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# REVIEW OF RELATIONSHIP OF WILD RICE TO SULFATE CONCENTRATION OF WATERS

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## INTRODUCTION

The question has been asked: Is it reasonable for the State of Minnesota to set an upper limit of 10 mg/l (ppm) sulfate ion for waters having natural stands of wild rice and receiving an industrial effluent containing sulfates. The limit referred to is in Section (d) (4) (A) of "Criteria for Classifications of Interstate Waters etc.". The specific situation is discharge of wastewater containing sulfates from the Clay Boswell Steam Electric Station at Cohasset, Minnesota. This station is operated by the Minnesota Power and Light Company. The Company considers the 10 ppm limit "unreasonable" and retained Dr. J.M. Stewart of the University of Manitoba, who has prepared a report on the situation.[10]

As a matter of background, the 10 ppm limit was placed in the Critera following a telephone call to me from someone (I do not remember whom) in the P.C.A. inquiring about water quality and wild rice. I said that there were no large and important natural and self-perpetuating wild rice stands in Minnesota where the sulfate ion content exceeded 10 ppm.

This is true, but it does not mean that there are no stands in which sulfates, at least at times, are higher. The upper limit for self-perpetuating stands in Minnesota appears to be about 40 ppm, with most of them usually below 10 ppm. The attached bar diagram (Figure 15 from a 1965 manuscript report by Mr. Roy Nelson of Minnesota D.N.R.) illustrates this. It is based upon field surveys by D.N.R. personnel of 283 lakes in which wild rice was found. It will be noted that about 90 percent of the areas with wild rice (mostly lakes) had waters in which the sulfate ion concentration was 10 ppm or less and that no "heavy yield" stands were found above 50 ppm.

BANDS EX. 24

An earlier compilation of data by myself (Moyle 1956) showed that the southern and western limits of the wild rice range in Minnesota coincided with the isoline (based on county averages) of 10 ppm sulphate[6] and, still earlier (Moyle 1945), data compliled as part of a Ph.D. study at the University of Minnesota showed a sulfate range of 2 to 36 ppm with a median of 4.2 ppm for northern wild rice (Zizania aquatica var. angustifolia) and 3.0 to 282.0 with a median of 21.2 ppm for giant wild rice (Z. aquatica)[5]. The 282 ppm site was a small stand in Marsh Lake near Montevideo that had probably been planted.

## NATURE OF THE RELATIONSHIP

In Minnesota, because of geology, soils and climate, the concentration of dissolved salts in surface waters increases from northeast to southwest; there are soft carbonate waters in the northeast, hard carbonate waters in much of northern, central and southern Minnesota, and sulfate or "alkali" waters in the southwest and extreme west - see attached maps.[6] Each water type has an associated aquatic flora. Wild Rice is a typical hard carbonate water plant of northern and central Minnesota. It also grows in the soft carbonate water area, but usually not in very soft waters (those with a total alkalinity below 20 ppm.). Westward and southward it becomes increasingly scarce as sulfate concentrations increase. It is usually absent from waters with sulfates higher than 40 ppm. It is absent, and probably always has been, from the Minnesota River, which usually has about 200 ppm sulfates, and from the Red River, which usually is around 80 ppm.[11] The Pelican River, which flows through Becker County near the western edge of the natural wild rice range, has a sulfate ion concentration of about 16 ppm (range 10- 25). It has wild rice in it.[9]

Because of its value to waterfowl, wild rice has been planted in many lakes where it did not grow naturally. Plantings in waters higher than 40 ppm sulfates have had the usual history of producing some plants the first year, a few plants the second year, and none the third year. Conditions other than water chemistry may also be involved, such as a abundance of carp and competition from other water plants (such as cattails) and algae. As a general rule of thumb, used for many years, the D.N.R. has not recommended planting of wild rice in waters where the sulfates exceed 10 ppm.

A pertinent question is: Is the relationship between sulfate concentrations and wild rice cause-and-effect or coincidental, with both related to one or more other conditions? This is not easily answered for it probably entails both concentrations of sulfates with associated ions, such as calcium and magnesium, are not themselves toxic in the sense that they kill aquatic plants directly. At higher concentrations (several hundred ppm) sulfates probably have an adverse osmotic effect, upsetting absorptive and water-regulating systems of the plant. For example, it has been found that along the Atlantic coast, wild rice does not grow in brackish waters where the salinity exceeds 400 ppm.[12] Also it does not grow in North Dakota waters that have a high concentration of dissolved salts (carbonates, sulfates, and chlorides).[11]

Sulfate salts, however, differ from carbonates and chlorides in that the sulfate ion can be reduced by bacteria to hydrogen sulfide. This occurs under anaerobic conditions, either in water or in bottom soils. Hydrogen sulfide is a toxic gas and in water has long been known to be toxic to fish at low concentrations (under 1 ppm). There is a general rule among fisheries workers that if you can smell it in a water supply, there is too much.

In recent years careful analytical work at the University of Minnesota by Dr. Lloyd L. Smith and his graduate students has shown it to be toxic to fish eggs (walleye and northern pike) and to small crustacean or "scud" (Gammarus) in concentrations of less than 0.3 ppm.[1,2,7] A level of less than 1/10 of this (about 0.02 ppm) is considered to be "safe".

Similarly, hydrogen sulfide has recently been found to be toxic for domestic rice (Oryza sativa) in paddies of southern United States when concentrations are about 0.1 ppm in paddy soils.[8] Here an interesting and important relationship has been found. Hydrogen sulfide can be and often is, utilized by the anaerobic bacterium (Beggiatoa) and thereby removed from the soil, benefitting the rice. In turn the rice roots give off a substance that benefits the bacteria.

It has also been found by Smith and his students that little or no hydrogen sulfide is given off by submerged inorganic soils (such as sand and gravel) and that it is removed and dispersed by flowing water.

As related to wild rice, it seems likely that hydrogen sulfide may well inhibit the germinating of the seed or growth of young plants, but this remains to be investigated. It is known that the germination and growth is best in larger areas where there is wave action or in smaller areas where there is inflow of water. Planting is often done at such sites.

Finally, it should be emphasized that a small amount of sulfur is necessary for all life, it being an essential component of protein.

## RECOMMENDATIONS

In view of the foregoing considerations and the fact that the wastewater from the Clay Boswell Station will be discharged into flowing water, it seems safe to set an upper limit on sulfates in the river water after mixing, of 20 mg/l. The concentration of sulfate ion from other sources in this stretch of the Mississippi River is usually between 7 and 12 ppm. Twenty ppm is within the range of sulfate known in Minnesota to be associated with self perpetuating stands, such as the rice in the Pelican River, Becker County.

It is my opinion that the upper limit of "at least 200 ppm" recommended by Dr. Stewart in his report is too high under Minnesota Conditions and may be injurious to wild rice stands downstream, especially in backwaters or where the water is pumped from the river for use in paddies.

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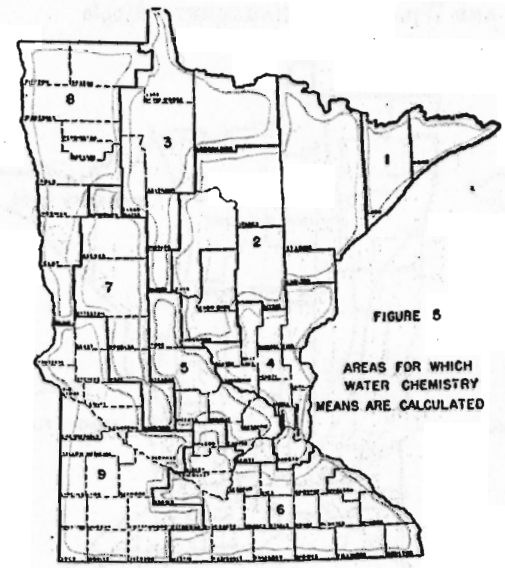


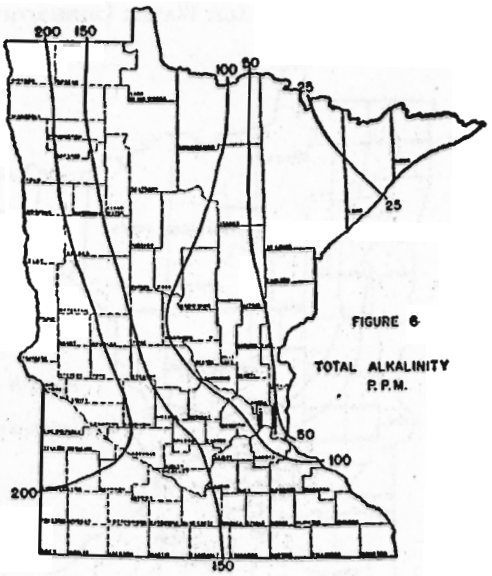


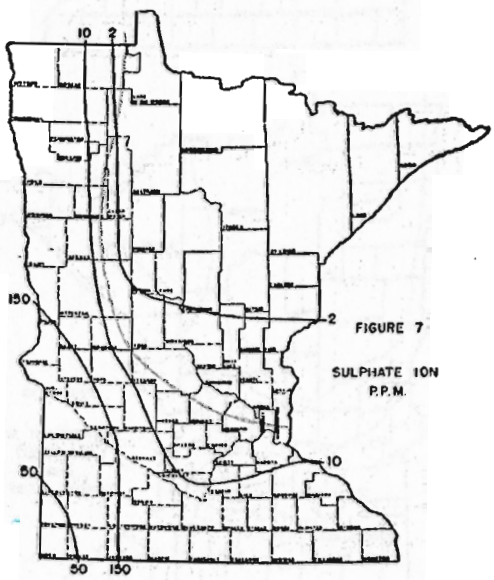


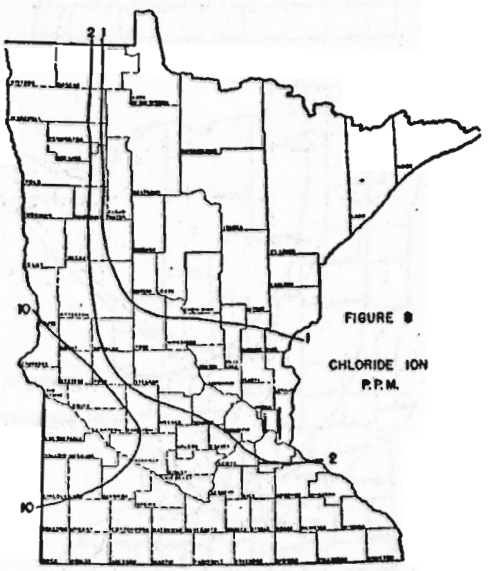


FIG. 5. Areas of similar water quality arranged in order of increasing salinity. FIGS. 6 to 8. Isolines of some chemical components of surface waters. See text for explanation.

sidered on a regional basis and means and medians of fairly large series used. Of these two kinds of averages, the median appears to be most representative of usual conditions in lakes of the series. The mean tends to be influenced by analyses from a few bodies of water in which salt concentrations are usually high or low. Except for analyses for total alkalinity, the means of series are usually somewhat larger than the medians.

