DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER BUREAU
WATER RESOURCES PROTECTION

Filed with the Secretary of State on January 13, 2006

These rules become effective immediately upon filing with the Secretary of State unless adopted under sections 33, 44, 45a(6), or 48 of 1969 PA 306. Rules adopted under these sections become effective 7 days after filing with the Secretary of State.

(By authority conferred on the department of environmental quality by sections 3103 and 3106 of 1994 PA 451, MCL 324.3103 and 324.3106)

R 323.1041, R 323.1043, R 323.1044, R 323.1050, R 323.1053, R 323.1055, R 323.1057, R 323.1060, R 323.1062, R 323.1064, R 323.1065, R 323.1069, R 323.1082, R 323.1090, R 323.1092, R 323.1096, R 323.1097, R 323.1100, R 323.1105, R 323.1116, and R 323.1117 of the Michigan Administrative Code are amended as follows:

PART 4. WATER QUALITY STANDARDS

R 323.1041 Purpose.
Rule 41. The purpose of the water quality standards as prescribed by these rules is to establish water quality requirements applicable to the Great Lakes, the connecting waters, and all other surface waters of the state, to protect the public health and welfare, to enhance and maintain the quality of water, to protect the state's natural resources, and to serve the purposes of Public Law 92-500, as amended, 33 U.S.C. 1251 et seq., Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, MCL 324.3101 to 324.3119, and the Great Lakes water quality agreement enacted November 22, 1978, and amended in 1987. These standards may not reflect current water quality in all cases. Water quality of certain surface waters of the state may not meet standards as a result of natural causes or conditions unrelated to human influence. Where surface waters of the state may have been degraded due to past human activities and attainment of standards in the near future is not economically or technically achievable, these standards shall be used to improve water quality. These standards are the minimum water quality requirements by which the surface waters of the state shall be managed.

R 323.1043 Definitions; A to L.
Rule 43. As used in this part:
(a) "Acceptable daily exposure (ADE)" means an estimate of the maximum daily dose of a substance that is not expected to result in adverse noncancer effects to the general human population, including sensitive subgroups.
(b) "Acceptable wildlife endpoints" means subchronic and chronic endpoints that affect reproductive or developmental success, organismal viability, or growth or any other endpoint that is, or is directly related to, a parameter that influences population dynamics.
(c) "Acute-chronic ratio (ACR)" means a standard measure of the acute toxicity of a material divided by an appropriate measure of the chronic toxicity of the same material under comparable conditions.

(d) "Adverse effect" means any deleterious effect to organisms due to exposure to a substance. The term includes effects that are or may become debilitating, harmful, or toxic to the normal functions of the organism. The term does not include nonharmful effects such as tissue discoloration alone or the induction of enzymes involved in the metabolism of the substance.

(e) "Agriculture use" means a use of water for agricultural purposes, including livestock watering, irrigation, and crop spraying.

(f) "Anadromous salmonids" means trout and salmon that ascend streams to spawn.

(g) "Aquatic maximum value (AMV)" means the highest concentration of a material in the ambient water column to which an aquatic community can be exposed briefly without resulting in unacceptable effects, calculated according to the methodology specified in R 323.1057(2). The AMV is equal to 1/2 of the tier I or tier II final acute value (FAV).

(h) "Baseline bioaccumulation factor" means, for organic chemicals, a BAF that is based on the concentration of freely dissolved chemicals in the ambient water and takes into account the partitioning of the chemical within the organism. For inorganic chemicals, the term means a BAF that is based on the wet weight of the tissue.

(i) "Baseline bioconcentration factor" means, for organic chemicals, a BCF that is based on the concentration of freely dissolved chemicals in the ambient water and takes into account the partitioning of the chemical within the organism. For inorganic chemicals, the term means a BCF that is based on the wet weight of the tissue.

(j) "Bioaccumulation" means the net accumulation of a substance by an organism as a result of uptake from all environmental sources.

(k) "Bioaccumulation factor (BAF)" means the ratio, in liters per kilogram, of a substance's concentration in tissue of an aquatic organism to its concentration in the ambient water where both the organism and its food are exposed and the ratio does not change substantially over time.

(l) "Bioaccumulative chemical of concern (BCC)" means a chemical which, upon entering the surface waters, by itself or as its toxic transformation product, accumulates in aquatic organisms by a human health bioaccumulation factor of more than 1,000 after considering metabolism and other physiochemical properties that might enhance or inhibit bioaccumulation. The human health bioaccumulation factor shall be derived according to R 323.1057(5). Chemicals with half-lives of less than 8 weeks in the water column, sediment, and biota are not BCCs. The minimum BAF information needed to define an organic chemical as a BCC is either a field-measured BAF or a BAF derived using the biota-sediment accumulation factor (BSAF) methodology. The minimum BAF information needed to define an inorganic chemical as a BCC, including an organometal, is either a field-measured BAF or a laboratory-measured bioconcentration factor (BCF). The BCCs to which these rules apply are identified in table 5 of R 323.1057.

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

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

(o) "Biota-sediment accumulation factor (BSAF)" means the ratio, in kilograms of organic carbon per kilogram of lipid, of a substance's lipid-normalized concentration in tissue of an aquatic organism to its organic carbon-normalized concentration in surface sediment in situations where the ratio does not change substantially over time, both the organism and its

food are exposed, and the surface sediment is representative of average surface sediment in the vicinity of the organism.

(p) "Carcinogen" means a substance which causes an increased incidence of benign or malignant neoplasms in animals or humans or that substantially decreases the time in which neoplasms develop in animals or humans.

(q) "Chronic effect" means an adverse effect that is measured by assessing an acceptable endpoint and results from continual exposure over several generations or at least over a significant part of the test species' projected life span or life stage.

(r) "Coldwater fishery use" means the ability of a waterbody to support a balanced, integrated, adaptive community of fish-species which thrive in relatively cold water, generally including any of the following:

(i) Trout.

(ii) Salmon.

(iii) Whitefish.

(iv) Cisco.

(s) "Connecting waters" means any of the following:

(i) The St. Marys river.

(ii) The Keweenaw waterway.

(iii) The Detroit river.

(iv) The St. Clair river.

(v) Lake St. Clair.

(t) "Control document" means any authorization issued by the department to any source of pollutants to surface waters of the state that specifies conditions under which the source is allowed to operate.

(u) "Conversion factor" means the decimal fraction of a metal corresponding to an estimate of the percent total recoverable metal that was dissolved in the aquatic toxicity tests that were most important in the derivation of the tier I or tier II aquatic life value for that metal.

(v) "Department" means the director of the Michigan department of environmental quality or his or her designee to whom the director delegates a power or duty by written instrument.

(w) "Depuration" means the loss of a substance from an organism as a result of any active or passive process.

(x) "Designated use" means those uses of the surface waters of the state as established by R 323.1100 whether or not they are being attained.

(y) "Discharge-induced mixing" means the mixing of a discharge and receiving water that occurs due to discharge momentum and buoyancy up to the point where mixing is controlled by ambient turbulence.

(z) "Dissolved oxygen" means the amount of oxygen dissolved in water and is commonly expressed as a concentration in terms of milligrams per liter.

(aa) "Dissolved solids" means the amount of materials dissolved in water and is commonly expressed as a concentration in terms of milligrams per liter.

(bb) "EC50" means a statistically or graphically estimated concentration that is expected to cause 1 or more specified effects in 50% of a group of organisms under specified conditions.

(cc) "Effluent" means a wastewater discharge from a point source to the surface waters of the state.

(dd) "Endangered species act (ESA)" means the endangered species act of 1973, as amended, 16 U.S.C. §1531 et seq.

(ee) "Endangered or threatened species" means Michigan species that have been identified as endangered or threatened pursuant to section 4 of the endangered species act and listed in 50 C.F.R. §17 (2000).

(ff) "Fecal coliform" means a type of coliform bacteria found in the intestinal tract of humans and other warm-blooded animals.

(gg) "Final acute value (FAV)" means the level of a chemical or mixture of chemicals that does not allow the mortality or other specified response of aquatic organisms to exceed 50% when exposed for 96 hours, except where a shorter time period is appropriate for certain species. The FAV shall be calculated under R 323.1057(2) if appropriate for the chemical.

(hh) "Final chronic value (FCV)" means the level of a substance or a mixture of substances that does not allow injurious or debilitating effects in an aquatic organism resulting from repeated long-term exposure to a substance relative to the organism's lifespan, calculated using the methodology specified in R 323.1057(2).

(ii) "Fish consumption use" means the ability of a surface water of the state to provide a fishery for human consumption that is consistent with the level of protection provided by these rules.

(jj) "Food chain multiplier (FCM)" means the ratio of a BAF to an appropriate BCF.

(kk) "Harmonic mean flow" means the number of daily flow measurements divided by the sum of the reciprocals of the flows.

(ll) "Human cancer value (HCV)" means the maximum ambient water concentration of a substance at which a lifetime of exposure from either drinking the water, consuming fish from the water, and conducting water-related recreation activities or consuming fish from the water and conducting water-related recreation activities will represent a plausible upper bound risk of contracting cancer of 1 in 100,000 using the exposure assumptions and methodology specified in R 323.1057(4).

(mm) "Human noncancer value (HNV)" means the maximum ambient water concentration of a substance at which adverse noncancer effects are not likely to occur in the human population from lifetime exposure through either drinking the water, consuming fish from the water, and conducting water-related recreation activities or consuming fish from the water and conducting water-related recreation activities, using the exposure assumptions and methodology specified in R 323.1057(4).

(nn) "Industrial water supply" means a water source intended for use in commercial or industrial applications or for noncontact food processing.

(oo) "Inland lake" means a surface water of the state that is an inland body of standing water situated in a topographic depression other than an artificial agricultural pond that is less than 1 acre, unless otherwise determined by the department. The department may designate a dammed river channel or an impoundment as an inland lake based on aquatic resources to be protected.

(pp) "Keweenaw waterway" means the entire Keweenaw waterway, including Portage lake, Houghton county.

(qq) "Lake Superior basin-bioaccumulative substances of immediate concern (LSB-BSIC)" means substances identified in the September 1991 binational program to restore and protect the Lake Superior basin, including all of the following:

(i) 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).

(ii) Octachlorostyrene.

(iii) Hexachlorobenzene.

(iv) Chlordane.

(v) Dichloro-diphenyl-trichloroethane (DDT) and metabolites.

(vi) Dieldrin.

(vii) Toxaphene.
(viii) Polychlorinated biphenyls (PCBs).
(ix) Mercury.
(rr) "LC50" means a statistically or graphically estimated concentration that is expected to be lethal to 50% of a group of organisms under specified conditions.
(ss) "Linearized multistage model" means a conservative mathematical model for cancer risk assessment. The model fits linear dose-response curves to low doses. The model is consistent with a no-threshold model of carcinogenesis.
(tt) "Loading capacity" means the greatest amount of pollutant loading that a water can receive without violating water quality standards.
(uu) "Lowest observed adverse effect level (LOAEL)" means the lowest tested dose or concentration of a substance that results in an observed adverse effect in exposed test organisms when all higher doses or concentrations result in the same or more severe effects.
(vv) "Lotic" means surface waters of the state that exhibit flow.

R 323.1044 Definitions; M to W.
Rule 44. As used in this part:
(a) "Maximum acceptable toxicant concentration (MATC)" means the concentration obtained by calculating the geometric mean of the lower and upper chronic limits from a chronic test. A lower chronic limit is the highest tested concentration that did not cause the occurrence of a specific adverse effect. An upper chronic limit is the lowest tested concentration which did cause the occurrence of a specific adverse effect and above which all tested concentrations caused such an occurrence.
(b) "Mixing zone" means the portion of a water body in which a point source discharge or venting groundwater is mixed with the receiving water.
(c) "Natural water temperature" means the temperature of a body of water without an influence from an artificial source or a temperature as otherwise determined by the department.
(d) "New discharge" means any building, structure, facility, or installation from which there is or may be a discharge of substances to the surface waters of the state, the construction of which commenced after July 29, 1997.
(e) "No observed adverse effect level (NOAEL)" means the highest tested dose or concentration of a substance that results in no observed adverse effect in exposed test organisms where higher doses or concentrations result in an adverse effect.
(f) "Nonpoint source" means a source of material to the surface waters of the state other than a source defined as a point source.
(g) "Octanol-water partition coefficient (K_{ow})" means the ratio of the concentration of a substance in the n-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.
(h) "Palatable" means the state of being agreeable or acceptable to the sense of sight, taste, or smell.
(i) "Partial body contact recreation" means any activities normally involving direct contact of some part of the body with water, but not normally involving immersion of the head or ingesting water, including fishing, wading, hunting, and dry boating.
(j) "Plant nutrients" means the chemicals, including nitrogen and phosphorus, necessary for the growth and reproduction of aquatic rooted, attached, and floating plants, fungi, or bacteria.

(k) "Point source" means a discharge that is released to the surface waters of the state by a discernible, confined, and discrete conveyance, including any of the following from which wastewater is or may be discharged:
(i) A pipe.
(ii) A ditch.
(iii) A channel.
(iv) A tunnel.
(v) A conduit.
(vi) A well.
(vii) A discrete fissure.
(viii) A container.
(ix) A concentrated animal feeding operation.
(x) A boat or other watercraft.
(l) "Public water supply source~~s~~" means the surface waters of the state at the point of water intake as identified in the publication "public water supply intakes in Michigan," dated December 9, 1999, and contiguous areas as the department determines necessary to assure protection of the source.
(m) "Receiving waters" means the surface waters of the state into which an effluent is or may be discharged.
(n) "Relative source contribution (RSC)" means the factor (percentage) used in calculating an HNV to account for all sources of exposure to a contaminant. The RSC reflects the percent of total exposure that can be attributed to surface water through water intake and fish consumption.
(o) "Risk associated dose (RAD)" means a dose of a known or presumed carcinogenic substance, in milligrams per kilogram per day, that, over a lifetime of exposure, is estimated to be associated with a plausible upper bound incremental cancer risk equal to 1 in 100,000.
(p) "Sanitary sewage" means treated or untreated effluent that contains human metabolic and domestic wastes.
(q) "Significant industrial user (SIU)" means either of the following:
(i) A nondomestic user subject to categorical pretreatment standards under 40 C.F.R. §403 (1992) and 40 C.F.R. chapter I, subchapter N (1990).
(ii) A nondomestic user to which 1 of the following provisions applies:
(A) The user discharges an average of 25,000 gallons per day or more of process wastewater to the publicly owned treatment works, excluding sanitary, noncontact cooling, and boiler blowdown wastewater.
(B) The user contributes a process wastestream that makes up 5% or more of the average dry weather hydraulic or organic capacity of the publicly owned treatment works.
(C) The user is designated as a significant industrial user by the control authority on the basis that the user has a potential for adversely affecting the publicly owned treatment works' operation or for violating any pretreatment standard or requirement.
Upon a finding that a nondomestic user meeting the criteria in this subdivision has no reasonable potential for adversely affecting the publicly owned treatment works' operation or for violating any pretreatment standard or requirement, the control authority may, at any time, on its own initiative or in response to a petition received from a nondomestic user or publicly owned treatment works, determine that a nondomestic user is not a significant nondomestic user.
(r) "Slope factor" means the incremental rate of cancer development calculated using a linearized multistage model or other appropriate model. It is expressed in milligrams per kilogram per day of exposure to the chemical in question and is also known as q_1*.

(s) "Standard" means a definite numerical value or narrative statement promulgated by the department to maintain or restore water quality to provide for, and fully protect, a designated use of the surface waters of the state.

(t) "Subchronic effect" means an adverse effect, measured by assessing an acceptable endpoint resulting from continual exposure for a period of time less than the time deemed necessary for a chronic test.

(u) "Surface waters of the state" means all of the following, but does not include drainage ways and ponds used solely for wastewater conveyance, treatment, or control:

(i) The Great Lakes and their connecting waters.

(ii) All inland lakes.

(iii) Rivers.

(iv) Streams.

(v) Impoundments.

(vi) Open drains.

(vii) Wetlands.

(viii) Other surface bodies of water within the confines of the state.

(v) "Suspended solids" means the amount of materials suspended in water and is commonly expressed as a concentration in terms of milligrams per liter.

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

(x) "Total body contact recreation" means any activities normally involving direct contact with water to the point of complete submergence, particularly immersion of the head, with considerable risk of ingesting water, including swimming.

(y) "Total maximum daily load (TMDL)" means an allowable pollutant loading to a surface water of the state as defined in R 323.1207.

(z) "Toxic substance" means a substance, except for heat, that is present in sufficient a concentration or quantity that is or may be harmful to plant life, animal life, or designated uses.

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

(bb) "Uptake" means the acquisition of a substance from the environment by an organism as a result of any active or passive process.

(cc) "Venting groundwater" means groundwater that is entering a surface water of the state from a facility, as defined in section 20101 of 1994 PA 451, MCL 324.20101.

(dd) "Warmwater fishery use" means the ability of a waterbody to support a balanced, integrated, adaptive community of fish species which thrive in relatively warm water, including any of the following:

(i) Bass.

(ii) Pike.

(iii) Walleye.

(iv) Panfish.

(ee) "Wasteload allocation (WLA)" means the allocation for an individual point source which ensures that the level of water quality to be achieved by the point source complies with these rules.

(ff) "Wastewater" means any of the following:

(i) Storm water runoff that could result in injury to a use designated in R 323.1100.

(ii) Liquid waste resulting from commercial, institutional, domestic, industrial, and agricultural activities, including cooling and condensing waters.

(iii) Sanitary sewage.

(iv) Industrial waste.

(gg) "Water quality value" means a tier I or tier II aquatic life or human health value or tier I wildlife value developed under R 323.1057.

(hh) "Watershed" means the geographic region within which water drains into a particular river, stream, or body of water.

(ii) "Wetland" means land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life.

(jj) "Whole effluent toxicity" means the total toxic effect of an effluent measured directly with a toxicity test under R 323.1219.

(kk) "Wildlife use" means that a waterbody will not likely cause population-level impacts to mammalian and avian wildlife populations from lifetime exposure to the waterbody as a source of drinking water and aquatic food, consistent with the level of protection provided by these rules.

(ll) "Wildlife value" means the maximum ambient water concentration of a substance at which adverse effects are not likely to result in population-level impacts to mammalian and avian wildlife populations from lifetime exposure through drinking water and aquatic food supply, using the methodology specified in R 323.1057(3).

