^{7.204-pH}} + \frac{1.6181}{1 + 10^{pH-7.204}}\right) * MIN(51.93 \text{ or } 23.12 * 10^{0.036*(20-T)})$$

Where: T = Temperature, °C.

ii. If unionid mussels are absent**:

$$ACC = 0.7249 * \left(\frac{0.0114}{1 + 10^{7.204-pH}} + \frac{1.6181}{1 + 10^{pH-7.204}}\right) * MIN(51.93 \text{ or } 62.15 * 10^{0.036*(20-T)})$$

Where: T = Temperature, °C.

2. Chronic Criterion Concentration: The 30-day rolling average concentration of total ammonia nitrogen (mg/L) shall not exceed, more than once every three years on the average, the CCC (chronic criterion) calculated using the following equations:

i. If unionid mussels are present:

$$CCC = 0.8876 * \left(\frac{0.0278}{1 + 10^{7.688-pH}} + \frac{1.1994}{1 + 10^{pH-7.688}}\right) * (2.126 * 10^{0.028*(20-Max(T \text{ or } 7))})$$

Where: T = Temperature, °C.

ii. If unionid mussels are absent** and when fish early life stages are present (from March 1 to October 31):

$$CCC = 0.9405 * \left(\frac{0.0278}{1 + 10^{7.688-pH}} + \frac{1.1994}{1 + 10^{pH-7.688}}\right) * MIN(6.920 \text{ or } 7.547 * 10^{0.028*(20-T)})$$

Where: T = Temperature, °C.

iii. If unionid mussels are absent** and when fish early life stages are absent (from November 1 to the last day of February):

$$CCC = 0.9405 * \left(\frac{0.0278}{1 + 10^{7.688-pH}} + \frac{1.1994}{1 + 10^{pH-7.688}}\right) * (7.547 * 10^{0.028*(20-Max(T \text{ or } 7))})$$

Where: T = Temperature, °C.

iv. In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the chronic criterion.

Note: Acute and chronic criteria concentrations for total ammonia-nitrogen (in mg/L) for different combinations of pH and temperature are shown in Appendix A.

** For purposes of determining the applicable water quality-based limitations on ammonia-nitrogen, unionid mussels shall be presumed to be present at all times in the Ohio River unless the applicant demonstrates to the satisfaction of the permitting authority and ORSANCO that mussels are absent.

F. CHEMICAL CONSTITUENTS:

1. The following constituents are presented in the total recoverable form. However, Ohio River criteria for these constituents are to be applied in the dissolved form (except for cyanide and selenium) which are calculated by multiplying the criteria in this table by the corresponding conversion factors from the table in Chapter 3.2.F.2, unless it can be demonstrated to the satisfaction of the Commission and its member states that a more appropriate analytical technique is available which provides a measurement of that portion of the metal present which causes toxicity to aquatic life.

Total Recoverable Constituent	**Acute Criterion Concentration (µg/L)**	**Chronic Criterion Concentration (µg/L)**
Arsenic	340	150
Cadmium	$e^{(1.0166(\ln Hard)-3.924)}$	$e^{(0.7409(\ln Hard)-4.719)}$
Chromium III	$e^{(0.819(\ln Hard)+3.7256)}$	$e^{(0.819(\ln Hard)+0.6848)}$
Chromium VI	16	11
Copper	$e^{(0.9422(\ln Hard)-1.700)}$	$e^{(0.8545(\ln Hard)-1.702)}$
Cyanide (free) *	22	5.2
Lead	$e^{(1.273(\ln Hard)-1.460)}$	$e^{(1.273(\ln Hard)-4.705)}$
Mercury	1.7	0.91
Nickel	$e^{(0.846(\ln Hard)+2.255)}$	$e^{(0.846(\ln Hard)+0.0584)}$
Selenium *		5
Silver	$e^{(1.72(\ln Hard)-6.59)}$	---
Zinc	$e^{(0.8473(\ln Hard)+0.884)}$	$e^{(0.8473(\ln Hard)+0.884)}$

* Ohio River criteria for cyanide (free) and selenium are to be applied in the total recoverable form as expressed in this table. Hardness is expressed as mg/L of $CaCO_3$.

2. Conversion factors presented in this table are to be applied to calculate Ohio River criteria in the dissolved form when multiplied by the criteria set forth in the table in Chapter 3.2.F.1 (with the exception of cyanide and selenium). Numeric values for hardness-dependent criteria at specified hardness values are listed in Appendix B.

Constituent	Acute Dissolved Criterion Conversion Factor	Chronic Dissolved Criterion Conversion Factor
Arsenic	1.0	1.0
Cadmium	1.136672-[ln(Hard)*(0.041838)]	1.101672-[ln(Hard)*0.041838]
Chromium (III)	0.316	0.86
Chromium (VI)	0.982	0.962
Copper	0.960	0.960
Lead	1.46203-[ln(Hard)*(0.145712)]	1.46203-[ln(Hard)*0.145712]
Mercury	0.85	0.85
Nickel	0.998	0.997
Silver	0.85	---
Zinc	0.978	0.986

G. OTHER TOXIC SUBSTANCES:

Water quality criteria for substances not otherwise specified in this section shall be derived based on the following:

1. For the protection of aquatic life, methodologies set forth in U.S. EPA's final Water Quality Guidance for the Great Lakes System, adopted in the Federal Register, March 23, 1995, shall be used (see Appendix D).

2. Limiting concentrations other than those derived from the above may be used for the protection of aquatic life when justified on the basis of scientifically defensible evidence.

3.3 HUMAN HEALTH PROTECTION

To protect human health, the following criteria shall be met outside the mixing zone:

A. BACTERIA:

1. Protection of public water supply use -- public water supply use shall be protected at all times. Fecal coliform bacteria content shall not exceed 2,000/100 mL as a monthly geometric mean based on not less than five samples per month.

2. Maximum allowable level of *E. coli* bacteria for contact recreation -- for the months of April through October, measurements of *E. coli* bacteria shall not exceed 130/100 mL as a 90-day geometric mean, based on not less than five samples per month, nor exceed 240/100 mL in more than 25 percent of samples.

B. CHEMICAL CONSTITUENTS:

Not to exceed the following concentrations:

Constituent	Concentration (mg/L)
Arsenic (total)	0.010
Barium (total)	1.0
Chloride	250.0
Fluoride	1.0
Mercury (total)	0.000012
Nitrite + Nitrate Nitrogen	10.0
Nitrite Nitrogen	1.0
Phenolics	0.005
Silver (total)	0.05
Sulfate	250.0

C. TOTAL AMMONIA-NITROGEN: Total ammonia-nitrogen shall not exceed 1.0 mg/L at any surface water intake for a public water system providing at least reasonable treatment.

D. RADIONUCLIDES: Gross total alpha activity (including radium-226, but excluding radon and uranium) shall not exceed 15 picocuries per liter (pCi/L) and combined radium-226 and radium-228 shall not exceed 4 pCi/L. Concentration of total gross beta particle activity shall not exceed 50 pCi/L; the concentration of total strontium-90 shall not exceed 8 pCi/L.

E. TOTAL DISSOLVED SOLIDS: To protect drinking water supplies from adverse taste and odor, concentrations of total dissolved solids (TDS) shall not exceed 500 mg/L at Ohio River drinking water intakes.

F. TEMPERATURE: The maximum temperature at any location where public access is possible, whether inside or outside a mixing zone, shall not exceed 110 degrees F to protect human health caused by exposure resulting from water contact.

CHAPTER 4: MIXING ZONE DESIGNATION

A. Where mixing zones are allowed by the permitting authority, the specific numerical limits for any mixing zone shall be determined on a case-by-case basis, and shall include considerations for existing uses, linear distance (i.e., length and width) from the point of discharge, surface area involved, and volume of receiving water within the defined zone.

B. Conditions within the mixing zone shall not be injurious to human health, in the event of a temporary exposure.

C. Acute water quality criteria, as specified in Chapter 3.2.F, will apply at all points within the mixing zone; except that, states may at their discretion allow a smaller zone in the immediate vicinity of the point of discharge sometimes referred to as a zone of initial dilution in which acute criteria are exceeded, provided the zone does not impact the water of another state, but the acute criteria must be met at the edge of the acute mixing zone or zone of initial dilution. Acute mixing zones shall be calculated in accordance with one of the approaches presented in Appendix E, or by such other method as may be demonstrated to be appropriate to the Commission.

D. The mixing zone shall be located so as not to interfere significantly with migratory movements and passage of fish, other aquatic life, and wildlife. No mixing zone shall adversely impact water quality so as to interfere with potable or industrial water supplies, bathing areas, reproduction of fish, other aquatic life and wildlife.

E. In no case shall a permitting authority grant a mixing zone that would likely jeopardize the continued existence of any endangered or threatened species listed under Section 4 of the Federal Endangered Species Act or result in the destruction or adverse modification of such species' critical habitat.

F. 1. Facilities with discharges which were in existence on or before October 16, 2003 will have mixing zones eliminated for any bioaccumulative chemical of concern (BCC) as soon as is practicable, as determined by the permitting authority, considering the following criteria:

i. Measures taken during the current permit cycle and an evaluation of those measures proposed to be taken during the next permit cycle to reduce or eliminate the necessity of a mixing zone for each BCC;

ii. The concentration and duration of the discharge, bioaccumulation factors and exposure considerations for each BCC for which the mixing zone is sought to be continued.

2. The necessity for continuation of a mixing zone for a BCC shall be evaluated and determined by the permitting authority during each permit renewal and reissuance utilizing the criteria above in subparagraph 1.i. and 1.ii.

3. The addition of waste streams to an existing facility shall be evaluated under this section by the permitting authority at the time of permit review.

4. Mixing zones shall continue to be prohibited for BCCs for discharges from facilities that came into existence after October 16, 2003.

5. No mixing zone for a BCC shall be approved by a permitting authority that would result in a violation of any water quality standard or impairment of any designated use of a waterbody.

6. BCCs are defined as any chemicals that accumulate in aquatic organisms by a human health bioaccumulation factor (BAF) greater than 1000 (after considering various specified factors), and have the potential upon entering surface waters to cause adverse effects, either by themselves or in the form of their toxic transformation, as a result of that accumulation. Currently, the list of BCCs, as described in the Final Rule to Amend the Final Water Quality Guidance for the Great Lakes System to Prohibit Mixing Zones for Bioaccumulative Chemicals of Concern, includes:

~~Bioaccumulative Chemicals of Concern~~

~~Lindane~~	~~Mirex~~
~~Hexachlorocyclohexane~~	~~Hexachlorobenzene~~
~~alpha-Hexachlorocyclohexane~~	~~Chlordane~~
~~beta-Hexachlorocyclohexane~~	~~DDD~~
~~delta-Hexachlorocyclohexane~~	~~DDT~~
~~Hexachlorobutadiene~~	~~DDE~~
~~Photomirex~~	~~Octachlorostyrene~~
~~1,2,4,5-Tetrachlorobenzene~~	~~PCBs~~
~~Toxaphene~~	~~2,3,7,8-TCDD~~
~~Pentachlorobenzene~~	~~Mercury~~
~~1,2,3,4-Tetrachlorobenzene~~	~~Dieldrin~~

~~G. If mixing zones from two or more proximate sources interact or overlap, the combined effect must be evaluated to ensure that applicable values will be met in the area where any applicable mixing zones overlap.~~

CHAPTER ~~5~~3: WASTEWATER DISCHARGE REQUIREMENTS

~~5~~3.1 GENERAL

A. No discharge of sewage, industrial wastes, toxic wastes, other wastes, cooling water or residues from potable water treatment plants shall cause or contribute to a violation of these wastewater discharge requirements, ~~shall~~ or preclude the attainment of any designated use of the main stem waters of the Ohio River.~~, or cause or contribute to a violation of the water quality criteria set forth in Chapter 3.~~

~~B. Each holder of an individual NPDES permit shall post and maintain a permanent marker at the establishment under permit as follows:~~

~~1. A marker shall be posted on the stream bank at each outfall discharging directly to the Ohio River.~~

~~2. The marker shall consist of, at a minimum, the name of the establishment to which the permit was issued, the permit number, and the outfall number. The information shall be printed in letters not less than two inches in height.~~

~~3. The marker shall be a minimum of two feet by two feet and shall be a minimum of three feet above ground level.~~

5.2 CRITICAL FLOW

For derivation of effluent limitations, the following river flows shall be used:

A. For substances identified as human carcinogens, wastewater discharge requirements shall be developed based on the in-stream concentration above the point of discharge, and calculated so as to prevent one additional cancer per one million population at the harmonic mean stream flow (see Appendix C).