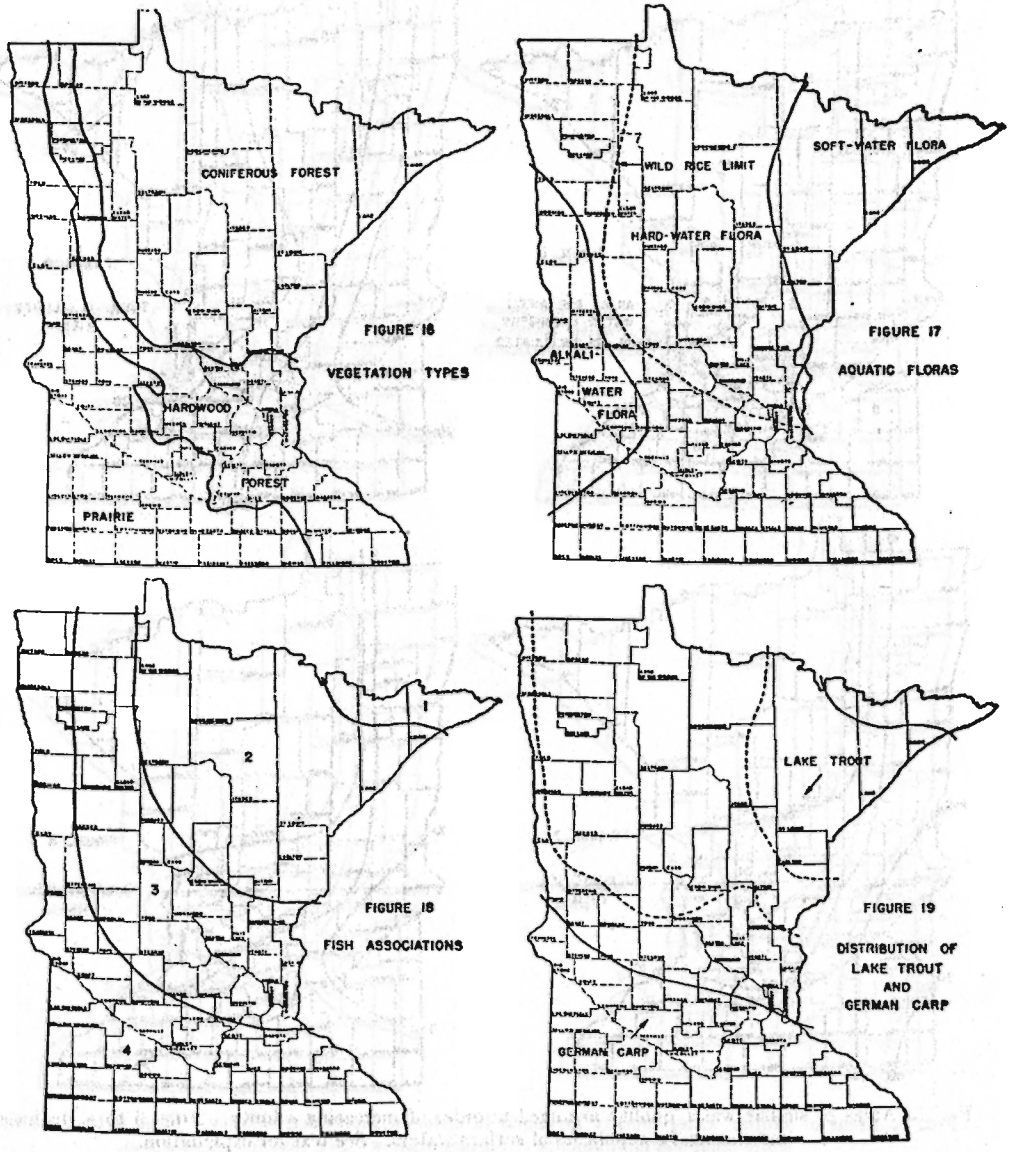


FIG. 16. Generalized plant geography of Minnesota. FIG. 17. Aquatic floras of Minnesota. Data from Moyle (1945). FIG. 18. Generalized original distribution of fish associations. FIG. 19. Ranges of lake trout and German carp. Solid line is principal range; broken line is limit of range.

ever, in most Minnesota waters is slight. Second, it should be remembered that although total alkalinity is expressed as calcium carbonate, a considerable portion of the carbonates may be and often is associated with metallic ions other than calcium; especially with magnesium. Calcium bicarbonate in pure water is soluble to the amount of 385 ppm at 59°F. (Clarke, 1924, p. 131) while calcium monocarbonate is soluble to the extent of 14 ppm at 77°F. (Hodgman, 1937). Sometimes, however, higher analytical results may be obtained because of suspension of limey material.

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# WILD RICE--SOME NOTES, COMMENTS AND PROBLEMS*

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There are many aspects to wild rice--its history, biology, prospects, management and special problems. Many of these are considered in detail in the papers, articles and reports listed in the attached bibliography. The Minnesota Department of Conservation is charged by law with the protection and management of wild rice growing in public waters and has been since 1939. Under Minnesota laws, wild rice and other aquatic plants growing in public waters have the same legal status as game and fish--being the property of the State in its sovereign capacity insofar as it is capable of being owned. However, in privately-owned areas, such as constructed paddies, wild rice can be grown and managed as a privately-owned crop. Use of surface waters as a water supply for raising wild rice requires a permit from the Minnesota Department of Conservation.

Wild rice has the distinction of being a wild grain which has long been used by primitive peoples but which has not, until very recently, been developed and grown as a crop. It has been harvested as a native self-sown grain and as such is also an excellent fall food for waterfowl. This has caused some conflicts between hunters and harvesters. Some wild rice lakes are also used for the rearing of northern pike for stocking in other lakes. Wild rice is a key feature in multiple-purpose management of many shallow lakes. Such lakes can supply a harvest of the grain, a harvest of fish and raise and provide hunting for wild ducks.

## The plant and its requirements

Wild rice (Zizania aquatica) is a robust annual grass that commonly grows in water 6 inches to 3 feet in depth. The seeds or grains which sink and rest on the bottom begin growth by producing a single seed root and a single submerged ribbon-like leaf in late spring. As the plant develops it produces a cluster of several leaves that ultimately float on the water surface. Unbranched roots arise at the stem nodes much like the adventitious roots of corn. In early summer the stem elongates and extends out of the water. The stem has grassy leaves and is terminated by a flowering and fruiting panicle. The female flowers, which produce the grains, are in a spike-like arrangement at the top of the panicle. The male flowers are borne on slender arching branches below the female

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flowers. The height of the mature plant varies greatly but is usually three to four feet above the water surface. The structure of the hollow stem or straw is peculiar in that there are regularly spaced partitions or septa between the stem nodes, thus allowing the stem to float even though portions of it may be injured. The flower structure is also peculiar in that the staminate flowers have six stamens rather than three as is usual in grasses.

The seeds germinate on and the roots grow in lake bottoms in which there is little or no dissolved oxygen. This causes oxygen relationships of this plant to be of special interest.

Growth of the roots of many aquatic plants is dependent upon oxygen received through the tissue from upper parts of the plant. Many such plants have special air-conducting tissues (aerenchyma) in the stems and leaves. That roots of aquatic plants receive oxygen can be demonstrated by observing oxidized iron next to the roots of plants pulled from mucky bottoms. The extent and effectiveness of internal gas transport in wild rice is unknown but may well be a factor that affects the depth to which the plant can grow.

Oxygen relationships of the seed are also of interest. Wild rice usually grows either along streams or along shores of lakes where there is considerable open stretch of water and heavy wave action in spring. These situations bring oxygenated water in contact with the seed. It is known that planting succeeds best in small lakes at places where there is inflowing water and that in large stands there is usually no rice beyond a depth of four feet (probably below the effect of wave action). However, rice often appears in deep water areas if the water level is lowered.

Several years ago we tested experimentally the effects of different dissolved oxygen concentrations on the germination of wild rice seed[17]. It was found that at continuous concentrations of 0.4 parts per million of dissolved oxygen, seed germination was highest (about 50 percent) but that after germination there was no appreciable growth or chlorophyll formation at this oxygen level. There was some growth at 1.7 p.p.m. and normal growth above 3.0 p.p.m. It appears, therefore, that low oxygen levels aid in breaking the dormancy of the seed but after germination at least moderate amounts of oxygen in the water are needed for further growth. This situation might be expected for in winter the shallow water of rice lakes, or at least the layer of water next to the soil, is usually devoid of dissolved oxygen. In spring the water is aerated by wave action or flow of water.

Under the conditions of the experiment about 25 percent of the rice seeds germinated and grew at favorable oxygen levels. This result is similar to an earlier test made of seed stored over winter in a spring and to that found by Mr. Algot Johnson for seed used in planting his paddy at Washkish.