R 323.1050 Physical characteristics.

Rule 50. The surface waters of the state shall not have any of the following physical properties in unnatural quantities which are or may become injurious to any designated use:

(a) Turbidity.
(b) Color.
(c) Oil films.
(d) Floating solids.
(e) Foams.
(f) Settleable solids.
(g) Suspended solids.
(h) Deposits.

R 323.1051 Dissolved solids.

Rule 51. (1) The addition of any dissolved solids shall not exceed concentrations which are or may become injurious to any designated use. Point sources containing dissolved solids shall be considered by the commission on a case-by-case basis and increases of dissolved solids in the waters of the state shall be limited through the application of best practicable control technology currently available as prescribed by the administrator of the United States environmental protection agency pursuant to section 304(b) of Public Law 92-500, as amended, 33 U.S.C. §466 et seq., except that in no instance shall total dissolved solids in the waters of the state exceed a concentration of 500 milligrams per liter as a monthly average nor more than 750 milligrams per liter at any time, as a result of controllable point sources.

(2) The waters of the state designated as a public water supply source shall not exceed 125 milligrams per liter of chlorides as a monthly average, except for the Great Lakes and connecting waters, where chlorides shall not exceed 50 milligrams per liter as a monthly average.

R 323.1053 Hydrogen ion concentration.
Rule 53. The hydrogen ion concentration expressed as pH shall be maintained within the range of 6.5 to 9.0 S.U. in all surface waters of the state, except for those waters where the background pH lies outside the range of 6.5 to 9.0 S.U. Any requests to artificially induce a pH change greater than 0.5 S.U. in surface waters where the background pH lies outside the range of 6.5 to 9.0 S.U., shall be considered by the department on a case-by-case basis.

R 323.1055 Taste- or odor-producing substances.
Rule 55. The surface waters of the state shall contain no taste-producing or odor-producing substances in concentrations which impair or may impair their use for a public, industrial, or agricultural water supply source or which impair the palatability of fish as measured by test procedures approved by the department.

R 323.1057 Toxic substances.
Rule 57. (1) Toxic substances shall not be present in the surface waters of the state at levels that are or may become injurious to the public health, safety, or welfare, plant and animal life, or the designated uses of the waters. As a minimum level of protection, toxic substances shall not exceed the water quality values specified in, or developed pursuant to, the provisions of subrules (2) to (4) of this rule or conditions set forth by the provisions of subrule (6) of this rule. A variance to these values may be granted consistent with the provisions of R 323.1103.
(2) Levels of toxic substances in the surface waters of the state shall not exceed the aquatic life values specified in tables 1 and 2, or, in the absence of such values, values derived according to the following processes, unless site-specific modifications have been developed pursuant to subdivision (r) of this subrule:
(a) Minimum data requirements to derive a tier I final acute value (FAV), which is used to calculate a tier I aquatic maximum value (AMV), include the results of acceptable acute tests for 1 freshwater species from each of the following:
(i) The family salmonidae in the class Osteichthyes.
(ii) One other family, preferably a commercially or recreationally important warmwater species, in the class Osteichthyes.
(iii) A third family in the phylum Chordata.
(iv) A planktonic crustacean.
(v) A benthic crustacean.
(vi) An insect.
(vii) A family in a phylum other than Arthropoda or Chordata.
(viii) A family in any order of insect or any phylum not already represented.
(b) Minimum data requirements to derive a tier I final chronic value (FCV) include acceptable chronic tests for the data requirements in subdivision (a) of this subrule or acute-to-chronic ratios (ACRs) shall be available with at least 1 species of aquatic animal in at least 3 different families provided that, of the 3 species, all of the following provisions apply:
(i) At least 1 is a fish.
(ii) At least 1 is an invertebrate.
(iii) At least 1 is an acutely sensitive freshwater species. The other 2 may be saltwater species.
(c) The following are acute test types to be used in the development of acute values:

(i) Daphnids, other cladocerans, and midges. Tests with daphnids and other cladocerans shall be started with organisms less than 24 hours old and tests with midges shall be started with second or third instar larvae. The results shall be a 48-hour EC50 based on the total percentage of organisms killed and immobilized. If the results of a 48-hour EC50 based on the total percentage of organisms killed and immobilized are not available, then the results shall be a 48-hour LC50. Tests longer than 48 hours are acceptable if the animals were not fed and the control animals were acceptable at the end of the test.

(ii) Bivalve mollusc embryos and larvae. Results of a 96-hour EC50 based on the percentage of organisms that have incompletely developed shells plus the percentage of organisms killed. If the results of a 96-hour EC50 based on the percentage of organisms that have incompletely developed shells plus the percentage of organisms killed are not available, then the lowest of the following shall be used:

(A) A 48-hour to 96-hour EC50 based on the percentage of organisms that have incompletely developed shells plus the percentage of organisms killed.

(B) A 48-hour to 96-hour EC50 based upon the percentage of organisms that have incompletely developed shells.

(C) A 48-hour to 96-hour LC50.

(iii) All other aquatic animal species. Results of a 96-hour EC50 based on the percentage of organisms exhibiting loss of equilibrium plus the percentage of organisms immobilized plus the percentage of organisms killed. If results of a 96-hour EC50 based on the percentage of organisms exhibiting loss of equilibrium plus the percentage of organisms immobilized plus the percentage of organisms killed are not available, then the lowest of the following shall be used:

(A) The 96-hour EC50 based on the percentage of organisms exhibiting loss of equilibrium plus the percentage of organisms immobilized.

(B) The 96-hour LC50.

(d) The following are chronic test types to be used in the development of chronic values:

(i) Life cycle toxicity tests. Tests with fish should begin with embryos or newly hatched young that are less than 48 hours old, continue through maturation and reproduction, and end not less than 24 days, or 90 days for salmonids, after the hatching of the next generation. Tests with daphnids should begin with young that are less than 24 hours old and last for not less than 21 days, or for ceriodaphnids not less than 7 days. Tests with mysids should begin with young that are less than 24 hours old and continue until 7 days past the median time of first brood release in the controls.

(ii) Partial life cycle toxicity tests for fishes. Exposure to the test material should begin with immature juveniles not less than 2 months before active gonad development, continue through maturation and reproduction, and end not less than 24 days, or 90 days for salmonids, after the hatching of the next generation.

(iii) Early life stage toxicity tests for fishes. Test durations are 28 to 32 days, or 60 days post hatch for salmonids, beginning shortly after fertilization and continuing through embryonic, larval, and early juvenile development.

(iv) Larval survival and growth test for fathead minnows, Pimephales promelas. The test is a static-renewal test 7 days in duration beginning with larvae that are less than 24 hours old. The tests shall be used on a case-by-case basis where the discharger demonstrates to the department, or the department determines, that the results of the tests are comparable to test results produced by any of the test methods identified in paragraphs (i) to (iii) of this subdivision.

(e) All of the following provisions apply in the selection of data for use in aquatic life value development:

(i) All data that are used shall be typed and dated and be accompanied by enough supporting information to indicate that acceptable test procedures, such as the procedures of the american society of testing and materials and the procedures of the United States EPA, were used and that the results are reliable.

(ii) Questionable data, data on formulated mixtures and emulsifiable concentrates, data on species that are nonresident to North America, and data obtained with previously exposed organisms shall not be used in the derivation of chemical-specific aquatic life values.

(iii) Acute values reported as "greater than" values and acute values that are above the solubility of the test material shall be used by assuming that the acute value is equal to the greater than value or the upper limit of the test material solubility, respectively.

(iv) The agreement of the data within and between species shall be considered. Acute values that appear to be questionable in comparison with other acute and chronic data for the same species and for other species in the same genus shall not be used.

(v) If the data indicate that 1 or more life stages are at least a factor of 2 more resistant than 1 or more other life stages of the same species, then the data for the more resistant life stages shall not be used in the calculation of an FAV.

(vi) Chronic values shall be based on the results of flow-through chronic tests in which the concentration of test material in the test solutions was measured at appropriate times during the test. However, renewal tests are acceptable for daphnids or the 7-day fathead minnow test.

(f) Where appropriate and where sufficient dissolved toxicological data or conversion factors are available, aquatic life water quality values for metals shall be expressed as dissolved to better approximate the bioavailable fraction in the water column.

(g) If the acute toxicity of the chemical has not been adequately shown to be related to hardness, pH, or other water quality characteristics, a tier I FAV shall be calculated using the following procedures:

(i) For each species for which at least 1 acceptable acute test result is available, the species mean acute value (SMAV) shall be calculated as the geometric mean of the results of all acceptable flow-through acute toxicity tests in which the concentrations of test material were measured with the most sensitive tested life stage of the species. For a species for which an acceptable flow-through acute toxicity test in which the concentrations of the test material were measured is not available, the SMAV shall be calculated as the geometric mean of all acceptable acute toxicity tests with the most sensitive tested life stage.

(ii) For each genus for which 1 or more SMAVs are available, the genus mean acute value (GMAV) shall be calculated as the geometric mean of the SMAVs.

(iii) Order the GMAVs from high to low.

(iv) Assign ranks, r, to the GMAVs from "1" for the lowest to "n" for the highest. If 2 or more GMAVs are identical, then assign them successive ranks.

(v) Calculate the cumulative probability, P, for each GMAV as r/(n + 1).

(vi) Select the 4 GMAVs that have cumulative probabilities closest to 0.05. If there are fewer than 59 GMAVs, the 4 GMAVs that have cumulative probabilities closest to 0.05 will always be the 4 lowest GMAVs.

(vii) Using the 4 selected GMAVs, and Ps, calculate the tier I FAV as follows:

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

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

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

$$\text{Tier I FAV} = e^{A}.$$

(h) If data for the chemical are available to show that the acute toxicity of at least 1 fish and 1 invertebrate species is related to a water quality characteristic, then a tier I FAV equation shall be calculated using the following procedures:

(i) For each species for which comparable acute toxicity values are available at 2 or more different values of the water quality characteristic, perform a least squares regression of the acute toxicity values on the corresponding values of the water quality characteristic to obtain the slope and its 95% confidence limits for each species. Because the best documented water quality relationship is between hardness and acute toxicity of metals in fresh water and a log-log relationship fits these data, geometric means and natural logarithms of both toxicity and water quality shall be used. For relationships based on other water quality characteristics, no transformation or a different transformation might fit the data better, and appropriate changes shall be made.

(ii) Decide whether the data for each species are relevant taking into account the range and number of the tested values of the water quality characteristic and the degree of agreement within and between species.

(iii) If useful slopes are not available for at least 1 fish and 1 invertebrate, if the useful slopes are too dissimilar, or if too few data are available to adequately define the relationship between acute toxicity and the water quality characteristic, then return to the provisions of subdivision (g) of this subrule, using the results of tests conducted under conditions and in waters similar to those commonly used for toxicity tests with the species.

(iv) For each species, calculate the geometric mean, W, of the acute values and then divide each of the acute values for each species by W. 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. To select tests for calculating W, use the data preference requirements described in subdivision (e)(i) of this subrule.

(v) For each species, calculate the geometric mean, X, of the water quality characteristic data points and then divide each of the data points for each species by X. This normalizes the water quality characteristic data points so that the geometric mean of the normalized data points for each species individually and for any combination of data points is 1.0.

(vi) For each species, perform a least squares regression of the normalized acute values on the normalized water quality characteristic. The resulting slopes and 95% confidence limits will be identical to those obtained in paragraph (i) of this subdivision.

(vii) Perform a least squares regression of all of the normalized acute values on the corresponding normalized values of the water quality characteristic to obtain the pooled acute slope, V, and its 95% confidence limits.

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

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

(ix) For each species, calculate the SMAV at Z using the equation:

$$\text{SMAV} = e^{Y}.$$

(x) For each species for which at least 1 acceptable acute test result is available, the species mean acute value (SMAV) shall be calculated as the geometric mean of the results of all acceptable flow-through acute toxicity tests in which the concentrations of test material were measured with the most sensitive tested life stage of the species. For a species for which an acceptable flow-through acute toxicity test in which the concentrations of the test

material was measured is not available, the SMAV shall be calculated as the geometric mean of all acceptable acute toxicity tests with the most sensitive tested life stage.

(xi) Obtain the tier I FAV at Z by using the procedure described in subdivision (g)(ii) to (vii) of this subrule.

(xii) The tier I FAV equation for any selected value of a water quality characteristic is:

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

Where:

V = pooled acute slope.

A = ln(tier 1 FAV at Z).

Z = selected value of the water quality characteristic as used in paragraph (viii) of this subdivision.

(i) If the acute and chronic toxicity of the chemical has not been adequately shown to be related to hardness, pH, or other water quality characteristics, then a tier I final chronic value (FCV) shall be calculated using the following procedures:

(i) If at least 1 maximum acceptable toxicant concentration (MATC) is available to meet each of the minimum data requirements as described in subdivision (a) of this subrule, then a species mean chronic value (SMCV) shall be determined for each species by calculating the geometric mean of the MATCs selected from acceptable tests in the following order of preference:

(A) All life cycle and partial life cycle toxicity tests with the species.

(B) All early life stage tests.

(C) All 7-day larval survival and growth tests for fathead minnows. Genus mean chronic values (GMCV) shall then be calculated as the geometric mean of the SMCVs for the genus. The tier I FCV shall be obtained using the procedure described in subdivision (g)(i) to (vii) of this subrule substituting FCV for FAV, chronic for acute, SMCV for SMAV, and GMCV for GMAV.

(ii) If MATCs are not available to meet the minimum data requirements as described in subdivision (a) of this subrule, then the tier I FCV shall be calculated as follows:

(A) For each MATC for which at least 1 corresponding acute value is available, calculate an acute-to-chronic ratio (ACR). An ACR is calculated by dividing the geometric mean of the results of all acceptable flow-through acute tests in which the concentrations are measured by the MATC. Static tests are acceptable for daphnids and midges. For fish, the acute test or tests should be conducted with juveniles. Tests used to develop an ACR shall meet 1 of the following conditions and be used in the following order of preference:

(1) The acute test or tests are part of the same study as the chronic test.

(2) The acute test or tests were conducted as part of a different study as the chronic tests, but in the same laboratory and dilution water.

(3) The acute and chronic tests were conducted in the same dilution water, but in different laboratories.

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

(C) The tier I ACR can be obtained in the following 3 ways, depending on the data available:

(1) If the species mean ACR seems to increase or decrease as the SMAVs increase, then the tier I ACR shall be calculated as the geometric mean of the ACRs for species that have SMAVs which are close to the FAV.

(2) If a major trend is not apparent and the ACRs for all species are within a factor of 10, then the tier I ACR shall be calculated as the geometric mean of all of the SMACRs.

(3) If the SMACRs are less than 2.0, and especially if they are less than 1.0, acclimation has probably occurred during the chronic test. In this situation, because continuous exposure and acclimation cannot be assured to provide adequate protection in field situations, the tier I ACR shall be assumed to be 2, so that the tier I FCV is equal to the aquatic maximum value (AMV).

(D) Calculate the tier I FCV by dividing the tier I FAV by the tier I ACR.

(j) If data for the chemical are available to show acute or chronic toxicity to at least 1 species is related to a water quality characteristic, then a tier I FCV equation shall be calculated using the following procedures:

(i) If MATCs are available to meet the minimum data requirements described in subdivision (a) of this subrule, then a tier I FAV equation shall be derived as follows:

(A) For each species for which comparable MATCs are available at 2 or more different values of the water quality characteristic, perform a least squares regression of the MATCs on the corresponding values of the water quality characteristic to obtain the slope and its 95% confidence limits for each species. Because the best documented water quality relationship is that between hardness and chronic toxicity of metals in fresh water and a log-log relationship fits these data, geometric means and natural logarithms of both toxicity and water quality shall be used. For relationships based on other water quality characteristics, no transformation or a different transformation might fit the data better, and appropriate changes shall be made.

(B) Decide whether the data for each species are relevant, taking into account the range and number of the tested values of the water quality characteristic and the degree of agreement within and between species.

(C) If a useful chronic slope is not available for at least 1 species or if the available slopes are too dissimilar or if too few data are available to adequately define the relationship between the MATC and the water quality characteristic, then assume that the chronic slope is the same as the acute slope, or return to subdivision (i) of this subrule, using the results of tests conducted under conditions and in water similar to conditions and water commonly used for toxicity tests with the species.

(D) For each species, calculate the geometric mean of the available MATCs, M, and then divide each MATC for a species by the mean for the species. This normalizes the MATCs so that the geometric mean of the normalized values for each species individually, and for any combination of species, is 1.0. To select tests for calculating M, use the data preference requirements described in subdivision (i)(i) of this subrule.

(E) For each species, calculate the geometric mean, P, of the water quality characteristic data points and then divide each of the data points for each species by P. This normalizes the water quality characteristic data points so that the geometric mean of the normalized data points for each species individually and for any combination of data points is 1.0.

(F) For each species, perform a least squares regression of the normalized chronic toxicity values on the corresponding normalized values of the water quality characteristic.

(G) Perform a least squares regression of all the normalized chronic values on the corresponding normalized values of the water quality characteristic to obtain the pooled chronic slope, L, and its 95% confidence limits.

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

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

(I) For each species, calculate an SMCV at Z using the equation:

$$SMCV = e^{Q}.$$

(J) Obtain the tier I FCV at Z by using the procedure described in subdivision (g)(ii) to (vii) of this subrule.

(K) The tier I FCV equation is written as follows:

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

Where:
L = pooled chronic slope.
S = ln(tier I FCV at Z).
Z = selected value of the water quality characteristic as used in subparagraph (h) of this paragraph.

(ii) If MATCs are not available to meet the minimum data requirements described in subdivision (a) of this subrule, then the tier I FCV equation shall be calculated as follows:

(A) If ACRs are available for enough species at enough values of the water quality characteristic to indicate that the ACR appears to be the same for all species and appears to be independent of the water quality characteristic, then calculate the tier I ACR as the geometric mean of the available SMACRs. The ACR shall be derived using the provisions in subdivision (i)(ii) of this subrule.

(B) Calculate the tier I FCV at the selected value Z of the water quality characteristic by dividing the tier I FAV at Z, derived in subdivision (h) of this subrule, by the tier I ACR.

(C) Use V = pooled acute slope as L = pooled chronic slope.

