Missouri Clean Water Commission Meeting
Department of Natural Resources
Lewis and Clark State Office Building
LaCharrette/Nightingale Creek Conference Rooms
1101 Riverside Drive
Jefferson City, Missouri

January 06, 2016

Proposed Revisions to Water Quality Standards
10 CSR 20-7.031

Issue: The department is finalizing its recommendation on proposed revisions to the Water Quality Standards (WQS) at 10 CSR 20-7.031 and is informing the Commission of items proposed for the rulemaking.

Background: Pursuant to Section 303(c) of the federal Clean Water Act, the department has held workgroup and stakeholder meetings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting new or revised standards. The water quality standards to be addressed during this rulemaking include U.S. Environmental Protection Agency (EPA) disapprovals from previous rulemakings and revisions as a result of stakeholder input and discussion.

Priorities established as a result of this process include addressing EPA disapproved items (i.e., numeric nutrient criteria for lakes, variance language), updating water quality criteria for pH and other pollutants, changes to sections describing mixing zones and general criteria, and updating reference to department documents and datasets.

The department has prepared preliminary draft revisions to the WQS to address the above issues, to make the standards functionally equivalent to federal standards and to improve the clarity, specificity and effectiveness of the rule.

Recommended Action: Information only.

List of Attachments:

- Presentation to stakeholder workgroup on scope of rulemaking, December 10, 2015.
- Excerpts of draft rule amendment.
- Comments on draft rule by MO-Ag, October 1, 2015.
- Comments on Lake Numeric Nutrient Criteria by Missouri Pork Association, Missouri Corn Growers Association, Missouri Soybean Association and Missouri Farm Bureau, October 9, 2015.
- Presentation to stakeholder workgroup on Lake Numeric Nutrient Criteria, November 10, 2015.
- Decision letter on previous standards changes from EPA, November 17, 2015.

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Missouri 2015 WQS Triennial Review

Water Quality Standards Workgroup
December 10, 2015

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Waters of the State

- 2015 HB 92 changed definition of "waters of the state" at RSMo, 644.016(27)
- 10 CSR 20-7.031(1)(DD)

(DD) Waters of the state—All **waters within the jurisdiction of this state, including all** rivers, streams, lakes, and other bodies of surface and subsurface water lying within or forming a part of the boundaries of the state which are not entirely confined and located completely upon lands owned, leased, or otherwise controlled by a single person or by two (2) or more persons jointly or as tenants in common*[and includes waters of the United States lying within the state]*.

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Mixing Zones

- Revises 10 CSR 20-7.031(5)(A)4.B.(III) to allow site-specific mixing zones > 20 cfs
- Clarifies definitions for mixing zones at 10 CSR 20-7.031(1)(Q) and zones of initial dilution at 10 CSR 20-7.031(1)(GG) to ensure protection of sensitive species

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(III) Streams with 7Q10 low flow of greater than twenty cubic feet per second (20 cfs)— (a) Mixing zone—one-quarter (1/4) of stream width, cross-sectional area, or volume of flow; length of one-quarter (1/4) mile. **If the discharger can document that rapid and complete mixing of the effluent occurs in the receiving stream, the mixing zone may be up to one-half (1/2) of the stream width, cross-sectional area, or volume of flow**;

(1)(Q) Mixing zone—An area of dilution of effluent in the receiving water beyond which chronic toxicity criteria must be met. **The area shall not include any species that are known to be sensitive to the toxic pollutant that would use this area for mixing.**

(1)(GG) Zone of initial dilution—A small area of initial mixing below an effluent outfall beyond which acute toxicity criteria must be met. **The area shall not include any species that are known to be sensitive to the toxic pollutant that would use this area for dilution.**

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Site-Specific Criteria

- Removes additional language at 10 CSR 20-7.031(5)(A)

(A) The maximum chronic toxicity criteria in Tables A and B shall apply to waters designated for the indicated uses given in the Missouri Use Designation Dataset and Tables G and H*[, except for waters designated for Ephemeral Aquatic Habitat or where less stringent criteria have been developed following a use attainability analysis]*...

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Site-Specific Criteria

- Removes additional language at 10 CSR 20-7.031(5)(S)3

(S)3 Site-specific criteria shall protect all life stages of resident species and prevent acute and chronic toxicity in all parts of a water body *[unless early life stages are determined absent]*.

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Hardness

- Revises hardness definition from 25th percentile to median (50th percentile)
- 10 CSR 20-7.031(1)(BB)

(BB) Water hardness—The total concentration of calcium and magnesium ions expressed as calcium carbonate. For purposes of this rule, hardness will be **the median** *[determined by the lower quartile (twenty-fifth percentile)]* value of a representative number of samples from the water *[body]* in question or from *[a]* similar water**s** *[body]* at the appropriate stream flow conditions **within the same ecoregion**.

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pH

- Clarification that pH is a chronic (four-day average) criteria
- 10 CSR 20-7.031(5)(E)

(E) pH. Water contaminants shall not cause **the four-day average pH concentration of representative samples***[pH]* to be outside of the range of 6.5 to 9.0 standard pH units **(chronic toxicity)**.

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General Criteria Revisions

- Clarification regarding allowed toxicity in mixing zones, zones of initial dilution (4)(D)
- Clarification regarding applicability of GC to nutrient impacts (4)(E)
- Addition of narrative GC for protection of downstream uses (4)(F)

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(4)(D) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life. **However, acute toxicity may be allowed by permit in zones of initial dilution, and chronic toxicity may be allowed by permit in mixing zones**;

(4)(E) Waters shall be free from nutrients in sufficient amounts to cause harmful algal blooms, high turbidity, offensive odor, reduced aquatic biodiversity, or prevent full maintenance of beneficial uses;

(4)(F) Waters shall maintain a level of water quality at their confluences to downstream waters that provides for the attainment and maintenance of the water quality standards of those downstream waters, including waters of another state.

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Antidegradation Implementation Procedure

- Updates reference to Antidegradation Implementation Procedure (AIP)
- 10 CSR 20-7.031(3)(D)

The three (3) levels of protection provided by the antidegradation policy in subsections (A) through (C) of this section shall be implemented according to procedures hereby incorporated by reference and known as the "Missouri Antidegradation Rule and Implementation Procedure, *[May 2, 2012]***April 6, 2016**." No later amendments or additions are included. This document shall be made available to anyone upon written request to the Department of Natural Resources, Water Protection Program, Water Pollution Control Branch, PO Box 176, Jefferson City, MO 65102-0176.

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Losing Stream Reference, Table J

- Updates reference to "Losing Stream" information in definition, removes Table J
- 10 CSR 20-7.031(1)(N)

(N) Losing stream— ... Losing streams are **identified***[listed]* in **the digital geospatial dataset 'LOSING_STREAM' developed by the Missouri Department of Natural Resources, Missouri Geological Survey***[Table J]*; additional streams may be determined to be losing by the Missouri Department of Natural Resources.

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Site-specific Criteria, Table K

- Removes table that contains disapproved or expired site-specific dissolved oxygen criteria
- 10 CSR 20-7.031, Table K
- 10 CSR 20-7.031(5)(J)

(J) Dissolved Oxygen. Water contaminants shall not cause the dissolved oxygen to be lower than the levels described in Table A*[or Table K—Site-Specific Criteria]*.

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Missouri Use Designation Dataset (MUDD)

- Updates GIS data to refine the delineation of start and end points of water body features, update and incorporate water body features according to 10 CSR 20-7.031(2), and recalculate stream mileages and lake acreages.

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Water Quality Criteria

- Updates Section 304(a) Water Quality Criteria values, formatting of Table A
- Updates Numeric Nutrient Criteria for lakes and reservoirs for Aquatic Life Protection and Drinking Water Supply uses

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WQS Variances

- Removes disapproved variance language from rule
- 10 CSR 20-7.031(12)

(12) Variances.
(A) A permittee or an applicant for a National Pollutant Discharge Elimination System (NPDES) or Missouri state operating permit*[,]* may pursue a temporary variance to a water quality standard*[pursuant to either section 644.061 or section 644.062, RSMo]*. In order to obtain U.S. Environmental Protection Agency approval for a water quality standards variance for purposes of the federal Clean Water Act, the following additional provisions apply:

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WQS Variances

3. A variance shall not be granted for actions that will violate general criteria conditions prescribed by 10 CSR 20-7.031(4) **unless the variance includes conditions and a schedule of compliance by which such violations will be eliminated.**

5. A variance may be granted if the applicant demonstrates that achieving the water quality standard is not feasible as supported by an analysis based on the factors provided in 40 CFR 131.10(g)*[, or other appropriate factors]*.

Title 10--DEPARTMENT OF NATURAL RESOURCES
Division 20--Clean Water Commission
Chapter 7--Water Quality

Rule Amendment DRAFT

10 CSR 20-7.031 Water Quality Standards

PURPOSE: This rule identifies uses of waters of the state, criteria to protect those uses, and defines the antidegradation policy. It is developed in response to the Missouri Clean Water Law and the federal Clean Water Act, Section 303(c)(1) and (2), which requires that state water quality standards be reviewed at least once every three (3) years. These revisions are pursuant to the national goal of protection of fish, shellfish, and wildlife and recreation in and on the water as outlined in Section 101(a)(2) of the Act.

PUBLISHER'S NOTE: The secretary of state has determined that the publication of the entire text of the material which is incorporated by reference as a portion of this rule would be unduly cumbersome or expensive. This material as incorporated by reference in this rule shall be maintained by the agency at its headquarters and shall be made available to the public for inspection and copying at no more than the actual cost of reproduction. This note applies only to the reference material. The entire text of the rule is printed here.

(1) Definitions.

(A) Acute toxicity—Conditions producing adverse effects or lethality on aquatic life following short-term exposure. The acute criteria in Tables A and B are maximum concentrations which protect against acutely toxic conditions. Acute toxicity is also indicated by exceedence of whole-effluent toxicity (WET) test conditions of paragraph (4)(I)2. For substances not listed in Table A or B, three-tenths (0.3) of the median lethal concentration, or the no observed acute effect concentration for representative species, may be used to determine absence of acute toxicity.

(B) Aquifer—A subsurface water-bearing bed or stratum which stores or transmits water in recoverable quantities that is currently being used or could be used as a water source for private or public use. It does not include water in the vadose zone.

(C) Designated uses. Uses specified for each water body whether or not they are being attained. Uses are designated according to section (2) of this rule and include, but are not limited to—

1. Protection and propagation of fish, shellfish and wildlife. Streams will be designated to one of the following aquatic habitat protection uses based on watershed size, scale within the stream network and other hydrological and physical data. Lakes and reservoirs will be designated to one of the following aquatic habitat protection uses based on limnological characteristics (such as temperature) and biological assemblages.

A. Warm Water Habitat (WWH)—Waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of warm-water biota—

(I) *[Warm water habitat (]*Great River*[)]*;
(II) *[Warm water habitat (]*Large River*[)]*;
(III) *[Warm water habitat (]*Small River*[)]*;
(IV) *[Warm water habitat (]*Creek*[)]*;
(V) *[Warm water habitat (]*Headwater*[)]*; and
(VI) *[Warm water habitat (]*Lake or reservoir*[)]*.

B. Cool Water Habitat (CLH)—Waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of cool-water biota. These waters can support a sensitive, high-quality sport fishery (i.e., smallmouth bass and rock bass)—

(I) *[Cool water habitat (]*Large River*[)]*;
(II) *[Cool water habitat (]*Small River*[)]*;
(III) *[Cool water habitat (]*Creek*[)]*;
(IV) *[Cool water habitat (]*Headwater*[)]*; and
(V) *[Cool water habitat (]*Lake or reservoir*[)]*.

C. Cold Water Habitat (CDH)—Waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of cold-water biota. These waters can support a naturally reproducing or stocked trout fishery and populations of other cold-water species—

(I) *[Cold water habitat (]*Large River*[)]*;
(II) *[Cold water habitat (]*Small River*[)]*;
(III) *[Cold water habitat (]*Creek*[)]*;
(IV) *[Cold water habitat (]*Headwater*[)]*; and
(V) *[Cold water habitat (]*Lake or reservoir*[)]*.

D. Ephemeral Aquatic Habitat (EAH)—Waters having surface flow or pools in response to precipitation events or snow melt, but without permanent surface flow or permanent pools; naturally-occurring water quality and habitat conditions may allow the maintenance of a limited or transient community of aquatic biota.

E. Modified Aquatic Habitat (MAH)—Waters in which natural habitat conditions have been physically, chemically or biologically modified; habitat and resulting water quality conditions may prevent the maintenance of a wide variety or diversity of aquatic biota.

F. Limited Aquatic Habitat (LAH)—Waters in which natural habitat conditions have been substantially and irretrievably altered; habitat and resulting water quality conditions do not allow maintenance of aquatic biota, or if present, the community is of poor variety or diversity.

2. Recreation in and on the water. Assignment of these uses does not grant an individual the right to trespass.

A. Whole body contact recreation (WBC)—Activities involving direct human contact with waters of the state to the point of complete body submergence. The water may be ingested accidentally and certain sensitive body organs, such as the eyes, ears, and the nose, will be exposed to the water. Although the water may be ingested accidentally, it is not intended to be used as a potable supply unless acceptable treatment is applied. Waters so designated are intended to be used for swimming, water skiing, or skin diving.

(I) Category A (WBC-A)—This category applies to waters that have been established by the property owner as public swimming areas welcoming access by the public for swimming purposes and waters with documented existing whole body contact recreational use(s) by the public. Examples of this category include, but are not limited to: public swimming beaches and property where whole body contact recreational activity is open to and accessible by the public through law or written permission of the landowner.

(II) Category B (WBC-B)—This category applies to waters designated for whole body contact recreation not contained within category A.

B. Secondary contact recreation (SCR)—Uses include fishing, wading, commercial and recreational boating, any limited contact incidental to shoreline activities, and activities in which users do not swim or float in the water. These recreational activities may result in contact with the water that is either incidental or accidental and the probability of ingesting appreciable quantities of water is minimal.

3. Human health protection (HHP)—Criteria to protect this use are based on the assumption of an average amount of fish consumed on a long-term basis. Protection of this use includes compliance with Food and Drug Administration (FDA) limits for fish tissue, maximum water concentrations corresponding to the 10^{-6} cancer risk level, and other human health fish consumption criteria.

4. Irrigation (IRR)—Application of water to cropland or directly to cultivated plants that may be used for human or livestock consumption. Occasional supplemental irrigation, rather than continuous irrigation, is assumed.

5. Livestock and wildlife protection (LWP)—Maintenance of conditions in waters to support health in livestock and wildlife.

6. Drinking water supply (DWS)—Maintenance of a raw water supply which will yield potable water after treatment by public water treatment facilities.

7. Industrial water supply (IND)—Water to support various industrial uses; since quality needs will vary by industry, no specific criteria are set in these standards.

8. Storm- and flood-water storage and attenuation (WSA)—Wetlands and other waters which serve as overflow and storage areas during flood or storm events slowly release water to downstream areas, thus lowering flood peaks and associated damage to life and property.

9. Habitat for resident and migratory wildlife species, including rare and endangered species (WHP)—Wetlands and other waters that provide essential breeding, nesting, feeding, and predator escape habitats for wildlife including waterfowl, birds, mammals, fish, amphibians, and reptiles.

10. Recreational, cultural, educational, scientific, and natural aesthetic values and uses (WRC)—Wetlands and other waters that serve as recreational sites for fishing, hunting, and observing wildlife; waters of historic or archaeological significance; waters which provide great diversity for nature observation, educational opportunities, and scientific study.

11. Hydrologic cycle maintenance (WHC)—Wetlands and other waters hydrologically connected to rivers and streams serve to maintain flow conditions during periods of drought. Waters that are connected hydrologically to the groundwater system recharge groundwater supplies and assume an important local or regional role in maintaining groundwater levels.

(D) Biocriteria—Numeric values or narrative expressions that describe the reference biological integrity of aquatic communities inhabiting waters that have been designated for aquatic-life protection.

(E) Chronic toxicity—Conditions producing adverse effects on aquatic life or wildlife following long-term exposure but having no readily observable effect over a short time period. Chronic numeric criteria in Tables A and B are maximum concentrations which protect against chronic toxicity; these values shall be considered four- (4-) day averages, with the exception of total ammonia as nitrogen which shall be considered a thirty- (30-) day average. Chronic toxicity is also indicated by exceedence of WET test conditions of subsection (5)(Q). For substances not listed in Table A or B, commonly used endpoints such as the no-observed effect concentration or inhibition concentration of representative species may be used to demonstrate absence of toxicity.

(F) Class—All waters listed in the Missouri Use Designation Dataset and in Table G and Table H of this rule shall have a hydrologic class. During normal flow periods, some rivers back water into tributaries which do not otherwise have a hydrologic

class. These permanent backwater areas are considered to have the same hydrologic class as the water body into which the tributary flows.

1. Class L1—Lakes used primarily for public drinking water supply.

2. Class L2—Major reservoirs.

3. Class L3—Other lakes which are waters of the state. These include both public and private lakes. For effluent regulation purposes, publicly-owned L3 lakes are those for which a substantial portion of the surrounding lands are publicly owned or managed.

4. Class P—Streams that maintain permanent flow even in drought periods.

5. Class P1—Standing-water reaches of Class P streams.

6. Class C—Streams that may cease flow in dry periods but maintain permanent pools which support aquatic life.

7. Class E—Streams that do not maintain permanent surface flow or permanent pools, but have ephemeral surface flow or pools in response to precipitation events.

8. Class W—Wetlands that are waters of the state that meet the criteria in the *Corps of Engineers Wetlands Delineation Manual* (January 1987), and subsequent federal revisions and supplements. Class W waters do not include wetlands that are artificially created on dry land and maintained for the treatment of mine drainage, stormwater control, drainage associated with road construction, or industrial, municipal, or agricultural waste.

(G) Early life stages of fish—The pre-hatch embryonic period, the post-hatch free embryo or yolk-sac fry, and the larval period during which the organism feeds. Juvenile fish, which are anatomically rather similar to adults, are not considered an early life stage.

(H) Existing uses—Those uses actually attained in the water body on or after November 28, 1975, whether or not they are identified in the water quality standards.

(I) Ecoregion—Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. By recognizing the spatial differences in the capacities and potentials of ecosystems, ecoregions stratify the environment by its probable response to disturbance (Bryce, Omernik, and Larsen, 1999).

(J) Epilimnion—Zone of atmospheric mixing in a thermostratified lake.

(K) *Escherichia coli* (*E. coli*)—A type of fecal coliform bacteria found in the intestines of animals and humans. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination. Sewage may contain many types of disease-causing organisms (pathogens).

(L) Hypolimnion—Zone beneath the zone of atmospheric mixing in a thermostratified lake.

(M) Lethal concentration$_{50}$ (LC_{50})—Concentration of a toxicant which would be expected to kill fifty percent (50%) of the individuals of the test species organisms in a test of specified length of time.

(N) Losing stream—A stream which distributes thirty percent (30%) or more of its flow during low flow conditions through natural processes, such as through permeable geologic materials into a bedrock aquifer within two (2) miles' flow distance downstream of an existing or proposed discharge. Flow measurements to determine percentage of water loss must be corrected to approximate the 7Q10 stream flow. If a stream bed or drainage way has an intermittent flow or a flow insufficient to measure in accordance with this rule, it may be determined to be a losing stream on the basis of channel development, valley configuration, vegetation development, dye tracing studies, bedrock characteristics, geographical data, and other geological factors. Losing streams are **identified***[listed]* in **the digital geospatial dataset 'LOSING_STREAM' developed by the Missouri Department of Natural Resources, Missouri Geological Survey***[Table J]*; additional streams may be determined to be losing by the Missouri Department of Natural Resources.

(O) Low-flow conditions—Where used in this regulation in the context of mixing zones, the low-flow conditions shall refer to the minimum amount of stream flow occurring immediately upstream of a wastewater discharge and available, in whole or in part, for attenuation of wastewater pollutants.

1. Seven- (7-) day, one- (1-) in-ten- (10-) year low flow (7Q10)—The lowest average flow for seven (7) consecutive days that has a probable recurrence interval of once-in-ten (10) years.

2. Sixty- (60-) day, one- (1-) in-two- (2-) year low flow (60Q2)—The lowest average flow for sixty (60) consecutive days that has a probable recurrence interval of once-in-two (2) years.

3. Thirty- (30-) day, one- (1-) in-ten- (10-) year low flow (30Q10)—The lowest average flow for thirty (30) consecutive days that has a probable recurrence interval of once-in-ten (10) years.

4. One- (1-) day, one- (1-) in-ten- (10-) year low flow (1Q10)—The lowest average flow for one (1) day that has a probable recurrence interval of once-in-ten (10) years.

(P) Missouri Use Designation Dataset—A digital geospatial dataset used in conjunction with geographic information systems and maintained by the department. This dataset documents the names and locations of the state's rivers, streams, lakes and reservoirs which have been assigned designated uses. The initial version of this dataset, as adopted on November 6, 2013, reflects Tables G and H plus any additional presumptive uses described in section (2). The dataset will also include information regarding both pending and approved determinations, variances, use attainability analyses and water quality standards revisions. The dataset uses the geospatial framework provided by the National Hydrography Dataset and is enhanced and supported by hydrological and physical information obtained through the Missouri Resource Assessment Partnership (MoRAP) and other scientific sources. The dataset is limited in geographic extent to the state of Missouri.

(Q) Mixing zone—An area of dilution of effluent in the receiving water beyond which chronic toxicity criteria must be met. **The area shall not include any species that are known to be sensitive to the toxic pollutant that would use this area for mixing.**

(R) National Hydrography Dataset (NHD)—A digital vector dataset used in conjunction with geographic information systems to describe the location of rivers, streams, lakes, reservoirs, and other surface water features. As applied in this rule, the term refers to the 1:100,000 scale dataset generated by the United States Geological Survey. This dataset provides the geospatial framework for the Missouri Use Designation Dataset.

(S) Outstanding national resource waters—Waters which have outstanding national recreational and ecological significance. These waters shall receive special protection against any degradation in quality. Congressionally-designated rivers, including those in the Ozark national scenic riverways and the wild and scenic rivers system, are so designated (see Table D).

(T) Outstanding state resource waters—High quality waters with a significant aesthetic, recreational, or scientific value which are specifically designated as such by the Clean Water Commission (see Table E).

(U) Ozark streams—Streams lying within the Ozark faunal region as described in the *Aquatic Community Classification System for Missouri*, Missouri Department of Conservation, 1989.

(V) Reference lakes or reservoirs—Lakes or reservoirs determined by Missouri Department of Natural Resources to be the best available representatives of ecoregion waters in a natural condition with respect to habitat, water quality, biological integrity and diversity, watershed land use, and riparian conditions.

(W) Reference stream reaches—Stream reaches determined by the department to be the best available representatives of ecoregion waters in a natural condition, with respect to habitat, water quality, biological integrity and diversity, watershed land use, and riparian conditions.

(X) Regulated-flow streams—A stream that derives a majority of its flow from an impounded area with a flow-regulating device.

(Y) Use Attainability Analysis (UAA)—A structured scientific assessment of the factors affecting the attainment of the use which may include physical, chemical, biological, and economic factors as described in 40 CFR 131.10(g).

(Z) Variance—A temporary modification to 10 CSR 20-7.031 that is deemed necessary in accordance with section (12) of this rule.

(AA) Water effect ratio—Appropriate measure of the toxicity of a material obtained in a site water divided by the same measure of the toxicity of the same material obtained simultaneously in a laboratory dilution water.

(BB) Water hardness—The total concentration of calcium and magnesium ions expressed as calcium carbonate. For purposes of this rule, hardness will be **the median** *[determined by the lower quartile (twenty-fifth percentile)]* value of a representative number of samples from the water *[body]* in question or from *[a]* similar waters *[body]* at the appropriate stream flow conditions **within the same ecoregion**.

(CC) Water quality criteria—Chemical, physical, and biological properties of water that are necessary to protect beneficial water uses.

(DD) Waters of the state—All **waters within the jurisdiction of this state, including all** rivers, streams, lakes, and other bodies of surface and subsurface water lying within or forming a part of the boundaries of the state which are not entirely confined and located completely upon lands owned, leased, or otherwise controlled by a single person or by two (2) or more persons jointly or as tenants in common*[and includes waters of the United States lying within the state]*.

(EE) Wetlands—Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. This definition is consistent with both the United States Army Corps of Engineers wetlands definition at 33 CFR 328.3(b) and the United States Environmental Protection Agency wetlands definition at 40 CFR 232.2(r).

(FF) Whole effluent toxicity tests—A toxicity test conducted under specified laboratory conditions on specific indicator organisms. To estimate chronic and acute toxicity of the effluent in its receiving stream, the effluent may be diluted to simulate the computed percent effluent at the edge of the mixing zone or zone of initial dilution.

(GG) Zone of initial dilution—A small area of initial mixing below an effluent outfall beyond which acute toxicity criteria must be met. **The area shall not include any species that are known to be sensitive to the toxic pollutant that would use this area for dilution.**

(HH) Zone of passage—A continuous water route necessary to allow passage of organisms with no acutely toxic effects produced on their populations.

(II) Other definitions as set forth in the Missouri Clean Water Law and 10 CSR 20-2.010 shall apply to terms used in this rule.

(2) Designation of Uses.

(A) Rebuttable presumption. Consistent with the presumptive beneficial use protections described by 40 CFR Part 131 and section 101(a)(2) of the federal Clean Water Act—

1. All perennial rivers and streams;
2. All streams with permanent pools;
3. All rivers and streams included within the 1:100,000 scale National Hydrography Dataset (NHD) described in subsection (1)(R) of this rule; and

4. All lakes and reservoirs that intersect the flow lines of rivers and streams identified in paragraph (2)(A)3. of this rule, shall be presumed to support the following designated uses: Aquatic habitat protection; Human health protection; Whole body contact recreation – Category B; and Secondary contact recreation, as defined in this rule. This presumption is rebuttable subject to demonstration based on use attainability analyses as described in subsection (2)(F) of this rule.

(B) Presumed Uses. All waters described in subsection (2)(A) shall also be assigned Livestock and wildlife protection and Irrigation designated uses, as defined in this rule.

(C) Other Uses. Use designations other than those mentioned in subsections (2)(A) and (2)(B) of this rule may be applied to waters identified in subsection (2)(A), Table G and Table H of this rule on a site-specific, case-by-case basis following approval by the Clean Water Commission and U.S. Environmental Protection Agency.

(D) Use Designation. Uses of waters shall be designated as follows—

1. Designated uses applied to individual water bodies or stream segments pursuant to subsections (2)(A) through (2)(C) of this rule shall include those identified in Tables G and H and in the Missouri Use Designation Dataset maintained by the department, except as described in paragraph (2)(D)3. of this rule.

2. Designated uses may be assigned on a case-by-case basis to water bodies or stream segments not otherwise represented in Tables G and H or in the Missouri Use Designation Dataset but falling within the jurisdiction of the Missouri Clean Water Law.

3. Assuming reasonable evidence, presumptive beneficial use protections described above shall not apply to water bodies without designated uses pursuant to Tables G or H prior to November 6, 2013 that meet one of the following criteria:

A. Waste treatment systems, or prior converted cropland, which are excluded from the federal definition of "waters of the United States" under 40 CFR 122.2; or

B. Man-made structures which were constructed solely to treat or convey wastewater; or

C. Man-made bodies of water or structures which lack perennial flow and were constructed to treat, convey, or temporarily hold or slow stormwater following precipitation events (this may include certain structures associated with Best Management Practices such as sediment basins, wet and dry detention basins, bioretention basins, rain gardens, bioswales, etc.); or

D. Water bodies that lack jurisdiction under either the federal Clean Water Act or Missouri Clean Water Law.

After receiving such evidence, the department shall make a written determination regarding the applicability of the above-described presumptions, and such determination shall be subject to appeal pursuant to section 621.250, RSMo.

(E) Missouri Use Designation Dataset. The department shall maintain the geospatial dataset described in subsection (1)(P) of this rule. Future revisions to water quality standards in the State of Missouri shall be reflected in the Missouri Use Designation Dataset and shall take effect upon approval by the Clean Water Commission and U.S. Environmental Protection Agency.

(F) Use Attainability. Demonstrations of use attainability for the protection of fish, shellfish and wildlife, recreation in and on the water, or human health protection shall assess the physical, chemical, biological, economic or other factors affecting the attainment of a use pursuant to 40 CFR 131.10(g). Use attainability analyses intended for other designated uses shall be designed and implemented on a case-by-case basis. In accordance with 40 CFR 131.10(j), the following potential actions must be preceded and supported by a use attainability analysis:

1. Designation of a water body for uses that do not include the protection of fish, shellfish and wildlife, recreation in and on the water, and human health protection;

2. Removal of one or more of the uses identified in paragraph 1. of this section; or

3. Application of any use sub-categories for the protection of fish, shellfish and wildlife, recreation in and on the water, or human health protection which require less stringent criteria.

