

Chloride and TDS Water Quality Standards Update
January 15, 2008
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Introduction and Summary

IDNR is currently developing new chloride water quality standards. Two Technical Advisory Committee (TAC) meetings have been held. The IDNR staff are currently reviewing the technical information and TAC discussion and will be making some important decisions regarding the chloride standards. Some members of the TAC have suggested that laboratory chloride toxicity tests be conducted to validate data used by EPA, the IDNR adopt new sulfate water quality standards and IDNR delete the “interim site specific” total dissolved solids (TDS) standards as part of this rule package.

TDS, chloride, and sulfate water quality standards impact discharges from cities with well water supplies that have high hardness or TDS concentrations, cooling towers, and industrial processes such as meat and food processing plants.

The IDNR recently adopted numerical water quality standards for several toxic pollutants that are identical for all three warm water aquatic life use designations. The standards required full life cycle protection for any species that could be present in any Iowa water for all streams. Therefore, most dischargers to very low flow, effluent dominated streams will have to meet excessively stringent water quality standards at the end of pipe discharge, including any new chloride standard.

IDNR is under pressure from environmental interest groups to adopt chloride standards now, without validation of questionable data used by EPA in its derivation of chloride standards, and not include new sulfate standards or delete the interim TDS standards.

In 2004, the Environmental Protection Commission (EPC) adopted an interim TDS standard that replaced the old, nebulous 750 mg/L TDS standard with a site specific standard approach that requires toxicity testing in situations where discharges result in receiving stream TDS concentrations greater than 1,000 mg/L. The EPC directed the IDNR to develop final standards by 2007 that address the TDS issue.

The current interim TDS standards are problematic because the IDNR is requiring chronic whole effluent toxicity testing for establishing TDS or specific constituent discharge limits. Chronic toxicity testing is expensive and the results are extremely variable. IDNR technical staff agree that the interim TDS standards should be replaced with standards for specific constituents of TDS such as chloride and sulfate.

Under pressure from legal action against USEPA, IDNR has worked with EPA in developing chloride standards and has ignored the TDS standards issue. The USEPA has recalculated the chloride standards with the inclusion of significantly more data than used as the basis for the

1988 EPA national guideline criteria. The inclusion of some particularly suspect 1961 data on the fingernail clam is the major issue with the EPA recalculation method.

The following is a summary of the acute and chronic chloride standards for the various recalculation options:

Calculation Method	Acute Standard, mg/L	Chronic Standard, mg/L
1988 USEPA Guidelines	860	230
USEPA Proposed Revision	546	425
USEPA Proposed data set with Fingernail clam deleted	852	663

IDNR staff and some TAC members recommend that additional acute toxicity tests be conducted on the fingernail clam and, if appropriate, replace the 1961 fingernail clam data with the new data. Experts expect that new fingernail clam data will prove a much higher acute value when the tests are conducted on species commonly found in Iowa and under hard water test conditions.

TAC members have received a proposal from Advent Environ and the Illinois Natural History Survey for the conducting the toxicity testing on the fingernail clam. These two groups conducted work on the Illinois sulfate standards development and have established very good credibility with the USEPA toxicologists.

IDNR does not have funds for conducting the tests. The Iowa Water Pollution Control Association (IWPCA) has budgeted some funds for partial support of the \$20,000 to \$25,000 cost for the toxicity testing program. The IWPCA can coordinate funding from other organizations and individual dischargers.

Some TAC members and IDNR technical staff agree that the new chloride standards rule package should include new sulfate standards and repeal of the interim TDS standards. This approach would address the 2004 directives from the EPC and would more efficient than addressing these issues piece meal. Illinois is currently in the final stages of rule making that includes repeal of its 1,000 mg/L TDS standard and adoption of new sulfate standards. The technical support for the Illinois standards can easily be applied to the Iowa standards development.

There is some pressure, however, from environmental interest groups to adopt chloride standards now. The Settlement Agreement between EPA and the environmental groups requires EPA to determine if an Iowa chloride standard is required and to establish as standard in the event an Iowa standard was not adopted by December 31, 2007. In the near future, IDNR management will decide whether to proceed now with final chloride standards in response to the legal action by environmental groups or take the time to develop chloride standards based on new fingernail clam toxicity tests, include new sulfate standards, and repeal the interim TDS standard in one rule revision package.

Historical Background

June 2004 EPC adopted interim TDS standards with direction to develop final TDS and/or specific parameter standards by 2007.

The Environmental Protection Commission (EPC) adopted the interim site specific TDS water quality standards in 2004 after they could not reach consensus on final TDS or chloride standards and it became evident that the IDNR economic impact analysis was flawed. The interim site specific TDS standard replaced a nebulous 750 mg/L TDS standard that was seldom applied to NPDES permits. The EPC directed the IDNR to conduct a state-wide TDS and chloride monitoring program in an effort to build a better data base for use in the economic impact analysis of any future TDS and chloride standards. The IWPCA members cooperated in conducting this monitoring program.

