Chapter NR 105

SURFACE WATER QUALITY CRITERIA AND SECONDARY VALUES FOR TOXIC SUBSTANCES

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NR 105.01 Purpose. The purpose of this chapter is to establish water quality criteria, and methods for developing criteria and secondary values for toxic substances to protect public health and welfare, the present and prospective use of all surface waters for public and private water supplies, and the propagation of fish and aquatic life and wildlife. This chapter also establishes how bioaccumulation factors used in deriving water quality criteria and secondary values for toxic and organoleptic substances shall be determined. Water quality criteria are a component of surface water quality standards. This chapter and chs. NR 102 to 104 constitute quality standards for the surface waters of Wisconsin.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89.; am. Register, August, 1997, No. 500, eff. 9-1-97.

NR 105.02 Applicability. The provisions of this chapter are applicable to surface waters of Wisconsin as specified in chs. NR 102 to 104 and in this chapter.

c1d SITE SPECIFIC CRITERIA AND SECONDARY VALUES. A criterion contained within this chapter or a secondary value calculated pursuant to this chapter may be modified for a particular surface water segment or body. A criterion or secondary value may be modified if specific information is provided which shows that the data used to derive the criterion or secondary value do not apply and if additional information is provided to derive a site-specific criterion or secondary value. Site-specific criteria are intended to be applicable to a specific surface water segment. Criteria may be modified for site-specific considerations according to the USEPA XWater Quality Standards HandbookY Second Edition, revised 1994. Any criterion modified for site-specific conditions shall be promulgated in ch. NR 104 before it can be applied on a site-specific basis. Site-specific modifications of criteria and secondary values shall be consistent with the procedures described in 40 CFR Part 132, Appendix F, Procedure 1: Site-specific modifications to criteria and values. 40 CFR Part 132, Appendix F, Procedure 1 as stated on September 1, 1997 is incorporated by reference.

Note: Copies of 40 CFR Part 132 Appendix F, Proc. 1 are available for inspection in the offices of the department of natural resources, secretary of state and the legislative reference bureau, Madison, WI or may be purchased from the superintendent of documents, US government printing office, Washington, D.C. 20402.

c2d STATEWIDE CRITERIA. cad The department may promulgate a less stringent criterion or remove a criterion from this chapter when the department determines that the previously promulgated criterion is more stringent than necessary, or unnecessary for the protection of humans, fish and other aquatic life or wildlife. The modification shall assure that the designated uses are protected and water quality standards continue to be attained.

cbd The department may promulgate a more stringent criterion in this chapter when the department determines that the previously promulgated criterion is inadequate for the protection of humans, fish and other aquatic life or wildlife.

c3d DETERMINATION OF SECONDARY VALUES FOR EFFLUENT LIMITATIONS. If a discharge contains a toxic substance, and if data to calculate a water quality criterion for that substance are not available, then, on a case-by-case basis, the department may calculate a secondary value as defined in this chapter and establish an effluent limitation for the toxic substance if the conditions contained in s. NR 106.05 c1d cbd are met.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; am. c1d and c2d, cr. c3d, Register, August, 1997, No. 500, eff. 9-1-97.

NR 105.03 Definitions. c1d XAcute toxicityY means the ability of a substance to cause mortality or an adverse effect in an organism which results from a single or short-term exposure to the substance.

c2d XAcute toxicity criterionY or XATCY means the maximum daily concentration of a substance which ensures adequate protection of sensitive species of aquatic life from the acute toxicity of that substance and will adequately protect the designated fish and aquatic life use of the surface water if not exceeded more than once every 3 years. If the available data indicate that one or more life stages of a particular species are more sensitive to a substance than other life stages of the same species, the ATC shall represent the acute toxicity of the most sensitive life stage.

c3d XAdequate protectionY means a level of protection which ensures survival of a sufficient number of healthy individuals in a population of aquatic species to provide for the continuation of an unreduced population of these species.

c4d XAdverse effectY means any effect resulting in a functional impairment or a pathological lesion, or both, which may affect the performance of the whole organism, or which contributes to a reduced ability to respond to an additional challenge. Adverse effects include toxicant-induced mutagenic, teratogenic, or carcinogenic effects or impaired, developmental, immunological or reproductive effects.

c5d XBaseline BAFY means for organic chemicals, a bioaccumulation factor normalized to 100% lipid that is based on the concentration of a freely dissolved chemical in the ambient water and takes into account the partitioning of the chemical within the organism. For inorganic chemicals, a bioaccumulation factor is based on the wet weight of the tissue.

c6d XBaseline BCFY means for organic chemicals, a bioconcentration factor normalized to 100% lipid that is based on the concentration of freely dissolved chemical in the ambient water and takes into account the partitioning of the chemical within

the organism. For inorganic chemicals, a bioconcentration factor is based on the wet weight of the tissue.

c7d XBioaccumulationY means the net accumulation of a substance by an organism as a result of uptake from all environmental sources.

c8d XBioaccumulation factorY or XBAFY means the ratio cin L{kgd of a substance[s concentration in the tissue of an aquatic organism to its concentration in the ambient water, in situations where both the organism and its food are exposed to the substance and where the ratio does not change substantially over time.

c9d XBioaccumulative chemical of concernY or XBCCY means any substance that has the potential to cause adverse effects which, upon entering the surface waters, accumulates in aquatic organisms by a human health or wildlife bioaccumulation factor greater than 1000.

c10d XBioconcentrationY means the net accumulation of a substance by an aquatic organism as a result of uptake directly from the ambient water through its gill membranes or other external body surfaces.

c11d XBioconcentration factorY or XBCFY means the ratio cin L{kgd of a substance[s concentration in the tissue of an aquatic organism to its concentration in the ambient water, in situations where the organism is exposed through the water only and where the ratio does not change substantially over time.

c12d XBiota-sediment accumulation factorY or XBSAFY means the ratio cin kg of organic carbon{kg of lipidd of a substance[s lipid-normalized concentration in the 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 where the surface sediment is representative of the average surface sediment in the vicinity of the organism.

c13d XCarcinogenY means any substance listed in Table 9 or a substance for which the induction of benign or malignant neoplasms has been demonstrated in:

cad Humans; or

cbd Two mammalian species; or

ccd One mammalian species, independently reproduced; or

cdd One mammalian species, to an unusual degree with respect to increased incidence, shortened latency period, variety of site, tumor type, or decreased age at onset; or

ced One mammalian species, supported by reproducible positive results in at least 3 different types of short-term tests which are indicative of potential oncogenic activity.

c14d XChronic toxicityY means the ability of a substance to cause an adverse effect in an organism which results from exposure to the substance for a time period representing that substantial portion of the natural life expectancy of that organism.

c15d XChronic toxicity criterionY or XCTCY means the maximum 4-day concentration of a substance which ensures adequate protection of sensitive species of aquatic life from the chronic toxicity of that substance and will adequately protect the designated fish and aquatic use of the surface water if not exceeded more than once every 3 years.

c16d XDepurationY means the loss of a substance from an organism as a result of any active or passive process.

c17d XEC_{50}Y means a concentration of a toxic substance which causes an adverse effect including mortality in 50% of the exposed organisms in a given time period.

c18d XFood-chain multiplierY or XFCMY means the ratio of a BAF to an appropriate BCF.

c19d XLC_{50}Y means a concentration of a toxic substance which is lethal to 50% of the exposed organisms in a given time period.

c20d XLD_{50}Y means a dose of a toxic substance which is lethal to 50% of the exposed organisms in a given time period.

c21d XLipid-soluble substanceY means a substance which is soluble in nonpolar organic solvents and which tends to accumulate in the fatty tissues of an organism exposed to the substance.

c22d XLowest observable adverse effect levelY or XLOAELY means the lowest tested concentration that caused an adverse effect in comparison with a control when all higher test concentrations caused the same effect.

c23d XNo observable adverse effect levelY or XNOAELY means the highest tested concentration that did not cause an adverse effect in comparison with a control when no lower test concentration caused an adverse effect.

c24d XOctanol{water partition coefficientY or XK_{OW}Y means the ratio of the concentration of a substance in the octanol phase to its concentration in the aqueous phase in an equilibrated 2-phase octanol-water system. For log K_{OW}, the log of the octanol-water partition coefficient is a base 10 logarithm.

c25d XSecondary valueY means a temporary value that represents the concentration of a substance which ensures adequate protection of sensitive species of aquatic life, wildlife or human health from the toxicity of that substance and will adequately protect the designated use of the surface water until database requirements are fulfilled to calculate a water quality criterion.

c26d XSteady stateY means that an equilibrium condition in the body burden of a substance in an organism has been achieved and is assumed when the rate of depuration of a substance matches its rate of uptake.

c27d XToxic substanceY means a substance or mixture of substances which through sufficient exposure, or ingestion, inhalation or assimilation by an organism, either directly from the environment or indirectly by ingestion through the food chain, will cause death, disease, behavioral or immunological abnormalities, cancer, genetic mutations, or developmental or physiological malfunctions, including malfunctions in reproduction or physical deformations, in such organisms or their offspring.

c28d XTrophic levelY means a functional classification of taxa within a community that is based on feeding relationships ce.g., aquatic plants comprise the first trophic level, herbivores comprise the second, small fish comprise the third, predatory fish the fourth, etc.d.

c29d XUptakeY means the acquisition of a substance from the environment by an organism as a result of any active or passive process.

c30d XWater quality parameterY means one of the indicators available for describing the distinctive quality of water including, but not limited to, hardness, pH, or temperature.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; renum. c5d to c19d to be c11d, c13d to c15d, c17d, c19d to c24d, c26d, c27d and c30d, cr. c5d to c7d, c9d, c10d, c12d, c16d, c18d, c25d, c28d and c29d and am. c8d, c11d and c24d, Register, August, 1997, No. 500, eff. 9-1-97.

NR 105.04 Determination of adverse effects. c1d Substances may not be present in surface waters at concentrations which adversely affect public health or welfare, present or prospective uses of surface waters for public or private water supplies, or the protection or propagation of fish or other aquatic life or wild or domestic animal life.

c2d A substance shall be deemed to have adverse effects on

fish or other aquatic life if it exceeds any of the following more than once every 3 years:

cad The acute toxicity criterion as specified in s. NR 105.05, or

cbd The chronic toxicity criterion as specified in s. NR 105.06.

ccd The acute and chronic toxicity criteria for ammonia nitrogen shall be determined on a case-by-case basis by the department for the appropriate aquatic life use category.

c3d A substance shall be deemed to have adverse effects on wildlife if it exceeds the wildlife criterion as specified in s. NR 105.07.

c4d A substance shall be deemed to have adverse effects on public health and welfare if it exceeds any of the following:

cad The human threshold criterion as specified in s. NR 105.08; or

cbd The human cancer criterion as specified in s. NR 105.09; or

ccd The taste and odor criterion as specified in s. NR 102.14.

c4md The presence of PFOA as defined in s. NR 102.03 c4ed, as well as the presence of PFOS as defined in s. NR 102.03 c4md, shall be deemed to have adverse effects on public health and welfare if these substances exceed the public health significance levels in s. NR 102.04 c8d cdd 1.

c5d A substance shall be deemed to have adverse effects or the reasonable potential to have adverse effects on aquatic life, wildlife or human health, if it exceeds a secondary value determined according to the procedures in ss. NR 105.05 to 105.08.

c6d The determination of the criteria or secondary values for substances as calculated under ss. NR 105.05 to 105.09 shall be based upon the available scientific data base. References to be used in obtaining scientific data may include, but are not limited to:

cad XWater Quality Criteria 1972Y, EPA-R3-73-033, National Academy of Sciences, National Academy of Engineering, United States Government Printing Office, Washington, D.C., 1974.

cbd XQuality Criteria for WaterY, EPA-440{9-76-003, United States Environmental Protection Agency, Washington, D.C., 1976.

ccd October 1980 and January 1985 U.S. Environmental Protection Agency cEPAd ambient water quality criteria documents.

cdd XPublic Health Related Groundwater Standards: Summary of Scientific Support Documentation for NR 140.10Y, Wisconsin Department of Health and Social Services, Division of Health, September 1985.

ced XPublic Health Related Groundwater Standards - 1986: Summary of Scientific Support Documentation for NR 140.10Y, Wisconsin Department of Health and Social Services, Division of Health, June 1986.

cfd Health advisories published on March 31, 1987 by EPA, Office of Drinking Water.

cgd Any other reports, documents or information published by EPA or any other federal agency.

chd Any other reports, documents or information that the department, deems to be reliable.

c7d When reviewing any of the references in sub. c6d to determine the effect of a substance, the department:

cad Shall use scientific studies on the toxicity of a substance to fish and other aquatic life and wild and domestic animals, indigenous to the state;

cbd May use scientific studies on the toxicity of a substance to fish or other aquatic life, plant, mammalian, avian, and reptilian species not indigenous to the state; and

ccd May consider biomonitoring information to determine the aquatic life toxicity of complex mixtures of toxic substances in addition to the chemical specific criteria specified in this chapter.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; am. c3d, renum. c5d and c6d to be c7d and am. c6d cintro.d and c7d cintro.d, cr. c5d, Register, August, 1997, No. 500, eff. 9-1-97; CR 21-083: cr. c4md Register July 2022 No.799, eff. 8-1-22.