After receiving such demonstration, the department shall make a written determination regarding the use attainability analysis, and such determination shall be subject to appeal pursuant to section 621.250, RSMo.

(3) Antidegradation. The antidegradation policy shall provide three (3) levels of protection.

(A) Tier One. Public health, existing in-stream water uses, and a level of water quality necessary to protect existing uses shall be maintained and protected.

(B) Tier Two. For all waters of the state, if existing water quality is better than applicable water quality criteria established in these rules, that existing quality shall be fully maintained and protected. Water quality may be lowered only if the state finds, after full satisfaction of the intergovernmental coordination and public participation requirements, that the lowered water quality is necessary to allow important economic and social development in the geographical area in which the waters are located. In allowing the lowering of water quality, the state shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control before allowing any lowering of water quality. This provision allows a proposed new or modified point or nonpoint source of pollution to result in limited lowering of water quality provided that—

1. The source does not violate any of the general criteria set forth in section (**4***[3]*) of this rule, or any of the criteria for protection of beneficial uses set forth in section (**5***[4]*) of this rule;

2. The source meets all applicable technological effluent limitations and minimum standards of design for point sources or minimum pollution control practices for nonpoint sources; and

3. The lowering of water quality, in the judgment of the department, is necessary for the accommodation of important economic and social development in the geographical vicinity of the discharge. In making a preliminary determination based on socioeconomic development considerations, the department may consider the potential for regional increases in utility rates, taxation levels, or recoverable costs associated with the production of goods or services that may result from the imposition of a strict no-degradation policy. Consideration may also be given to the possible indirect effects of a policy on per capita income and the level of employment in the geographical vicinity of the proposed pollution source. Any preliminary decision by the department to allow a limited lowering of water quality will be stated as such in a public notice issued pursuant to 10 CSR 20-6.010. Pursuant to that provision, a public hearing will be held in the geographical vicinity of the proposed pollution source, if the department determines there is significant public interest in and need for a hearing.

(C) Tier Three. There shall be no lowered water quality in outstanding national resource waters or outstanding state resource waters, as designated in Tables D and E.

(D) The three (3) levels of protection provided by the antidegradation policy in subsections (A) through (C) of this section shall be implemented according to procedures hereby incorporated by reference and known as the "Missouri Antidegradation Rule and Implementation Procedure, *[May 2, 2012]***April 6, 2016**." No later amendments or additions are included. This document shall be made available to anyone upon written request to the Department of Natural Resources, Water Protection Program, Water Pollution Control Branch, PO Box 176, Jefferson City, MO 65102-0176.

(4) General Criteria. The following water quality criteria shall be applicable to all waters of the state at all times including mixing zones. No water contaminant, by itself or in combination with other substances, shall prevent the waters of the state from meeting the following conditions:

(A) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly, or harmful bottom deposits or prevent full maintenance of beneficial uses;

(B) Waters shall be free from oil, scum, and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses;

(C) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor, or prevent full maintenance of beneficial uses;

(D) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life**. However, acute toxicity may be allowed by permit in zones of initial dilution, and chronic toxicity may be allowed by permit in mixing zones;**

(E) Waters shall be free from nutrients in sufficient amounts to cause harmful algal blooms, high turbidity, offensive odor, reduced aquatic biodiversity, or prevent full maintenance of beneficial uses;

(F) Waters shall maintain a level of water quality at their confluences to downstream waters that provides for the attainment and maintenance of the water quality standards of those downstream waters, including waters of another state.

(*[E]***G**) There shall be no significant human health hazard from incidental contact with the water;

(*[F]***H**) There shall be no acute toxicity to livestock or wildlife watering;

(*[G]***I**) Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community;

(*[H]***J**) Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment, and solid waste as defined in Missouri's Solid Waste Law, section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to sections 260.200–260.247, RSMo;

(*[I]***K**) Waters in mixing zones, ephemeral aquatic habitat and waters of the state lacking designated uses shall be subject to the following requirements:

1. The acute toxicity criteria of Tables A and B and the requirements of subsection (5)(B); and
2. The following whole effluent toxicity conditions must be satisfied:

A. Single dilution method. The percent effluent at the edge of the zone of initial dilution will be computed and toxicity tests performed at this percent effluent. These tests must show statistically-insignificant mortality on the most sensitive of at least two (2) representative, diverse species; and

B. Multiple dilution method. An LC_{50} will be derived from a series of test dilutions. The computed percent effluent at the edge of the zone of initial dilution must be less than three-tenths (0.3) of the LC_{50} for the most sensitive of at least two (2) representative, diverse species.

(5) Specific Criteria. The specific criteria shall apply to waters contained in Tables G and H of this rule and the Missouri Use Designation Dataset. Protection of drinking water supply is limited to surface waters designated for raw drinking water supply and aquifers. Protection of whole body contact recreation is limited to waters designated for that use.

(A) The maximum chronic toxicity criteria in Tables A and B shall apply to waters designated for the indicated uses given in the Missouri Use Designation Dataset and Tables G and H*[, except for waters designated for Ephemeral Aquatic Habitat or where less stringent criteria have been developed following a use attainability analysis]*. All Table A and B criteria are chronic toxicity criteria, except those specifically identified as acute criteria. Water contaminants shall not cause or contribute to concentrations in excess of these values. Table A values listed as health advisory levels shall be used in establishing discharge permit limits and management strategies until additional data becomes available to support alternative criteria, or other standards are established. However, exceptions may be granted in the following cases:

1. Permanent flow streams when the stream flow is less than 7Q10;

2. Regulated flow streams if the flow is less than the minimum release flow agreed upon by the regulating agencies;

3. For the natural and unavoidable chemical and physical changes that occur in the hypolimnion of lakes. Streams below impoundments shall meet applicable specific criteria;

4. For mixing zones.

A. The mixing zone shall be exempted from the chronic criteria requirements of this section for those components of waste that are rendered nontoxic by dilution, dissipation, or rapid chemical transformation. Acute numeric criteria of Tables A and B and whole effluent acute toxicity requirements of subsection (4)(I) must be met at all times within the mixing zone, except within the zone of initial dilution. The following criteria do not apply to thermal mixing zones. Criteria for thermal mixing zones are listed in paragraph (5)(D)6.

B. The maximum size of mixing zones and zone of initial dilution will be determined as follows**; the size may be refined by the use of mixing zone models, e.g. CORMIX, as appropriate**:

(I) Streams with 7Q10 low flows of less than one-tenth cubic foot per second (0.1 cfs);

(a) Mixing zone—not allowed; and

(b) Zone of initial dilution—not allowed;

(II) Streams with 7Q10 low flow of one-tenth to twenty cubic feet per second (0.1–20 cfs)—

(a) Mixing zone—one-quarter (1/4) of the stream width, cross-sectional area, or volume of flow; length one-quarter (1/4) mile. If the discharger can document that rapid and complete mixing of the effluent occurs in the receiving stream, the mixing zone may be up to one-half (1/2) of the stream width, cross-sectional area, or volume of flow; and

(b) Zone of initial dilution—one-tenth (0.1) of the mixing zone width, cross-sectional area, or volume of flow;

(III) Streams with 7Q10 low flow of greater than twenty cubic feet per second (20 cfs)—

(a) Mixing zone—one-quarter (1/4) of stream width, cross-sectional area, or volume of flow; length of one-quarter (1/4) mile. **If the discharger can document that rapid and complete mixing of the effluent occurs in the receiving stream, the mixing zone may be up to one-half (1/2) of the stream width, cross-sectional area, or volume of flow**; and

(b) Zone of initial dilution—one-tenth (0.1) of the mixing zone width, cross-sectional area, or volume of flow and no more than ten (10) times the effluent design flow volume unless the use of diffusers or specific mixing zone studies can justify more dilution; and

(IV) Lakes.

(a) Mixing zone—not to exceed one-quarter (1/4) of the lake width at the discharge point or one hundred feet (100') from the discharge point, whichever is less.

(b) Zone of initial dilution—not allowed.

C. A mixing zone shall not overlap another mixing zone in a manner that the maintenance of aquatic life in the body of water in the overlapping area would be further adversely affected.

D. Other factors that may prohibit or further limit the size and location of mixing zones are the size of the river, the volume of discharge, the stream bank configuration, the mixing velocities, other hydrologic or physiographic characteristics, and the designated uses of the water, including type of aquatic life supported, potential effects on mouths of tributary streams, and proximity to water supply intakes.

E. Zones of passage must be provided wherever mixing zones are allowed.

F. Mixing zone and zone of initial dilution size limits will normally be based on streams at the 7Q10 low flow. However, this percent of stream size limits also applies at higher stream flows and discharge limitations may be based on higher stream flows if discharge volume or quality may be adjusted to correlate with stream flow; and

5. For wetlands. Water quality needs will vary depending on the individual characteristics of the wetland. Application of numeric criteria will depend on the specific aquatic life, wildlife, and vegetation requirements.

A. Specific criteria for wetlands shall be developed using scientific procedures including, but not limited to, those procedures described in the U.S. Environmental Protection Agency's *Water Quality Standards Handbook*, Second Edition, August 1994 as published by the Office of Science and Technology, Office of Water, U.S. Environmental Protection Agency, Washington, DC 20460, which are hereby incorporated by reference and do not include any later amendments or additions. The department shall maintain a copy of the referenced documents and shall make them available to the public for inspection and copying at no more than the actual cost of reproduction.

B. Specific criteria shall protect all life stages of species associated with wetlands and prevent acute and chronic toxicity in all parts of the wetland.

C. Specific criteria shall include both chronic and acute concentrations to better reflect the different tolerances to the inherent variability between concentrations and toxicological characteristics of a condition.

D. Specific criteria shall be clearly identified as maximum "not to be exceeded" or average values, and if an average, the averaging period and the minimum number of samples. The conditions, if any, when the criteria apply shall be clearly stated (e.g., specific levels of hardness, pH, or water temperature). Specific sampling requirements (e.g., location, frequency), if any, shall also be identified.

E. The data, testing procedures, and application (safety) factors used to develop specific criteria shall reflect the nature of the condition (e.g., persistency, bioaccumulation potential) and the most sensitive species associated with the wetland.

F. Each specific criterion shall be promulgated in rule 10 CSR 20-7.031. The public notice shall include a description of the affected wetland and the reasons for applying the proposed criterion. A public hearing may be held in the geographical vicinity of the affected wetland. Any specific criterion promulgated under these provisions is subject to U.S. Environmental Protection Agency approval prior to becoming effective.

(B) Toxic Substances.

1. Water contaminants shall not cause the criteria in Tables A and B to be exceeded. Concentrations of these substances in bottom sediments or waters shall not harm benthic organisms and shall not accumulate through the food chain in harmful concentrations, nor shall state and federal maximum fish tissue levels for fish consumption be exceeded. More stringent criteria may be imposed if there is evidence of additive or synergistic effects.

2. For compliance with this rule, metals shall be analyzed by the following methods:

A. Aquatic life protection and human-health protection—fish consumption.

(I) Mercury—total recoverable metals.

(II) All other metals—dissolved metals;

B. Drinking water supply—total recoverable metals; and

C. All other beneficial uses—total recoverable metals.

3. Other potentially toxic substances for which sufficient toxicity data are not available may not be released to waters of the state until safe levels are demonstrated through adequate bioassay studies.

4. Drinking water criteria, for substances which are rendered nontoxic by transformation processes in the surface water body, shall apply at water supply withdrawal points.

5. Site-specific alternative criteria for human health-fish consumption may be allowed. Designation of these site-specific criteria must follow procedures set forth in U.S. Environmental Protection Agency's *Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health, October 2000* (EPA-822-B-00-004), as published by the Office of Science and Technology, Office of Water, U.S. Environmental Protection Agency, Washington, DC 20460, which is hereby incorporated by reference and does not include any later amendments or additions. The department shall maintain a copy of the referenced document and shall make it available to the public for inspection and copying at no more than the actual cost of reproduction.

6. Metals criteria for which toxicity is hardness dependent are in equation format in Table A.

7. Total ammonia nitrogen. For any given sample, the total ammonia nitrogen criteria shall be based on the pH and temperature of the water body measured at the time of each sample at the point of compliance.

A. The acute criteria shall not be exceeded at any time except in those waters for which the department has allowed a zone of initial dilution (ZID). The one- (1-) day Q_{10} low flow condition will be used in determining acute total ammonia nitrogen criteria.

B. The chronic criteria shall not be exceeded except in water segments for which the department has allowed a mixing zone (MZ). The chronic criteria shall be based on a thirty- (30-) day exposure period. Therefore, the thirty- (30-) day Q_{10} low flow condition of the receiving water body will be used in determining chronic total ammonia nitrogen criteria.

C. Without sufficient and reliable data, it is assumed that early life stages are present and must be protected at all times of the year.

(I) Sufficient and reliable data shall include, but are not limited to, seasonal studies on the fish species distributions, spawning periods, nursery periods, duration of sensitive life stages, and water body temperature. Best professional judgment from fisheries biologists and other scientists will be considered as appropriate.

(II) The time frames during the year when early life stages are considered to be absent are those time periods when early life stages are present in numbers that, if chronic toxicity did occur, would not affect the long-term success of the populations.

(III) A source of information for determining the duration of early life stages is *The American Society for Testing and Materials (ASTM) Standard E-1241*, "Standard Guide for Conducting Early Life-Stage Toxicity Tests with Fishes."

(IV) Protection of early life stages should include the most sensitive species that have used a water body for spawning and rearing since November 28, 1975.

(C) Bacteria. The protection of whole body contact recreation is limited to waters designated for that use. The recreational season is from April 1 to October 31. The *E. coli* count shall not exceed the criterion listed in Table A as a geometric mean during the recreational season in waters designated for whole body contact recreation. The *E. coli* count shall not exceed one hundred twenty-six (126) per one hundred milliliters (100 mL) at any time in losing streams. For waters designated for secondary contact recreation, the *E. coli* count shall not exceed one thousand one hundred thirty-four (1,134) per one hundred milliliters (100 mL) as a geometric mean during the recreational season.

(D) Temperature.

1. For warm water habitats beyond the mixing zone, water contaminant sources and physical alteration of the water course shall not raise or lower the temperature of a stream more than five degrees Fahrenheit (5 °F) or two and seven-ninths degrees Celsius (2 7/9 °C). Water contaminant sources shall not cause or contribute to stream temperature in excess of ninety degrees Fahrenheit (90 °F) or thirty-two and two-ninths degrees Celsius (32 2/9 °C). However, site-specific ambient temperature data and requirements of sensitive resident aquatic species will be considered, when data are available, to establish alternative maxima or deviations from ambient temperatures.

2. For cool water habitats beyond the mixing zone, water contaminant sources and physical alteration of the water course shall not raise or lower the temperature of a stream more than five degrees Fahrenheit (5 °F) or two and seven-ninths degrees Celsius (2 7/9 °C). Water contaminant sources shall not cause or contribute to stream temperature in excess of eighty-four degrees Fahrenheit (84 °F) or twenty-eight and eight-ninths degrees Celsius (28 8/9 °C).

3. For cold water habitats beyond the mixing zone, water contaminant sources and physical alteration of the water course shall not raise or lower the temperature of the water body more than two degrees Fahrenheit (2 °F) or one and one-ninth degrees Celsius (1 1/9 °C). Water contaminant sources shall not cause or contribute to temperatures above sixty-eight degrees Fahrenheit (68 °F) or twenty degrees Celsius (20 °C).

4. Water contaminant sources shall not cause any measurable rise in the temperature of lakes. An increase is allowable for Lake Springfield, Thomas Hill Reservoir, and Montrose Lake; however, discharges from these lakes must comply with temperature limits for streams.

5. For the Mississippi River Zones 1A and 2, the water temperature outside the mixing zone shall not exceed the maximum limits indicated in the following list during more than one percent (1%) of the time in any -calendar year. In Zone 1B, limits may not be exceeded more than five percent (5%) of the time in a calendar year. At no time shall the river water temperature outside of the thermal mixing zone exceed the listed limits by more than three degrees Fahrenheit (3 °F) or one and six-ninths degrees Celsius (1 6/9 °C).

	A and B		**C**	
	(°F)	(°C)	(°F)	(°C)
January	45	7 2/9	50	10
February	45	7 2/9	50	10
March	57	13 8/9	60	15 5/9
April	68	20	70	21 1/9
May	78	25 5/9	80	26 6/9
June	86	30	87	30 5/9
July	88	31 1/9	89	31 6/9
August	88	31 1/9	89	31 6/9
September	86	30	87	30 5/9
October	75	23 8/9	78	25 5/9
November	65	18 3/9	70	21 1/9
December	52	11 1/9	57	13 8/9

A = Zone 1A—Des Moines River to Lock and Dam No. 25.
B = Zone 1B—Lock and Dam No. 25 to Lock and Dam No. 26.
C = Zone 2—Lock and Dam No. 26 to the Missouri-Arkansas state line.

6. Thermal mixing zones shall be limited to twenty-five percent (25%) of the cross-sectional area or volume of a river, unless biological surveys performed in response to section 316(a) of the federal Clean Water Act (or equivalent) indicate no significant adverse impact on aquatic life. Thermal plume lengths and widths within rivers, and all plume dimensions within lakes, shall be determined on a case-by-case basis and shall be based on physical and biological surveys when appropriate.

(E) pH. Water contaminants shall not cause **the four-day average pH concentration of representative samples***[pH]* to be outside of the range of 6.5 to 9.0 standard pH units (**chronic toxicity**).

(F) Taste- and Odor-Producing Substances. Taste- and odor-producing substances shall be limited to concentrations in the streams or lakes that will not interfere with beneficial uses of the water. For those streams and lakes designated for drinking water supply use, the taste- and odor-producing substances shall be limited to concentrations that will not interfere with the production of potable water by reasonable water treatment processes.

(G) Turbidity and Color. Water contaminants shall not cause or contribute to turbidity or color that will cause substantial visible contrast with the natural appearance of the stream or lake or interfere with beneficial uses.

(H) Solids. Water contaminants shall not cause or contribute to solids in excess of a level that will interfere with beneficial uses. The stream or lake bottom shall be free of materials which will adversely alter the composition of the benthos, interfere with the spawning of fish or development of their eggs, or adversely change the physical or chemical nature of the bottom.

(I) Radioactive Materials. All streams and lakes shall conform to state and federal limits for radionuclides established for drinking water supply.

(J) Dissolved Oxygen. Water contaminants shall not cause the dissolved oxygen to be lower than the levels described in Table A*[or Table K—Site-Specific Criteria]*.

(K) Total Dissolved Gases. Operation of impoundments shall not cause the total dissolved gas concentrations to exceed one hundred ten percent (110%) of the saturation value for gases at the existing atmospheric and hydrostatic pressures.

(L) Sulfate and Chloride Limit for Protection of Aquatic Life. Water contaminants shall not cause sulfate or chloride criteria to exceed the levels described in Table A.

(M) Carcinogenic Substances. Carcinogenic substances shall not exceed concentrations in water which correspond to the 10^{-6} cancer risk rate. This risk rate equates to one (1) additional cancer case in a population of one (1) million with lifetime exposure. Derivation of this concentration assumes average water and fish consumption amounts. Assumptions are two (2) liters of water and six and one-half (6.5) grams of fish consumed per day. Federally established final maximum contaminant levels for drinking water supply shall supersede drinking water supply criteria developed in this manner.

(N) Nutrients and Chlorophyll.

1. Definitions.

A. For the purposes of this rule, *[—*
(I) A] **all** lakes and reservoirs shall be referred to as "lakes".*[; and*
(II) Only total phosphorus (TP) criteria are derived from lake characteristics. Total nitrogen (TN) and chlorophyll (Chl) criteria are determined as a function of TP criteria.]

B. Lake ecoregions—Due to differences in **watershed** topography, soils, and geology, nutrient criteria for lakes and reservoirs will be determined by the use of four (4) major ecoregions **based upon dominant watershed ecoregion.** These regions were delineated by grouping the ecological subsections described in Nigh and Schroeder, 2002, *Atlas of Missouri Ecoregions, [Missouri Department of Conservation]* as follows:
(I) Plains: **OP1 – Scarped Osage Plains: OP2 – Cherokee Plains;** TP2—Deep Loess Hills; TP3—Loess Hills; TP4—Grand River Hills; TP5—Chariton River Hills; TP6—Claypan Till Plains; TP7—Wyaconda River Dissected Till Plains; TP8—Mississippi River Hills;
(II) Ozark Border: MB2a—Crowley's Ridge Loess Woodland/Forest Hills; OZ11—Prairie Ozark Border; OZ12—Outer Ozark Border; OZ13—Inner Ozark Border;
(III) Ozark Highland: OZ1—Springfield Plain; OZ2—Springfield Plateau; OZ3—Elk River Hills; OZ4—White River Hills; OZ5—Central Plateau; OZ6—Osage River Hills; OZ7—Gasconade River Hills; OZ8—Meramec River Hills; OZ9—Current River Hills; OZ10—St. Francois Knobs and Basins; OZ14—Black River Ozark Border; and
(IV) Big River Floodplain: MB1—Black River Alluvial Plain; MB2b—Crowley's Ridge Footslopes and Alluvial Plains; MB3—St. Francis River Alluvial Plain; MB4, OZ16, TP9—Mississippi River Alluvial Plain; OZ15, TP1—Missouri River Alluvial Plain.

C. Nutrient Criteria—**The following nutrient criteria represent the desired condition for a water body necessary to protect the designated uses assigned in rule:**
[(I) Prediction value—A TP concentration that is derived from the characteristics of a lake including dam height in feet, hydraulic residence time in years, and percentage of the watershed that was historically covered by prairie grasses. Prediction values for total phosphorus are calculated directly from these characteristics.
(II) Reference value—A TP concentration that is representative of lakes within an ecoregion having the following characteristics:
(a) Less than twenty percent (20%) of the watershed is in crop land and urban land combined;
(b) There are no point source wastewater discharges and no concentrated animal feeding operations within the watershed;
(c) In the Plains region, more than fifty percent (50%) of the watershed is in grass land; and
(d) In the Ozark Highlands region, more than fifty percent (50%) of the watershed is in woodland.]
(I) Lake Ecoregion Criteria – Maximum Ambient Concentration of Chlorophyll-a (Chl-a) that is based on the geometric mean of a minimum of three (3) years of data for lakes within a lake ecoregion that have not been assigned site-specific criteria.
[(III) Site-specific value—A TP concentration for a lake that has been identified as having trophic characteristics for which the reference of the ecoregion and the prediction values for that water body are not adequate to prevent deterioration of water quality. Site-specific criteria are applicable to lakes having a geometric mean TP concentration equal to or less than the 10th percentile value of the range of geometric mean TP concentrations measured in reference lakes within a lake ecoregion. Site-specific criteria are also applicable to lakes with actual TP geometric mean concentrations that are at or below the reference value where the prediction value is at or below the 10th percentile for TP geometric mean concentrations within a lake ecoregion. The 10th percentile values for each ecoregion are listed in Table L and lakes with site-specific criteria are listed in Tables M and N.]
(II) Lake Site-Specific Criteria – Maximum Ambient Concentrations of total phosphorus (TP), total nitrogen (TN), or Chl-a that are based on the geometric mean of a minimum of three (3) years of data and the unique characteristics of the waterbody.

D. Nutrient Screening Values—The following nutrient screening values represent nutrient concentrations that, over time, set the potential to threaten the designated uses assigned in rule:
(I) Long-Term Screening Value – Maximum Ambient Concentrations of TP, TN, and Chl-a that are based on the geometric mean of a minimum of three (3) years of nutrient data.
(II) Short-Term Screening Value – Maximum Ambient Concentrations of TP, TN, and Chl-a that are based on the geometric mean of one (1) year of nutrient data.

E. Tributary arm—A substantial segment of a*[n]* **Class** L2 lake that is primarily recharged by a source or sources other than the main channel of the lake.

2. This rule applies to all lakes *[and reservoirs]* that are waters of the state and *[that are outside the Big River Floodplain ecoregion and]* have an area of at least ten (10) acres during normal pool **condition. Big River Floodplain lakes shall not be subject to these criteria.**

3. **Lake Ecoregion Criteria and Long-Term and Short-Term Screening Values for TP, TN, and Chl-a are listed in Table L. Lake Site-Specific Criteria for TP, TN, and Chl-a are listed in Table M. Additional lake site-specific criteria may be developed in accordance with subsection (5)(S) to account for the unique characteristics of the waterbody that affect trophic status, such as lake morphology, hydraulic residence time, temperature, internal nutrient cycling, or watershed contribution from multiple ecoregions. TP criteria for tributary arms of Class L2 lakes are listed in Table N.** *[Nutrient criteria for lakes and reservoirs with site-specific criteria are listed in Tables M and N. Nutrient criteria for other lakes are as follows:*

A. Total phosphorus (TP)—

(I) For lakes in which the TP prediction value or the actual TP concentration does not exceed the reference value listed in Table L, the TP criterion shall be the reference value, except as described below;
(II) For lakes in which the TP prediction value does not exceed the reference value, and the actual TP value does not exceed the prediction value, the TP criterion shall be the prediction value;
(III) For lakes in which the TP prediction value and the actual TP concentration exceed the reference value listed in Table L, the TP criterion shall be limited to the prediction value; and
(IV) Site-specific TP criteria for the tributary arms of L2 lakes are listed in Table N;

B. Total nitrogen (TN)—
(I) For lakes in which the TP prediction value does not exceed the reference value listed in Table L, TN concentration shall be limited to twenty (20) times the TP reference value;
(II) For lakes in which the TP prediction value does not exceed the reference value, and the actual TP value does not exceed the prediction value, TN concentration shall be limited to twenty (20) times the TP prediction value;
(III) For lakes in which the TP prediction value exceeds the TP reference value listed in Table L, TN concentration shall be limited to twenty (20) times the TP prediction value; and
(IV) This portion of the rule does not apply to lakes that are held to site-specific criteria for TP, TN, and Chl, as listed in Tables M and N; and

C. Chlorophyll (Chl)—Chl criteria shall be calculated from TP criteria as follows:
(I) Plains: Chl:TP = 0.44;
(II) Ozark Border and Ozark Highlands: Chl:TP = 0.42; and
(III) This portion of the rule does not apply to lakes that are held to site-specific criteria for TP, TN, and Chl, as listed in Tables M and N.]

4. All TP, TN, and **Chl-a** concentrations must be calculated as the geometric mean of a minimum of four (4) representative samples per year for **three (3) years for purposes of comparison to criteria and long-term screening values.** ***[four (4) years that are not necessarily consecutive].*** **All TP, TN, and Chl-a concentrations must be calculated as the geometric mean of a minimum of four (4) representative samples per year for one (1) year for purposes of comparison to short-term screening values.** All samples must be collected from the **lake** surface, near the outflow end of the lake, and during the period May 1–**September 30** *[August 31]*.

5. Lakes with water quality that exceed Nutrient Criteria identified in Tables L and M are to be deemed impaired for excess nutrients.

6. Lakes with water quality that exceed long-term or short-term screening values for Chl-a, TN, or TP will be assessed for impairment using a weight of evidence evaluation. Weight of evidence factors for aquatic life uses include: a) occurrence of eutrophication related fish mortality or morbidity events, b) epilimnetic excursions from dissolved oxygen or pH criteria, and c) excessive levels of mineral turbidity that consistently limit algal productivity during the period May 1 – September 30. Weight of evidence factors for drinking water supply uses include: a) impacts on water treatment operations due to eutrophication including excessive disinfection byproduct formation or unacceptable aesthetics, and b) reoccurring algal toxins in excess of guideline values found in the 4th edition of the World Health Organization's Guidelines for Drinking-water Quality.

7. Lakes with water quality that exceed long-term or short-term Screening values for Chl-a, TN, or TP for which the weight of evidence as described in paragraph 6 of this rule does not clearly indicate impairment or lack of impairment will receive continued observation and monitoring until such time as a determination can be made concerning their impairment status.

(O) All methods of sample collection, preservation, and analysis used in applying criteria in these standards shall be in accord with those prescribed in the latest edition of *Standard Methods for the Examination of Water and Wastewater* or other procedures approved by the Environmental Protection Agency and the Missouri Department of Natural Resources.

(P) Criteria to protect designated uses are based on current technical literature, especially the Environmental Protection Agency's publication, *Quality Criteria for Water*, 1986. Criteria may be modified or expanded as additional information is developed or as needed to define narrative criteria for particular situations or locations.

(Q) WET Chronic Tests. Chronic WET tests performed at the percent effluent at the edge of the mixing zone shall not be toxic to the more sensitive of at least two (2) representative, diverse species. Pollutant attenuation processes such as volatilization and biodegradation which may occur within the allowable mixing zone will be considered in interpreting results.

(R) Biocriteria. The biological integrity of waters, as measured by lists or numeric indices of benthic invertebrates, fish, algae, or other appropriate biological indicators, shall not be significantly different from reference waters. Waters targeted for numeric biological criteria assessment must be contained within the Missouri Use Designation Dataset and shall be compared to reference waters of similar size, scale within the stream network, habitat type, and aquatic ecoregion type. Reference water locations for some aquatic habitat types are listed in Table I.