Observations made on wild stands suggest that some of the seed does not germinate the first year and may lay on or in the bottom mud for at least five years--especially if water levels are high. Delayed germination of seeds of wild plants--especially upland weeds--has long been known.

In Minnesota wild rice is not found in waters high in alkali or sulfate salts. There are no large stands in waters in which the concentration of sulfate ion exceeds 10 parts per million. Waters with concentrations greater

than this are found mostly in that part of the state that was originally prairie--in the southwest and extreme west. Plantings in such waters have failed to produce stands. Even though there may be some growth the first season such stands have not perpetuated themselves. The dividing line between the area having wild rice and that not having it is often quite sharp. It is a matter of a few miles in the Detroit Lakes area. The physiology of this relationship is unknown but it may be due to magnesium toxicity, since magnesium is commonly associated with sulfates, or may be due to the breakdown of sulfates to hydrogen sulfide in the submerged soils.

In Minnesota the fairly sharp separation between carbonate waters in which wild rice grows well, and sulfate waters is mostly a matter of geology and soils. Rainfall and evaporation are also concerned and sulfate waters are characteristic of semi-arid and arid regions--such as those that are characterized by prairie grasses.

Wild rice usually grows on submerged organic soils, especially those that are decayed and somewhat mucky and which contain lime (often evidenced by snail shells in them). Often such soils overlie a hard bottom of sand and clay. Best sites for paddies are often in old glacial lake beds where muck overlays lake clays. In rivers, however, it sometimes grows on sand and silt.

Natural distribution and ecology of wild rice

There are two generally accepted species of wild rice, Zizania aquatica of eastern North America, and Zizania latifolia of eastern Asia, especially Manchuria. Wild rice is not native of western North America, central Asia or Europe. The disrupted distribution illustrated by the two species of wild rice is worthy of comment for there are a considerable number of plants that are distributed in the same way--plants for which the identical or closely related species are found only in eastern North America and eastern Asia. Examples are the tulip tree, sassafras, moonseed, aralias, lopseed, blue cohosh and May apple. They are remnants of an ancient--probably Cretaceous--flora that once had a continuous distribution but which now has this disrupted pattern.

This disrupted distribution pattern is mentioned to point out that wild rice is an ancient kind of grass that antedates man and his ability to distribute it by planting. Although Indians may have, and probably did, plant some North American stands, the original distribution must have come about in other ways.

In North America wild rice grows as a wild plant from Manitoba eastward across southern Canada to New Brunswick. In the central part of North America its southern limit is Kansas and Virginia, but it extends southward along the Atlantic Coast to Florida and along the Gulf to Louisiana. Its greatest abundance, however, is in the Great Lakes area, especially in Minnesota, Wisconsin, Michigan and southern Ontario and Manitoba--areas in which the topography and drainage have been molded by continental glaciation in fairly recent Pleistocene time. It has been planted, with varying degrees of success, in many other places, primarily as a waterfowl food plant.

In Minnesota it is most common in the northern half of the state along moderate-sized slow-flowing streams and in shallow lakes lying in poorly drained topography. Often the lakes containing it occupy shallow depressions in the basins of former larger glacial lakes or lie in quite level ground-moraine country. Some of the streams along which wild rice grows occupy old

glacial drainage channels. Drainage outlets and streams flowing from lakes are often inadequate to carry away excess water in years of heavy snowfall or high spring rainfall with the result that water levels fluctuate considerably. This fluctuation eliminates such perennial plants as cattails, reeds, and sedges that compete for space with wild rice and which can eventually displace it. With the return of lower water levels wild rice can grow without competition. Basically such water level fluctuation sets back plant succession to an early stage favorable to the annual wild rice--a situation generally similar to cultivation of upland soils.

Some of our present wild rice stands are known to have existed nearly as long as there are historical records for the state--some for more than 300 years. Early explorers and fur traders noted that the crop often failed because of high water and this resulted in difficult times for Indians who depended upon wild rice for food. Recent histories of several Minnesota stands indicate that, on the average, a stand can be expected to produce one bumper crop, two fair crops and one failure in a four-year period. Statewide during the past 30 years the crop has varied from a few thousand to over a million pounds of processed rice.

Management of natural stands for maximum production of wild rice should take into account both the natural ecological trends in wild rice lakes and meet the requirements of the wild rice plant. Water level control structures for wild rice stands should allow a wide range (4 to 5 feet) of water level control so the perennial "weeds" can be eliminated occasionally by holding the water high for a growing season. The channel below such dams must often be enlarged so that it is adequate to carry off excess water when this is not wanted. The best operation for production years is to hold the water level in spring so that as much of the water should be dropped slowly --about six inches--throughout the summer. Rapid fluctuations in water level should be avoided in early summer when the wild rice is in the floating-leaf stage. At that time a rapid rise of 6 inches to 1 foot, especially if combined with storms and heavy wave action, can cause the plants to pull and drift ashore and the crop to fail.

Installation of a dam alone on a wild rice stand to try to maintain "stable" water levels is of no avail and may even injure the lake for wild rice production. This happened on several Minnesota lakes in the 1930's when dams were constructed by work relief agencies before we had our present understanding as to the requirements of this wild crop.

It has been pointed out that natural distribution of wild rice antedates man and that its occurrence and abundance is related to fluctuating water levels and chemical requirements of the plant. We have not, however, answered the question "How did wild rice get to places where it now grows?" Along streams the seeds and whole plants, if torn loose, can be washed down stream, but isolated lakes and headwater areas must have been seeded in some other way. Some plantings were undoubtedly made by Indians. The Chippewas have folk tales about one Wah-nah-boo-shu, who discovered how tasty wild rice was in soup and planted all the lakes he knew[5,13]. The most likely natural method of seeding isolated stands appears to be transportation by ducks. It is postulated that such planting occurs, not by the passage of seeds through the digestive tract, as with many hard-seeded aquatic plants, but by the grain being carried in the crop. Ducks will gorge themselves on the seeds and these remain unharmed in the crop for some hours. If such a duck were killed by a mink, falcon or turtle on

another water area, seeding could easily occur. By this method the seed would also be kept moist and viable while being transported.

Wild rice and Indians

Much has been written on the use of wild rice by Indians, their methods of harvesting and use of wild rice as part of their cultural pattern. This is discussed in the papers of Jenks[3], Steeves[13], and Taube[18]. Under aboriginal conditions wild rice made up perhaps a quarter of the food of the Indians of the Lake States. Dr. Jenks was of the opinion that these Indians did not develop an agricultural economy because of the availability of this native grain. Some of the cultural patterns associated with wild rice are the basis of our present legal regulations applying to harvesting.

The Indians as tribes, clans and smaller groups had certain proprietary interests in wild rice stands. Village sites were often near such stands and there was considerable fighting between the Chippewas and the Sioux for possession of them. The concept of property rights among primitive Minnesota Indians is discussed by Hickerson[7]. Larger harvesting operations were often supervised by a tribal chief or an experienced harvester who acted as a "wild rice chief". For example, David Stanchfield[14], a pioneer lumberman, tells how the Chippewa at Mille Lacs under Chief Hole-in-a-Day organized the harvest on nearby stands--stands which are still harvested. Here the standing stalks of ripening rice were gathered together and tied into sheaves on the stand, each family being allotted four to five rows of sheaves across the lake. When all the rice was ripe, the sheaves were untied and the grains knocked into a boat. In this way loss from shattering and to birds was greatly reduced. The processed grain was stored for winter use in birch bark packages called "mokaks", each holding a half to a bushel. It is likely, however, that much Indian harvesting was done by the present method of poling a boat through the stand and knocking the seeds off with short wooden flails.

The Sioux were driven from the Minnesota wild rice range by the Chippewa by 1850 and then the Chippewas were moved to reservations. Under the provisions of several treaties, they often were provided with lands containing sizeable wild rice stands. Some of these stands, such as Nett Lake in St. Louis County and Lower Rice Lake in Clearwater, are still under the control of the Chippewa tribe and only Indian harvesters are permitted. It should be noted that most Minnesota Indian reservations (all except the Red Lake and Nett Lake Lake Reservations) were established as "open" reservations on which individual Indians could sell lands allotted to them. Here much of the land is now in the ownership of whites and for such open reservations the Minnesota Wild Rice Law, passed in 1939, stipulates that within the original boundaries of these open reservations harvesting shall be restricted to Indians and white residents of the reservation.

The Wild Rice Law also tried to perpetuate the Chippewa system of having a Wild Rice Chief supervise the harvest on each stand--the chief being replaced by a local "committee". This has been tried on many stands and is still used on some. However, it has often proven unworkable because there is no provision for paying committeemen and most of them prefer to take part in the harvest rather than supervise it. As a result most of the field direction of harvest is by paid employees of the Conservation Department, especially Conservation Officers.

Harvesting is restricted to Indians on tribal lands and on several of the stands controlled by the U. S. Fish and Wildlife Service. These stands usually total about 6,000 acres or a fifth to a third of the harvested area in any year.

The stands on Fish and Wildlife Service lands are managed both for rice production and waterfowl use. In 1963, for example, 138,000 pounds of rice (non-processed) were taken by Indians from the Tamarack Refuge in Becker County and Rice Lake Refuge in Aitkin County.

The harvesting technique permitted under Minnesota law preserves the traditional Indian method, requiring that on public waters hand flails and small hand-operated boats be used.

Indian and white harvesters have long recognized that there are different kinds or strains of wild rice. The rice that grows along rivers, especially on sandy soil, is usually small-grained and ripens early. It is often known as "bird" or "river" rice. Some of the best rice for purposes of harvesting salable grain grows in Nett Lake on the Nett Lake Indian Reservation, and the Indians here are very protective of this choice long-grained rice as a seed source. Other qualities and differences in wild rice have also been noted. For example, in the early 1940's Paul LaRoque, a Chippewa Indian who was then Assistant Director of the wild rice harvest, commented that as a boy he had harvested wild rice with his grandfather on Big Rice Lake near Remer in Cass County, and this rice was known to the Indians as "double-jacket" rice because the hulls on the grain were especially thick and hard to remove. The wild rice grown on different stands is sufficiently different so that an experienced buyer can often tell where it came from by looking at it.