(D) The tier I FCV equation is written as follows:

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

Where:
L = pooled chronic slope.
S = ln(tier I FCV at Z).
Z = selected value of the water quality characteristic as used in subparagraph (B) of this paragraph.

(k) If the minimum data requirements in subdivision (a) of this subrule are not available to derive a tier I FAV, it is possible to derive a tier II FAV if the data base for the chemical contains a GMAV for Ceriodaphnia sp., Daphnia sp., or Simocephalus sp. and 1 other freshwater species that meets any additional minimum requirements of subdivision (a) of this subrule. To select tests for calculating a tier II FAV, use the data preference requirements described in subdivision (g)(i) of this subrule. The tier II FAV shall be calculated for a chemical as follows:

(i) The lowest GMAV in the database is divided by the tier II acute factor (AF) from table 3 corresponding to the number of satisfied tier I minimum data requirements listed in subdivision (a) of this subrule.

(ii) If appropriate, the tier II FAV shall be made a function of a water quality characteristic in a manner similar to that described in subdivision (h) of this subrule.

(l) If the minimum data requirements in subdivision (b) of this subrule are not available to derive a tier I FCV, it is possible to derive a tier II FCV for a chemical by 1 of the following methods listed in order of preference:

(i) $\text{Tier II FCV} = \dfrac{\text{tier I FAV}}{\text{tier II ACR}}$

Where:
Tier II ACR = tier II acute-chronic ratio determined by assuming enough ACRs of 18 so that the total number of ACRs for the chemical equals 3. The tier II ACR is the geometric mean of the 3 ACRs.

(ii) Tier II FCV = $\frac{\text{tier II FAV}}{\text{tier I ACR}}$

Where:

Tier I ACR = the final acute-chronic ratio for the chemical derived using the provisions in subdivision (i)(ii) of this subrule.

(iii) Tier II FCV = $\frac{\text{tier II FAV}}{\text{tier II ACR}}$

(iv) If appropriate, the tier II FCV shall be made a function of a water quality characteristic in a manner similar to that described in subdivision (j) of this subrule.

(m) If, for a commercially or recreationally important species of the surface waters of the state, the geometric mean of the acute values or chronic values from a flow-through test in which the concentrations of the test materials were measured is lower than the calculated FAV or FCV, then that geometric mean shall be used as the FAV or FCV instead of the calculated FAV or FCV. For chemicals that have final acute or chronic value equations, if the SMAV or SMCV at Z of a commercially or recreationally important species of the surface waters of the state is lower than the calculated FAV or FCV at Z, then that SMAV or SMCV shall be used as the FAV or FCV at Z.

(n) The tier I or tier II aquatic maximum value (AMV) shall be derived by dividing the tier I or tier II FAV by 2.

(o) A water concentration protective of aquatic plants shall be evaluated for a chemical on a case-by-case basis if data are available from tests with an important aquatic plants species in which the concentration of test material is measured and the endpoint is biologically important. If appropriate, the tier I or tier II FCV shall be lowered to be protective of aquatic plants.

(p) On the basis of all available pertinent laboratory and field information, determine if the tier I and tier II aquatic life values are consistent with sound scientific evidence. If the values are not consistent with sound scientific evidence, then the values shall be adjusted to more appropriately reflect the weight of scientific evidence.

(q) The tier I or tier II AMV shall be applied as a 24-hour average and compliance shall be based on the average of all samples taken at a site within the same 24-hour period. The tier I or tier II FCV shall be applied as a monthly average and compliance shall be based on the average of all daily measurements taken at a site within the same calendar month.

(r) Aquatic life values may be modified on a site-specific basis to be more or less stringent to reflect local environmental conditions. All of the following provisions apply to aquatic life values modification:

(i) Less stringent modifications shall be based on sound scientific rationale, shall be protective of designated uses of the surface waters of the state, and shall not jeopardize the continued existence of endangered or threatened species listed or proposed under section 4 of the endangered species act or result in the destruction or adverse modification of the species' critical habitat.

(ii) Modifications may be derived using the recalculation procedure, water effect ratio procedure, or resident species procedure described in section 3.7 entitled "Site-Specific Aquatic Life Criteria" in chapter 3 of the United States EPA Water Quality Standards Handbook, second edition - revised (1994). In addition, modifications may be derived using the procedure entitled "Streamlined Water Effect Ratio Procedure for Discharges of Copper" (United States EPA, 2001).

(iii) For the purposes of implementing the recalculation and resident species procedures described under paragraph (ii) of this subdivision, species that occur at a site include species to which any of the following provisions apply:

(A) The species are present at the site at any time of the year or are determined by a representative sampling regime.

(B) The species are present at the site only seasonally due to migration.

(C) The species are present intermittently because they periodically return to or extend their ranges into the site.

(D) The species were present at the site in the past, are not currently present at the site due to degraded conditions, and are expected to return to the site when conditions improve.

(E) The species are present in nearby bodies of water, are not currently present at the site due to degraded conditions, and are expected to be present at the site when conditions improve.

(iv) For the purposes of implementing the recalculation and resident species procedures described under paragraph (ii) of this subdivision, the species that occur at a site do not include species which were once present at the site, but which cannot exist at the site now due to permanent physical alteration of the habitat at the site.

(v) More stringent modifications to protect endangered or threatened species listed or proposed under section 4 of the endangered species act may be accomplished using either of the following procedures:

(A) For a listed or proposed species or for a surrogate of a listed or proposed species, if the SMAV or SMCV is lower than the calculated FAV or FCV, the lower SMAV or SMCV may be used instead of the calculated FAV or FCV in developing site-specific modified criteria.

(B) The recalculation procedure described in section 3.7 entitled "Site-Specific Aquatic Life Criteria" in chapter 3 of the United States EPA Water Quality Standards Handbook, second edition-revised (1994).

(vi) Any site-specific modifications developed pursuant to this subdivision shall be approved by the department.

(3) Levels of toxic substances in the surface waters of the state shall not exceed the wildlife values specified in table 4 or, in the absence of such values, the wildlife values derived according to the following process, unless site-specific modifications have been developed pursuant to subdivision (n) of this subrule:

(a) Tier I wildlife values for the BCCs listed in table 5, with the exception of the wildlife values listed in table 4, shall be calculated using the following equation:

$$WV = \frac{\dfrac{TD}{UF_A \times UF_S \times UF_L} \times Wt}{W + \sum(F_{TLi} \times BAF_{TLi}^{WL})}$$

Where:

WV = wildlife value in milligrams of substance per liter (mg/L).

TD = test dose (TD) in milligrams of substance per kilograms per day (mg/kg/d) for the test species. This shall be either a NOAEL or a LOAEL.

UF_A = uncertainty factor (UF) for extrapolating toxicity data across species (unitless). A species-specific UF shall be selected and applied to each representative species, consistent with the equation.

UF_S = UF for extrapolating from subchronic to chronic exposures (unitless).

UF_L = UF for LOAEL to NOAEL extrapolations (unitless).

Wt = average weight in kilograms (kg) for the representative species.

W = average daily volume of water consumed in liters per day (L/d) by the representative species.

F_{TLi} = average daily amount of food consumed from trophic level i in kilograms per day (kg/d) by the representative species.

BAF^{WL}_{TLi} = bioaccumulation factor (BAF) for wildlife food in trophic level i in liters per kilogram (L/kg), developed using the BAF methodology in subrule (5) of this rule. For consumption of piscivorous birds by other birds, for example herring gulls by eagles, 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.

(b) Piscivorous species are identified as the focus of concern for wildlife values. Three avian species - eagle, kingfisher, and herring gull - and 2 mammalian species - mink and otter - are used as representative species for protection. The TD obtained from toxicity data for each taxonomic class is used to calculate WVs for each of the 5 representative species.

(c) 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. The lower of the mammalian and avian WVs shall be the final WV.

(d) A TD value is required for WV calculation. To derive a WV, the data set shall be sufficient to generate a subchronic or chronic dose-response curve for any given substance for both mammalian and avian species using acceptable wildlife endpoints. In reviewing the toxicity data available that meet the minimum data requirements for each taxonomic class, data from peer-reviewed field studies of wildlife species take precedence over other types of studies where the studies are of adequate quality. An acceptable field study shall be of subchronic or chronic duration, provide a defensible, chemical-specific dose-response curve in which cause and effect are clearly established, and assess acceptable wildlife endpoints. When acceptable wildlife field studies are not available or are determined to be of inadequate quality, the needed toxicity information may come from peer-reviewed laboratory studies. When laboratory studies are used, preference shall be given to laboratory studies with wildlife species over traditional laboratory animals to reduce uncertainties in making interspecies extrapolations. All available laboratory data and field studies shall be reviewed to corroborate the final WV, to assess the reasonableness of the toxicity value used, and to assess the appropriateness of any UFs that are applied. All of the following requirements apply when evaluating the studies from which a TD is derived:

(i) The mammalian data shall come from at least 1 well-conducted study of 90 days or more that is designed to observe acceptable wildlife endpoints.

(ii) The avian data shall come from at least 1 well-conducted study of 70 days or more that is designed to observe acceptable wildlife endpoints.

(iii) In reviewing the studies from which a TD is derived for use in calculating a WV, studies involving exposure routes other than oral may be considered only when an equivalent oral daily dose can be estimated and technically justified. The WV calculations are based on an oral route of exposure.

(iv) In assessing the studies that meet the minimum data requirements, preference should be given to studies that assess effects on developmental or reproductive endpoints because, in general, these are more important endpoints in ensuring that a population's productivity is maintained.

(e) In selecting data to be used in the derivation of WVs, the evaluation of acceptable endpoints will be the primary selection criterion. All data that are not part of the selected subset may be used to assess the reasonableness of the toxicity value and the appropriateness of the UFs. In addition, the following provisions shall apply:

(i) If more than 1 TD value based on different endpoints of toxicity is available within a taxonomic class, then that TD, which is likely to reflect best potential impacts to wildlife populations through resultant changes in mortality or fecundity rates, shall be used for the calculation of WVs.

(ii) If more than 1 TD based on the same endpoint toxicity is available within a taxonomic class, then the TD from the most sensitive species shall be used.

(iii) If more than 1 TD based on the same endpoint of toxicity is available for a given species, then the TD for that species shall be calculated using the geometric mean of the TDs for the same endpoint of toxicity.

(f) If a TD is available in units other than milligrams of substance per kilograms per day (mg/kg/d), then the following procedures shall be used to convert the TD to the appropriate units before calculating a WV:

(i) If the TD is given in milligrams of toxicant per liter of water consumed by the test animals (mg/L), then the TD shall be multiplied by the daily average volume of water consumed by the test animals in liters per day (L/d) and divided by the average weight of the test animals in kilograms (kg).

(ii) If the TD is given in milligrams of toxicant per kilogram of food consumed by the test animals (mg/kg), then the TD shall be multiplied by the average amount of food in kilograms consumed daily by the test animals (kg/d) and divided by the average weight of the test animals in kilograms (kg).

(g) When drinking and feeding rates and body weight are needed to express the TD in milligrams of substance per kilograms per day (mg/kg/d), they are obtained from the study from which the TD was derived. If not already determined, body weight and drinking and feeding rates are to be converted to a wet weight basis. If the study does not provide the needed values, then the values shall be determined as follows:

(i) For studies done with domestic laboratory animals, use either the publication entitled "Registry of Toxic Effects, a Comprehensive Guide," 1993, United States Department of Health and Human Services, NIOSH Publication No. 97-119, or the publication entitled "Recommendations for and Documentation of Biological Values for use in Risk Assessment," United States EPA, 1988 NTIS-PB88-179874.

(ii) If the references in paragraph (i) of this subdivision do not contain the information for the species used in a given study, then the following allometric equations shall be used:

(A) For mammalian species, the general allometric equations are as follows:

(1) $F = 0.0687 \times (Wt)^{0.82}$

Where:

F = feeding rate of mammalian species in kilograms per day (kg/d) dry weight.

Wt = average weight in kilograms (kg) of the test animals.

(2) $W = 0.099 \times (Wt)^{0.90}$

Where:

W = drinking rate of mammalian species in liters per day (L/d).

Wt = average weight in kilograms (kg) of the test animals.

(B) For avian species, the general allometric equations are as follows:

(1) $F = 0.0582\ (Wt)^{0.65}$

Where:

F = feeding rate of avian species in kilograms per day (kg/d) dry weight.

Wt = average weight in kilograms (kg) of the test animals.

(2) $W = 0.059 \times (Wt)^{0.67}$

Where:

W = drinking rate of avian species in liters per day (L/d).

Wt = average weight in kilograms (kg) of the test animals.

(h) If an NOAEL is unavailable as the TD and an LOAEL is available, then the LOAEL may be used to estimate the NOAEL. If used, the LOAEL shall be divided by a UF to estimate an NOAEL for use in deriving WVs. The value of the UF shall not be less than 1

and should not exceed 10, depending on the dose-response curve and any other available data, and is represented by UF_L in the equation expressed in subdivision (a) of this subrule.

(i) If only subchronic data are available, then the TD may be derived from subchronic data. In such cases, the TD shall be divided by a UF to extrapolate from subchronic to chronic levels. The value of the UF shall not be less than 1 and should not exceed 10, and is represented by UF_S in the equation expressed in subdivision (a) of this subrule. This UF is to be used when assessing highly bioaccumulative substances where toxicokinetic considerations suggest that a bioassay of limited length underestimates chronic effects.

(j) The selection of the UF_A shall be based on the available toxicological data and on available data concerning the physicochemical, toxicokinetic, and toxicodynamic properties of the substance in question and the amount and quality of available data. This UF_A is a UF that is intended to account for differences in toxicological sensitivity among species and both of the following provisions apply:

(i) The UF_A shall not be less than 1 and should not exceed 100 and shall be applied to each of the 5 representative species based on existing data and best professional judgment. The value of UF_A may differ for each of the representative species.

(ii) The UF_A shall be used only for extrapolating toxicity data across species within a taxonomic class; however, an interclass extrapolation employing a UF_A may be used for a given chemical if it can be supported by a validated biologically-based dose-response model or by an analysis of interclass toxicological data, considering acceptable endpoints, for a chemical analog that acts under the same mode of toxic action.

(k) The body weights (Wt), feeding rates (F_{TLi}), drinking rates (W), and trophic level dietary composition (as food ingestion rate and percent in diet) for each of the 5 representative species are presented in table 6. The methodology for development of bioaccumulation factors is presented in subrule (5) of this rule. Trophic level 3 and 4 BAFs are used to derive WVs because these are the trophic levels at which the representative species feed.

(l) Determine, on the basis of all pertinent data available, whether the wildlife values derived are consistent with sound scientific evidence. If they are not, the values shall be adjusted to more appropriately reflect the weight of available scientific evidence.

(m) The WVs shall be applied as a monthly average and compliance shall be based on the average of all daily measurements taken at a site within the same calendar month.

(n) Wildlife values may be modified on a site-specific basis to be more or less stringent to reflect local environmental conditions. The modifications shall be derived by making appropriate site-specific adjustments to the methodology in this subrule. The following provisions shall apply:

(i) Less stringent modifications shall be protective of designated uses of the surface waters of the state, shall be based on sound scientific rationale, shall not jeopardize the continued existence of endangered or threatened species listed or proposed under section 4 of the endangered species act or result in the destruction or adverse modification of the species' critical habitat, and shall consider the mobility of both the prey organisms and wildlife populations in defining the site for which criteria are developed.

(ii) More stringent modifications to protect endangered or threatened species listed or proposed under section 4 of the endangered species act may be accomplished by the use of an intraspecies uncertainty factor to account for protection of individuals within a wildlife population.

(iii) Any site-specific modifications developed pursuant to this subdivision shall be approved by the department.

(4) Levels of toxic substances in the surface waters of the state shall not exceed the human health values specified in tables 7 and 8 or, in the absence of such values, the

values derived according to the following process, unless site-specific modifications have been developed pursuant to subdivision (h) of this subrule:

(a) Human cancer values (HCVs) and human noncancer values (HNVs) shall be derived based on either a tier I or tier II classification. The 2 tiers are primarily distinguished by the amount of toxicity data available for deriving the concentration levels and the quantity and quality of data on bioaccumulation. The best available toxicity data on the adverse health effects of a chemical and the best data on bioaccumulation factors shall be used when developing human health values. The toxicity data shall include data from well-conducted epidemiological studies or animal studies, or both, that provide, for carcinogens, an adequate weight of evidence of potential human carcinogenicity and, for tier I values for noncarcinogens, a dose-response relationship involving critical effects biologically relevant to humans. These data shall be obtained from sources described in 40 C.F.R. §132, appendix C, item II, “Minimum Data Requirements” (1995), including the integrated risk information system (IRIS), the scientific literature, and other informational databases, studies, or reports that contain adverse health effects data of adequate quality for use in this procedure. Strong consideration shall be given to the most currently available guidance provided by IRIS in deriving values, supplemented with any recent data not incorporated into IRIS. Minimum data requirements to derive the human health values are as follows:

(i) HCVs shall be derived if there is adequate evidence of potential human carcinogenic effects for a chemical. Carcinogens shall be classified, depending on the weight of evidence, as either human carcinogens, probable human carcinogens, or possible human carcinogens. To develop tier I and tier II human cancer values, the following minimum data sets are necessary:

(A) Weight of evidence of potential human carcinogenic effects sufficient to derive a tier I HCV shall generally include human carcinogens and probable human carcinogens and can include, on a case-by-case basis, possible human carcinogens if studies have been well-conducted, although based on limited evidence, when compared to studies used in classifying human and probable human carcinogens. The decision to use data on a possible human carcinogen for deriving tier I values shall be a case-by-case determination. In determining whether to derive a tier I HCV, available information on mode of action, such as mutagenicity/genotoxicity (determinations of whether the chemical interacts directly with DNA), structure activity, and metabolism shall also be considered.

(B) Weight of evidence of possible human carcinogenic effects sufficient to derive a tier II HCV shall include the possible human carcinogens for which, at a minimum, there are data sufficient for quantitative risk assessment, but for which data are inadequate for tier I value development due to a tumor response of marginal statistical significance or inability to derive a strong dose-response relationship. In determining whether to derive tier II human cancer values, available information on mode of action, such as mutagenicity/genotoxicity (determinations of whether the chemical interacts directly with DNA), structure activity, and metabolism shall also be considered. As with the use of data on possible human carcinogens in developing tier I values, the decision to use data on possible human carcinogens to derive tier II values shall be made on a case-by-case basis.