(S) Site-Specific Criteria Development for the Protection and Propagation of Fish, Shellfish, and Wildlife. When water quality criteria in this regulation are either underprotective or overprotective of water quality due to factors influencing bioavailability, or non-anthropogenic conditions for a given water body segment, a petitioner may request site-specific criteria. The petitioner must provide the department with sufficient documentation to show that the current criteria are not adequate and that the proposed site-specific criteria will protect all existing and/or potential uses of the water body.

1. Site-specific criteria may be appropriate where, but is not limited to the examples given in subparagraphs A. or B. of this paragraph.

A. The resident aquatic species of the selected water body have a different degree of sensitivity to a specific pollutant as compared to those species in the data set used to calculate the national or state criteria as described in either of the following parts:

(I) Natural adaptive processes have enabled a viable, balanced aquatic community to exist in waters where natural (non-anthropogenic) background conditions exceed the criterion (e.g., resident species have evolved a genetically-based greater tolerance to high concentrations of a chemical); or

(II) The composition of aquatic species in a water body is different from those used in deriving a criterion (e.g., most of the species considered among the most sensitive, such as salmonids or the cladoceran, *Ceriodaphinia dubia*, which were used in developing a criterion, are absent from a water body).

B. The physical and/or chemical characteristics of the water body alter the biological availability and/or toxicity of the pollutant (e.g., pH, alkalinity, salinity, water temperature, hardness). Such an example is the Water Effect Ratio (WER) defined at (1)(AA) of this rule.

2. All petitioners seeking to develop site-specific criteria shall coordinate with the department early in the process. This coordination will ensure the use of adequate, relevant, and quality data; proper analysis and testing; and defendable procedures.

A. The department will provide guidance for establishing site-specific water quality criteria using scientific procedures including, but not limited to, those procedures described in:

(I) U.S. Environmental Protection Agency's *Water Quality Standards Handbook*, Second Edition, August 1994;

(II) U.S. Environmental Protection Agency's *Interim Guidance on Determination and Use of Water-Effect Ratios for Metals* (EPA-823-B-94-001) and subsequent 1997 modifications;

(III) U.S. Environmental Protection Agency's *Streamlined Water-Effect Ratio Procedure for Discharges of Copper* (EPA-822-R-01-005); and

(IV) U.S. Environmental Protection Agency's *Aquatic Life Ambient Freshwater Quality Criteria – Copper 2007 Revision* (EPA-822-R-07-001).

B. Site-specific criteria development for the Protection and Propagation of Fish, Shellfish and Wildlife shall be performed using the guidance documents listed in parts (5)(S)2.A.(I)–(IV) as published by the Office of Science and Technology, Office of Water, U.S. Environmental Protection Agency, Washington, DC 20460, which are hereby incorporated by reference and do not include any later amendments or additions. The department shall maintain a copy of the referenced documents and shall make them available to the public for inspection and copying at no more than the actual cost of reproduction.

3. Site-specific criteria shall protect all life stages of resident species and prevent acute and chronic toxicity in all parts of a water body*[unless early life stages are determined absent]*.

4. Site-specific criteria shall include both chronic and acute concentrations to better reflect the different tolerances of resident species to the inherent variability between concentrations and toxicological characteristics of a chemical.

5. Site-specific criteria shall be clearly identified as maximum "not to be exceeded" or average values, and if an average, the averaging period and the minimum number of samples. The conditions, if any, when the criteria apply shall be clearly stated (e.g., specific levels of hardness, pH, or water temperature). Specific sampling requirements (e.g., location, frequency), if any, shall also be identified.

6. The data, testing procedures, and application (safety) factors used to develop site-specific criteria shall reflect the nature of the chemical (e.g., persistency, bioaccumulation potential, and avoidance or attraction responses in fish) and the most sensitive resident species of a water body.

7. The size of a site may be limited to a single water segment, single water subsegment, or may cover a whole watershed depending on the particular situation for which the specific criterion is developed. A group of water bodies may be considered one (1) site if their respective aquatic communities are similar in composition and have comparable water quality.

8. The department shall determine if a site-specific criterion is adequate and justifiable. Each site-specific criterion shall be promulgated into rule 10 CSR 20-7.031. The public notice shall include a description of the affected water body or water body segment and the reasons for applying the proposed criterion. If the department determines that there is significant public interest, a public hearing may be held in the geographical vicinity of the affected water body or water body segment. Any site-specific criterion promulgated under these provisions is subject to U.S. Environmental Protection Agency approval prior to becoming effective.

(6) Groundwater.

(A) Water contaminants shall not cause or contribute to exceedence of Table A, groundwater limits in aquifers and caves. Table A values listed as health advisory levels shall be used in establishing management strategies and groundwater cleanup criteria, until additional data becomes available to support alternative criteria or other standards are established. Substances not listed in Table A shall be limited so that drinking water, livestock watering, and irrigation uses are protected.

(B) When criteria for the protection of aquatic life or human health protection-fish consumption in Table A are more stringent than groundwater criteria, appropriate criteria for the protection of aquatic life or human health protection-fish consumption shall apply to waters in caves and to aquifers which contribute an important part of base flow of surface waters designated for aquatic life protection. Other substances not listed in Table A shall be limited in these aquifers and caves so that the aquatic life use is protected.

(C) Groundwater and other criteria shall apply in any part of the aquifer, including the point at which the pollutant enters the aquifer. A specific monitoring depth requirement for releases to aquifers is included in 10 CSR 20-7.015(7)(A).

(D) For aquifers in which contaminant concentrations exceed groundwater criteria or other protection criteria, and existing and potential uses are not impaired, alternative site-specific criteria may be allowed. To allow alternative criteria, the management authority must demonstrate that alternative criteria will not impair existing and potential uses. The demonstration must consider the factors and be subject to the review requirements of 10 CSR 20-7.015(7)(F).

(7) Metropolitan No-Discharge Streams. No water contaminant except uncontaminated cooling water, permitted stormwater discharges in compliance with permit conditions and excess wet-weather bypass discharges not interfering with beneficial uses, shall be discharged to the watersheds of streams listed in Table F. Existing interim discharges may be allowed until interceptors are available within two thousand feet (2,000') or a distance deemed feasible by the department, or unless construction of outfalls to alternative receiving waters not listed in Table F is deemed feasible by the department. Existing discharges include wastewater volumes up to the design capacity of existing permitted treatment facilities, including phased increases in design capacity approved by the department prior to the effective date of this rule. Additional facilities may be constructed to discharge to these waters only if they are intended to be interim facilities in accordance with a regional wastewater treatment plan approved by the department.

(8) Outstanding National Resource Waters. Under section (3), antidegradation section of this rule, new releases to outstanding national resource waters from any source are prohibited and releases from allowed facilities are subject to special effluent limitations as required in 10 CSR 20-7.015(6). Table D contains a list of the outstanding national resource waters in Missouri.

(9) Outstanding State Resources Waters. The commission wishes to recognize certain high-quality waters that may require exceptionally stringent water-quality management requirements to assure conformance with the antidegradation policy. The degree of management requirements will be decided on an individual basis. To qualify for inclusion, all of the following criteria must be met. The waters listed in Table E must—

(A) Have a high level of aesthetic or scientific value;

(B) Have an undeveloped watershed; and

(C) Be located on or pass through lands which are state or federally owned, or which are leased or held in perpetual easement for conservation purposes by a state, federal, or private conservation agency or organization.

(10) Lake Taneycomo. The commission wishes to recognize the uniqueness of Lake Taneycomo with respect to its high water clarity, its importance as a trout fishery, and as the central natural resource in the rapidly developing Branson area and threats to the lake's water quality imposed by development. An especially stringent antidegradation policy will be observed in the development of effluent rules, discharge permits, and nonpoint-source management plans and permits to assure that the high visual quality and aquatic resources are maintained. The use of the best treatment technology for point- and nonpoint-source discharges in the lake's watershed between Table Rock Lake and Power Site Dam will be the guiding principle in establishing limitations.

(11) Compliance with Water Quality Based Limitations. Compliance with new or revised National Pollutant Discharge Elimination System (NPDES) or Missouri operating permit limitations based on criteria in this rule shall be achieved in accordance with federal regulation at 40 CFR Part 122.47, "Schedules of Compliance," May 15, 2000, as published by the Office of the Federal Register, National Archives and Records Administration, Superintendent of Documents, Pittsburgh, PA 15250-7954, which is hereby incorporated by reference and does not include any later amendments or additions. The department shall maintain a copy of the referenced document and shall make it available to the public for inspection and copying at no more than the actual cost of reproduction.

(12) **Water Quality Standards** Variances. *[(A)]* A permittee or an applicant for a National Pollutant Discharge Elimination System (NPDES) or Missouri state operating permit*[,]* may pursue a temporary variance to a water quality standard*[pursuant to either section 644.061 or section 644.062, RSMo]*. In order to obtain U.S. Environmental Protection Agency approval for a water quality standards variance for purposes of the federal Clean Water Act, the following additional provisions apply:

(A)*[1.]* A variance applies only to the applicant identified in such variance and only to the water quality standard specified in the variance. A variance does not modify an underlying water quality standard*[.]*;

(B)*[2.]* A variance shall not be granted if water quality standards will be attained by implementing technology-based effluent limits required under 10 CSR 20-7.015 of this rule and by implementing cost-effective and reasonable best management practices for non-point source control*[.]*;

[3. A variance shall not be granted for actions that will violate general criteria conditions prescribed by 10 CSR 20-7.031(4).]

(C)*[4.]* A variance shall not be granted that would likely jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of such species' critical habitat*[.]*;

(D)*[5.]* A variance may be granted if the applicant demonstrates that achieving the water quality standard is not feasible as supported by an analysis based on the factors provided in 40 CFR 131.10(g)*[, or other appropriate factors.]*;

(E)*[6.]* In granting a variance, conditions and time limitations shall be set by the department with the intent that progress be made toward attaining water quality standards*[.]*;

(F)*[7.]* Each variance shall be granted only after public notification and opportunity for public comment. Once any variance to water quality standards is granted, the department shall submit the variance, with an Attorney General Certification that the Clean Water Commission adopted the variance in accordance with state law, to the U.S. Environmental Protection Agency for approval.

(13) Losing Streams.

(A) Losing stream determinations will usually be made upon the first application for discharge to a specific water or location within a watershed for a wastewater treatment facility, subdivision development, or animal waste management facility.

(B) Permits or other approvals for those applications will be processed in accordance with the determinations. Additional permits or approvals will be processed in accordance with the latest determination.

(C) For application purposes, any proposed facility within five (5) miles of a known losing stream segment should presume that facility's receiving stream segment is also losing until and unless a specific geologic evaluation is made of that stream and concludes the stream segment is gaining.

(D) Existing facilities operating under a state operating permit and new facilities being constructed under a construction permit in proximity to stream segments subsequently determined to be losing will be allowed to continue in operation at permitted or approved effluent limits for a period of time lasting the design life of the facility (usually twenty (20) years from the original construction completion), provided the facility is in compliance with its effluent limits and remains in compliance with those limits, and if neither of the following conditions is present:

1. If the discharge from such a facility can be eliminated by connection to a locally available facility, the facility shall be connected within three (3) years of the losing stream determination. A local facility shall be considered available if that facility or an interceptor is within two thousand feet (2000') or a distance deemed feasible by the department; and

2. If the discharge from such a facility is shown to cause pollution of groundwater, the facility shall be upgraded to appropriate effluent standards within three (3) years. The department shall include appropriate groundwater monitoring requirements in permits for any such facilities so that pollution, should it occur, would be detected.

(E) Any additional permits or approvals for increased treatment plant design capacity will be processed in accordance with the newest losing stream determination. No additional permits or approvals for any facilities shall be construed as lengthening the time for compliance with losing stream effluent limitations as established in subsection (13)(D).

(14) Severance. If a section, subsection, paragraph, sentence, clause, phrase, or any part of this rule be declared unconstitutional or invalid for any reason, the remainder of this rule shall not be affected and shall remain in full force and effect.

(15) Effective Date. This rule becomes effective immediately upon adoption and compliance with the requirements of subsection 644.036.3., RSMo, of the Missouri Clean Water Law and Chapter 536, RSMo.

Title 10--DEPARTMENT OF NATURAL RESOURCES
Division 20--Clean Water Commission
Chapter 7--Water Quality

10 CSR 20-7.031 Water Quality Standards

PURPOSE: This rule identifies uses of waters of the state, criteria to protect those uses, and defines the antidegradation policy. It is developed in response to the Missouri Clean Water Law and the federal Clean Water Act, Section 303(c)(1) and (2), which requires that state water quality standards be reviewed at least once every three (3) years. These revisions are pursuant to the national goal of protection of fish, shellfish, and wildlife and recreation in and on the water as outlined in Section 101(a)(2) of the Act.

PUBLISHER'S NOTE: The secretary of state has determined that the publication of the entire text of the material which is incorporated by reference as a portion of this rule would be unduly cumbersome or expensive. This material as incorporated by reference in this rule shall be maintained by the agency at its headquarters and shall be made available to the public for inspection and copying at no more than the actual cost of reproduction. This note applies only to the reference material. The entire text of the rule is printed here.

[Table A—Criteria for Designated Uses

WBC = Whole Body Contact Recreation
SCR = Secondary Contact Recreation
AQL = Protection of Aquatic Life
DWS = Drinking Water Supply
LWW = Livestock and Wildlife Watering
GRW = Groundwater

Pollutant (µg/L)	***AQL***
Chlorine (total residual)	
cold-water	*2*
warm-water chronic—	*10*
acute—	*19*
Cyanide (amenable to chlorination)	
chronic—	*5*
acute—	*22*
Hydrogen sulfide (un-ionized)	*2*

Pollutant (mg/L)	***AQL***	***DWS***	***LWW***	***GRW***
Chloride chronic—	*(+)*	*250*		
acute—	*(+)*			
Sulfate	*(+)*	*250*		
Fluoride		*4*	*4*	*4*
Nitrate-N		*10*		*10*
*Dissolved oxygen (minimum)**				
warm-water and cool-water fisheries	*5*			
cold-water fisheries	*6*			
Oil and grease	*10*			

+ See Non-Metals (Hardness Dependent).
** Site-Specific Criteria have been promulgated for waters listed in Table K.*

Pollutant (/100 mL)	***WBC-A***	***WBC-B***	***SCR***
*E. coli Bacteria***	*126*	*206*	*1134*

***Geometric mean during the recreational season in waters designated for recreation or at any time in losing streams. The recreational season is from April 1 to October 31.*

Pollutant	***AQL***	
Temperature (maximum)	*°F*	*°C*
warm-water	*90*	*32 2/9*

cool-water	*84*	*28 8/9*
cold-water	*68*	*20*
Temperature (maximum change)		
warm-water	*5*	*2 7/9*
cool-water	*5*	*2 7/9*
cold-water	*2*	*1 6/9*

Pollutant (percent saturation)	***AQL***
Total Dissolved Gases	*110%*

AQL = Protection of Aquatic Life
HHF = Human Health Protection-Fish Consumption
DWS = Drinking Water Supply
IRR = Irrigation
LWW = Livestock Wildlife Watering
GRW = Groundwater

Pollutant (µg/L)	***AQL***	***HHF***	***DWS***	***IRR***	***LWW***	***GRW***
Metals *(refer to text in 10 CSR 20-7.031(5[4])(B)2.)*						
(Not Hardness Dependant)						
Aluminum (acute)	*750*					
Antimony		*4,300*	*6*			*6*
Arsenic	*20*		*50*	*100*		*50*
Barium			*2,000*			*2,000*
Beryllium	*5*		*4*	*100*		*4*
Boron				*2,000*		*2,000*
Cadmium	*		*5*			*5*
Chromium III	*		*100*	*100*		*100*
Chromium VI						
chronic	*10*					
acute	*15*					
Cobalt					*1,000*	*1,000*
Copper	*		*1,300*		*500*	*1,300*
Iron	*1,000*					*300*
Lead	*		*15*			*15*
Manganese						*50*
Mercury			*2*			*2*
chronic	*0.5*					
acute	*2.4*					
Nickel	*		*100*			*100*
Selenium	*5*		*50*			*50*
Silver	*		*50*			*50*
Thallium		*6.3*	*2*			*2*
Zinc	*		*5,000*			*5,000*

**See Metals (Hardness Dependent)*

AQL = Protection of Aquatic Life

Pollutant (µg/L)	**AQL**	
Metals (Hardness Dependent)		
Cadmium (µg/L)	*Acute:*	*e(1.0166*ln(Hardness) − 3.062490) * (1.136672 − (ln(Hardness)*0.041838))*
	Chronic:	*e(0.7409*ln(Hardness) − 4.719948) * (1.101672 − (ln(Hardness)*0.041838))*
Chromium III (µg/L)	*Acute:*	*e(0.8190*ln(Hardness) + 3.725666) * 0.316*
	Chronic:	*e(0.8190*ln(Hardness) + 0.684960) * 0.860*
Copper (µg/L)	*Acute:*	*e(0.9422*ln(Hardness) − 1.700300) * 0.960*
	Chronic:	*e(0.8545*ln(Hardness) − 1.702) * 0.960*
Lead (µg/L)	*Acute:*	*e(1.273*ln(Hardness) − 1.460448) * (1.46203 − (ln(Hardness)*0.145712))*
	Chronic:	*e(1.273*ln(Hardness) − 4.704797) * (1.46203 − (ln(Hardness)*0.145712))*
Nickel (µg/L)	*Acute:*	*e(0.8460*ln(Hardness) + 2.255647) * 0.998*
	Chronic:	*e(0.8460*ln(Hardness) + 0.058978) * 0.997*
Silver (µg/L)	*Acute:*	*e(1.72*ln(Hardness) − 6.588144) * 0.850*
Zinc (µg/L)	*Acute:*	*e(0.8473*ln(Hardness) + 0.884) * 0.98*
	Chronic:	*e(0.8473*ln(Hardness) + 0.884) * 0.98*

	Hardness								
	50–74	**75–99**	**100–124**	**125–149**	**150–174**	**175–199**	**200–224**	**225–249**	**250+**
Cadmium									
Acute:	2.4	3.6	4.8	5.9	7.1	8.2	9.4	10.5	11.6
Chronic:	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5
Chromium III									
Acute:	323	450	570	684	794	901	1,005	1,107	1,207
Chronic:	42	59	74	89	103	117	131	144	157
Copper									
Acute:	7	10	13	17	20	23	26	29	32
Chronic:	5	7	9	11	13	14	16	18	20
Lead									
Acute:	30	47	65	82	100	118	136	154	172
Chronic:	1	2	3	3	4	5	5	6	7
Nickel									
Acute:	261	367	469	566	660	752	842	930	1,017
Chronic:	29	41	52	63	73	84	94	103	113
Silver									
Acute:	1.0	2.0	3.2	4.7	6.5	8.4	10.6	13.0	15.6
Zinc									
Acute:	65	92	117	142	165	188	211	233	255
Chronic:	65	92	117	142	165	188	211	233	255

AQL = Protection of Aquatic Life

Pollutant (mg/L)	**AQL**	
Non-Metals (Hardness Dependent)		
Chloride (mg/L)	*Acute:*	$287.8 * (Hardness)^{0.205797} * (Sulfate)^{-0.07452}$
	Chronic:	$177.87 * (Hardness)^{0.205797} * (Sulfate)^{-0.07452}$

Sulfate (mg/L)	*Chloride, Cl- (mg/L)*		
Hardness, H (mg/L)	*Cl- < 5*	*5 □ Cl- < 25*	*25 □ Cl- □ 500*
H < 100	*500*	*500*	*500*
100 □ H □ 500	*500*	*S1*	*S2*
H > 500	*500*	*2,000*	*2,000*

*S1 = [-57.478 + 5.79 (hardness) + 54.163 (chloride)] * 0.65*
*S2 = [1276.7 + 5.508 (hardness) − 1.457 (chloride)] * 0.65*

AQL = *Protection of Aquatic Life*
HHF = *Human Health Protection-Fish Consumption*
DWS = *Drinking Water Supply*
GRW = *Groundwater*

Pollutant (µg/L)	**AQL**	**HHF**	**DWS**	**GRW**
Organics				
Acrolein		780	320	320
Bis-2-chloroisopropyl ether		4,360	1,400	1,400
2, chlorophenol		400	.1	.1
2,4-dichlorophenol	7	790	93	93
2,4-dinitrophenol		14,000	70	70
2,4-dimethylphenol		2,300	540	540
2,4,5-trichlorophenol		9,800	2,600	2,600
2,4,6-trichlorophenol		6.5	2	2
2-methyl-4,6-dinitrophenol		765	13	13
Ethylbenzene	320		700	700
Hexachlorocyclopentadiene	.5		50	50
Isophorone		2,600	36	36
Nitrobenzene		1,900	17	17
Phenol			100	300
chronic—	2,560			
acute—	10,200			
Dichloropropene		1,700	87	87
Para(1,4)-dichlorobenzene		2,600	75	75
Other Dichlorobenzenes		2,600	600	600
1,2,4-trichlorobenzene		940	70	70
1,2,4,5-tetrachlorobenzene		2.9	2.3	2.3
pentachlorobenzene		4.1	3.5	3.5
1,1,1-trichloroethane			200	200
1,1,2-trichloroethane		42	5	5
2,4-dinitrotoluene		9	.11	.04
1,2-diphenylhydrazine		.54	.04	.04
di (2-ethylhexyl) adipate			400	400
n-nitrosodiphenylamine		16	5	5
n-nitrosopyrrolidene		91.9		
2-chloronaphthalene	4,300			
n-nitrosodi-n-propylamine		1.4		

Pollutant (µg/L)	**AQL**	**DWS**	**GRW**
Pesticides			
Demeton	.1		
Endosulfan			
chronic—	.056		
acute—	0.11		
Guthion	.01		
Malathion	.1		
Parathion	.04		
2,4-D		70	70
2,4,5-TP		50	50
Chlorpyrifos	.04		
Alachlor		2	2
Atrazine		3	3
Carbofuran		40	40
Dalapon		200	200
Dibromochloropropane		.2	.2
Dinoseb		7	7
Diquat		20	20
Endothall		100	100
Ethylene dibromide		.05	.05
Oxamyl (vydate)		200	200
Picloram		500	500
Simazine		4	4

AQL = Protection of Aquatic Life
HHF = Human Health Protection-Fish Consumption
DWS = Drinking Water Supply
GRW = Groundwater

Pollutant (µg/L)	***AQL***	***HHF***	***DWS***	***GRW***
Bioaccumulative, Anthropogenic Toxics (+)				
PCBs		*.000045*		*.000045*
4-4' dichlorodiphenyldichloroethane (DDT)		*0.00059*	*0.00059*	*0.00059*
4-4' dichlorodiphenyldichloroethylene (DDE)		*0.00059*	*0.00059*	*0.00059*
4-4' dichlorodiphenyldichloroethane (DDD)		*0.00084*	*0.00083*	*0.00083*
Endrin		*.0023*	*2*	*2*
Endrin aldehyde		*.0023*	*.75*	*.75*
Aldrin		*.000079*	*.00013*	*.00013*
Dieldrin		*.000076*	*.00014*	*.00014*
Heptachlor	*.0038*	*.0002*	*0.4*	*0.4*
Heptachlor epoxide		*.00011*	*0.2*	*0.2*
Methoxychlor	*.03*		*40*	*40*
Mirex	*.001*			
Toxaphene		*.000073*	*3*	*3*
Lindane (gamma-BHC)		*.062*	*.2*	*.2*
Alpha,beta,delta-BHC		*.0074*	*.0022*	*.0022*
Chlordane		*.00048*	*2*	*2*
Benzidine		*.00053*	*.00012*	*.00012*
*2,3,7,8-tetrachlorodibenzo-p-dioxin (ng/L)** *(TCDD or dioxin)*		*.000014*	*0.000013*	*0.000013*
*Pentachlorophenol***	*3.2–pH 6.5*	*8*	*1*	*1*
	5.3–pH 7.0			
	8.7–pH 7.5			
	14.0–pH 8.0			
	23.0–pH 8.5			

+Many of these values are below current detection limits; analyses will be determined by the 17th edition of Standard Methods or the most current methods approved by the Environmental Protection Agency.

**Units for dioxin are nanograms/liter (ng/L); 1 µg/L = 1,000 ng/L.*

***Toxic impurities may be present in technical-grade pentachlorophenol; monitoring and discharge control will assure that impurities are below toxic concentrations.*

HHF = Human Health Protection-Fish Consumption
DWS = Drinking Water Supply
GRW = Groundwater

Pollutant (µg/L)	***HHF***	***DWS***	***GRW***
Anthropogenic Carcinogens(+)			
Acrylonitrile	*.65*	*.058*	*.058*
Hexachlorobenzene	*.00074*	*1*	*1*
Bis (2-chloroethyl) ether	*1.4*	*.03*	*.03*
Bis (chloromethyl) ether	*0.00078*	*.00013*	*.00013*
Hexachloroethane	*8.7*	*1.9*	*1.9*
3,3'-dichlorobenzidine	*0.08*	*.04*	*.04*
Hexachlorobutadiene	*50*	*.45*	*.45*
n-nitrosodimethylamine	*8*	*.0007*	*.0007*

(+) Some of these values are below current detection limits; analyses will be determined by the 17th edition of Standard Methods or the most current methods approved by the Environmental Protection Agency.

