

WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 1

Minn. Chamber of Com. v. Minn. Pollution Control Agency, No. 62-CV-10-1184, 2012 WL
2872026 (Minn. Dist. Ct., 2nd Jud. Dist., May 10, 2012).

Minn. Chamber of Commerce v. Minn. Pollution Control Agency

Minnesota District Court, County of Ramsey, Second Judicial District

May 10, 2012, Decided; May 10, 2012, Entered

Court File No. 62-CV-10-11824

Reporter

2012 Minn. Dist. LEXIS 194 *

Minnesota Chamber of Commerce, Plaintiff, vs.
Minnesota Pollution Control Agency, Defendant, and
WaterLegacy, Defendant-Intervenor.

Subsequent History: Affirmed by Minn. Chamber of
Commerce v. Minn. Pollution Control Agency, 2012
Minn. App. Unpub. LEXIS 1199 (Minn. Ct. App., Dec.
17, 2012)

Prior History: Minnesota Chamber of Commerce v.
Minnesota Pollution Control Agency, 469 N.W.2d 100,
1991 Minn. App. LEXIS 388 (Minn. Ct. App., 1991)

Core Terms

wild rice, sulfate, waters, water quality standards, void
for vagueness, stands, cultivated, irrigation, narrative,
plant, rice, summary judgment, discharges,
unconstitutionally vague, Clean Water Act, agricultural,
designated, wildlife, levels, vague, declaratory
judgment, matter of law, susceptible, injunction,
Pollution, aquatic

Counsel: [*1] For Plaintiff: Thaddeus Lightfoot, Esq.
For Minnesota Pollution Control Agency, Defendant:
Robert B. Roche, Assistant Attorney General.

For WaterLegacy, Defendant-Intervenor: Paula
Maccabee, Esq.

Judges: HON. MARGARET M. MARRINAN, JUDGE
OF DISTRICT COURT.

Opinion by: MARGARET M. MARRINAN

Opinion

FINDINGS OF FACT, CONCLUSIONS OF LAW AND ORDER FOR JUDGMENT

This matter came on for hearing on the parties' cross
motions for summary judgment on March 1, 2012.
Thaddeus Lightfoot, Esq., appeared on behalf of
Plaintiff; Assistant Attorney General Robert B. Roche
appeared on behalf of Defendant Minnesota Pollution
Control Agency; Paula Maccabee, Esq., appeared on
behalf of Defendant-Intervenor WaterLegacy.

Plaintiff has withdrawn its claim regarding Count I of
the Amended Complaint.

Plaintiff seeks partial summary judgment on the
remaining following counts:

1) Count II: in which it alleges that the "Wild Rice
Rule" is unconstitutionally vague and thus a
violation of due process. The basis for this
allegation is that the term "when rice may be
susceptible to damage from high sulfate levels" is
not defined.

2) Count III: in which it alleges that Defendant's
actions applying the "Wild Rice Rule" exceed
Defendant's statutory authority [*2] and are
arbitrary and capricious because:

a. Defendant would apply them to all waters in
the state rather than limit them to waters used
for agricultural irrigation in the production of
wild rice; and

b. Defendant has created a narrative wild rice
classification for Class 4A waters without
specifically listing or otherwise classifying
those waters; and

c. Defendant has required that Plaintiff members perform wild rice surveys to determine whether waters fall within the narrative sub-classification.

3) Count IV: in which it asks the Court to construe the Wild Rice Rule under the authority of the Minnesota Declaratory Judgments Act (Minn. Stat. Ch.555).

Defendant and Defendant-Intervenor seek summary judgment regarding all of Plaintiff's claims.

FINDINGS OF FACT

1. The Minnesota Legislature has adopted wild rice as the official grain of the State of Minnesota and has explicitly recognized the importance of protecting it. Minn. Stat. § 1.148, subd. 1 (2010).

2. In keeping with the policy set by Minn. R. 7050.0186,¹ and in order to comply with the United States Environmental Protection Agency (EPA) requirements under the Federal Water Pollution Control Act Amendments of 1972, in 1973 the Minnesota Pollution Control Agency [*3] (MPCA) adopted water quality standards for Class 4 waters of the state.

The rationale for protection of these waters is addressed by Minn. R. 7050.0224, subp.1:

The *numeric* and *narrative* [emphasis supplied] water quality standards in this part prescribe the qualities or properties of the waters of the state that are necessary for the agriculture and wildlife designated public uses and benefits. Wild rice is an aquatic plant resource found in certain waters within the state. The harvest and use of grains from this plant serve as a food source for wildlife and humans. In recognition of the ecological importance of this resource, and in conjunction with

Minnesota Indian tribes, selected wild rice waters have been specifically identified [WR] and listed in part 7050.0470, subp.1.² The quality of these waters and the aquatic habitat necessary to support the propagation and maintenance of wild rice plant species must not be materially impaired or degraded. If the standards in this part are exceeded in waters of the state that have the Class 4 designation, it is considered indicative of a polluted condition which is actually or potentially deleterious, harmful, detrimental, or injurious with [*4] respect to the designated uses.