B. For substances not identified as human carcinogens, wastewater discharge requirements shall be developed based on the in-stream concentration above the point of discharge and calculated to meet the water quality criteria at the minimum seven day, ten year flow (see Appendix C).

5.3 WASTEWATER DISCHARGES FOR CHEMICAL CONSTITUENTS

Wastewater discharge requirements for these constituents shall be expressed as total recoverable limits based on the dissolved aquatic life criteria multiplied by the appropriate translators, the appropriate in-stream concentration upstream of the point of discharge, and the minimum appropriate critical flow as contained in Appendix C. The appropriate critical flow shall be the seven day, ten year low flow for chronic criteria, and the one day, ten year low flow for acute criteria. The appropriate translators for arsenic, copper, nickel and zinc are in the table below. Translators for cadmium, chromium (III), chromium (VI), lead, mercury, and silver are the inverse of the values contained in the table in Chapter 3.2.F.2. Other translators may be used after successful demonstration to the Commission and its member states.

Constituent	Translators of Upper Ohio River (river miles 0-265)	Translators of Middle Ohio River (river miles 266-629)	Translators of Lower Ohio River (river miles 630-981)
Arsenic	1+(0.040*TSS)	1+(0.023*TSS)	1+(0.013*TSS)
Copper	1+(0.049*TSS)	1+(0.033*TSS)	1+(0.023*TSS)
Nickel	1+(0.035*TSS)	1+(0.039*TSS)	1+(0.032*TSS)
Zinc	1+(0.21*TSS)	1+(0.15*TSS)	1+(0.083*TSS)

Note: Total Suspended Solids (TSS) values in translator formulas are to be applied in units of mg/L.

53.42 SEWAGE

A. MINIMUM LEVEL OF TREATMENT:

Sewage shall be treated prior to discharge, to meet the following effluent limitations in addition to the requirements of Chapter 53.1.

~~1. Biochemical Oxygen Demand~~

~~i. Five-day biochemical oxygen demand (BOD_5) -- the arithmetic mean of the values for effluent samples collected in a month shall not exceed 30 mg/L, and the arithmetic mean of the values for effluent samples collected in a week shall not exceed 45 mg/L.~~

~~ii. Five-day carbonaceous biochemical oxygen demand ($CBOD_5$) may be substituted for BOD_5, provided that the arithmetic mean of the values for effluent samples collected in a month shall not exceed 25 mg/L, and the arithmetic mean of the values of effluent samples collected in a week shall not exceed 40 mg/L.~~

~~2~~1. Suspended Solids

The arithmetic mean of the values for effluent samples collected in a month shall not exceed 30 mg/L, and the arithmetic mean of the values for effluent samples collected in a week shall not exceed 45 mg/L.

~~3. pH~~

~~The effluent values for pH shall be maintained within the limits of 6.0 to 9.0 standard units.~~

~~4. Bacteria~~

~~i. The geometric mean of the fecal coliform bacteria content of effluent samples collected in a month shall not exceed 2,000/100 mL.~~

~~ii. During the months of April through October, the geometric mean of the *E. coli* bacteria content of effluent samples collected in a 90-day period shall not exceed 130/100 mL, and no more than 25 percent of the values shall exceed 240/100 mL.~~

B. ALTERNATIVE TREATMENT:

Such facilities as waste stabilization ponds and trickling filters shall be deemed to provide effective treatment of sewage, provided that the requirements of Chapter ~~5~~3.1~~, 5.4.A~~ are met, that the effluent does not cause any violations of ~~applicable states' water quality standards or~~ Chapter 2 ~~and Chapter 3~~ of these regulations, and that the following requirements are met:

~~1. Biochemical Oxygen Demand~~

~~i. Five-day biochemical oxygen demand (BOD_5) -- the arithmetic mean of the values for effluent samples collected in a month shall not exceed 45 mg/L; and the arithmetic mean of the values for effluent samples collected in a week shall not exceed 65 mg/L.~~

~~ii. Five-day carbonaceous biochemical oxygen demand ($CBOD_5$) may be substituted for BOD_5, provided that the levels are not less stringent than the following: the arithmetic mean of the values for effluent samples collected in a month shall not exceed 40 mg/L and; the arithmetic mean of the values for effluent samples collected in a week shall not exceed 60 mg/L.~~

~~2~~1. Suspended Solids

The arithmetic mean of the values for effluent samples collected in a month shall not exceed 45 mg/L; and the arithmetic mean of the values for effluent samples collected in a week shall not exceed 65 mg/L.

~~C. COMBINED SEWER SYSTEMS:~~

~~1. Prohibition of Dry Weather Discharges~~

~~No combined sewer overflow (CSO) to the Ohio River shall occur under dry weather flow conditions unless the discharge is caused by elevated river stage. All discharges from combined sewers must be in compliance with the NPDES permit and the National Combined Sewer Overflow Control Policy.~~

~~2. System Overflows During Wet Weather~~

~~A direct discharge, if caused by temporary excess flows due to storm water collected and conveyed through combined sewer systems, shall not be considered in violation of these wastewater discharge requirements, providing that the discharger is demonstrating compliance with the nine minimum controls as specified in the National Combined Sewer Overflow Control Policy. The nine minimum controls are as follows:~~

~~i. Proper operation and regular maintenance programs for the sewer system and the CSOs;~~

~~ii. Maximum use of the collection system for storage;~~

~~iii. Review and modification of pre-treatment requirements to assure CSO impacts are minimized;~~

~~iv. Maximization of flow to the POTW for treatment;~~

v. Prohibition of CSOs during dry weather;

vi. Control of solid and floatable materials in CSOs;
vii. Pollution prevention;

viii. Public notification to ensure that the public receives adequate notice of CSO occurrences and CSO impacts;

ix. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

In addition, the system must be operated in accordance with an approved Long Term Control Plan (LTCP), where required, and the discharge must not interfere with the attainment of the water quality criteria set forth in Chapter 3 except in situations where alternative criteria are authorized by the permitting agency and the Commission. Authorization of such alternative criteria shall be based upon and justified through a Use Attainability Analysis (UAA) consistent with 40 CFR 131.10g. The LTCP must be developed and implemented to fully attain the alternative criteria.

The approved LTCP and UAA will identify the conditions, at or above which, the contact recreation use and associated bacteria criteria cannot be achieved, and will identify alternative bacteria criteria that can be achieved. The alternative bacteria criteria shall apply for the period during which conditions exist and shall not exceed 2000 fecal coliform per 100 mL as a monthly geometric mean for the protection of public water supplies.

3. Treatment of Flows from Combined Sewer Systems during Wet Weather Conditions

In cases where municipal wastewater treatment plants serving combined sewer areas have primary treatment capacity in excess of secondary treatment capacity, opportunities may exist for partial treatment of combined flows which would otherwise be discharged as untreated combined sewer overflows. In such cases, in order to maximize the treatment of wet weather flows from combined sewer systems and reduce the frequency and duration of combined sewer overflow (CSO) events, bypass of the secondary treatment during wet weather conditions may be allowed on an interim basis, provided the following conditions are met:

i. the facilities are properly operated and maintained;

ii. the maximum possible quantity of wastewater (determined through an approved engineering study) receives secondary treatment in accordance with discharge requirements; and

iii. the discharge does not cause exceedances of water quality criteria in the Ohio River outside the mixing zone.

Bypasses of secondary treatment which are necessary in order to implement a CSO long-term control plan which includes primary treatment options at the municipal wastewater treatment plant may be allowed, provided it is not technically or financially feasible to provide secondary treatment of greater amounts of wet weather flow. The consideration of feasible alternatives should be documented in the development of the long-term control plan.

5.5 INDUSTRIAL WASTES, INCLUDING TOXIC WASTES

A. The minimum level of treatment for industrial wastes including toxic wastes, prior to discharge, shall be in accordance with national effluent limitations and guidelines adopted by the Administrator of the U.S. EPA pursuant to Sections 301 and 302 of the Federal Clean Water Act, national standards of performance for new sources adopted pursuant to Section 306 of the Federal Clean Water Act, and national toxic and pretreatment effluent limitations, adopted pursuant to Section 307 of the Federal Clean Water Act or in accordance with the standards of the state in which the discharge occurs.

B. Effluent limitations for discharges of industrial wastes, including toxic wastes may be based on the net discharge of pollutants, provided that the following conditions are met:

1. Any determination for net discharge of pollutants must be made on a pollutant-by-pollutant, outfall-by-outfall basis.

2. A net discharge of pollutants would only be allowed in the absence of a TMDL applicable to the discharge.

3. The facility withdraws 100 percent of the intake water containing the pollutant from the same body of water into which the discharge is made.

4. The facility does not contribute any additional mass of the identified intake pollutant to its wastewater.

5. The facility does not alter the identified intake pollutant chemically or physically in a manner that would cause adverse water quality impacts to occur that would not occur if the pollutants were left in-stream.

6. The facility does not increase the identified intake pollutant concentration, as defined by the permitting authority, at the edge of the mixing zone, or at the point of discharge if a mixing zone is not allowed, as compared to the pollutant concentration in the intake water, unless the increased

concentration does not cause or contribute to an excursion above an applicable water quality standard.

7. The timing and location of the discharge would not cause adverse water quality impacts to occur that would not occur if the identified intake pollutant were left in-stream.

C. Industrial waste treatment facilities shall notify ORSANCO of all upsets and bypasses within two hours of their discovery.

5.6 RESIDUES FROM POTABLE WATER TREATMENT PLANTS

The use of controlled discharge for residues from potable water treatment plant processes of sedimentation, coagulation, and filtration may be authorized provided that, as a minimum, the discharge meets all the requirements of Chapters 3.1 and 5.1.

5.7 COOLING WATER

A. A discharge of cooling water shall meet the requirements of Chapter 5.1. and shall not cause violations of the temperature criteria set forth in Chapter 3.2.C, except as authorized by a variance issued pursuant to Section 316(a) of the Federal Clean Water Act.

B. Any cooling water additives that will ultimately be discharged to the environment must be approved by the appropriate state agency.

5.8 OTHER WASTES

The discharge of Other Wastes (other than those specified above) shall meet the requirements of Chapter 5.1 and shall not cause or contribute to a violation of the water quality criteria set forth in Chapter 3.

5.93.3 ANALYTICAL METHODS

Tests or analytical determinations establish compliance or non-compliance with the Wastewater Discharge Requirements and stream criteria established herein shall be made in accordance with accepted procedures such as those contained in the: (a) latest edition of Standard Methods for the Examination of Water and Wastewater, prepared and published jointly by the American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF); (b) Annual Book of ASTM Standards, Part 31 – Water, by the American Society for Testing and Materials; (c) Guidelines Establishing Test Procedures for the Analysis of Pollutants (40 CFR 136) by the U.S. EPA; or (d) by such other methods as are approved by the

Commission as equal or superior to or not available within methods in documents listed above, provided such other test methods are available to the public.