Pollutant (µg/L)	***HHF***	***DWS***	***GRW***
Volatile Organics			
Chlorobenzene	*21,000*	*100*	*100*
Carbon Tetrachloride	*5*	*5*	*5*
Trihalomethanes		*80*	*80*
Bromoform	*360*	*4.3*	*4.3*
Chlorodibromomethane	*34*	*0.41*	*0.41*
Dichlorobromomethane	*46*	*0.56*	*0.56*
Chloroform	*470*	*5.7*	*5.7*
Methyl Bromide	*4,000*	*48*	*48*
Methyl Chloride	*470*	*5*	*5*
Methylene Chloride	*1,600*	*4.7*	*4.7*
Dichlorodifluoromethane	*570,000*		
Trichlorofluoromethane	*860,000*		
1,2-dichloroethane	*99*	*5*	*5*
1,1,2,2-tetrachloroethane	*11*	*.17*	*.17*
1,1-dichloroethylene	*3.2*	*7*	*7*
1,2-trans-dichloroethylene	*140,000*	*100*	*100*
1,2-cis-dichloroethylene		*70*	*70*
Trichloroethylene	*80*	*5*	*5*
Tetrachloroethylene	*8.85*	*0.8*	*0.8*
Benzene	*71*	*5*	*5*
Toluene	*200,000*	*1,000*	*1,000*
Xylenes (total)		*10,000*	*10,000*
Vinyl chloride	*525*	*2*	*2*
Styrene		*100*	*100*
1,2-dichloropropane	*39*	*0.52*	*0.52*

Pollutant (Fibers/L)	***DWS***	***GRW***
Asbestos	*7,000,000*	

HHF = Human Health Protection-Fish Consumption
DWS = Drinking Water Supply
GRW = Groundwater

Pollutant (µg/L)	***HHF***	***DWS***	***GRW***
Polynuclear Aromatic Hydrocarbons			
Anthracene	*110,000*	*9,600*	*9,600*
Fluoranthene	*370*	*300*	*300*
Fluorene	*14,000*	*1,300*	*1,300*
Pyrene	*11,000*	*960*	*960*
Benzo(a)pyrene	*.049*	*0.2*	*0.2*
*other polynuclear aromatic hydrocarbons**	*.049*	*.0044*	*.0044*
Acenaphthene	*2,700*	*1,200*	*1,200*

**This concentration is allowed for each of the following PAHs: benzo(a)anthracene, 3,4-benzofluoranthene, chrysene, dibenzo-(a,h)anthracene, indeno(1,2,3-cd)pyrene and benezo(k)fluoranthene. Higher values may be allowed if natural background concentrations exceed these values.*

Pollutant (µg/L)	***HHF***	***DWS***	***GRW***
Phthalate Esters			
Bis(2-ethylhexyl) phthalate	*5.9*	*6*	*6*
Butylbenzyl phthalate	*5,200*	*3,000*	*3,000*
Diethyl phthalate	*120,000*	*23,000*	*23,000*
Dimethyl phthalate	*2,900,000*	*313,000*	*313,000*
Di-n-butyl phthalate	*12,000*	*2,700*	*2,700*

Health Advisory Levels

Pollutant (µg/L)	***DWS***	***GRW***
Ametryn	*60*	*60*
Baygon	*3*	*3*
Bentazon	*20*	*20*
Bis-2-chloroisopropyl ether	*300*	*300*
Bromacil	*90*	*90*
Bromochloromethane	*90*	*90*
Bromomethane	*10*	*10*
Butylate	*350*	*350*
Carbaryl	*700*	*700*
Carboxin	*700*	*700*
Chloramben	*100*	*100*
o-chlorotoluene	*100*	*100*
p-chlorotoluene	*100*	*100*
Chlorpyrifos	*20*	*20*
DCPA (dacthal)	*4,000*	*4,000*
Diazinon	*0.6*	*0.6*
Dicamba	*200*	*200*
Diisopropyl methylphosphonate	*600*	*600*
Dimethyl methylphosphonate	*100*	*100*
1,3-dinitrobenzene	*1*	*1*
Diphenamid	*200*	*200*
Diphenylamine	*200*	*200*
Disulfoton	*0.3*	*0.3*
1,4-dithiane	*80*	*80*
Diuron	*10*	*10*

Table A1

POLLUTANT	CAS #	Aquatic Life Protection		Human Health Protection		DWS	IRR/LWP	GRW
		Acute	Chronic	Org. + Water	Org. Only			
METALS (µg/L)	Note: The proposed values for updated criteria are shown in **bold.** Previous criteria being removed are shown in *[bracketed italics]*. Exceptions where the 304(a) recommendations are not being proposed are highlighted.					DWS = Drinking Water Supply IRR = Irrigation LWP = Livestock and Wildlife Protection GRW = Groundwater		
Aluminum (pH 6.5-9.0)	7429905	750						
Antimony	7440360			**5.6**	*[4,300]* **640**	6		6
Arsenic	7440382	**340**	*[20]* **150**	**0.018**	**0.14**	50	100	50
Barium	7440393			**1,000**		2,000		2,000
Beryllium	7440417		*[5]*			4	100	4
Boron	7440428						2,000	2,000
Cadmium	7440439	**Table A2**	Table A2			5		5
Chromium (III)	16065831	Table A2	**Table A2**			100	100	100
Chromium (VI)	18540299	*[15]* **16**	*[10]* **11**					
Cobalt	7440484						1,000	1,000
Copper	7440508	Table A2	Table A2	**1,300**		1,300	500	1,300
Iron	7439896		1,000					300
Lead	7439921	Table A2	Table A2			15		15
Manganese	7439965							50
Mercury	7439976	*[2.4]* **1.4**	*[0.5]* **0.77**			2		2
Methylmercury	22967926	**1.4**	**0.77**		**0.3 mg/kg**			
Nickel	7440020	Table A2	**Table A2**	**610**	**4,600**	100		100
Selenium	7782492		5	**170**	**4,200**	50		50
Silver	7440224	Table A2				50		50
Thallium	7440280			**0.24**	*[6.3]* **0.47**	2		2
Zinc	7440666	Table A2	Table A2	**7,400**	**26,000**	5,000		5,000
OTHER INORGANIC SUBSTANCES (µg/L)								
Alkalinity (minimum $CaCO_3$)			**20,000**					
Ammonia	7664417	Table B1	Tables B2 & B3					
Asbestos	1332214			**7 million fibers/L**		7 million fibers/L		
Chloride	16887006	**860,000**	**230,000**			250,000		

		Aquatic Life Protection		Human Health Protection		DWS	IRR/LWP	GRW
POLLUTANT	CAS #	Acute	Chronic	Org. + Water	Org. Only			
Chlorine, Total Residual (Coldwater Aquatic Habitat)	7782505		2					
Chlorine, Total Residual (Warmwater Aquatic Habitat)	7782505	19	*[10]* **11**					
Cyanide	57125	22	*[5]* **5.2**	4	**400**			
E. coli Bacteria (cfu/100 mL)		WBC-A: 126 WBC-B: 206 SCR: 1,134						
Fluoride						4,000	4,000	4,000
Gases, Total Dissolved (percent saturation)		110%	110%					
Hydrogen Sulfide	7783064		2					
Nitrates	14797558			10,000		10,000		10,000
Oil and Grease			10,000					
Oxygen, Dissolved	7782447	**Table A3**	**Table A3**					
pH			6.5 - 9	**5 - 9**				
Solids Suspended and Turbidity			**Narrative Statement**					
Sulfate		**10 CSR 20-7.031(5)(L)**	**10 CSR 20-7.031(5)(L)**			250,000		
Temperature		**10 CSR 20-7.031(5)(D)**	**10 CSR 20-7.031(5)(D)**					
ORGANIC SUBSTANCES (µg/L)								
Benzenes								
Benzene	71432			**2.1**	*[71]* **58**	5		5
Chlorobenzene	108907			**100**	*[21,000]* **800**	100		100
1,2-Dichlorobenzene (ortho-dichlorobenzene)	95501			**1,000**	*[2,600]* **3,000**	600		600
1,3-Dichlorobenzene (meta-dichlorobenzene)	541731			7	*[2,600]* **10**	600		600
1,4-Dichlorobenzene (para-dichlorobenzene)	106467			**300**	*[2,600]* **900**	75		75
1,2,4-Trichlorobenzene	120821			**0.071**	*[940]* **0.076**	70		70
1,2,4,5-Tetrachlorobenzene	95943			**0.03**	*[2.9]* **0.03**	2.3		2.3
Pentachlorobenzene	608935			**0.1**	*[4.1]* **0.1**	3.5		3.5
Hexachlorobenzene	118741			**0.000079**	*[0.00074]* **0.000079**	1		1
Ethylbenzene	100414		*[320]*	**68**	**130**	700		700
Nitrobenzene	98953			**10**	*[1,900]* **600**	17		17
Styrene (Vinyl Benzene)	100425					100		100

		Aquatic Life Protection		Human Health Protection		DWS	IRR/LWP	GRW
POLLUTANT	CAS #	Acute	Chronic	Org. + Water	Org. Only			
Chlorinated Hydrocarbons								
Carbon Tetrachloride (Tetrachloromethane)	56235			**0.4**	*5*	5		5
1,2-Dichloroethane	107062			**9.9**	*[99]* **650**	5		5
1,1,1-Trichloroethane	71556			**10,000**	**200,000**	200		200
1,1,2-Trichloroethane	79005			**0.55**	*[42]* **8.9**	5		5
1,1,2,2-Tetrachloroethane	79345			**0.2**	*[11]* **3**	0.17		0.17
Hexachloroethane	67721			**0.1**	*[8.7]* **0.1**	1.9		1.9
1,1-Dichloroethylene	75354			**300**	*[3.2]* **20,000**	7		7
cis-1,2-Dichloroethylene	156592					70		70
trans-1,2-Dichloroethylene	156605			**100**	*[140,000]* **4,000**	100		100
Trichloroethylene	79016			**0.6**	*[80]* **7**	5		5
Tetrachloroethylene	127184			**10**	*[8.85]* **29**	0.8		0.8
1,2-Dichloropropane	78875			**0.9**	*[39]* **31**	0.52		0.52
1,3-Dichloropropene (Dichloropropene)	542756			**0.27**	*[1,700]* **12**	87		87
Other Halogenated Hydrocarbons								
Ethylene Dibromide (1,2-Dibromoethane)	106934					0.05		0.05
Methyl Bromide (Bromomethane)	74839			**100**	*[4,000]* **10,000**	48		48
Methyl Chloride (Chloromethane)	74873				*[470]*	5		5
Methylene Chloride (Dichloromethane)	75092			**20**	*[1,600]* **1,000**	4.7		4.7
Total Trihalomethanes (TTHMs)						80		80
Chlorodibromomethane	124481			**0.8**	*[34]* **21**	0.41		0.41
Dichlorobromomethane	75274			**0.95**	*[46]* **27**	0.56		0.56
Tribromomethane (Bromoform)	75252			**7**	*[360]* **120**	4.3		4.3
Trichloromethane (Chloroform)	67663			**60**	**2,000**	5.7		5.7
[Dichlorodifluoromethane]	*75718*		*[570,000]*					
[Trichlorofluoromethane]	*75694*		*[860,000]*					
Vinyl Chloride	75014			**0.022**	*[525]* **1.6**	2		2
Ethers								
Bis(2-Chloroethyl) Ether	111444			**0.03**	*[1.4]* **2.2**	0.03		0.03

		Aquatic Life Protection		Human Health Protection		DWS	IRR/LWP	GRW
POLLUTANT	CAS #	Acute	Chronic	Org. + Water	Org. Only			
Bis(2-Chloro-1-Methylethyl) Ether	108601			**200**	*[4,360]* **4,000**	1,400		1,400
Bis(Chloromethyl) Ether	542881			**0.00015**	*[0.00078]* **0.017**	0.00013		0.00013
Miscellaneous Organics								
2,3,7,8-Tetrachlorodibenzo-p-dioxin 2,3,7,8-TCDD (Dioxin)	1746016			**5.00E-09**	*[1.4E-8]* **5.1E-9**	1.3 E-08		1.3E-08
Di(2-ethylhexyl) adipate	103231					400		400
Isophorone	78591			**34**	*[2,600]* **1,800**	36		36
Polychlorinated Biphenyls (PCBs)			**0.014**	**0.000064**	*[0.000045]* **0.000064**			0.000045
Tributyltin (TBT)		**0.46**	**0.072**					
Nitrogen Containing Compounds								
Nitrosamines				**0.0008**	**1.24**			
N-Nitrosodibutylamine	924163			**0.0063**	**0.22**			
N-Nitrosodiethylamine	55185			**0.0008**	**1.24**			
N-Nitrosodimethylamine	62759			**0.00069**	*[8]* **3.0**	0.0007		0.0007
N-Nitrosodiphenylamine	86306			**3.3**	*[16]* **6.0**	5		5
N-Nitrosodi-n-propylamine	621647			**0.005**	*[1.4]* **0.51**			
N-Nitrosopyrrolidine	930552			**0.016**	*[91.9]* **34**			
Acrylonitrile (2-propenenitrile)	107131			**0.061**	*[0.65]* **7.0**	0.058		0.058
Benzidine (4,4'-diaminobiphenyl)	92875			**0.00014**	*[0.00053]* **0.011**	0.00012		0.00012
3,3'-Dichlorobenzidine	91941			**0.049**	*[0.08]* **0.15**	0.04		0.04
1,2-Diphenylhydrazine	122667			**0.03**	*[0.54]* **0.2**	0.04		0.04
Polynuclear Aromatic Hydrocarbons (PAHs)								
Acenaphthene	83329			**70**	*[2,700]* **90**	1,200		1,200
Anthracene	120127			**300**	*[110,000]* **400**	9,600		9,600
Benzo-a-Anthracene	56553			**0.0012**	*[0.049]* **0.0013**	0.0044		0.0044
Benzo-a-Pyrene	50328			**0.00012**	*[0.049]* **0.00013**	0.2		0.2
Benzo-b-Fluoranthene	205992			**0.0012**	*[0.049]* **0.0013**	0.0044		0.0044
Benzo-k-Fluoranthene	207089			**0.012**	*[0.049]* **0.013**	0.0044		0.0044
2-Chloronaphthalene	91587	*[4300]*		**800**	**1,000**			
Chrysene	218019			**0.12**	*[0.049]* **0.13**	0.0044		0.0044

		Aquatic Life Protection		Human Health Protection		DWS	IRR/LWP	GRW
POLLUTANT	CAS #	Acute	Chronic	Org. + Water	Org. Only			
Dibenzo-a-b-Anthracene	53703			**0.00012**	*[0.049]* **0.00013**	0.0044		0.0044
Fluoranthene	206440			**20**	*[370]* **20**	300		300
Fluorene	86737			**50**	*[14,000]* **70**	1,300		1,300
Indeno(1,2,3-cd)Pyrene	193395			**0.0012**	*[0.049]* **0.0013**	0.0044		0.0044
Pyrene	129000			**20**	*[11,000]* **30**	960		960
Phthalate Esters								
Bis(2-Ethylhexyl) Phthalate	117817			**0.32**	*[5.9]* **0.37**	6		6
Butylbenzyl Phthalate	85687			**0.1**	*[5,200]* **0.1**	3,000		3,000
Diethyl Phthalate	84662			**600**	*[120,000]* **600**	23,000		23,000
Dimethyl Phthalate	131113			**2,000**	*[2,900,000]* **2,000**	313,000		313,000
Di-n-Butyl Phthalate	84742			**20**	*[12,000]* **30**	2,700		2,700
Phenolic Compounds								
2-Chlorophenol	95578			**30**	*[400]* **800**	0.1		0.1
2,4-Dichlorophenol	120832		*[7]*	**10**	*[790]* **60**	93		93
2,4-Dimethylphenol	105679			**100**	*[2,300]* **3,000**	540		540
2-Methyl-4,6-Dinitrophenol	534521			**2**	*[765]* **30**	13		13
2,4-Dinitrophenol	51285			**10**	*[14,000]* **300**	70		70
Dinitrophenols	25550587			**10**	**1,000**			
3-Methyl-4-Chlorophenol	**59507**			**500**	**2,000**			
Nonylphenol	**84852153**	28	**6.6**					
Pentachlorophenol	87865	**Table A2**	**Table A2**	**0.03**	*[8]* **0.04**	1		1
Phenol **(Coldwater Aquatic Habitat)**	108952	*[10,200]* **5,293**	*[2,560]* **157**	**4,000**	**300,000**	100		300
Phenol **(Warmwater Aquatic Habitat)**	108952	*[10,200]* **5,293**	2,560	**4,000**	**300,000**	100		300
2,4,5-Trichlorophenol	95954			**300**	*[9,800]* **600**	2,600		2600
2,4,6-Trichlorophenol	88062			**1.5**	*[6.5]* **2.8**	2		2
Toluenes								
2,4-Dinitrotoluene	121142			**0.049**	*[9]* **1.7**	0.11		0.04
Toluene	108883			**57**	*[200,000]* **520**	1,000		1,000
Xylenes (Total)	1330207					10,000		10,000

		Aquatic Life Protection		Human Health Protection		DWS	IRR/LWP	GRW
POLLUTANT	CAS #	Acute	Chronic	Org. + Water	Org. Only			
PESTICIDES								
Acrolein	107028	**3**	**3**	**3**	*[780]* **400**	320		320
Alachlor	15972608					2		2
Aldrin	309002	**3**		**0.00000077**	*[0.000079]* **0.00000077**	0.00013		0.00013
Atrazine	1912249					3		3
Carbaryl	**63252**	**2.1**	**2.1**					
Carbofuran	1563662					40		40
Chlordane	57749	**2.4**	**0.0043**	**0.00031**	*[0.00048]* **0.00032**	2		2
Chloropyrifos	2921882	**0.083**	*[0.04]* **0.041**			20		
Chlorophenoxy Herbicide (2,4-D)	94757			**1,300**	**12,000**	70		70
Chlorophenoxy Herbicide (2,4,5,-TP)	93721			**100**	**400**	50		50
Dalapon	75990					200		200
Demeton	8065483		0.1					
Diazinon	333415	**0.17**	**0.17**					
1,2-Dibromo-3-chloropropane (DBCP)	96128					0.2		0.2
4-4'-Dichlorodiphenyldichloroethylene (DDE)	72559			**0.000018**	*[0.00059]* **0.000018**	0.00059		0.00059
4-4'-Dichlorodiphenyldichloroethane (DDD)	72548			**0.00012**	*[0.00084]* **0.00012**	0.00083		0.00083
4-4'-Dichlorodiphenyltrichloroethane (DDT)	50293	**1.1**	**0.001**	**0.00003**	*[0.00059]* **0.00003**	0.00059		0.00059
Dieldrin	60571	**0.24**	**0.056**	**0.0000012**	*[0.000076]* **0.0000012**	0.00014		0.00014
Dinoseb	88857					7		7
Diquat	85007					20		20
alpha-Endosulfan (Endosulfan)	959988	*[0.11]* **0.22**	0.056	**20**	**30**			
beta-Endosulfan (Endosulfan)	33213659	*[0.11]* **0.22**	0.056	**20**	**40**			
Endosulfan Sulfate	**1031078**			**20**	**40**			
Endothall	145733					100		100
Endrin	72208	**0.086**	**0.036**	**0.03**	*[0.0023]* **0.03**	2		2
Endrin Aldehyde	7421934			**1**	*[0.0023]* **1**	0.75		0.75
Glyphosate	1071836					700		700

		Aquatic Life Protection		Human Health Protection		DWS	IRR/LWP	GRW
POLLUTANT	CAS #	Acute	Chronic	Org. + Water	Org. Only			
Guthion	86500		0.01					
Heptachlor	76448	**0.52**	0.0038	**0.0000059**	*[0.0002]* **0.0000059**	0.4		0.4
Heptachlor Epoxide	1024573	**0.52**	**0.0038**	**0.000032**	*[0.00011]* **0.000032**	0.2		0.2
Hexachlorobutadiene	87683			**0.01**	*[50]* **0.01**	0.45		0.45
Hexachlorocyclopentadiene	77474		*[0.5]*	**4**	**4**	50		50
alpha-Hexachlorocyclohexane (alpha-BHC)	319846			**0.00036**	*[0.0074]* **0.00039**	0.0022		0.0022
beta-Hexachlorocyclohexane (beta-BHC)	319857			**0.008**	*[0.0074]* **0.014**	0.0022		0.0022
gamma-Hexachlorocyclohexane (gamma-BHC; Lindane)	58899	**0.95**		**4.2**	*[0.062]* **4.4**	0.2		0.2
Technical-Hexachlorocyclohexane	608731			**0.0066**	**0.01**			
Malathion	121755		0.1					
Methoxychlor	72435		0.03	**0.02**	**0.02**	40		40
Mirex	2385855		0.001					
Oxamyl (Vydate)	23135220					200		200
Picloram	1918021					500		500
Parathion	56382	**0.065**	*[0.04]* **0.013**					
Simazine	122349					4		4
Toxaphene	8001352	**0.73**	**0.0002**	**0.0007**	*[0.000073]* **0.00071**	3		3

Table A2.

POLLUTANT	CAS #	
METALS (µg/L) - Hardness Dependent		
Cadmium	7440439	**Acute** = $[e^{(1.0166*\ln(Hardness) - 3.062490)} * (1.136672 - (\ln(Hardness)*0.041838))]$ $\mathbf{e^{(1.0166*\ln(Hardness) - 3.924)} * (1.136672 - (\ln(Hardness)*0.041838))}$ Chronic = $e^{(0.7409*\ln(Hardness) - 4.719948)} * (1.101672 - (\ln(Hardness)*0.041838))$
Chromium (III)	16065831	Acute = $e^{(0.8190*\ln(Hardness) + 3.725666)} * 0.316$ **Chronic** = $[e^{(0.8190*\ln(Hardness) + 0.6848)} * 0.860]$ $\mathbf{e^{(0.8190*\ln(Hardness) + 0.6848)} * 0.860}$
Copper	7440508	Acute = $e^{(0.9422*\ln(Hardness) - 1.700300)} * 0.960$ Chronic = $e^{(0.8545*\ln(Hardness) - 1.702)} * 0.960$
Lead	7439921	Acute = $e^{(1.273*\ln(Hardness) - 1.460448)} * (1.46203 - (\ln(Hardness)*0.145712))$ Chronic = $e^{(1.273*\ln(Hardness) - 4.704797)} * (1.46203 - (\ln(Hardness)*0.145712))$
Nickel	7440020	Acute = $e^{(0.8460*\ln(Hardness) + 2.255647)} * 0.998$ **Chronic** = $[e^{(0.8460*\ln(Hardness) + 0.0584)} * 0.997]$ $\mathbf{e^{(0.8460*\ln(Hardness) + 0.0584)} * 0.997}$
Silver	7440224	Acute = $e^{(1.72*\ln(Hardness) - 6.588144)} * 0.850$
Zinc	7440666	Acute = $e^{(0.8473*\ln(Hardness) + 0.884)} * 0.98$ Chronic = $e^{(0.8473*\ln(Hardness) + 0.884)} * 0.98$
OTHER POLLUTANTS (µg/L) - Equation Dependent		
Pentachlorophenol	**87865**	**Acute** = $e^{((1.005 * (pH)) - 4.869)}$ **Chronic** = $e^{((1.005 * (pH)) - 5.134)}$

Table A3

POLLUTANT	
DISSOLVED OXYGEN (mg/L)	

	Cold-water Fishery	Warm-water and Cool-water Fishery
Minimum[1]	6 mg/L	5 mg/L

1 - All minima should be considered as instantaneous concentrations to be achieved at

Table A4

POLLUTANT	CAS #	DWS	GRW
HEALTH ADVISORY LEVELS (µg/L)			
Ametryn	834128	60	60
Baygon	114261	3	3
Bentazon	25057890	20	20
Bis-2-chloroisopropyl ether	108601	300	300
Bromacil	314409	90	90
Bromochloromethane	74975	90	90
Bromomethane	74839	10	10
Butylate	2008415	350	350
Carbaryl	63252	700	700
Carboxin	5234684	700	700
Chloramben	133904	100	100
o-chlorotoluene	95498	100	100
p-chlorotoluene	106434	100	100
Chlorpyrifos	2921882	20	20
DCPA (dacthal)	1861321	4000	4000
Diazinon	333415	0.6	0.6
Dicamba	1918009	200	200
Diisopropyl methylphosphonate	1445756	600	600
Dimethyl methylphosphonate	756796	100	100
1,3-dinitrobenzene	99650	1	1
Diphenamid	957517	200	200
Diphenylamine	122394	200	200
Disulfoton	298044	0.3	0.3
1,4-dithiane	505293	80	80
Diuron	330541	10	10
Fenamiphos	22224926	2	2
Fluometron	2164172	90	90
Fluorotrichloromethane	75694	2000	2000
Fonofos	944229	10	10
Hexazinone	51235042	200	200

POLLUTANT	CAS #	DWS	GRW
Malathion	121755	200	200
Maleic hydrazide	123331	4000	4000
MCPA (4(chloro-2-methoxyphenoxy) acetic acid)	94746	10	10
Methyl parathion	298000	2	2
Metolachlor	51218452	70	70
Metribuzin	21087649	100	100
Naphthalene	91203	20	20
Nitroguanidine	556887	700	700
para-Nitrophenol	100027	60	60
Paraquat	1910425	30	30
Pronamide	23950585	50	50
Propachlor	1918167	90	90
Propazine	139402	10	10
Propham	122429	100	100
2,4,5-T (Trichlorophenoxy-acetic acid)	93765	70	70
Tebuthiuron	34014181	500	500
Terbacil	5902512	90	90
Terbufos	13071799	0.9	0.9
1,1,1,2-Tetrachloroethane	630206	70	70
1,2,3-Trichloropropane	96184	40	40
Trifluralin	1582098	5	5
Trinitroglycerol	55630	5	5
2,4,6-Trinitrotoluene (Trinitrotoluene)	118967	2	2

Table B1. Acute Criteria for Total Ammonia Nitrogen (mg N/L)

pH	Cold-Water Fisheries (1)	Cool & Warm-Water Fisheries (2)
6.6	31.3	46.8
6.7	29.8	44.6
6.8	28.1	42.0
6.9	26.2	39.1
7.0	24.1	36.1
7.1	22.0	32.8
7.2	19.7	29.5
7.3	17.5	26.2
7.4	15.4	23.0
7.5	13.3	19.9
7.6	11.4	17.0
7.7	9.6	14.4
7.8	8.1	12.1
7.9	6.7	10.1
8.0	5.6	8.4
8.1	4.6	6.9
8.2	3.8	5.7
8.3	3.1	4.7
8.4	2.5	3.8
8.5	2.1	3.2
8.6	1.7	2.6
8.7	1.4	2.2
8.8	1.2	1.8
8.9	1.0	1.5
9.0	0.8	1.3

(1) *Salmonids present:* $CMC = [0.275 / (1 + 10^{7.204-pH})] + [39.0 / (1 + 10^{ph-7.204})]$
(2) *Salmonids absent:* $CMC = [0.411 / (1 + 10^{7.204-pH})] + [58.4 / (1 + 10^{pH-7.204})]$

Table B2. Chronic Criteria for Total Ammonia Nitrogen (mg N/L): Early Life Stages absent (3)(4)

	Temperature (°C)																
6.5	10.8	10.1	9.5	8.9	8.3	7.8	7.3	6.8	6.4	6.0	5.3	4.6	4.1	3.6	3.1	2.8	2.4
6.6	10.7	9.9	9.3	8.7	8.2	7.7	7.2	6.7	6.3	5.9	5.2	4.6	4.0	3.5	3.1	2.7	2.4
6.7	10.5	9.8	9.2	8.6	8.0	7.5	7.1	6.6	6.2	5.8	5.1	4.5	3.9	3.5	3.0	2.7	2.3
6.8	10.2	9.5	8.9	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.0	4.4	3.8	3.4	3.0	2.6	2.3
6.9	9.9	9.3	8.7	8.1	7.6	7.2	6.7	6.3	5.9	5.5	4.8	4.3	3.7	3.3	2.9	2.5	2.2
7.0	9.6	9.0	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.3	4.7	4.1	3.6	3.2	2.8	2.4	2.1
7.1	9.2	8.6	8.0	7.5	7.1	6.6	6.2	5.8	5.4	5.1	4.5	3.9	3.5	3.0	2.7	2.3	2.0
7.2	8.7	8.2	7.6	7.2	6.7	6.3	5.9	5.5	5.2	4.9	4.3	3.7	3.3	2.9	2.5	2.2	1.9
7.3	8.2	7.7	7.2	6.7	6.3	5.9	5.6	5.2	4.9	4.6	4.0	3.5	3.1	2.7	2.4	2.1	1.8
7.4	7.6	7.1	6.7	6.3	5.9	5.5	5.2	4.8	4.5	4.3	3.7	3.3	2.9	2.5	2.2	1.9	1.7
7.5	7.0	6.6	6.2	5.8	5.4	5.1	4.8	4.5	4.2	3.9	3.4	3.0	2.6	2.3	2.0	1.8	1.6
7.6	6.4	6.0	5.6	5.3	5.0	4.6	4.3	4.1	3.8	3.6	3.1	2.7	2.4	2.1	1.9	1.6	1.4
7.7	5.8	5.4	5.1	4.7	4.4	4.2	3.9	3.7	3.4	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.3
7.8	5.1	4.8	4.5	4.2	4.0	3.7	3.5	3.2	3.0	2.8	2.5	2.2	1.9	1.7	1.5	1.3	1.1
7.9	4.5	4.2	3.9	3.7	3.5	3.2	3.1	2.8	2.7	2.5	2.2	1.9	1.7	1.5	1.3	1.1	1.0
8.0	3.9	3.7	3.4	3.2	3.0	2.8	2.6	2.5	2.3	2.2	1.9	1.7	1.5	1.3	1.1	1.0	0.8
8.1	3.4	3.1	2.9	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.6	1.4	1.2	1.1	1.0	0.8	0.7
8.2	2.9	2.7	2.5	2.4	2.2	2.1	1.9	1.8	1.7	1.6	1.4	1.2	1.1	0.9	0.8	0.7	0.6
8.3	2.4	2.3	2.1	2.0	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.0	0.9	0.8	0.7	0.6	0.5
8.4	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.7	0.7	0.6	0.5	0.4
8.5	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4
8.6	1.4	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3
8.7	1.2	1.1	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.2
8.8	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2
8.9	0.9	0.8	0.8	0.6	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2
9.0	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.1

(3) Without sufficient and reliable data, it is assumed that Early Life Stages are present and must be protected at all times of the year.