Yields and harvests

As previously noted, under hand harvesting methods required by Minnesota law, the harvest of wild rice usually does not exceed 100 pounds of non-processed (commonly called "green") rice per acre and 40 pounds of processed rice. Some recent information on this comes from Mr. Jay Janacek, Game Manager at Grand Rapids, Minnesota, who has gathered information on wild rice harvesting on the Mud-Goose Lake area near Ball Club. In 1967, a year of good crops here and high prices, the harvest amounted to 62 pounds per acre (green rice) for the 1600-acre area from which the rice was taken. Using a factor 1 pound of processed rice from 2.5 pounds of green rice this is equivalent to 25 pounds of processed rice per acre. The usual harvest in Minnesota in recent years has, as determined from reports of buyers and processors, been about 2 million pounds ("green") and this has ranged usually between 1 million and 3 million.

The rice harvested from wild stands represents only a small fraction of the crop, even if the stands are harvested several times. This proportion has been variously estimated at between 5 and 25 percent [1,4,8].

In an experimental 40-acre paddy at Washkish, Mr. Algot Johnson's[4] use of a mechanical harvester combined with hand Indian harvesting took 370 pounds (green) rice per acre (150 pounds processed) and this, he estimated, represented only about one-third of the total crop. Rogosin[10] by expanding yield data from rice grown experimentally in small boxes calculated total yield of 22 to 129 pounds per acre (processed) for unfertilized soil and 150 to 537 for fertilized soil. He found the yield was related to density of planting of seed. The highest returns from seed planted were 14-fold on fertilized soil planted at the rate of 160,000 grains per acre and 5-fold from fertilized soil planted at the rate of 1,600,000 grains per acre. Since there are 5,000 to 9,000 grains per pound of seed (Washkish data of Mr. Johnson) these represent returns from planting about 20 to 200 pounds per acre. There is no accepted standard weight in pounds for a bushel of non-processed wild rice, this varying greatly with the moisture content of the grain and the hulls and the proportion of filled grains, but, roughly, these two planting rates can be

considered to be one-half and five bushels per acre. It might be noted that seed wild rice is usually sold by the quart by aquatic nurseries and that for wildlife plantings a bushel (32 quarts) per acre is often used. Samples of "green" rice collected by the Minnesota Department of Agriculture in 1966 ranged in air-dry weight from 13.6 to 22.7 pounds per bushel with an average of 17.1 pounds--roughly half that of oats.

In summary: (1) hand harvesting takes only a small part of the crop from wild stands and usually this harvest amounts to 40 pounds or less (processed rice) per acre; (2) under intensive management and careful harvesting a yield of 150 pounds per acre is possible from wild strains. With a non-shattering strain, fertilization and intensive harvesting a yield of 500 pounds per acre could be produced if all the grain were harvested. Brooks[1] gives a more optimistic estimate of 1500 to 1800 pounds per acre; and (3) planting rate for greatest return from seed planted is probably around one bushel (32 quarts dry measure or 40 to 50 pounds) per acre and for greatest overall yield, on fertilized soil, about 5 bushels per acre.

## The wild rice industry

Wild rice remained principally an Indian food of not much commercial importance until after 1900. However, in the early days some was bought by fur trading companies to augment the food supply at their posts. For example, in the early 1800's the Northwest Fur Company bought 1200 to 1500 bushels a year in the Rainy Lake area[13]. In later years some was purchased or traded to local white residents and logging camps. According to L. A. Rossman[11], pioneer newspaper publisher at Grand Rapids, the first commercial dealer in wild rice in Minnesota was Frank Vance, who had a store near Squaw Lake in Itasca County. He bought green rice from the Indians at a cent or a cent-and-one-half a pound, and finished rice for 5 cents a pound. This he sold "almost uniformly" for 10 cents a pound. He also developed the first mechanical processing equipment. He sold 5 or 6 tons a year. Mr. Rossman gives no exact dates but this was prior to World War I, probably around 1900-1910. During World War I the price of finished rice rose to 30 or 40 cents a pound, and others went into the business. Some constructed harvesting machines, boats with reels like that of a grain binder, to knock the grains into the boat. Photographs of machines of this type used in Manitoba more recently are shown in Steeve's paper[13].

In 1939 the use of such mechanical "pickers" on public waters was outlawed in Minnesota and in that year the Conservation Department put the wild rice law into effect and supervised the harvest. There was difficulty in organizing the harvest and in 1940--a year of a bumper crop--the first survey of the stands was made by the writer and the harvest better organized. Green rice then sold for 5 to 6 cents a pound and finished rice for about 15 cents. In years of ordinary crops, however, in the 1940's the rice usually sold on the stands for 8 to 15 cents a pound. Processed rice wholesaled at 30-40 cents and retailed at 50-60 cents a pound[11].

Demand for wild rice as a culinary novelty and gourmet food has increased greatly since then--at least partly due to activities of the processors who early organized a Wild Rice Producers Association. Processing methods have been improved and the product made more attractive to the customer. In recent years wild rice has commonly retailed from $4.00 to $5.00 a pound. The retail price hit a peak of about $8.00 a pound in some places in 1966, following three years of mediocre crops. In recent years prices paid to harvesters on the stands have usually been in the range of 35 to 75 cents a pound, but in 1967 soared to between $1.00 and $1.75.

Between 1939 and 1953 the number of licensed harvesters ranged from 292 to 2514. In 1960 there were 10,486 licensed wild rice harvesters in Minnesota and 285 licensed buyers. In 1967 there were 15,750 licensed harvesters and in 1968, 16,443.

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Slide 2

ORIGINAL COPY

# MP&LClayBoswellPermitHearingTestimonyExcerpts- March19,1975

STATE OF MINNESOTA
COUNTY OF RAMSEY

MINNESOTA POLLUTION CONTROL AGENCY

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In the Matter of the Applications for National POLLUTANT Discharge Elimination System Permits to Discharge from three Steam Electric Generating Plants of Minnesota Power & Light Co.

---

The above-entitled matter came on for hearing before Richard L. Pemberton on the 19th day of March, 1975, at the PCA Building, 1935 West County Road B-2, Roseville, Minnesota, commencing at approximately 1:30 o'clock p.m.

* * *



BANDS EX. 26

APPEARANCES:

Richard L. Pemberton, Esquire, of the firm of RUFER, HEFTE, PEMBERTON, SCHULZE & SORLIE, 110 North Mill Street, Fergus Falls, Minnesota, appeared as Hearing Officer.

William Donohue, Esquire, Special Assistant Attorney General, 1935 West County Road B-2, Roseville, Minnesota, appeared representing The Minnesota Pollution Control Agency.

G. W. Harries, Esquire, Attorney at Law, 1200 Alworth Building, Duluth, Minnesota, appeared representing Minnesota Power and Light Company.

* * *

WHEREUPON, the following proceedings were duly had:

* * *

# I N D E X

So we just didn't count all of the small stands, you know.

Q Are many of the significant stands in Minnesota located on streams, or flowing bodies of water?

A Yes, quite a few of them are.

Q And of those that are located on streams, to your knowledge what concentrations of sulfates are present in the water?

A Well, it's usually between two and ten, although I know of one stream, the Pelican River in western Becker County, that has a selfperpetuating stand on it that sometimes gets as high as 25.

Q Okay. When you say as high as 25, you are referring to parts per million of sulfates?

A That's right.

Q Okay. In your opinion, is there a relationship between sulfate concentrations in water and wild rice?

A Well, at least wild rice doesn't grow where there are high concentrations of sulfate here in the state. And as near as I can find out, it never has grown in such areas.

Q Could you describe how you think that relationship operates between sulfate concentrations and wild rice production?

A Well, that's quite speculative. Now it seems to me that

the most likely cause is that in organic soils, mucky soils, on which wild rice ordinarily grows. If you have such high concentrations of sulfates present, some of them are going to be reduced to hydrogen sulfide, which is a toxic gas and is soluble in water. And this is known to be toxic to fish eggs and crustacea and in cultivated rice paddies in the south to cultivated rice. But that's something that never has been checked experimentally.

Q Okay. Is there any other mechanism that the relationship of sulfate concentration and wild rice could work through?

A Yes. If you have very high concentrations along with high carbonate and fluorides, you have a high total concentration of salts in the water. Now, these become really brackish, or saline waters, or alkaline waters sometimes that's called. And the effect there may be an osmotic effect; that is, the high concentrations in the water prevent the plant from taking in the nutrients it needs in water. It sort of dries up the plant, you might say. And of course, that sort of thing has been known for a long time, especially in coastal waters where the salts are mostly chlorides.

Q It's my understanding then that your work then is mainly observational with planting.

wild rice in a high sulfate water concentration under controlled conditions?