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~~**Acute and Chronic Criteria Concentrations**~~
~~**for Total Ammonia-Nitrogen (in mg/L)**~~
~~**For Varying Combinations of pH and Temperature**~~

~~Table A1: Temperature and pH-Dependent Values of the Acute Criterion for Total Ammonia Nitrogen; Unionid Mussels Present~~

pH	Temperature, Celsius																				
	0-10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6.5	51	48	44	41	37	34	32	29	27	25	23	21	19	18	16	15	14	13	12	11	9.9
6.6	49	46	42	39	36	33	30	28	26	24	22	20	18	17	16	14	13	12	11	10	9.5
6.7	46	44	40	37	34	31	29	27	24	22	21	19	18	16	15	14	13	12	11	9.8	9.0
6.8	44	41	38	35	32	30	27	25	23	21	20	18	17	15	14	13	12	11	10	9.2	8.5
6.9	41	38	35	32	30	28	25	23	21	20	18	17	15	14	13	12	11	10	9.4	8.6	7.9
7.0	38	35	33	30	28	25	23	21	20	18	**17**	15	14	13	12	11	10	9.4	8.6	7.9	7.3
7.1	34	32	30	27	25	23	21	20	18	17	15	14	13	12	11	10	9.3	8.5	7.9	7.2	6.7
7.2	31	29	27	25	23	21	19	18	16	15	14	13	12	11	9.8	9.1	8.3	7.7	7.1	6.5	6.0
7.3	27	26	24	22	20	18	17	16	14	13	12	11	10	9.5	8.7	8.0	7.4	6.8	6.3	5.8	5.3
7.4	24	22	21	19	18	16	15	14	13	12	11	9.8	9.0	8.3	7.7	7.0	6.5	6.0	5.5	5.1	4.7
7.5	21	19	18	17	15	14	13	12	11	10	9.2	8.5	7.8	7.2	6.6	6.1	5.6	5.2	4.8	4.4	4.0
7.6	18	17	15	14	13	12	11	10	9.3	8.6	7.9	7.3	6.7	6.2	5.7	5.2	4.8	4.4	4.1	3.8	3.5
7.7	15	14	13	12	11	10	9.3	8.6	7.9	7.3	6.7	6.2	5.7	5.2	4.8	4.4	4.1	3.8	3.5	3.2	2.9
7.8	13	12	11	10	9.3	8.5	7.9	7.2	6.7	6.1	5.6	5.2	4.8	4.4	4.0	3.7	3.4	3.2	2.9	2.7	2.5
7.9	11	9.9	9.1	8.4	7.7	7.1	6.6	6.0	5.6	5.1	4.7	4.3	4.0	3.7	3.4	3.1	2.9	2.6	2.4	2.2	2.1
8.0	8.8	8.2	7.6	7.0	6.4	5.9	5.4	5.0	4.6	4.2	3.9	3.6	3.3	3.0	2.8	2.6	2.4	2.2	2.0	1.9	1.7
8.1	7.2	6.8	6.3	5.8	5.3	4.9	4.5	4.1	3.8	3.5	3.2	3.0	2.7	2.5	2.3	2.1	2.0	1.8	1.7	1.5	1.4
8.2	6.0	5.6	5.2	4.8	4.4	4.0	3.7	3.4	3.1	2.9	2.7	2.4	2.3	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.2
8.3	4.9	4.6	4.3	3.9	3.6	3.3	3.1	2.8	2.6	2.4	2.2	2.0	1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.0	0.96
8.4	4.1	3.8	3.5	3.2	3.0	2.7	2.5	2.3	2.1	2.0	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.93	0.86	0.79
8.5	3.3	3.1	2.9	2.7	2.4	2.3	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.90	0.83	0.77	0.71	0.65
8.6	2.8	2.6	2.4	2.2	2.0	1.9	1.7	1.6	1.5	1.3	1.2	1.1	1.0	1.0	0.88	0.81	0.75	0.69	0.63	0.58	0.54
8.7	2.3	2.2	2.0	1.8	1.7	1.6	1.4	1.3	1.2	1.1	1.0	0.94	0.87	0.80	0.74	0.68	0.62	0.57	0.53	0.49	0.45
8.8	1.9	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.93	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37
8.9	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.93	0.85	0.79	0.72	0.67	0.61	0.56	0.52	0.48	0.44	0.40	0.37	0.34	0.32
9.0	1.4	1.3	1.2	1.1	1.0	0.93	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37	0.34	0.32	0.29	0.27

~~Table A2: Temperature and pH-Dependent Values of the Acute Criterion for Total Ammonia Nitrogen; Unionid Mussels Absent~~

pH	Temperature, Celsius																
	0-14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
6.5	51	51	51	51	51	51	51	51	51	48	44	40	37	34	31	29	27
6.6	49	49	49	49	49	49	49	49	49	46	42	39	36	33	30	28	26
6.7	46	46	46	46	46	46	46	46	46	43	40	37	34	31	29	26	24
6.8	44	44	44	44	44	44	44	44	44	41	38	35	32	29	27	25	23
6.9	41	41	41	41	41	41	41	41	41	38	35	32	30	27	25	23	21
7.0	38	38	38	38	38	38	**38**	38	38	35	32	30	27	25	23	21	20
7.1	34	34	34	34	34	34	34	34	34	32	29	27	25	23	21	19	18
7.2	31	31	31	31	31	31	31	31	31	29	26	24	22	21	19	17	16
7.3	27	27	27	27	27	27	27	27	27	26	23	22	20	18	17	16	14
7.4	24	24	24	24	24	24	24	24	24	22	21	19	17	16	15	14	13
7.5	21	21	21	21	21	21	21	21	21	19	18	16	15	14	13	12	11
7.6	18	18	18	18	18	18	18	18	18	17	15	14	13	12	11	10	9.3
7.7	15	15	15	15	15	15	15	15	15	14	13	12	11	10	9.3	8.6	7.9
7.8	13	13	13	13	13	13	13	13	13	12	11	10	9.2	8.5	7.8	7.2	6.6
7.9	11	11	11	11	11	11	11	11	11	9.9	9.1	8.4	7.7	7.1	6.5	6.0	5.5
8.0	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.2	7.5	6.9	6.4	5.9	5.4	5.0	4.6
8.1	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	6.8	6.2	5.7	5.3	4.9	4.5	4.1	3.8
8.2	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	5.6	5.1	4.7	4.4	4.0	3.7	3.4	3.1
8.3	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.6	4.2	3.9	3.6	3.3	3.0	2.8	2.6
8.4	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	3.8	3.4	3.2	3.0	2.7	2.5	2.3	2.1
8.5	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.1	2.9	2.6	2.4	2.2	2.1	1.9	1.8
8.6	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.6	2.4	2.2	2.0	1.9	1.7	1.6	1.4
8.7	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.2	2.0	1.8	1.7	1.5	1.4	1.3	1.2
8.8	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.0
8.9	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.92	0.85
9.0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.2	1.1	1.0	0.93	0.85	0.78	0.72

~~Table A3: Temperature and pH-Dependent Values of the Chronic Criterion for Total Ammonia Nitrogen; Unionid Mussels Present~~

pH	**Temperature, Celsius**																						
	0-7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
6.5	4.9	4.6	4.3	4.1	3.8	3.6	3.3	3.1	2.9	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.6	1.5	1.5	1.4	1.3	1.2	1.1
6.6	4.8	4.5	4.3	4.0	3.8	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1
6.7	4.8	4.5	4.2	3.9	3.7	3.5	3.2	3.0	2.8	2.7	2.5	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1
6.8	4.6	4.4	4.1	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1
6.9	4.5	4.2	4.0	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0
7.0	4.4	4.1	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.2	2.0	**1.9**	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0
7.1	4.2	3.9	3.7	3.5	3.2	3.0	2.8	2.7	2.5	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	1.0
7.2	4.0	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.0	1.0	0.90
7.3	3.8	3.5	3.3	3.1	2.9	2.7	2.6	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.0	1.0	0.91	0.85
7.4	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.0	1.0	0.90	0.85	0.79
7.5	3.2	3.0	2.8	2.7	2.5	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.89	0.83	0.78	0.73
7.6	2.9	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.6	1.5	1.4	1.4	1.3	1.2	1.1	1.1	1.0	0.92	0.86	0.81	0.76	0.71	0.67
7.7	2.6	2.4	2.3	2.2	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.94	0.88	0.83	0.78	0.73	0.68	0.64	0.60
7.8	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.89	0.84	0.79	0.74	0.69	0.65	0.61	0.57	0.53
7.9	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.89	0.84	0.79	0.74	0.69	0.65	0.61	0.57	0.53	0.50	0.47
8.0	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.94	0.88	0.83	0.78	0.73	0.68	0.64	0.60	0.56	0.53	0.50	0.44	0.44	0.41
8.1	1.5	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.92	0.87	0.81	0.76	0.71	0.67	0.63	0.59	0.55	0.52	0.49	0.46	0.43	0.40	0.38	0.35
8.2	1.3	1.2	1.2	1.1	1.0	1.0	0.90	0.84	0.79	0.74	0.70	0.65	0.61	0.57	0.54	0.50	0.47	0.44	0.42	0.39	0.37	0.34	0.32	0.30
8.3	1.1	1.1	1.0	0.93	0.87	0.82	0.76	0.72	0.67	0.63	0.59	0.55	0.52	0.49	0.46	0.43	0.40	0.38	0.35	0.33	0.31	0.29	0.27	0.26
8.4	0.95	0.89	0.84	0.79	0.74	0.69	0.65	0.61	0.57	0.53	0.50	0.47	0.44	0.41	0.39	0.36	0.34	0.32	0.30	0.28	0.26	0.25	0.23	0.22
8.5	0.80	0.75	0.71	0.67	0.62	0.58	0.55	0.51	0.48	0.45	0.42	0.40	0.37	0.35	0.33	0.31	0.29	0.27	0.25	0.24	0.22	0.21	0.20	0.18
8.6	0.68	0.64	0.60	0.56	0.53	0.49	0.46	0.43	0.41	0.38	0.36	0.33	0.31	0.29	0.28	0.26	0.24	0.23	0.21	0.20	0.19	0.18	0.16	0.15
8.7	0.57	0.54	0.51	0.47	0.44	0.42	0.39	0.37	0.34	0.32	0.30	0.28	0.27	0.25	0.23	0.22	0.21	0.19	0.18	0.17	0.16	0.15	0.14	0.13
8.8	0.49	0.46	0.43	0.40	0.38	0.35	0.33	0.31	0.29	0.27	0.26	0.24	0.23	0.21	0.20	0.19	0.17	0.16	0.15	0.14	0.13	0.13	0.12	0.11
8.9	0.42	0.39	0.37	0.34	0.32	0.30	0.28	0.27	0.25	0.23	0.22	0.21	0.19	0.18	0.17	0.16	0.15	0.14	0.13	0.12	0.12	0.11	0.10	0.09
9.0	0.36	0.34	0.32	0.30	0.28	0.26	0.24	0.23	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.14	0.13	0.12	0.11	0.11	0.10	0.09	0.09	0.08

~~Table A4: Temperature and pH-Dependent Values of the Chronic Criterion for Total Ammonia Nitrogen; Unionid Mussels Absent and Fish Early Life Stages Present (March 1 – October 31)~~

pH	Temperature, Celsius																
	0-14	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
6.5	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.0	6.6	6.2	5.8	5.4	5.1	4.8	4.5	4.2
6.6	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	6.9	6.5	6.1	5.7	5.4	5.0	4.7	4.4	4.1
6.7	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	6.8	6.4	6.0	5.6	5.3	4.9	4.6	4.3	4.1
6.8	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.9	6.6	6.2	5.8	5.5	5.1	4.8	4.5	4.2	4.0
6.9	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.5	6.1	5.7	5.3	5.0	4.7	4.4	4.1	3.9
7.0	6.5	6.5	6.5	6.5	6.5	6.5	6.5	**6.5**	6.2	5.8	5.5	5.1	4.8	4.5	4.2	4.0	3.7
7.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.0	5.6	5.3	4.9	4.6	4.3	4.1	3.8	3.6
7.2	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.7	5.3	5.0	4.7	4.4	4.1	3.9	3.6	3.4
7.3	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.4	5.0	4.7	4.4	4.1	3.9	3.6	3.4	3.2
7.4	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.0	4.7	4.4	4.1	3.9	3.6	3.4	3.2	3.0
7.5	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.6	4.3	4.1	3.8	3.6	3.3	3.1	2.9	2.8
7.6	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.2	3.9	3.7	3.5	3.2	3.0	2.9	2.7	2.5
7.7	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.8	3.5	3.3	3.1	2.9	2.7	2.6	2.4	2.3
7.8	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.1	2.0
7.9	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.0	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8
8.0	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.4	2.3	2.1	2.0	1.9	1.7	1.6	1.5
8.1	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3
8.2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1
8.3	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.96
8.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.2	1.1	1.1	0.99	0.93	0.87	0.81
8.5	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.0	0.95	0.89	0.83	0.78	0.73	0.69
8.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.97	0.91	0.85	0.80	0.75	0.70	0.66	0.62	0.58
8.7	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.82	0.77	0.72	0.68	0.64	0.60	0.56	0.52	0.49
8.8	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.70	0.65	0.61	0.58	0.54	0.51	0.47	0.44	0.42
8.9	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.60	0.56	0.52	0.49	0.46	0.43	0.41	0.38	0.36
9.0	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.51	0.48	0.45	0.42	0.40	0.37	0.35	0.33	0.31