Minnesota's wild rice sulfate standard is found in Minn. R. 7050.0224, subp. 2 (2011). The rule provides in pertinent part:

Class 4A waters. The quality of Class 4A waters of the state shall be such as to permit their use for irrigation without significant damage or adverse effects *upon any crops or vegetation usually grown in the waters or area*, [emphasis supplied] including truck garden crops. The following standards shall be used as a guide in determining the suitability of the waters for such uses ...: Sulfates (SO₄) 10 mg/L, applicable to water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels.

Minn. R. 7050.0224, subp. 2 (2011).

Of the subparts to the water quality standards in Minn.R. 7050.0224, subpart 2 (Class 4A waters) is the only one that specifically refers to crops and vegetation. Classes 4B and C have as their focus livestock and wildlife.

3. The MPCA adopted a wild rice numeric sulfate standard of 10 milligrams per liter ("mg/L") for water used for production of wild rice based on recommendations by the Minnesota Department of Natural Resources ("MDNR") that sulfate concentrations above that level are a serious detriment to the natural and cultivated growth of wild rice.

4. In addition to the numeric standard, Minnesota Rules

¹"It is the policy of the state to protect wetlands and prevent significant adverse impacts on wetland beneficial uses caused by chemical, physical, biological or radiological changes. The quality of wetlands shall be maintained to permit the [*5] propagation and maintenance of a healthy community of aquatic and terrestrial species indigenous to wetlands, preserve wildlife habitat, and support biological diversity of the landscape. In addition these waters shall be suitable for.... irrigation... as specified in part 7050.0224, subpart 4...."

²This rule specifically identifies as [WR] the sub-set of wild rice waters in the Lake Superior watershed.

also adopted a narrative standard that applies only to specifically identified wild rice waters. Minn.R. 7050.0224, subp.1, *supra*.

5. Whether standing alone, or viewed in tandem with the above rules, the term "when the rice may be susceptible to damage by high sulfate levels" is straightforward and understandable: if the rice is at a point in development when sulfates can damage it, the maximum sulfate [*6] level is 10 mg/L.

6. Testimony from the hearing on the initial adoption of the wild rice sulfate standard clearly establishes that, from the time of its initial adoption, the MPCA intended the wild rice sulfate standard to protect both naturally growing and cultivated wild rice.³

7. The first time that the MPCA imposed a discharge limit based on the wild rice sulfate rule (Minn. R. 7050.0224, Subp. 2) was in a 1975 permit for the Clay Boswell Steam Electric Station ("Clay Boswell Permit").

8. The record of the administrative hearing for the Clay Boswell Permit reflects that the hearing examiner supported application of a sulfate limit in that permit in order to protect natural stands of wild rice, not agricultural irrigation of cultivated wild rice.⁴

9. The MPCA issued sulfate limits three other times: a June 17, 2010 permit modification for U.S. Steel Corporation (Keetac mining area) and two October 25, 2011 permits for U.S. Steel (Keetac mining area and tailings basin). It is notable that the areas [*7] in question affect *natural* stands of wild rice, not the agricultural irrigation of cultivated rice. The direct receiving waters included both listed waters (Welcome Creek and O'Brien Creek) and unlisted waters (Welcome Lake and O'Brien Reservoir). All of these waters were classified as Class 4A and 4B waters. U.S. Steel neither requested an administrative hearing nor challenged the permit at the Court of Appeals.

10. In 2010, the EPA, addressing the issue of sulfate discharge for the Keetac mine expansion and the

proposed PolyMet NorthMet mining project, advised Defendant MPCA that the wild rice protection rule must be applied to limit that discharge in receiving waters. Both of those projects affected natural stands of wild rice, rather than agricultural irrigation for cultivated rice⁵ The waters to which this sulfate limit applied included lakes, rivers and creeks not specifically listed as wild rice waters in Minn. R. 7050.0470, Subp. 1.⁶

11. The MPCA has approximately ten years of sulfate data for mining discharges because it has monitored wastewater discharges from [*8] mining operations in order to evaluate their overall toxicity and their potential to adversely affect groundwater. The agency concluded that this data could be useful in evaluating the potential impact of mining discharges on the wild rice sulfate standard.⁷

12. To determine whether sulfate dischargers are potentially interfering with attaining the wild rice sulfate standard, the MPCA reviews permit applications on a case-by-case basis. Where the data suggests that a discharge has high levels of sulfates upstream of a water identified as one potentially used for production of wild rice, the agency may request dischargers to conduct surveys to determine if the discharge is, in fact, upstream of a water used for production of wild rice. This authority derives from M.S. 115.03, subd. 1 (e) (7) [*9] which gives the agency the authority to require owners and operators of such discharge systems to do so.

13. As part of the permit review process, the MPCA reviews the following information: (i) available wild rice records and databases that the MDNR maintains; (ii) consultation with aquatic plant biologists at the MDNR; (iii) information received from external stakeholders, including, but not limited to, Native

³ Affidavit of Gerald Blaha, Ex. C, p. 27: testimony of John McGuire, Chief of the Section of Standards and Surveys, Division of Water Quality, MPCA.

⁴ Affidavit of Gerald Blaha, Paragraph 9.

⁵ Affidavit of Paula Maccabee, Ex. 8 and 9.

⁶ Swan Lake, Swan River, Hay Creek, Hay Lake and Upper Partridge River. *Id.*

⁷ The MPCA does not yet have similar data for municipal discharges, but is in the process of obtaining it as part of a broader MPCA strategy to evaluate the impact of wastewater discharges on Class 3 and Class 4 water standards. It intends to use the monitoring data to determine whether additional discharge limits are necessary to protect Class 3 and 4 water quality standards, including the wild rice sulfate standard.