NR 105.05 Acute toxicity criteria and secondary acute values for aquatic life. c1d MINIMUM DATABASE FOR ACUTE CRITERION DEVELOPMENT. cad To derive an acute toxicity criterion for aquatic life, the minimum information required shall be the results of acceptable acute toxicity tests with one or more species of freshwater animal in at least 8 different families provided that of the 8 species:

1. At least one is a salmonid fish in the family Salmonidae in the class Osteichthyes,

2. At least one is a non-salmonid fish from another family in the class Osteichthyes, preferably a commercially or recreationally important warmwater species,

3. At least one is a planktonic crustacean ce.g., cladoceran, copepodd,

4. At least one is a benthic crustacean ce.g., ostracod, isopod, amphipod, crayfishd,

5. At least one is an insect ce.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midged,

6. At least one is a fish or amphibian from a family in the phylum Chordata not already represented in one of the other subdivisions.

7. At least one is an organism from a family in a phylum other than Arthropoda or Chordata ce.g., Rotifera, Annelida, Molluscad, and

8. At least one is an organism from a family in any order of insect or any other phylum not already represented in subds. 1. to 7.

9. If all 8 of the families in subds. 1. to 8. are represented, an acute toxicity criterion may be developed for surface waters classified as cold water using information on all of those families. If an acute toxicity criterion is developed for surface waters classified as cold water, acute toxicity criteria may also be developed for any of the surface water classifications in s. NR 102.04 c3d cbd to ced using the procedure in sub. c2d or c3d and data on families in subds. 1. to 8. which are representative of the aquatic life communities associated with those classifications. For each substance, in no case may the criterion for a lower quality fish and aquatic life subcategory as defined in s. NR 102.04 be less than the criterion for a higher quality fish and aquatic life subcategory.

10. For a substance, if all of the families in subds. 1. to 8. are not represented, an acute toxicity criterion may not be developed for that substance. Instead, any available data may be used to develop a secondary acute value cSAVd for that substance according to s. NR 105.02 c3d and sub.c4d.

cbd The acceptability of acute toxicity test results shall be judged according to the guidelines in section IV of the United States environmental protection agency[s 1985 XGuidelines for Deriving National Numerical Water Quality Criteria for the Protection of Aquatic Organisms and Their UsesY or 40 CFR Part 132, Appendix A. II, IV and V, as stated on September 1, 1997, is incorporated by reference.

Note: Copies of 40 CFR Part 132, Appendix A Sections II, IV and V are available for inspection in the offices of the department of natural resources, secretary of state and the legislative reference bureau, Madison,

WI or may be purchased from the superintendent of documents, US government printing office, Washington, D.C. 20402.

c2d ACUTE TOXICITY CRITERIA FOR SUBSTANCES WITH TOXICITY UNRELATED TO WATER QUALITY PARAMETERS. If the acute toxicity of a substance has not been adequately shown to be related to a water quality parameter ci.e., hardness, pH, temperature, etc.d, the acute toxicity criterion cATCd is calculated using the procedures specified in this subsection.

cad 1. For each species for which at least one acute value is available, the species mean acute value cSMAVd is calculated as the geometric mean of all acceptable acute toxicity tests using the guidelines in sub. c1d cbd.

2. For each genus for which one or more SMAVs are available, the genus mean acute value cGMAVd is calculated as the geometric mean of the SMAVs available for the genus.

cbd The GMAVs are ordered from high to low.

ccd Ranks cRd are assigned to the GMAVs from 1 for the lowest to N for the highest. If 2 or more GMAVs are identical, successive ranks are arbitrarily assigned.

cdd The cumulative probability cPd is calculated for each GMAVs as P=R{cN + 1d.

ced The 4 GMAVs are selected which have P closest to 0.05. If there are less than 59 GMAVs, these will always be the lowest GMAVs.

cfd Using the selected GMAVs and Ps, the ATC is calculated using the following:

1. Let EV = sum of the 4 ln GMAVs,
   EW = sum of the 4 squares of the ln GMAVs,
   EP = sum of the 4 P values,
   EPR = sum of the 4 square roots of P, and
   JR = square root of 0.05.
2. S = ccEW - cEVd^{2} {4d{cEP-cEPRd^{2} {4dd$^{0.5.}$
3. L = cEV - ScEPRdd{4.
4. A = cJRdcSd + L.
5. Final Acute Value cFAVd= e^{A}.
6. ATC = FAV{2.

cgd If, for a commercially, recreationally or ecologically important species, the geometric mean of the acute values from flow-through tests in which the concentration of test material was measured is lower than the calculated ATC [FAV], then that geometric mean is used as the ATC [FAV] instead of the calculated one.

chd Table 1 contains the acute toxicity criteria for fish and aquatic life subcategories listed in s. NR 102.04 c3d that are calculated using the procedures described in this subsection for substances meeting the database requirements indicated in sub. c1d cad.

c3d ACUTE TOXICITY CRITERIA FOR SUBSTANCES WITH TOXICITY RELATED TO WATER QUALITY PARAMETERS. If data are available on a substance to show that acute toxicity to 2 or more species is similarly related to a water quality parameter ci.e., hardness, pH, temperature, etc.d, the acute toxicity criterion cATCd is calculated using the procedures specified in this subsection.

cad For each species for which acceptable acute toxicity tests using the guidelines in sub. c1d cbd are available at 2 or more different values of the water quality parameter, a least squares regression of the acute toxicity values on the corresponding values of the water quality parameter is performed to obtain the slope of the curve that best describes the relationship. Because the most commonly documented relationship is that between hardness and acute toxicity of metals 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 subsection to illustrate this method. For relationships based on other water quality parameters, no transformation or a different transformation might fit the data better, and appropriate changes shall be made as necessary throughout this subsection.

cbd For each species, the geometric mean of the available acute values cWd is calculated and then each of those acute values is divided by the mean for that 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.

ccd For each species, the geometric mean of the available corresponding water quality parameter values cXd is calculated and then each of those water quality parameter values is divided by the mean for that species. This normalizes the water quality parameter values so that the geometric mean of the normalized values for each species individually and for any combination of species is 1.0.

cdd A least squares regression of all the normalized acute values on the corresponding normalized values of the water quality parameter is performed to obtain the pooled acute slope cVd. If the coefficient of determination, or r value, calculated from that regression is found not to be significant based on a standard F-test at a 0.05 level, then the pooled acute slope shall be set equal to zero.

ced For each species the logarithmic intercept cYd is calculated using the equation: Y = ln W - Vcln Xd.

cfd 1. For each species the species mean acute intercept cSMAId is calculated as e^{Y}.

2. For each genus for which one or more SMAIs are available, the genus mean acute intercept cGMAId is calculated as the geometric mean of the SMAIs available for the genus.

cgd The GMAIs are ordered from high to low.

chd Ranks cRd are assigned to the GMAIs from 1 for the lowest to N for the highest. If 2 or more GMAIs are identical, successive ranks are arbitrarily assigned.

cid The cumulative probability cPd is calculated for each GMAI as P=R{cN+1d.

cjd The 4 GMAIs are selected which have P closest to 0.05. If there are less than 59 GMAIs, these will always be the lowest GMAIs.

ckd Using the selected GMAIs and Ps, the ATC is calculated using the following:

1. Let EV = sum of the 4 ln GMAIs,
   EW = sum of the 4 squares of the ln GMAIs,
   EP = sum of the 4 P values,
   EPR = sum of the 4 square roots of P, and
   JR = square root of 0.05.
2. S = ccEW - cEVd^2 {4d {cEP-cEPRd^2 {4dd$^{0.5.}$
3. L = cEV - ScEPRdd{4.
4. A = cJRdcSd + L.
5. Final Acute Intercept cFAId = e^{A}.
6. Acute Criterion Intercept cACId = FAI{2.

cLd The acute toxicity equation cATEd is written as:

ATC = $_{c}$cV lncwater quality parameterd + ln ACId.

The ATE shall be applicable only over the range of water quality parameters equivalent to the mean plus or minus 2 standard deviations using the entire fresh water acute toxicity data base and the water quality parameter transformation employed in par. cad. If the value at a specific location is outside of that range, the endpoint of the range nearest to that value shall be used to determine the criterion. Additional information may be used to modify those ranges. The final acute value cFAVd equals 2 times the ATC cacute toxicity criteriond calculated using the formula in this paragraph.

cmd If, for a commercially, recreationally or ecologically important species, the SMAI is lower than the calculated ACI, then that SMAI is used as the ACI instead of the calculated one.

cnd Table 2 contains the acute toxicity criteria for the fish and aquatic life subcategories listed in s. NR 102.04 c3d that are calculated using the procedures described in this subsection for substances meeting the database requirements indicated in sub. c1d cad. Table 2A contains the water quality parameter ranges calculated in par. cLd.

c4d SECONDARY ACUTE VALUES. If all 8 minimum data requirements for calculating acute toxicity criteria in sub. c1d cad are not met, secondary acute values cSAVsd shall be determined using the procedure in this subsection.

cad In order to calculate a SAV, the database shall contain, at a minimum, a genus mean acute value cGMAVd for one of the following 3 genera in the family Daphnidae - *Ceriodaphnia sp., Daphnia sp.*, or *Simocephalus sp.* To calculate a SAV, the lowest GMAV in the database is divided by the Secondary Acute Factor cSAFd. The SAF is an adjustment factor corresponding to the number of satisfied minimum data requirements, listed in sub. c1d cad. SAFs are listed in Table 2B.

cbd Whenever appropriate, the effects of variable water quality parameters shall be considered when calculating a SAV, consistent with the procedures described in sub. c3d.

ccd Whenever, for a commercially, recreationally or ecologically important species, the SMAV is lower than the calculated SAV, that SMAV shall be used as the SAV instead of the calculated SAV.

c5d ACUTE TOXICITY CRITERIA EXPRESSED IN THE DISSOLVED FORM. Acute water quality criteria may be expressed as a dissolved concentration. The conversion of an acute water quality criterion expressed as a total recoverable concentration, to an acute water quality criterion expressed as a dissolved concentration, the portion of the substance which will pass through a 0.45 um filter, shall be done using the equations in pars. cad and cbd. Substances which may have criteria expressed as a dissolved concentration are listed in par. cad with corresponding conversion factors.

cad The conversion of the water quality criterion expressed as total recoverable cWQC$_{\text{Total R.}}$d to the water quality criterion expressed as dissolved cWQC$_{D}$d shall be performed as follows:

WQC$_{D}$ = cCFdcWQC$_{\text{Total R.}}$d

Where: WQC$_{\text{Total R.}}$ = Criteria from NR 105, Table 1 or 2.
CF = Conversion factor for total recoverable to dissolved.