~~Table A5: Temperature and pH-Dependent Values of the Chronic Criterion for Total Ammonia Nitrogen; Unionid Mussels Absent and Fish Early Life Stages Absent (November 1 – February 29)~~

pH	Temperature, Celsius																							
	0-7	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
6.5	19	17	16	15	14	13	13	12	11	10	9.7	9.1	8.5	8.0	7.5	7.0	6.6	6.2	5.8	5.4	5.1	4.8	4.5	4.2
6.6	18	17	16	15	14	13	12	12	11	10	9.6	9.0	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.4	5.0	4.7	4.4	4.1
6.7	18	17	16	15	14	13	12	11	11	10	9.4	8.8	8.3	7.7	7.3	6.8	6.4	6.0	5.6	5.3	4.9	4.6	4.3	4.1
6.8	17	16	15	14	14	13	12	11	10	9.8	9.2	8.6	8.1	7.6	7.1	6.7	6.2	5.8	5.5	5.1	4.8	4.5	4.2	4.0
6.9	17	16	15	14	13	12	12	11	10	9.5	8.9	8.4	7.8	7.4	6.9	6.5	6.1	5.7	5.3	5.0	4.7	4.4	4.1	3.9
7.0	16	15	14	14	13	12	11	10	9.8	9.2	8.6	8.1	7.6	**7.1**	6.7	6.2	5.9	5.5	5.1	4.8	4.5	4.2	4.0	3.7
7.1	16	15	14	13	12	11	11	10	9.4	8.8	8.3	7.7	7.3	6.8	6.4	6.0	5.6	5.3	4.9	4.6	4.3	4.1	3.8	3.6
7.2	15	14	13	12	12	11	10	9.5	9.0	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.3	5.0	4.7	4.4	4.1	3.9	3.6	3.4
7.3	14	13	12	12	11	10	9.6	9.0	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.4	5.0	4.7	4.4	4.1	3.9	3.6	3.4	3.2
7.4	13	12	12	11	10	9.5	9.0	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.3	5.0	4.7	4.4	4.1	3.9	3.6	3.4	3.2	3.0
7.5	12	11	11	10	9.4	8.8	8.2	7.7	7.2	6.8	6.4	6.0	5.6	5.2	4.9	4.6	4.3	4.1	3.8	3.6	3.3	3.1	2.9	2.8
7.6	11	10	10	9.1	8.5	8.0	7.5	7.0	6.6	6.2	5.8	5.4	5.1	4.8	4.5	4.2	3.9	3.7	3.5	3.2	3.0	2.9	2.7	2.5
7.7	9.9	9.3	8.7	8.1	7.7	7.2	6.8	6.3	5.9	5.6	5.2	4.9	4.6	4.3	4.0	3.8	3.5	3.3	3.1	2.9	2.7	2.6	2.4	2.3
7.8	8.8	8.3	7.8	7.3	6.8	6.4	6.0	5.6	5.3	5.0	4.6	4.4	4.1	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.1	2.0
7.9	7.8	7.3	6.8	6.4	6.0	5.6	5.3	5.0	4.6	4.4	4.1	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8
8.0	6.8	6.3	6.0	5.6	5.2	4.9	4.6	4.3	4.0	3.8	3.6	3.3	3.1	2.9	2.7	2.6	2.4	2.3	2.1	2.0	1.9	1.7	1.6	1.5
8.1	5.8	5.5	5.1	4.8	4.5	4.2	4.0	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3
8.2	5.0	4.7	4.4	4.1	3.9	3.6	3.4	3.2	3.0	2.8	2.6	2.5	2.3	2.2	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1
8.3	4.2	4.0	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	1.0
8.4	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.92	0.87	0.81
8.5	3.0	2.8	2.7	2.5	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	1.0	0.89	0.83	0.78	0.73	0.69
8.6	2.6	2.4	2.2	2.1	2.0	1.9	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.0	1.0	0.91	0.85	0.80	0.75	0.70	0.66	0.62	0.58
8.7	2.2	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.93	0.88	0.82	0.77	0.72	0.68	0.63	0.60	0.56	0.52	0.49
8.8	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.0	1.0	0.90	0.85	0.79	0.74	0.70	0.65	0.61	0.58	0.54	0.51	0.47	0.44	0.42
8.9	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.94	0.88	0.82	0.77	0.72	0.68	0.64	0.60	0.56	0.52	0.49	0.46	0.43	0.40	0.38	0.36
9.0	1.4	1.3	1.2	1.1	1.0	1.0	0.92	0.87	0.81	0.76	0.71	0.66	0.62	0.58	0.55	0.51	0.48	0.45	0.42	0.40	0.37	0.35	0.33	0.31

Appendix B

Dissolved Metals Criteria

Table B1: Numerical Values of Dissolved Metals Criteria at Specified Hardness Levels

Hardness	Cadmium		Chromium (III)		Lead		Silver	
	Acute Criterion (ug/L)	Chronic Criterion (ug/L)	Acute Criterion (ug/L)	Chronic Criterion (ug/L)	Acute Criterion (ug/L)	Chronic Criterion (ug/L)	Acute Criterion (ug/L)	Chronic Criterion (ug/L)
50	1.03	0.15	323	42.0	30.1	1.17	0.98	---
100	2.01	0.25	570	74.1	64.6	2.52	3.22	---
150	2.99	0.33	794	103	100	3.90	6.46	---
200	3.95	0.40	1005	131	136	5.31	10.6	---
250	4.90	0.46	1207	157	172	6.72	15.6	---
300	5.85	0.53	1401	182	209	8.13	21.3	---

Hardness	Copper		Nickel		Zinc	
	Acute Criterion (ug/L)	Chronic Criterion (ug/L)	Acute Criterion (ug/L)	Chronic Criterion (ug/L)	Acute Criterion (ug/L)	Chronic Criterion (ug/L)
50	6.99	4.95	261	28.9	65.1	65.7
100	13.4	8.96	469	52.0	117	118
150	19.7	12.7	660	73.3	165	167
200	25.8	16.2	842	93.5	211	213
250	31.9	19.6	1017	113	255	257
300	37.8	22.9	1187	132	297	300

Appendix C

Critical Flow Values

FROM	TO	Minimum 7-day 10-year Low Flow, cfs[1]	Minimum 1-day 10-year Low Flow, cfs[2]	Harmonic Mean Flow, cfs[2]
Pittsburgh (MP 0.0)	Montgomery Dam (MP 31.7)	4,730	4,200	16,200
Montgomery Dam (MP 31.7)	Willow Island Dam (MP 161.7)	5,880	5,000	20,500
Willow Island Dam (MP 161.7)	Racine Dam (MP 237.5)	6,560	5,170	24,500
Racine Dam (MP 237.5)	R.C. Byrd Dam (MP 279.2)	6,700	5,170	26,000
R.C. Byrd Dam (MP 279.2)	Guyandotte River (MP 305.2)	9,120	5,870	34,500
Guyandotte River (MP 305.2)	Big Sandy River (MP 317.1)	9,300	6,000	35,900
Big Sandy River (MP 317.1)	Greenup Dam (MP 341.0)	10,000	7,000	38,400
Greenup Dam (MP 341.0)	Meldahl Dam (MP 436.2)	10,600	7,960	42,100
Meldahl Dam (MP 436.2)	McAlpine Dam (MP 606.8)	10,600	8,670	45,300
McAlpine Dam (MP 606.8)	Newburgh Dam (MP 776.1)	11,000	8,670	49,000
Newburgh Dam (MP 776.1)	J.T. Myers Dam (MP 846.0)	12,900	10,000	60,900
J.T. Myers Dam (MP 846.0)	Smithland Dam (MP 918.5)	16,900	12,700	78,600
Smithland Dam (MP 918.5)	Cairo Point (MP 981.0)	51,000	40,900	175,000

[1]Minimum 7-day, 10-year flow (in cubic feet per second) provided by the U.S. Army Corps of Engineers.
[2]Based on Commission analysis of stream flow data provided by the U.S. Army Corps of Engineers.

Appendix D

Great Lakes Water Quality Initiative Methodologies for Development of Aquatic Life Criteria and Values

Methodology for Deriving Aquatic Life Criteria: Tier I

Great Lakes States and Tribes shall adopt provisions consistent with (as protective as) this appendix.

I. Definitions

Material of Concern. When defining the material of concern, the following should be considered:

Each separate chemical that does not ionize substantially in most natural bodies of water should usually be considered a separate material, except possibly for structurally similar organic compounds that only exist in large quantities as commercial mixtures of the various compounds and apparently have similar biological, chemical, physical, and toxicological properties.

For chemicals that ionize substantially in most natural bodies of water (e.g., some phenols and organic acids, some salts of phenols and organic acids, and most inorganic salts and coordination complexes of metals and metalloid), all forms that would be in chemical equilibrium should usually be considered one material. Each different oxidation state of a metal and each different non-ionizable covalently bonded organometallic compound should usually be considered a separate material.

The definition of the material of concern should include an operational analytical component. Identification of a material simply as "sodium," for example, implies "total sodium," but leaves room for doubt. If "total" is meant, it must be explicitly stated. Even "total" has different operational definitions, some of which do not necessarily measure "all that is there" in all samples. Thus, it is also necessary to reference or describe the analytical method that is intended. The selection of the operational analytical component should take into account the analytical and environmental chemistry of the material and various practical considerations, such as labor and equipment requirements, and whether the method would require measurement in the field or would allow measurement after samples are transported to a laboratory.

The primary requirements of the operational analytical component are that it be appropriate for use on samples of receiving water, that it be compatible with the available toxicity and bioaccumulation data without making extrapolations that are too hypothetical, and that it rarely results in underprotection or overprotection of aquatic organisms and their uses. Toxicity is the property of a material, or combination of materials, to adversely affect organisms.

b. Because an ideal analytical measurement will rarely be available, an appropriate compromise measurement will usually have to be used. This compromise measurement must fit with the general approach that if an ambient concentration is lower than the criterion, unacceptable effects will probably not occur, i.e., the compromise measure must not err on the side of underprotection when measurements are made on a surface water. What is an appropriate measurement in one situation might not be appropriate for another. For example, because the chemical and physical properties of an effluent are usually quite different from those of the receiving water, an analytical method that is appropriate for analyzing an effluent might not be appropriate for expressing a criterion, and vice versa. A criterion should be based on an appropriate analytical measurement, but the criterion is not rendered useless if an ideal measurement either is not available or is not feasible.

Note: The analytical chemistry of the material might have to be taken into account when defining the material or when judging the acceptability of some toxicity tests, but a criterion must not be based on the sensitivity of an analytical method. When aquatic organisms are more sensitive than routine analytical methods, the proper solution is to develop better analytical methods.

It is now the policy of U.S. EPA that the use of dissolved metals to set and measure compliance with water quality standards is the recommended approach, because dissolved metals more closely approximates the bioavailable fraction of metal in the water column than does total recoverable metal. One reason is that a primary mechanism for water column toxicity is adsorption at the gill surface which requires metals to be in the dissolved form. Reasons for the consideration of total recoverable metals criteria include risk management considerations not covered by evaluation of water column toxicity. A risk manager may consider sediments and food chain effects and may decide to take a conservative approach for metals, considering that metals are very persistent chemicals. This approach could include the use of total recoverable metals in water quality standards. A range of different risk management decisions can be justified. U.S. EPA recommends that State water quality standards be based on dissolved metals. U.S. EPA will also approve a State risk management decision to adopt standards based on total recoverable metals, if those standards are otherwise approvable under this program.

B. **Acute Toxicity.** Concurrent and delayed adverse effect(s) that results from an acute exposure and occurs within any short observation period which begins when the exposure begins, may extend beyond the exposure period, and usually does not constitute a substantial portion of the life span of the organism. (Concurrent toxicity is an adverse effect to an organism that results from, and occurs during, its exposure to one or more test materials.) Exposure constitutes contact with a chemical or physical agent. Acute exposure, however, is exposure of an organism for any short period which usually does not constitute a substantial portion of its life span.

C. **Chronic Toxicity.** Concurrent and delayed adverse effect(s) that occurs only as a result of a chronic exposure. Chronic exposure is exposure of an organism for any long period or for a substantial portion of its life span.

