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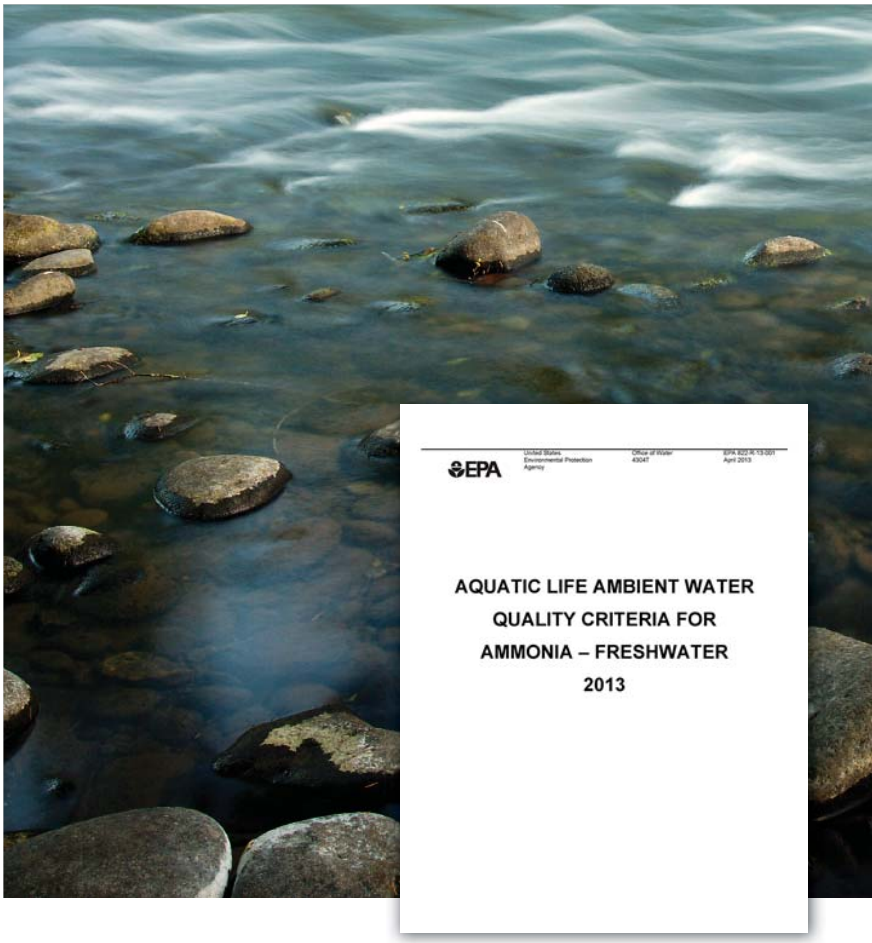
Potential Impact of the Fresh Water Nutrient Criteria to your Wastewater Treatment Plant

A federal water quality criteria change called the Ammonia rule is making its way through the U.S. and may require operational changes or capital improvements to your wastewater treatment plant to meet tighter effluent limits. It's important to understand key issues, alternatives to addressing the rule at your plant, and potential solutions for this unfunded mandate, to ensure your plant meets compliance.



In 2013, the U.S. Environmental Protection Agency (EPA) published new aquatic life ambient water quality criteria for ammonia in fresh water, concerned with the toxic effects of ammonia (a component of total nitrogen (TN) discharges). These criteria are not one of the environmental regulations, or past federal actions, under review by the current U.S. administration.

The new acute and chronic criteria, known as the Ammonia rule, were developed based on an expanded scientific understanding and sensitive species list. Focus of the ammonia toxicity assessment is in the immediate near-field mixing zones, where treated wastewater effluent is discharged to receiving waterbodies. The criteria are for fresh water since the most in-sensitive species include freshwater mussels, as well as snails, reportedly presented in 80-90% of all U.S. waters.

Over the past few years, various states across the U.S. have adopted these new criteria, either identical to federal guidelines or with certain modifications to the criteria or its regulatory procedures.

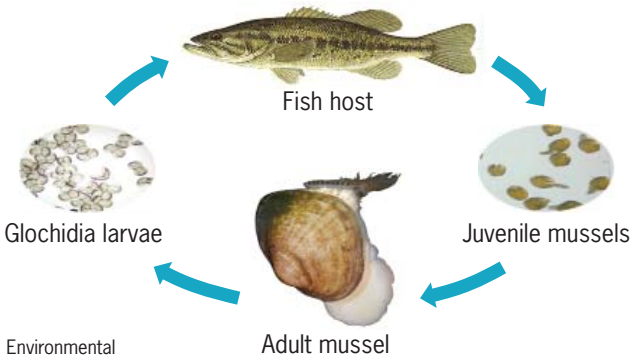
Thought initially to only be a concern for those wastewater treatment plants (WWTPs) without seasonal nitrification capabilities, criteria application and site-specific evaluations have shown that seasonal (e.g., summer, winter) limits can be significantly lower, and possibly even lower than conventional nitrification limits-of-technology where there are lower dilution factors due to relative upstream low-flow ("7Q10", "30Q2") stream conditions or minimal outfall discharge mixing. Site-specific mixing-zone studies (e.g., costly multi-season or multi-year endeavors) may or may not improve the conditions and parameters driving the ammonia limits derivation.