Conversion factors are as follows:

Arsenic	1.000
Cadmium	0.850
Chromium cIIId	0.316
Chromium cVId	0.982
Copper	0.960
Lead	0.875
Mercury	0.850
Nickel	0.998
Selenium	0.922
Silver	0.850
Zinc	0.978

cbd The translation of the WQC$_{D}$ into the water quality criterion which accounts for site-specific conditions cWQC$_{TRAN}$d shall be performed as follows:

WQC$_{TRAN}$ = cTranslatordcWQC$_{D}$d

Where: Translator cunitlessd = ccM$_{P}$dcTSSd + M$_{D}$d{M$_{D}$

M_P = Particle-bound concentration of the pollutant cug{gd in receiving water.

M_D = Dissolved concentration of the pollutant in receiving water cug{Ld.

TSS = Total Suspended Solids cg{Ld concentration in receiving water.

ccd The procedures in pars. cad and cbd may also be used for the conversion of secondary values from total recoverable to dissolved.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; am. c1d cad 1. to 5., c1d cbd, c2d cad to cfd, c3d cad and cfd to cLd, r. and recr. c1d cad 6., cr. c1d cad 7. to 10., c4d and c5d, Register, August, 1997, No. 500, eff. 9-1-97; CR 03-050: am. c3d cLd and cmd Register February 2004 No. 578, eff. 3-1-04.

NR 105.06 Chronic toxicity criteria and secondary chronic values for fish and aquatic life. c1d MINIMUM DATABASE FOR CHRONIC CRITERION DEVELOPMENT. cad To derive a chronic toxicity criterion for aquatic life, the minimum information required shall be results of acceptable chronic toxicity tests with one or more species of freshwater animal in at least 8 different families provided that of the 8 species:

1. At least one is a salmonid fish, in the family Salmonidae in the class Osteichthyes,

2. At least one is a non-salmonid fish, from another family in the class Osteichthyes, preferably a commercially or recreationally important warmwater species,

3. At least one is a planktonic crustacean ce.g., cladoceran, copepodd,

4. At least one is a benthic crustacean ce.g., ostracod, isopod, amphipod, crayfishd,

5. At least one is an insect ce.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midged,

6. At least one is a fish or amphibian from a family in the phylum Chordata not already represented in one of the other subdivisions,

7. At least one is an organism from a family in a phylum other than Arthropoda or Chordata ce.g., Rotifera, Annelida, Molluscad, and

8. At least one is an organism from a family in any order of insect or any other phylum not already represented in subds. 1. to 7.

9. If all 8 of the families in subds. 1. to 8. are represented, a chronic toxicity criterion may be developed for surface waters classified as cold water using information on all of those families. If a chronic toxicity criterion is developed for surface waters classified as cold water, chronic toxicity criteria may also be developed for any of the surface water classifications in s. NR 102.04 c3d cbd to ced using the procedure in sub. c2d or c3d and data on families in subds. 1. to 8. which are representative of the aquatic life communities associated with those classifications. For each substance, in no case may the criterion for a lower quality fish and aquatic life subcategory as defined in s. NR 102.04 be less than the criterion for a higher quality fish and aquatic life subcategory.

10. For a substance, if all the families in subds. 1. to 8. are not represented, acute-chronic ratios as calculated in sub. c5d may be used to generate the chronic toxicity values necessary to calculate a chronic toxicity criterion.

11. For a substance, if all of the families in subds. 1. to 8. are not represented, a chronic toxicity criterion may not be developed for that substance except as provided in subd. 10. Instead, any available data may be used to develop a secondary acute value cSAVd for that substance according to sub. c4d.

cbd The acceptability of chronic toxicity test results shall be judged according to the guidelines in section VI of the United States environmental protection agency[s 1985 XGuidelines for Deriving National Numerical Water Quality Criteria for the Protection of Aquatic Organisms and Their UsesY or 40 CFR Part 132 Appendix A, sections VI and VII as stated on September 1, 1997, is incorporated by reference.

Note: Copies of 40 CFR Part 132, Appendix A, Sections VI and VII are available for inspection in the offices of the department of natural resources, secretary of state and the legislative reference bureau, Madison, WI or may be purchased from the superintendent of documents, US government printing office, Washington, D.C. 20402.

c2d CALCULATION OF A CHRONIC CONCENTRATION. A chronic concentration is obtained by calculating the geometric mean of the chronic lowest observable adverse effect level and the chronic no observable adverse effect level.

c3d CHRONIC TOXICITY CRITERIA FOR SUBSTANCES WITH TOXICITY UNRELATED TO WATER QUALITY PARAMETERS. If the chronic toxicity of a substance has not been adequately shown to be related to a water quality parameter, i.e., hardness, pH, temperature, etc., the chronic toxicity criterion cCTCd is calculated using the procedures specified in this subsection.

cad 1. For each species for which at least one chronic value is available, the species mean chronic value cSMCVd is calculated as the geometric mean of all acceptable chronic toxicity tests using the guidelines in sub. c1d cbd.

2. For each genus for which one or more SMCVs are available, the genus mean chronic value cGMCVd is calculated as the geometric mean of the SMCVs available for the genus.

cbd The GMCVs are ordered from high to low.

ccd Ranks cRd are assigned to the GMCVs from 1 for the lowest to N for the highest. If 2 or more GMCVs are identical, successive ranks are arbitrarily assigned.

cdd The cumulative probability cPd is calculated for each GMCVs as P=R{cN + 1d.

ced The 4 GMCVs are selected which have P closest to 0.05. If there are less than 59 GMCVs, these will always be the lowest GMCVs.

cfd Using the selected GMCVs and Ps, the final chronic value cFCVd is calculated using the following:

1. Let EV = sum of the 4 ln GMCVs,
   EW = sum of the 4 squares of the ln GMCVs,
   EP = sum of the 4 P values,
   EPR = sum of the 4 square roots of P, and
   JR = square root of 0.05.
2. S = ccEW - cEVd^2 {4d{cEP-cEPRd ^{2}{4dd$^{0.5}$
3. L = cEV - ScEPRdd{4.
4. A = cJRdcSd + L.
5. FCV = e^A.

cgd If, for a commercially, recreationally or ecologically important species, the geometric mean of the chronic values is lower than the calculated FCV then that geometric mean is used as the FCV instead of the calculated one.

chd The chronic toxicity criterion cCTCd equals the lower of the FCV and the final plant value calculated using the procedure in s. NR 105.11.

cid Table 3 contains the chronic toxicity criteria for the fish and aquatic life subcategories listed in s. NR 102.04 c3d that are calculated using the procedures described in this subsection for substances meeting the database requirements indicated in sub. c1d.

c4d CHRONIC TOXICITY CRITERIA FOR SUBSTANCES WITH TOXICITY RELATED TO WATER QUALITY PARAMETERS. cad If data are available on a substance to show that chronic toxicity to

2 or more species is similarly related to a water quality parameter ci.e., hardness, pH, temperature, etc.d, the chronic toxicity criterion cCTCd is calculated using the procedures specified in this paragraph.

1. For each species for which acceptable chronic toxicity tests using the guidelines in sub. c1d cbd are available at 2 or more different values of the water quality parameter, a least squares regression of the chronic toxicity values on the corresponding values of the water quality parameter is performed to obtain the slope of the curve that best describes the relationship. Because the most commonly documented relationship is that between hardness and the chronic toxicity of metals 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 subsection to illustrate this method. For relationships based on other water quality parameters, no transformation or a different transformation might fit the data better, and appropriate changes shall be made as necessary throughout this subsection.

2. For each species, the geometric mean of the available chronic values cWd is calculated and then each of the chronic values is divided by the mean for that 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.

3. For each species, the geometric mean of the available corresponding water quality parameter values cXd is calculated and then each of the water quality parameter values is divided by the mean for that species. This normalizes the water quality parameter values so that the geometric mean of the normalized values for each species individually and for any combination of species is 1.0.

4. A least squares regression of all the normalized chronic values on the corresponding normalized values of the water quality parameter is performed to obtain the pooled chronic slope cVd. If the coefficient of determination, or r value, calculated from that regression is found not to be significant based on a standard F-test at a 0.05 level, then the pooled chronic slope shall be set equal to zero.

5. For each species the logarithmic intercept cYd is calculated using the equation: Y = ln W - Vcln Xd.

6. a. For each species the species mean chronic intercept cSMCId is calculated as e^{Y}.

b. For each genus for which one or more SMCIs are available, the genus mean chronic intercept cGMCId is calculated as the geometric mean of the SMCIs available for the genus.

7. The GMCIs are ordered from high to low.

8. Ranks cRd are assigned to the GMCIs from 1 for the lowest to N for the highest. If 2 or more GMCIs are identical, successive ranks are arbitrarily assigned.

9. The cumulative probability cPd is calculated for each GMCI as P=R{cN + 1d.

10. The 4 GMCIs are selected which have P closest to 0.05. If there are less than 59 GMCIs, these will always be the lowest GMCIs.

11. Using the selected GMCIs and Ps, the final chronic value cFCVd is calculated using the following:

a. Let EV = sum of the 4 ln GMCIs,
EW = sum of the 4 squares of the ln GMCIs,
EP = sum of the 4 P values,
EPR = sum of the 4 square roots of P, and
JR = square root of 0.05.

b. S = ccEW-cEVd^{2}{4d{cEP-cEPRd^{2}{4dd$^{0.5}$

c. L = cEV - ScEPRdd{4.

d. A = cJRdcSd + L.

e. Final Chronic Intercept cFCId = e^{A}.

12. The final chronic equation cFCEd is written as:
FCV = $_{e}$cV lncwater quality parameterd + ln FCId.

The FCE shall be applicable only over the range of water quality parameters equivalent to the mean o 2 standard deviations using the entire freshwater chronic toxicity data base and the water quality parameter transformation employed in subd. 1. If the value at a specific location is outside of that range, the endpoint of the range nearest to that value shall be used to determine the criterion. Additional information may be used to modify those ranges.

13. If, for a commercially, recreationally or ecologically important species, the SMCI is lower than the calculated FCI, then that SMCI is used as the FCI instead of the calculated one.

cbd At a value of the water quality parameter, the chronic toxicity criterion cCTCd equals the lower of the FCV and the final plant value calculated using the procedure in s. NR 105.11.

ccd Table 4 contains the chronic toxicity criteria for the fish and aquatic life subcategories listed in s. NR 102.04 c3d that are calculated using the procedures described in this subsection for substances meeting the database requirements indicated in sub. c1d. Table 4A contains the water quality parameter ranges calculated in par. cad 1.

c5d ACUTE-CHRONIC RATIOS. cad The acute-chronic ratio is used to estimate the chronic toxicity of a substance to fish or other aquatic species when the database of sub. c1d cad is not satisfied.

cbd The acute-chronic ratio for a species equals the acute concentration from data considered under s. NR 105.05 c1d divided by the chronic concentration from data calculated under sub. c1d, subject to the following conditions:

1. If the acute toxicity of a substance is related to any water quality parameter, the acute-chronic ratio shall be based on acute and chronic toxicity data obtained from organisms exposed to test water with similar, if not identical, values of those water quality parameters. Preference under this paragraph shall be given to data from acute and chronic tests done by the same author or reference in order to increase the likelihood of comparable test conditions.