II. Collection Of Data

Collect all data available on the material concerning toxicity to aquatic animals and plants.

All data that are used should be available in typed, dated, and signed hard copy (e.g., publication, manuscript, letter, memorandum, etc.) with enough supporting information to indicate that acceptable test procedures were used and that the results are reliable. In some cases, it might be appropriate to obtain written information from the investigator, if possible. Information that is not available for distribution shall not be used.

Questionable data, whether published or unpublished, must not be used. For example, data must be rejected if they are from tests that did not contain a control treatment, and tests in which too many organisms in the control treatment died or showed signs of stress or disease.

Data on technical grade materials may be used, if appropriate, but data on formulated mixtures and emulsifiable concentrates of the material must not be used.

For some highly volatile, hydrolyzable, or degradable materials, it might be appropriate to use only results of flow-through tests in which the concentrations of test material in test solutions were measured using acceptable analytical methods. A flow-through test is a test with aquatic organisms in which test solutions flow into constant-volume test chambers either intermittently (e.g., every few minutes) or continuously, with the excess flowing out.

Data must be rejected if obtained using:

Brine shrimp, because they usually only occur naturally in water with salinity greater than 35 g/kg.

Species that do not have reproducing wild populations in North America.

Organisms that were previously exposed to substantial concentrations of the test material or other contaminants.

Saltwater species except for use in deriving Acute-Chronic Ratios (ACR). An ACR is a standard measure of the acute toxicity of a material divided by an appropriate measure of the chronic toxicity of the same material under comparable conditions.

G. Questionable data, data on formulated mixtures and emulsifiable concentrates, and data obtained with species non-resident to North America or previously exposed organisms may be used to provide auxiliary information but must not be used in the derivation of criteria.

III. Required Data

A. Certain data should be available to help ensure that each of the major kinds of possible adverse effects receives adequate consideration. An adverse effect is a change in an organism that is harmful to the organism. Exposure means contact with a chemical or physical agent. Results of acute and chronic toxicity tests with representative species of aquatic animals are necessary so that data available for tested species can be considered a useful indication of the sensitivities of appropriate untested species. Fewer data concerning toxicity to aquatic plants are usually available because procedures for conducting tests with plants and interpreting the results of such tests are not as well developed.

B. To derive a Tier I criterion for aquatic organisms and their uses, the following must be available:

Results of acceptable acute (or chronic) tests (see section IV or VI of this appendix) with at least one species of freshwater animal in at least eight different families such that all of the following are included:

a. The family Salmonidae in the class Osteichthyes;
b. One other family (preferably a commercially or recreationally important, warmwater species) in the class Osteichthyes (e.g., bluegill, channel catfish);
c. A third family in the phylum Chordata (e.g., fish, amphibian);
d. A planktonic crustacean (e.g., a cladoceran, copepod);
e. A benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish);
f. An insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge);
g. A family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca);
h. A family in any order of insect or any phylum not already represented.

Acute-chronic ratios (see section VI of this appendix) with at least one species of aquatic animal in at least three different families provided that of the three species:

a. At least one is a fish,
b. At least one is an invertebrate, and
c. At least one species is an acutely sensitive freshwater species.

Results of at least one acceptable test with a freshwater algae or vascular plant is desirable but not required for criterion derivation (see section VIII of this appendix). If plants are among the aquatic organisms most sensitive to the material, results of a test with a plant in another phylum (division) should also be available.

C. If all required data are available, a numerical criterion can usually be derived except in special cases. For example, derivation of a chronic criterion might not be possible if the available ACRs vary by more than a factor of ten with no apparent pattern. Also, if a criterion is to be related to a water quality characteristic (see sections V and VII of this appendix), more data will be required.

D. Confidence in a criterion usually increases as the amount of available pertinent information increases. Thus, additional data are usually desirable.

IV. Final Acute Value

A. Appropriate measures of the acute (short-term) toxicity of the material to a variety of species of aquatic animals are used to calculate the Final Acute Value (FAV). The calculated FAV is a calculated estimate of the concentration of a test material such that 95 percent of the genera (with which acceptable acute toxicity tests have been conducted on the material) have higher Genus Mean Acute Values (GMAVs). An acute test is a comparative study in which organisms, that are subjected to different treatments, are observed for a short period usually not constituting a substantial portion of their life span. However, in some cases, the Species Mean Acute Value (SMAV) of a commercially or recreationally important species is lower than the calculated FAV, then the SMAV replaces the calculated FAV in order to provide protection for that important species.

B. Acute toxicity tests shall be conducted using acceptable procedures. For good examples of acceptable procedures see American Society for Testing and Materials (ASTM) Standard E 729, Guide for Conducting Acute Toxicity Tests with Fishes, Macroinvertebrates and Amphibians.

C. Results of acute tests during which the test organisms were fed should not be used, unless data indicate that the food did not affect the toxicity of the test material.

D. Results of acute tests conducted in unusual dilution water, e.g., dilution water in which total organic carbon or particulate matter exceeded five mg/L, should not be used, unless a relationship is developed between acute toxicity and organic carbon or particulate matter, or unless data show that organic carbon or particulate matter, etc., do not affect toxicity.

E. Acute values must be based upon endpoints which reflect the total severe adverse impact of the test material on the organisms used in the test. Therefore, only the following kinds of data on acute toxicity to aquatic animals shall be used:

1. Tests with daphnids and other cladocerans must be started with organisms less than 24 hours old and tests with midges must be started with second or third instar larvae. It is preferred that the results should be the 48-hour EC50 based on the total percentage of organisms killed and immobilized. If such an EC50 is not available for a test, the 48-hour LC50 should be used in place of the desired 48-hour EC50. An EC50 or LC50 of longer than 48 hours can be used as long as the animals were not fed and the control animals were acceptable at the end of the test. An EC50 is a statistically or graphically estimated concentration that is expected to cause one or more specified effects in 50 percent of a group of organisms under specified conditions. An LC50 is a statistically or

graphically estimated concentration that is expected to be lethal to 50 percent of a group of organisms under specified conditions.

2. It is preferred that the results of a test with embryos and larvae of barnacles, bivalve mollusks (clams, mussels, oysters and scallops), sea urchins, lobsters, crabs, shrimp and abalones be the 96-hour EC50 based on the percentage of organisms with incompletely developed shells plus the percentage of organisms killed. If such an EC50 is not available from a test, of the values that are available from the test, the lowest of the following should be used in place of the desired 96-hour EC50: 48- to 96-hour EC50s based on percentage of organisms with incompletely developed shells plus percentage of organisms killed, 48- to 96-hour EC50s based upon percentage of organisms with incompletely developed shells, and 48-hour to 96-hour LC50s.

3. It is preferred that the result of tests with all other aquatic animal species and older life stages of barnacles, bivalve mollusks (clams, mussels, oysters and scallops), sea urchins, lobsters, crabs, shrimp and abalones be the 96-hour EC50 based on percentage of organisms exhibiting loss of equilibrium plus percentage of organisms immobilized plus percentage of organisms killed. If such an EC50 is not available from a test, of the values that are available from a test the lower of the following should be used in place of the desired 96-hour EC50: the 96-hour EC50 based on percentage of organisms exhibiting loss of equilibrium plus percentage of organisms immobilized and the 96-hour LC50.

4. Tests whose results take into account the number of young produced, such as most tests with protozoans, are not considered acute tests, even if the duration was 96 hours or less.

5. If the tests were conducted properly, acute values reported as "greater than" values and those that are above the solubility of the test material should be used, because rejection of such acute values would bias the FAV by eliminating acute values for resistant species.

F. If the acute toxicity of the material to aquatic animals has been shown to be related to a water quality characteristic such as hardness or particulate matter for freshwater animals, refer to section V of this appendix.

G. The agreement of the data within and between species must be considered. Acute values that appear to be questionable in comparison with other acute and chronic data for the same species and for other species in the same genus must not be used. For example, if the acute values available for a species or genus differ by more than a factor of ten, rejection of some or all of the values would be appropriate, absent countervailing circumstances.

H. If the available data indicate that one or more life stages are at least a factor of two more resistant than one or more other life stages of the same species, the data for the more resistant life stages must not be used in the calculation of the SMAV because a species cannot be considered protected from acute toxicity if all of the life stages are not protected.

I. For each species for which at least one acute value is available, the SMAV shall be calculated as the geometric mean of the results of all acceptable flow-through acute toxicity tests in which the concentrations of test material were measured with the most sensitive tested life stage of the species. For a species for which no such result is available, the SMAV shall be calculated as the geometric mean of all acceptable acute toxicity tests with the most sensitive tested life stage, i.e., results of flow-through tests in which the concentrations were not measured and results of static and renewal tests based on initial concentrations (nominal concentrations are acceptable for most test materials if measured concentrations are not available) of test material. A renewal test is a test with aquatic organisms in which either the test solution in a test chamber is removed and replaced at least once during the test or the test organisms are transferred into a new test solution of the same composition at least once during the test. A static test is a test with aquatic organisms in which the solution and organisms that are in a test chamber at the beginning of the test remain in the chamber until the end of the test, except for removal of dead test organisms.

Note 1: Data reported by original investigators must not be rounded off. Results of all intermediate calculations must not be rounded off to fewer than four significant digits.

Note 2: The geometric mean of N numbers is the N^{th} root of the product of the N numbers. Alternatively, the geometric mean can be calculated by adding the logarithms of the N numbers, dividing the sum by N, and taking the antilog of the quotient. The geometric mean of two numbers is the square root of the product of the two numbers, and the geometric mean of one number is that number. Either natural (base e) or common (base 10) logarithms can be used to calculate geometric means as long as they are used consistently within each set of data, i.e., the antilog used must match the logarithms used.

Note 3: Geometric means, rather than arithmetic means, are used here because the distributions of sensitivities of individual organisms in toxicity tests on most materials and the distributions of sensitivities of species within a genus are more likely to be lognormal than normal. Similarly, geometric means are used for ACRs because quotients are likely to be closer to lognormal than normal distributions. In addition, division of the geometric mean of a set of numerators by the geometric mean of the set of denominators will result in the geometric mean of the set of corresponding quotients.

J. For each genus for which one or more SMAVs are available, the GMAV shall be calculated as the geometric mean of the SMAVs available for the genus.

K. Order the GMAVs from high to low.

L. Assign ranks, R, to the GMAVs from "1" for the lowest to "N" for the highest. If two or more GMAVs are identical, assign them successive ranks.

M. Calculate the cumulative probability, P, for each GMAV as R/(N + 1).

N. Select the four GMAVs which have cumulative probabilities closest to 0.05 (if there are fewer than 59 GMAVs, these will always be the four lowest GMAVs).

O. Using the four selected GMAVs, and Ps, calculate:

$$L = \frac{\Sigma(\ln\ GMAV) - S(\Sigma(\sqrt{P}\,))}{4}$$

$$S^2 = \frac{\Sigma((\ln\ GMAV\,)^2\,) - \frac{(\Sigma(\ln\ GMAV)\,)^2}{4}}{\Sigma(P) - \frac{(\Sigma(\sqrt{P}\,)\,)^2}{4}}$$

$$A = S(\sqrt{0.05}\,) + L$$

Note: Natural logarithms (logarithms to base e, denoted as ln) are used herein merely because they are easier to use on some hand calculators and computers than common (base 10) logarithms. Consistent use of either will produce the same result.

P. If, for a commercially or recreationally important species, the geometric mean of the acute values from flow-through tests in which the concentrations of test material were measured is lower than the calculated Final Acute Value (FAV), then that geometric mean must be used as the FAV instead of the calculated FAV.

Q. See section VI of this appendix.

V. Final Acute Equation

A. When enough data are available to show that acute toxicity to two or more species is similarly related to a water quality characteristic, the relationship shall be taken into account as described in sections V.B through V.G of this appendix or using analysis of covariance. The two methods are equivalent and produce identical results. The manual method described below provides an understanding of this application of covariance analysis, but computerized versions of covariance analysis are much more convenient for analyzing large data sets. If two or more factors affect toxicity, multiple regression analysis shall be used.

B. For each species for which comparable acute toxicity values are available at two or more different values of the water quality characteristic, perform a least squares regression of the acute toxicity values on the corresponding values of the water quality characteristic to obtain the slope and its 95 percent confidence limits for each species.