(4) Early Life Stages absent:

$$CCC = [0.0577 / (1 + 10^{7.688-pH})]+[2.487 / (1 + 10^{pH-7.688})] * 1.45 * 10^{0.028 * (25-MAX(T, 7))}$$

Table B3. Chronic Criteria for Total Ammonia Nitrogen (mg N/L): Early Life Stages present (5)

	Temperature (°C)									
6.5	6.6	6.6	6.0	5.3	4.6	4.1	3.6	3.1	2.8	2.4
6.6	6.5	6.5	5.9	5.2	4.6	4.0	3.5	3.1	2.7	2.4
6.7	6.4	6.4	5.8	5.1	4.5	3.9	3.5	3.0	2.7	2.3
6.8	6.2	6.2	5.7	5.0	4.4	3.8	3.4	3.0	2.6	2.3
6.9	6.1	6.1	5.5	4.8	4.3	3.7	3.3	2.9	2.5	2.2
7.0	5.9	5.9	5.3	4.7	4.1	3.6	3.2	2.8	2.4	2.1
7.1	5.6	5.6	5.1	4.5	3.9	3.5	3.0	2.7	2.3	2.0
7.2	5.3	5.3	4.9	4.3	3.7	3.3	2.9	2.5	2.2	1.9
7.3	5.0	5.0	4.6	4.0	3.5	3.1	2.7	2.4	2.1	1.8
7.4	4.7	4.7	4.3	3.7	3.3	2.9	2.5	2.2	1.9	1.7
7.5	4.3	4.3	3.9	3.4	3.0	2.6	2.3	2.0	1.8	1.6
7.6	3.9	3.9	3.6	3.1	2.7	2.4	2.1	1.9	1.6	1.4
7.7	3.5	3.5	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.3
7.8	3.1	3.1	2.8	2.5	2.2	1.9	1.7	1.5	1.3	1.1
7.9	2.8	2.8	2.5	2.2	1.9	1.7	1.5	1.3	1.1	1.0
8.0	2.4	2.4	2.2	1.9	1.7	1.5	1.3	1.1	1.0	0.8
8.1	2.1	2.1	1.9	1.6	1.4	1.2	1.1	1.0	0.8	0.7
8.2	1.7	1.7	1.6	1.4	1.2	1.1	0.9	0.8	0.7	0.6
8.3	1.5	1.5	1.3	1.2	1.0	0.9	0.8	0.7	0.6	0.5
8.4	1.2	1.2	1.1	1.0	0.9	0.7	0.7	0.6	0.5	0.4
8.5	1.0	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4
8.6	0.9	0.9	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3
8.7	0.7	0.7	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.2
8.8	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2
8.9	0.5	0.5	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2
9.0	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.1

(5) Early Life Stages present:

$$CCC = [0.0577 / (1 + 10^{7.688-pH})]+[2.487 / (1 + 10^{pH-7.688})] * MIN(2.85, 1.45 * 10^{0.028 * (25 - T)})$$

Table B1. Acute Criteria for Total Ammonia Nitrogen (mg N/L)

pH	Cold-Water Fisheries (1)	Cool & Warm-Water Fisheries (2)
6.5	32.6	48.8
6.6	31.3	46.8
6.7	29.8	44.6
6.8	28.1	42.0
6.9	26.2	39.1
7.0	24.1	36.1
7.1	22.0	32.8
7.2	19.7	29.5
7.3	17.5	26.2
7.4	15.4	23.0
7.5	13.3	19.9
7.6	11.4	17.0
7.7	9.6	14.4
7.8	8.1	12.1
7.9	6.7	10.1
8.0	5.6	8.4
8.1	4.6	6.9
8.2	3.8	5.7
8.3	3.1	4.7
8.4	2.5	3.8
8.5	2.1	3.2
8.6	1.7	2.6
8.7	1.4	2.2
8.8	1.2	1.8
8.9	1.0	1.5
9.0	0.8	1.3

(1) Salmonids present: CMC = $[0.275 / (1+10^{7.204-pH})] + [39.0 / (1+10^{pH-7.204})]$
(2) Salmonids absent: CMC = $[0.411 / (1+10^{7.204-pH})] + [58.4 / (1+10^{pH-7.204})]$

Table B2. Chronic Criteria for Total Ammonia Nitrogen (mg N/L): Early Life Stage Absent (3)(4)

	Temperature (°C)																
pH	**0-7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**
6.5	10.8	10.1	9.5	8.9	8.3	7.8	7.3	6.8	6.4	6.0	5.3	4.6	4.1	3.6	3.1	2.8	2.4
6.6	10.7	9.9	9.3	8.7	8.2	7.7	7.2	6.7	6.3	5.9	5.2	4.6	4.0	3.5	3.1	2.7	2.4
6.7	10.5	9.8	9.2	8.6	8.0	7.5	7.1	6.6	6.2	5.8	5.1	4.5	3.9	3.5	3.0	2.7	2.3
6.8	10.2	9.5	8.9	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.0	4.4	3.8	3.4	3.0	2.6	2.3
6.9	9.9	9.3	8.7	8.1	7.6	7.2	6.7	6.3	5.9	5.5	4.8	4.3	3.7	3.3	2.9	2.5	2.2
7.0	9.6	9.0	8.4	7.9	7.4	6.9	6.5	6.1	5.7	5.3	4.7	4.1	3.6	3.2	2.8	2.4	2.1
7.1	9.2	8.6	8.0	7.5	7.1	6.6	6.2	5.8	5.4	5.1	4.5	3.9	3.5	3.0	2.7	2.3	2.0
7.2	8.7	8.2	7.6	7.2	6.7	6.3	5.9	5.5	5.2	4.9	4.3	3.7	3.3	2.9	2.5	2.2	1.9
7.3	8.2	7.7	7.2	6.7	6.3	5.9	5.6	5.2	4.9	4.6	4.0	3.5	3.1	2.7	2.4	2.1	1.8
7.4	7.6	7.2	6.7	6.3	5.9	5.5	5.2	4.8	4.5	4.3	3.7	3.3	2.9	2.5	2.2	1.9	1.7
7.5	7.0	6.6	6.2	5.8	5.4	5.1	4.8	4.5	4.2	3.9	3.4	3.0	2.6	2.3	2.0	1.8	1.6
7.6	6.4	6.0	5.6	5.3	5.0	4.6	4.3	4.1	3.8	3.6	3.1	2.7	2.4	2.1	1.9	1.6	1.4
7.7	5.8	5.4	5.1	4.7	4.4	4.2	3.9	3.7	3.4	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.3
7.8	5.1	4.8	4.5	4.2	4.0	3.7	3.5	3.2	3.0	2.8	2.5	2.2	1.9	1.7	1.5	1.3	1.1
7.9	4.5	4.2	3.9	3.7	3.5	3.2	3.1	2.8	2.7	2.5	2.2	1.9	1.7	1.5	1.3	1.1	1.0
8.0	3.9	3.7	3.4	3.2	3.0	2.8	2.6	2.5	2.3	2.2	1.9	1.7	1.5	1.3	1.1	1.0	0.8
8.1	3.4	3.1	2.9	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.6	1.4	1.2	1.1	1.0	0.8	0.7
8.2	2.9	2.7	2.5	2.4	2.2	2.1	1.9	1.8	1.7	1.6	1.4	1.2	1.1	0.9	0.8	0.7	0.6
8.3	2.4	2.3	2.1	2.0	1.9	1.7	1.6	1.5	1.4	1.3	1.2	1.0	0.9	0.8	0.7	0.6	0.5
8.4	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.9	0.7	0.7	0.6	0.5	0.4
8.5	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4
8.6	1.4	1.4	1.3	1.2	1.1	1.0	1.0	0.9	0.8	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3
8.7	1.2	1.1	1.1	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.2
8.8	1.0	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2
8.9	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2
9.0	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.1

(3) Without sufficient and reliable data, it is assumed that Early Life Stages are present and must be protected at all times of the year.

(4) Early Life Stages absent $CCC = [0.0577 / (1+10^{7.688-pH})]+[2.487 / (1+10^{pH-7.688})] * 1.45 * 10^{0.028 * (25-MAX(T, 7))}$

Table B3. Chronic Criteria for Total Ammonia Nitrogen (mg N/L): Early Life Stages present (5)

	Temperature (°C)									
pH	**0**	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**
6.5	6.6	6.6	6.0	5.3	4.6	4.1	3.6	3.1	2.8	2.4
6.6	6.5	6.5	5.9	5.2	4.6	4.0	3.5	3.1	2.7	2.4
6.7	6.4	6.4	5.8	5.1	4.5	3.9	3.5	3.0	2.7	2.3
6.8	6.2	6.2	5.7	5.0	4.4	3.8	3.4	3.0	2.6	2.3
6.9	6.1	6.1	5.5	4.8	4.3	3.7	3.3	2.9	2.5	2.2
7.0	5.9	5.9	5.3	4.7	4.1	3.6	3.2	2.8	2.4	2.1
7.1	5.6	5.6	5.1	4.5	3.9	3.5	3.0	2.7	2.3	2.0
7.2	5.3	5.3	4.9	4.3	3.7	3.3	2.9	2.5	2.2	1.9
7.3	5.0	5.0	4.6	4.0	3.5	3.1	2.7	2.4	2.1	1.8
7.4	4.7	4.7	4.3	3.7	3.3	2.9	2.5	2.2	1.9	1.7
7.5	4.3	4.3	3.9	3.4	3.0	2.6	2.3	2.0	1.8	1.6
7.6	3.9	3.9	3.6	3.1	2.7	2.4	2.1	1.9	1.6	1.4
7.7	3.5	3.5	3.2	2.8	2.5	2.2	1.9	1.7	1.5	1.3
7.8	3.1	3.1	2.8	2.5	2.2	1.9	1.7	1.5	1.3	1.1
7.9	2.8	2.8	2.5	2.2	1.9	1.7	1.5	1.3	1.1	1.0
8.0	2.4	2.4	2.2	1.9	1.7	1.5	1.3	1.1	1.0	0.8
8.1	2.1	2.1	1.9	1.6	1.4	1.2	1.1	1.0	0.8	0.7
8.2	1.7	1.7	1.6	1.4	1.2	1.1	0.9	0.8	0.7	0.6
8.3	1.5	1.5	1.3	1.2	1.0	0.9	0.8	0.7	0.6	0.5
8.4	1.2	1.2	1.1	1.0	0.9	0.7	0.7	0.6	0.5	0.4
8.5	1.0	1.0	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4
8.6	0.9	0.9	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3
8.7	0.7	0.7	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.2
8.8	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2
8.9	0.5	0.5	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2
9.0	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.1

[(1) Salmonids present: CMC = $[0.275 / (1+10^{7.204-pH})] + [39.0 / (1+10^{pH-7.204})]$
(2) Salmonids absent: CMC = $[0.411 / (1+10^{7.204-pH})] + [58.4 / (1+10^{pH-7.204})]$
(3) Without sufficient and reliable data, it is assumed that Early Life Stages are present and must be protected at all times of the year.
(4) Early Life Stages absent
CCC = $[0.0577 / (1+10^{7.688-pH})]+[2.487 / (1+10^{pH-7.688})] * 1.45 * 10^{0.028 * (25-MAX(T, 7))}]$
(5) Early Life Stages present CCC = $[0.0577 / (1+10^{7.688-pH})]+[2.487 / (1+10^{pH-7.688})] * MIN(2.85, 1.45 * 10^{0.028 * (25 - T)})$

Table G-Lake Classifications and Use Designations

NOTE: Fishing, Swimming, irrigation and livestock watering may not be allowed in some lakes by the local management authorities. The use designations refer only to the protection of water quality for those potential uses. Although irrigation is not listed it applies to all waters, as stated in the rule language.

WATER BODY	CLASS AQL	CDF	ACRES WBC	LOCATION SCR	COUNTY(IES) DWS	IND	LWW		
10-05-16 MUDD V2	L3	26517.0	Statewide	Statewide	X	X	B	X	
Adrian Reservoir	L1	45.0	03,41N,31W	Bates	X	X	B		X
Agate Lake	L3	210.7	13,60N,06W	Lewis	X	X	A	X	
Amarugia Lake	L3	39.0	10/11,43N,32W	Cass	X	X	B	X	
Anderson's Whippoorwill Farm Lake	L3	30.0	SW SE 28,28N,11E	Stoddard	X	X	B		
Anthonies Mill Lake	L3	91.0	SW SW 19,39N,01W	Washington	X	X	B	X	
Antimi Lake	L3	2.0	NE NE 3,48N,12W	Boone	X	X	B		
Apollo Lake	L3	15.0	21,36N,05E	St. Francois	X	X	B	X	
Appleton City Lake	L1	35.0	12,39N,29W	Bates	X	X	B		X
Archie Lakes	L1	7.3	SESE28,43N,31W	Cass	X	X	B		X
Armstrong Lake	L1	8.0	NE NE 28,52N,16W	Howard	X	X	B		X
Athens State Park Lake	L3	8.0	30,67N,07W	Clark	X	X	A	X	
Atkinson Lake	L3	434.0	NW SE06,37N,28W	St. Clair/Vernon	X	X	A	X	
Atlanta City Lake	L1	17.0	SE SW29,59N,14W	Macon	X	X	B		X
Austin Community Lake	L3	21.0	30,29N,11W	Texas	X	X	A	X	
Baha Trail Lake	L3	16.0	05,39N,01E	Washington	X	X	B	X	
Baring Country Club Lake	L1	81.0	SE26,63N,12W	Knox	X	X	A	X	X
Bass Lake	L3	29.0	13,47N,08W	Callaway	X	X	A	X	
Bean Lake	L3	420.0	12,13,14,23, 24, 54N,37W	Platte	X	X	B	X	
Bear Creek Watershed Lake	L3	26.7	6,63N,09W	Clark	X	X	B	X	
Beaver Lake	L3	14.0	22,25N,04E	Butler	X	X	A		
Bee Tree Lake	L3	10.0	03,42N,06E	St. Louis	X	X	B	X	
Belcher Branch Lake	L3	42.0	08/17,55N,34W	Buchanan	X	X	B	X	
Belle City Lake	L3	6.0	20,41N,07W	Maries	X	X	B		
Ben Branch Lake	L3	37.0	15/14,44N,08W	Osage	X	X	B	X	
Berndt Lake	L1	21.0	NE SW30,66N,23W	Mercer	X	X	B		X
Bevier Lake	L3	5.0	S SE,14,57N,15W	Macon	X	X	B		
Big Buffalo C.A. Lakes	L3	7.9	2,12,41N,20W	Benton	X	X	B		
Big Lake	L3	666.0	18&19,30,61N,39W	Holt	X	X	A	X	
Big Oak Tree S.P. Lake	L3	33.0	14,23N,16E	Mississippi	X	X	B		
Big Soldier Lake	L3	5.0	36,50N,19W	Saline	X	X	B	X	
Bilby Ranch Lake	L3	95.0	13/24,64N,38W	Nodaway	X	X	B	X	
Binder Lake	L3	127.0	SW SE36,45N,13W	Cole	X	X	B	X	
Blind Pony Lake	L3	96.0	NW SE18,49N,22W	Saline	X	X	B	X	
Bloodland Lake (Ft. Wood)	L3	38.1	04,34N,11W	Pulaski	X	X	B	X	
Blue Mountain Lake	L1	14.0	NW SE,09,33N,5E	Madison	X	X	B		X
Blue Springs Lake	L3	642.0	33 ,49N,31W	Jackson	X	X	A	X	
Blues Pond	L3	10.0	09,37N,08W	Phelps	X	X	B	X	
Bluestem Lake	L3	13.0	22,47N,31W	Jackson	X	X	B	X	
Bo Co Mo Lake	L3	140.0	NW NE10,49N,13W	Boone	X	X	B	X	

LWW (LWP) Livestock and Wildlife Watering
AQL (WWH, HHP) Protection of Warm Water Aquatic Life, Human Health Fish Consumption
CDF (CDH) Cold Water Fishery
WBC Whole Body Contact Recreation
SCR Secondary Contact Recreation
DWS Drinking Water Supply
IND Industrial

TABLE H-STREAM CLASSIFICATIONS AND USE DESIGNATIONS

WATER BODY	CLASS WBC	SCR	MILES DWS	FROM IND	TO	COUNTY	COUNTY 2	IRR	LWW	AQL	CLF	CDF
10-05-16 MUDD V2	C	84845.0		Statewide	Statewide	Statewide	x	x	x	B	x	
AB Cr.	C	4.2	Mouth	32,37N,18W	Dallas	Camden		x	x	B		
Ackerman Ditch	C	14.1	Mouth	24,24N,6E	Butler		x	x	x	B		
Agee Cr.	C	4.8	Mouth	24,61N,34W	Andrew			x	x	B		
Alder Br.	C	4.7	2,34N,26W	5,34N,25W	Cedar			x	x	B		
Alder Cr.	C	11.4	Mouth	21,35N,28W	Cedar			x	x	B		
Allen Br.	P	1.8	Mouth	22,37N,1E	Washington			x	x	B		
Allen Br.	C	1.5	22,37N,1E	34,37N,1E	Washington			x	x	B		
Allen Br.	C	3.0	Mouth	05,34N,05E	St. Francois			x	x	B		
Alley Br.	P	1.5	Mouth	25,29N,5W	Shannon			x	x	B		
Alley Br.	C	2.6	25,29N,5W	22,29N,5W	Shannon			x	x	B		
Allie Cr.	C	2.6	Mouth	1,33N,10E	Cape Girardeau	Bollinger		x	x	B		
Anderson Br.	C	1.0	Mouth	31,45N,20W	Pettis			x	x	B		
Anderson Cr.	C	1.9	Mouth	31,33N,09W	Texas			x	x	B		
Andrews Br.	C	1.8	Mouth	Sur 3062,37N,6E	St. Francois			x	x	B		
Anthony Br.	P	0.5	Mouth	6,22N,5W	Oregon			x	x	B		
Antire Cr.	P	1.9	Mouth	34,44N,4E	St. Louis			x	x	B		
Apple Cr.	P	44.8	Mouth	21,34N,10E	Perry			x	x	A	x	x
Apple Cr.	C	1.7	16,34N,10E	18,34N,10E	Perry			x	x	B		
Arapahoe Cr.	C	8.0	Mouth	11,61N,36W	Andrew			x	x	B		
Archer Cr.	P	1.2	Mouth	14,41N,20W	Benton			x	x	B		
Arnault Br.	P	2.2	Mouth	10,38N,2E	Washington			x	x	B		
Arnault Br.	C	1.0	10,38N,2E	15,38N,2E	Washington			x	x	B		
Arnold Cr.	C	1.1	Mouth	24,40N,1E	Washington			x	x	B		
Arthur Cr.	P	5.9	Mouth	14,31N,9W	Texas			x	x	B		
Arthur Cr.	C	2.5	14,31N,9W	25,31N,9W	Texas			x	x	B		
Ash Ditch	P	6.6	Mouth	13,25N,14E	New Madrid			x	x	B		
Ash Ditch	C	8.0	13,25N,14E	5,26N,15E	New Madrid	Mississippi		x	x	B		
Ash Slough Ditch	P	17.2	Mouth	35,26N,13E	New Madrid		x	x	x	B	x	
Asher Cr.	P	8.7	Mouth	4,30N,23W	Polk	Greene		x	x	B		
Asher Cr.	C	4.0	4,30N,23W	14,30N,23W	Greene			x	x	B		
Asher Cr.	P	1.0	Mouth	1,26N,7E	Wayne			x	x	B		
Asher Cr.	C	1.2	1,26N,7E	2,26N,7E	Wayne			x	x	B		
Asher Hollow Cr.	C	4.0	Mouth	24,37N,06W	Crawford	Phelps		x	x	B		
Ashley Br.	P	0.5	Mouth	30,39N,1W	Washington			x	x	B		
Ashley Br.	C	1.6	30,39N,1W	32,39N,1W	Washington			x	x	B		
Ashley Cr.	P	2.5	Mouth	35,32N,7W	Dent			x	x	B		
Ashly Br.	C	0.7	Mouth	27,38N,1E	Washington			x	x	B		
Aslinger Br.	P	1.0	Mouth	16,32N,8E	Madison			x	x	B		
Aslinger Br.	C	1.0	16,32N,8E	County Line	Madison			x	x	B		
Atwell Cr.	P	1.2	Mouth	2,38N,12W	Miller			x	x	B		
Atwell Cr.	C	2.0	2,38N,12W	11,38N,12W	Miller			x	x	B		
Auxvasse Cr.	P	8.2	Mouth	8,46N,8W	Callaway			x	x	B	x	
Auxvasse Cr.	C	39.9	8,46N,8W	22,49N,10W	Callaway			x	x	B		
Avery Hollow	C	0.9	Mouth	04,38N,03W	Crawford			x	x	B		
Bachelor Cr.	C	6.8	Mouth	19,49N,7W	Callaway			x	x	B		
Back Cr.	C	3.8	Mouth	11,35N,6E	St. Francois			x	x	B		
Bagby Br.	C	2.3	Mouth	1,52N,16W	Randolph			x	x	B		
Bailey Br.	P	1.8	Mouth	31,36N,1W	Washington			x	x	B		
Baileys Cr.	P	15.7	Mouth	5,44N,7W	Gasconade	Osage		x	x	B		
Baileys Cr.	C	6.6	5,44N,7W	20,44N,7W	Osage			x	x	B		
Baker Br.	C	3.5	Mouth	35,38N,28W	St. Clair			x	x	B		
Baker Cr.	C	3.5	32,29N,15W	12,28N,16W	Wright			x	x	B		

[Table J—Losing Streams

Note: The losing streams' beginning and ending locations in the FROM and TO columns are expressed in conventional "Section, Township, Range" format. For example, the FROM location for the first "Clear Creek" listing below should read as follows: "The southeast quarter of the northeast quarter of the northwest quarter of Section 10 in Township 25 North, Range 27 West."

Stream Name	***Counties***	***Miles***	***From***	***To***
Calton Cr.	*Barry*	*2.5*	*SE SE SE 18 25N 26W*	*SE SE SE 25 25N 27W*
Calton Cr.	*Barry*	*4.0*	*NE NE SE 12 25N 26W*	*W SW NW 16 25N 26W*
Clear Cr.	*Barry*	*4.0*	*SE NE NW 10 25N 27W*	*SE SE SW 31 26N 27W*
Trib. to Clear Cr.	*Barry*	*0.5*	*SE SW SW 35 26N 28W*	*NE SW NE 35 26N 28W*
L. Flat Cr.	*Barry*	*3.0*	*SE SE NE 36 25N 27W*	*NW NE NW 01 24N 27W*
L. Flat Cr.	*Barry*	*3.0*	*NW NW NW 35 25N 27W*	*SE SE NE 36 25N 27W*
Trib. to Clear Cr.	*Barry*	*0.5*	*SE SE NW 02 25N 28W*	*SE NE SE 35 26N 28W*
Trib. to Clear Cr.	*Barry*	*1.0*	*NW SE SW 01 25N 28W*	*NE SE SW 36 26N 28W*
Trib. to Clear Cr.	*Barry Lawrence*	*1.0*	*SW SE SW 34 26N 28W*	*NW NW SE 27 26N 28W*
Trib. to Clear Cr.	*Barry*	*1.0*	*SE NE SE 09 25N 27W*	*SW NW NW 09 25N 27W*
Trib. to Clear Cr.	*Barry*	*1.0*	*NW SW NW 08 25N 27W*	*NW NW SW 05 25N 27W*
Hudson Cr.	*Barry*	*4.0*	*SW SW SE 13 25N 28W*	*SW NW NW 16 25N 28W*
Hudson Cr.	*Barry*	*3.0*	*SW SE SE 29 25N 27W*	*SW SW SE 13 25N 28W*
Trib. to Hudson Cr.	*Barry*	*1.0*	*NW NE SE 20 25N 27W*	*SE SW SE 19 25N 27W*
Trib. to Hudson Cr.	*Barry*	*1.0*	*NW SE SW 30 25N 27W*	*NE SW SW 19 25N 27W*
Trib. to Hudson Cr.	*Barry*	*1.0*	*SW NE NE 23 25N 28W*	*NE NW SW 13 25N 28W*
Trib. to Hudson Cr.	*Barry*	*1.0*	*SW NW SE 18 25N 27W*	*NE SW NW 13 25N 28W*
Trib. to Hudson Cr.	*Barry*	*1.0*	*NE NE NE 12 25N 28W*	*NE SE SE 11 25N 28W*
Trib. to Hudson Cr.	*Barry*	*1.0*	*NE NW SW 14 25N 28W*	*SW NE SE 10 25N 28W*
Flat Cr.	*Barry*	*3.0*	*SW SW NW 23 22N 28W*	*SW SE NW 06 22N 27W*
Trib. to Flat Cr.	*Barry*	*1.5*	*SE SW NE 09 22N 27W S*	*E SE NE 05 22N 27W*
Trib. to Flat Cr.	*Barry*	*1.0*	*NE NW SE 22 23N 27W*	*NW SE SE 21 23N 27W*
Dry Hollow	*Barry*	*7.0*	*SW SW SW 10 21N 28W*	*NE SE NE 33 22N 27W*
Browning Hollow	*Barry Lawrence*	*3.0*	*SE NW SE 36 26N 27W*	*NE SW NE 20 26N 26W*
Kelly Cr.	*Barry*	*5.0*	*SE SE SW 02 25N 27W*	*SW SW SE 31 26N 27W*
Spring R.	*Barry Lawrence*	*2.0*	*NE SE SE 36 26N 26W*	*NW SE NE 20 26N 26W*

[Table K: Site-Specific Criteria

Parameter:	*Dissolved Oxygen*	*Daily Average Criterion*	*3.6 mg/L*
Waterbody:	*East Fork Locust Creek*	*Daily average dissolved oxygen concentrations shall not fall below 3.6 mg/L between July 1 and September 30 as measured by a minimum of four samples collected within a 24-hour period. All measurements shall be spaced a minimum of 5 hours apart.*	
Season:	*July – September*		
Hydrology:	*Baseflow Conditions*		
County:	*Sullivan*	*Daily Minimum Criterion*	*0.9 mg/L*
Miles:	*29.6*	*Daily minimum dissolved oxygen concentration shall not fall below 0.9 mg/L between July 1 and September 30 as measured by the average of three samples collected over any consecutive 6-hour period. All measurements shall be spaced a minimum of 1.5 hours apart.*	
From:	*Mouth*		
To:	*Section 12, T64N, R20W*		

Parameter:	*Dissolved Oxygen*	*Daily Average Criterion*	*3.6 mg/L*
Waterbody:	*Little East Fork Locust Creek*	*Daily average dissolved oxygen concentrations shall not fall below 3.6 mg/L between July 1 and September 30 as measured by a minimum of four samples collected within a 24-hour period. All measurements shall be spaced a minimum of 5 hours apart.*	
Season:	*July – September*		
Hydrology:	*Baseflow Conditions*		
County:	*Sullivan*	*Daily Minimum Criterion*	*0.9 mg/L*
Miles:	*9.0*	*Daily minimum dissolved oxygen concentration shall not fall below 0.9 mg/L between July 1 and September 30 as measured by the average of three samples collected over any consecutive 6-hour period. All measurements shall be spaced a minimum of 1.5 hours apart.*	
From:	*Mouth*		
To:	*Section 12, T64N, R20W*		

Parameter:	*Dissolved Oxygen*	*Daily Average Criterion**	*4.4 mg/L*
Waterbody:	*Sni-a-Bar Creek*	*Daily average dissolved oxygen concentrations shall not fall below 4.4 mg/L between July 1 and September 30 as measured by a minimum of four samples collected within a 24-hour period. All measurements shall be spaced a minimum of 5 hours apart.*	
Season:	*July – September*		
Hydrology:	*Baseflow Conditions*		
County:	*Jackson*	*Daily Minimum Criterion**	*4.0 mg/L*
Miles:	*5.0*	*Daily minimum dissolved oxygen concentration shall not fall below 4.0 mg/L between July 1 and September 30.*	
From:	*Confluence with Horseshoe Creek, Section 21, T49N, R29W*		
To:	*Entry of tributary carrying discharge from Blue Springs Sni-a-Bar wastewater treatment plant, Section 35, T49N, R30W*		
**These criteria shall expire on October 31, 2014. After October 31, 2014, the criteria shall be as stated in Table A.*			

Parameter:	*Dissolved Oxygen*	*Daily Average Criterion*	*4.7 mg/L*
Waterbody:	*Pike Creek*	*Daily average dissolved oxygen concentration shall not fall below 4.7 mg/L during summer baseflow conditions as measured by a minimum of four samples collected within a 24-hour period. All measurements shall be spaced a minimum of 5 hours apart.*	
Season:	*July – September*		
Hydrology:	*Baseflow Conditions*		
County:	*Butler*	*Daily Minimum Criterion*	*2.6 mg/L*
Miles:	*0.1*	*Daily minimum dissolved oxygen concentrations shall not fall below 2.6 mg/L during summer baseflow conditions.*	
From:	*Confluence with Main Ditch / Sec. 15, T24N, R6E*		
To:	*Poplar Bluff Wastewater Treatment Plant / Sec. 15, T24N, R6E*		

Parameter:	*Dissolved Oxygen*	*Daily Average Criterion*	*4.7 mg/L*
Waterbody:	*Main Ditch*	*Daily average dissolved oxygen concentration shall not fall below 4.7 mg/L during summer baseflow conditions as measured by a minimum of four samples collected within a 24-hour period. All measurements shall be spaced a minimum of 5 hours apart.*	
Season:	*July – September*		
Hydrology:	*Baseflow Conditions*		
County:	*Butler*	*Daily Minimum Criterion*	*2.6 mg/L*
Miles:	*14*	*Daily minimum dissolved oxygen concentrations shall not fall below 2.6 mg/L during summer baseflow conditions.*	
From:	*Confluence with Pike Creek / Sec. 15, T24N, R6E*		
To:	*Confluence with Pike Ditch / Sec. 18, T22N, R6E*		

I

[Table L: Total Phosphorus (TP) Criteria for Classified Lakes

Lake Ecoregion	*TP Reference Value (µg/L)*	*TP Prediction Value (µg/L) (1)*	*TP 10th Percentile Reference Value for Site Specific Criteria (µg/L)*
Plains	*58*	*a/4 + 16/b + 570/c*	*20*
Ozark Border	*41*	*15 + 740/c*	*16*
Ozark Highland	*26*	*5 + 740/c*	*9*

(1) Coefficients: a = percentage of watershed originally in prairie (0 to 100); b = hydraulic residence time in years; c = dam height in feet]

Table L: Lake Ecoregion Nutrient Criteria and Long-Term and Short-Term Screening Values (µg/L)