2. If the acute and chronic toxicity data indicate that the acute-chronic ratio varies with changes in the values of the water quality parameters, the acute-chronic ratio used at specified values of the water quality parameters shall be based on the ratios at values closest to that specified.

3. If the acute toxicity of a substance is unrelated to water quality parameters, the acute-chronic ratio may be derived from any acute and chronic test on a species regardless of the similarity in values of those parameters. Preference under this paragraph shall be given to data from acute and chronic tests done by the same author or reference to increase the likelihood of comparable test conditions.

ccd A final chronic value shall be calculated for a substance under this subsection only if at least one acute-chronic ratio is available for at least one species of aquatic animal in at least 3 different families, provided that of the 3 species, one is a fish, one is an invertebrate, and the third is a relatively sensitive freshwater species on an acute toxicity basis. The other 2 may be saltwater species.

cdd The geometric mean acute-chronic ratio is calculated for each species using the available acute-chronic ratios for that species. That mean ratio shall be called the species mean acute-chronic ratio cSMACRd.

ced For a given substance, if the SMACR appears to increase

or decrease as the species or genus mean acute values cSMAVs or GMAVsd calculated for that substance using the procedure described in s. NR 105.05 increase, the final acute-chronic ratio cFACRd shall be equal to the geometric mean of the SMACRs for species with SMAVs closest to the final acute value.

cfd For a given substance, if no trend is apparent regarding changes in SMACRs and GMAVs, the FACR shall be equal to the geometric mean of all SMACRs available for that substance.

cgd For a given substance, the final chronic value cFCVd shall be equal to the final acute value cFAVd divided by the final acute-chronic ratio cFACRd. The chronic toxicity criterion shall be equal to the lower of the FCV and the final plant value as calculated using the procedure in s. NR 105.11, if available.

chd Chronic toxicity criteria for the fish and aquatic life subcategories listed in s. NR 102.04 c3d that are calculated using acute-chronic ratios are listed in Table 5 for substances with acute toxicity unrelated to water quality parameters and in Table 6 for substances with acute toxicity related to water quality parameters. Equations listed in Table 6 are applicable over the range of water quality parameters as contained in Table 4A. Table 2A should be used where no range is listed in Table 4A.

c6d SECONDARY CHRONIC VALUES. If all 8 minimum data requirements for calculating FCVs in sub. c1d cad are not met for a substance, secondary chronic values cSCVsd shall be calculated for that substance using the procedure in this subsection.

cad If any one of the combinations of information in subds. 1. to 3. is available, a SCV may be calculated. To calculate a SCV for a substance, the acute value from subds. 1. to 3. is divided by the applicable acute-chronic ratio in the same subdivision.

1. Calculate a FAV using the procedure in s. NR 105.05 c2d and divide it by a secondary acute-chronic ratio cSACRd using the procedure in sub. c7d.

2. Calculate a SAV using the procedure in s. NR 105.05 c4d and divide it by a final acute-chronic ratio cFACRd using the procedure in sub. c5d.

3. Calculate a SAV using the procedure in s. NR 105.05 c4d and divide it by a SACR using the procedure in sub. c7d.

cbd If appropriate, the SCV shall be made a function of a water quality characteristic in a manner similar to that described in sub. c4d cad.

ccd If, for a commercially, recreationally or ecologically important species, the SMCV is lower than the calculated SCV, that SMCV shall be used as the SCV instead of the calculated SCV.

cdd If there is an FPV available using the procedure in s. NR 105.11 which is lower than the calculated SCV, that FPV shall be used as the SCV instead of the calculated SCV.

c7d SECONDARY ACUTE-CHRONIC RATIOS. cad If a FACR cannot be calculated using the procedure in sub. c5d because SMACRs are not available for a fish, an invertebrate or an acutely sensitive freshwater species, a secondary acute-chronic ratio cSACRd may be calculated using the procedure in this subsection.

cbd The SACR shall be equal to the geometric mean of 3 acute-chronic ratios. Those ratios consist of the SMACRs available for the species in sub. c5d ccd. When SMACRs are not available for the species in par. cad, the default acute-chronic ratio to be used is 18. Use of a SACR will result in the calculation of a secondary chronic value.

c8d CHRONIC TOXICITY CRITERIA EXPRESSED IN THE DISSOLVED FORM. Chronic water quality criteria may be expressed as a dissolved concentration. The conversion of a chronic water quality criterion expressed as a total recoverable concentration to a chronic water quality criterion expressed as a dissolved concentration, the portion of the substance which will pass through a 0.45 um filter, shall be done using the equations in pars. cad and cbd. Substances which may have criteria expressed as a dissolved concentration are listed in par. cad with corresponding conversion factors.

cad The conversion of the water quality criterion expressed as total recoverable $cWQC_{Total\ R}$.d to the water quality criterion expressed as dissolved $cWQC_D$d shall be performed as follows:

$$WQC_D = cCFdcWQC_{Total\ R}.d$$

Where: $WQC_{Total\ R}$. = Criteria from NR 105, Table 5 or 6.
CF = Conversion factor for total recoverable to dissolved.

Conversion factors are as follows:

Arsenic	1.000
Cadmium	0.850
Chromium cIIId	0.860
Chromium cVId	0.962
Copper	0.960
Lead	0.792
Mercury	0.85
Nickel	0.997
Selenium	0.922
Zinc	0.986

cbd The translation of the WQC_D into the water quality criterion which accounts for site-specific conditions $cWQC_{TRAN}$d shall be performed as follows:

$$WQC_{TRAN} = cTranslatordcWQC_Dd$$

Where: Translator cunitlessd = $ccM_PdcTSSd + M_Dd\{M_D$

M_P = Particle-bound concentration of the pollutant cug{gd in receiving water.

M_D = Dissolved concentration of the pollutant in receiving water cug{Ld.

TSS = Total Suspended Solids cg{Ld concentration in receiving water.

ccd The procedures in pars. cad and cbd may also be used for the conversion of secondary values from total recoverable to dissolved.

Table 1
Acute Toxicity Criteria for Substances With Toxicity Unrelated to Water Quality
cin ug{L except where indicatedd

Substance	Cold Water	Warm Water Sportfish, Warm Water Forage, and Limited Forage Fish	Limited Aquatic Life
Arsenic c+3d*	339.8	339.8	339.8
Chromium c+6d*	16.02	16.02	16.02
Mercury c+2d*	0.83	0.83	0.83
Cyanide, free	22.4	45.8	45.8
Chloride	757,000	57,000	757,000
Chlorine*	19.03	19.03	19.03
Gamma - BHC	0.96	0.96	0.96
Dieldrin	0.24	0.24	0.24
Endrin	0.086	0.086	0.12
Toxaphene	0.73	0.73	0.73
Chlorpyrifos	0.041	0.041	0.041
Parathion	0.057	0.057	0.057

Note: * - Criterion listed is applicable to the Xtotal recoverableY form except for chlorine which is applicable to the Xtotal residualY form.

Table 2
Acute Toxicity Criteria for Substances With Toxicity Related to Water Quality
call in ug{Ld

Water Quality Parameter: Hardness cin ppm as $CaCO_3$d

$ATC=e^{cV \text{ in hardnessd} + \ln ACId}$

Substance	V	ln ACI	ATC at Various Hardness cppmd Levels 50	100	200
Total Recoverable Cadmium:					
Cold Water	1.147	-3.8104	1.97	4.36	9.65
Warm Water Sportfish, Warm Water Forage and Limited Forage Fish	1.147	-2.9493	4.65	10.31	22.83
Limited Aquatic Life	1.147	-1.9195	13.03	28.87	63.92
Total Recoverable Chromium c+3d:					
All Surface Waters	0.819	3.7256	1022	1803	3181
Total Recoverable Copper:					
All Surface Waters	0.9436	-1.6036	8.07	15.51	29.84
Total Recoverable Lead:					
All Surface Waters	0.9662	0.2226	54.73	106.92	208.90
Total Recoverable Nickel:					
All Surface Waters	0.846	2.255	261	469	843
Total Recoverable Zinc:					
All Surface Waters	0.8745	0.7634	65.66	120.4	220.7

Water Quality Parameter: pH

$ATC = e^{cVcpHd + \ln ACId}$

Substance	V	ln ACI	6.5	7.8	8.8
Pentachlorophenol:					
All Surface Waters	1.0054	-4.877	5.25	19.40	53.01

Table 2A
Water Quality Parameter Ranges for Substances With Acute Toxicity Related to Water Quality

Substance	Parameter	Applicable Range
Cadmium	Hardness cppmd	6 - 457
Chromium c+3d	Hardness cppmd	13 - 301
Copper	Hardness cppmd	13 - 495
Lead	Hardness cppmd	12 - 356
Nickel	Hardness cppmd	13 - 268
Zinc	Hardness cppmd	12 - 333
Pentachlorophenol	pH cs.u.d	6.6 - 8.8

Table 2B
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

Table 2C
Acute Toxicity Criteria for Ammonia With Toxicity Related to Water Qualitycall in mg{Ld
Cold Water cCWd Categories 1-5 are applicable only to ammonia criteria.[1]

Water Quality Parameter: pH

ATC cin mg{Ld = [A { c1 + $10^{c7.204] pHd}$d] + [B {c1 + $10^{cpH] 7.204d}$d]

Substance	A	B	7.5	8.0	8.5
Ammonia cas Nd in mg{L:					
CW Category 1 & 4	0.275	39.0	13.28	5.62	2.14
CW Category 2 & 3	0.343	48.7	16.59	7.01	2.67
CW Category 5, Warm Water Sport Fish, Warm Water Forage, and Limited Forage Fish	0.411	58.4	19.89	8.41	3.20
Limited Aquatic Life	0.633	90.0	30.64	12.95	4.93

[1] For ammonia, along with data on all warm water fish species and invertebrates, the cold water criteria are calculated using data on all cold water fish species with the following exceptions:

CW Category 1 = Default category of cold water classification. This category includes all fish. [Note: CW Category 1 is always applicable in Lake Superior, Lake Michigan, and Green Bay north of 44v 32[30Y north latitude.]

CW Category 2 = Inland lakes with populations of cisco, lake trout, brook trout or brown trout, but no other trout or salmonid species. This category excludes data on genus *Onchorhynchus*.

CW Category 3 = Inland lakes with populations of cisco, but no trout or salmonid species. This category excludes data on genera *Onchorhynchus, Salmo*, and *Salvelinus*.

CW Category 4 = Inland trout waters with brook, brown, or rainbow trout, but no whitefish or cisco. This category excludes data on genus *Prosopium*.

CW Category 5 = Inland trout waters with brook and brown trout, but no whitefish, cisco, or other trout or salmonid species. This category excludes data on genera *Prosopium* and *Onchorhynchus*.

Table 3
Chronic Toxicity Criteria for Substances With Toxicity Unrelated to Water Qualitycall in ug{Ld

Substance	Cold Water	Warm Water Sportfish, Warm Water Forage and Limited Forage Fish	Limited Aquatic Life
		cReservedd	

Note: This table is reserved for criteria that USEPA has indicated may be available in the near future.