Note: Because the best documented relationship is that between hardness and acute toxicity of metals in fresh water and a log-log relationship fits these data, geometric means and natural logarithms of both toxicity and water quality are used in the rest of this section. For relationships based on other water quality characteristics, such as pH or temperature, no transformation or a different transformation might fit the data better, and appropriate changes will be necessary throughout this section.

C. Decide whether the data for each species are relevant, taking into account the range and number of the tested values of the water quality characteristic and the degree of agreement within and between species. For example, a slope based on six data points might be of limited value if it is based only on data for a very narrow range of values of the water quality characteristic. A slope based on only two data points, however, might be useful if it is consistent with other information and if the two points cover a broad enough range of the water quality characteristic. In addition, acute values that appear to be questionable in comparison with other acute and chronic data available for the same species and for other species in the same genus should not be used. For example, if after adjustment for the water quality characteristic, the acute values available for a species or genus differ by more than a factor of ten, rejection of some or all of the values would be appropriate, absent countervailing justification. If useful slopes are not available for at least one fish and one invertebrate or if the available slopes are too dissimilar or if too few data are available to adequately define the relationship between acute toxicity and the water quality characteristic, return to section IV.G of this appendix, using the results of tests conducted under conditions and in waters similar to those commonly used for toxicity tests with the species.

D. For each species, calculate the geometric mean of the available acute values and then divide each of the acute values for the species by the geometric mean for the species. This normalizes the acute values so that the geometric mean of the normalized values for each species individually and for any combination of species is 1.0.

E. Similarly, normalize the values of the water quality characteristic for each species individually using the same procedure as above.

F. Individually for each species, perform a least squares regression of the normalized acute values of the water quality characteristic. The resulting slopes and 95 percent confidence limits will be identical to those obtained in section V.B. of this appendix. If, however, the data are actually plotted, the line of best fit for each individual species will go through the point 1,1 in the center of the graph.

G. Treat all of the normalized data as if they were all for the same species and perform a least squares regression of all of the normalized acute values on the corresponding normalized values of the water quality characteristic to obtain the pooled acute slope, V, and its 95 percent confidence limits. If all of the normalized data are actually plotted, the line of best fit will go through the point 1,1 in the center of the graph.

H. For each species, calculate the geometric mean, W, of the acute toxicity values and the geometric mean, X, of the values of the water quality characteristic. (These were calculated in sections V.D and V.E of this appendix.)

I. For each species, calculate the logarithm, Y, of the SMAV at a selected value, Z, of the water quality characteristic using the equation:

$$Y = \ln W - V(\ln X - \ln Z)$$

J. For each species, calculate the SMAV at X using the equation:

$$SMAV = e^{Y}$$

Note: Alternatively, the SMAVs at Z can be obtained by skipping step H above, using the equations in steps I and J to adjust each acute value individually to Z, and then calculating the geometric mean of the adjusted values for each species individually. This alternative procedure allows an examination of the range of the adjusted acute values for each species.

Obtain the FAV at Z by using the procedure described in sections IV.J through IV.O of this appendix.

If, for a commercially or recreationally important species, the geometric mean of the acute values at Z from flow-through tests in which the concentrations of the test material were measured is lower than the FAV at Z, then the geometric mean must be used as the FAV, instead of the FAV.

The Final Acute Equation is written as:

$$FAV = e^{(V[\ln(\text{water quality characteristic})] + A - V[\ln Z])},$$

where V = pooled acute slope, and A = ln(FAV at Z).

Because V, A, and Z are known, the FAV can be calculated for any selected value of the water quality characteristic.

VI. Final Chronic Value

A. Depending on the data that are available concerning chronic toxicity to aquatic animals, the Final Chronic Value (FCV) can be calculated in the same manner as the FAV or by dividing the FAV by the Final Acute-Chronic Ratio (FACR). In some cases, it might not be possible to calculate a FCV. The FCV is (a) a calculated estimate of the concentration of a test material such that 95 percent of the genera (with which acceptable chronic toxicity tests have been conducted on the material) have higher GMCVs, or (b) the quotient of an FAV divided by an appropriate ACR, or (c) the SMCV of an important and/or critical species, if the SMCV is lower than the calculated estimate or the quotient, whichever is applicable.

Note: As the name implies, the ACR is a way of relating acute and chronic toxicities.

B. Chronic values shall be based on results of flow-through (except renewal is acceptable for daphnids) chronic tests in which the concentrations of test material in the test solutions were properly measured at appropriate times during the test. A chronic test is a comparative study in which organisms, that are subjected to different treatments, are observed for a long period or a substantial portion of their life span.

C. Results of chronic tests in which survival, growth, or reproduction in the control treatment was unacceptably low shall not be used. The limits of acceptability will depend on the species.

D. Results of chronic tests conducted in unusual dilution water, e.g., dilution water in which total organic carbon or particulate matter exceeded five mg/L, should not be used, unless a relationship is developed between chronic toxicity and organic carbon or particulate matter, or unless data show that organic carbon, particulate matter, etc., do not affect toxicity.

E. Chronic values must be based on endpoints and lengths of exposure appropriate to the species. Therefore, only results of the following kinds of chronic toxicity tests shall be used:

Life-cycle toxicity tests consisting of exposures of each of two or more groups of individuals of a species to a different concentration of the test material throughout a life cycle. To ensure that all life stages and life processes are exposed, tests with fish should begin with embryos or newly hatched young less than 48 hours old, continue through maturation and reproduction, and should end not less than 24 days (90 days for salmonids) after the hatching of the next generation. Tests with daphnids should begin with young less than 24 hours old and last for not less than 21 days, and for ceriodaphnids not less than seven days. For good examples of acceptable procedures see American Society for Testing and Materials (ASTM) Standard E 1193 Guide for conducting renewal life-cycle toxicity tests with *Daphnia magna* and ASTM Standard E 1295 Guide for conducting three-brood, renewal toxicity tests with *Ceriodaphnia dubia*. Tests with mysids should begin with young less than 24 hours old and continue until seven days past the median time of first brood release in the controls. For fish, data should be obtained and analyzed on survival and growth of adults and young, maturation of males and females, eggs spawned per female, embryo viability (salmonids only), and hatchability. For daphnids, data should be obtained and analyzed on survival and young per female. For mysids, data should be obtained and analyzed on survival, growth, and young per female.

Partial life-cycle toxicity tests consist of exposures of each of two more groups of individuals of a species of fish to a different concentration of the test material through most portions of a life cycle. Partial life-cycle tests are allowed with fish species that require more than a year to reach sexual maturity, so that all major life stages can be exposed to the test material in less than 15 months. A life-cycle test is a comparative study in which organisms, that are subjected to different treatments, are observed at least from a life stage in one generation to the same life-stage in the next generation. Exposure to the test material should begin with immature juveniles at least two months prior to active gonad development, continue through maturation and reproduction, and end not less than 24 days (90 days for salmonids) after the hatching of the next generation. Data should be obtained and analyzed on survival and growth of adults and young, maturation of males and females, eggs spawned per female, embryo viability (salmonids only), and hatchability.

Early life-stage toxicity tests consisting of 28-day to 32-day (60 days post hatch for salmonids) exposures of the early life stages of a species of fish from shortly after fertilization through embryonic, larval, and early juvenile development. Data should be obtained and analyzed on survival and growth.

Note: Results of an early life-stage test are used as predictions of results of life cycle and partial life-cycle tests with the same species. Therefore, when results of a life cycle or partial life-cycle test are available, results of an early life-stage test with the same species should not be used. Also, results of early life-stage tests in which the incidence of mortalities or abnormalities increased substantially near the end of the test shall not be used because the results of such tests are possibly not good predictions of comparable life-cycle or partial life-cycle tests.

F. A chronic value may be obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test or by analyzing chronic data using regression analysis.

A lower chronic limit is the highest tested concentration:
In an acceptable chronic test;
Which did not cause an unacceptable amount of adverse effect on any of the specified biological measurements; and
Below which no tested concentration caused an unacceptable effect.

An upper chronic limit is the lowest tested concentration:
In an acceptable chronic test;
Which did cause an unacceptable amount of adverse effect on one or more of the specified biological measurements; and
Above which all tested concentrations also caused such an effect.

Note: Because various authors have used a variety of terms and definitions to interpret and report results of chronic tests, reported results should be reviewed carefully. The amount of effect that is considered unacceptable is often based on a statistical hypothesis test, but might also be defined in terms of a specified percent reduction from the controls. A small percent reduction (e.g., three percent) might be considered acceptable even if it is statistically significantly different from the control, whereas a large percent reduction (e.g., 30 percent) might be considered unacceptable even if it is not statistically significant.

If the chronic toxicity of the material to aquatic animals has been shown to be related to a water quality characteristic such as hardness or particulate matter for freshwater animals, refer to section VII of this appendix.

If chronic values are available for species in eight families as described in section III.B.1 of this appendix, a SMCV shall be calculated for each species for which at least one chronic value is available by calculating the geometric mean of the results of all acceptable life-cycle and partial life-cycle toxicity tests with the species; for a species of fish for which no such result is available, the SMCV is the geometric mean of all acceptable early life-stage tests. Appropriate GMCVs shall also be calculated. A GMCV is the geometric mean of the SMCVs for the genus. The FCV shall be obtained using the procedure described in sections IV.J through IV.O of this appendix, substituting SMCV and GMCV for SMAV and GMAV respectively. (See section VI.M of this appendix.)

Note: Sections VI.I through VI.L of this appendix are for use when chronic values are not available for species in eight taxonomic families as described in section III.B.1 of this appendix.

For each chronic value for which at least one corresponding appropriate acute value is available, calculate an ACR, using for the numerator the geometric mean of the results of all acceptable flow-through (except static is acceptable for daphnids and midges) acute tests in the same dilution water in which the concentrations are measured. For fish, the acute test(s) should be conducted with juveniles. The acute test(s) should be part of the same study as the chronic test. If acute tests were not conducted as part of the same study, but were conducted as part of a different study in the same laboratory and dilution water, then they may be used. If no such acute tests are available, results of acute tests conducted in the same dilution water in a different laboratory may be used. If no such acute tests are available, an ACR shall not be calculated.

For each species, calculate the SMACR as the geometric mean of all ACRs available for that species.

For some materials, the ACR seems to be the same for all species, but for other materials the ratio seems to increase or decrease as the SMAV increases. Thus the FACR can be obtained in three ways, depending on the data available:

If the species mean ACR seems to increase or decrease as the MAVs increase, the FACR shall be calculated as the geometric mean of the ACRs for species whose SMAVs are close to the FAV.

If no major trend is apparent and the ACRs for all species are within a factor of ten, the FACR shall be calculated as the geometric mean of all of the SMACRs.

If the most appropriate SMACRs are less than 2.0, and especially if they are less than 1.0, acclimation has probably occurred during the chronic test. In this situation, because continuous exposure and acclimation cannot be assured to provide adequate protection in field situations, the FACR should be assumed to be 2.0, so that the FCV is equal to the Criterion Maximum Concentration (CMC). (See section X.B of this appendix.)

If the available SMACRs do not fit one of these cases, a FACR may not be obtained and a Tier I FCV probably cannot be calculated.

L. Calculate the FCV by dividing the FAV by the FACR:

FCV = FAV/FACR

If there is a Final Acute Equation rather than a FAV, see Section V of this appendix.

If the SMCV of a commercially or recreationally important species is lower than the calculated FCV, then that SMCV must be used as the FCV instead of the calculated FCV.

See section VIII of this appendix.

VII. Final Chronic Equation

A Final Chronic Equation can be derived in two ways. The procedure described in section VII.A of this appendix will result in the chronic slope being the same as the acute slope. The procedure described in sections VII.B. through N of this appendix will usually result in the chronic slope being different from the acute slope.

If ACRs are available for enough species at enough values of the water quality characteristic to indicate that the ACR appears to be the same for all species and appears to be independent of the water quality characteristic, calculate the FACR as the geometric mean of the available SMACRs.

Calculate the FCV at the selected value Z of the water quality characteristic by dividing the FAV at Z (see section V.M of this appendix) by the FACR.

Use V = pooled acute slope (see section V.M of this appendix), and L = pooled chronic slope.

See section VII.M of this appendix.

