2019 Total Ammonia Nitrogen Criteria Implementation Guidance

Intent

The intent of this guidance is to establish a procedure for developing ammonia WQBELs for use in renewal operating permits and applicable dischargers. This guidance is not specifically intended for derivation of limits for new or expanded discharges, although it may be used for that purpose pursuant to an Antidegradation Review.

Background

Missouri's Water Quality Standards, amended November 30, 2005, incorporate the U.S. Environmental Protection Agency criteria document "1999 Update of Ambient Water Quality Criteria for Ammonia." On August 9, 2007, the Missouri Department of Natural Resources implemented its guidance "Total Ammonia Nitrogen Criteria Implementation Guidance (2007 Ammonia Guidance)," which established a procedure for developing water quality based effluent limitations (WQBELs) for ammonia.

This "2019 Total Ammonia Nitrogen Criteria Implementation Guidance" replaces the 2007 Ammonia Guidance.

Ammonia Criteria Effluent Limit Calculations

Temperature and pH affect the toxicity of ammonia and play a role in limit derivation. Where site-specific data for pH and temperature are available and appropriate, staff will use those values. In the absence of site-specific data, staff will use a default value for pH of 7.8 SU; and the temperature values from the Waterbody Type Temperature Comparison table below.

Waterbody Type Temperature Comparison*

Month	**Streams (°C)**	Rounded to Nearest Whole Number (°C)
January	**4.3**	4
February	**5.3**	5
March	**9.3**	9
April	**14.4**	14
May	**18.9**	19
June	**23.1**	23
July	**25.5**	26
August	**25.0**	25
September	**21.7**	22
October	**16.1**	16
November	**10.4**	10
December	**6.2**	6

* - Stream temperatures obtain from the Department's Water Quality Assessment Database portal

One of the primary changes in this guidance is the adaptation of Section 5.4.2 of the EPA's Technical Support Document for Water Quality-based Toxic Controls (TSD), which allows for direct application of both the acute and chronic wasteload allocations (WLA) as permit limits for toxic pollutants, The Department believes this is a more appropriate limit derivation approach.

Using this method for a discharge to a waterbody where mixing is not allowed, the criterion continuous concentration (CCC) and the criterion maximum concentration (CMC) will equal the chronic and acute WLA respectively. The WLAs are then applied as effluent limits, per Section 5.4.2 of the TSD, where the CMC is the Daily Maximum and the CCC is the Monthly Average as shown in the New Derivation Ammonia table below.

New Derivation Ammonia Limits

Month	Water Temp (°C)	CCC = Monthly Average* CMC = Daily Maximum*	
		Monthly Average**	Daily Maximum
January	4	3.2	12.1
February	5	3.2	12.1
March	9	3.2	12.1
April	14	3.2	12.1
May	19	2.4	12.1
June	23	1.8	12.1
July	26	1.5	12.1
August	25	1.6	12.1
September	22	2.0	12.1
October	16	2.9	12.1
November	10	3.2	12.1
December	6	3.2	12.1

* Default pH of 7.8 SU

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

The New Derivation Ammonia Limits table displays the monthly limits for any given facility that discharges to a waterbody where mixing is not allowed, early life stages are present, and Salmonids absent. Values listed under New Derivation Ammonia Limits result from the simple, straight forward approach per section 5.4.2 of the TSD, as follows:

- Monthly Average = Chronic WLA = Total Ammonia Nitrogen CCC, and
- Daily Maximum = Acute WLA = Total Ammonia Nitrogen CMC.

Because temperature does not affect the CMC, the Daily Maximum will remain at 12.1 mg/L; however, because temperature does affect the CCC, Monthly Average limits will differ based on temperature.

Reasonable Potential Analysis

Federal regulation 40 CFR 122.44(d)(1)(i) requires effluent limitations for all pollutants that are or may be discharged at levels that will cause or have the reasonable potential to cause or contribute to an in-stream excursion above a narrative or numeric water quality standard.

The Operating Permit Section will continue to use the two-season approach (summer and winter) for determining reasonable potential. The two-season approach provides more conservative protection to streams, as it assumes the most stringent month as the not-to-exceed value when determining RP. However, it also allows the permittee to use the maximum number of data points, which will reduce the multiplying factor, which is used during RP.