American tribes and environmental groups; and (iv) information provided by the discharger.

14. The MDNR's list of waters where wild rice has been identified is not an exhaustive list of waters used for production of wild rice. Where a permit applicant discharges upstream of a water that is not on the MDNR list, but which has been identified as potentially producing wild rice, the MPCA has requested that the permit applicant conduct a survey of any wild rice stands in the receiving waters to help determine whether the receiving water is a water used for production of wild rice.

15. Any party who disagrees with the MPCA's determination of 1) whether a water qualifies as a water used for production of wild rice or 2) whether the permit needs to include a sulfate limit [*10] has the option of requesting a contested case hearing before an administrative law judge on the issue pursuant to Minn. R. 7000.1800. Although Plaintiff's members allege they have been affected by the wild rice sulfate standard, they failed to request such a hearing, and have sought relief under Chapter 555 of the Minnesota Statutes.

16. During the 2011 Minnesota Legislative Session, it was proposed that the application of Minnesota's wild rice sulfate standard be suspended, or that the sulfate standard be increased from 10 mg/L to 50 mg/L. In response to those proposals, on May 13, 2011 the U.S. EPA⁸ wrote the sponsoring legislators warning that:

- 1) "[L]egislation changes [to] the EPA-approved water quality standards for Minnesota...must be submitted to EPA for review...and are not effective for Clean Water Act (CWA) purposes, including [National Pollutant Discharge Elimination System] permits, unless and until approved by EPA; and
- 2) If it "determined that a state is not administering its federally approved NPDES program in accordance with requirements of the CWA, EPA has the authority to...withdraw authorization of the program...."

17. Rather than passing either of the above bills, the 2011 Minnesota legislature passed, and the governor signed, a bill regarding the wild rice sulfate standard.

Minn. Laws 2011 1 Sp. c. 2, art. 4, § 32. That law requires the MPCA to form an advisory group and conduct an extensive study of the impacts of sulfates and other substances on wild rice. *Id.* at § 32(c)&(d). Once that research is complete, the bill requires the MPCA to amend the wild rice sulfate standard to:

- (i) address water quality for both natural stands of wild rice and cultivated wild rice;
- (ii) specifically designate waters to which the wild rice sulfate standard applies; and
- (iii) designate the times of year when the standard applies. *Id.* at § 32(a)(1)-(3).

18. Pursuant to that legislation, the MPCA has formed an advisory group and held three meetings of that group to date (October 10, 2011, November 30, 2011 and March 27, 2012), established a study protocol, published a Request for Proposals to undertake research outlined in the study protocol, submitted a legislative report as required by December 15, 2011, and awarded a contract to the University of Minnesota to conduct the [*12] wild rice/sulfate studies.

CONCLUSIONS OF LAW

1. Plaintiff has withdrawn its claim that the MPCA's application of the wild rice sulfate standard has violated the Equal Protection Clause of the United States Constitution. Summary Judgment in favor of the MPCA and Defendant-Intervenor is therefore proper as to that claim.

2. Summary judgment is appropriate under the Minnesota Rules of Civil Procedure, when "the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if any, show that there is no genuine issue as to any material fact and that either party is entitled to judgment as a matter of law. Minn.R.Civ.P. 56.03.

3. There are no genuine issues of material fact and the MPCA has demonstrated that it is entitled to judgment as a matter of law on each of Plaintiff's alleged claims.

A. Counts II and Count III: The Wild Rice Rule does not violate due process. It is not unconstitutionally

⁸ The EPA has delegated the administration of the federal [*11] Clean Water Act in Minnesota to the MPCA.

vague, nor is the application of the rule arbitrary and capricious.

4. An agency rule is unreasonable (and therefore invalid) when it fails to comport with substantive due process because it is not rationally related to the objective sought to be achieved.⁹ [*13] The rationale underlying the Wild Rice Rule (Minn. R. 7050.0224, subp. 2) is found in the subparagraph preceding it: since wild rice is a food source for both wildlife and humans, the quality of the waters and the aquatic habitat necessary to support its propagation and maintenance must not be materially impaired or degraded. The policy upon which this rationale is based (Minn.R.7050.0186) is the protection of the quality of wetlands so as to "permit the propagation and maintenance of a healthy community of...species indigenous to wetlands...In addition these waters shall be suitable for...irrigation...."

5. Where a rule is challenged as "invalid as applied", Minnesota law allows only limited judicial inquiry into the validity of an administrative regulation in question. The party challenging the rule bears a heavy burden and must establish that the rule is not rationally related to the legislative ends sought to be achieved or that in adopting the rule the MPCA exceeded its statutory authority.¹⁰

6. [*14] Plaintiff has not met its burden of proving that the MPCA's application of the wild rice sulfate rule conflicts with statutory authority or is otherwise not rationally related to the legislative goal of protecting the environment. MPCA's application of the wild rice sulfate rule is reasonably related to achieving the legitimate goal of protecting Minnesota's environment.

7. Minnesota's Class 4 waters, which encompass the sub-classification of Class 4A waters, are "waters of the state that are or may be used for any agricultural purposes, including stock watering and irrigation, or by waterfowl or other wildlife, and for which quality control is or may be necessary to protect terrestrial life and its habitat or the public health, safety, or welfare."