Table 4
Chronic Toxicity Criteria for Substances With Toxicity Related to Water Quality call in ug{Ld

Water Quality Parameter: Hardness cin ppm as $CaCO_3$

CTC=$e^{cV\ lnchardnessd + ln\ CCId}$

Substance	V	ln CCI	CTC at Various Hardness cppmd Levels 50	100	175
Total Recoverable Cadmium:					
All Surface Waters	0.7852	-2.7150	1.43	2.46	3.82

Table 4A
Water Quality Parameter Ranges for Substances With Chronic Toxicity Related to Water Quality

Substance	Parameter	Applicable Range
Cadmium	Hardness cppmd	18-175

Table 4B
Chronic Toxicity Criteria for Ammonia with Toxicity Related to Water Quality call in mg{Ld

Substance: Ammonia cas Nd
Water Quality Parameters: Temperature in degrees Celsius, pH

30-Day CTC:

CTC = E X cc0.0676{c1 + $10^{c7.688] pHd}$dd + c2.912{c1 + $10^{cpH] 7.688d}$ddd X C

4-Day CTC = 30-Day CTC X 2.5

Cold Water call periodsd, Warm Water Sport Fish and Warm Water Forage Fish cperiods with Early Life Stages Presentd:

C = minimum of c2.85d or c1.45 X $10^{c0.028\ X\ c25\ -\ Tdd}$d

T = Temperature in degrees Celsius

E = 0.854

Warm Water Sport Fish and Warm Water Forage Fish cperiods with Early Life Stages Absentd:

C = c1.45 X $10^{c0.028\ X\ c25\ -\ Tdd}$d

T = Maximum of cactual temperature in degrees Celsiusd and c7d

E = 0.854

Limited Forage Fish cperiods with Early Life Stages Presentd:
C = minimum of c3.09d or c3.73 X $10^{c0.028 \text{ X } c25 - Tdd}$d
T = temperature in degrees Celsius
E = 1

Limited Forage Fish cperiods with Early Life Stages Absentd:
C = c3.73 X $10^{c0.028 \text{ X } c25 - Tdd}$d
T = Maximum of cactual temperature in degrees Celsiusd and c7d
E = 1

Limited Aquatic Life call periodsd:
C = c8.09 X $10^{c0.028 \text{ X } c25 - Tdd}$d
T = Maximum of cactual temperature in degrees Celsiusd and c7d
E = 1

	30-day CTC in mg{L @ pH of:		
	7.5	8.0	8.5
Cold Water, Warm Water Sport Fish cEarly Life Stages Presentd, and Warm Water Forage Fish cEarly Life Stages Presentd:			
@ 25 degrees Celsius	2.22	1.24	0.55
@ 14.5 degrees Celsius or less	4.36	2.43	1.09
Warm Water Sport Fish cEarly Life Stages Absentd, and Warm Water Forage Fish cEarly Life Stages Absentd:			
@ 25 degrees Celsius	2.22	1.24	0.55
@ 7 degrees Celsius or less	7.09	3.95	1.77
Limited Forage Fish cEarly Life Stages Presentd:			
@ 27 degrees Celsius or less	5.54	3.09	1.38
Limited Forage Fish cEarly Life Stages Absentd:			
@ 25 degrees Celsius	6.69	3.73	1.67
@ 7 degrees Celsius or less	21.34	11.90	5.33
Limited Aquatic Life:			
@ 25 degrees Celsius	14.50	8.09	3.62
@ 7 degrees Celsius or less	46.29	25.82	11.56

Note: The terms Xearly life stage presentY and Xearly life stage absentY are defined in subch. III of ch. NR 106.

Table 5
Chronic Toxicity Criteria Using Acute-Chronic Ratios for Substances with Toxicity Unrelated to Water Quality call in ug{Ld

Substance	Cold Water	Warm Water Sportfish and Warm Water Forage	Limited Forage Fish and Limited Aquatic Life
Arsenic c+3d*	148	152.2	152.2
Chromium c+6d*	10.98	10.98	10.98
Mercury c+2d*	0.44	0.44	0.44
Cyanide, free	5.22	11.47	11.47
Chloride	395,000	395,000	395,000
Selenium	5.0	5.0	46.5
Chlorine*	7.28	7.28	7.28
Dieldrin	0.055	0.077	0.077
Endrin	0.036	0.050	0.050
Parathion	0.011	0.011	0.011

Note: *Criterion listed is applicable to the Xtotal recoverableY form except for chlorine which is applicable to the Xtotal residualY form.

Table 6
Chronic Toxicity Criteria Using Acute-Chronic Ratios for Substances With Toxicity Related to Water Quality call in ug{Ld

Water Quality Parameter: Hardness cin ppm as $CaCO_3$d

			CTC at Various Hardness cppmd Levels		
CTC=$e^{cV\ lnchardnessd + ln\ CCId}$					
Substance	V	ln CCI	50	100	200
Total Recoverable Chromium c+3d:					
Cold Water	0.819	0.6851	48.86	86.21	152.1
Warm Water Sportfish	0.819	1.112	74.88	132.1	233.1
All others	0.819	1.112	74.88	132.1	233.1
Total Recoverable Copper:					
All Surface Waters	0.8557	-1.6036	5.72	10.35	18.73
Total Recoverable Lead:					
All Surface Waters	0.9662	-1.1171	14.33	28.01	54.71
Total Recoverable Nickel:					
Cold Water, Warm Water Sportfish, Warm Water Forage, and Limited Forage Fish	0.846	0.059	29.0	52.2	93.8
Limited Aquatic Life	0.846	0.4004	40.8	73.4	132.0
Total Recoverable Zinc					
All Surface Waters	0.8745	0.7634	65.66	120.4	220.7

Water Quality Parameter: pH

			CTC at Various pH cs.u.d Levels		
CTC=$e^{cVcpHd + ln\ CCId}$					
Substance	V	ln CCI	6.5	7.8	8.8
Pentachlorophenol:					
Cold Water	1.0054	-5.1468	4.43	14.81	40.48
All Other Surface Waters	1.0054	-4.9617	5.33	17.82	48.70

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; am. c5d cfd and Tables 2, 2a, 4, 4a and 6, Register, July, 1995, No. 475, eff. 8-1-95; am. c1d cad 1., 2., 4., and 5., c1d cbd, c3d cintro.d, cad to cgd, c4d cad 1., 7. to 13., c5d ccd, renum. c1d cad 6. to be c1d cad 10., c3d chd to be c3d cid and am. c1d cad 10, c4d cad 6. to be c4d cad 6. a., c4d cbd to be c4d ccd, c5d ced to cid to be c5d cdd to chd and am. c5d ced to cgd, cr. c3d chd, c4d cad 6. b., c4d cbd, c5d cbd 3., c6d to c8d, r. and recr., Tables 1 to 2a, 3 to 6, r. c5d cdd; am. Tables 1 and 5, Register, January, 2000, No. 529, eff. 2-1-00; CR 03-050: am. Tables 2 and 6, cr. Tables 2C and 4B Register February 2004 No. 578, eff. 3-1-04; CR 07-110: am Tables 2, 2A, 5 and 6 Register November 2008 No. 635, eff. 12-1-08; CR 09-123: am. c5d chd, c8d cad, Tables 4B and 5 Register July 2010 No. 655, eff. 8-1-10.

NR 105.07 Wildlife criteria. c1d The wildlife criterion is the concentration of a substance which if not exceeded protects Wisconsin[s wildlife from adverse effects resulting from ingestion of surface waters of the state and from ingestion of aquatic organisms taken from surface waters of the state.

cad For any substance not shown in Table 7, the wildlife criterion cWCd is the lower of the available mammalian or avian wildlife values cWVsd calculated pursuant to sub. c2d. A wildlife criterion protective of Wisconsin[s reptile fauna may be

calculated pursuant to sub. c2d whenever data specific to reptiles are available.

cbd Table 7 contains the wildlife criteria calculated according to the procedures of this chapter.

Table 7
Wildlife Criteria

Substance	Criteria cin ng{L, except where indicatedd
DDT & Metabolites	0.011
Mercury	1.3
Polychlorinated Biphenyls	0.12
2,3,7,8 - TCDD	0.003 cpg{Ld

c2d cad Mammalian and avian wildlife values shall be calculated as follows using information available from scientifically acceptable studies of animal species exposed repeatedly to the substance via oral routes including gavage:

$$WV = \frac{NOAEL \times Wt_A \times SSF}{W + \Sigma[F_{TLi} \times BAF_{TLi}]}$$

Where:
- WV= Wildlife value in milligrams per liter cmg{Ld.
- NOAEL= No observed adverse effect level in milligrams of substance per kilogram of body weight per day cmg{kg-dd as derived from subchronic or chronic mammalian or avian studies or as specified in subs. c3d to c5d.
- Wt= Average weight in kilograms ckgd of the representative species.
- W= Average daily volume of water in liters consumed per day cL{dd by the representative species or as specified in sub. c6d.
- SSF= Species sensitivity factor, ranging between 0.01 and 1 to account for interspecies differences in sensitivity.
- F_{TLJ}= Average daily amount of food consumed from trophic level i by the representative species in kilograms per day ckg{dd or as specified in sub. c6d.
- BAF_{TLJ}= Bioaccumulation factor for wildlife food in trophic level i with units of liter per kilogram cL{kgd as derived in s. NR 105.10. For consumption of piscivorous birds by other birds ce.g., herring gull by eaglesd, the BAF is derived by multiplying the trophic level 3 BAF for fish by a biomagnification factor to account for the biomagnification from fish to the consumed birds.

cbd The selection of the species sensitivity factor cSSFd shall be based on the available toxicological data base and available physicochemical and toxicokinetic properties of the substance and the amount and quality of available data.

ccd The bald eagle, kingfisher, herring gull, mink and otter are representative of avian and mammalian species to be protected by wildlife criteria. A NOAEL specific to each taxonomic class is used to calculate WVs for each of the 5 representative species. The avian WV is the geometric mean of the WVs calculated for the 3 representative avian species. The mammalian WV is the geometric mean of the WVs calculated for the 2 representative mammalian species.

cdd In those cases in which more than one NOAEL is available, the following shall apply:

1. If more than one NOAEL is available within a taxonomic class, based on the same endpoint of toxicity, the NOAEL from the most sensitive species shall be used.

2. If more than one NOAEL is available for a given species, based on the same enpoint of toxicity, the NOAEL for that species shall be calculated using the geometric mean of those NOAELs.

ced Because wildlife consume fish from both trophic levels 3 and 4, baseline BAFs shall be available for both trophic levels 3 and 4 to calculate either a criterion or secondary value for a chemical. When appropriate, ingestion through consumption of invertebrates, plants, mammals and birds in the diet of wildlife species to be protected shall be included.

c3d In those cases in which a no observed adverse effect level cNOAELd is available from studies of mammalian or avian species exposed repeatedly to the substance via oral routes including gavage, but is available in units other than mg{kg-d as specified in sub. c2d, the following procedures shall be used to express the NOAEL prior to calculating the wildlife value:

cad If the NOAEL is given in milligrams of toxicant per liter of water consumed cmg{Ld, the NOAEL shall be multiplied by the daily average volume of water consumed by the test animals in liters per day cL{dd and divided by the average weight of the test animals in kilograms ckgd.

cbd If the NOAEL is given in milligrams of toxicant per kilogram of food consumed cmg{kgd, the NOAEL shall be multiplied by the average amount of food in kilograms consumed daily by the test animals ckg{dd and divided by the average weight of the test animals in kilograms ckgd.

c4d In those cases in which a NOAEL is unavailable and a lowest observed adverse effect level cLOAELd is available from studies of animal species exposed repeatedly to the substance via oral routes including gavage, the LOAEL may be substituted with proper adjustment to estimate the NOAEL. An uncertainty factor of between one and 10 may be applied to the LOAEL, depending on the sensitivity of the adverse effect, to reduce the LOAEL into the range of a NOAEL. If the LOAEL is available in units other than mg{kg-d, the LOAEL shall be expressed in the same manner as that specified for the NOAEL in sub. c3d.

c5d In instances where a NOAEL is based on subchronic data, an uncertainty factor may be applied to extrapolate from subchronic to chronic levels. The value of the uncertainty factor may not be less than 0.1 and may not exceed 1.0. This factor is to be used when assessing highly bioaccumulative substances where toxicokinetic considerations suggest that a bioassay of limited length underestimates chronic effects.

c6d If drinking or feeding rates are not available for representative species, drinking cWd and feeding rates $cF_{TLi}d$ shall be calculated for representative mammalian or avian species by using the allometric equations given in pars. cad and cbd.

cad For mammalian species the allometric equations are as follows:

1. $F_{TLi}=0.0687 \times cWtd^{0.82}$
   Where:
   - F_{TLi} = Feeding rate of mammalian species in kilograms per day ckg{dd.
   - Wt = Average weight in kilograms ckgd of the test animals.