One approach is to assess whether the mussels are present in the receiving stream, which is addressed in the federal technical support document, "Conducting and Reviewing Freshwater Mussel Occurrence Surveys for Development of Site-specific Water Quality Criteria for Ammonia" (EPA 800-R-13-003).

The 2013 final freshwater aquatic life criteria for ammonia are pH- and temperature-dependent. At pH of 7 S.U. and 20°C, the criteria are listed in Table 1 below. The resulting effect is often about 60% lower for the summer and winter ammonia monthly average and weekly limits. While the ammonia criteria toxicity test database is extensive, the upstream and in-stream (with treated effluent discharge) pH and temperature values (and associated D.O., $CBOD_5$, NH_3-N) are often underdeveloped for specific sites. National Pollutant Discharge Elimination System (NPDES) permits may or may not require routine (e.g., quarterly, monthly) monitoring, along with effluent reporting. It is important to understand what site-specific information is available and what assumptions are being made when in-stream toxicity is evaluated. Additionally, policies and procedures governing unnamed tributaries and intermittent streams, where in-stream data are limited, are critical to setting ammonia limits for some WWTPs.

Furthermore, approximately 30 states have adopted numeric criteria into their water quality standards for nitrogen, phosphorus, or both, for one or more of their waterbodies. Others with narrative criteria are developing nutrient reduction strategies using different drivers and evaluation methods. There are numerous watershed-wide nutrient reduction programs (i.e., Chesapeake Bay, Great Lakes Initiative, Long Island Sound, Great Bay, Neuse River, Gulf of Mexico Hypoxia Initiative) involving multiple states and corresponding state-level

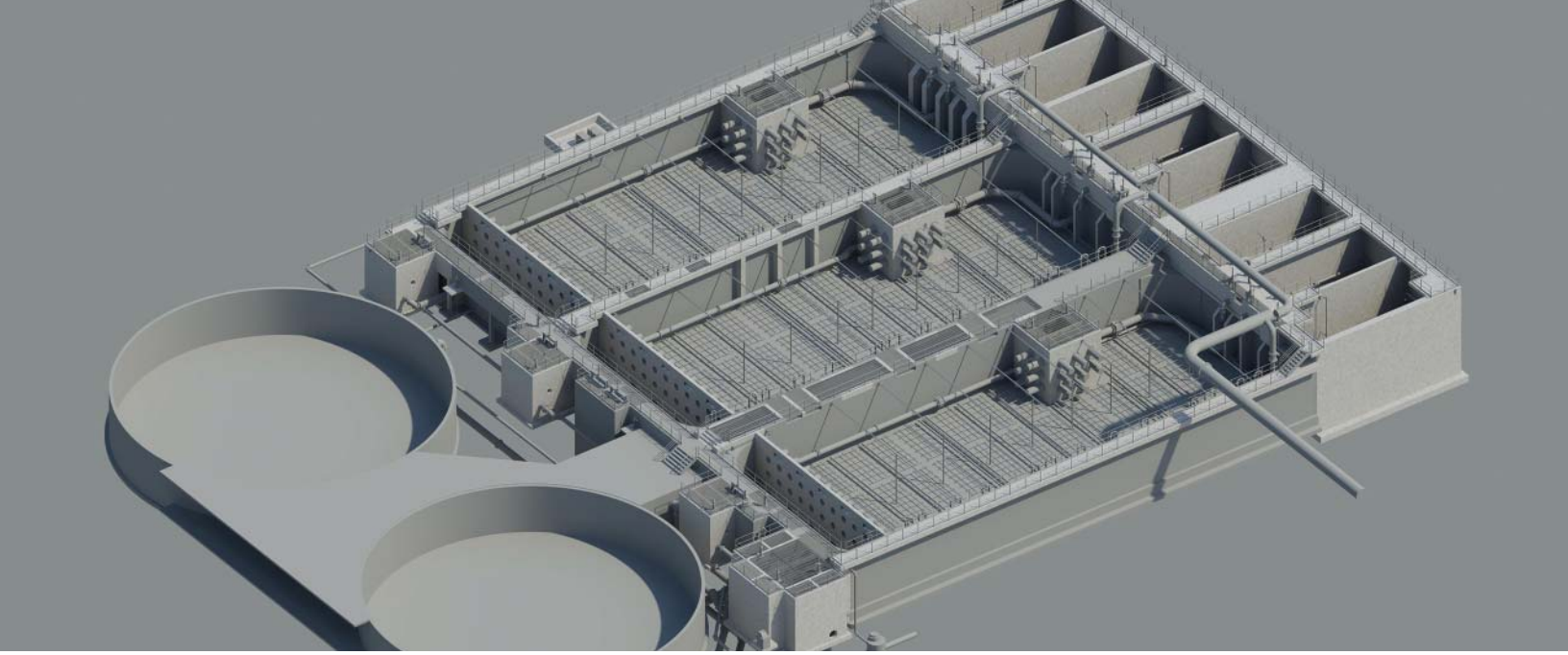
Unionid Freshwater Mussel Life History



U.S. Environmental Protection Agency

Table 1
Freshwater Aquatic Life Criteria for Ammonia

Criterion	1999	2013
Acute	24 (a)	17 (a)
Chronic	4.5	1.9
(a) Salmonids present		



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programs, as well as total maximum daily load (TMDL) developments requiring nutrient removal. The new Ammonia rule may result in monthly average and weekly limits that control biological treatment requirements.