(ii) To derive HNVs, all available toxicity data shall be evaluated. The full range of possible health effects of a chemical shall be considered in order to best describe the dose-response relationship of the chemical, and to calculate values which will protect against the most sensitive endpoint or endpoints of toxicity. Although it is desirable to have an extensive database that considers a wide range of possible adverse effects, this type of data exists for a very limited number of chemicals. For many others, there is a range in quality and quantity of data available. To assure minimum reliability of values, it is necessary to

establish a minimum database with which to develop tier I or tier II values. The following procedures represent the minimum data sets necessary for this procedure:

(A) The minimum data set sufficient to derive a tier I HNV shall include at least 1 well-conducted epidemiologic study or animal study. A well-conducted epidemiologic study shall quantify exposure levels and demonstrate positive association between exposure to a chemical and adverse effects in humans. A well-conducted study in animals shall demonstrate a dose-response relationship involving 1 or more critical effects biologically relevant to humans. Ideally, the duration of a study should span multiple generations of exposed test species or at least a major portion of the lifespan of 1 generation. This type of data is currently very limited. By the use of uncertainty adjustments, shorter-term studies, such as 90-day subchronic studies, with evaluation of more limited effects, may be used to extrapolate to longer exposures or to account for a variety of adverse effects. For tier I values developed pursuant to this procedure, such a limited study shall be conducted for not less than 90 days in rodents or for 10% of the lifespan of other appropriate test species and shall demonstrate a no observable adverse effect level (NOAEL). Chronic studies of 1 year or longer with rodents or 50% of the lifespan or longer with other appropriate test species that demonstrate a lowest observable adverse effect level (LOAEL) may be sufficient for use in tier I value derivation if the effects observed at the LOAEL were relatively mild and reversible as compared to effects at higher doses. This does not preclude the use of a LOAEL from a study of chronic duration with only 1 or 2 doses if the effects observed appear minimal when compared to effect levels observed at higher doses in other studies.

(B) If the minimum data for deriving tier I values are not available to meet the tier I data requirements, then a more limited data base may be considered for deriving tier II values. As with tier I, all available data shall be considered and ideally should address a range of adverse health effects with exposure over a substantial portion of the lifespan, or multiple generations, of the test species. If such data are lacking, it may be necessary to rely on less extensive data to establish a tier II value. With the use of appropriate uncertainty factors to account for a less extensive database, the minimum data sufficient to derive a tier II value shall include a NOAEL from at least 1 well-conducted short-term repeated dose study. The study shall be conducted with animals, be of not less than 28 days duration, demonstrate a dose-response, and involve effects biologically relevant to humans. Data from studies of longer duration (more than 28 days) that may demonstrate other study conditions, as well as LOAELs from the studies (more than 28 days), may be more appropriate in some cases for derivation of tier II values. Use of a LOAEL should be based on consideration of the severity of effect, the quality of the study, and the duration of the study.

(iii) Bioaccumulation factor minimum data requirements for tier determination include the following:

(A) To be considered a tier I cancer or noncancer human health value, along with satisfying the minimum toxicity data requirements of paragraphs (i)(A) and (ii)(A) of this subdivision, an organic chemical shall meet 1 of the following bioaccumulation data requirements:

(1) A field-measured BAF.

(2) A BAF derived using the BSAF methodology.

(3) A chemical that has a BAF of less than 125 regardless of what method in subrule (5) of this rule was used to derive the BAF.

(B) To be considered a tier I cancer or noncancer human health value, along with satisfying the minimum toxicity data requirements of paragraphs (i)(A) and (ii)(A) of this subdivision, an inorganic chemical, including organometals such as mercury, shall meet 1 of the following bioaccumulative data requirements:

(1) A field-measured BAF.
(2) A laboratory-measured BCF.
(C) Cancer or noncancer human health values are considered tier II if they do not meet either the minimum toxicity data requirements of paragraphs (i)(A) and (ii)(A) of this subdivision or the minimum bioaccumulation data requirements of subparagraph (A) or (B) of this paragraph.
(b) The fundamental principles for human health cancer values development are as follows:
(i) A non-threshold mechanism of carcinogenesis shall be assumed unless biological data adequately demonstrate the existence of a threshold on a chemical-specific basis.
(ii) All appropriate human epidemiologic data and animal cancer bioassay data shall be considered. Data specific to an environmentally appropriate route of exposure shall be used. Oral exposure is preferred over dermal and inhalation exposure since, in most cases, the exposure routes of greatest concern are fish consumption and drinking water/incidental ingestion. The risk associated dose shall be set at a level corresponding to an incremental cancer risk of 1 in 100,000. If acceptable human epidemiologic data are available for a chemical, then the data shall be used to derive the risk associated dose. If acceptable human epidemiologic data are not available, then the risk associated dose shall be derived from available animal bioassay data. Data from a species that is considered most biologically relevant to humans, that is, responds most like humans, is preferred where all other considerations regarding quality of data are equal. In the absence of data to distinguish the most relevant species, data from the most sensitive species tested, that is, the species showing a carcinogenic effect at the lowest administered dose, shall generally be used.
(iii) If animal bioassay data are used and a non-threshold mechanism of carcinogenicity is assumed, then the data are fitted to a linearized multistage computer model, for example, a GLOBAL ’86 or equivalent model. GLOBAL ’86 is the linearized multistage model which was derived by Howe, Crump, and Van Landingham (1986) which the Unites States EPA uses to determine cancer potencies (Howe et al., 1986). The upper-bound 95% confidence limit on risk, or the lower 95% confidence limit on dose, at the 1 in 100,000 risk level shall be used to calculate a risk associated dose (RAD) for individual chemicals. Other models, including modifications or variations of the linear multistage model that are more appropriate to the available data may be used where scientifically justified.
(iv) If the duration of the study is significantly less than the natural lifespan of the test animal, then the slope may be adjusted on a case-by-case basis to compensate for latent tumors that were not expressed.
(v) A species scaling factor shall be used to account for differences between test species and humans. It shall be assumed that milligrams per surface area per day is an equivalent dose between species. All doses presented in mg/kg bodyweight will be converted to an equivalent surface area dose by raising the mg/kg dose to the 3/4 power. However, if adequate pharmacokinetic and metabolism studies are available, then these data may be factored into the adjustment for species differences on a case-by-case basis.
(vi) Additional data selection and adjustment decisions shall also be made in the process of quantifying risk. Consideration shall be given to tumor selection for modeling, that is, pooling estimates for multiple tumor types and identifying and combining benign and malignant tumors. All doses shall be adjusted to give an average daily dose over the study duration. Adjustments in the rate of tumor response shall be made for early mortality in test species. The goodness-of-fit of the model to the data shall also be assessed.
(vii) If a linear, non-threshold dose-response relationship is assumed, then the RAD shall be calculated using the following equation:

$$RAD = \frac{0.00001}{q1^*}$$

Where:

RAD = risk associated dose in milligrams of toxicant per kilogram body weight per day (mg/kg/day).

0.00001 (1×10^{-5}) = incremental risk of developing cancer equal to 1 in 100,000.

q_1* = slope factor $(mg/kg/day)^{-1}$.

(viii) If human epidemiologic data or other biological data (animal), or both, indicate that a chemical causes cancer via a threshold mechanism, then the risk associated dose may, on a case-by-case basis, be calculated using a method that assumes a threshold mechanism is operative.

(c) The fundamental principles for human health noncancer value development are as follows:

(i) Noncarcinogens shall generally be assumed to have a threshold dose or concentration below which no adverse effects should be observed. Therefore, the noncancer value is the maximum water concentration of a substance at or below which a lifetime exposure from drinking the water, consuming fish caught in the water, and ingesting water as a result of participating in water-related recreation activities is likely to be without appreciable risk of deleterious effects.

(ii) For some noncarcinogens, there may not be a threshold dose below which no adverse effects should be observed. Chemicals acting as genotoxic teratogens and germline mutagens are thought to possibly produce reproductive or developmental effects, or both, through a genetically linked mechanism that may have no threshold. Other chemicals also may not demonstrate a threshold. Values for these types of chemicals will be established on a case-by-case basis using appropriate assumptions reflecting the likelihood that no threshold exists.

(iii) All appropriate human and animal toxicologic data shall be reviewed and evaluated. To the maximum extent possible, data most specific to the environmentally relevant route of exposure shall be used. Oral exposure is preferred over dermal and inhalation exposure since, in most cases, the exposure routes of greatest concern are fish consumption and drinking water/incidental ingestion. If acceptable human epidemiologic data are not available, then animal data from species most biologically relevant to humans shall be used. In the absence of data to distinguish the most relevant species, data from the most sensitive animal species tested, that is, the species showing a toxic effect at the lowest administered dose given a relevant route of exposure should generally be used.

(iv) Minimum data requirements are specified in subdivision (a)(ii)(A) of this subrule. The experimental exposure level representing the highest level tested at which no adverse effects were demonstrated (NOAEL) from studies satisfying the minimum data requirements shall be used for value calculations. In the absence of a NOAEL, a LOAEL from studies satisfying the minimum data requirements may be used if based on relatively mild and reversible effects.

(v) Uncertainty factors shall be used to account for the uncertainties in predicting acceptable dose levels for the general human population based upon experimental animal data or limited human data. The uncertainty factors shall be determined as follows:

(A) An uncertainty factor of 1 to 10 shall be used when extrapolating from valid experimental results from studies on prolonged exposure to average healthy humans. This factor of up to tenfold is used to protect sensitive members of the human population.

(B) An uncertainty factor of 1 to 10 shall be used when extrapolating from valid results of long-term studies on experimental animals when results of studies of human exposure are not available or are inadequate. When considered with subparagraph (A) of this paragraph,

a factor of up to one hundredfold is used in extrapolating data from the average animal to protect sensitive members of the human population.

(C) An uncertainty factor of 1 to 10 shall be used when extrapolating from animal studies for which the exposure duration is less than chronic, but more than subchronic (90 days or more in length), or when other significant deficiencies in study quality are present, and when useful long-term human data are not available. When considered with subparagraphs (A) and (B) of this paragraph, a factor of up to one thousandfold is used in extrapolating data from less than chronic, but more than subchronic, studies for average animals to protect sensitive members of the human population from chronic exposure.

(D) An uncertainty factor of 1 to 3 shall be used when extrapolating from animal studies for which the exposure duration is less than subchronic (less than 90 days). When considered with subparagraphs (A), (B), and (C) of this paragraph, a factor of up to 3 thousandfold is used in extrapolating data from less than subchronic studies for average animals to protect sensitive members of the human population from chronic exposure.

(E) An additional uncertainty factor of 1 to 10 may be used when deriving a value from a LOAEL. The UF accounts for the lack of an identifiable NOAEL. The level of additional uncertainty applied may depend upon the severity and the incidence of the observed adverse effect.

(F) An additional uncertainty factor of 1 to 10 may be applied when there are limited effects data or incomplete subacute or chronic toxicity data, for example, reproductive/developmental data. The level of quality and quantity of the experimental data available and structure-activity relationships may be used to determine the factor selected.

(G) When deriving a UF for use in developing an HNV, the total uncertainty, as calculated following subparagraphs (A) to (F) of this paragraph, shall not exceed 10,000 for tier I values and 30,000 for tier II values.

(vi) All study results shall be converted, as necessary, to the standard unit for acceptable daily exposure of milligrams of toxicant per kilogram of body weight per day (mg/kg/day). Doses shall be adjusted for continuous exposure (7 days/week, 24 hours/day).

(vii) The acceptable daily exposure (ADE) shall be calculated as follows:

$$ADE = \frac{\text{NOAEL or LOAEL}}{UF}$$

Where:

ADE = acceptable daily exposure in milligrams of toxicant per kilogram body weight per day (mg/kg/day).

NOAEL/LOAEL = the study NOAEL or LOAEL.

UF = the uncertainty factor derived in paragraph (v) of this subdivision.

(d) Human health cancer values shall be derived using the following equation:

$$HCV = \frac{RAD \times BW}{WC + [(FC_{TL3} \times BAF_3) + (FC_{TL4} \times BAF_4)]}$$

Where:

HCV = human cancer value in milligrams per liter (mg/L).

RAD = risk associated dose in milligrams toxicant per kilogram body weight per day (mg/kg/day) that is associated with a lifetime incremental cancer risk equal to 1 in 100,000 for individual chemicals.

BW = weight of an average human (BW = 70 kg).

WC_d = per capita water consumption, both drinking and incidental exposure, for surface waters specified in R 323.1100(8) = 2 liters/day, or

WC_r = per capita incidental daily water ingestion for surface waters not specified in R 323.1100(8) = 0.01 liters/day.

FC_{TL3} = consumption of regionally caught trophic level 3 fish = 0.0036 kg/day.

FC_{TL4} = consumption of regionally caught trophic level 4 fish = 0.0114 kg/day.

BAF_3 = bioaccumulation factor for trophic level 3 fish, as derived using the BAF methodology in subrule (5) of this rule.

BAF_4 = bioaccumulation factor for trophic level 4 fish, as derived using the BAF methodology in subrule (5) of this rule.

(e) Human noncancer values shall be derived using the following equation:

$$HNV = \frac{ADE \times BW \times RSC}{WC + [(FC_{TL3} \times BAF_3) + (FC_{TL4} \times BAF_4)]}$$

Where:

HNV = human noncancer value in milligrams per liter (mg/l).

ADE = acceptable daily exposure in milligrams toxicant per kilogram body weight per day (mg/kg/day).

RSC = relative source contribution factor of 0.8. An RSC derived from actual exposure data may be developed on a case-by-case basis.

BW = weight of an average human (BW = 70 kg).

WC_d = per capita water consumption, both drinking and incidental exposure, for surface waters specified in R 323.1100(8) = 2 liters/day, or

WC_r = per capita incidental daily water ingestion for surface waters not specified in R 323.1100(8) = 0.01 liters/day.

FC_{TL3} = consumption of regionally caught trophic level 3 fish = 0.0036 kg/day.

FC_{TL4} = consumption of regionally caught trophic level 4 fish = 0.0114 kg/day.

BAF_3 = human health bioaccumulation factor for edible portion of trophic level 3 fish, as derived using the BAF methodology in subrule (5) of this rule.

BAF_4 = human health bioaccumulation factor for edible portion of trophic level 4 fish, as derived using the BAF methodology in subrule (5) of this rule.

(f) Determine, on the basis of all pertinent data available, whether the human health cancer and noncancer values derived are consistent with sound scientific evidence. If they are not, the values shall be adjusted to more appropriately reflect the weight of available scientific evidence.

(g) The tier I and tier II human health values shall be applied as monthly averages, and compliance shall be based on the average of all daily measurements taken at a site within the same calendar month.

(h) Human health values may be modified on a site-specific basis to be more or less stringent to reflect local environmental conditions or local human exposure. Less stringent human health values shall be protective of designated uses of the surface waters of the state and shall be based on sound scientific rationale. Any such modifications shall be derived by making appropriate site-specific adjustments to the methodology in this subrule and shall be approved by the department.

(5) Bioaccumulation factors (BAFs) used in the derivation of values in subrules (3) and (4) of this rule shall be developed according to the following process:

(a) Baseline BAFs shall be derived using the following 4 methods, listed in order of preference:

(i) A measured baseline BAF for an organic or inorganic chemical derived from a field study of acceptable quality.

(ii) A predicted baseline BAF for an organic chemical derived using field-measured biota-sediment accumulation factors (BSAFs) of acceptable quality.

(iii) A predicted baseline BAF for an organic or inorganic chemical derived from a bioconcentration factor (BCF) measured in a laboratory study of acceptable quality and a food chain multiplier (FCM).

(iv) A predicted baseline BAF for an organic chemical derived from an octanol-water partition coefficient (K_{ow}) of acceptable quality and an FCM.

(b) Selection of data for deriving BAFs shall be conducted as follows:

(i) Procedural and quality assurance requirements shall be met for field-measured BAFs as follows:

(A) The field studies used shall be limited to studies conducted in the Great Lakes system with fish at or near the top of the aquatic food chain (trophic levels 3 or 4 or 3 and 4).

(B) The trophic level of the fish species shall be determined.

(C) The site of the field study should not be so unique that the BAF cannot be extrapolated to other locations where the values will apply.

(D) For organic chemicals, the percent lipid shall be either measured or reliably estimated for the tissue used in the determination of the BAF.

(E) The concentration of the chemical in the water shall be measured in a way that can be related to particulate organic carbon (POC) or dissolved organic carbon (DOC), or both, and should be relatively constant during the steady-state time period.

(F) For organic chemicals that have a log K_{ow} of more than 4, the concentrations of POC and DOC in the ambient water shall be either measured or reliably estimated.

(G) For inorganic and organic chemicals, BAFs shall be used only if they are expressed on a wet weight basis. BAFs reported on a dry weight basis cannot be converted to wet weight unless a conversion factor is measured or reliably estimated for the tissue used in the determination of the BAF.

(ii) All of the following procedural and quality assurance requirements shall be met for field-measured BSAFs:

(A) The field studies used shall be limited to studies conducted in the Great Lakes system with fish at or near the top of the aquatic food chain, for example, in trophic levels 3 or 4 or 3 and 4.

(B) Samples of surface sediments (0 to 1 centimeters is ideal) shall be from locations in which there is net deposition of fine sediment and is representative of average surface sediment in the vicinity of the organism.

(C) The K_{ow}s used shall be of acceptable quality as described in paragraph (v) of this subdivision.

(D) The site of the field study should not be so unique that the resulting BAF cannot be extrapolated to other locations where the values will apply.

(E) The trophic level of the fish species shall be determined.

(F) The percent lipid shall be either measured or reliably estimated for the tissue used in the determination of the BAF.

(iii) The following procedural and quality assurance requirements shall be met for laboratory-measured BCFs:

(A) The test organism shall not be diseased, unhealthy, or adversely affected by the concentration of the chemical.

(B) The total concentration of the chemical in the water shall be measured and should be relatively constant during the steady-state time period.

(C) The organisms shall be exposed to the chemical using a flow-through or renewal procedure.

(D) For organic chemicals, the percent lipid shall be either measured or reliably estimated for the tissue used in the determination of the BCF.