Lake Ecoregion	**Chl-a Criterion**	**Short-Term Screening Value**			**Long-Term Screening Value**		
		TP	**TN**	**Chl-a**	**TP**	**TN**	**Chl-a**
Plains (DWS)	**26**	**65**	**1,000**	**26**	**26**	**560**	**10**
Plains (AQL)	**40**	**100**	**1,300**	**40**	**50**	**850**	**20**
Ozark Border (DWS)	**26**	**70**	**1,000**	**26**	**29**	**600**	**10**
Ozark Border (AQL)	**22**	**60**	**960**	**22**	**26**	**580**	**9.0**
Ozark Highland (DWS)	**26**	**52**	**1,000**	**26**	**24**	**550**	**10**
Ozark Highland (AQL)	**15**	**34**	**700**	**15**	**18**	**430**	**7.0**

Table M: *[Lakes with]* Site-Specific **Nutrient** Criteria

Lake Ecoregion	Lake	County	Site-Specific Criteria (µg/L)		
			TP	TN	Chl-a
Plains	Bowling Green Lake	Pike	21	502	6.5
	Bowling Green Lake (old)	Pike	31	506	5.0
	Forest Lake	Adair	21	412	4.3
	Fox Valley Lake	Clark	17	581	6.3
	Hazel Creek Lake	Adair	27	616	6.9
	Lincoln Lake – Cuivre River State Park	Lincoln	16	413	4.3
	Marie, Lake	Mercer	14	444	3.6
	Nehai Tonkaia Lake	Chariton	15	418	2.7
	Viking, Lake	Daviess	25	509	7.8
	Waukomis Lake	Platte	25	553	11.0
	Weatherby Lake	Platte	16	363	5.1
Ozark Border	Goose Creek Lake	St Francois	12	383	3.2
	Wauwanoka, Lake	Jefferson	12	384	6.1
Ozark Highlands	Clearwater Lake	Wayne-Reynolds	13	220	2.6
	Council Bluff Lake	Iron	7	229	2.1
	Crane Lake	Iron	9	240	2.6
	Fourche Lake	Ripley	9	236	2.1
	Loggers Lake	Shannon	9	200	2.6
	Lower Taum Sauk Lake	Reynolds	9	203	2.6
	Noblett Lake	Douglas	9	211	2.0
	St. Joe State Park Lakes	St Francois	9	253	2.0
	Sunnen Lake	Washington	9	274	2.6
	Table Rock Lake	Stone	9	253	2.6
	Terre du Lac Lakes	St Francois	9	284	1.7
	Timberline Lakes	St Francois	8	276	1.5

[Table N: Total Phosphorus Criteria in Tributary Arms of Major [Reservoirs] ***Lakes***

Reservoir	*Tributary Arm*	*Sample Site (dec. deg.)*		*TP (µg/L)*
		Latitude	*Longitude*	
Ozarks, Lake of the	*Grand Glaize*	*38.11*	*-92.664*	*26*
	Gravois	*38.245*	*-92.745*	*26*
	Niangua	*38.071*	*-92.822*	*26*
Table Rock Lake	*James River*	*[36.678]* ***36.6775***	*[-93.535]* ***-93.5353***	*[16]* ***22***
	Kings River	*[36.576]* ***36.5647***	*[-93.596]* ***-93.5972***	*18*
	Long Creek	*[36.557]* ***36.5256***	*[-93.294]* ***-93.3021***	*[12]* ***14***

]

AUTHORITY: sections 644.021 and 644.026, RSMo Supp. 2013. Original rule filed May 13, 1977, effective Dec. 11, 1977. Amended: Filed Oct. 15, 1980, effective April 11, 1981. Amended: Filed July 12, 1984, effective Dec. 13, 1984. Rescinded and readopted: Filed Aug. 4, 1987, effective Dec. 12, 1987. Amended: Filed Nov. 14, 1988, effective April 15, 1989. Rescinded and readopted: Filed Sept. 5, 1990, effective March 14, 1991. Amended: Filed Sept. 2, 1993, effective May 9, 1994. Amended: Filed Nov. 14, 1995, effective July 30, 1996. Amended: Filed March 1, 1996, effective Nov. 30, 1996. Amended: Filed March 31, 2005, effective Dec. 31, 2005. Amended: Filed Dec. 13, 2007, effective Aug. 30, 2008. Emergency amendment filed Nov. 12, 2008, effective Nov. 22, 2008, expired May 20, 2009. Amended: Filed Feb. 3, 2009, effective Oct. 30, 2009. Amended: Filed Oct. 31, 2011, effective June 30, 2012. Amended: Filed May 15, 2013, effective Feb. 28, 2014.*

**Original authority: 644.021, RSMo 1972, amended 1973, 2000, 2002, 2007 and 644.026, RSMo 1972, amended 1973, 1987, 1993, 1995, 2000, 2012.*

MO-AG

Missouri Agribusiness Association

DATE October 1, 2015
TO MDNR- Water Protection Program
FROM Steve Taylor, MO-AG
Subject Preliminary DRAFT comments on proposed WQS/NNC rule and rationale document

1. The rule, with justification from the rationale document, appear to transfer water treatment costs. MDNR sets a 10 µg/L screening value partially based on taste and odor issues. MDNR suggests that "taste and odor problems would cease when chl-a concentrations are maintained at a level below 10 µg/L." MDNR does not differentiate between source, raw, and finished drinking water. EPA's "Do Not Drink" recommendation is 1.6 µg/L. EPA states that "treatment strategies can be implemented easily and quickly to provide immediate response to any cyanotoxins detected in raw or finished water and prevent cyanotoxins from breaking through into treated water". EPA states that if drinking water reaches 1.6 µg/L, water utilities should adjust existing treatment to reduce the concentration to below 0.3 µg/L as soon as possible. Microcystins should be the primary concern of a drinking water NNC. Chl-a is an indicator of nutrient levels which are one of several factors in formation of microcystins. A chl-a level of 40 µg/L or more for raw water (not source water) with site-specific criteria as needed should be considered.

2. In matters of policy, MDNR points to MDC and states that the MDNR/MDC goal is not to maximize sport fish harvest but that the goal is 'maintenance of sport fisheries'. MDNR/MDC policy should not be to not maximize sport fish harvest. In matters of research, MDC/MU (Michaletz, Obrecht, Jones, 2012) say the following: growth and size structure of sport fishes usually improved with increasing lake fertility, first-year growth of black crappies increased with chlorophyll concentrations up to a threshold of ≈ 100 µg/L, sport fish biomass and harvest tend to increase with fertility, substantial reductions in nutrient inputs have led to declines in sport fisheries in some lakes, and that caution should be used when reducing nutrient input into lakes. MDC/MU researchers do also say that harmful effects of high nutrient concentrations on sport fish populations may occur in hypereutrophic lakes (hypereutrophic defined as chl-a levels >75.0 µg/L). This data would seem to support a general statewide criteria of 60 µg/L or more, particularly for the Plains. In unique Ozark areas and special case plains lakes, site-specific criteria could be developed.

3. Describing the sampling process as a 'minimum of four (4) representative samples per year' should be removed. The rule should specify 'one representative sample must be collected during May, June, July, and in the month of August.' The rule should specifically state where the sample is taken and it should distinguish lakes where drinking water is a use. The rule could state "for lakes where drinking water use is not applicable, a representative source water sample of the water column of the epilimnetic layer shall be taken. If an epilimnetic layer does not exist, a representative source water sample shall be taken in a water column defined by where an epilimnetic layer historically has existed. For lakes where uses include drinking water, a representative raw water sample shall be taken."

4. The concept of screeners could be helpful if the screeners are well-defined, and, if the purpose correlates to the screener values. The proposed rule state a lake that exceed screening

values 'does not clearly indicate impairment or lack of impairment" and will "receive monitoring until such time as a determination can be made concerning their impairment status". Impairment status should be determined solely by whether a criterion value is exceeded. The proposed rule should state that exceeding a screener value will result in the lake receiving increased attention in order to avoid impairment. Screeners should serve to identify lakes that are at serious risk of impairment. The long term screener should be an indicator of a chronic level of on-going elevated levels of nutrients and the short-term screener should indicate a more acute level, taking into account short-term events that may just only temporarily elevate levels with no other consequences. With this methodology, the short term screener value should be greater than the criteria value. The long term screeners should indicate a trend and should be set just below criteria in order to trigger action before triggering criteria.

5. The rule allows the screener value/weight of evidence evaluation process to also determine impairment. Putting aside objections to this process as described in #4 above, it should be noted that this evaluation process is not adequately described in the rule. Given that much of the success of the rule may very well hinge on this concept, it would be very appropriate to include more text in the rule itself objectively describing this process. A general definition and description of "epilimnetic excursions from dissolved oxygen or pH criteria" and the levels of DO and pH that are cause for concern should be objectively described. Regarding "excessive levels of mineral turbidity that consistently limit algal productivity," clarification is needed relating a turbidity/sediment criteria and NNC. The rule needs to better describe how turbidity relates to nutrient criteria & evaluation of lake for aquatic impairment from nutrients and what levels are cause for concern.

6. Again, the rule and document appear to be written to transfer water treatment cost. Weight of evidence evaluation for drinking water supplies is more applicable to issues addressed by the MDNR PDWP branch. With that said, more objective description of 'impacts on water treatment operations', 'excessive' disinfection, and 'unacceptable aesthetics' are needed. MDNR should reference EPA's "Recommendations for Public Water Systems to Manage Cyanotoxins in Drinking Water" (June 2015) as well as AWWA's "A Water Utility Manager's Guide to Cyanotoxins". EPA recognizes that "the formation of algal blooms is dependent upon a number of environmental conditions, including the presence of nutrients, climate, and stratification of the water source". EPA "provides a stepwise approach PWSs could use to inform their decisions on whether and how to monitor and (or) treat for microcystins." EPA believes its guidelines are more representative than WHO and EPA has stated that WHO will re-evaluate their guideline based on EPA's assessments. Based on this, reference to WHO should be deleted. Missouri will ultimately be forced to utilize EPA guidance.

7. A general observation regarding the term 'weight of evidence' (WofE). WofE is a term that has been used for many years in MDNR's NNC meetings. WofE should be better defined in the rule. In some cases, WofE refers to specific, objective measures that utilizes a statistical quantitative method. In other instances, WofE infers subjective considerations such as in a court of law were weight of evidence measures credible proof. The vagueness of the proposed rule description of the WofE evaluation does not help in defining what is exactly meant here by the use of the WofE term.

Missouri Pork Association
Missouri Corn Growers Association
Missouri Soybean Association
Missouri Farm Bureau

RECEIVED
OCT 19 2015
Water Protection Program

October 15, 2015

John Madras, Director
Water Protection Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

Re: Lake Numeric Nutrient Criteria

Dear Mr. Madras:

As we understand, the Missouri Department of Natural Resources (DNR) is planning to start the rulemaking process on new regulation that will establish state-wide lake Numeric Nutrient Criteria for protection of aquatic life and drinking water supply designated uses within Missouri's water quality standards. This letter addresses the Missouri Pork Association, the Missouri Soybean Association, the Missouri Corn Growers Association and the Missouri Farm Bureau's current position and recommended action on this DNR rulemaking proposal.

On March 2, 2009, DNR proposed lake numeric nutrient criteria in the *Missouri Register* which was subsequently adopted by the Clean Water Commission and published final on September 15, 2009. After a nearly two-year long review, EPA issued a decision letter dated August 16, 2011 approving in part and disapproving in part Missouri's 2009 lake nutrient criteria. With the sole exception of Table M, EPA disapproved all of Section (4)(N) of 10 C.S.R. § 20-7.031. Section (4)(N) was an attempt by DNR to establish state-wide numeric criteria for nitrogen, phosphorus and chlorophyll in lakes and reservoirs. To date, Missouri has not adopted or submitted to EPA revised lake nutrient criteria, nor has EPA proposed or promulgated lake nutrient criteria for Missouri. While no rulemaking action has been taken by DNR or EPA during this time period, EPA and DNR have advanced other key nutrient related policy actions that are directly germane and should be implemented fully before any further rulemaking action on numeric nutrient criteria.

Throughout the last year, it has become apparent to us that DNR's effort is driven primarily by the prior EPA disapproval. In the meantime, it appears to us that the department has lost sight of whether the regulatory expansion imposed by the rule is justified, worthwhile and most of all, necessary. We have observed very little discussion about how necessary, effective and productive this regulatory approach to nutrients will actually be. There has been little to no discussion about the current aquatic life or drinking water quality conditions within the subject lakes. We wonder, is the aquatic life condition(s) within our lakes threatened at a level that

justifies this state-wide regulatory expansion? Are there other ways that the department can assess conditions and target resources more effectively without the regulatory hardship that mandatory state-wide criteria will bring?

From our perspective, DNR's current approach can be summed up simply as a "regulate first and educate last" strategy. Our position is that DNR should first characterize the on-the-ground need for action; second, substantiate the need for action; third, work with stakeholders to determine the possible universe and scope of pro-active non-regulatory actions to address the need, and then finally after all viable non-regulatory options are fully considered and tried, begin discussing possible regulatory-based action with stakeholders. With these steps in mind, we question whether DNR has given any meaningful consideration to alternatives in lieu of lake criteria. More specifically, has DNR considered non-regulatory alternatives that would otherwise avoid what is certain to be a complex and challenging regulatory burden?

We believe there are more practical solutions available to address nutrients in surface waters. We respectfully request that DNR re-focus its resources and efforts on nutrient reduction plans and policy that have recently been developed in accordance with EPA directives discussed further below. We urge DNR to seek a path that will have stronger stakeholder support and buy-in, is realistic and achievable, and that can remain flexible and adaptable. Consuming time and resources on debating and implementing a scientifically questionable nutrient scheme that we know upfront will prove to be extremely costly and problematic to implement, and may be generally unachievable, serves no good public purpose. Therefore the only rulemaking action on nutrients that we support at this time, as it relates to Missouri's water quality standards, is for DNR to rescind the previously disapproved numeric lake nutrient criteria that is still on the books in state regulation. In the paragraphs that follow, we explain why this is good public policy and a valid option allowed by EPA regulation.

On March 16, 2011, Nancy Stoner, Acting Assistant Administrator of the EPA Office of Water, issued a memorandum entitled: "Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions." The memorandum (commonly referred to as the "Stoner memo") discusses EPA's commitment to partner with states to make progress in accelerating the reduction of nitrogen and phosphorus loadings to our nation's waters. The memorandum discusses how each state is encouraged to develop and implement its own strategy that allows for flexibility in tailoring a strategy's approach and components. Notably, the Stoner memo placed little emphasis on, much less required, states to adopt numeric nutrient criteria. Instead, the memo simply encouraged states to begin developing work plans. Furthermore, the memo states clearly, "States need room to innovate and respond to local water quality needs, so a one-size-fits-all solution to nitrogen and phosphorus pollution is neither desirable nor necessary." In response to the Stoner memo, Missouri like many other states, proceeded to develop and adopt a state nutrient reduction strategy.

Three years ago DNR assembled a broad based group of stakeholders to discuss and draft a Nutrient Reduction Strategy for Missouri. After many meetings and extensive drafting efforts, in December 2014 the DNR and stakeholders finalized the Missouri Nutrient Reduction Strategy.

The Nutrient Reduction Strategy was designed to work as a non-regulatory mechanism to protect the designated use of water bodies from nutrient enrichment. This idea was captured head-on in the Strategy's vision, that being *"All Missouri waters have acceptable levels of nutrients that maintain water quality for all designated uses."* The Strategy seeks to achieve this vision by presenting broadly-agreed upon recommended actions across all industry sectors that will reduce nutrient loads incrementally and cost-effectively. It follows an adaptive management approach, focusing near-term efforts on practical and proven actions that are available today, while leaving the door open for additions and changes to actions as necessary and as proven effective and practical for Missouri. The Strategy clearly lays this principle out upfront on page 6, stating *"In creating this strategy, Missouri was led by the desire to create a practical strategy containing reasonable recommended actions for the next few years. The strategy can then be broadened to include additional recommendations as new technologies or approaches are proven to be effective while maintaining momentum on existing actions."*

Although the Nutrient Reduction Strategy is a non-regulatory approach to control nutrients, Missouri has long standing general water quality criteria in its water quality standards to identify nutrient impairments to the extent they exist in the state. We believe Missouri's general water quality criteria and the new Nutrient Reduction Strategy are key components of an existing, comprehensive state strategy to achieve nutrient load reductions in lieu of regulatory-based numeric lake nutrient criteria. Therefore, we urge DNR to rescind the lake nutrient criteria from the standards and engage in a more pro-active non-regulatory approach to protect Missouri's waters.

According to 40 C.F.R. § 131.21, Missouri can enact and submit for approval new standards that delete lake nutrient criteria. In order to become the applicable water quality standard, revised standards that delete the lake nutrient criteria need only be approved by the EPA. Upon submission of a state rulemaking that rescinds DNR's lake nutrient criteria together with supporting justification, EPA has the legal obligation to approve such a rescission. This decision would supersede the previous disapproval by EPA of the lake nutrient criteria and place Missouri more in line with EPA's current policy as set forth in the Stoner memo. We also note that most states, including Kansas and Iowa, do not have state-wide numeric lake nutrient criteria.

In conclusion, we believe that the Clean Water Commission should immediately undertake a rulemaking to rescind the previously disapproved lake nutrient criteria from Missouri's water quality standards. DNR can justify this action based on its current regulatory authority, the scientific and practical uncertainty surrounding numeric criteria, and the department's new policy on nutrients articulated in its Nutrient Reduction Strategy. In keeping with this strategy's principles and purpose, promulgating numeric nutrient criteria should be considered a non-viable action at this time. DNR should focus its time and resources on implementing the strategy through pro-active collaboration and partnership which will provide greater and more cost-effective opportunity to produce positive results for Missouri. Our respective organizations stand ready to work with the department and other stakeholders toward this end.

Sincerely,

Missouri Pork Association

Don Nikodim, Executive Director

Missouri Corn Growers Association

Gary Marshall, Executive Director

Missouri Soybean Association

Gary Wheeler, Executive Director

Missouri Farm Bureau

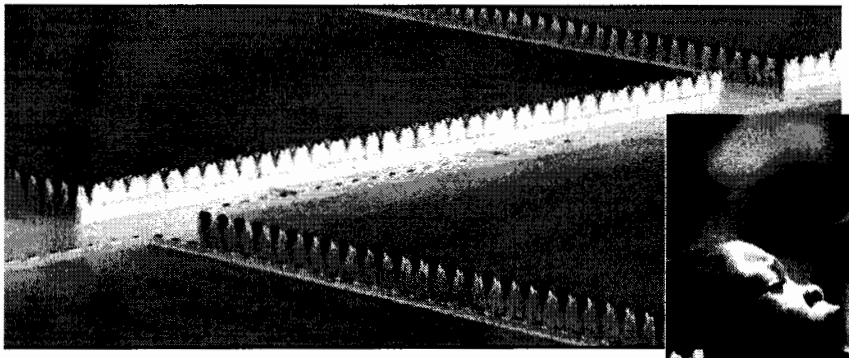
Leslie Holloway, Director, Regulatory Affairs

Water Quality Standards Workgroup Meeting

Lake Numeric Nutrient Criteria
November 10, 2015

Drinking Water Supply Beneficial Use - 10 CSR 20-7.031(C)6

- **Drinking Water Supply –** *Maintenance of a raw water supply which will yield potable water after treatment by public water treatment facilities.*



EPA Health Advisories for Cyanotoxins

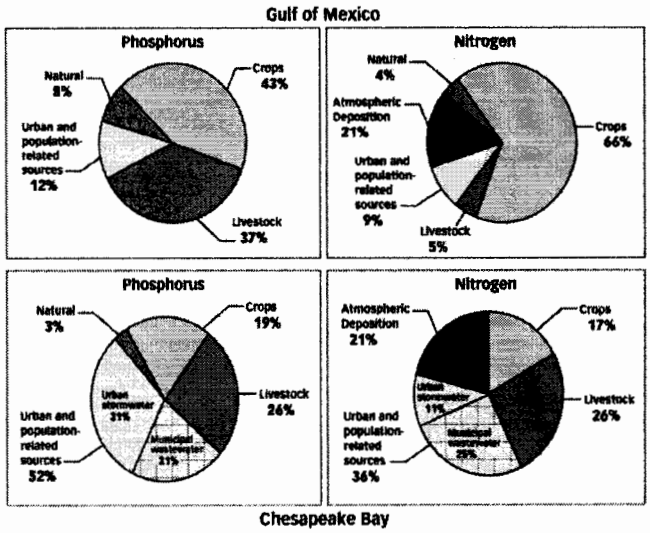
Lesley D'Anglada
Health and Ecological Criteria Division
Office of Science and Technology
Office of Water

May 11, 2015
Stakeholder Meeting

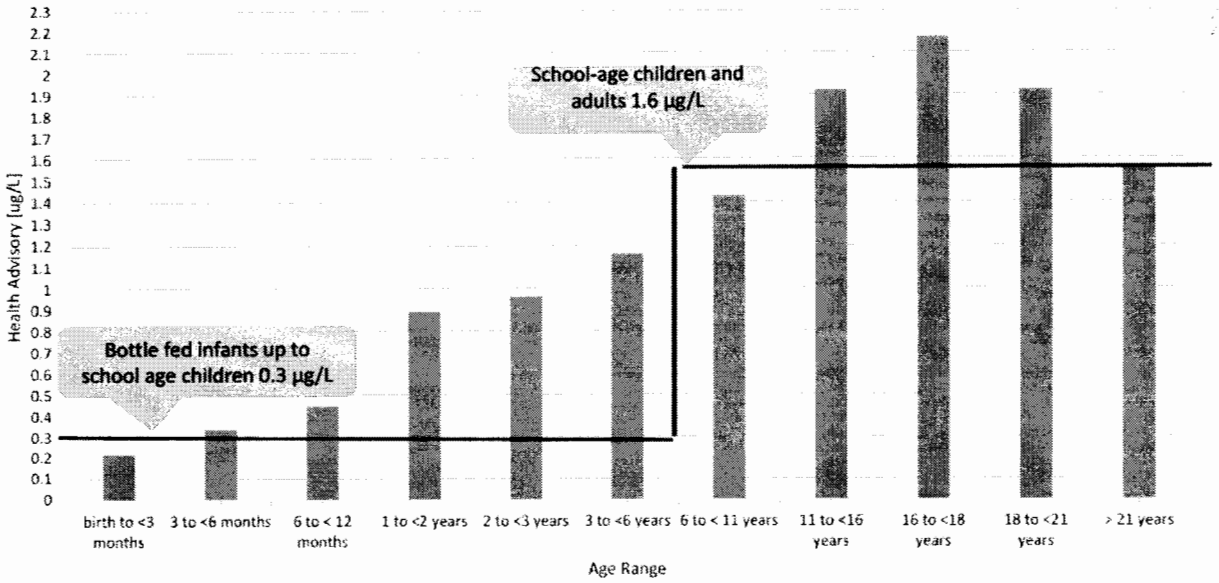
Causes of Nutrient Pollution

- Nitrogen and phosphorus support the growth of algae and aquatic plants, which provide food and habitat for fish, shellfish and smaller organisms that live in water
- But when too much nitrogen and phosphorus enter the environment – usually from human activities – algae, including HABs, can grow excessively
- Very recent work has suggested that high concentrations of nitrogen are linked to increased concentrations of microcystins

Relative Nutrient Source Contributions



EPA Microcystins Health Advisory by Age Group



Do Not Drink – children under 6 and sensitive populations (pregnant women, elderly and immune-compromised individuals)
Microcystin: 0.3 µg/L
Anatoxin-a: 20 µg/L
Cylindrospermopsin: 0.7 µg/L
Saxitoxin: 0.2 µg/L

Do Not Drink – children 6 and older and adults
Microcystin: 1.6 µg/L
Anatoxin-a: 20 µg/L
Cylindrospermopsin: 3.0 µg/L
Saxitoxin: 0.2 µg/L

Do Not Use (based on the Recreational No Contact Advisory thresholds)
Microcystin: 20 µg/L
Anatoxin-a: 300 µg/L
Cylindrospermopsin: 20 µg/L
Saxitoxin: 3 µg/L

Potential Actions Public Water Systems and States Can Take to Prepare for and Respond to Cyanotoxin Health Risks in Drinking Water

Presenter: Ryan Albert
Office of Ground Water and Drinking Water

May 11, 2015
Stakeholder Meeting

Setting the Stage: Definitions
(For purpose of this presentation)

- Source water – water from lakes, reservoirs, rivers, or streams that is used as a drinking water source
- Raw water – water that enters the drinking water intake, but has not yet received any treatment
- Finished water – "water that is introduced into the distribution system of a public water system and is intended for distribution and consumption without further treatment, except as treatment necessary to maintain water quality in the distribution system. . . ." (40 CFR 141.2)

Setting the Stage: Microcystin Methods Overview

Summary Options	ELISA-Field (Tube/Strips)	ELISA-Lab	HPLC-UV (PDA)	HPLC-MS/MS
Specificity	Total Microcystins	Total Microcystins	Total Microcystins– limited specificity	6 Specific Microcystin congeners (EPA method 544)
Approx. Limit of Quantification (LOQ)	~0.5 – 1 ug/L	~ 0.3 µg/L	~ 0.3 µg/L	~ 0.02 µg/L
Time to result	10 – 60 minutes	4 hours or less	~ 1 day	~ 1 day
Estimated Cost per Analysis	$30-100	$50-150	$150-250	$200-350

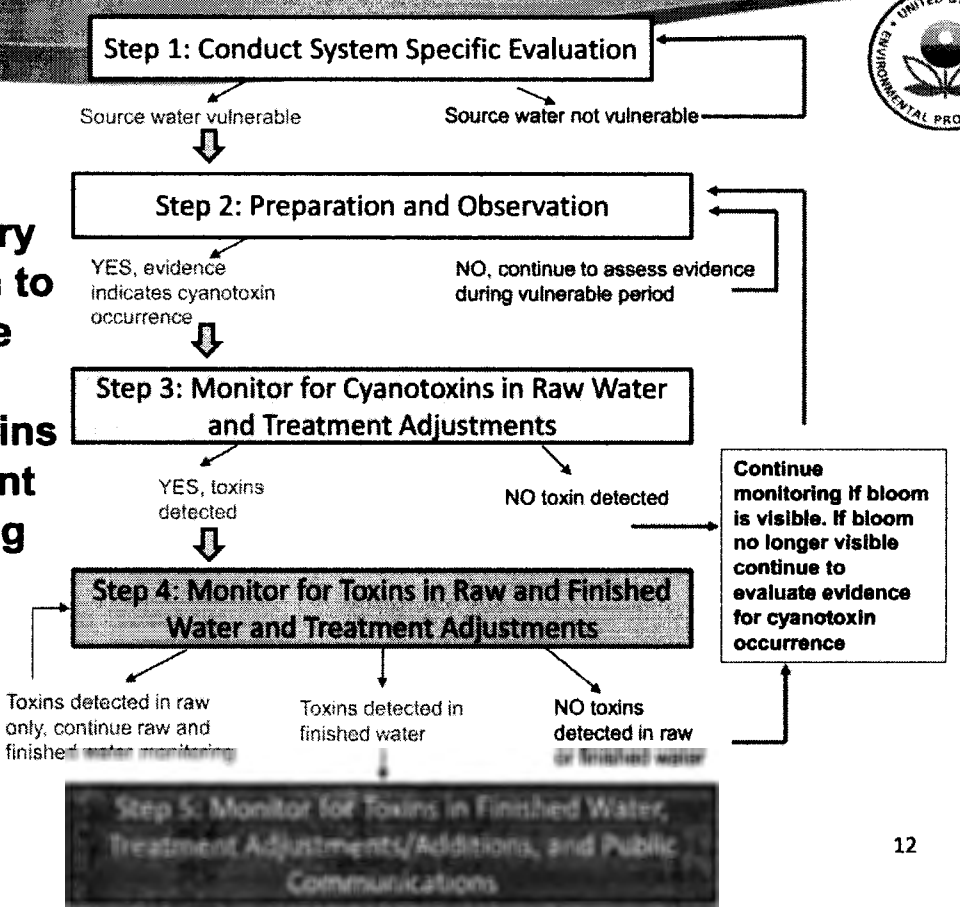
Setting the Stage: Treatment Overview

- Conventional treatment is effective in removing cyanobacterial cells (containing intracellular cyanotoxins)
  - Greater than **90%** cell removal when using coagulation, sedimentation, and filtration
  - Greater than **80%** buoyant cell removal when using coagulation/flocculation and Dissolved Air Flotation (DAF)
  - Adjustment of current treatment may achieve higher levels of cell removal
  - Conventional treatment is not consistently effective for removal of dissolved (extracellular) cyanotoxins
  - Pre-oxidation can lyse the cells, releasing toxins and increasing the problem (by increasing dissolved cyanotoxins)

Setting the Stage: Treatment Overview

- Activated Carbon is effective in removing cyanotoxins
  - Powdered Activated Carbon (PAC) has greater than 80% removal efficacy for dissolved cyanotoxins
  - Ineffective for removal of cells containing intracellular toxins
  - Jar testing can be used to determine an effective PAC dose
- Ozone is effective in oxidizing dissolved cyanotoxins
  - Ozone documented to destroy greater than 95% of dissolved cyanotoxins
  - Given adequate dosing, ozone can achieve destruction of cells as well as the dissolved toxins released due to cell lysis caused by ozone
  - May increase the potential for the formation of bromate and other disinfection byproducts

