

## SEASONAL APPLICATION OF WILD RICE SULFATE STANDARD – PARTRIDGE AND EMBARRASS RIVERS

### ISSUE:

Minnesota Rule 7050.0224 identifies a Class 4A water quality standard of 10 mg/L for sulfate, “...applicable to water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels”. In order to effectively apply the standard, the period when wild rice may be susceptible to high sulfate levels needs to be determined.

### OBJECTIVE:

This document focuses on the development of a MPCA staff recommendation for the time period of application of the wild rice standard for waters used for the production of wild rice potentially affected by the proposed PolyMet and Mesabi Nugget projects, namely portions of the Partridge and Embarrass River systems, for which sufficient information is available to make a recommendation.

### SUPPORTING INFORMATION:

- Minnesota Power Hearings (1975)
  - General consensus of the three wild rice experts testifying (Drs. Stewart, Grava and Moyle) was that if sulfate concentrations in water did affect wild rice, the most critical time would be during the spring of the year
  - Dr. Stewart testified that wild rice gets most of its nutrients from the water column from germination (late April to early May) to the aerial leaf stage with the most critical time being the early leaf stage (May)
  - Dr. Grava testified that high sulfate concentrations in the water at the time the seed germinates would be detrimental with this period of sensitivity extending until the aerial leaf is developed – he concludes that the overall period of sensitivity would be the months of April, May and June
  - Dr. Moyle testified that the period when high sulfate concentrations would be more critical than other times would be May and early June
  - Dr. Stewart testified that sulfate in the water column can be deposited or transferred to the sediment which can, under certain conditions (e.g. anaerobic or reducing conditions) create hydrogen sulfide which is known to be toxic to wild rice – oxygenated environments would be unfavourable for the conversion of sulfate to hydrogen sulfide in the sediment.
  - Dr. Grava testified that hydrogen sulfide toxicity would be less likely in flowing water conditions than in stagnant water conditions – due generally to oxygenated sediment conditions preventing the formation of hydrogen sulfide and the moving water preventing accumulation of any hydrogen sulfide that may form
  - The Hearing Officer concluded, based on the testimony provided, that the more stringent discharge limits should be included in the permit for the critical months for wild rice (late April to mid June)

- Grava and Raisenen (1978)
  - Approximately 80% of nutrient (e.g., N, K, P) accumulation in the wild rice plant takes place between day 15 and day 90 following seed germination – up to 50% of that occurs between approximately day 55 and day 65.
- Oelke (1982)
  - Wild rice requires 106 – 130 days to mature in north central Minnesota, depending upon temperature during the growing season and variety. Flowering begins in late July and grain formation in August
- Rogosin (1986)
  - Seed germination occurs about the middle of May in northern areas when waters are free of ice. Stems begin to emerge in July
- Meeker (1993)
  - Germination of wild rice seed begins immediately at ice-out, which in his study area in northern Wisconsin can vary between mid April and early May depending on year and geographic location
- Lohse-Hanson Internal Memo (1988)
  - Memo prepared for Jim Strudell in NPDES permitting in response to questions raised by DNR Waters regarding the discharge from the Minntac tailings basin
  - Advised that the sulfate standard applies April 1 to June 30 and recommended no discharge of high sulfate basin water during this period
  - Advised that the sulfate standard does not apply July 1 to August 31 but recommended that a discharge be controlled so as not to adversely affect water levels
  - Advised that the sulfate standard does not apply September 1 to March 31 and stated that no information was available to suggest that a discharge was harmful at that time
  - These recommendations were based largely on recommendations from the Hearing Officer in the 1975 Minnesota Power hearing
- Doug Hall Letter to USX (2000)
  - Stated that the draft reissued permit for the Minntac tailings basin would likely include a discharge limit for sulfate of 10 mg/L effective April through September
  - The letter did not provide a rationale for the recommended effective period
- Strudell / White Internal Email (2004)
  - NPDES permitting requested of Environmental Outcomes confirmation of the effective period of April through September identified in the 2000 Doug Hall Letter to Minntac
  - Environmental Outcomes confirmed the recommendation of the entire growing season from April through September
- Minntac EIS – Wild Rice Technical Memo (2004)
  - By referencing the 2000 Doug Hall letter, the EIS stated that “the MPCA considers the 10 mg/L sulfate standard applicable to industrial discharges between the months of April and September”
  - Identified that this period “brackets the critical germination, boot stages and emergence stages of wild rice” (Note that these critical plant stages are completed well before September, the end of the identified period)