A. No.

Q. Eliminating other possible factors?

A. No.

Q. I think you mentioned a situation where high sulfates and high carbonates produce a brackish water situation.

A. Yes.

Q. I take it that is attributable to the whole combination that you mentioned and not merely the sulfates.

A. Yes. See, and oftentimes you have got to add in chlorides there too.

Q. But that is not attributable particularly to the sulfate, it's to the whole combination?

A. Yes, that's right.

Q. Okay. I take it that it's some years since you have visited Manitoba.

A. Oh, yes, maybe five or six years.

Q. And you testified that you observed only one stand there at that time.

A. Well, observed one stand in Saskatchewan.

Q. I beg your pardon.

A. Ya.

Q. Then let me ask about Manitoba.

A. I didn't look there.

Subject: EPA Requesting Tribal Consultation on Mesabi Nugget
From: Wagener.Christine@epamail.epa.gov
To: samoore@boreal.org, "Margaret Watkins" <watkins@boreal.org>
Cc: Mayo.Kathleen@epamail.epa.gov, Holst.Linda@epamail.epa.gov,
Pfeifer.David@epamail.epa.gov, Chico.Anita@epamail.epa.gov
Date: Thu, 15 Nov 2012 16:49:07 -0600
X-Mailer: Lotus Domino Web Server Release 8.5.3FP2 July 02, 2012
X-MIMETrack: Serialize by HTTP Server on
EPAMAILR521/USEPA/US(Release 8.5.3FP2|July 02, 2012) at
11/15/2012 04:49:07 PM,
Serialize complete at 11/15/2012 04:49:07 PM,
Serialize by Router on EPAHUB11/USEPA/US(Release 8.5.2FP1
HF34|January 11, 2011) at
11/15/2012 05:49:11 PM
X-Spam-Boreal-Status: No, score=-4.3, required=6.0, tests=BAYES_50,
RCVD_IN_DNSWL_HI, RP_MATCHES_RCVD, T_MIME_NO_TEXT
X-Spam-Level:
X-Spam-Server: imap.boreal.org
X-Scanned-By: MIMEDefang 2.72 on 216.70.16.14

Dear Seth and Margaret,

EPA Region 5 received a variance request from the Minnesota Pollution Control Agency for water quality standards related to the Mesabi Nugget LLC. Area 1 Pit discharge SD 001 to Second Creek in St. Louis County. This discharge was historically connected to the LTV Mining Company which went bankrupt in 2000. Mesabi Nugget assumed ownership of the property with the intent of using some the facilities, including the old mining pits, for a large scale demonstration plant that uses an innovative process to produce high quality iron pellets for ultimate use in steel making operations. The plant began operation in 2009, but some of the "kinks" in the air quality control system are still being worked out before they assume full operational capability. This has complicated the design process of their final wastewater treatment facility.

EPA is well aware of the Grand Portage Tribe's interest in the proposed variance, due to its proximity to Tribal Treaty Territory and the Partridge and St. Louis Rivers. We are emailing the attached PDF file of the letter inviting consultation with the Grand Portage Tribal Chairman to your chair to expedite scheduling of consultation activities. We are particularly interested in the following feedback from you:

- If the Grand Portage Chairman is not interested in consulting directly with EPA, we'd like to know is authorized or will be designated to speak on behalf of the Tribe on this issue.
- We are interested in knowing the Tribe's preferred method of consultation.
- In addition to Grand Portage, EPA is also inviting the Bois Forte and Fond du Lac Tribes to consult on the proposed variance. Would your Tribe be open to a group consultation event with the other two Tribes, or a separate event?

**BANDS EX. 27**

- What are the best dates/time frames when we can schedule a consultation conference call with the Grand Portage Tribe?

As you can see from the attached letter, our window for consultation is narrow, but we are certainly willing to work with you to accommodate your schedules.

While your Tribal Chairman may prefer to interact directly with our Water Division Director, Tinka Hyde, we want to do as much as possible at the staff level to expedite the scheduling of our consultation activities. I look forward to hearing back from you with your advice and recommendations.

Sincerely,


# Chris Wagener

# Christine M. Wagener, PhD
# Specialist, Water Quality Standards
# U.S. EPA, Region 5
# Water Quality Branch
# Chicago, IL 60604
# 312-886-0887

**Tribal-EPA Consultation Opportunity: Minnesota Pollution Control Agency Request for Approval of a Variance from Minnesota's Water Quality Standards for Agricultural and Industrial Uses for Hardness, Bicarbonate, Dissolved Salts, and Specific Conductance for Mesabi Nugget Delaware LLC**

**Date:** NOV 15 2012

Overview

Mesabi Nugget Delaware LLC produces iron nuggets from iron ore concentrate, coal, fluxes and binders. The iron nuggets are used in making steel. Mesabi Nugget Delaware LLC discharges treated effluent to Second Creek in St. Louis County, Minnesota. Second Creek is a tributary to the Partridge River, which is a tributary to the Saint Louis River, which discharges to Lake Superior. The affected criterion for hardness is to protect Minnesota's 3C Industrial Use. The remainder of the affected criteria are to protect Minnesota's 4A Agricultural Use.

The Minnesota Pollution Control Agency (MPCA) submitted the variance request to its Citizens' Board with a recommendation that the variance request be granted. The Citizen's Board approved granting the variance on October 23, 2012. The variance is now before the U.S. Environmental Protection Agency for review and approval under section 303(c) of the Clean Water Act (CWA).

This consultation opportunity is a continuation of ongoing discussions regarding this variance between EPA and Tribes.

Background

Water quality standards consist of designated uses, water quality criteria to protect the designated uses, and an antidegradation policy and implementation procedures. Occasionally, states impose water quality-based effluent limits (WQBELs) in National Pollutant Discharge Elimination System (NPDES) permits that the NPDES permit holders are unable to achieve. Under the CWA, permittees may seek relief from WQBELs by applying for a variance from water quality standards where states' water quality standards allow for variances.

A variance is a temporary change to a waterbody's designated use and the associated water quality criteria. Variances must be based on a demonstration showing the standards are not attainable for one or more of the reasons found in the federal regulations at 40 CFR 131.10(g). One of these reasons that is often cited as the basis for a variance is that the standard "would result in substantial and widespread economic and social impact" to the community. Although approval of a variance may provide temporary relief to an individual discharger, the highest attainable designated use and associated criteria must be preserved for the waterbody overall during the variance period, and approval of a variance is contingent on a number of conditions being met during the duration of the variance, such as source reduction measures. Once a state reviews and approves a variance request, EPA must also review and approve the request for the

variance to become effective. More information can be found in EPA's Water Quality Standards Handbook at http://water.epa.gov/scitech/swguidance/standards/handbook/chapter05.cfm#section3.

Basis

Minnesota's water quality standards at 7050.0190 allow for MPCA to grant variances from the Minnesota water quality standards when the following circumstances are met:

> In any case where, upon application of the responsible person or persons, the agency finds that by reason of exceptional circumstances the strict enforcement of any provision of these standards would cause undue hardship, that disposal of the sewage, industrial waste, or other waste is necessary for the public health, safety, or welfare; and that strict conformity with the standards would be unreasonable, impractical, or not feasible under the circumstances; the agency in its discretion may grant a variance there from upon such conditions as it may prescribe for prevention, control, or abatement of pollution in harmony with the general purposes of these classifications and standards and the intent of the applicable state and federal laws. The United States Environmental Protection Agency shall be advised of any variances that may be issued under this part together with information as to the need therefore.

In the case of the Mesabi Nugget Delaware LLC variance, MPCA's Citizens' Board concurred with the recommendation of MPCA staff that the information provided by Mesabi Nugget Delaware LLC satisfied the required demonstrations for granting a variance under Minnesota's rules.

Environmental Impact

Granting this variance is expected to result in water quality in the affected waters that may not support Minnesota's Class 3C Industrial and 4A Agriculture uses. Mesabi Nugget Delaware LLC provided information to MPCA asserting that, with the exception of the existing use of the waters for wild rice production under class 4A, the industrial and agriculture uses are not existing uses for the affected waters. Mesabi Nugget Delaware LLC is not seeking a variance from the sulfate criterion to protect waters used for the production of wild rice under Class 4A.

Context

Under the CWA, states and tribes must submit new and revised water quality standards to the EPA for review and approval or disapproval. A variance is considered a temporary revision to a water quality standard, thus requiring EPA approval before it may become effective for CWA purposes. Disapproval is required when a new or revised water quality standard is not consistent with the requirements of the CWA and/or the federal water quality standards regulations. Approval of the Mesabi Nugget Delaware LLC variance request by EPA would mean that the facility may discharge treated wastewater with concentrations of hardness, bicarbonate, dissolved salts, and specific conductance greater than the limits that would be necessary to comply with criteria specified in Minnesota's water quality standards. The variance allows Mesabi Nugget

Delaware LLC to discharge the variance parameters at concentrations in excess of the limits that would be necessary to ensure compliance with the unvaried water quality standards. Under the variance, the variance parameters would be discharged at or below the following concentrations:

| Parameter | Daily Maximum | Monthly Average |
|---|---|---|
| Hardness | 863 mg/L | 831 mg/L |
| Total Dissolved Salts | 1228 mg/L | 1160 mg/L |
| Specific Conductance | 1965 umhos/cm | 1889 umhos/cm |
| Bicarbonate | 378 mg/L | 363 mg/L |

The variance and the proposed permit implementing the variance also include requirements for Mesabi Nugget Delaware LLC to conduct short-term and long-term investigations to identify ways to improve the quality of the effluent.

Status

EPA is currently reviewing the Mesabi Nugget Delaware LLC variance proposal, with a review deadline of December 15, 2012.

EPA Contact
Christine Wagener
312-886-0887
wagener.christine@epa.gov

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

NOV 15 2012

REPLY TO THE ATTENTION OF:

WQ-16J

Norman W. Deschampe, Chairman
Grand Portage Reservation Tribal Council
P.O. Box 428
Grand Portage, Minnesota 55605

Dear Chairman Deschampe:

On May 4, 2011, the U.S. Environmental Protection Agency issued its Policy on Consultation and Coordination with Indian Tribes, which reaffirms EPA's commitment to invite tribal consultation whenever tribal interests may be affected. EPA Region 5 invites input from the Grand Portage Band of the Minnesota Chippewa Tribe on a proposed water quality standards (WQS) variance for Mesabi Nugget Delaware, an iron ore mining company, seeking to discharge to Second Creek in Minnesota. EPA must approve a WQS variance before it can be implemented within a state permit. Before deciding whether to approve the variance, I am initiating consultation on the proposed variance due to potential concerns about Minnesota tribal interests downstream of the mine as well as in the 1854 ceded territory.