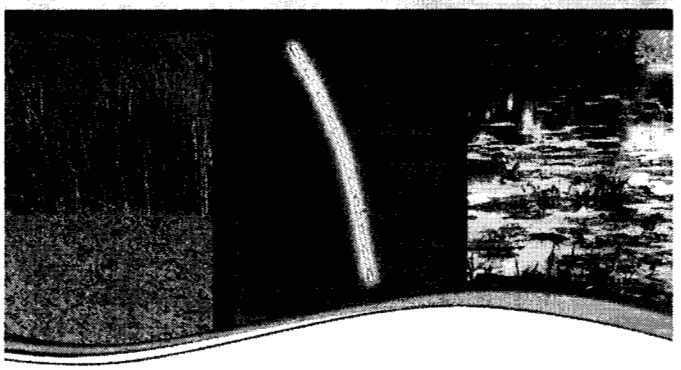
Preliminary Approach to Determine Whether Cyanotoxins are Present in Drinking Water



Step 5: Monitor for Toxins in Finished Water, Treatment Adjustments, and Public Communications

Low Level	Medium Level	[redacted]
Microcystins: ≤ 0.3 µg/L	Microcystins: > 0.3µg/L ≤ 1.6 µg/L	Microcystins: > 1.6 µg/L
Communication		
Continue communication with State primacy agency and local health officials on monitoring results.	Notify local public health agency, primacy agency and the public. Recommend use of alternative sources for children younger than school-age.	[redacted]
Treatment Actions		
Modify treatment as necessary to keep algal toxins below HA values.	Adjust existing treatment to reduce the concentration to below 0.3 µg/L (MC) as soon as possible. Modify or amend treatment as necessary.	[redacted]
Monitoring		
Continue sampling raw and finished water at least 2-3 times per week until levels are below quantification in at least 2-3 consecutive samples in raw water, then return to Step 3.	Continue sampling raw and finished water daily until finished water levels are below quantification in at least 2-3 consecutive samples.	[redacted]

A Water Utility Manager's Guide to Cyanotoxins



American Water Works Association

Water Research Foundation
advancing the science of water

Eutrophication Impacts to Drinking Water Utilities

- **Increased organic compounds that serve as precursors for disinfection byproducts**
  - Trihalomethanes
  - Haloacetic acids
- **Taste and odor compounds**
  - Trans-1,10 dimethyl-trans-9-decalol (geosmin)
  - 2-methylisoborneol (MIB)
- **Cyanobacterial toxins**
  - Microcystins
  - Cylindrospermopsin
  - Anatoxin-a
  - Saxitoxin

Proposed Drinking Water Supply Criteria and Screening Values

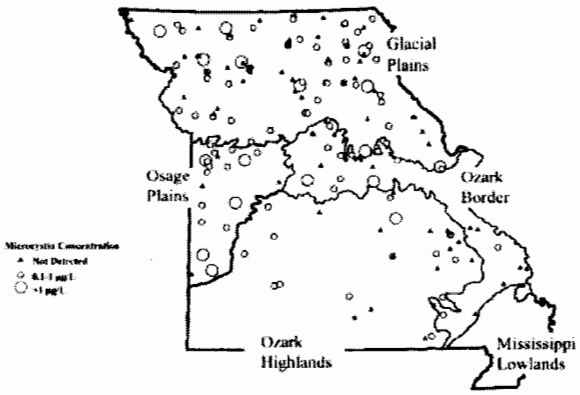
Table L: Lake Ecoregion Nutrient Criteria and Long-Term and Short-Term Screening Values (µg/L)

Lake Ecoregion	Chl-a Criterion	Short-Term Screening Value			Long-Term Screening Value		
		TP	TN	Chl-a	TP	TN	Chl-a
Plains (DWS)	26	65	1,000	26	26	560	10
Plains (AQL)	40	100	1,300	40	50	850	20
Ozark Border (DWS)	26	70	1,000	26	29	600	10
Ozark Border (AQL)	22	60	960	22	26	580	9.0
Ozark Highland (DWS)	26	52	1,000	26	24	550	10
Ozark Highland (AQL)	15	34	700	15	18	430	7.0

Eutrophication Impacts to Drinking Water Utilities

- **Increased organic compounds that serve as precursors for disinfection byproducts**
  - Trihalomethanes
  - Haloacetic acids
- **Taste and odor compounds**
  - Trans-1,10 dimethyl-trans-9-decalol (geosmin)
  - 2-methylisoborneol (MIB)
- **Cyanobacterial toxins**
  - Microcystins
  - Cylindrospermopsin
  - Anatoxin-a

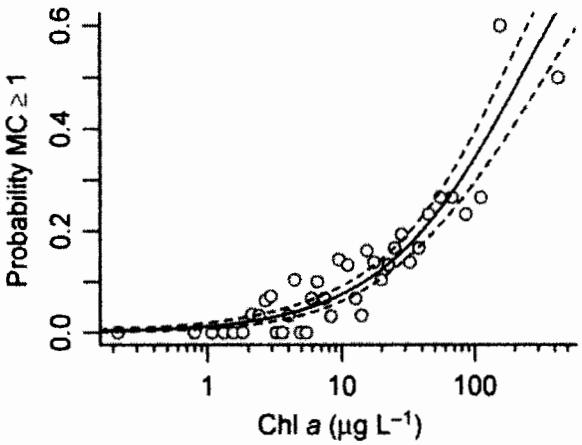
Microcystin in Missouri Reservoirs (Graham and Jones, 2009)



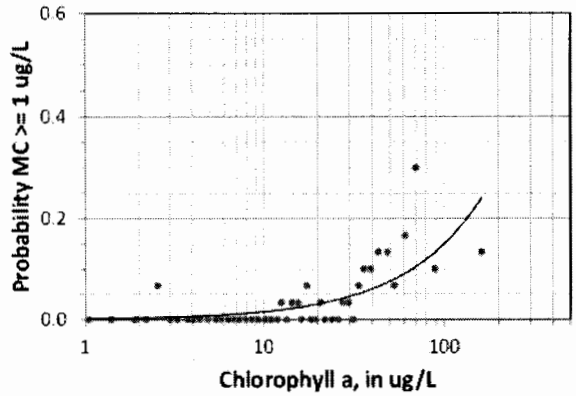
Total Microcystin (ug/L)	n	Chl-a Median (ug/L)	Chl-a Range (ug/L)
nd	1,082	11	1-252
0.1-1	271	26	1-267
>1	49	49	2-131

Microcystin
National vs Missouri Dataset

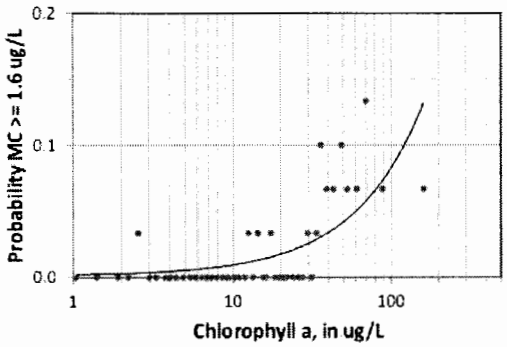
National Dataset (Yuan, 2014)

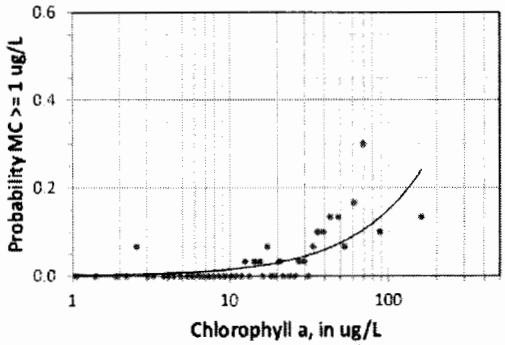


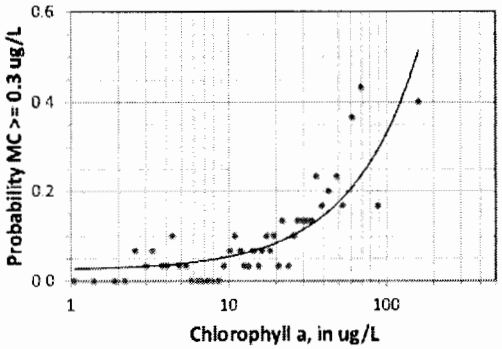
Missouri Dataset
(Graham and Jones, 2009)



Microcystin (Missouri Dataset) – Probability Comparison of Different MC Levels







Reservoirs with at least 4 Microcystin samples ≥ 0.3 ug/L

Reservoir	Region	# samples ≥ 0.3 ug/L	Median MC (ug/L)	Long-term Chl Geomean (ug/L)	Range of Annual Chl Geomeans (ug/L)	Chl Geomean Period
Bilby Ranch	Plains	20 of 26	0.89	25	12-38	2003, 2005-2012
Bushwacker	Plains	6 of 8	0.67	12	8-23	2003, 2005, 2009
Harrison Co.	Plains	7 of 26	0.86	37	21-39	2008-2012
Kraut Run	Plains	4 of 7	1.69	69	50-102	2003-2012
LaBelle #2	Plains	6 of 12	6.25	42	39-58	2003-2007, 2010-2011
Little Dixie	Plains	5 of 12	0.47	31	18-49	2003-2013
Marceline City	Plains	11 of 22	11.24	30	18-60	2005-2010
McCredie	Plains	4 of 4	1.18	72	na	na
Ben Branch	Ozark High.	4 of 4	1.48	12	5-19	2007-2009, 2011-2012
Indian Hills	Ozark High.	4 of 4	0.78	24	24	2003-2004

Drinking Water Compliance Report
Disinfection Byproducts - MCL Violations (2010-2014)

System	Waterbody	Total Trihalomethane	Total Haloacetic Acids
Adrian	Adrian Lake, South Grand River	2014	--
Bowling Green	Lake #1, Lake #2	2011	--
Breckenridge	Breckenridge Lake	2010-2012	2010
Bucklin	Mussel Fork Creek, Bucklin Lake	2011-2012	2010
Daviess Co PWSD 3	Lake Viking	2010-2011	--
Fredericktown	Fredericktown Lake	--	2014
Garden City	Garden City Lake, New Lake	2010-2013	--
Hamilton	Marrowbone Creek, Hamilton Lake	2010-2012	--
Lamar	Lamar Lake	2010	--
Maysville	Willowbrook Lake	2010-2011, 2013-2014	--
Memphis	Memphis New Lake, Memphis Old Lake	2013	2013

Note: This table does not represent an exhaustive list of all DBP MCL violations. This table excludes system violations where the waterbody could not be identified or was not a reservoir, or where water quality data could not be located. Additionally, where a system pulls water from multiple sources, it is unclear which source caused the MCL violation.

Disinfection Byproduct Data Summary

Drinking Water Reservoir	Region	Long-term Chl Geomean (ug/L)	Range of Annual Chl Geomeans (ug/L)	[illegible]
Adrian Lake	Plains	33	29-37	2011-2012
Bowling Green Lake Old	Plains	6	0.3-27	2003-2010, 2013
Breckenridge Lake	Plains	13	5-62	2003, 2010-2011
Bucklin Lake	Plains	23	9-55	2010-2012
Garden City #1	Plains	38	38	2011
Garden City #2	Plains	49	49	2012
Lamar Lake	Plains	47	31-76	2003-2010, 2013
Memphis Lake #1	Plains	44	44	2009
Memphis Lake #2	Plains	35	34-35	2005-2006
Vandalia Reservoir	Plains	21	16-29	2011-2012
Lake Viking	Plains	7	5-14	2003, 2005-2012
Willowbrook Lake	Plains	28	24-36	2005-2006
Fredericktown Lake	Ozark High.	31	28-34	2004-2005, 2008

Summary of Microcystin and Disinfection Byproduct Data

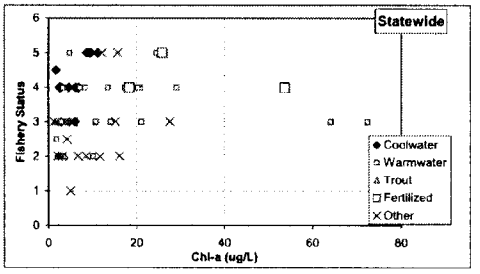
- **Microcystin Summary**
  - Mean = 35 ug/L
  - Median = 31 ug/L
  - Range = 12-72 ug/L
- **Disinfection Byproduct Summary**
  - Mean = 29 ug/L
  - Median = 31 ug/L
  - Range = 6-49 ug/L

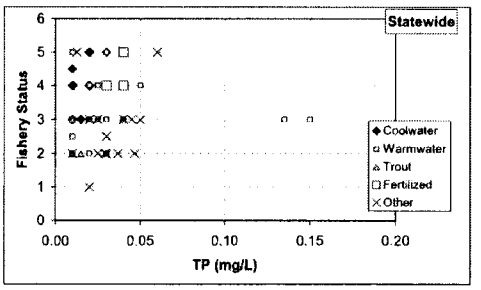
Aquatic Life Protection - 10 CSR 20-7.031(C)1.A.,B.,C.

- **Warm Water Habitat –** *Waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of warm-water biota.*
- **Cool Water Habitat -** *Waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of cool-water biota. These waters can support a sensitive, high-quality sport fishery (i.e., smallmouth bass and rock bass).*
- **Cold Water Habitat -** *Waters in which naturally-occurring water quality and habitat conditions allow the maintenance of a wide variety of cold-water biota. These waters can support a naturally reproducing or stocked trout fishery and population of other cold-water species.*

Virginia's Method for Developing Nutrient Criteria for Reservoirs

- **Nutrient criteria recommendations developed by Academic Advisory Committee**
- **Premise –** Status of the recreational fishery can be considered as an indicator of the impoundments' suitability for aquatic life
- **Method**
  - Literature review
  - The status of the recreational fishery in each impoundment was rated on a scale of 1 (poor) to 5 (excellent) by VDGIF biologists
  - Data analysis was conducted by plotting fishery status against Chl-a and TP
  - The plots did "***<u>not yield well-defined relationships</u>***. *We believe the reason for this is size variability. . . . Generally, fish populations in small lakes are more subject to influence by non-nutrient factors . . . Non-nutrient factors . . . include inorganic turbidity (suspended sediments) and lake physical features and structural elements.*"





Proposed Aquatic Life Criteria and Screening Values

Table L: Lake Ecoregion Nutrient Criteria and Long-Term and Short-Term Screening Values (µg/L)

Lake Ecoregion	Chl-a Criterion	Short-Term Screening Value			Long-Term Screening Value		
		TP	TN	Chl-a	TP	TN	Chl-a
Plains (DWS)	26	65	1,000	26	26	560	10
Plains (AQL)	40	100	1,300	40	50	850	20
Ozark Border (DWS)	26	70	1,000	26	29	600	10
Ozark Border (AQL)	22	60	960	22	26	580	9.0
Ozark Highland (DWS)	26	52	1,000	26	24	550	10
Ozark Highland (AQL)	15	34	700	15	18	430	7.0

MU/MDC Sport Fish Study

Fish Species:

Largemouth Bass, Bluegill, Redear Sunfish, White Crappie and Black Crappie

Measures of Fishery Health:

Catch per Effort (CPE) How many fish are there?

Proportional Size Distribution (PSD) Are they all small fish fish?

PSD of Preferred-size Fish (PSD-P) Are there lots of big/trophy fish?

Mean Length at Age 3 (ML3) How fast do the fish grow?

MU/MDC Sport Fish Study

Environmental Data:

TP

CHL

Lake Surface Area

Watershed Area : Lake Area Ratio

Non-Volatile Suspended Solids (measure of turbidity)

Urban Land Cover

Aquatic Vegetation (sparse or abundant)

Gizzard Shad (present or not)

Common Carp (present of not)

Various population measures of the five game fish species

MU/MDC Sport Fish Study

	CPE	PSD	PSD-P	ML3
Largemouth Bass				
Bluegill				
Redear Sunfish				
White Crappie				
Black Crappie				

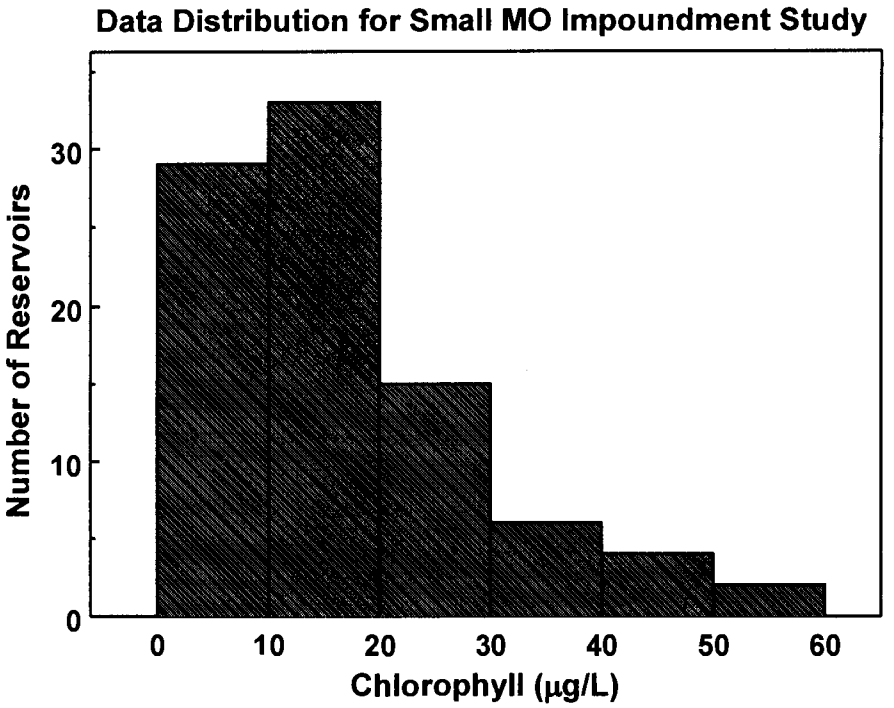
MU/MDC Fish Sport Study

	CPE	PSD	PSD-P	ML3
Largemouth Bass	BLGCPE	TP	LMBCPE	SA
Bluegill	LMBCPE	LMBCPE	LMBCPE	LMBPSD-P
Redear Sunfish	LMBPSD	REDCPE	REDCPE	TP
White Crappie	NVSS	BLGCPE	LMBCPE	WHCCPE
Black Crappie	LMBPSD	BLGCPE	CHL	LMBPSD-P

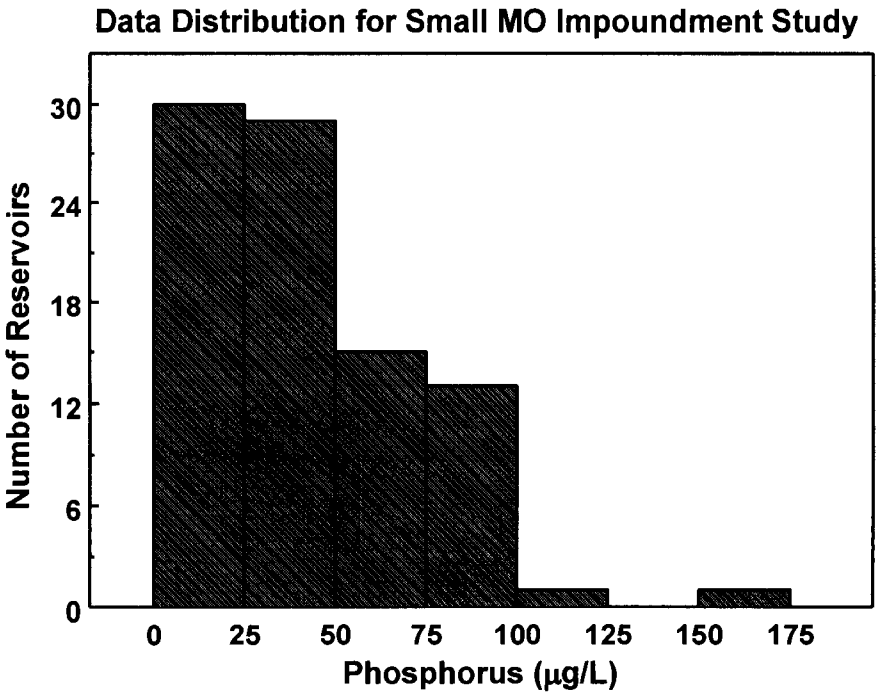
MU/MDC Sport Fish Study

- **Objective -** Examine the relative importance of watershed characteristics, impoundment morphology, water quality, and species interactions in explaining difference in relative abundance, growth, and size structure of largemouth bass, bluegill, redear sunfish, white crappie and black crappie among small Missouri impoundments.
- **Findings**
  - Numerous influences affect sport fish populations.
  - Variable associated with predation, competition, and lake fertility were most important in explaining variation in sport fish demographics.
  - Largemouth bass predation was a strong force in structuring sunfish and crappie populations.
  - Bluegills are positively associated with largemouth bass
  - TP and Chl were positively associated with growth and size structure of largemouth bass, bluegill, redear sunfish, and black crappies.
  - For black crappie PSD-P and largemouth bass PSD there seemed to be a threshold at Chl of 40-60 ug/L, beyond which these size structure variables declined.
  - Largemouth bass and redear sunfish CPE declined with increased lake fertility but were especially low for most lakes with TP>100 ug/L or Chl > 40-60 ug/L.

MU/MDC Sport Fish Study



MU/MDC Sport Fish Study



MU/MDC Recommendations

	Primary fish species			
Physiographic section	Small impoundments (<1,000 acres)	Large reservoirs (≥1,000 acres)	Water quality conditions[a] Mean (range)	Proposed criteria[b]
Glacial Plains	Largemouth bass, bluegill, white crappie, black crappie, redear sunfish, green sunfish, gizzard shad, common carp (invasive), channel catfish (stocked)	Largemouth bass, bluegill, white crappie, black crappie, gizzard shad, common carp (invasive), channel catfish, flathead catfish, blue catfish, freshwater drum, white bass, bigmouth buffalo, smallmouth buffalo, river carpsucker, longnose gar, shortnose gar	Chla: 21.6 µg/L (2.5-114.3 µg/L) Secchi depth: 0.9 m (0.4-2.6 m)	Chla: 30 µg/L Secchi depth: 0.6 m
Ozark Border	Largemouth bass, bluegill, white crappie, black crappie, redear sunfish, green sunfish, gizzard shad, common carp (invasive), channel catfish (stocked)	N/A	Chla: 13.6 µg/L (1.5-35.7 µg/L) Secchi depth: 1.4 m (0.7-4.0 m)	Chla: 22 µg/L Secchi depth: 0.7 m
Ozark Highlands	Largemouth bass, bluegill, white crappie, black crappie, redear sunfish, green sunfish, gizzard shad, common carp (invasive), channel catfish (stocked)	Largemouth bass, smallmouth bass, spotted bass, bluegill, walleye, longear sunfish, rock bass, white crappie, black crappie, walleye, gizzard shad, threadfin shad, common carp (invasive), channel catfish, flathead catfish, blue catfish, freshwater drum, white bass, bigmouth buffalo, smallmouth buffalo, river carpsucker, river redhorse, black redhorse, logperch, brook silversides, paddlefish, longnose gar, shortnose gar	Chla: 7.3 µg/L (1.1-25.3 µg/L) Secchi depth: 2.0 m (0.8-4.3 m)	Chla: 15 µg/L Secchi depth: 0.9 m

[a]Data from Jones et al. (2008).

[b]Justification for these criteria are listed below.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 7
11201 Renner Boulevard
Lenexa, Kansas 66219

NOV 17 2015

Ms. Sara Parker Pauley, Director
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102

Dear Ms. Pauley:

On March 19, 2014, the U.S. Environmental Protection Agency received a submittal of new and revised water quality standards from the Missouri Department of Natural Resources.[1] The new and revised WQS were approved by the Missouri Clean Water Commission on November 6, 2013, were published in the Code of State Regulations on January 29, 2013, and became effective under state law on February 28, 2014. The submittal package included a certification letter from the Missouri Attorney General's Office, dated January 13, 2014.

On October 22, 2014, the EPA acted on the following components of the WQS submittal:

(1) The renaming/redefining of the uses applied by Missouri for the protection and propagation of fish, shellfish and wildlife;

(2) New regulatory language identifying categories of lakes and streams in Missouri designated for the beneficial uses discussed in section 101(a)(2) of the Clean Water Act (i.e., "fishable and swimmable" uses) and other beneficial uses;

(3) The adoption of the Missouri Use Designation Dataset (MUDD, version 1.0) as well as certain terms and definitions applicable to this dataset;

(4) Revisions to Table G and Table H reflecting the results of recent use attainability analyses and the adoption of MUDD.

On May 14, 2015, the EPA acted on three additional elements in the state's WQS submittal, all bearing on the development and application of site-specific criteria for the protection and propagation of fish, shellfish and wildlife.

Today, the EPA is taking the following actions:

- Approving the new definition for "variance" found at 10 CSR 20-7.031(1)(Z), partially approving and partially disapproving the new variance authorizing provision found at 10 CSR 20-7.031(12),

[1] Some supporting electronic files were inadvertently omitted from the original WQS submittal package. These files were subsequently forwarded by the MDNR, arriving at the EPA regional office in Lenexa on or before June 9, 2014.

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and disapproving two state statutes (sections 644.061 and 644.062, RSMo) adopted by reference at 10 CSR 20-7.031(12).

- Disapproving the revised antidegradation implementation procedure adopted by reference at 10 CSR 20-7.031(3)(D).

- Approving the revised regulatory language found at 10 CSR 20-7.031(4)(I), which addresses the level of water quality protection accorded ephemeral waters and waters lacking designated uses.

- Partially approving and partially disapproving the revised regulatory language found at 10 CSR 20-7.031(5), which addresses the development and application of specific (numeric) water quality criteria.

RATIONALE FOR APPROVAL/DISAPPROVAL ACTIONS

I. New Variance Definition and Authorizing Provision

A. Regulatory Background

A WQS variance is a time-limited use and corresponding criterion targeted to a specific pollutant, pollutant source and/or water body and reflecting the highest attainable water quality condition during a specified time period. Under section 303(c) of the CWA, the establishment of a WQS variance requires both a public participation process and the prior approval of the EPA. To obtain approval, a state must show that the designated use is unattainable during the specified time period owing to one or more of the factors listed at 40 CFR Part 131.10(g). A variance provides a state additional time to implement adaptive management approaches for improving water quality while retaining the designated use as a long-term goal. States have adopted, and the EPA has approved, WQS variances applicable to individual dischargers, groups of dischargers, and entire water bodies or segments thereof.[2]

Missouri's WQS submittal contains the following new definition for "variance" at 10 CSR 20-7.031(1)(Z): "Variance—A temporary modification to 10 CSR 20-7.031 that is deemed necessary in accordance with section (12) of this rule." The referenced section, 10 CSR 20-7.031(12), contains the following newly adopted authorizing language:

(12) Variances.

(A) A permittee or an applicant for a National Pollutant Discharge Elimination System (NPDES) or Missouri state operating permit, may pursue a temporary variance to a water quality standard pursuant to either section 644.061 or section 644.062, RSMo. In order to obtain U.S. Environmental Protection Agency approval for a water quality standards variance for purposes of the federal Clean Water Act, the following additional provisions apply:

[2] *Water Quality Standards Handbook: Second Edition* (EPA-823-B-94-006)

1. *A variance applies only to the applicant identified in such variance and only to the water quality standard specified in the variance. A variance does not modify an underlying water quality standard.*

2. *A variance shall not be granted if water quality standards will be attained by implementing technology-based effluent limits required under 10 CSR 20-7.015 of this rule and by implementing cost-effective and reasonable best management practices for non-point source control.*

3. *A variance shall not be granted for actions that will violate general criteria conditions prescribed by 10 CSR 20-7.031(4).*

4. *A variance shall not be granted that would likely jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of such species' critical habitat.*

5. *A variance may be granted if the applicant demonstrates that achieving the water quality standard is not feasible as supported by an analysis based on the factors provided in 40 CFR 131.10(g), or other appropriate factors.*

6. *In granting a variance, conditions and time limitations shall be set by the department with the intent that progress be made toward attaining water quality standards.*

7. *Each variance shall be granted only after public notification and opportunity for public comment. Once any variance to water quality standards is granted, the department shall submit the variance, with an Attorney General Certification that the Clean Water Commission adopted the variance in accordance with state law, to the U.S. Environmental Protection Agency for approval.*

B. The EPA's Findings

The state's new definition for "variance" at 10 CSR 20-7.031(1)(Z) references 10 CSR 20-7.031(12). In turn, 10 CSR 20-7.031(12)(A) incorporates two state statutes by reference, sections 644.061 and 644.062, RSMo. These statutes expand the scope of 10 CSR 20-7.031(1)(Z) and 10 CSR 20-7.031(12) and otherwise constitute policies that affect the application and implementation of the state's WQS. As such, they are subject to federal review and approval or disapproval under 40 CFR Part 131.13. The following considerations prevent these statutes, and portions of 10 CSR 20-7.031(12), from being approved by the EPA for CWA purposes in their adopted form:

- Section 644.061, RSMo, authorizes the Missouri Clean Water Commission to "grant individual variances beyond the limitations prescribed in sections 644.006 to 644.141 [the Missouri Clean Water Law] whenever it is found ... that compliance with any provisions of sections 644.006 to 644.141 or rule or regulation, standard, requirement, limitation, or order of the commission or director adopted pursuant thereto will result in an arbitrary and unreasonable taking of property or in the practical closing and elimination of any lawful

business, occupation or activity ... without sufficient corresponding benefit or advantage to the people ... ."