2. $W=0.099 \times cWtd^{0.90}$

Where: W = Drinking rate of mammalian species in liters per day cL{dd.
Wt = Average weight in kilograms ckgd of the test animals.

cbd For avian species the allometric equations are as follows:

1. $F_{TLi} = 0.0582\ cWtd^{0.65}$
Where: F_{TLi} = Feeding rate of avian species in kilograms per day ckg{dd.
Wt = Average weight in kilograms ckgd of the test animals.

2. $W = 0.059 \times cWtd^{0.67}$
Where: W = Drinking rate of avian species in liters per day cL{dd.
Wt = Average weight in kilograms ckgd of the test animals.

Note: Criteria to protect domestic animals will be considered on an as needed basis using a model that accounts for domestic animal exposure through drinking water. Because domestic animals do not regularly consume aquatic organisms, the wildlife exposure model is not appropriate.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; am. table 7, Register, July, 1991, No. 427, eff. 8-1-91; am. c1d, c2d cad, cbd, c3d cintro.d, c6d cintro.d, r. and recr. c2d ccd, c5d, cr. c2d cdd, ced, r. c6d cad, renum. c6d cbd and ccd to be c6d cad and cbd and am., Register, August, 1997, No. 500, eff. 9-1-97.

NR 105.08 Human threshold criteria. c1d The human threshold criterion cHTCd is the maximum concentration of a substance established to protect humans from adverse effects resulting from contact with or ingestion of surface waters of the state and from ingestion of aquatic organisms taken from surface waters of the state. Human threshold criteria are derived for those toxic substances for which a threshold dosage or concentration can be estimated below which no adverse effect or response is likely to occur.

c2d For noncarcinogenic components of mixtures in effluents, interactions among substances may be additive, antagonistic or synergistic and may be accounted for by a model that is supported by credible scientific evidence. The risks are assumed to be additive when substances are members of the same structural class and cause potential adverse effects via the same mechanism of action, influencing the same kind of endpoint, and shall be accounted for by a model that is supported by credible scientific evidence.

c3d Human threshold criteria are listed in Table 8. Criteria for the same substance may be different depending on the surface water classification, due to the lipid value of representative fish, a component of the BAF, and whether or not the water may be a source of drinking water. Further application of these criteria to protect drinking water and downstream uses in the Great Lakes system shall be according to s. NR 106.06 c1d

c4d To derive human threshold criteria for substances not included in Table 8 the following methods shall be used:

cad The human threshold criterion shall be calculated as follows:

$$HTC = \frac{ADE \times 70\ kg \times RSC}{W_H + cF_H \times BAFd}$$

Where: HTC = Human threshold criterion in milligrams per liter cmg{Ld.
ADE = Acceptable daily exposure in milligrams toxicant per kilogram body weight per day cmg{kg-dd as specified in sub. c5d.
70 kg = Average weight of an adult male in kilograms ckgd.
RSC = Relative source contribution factor used to account for routes of exposure other than consumption of contaminated water and aquatic organisms. In the absence of sufficient data on alternate sources of exposure, including but not limited to non-fish diet and inhalation, the relative source contribution factor shall be set equal to 0.8.
W_H = Average per capita daily water consumption of 2 liters per day cL{dd for surface waters classified as public water supplies or, for all other surface waters, 0.01 liters per day cL{dd for exposure through body contact or ingestion of small volumes of water during swimming or other recreational activities.
F_H = Average per capita daily consumption of sport-caught fish by Wisconsin anglers equal to 0.02 kilograms per day ckg{dd.
BAF = Aquatic organism bioaccumulation factor with units of liter per kilogram cL{kgd as derived in s. NR 105.10.

Table 8
Human Threshold Criteria
cug{L unless specified otherwised

		Public Water Supply		Non-Public Water Supply		
	Substance	Warm Water Sport Fish Communities	Cold Water[4] Communities	Warm Water Forage, Limited Forage, and Warm Water Sport Fish Communities	Cold Water Communities	Limited Aquatic Life
1.	Acrolein	7.2	3.4	15	4.4	2,800
2.	Antimony	5.6	5.6	373	373	1,120
3.	Benzene[2]	5	5	610	260	4,000
4.	Bisc2-chloroisopropyld ether	1,100	1,100	55,000	34,000	220,000
5.	Cadmium	4.4	4.4	370	370	880
6.	*Chlordane cng{Ld	2.4	0.70	2.4	0.70	310,000
7.	Chlorobenzene[2]	100	100	1,210	400	28,000
8.	Chromium, total[2]	100	100			
9.	Chromium c+3d	41,750	41,750	3,818,000	3,818,000	8,400,000
10.	Chromium c+6d	83.5	83.5	7,636	7,636	16,800
11.	Cyanide, Total[2]	138.6	138.6	9,300	9,300	28,000
12.	*4.4[-DDT cng{Ld	3.0	0.88	3.0	0.88	2800000
13.	1,2-Dichlorobenzene[2]	446	273	1,509	481	126,000
14.	1,3-Dichlorobenzene	1,400	710	3,300	1,000	500,000
15.	cis-1,2-Dichloroethene[2]	70	70	14,000	9,000	56,000
16.	trans-1,2-Dichloroethene[2]	100	100	24,000	13,000	110,000
17.	Dichloromethane[2] cmethylene chlorided	5	5	95,000	72,000	328,000
18.	2,4-Dichlorophenol	74	58	580	180	17,000
19.	Dichloropropenes[3] c1,3-Dichloropropened	8.3	8.2	420	260	1,700
20.	*Dieldrin cng{Ld	0.59	0.17	0.59	0.17	280,000
21.	2,4-Dimethylphenol	450	430	11,000	4,500	94,000
22.	Diethyl phthalate[2]	5,000	5,000	68,000	21,000	4,500,000
23.	Dimethyl phthalate cmg{Ld	241	184	1,680	530	56,000
24.	4,6-Dinitro-o-cresol	100	96	1,800	640	22,000
25.	Dinitrophenols[3] c2,4-Dinitrophenold	55	55	2,800	1,800	11,000
26.	2,4-Dinitrotoluene	0.51	0.48	13	5.3	110
27.	Endosulfan	87	41	181	54	33,600
28.	Ethylbenzene[2]	567	401	2,920	931	140,000
29.	Fluoranthene	890	610	4,300	1,300	220,000
30.	*Hexachlorobenzene	0.075	0.022	0.075	0.022	4,500
31.	Hexachlorocyclopentadiene	34.7	25.6	195	65.3	8,400
32.	Hexachloroethane	8.7	3.3	13	3.7	5,600
33.	*gamma-BHC clindaned[2]	0.20	0.20	0.84	0.25	1,900
34.	Isophorone	5,500	5,300	180,000	80,000	1,100,000
35.	Lead	10	10	140	140	2,240
36.	*Mercury[5]	0.0015	0.0015	0.0015	0.0015	336
37.	Nickel[2]	100	100	43,000	43,000	110,000
38.	*Pentachlorobenzene	0.46	0.14	0.47	0.14	4,500
39.	Selenium[2]	50	50	2,600	2,600	28,000
40.	Silver	140	140	28,000	28,000	28,000
41.	*2,3,7,8-TCDD cpg{Ld	0.11	0.032	0.11	0.032	7,300
42.	*1,2,4,5-Tetrachlorobenzene	0.54	0.17	0.58	0.17	1,700
44.	Toluene[2]	1,000	1,000	15,359	5,201	280,000
45.	1,1,1-Trichloroethane[2]	200	200	270,000	110,000	2,000,000
46.	2,4,5-Trichlorophenol	1,600	830	3,900	1,200	560,000

* Indicates substances that are BCCs.
[1] A human threshold criterion expressed in micrograms per liter cug{Ld can be converted to milligrams per liter cmg{Ld by dividing the criterion by 1000.
[2] For this substance the human threshold criteria for public water supply receiving water classifications equal the maximum contaminant level pursuant to s. NR 105.08 c4d cbd.
[3] The human threshold criteria for this chemical class are applicable to each isomer.
4 For BCCs, these criteria apply to all water of the Great Lakes system.
[5] The mercury criteria were calculated using 20 g{day fish consumption and the human non-cancer criteria derivation procedure in 40 CFR Part 132, Appendix C. For these criteria, 40 CFR Part 132, Appendix C as stated on September 1, 1997 is incorporated by reference.

cbd For surface waters classified as public water supplies, if the human threshold criterion for a toxic substance as calculated in par. cad exceeds the maximum contaminant level cMCLd for that substance as specified in ch. NR 809 or the July 8, 1987 Federal Register c52 FR 25690d, the MCL shall be used as the human threshold criterion.

c5d The acceptable daily exposure cADEd referenced in sub. c4d represents the maximum amount of a substance which if ingested daily for a lifetime results in no adverse effects to humans. Paragraphs cad to ccd list methods for determining the acceptable daily exposure.

cad The department shall review available references for acceptable daily exposure or equivalent values, such as a reference dose cRfDd as used by the U.S. environmental protection agency, and for human or animal toxicological data from which an acceptable daily exposure can be derived. Suitable references for review include, but are not limited to, those presented in s. NR 105.04 c5d.

cbd When human or animal toxicological data are available, the department may derive an acceptable daily exposure by using as guidance procedures presented by the U.S. environmental protection agency in XWater Quality Criteria Documents; AvailabilityY c45 FR 79318, November 28, 1986d. Additional guidance for deriving acceptable daily exposures from toxicological data

are given in subds. 1. to 4. Alternate procedures may be used if supported by credible scientific evidence.

1. No observable adverse effect levels cNOAELsd and lowest observable adverse effect levels cLOAELsd from studies of humans or mammalian test species shall be divided by an uncertainty factor to derive an acceptable daily exposure. Uncertainty factors reflect uncertainties in predicting acceptable exposure levels for the general human population based upon experimental animal data or limited human data. Factors to be considered when selecting an uncertainty factor include, but are not limited to, interspecies and individual variations in response and susceptibility to a toxicant, and the quality and quantity of the available data. The following guidelines shall be considered when selecting an uncertainty factor:

a. Use an uncertainty factor of 10 when extrapolating from valid experimental results from studies on prolonged ingestion by humans. This 10-fold factor protects sensitive members of the human population.

b. Use an uncertainty factor of 100 when extrapolating from valid results of long-term feeding studies on experimental animals with results of studies of human ingestion not available or insufficient ce.g., acute exposure onlyd. This represents an additional 10-fold uncertainty factor in extrapolating data from the average animal to the average human.

c. Use an uncertainty factor of 1000 when extrapolating from less than chronic results on experimental animals with no useful long-term or acute human data. This represents an additional 10-fold uncertainty factor in extrapolating from less than chronic to chronic exposures.

d. Use an additional uncertainty factor of between 1 and 10 depending on the severity of the adverse effect when deriving an acceptable daily exposure from a lowest observable adverse effect level cLOAELd. This uncertainty factor reduces the LOAEL into the range of a no observable adverse effect level cNOAELd.

e. Use an additional uncertainty factor of 10 when deriving an acceptable daily exposure for a substance which the U.S. environmental protection agency classifies as a Xgroup CY carcinogen, but which is not defined as a carcinogen in s. NR 105.03 c13d.