The EPC also directed the IDNR to develop TDS standards and/or standards for specific TDS constituents such as chloride by June 2007.

June 2005 Iowa environmental groups sued USEPA regarding chloride standards and ultimately entered into a Settlement Agreement that requires IDNR to adopt chloride standards by December 31, 2007.

Environmental interest groups (Iowa Environmental Council, Northeast Iowa Citizens for Clean Water, the Sierra Club, and Steve Veysey) filed a Civil Action in U.S. District Court against USEPA that objected to the EPA's December 2004 approval of the revised TDS water quality standards. The subsequent August 2006 Settlement Agreement includes a provision for the IDNR to adopt chloride standards and includes the following provision for EPA action in the event IDNR does not perform per the schedule:

“The parties expect that the IDNR will adopt acute and chronic water quality criteria for chloride and submit those criteria to EPA for approval/disapproval pursuant to CWA section 303(c)(2)(A) no later than December 31, 2007. If, however, the IDNR does not submit new or revised criteria for chloride by December 31, 2007, EPA agrees to determine, on or before April 15, 2008, whether new or revised water quality criteria for chloride are necessary for Iowa pursuant to CWA section 303(c)(4)(B). EPA's obligation to make such a determination will terminate if the IDNR submits new or revised water quality criteria for chloride before this determination is signed.”

March 2006 INDR adopted new stream use designation standards that results in significantly more stringent discharge limits to small streams.

IDNR adopted major revisions to the water quality standards by revising the designated uses for all streams to the highest level of aquatic life and recreational use protection. This action was in response to the threat of litigation by environmental groups for alleged IDNR failure to adequately address the Clean Water Act “fishable and swimmable” level of water quality

protection. Many small streams and drainage ways that were previously classified as General Use are now classified as B-WW-1. Discharge permits to General Use streams were based on preventing acute toxicity to the fathead minnow. Discharge permits to B-WW-1 streams are based on preventing chronic toxicity to all life stages of any organism that could be present in Iowa waters.

IDNR is currently attempting to revise the designated uses on many small streams with the Use Attainability Analysis (UAA) approach. The revision in aquatic life use designations from B-WW-1 to B-WW-2 and B-WW-3 will have little, if any, impact on discharge limits because the numeric standards for most standards are identical for all three aquatic life use designations.

Since many small towns discharge to streams that were previously classified as General Use, this revision to the designated uses and levels of aquatic life protection has a very significant impact on the application of any numerical water quality standards such as ammonia and chloride. For many dischargers to small streams, the future discharge limits will be equal to the chronic water quality standards.

January 2007 IDNR administrators submitted rules for 25 chemical parameter standards that included the same numerical standards for all warm water aquatic life designated uses and may have set precedent that requires the same numerical standards for all stream designations.

In its haste to adopt the March 2006 revisions to the aquatic life use designation standards under threat of lawsuit from environmental groups, IDNR failed to adequately define the appropriate levels of aquatic life protection for each of the designated uses. In late 2006, IDNR staff developed draft standards for the 25 chemical parameters that were based on different levels of protection for the three different warm water aquatic life designated uses. The TAC was in general agreement with the IDNR staff approach as it was an attempt to apply different standards to the different stream use designations.

IDNR administrative staff ignored the IDNR staff and TAC recommendations regarding the 25 chemical criteria and elected to submit the draft rules for EPC approval with the same numerical standards for all warm water use designations. The Director justified this action because the USEPA was delaying approval of the 2006 rules pending adoption of the chemical parameter standards and any deviation from the EPA national guideline criteria for these parameters would cause further delay.

Prior to this action, many TAC members thought that the IDNR would develop different numerical standards for the three different warm water use designations. This action may have set a precedent that does not provide for different numerical standards for each warm water use designation. This raises the obvious questions:

1. What is the purpose of three different warm water aquatic life use designations if the numerical standards are the same for all use designations?
2. What is the purpose for performing the Use Attainability Analyses for aquatic life protection if the standards are the same for all use designations?

November 26, 2007 IDNR and USEPA presented proposals for chloride standards at the first TAC meeting.

IDNR held the first TAC meeting on November 26 for discussion of chloride water quality standards. The IDNR delayed this initial TAC meeting due to a new, more efficient rule development approach that was developed in a Kaisan meeting between IDNR and EPA Region 7 staff. IDNR staff worked with EPA staff in technical review of chloride water quality standards issues prior to the initial TAC meeting. The intent of this process was to present proposed standards to the TAC that would be approved by EPA. IDNR staff worked extensively with toxicologists from the EPA Duluth laboratory. EPA Region 7 and Duluth toxicologists participated in the TAC meeting.