The above statutory language fails to comport with the CWA and applicable federal regulations, because it allows WQS variances to be based on considerations other than those described at 40 CFR 131.10(g). Specifically, the impacts described in section 644.061 may not rise, in all instances, to the level of a "*substantial* and *widespread* economic and social impact" (emphasis added) as this phrase is applied at 40 CFR 131.10(g)(6). Substantial and widespread economic and social impacts are discussed in the EPA's *Interim Economic Guidance for Water Quality Standards Workbook* (EPA-823-B-95-002). The introductory section of this document reads, in part:

> *For public-sector entities, such as a publicly owned treatment works (POTW), substantial impacts include financial impacts* ***on the community****, taking into consideration current socioeconomic conditions. Widespread, on the other hand, refers to changes* ***in the community****'s socioeconomic conditions. By contrast, for private-sector entities, substantial impacts refer to financial impacts and widespread impacts refer to socioeconomic impacts* ***on the surrounding community.*** [Emphasis added.]

Section 644.061 also authorizes the Commission to grant variances from technology-based effluent regulations and permit limits. However, under federal law, variances of this kind are allowed only under limited circumstances and must be approved by the EPA prior to implementation (40 CFR Parts 122, 124, 125 and 133). Additionally, in evaluating any request for a *WQS variance* under 40 CFR Part 131.10(g), consideration is restricted to those impacts resulting from the implementation of WQS and water quality-based effluent limits. Variances from technology-based regulations and effluent limits are not authorized under 40 CFR Part 131.10(g).[3]

- The second cited statute, section 644.062, RSMo, authorizes the director of MDNR to grant provisional variances for periods as long as 45 days "whenever it is determined ... that compliance on a short-term basis with the limitations prescribed in sections 644.006 to 644.141, or rule, standard, requirement, limitation, or order of the director adopted thereto due to conditions beyond reasonable control such as extended elevated temperatures or extreme drought conditions will result in an arbitrary or unreasonable hardship that exists solely because of the regulatory requirement in question and the costs of compliance are substantial and certain." In granting a provisional variance under section 644.062, the director must "consider the hardship imposed by requiring compliance on a short-term basis and adverse impacts that may result from granting the provisional variance." Moreover, the director "shall exercise wide discretion in weighing the equities involved and the advantages and disadvantages to the applicant and to those affected by water contaminants emitted by the applicant." Section 644.062 also allows a provisional variance to be extended by the director for up to 45 additional days, for a maximum total duration of 90 days in a given calendar year.

[3] Policy memorandum signed by Tudor Davies, EPA, April 27, 1995

In effect, section 644.062 authorizes the director of MDNR to issue short-term-variances from WQS in response to prolonged heatwaves, severe droughts and other, unspecified emergencies without any opportunity for public input and without the prior approval of the EPA. Unilateral actions of this sort are inconsistent with 40 CFR 131.20 and section 303(c)(1) of the CWA, which require states to hold public hearings for the purpose of reviewing, modifying and approving WQS, and with 40 CFR 131.13 and section 303(c)(2)(A) of the CWA, which require states to submit new and revised WQS to the EPA for review and approval or disapproval. In situations where a weather-related emergency or a similar contingency leads to an uncontrollable condition requiring some degree of regulatory flexibility, accommodating actions normally are (1) taken by the permitting authority only after consulting with the EPA, and (2) based on the concept of enforcement discretion rather than WQS variances.[4] In situations involving thermal discharges, variances from WQS also may be appropriately pursued under section 316(a) of the CWA. Enforcement discretion and section 316(a) variances are regulatory tools already available to the state.

Section 644.062 also authorizes the Commission to grant variances from technology-based effluent regulations and permit limits. However, under federal law, variances of this kind are allowed only under limited circumstances and must be approved by the EPA prior to implementation (40 CFR Parts 122, 124, 125 and 133). Additionally, in evaluating any request for a *WQS variance* under 40 CFR Part 131.10(g), consideration is restricted to those impacts resulting from the implementation of WQS and water quality-based effluent limits. Variances from technology-based regulations and effluent limits are not authorized under 40 CFR Part 131.10(g).[2-3]

- The state's variance authorizing provision at 10 CSR 20-7.031(12)(A)5 reads: "A variance may be granted if the applicant demonstrates that achieving the water quality standard is not feasible as supported by an analysis based on the factors provided in 40 CFR Part 131.10(g), or other appropriate factors." This reference to "other appropriate factors" lends itself to broad interpretation and to considerations extending beyond the scope of 40 CFR Part 131.10(g) and section 303(c) of the CWA. As noted previously, WQS variances (other than section 316(a) variances) must be based on one or more of the factors described at 40 CFR Part 131.10(g).

The EPA hereby disapproves sections 644.061 and 644.062, RSMo, because, as noted above, these statutes fail to comport with sections 301, 303(c), 304 and 306 of the CWA and applicable federal regulations (40 CFR Parts 122, 124, 125, 131 and 133). The EPA also disapproves references to these statutes appearing in the opening paragraph of 10 CSR 20-7.031(12)(A) but approves the remaining language in this paragraph, such that the approved language reads: *(A) A permittee or an applicant for a National Pollutant Discharge Elimination System (NPDES) or Missouri state operating permit, may pursue a temporary variance to a water quality standard. In order to obtain U.S. Environmental Protection Agency approval for a water quality standards variance for purposes of the federal Clean Water Act, the following additional provisions apply:*

The phrase "other appropriate factors" at 10 CSR 20-7.031(12)(A)5 also is disapproved by the EPA, because, as noted above, this phrase fails to comport with 40 CFR 131.10(g) and section

[4] Policy memorandum signed by Steven Herman, EPA, March 3, 1995

303(c) of the CWA. However, the remaining language at 10 CSR 20-7.031(12)(A)5 is approved by the EPA, because this language is consistent with the CWA and 40 CFR 131.10(g). The approved language reads: *5. A variance may be granted if the applicant demonstrates that achieving the water quality standard is not feasible as supported by an analysis based on the factors provided in 40 CFR 131.10(g).*

The remaining language at 10 CSR 20-7.031(12) is consistent with sections 301(b), 303(c) and 306 of the CWA, and with 40 CFR 131.10(g), and is hereby approved by the EPA. This approval extends to all of 10 CSR 20-7.031(12)(A)1-4 and 10 CSR 20-7.031(12)(A)6-7. The EPA also approves the state's new definition for "variance" found at 10 CSR 20-7.031(1)(Z), because this definition is consistent with federal law following the above disapproval actions.

Collectively, the approved language at 10 CSR 20-7.031(1)(Z) and10 CSR 20-7.031(12) should enable the state to provide meaningful regulatory relief in situations where a WQS cannot be achieved in the short term owing to at least one of the factors identified in the federal regulations at 40 CFR Part 131.10(g). Variances granted under 10 CSR 20-7.031(12) and approved by the EPA may be applied by the state in the issuance of water quality certifications and in the implementation of water quality-based effluent limits under sections 401 and 402 of the CWA. The state is reminded that variances approved by the EPA do not replace designated uses and associated water quality criteria, nor do they provide a basis for delisting impaired waters under section 303(d) of the CWA. The EPA looks forward to working closely with the MDNR in the implementation of the state's new variance authorizing provision.

II. Revised Antidegradation Implementation Procedure

A. Regulatory Background

10 CSR 20-7.031(3)(D) adopts a revised antidegradation implementation procedure, or AIP, by reference.[5] On August 16, 2011, the EPA disapproved an earlier version of the AIP because it treated a cumulative reduction in segment assimilative capacity (SAC) of twenty percent or less as a *de minimis* change in water quality not warranting a Tier 2 antidegradation review.[6] The EPA found in its decision letter that a twenty percent reduction in SAC was not scientifically defensible and that the state did not provide adequate technical justification for the twenty percent cumulative cap.

As a potential remedy, the EPA indicated it would support the state's adoption of a revised AIP lacking any *de minimis* provision or incorporating only a ten percent cumulative cap on SAC reduction. The decision letter noted that SAC reductions of less than ten percent had been found by the EPA, and by several states, to strike a reasonable balance between the need to limit the number of detailed antidegradation reviews and the need to maintain and protect high quality waters.[7] The letter also noted that a federal district court had found, in 2003, that the EPA's approval of a *de minimis* ten percent cumulative cap was reasonable, supported by the available scientific evidence, and otherwise consistent with the requirements of the CWA; however, the

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[5] *Missouri Antidegradation Rule and Implementation Procedure, May 2, 2012*

[6] Letter from Karen Flournoy, EPA, to Sara Parker Pauley, MDNR, August 16, 2011

[7] *Final Water Quality Guidance for the Great Lakes Systems,* Federal Register: March 23, 1995 (Volume 60, Numer 56)

court also held that a twenty percent cumulative cap was arbitrary and capricious because there was no evidence cited in the administrative record to support the notion that, under such a cumulative cap, any degradation in water quality would be truly *de minimis (Ohio Valley Envtl. Coal.*, 279 F. Supp. 2d 732, 770-773).

Missouri responded to the EPA's disapproval action by incorporating a ten percent cumulative cap in its revised AIP and by referencing the revised AIP in its WQS. The AIP (page 8) now defines significant degradation as "[a] reduction by 10 percent or more in the facility assimilative capacity for any pollutant as a result of any single discharge, or ... [a] reduction of the segment assimilative capacity for any pollutant by **10 percent** or more as a result of all discharges combined ... after existing water quality [is] determined [emphasis added]. Events or activities causing significant degradation are required to undergo a Tier 2 review."

Section II.A of the revised AIP (page 15) specifies that, in determining the required scope of an antidegradation review, MDNR shall "determine whether or not [a] proposed new or expanded discharge will result in a significant degradation for a POC [pollutant of concern]." This same section (page 16) also establishes that the impact of a discharge on water quality shall be deemed insignificant if the "*reduction of the facility assimilative capacity... for* [a] *pollutant by less than 10 percent* [will occur] *as a result of any single discharge and the reduction of the segment assimilative capacity... for any pollutant by less than **10 percent*** [will occur] *as a result of all discharges combined after* [existing water quality is] *determined* [emphasis added]."

The revised AIP at section II.A.3 (page 22) further establishes that:

> *Degradation of a water's assimilative capacity may be allowed if it is considered minimal degradation or if it is justified in accordance with an antidegradation review performed in accordance with this document. The assimilative capacity represents the amount of contamination load that can be discharged to a specific water body without exceeding the WQS applicable to the POC. Degradation is considered minimal if the new or proposed loading (i.e., event-specific) is less than 10 percent of the facility assimilative capacity...and the cumulative degradation is less than **10 percent** of the segment assimilative capacity* [emphasis added].

Lastly, section II.A.3 (page 23) requires that a Tier 2 antidegradation review be conducted by the MDNR whenever cumulative degradation represents ten percent or more of the SAC.

B. The EPA's Findings

The above-mentioned revisions to the state's AIP address those objections raised in the EPA's August 16, 2011, decision letter but raise another concern. Specifically, in assessing the need for a Tier 2 review, the AIP treats essentially all SAC reductions of less than ten percent as *de minimis* changes in water quality, making no distinction between the changes caused by bioaccumulative pollutants and those caused by non-bioaccumulative pollutants. The EPA knows of no single threshold value (percentage reduction in SAC) that can be safely applied in a *de minimis* manner, and in all situations, to bioaccumulative pollutants. Depending on a water body's physical, chemical and biological properties, and on the circumstances surrounding the lowering of water quality, even a small increase in the level of a bioaccumulative pollutant may

pose an unacceptable risk to aquatic organisms and/or human health. As explained by the EPA in a recent WQS action involving the State of Idaho[8]:

- Any increase in the rate of mass loading of a bioaccumulative contaminant has the potential to significantly lower water quality because such substances accumulate in the biota, do not readily degrade and often result in adverse effects at concentrations well below those that can be accurately measured in the ambient environment.

- Aquatic organisms can accumulate chemicals in their bodies when they are exposed to these chemicals through water, diet and other sources. The extent of bioaccumulation by aquatic organisms varies widely depending on the affected species, the water body, water chemistry, and the chemical in question, but it can be extremely high for some highly persistent and lipid-soluble chemicals. Concentrations of such chemicals in fish and shellfish can pose unacceptable long-term risks to humans consuming these organisms.

The EPA hereby disapproves 10 CSR 20-7.031(3)(D), because, as noted above, application of the *de minimis* provision in the state's AIP could lead, in certain situations, to the impairment of Tier 2 waters, an outcome prohibited by 40 CFR Parts 131.12(a)(1) and 131.12(a)(2). We would encourage the state to revise its AIP, either by removing the *de minimis* provision or by no longer applying this provision automatically to activities/discharges constituting sources of bioaccumulative pollutants. Under the latter option, a Tier 2 antidegradation review could be required by the state whenever a proposed activity/discharge would increase the ambient concentration of a bioaccumulative substance; alternatively, in situations involving SAC reductions of less than ten percent, the state could reserve the right to require, or not to require, a Tier 2 antidegradation review after considering the physical, chemical and biological properties of the affected surface water, the circumstances surrounding the lowering of water quality, and the attendant risks to the environment and to human health.

Lastly, we note that the AIP at Appendix 3 (page 52) contains a reference to a 100% (rather than a 10%) cumulative threshold. This reference, which appears to be a typographical error, must be corrected in any revised AIP submitted by the state to the EPA.

III. Revised Provisions Affecting Ephemeral Waters and Non-Designated Waters

A. Regulatory Background

Missouri's general (narrative) water quality criteria at 10 CSR 20-7.031(4) are applied to all waters of the state and serve to (1) protect the public health, (2) safeguard aquatic and terrestrial wildlife and domestic livestock, (3) preserve the aesthetic condition of surface waters and (4) protect the designated uses of surface waters, where applicable. These criteria include the following provisions bearing on toxic substances (bold text represents newly adopted language; strike-through text represents newly deleted language):

[8] Letter from Daniel Opalski, EPA, to Barry Burnell, Idaho Department of Environmental Quality, dated July 23, 2013

(4) General Criteria. The following water quality criteria shall be applicable to all waters of the state at all times including mixing zones. No water contaminant, by itself or in combination with other substances, shall prevent the waters of the state from meeting the following conditions...

(D) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal, or aquatic life...

(G) Waters shall be free from physical, chemical, or hydrologic changes that would impair the natural biological community...

(I) Waters in mixing zones, ***ephemeral aquatic habitat*** *and ~~unclassified~~ waters* ***of the state lacking designated uses*** *shall be subject to the following requirements:*

1. *The acute toxicity criteria of Tables A and B and the requirements of subsection (5)(B); and*

2. *The following whole effluent toxicity conditions must be satisfied:*

A. *Single dilution method. The percent effluent at the edge of the zone of initial dilution will be computed and toxicity tests performed at this percent effluent. These tests must show statistically-insignificant mortality on the most sensitive of at least two (2) representative, diverse species; and*

B. *Multiple dilution method. An LC_{50} will be derived from a series of test dilutions. The computed percent effluent at the edge of the zone of initial dilution must be less than three-tenths (0.3) of the LC_{50} for the most sensitive of at least two (2) representative, diverse species.*

C. The EPA's Findings

In revising 10 CSR 20-7.031(4)(I), Missouri deleted an earlier reference to "unclassified waters" and added the terms "ephemeral aquatic habitat" and "waters of the state lacking designated uses." The EPA interprets this to mean that:

(1) The occurrence of toxic substances in toxic amounts, manifested in the form of either acute toxicity or chronic toxicity, is prohibited in all waters of the state (10 CSR 20-7.031(4)(D) and (4)(G)) and

(2) The acute criteria set forth in tables A and B of the WQS are likewise applicable to all waters of the state, including all waters designated for ephemeral aquatic habitat and all waters lacking designated uses (10 CSR 20-7.031(4)(I)1). The EPA hereby approves the revised language at 10 CSR 20-7.031(4)(I) as an interim step in achieving the objectives of section 101(a)(2) of the CWA as applied to ephemeral aquatic habitats and waters lacking designated uses.

The revised language at 10 CSR 20-7.031(4)(I) provides all waters designated for EAH and all waters lacking designated uses with a baseline level of water quality protection, largely in the form of acute criteria. However, this language does not exempt these waters from the future application

of other forms of numeric criteria (e.g., chronic criteria; recreational criteria). The state has not yet adopted criteria specifically designed to protect the EAH use, nor has it assigned any uses and corresponding criteria to wetlands and many smaller streams and lakes meeting the definition of waters of the United States. The EPA is aware that the MDNR has hosted stakeholder meetings in recent months to address these deficiencies and expects the state to

(1) Expeditiously develop and adopt scientifically defensible criteria for the protection of the EAH use and

(2) Expeditiously assign CWA section 101(a)(2) uses to jurisdictional wetlands and other waters of the United States currently lacking designated uses, except where it is demonstrated that section 101(a)(2) uses are unattainable pursuant to 40 CFR Part 131.10(g).

The state is reminded that, prior to assigning EAH to any waters of the United States, it must demonstrate that this use represents the highest attainable use (40 CFR Parts 131.2, 131.5, 131.6 and 131.10), and it must promulgate numeric criteria for this use that are scientifically defensible and protective of resident and migratory forms of aquatic and semiaquatic life (40 CFR Part 131.11).[9]

Lastly, 10 CSR 20-7.031(4)(I)2 continues to require *both* a single dilution-based procedure and a multiple dilution-based procedure in the assessment of whole-effluent acute toxicity. The EPA strongly discourages the use of single dilution-based tests, which tend to produce highly variable results, and encourages instead the use of multiple dilution-based procedures.[10] This position also is reflected in the state's own effluent regulations, which stipulate, at 10 CSR 20-7.015(9)(L)2.A, that "WET tests shall be a multiple dilution series, static, non-renewable test to determine the degree at which forty-eight to ninety-six hour (48–96 hour) exposure to the effluent is acutely toxic to aquatic life expressed in species survival." 10 CSR 20-7.031(4)(I)2.B also contains a reference to the "LC_{50}." This reference appears to be in error, as the criterion maximum concentration should be set at 0.3 times the applicable acute toxicity unit (0.3 TU_a) pursuant to the EPA's long-standing guidance on zones of initial dilution.[11] The EPA strongly encourages the state to revise 10 CSR 20-7.031(4)(I)2, in a manner that (1) requires the use of a multiple dilution-based procedure in the development of WET permit limits and (2) provides for a consistent level of water quality protection based on the application of 0.3 TU_a at the edge of the zone of initial dilution.

IV. Assorted Revisions to the State's Specific Criteria Provisions

A. 10 CSR 20-7.031(5) addresses the application of specific (numeric) water quality criteria. The state has revised the first paragraph in this section in the following manner (bold text represents newly adopted language; strike-through text represents newly deleted language):

(5) Specific criteria. The specific criteria shall apply to ~~classified~~ waters ***contained in Tables G and H of this rule and the Missouri Use Designation Dataset.*** *Protection of drinking water supply is limited to surface waters designated for raw drinking water supply and aquifers.*

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[9] Letter from Karen Flournoy, EPA, to Sara Parker Pauley, MDNR, dated October 22, 2014

[10] Letter from Karen Flournoy, EPA to John Hoke, MDNR, dated September 18, 2013

[11] *Technical Support Document for Water Quality-Based Toxics Control* (EPA/505/2-90-001)

Protection of whole body contact recreation is limited to ~~classified~~ waters designated for that use.

The above paragraph establishes that numeric water quality criteria apply to those waters of the state identified in MUDD and in tables G and H of the WQS. These waters are designated for CWA section 101(a)(2) uses and other uses, except where UAAs have demonstrated that such uses are unattainable under 40 CFR Part 131.10(g). The revised paragraph comports with 40 CFR 131.11 and is hereby approved by the EPA. In approving this paragraph, the EPA expects the state to expeditiously (1) expand and refine MUDD by assigning appropriate uses to wetlands and other waters currently lacking designated uses and (2) adopt criteria for such waters that are scientifically defensible and protective of the assigned uses.

B. 10 CSR 20-7.031(5)(A) has been revised in a manner that exempts certain waters from the application of chronic criteria. The first sentence in this provision reads as follows (bold text represents newly adopted language):

(A) The maximum chronic toxicity criteria in Tables A and B shall apply to waters designated for the indicated uses given in ***the Missouri Use Designation Dataset and*** *Tables G and H,* ***except for waters designated for Ephemeral Aquatic Habitat or where less stringent criteria have been developed following a use attainability analysis.***

The above sentence is inconsistent with other provisions in the state's WQS and with applicable federal regulations. Consider the following points:

- 10 CSR 20-7.031(5)(A) seemingly should have referenced the state's site-specific criteria provisions at 10 CSR 20-7.031(5)(S) rather than the term "use attainability analysis." The provisions at 10 CSR 20-7.031(5)(S) lend themselves to the development of alternative criteria by (1) identifying the circumstances under which site-specific criteria may be justifiable and (2) establishing the procedures and methods that must be followed when developing such criteria. The revised language at 10 CSR 20-7.031(5)(A) also emphasizes the development of "less stringent criteria." The state should bear in mind that, in certain instances, site-specific criteria may be more stringent than the criteria they supplant (see 10 CSR 20-7.031(5)(S)).

- Missouri has provided no scientific justification for the revised language at 10 CSR 20-7.031(5)(A) that categorically exempts ephemeral aquatic habitats from all chronic criteria. Chronic criteria typically are applied as four day averages with an allowable excursion frequency of once in three years.[2] In the absence of any supporting scientific evidence, the EPA believes it would be imprudent to assume that ephemeral streams in the state never flow for periods of four days or more in a three-year period, or that organisms inhabiting these streams never are exposed to waterborne pollutants for periods of four days or more in a three-year period.

  The state has established an EAH use category at 10 CSR 20-7.031(1)(C)1.D but has not developed and adopted numeric water quality criteria for this category or assigned EAH to any waters. It is anticipated that the state will eventually develop numeric criteria specifically

for the EAH use, at which time it may wish to examine the applicability or non-applicability of four-day averaging periods and three-year recurrence intervals. Criteria ultimately adopted by the state must be based on a sound scientific rationale and must be protective of the EAH use (40 CFR Part 131.11). When submitting new or revised criteria to the EPA, the state must describe the methods and analyses used to develop the criteria (40 CFR Part 131.6(b)). The state also must provide information on any general policies affecting the application and implementation of the submitted criteria (40 CFR Part 131.6(f)).

Based on the above considerations, the EPA partially approves and partially disapproves the revised language at 10 CSR 20-7.031(5)(A): the revised language bearing on MUDD is approved because it comports with 40 CFR Part 131.11, whereas the revised language bearing on the EAH use and on UAAs is disapproved because it fails to comport with 40 CFR Parts 131.6 and 131.11. The approved portion of 10 CSR 20-7.031(5)(A) reads as follows (strike-through text represents disapproved language):

(A) The maximum chronic toxicity criteria in Tables A and B shall apply to waters designated for the indicated uses given in the Missouri Use Designation Dataset and Tables G and H~~, except for waters designated for Ephemeral Aquatic Habitat or where less stringent criteria have been developed following a use attainability analysis~~.

C. 10 CSR 20-7.031(5)(B)5 establishes a process for developing site-specific criteria for the human health/fish consumption use. This provision has been revised by the state in the following manner (bold text represents newly adopted language; strike-through text represents newly deleted language):

5. *Site-specific alternative criteria for human health-fish consumption may be allowed. Designation of these site-specific criteria must follow ~~the established variance request process~~* ***procedures set forth in U.S. Environmental Protection Agency's Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health, October 2000 (EPA-822-B-00-004), as published by the Office of Science and Technology, Office of Water, U.S. Environmental Protection Agency, Washington, DC 20460, which is hereby incorporated by reference and does not include any later amendments or additions. The department shall maintain a copy of the referenced document and shall make it available to the public for inspection and copying at no more than the actual cost of reproduction.***

The referenced document (EPA-822-B-00-004) presents detailed recommendations for the development of human health criteria, focusing on procedures used in the evaluation of cancer risks, other health-related risks, human exposure to pollutants, and pollutant bioaccumulation potential in fish. States are encouraged to follow the procedures described in this document when developing fish consumption-based criteria reflective of local (site-specific) conditions. The EPA approves the above-noted changes to 10 CSR 20-7.031(5)(B)5, because these changes are fully consistent with 40 CFR 131.11.

D. 10 CSR 20-7.031(5)(R) addresses numeric biological criteria and has been revised by the state in the following manner (bold text represents newly adopted language; strike-through text represents newly deleted language):

(R) Biocriteria. The biological integrity of waters, as measured by lists or numeric ~~diversity~~ indices of benthic invertebrates, fish, algae, or other appropriate biological indicators, shall not be significantly different from reference waters. Waters ***targeted for numeric biological criteria assessment must be contained within the Missouri Use Designation Dataset and*** *shall be compared to reference waters of similar size,* ***scale within the stream network, habitat type, and aquatic*** *~~within an~~ ecoregion* ***type.*** *Reference water locations* ***for some aquatic habitat types*** *are listed in Table I.*

These revisions describe in greater detail the physical and geographical considerations made by the state in the selection of reference waters, and they clarify that Table I does not represent a comprehensive list of reference waters in Missouri. The revised language also requires that waters actually targeted for numeric biological assessment be contained in MUDD (i.e., designated beforehand for the protection and propagation of fish, shellfish and wildlife). This language comports with 40 CFR Part 131.11(b)(2) and is hereby approved by the EPA. However, the EPA again emphasizes that the state must expeditiously (1) expand and refine MUDD by assigning appropriate uses to wetlands and other waters currently lacking designated uses and (2) adopt criteria for these waters that are scientifically defensible and protective of the assigned uses.

E. 10 CSR 20-7.031(5)(S) addresses the development and application of site-specific water quality criteria in Missouri. The header and opening sentence of this subsection have been revised by the state in the following manner (bold text represents newly adopted language; strike-through text represents newly deleted language):

(S) Site-Specific Criteria for the Protection ***and Propagation of Fish, Shellfish and Wildlife*** *~~of Aquatic Life~~. When water quality criteria in this regulation are either underprotective or overprotective of water quality due to* ***factors influencing bioavailability, or*** *~~natural,~~ non-anthropogenic conditions for a given water body segment, a petitioner may request site-specific criteria.*

This revision appears to allow certain anthropogenic factors affecting bioavailability (e.g., human-induced increases in water hardness or dissolved organic carbon concentration; human-induced changes in pH or temperature) to be considered during the development and application of site-specific criteria. Provided that the considered anthropogenic factors comport with all applicable technology-based effluent limits, narrative and numeric water quality criteria, and antidegradation regulations and implementation policies, and provided that the resulting criteria are scientifically defensible and protective of the designated use, this revision is consistent with 40 CFR Part 131.11. The EPA approves the above-noted changes to 10 CSR 20-7.031(5)(S).

F. 10 CSR 20-7.031(5)(S)3 also addresses site-specific criteria and has been revised by the state in the following manner (bold text represents newly adopted language):

3. *Site-specific criteria shall protect all life stages of resident species and prevent acute and chronic toxicity in all parts of a water body* ***unless early life stages are determined absent.***

The intent of the newly adopted language is unclear. As worded, the revised sentence could be interpreted to mean that site-specific criteria are not required to be protective of resident species or preventative of acute and chronic toxicity where early life stages are determined absent. Any criterion developed pursuant to such an interpretation would not be protective of the aquatic habitat use and, therefore, would be inconsistent with 40 CFR Part 131.11. Based on this concern, the EPA disapproves the revised language at 10 CSR 20-7.031(5)(S)3. The state may wish to rewrite this provision in a manner acknowledging that site-specific criteria must be protective of those organisms and life stages that actually occur, or normally would be expected to occur, in the affected surface waters. This would include any organisms and life stage entering the waters on a seasonal or episodic basis.[12]

CONCLUDING REMARKS

The EPA appreciates Missouri's continuing efforts to protect and restore water quality and its overall commitment to the triennial WQS review and revision process. We look forward to working with the MDNR, the Commission and interested stakeholders on future WQS revisions. Should you have any questions or comments regarding today's actions, please contact John DeLashmit, Chief, Water Quality Management Branch, at (913) 551-7821.

Sincerely,

Karen A. Flournoy
Director
Water, Wetlands and Pesticides Division

cc: Mr. John Madras, MDNR
Mr. Corey Buffo, EPA HQ

[12] *Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria* (EPA-823-R-13-001)