Minn. R. 7050.0140, subp. 5 (2011).

8. Minnesota's Class 4A water quality standards are intended to protect both naturally occurring vegetation grown in the waters themselves and cultivated crops in the area around the water. The MPCA's application of the wild rice sulfate standard to protect naturally growing wild rice in ambient waters of the state is legally valid because it is consistent with the plain language of the water quality standard. [*15] Minn. R. 7050.0224, subp. 2.

9. Under Minnesota law, "[t]he object of all interpretation and construction of laws is to ascertain and effectuate the intention of the legislature." Minn. Stat. § 645.16 (2010). Minnesota courts apply the provisions of chapter 645 to both statutes and administrative rules. The administrative and legislative records clearly demonstrate that the MPCA has always intended the wild rice sulfate rule to protect both cultivated and natural stands of wild rice. The agency's application of the rule to waters with natural stands of wild rice is legally valid because it is consistent with the administrative history and intention of the regulation.

10. The MPCA's application of the wild rice sulfate rule to protect waters with natural stands of wild rice is also consistent with a number of established legislative policies and statutory duties, among them the duty to ensure that the State of Minnesota maintains its responsibility to administer the federal Clean Water Act in Minnesota.¹¹

11. In the 2011 special session, the legislature specifically directed the MPCA to adopt an amended rule which shall "address water quality standards for waters containing natural beds of wild rice, as well as for irrigation waters used for production of wild rice" Minn. Laws 2011 1 Sp. c. 2, art. 4, § 32 (a)(1). The MPCA's application of the wild rice rule to protect natural stands of wild rice is consistent with legislative policy that explicitly recognizes the importance of wild rice to the State of Minnesota.

⁹ *Mammenga v. Dep't of Human Services*, 442 N.W. 2d 786, 789 (Minn. 1989).

¹⁰ *Mammenga v. Dep't of Human Services*, 442 N.W. 2d 786 (Minn. 1989); *Hirsch v. Bartley-Lindsay Co.*, 537 N.W.2d 480 (Minn. 1995).

¹¹ Minn. Stat. § 115.03, subd. 5 (2010) ("the agency shall have the authority to . . . establish and appl[y] rules . . . and permit conditions, consistent with and, therefore not less [*16] stringent than the provisions of the Federal Water Pollution Control Act, as amended, applicable to the participation by the State of Minnesota in the national pollutant discharge elimination system (NPDES)")

12. The wild rice sulfate standard is a numeric standard set forth in Minn. R. 7050.0224, subp. 2. Minn. R. 7050.0224, subp.1 also includes a narrative standard that applies only to specifically identified wild rice waters. Minn. R. 7050.0470, subp. 1 (2011), in turn, specifically identifies [WR] the sub-set of wild rice waters in the Lake Superior watershed to which this narrative applies.

To the extent Plaintiff claims that the narrative wild rice standard does [*17] not identify the waters to which that narrative standard applies, the claim fails as a matter of law.

13. Under Minnesota law, "[a] statute that does not implicate First Amendment freedoms is facially void for vagueness only if it is vague in all its applications. Unless the statute proscribes no comprehensible course of conduct at all, it will be upheld against a facial challenge."¹²

14. The Plaintiff has not established that the wild rice sulfate rule is vague in all of its applications or that it proscribes no comprehensible course of conduct at all. The MPCA applied this rule in the Clay Boswell Permit and an independent hearing examiner supported the application of the rule in that case. The MPCA has recently applied the rule in the reissuance of the U.S. Steel Keewatin Taconite permit. U.S. Steel neither requested an administrative hearing nor challenged the permit in the Court of Appeals.

15. Under Minnesota law, a party challenging a law on constitutional grounds, including vagueness, bears a heavy burden [*18] of proof.¹³ The Plaintiff must overcome every presumption of constitutionality and show that the wild rice sulfate standard is

unconstitutionally vague as applied to Plaintiff's members. Plaintiff has not met this burden.

Sulfate Standard not Void for Vagueness

16. Contrary to Plaintiff's assertion, the fact that the wild rice sulfate standard does not include an explicit definition for the term "when the rice may be susceptible to damage by high sulfate levels" does not render the rule void as applied. The void for vagueness doctrine demands [*19] only that laws be drafted with "sufficient definiteness that ordinary people can understand what conduct is prohibited."¹⁴ Even if a law speaks in "broad, flexible standards that require persons subject to a statute to exercise judgment," or requires persons to "rely on common sense and intelligence to determine whether their conduct complies with the law [it] does not render the law unconstitutionally vague."¹⁵

17. The civil, regulatory nature of the wild rice sulfate standard is subject to a "vagueness test" that is less strict than for criminal statutes. "To find a civil statute void for vagueness, the statute must be 'so vague and indefinite as really to be no rule or standard at all.'"¹⁶ The challenged law must "define the forbidden or required act in terms so vague that individuals must guess at its meaning"¹⁷ Put another way: "a statute will be upheld against a facial challenge unless [it] proscribes no comprehensible course of conduct at all".¹⁸

18. Civil laws regulating business are less likely to be void for vagueness than criminal laws "because businesses, which face economic demands to plan behavior carefully, can be expected to consult relevant

¹² *State v. Normandale Properties, Inc.*, 420 N.W.2d 259, 262 (Minn. Ct. App. 1988) (citing *Village of Hoffman Estates v. Flipside Hoffman Estates, Inc.*, 455 U.S. 489, 102 S.Ct. 1186, 1191, 71 L. Ed. 2d 362 (1982)).