2. Results from studies of humans or mammalian test species used to derive acceptable daily exposures shall have units of milligrams of toxicant per kilogram of body weight per day cmg{kg-dd. When converting study results to the required units, a water consumption of 2 liters per day cL{dd and a body weight of 70 kilograms ckgd is assumed for humans. The following examples and procedures illustrate the conversion of units:

a. Results from human studies which are expressed in milligrams of toxicant per liter of water consumed cmg{Ld are converted to mg{kg-d by multiplying the results by 2 L{d and dividing by 70 kg.

b. Results from animal studies which are expressed in milligrams of toxicant per liter of water consumed cmg{Ld are converted to mg{kg-d by multiplying the results by the daily average volume of water consumed by the test animals in liters per day cL{dd and dividing by the average weight of the test animals in kilograms ckgd.

c. Results from animal studies which are expressed in milligrams of toxicant per kilogram of food consumed cmg{kgd are converted to mg{kg-d by multiplying the results by the average amount of food consumed daily by the test animals in kilograms per day ckg{dd and dividing by the average weight of the test animals in kilograms ckgd.

d. If a study does not specify water or food consumption rates, or body weight of the test animals, standard values taken from appropriate references, such as the National Institute of Occupational Safety and Health, 1980, Registry of Toxic Effects of Chemical Substances, may be used to convert units.

e. Results from animal studies in which test animals were not exposed to the toxicant each day of the test period shall be multiplied by the ratio of days that the test animals were dosed to the total days of the test period. For the purposes of this adjustment, the test period is defined as the interval beginning with the administration of the first dose and ending with the administration of the last dose, inclusive.

3. When assessing the acceptability and quality of human or animal toxicological data from which an acceptable daily exposure can be derived, the department may use the following documents as guidance:

a. XGuidelines for Mutagenicity Risk AssessmentY, c51 FR 34006, September 24, 1986d.

b. XGuidelines for the Health Risk Assessment of Chemical MixturesY, c51 FR 34014, September 24, 1986d.

c. XGuidelines for the Health Assessment of Suspect Development ToxicantsY, c51 FR 34028, September 24, 1986d.

d. XGuidelines for Exposure AssessmentY, c51 FR 34042, September 24, 1986d.

e. Any other documents that the department deems reliable.

4. When the available human or animal toxicological data contains conflicting information, the department may consult with experts outside of the department for guidance in the selection of the appropriate data.

ccd Using sound scientific judgment, the department shall select an acceptable daily exposure as derived in pars. cad and cbd for calculation of the human threshold criterion. When selecting an acceptable daily exposure, the department shall adhere to the following guidelines unless a more appropriate procedure is supported by credible scientific evidence:

1. Acceptable daily exposures based on human studies are given preference to those based on animal studies.

2. When deriving an acceptable daily exposure from animal studies preference is given to chronic studies involving oral routes of exposure, including gavage, over a significant portion of the animals[life span. If acceptable studies using oral exposure routes are not available, acceptable daily exposures derived from studies using alternate exposure routes, such as inhalation, may be used.

3. When 2 or more acceptable daily exposure values are available and have been derived from studies having equal preference as defined in subds. 1. and 2., the lowest acceptable daily exposure is generally selected. If the acceptable daily exposure values differ significantly, the department may consult with experts outside of the department for guidance in the selection of the more appropriate acceptable daily exposure.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; correction in c3d cbd made under s. 13.93 c2md cbd 7., Stats., Register, September, 1995, No. 477; renum. c2d to c4d to be c3d to c5d and am., cr. c2d, r. and recr. Table 8, am. c5d cintro.d, 1. cintro.d, d., e., 2 cintro.d and ccd and am., Register, August, 1997, No. 500, eff. 9-1-97; CR 03-050: am. Table 8 Register February 2004 No. 578, eff. 3-1-04; CR 07-110: am. Table 8 Register November 2008 No. 635, eff. 12-1-08; CR 09-123: am Table 8 Register July 2010 No. 655, eff. 8-1-10.

NR 105.09 Human cancer criteria. c1d The human cancer criterion cHCCd is the maximum concentration of a substance or mixture of substances established to protect humans from an unreasonable incremental risk of cancer resulting from contact with or ingestion of surface waters of the state and from ingestion of aquatic organisms taken from surface waters of the state. Human cancer criteria are derived for those toxic substances which are carcinogens as defined in s. NR 105.03 c13d.

c2d For any single carcinogen or any mixture of carcinogens

the incremental cancer risk from exposure to surface waters and aquatic organisms taken from surface waters may not exceed one in 100,000. The combined cancer risk of individual carcinogens in a mixture is assumed to be additive unless an alternate model is supported by credible scientific evidence.

c3d Human cancer criteria are listed in Table 9. Criteria for the same substance may be different depending on the surface water classification, due to the lipid value of representative fish, a component of the BAF, and whether or not the water may be a source of drinking water. Further application of these criteria to protect drinking water and downstream uses in the Great Lakes system shall be according to s. NR 106.06 c1d.

Table 9
Human Cancer Criteria
cug{L unless specified otherwise[1]d

		Public Water Supply		Non-Public Water Supply		
	Substance	Warm Water Sport Fish Communities	Cold Water[4] Communities	Warm Water Forage, Limited Forage, and Warm Water Sport Fish Communities	Cold Water Communities	Limited Aquatic Life
1.	Acrylonitrile	0.57	0.45	4.6	1.5	130
2.	Arsenic	0.2	0.2	13.3	13.3	40
3.	*alpha-BHC	0.012	0.0037	0.013	0.0039	11
4.	*gamma-BHC clindaned	0.052	0.018	0.064	0.019	54
5.	*BHC, technical grade	0.038	0.013	0.047	0.014	39
6.	Benzene[2]	5	5	140	45	1300
7.	Benzidine cng{Ld	1.5	1.5	81	55	300
8.	Beryllium	0.054	0.054	0.33	0.33	16
9.	Bisc2-chloroethyld ether	0.31	0.29	7.6	3.0	64
10.	Biscchloromethyld ether cng{Ld	1.6	1.6	96	79	320
11.	Carbon tetrachloride	2.5	2.1	29	9.5	540
12.	*Chlordane cng{Ld	0.41	0.12	0.41	0.12	54000
13.	Chloroethene cvinyl chlorided	0.18	0.18	10	6.8	37
14.	Chloroform ctrichloromethaned	55	53	1960	922	11200
15.	*4,4[-DDT cng{Ld	0.22	0.065	0.22	0.065	206000
16.	1,4-Dichlorobenzene	14	12	163	54	2940
17.	3,3[l]-Dichlorobenzidine	0.5	0.3	1.3	0.4	140
18.	1,3-Dichloropropene	3.4	3.4	173	108	700
19.	1,2-Dichloroethane	3.8	3.8	217	159	770
20.	Dichloromethane[2] cmethylene chlorided	5	5	2700	2100	9600
21.	*Dieldrin cng{Ld	0.0091	0.0027	0.0091	0.0027	4400
22.	2,4-Dinitrotoluene	0.51	0.48	13	5.3	110
23.	1,2-Diphenylhydrazine	0.38	0.31	3.3	1.04	88
24.	Halomethanes[3]	55	53	1960	922	11200
25.	*Hexachlorobenzene cng{Ld	0.73	0.22	0.73	0.22	44000
26.	*Hexachlorobutadiene	0.59	0.19	0.69	0.2	910
27.	Hexachloroethane	7.7	2.9	11	3.3	5000
28.	N-Nitrosodiethylamine cng{Ld	2.3	2.3	150	140	460
29.	N-Nitrosodimethylamine	0.0068	0.0068	0.46	0.46	1.4
30.	N-Nitrosodi-n-butylamine	0.063	0.062	2.5	1.3	13
31.	N-Nitrosodiphenylamine	44	23	116	34	13000
32.	N-Nitrosopyrrolidine	0.17	0.17	11	11	34
33.	*Polychlorinated biphenyls cng{Ld	0.01	0.003	0.01	0.003	9100
34.	*2,3,7,8-Tetrachlorodibenzo-p-dioxin cpg{Ld	0.014	0.0041	0.014	0.0041	930
35.	1,1,2,2-Tetrachloroethane	1.7	1.6	52	22	350
36.	Tetrachloroethene[2]	5.0	4.6	46	15	1300
37.	*Toxaphene cng{Ld	0.11	0.034	0.14	0.034	63600
38.	1,1,2-Trichloroethane[2]	5.0	5.0	195	87	1200
39.	Trichloroethene[2]	5	5	539	194	6400
40.	2,4,6-Trichlorophenol	29	24	300	97	6400

* Indicates substances that are BCCs.

[1] A human cancer criterion expressed in micrograms per liter cug{Ld, nanograms per liter cng{Ld or picograms per liter cpg{Ld can be converted to milligrams per liter cmg{Ld by dividing the criterion by 1000, 1,000,000 or 1,000,000,000, respectively.

[2] For this substance the human cancer criteria for public water supply receiving water classifications equal the maximum contaminant level pursuant to s. NR 105.09 c4d cbd.

[3] Human cancer criteria for halomethanes are applicable to any combination of the following chemicals: bromomethane cmethyl bromided, chloromethane cmethyl chlorided, tribromomethane cbromoformd, bromodichloromethane cdichloromethyl bromided, dichlorodifluoromethane cfluorocarbon 12d and trichlorofluoromethane cfluorocarbon 11d.

[4] For BCCs, these criteria apply to all waters of the Great Lakes system.

c4d To derive human cancer criteria for substances not included in Table 9 the following methods shall be used:

cad The human cancer criterion shall be calculated as follows:

$$HCC = \frac{RAD \times 70\ kg}{W_H + cF_H \times BAFd}$$

Where:

HCC = Human cancer criterion in milligrams per liter cmg{Ld.

RAD = Risk associated dose in milligrams toxicant per kilogram body weight per day cmg{kg-dd that is associated with a lifetime incremental cancer risk equal to one in 100,000 as derived in sub. c5d.

70 kg = Average weight of an adult male in kilograms ckgd.

W_H = Average per capita daily water consumption of 2 liters per day cL{dd for surface waters classified as public water supplies or, for other surface waters, 0.01 liters per day cL{dd for exposure through contact or ingestion of small volumes of water during swimming or during other recreational activities.

F_H = Average per capita daily consumption of sport-caught fish by Wisconsin anglers equal to 0.02 kilograms per day ckg{dd.

BAF = Aquatic life bioaccumulation factor with units of liter per kilogram cL{kgd as derived in s. NR 105.10.

cbd For surface waters classified as public water supplies, if the human cancer criterion for a toxic substance as calculated in par. cad exceeds the maximum contaminant level cMCLd for that substance as specified in ch. NR 809 or the July 8, 1987 Federal Register c52 FR 25690d, the MCL shall be used as the human cancer criterion.

c5d The risk associated dose cRADd referenced in sub. c4d represents the maximum amount of a substance which if ingested daily for a lifetime of 70 years has an incremental cancer risk equal to one case of human cancer in a population of 100,000. Methods for deriving the risk associated dose are specified in pars. cad to cdd.

cad The department shall review available references for acceptable human and animal studies from which the risk associated dose can be derived. The department shall use sound scientific judgment when determining the acceptability of a study and may use the U.S. environmental protection agency[s XGuidelines for Carcinogen Risk AssessmentY cFR 51 33992, September 24, 1986d as guidance for judging acceptability. Suitable references for review include, but are not limited to, those presented in s. NR 105.04 c5d.

cbd If an acceptable human epidemiologic study is available, contains usable exposure data, and indicates a carcinogenic effect, the risk associated dose shall be set equal to the lifetime average exposure which would produce an incremental cancer risk of one in 100,000 based on the exposure information from the study and assuming the excess cancer risk is proportional to the lifetime average exposure. If more than one human epidemiologic study is judged to be acceptable, the most protective risk associated dose derived from the studies is generally used to calculate the human cancer criterion. If the risk associated dose values differ significantly, the department may consult with experts outside of the department for guidance in the selection of the more appropriate value.

ccd In the absence of an acceptable human epidemiologic study, the risk associated dose shall be derived from available studies which use mammalian test species and which are judged acceptable. Methods for deriving the risk associated dose are specified in subds. 1. to 4.

