Missouri
Department of
Natural Resources

7.031 (5) Specific Criteria

(N) Nutrients and Chlorophyll.

1. Definitions.

A. For the purposes of this rule, *[—*

(I) A] **a**ll 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 topography, soils, and geology, nutrient criteria for lakes and reservoirs will be determined by the use of four (4) major ecoregions. 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. Criteria values.

[(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) General Lake Ecoregion Criteria – Maximum Ambient Concentrations of Total Phosphorus (TP), Total Nitrogen (TN), and Chlorophyll-a (Chl-a), in micrograms per liter (µg/L), for lakes within a lake ecoregion that have not been assigned site specific criteria in Table M of this rule.

(II) Alternate Lake Ecoregion Criteria – Maximum Ambient Concentrations of TP and TN in micrograms per liter (µg/L), for lakes within a lake ecoregion that have not been assigned site specific criteria in Table M of this rule, and have been in compliance with Chl-a Criteria for a minimum of three (3) consecutive years. Alternate ecoregion criteria may not be exceeded more than once during a three year period.

[(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.]

(III) Site Specific Criteria – Ambient Concentrations of TP, TN, and Chl-a for lakes that have been identified as having trophic characteristics for which the general ecoregion criteria values are not adequate to protect designated uses.

D. Tributary arm—A substantial segment of a*[n]* **Class** L2 ake 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**.

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3. **General and Alternate Lake ecoregion criteria for TP, TN, and Chl -a are listed in Table L. Site -specific criteria for TP, TN, and Chl -a are listed in Table M. 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 chlorophyll -a concentrations must be calculated as the geometric mean of a minimum of four (4) representative samples per year for **three (3) years.** *[four (4) years that are not necessarily consecutive]*. All samples must be collected from the surface, near the outflow end of the lake, and during the period May 1– **October 31** *[August 31]*.

5. In a single year, geometric means of Chl-a shall not exceed 40 µg/L in the Plains, 22 µg/L in the Ozark Border, and 15 µg/L in the Ozark Highlands.

[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: General and Alternate Lake Ecoregion Criteria (µg/L)

Lake Ecoregion	**TP**	**TN**	**Chl-a**	**Alternate Criteria**	
				TP	**TN**
Plains (DWS)	**20**	**500**	**10.0**	**35**	**650**
Plains	**40**	**750**	**20.0**	**60**	**1,000**
Ozark Border	**20**	**500**	**9.0**	**35**	**700**
Ozark Highland	**14**	**350**	**7.0**	**23**	**530**

DWS refers to those lakes that are used as source water for drinking water supply.

Table M: Lakes with Site-Specific Criteria

Lake	Lake	County	Site-Specific Criteria (µg/L)

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Ecoregion			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
		Latitude	Longitude	(µg/L)
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	-93.535	16
	Kings River	36.576	-93.596	18
	Long Creek	36.557	-93.294	12

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