¹³ "In attacking a rule on due process grounds, including a vagueness challenge, the challenger bears a heavy burden [cit. om.] The standard for determining vagueness is well-settled: [it is] void for vagueness if it fails to give a person of ordinary intelligence a reasonable opportunity to know what is prohibited or fails to provide sufficient standards for enforcement...The rule should be upheld unless the terms are so uncertain and indefinite that after exhausting all rules of construction it is impossible to ascertain legislative intent." *Minnesota Chamber of Commerce v. Minnesota Pollution Control Agency*, 469 N.W.2d 100, 107 (Mn.App. 1991).

¹⁴ *State v. Romine*, 757 N.W.2d 884, 891 (Minn. Ct. App. 2008) (quoting *Kolender v. Lawson*, 461 U.S. 352, 103 S. Ct. 1855, 1858, 75 L. Ed. 2d 903 (1983)).

¹⁵ *State v. Enyeart*, 676 N.W.2d 311, 321 (Minn. Ct. App. 2004).

¹⁶ *Seniors Civil Liberties Ass'n v. Kemp*, 965 F.2d 1030, 1036 (11th Cir. 1992).

¹⁷ *Humenansky v. Minn. Bd. of Med. Examiners*, 525 N.W.2d 559, 564 [*20] (citing *Kolender v. Lawson*, 461 U.S. 352, 103 S. Ct. 1855, 1858, 75 L. Ed. 2d 903 (1983)).

¹⁸ *State v. Normandale Properties, Inc.*, 420 N.W.2d 259, 262 (Minn. App 1988).

legislation in advance of action. Indeed, the regulated enterprise may have the ability to clarify the meaning of the regulation by its own inquiry, or by resort to an administrative process."¹⁹

19. The application of the wild rice sulfate rule to Plaintiff in this case is not unconstitutionally vague under this standard. Plaintiff's members are not left to guess as to what conduct is prohibited or required under this rule.

20. The wild rice sulfate rule is an ambient water quality standard. As such, it describes the desired condition of Minnesota's waters, but is not a discharge standard and does not proscribe or prohibit conduct.²⁰ The only way that the MPCA can require or prohibit action based on the wild rice sulfate standard is through a permitting action.²¹

21. Before the MPCA issues a permit for a point source such as Plaintiff's members, it is legally required to publish a draft of the permit for public review and comment. Minn. R. 7001.0100 (2011). If Plaintiff's proposed permit includes a limit based on that rule, then Plaintiff's members have thirty days to review, comment on, and question that proposed limit. Any party who disagrees with the terms of a proposed MPCA permit has the right to request a contested case hearing before an administrative law judge to review and clarify the terms of the proposed permit. Minn. R. 7000.1800 (2011). Any party who is aggrieved by the agency's final decision in a permitting action has a right of certiorari review by the Court of Appeals. Minn. Stat. § 115.05, subd. 11 (2010). Plaintiff [*22] has not and cannot show that any of its members have been left guessing as to what conduct is required or prohibited. Plaintiff's void for vagueness challenge fails as a matter of law.

¹⁹ *Village of Hoffman Estates*, 102 S.Ct. at 1193

²⁰ Minn. R. 7050.0224, subp. 2.

²¹ See, for [*21] example., 40 C.F.R. § 122.44(d)(1) (2011) (requiring permitting authority to impose discharge limits in permits where evidence shows that discharge has reasonable potential to cause or contribute to a violation of a water quality standard in a receiving water); Minn. R. 7001.0150, subp. 2 (2011) (requiring MPCA issued permits to include terms necessary to achieve compliance with applicable state and federal law).

22. The term "when the rice may be susceptible to damage by high sulfate levels" is straightforward and can be understood using plain language. If wild rice is at a point in its life cycle when sulfates will damage the plant, then the receiving water must not exceed 10 mg/L. Because the rule can be applied based on its plain language, it is not void for vagueness. The goal of the law is to protect production of wild rice in Minnesota. In view of that goal it is reasonable to conclude that the standard applies at a point in the wild rice life cycle when sulfate is found to damage the plant. The rule is not void for vagueness.

"Bodies of Water" not Void for Vagueness

23. The fact that the MPCA does not specifically list every body of water to which the wild rice sulfate standard applies neither violates the Due Process clause of the Constitution nor does it exceed MPCA's statutory authority: neither the Constitution nor Minnesota or federal statutes require a state to list expressly every surface water to [*23] which a water quality standard applies. Such a requirement would be particularly absurd in a state such as Minnesota.²²

24. Nor does the lack of a specific listing render the rule unconstitutionally vague. Plaintiff's members are not left guessing as to whether the wild rice sulfate standard applies to a particular water or as to what is required of them under the standard because the proposed permit details exactly what is required of Plaintiff's members.