1. A linear, non-threshold dose-response relationship as applied by the U.S. environmental protection agency in XWater Quality Criteria Documents; AvailabilityY c45 FR 79318, November 28, 1980d shall be assumed unless a more appropriate dose-response relationship or extrapolation model is supported by credible scientific evidence.

Note: The linear non-threshold dose-response model used by the U.S. environmental protection agency provides an upper-bound estimate ci.e., the one-sided 95% upper confidence limitd of incremental cancer risk. The true cancer risk is unknown. While the true cancer risk is not likely to be greater than the upper bound estimate, it may be lower.

2. When a linear, non-threshold dose-response relationship is assumed, the risk associated dose shall be calculated using the following equation:

$$RAD = \frac{1}{q_1^*} \times 0.00001$$

Where:

RAD = Risk associated dose in milligrams toxicant per kilogram body weight per day cmg{kg-dd.

0.00001 = Incremental risk of human cancer equal to one in 100,000.

q_1^* = Upper 95% confidence limit cone-sidedd of the carcinogenic potency factor in days per milligram toxicant per kilogram body weight cd-kg{mgd as derived from the procedures referenced in subd. 1. and the guidance presented in subd. 3.

3. The department shall adhere to the following guidance for deriving carcinogenic potency factors, or corresponding values if an alternate dose-response relationship or extrapolation model is used, unless more appropriate procedures are supported by credible scientific evidence:

a. If 2 or more mammalian studies are judged acceptable, but vary in either species, strain or sex of the test animals, or in tumor type or site, the study giving the greatest carcinogenic potency factor shall be used. Studies which produce a spuriously high carcinogenic potency factor due to the use of a small number of test animals may be excluded.

b. If 2 or more mammalian studies are judged acceptable, are comparable in size and are identical in regard to species, strain and sex of the test animals and to tumor sites, the geometric mean of the carcinogenic potency factors derived from each study shall be used.

c. If in an acceptable study, tumors were induced at more than one site, the number of animals with tumors at one or more

of the sites shall be used as incidence data when deriving the cancer potency factor.

d. The combination of benign and malignant tumors shall be used as incidence data when deriving the cancer potency factor.

e. Calculation of an equivalent dose between animal species and humans using a surface area conversion, and conversion of units of exposure to milligrams of toxicant per day cmg{dd shall be performed as specified by the U.S. environmental protection agency in XWater Quality Criteria Documents; AvailabilityY c45 FR 79318, November 28, 1980d.

f. If the duration of the mammalian study cDd is less than the natural life span of the test animal cLSd, the carcinogenicity potency factor is multiplied by the factor cD{LSd3.

4. When available mammalian studies contain conflicting information, the department shall consult with the department of health services and may consult with experts outside of the department for guidance in the selection of the appropriate study.

cdd If both a human epidemiologic study and a study of mammalian test species are judged reliable but only the animal study indicates a carcinogenic effect, it is assumed that a risk of cancer to humans exists but that it is less than could have been detected in the epidemiologic study. An upper limit of cancer incidence may be calculated assuming that the true incidence is just below the level of detection in the cohort of the epidemiologic study. The department may consult with experts outside of the department for guidance in the selection of the appropriate study.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; am. table 9 and c6d, Register, July, 1991, No. 427, eff. 8-1-91; correction in c4d cbd made under s. 13.93 c2md cbd 7., Stats., Register, September, 1995, No. 477; am. c1d, c3d, r. and recr. Table 9, am. c4d cad, cbd, c5d cintro.d, cad cbd, ccd cintro.d and 2., r. c6d, Register, August, 1997, No. 500, eff. 9-1-97; CR 03-050: am. Table 9 Register February 2004 No. 578, eff. 3-1-04; CR 07-110: am. Table 9 Register November 2008 No. 635, eff. 12-1-08; CR 09-123: am. Table 9 Register July 2010 No. 655, eff. 8-1-10; correction in c5d ccd 4. made under s. 13.92 c4d cbd 6., Stats., Register April 2023 No. 808.

NR 105.10 Bioaccumulation factor. c1d The bioaccumulation factor used to derive wildlife, human threshold, human cancer and taste and odor criteria or secondary values is determined from a baseline BAF using the methodology provided in Appendix B to 40 CFR part 132. 40 CFR part 132, Appendix B as stated on September 1, 1997, is incorporated by reference. BAFs shall be used to calculate criteria and secondary values for human health and wildlife. Use of a BAF greater than 1000, as determined from either of the methods referred to in sub. c2d ccd or cdd for organic substances, will result in the calculation of a secondary value. The baseline BAF is based on the concentration of freely dissolved substances in the ambient water to facilitate extrapolation from one water to another.

c2d Baseline BAFs shall be derived using one of the following 4 methods, which are listed from most preferred to least preferred.

cad A measured baseline BAF for an organic or inorganic substance derived from a field study of acceptable quality;

cbd A predicted baseline BAF for an organic substance derived using field-measured BSAFs of acceptable quality;

ccd A predicted baseline BAF for an organic or inorganic substance derived from a BCF measured in a laboratory study of acceptable quality and a food-chain multiplier. Food-chain multipliers are provided in 40 CFR part 132, Appendix B; or

cdd A predicted baseline BAF for an organic substance derived from a K_{OW} of acceptable quality and a food-chain multiplier.

c3d REVIEW AND SELECTION OF DATA. Measured BAFs, BSAFs and BCFs shall meet the quality assurance requirements provided in 40 CFR part 132, Appendix B and shall be obtained from available sources including the following:

cad EPA Ambient Water Quality Criteria documents issued after January 1, 1980.

cbd Published scientific literature.

ccd Reports issued by EPA or other reliable sources.

cdd Unpublished data.

c4d HUMAN HEALTH AND WILDLIFE BAFS FOR ORGANIC SUBSTANCES. cad To calculate human health and wildlife BAFs for organic substances, the K_{OW} of the substance shall be used with a POC concentration of 0.00000004 kg{L and a DOC concentration of 0.000002 kg{L to yield the fraction freely dissolved:

$$f_{fd} = \frac{1}{1 + \frac{cDOCdcK_{ow}d + cPOCdcKowd}{10}}$$

$$= \frac{1}{1 + \frac{c0.000002\ kg\{LdcK_{ow}d + c0.00000004\ kg\{LdcKowd}{10}}$$

$$= \frac{1}{1 + c0.00000024\ kg\{LdcK_{ow}d}$$

Where:

DOC = concentration of dissolved organic carbon, kg of dissolved organic carbon{L of water.

POC = concentration of particulate organic carbon, kg of particulate organic carbon{L of water.

cbd The human health BAFs for an organic substance shall be calculated using the following equations:

For warm water communities:

Human Health BAF = [cbaseline BAFdc0.013d+ 1]cf_{fd}d

For cold water communities:

Human Health BAF = [cbaseline BAFdc0.044d+ 1]cf_{fd}d

Where: 0.013 and 0.044 are the fraction lipid values for warm and cold water fish and aquatic life communities, respectively, that are required to derive human health criteria and secondary values.

baseline BAF = the baseline BAF calculated according to 40 CFR part 132, Appendix B.

ccd The wildlife BAFs for an organic substance shall be calculated using the following equations:

1. For trophic level 3:
   Wildlife BAF = [cbaseline BAFdc0.0646d+ 1]cf_{fd}d
2. For trophic level 4:
   Wildlife BAF = [cbaseline BAFdc0.1031d+ 1]cf_{fd}d

Where: 0.0646 and 0.1031 are the standardized fraction lipid values for dietary consumption from trophic level 3 and 4 fish taxa, respectively, that are required to derive wildlife criteria and secondary values.

baseline BAF = the baseline BAF calculated according to 40 CFR part 132, Appendix B.

c5d HUMAN HEALTH AND WILDLIFE BAFS FOR INORGANIC SUBSTANCES. cad *Human health.* 1. Measured BAFs and BCFs used to determine human health BAFs for inorganic substances shall be based on edible tissue ce.g., muscled of freshwater fish. If it is demonstrated that whole-body BAFs or BCFs are similar to edible-tissue BAFs or BCFs, then these data are acceptable. BCFs and BAFs based on measurements of aquatic plants and invertebrates may not be used in the derivation of human health criteria and values.

2. If one or more field-measured baseline BAFs for an inorganic substance are available from studies conducted in the Great Lakes system with the muscle of fish, the geometric mean of the species mean baseline BAFs shall be used as the human health BAF for that substance.

3. If an acceptable measured baseline BAF is not available for an inorganic substance and one or more acceptable edible-portion BCFs are available for the substance, a predicted baseline BAF shall be calculated by multiplying the geometric mean of the BCFs times a FCM. The FCM will be 1.0 unless chemical-specific biomagnification data support using a multiplier other than 1.0. The predicted baseline BAF shall be used as the human health BAF for that substance.

cbd *Wildlife.* 1. Measured BAFs and BCFs used to determine wildlife BAFs for inorganic substances shall be based on whole-body freshwater fish and invertebrate data. If it is demonstrated that edible-tissue BAFs or BCFs are similar to whole-body BAFs or BCFs, then these data are acceptable.

2. If one or more field-measured baseline BAFs for an inorganic substance is available from studies conducted in the Great Lakes system with whole body of fish or invertebrates, then the following apply:

a. For each trophic level, a species mean measured baseline BAF shall be calculated as the geometric mean if more than one measured BAF is available for a given species.

b. For each trophic level, the geometric mean of the species mean measured baseline BAFs shall be used as the wildlife BAF for that substance.

3. If an acceptable measured baseline BAF is not available for an inorganic substance and one or more acceptable whole-body BCFs are available for the substance, a predicted baseline BAF shall be calculated by multiplying the geometric mean of the BCFs times a FCM. The FCM shall be 1.0 unless chemical-specific biomagnification data support using a multiplier other than 1.0. The predicted baseline BAF shall be used as the wildlife BAF for that substance.

Note: Copies of 40 CFR Part 132, Appendix B are available for inspection in the offices of the department of natural resources, secretary of state and the legislative reference bureau, Madison, WI or may be purchased from the superintendent of documents, US government printing office, Washington, D.C. 20402.

History: Cr. Register, February, 1989, No. 398, eff. 3-1-89; r. and recr., Register, August, 1997, No. 500, eff. 9-1-97.

NR 105.11 Final plant values. c1d A Final Plant Value cFPVd 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 substance were measured and the adverse effect was biologically important. Appropriate measures of the toxicity of the substance to aquatic plants are used to compare the relative sensitivities of aquatic plants and animals.

c2d A plant value is the result of a 96-hour test conducted with an algae or a chronic test conducted with an aquatic vascular plant. A test of the toxicity of a metal to a plant may not be used if the medium contained an excessive amount of a complexing agent, such as EDTA, that might affect the toxicity of the metal. Concentrations of EDTA above 200 µg{L should be considered excessive.

c3d The FPV shall be established 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.

Note: Although procedures for conducting and interpreting the results of toxicity tests with plants are not well advanced, 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.

History: Cr. Register, August, 1997, No. 500, eff. 9-1-97.