(E) For organic chemicals that have a log K_{ow} of more than 4, the concentrations of POC and DOC in the test solution shall be either measured or reliably estimated.

(F) Laboratory-measured BCFs should be determined using fish species, but BCFs determined with molluscs and other invertebrates may be used with caution. For example, because invertebrates metabolize some chemicals less efficiently than vertebrates, a baseline BCF determined for such a chemical using invertebrates is expected to be higher than a comparable baseline BCF determined using fish.

(G) If laboratory-measured BCFs increase or decrease as the concentration of the chemical increases in the test solutions in a bioconcentration test, then the BCF measured at the lowest test concentration that is above concentrations existing in the control water shall be used. A BCF should not be calculated from a control treatment. The concentrations of an inorganic chemical in a bioconcentration test should be greater than normal background levels and greater than levels required for normal nutrition of the test species if the chemical is a micronutrient, but below levels that adversely affect the species. Bioaccumulation of an inorganic chemical might be overestimated if concentrations are at or below normal background levels due to, for example, nutritional requirements of the test organisms.

(H) For inorganic and organic chemicals, BCFs shall be used only if they are expressed on a wet weight basis. BCFs reported on a dry weight basis cannot be converted to wet weight unless a conversion factor is measured or reliably estimated for the tissue used in the determination of the BAF.

(I) BCFs for organic chemicals may be based on measurement of radioactivity only when the BCF is intended to include metabolites or when there is confidence that there is no interference due to metabolites.

(J) The calculation of the BCF shall appropriately address growth dilution.

(K) Other aspects of the methodology used should be similar to the aspects of the methodology described in the american society for testing and materials (ASTM) standard entitled "Standard Guide for Conducting Bioconcentration Tests with Fishes and Saltwater Bivalve Molluscs," Standard E 1022-94 (1994), which is adopted by reference in R 323.1117.

(iv) The following procedural and quality assurance requirements shall be met for predicted BCFs:

(A) The K_{ow} used shall be of acceptable quality as described in paragraph (v) of this subdivision.

(B) The predicted baseline BCF shall be calculated using the following equation:

$$\text{Predicted baseline BCF} = K_{ow}$$

Where:

K_{ow} = octanol-water partition coefficient.

(v) The value of K_{ow} used for an organic chemical shall be determined by giving priority to the experimental and computational techniques used as follows:

Log K_{ow} <4:	Priority	Technique
	1	Slow-stir
	1	Generator-column
	1	Shake-flask
	2	Reverse-phase liquid chromatography on C18 chromatography packing with extrapolation to 0% solvent

	3	Reverse-phase liquid chromatography on C18 chromatography packing without extrapolation to 0% solvent
	4	Calculated by the CLOGP program

Log K_{ow} >4:	Priority	Technique
	1	Slow-stir
	1	Generator-column
	2	Reverse-phase liquid chromatography on C18 chromatography packing with extrapolation to 0% solvent
	3	Reverse-phase liquid chromatography on C18 chromatography packing without extrapolation to 0% solvent
	4	Shake-flask
	5	Calculated by the CLOGP program

The CLOGP program is a computer program available from Pomona College. A value of K_{ow} that seems to be different from the others should be considered an outlier and not used. The value of K_{ow} used for an organic chemical shall be the geometric mean of the available K_{ow}s with highest priority or can be calculated from the arithmetic mean of the available log K_{ow}s with the highest priority. Because it is an intermediate value in the derivation of a BAF, the value used for the K_{ow} of a chemical shall not be rounded to fewer than 3 significant digits, and a value for log K_{ow} shall not be rounded to fewer than 3 significant digits after the decimal point.

(c) It is assumed that BAFs and BCFs for organic chemicals can be extrapolated on the basis of percent lipid from one tissue to another and from one aquatic species to another in most cases. Because BAFs and BCFs for organic chemicals are related to the percent lipid, it does not make any difference whether the tissue sample is whole body or edible portion, but both the BAF (or BCF) and the percent lipid shall be determined for the same tissue. The percent lipid of the tissue should be measured during the BAF or BCF study, but in some cases the percent lipid can be reliably estimated from measurements on tissue from other organisms. If percent lipid is not reported for the test organisms in the original study, then it may be obtained from the author or, in the case of a laboratory study, lipid data for the same or a comparable laboratory population of test organisms that were used in the original study may be used. The lipid-normalized concentration, C_ℓ, of a chemical in tissue is defined using the following equation:

$$C_\ell = \frac{C_B}{f_\ell}$$

Where:

C_B = concentration of the organic chemical in the tissue of aquatic biota (either whole organism or specified tissue) (mg/g).

f_ℓ = fraction of the tissue that is lipid.

(d) By definition, baseline BAFs and BCFs for organic chemicals, whether measured or predicted, are based on the concentration of the chemical that is freely dissolved in the ambient water in order to account for bioavailability. The relationship between the total concentration of the chemical in the water, that is, that which is freely dissolved plus that which is sorbed to particulate organic carbon or to dissolved organic carbon, to the freely dissolved concentration of the chemical in the ambient water shall be calculated using the following equation:

$$C_w^{fd} = (f_{fd})(C_w^t)$$

Where:

C_w^{fd} = freely dissolved concentration of the organic chemical in the ambient water.

C_w^t = total concentration of the organic chemical in the ambient water.

f_{fd} = fraction of the total chemical in the ambient water that is freely dissolved.

The fraction of the total chemical in the ambient water that is freely dissolved, f_{fd}, shall be calculated using the following equation:

$$f_{fd} = \frac{1}{1 + \frac{(DOC)(K_{OW})}{10} + (POC)(K_{OW})}$$

Where:

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

K_{ow} = octanol-water partition coefficient of the chemical.

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

(e) In the absence of a field-measured BAF or a predicted BAF derived from a BSAF, an FCM shall be used to calculate the baseline BAF for trophic levels 3 and 4 from a laboratory-measured or predicted BCF. For an organic chemical, the FCM used shall be derived from table 9 using the chemical's log K_{ow} and linear interpolation. An FCM of more than 1.0 applies to most organic chemicals that have a log K_{ow} of 4 or more. The trophic level used shall take into account the age or size of the fish species consumed by the human, avian, or mammalian predator because for some species of fish the young are in trophic level 3 whereas the adults are in trophic level 4.

(f) A baseline BAF shall be calculated from a field-measured BAF of acceptable quality using the following equation:

$$\text{Baseline BAF} = \left[\frac{\text{Measured } BAF_T^t}{f_{fd}} - 1 \right] \left(\frac{1}{f_\ell} \right)$$

Where:

BAF_T^t = BAF based on total concentration in tissue and water.

f_ℓ = fraction of the tissue that is lipid.

f_{fd} = fraction of the total chemical that is freely dissolved in the ambient water.

The trophic level to which the baseline BAF applies is the same as the trophic level of the organisms used in the determination of the field-measured BAF. For each trophic level, a species mean measured baseline BAF shall be calculated as the geometric mean if more than 1 measured baseline BAF is available for a given species. For each trophic level, the geometric mean of the species mean measured baseline BAFs shall be calculated. If a baseline BAF based on a measured BAF is available for either trophic level 3 or 4, but not both, then a measured baseline BAF for the other trophic level shall be calculated using the ratio of the FCMs that are obtained by linear interpolation from table 9 for the chemical.

(g) A baseline BAF for organic chemical "i" shall be calculated from a field-measured BSAF of acceptable quality using the following equation:

$$(\text{Baseline BAF})_i = (\text{Baseline BAF})_r \bullet \frac{(BSAF)_i \bullet (K_{OW})_i}{(BSAF)_r \bullet (K_{OW})_r}$$

Where:
$(BSAF)_i$ = BSAF for chemical i.
$(BSAF)_r$ = BSAF for the reference chemical r.
$(K_{ow})_i$ = octanol-water partition coefficient for chemical i.
$(K_{ow})_r$ = octanol-water partition coefficient for the reference chemical r.
A BSAF shall be calculated using the following equation:

$$BSAF = \frac{C_\ell}{C_{SOC}}$$

Where:
C_ℓ = the lipid-normalized concentration of the chemical in tissue.
C_{soc} = the organic carbon-normalized concentration of the chemical in sediment.
The organic carbon-normalized concentration of a chemical in sediment, C_{soc}, shall be calculated using the following equation:

$$C_{SOC} = \frac{C_S}{f_{OC}}$$

Where:
C_s = concentration of chemical in sediment (mg/g sediment).
f_{oc} = fraction of the sediment that is organic carbon.
Predicting BAFs from BSAFs requires data from a steady-state or near steady-state condition between sediment and ambient water for both a reference chemical "r" with a field-measured BAF_ℓ^{fd} and other chemicals "n=i" for which BSAFs are to be determined.
The trophic level to which the baseline BAF applies is the same as the trophic level of the organisms used in the determination of the BSAF. For each trophic level, a species mean baseline BAF shall be calculated as the geometric mean if more than 1 baseline BAF is predicted from BSAFs for a given species. For each trophic level, the geometric mean of the species mean baseline BAFs derived using BSAFs shall be calculated. If a baseline BAF based on a measured BSAF is available for either trophic level 3 or 4, but not both, a baseline BAF for the other trophic level shall be calculated using the ratio of the FCMs that are obtained by linear interpolation from table 9 for the chemical.
(h) A baseline BAF for trophic level 3 and a baseline BAF for trophic level 4 shall be calculated from a laboratory-measured BCF of acceptable quality and an FCM using the following equation:

$$\text{Baseline BAF} = (FCM)\left[\frac{\text{Measured } BCF_T^t}{f_{fd}} - 1\right]\left(\frac{1}{f_\ell}\right)$$

Where:
BCF_T^t = BCF based on total concentration in tissue and water.
f_ℓ = fraction of the tissue that is lipid.
f_{fd} = fraction of the total chemical in the test water that is freely dissolved.
FCM = the food chain multiplier obtained from table 9 by linear interpolation for trophic level 3 or 4, as necessary.
For each trophic level, a species mean baseline BAF shall be calculated as the geometric mean if more than 1 baseline BAF is predicted from laboratory-measured BCFs for a given species. For each trophic level, the geometric mean of the species mean baseline BAFs based on laboratory-measured BCFs shall be calculated.
(i) A baseline BAF for trophic level 3 and a baseline BAF for trophic level 4 shall be calculated from a K_{ow} of acceptable quality and an FCM using the following equation:

$$\text{Baseline BAF} = (FCM)(\text{predicted baseline BCF}) = (FCM)(K_{OW})$$

Where:

FCM = the food chain multiplier obtained from table 9 by linear interpolation for trophic level 3 or 4, as necessary.

K_{ow} = octanol-water partition coefficient.

(j) Human health and wildlife BAFs for organic chemicals shall be derived as follows:

(i) The K_{ow} of the chemical 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:

$$f_{fd} = \frac{1}{1 + \frac{(DOC)(Kow)}{10} + (POC)(K_{ow})}$$

$$= \frac{1}{1 + \frac{(0.000002\ kg/L)(Kow)}{10} + (0.00000004\ kg/L)(K_{ow})}$$

$$= \frac{1}{1 + (0.00000024\ kg/L)(K_{ow})}$$

(ii) The human health BAF for an organic chemical shall be calculated using the following equations:

(A) For trophic level 3:

$$\text{Human health BAF}^{HH}_{TL\ 3} = [(\text{baseline BAF})(0.0182) + 1](f_{fd})$$

(B) For trophic level 4:

$$\text{Human health BAF}^{HH}_{TL\ 4} = [(\text{baseline BAF})(0.0310) + 1](f_{fd})$$

Where:

0.0182 and 0.0310 are the standardized fraction lipid values for trophic levels 3 and 4, respectively, that are used to derive human health values.

(iii) The wildlife BAF for an organic chemical shall be calculated using the following equations:

(A) For trophic level 3:

$$\text{Wildlife BAF}^{WL}_{TL\ 3} = [(\text{baseline BAF})(0.0646) + 1](f_{fd})$$

(B) For trophic level 4:

$$\text{Wildlife BAF}^{WL}_{TL\ 4} = [(\text{baseline BAF})(0.1031) + 1](f_{fd})$$

Where:

0.0646 and 0.1031 are the standardized fraction lipid values for trophic levels 3 and 4, respectively, that are used to derive wildlife values.

(k) To calculate human health and wildlife BAFs for inorganic chemicals, the baseline BAFs for trophic levels 3 and 4 are both assumed to equal the BCF determined for the chemical with fish. The FCM is assumed to be 1 for both trophic levels 3 and 4. However, an FCM greater than 1 might be applicable to some metals, such as mercury, if, for example, an organometallic form of the metal biomagnifies. The process specified in paragraphs (i) and (ii) of this subdivision shall be followed:

(i) The human health BAFs for inorganic chemicals shall be calculated as follows:

(A) Measured BAFs and BCFs used to determine human health BAFs for inorganic chemicals shall be based on edible tissue of freshwater fish unless it is demonstrated that whole-body BAFs or BCFs are similar to edible-tissue BAFs or BCFs. BCFs and BAFs based on measurements of aquatic plants and invertebrates shall not be used in the derivation of human health values.

(B) If 1 or more field-measured baseline BAFs for an inorganic chemical are available from studies conducted in the Great Lakes system with the muscle of fish, for each trophic

level, a species mean measured baseline BAF shall be calculated as the geometric mean if more than 1 measured BAF is available for a given species; and the geometric mean of the species mean measured baseline BAFs shall be used as the human health BAF for that chemical.

(C) If an acceptable measured baseline BAF is not available for an inorganic chemical and 1 or more acceptable edible-portion laboratory-measured BCFs are available for the chemical, then a predicted baseline BAF shall be calculated by multiplying the geometric mean of the BCFs times an 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 chemical.

(ii) The wildlife BAFs for inorganic chemicals shall be calculated as follows:

(A) Measured BAFs and BCFs used to determine wildlife BAFs for inorganic chemicals shall be based on whole-body freshwater fish and invertebrate data unless it is demonstrated that edible-tissue BAFs or BCFs are similar to whole-body BAFs or BCFs.

(B) If 1 or more field-measured baseline BAFs for an inorganic chemical are available from studies conducted in the Great Lakes system with the whole body of fish or invertebrates, for each trophic level, a species mean measured baseline BAF shall be calculated as the geometric mean if more than 1 measured BAF is available for a given species; and the geometric mean of the species mean measured baseline BAFs shall be used as the wildlife BAF for that chemical.

(C) If an acceptable measured baseline BAF is not available for an inorganic chemical and 1 or more acceptable whole-body laboratory-measured BCFs are available for the chemical, then a predicted baseline BAF shall be calculated by multiplying the geometric mean of the BCFs times an 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 wildlife BAF for that chemical.

(l) For both organic and inorganic chemicals, human health and wildlife BAFs for both trophic levels shall be reviewed for consistency with all available data concerning the bioaccumulation, bioconcentration, and metabolism of the chemical. For example, information concerning octanol-water partitioning, molecular size, or other physicochemical properties that might enhance or inhibit bioaccumulation should be considered for organic chemicals. BAFs derived in accordance with the methodology specified in this subrule shall be modified if changes are justified by available data.

(m) BAFs may be modified on a site-specific basis to be higher or lower to reflect local environmental conditions. Any site-specific modifications shall be derived by making appropriate site-specific adjustments to the methodology in this subrule and shall be approved by the department. Lower BAFs shall be protective of designated uses of the surface waters of the state and shall be based on sound scientific rationale to address site-specific factors, including all of the following factors:

(i) The fraction of the total chemical that is freely dissolved in the ambient water is different than that used to derive the statewide BAFs.

(ii) Input parameters of the Gobas model and the disequilibrium constant are different at the site than the input parameters and the disequilibrium constant used to derive the statewide BAFs.

(iii) The percent lipid of aquatic organisms that are consumed and occur at the site is different than the percent lipid of aquatic organisms used to derive the statewide BAFs.

(iv) Site-specific field-measured BAFs or BSAFs are determined.

(6) In addition to the values derived by the method set forth in subrule (2) of this rule, biological techniques, including whole effluent toxicity requirements, may be used to assure

that the acute and chronic aquatic life requirements of these rules are met in the surface waters of the state.

(7) If new information becomes available for the department to make a determination that any of the water quality values in tables 1, 2, 4, 7, and 8 should be revised, then a rule change shall be initiated by the department to modify the values. The revised values will be considered for the purposes of developing water quality-based effluent limits for national pollutant discharge elimination system permits and appropriate adjustments shall be made when the permit is reissued.

(8) Tables 1 to 9 read as follows:

Table 1. Aquatic Maximum Values for Protection of Aquatic Life in Ambient Waters.

Chemical	AMV[1] (ug/L)	Conversion Factor (CF)
Arsenic[2]	340	1.0
Cadmium[2]	$(e^{1.128(\ln H)-3.6867})(CF)$	1.136672-(lnH)(0.041838)
Chromium (III)[2]	$(e^{0.819(\ln H)+3.7256})(CF)$	0.316
Chromium (VI)[2]	16	0.982
Copper[2]	$(e^{0.9422(\ln H)-1.7})(CF)$	0.96
Cyanide[3]	22	n/a
Dieldrin[4]	0.24	n/a
Endrin[4]	0.086	n/a
Lindane[4]	0.95	n/a
Mercury[2]	1.4	0.85
Nickel[2]	$(e^{0.846(\ln H)+2.255})(CF)$	0.998
Parathion[4]	0.065	n/a
Pentachlorophenol[4]	$e^{1.005(pH)-4.869}$	n/a
Zinc[2]	$(e^{0.8473(\ln H)+0.884})(CF)$	0.978

[1]AMV is the aquatic maximum value and is equal to 1/2 the FAV. The AMV shall be rounded to 2 significant digits.
[2]Value is expressed as a dissolved concentration calculated using the specified conversion factor.
[3]Value is expressed as free cyanide.
[4]Value is expressed as a total concentration.

Note: The term "lnH" is the natural log of hardness, expressed as mg/L $CaCO_3$.
The term "n/a" means not applicable.

Table 2. Chronic Water Quality Values for Protection of Aquatic Life in Ambient Waters.