25. The wild rice sulfate standard is likewise consistent with state and federal statutory requirements.

State Law

26. Under Minnesota law, the MPCA has the duty and the authority "to establish and alter such reasonable pollution standards for any waters of the state in relation to the public use to which they are or may be put as it shall deem necessary for the purposes of this chapter" Minn. Stat. § 115.03, subd. 1(c) (2010). Nothing in the statute suggests that the MPCA is required to list

²² According to the Minnesota Legislative Manual (2011-2012) there are 11,842 lakes of more than 10 acres, 3 major river systems, and 6,564 (69,200 miles) rivers and streams.

every single water to which a water quality standard applies. The [*24] legislature has given the MPCA broad discretion as to how to best structure Minnesota's water quality standards and has expressly recognized that it is proper for the MPCA to establish water quality standards for *groups* of waters instead of listing every single water to which a standard applies. The legislature has required the MPCA to "group the designated waters of the state into classes, and adopt classifications and standards of purity and quality therefore." Minn. Stat. § 115.44, subd. 2 (2010).

27. The MPCA's administrative rules likewise recognize the need for the agency to employ grouping in the establishment of water quality standards.²³ The assertion that Minnesota law requires a specific list of each water to which a water quality standard applies is without merit.

28. In adopting the wild rice sulfate standard, the MPCA established a group of waters to which the standard applies. That group of waters consists of "waters used for production of wild rice." Minn. R. 7050.0224, subp. 2 (2011). This type of grouping is expressly authorized under Minnesota [*25] law.

29. As the EPA made clear in its May 13, 2011 letter to the Minnesota Legislature, the EPA has formally approved Minnesota's wild rice sulfate standard. When the EPA approves a state's water quality standard, it must determine whether the standard is "consistent with the requirements of the Clean Water Act." 40 C.F.R. § 131.5 (a)(1). In approving the wild rice sulfate standard, the EPA concluded that the standard is consistent with the federal Clean Water Act. Plaintiff's assertion that the wild rice sulfate standard is in any way inconsistent with the Clean Water Act lacks merit.

Federal Law

30. There is no requirement in federal law for the state to list expressly every single water to which a water quality standard applies in order for the standard to apply. On the contrary, the federal Clean Water Act allows for application of water quality standards to water bodies that are implicated without being expressly

listed on an individual basis.

31. Minn. Laws 2011 1 Sp. c. 2, art. 4, § 32(a)(2) directs the MPCA to initiate rulemaking regarding identification of waters to which this wild rice sulfate standard applies. Plaintiff's assertion that state and federal law would require such [*26] a listing is inaccurate and would significantly impede the MPCA's ability to fulfill its statutory obligation to promulgate and enforce water quality standards for the State of Minnesota.

32. The Wild Rice Rule (Minn. R. 7050.0224, subp.2) is rationally related to both the stated policy and rationale of the rules and is not void for vagueness.

B. Count IV: Plaintiff's are not entitled to a Declaratory Judgment.

33. M.S. 555.02 specifies the actions a court may construe under the Declaratory Judgment Act:

Any person...whose rights, status or other legal relations are affected by a statute, municipal ordinance, contract, or franchise may have determined any question of construction or validity arising [under the same] and obtain a declaration of rights, status or other legal relations thereunder.

34. This act is not an express independent source of jurisdiction²⁴: it does not create an independent cause of action. Because Plaintiff's substantive claims all fail as a matter of law, Plaintiff's Declaratory Judgment Act claim must also be dismissed.

35. To the extent that Plaintiff's claims are [*27] based on permitting actions that the MPCA may take in the future, those claims are conjectural and not subject to court action at this time.²⁵

36. Given the above, Plaintiff has adequate remedies at law and is not entitled to a declaratory judgment.

C. Request for Equitable Relief

²⁴ *Alliance for Metropolitan Stability v. Metropolitan Council*, 671 N.W.2d 905, 915 (Minn. App. 2003).

²⁵ Any such quasi-judicial action is reviewable via certiorari to the Court of Appeals under M.S. 115.05, subd. 11(2010).

²³ See Minn. R. 7050.0140, subp. 1 ("the waters of the state are grouped into one or more of the classes in subparts 2 to 8.")

37. Plaintiff has requested that the Court "preliminarily and permanently" enjoin the MPCA from imposing any of the sulfate discharge limitations discussed above. Case law addressing Minn.R.Civ. P. 65.02 (temporary injunctions) has established five factors determining whether such an injunction should be granted: a) the nature of the relationship; b) relative hardships; c) likelihood of success on the merits; d) public policy; and e) administrative burdens.²⁶

38. Analyzed under those factors, Plaintiff's request should be denied. As with Minn. R. Civ.P.65.01, the threshold question is whether there is immediate and irreparable injury that constitutes a ground for the issuance of the injunction and whether that party [*28] does not have an adequate remedy at law.²⁷ The failure to meet this burden is, in and of itself, a sufficient basis on which to deny the relief.²⁸ In this case, each of Plaintiff's claims are based on actions that the MPCA allegedly *may* take in the context of permitting proceedings. Plaintiff has an adequate remedy at law for any MPCA permitting decision: the right to request a contested case hearing before an administrative law judge on any MPCA permitting matter,²⁹ and a statutory right of certiorari review of any final MPCA permitting decision before the Minnesota Court of Appeals.³⁰ Because Plaintiff clearly has adequate remedies at law in this case its request for equitable relief must be denied.