A summary of the variance is enclosed for your review. I am offering two opportunities for the Grand Portage Band to provide input:

Conference call: My staff and I will offer a consultation conference call scheduled at your convenience, but before December 1, 2012. You may contact me directly at (312) 353-2147 to schedule the call. Alternatively, my staff are also actively working with your Environmental Director to arrange the call if the Grand Portage Band wishes to participate. During the call, we will summarize the variance, answer questions and obtain tribal input. We are particularly interested in knowing whether tribal interests may be affected by the variance.

Written comments: The Grand Portage Band may provide comments/concerns in writing if postmarked by December 5, 2012. If you need more information before developing your comments, please contact Christine Wagener at (312) 886-0887, or via email at wagener.christine@epa.gov.

EPA has regulatory deadlines to meet for variance actions and we would like to complete our review by December 5, 2012, and finalize our decision by December 15, 2012. If the Grand Portage Band does not wish to participate in the above mentioned consultation opportunities, please inform us as soon as possible. Obtaining your written response declining consultation is just as important for our records as the actual consultation events. If we do not receive any response from the Grand Portage Band we must, unfortunately, presume that our invitation to

consult has been declined and we must move forward and take action on the variance within our regulatory timelines.

Thank you for your consideration of this matter.

Sincerely,

Tinka G. Hyde
Director, Water Division

Enclosure

cc: Seth Moore, Biology Program
Margaret Watkins, Environmental Department

**From:** Hyde.Tinka@epamail.epa.gov [mailto:Hyde.Tinka@epamail.epa.gov]
**Sent:** Friday, November 16, 2012 11:23 AM
**To:** Karen Diver
**Cc:** Reginald DeFoe; Nancy Schuldt
**Subject:** EPA Offer to CONSULT - Mesabi Nugget NPDES Permit

Dear Chairwoman Diver:

On October 23, 2012, the Minnesota Pollution Control Agency (MPCA) Citizens' Board approved the issuance of a National Pollutant Discharge Elimination System (NPDES) permit for discharges associated with the Mesabi iron nugget facility in Hoyt Lakes, Minnesota. EPA is currently reviewing this permit, however, prior to issuance of the permit and in accordance with Section 402(d) of the Clean Water Act and the Memorandum of Agreement between EPA and MPCA, MPCA must formally send the proposed permit that MPCA intends to finalize to EPA for review. EPA expects that MPCA will submit such a request for review sometime in December 2012. EPA staff has been coordinating with your staff on this state permitting matter since early 2012. The purpose of this message is to provide the Tribe an opportunity to formally consult with EPA regarding this state permitting matter.

Specifically, if the Tribe wishes to formally consult with EPA on this state permitting matter, any written input you would like to provide on MPCA's latest draft permit (Attachment 4 of MPCA's October 12, 2012 Citizens' Board documents: http://www.pca.state.mn.us/index.php/view-document.html?gid=18639) should be received by EPA on or before December 12, 2012. In addition, you can provide verbal input during a conference call from 10:00 – 11:00 a.m. CST on December 5, 2012. The call-in number (877) 226-9607 and the access code is 9980159052#. The EPA Region 5 primary contact on this state permitting matter is Stephen Jann. He is available at (312) 886-2446. Finally, please let us know if the Tribe does not wish to consult with EPA on this state permitting matter.

In accordance with the MOA between EPA and MPCA, once MPCA formally submits the proposed permit to EPA, EPA will have fifteen days to comment upon, object to or make recommendations with respect to the proposed permit. EPA's authority to require any changes to a proposed state permit is generally limited to the grounds for objection specified at 40 C.F.R. 123.44(c).

I note, in closing, that EPA initiated consultation with the Grand Portage Tribe in a letter dated 11/15/12 on a separate, albeit related, matter: EPA's action under Section 303(c)(3) to approve or disapprove the State of Minnesota's proposed variance to certain water quality standards for certain waters impacted by the Mesabi iron nugget facility. Please contact David Pfeifer at (312) 353-9024 if you have any question or comments regarding that separate, water quality standards matter.

**BANDS EX. 28**

Tinka G. Hyde
Director, Water Division
U.S. EPA (W-15J)
77 W. Jackson Blvd., Chicago, IL 60604-3590
Fax: (312) 697-2562, Phone: (312) 886-9296

**GRAND PORTAGE BAND OF CHIPPEWA**
**ENVIRONMENTAL DEPARTMENT**
**P.O. Box 428, Grand Portage, MN 55605**
**(218) 475-2026**

**FOND DU LAC BAND OF LAKE SUPERIOR**
**CHIPPEWA ENVIRONMENTAL PROGRAM**
**1720 Big Lake Road, Cloquet, MN 55720**
**(218) 878-7110**

December 12, 2012

Kevin Pierard
NPDES Program Branch Chief
US EPA Region 5
77 W. Jackson Boulevard
Mail code MN 16J
Chicago, IL 60604-3507

Re: Fond du Lac and Grand Portage contest the issuance of the proposed 2012 Mesabi Nugget NPDES/SDS Permit MN0067687

Dear Mr. Pierard:

Thank you for the opportunity to consult with US EPA regarding the proposed Mesabi Nugget NPDES/SDS permit MN0067687. Grand Portage and Fond du Lac are federally recognized Indian tribes and are member bands of the Minnesota Chippewa Tribe ("MCT"). Along with other MCT Bands, the Bands retain hunting, fishing, and other usufructuary rights that extend throughout the entire northeast portion of the state of Minnesota under the 1854 Treaty of LaPointe[1] (the "Ceded Territory"), which encompasses the area of the Project.[2] In the Ceded

[1] Treaty with the Chippewa, 1854, 10 Stat. 1109, in Charles J. Kappler, ed., *Indian Affairs: Laws and Treaties*, Vol. II (Washington: Government Printing Office, 1904), available on-line at



**BANDS EX. 29**

Territory, the MCT Bands have a legal interest in protecting natural resources, which are also treaty resources. Minnesota tribes have successfully sued to enforce off-reservation treaty rights[3] and MCT Bands now jointly manage treaty resources within the Ceded Territory with the DNR.[4] Any project within the Ceded Territory that has the potential to affect treaty resources, which includes any project that may affect air and water quality, fisheries, wildlife habitat, or other natural resources, requires notice to and consultation with the Bands. Additionally, both Bands have federally approved water quality standards to protect waters of the reservations[5]. The Fond du Lac Reservation is located downstream in the St. Louis River watershed from the Mesabi Nugget permitted discharge, and the Band is concerned that pollutants from this facility may directly or indirectly impact the water quality and aquatic resources of the Reservation.

**A. Discharge may impact downstream water quality of waters of the Reservation.**

Fond du Lac shares jurisdiction over 23 miles of the St. Louis River, downstream of the Mesabi Nugget permitted discharge. The St. Louis River is impaired for mercury in fish, leading to very restrictive fish consumption advisories. The Band has, during multiple biennial assessment cycles, concurred with the MPCA on this impairment of this reach of the St. Louis River. The St. Louis River is also the most significant on-Reservation fisheries resource, and is considered to be a high quality or Tier 2 water, as it "surpasses, on a pollutant by pollutant basis", the Band's water quality standards; the only exception being the mercury concentration in fish tissue. There is a substantial body of scientific research linking sulfate to the methylation of mercury (conversion of ionic or elemental mercury to its bioavailable form), including studies in Minnesota that demonstrate increased mercury methylation rates in wetlands that have been experimentally treated with sulfate additions. Waters in this ecoregion are naturally very low in sulfate, but again, substantial data collected by the MPCA, the Band, the Minnesota Department of Natural Resources, and the mining companies and their consultants shows that sulfate concentrations in the St. Louis River are elevated significantly where mine discharges enter the river, and this elevated sulfate concentration persists downstream as far as the Area of Concern (essentially the last 30 miles of the river, before it discharges to Lake Superior). This elevated

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http://digital.library.okstate.edu/kappler/Vol2/treaties/chi0648.htm (last visited Dec. 12, 2012).

[2] *See* Map of 1854 Ceded Territory, available on-line at http://www.1854treatyauthority.org/about/codesmap.htm (last visited Dec. 12, 2012).

[3] *See*, *e.g.*, *Minnesota v. Mille Lacs Band of Chippewa Indians*, 526 U.S. 172, 201-202 (1999).

[4] *See*, *e.g.*, DNR's 1854 Treaty page, available on-line at http://www.dnr.state.mn.us/aboutdnr/laws_treaties/1854/index.html (last visited Dec. 12, 2012).

[5] *See*, *e.g.,* US EPA Water Quality Standards, available on-line at http://water.epa.gov/scitech/swguidance/standards/wqslibrary/tribes.cfm (last visited Dec. 12, 2012).

sulfate may contribute to the mercury in fish impairment far downstream of the point of discharge.

We assume that the MPCA does not issue a §401 certification for a NPDES/SDS permit that they draft; compliance with state water quality standards may be assumed by their issuance of the permit and any conditions. However, under CWA §401 (a)(2), neighboring states and tribes downstream or otherwise potentially affected by the discharge have an opportunity to raise objections to, and comment on, the federal permit or license. Grand Portage and Fond du Lac ask EPA Region 5 to fully consider the downstream direct and indirect water quality impacts of the proposed permitted discharge, and consistency with tribal water quality protection goals.