Chemical	FCV[1] (ug/L)	Conversion Factor (CF)
Arsenic[2]	150	1.0
Cadmium[2]	$(e^{0.7852(\ln H)-2.715})(CF)$	1.101672-(lnH)(0.041838)
Chromium (III)[2]	$(e^{0.819(\ln H)+0.6848})(CF)$	0.86
Chromium (VI)[2]	11	0.962
Copper[2]	$(e^{0.8545(\ln H)-1.702})(CF)$	0.96
Cyanide[3]	5.2	n/a
Dieldrin[4]	0.056	n/a
Endrin[4]	0.036	n/a
Mercury[2]	0.77	0.85
Nickel[2]	$(e^{0.846(\ln H)+0.0584})(CF)$	0.997
Parathion[4]	0.013	n/a
Pentachlorophenol[4]	$e^{1.005(pH)-5.134}$	n/a
Selenium[5]	5	n/a
Zinc[2]	$(e^{0.8473(\ln H)+0.884})(CF)$	0.986

[1]FCV is the final chronic value. The FCV shall be rounded to 2 significant digits.
[2]Value is expressed as a dissolved concentration calculated using the specified conversion factor.
[3]Value is expressed as free cyanide.
[4]Value is expressed as a total concentration.
[5]Value is expressed as a total recoverable concentration.

Note: The term "lnH" is the natural log of hardness, as expressed in mg/L $CaCO_3$.
The term "n/a" means not applicable.

Table 3. Tier II Acute Factors.

Number of minimum data requirements satisfied	Acute Factor
2.....	13.0
3.....	8.0
4.....	7.0
5.....	6.1
6.....	5.2
7.....	4.3

Table 4. Water Quality Values for Protection of Wildlife.

Chemical	Wildlife Value (ug/L)
DDT and metabolites	0.000011
Mercury, including methylmercury	0.0013
PCBs (class)	0.00012
2,3,7,8-TCDD	0.0000000031

Table 5. Bioaccumulative Chemicals of Concern.

Chlordane
4,4'-DDD
4,4'-DDE
4,4'-DDT
Dieldrin
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclohexanes
alpha-Hexachlorocyclohexane
beta-Hexachlorocyclohexane
delta-Hexachlorocyclohexane
Lindane
Mercury
Mirex
Octachlorostyrene
Polychlorinated biphenyls (PCBs)
Pentachlorobenzene
Photomirex
2,3,7,8-TCDD
1,2,3,4-Tetrachlorobenzene
1,2,4,5-tetrachlorobenzene
Toxaphene

Table 6. Exposure Parameters for the 5 Representative Species Identified for Protection.

Species	Adult Body Weight	Water Ingestion Rate	Food Ingestion Rate of Prey in Each Trophic Level	Trophic Level of Prey
Units	kg	L/day	kg/day	Percent of diet
Mink	0.80	0.081	TL3: 0.159 Other: 0.0177	TL3: 90 % Other: 10 %
Otter	7.4	0.600	TL3: 0.977 TL4: 0.244	TL3: 80 % TL4: 20 %
Kingfisher	0.15	0.017	TL3: 0.0672	TL3: 100 %
Herring gull	1.1	0.063	TL3: 0.192 TL4: 0.0480 Other: 0.0267	Fish: 90 % TL3: 80 % TL4: 20 % Other: 10 %
Bald eagle	4.6	0.160	TL3: 0.371 TL4: 0.0929 PB: 0.0283 Other: 0.0121	Fish: 92 % TL3: 80 % TL4: 20 % Birds: 8 % PB: 70 % Non-aquatic: 30 %

Note: TL3 = trophic level 3 fish.
TL4 = trophic level 4 fish.
PB = piscivorous birds.
Other = nonaquatic birds and mammals.

Table 7. Human Noncancer Values for Protection of Human Health.

Chemical	HNV (ug/L) Drinking	Nondrinking
Benzene	19	510
Chlordane	0.0014	0.0014
Chlorobenzene	470	3200
Cyanides	600	48000
DDT	0.002	0.002
Dieldrin	0.00041	0.00041
2,4-dimethylphenol	450	8700
2,4-dinitrophenol	55	2800
Hexachlorobenzene	0.046	0.046
Hexachloroethane	6.0	7.6
Lindane	0.47	0.50
Mercury (including methylmercury)	0.0018	0.0018
Methylene chloride	1600	90000
2,3,7,8-TCDD	0.000000067	0.000000067
Toluene	5600	51000

Table 8. Human Cancer Values for the Protection of Human Health.

Chemical	HCV (ug/L) Drinking	Nondrinking
Benzene	12	310
Chlordane	0.00025	0.00025
DDT	0.00015	0.00015
Dieldrin	0.0000065	0.0000065
Hexachlorobenzene	0.00045	0.00045
Hexachloroethane	5.3	6.7
Methylene chloride	47	2600
PCBs (class)	0.000026	0.000026
2,3,7,8-TCDD	0.0000000086	0.0000000086
Toxaphene	0.000068	0.000068
Trichloroethylene	29	370

Table 9. Food Chain Multipliers for Trophic Levels 2, 3, and 4.

Log K_{ow}	Trophic Level 2	Trophic[a] Level 3	Trophic Level 4
2.0	1.000	1.005	1.000
2.5	1.000	1.010	1.002
3.0	1.000	1.028	1.007
3.1	1.000	1.034	1.007
3.2	1.000	1.042	1.009
3.3	1.000	1.053	1.012
3.4	1.000	1.067	1.014
3.5	1.000	1.083	1.019
3.6	1.000	1.103	1.023
3.7	1.000	1.128	1.033
3.8	1.000	1.161	1.042
3.9	1.000	1.202	1.054
4.0	1.000	1.253	1.072
4.1	1.000	1.315	1.096
4.2	1.000	1.380	1.130
4.3	1.000	1.491	1.178
4.4	1.000	1.614	1.242
4.5	1.000	1.766	1.334
4.6	1.000	1.950	1.459
4.7	1.000	2.175	1.633
4.8	1.000	2.452	1.871
4.9	1.000	2.780	2.193
5.0	1.000	3.181	2.612
5.1	1.000	3.643	3.162
5.2	1.000	4.188	3.873
5.3	1.000	4.803	4.742
5.4	1.000	5.502	5.821
5.5	1.000	6.266	7.079
5.6	1.000	7.096	8.551
5.7	1.000	7.962	10.209
5.8	1.000	8.841	12.050
5.9	1.000	9.716	13.964
6.0	1.000	10.556	15.996
6.1	1.000	11.337	17.783
6.2	1.000	12.064	19.907
6.3	1.000	12.691	21.677
6.4	1.000	13.228	23.281
6.5	1.000	13.662	24.604
6.6	1.000	13.980	25.645
6.7	1.000	14.223	26.363
6.8	1.000	14.355	26.669
6.9	1.000	14.388	26.669

Table 9. Continued.

Log K_{ow}	Trophic Level 2	Trophic[a] Level 3	Trophic Level 4
7.0	1.000	14.305	26.242
7.1	1.000	14.142	25.468
7.2	1.000	13.852	24.322
7.3	1.000	13.474	22.856
7.4	1.000	12.987	21.038
7.5	1.000	12.517	18.967
7.6	1.000	11.708	16.749
7.7	1.000	10.914	14.388
7.8	1.000	10.069	12.050
7.9	1.000	9.162	9.840
8.0	1.000	8.222	7.798
8.1	1.000	7.278	6.012
8.2	1.000	6.361	4.519
8.3	1.000	5.489	3.311
8.4	1.000	4.683	2.371
8.5	1.000	3.296	1.146
8.7	1.000	2.732	0.778
8.8	1.000	2.246	0.521
8.9	1.000	1.837	0.345
9.0	1.000	1.493	0.226

[a] The FCMs for trophic level 3 are the geometric mean of the FCMs for sculpin and alewife.

R 323.1058 Radioactive substances.

Rule 58. The control and regulation of radioactive substances discharged to the waters of the state shall be pursuant to the criteria, standards, or requirements prescribed by the United States nuclear regulatory commission in 10 C.F.R. §20.1 et seq. and by the United States environmental protection agency.

R 323.1060 Plant nutrients.

Rule 60. (1) Consistent with Great Lakes protection, phosphorus which is or may readily become available as a plant nutrient shall be controlled from point source discharges to achieve 1 milligram per liter of total phosphorus as a maximum monthly average effluent concentration unless other limits, either higher or lower, are deemed necessary and appropriate by the department.

(2) In addition to the protection provided under subrule (1) of this rule, nutrients shall be limited to the extent necessary to prevent stimulation of growths of aquatic rooted, attached, suspended, and floating plants, fungi or bacteria which are or may become injurious to the designated uses of the surface waters of the state.

R 323.1062 Microorganisms.

Rule 62. (1) All surface waters of the state protected for total body contact recreation shall not contain more than 130 Escherichia coli (E. coli) per 100 milliliters, as a 30-day geometric mean. Compliance shall be based on the geometric mean of all individual samples taken during 5 or more sampling events representatively spread over a 30-day period. Each sampling event shall consist of 3 or more samples taken at representative locations within a defined sampling area. At no time shall the surface waters of the state protected for total body contact recreation contain more than a maximum of 300 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples taken during the same sampling event at representative locations within a defined sampling area.

(2) All surface waters of the state protected for partial body contact recreation shall not contain more than a maximum of 1,000 E. coli per 100 milliliters. Compliance shall be based on the geometric mean of 3 or more samples, taken during the same sampling event, at representative locations within a defined sampling area.

(3) Discharges containing treated or untreated human sewage shall not contain more than 200 fecal coliform bacteria per 100 milliliters, based on the geometric mean of all of 5 or more samples taken over a 30-day period, nor more than 400 fecal coliform bacteria per 100 milliliters, based on the geometric mean of all of 3 or more samples taken during any period of discharge not to exceed 7 days. Other indicators of adequate disinfection may be utilized where approved by the department.

(4) The department may suspend the provisions of subrule (3) of this rule, for the purpose of discharge permit issuance, from November 1 to April 30, upon an adequate demonstration by the applicant that designated uses will be protected. At a minimum, the provisions of subrule (2) of this rule shall be met.

(5) Acceptable levels of infectious organisms that are not specifically addressed by the provisions of subrules (1), (2), and (3) of this rule shall be established by the department on a case-by-case basis to assure that designated uses are protected.

R 323.1064 Dissolved oxygen in Great Lakes, connecting waters, and inland streams.

Rule 64. (1) A minimum of 7 milligrams per liter of dissolved oxygen in all Great Lakes and connecting waterways shall be maintained, and, except for inland lakes as prescribed in R 323.1065, a minimum of 7 milligrams per liter of dissolved oxygen shall be maintained at all times in all inland waters designated by these rules to be protected for coldwater fish. In all other waters, except for inland lakes as prescribed by R 323.1065, a minimum of 5 milligrams per liter of dissolved oxygen shall be maintained. These standards do not apply for a limited warmwater fishery use subcategory or limited coldwater fishery use subcategory established pursuant to R 323.1100(11) or during those periods when the standards specified in subrule (2) of this rule apply.

(2) Surface waters of the state which do not meet the standards set forth in subrule (1) of this rule shall be upgraded to meet those standards. The department may issue permits pursuant to R 323.2145 which establish schedules to achieve the standards set forth in subrule (1) of this rule for point source discharges to surface waters which do not meet the standards set forth in subrule (1) of this rule and which commenced discharge before December 2, 1986. For point source discharges which commenced before December 2, 1986, the dischargers may demonstrate to the department that the dissolved oxygen standards specified in subrule (1) of this rule are not attainable through further feasible and prudent reductions in their discharges or that the diurnal variation between the daily average and daily minimum dissolved oxygen concentrations in those waters exceeds 1 milligram per liter, further reductions in oxygen-consuming substances from such discharges will not be required, except as necessary to meet the interim standards specified in this subrule, until comprehensive plans to upgrade these waters to the standards specified in subrule (1) of this rule have been approved by the department and orders, permits, or other actions necessary to implement the approved plans have been issued by the department. In the interim, all of the following standards apply:

(a) For surface waters of the state designated for use for coldwater fish, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 6 milligrams per liter at the design flow during the warm weather season in accordance with R 323.1090(2) and (3). At the design flows during other seasonal periods, as provided in R 323.1090(3), a minimum of 7 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.

(b) For surface waters of the state designated for use for warmwater fish and other aquatic life, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below a minimum of 4 milligrams per liter, or below 5 milligrams per liter as a daily average, at the design flow during the warm weather season in accordance with R 323.1090(3) and (4). At the design flows during other seasonal periods as provided in R 323.1090(3), a minimum of 5 milligrams per liter shall be maintained. At flows greater than the design flows, dissolved oxygen shall be higher than the respective minimum values specified in this subdivision.

(c) For surface waters of the state designated for use for warmwater fish and other aquatic life, but also designated as principal migratory routes for anadromous salmonids, except for inland lakes as prescribed in R 323.1065, the dissolved oxygen shall not be lowered below 5 milligrams per liter as a minimum during periods of migration.

(3) The department may cause a comprehensive plan to be prepared to upgrade waters to the standards specified in subrule (1) of this rule taking into consideration all factors affecting dissolved oxygen in these waters and the cost effectiveness of control measures to upgrade these waters and, after notice and hearing, approve the plan. After notice and hearing, the department may amend a comprehensive plan for cause. In undertaking the

comprehensive planning effort the department shall provide for and encourage participation by interested and impacted persons in the affected area. Persons directly or indirectly discharging substances which contribute towards these waters not meeting the standards specified in subrule (1) of this rule may be required after notice and order to provide necessary information to assist in the development or amendment of the comprehensive plan. Upon notice and order, permit, or other action of the department, persons directly or indirectly discharging substances which contribute toward these waters not meeting the standards specified in subrule (1) of this rule shall take the necessary actions consistent with the approved comprehensive plan to control these discharges to upgrade these waters to the standards specified in subrule (1) of this rule.

R 323.1065 Dissolved oxygen; inland lakes.

Rule 65. (1) The following standards for dissolved oxygen shall apply to the lakes designated for coldwater fish in R 323.1100(4) and (6):

(a) In stratified coldwater lakes which have dissolved oxygen concentrations less than 7 milligrams per liter in the upper half of the hypolimnion, a minimum of 7 milligrams per liter dissolved oxygen shall be maintained throughout the epilimnion and upper 1/3 of the thermocline during stratification. Lakes capable of sustaining oxygen throughout the hypolimnion shall maintain oxygen throughout the hypolimnion. At all other times, dissolved oxygen concentrations greater than 7 milligrams per liter shall be maintained.

(b) Except for lakes described in subdivision (c) of this subrule, in stratified coldwater lakes which have dissolved oxygen concentrations greater than 7 milligrams per liter in the upper half of the hypolimnion, a minimum of 7 milligrams per liter of dissolved oxygen shall be maintained in the epilimnion, thermocline, and upper half of the hypolimnion. Lakes capable of sustaining oxygen throughout the hypolimnion shall maintain oxygen throughout the hypolimnion. At all other times, dissolved oxygen concentrations greater than 7 milligrams per liter shall be maintained.

(c) In stratified coldwater lakes which have dissolved oxygen concentrations greater than 7 milligrams per liter throughout the hypolimnion, a minimum of 7 milligrams per liter shall be maintained throughout the lake.

(d) In unstratified coldwater lakes, a minimum of 7 milligrams per liter of dissolved oxygen shall be maintained throughout the lake.

(2) For all other inland lakes not specified in subrule (1) of this rule, during stratification, a minimum dissolved oxygen concentration of 5 milligrams per liter shall be maintained throughout the epilimnion. At all other times, dissolved oxygen concentrations greater than 5 milligrams per liter shall be maintained.

R 323.1069 Temperature; general considerations.

Rule 69. (1) In all surface waters of the state, the points of temperature measurement normally shall be in the surface 1 meter; however, where turbulence, sinking plumes, discharge inertia or other phenomena upset the natural thermal distribution patterns of receiving waters, temperature measurements shall be required to identify the spatial characteristics of the thermal profile.

(2) Monthly maximum temperatures, based on the ninetieth percentile occurrence of natural water temperatures plus the increase allowed at the edge of the mixing zone and in part on long-term physiological needs of fish, may be exceeded for short periods when natural water temperatures exceed the ninetieth percentile occurrence. Temperature increases during these periods may be permitted by the department, but in all cases shall

not be greater than the natural water temperature plus the increase allowed at the edge of the mixing zone.

(3) Natural daily and seasonal temperature fluctuations of the receiving waters shall be preserved.

R 323.1070 Temperature of Great Lakes and connecting waters.

Rule 70. (1) The Great Lakes and connecting waters shall not receive a heat load which would warm the receiving water at the edge of the mixing zone more than 3 degrees Fahrenheit above the existing natural water temperature.

(2) The Great Lakes and connecting waters shall not receive a heat load which would warm the receiving water at the edge of the mixing zone to temperatures in degrees Fahrenheit higher than the following monthly maximum temperature:

(a) Lake Michigan north of a line due west from the city of Pentwater.

J	F	M	A	M	J	J	A	S	O	N	D
40	40	40	50	55	70	75	75	75	65	60	45

(b) Lake Michigan south of a line due west from the city of Pentwater.

J	F	M	A	M	J	J	A	S	0	N	D
45	45	45	55	60	70	80	80	80	65	60	50

(c) Lake Superior and the St. Marys river:

J	F	M	A	M	J	J	A	S	0	N	D
38	36	39	46	53	61	71	74	71	61	49	42

(d) Lake Huron north of a line due east from Tawas point:

J	F	M	A	M	J	J	A	S	0	N	D
40	40	40	50	60	70	75	80	75	65	55	45

(e) Lake Huron south of a line due east from Tawas point, except Saginaw bay.

J	F	M	A	M	J	J	A	S	0	N	D
40	40	40	55	60	75	80	80	80	65	55	45

(f) Lake Huron, Saginaw bay:

J	F	M	A	M	J	J	A	S	0	N	D
45	45	45	60	70	75	80	85	78	65	55	45

(g) St. Clair river:

J	F	M	A	M	J	J	A	S	0	N	D
40	40	40	50	60	70	75	80	75	65	55	50

(h) Lake St. Clair:

J	F	M	A	M	J	J	A	S	0	N	D
40	40	45	55	70	75	80	83	80	70	55	45

(i) Detroit river:

J	F	M	A	M	J	J	A	S	0	N	D
40	40	45	60	70	75	80	83	80	70	55	45

(j) Lake Erie:

J	F	M	A	M	J	J	A	S	0	N	D
45	45	45	60	70	75	80	85	80	70	60	50

R 323.1072 Temperature: inland lakes, general standards.