EPA staff acknowledged that the 1988 EPA national guideline criteria for chloride were too stringent and they presented alternative, less stringent standards based on a much larger data base than used in the 1988 national guideline development. EPA staff proposed to use data from a 1961 study that were not included in the data set used in the 1988 guidelines. The inclusion of this 1961 data has a significant impact on the recalculation of the chloride criterion.

December 14, 2007 TAC members presented a technical review of the EPA proposed chloride standards and recommended the rule package include new sulfate standards and elimination of the interim TDS standard at the second TAC meeting.

IDNR held the second TAC meeting on December 14. Some of the TAC members presented a technical review of the EPA proposed chloride criterion and questioned the validity of the 1961 data that EPA included in the chloride criterion calculation. They also recommended that the proposed rule revision package include elimination of the interim TDS standards rule and addition of a sulfate standard. This is similar to the TDS and sulfate standards rule revisions that Illinois is adopting with USEPA approval. IDNR and EPA Region 7 staff indicated that they are under legal pressure of the Settlement Agreement with the environmental interest groups to adopt chloride standards very soon and they may not have time to perform laboratory tests to replace the questionable 1961 data, develop sulfate standards, or develop the technical justification for eliminating the interim TDS standard.

IDNR staff indicated that they would make a decision on how to proceed with the chloride standards rule revision after they review the December 14 TAC comments. They indicated that “upper level IDNR management” would make the decision.

Chloride Standards

IDNR staff reviewed technical literature and information on chloride toxicity submitted by TAC members. The IDNR staff also consulted with USEPA toxicologists at the EPA Duluth laboratory and Region 7 office in review of the development of chloride water quality standards.

The USEPA 1988 national guideline criteria for chloride toxicity are considered by IDNR and many USEPA staff as too stringent. USEPA staff significantly expanded the data base of published chloride toxicity data in its review of the 1988 guidelines and recalculated the acute and chloride standards. They included some 1961 chloride toxicity data for the fingernail clam that has a significant impact on the chloride acute and chronic value determination. This 1961 data was not included in the development of the USEPA 1988 guideline criteria, apparently due to EPA lack of awareness of the data availability in 1988.

While fingernail clams are common in Iowa, the species used in the 1961 study cited by EPA are not common in Iowa. Toxicologists indicated concern that the 1961 tests were conducted at higher temperatures than the fingernail clams’ normal environment. The clams’ sensitivity to chloride in the 1961 tests may be attributed in part to thermal stress at the elevated test temperature.

The acute and chronic chloride standards are very dependent on the acute toxicity of the four most sensitive organisms in the data base. The following four organisms and associated acute chloride values were used by USEPA in its recalculation of the chloride standards:

Fingernail clam (<i>Sphaerium tenue</i>)	682 mg/L (1961 data)
Cladoceran (<i>Ceriodaphnia dubia</i>)	1,402 mg/L
Snail (<i>Gyraulus circumstriatus</i>)	1,941 mg/L
Cladoceran (<i>Daphnia magna</i>)	2,142 mg/L

As indicated above, the 1961 data on the fingernail clam is significantly lower than the other three most sensitive species. The most sensitive mussel in the data base, *Lampsilis siliquoidea*, has a published acute toxicity of 2,295 mg/L, or over three times the fingernail clam value. Based on recent work on fingernail clams conducted by the state of Illinois in developing new sulfate standards, toxicologists expect that the toxicity of chloride to fingernail clams is similar to *Ceriodaphnia dubia*, or about 1,400 mg/L. Therefore, the 1961 fingernail clam data appear suspect.

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As indicated above, deleting the questionable fingernail clam data results in a 56% increase in both the acute and chronic standards.

The IDNR could replace the 1961 data with results of new tests of chloride toxicity on the fingernail clam. As demonstrated in the recent Illinois development of new sulfate standards, the toxicity of chloride is probably a function of hardness. Chloride is probably less toxic at higher hardness, typical of Iowa waters, than at the lower hardness used in standard laboratory toxicity test methods. Therefore, it appears most prudent to conduct a battery of acute chloride toxicity tests on the fingernail clam at various hardness values when evaluating chloride toxicity in Iowa waters. These data would be used in replacing the questionable 1961 data in the derivation of chloride standards for Iowa.

There are two potential problems to this approach of replacing the 1961 data with new fingernail clam test results:

1. The IDNR does not have funds for conducting the \$20,000 to \$25,000 toxicity study on the fingernail clam.
2. The USEPA is under pressure from the August 2006 Settlement Agreement with environmental interest groups for adoption of final chloride standards in Iowa now.

A member of one of the environmental groups is a TAC member. This environmental group representative indicated support for conducting the study on the fingernail clam and thereby delay the adoption of final chloride standards for about six months.