B. When enough data are available to show that chronic toxicity to at least one species is related to a water quality characteristic, the relationship should be taken into account as described in Sections C through G below or using analysis of covariance. The two methods are equivalent and produce identical results. The manual method described below provides an understanding of this application of covariance analysis, but computerized versions of covariance analysis are much more convenient for analyzing large data sets. If two or more factors affect toxicity, multiple regression analysis shall be used.

C. For each species for which comparable chronic toxicity values are available at two or more different values of the water quality characteristic, perform a least squares regression of the chronic toxicity values on the corresponding values of the water quality characteristic to obtain the slope and its 95 percent confidence limits for each species.

Note: Because the best documented relationship is that between hardness and acute toxicity of metals in fresh water and a log-log relationship fits these data, geometric means and natural logarithms of both toxicity and water quality are used in the rest of this section. For relationships based on other water quality characteristics, such as pH or temperature, no transformation or a different transformation might fit the data better, and appropriate changes will be necessary throughout this section. It is probably preferable, but not necessary, to use the same transformation that was used with the acute values in section V of this appendix.

Decide whether the data for each species are relevant, taking into account the range and number of the tested values of the water quality characteristic and the degree of agreement within and between species. For example, a slope based on six data points might be of limited value if it is based only on data for a very narrow range of values of the water quality characteristic. A slope based on only two data points, however, might be more useful if it is consistent with other information and if the two points cover a broad range of the water quality characteristic. In addition, chronic values that appear to be questionable in comparison with other acute and chronic data available for the same species and for other species in the same genus in most cases should not be used. For example, if after adjustment for the water quality characteristic, the chronic values available for a species or genus differ by more than a factor of ten, rejection of some or all of the values is, in most cases, absent countervailing circumstances, appropriate. If a useful chronic slope is not available for at least one species or if the available slopes are too dissimilar or if too few data are available to adequately define the relationship between chronic toxicity and the water quality characteristic, it might be appropriate to assume that the chronic slope is the same as the acute slope, which is equivalent to assuming that the ACR is independent of the water quality characteristic. Alternatively, return to section VI.H of this appendix, using the results of tests conducted under conditions and in waters similar to those commonly used for toxicity tests with the species.

Individually for each species, calculate the geometric mean of the available chronic values and then divide each chronic value for a species by the mean for the species. This normalizes the chronic values so that the geometric mean of the normalized values for each species individually, and for any combination of species, is 1.0.

Similarly, normalize the values of the water quality characteristic for each species individually.

Individually for each species, perform a least squares regression of the normalized chronic toxicity values on the corresponding normalized values of the water quality characteristic. The resulting slopes and the 95 percent confidence limits will be identical to those obtained in section VII.B of this appendix. Now, however, if the data are actually plotted, the line of best fit for each individual species will go through the point 1,1 in the center of the graph.

Treat all of the normalized data as if they were all the same species and perform a least squares regression of all of the normalized chronic values on the corresponding normalized values of the water quality characteristic to obtain the pooled chronic slope, L, and its 95 percent confidence limits. If all normalized data are actually plotted, the line of best fit will go through the point 1,1 in the center of the graph.

For each species, calculate the geometric mean, M, of the toxicity values and the geometric mean, P, of the values of the water quality characteristic. (These are calculated in sections VII.E and F of this appendix.)

For each species, calculate the logarithm, Q, of the SMCV at a selected value, Z, of the water quality characteristic using the equation:

$$Q = \ln M - L(\ln P - \ln Z)$$

Note: Although it is not necessary, it is recommended that the same value of the water quality characteristic be used here as was used in section V of this appendix.

K. For each species, calculate a SMCV at Z using the equation:

$$SMCV = e^{Q}$$

Note: Alternatively, the SMCV at Z can be obtained by skipping section VII.J of this appendix, using the equations in sections VII.J and K of this appendix to adjust each chronic value individually to Z, and then calculating the geometric means of the adjusted values for each species individually. This alternative procedure allows an examination of the range of the adjusted chronic values for each species.

Obtain the FCV at Z by using the procedure described in sections IV.J through O of this appendix.

If the SMCV at Z of a commercially or recreationally important species is lower than the calculated FCV at Z, then that SMCV shall be used as the FCV at Z instead of the calculated FCV.

The Final Chronic Equation is written as:

$$FCV = e^{(L[\ln(\text{water quality characteristic})] + \ln S - L[\ln Z])}$$

where:
L = pooled chronic slope
S = FCV at Z.

Because L, S, and Z are known, the FCV can be calculated for any selected value of the water quality characteristic.

VIII. Final Plant Value

A Final Plant Value (FPV) is the lowest plant value that was obtained with an important aquatic plant species in an acceptable toxicity test for which the concentrations of the test material were measured and the adverse effect was biologically important. Appropriate measures of the toxicity of the material to aquatic plants are used to compare the relative sensitivities of aquatic plants and animals. Although procedures for conducting and interpreting the results of toxicity tests with plants are not well-developed, results of tests with plants usually indicate that criteria which adequately protect aquatic animals and their uses will, in most cases, also protect aquatic plants and their uses.

A plant value is the result of a 96-hour test conducted with an alga or a chronic test conducted with an aquatic vascular plant.

Note: A test of the toxicity of a metal to a plant shall not be used if the medium contained an excessive amount of a completing agent, such as EDTA, that might affect the toxicity of the metal. Concentrations of EDTA above 200 µg/L should be considered excessive.

C. The FPV shall be obtained by selecting the lowest result from a test with an important aquatic plant species in which the concentrations of test material are measured and the endpoint is biologically important.

IX. Other Data

Pertinent information that could not be used in earlier sections might be available concerning adverse effects on aquatic organisms. The most important of these are data on cumulative and delayed toxicity, reduction in survival, growth, or reproduction, or any other adverse effect that has been shown to be biologically important. Delayed toxicity is an adverse effect to an organism that results from, and occurs after the end of, its exposure to one or more test materials. Especially important are data for species for which no other data are available. Data from behavioral, biochemical, physiological, microcosm, and field studies might also be available. Data might be available from tests conducted in unusual dilution water (see sections IV.D and VI.D of this appendix), from chronic tests in which the concentrations were not measured (see section VI.B of this appendix), from tests with previously exposed organisms (see section II.F.3 of this appendix), and from tests on formulated mixtures or emulsifiable concentrates (see section II.D of this appendix). Such data might affect a criterion if the data were obtained with an important species, the test concentrations were measured, and the endpoint was biologically important.

X. Criterion

A criterion consists of two concentrations: the Criterion Maximum Concentration (CMC) and the Criterion Continuous Concentration (CCC).

The CMC is equal to one-half the FAV. The CMC is an estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.

The CCC is equal to the lowest of the FCV or the FPV (if available) unless other data (see section IX of this appendix) show that a lower value should be used. The CCC is an estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. If toxicity is related to a water quality characteristic, the CCC is obtained from the Final Chronic Equation or FPV (if available) that results in the lowest concentrations in the usual range of the water quality characteristic, unless other data (see section IX of this appendix) show that a lower value should be used.

Round both the CMC and the CCC to two significant digits.

E. The criterion is stated as:

The procedures described in the Tier I methodology indicate that, except possibly where a commercially or recreationally important species is very sensitive, aquatic organisms should not be affected unacceptably if the four-day average concentration of (1) does not exceed (2) µg/L more than once every three years on the average and if the one-hour average concentration does not exceed (3) µg/L more than once every three years on the average.

where:

(1) = Insert name of material

(2) = Insert the CCC

(3) = Insert the CMC

If the CMC averaging period of one hour or the CCC averaging period of four days is inappropriate for the pollutant, or if the once-in-three-year allowable excursion frequency is inappropriate for the pollutant or for the sites to which a criterion is applied, then the State may specify alternative averaging periods or frequencies. The choice of an alternative averaging period or frequency shall be justified by a scientifically defensible analysis demonstrating that the alternative values will protect the aquatic life uses of the water. Appropriate laboratory data and/or well-designed field biological surveys shall be submitted to U.S. EPA as justification for differing averaging periods and/or frequencies of exceedance.

XI. Final Review

The derivation of the criterion should be carefully reviewed by rechecking each step of the Guidance in this part. Items that should be especially checked are:

1. If unpublished data are used, are they well documented?

2. Are all required data available?

3. Is the range of acute values for any species greater than a factor of ten?

4. Is the range of SMAVs for any genus greater than a factor of ten?

5. Is there more than a factor of ten difference between the four lowest GMAVs?

6. Are any of the lowest GMAVs questionable?

7. Is the FAV reasonable in comparison with the SMAVs and GMAVs?

8. For any commercially or recreationally important species, is the geometric mean of the acute values from flow-through tests in which the concentrations of test material were measured lower than the FAV?

9. Are any of the chronic values used questionable?

10. Are any chronic values available for acutely sensitive species?

11. Is the range of acute-chronic ratios greater than a factor of ten?

12. Is the FCV reasonable in comparison with the available acute and chronic data?

13. Is the measured or predicted chronic value for any commercially or recreationally important species below the FCV?

14. Are any of the other data important?

15. Do any data look like they might be outliers?

16. Are there any deviations from the guidance in this part? Are they acceptable?

B. On the basis of all available pertinent laboratory and field information, determine if the criterion is consistent with sound scientific evidence. If it is not, another criterion, either higher or lower, shall be derived consistent with the Guidance in this part.

Methodology for Deriving Aquatic Life Values: Tier II

XII. Secondary Acute Value

If all eight minimum data requirements for calculating an FAV using Tier I are not met, a Secondary Acute Value (SAV) shall be calculated for a chemical as follows:

To calculate a SAV, the lowest GMAV in the database is divided by the Secondary Acute Factor (SAF) (Table A-1 of this appendix) corresponding to the number of satisfied minimum data requirements listed in the Tier I methodology (section III.B.1 of this appendix). Requirements for definitions, data collection and data review, contained in sections I, II, and IV shall be applied to calculation of a SAV. If all eight minimum data requirements are satisfied, a Tier I criterion calculation may be possible. In order to calculate a SAV, the database must contain, at a minimum, a genus mean acute value (GMAV) for one of the following three genera in the family Daphnidae - *Ceriodaphnia sp.*, *Daphnia sp.*, or *Simocephalus sp.*

If appropriate, the SAV shall be made a function of a water quality characteristic in a manner similar to that described in Tier I.

XIII. Secondary Acute-Chronic Ratio

If three or more experimentally determined ACRs, meeting the data collection and review requirements of section VI of this appendix, are available for the chemical, determine the FACR using the procedure described in section VI of this appendix. If fewer than three acceptable experimentally determined ACRs are available, use enough assumed ACRs of 18 so that the total number of ACRs equals three. Calculate the Secondary Acute-Chronic Ratio (SACR) as the geometric mean of the three ACRs. Thus, if no experimentally determined ACRs are available, the SACR is 18.

XIV. Secondary Chronic Value

Calculate the Secondary Chronic Value (SCV) using one of the following:

A. $SCV = \frac{FAV}{SACR}$ (use FAV from Tier I)

B. $SCV = \frac{SAV}{FACR}$

C. $SCV = \frac{SAV}{SACR}$

If appropriate, the SCV will be made a function of a water quality characteristic in a manner similar to that described in Tier I.

XV. Commercially Or Recreationally Important Species

If for a commercially or recreationally important species the geometric mean of the acute values or chronic values from flow-through tests in which the concentrations of the test materials were measured is lower than the calculated SAV or SCV, then that geometric mean must be used as the SAV or SCV instead of the calculated SAV or SCV.

XVI. Tier II Value

A Tier II value shall consist of two concentrations: the Secondary Maximum Concentration (SMC) and the Secondary Continuous Concentration (SCC).

The SMC is equal to one-half of the SAV.

The SCC is equal to the lowest of the SCV or the Final Plant Value, if available, unless other data (see section IX of this appendix) show that a lower value should be used.

If toxicity is related to a water quality characteristic, the SCC is obtained from the Secondary Chronic Equation or FPV, if available, that results in the lowest concentrations in the usual range of the water quality characteristic, unless other data (see section IX of this appendix) show that a lower value should be used.

Round both the SMC and the SCC to two significant digits.

The Tier II value is stated as:

The procedures described in the Tier II methodology indicate that, except possibly where a locally important species is very sensitive, aquatic organisms should not be affected unacceptably if the four-day average concentration of (1) does not exceed (2) µg/L more than once every three years on the average and if the one-hour average concentration does not exceed (3) µg/L more than once every three years on the average, where:

(1) = insert name of material
(2) = insert the SCC
(3) = insert the SMC

As discussed above, States and Tribes have the discretion to specify alternative averaging periods or frequencies.