Rule 72. Inland lakes shall not receive a heat load which would:

(a) Increase the temperature of the thermocline or hypolimnion or decrease the volume thereof.

(b) Increase the temperature of the receiving waters at the edge of the mixing zone more than 3 degrees Fahrenheit above the existing natural water temperature.

(c) Increase the temperature of the receiving waters at the edge of the mixing zone to temperatures greater than the following monthly maximum temperatures:

J	F	M	A	M	J	J	A	S	0	N	D
45	45	50	60	70	75	80	85	80	70	60	50

R 323.1073 Temperature; inland lakes, anadromous salmonid migrations.

Rule 73. Warmwater inland lakes which serve as principal migratory routes for anadromous salmonids shall not receive a heat load during periods of migration at such locations and in a manner which may adversely affect salmonid migration or raise the receiving water temperature at the edge of the mixing zone more than 3 degrees Fahrenheit above the existing natural water temperature.

R 323.1075 Temperature of rivers, streams, and impoundments.

Rule 75. (1) Rivers, streams, and impoundments naturally capable of supporting coldwater fish shall not receive a heat load which would do either of the following:

(a) Increase the temperature of the receiving waters at the edge of the mixing zone more than 2 degrees Fahrenheit above the existing natural water temperature.

(b) Increase the temperature of the receiving waters at the edge of the mixing zone to temperatures greater than the following monthly maximum temperatures:

J	F	M	A	M	J	J	A	S	0	N	D
38	38	43	54	65	68	68	68	63	56	48	40

(2) Rivers, streams, and impoundments naturally capable of supporting warmwater fish shall not receive a heat load which would warm the receiving water at the edge of the mixing zone more than 5 degrees Fahrenheit above the existing natural water temperature.

(3) Rivers, streams, and impoundments naturally capable of supporting warmwater fish shall not receive a heat load which would warm the receiving water at the edge of the mixing zone to temperatures greater than the following monthly maximum temperatures:

(a) For rivers, streams, and impoundments north of a line between Bay City, Midland, Alma and North Muskegon:

J	F	M	A	M	J	J	A	S	0	N	D
38	38	41	56	70	80	83	81	74	64	49	39

(b) For rivers, streams, and impoundments south of a line between Bay City, Midland, Alma, and North Muskegon, except the St. Joseph river:

J	F	M	A	M	J	J	A	S	0	N	D
41	40	50	63	76	84	85	85	79	68	55	43

(c) St. Joseph river:

J	F	M	A	M	J	J	A	S	0	N	D
50	50	55	65	75	85	85	85	85	70	60	50

(4) Non-trout rivers and streams that serve as principal migratory routes for anadromous salmonids shall not receive a heat load during periods of migration at such locations and in a manner which may adversely affect salmonid migration or raise the receiving water temperature at the edge of the mixing zone more than 5 degrees Fahrenheit above the existing natural water temperature.

R 323.1082 Mixing zones.

Rule 82. (1) A mixing zone is that portion of a water body allocated by the department where a point source or venting groundwater discharge is mixed with the surface waters of the state. Exposure in mixing zones shall not result in deleterious effects to populations of aquatic life or wildlife. As a minimum restriction, the final acute value (FAV) for aquatic life shall not be exceeded when determining a wasteload allocation (WLA) for acute aquatic life protection, unless it is determined by the department that a higher level is acceptable or it can be demonstrated to the department that an acute mixing zone is acceptable consistent with subrule (7) of this rule. The mixing zone shall not prevent the passage of fish or fish food organisms in a manner that would result in adverse impacts on the immediate or future populations of the fish or fish food organisms. The area of mixing zones shall be minimized. To this end, devices for rapid mixing, dilution, and dispersion are encouraged where practicable. A watercourse or portions of a watercourse that, without 1 or more point source discharges, would have no flow except during periods of surface runoff may be considered as a mixing zone for a point source discharge. A mixing zone established in this manner shall not apply to pollutants of initial focus specified in 40 C.F.R. §132 (1995) unless a site-specific determination under R 323.1057(2) has been conducted that shows that the existing and expected aquatic life in the watercourse will be adequately protected in the absence of chronic aquatic life water quality values.

(2) Unless otherwise stated in this rule, not more than 25% of the receiving water design flow for lotic systems, as stated in R 323.1090(2), shall be used when determining a whole effluent toxicity limit or a wasteload allocation for a toxic substance, in the absence of, or consistent with, a total maximum daily load, unless it can be demonstrated to the department that the use of a larger volume is acceptable consistent with subrule (7) of this rule.

(3) For ammonia and substances not included in subrule (2) of this rule, the design flow for lotic systems, as stated in R 323.1090(2)(a) or (3), shall be used when determining WLAs if the provisions in subrule (1) of this rule are met, unless the department determines that a more restrictive volume is necessary.

(4) For all substances, physical mixing zone boundaries may be established and shall be determined by the department on a case-by-case basis.

(5) Mixing zones in the Great Lakes and inland lakes for the purpose of determining WLAs and WET limits shall assume no greater dilution than 1 part effluent to 10 parts receiving water, unless it can be demonstrated to the department that use of a larger volume is acceptable consistent with subrule (7) of this rule. Except for ammonia, a larger mixing zone shall not be granted if it exceeds the area where discharge-induced mixing occurs. Mixing zones established under this subrule for thermal discharges to meet the Great Lakes and inland lake requirements of R 323.1069, R 323.1070, R 323.1072, R 323.1073, and R 323.1075 shall be determined by the department on a case-by-case basis.

(6) In addition to subrules (1), (2), (4), and (5) of this rule, the following provisions are applicable to bioaccumulative chemicals of concern (BCCs) when establishing WLAs:

(a) There shall be no mixing zones available for new discharges of BCCs to the surface waters of the state.

(b) Mixing zones for BCCs may be allowed for existing discharges to the surface waters of the state through November 14, 2010, pursuant to the provisions of this rule. After this date, except as provided in subdivisions (c) and (d) of this subrule, permits shall not authorize mixing zones for existing discharges of BCCs to the surface waters of the state, and WLAs for such discharges shall be set equal to the most stringent water quality value for that BCC.

(c) The department may grant mixing zones for any existing discharge of BCCs to the surface waters of the state where it can be demonstrated, on a case-by-case basis, that failure to grant a mixing zone would preclude water conservation measures that would lead to overall load reductions in BCCs.

(d) Upon the request of an existing discharger of a BCC to the surface waters of the state, the department may grant mixing zones beyond November 14, 2010, based upon technical and economic considerations, subject to all of the following provisions:

(i) The department must determine that all of the following provisions are satisfied:

(A) The discharger is in compliance with, and will continue to implement, all applicable technology-based treatment and pretreatment requirements of the clean water act of 1972, as amended, 33 U.S.C. §§301, 302, 304, 306, 307, 401, and 402, and is in compliance with its existing NPDES WQBELs, including those based on a mixing zone.

(B) The discharger has reduced, and will continue to reduce, to the maximum extent possible, the loading of the BCC for which a mixing zone is requested, by the use of cost-effective controls or pollution-prevention alternatives that have been adequately demonstrated and are reasonably available to the discharger.

(C) The discharger has evaluated alternative means of reducing the BCC elsewhere in the watershed.

(ii) In making the determination in paragraph (i) of this subdivision, the department shall consider all of the following factors:

(A) The availability and feasibility, including cost effectiveness, of additional controls or pollution prevention measures for reducing and ultimately eliminating BCCs for the discharger, including additional controls or pollution prevention measures used by similar dischargers for reducing and ultimately eliminating BCCs.

(B) Whether the discharger or affected communities will suffer unreasonable economic effects if the mixing zone is eliminated.

(C) The extent to which the discharger will implement an ambient monitoring plan to ensure compliance with water quality values at the edge of any authorized mixing zone.

(D) Other information the department deems appropriate.

(iii) Any exceptions to the mixing zone elimination provision for existing discharges of BCCs granted pursuant to this subdivision shall comply with all of the following provisions:

(A) Not result in any less stringent limitations than the limitations that existed on July 29, 1997.

(B) Be limited to 1 permit term unless the department makes a new determination in accordance with this subrule for each successive permit application in which a mixing zone for the BCC is sought.

(C) Not likely jeopardize the continued existence of any endangered or threatened species listed or proposed under section 4 of the endangered species act or result in the destruction or adverse modification of the species' critical habitat.

(iv) For each draft NPDES permit that allows a mixing zone for a BCC after November 14, 2010, the NPDES fact sheet shall specify relevant information used to establish the mixing zone, including the mixing provisions used in calculating the permit limits and the identity of each BCC for which a mixing zone is proposed.

(7) For purposes of establishing a mixing zone other than as specified in subrules (1), (2), and (5) of this rule, a mixing zone demonstration shall be submitted to the department for approval and all of the following provisions apply:

(a) The mixing zone demonstration shall include all of the following:

(i) A description of the amount of dilution occurring at the boundaries of the proposed mixing zone and the size, shape, and location of the area of mixing, including the manner in which diffusion and dispersion occur.

(ii) For sources discharging to the Great Lakes and inland lakes, a definition of the location at which discharge-induced mixing ceases.

(iii) Documentation of the substrate character within the mixing zone.

(iv) Confirmation that the mixing zone does not interfere with or block the passage of fish or aquatic life.

(v) Confirmation that the mixing zone would not likely jeopardize the continued existence of any endangered or threatened species listed or proposed under section 4 of the endangered species act or result in the destruction or adverse modification of the species' critical habitat.

(vi) Confirmation that the mixing zone does not extend to a public water supply source pursuant to R 323.1100(8).

(vii) Confirmation that the mixing zone would not interfere with the designated or existing uses of the receiving water or downstream waters.

(viii) Documentation of background water quality concentrations.

(ix) Confirmation that the mixing zone does not promote undesirable aquatic life or result in a dominance of nuisance species.

(x) Confirmation that, by allowing additional mixing/dilution, the following will not occur:

(A) The formation of objectionable deposits.

(B) The concentration of floating debris, oil, scum, and other matter in concentrations that form nuisances.
(C) The production of objectionable color, odor, taste, or turbidity.
(b) The mixing zone demonstration shall also address all of the following items:
(i) Whether or not adjacent mixing zones overlap.
(ii) Whether organisms would be attracted to the area of mixing as a result of the effluent character.
(iii) Whether the habitat supports endemic or naturally occurring species.
(iv) Why an increased mixing zone is necessary.
(v) Describe any pollution prevention measures that were evaluated to eliminate the need for an increased mixing zone.
(c) The mixing zone demonstration shall be based on the assumption that environmental fate or other physical, chemical, or biological factors do not affect the concentration of the toxic substance in the water column, within the proposed mixing zone, unless both of the following occur:
(i) Scientifically valid field studies or other relevant information demonstrate that degradation of the toxic substance is expected to occur during typical environmental conditions expected to be encountered.
(ii) Scientifically valid field studies or other relevant information address other factors that affect the level of toxic substances in the water column, including all of the following factors:
(A) Sediment release or resuspension.
(B) Chemical speciation.
(C) Biological and chemical transformation.

R 323.1090 Applicability of water quality standards.
Rule 90. (1) The requirements prescribed by these rules shall not apply within mixing zones, except for the requirements prescribed in R 323.1050, or as otherwise specified by these rules.
(2) Water quality standards prescribed by these rules are minimally acceptable water quality conditions and shall apply at all flows equal to or exceeding the design flows, except where the department determines that a more restrictive design flow is necessary. The design flows in lotic systems shall be as follows:
(a) Unless otherwise stated in this rule, the design flow is equal to the lowest of the 12 monthly 95% exceedance flows. The 95% exceedance flow is the flow equal to or exceeded 95% of the time for the specified month.
(b) For human health values, the design flow is equal to the harmonic mean flow.
(c) For wildlife values, the design flow is equal to the 90-day, 10-year low flow (90Q10).
(3) A maximum of 4 seasonal design flows may be granted when determining surface water effluent limitations for ammonia or substances not addressed by R 323.1057 if it is determined by the department that the use of such design flows will protect water quality and be consistent with the protection of the public health, safety, and welfare. The seasonal design flows shall be the lowest of the monthly 95% exceedance flow for the months in each season.
(4) Alternate design flows may be used for intermittent wet weather discharges as necessary to protect the designated uses of the receiving water.

R 323.1092 Applicability of water quality standards to dredging or construction activities.
Rule 92. Unless the department determines, after consideration of dilution and dispersion, that such activities result in unacceptable adverse impacts on designated uses, the water quality standards prescribed by these rules shall not apply to dredging or construction activities within the surface waters of the state where such activities occur or during the periods of time when the aftereffects of dredging or construction activities degrade water quality within such waters of the state, if the dredging operations or construction activities have been authorized by the United States army corps of engineers or the department. The water quality standards shall apply, however, in nonconfined surface waters of the state utilized for the disposal of spoil from dredging operations, except within spoil disposal sites specifically defined by the United States army corps of engineers or the department.

R 323.1096 Determinations of compliance with water quality standards.
Rule 96. Analysis of the surface waters of the state to determine compliance with the water quality standards prescribed by these rules shall be made pursuant to procedures outlined in 40 C.F.R. §136 (2000), which are adopted by reference in R 323.1117 or other methods prescribed or approved by the department.

R 323.1097 Materials applications not subject to standards.
Rule 97. The application of materials for water resource management projects pursuant to state statutory provisions is not subject to the standards prescribed by these rules, but all projects shall be reviewed and approved by the department before application.

R 323.1098 Antidegradation.
Rule 98. (1) This rule applies to any action or activity pursuant to part 31 of Act No. 451 of the Public Acts of 1994, as amended, being §324.3101 et seq. of the Michigan Compiled Laws, that is anticipated to result in a new or increased loading of pollutants by any source to surface waters of the state and for which independent regulatory authority exists requiring compliance with water quality standards.
(2) For all waters, the level of water quality necessary to protect existing uses shall be maintained and protected. Where designated uses of the water body are not attained, there shall be no lowering of the water quality with respect to the pollutant or pollutants that are causing the nonattainment.
(3) Where, for individual pollutants, the quality of the waters is better than the water quality standards prescribed by these rules, that water shall be considered high quality and that quality shall be maintained and protected unless allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. For high quality waters, no action resulting in the lowering of water quality shall occur unless the provisions of this rule have been complied with.
(4) A person applying for a control document in a high quality water or a Lake Superior basin - outstanding international resource water for a new or increased loading of pollutants shall show how the discharge is exempted under subrule (8) or (9) of this rule or provide a demonstration as follows:
(a) The applicant shall identify the social or economic development and the benefits to the area in which the waters are located that would be foregone if the new or increased loading of pollutants is not allowed. The factors to be addressed may include any of the following:
(i) Employment increases.

(ii) Production level increases.
(iii) Employment reductions avoidance.
(iv) Efficiency increases.
(v) Industrial, commercial, or residential growth.
(vi) Environmental or public health problem corrections.
(vii) Economic or social benefits to the community.

(b) For discharges of BCCs that result from operations at the facility, the applicant shall include an identification of the alternatives evaluated and the alternatives to be implemented to comply with the following requirements:

(i) The discharger shall minimize the new or increased loading of the BCC by implementation of any cost-effective pollution prevention alternatives and techniques which have been adequately demonstrated and which are reasonably available to the discharger that would eliminate or significantly reduce the new or increased loading of the BCC.

(ii) If pollution prevention alternatives implemented under paragraph (i) of this subdivision do not eliminate the new or increased loading of the BCC, then the discharger shall evaluate alternative or enhanced treatment techniques which have been adequately demonstrated and which are reasonably available to the discharger that would eliminate the new or increased loading of the BCC and shall implement the techniques that have a cost that is reasonable relative to the cost of treatment necessary to achieve applicable effluent limitations.

(iii) If the new or increased loading is a point source discharge to a Lake Superior basin-outstanding international resource water as defined in subrule (7) of this rule and if the BCC of concern is a LSB-BSIC, then the requirements of paragraph (ii) of this subdivision do not apply. If the pollution prevention alternatives implemented under paragraph (i) of this subdivision do not eliminate the new or increased loading of the LSB-BSIC to a Lake Superior basin-outstanding international resource water, then the discharger shall evaluate and implement the best technology in process and treatment (BTPT) that would eliminate or reduce the new or increased loading of the LSB-BSIC. BTPT shall be the most advanced treatment techniques which have been adequately demonstrated and which are reasonably available to the discharger. However, innovative or experimental technology shall also be considered if proposed by the discharger. Upon demonstration by the permittee, the requirement to implement BTPT may be waived by the department for new or increased loadings of LSB-BSICs that occur as trace contaminants in naturally occurring raw materials at the facility. If the BTPT requirement is waived, then the requirements of paragraph (ii) of this subdivision shall apply.

(5) If the department determines that the antidegradation demonstration information from subrule (4) of this rule shows that lowering of water quality is necessary to support important social and economic development in the area and that, if applicable, BTPT will be implemented consistent with subrule (4)(b)(iii) of this rule, then the department shall authorize the lowering of water quality through issuance of the control document. In no event may this decision allow water quality to be lowered below the minimum level required to fully support the designated uses. The antidegradation demonstration shall be available to the public for review during any public comment period on the control document.

(6) If high quality water bodies are designated outstanding state resource waters (OSRW) by the department, then controls shall be applied on pollutant sources to the OSRW or tributaries so that the water quality is not lowered in the OSRW. A short-term, temporary, for example, weeks or months, lowering of water quality in the OSRW may be permitted by the department on a case-by-case basis. The following water bodies are designated as OSRWs:

(a) The following water bodies designated as wild rivers pursuant to the Michigan scenic rivers act of 1991, 16 U.S.C. §1271 et seq:

(i) The Carp river (Mackinac county) - the 7.5-mile segment from Michigan state highway 123, T42N, R5W, section 2, to 1/4 of a mile upstream from forest development road 3119, T42N, R4W, section 4.

(ii) The Carp river (Mackinac county) - the 4.9-mile segment from 1/4 of a mile downstream of forest development road 3119, T42N, R4W, section 3, to McDonald rapids.

(iii) The east branch of the Ontonagon river (Houghton and Ontonagon counties) - the 25.5-mile segment from the east branch of the Ontonagon river's confluence with an unnamed stream in T48N, R37W, section 30, to the Ottawa national forest boundary, T50W, R38W, section 33.