**B. Mesabi Nugget violated 2007 permit conditions.**

The 2007 NPDES permit MN0067687 expired June 30, 2010. Page 5 of the 2007 NPDES Permit grants a variance from MN WQS stating: "*A variance from the Class 3B water quality standards for hardness and the Class 4A water quality standards for specific conductance, total dissolved salts (solids) and bicarbonates is included in this permit. As a result of the variance, the permit includes interim effluent limitations for the variance parameters during the life of the permit with final effluent limitations becoming effective upon expiration of the permit and variance.*[6]" Mesabi Nugget did not achieve the final effluent limitations required by the 2007 variance, and in fact water quality measurements shown from baseline monitoring and monitoring required by the permit indicate that concentrations of the variance pollutants became considerably more concentrated between 2007 and 2010. On page 28, Chapter 5 of the 2007 permit provides:" *Total Facility Requirements*, part 4 *Special Requirements*, subpart 4.9 "*Within 90 days of MPCA approval of the preliminary engineering design, the Permittee shall submit for MPCA approval final plans and specifications for the wastewater treatment system.*" And " *4.11 The Permittee shall not commence production of iron nuggets at the manufacturing plant until the wastewater treatment plant has been fully constructed and is in a fully operational status. The Permittee may conduct limited commissioning of plant equipment provided such commissioning does not result in the generation of wastewater*." In 2011, MPCA also issued a Stipulation Agreement between MPCA and Mesabi Nugget that states: " *During the past three years there are alleged to have been violations of the permit including effluent limit violations, violations for failure to submit required reports/notifications, failure to conduct required monitoring and construction without MPCA approval. Currently the Facility is not discharging at outfall SD001*." However, the company is generating wastewater that is currently being stored in Area 2WX Pit after discharges ceased to Area 1Pit.

**C. Proposed Permit does not comply with CWA.**

Federal regulations provide that any permit must contain limits and conditions necessary to ensure compliance with all applicable water quality standards, especially where the state

[6] NPDES Permit 2007 MN0067687

knows that a discharge will cause or contribute to an excursion of water quality standards.[7] The means by which a violator can be brought into compliance is a Schedule of Compliance (SOC), or "an enforceable sequence of actions . . . leading to compliance with an effluent limitation . . . ."[8] SOCs longer that one year must include interim requirements and dates for their achievement on at least an annual basis in the permit.[9] SOCs may extend beyond the term of a permit, if this is done in a manner that is consistent with the Clean Water Act (CWA) and EPA's regulations.[10] The purpose is to accomplish the final effluent limitation "as soon as possible."[11]

Additionally, 40 CFR § 122.47(a)(2) states: *The first NPDES permit issued to a new source or a new discharger shall contain a schedule of compliance only when necessary to allow a reasonable opportunity to attain compliance with requirements issued or revised* ***after commencement of construction but less than three years before commencement of the relevant discharge.*** *For recommencing dischargers, a schedule of compliance shall be available only when necessary to allow a reasonable opportunity to attain compliance with requirements issued or revised less than three years before recommencement of discharge.* Allowing Mesabi Nugget a 14 year SOC without any means to ensure attainment of final effluent limitations is not consistent with the CWA. In addition, the draft variance violates the Great Lakes Water Quality Standards by allowing a variance throughout the 14 year proposed schedule of compliance. 40 C.F.R. Part 132, Appendix F. Procedure 2 (b), *Variances from Water Quality Standards for Point Sources* provides: **B.** ***Maximum Timeframe for Variances.*** *A WQS variance shall not exceed five years or the term of the NPDES permit, whichever is less. A State or Tribe shall review, and modify as necessary, WQS variances as part of each water quality standards review pursuant to section 303(c) of the CWA.*

Finally, in a May 10, 2007 memo[12] from the Director of EPA's Office of Wastewater Management to EPA Region 9 regarding the use of compliance schedules in NPDES permitting, Director Hanlon stated that "*Factors relevant to whether a compliance schedule in a specific permit is "appropriate" under 40 C.F.R. § 122.47(a) include: how much time the discharger has already had to meet the WQBEL(s) under prior permits; the extent to which the discharger has made good faith efforts to comply with the WQBELs and other requirements in its prior permit(s); whether there is any need for modifications to treatment facilities, operations or measures to meet the WQBELs and if so, how long would it take to implement the modifications to treatment, operations or other measures; or whether the discharger would be expected to use the same treatment facilities, operations or other measures to meet the WQBEL as it would have used to meet the WQBEL in the prior permit*." It is apparent to the Bands that while Mesabi

[7] 40 C.F.R. § 122.44(d).
[8] 33 U.S.C. § 1362(17).
[9] 40 C.F.R. § 122.47(a)(3).
[10] 40 C.F.R. §§ 122.44 and 122.47.
[11] 40 C.F.R. § 122.47(a)(1).
[12] Exhibit A., attached

Nugget has already had sufficient time to meet WQBELs, it has not made any notable 'good faith efforts' to comply with the WQBELs.

**D. Effluent limits must be imposed to achieve designated uses and protect existing uses.**

The cause of intermittent toxicity to aquatic life in Area 1 Pit, particularly in the month of September, has not been identified or resolved. However, based on WET testing, toxicity is thought to be related to high concentrations of total dissolved solids, of which sulfate is a significant portion[13]. Flow from the rotary hearth furnace and scrubber blow down process water has been estimated to be 445 gallons per minute, containing approximately 9,000 mg/l of total dissolved solids, resulting in an addition of 22,000 kilograms per day of total dissolved solids to Area 1 Pit. [14] The chemical interactions resulting from existing pit water with the in-pit waste rock stockpile are thought to also contribute a significant load of pollutants. [15] And, over time, the concentrations of chloride, sodium, sulfate, total dissolved solids, specific conductance, hardness and alkalinity are not only projected to increase in Area 1 Pit [16], but have shown remarkable increases in concentration from the 2008-2009 baseline water quality data collected by Barr Engineering.[17]

MPCA asserted in the Findings of Fact for the draft permit presented to the MPCA Citizens Board, on page 4: "There is no known historic, existing or foreseeable future use of Second Creek or Partridge River for the Class 3C or Class 4A designated uses."[18] However, in Appendix I – Supporting Information, MPCA acknowledges: "Second Creek below the confluence of First Creek, and the Partridge River from Colby Lake to the St. Louis River, are waters used for the production of wild rice[19]." The aquatic life, wildlife, and agricultural beneficial uses in Second Creek are likely impaired as a result of known intermittent toxic discharges from Area 1 Pit. However, when MPCA assessed waters for impairments in the St. Louis River watershed in 2009, Second Creek was not assessed. An "existing use" (meaning a use that was attained on a waterbody by November 28, 1975, whether or not the waterbody was

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[13] *I.d.*

[14] Barr Engineering, Area 1 Pit Water Treatment Evaluation in Support of the Non-Degradation Analysis, Mesabi Nugget Phase II Project, November, 2009.

[15] *I.d.*

[16] *I.d.*

[17] Barr Engineering, Area 1 Pit Water Treatment Evaluation in Support of the Non-Degradation Analysis, Mesbi Nugget Phase II Project, November, 2009.

[18] Minnesota Pollution Control Agency Industrial Division, October 23, 2012, Mesabi Nugget Delaware, LLC – Request for Approval of Findings of Fact, Conclusions of Law, and Order and Authorization to Grant a Variance and to Reissue National Pollutant Discharge and Elimination System/State Disposal System Permit MN0067657.

[19] *I.d.* Appendix I – Supporting Information

included in the water quality standards)[20] cannot be modified or changed unless designated uses are added that require more stringent criteria. "Existing beneficial uses and the water quality necessary to protect the existing uses must be maintained and protected from point and nonpoint sources of pollution."[21] The CWA states that a designated use cannot be removed if the use can be attained by implementing effluent limits and best management practices.[22] Designated uses may be changed only based upon findings of a use attainability analysis that has demonstrated that attaining the designated use is not possible.[23] MPCA has not performed a Use Attainability Analysis for Second Creek.

Although additional chronic WET testing requirements have been added to the permit, biological monitoring is one of the assessment tools MPCA uses to determine if a waterbody is impaired. If a waterbody is considered to be impaired, additional water quality-based effluent limits must be applied. WET testing simply indicates if the water being discharged is toxic or not. Therefore, biological monitoring should be required as a permit condition, and MPCA should require the company's sampling plan and data collection methodologies be consistent with the state's, so that the data can then be used to determine attainment or impairment of the aquatic life, wildlife, and agricultural beneficial uses in Second Creek.

**E. Mesabi Nugget has not demonstrated technological infeasibility or shown substantial and widespread social and economic impact as required by federal law.**

Mesabi Nugget has not been required to assess the social and economic benefits to clean water that include human health, tourism, tribal usufructuary rights and subsistence. Mesabi Nugget is a joint venture between Steel Dynamics (81 percent) and Kobe Steel (19 percent)[24]. Steel Dynamics, Inc. announced 2012 third quarter net income of $12.8 million, or $0.06 per diluted share, on net sales of $1.7 billion[25]. Mesabi Nugget has not shown that wastewater treatment is economically infeasible, and in fact has stated that wastewater treatment is not technically feasible. A cost analysis of various treatment options was performed by Mesabi Nugget in 2009 [26]. Reverse osmosis/nano filtration was found to be the least expensive option.

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[20] *40 C.F.R.* §131.3 (e).

[21] Minn. R. 7050.0185, Subpart 1

[22] Per 40 C.F.R. Section 131.10(d), "[w]hen designating uses, States may wish to designate only the uses that are attainable. However, if the State does not designate the uses specified in section 101(a)(2) of the Act, the State must perform a use attainability analysis under section 131.10(j) of the regulation. States are encouraged to designate uses that the State believes can be attained in the future."

[24] http://www.mesabinuggetmn.com/ourcompany.php (last visited Dec. 12, 2012).

[25] http://www.steeldynamics.com/3q-2012-quarterly-report/ (last visited Dec. 12, 2012).

[26] Barr Engineering, Area 1 Pit Water Treatment Evaluation in Support of the Non-Degradation Analysis, Mesbi Nugget Phase II Project, November, 2009.

This treatment option was favorably tested by US Steel Minntac [27] and demonstrated minimal scaling or fouling. On property adjacent to Mesabi Nugget and also on the old LTV property, PolyMet has demonstrated through pilot testing that reverse osmosis/nano filtration is not only technically feasible, but can result in compliance with all water quality standards including the MN WQS for the protection for wild rice [28]. And, PolyMet is not waiting for operations to commence to design and pilot the reverse osmosis/nano filtration wastewater treatment facility. Mesabi Nuggets claim that they must wait a few years to pilot test an adequate wastewater treatment system is a stalling tactic not allowed under the CWA.