XVII. Appropriate Modifications

On the basis of all available pertinent laboratory and field information, determine if the Tier II value is consistent with sound scientific evidence. If it is not, another value, either higher or lower, shall be derived consistent with the Guidance in this part.

Table A-1: Secondary Acute Factors

Number of Minimum Data Requirements Satisfied	Adjustment Factor
1	21.9
2	13.0
3	8.0
4	7.0
5	6.1
6	5.2
7	4.3

XVIII. Definitions

The following definitions apply in this part. Terms not defined in this section have the meaning given by the Clean Water Act and U.S. EPA implementing regulations.

Acute-chronic ratio (ACR) is a standard measure of the acute toxicity of a material divided by an appropriate measure of the chronic toxicity of the same material under comparable conditions.

Acute toxicity is concurrent and delayed adverse effect(s) that results from an acute exposure and occurs within any short observation period which begins when the exposure begins, may extend beyond the exposure period, and usually does not constitute a substantial portion of the life span of the organism.

Adverse effect is any deleterious effect to organisms due to exposure to a substance. This includes effects which are or may become debilitating, harmful or toxic to the normal functions of the organism, but does not include non-harmful effects such as tissue discoloration alone or the induction of enzymes involved in the metabolism of the substance.

Bioaccumulation is the net accumulation of a substance by an organism as a result of uptake from all environmental sources.

Bioaccumulation factor (BAF) is the ratio (in L/kg) of a substance's concentration in tissue of an aquatic organism to its concentration in the ambient water, in situations where both the organism and its food are exposed and the ratio does not change substantially over time.

Bioaccumulative chemical of concern (BCC) is any chemical that has the potential to cause adverse effects which, upon entering the surface waters, by itself or as its toxic transformation product, accumulates in aquatic organisms by a human health bioaccumulation factor greater than 1000, after considering metabolism and other physicochemical properties that might enhance or inhibit bioaccumulation, in accordance with the methodology in appendix B of this part. Chemicals with half-lives of less than eight weeks in the water column, sediment, and biota are not BCCs. The minimum BAF information needed to define an organic chemical as a BCC is either a field-measured BAF or a BAF derived using the BSAF methodology. The minimum BAF information needed to define an inorganic chemical, including an organometal, as a BCC is either a field-measured BAF or a laboratory-measured BCF. BCCs include, but are not limited to, the pollutants identified as BCCs in Chapter 4.F.

Bioconcentration is the net accumulation of a substance by an aquatic organism as a result of uptake directly from the ambient water through gill membranes or other external body surfaces.

Bioconcentration factor (BCF) is the ratio (in L/kg) of a substance's concentration in tissue of an aquatic organism to its concentration in the ambient water, in situations where the organism is exposed through the water only and the ratio does not change substantially over time.

Biota-sediment accumulation factor (BSAF) is the ratio (in kg of organic carbon/kg of lipid) of a substance's lipid-normalized concentration in tissue of an aquatic organism to its organic carbon-normalized concentration in surface sediment, in situations where the ratio does not change substantially over time, both the organism and its food are exposed, and the surface sediment is representative of average surface sediment in the vicinity of the organism.

Carcinogen is a substance which causes an increased incidence of benign or malignant neoplasms, or substantially decreases the time to develop neoplasms, in animals or humans.

Chronic toxicity is concurrent and delayed adverse effect(s) that occurs only as a result of a chronic exposure.

Criterion continuous concentration (CCC) is an estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

Criterion maximum concentration (CMC) is an estimate of the highest concentration of a material in the water column to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.

EC50 is a statistically or graphically estimated concentration that is expected to cause one or more specified effects in 50 percent of a group of organisms under specified conditions.

Endangered or threatened species are those species that are listed as endangered or threatened under section 4 of the Endangered Species Act.

Existing discharger is any building, structure, facility, or installation from which there is or may be a "discharge of pollutants" (as defined in 40 CFR 122.2), that is not a new discharger.

Final acute value (FAV) is (a) a calculated estimate of the concentration of a test material such that 95 percent of the genera (with which acceptable acute toxicity tests have been conducted on the material) have higher GMAVs, or (b) the SMAV of an important and/or critical species, if the SMAV is lower than the calculated estimate.

Final chronic value (FCV) is (a) a calculated estimate of the concentration of a test material such that 95 percent of the genera (with which acceptable chronic toxicity tests have been conducted on the material) have higher GMCVs, (b) the quotient of an FAV divided by an appropriate acute-chronic ratio, or (c) the SMCV of an important and/or critical species, if the SMCV is lower than the calculated estimate or the quotient, whichever is applicable.

Final plant value (FPV) is the lowest plant value that was obtained with an important aquatic plant species in an acceptable toxicity test for which the concentrations of the test material were measured and the adverse effect was biologically important.

Genus mean acute value (GMAV) is the geometric mean of the SMAVs for the genus.

Genus mean chronic value (GMCV) is the geometric mean of the SMCVs for the genus.

Human cancer criterion (HCC) is a Human Cancer Value (HCV) for a pollutant that meets the minimum data requirements for Tier I.

Human cancer value (HCV) is the maximum ambient water concentration of a substance at which a lifetime of exposure from either: drinking the water, consuming fish from the water, and water-related recreation activities; or consuming fish from the water, and water-related recreation activities, will represent a plausible upper-bound risk of contracting cancer of one in 100,000 using the exposure assumptions specified in the Methodologies for the Development of Human Health Criteria and Values.

Human noncancer criterion (HNC) is a Human Noncancer Value (HNV) for a pollutant that meets the minimum data requirements for Tier I.

Human noncancer value (HNV) is the maximum ambient water concentration of a substance at which adverse noncancer effects are not likely to occur in the human population from lifetime exposure via either: drinking the water, consuming fish from the water, and water-related recreation activities; or consuming fish from the water, and water-related recreation activities using the Methodologies for the Development of Human Health Criteria and Values.

LC50 is a statistically or graphically estimated concentration that is expected to be lethal to 50 percent of a group of organisms under specified conditions.

Load allocation (LA) is the portion of a receiving water's loading capacity that is attributed either to one of its existing or future nonpoint sources or to natural background sources, as more fully defined at 40 CFR 130.2(g). Nonpoint sources include: in-place contaminants, direct wet and dry deposition, groundwater inflow, and overland runoff.

Loading capacity is the greatest amount of loading that a water can receive without violating water quality standards.

Lowest observed adverse effect level (LOAEL) is the lowest tested dose or concentration of a substance which resulted in an observed adverse effect in exposed test organisms when all higher doses or concentrations resulted in the same or more severe effects.

Method detection level is the minimum concentration of an analyte (substance) that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero as determined by the procedure set forth in appendix B of 40 CFR part 136.

Minimum level (ML) is the concentration at which the entire analytical system must give a recognizable signal and acceptable calibration point. The ML is the concentration in a sample that is equivalent to the concentration of the lowest calibration standard analyzed by a specific analytical procedure, assuming that all the method-specified sample weights, volumes and processing steps have been followed.

New discharger is any building, structure, facility, or installation from which there is or may be a "discharge of pollutants" (as defined in 40 CFR 122.2).

No observed adverse effect level (NOAEL) is the highest tested dose or concentration of a substance which resulted in no observed adverse effect in exposed test organisms where higher doses or concentrations resulted in an adverse effect.

No observed effect concentration (NOEC) is the highest concentration of toxicant to which organisms are exposed in a full life-cycle or partial life-cycle (short-term) test, that causes no observable adverse effects on the test organisms (i.e., the highest concentration of toxicant in which the values for the observed responses are not statistically significantly different from the controls).

Quantification level is a measurement of the concentration of a contaminant obtained by using a specified laboratory procedure calibrated at a specified concentration above the method detection level. It is considered the lowest concentration at which a particular contaminant can be quantitatively measured using a specified laboratory procedure for monitoring of the contaminant.

Quantitative structure activity relationship (QSAR) or structure activity relationship (SAR) is a mathematical relationship between a property (activity) of a chemical and a number of descriptors of the chemical. These descriptors are chemical or physical characteristics obtained experimentally or predicted from the structure of the chemical.

Risk associated dose (RAD) is a dose of a known or presumed carcinogenic substance in (mg/kg)/day which, over a lifetime of exposure, is estimated to be associated with a plausible upper bound incremental cancer risk equal to one in 100,000.

Species mean acute value (SMAV) is the geometric mean of the results of all acceptable flow-through acute toxicity tests (for which the concentrations of the test material were measured) with the most sensitive tested life stage of the species. For a species for which no such result is available for the most sensitive tested life stage, the SMAV is the geometric mean of the results of all acceptable acute toxicity tests with the most sensitive tested life stage.

Species mean chronic value (SMCV) is the geometric mean of the results of all acceptable life-cycle and partial life-cycle toxicity tests with the species; for a species of fish for which no such result is available, the SMCV is the geometric mean of all acceptable early life-stage tests.

Stream design flow is the stream flow that represents critical conditions, upstream from the source, for protection of aquatic life, human health, or wildlife.

Threshold effect is an effect of a substance for which there is a theoretical or empirically established dose or concentration below which the effect does not occur.

Tier I criteria are numeric values derived by use of the Tier I methodologies in Appendices A, C and D of this part, the methodology in Appendix B of this part, and the procedures in Appendix E of this part, that either have been adopted as numeric criteria into a water quality standard or are used to implement narrative water quality criteria.

Tier II values are numeric values derived by use of the Tier II methodologies in Appendices A and C of this part, the methodology in Appendix B of this part, and the procedures in Appendix E of this part, that are used to implement narrative water quality criteria.

Total maximum daily load (TMDL) is the sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background, as more fully defined at 40 CFR 130.2(i). A TMDL sets and allocates the maximum amount of a pollutant that may be introduced into a water body and still assure attainment and maintenance of water quality standards.

Uncertainty factor (UF) is one of several numeric factors used in operationally deriving criteria from experimental data to account for the quality or quantity of the available data.

Uptake is acquisition of a substance from the environment by an organism as a result of any active or passive process.

Waste load allocation (WLA) is the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution, as more fully defined at 40 CFR 130.2(h). In the absence of a TMDL approved by U.S. EPA pursuant to 40 CFR 130.7 or an assessment and remediation plan developed and approved in accordance with procedure 3.A of appendix F of this part, a WLA is the allocation for an individual point source, that ensures that the level of water quality to be achieved by the point source is derived from and complies with all applicable water quality standards.

Wet weather point source means any discernible, confined and discrete conveyance from which pollutants are, or may be, discharged as the result of a wet weather event. Discharges from wet weather point sources shall include only: discharges of storm water from a municipal separate storm sewer as defined at 40 CFR 122.26(b)(8); storm water discharge associated with industrial activity as defined at 40 CFR 122.26(b)(14); discharges of storm water and sanitary wastewater (domestic, commercial, and industrial) from a combined sewer overflow; or any other storm water discharge for which a permit is required under section 402(p) of the Clean Water Act. A storm water discharge associated with industrial activity which is mixed with process wastewater shall not be considered a wet weather point source.

Appendix E

Alternate Approaches For Calculating Acute Mixing Zones

Alternative 1:

Apply the acute criterion at the end-of-pipe.

Alternative 2 (for high velocity discharges => 3 m/s):

The acute criterion should be met within 50 times the discharge length scale (50 times square root of the cross-sectional pipe area). The scientific basis for this alternative is that these conditions will ensure that the acute criterion is met within a few minutes under practically all conditions.

Alternative 3 (for low velocity discharges < 3 m/s):

The acute criterion should be met:

Within ten percent of the distance from the end-of-pipe to the edge of the regulatory mixing zone in any direction. This will restrict the acute zone to a relatively small area around the discharge pipe.

Within a distance of 50 times the square root of the pipe diameter (discharge length scale). This will ensure a dilution factor of at least ten at the edge of the acute mixing zone.

Within a distance of five times the local in any horizontal direction water depth. This will ensure that mixing zones are not established in shallow, near-shore waters.

Alternative 4 (demonstration by discharger):

A discharger may demonstrate that a drifting organism would not be exposed to one-hour average concentrations exceeding acute aquatic life criteria or would not receive harmful exposure when evaluated by other valid toxicological analyses.

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