Two Season RPA Approach

Month	Quarter	Temperature (C°)	pH	CCC (mg/L)	CMC (mg/L)
Summer					
April	2	14	7.8	3.2	12.1
May	2	19	7.8	2.4	12.1
June	2	23	7.8	1.8	12.1
July	3	26	7.8	***1.5***	12.1
August	3	25	7.8	1.6	12.1
September	3	22	7.8	2.0	12.1
Winter					
January	1	4	7.8	3.2	12.1
February	1	5	7.8	3.2	12.1
March	1	9	7.8	3.2	12.1
October	4	16	7.8	***2.9***	12.1
November	4	10	7.8	3.2	12.1
December	4	6	7.8	3.2	12.1

Mixing and Zone of Initial Dilution Considerations

The direct application of both acute and chronic criteria as WLA is also applicable for facilities that discharge into receiving waterbodies with mixing considerations. The CCC and CMC will need to be calculated into WLA with mixing considerations using the mass-balance equation:

$$Ce = \frac{(Qe + Qs)C - (Qs \times Cs)}{(Qe)}$$

Where C = downstream concentration
Cs = upstream concentration
Qs = upstream flow
Ce = effluent concentration
Qe = effluent flow

Example:
A wastewater treatment facility has a design flow of 0.4 cfs and discharges to a P stream with default flows established below.

Receiving Stream Low-Flow Values

Receiving Stream	Low-Flow Values (CFS)*	
	1Q10	30Q10
Stream Name	0.1	1.0

* - 7Q10 is not used for ammonia derivation

Mixing Consideration

Mixing Zone (CFS)		Zone of Initial Dilution (CFS)	
1Q10	30Q10	1Q10	30Q10
0.025	0.25	0.0025	NA

January

Chronic WLA: $C_e = ((0.4 + 0.25)3.2 – (0.25 * 0.01)) / 0.4$
$C_e = 5.2$ mg/L

Acute WLA: $C_e = ((0.4 + 0.0025)12.1 – (0.0025 * 0.01)) / 0.4$
$C_e = 12.2$ mg/L

Acute WLA = MDL
Chronic WLA = AML

MDL = 12.2 mg/L
AML = 5.2 mg/L

Using the above mixing consideration values and values from the New Derivation Ammonia Limits table above, the permit limits for the example facility are as follows assuming the facility has reasonable potential with monthly monitoring and reporting requirements:

Example of Monthly Limits

Month	Chronic	Acute	MDL	AML
January	3.2	12.1	12.2	5.2
February	3.2	12.1	12.2	5.2
March	3.2	12.1	12.2	5.2
April	3.2	12.1	12.2	5.2
May	2.4	12.1	12.2	3.9
June	1.8	12.1	12.2	2.9
July	1.5	12.1	12.2	2.4

August	1.6	12.1	12.2	2.6
September	2.0	12.1	12.2	3.2
October	2.9	12.1	12.2	4.7
November	3.2	12.1	12.2	5.2
December	3.2	12.1	12.2	5.2

If the facility above has quarterly sampling and reporting, then the most stringent quarterly limits for the particular quarter would be applicable. This approach is the same regardless if the receiving stream has mixing considerations or not.

Example of Monthly Limits

Quarter	Chronic	Acute	MDL	AML
1st	3.2	12.1	12.2	5.2
2nd	1.8	12.1	12.2	2.9
3rd	1.5	12.1	12.2	2.4
4th	2.9	12.1	12.2	4.7

In the event that mixing considerations derive an AML less stringent than the MDL, the AML will be set to the same value as the MDL.

Controlled Discharges

Federal regulation 40 CFR 122.45 defines non-continuous discharges as, "discharges which are not continuous as defined in 40 CFR 122.2, shall be particularly described and limited, considering the following factors, as appropriate:". The factors are as follows:

- Frequency: permit writers review the frequency of historical discharge events to determine the feasibility of the permittee to control discharges for less than 30 days.
- Total mass: typically permit writers establish ammonia limits as a concentration unless there is a specific need to establish the limit as a mass.
- Maximum rate of discharge: the permit establishes conditions to avoid adverse changes affecting the hydrology of the receiving stream by requiring the permittee to dissipate the energy of the controlled discharge.
- Prohibition or limitation of specified pollutants by mass, concentration, or other appropriate measures: the permittee cannot exceed ammonia acute criteria at the end of the zone of initial dilution or end of pipe where mixing considerations are not allowed.

Using the above approach for controlled discharges, the permittee will receive only a MDL based on ammonia's CMC. No AML will be established in the permit.