39. Analyzed under the *Dahlberg* factors, the Court reaches the same conclusion. In this case the determinative factors under *Dahlberg* are a) the likelihood of success on the merits (see discussion, *supra*;) and b) public policy³¹ Balancing the relative hardships between [*29] the parties, the analysis also favors the Defendant. While complying with the rules

may be more costly to the Plaintiff's members, the rationale for Defendant's action is clearly stated in Minn.R. 7050.0224, subp.1:

"...The harvest and use of grains from this plant serve as a food source for wildlife and humans...the quality of these waters and aquatic habitat necessary to support the propagation and maintenance of wild rice plant species must not be materially impaired or degraded...

40. Plaintiff's argument that its members may have to take action to comply with the wild rice sulfate standard during the interim period in which the MPCA conducts the research necessary to amend the rule as directed by the Legislature is without merit. The Legislature has already addressed how the wild rice sulfate standard is to be applied during that interim period.³²

For this Court to second-guess the Legislature's determination of how the standard should be applied while the standard is in the process of being amended is inappropriate. Plaintiff's request for injunctive relief [*30] should be denied.

NOW THEREFORE, IT IS HEREBY ORDERED:

1. The motion for summary judgment of Defendant MPCA and Defendant-Intervenor WaterLegacy's is granted in its entirety.
2. Plaintiff's motion for a "preliminary and permanent" injunction is denied.
2. Plaintiff's partial motion for summary judgment is denied in its entirety.
3. Plaintiff's Complaint is dismissed in its entirety with prejudice and on the merits.

10 May 2012

/s/ Margaret M. Marrinan

HON. MARGARET M. MARRINAN

JUDGE OF DISTRICT COURT

End of Document

²⁶ *Dahlberg Bros., Inc. v. Ford Motor Co.*, 272 Minn. 264, 137 N.W.2d 314 (1965).

²⁷ *Unlimited Horizon Mktg., Inc. v. Precision Hub, Inc.*, 533 N.W. 2d 63 (Minn. App. 1995).

²⁸ *Morse v. City of Waterville*, 458 N.W. 2d 728 (Minn. App. 1990).

²⁹ Minn. R. 7000.1800 (2011).

³⁰ Minn. Stat. § 115.05, subd. 11(1) (2010).

³¹ See discussion *supra* at p. 3 regarding Minn.R. 7050.0186, M.S. 1.148, subd. 1.

³² Minn. Laws. 2011 1 Sp. c. 2, art. 4, § 32 (e).

WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 2

MPCA Board Packet *In re U.S. Steel Corp., Minnesota Ore Operations, Keetac NPDES/SDS
Permits MN0031879 and MN0055948*, October 14, 2011.



Minnesota Pollution Control Agency

520 Lafayette Road North | St. Paul, Minnesota 55155-4194 | 651-296-6300

800-657-3864 | 651-282-5332 TTY | www.pca.state.mn.us | Equal Opportunity Employer

October 14, 2011

RE: United States Steel Corporation, Minnesota Ore Operations, Keetac - Request for Approval of Findings of Fact, Conclusions of Law, and Order and Authorization to Issue National Pollutant Discharge Elimination System/State Disposal System Permits MN0031879 and MN0055948

TO: INTERESTED PARTIES

Enclosed for your information is a copy of the Minnesota Pollution Control Agency (MPCA) Citizens' Board (Board) Item documents for the proposed United States Steel Corporation, Minnesota Ore Operations – Keetac National Pollutant Discharge Elimination System/State Disposal System Permits MN0031879 and MN0055948 (Permits), Itasca County, and a copy of the Board Agenda. The Board packet includes:

- Proposed Findings of Fact, Conclusions of Law, and Order for the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) Permits
- Comment letters received on the Draft Permits
- Responses to written comments received on the draft permits
- Table of changes to draft Permits
- Proposed Permits
- Statement of Basis for the Proposed Permits
- Map of the facility

The United States Steel Corporation, Minnesota Ore Operations – Keetac - Request for Approval of Findings of Fact, Conclusions of Law, and Order and Request and Authorization to Issue National Pollutant Discharge Elimination System/State Disposal System Permits MN0031879 and MN0055948 Board Packet may also be viewed at the MPCA St. Paul Office and on our MPCA Web site at <http://www.pca.state.mn.us/about/board/bdagenda.html>.

The draft Permits and Statement of Basis documents are very lengthy. In an effort to save postage and resources, the draft Permit and Statement of Basis will not be included in this mailing. All Board Item documents, including the draft Permit and Statement of Basis may be reviewed at the MPCA offices in St. Paul and on the MPCA Web site at <http://www.pca.state.mn.us/about/board/bdagenda.html>. Requests for copies of these documents may be made by contacting the St. Paul office at 651-757-2084.

The Board Item will be presented at the MPCA Board Meeting on October 25, 2011. Please refer to the enclosed Board Agenda for specific location, dates, and times. We encourage your attendance at the Board Meeting. If you have any questions regarding the enclosed Board Item or the specifics of the meeting, feel free to contact Brandon Smith of our staff at 651-757-2740.

Sincerely,

A handwritten signature in cursive script that reads "Ann Foss".