Nitrogen removal involves nitrification (ammonia removal, conversion to nitrate, nitrogen gas, or both, when followed by denitrification (nitrate-nitrite removal)). Ammonia toxicity requirements go hand-in-hand with nutrient removal, and the new Ammonia rule may govern plant performance requirements either through lower monthly and weekly limits or seasonal limits that overrule watershed nutrient reduction design and operating strategies more geared toward seasonal or annual averages. Additionally, there is minimal funding assistance or grant eligibility associated with the Ammonia rule – another "unfunded mandate" for point source dischargers to address in the coming years.

One current example of how the Ammonia rule has worked itself from the federal to the state and local levels is in Virginia. After separating the Ammonia rule from the rest of its "Triennial Water Quality Review" process in 2016-2017, the Virginia Department of Environmental Quality (DEQ) is completing its publication of proposed revisions and public comment period and hearings prior to an anticipated State Water Control Board action in March or June 2018, leading to its application with Virginia Pollutant Discharge Elimination System (VPDES) permits beginning mid-2018. Adoption and update of DEQ policies and procedures will trigger costly capital and operations & maintenance upgrades of all sizes throughout the state, including some plants already achieving high-quality effluent, meeting stringent annual nutrient wasteload caps and local water quality requirements, where ammonia compliance becomes a controlling parameter.

Aeration control and efficiency are critical to the equation, with aeration already more than half of a typical WWTP's energy requirements. One independent estimate is $512 million capital costs at WWTPs and a $34 million per year operations & maintenance cost increase in Virginia, where its largest 125 "significant" point source dischargers have already been upgraded to advanced nutrient removal levels. Additionally, where nutrient trading may be available for nutrient reduction strategies, it is not for ammonia toxicity compliance. The public comment period is one opportunity to review and possibly change the compliance schedule (e.g., schedule time or ties to

other planned work), adjust key technical parameter values or evaluation methods, or introduce factors such as affordability thresholds and funding sources to comply.

Possible treatment process modifications include adjustments to process control characteristics. Solids retention time (SRT), mixed liquor suspended solids (MLSS), and food-to-microorganism (F/M) ratio are important parameters related to nitrification and biological treatment control – along with process conditioning through selectors (improving settleability), return activated sludge / waste activated sludge (RAS / WAS) and sludge blanket control, internal recycle rate adjustment, sidestream load management, and routine or provisional chemical feed.

Aeration modifications, which are at the heart of many ammonia compliance approaches, can involve changes to physical aeration equipment, controls, operation, and function of equipment and aerated zones. Options include addressing minimum, average, and peak oxygen demand conditions (e.g., capacity, efficiency); installation of energy-efficient blowers; variable frequency drives to provide adjustable control to air blowers or surface aerators; diffusers with improved distribution and oxygen transfer efficiency, airflow meters, air control valves, on/off cycling; and/or the installation of dissolved oxygen (DO), and ammonia or oxidation-reduction potential control instrumentation and monitoring and control systems. Additional techniques include load management such as upstream carbon (biochemical oxygen demand (BOD)) diversion prior to aeration.

HOW CAN OBG HELP?

OBG has applied these treatment processes and aeration methods as part of various WWTP upgrade projects.

Point source dischargers are only one of the many sources of ammonia discharge (e.g., agricultural, air deposition, urban stormwater runoff, and other non-point); policy and practice have often focused on the permitted end-of-pipe at the WWTP.

OBG applies its nutrient removal expertise – from biological and chemical nutrient removal through limit-of-technology enhanced nutrient removal (ENR) performance – and experience with decades-long nutrient reduction programs, including the Chesapeake Bay, Great Lakes Initiative, and Long Island Sound, as well as other site-specific circumstances (e.g., high-quality watershed requirements, cold wet-weather treatment, and non-domestic loadings) to provide sound and cost-effective capital improvements and operating strategies to meet any need. This support may involve advanced master planning, performance evaluation and testing, building in operational flexibility (i.e., influent, main treatment, and sidestreams), or advanced treatment upgrade design.

The Ammonia rule may be solved through various regulatory and environmental strategies, operational techniques and training, enhancements or upgrades to existing biological treatment systems, including aeration and mixing, process control and monitoring, and holistic management approaches.

About Bill Meinert, PE: Bill is a vice president in OBG's water business with 30 years of experience in municipal consulting. He leads large, complex wastewater conveyance and treatment projects for public-sector clients throughout the eastern U.S., start to finish. Bill can be reached at **Bill.Meinert@obg.com**.