(iv) The middle branch of the Ontonagon river (Ontonagon county) - the 17.4-mile segment from Trout creek, T48N, R38W, section 20, to the northern boundary of the Ottawa national forest, T50N, R39W, section 12.

(v) The Sturgeon river (Baraga and Houghton counties) - the 16.5-mile segment from the Sturgeon river's entry into the Ottawa national forest, T48N, R35W, section 12, to Prickett lake.

(vi) The east branch of the Tahquamenon river (Chippewa county) - the 3.2-mile segment from the center of T46N, R6W, section 20, to the boundary of the Hiawatha national forest, T46N, R6W, section 19.

(vii) The Yellow Dog river (Marquette county) - the 4-mile segment from the Yellow Dog river's origin at the outlet of Bulldog lake dam, T50N, R29W, section 31, to the boundary of the Ottawa national forest, T50N, R29W, section 17.

(b) The main, north, south, east, and west branches of the Two-Hearted river and Dawson creek from their headwaters to the mouth of the river at Lake Superior, which are designated as wilderness rivers pursuant to part 305 of Act No. 451 of the Public Acts of 1994, as amended, being §324.30501 et seq. of the Michigan Compiled Laws.

(c) Water bodies within the designated boundaries of the following national parks or national lakeshores:

(i) Sleeping bear dunes national lakeshore.

(ii) Pictured rocks national lakeshore.

(iii) Isle royale national park.

(7) All surface waters of the Lake Superior basin that are not identified as OSRWs are designated as Lake Superior basin - outstanding international resource waters (LSB-OIRW). Under the LSB-OIRW designation, new or increased loadings of any LSB-BSIC from point sources to the surface waters of the Lake Superior basin are prohibited unless the new or increased loading of a LSB-BSIC is consistent with the requirements of this rule.

(8) Except for water bodies designated as OSRWs, or as the department may determine on a case-by-case basis that the application of the procedures in this rule are required to adequately protect water quality, the following do not constitute a lowering of water quality.

(a) The short-term, temporary, for example, weeks or months, lowering of water quality.

(b) Bypasses that are not prohibited by regulations set forth in 40 C.F.R. §122.41(m) (1995).

(c) Response actions undertaken to alleviate a release into the environment of pollutants that may pose an imminent and substantial danger to the public health or welfare under any of the following:

(i) The comprehensive environmental response, compensation and liability act of 1980, (CERCLA), as amended, 42 U.S.C. §9601 et seq.

(ii) The resource conservation and resource recovery act of 1976, as amended, 42 U.S.C. §6901 et seq.

(iii) Part 201 of Act No. 451 of the Public Acts of 1994, as amended, being §§324.20101 to 324.20141 of the Michigan Compiled Laws.
(iv) Part 213 of Act No. 451 of the Public Acts of 1994, as amended, being §§324.21301 to 324.21331 of the Michigan Compiled Laws.
(v) Part 31 of Act No. 451 of the Public Acts of 1994, as amended, being §§324.3101 to 324.3119 of the Michigan Compiled Laws.
(d) Discharges of pollutant quantities from the intake water at a facility proposing a new or increased loading of a pollutant, if the intake and discharge are on the same body of water.
(e) Increasing the sewered area, connecting new sewers and customers, or accepting trucked-in wastes, such as septage and holding tank wastes, by a publicly owned treatment works, if the increase is within the design flow of the facility, there is no increased loading due to nondomestic wastes from a significant industrial user for BCCs that are not specifically limited in the current permit, and there is no significant change expected in the characteristics of the wastewater collected.
(f) Intermittent increased loadings related to wet-weather conditions.
(g) New or increased loadings due to implementation of department-approved industrial or municipal controls on wet-weather related flows, including combined sewer overflows and industrial storm water.
(h) New or increased loadings authorized by certificates of coverage under NPDES general permits and notices of coverage for storm water from construction activities.
(i) Increased non-BCC loadings within the authorized levels of a limit in an existing control document.
(j) Increased BCC loadings within the authorized levels of a limit in an existing control document, except for those BCC loadings that result from actions by the permittee that would otherwise require submittal of an increased use request.
(k) New or increased loadings at a site where there is a simultaneous enforceable decrease in the allowed loading of the pollutant under consideration from sources contributing to the receiving water body, such that there is no net increase in the loading of the pollutant to the water body at that site consistent with trading rules established by the department.
(9) Except for water bodies designated as OSRWs, the following do not constitute a lowering of water quality:
(a) Increased loadings within the existing capacity and processes that are covered by the existing applicable control document, including the following:
(i) Normal operational variability.
(ii) Changes in intake water pollutants.
(iii) Increasing the production hours of the facility, for example, adding a second shift.
(iv) Increasing the rate of production.
(b) Changes in a control document that are not a result of changes in pollutant loading, but are the result of any of the following:
(i) Improved monitoring data.
(ii) New or improved analytical methods or sensitivity.
(iii) New or modified water quality values.
(c) Increased loadings of a pollutant which do not involve a BCC and which use less than 10% of the unused loading capacity that exists at the time of the request.

R 323.1099 Rescinded.

R 323.1100 Designated uses.

Rule 100. (1) At a minimum, all surface waters of the state are designated and protected for all of the following uses:

(a) Agriculture.

(b) Navigation.

(c) Industrial water supply.

(d) Warmwater fishery.

(e) Other indigenous aquatic life and wildlife.

(f) Partial body contact recreation.

(g) Fish consumption.

(2) All surface waters of the state are designated and protected for total body contact recreation from May 1 to October 31 in accordance with the provisions of R 323.1062. Total body contact recreation immediately downstream of wastewater discharges, areas of significant urban runoff, combined sewer overflows, and areas influenced by certain agricultural practices is contrary to prudent public health and safety practices, even though water quality standards may be met.

(3) If designated uses are interrupted due to uncontrollable circumstances during or following flood conditions, accidental spillages, or other emergencies, then notice shall be served upon entities affected by the interruption in accordance with procedures established by the department. Prompt corrective action shall be taken by the discharger to restore the designated uses.

(4) All inland lakes identified in the publication entitled "Coldwater Lakes of Michigan," as published in 1976 by the department of natural resources, are designated and protected for coldwater fisheries.

(5) All Great Lakes and their connecting waters, except for the entire Keweenaw waterway, including Portage lake, Houghton county, and Lake St. Clair, are designated and protected for coldwater fisheries.

(6) All lakes listed in the publication entitled "Designated Trout Lakes and Regulations," issued September 10, 1998, by the director of the department of natural resources under the authority of part 411 of 1994 PA 451, MCL 324.41101 et seq., are designated and protected for coldwater fisheries.

(7) All waters listed in the publication entitled "Designated Trout Streams for the State of Michigan," Director’s Order No. DFI-101.97, by the director of the department of natural resources under the authority of section 48701(m) of 1994 PA 451, MCL 324.48701(m) are designated and protected for coldwater fisheries.

(8) All surface waters of the state that are identified in the publication "Public Water Supply Intakes in Michigan," dated December 9, 1999, are designated and protected as public water supply sources at the point of water intake and in such contiguous areas as the department may determine necessary for assured protection. In addition, all Michigan waters of the Great Lakes and connecting waters shall meet the human cancer and human noncancer values for drinking water established pursuant to R 323.1057(4). The requirement to meet the human cancer and human noncancer values for drinking water shall not apply to pollutant loadings from a tributary in an area where a tributary mixes with the Great Lake, connecting water, or a waterbody that has been designated for use as a public water supply source, unless a water intake was located in this area on April 2, 1999.

(9) Water quality of all surface waters of the state serving as migratory routes for anadromous salmonids shall be protected as necessary to assure that migration is not adversely affected.

(10) Effluent discharges to wetlands that result in water quality that is inconsistent with that prescribed by these rules may be permitted after a use attainability analysis shows that designated uses are not and cannot be attained and shows that attainable uses will be protected.

(11) After completion of a comprehensive plan developed under R 323.1064(3), upon petition by a municipality or other person, and in conformance with the requirements of 40 C.F.R. §131.10 (1995), designation of uses, which are adopted by reference in R 323.1117, the department may determine that attainment of the dissolved oxygen standards of R 323.1064(1) is not feasible and designate, by amendment to this rule, a limited warmwater fishery use subcategory of the warmwater fishery use or a limited coldwater fishery use subcategory of coldwater fishery use. For waters so designated, the dissolved oxygen standards specified in the provisions of R 323.1064(2) and all other applicable standards of these rules apply. For waters so designated, the dissolved oxygen standards specified in R 323.1064(1) do not apply. Not less than 60 days before a municipality or other person files a petition pursuant to this subrule, a petitioner shall provide written notice to the department and the clerk of the municipalities in which the affected waters are located of the petitioner's intent to file a petition.

R 323.1103 Variances.

Rule 103. (1) A variance may be granted from any water quality standard (WQS) that is the basis of a water quality-based effluent limitation in a national pollutant discharge elimination system (NPDES) permit, as restricted by the following provisions:

(a) A WQS variance applies only to the permittee or permittees requesting the variance and only to the pollutant or pollutants specified in the variance. The variance does not modify the water quality standards for the water body as a whole.

(b) A variance shall not apply to new dischargers unless the proposed discharge is necessary to alleviate an imminent and substantial danger to the public health or welfare.

(c) A WQS variance shall not be granted that would likely jeopardize the continued existence of any endangered or threatened species listed under section 4 of the endangered species act or result in the destruction or adverse modification of the species' critical habitat.

(d) A WQS variance shall not be granted if the standard in the receiving water will be attained by implementing the treatment technology requirements under the clean water act of 1972, as amended, 33 U.S.C. §§301(b) and 306, and by the discharger implementing cost-effective and reasonable best management practices for nonpoint sources over which the discharger has control within the vicinity of the facility.

(e) The duration of a WQS variance shall not exceed the term of the NPDES permit. If the time frame of the variance is the same as the permit term, then the variance shall stay in effect until the permit is reissued or revoked.

(2) A variance may be granted if the permittee demonstrates to the department that attaining the WQS is not feasible for any of the following reasons:

(a) Naturally occurring pollutant concentrations prevent the attainment of the WQS.

(b) Natural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the WQS.

(c) Human-caused conditions or sources of pollution prevent the attainment of the WQS and cannot be remedied or more environmental damage would occur in correcting the conditions or sources of pollution than would occur by leaving the conditions or sources in place.

(d) Dams, diversions, or other types of hydrologic modifications preclude the attainment of the WQS, and it is not feasible to restore the water body to its original condition or to operate the modification in a way that would result in the attainment of the WQS.

(e) Physical conditions related to the natural features of the water body preclude attainment of WQS.

(f) Controls more stringent than the treatment technology requirements in the clean water act of 1972, as amended, 33 U.S.C. §§301(b) and 306 would result in unreasonable economic effects on the discharger and affected communities.

(3) In addition to the requirements of subrule (2) of this rule, a permittee shall do both of the following:

(a) Show that the variance requested conforms to the antidegradation demonstration requirements of R 323.1098.

(b) Characterize the extent of any increased risk to human health and the environment associated with granting the variance compared with compliance with WQS without the variance in a way that enables the department to conclude that the increased risk is consistent with the protection of the public health, safety, and welfare.

(4) A permittee may request a variance when a NPDES permit application is submitted or during permit development. A variance request may also be submitted with a request for a permit modification. The variance request to the department shall include the following information:

(a) All relevant information which demonstrates that attaining the WQS is not feasible based on 1 or more of the conditions in subrule (2) of this rule.

(b) All relevant information which demonstrates compliance with subrule (3) of this rule.

(5) The variance request shall be available to the public for review during the public comment period on the draft NPDES permit. The preliminary decision regarding the variance shall be included in the public notice of the draft NPDES permit. The department will notify the other Great Lakes states of the preliminary variance decision.

(6) If the department determines, based on the conditions of subrules (2) and (3) of this rule, that the variance request demonstrates that attaining the WQS is not feasible, then the department shall authorize the variance through issuance of the NPDES permit. The permit shall contain all conditions needed to implement the variance, including, at a minimum, all of the following conditions:

(a) That compliance with an effluent limitation that, at the time the variance is granted, represents the level currently achievable by the permittee. For an existing discharge, the effluent limitation shall be no less stringent than that achieved under the previous permit.

(b) That reasonable progress be made in effluent quality toward attaining the water quality standards. If the variance is approved for any BCC, a pollutant minimization program shall be conducted consistent with the provisions in paragraphs (i) through (iv) of R 323.1213(d). The department shall consider cost-effectiveness during the development and implementation of the pollutant minimization program.

(c) That if the duration of a variance is shorter than the duration of a permit, then compliance with an effluent limitation that is sufficient to meet the underlying water quality standard shall be achieved when the variance expires.

(7) The department shall deny a variance request through action on the NPDES permit if a permittee fails to make the demonstrations required under subrules (2) and (3) of this rule.

(8) A variance may be renewed, subject to the requirements of subrules (1) through (7) of this rule. As part of any renewal application, a permittee shall again demonstrate that attaining WQS is not feasible based on the requirements of subrules (2) and (3) of this rule. A permittee's application shall also contain information concerning the permittee's

compliance with the conditions incorporated into the permittee's permit as part of the original variance pursuant to subrule (6) of this rule.

(9) Notwithstanding the provision in subrule (1)(a) of this rule, the department may grant multiple discharger variances. If the department determines that a multiple discharger variance is necessary to address widespread WQS compliance issues, including the presence of ubiquitous pollutants or naturally high background levels of pollutants in a watershed, then the department may waive the variance demonstration requirements in subrules (2), (3), and (4) of this rule. A permittee that is included in the multiple discharger variance will be subject to the permit requirements of subrule (6) of this rule if it is determined under R 323.1211 that there is reasonable potential for the pollutant to exceed a permit limitation developed under to R 323.1209.

R 323.1105 Multiple designated uses.

Rule 105. When a particular portion of the surface waters of the state is designated for more than 1 use, the most restrictive water quality standards for 1 or more of those designated uses shall apply to that portion.

R 323.1116 Availability of documents.

Rule 116. The following documents referenced in this part are available for inspection at, and may be obtained at no cost from, the Lansing Office of the Department of Environmental Quality, P.O. Box 30273, Lansing, Michigan 48909-7773:

(a) "Designated Trout Lakes and Regulations," September 10, 1998.

(b) "Coldwater Lakes of Michigan," August 1976.

(c) "Designated Trout Streams for the State of Michigan," Director's Order No. DFI-101.97.

(d) "Public Water Supply Intakes in Michigan," December 9, 1999.

R 323.1117 Adoption of standards by reference.

Rule 117. All of the following standards are adopted by reference in these rules. Copies are available for inspection at the Lansing office of the Department of Environmental Quality, may be obtained from the Department of Environmental Quality, P.O. Box 30273, Lansing, Michigan 48909-7773, at a cost as of the time of adoption of these rules of 5 cents per page and a labor rate of $20.18 per hour, or may be otherwise obtained as indicated:

(a) "Guidelines Establishing Test Procedures for Analysis of Pollutants," 40 C.F.R. §136 et seq. (2000). Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, at a cost as of the time of adoption of these rules of $61.00, or via the internet at http://www.access.gpo.gov/nara.

(b) "Standards for Protection Against Radiation," 10 C.F.R. §20 et seq. (1995). Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, at a cost as of the time of adoption of these rules of $61.00, or via the internet at http://www.access.gpo.gov/nara.

(c) "Designation of Uses," 40 C.F.R. §131.10 (1995). Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, at a cost as of the time of adoption of these rules of $43.00, or via the internet at http://www.access.gpo.gov/nara.

(d) "Standard Guide for Conducting Bioconcentration Tests with Fishes and Saltwater Bivalve Molluscs" ASTM standard E 1022-94, 1994. Copies may be obtained from the

American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428-2959, at a cost as of the time of adoption of these rules of $45.60.

(e) "Conditions Applicable to all Permits," 40 C.F.R. §122.41(m) (1995). Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, at a cost as of the time of adoption of these rules of $43.00, or via the internet at http://www.access.gpo.gov/nara.

(f) Gobas, F.A.P.C. 1993. "A Model for Predicting the Bioaccumulation of Hydrophobic Organic Chemicals in Aquatic Foodwebs: Applications to Lake Ontario," Ecological Modeling, volume 69, pages 1 to 17.

(g) Howe, R.B., K.S. Crump, and C. Van Landingham (1986), Global '86, "A Computer Program to Extrapolate Quantal Animal Toxicity Data to Low Doses," United States EPA, Research Triangle Institute, K.S. Crump and Company, Inc.

(h) "Table 6. – Pollutants of Initial Focus in the Great Lakes Water Quality Initiative," 40 C.F.R. §132 (1995). Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, at a cost as of the time of adoption of these rules of $43.00, or via the internet at http://www.access.gpo.gov/nara.

(i) "Water Quality Standards Handbook, Second Edition, Section 3.7 – Site-specific Aquatic Life Criteria," EPA-823-b-94-005a, August 1994. Copies may be obtained from the National Service Center for Environmental Publications, P.O. Box 42419, Cincinnati, Ohio 45242-0419, or via the internet at http://www.epa.gov/ncepihom/index.htm , at no cost.

(j) "Recommendations for and Documentation of Biological Values for use in Risk Assessment," United States EPA, EPA/600/6-87/008, 1988.

(k) "Minimum Data Requirements," 40 C.F.R. §132, Appendix C, Item II, (1995). Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, at a cost as of the time of adoption of these rules of $43.00, or via the internet at http://www.access.gpo.gov/nara.

(l) "Registry of Toxic Effects of Chemical Substances (RTECS) Comprehensive Guide to the RTECS," Publication Number 97-119, United States Department of Health and Human Services, National Institute for Occupational Safety and Health, July 1997. Copies may be obtained from the National Institute for Occupational and Institutional Health, 4676 Columbia Parkway, C13, Cincinnati, OH 45226, or via the internet at http://www.cdc.gov/niosh/97-119.html, at no cost.

(m) United States EPA (2001), “Streamlined Water-Effect Ratio Procedure for Discharges of Copper”, EPA-822-R-01-005, March 2001. Copies may be obtained from the National Service Center for Environmental Publications, P.O. Box 42419, Cincinnati, Ohio 45242-0419, or via the internet at http://www.epa.gov/waterscience/criteria/copper, at no cost.