TAC members have a proposal from Advent Environ, the firm that worked on the recent development of the Illinois sulfate standards and the Illinois Natural History Survey, the lab that conducted the toxicity tests on organisms including the fingernail clam for the Illinois sulfate standards development. The scope of work includes developing the test protocol with USEPA review and concurrence, parallel acute toxicity tests at two labs using the fingernail clam at three hardness concentrations to define acute chloride concentration as a function of hardness, and final data presentation.

The cost for the chloride toxicity testing and report is \$20,000 to \$25,000. The IWPCA Board of Directors has included some funds for partial support of the study in its 2008 budget. IWPCA can receive funds from other organizations and dischargers that wish to contribute to this effort.

TDS Standards

In 2004, the EPC directed the IDNR to review the TDS standards issue and develop final rules for TDS and/or the specific toxic constituents that make up TDS by 2007. Therefore, it was the intent of EPC that IDNR would develop standards in addition to chloride as appropriate to address the TDS standards issue.

The interim “site specific” TDS standards have serious implementation problems. The IDNR is requiring the use of chronic toxicity testing on fathead minnow and *Ceriodaphnia dubia* for any discharge that results in greater than 1,000 mg/L TDS in the receiving stream. The chronic test is a very difficult laboratory procedure, expensive, and has very poor reproducibility. IDNR has concluded that the interim “site specific” TDS standard is not a good long term method for establishing discharge limitations for toxic dissolved solids.

IDNR staff have concluded, and most TAC members agree, that the TDS interim standard should be eliminated. The protection from toxic dissolved solids should be achieved with standards for specific chemical parameters such as chloride and sulfate rather than a standard for the nonspecific TDS parameter.

Illinois is currently in the final rule making stages of eliminating its 1,000 mg/L TDS standard and adopting new sulfate standards. Illinois has had a 500 mg/L chloride standard for several years. Illinois has conducted an extensive, multi year study and evaluation of the TDS and sulfate standards issue. Illinois worked closely with USEPA toxicologists at the Duluth laboratory, the same toxicologists that worked with IDNR staff in evaluating the Iowa chloride standards. Therefore, USEPA toxicologists should support a proposed elimination of the Iowa interim TDS standards.

There are two potential problems with eliminating the interim TDS standards as part of the chloride standards rules:

1. Even though USEPA Region 5 and Duluth toxicologists agree with the Illinois approach to replacing the TDS standard with sulfate and chloride, the USEPA Region 7 staff may not agree to this approach. (They may need additional “proof” that the proposed rules provide the same level of aquatic life protection as the current interim TDS standards.)
2. IDNR administrative staff may claim there is not adequate time to develop the rules for elimination of the interim TDS standards due to the 2005 USEPA Settlement Agreement that pressures Iowa to adopt final chloride standards now.

It appears that the Illinois technical evaluations of TDS can be easily and expediently transferred to the Iowa TDS standard elimination issue. Therefore, the elimination of the TDS interim standards could probably be included with the chloride rule package if the USEPA Region 7 staff agree that there is not an immediate need to adopt a chloride standard as per the 2006 EPA Settlement Agreement with the environmental groups.

Sulfate Standards

If the TDS interim standards are eliminated, the discharge of toxic constituents will be controlled by numerical standards on specific dissolved solids such as chloride. Over time, the list of toxic parameters will be expanded as the base of knowledge on toxicity of specific constituents grows. This is the purpose of the USEPA requirement for triennial review of state water quality standards.

Sulfate is a toxic constituent that could be present in Iowa discharges. It seems prudent to include new sulfate standards as part of the chloride standards and TDS standards elimination rule package. This would also address potential concerns that the elimination of the interim TDS standards does not provide protection equivalent to the current standards.

Illinois is currently in the final stages of sulfate standards rule making. The proposed Illinois sulfate standards were developed from extensive laboratory toxicity studies and literature review. The proposed numeric sulfate standards are variable, based on the hardness and chloride concentrations.

The proposed Illinois sulfate standard varies from 500 mg/L at hardness less than 100 mg/L to 2,000 mg/L at hardness greater than 500 mg/L and chloride greater than 5 mg/L. At 100 mg/L hardness and 500 mg/L chloride, the sulfate standard is 714 mg/L.

These proposed sulfate standards could impact some industrial and noncontact cooling water dischargers with high sulfate concentrations to low flow streams. Approximately 60 municipal water supplies exceed 700 mg/L sulfate and 32 supplies exceed 1,000 mg/L sulfate.

Since Illinois worked closely with USEPA Duluth laboratory toxicologists in developing the sulfate standards, it appears USEPA should approve the same sulfate standards in Iowa. Iowa could simply use the Illinois technical documents in support of new Iowa sulfate standards.

More Information

For more information on these issues or to contribute funds for the chloride toxicity testing program, contact Greg Sindt at gregsi@bolton-menk.com or 515-290-0274.