- Reviewed various research data on higher sulfate levels and from this concluded that “it is reasonable to assume that ‘appropriate’ sulfate levels for wild rice growth are bracketed within a range of 10-250 mg/L.
  - Did not include sulfate as a ‘baseline criteria for assessing impacts to wild rice (instead focused on water level, alkalinity, pH, hardness, heavy metals, etc.)
- MPCA Staff Communication with Dr. John Pastor (UMD) (2010)
  - Approximately 60 – 65 percent of the plant’s nitrogen nutrient is taken up before it enters the reproductive growth phase. Then there is a secondary uptake “burst” from the sediments right before seed production. Also referenced internal translocation of nitrogen from parts of the plant into the developing grain.

## SUMMARY

There appears to be an overall consensus from experts that the primary period of both nutrient uptake from the water column and susceptibility of the wild rice plant to high sulfate levels is from seed germination to leaf emergence with additional information suggesting a secondary period when the seed is developed in mid to late August. Assuming germination takes place at ice-out (which is generally mid April to mid May in the northern half of the state) and leaf emergence takes place by early July, it seems reasonable to determine that the main period of susceptibility extends primarily from mid April to mid July with a secondary period in August. Furthermore, notwithstanding the inclination of wild rice to grow at the edges and other slower moving portions of river systems, the Partridge and Embarrass River systems, in general, do not appear to have the morphology or hydrology characteristics that would promote the anaerobic/reducing conditions necessary to result in hydrogen sulfide toxicity towards wild rice.

## MPCA STAFF RECOMMENDATION

To be conservative, and to take into account variability associated with annual climatic variations, geographic locations and individual stand variability the MPCA staff recommendation is that the 10 mg/L sulfate standard is applicable for portions of the Partridge and Embarrass River systems used for the production of wild rice from April 1 through August 31. This timeframe applies at the specific reaches of these river systems that have been determined to be waters used for the production of wild rice; the travel and residence time of the river system from the point of discharge to the location of wild rice will need to be considered when evaluating a specific discharge.

MPCA staff further recommends that continuation of ongoing annual monitoring of wild rice areas to identify cyclical and/or long-term trends be included, as appropriate, in water quality permits issued for projects discharging to the Partridge and/or Embarrass River systems with the understanding that should monitoring indicate an adverse impact, the standard ‘reopener language’ in the permit can be used to make appropriate changes to the permit.

The MPCA staff specifically considered the following information in the development of its recommendation:

- The variability of ice out within the river systems and from year to year. (The year 2010 was a record early year for ice out in northern Minnesota with ice out occurring approximately April 6<sup>th</sup> for lakes in the vicinity of the two river systems.)

- The travel/residence time within the river systems from upstream/headwater portions of the river systems to downstream portions near the mouths of the rivers. This time could range from days in the free flowing upstream portions of the rivers to weeks in the river segments downstream of the flow-through lakes (such as Colby Lake or Wynne/Sabin Lakes).
- General concern was expressed by interested parties on the potential for elevated sulfate in the water column during the 'non-growing season' resulting in the formation of toxic levels of hydrogen sulfide in the sediments. The flow and stream characteristics of the river systems was considered with the resulting recognition that, consistent with expert testimony presented in the Minnesota Power hearings, deleterious levels of hydrogen sulfide would not be expected to develop in identified wild rice areas that have relatively free-flowing flow characteristics or a relatively oxygenated substrate. (Average annual minimum flows within wild rice areas in both rivers is on the order of 1 cfs or greater.)
- The limited potential in the natural river systems for freeze/thaw impacts on the wild rice seed bed (however, that potential should be evaluated for projects/permits resulting in artificial fluctuations to natural stream flow).

This MPCA staff recommendation is based on information currently available. MPCA staff will consider additional information that may become available in the future, whether from project proposers or from other interested/affected parties, and reserves the right to modify the staff recommendation accordingly.