**Conclusion**

Grand Portage and Fond du Lac are federally recognized Indian tribes that have federally approved water quality standards to protect waters of the reservations. Both Bands retain hunting, fishing, and other usufructuary rights that extend throughout the entire northeast portion of the state of Minnesota where Mesabi Nugget is located. The Mesabi Nugget discharge has the potential to adversely affect treaty resources, which include water quality, fisheries, wildlife habitat, and other natural resources. The discharge may adversely impact the quality of Fond du Lac Reservation waters and water resources located downstream of Mesabi Nugget. Therefore, effluent limits must be imposed to achieve designated uses and protect existing uses including usufructuary rights. The proposed conditions for the Mesabi Nugget NPDES/SDS permit that allow a fourteen year SOC and variance are not protective of existing or designated uses, do not comply with timeframe provisions in the CWA, or take into consideration what appears to be the lack of "good faith efforts" including previous permit violations. And, Mesabi Nugget has not reasonably demonstrated that adequate wastewater treatment is economically or technically infeasible.

Sincerely,

Margaret Watkins

Margaret Watkins
Grand Portage Water Quality Specialist

Nancy Schuldt
Fond du Lac Water Program Manager

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[27] General Electric, ZeeWeed 500 Tertiary Membrane Technology and NF Post Treatment Pilot Scale Demonstration Final Report, May1, 2008.

[28] Business North, November 19, 2012, PolyMet reaches key environmental goals.

Cc. Tinka Hyde, US EPA Region 5
Stephan Jann, US EPA Region 5
Barbara Wester, US EPA Region 5
Dan Cozza, US EPA Region 5

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
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CHICAGO, IL 60604-3590

DEC 27 2012

REPLY TO THE ATTENTION OF: WQ-16J

Karen Diver, Chairwoman
Fond du Lac Tribal Council
1720 Big Lake Road
Cloquet, Minnesota 55720

Dear Chairwoman Diver:

In a November 15, 2012 letter, the U.S. Environmental Protection Agency invited the Grand Portage Band of Chippewa Indians (Grand Portage), the Fond du Lac Band of Lake Superior Chippewa Indians (Fond du Lac), and the Bois Forte Band of Chippewa Indians (Bois Forte) tribal governments to provide input on EPA's review of the Minnesota Pollution Control Agency's (MPCA's) request for approval of a variance from water quality standards for Mesabi Nugget Delaware, LLC – Hoyt Lakes, Minnesota (MN Permit No. MN0067687) under Section 303(c) of the Clean Water Act (CWA). In response to the invitations to consult, EPA held two consultation teleconferences and received written comments from Grand Portage and Fond du Lac.

**Record of Consultation**

EPA held consultation calls on November 29, 2012, with representatives from Bois Forte, and on December 3, 2012, with representatives from Fond du Lac and Grand Portage. During the calls, tribal representatives raised a number of issues, many of which are addressed in EPA's decision document for its review of the variance. EPA notes that several issues were raised during this consultation that do not fall within EPA's review of the variance request, including those issues that are covered by the permit approved by the MPCA Citizens Board. Issues raised during consultation that relate to the permit for this source will be addressed when EPA completes its review of MPCA's permit, in a separate document summarizing consultation issues for EPA's permit review.

Major issues identified during consultation and related to EPA's review of the variance are summarized below.

**Comment 1**: The variance must be limited to five years or the term of the NPDES permit, whichever is less, pursuant to 40 CFR 132, Appendix F, Procedure 2. Additionally, Fond du Lac and Grand Portage noted that there are time limits associated with schedules of compliance for NPDES permits, pursuant to 40 CFR 122.47(a) and for variances pursuant to 40 CFR Part 132. Additional concerns included that the variance request should also specify steps to be taken during the period of the variance to make reasonable progress toward attaining the water quality standards.

**BANDS EX. 30**

**Response**: For the reasons explained in EPA's Decision Document at Section III.B.5. relating to 40 CFR 131.5(a)(5), this variance is not subject to the five year expiration period set out in 40 CFR 132, Appendix F, Procedure 2.

Minnesota included a copy of the October 17, 2012 permit with its submittal of the variance to EPA for review. Chapter 1.8 of the permit specifies the permit conditions derived from the variance from water quality standards. Chapters 1.8.4 – 1.8.23 comprise the schedule of activities Mesabi must complete as conditions of the permit to implement the variance granted by MPCA and approved by EPA. This schedule would not be a compliance schedule, as provided for in 40 CFR 122.47(a) (and as further outlined in the May 10, 2007 memorandum from James Hanlon to Alexis Strauss, "Compliance Schedules for Water Quality-Based Effluent Limitations in NPDES Permits"), because a variance is based upon a temporary period of time during which the standard is unattainable. A compliance schedule does not alter the applicable standard.

Additionally, MPCA's variance request explains the steps to be taken during the period of the variance to make progress necessary to attain water quality standards. MPCA has explained that Mesabi Nugget is conducting studies on their air emission control/scrubber systems as required by the facility's Air Emissions Permit. The choice of air emission control systems has the potential to result in significant changes in the influent to a reverse osmosis (RO) treatment system compared to what has been seen from the time of startup of the facility in 2010. For example, if the air emission studies result in a requirement to install a selective noncatalytic reduction system (SNCR) or alternate technology to control Nitrogen Oxide ($NO_x$) compounds, significant quantities of nitrogen compounds would end up in the wastewater treatment system. These nitrogen compounds can be detrimental to the performance of RO membranes and may require the installation of additional pretreatment. Therefore, it would be difficult to design and install the wastewater pretreatment and RO treatment systems at this time. The results of the air emission control studies are expected to be submitted to the MPCA no later than the end of May 2013. The variance schedule also includes short term requirements designed to improve water quality. Further information can be found in EPA's Decision Document at Section III.

**Comment 2**: MPCA's variance does not take into consideration designated uses, nor protect existing uses, which include the production of wild rice.

**Response**: See EPA's Decision Document at Sections I.F. and III., relating to 40 CFR 131.10(a).

**Comment 3**: Mesabi Nugget asserts that Reverse Osmosis/Nano Filtration (RO/NF) is technically infeasible and pilot testing must wait until after their pellet making furnace is fine-tuned. PolyMet, on the adjoining property, has pilot tested RO before even constructing their plant site.

**Response**: See EPA's Decision Document at Sections I.F and H.; and III.B.1.g, relating to 40 CFR 131.10(g). The proposed PolyMet mine project is the subject of an ongoing Environmental Impact Statement development and review process. PolyMet has not received an NPDES permit to discharge. Although PolyMet is pilot testing an RO process for their proposed operations, the

process is not immediately transferable to other operators. In addition, the PolyMet facility plans to dispose of the RO retentate by storing it on site rather than through crystallization as proposed by Mesabi. The crystallization process adds an additional waste stream treatment process which Mesabi must design, test, and construct, and which has not been evaluated by PolyMet. There is no ready, or "off the shelf," RO system available from a vendor that Mesabi can purchase and install. Instead, the treatment processes must be tailored to the specific wastewater produced by the Mesabi facility and this cannot occur until the processes contributing wastewater, especially the air pollution control systems, are finalized. We note that MPCA also anticipates that Mesabi Nugget would have to undertake a certain amount of data collection, design, and testing prior to installation of a full-scale RO-based treatment system.

**Comment 4**: The information provided by Mesabi Nugget in support of their request for a variance from water quality standards does not provide adequate consideration of the economic condition of its corporate owner, Steel Dynamics, and that Steel Dynamics' corporate reporting suggests the company has the ability to pay for the treatment needed at the Mesabi Nugget facility to comply with water quality standards.

**Response**: As explained in EPA's Decision Document at Section III.B.1.g relating to 40 CFR 131.10(g), there are six potential bases for a variance granted under this section. For the reasons discussed in the Decision Document, EPA determined that the variance was appropriate under 40 CFR 131.10(g)(3) (i.e., human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied...). Therefore, it was not necessary for EPA to determine whether the variance would have been appropriate under 40 CFR 131.10(g)(6) (i.e., economic and social impact).

**Comment 5**: Designated uses may be changed only based upon finding that the designated use cannot be attained, following a use attainability analysis. MPCA has not done a UAA for Second Creek and Partridge River.

**Response**: See discussion in EPA's Decision document at Sections III.A; and III.B.

**Comment 6**: The variance will allow more discharge without specifying how Mesabi will achieve compliance with Minnesota's water quality standards.

**Response**: See response to Comment 1 above.

**Comment 7**: Mesabi Nugget's request for a variance is inconsistent with the requirements of Brownfields Revitalization and Environmental Restoration Act of 2001 and Minnesota's Voluntary Investigation and Cleanup (VIC) program.

**Response**: Minnesota's VIC program is a voluntary program that provides developers with liability protection and other incentives for cleaning up and developing property. EPA is not aware of any information that would preclude a property's enrollment in the VIC program from being resold for redevelopment. Additionally, EPA has no information showing how Mesabi Nugget's properties enrolled in the VIC program raise considerations for EPA's action on this variance request.

**Results of Consultation**

In conducting its review of the variance, EPA considered the concerns raised by the Tribes as discussed above. Concerns regarding MPCA's permit for this project will be addressed in a separate response to comments document that will be provided once EPA completes its review of the permit.

I would like to thank all of you for participating in the consultation process. If you have any questions or concerns regarding this matter, please contact me at 312-886-9296 or David Pfeifer of my staff, at 312-353-9024.

Sincerely,

Tinka G. Hyde
Director, Water Division

Enclosure

cc: Wayne Dupuis, Environmental Program Manager, Environmental Program
Nancy Schuldt, Water Projects Coordinator, Environmental Program