Ann M. Foss
Director
Strategic Projects Sector
Industrial Division

AMF:rm

Enclosures

MINNESOTA POLLUTION CONTROL AGENCY

Industrial Division Strategic Projects Sector

Board Item Cover Sheet

MEETING DATE:	<u>October 25, 2011</u>	DATE MAILED:	<u>October 14, 2011</u>
Presenter(s):	<u>Brandon Smith <i>BES</i></u>	Phone Number:	<u>651-757-2740</u>
Project Manager:	<u>Brian Timerson <i>BT</i></u>	Phone Number:	<u>651-757-2785</u>
Sector Director:	<u>Ann Foss <i>AMF</i></u>	Phone Number:	<u>651-757-2366</u>
Division Director:	<u>Jeff Smith</u>	Phone Number:	<u>651-757-2735</u>
Asst. Co.: (if issue applies to water or air issue)	<u>Rebecca Flood</u>	Phone Number:	<u>651-757-2022</u>
Deputy Commissioner:	<u>John Stine <i>JDS</i></u>	Phone Number:	<u>651-757-2014</u>
Attorney:	<u>Robert Roche</u>	Phone Number:	<u>651-757-1372</u>

TITLE OF BOARD ITEM: United States Steel Corporation, Minnesota Ore Operations - Keetac, Keewatin,
Minnesota - Request for Approval of Findings of Fact, Conclusions of Law, and
Order and Request for Authorization to Issue National Pollutant Discharge Elimination
System/State Disposal System Permits MN0031879 and MN0055948.

LOCATION: Keewatin Itasca
City/Township County

TYPE OF ACTION: Permit Issuance

RECOMMENDED ACTION: Authorization to Issue National Pollutant Discharge Elimination System/State
Disposal System Permits MN0031879 and MN0055948.

ISSUE STATEMENT:

The Minnesota Pollution Control Agency (MPCA) staff requests that the MPCA Citizens' Board (Board) approve reissuance of National Pollutant Discharge Elimination System (NPDES)/State Disposal System(SDS) Permits MN0031879 and MN0055948 (Permits) for the United States Steel Corporation – Minnesota Ore Operations (Permittee) – Keetac Mining Area facility. The MPCA staff prepared the draft Permits for the Keetac Mining Area facility, and submitted the draft Permits for public comments on June 27, 2011. The public comment period for the Permits was extended twice, closing on August 19, 2011. Prior to extending the public comment period to end on August 19, 2011, the MPCA received 179 requests for extension of the public comment period, 177 were received in substantially identical e-mails. In addition to the requests for extension of the public comment period, the MPCA received 117 comment letters regarding the Permit, 106 of which were received in substantially identical e-mails. Comments received on the draft Permits centered primarily on the relationship between the Permits and a proposed expansion on mining at the Keetac facility, water quality-based effluent limitations, and a compliance schedule in the draft Permits for the application of final effluent limitations for sulfate, which are based on an ambient water quality standard for wild rice production waters. In response to comments received, the MPCA staff has modified the draft Permits to clarify and improve enforceability of compliance schedule requirements. The MPCA staff recommends that the Board approve the reissuance of each of the Permits.

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ATTACHMENTS:

1. Proposed Findings of Fact, Conclusions of Law, and Order Permit No. MN0031879
2. Proposed Findings of Fact, Conclusions of law and Order Permit No. MN0055948
- Appendix A – Comment Letters received on the Draft Permits
- Appendix B – Responses to Comments Received on the Draft Permits
- Appendix C – Table of Changes to Draft NPDES/SDS Permits
3. Proposed NPDES/SDS Permit No. MN0031879
4. Proposed NPDES/SDS Permit No. MN0055948
5. Statement of Basis Permit No. MN0031879
6. Statement of Basis Permit No. MN0031879
7. Map of Facility

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MINNESOTA POLLUTION CONTROL AGENCY
Industrial Division
Land and Water Quality Permits Section

United States Steel Corporation, Minnesota Ore Operations, Keetac
National Pollutant Discharge Elimination System/State Disposal System
Permits MN0031879 and MN0055948

October 25, 2011

ISSUE STATEMENT

The Minnesota Pollution Control Agency (MPCA) staff requests that the MPCA Citizens' Board (Board) approve reissuance of National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Permits MN0031879 and MN0055948 (Permits) for the United States Steel Corporation – Minnesota Ore Operations (Permittee) – Keetac facility. The MPCA staff prepared the draft Permits for the Keetac facility, and submitted the draft Permits for public comments on June 27, 2011. The public comment periods for the Permits were extended twice, closing on August 19, 2011. Prior to extending the public comments period to end on August 19, 2011, the MPCA received 179 requests for extension of the public comments period, 177 were received in substantially identical e-mails. In addition to the requests for extension of the public comment periods, the MPCA received 117 comment letters regarding the Permits, 106 of which were received in substantially identical e-mails. Comments received on the draft Permits centered primarily on the relationship between the Permits and a proposed expansion on mining at the Keetac facility, water quality-based effluent limitations, and a compliance schedule in the draft Permits for the application of final effluent limitations for sulfate, which are based on an ambient water quality standard for wild rice production waters. In response to comments received, the MPCA staff has modified the draft Permits to clarify and improve enforceability of compliance schedule requirements. The MPCA staff recommends that the Board approve the reissuance of each of the Permits.

I. BACKGROUND:

A. Facility Description

The principal activity at the Keetac facility is the open pit mining of taconite from the Biwabik Iron Formation for processing into taconite pellets. The Keetac facility is currently subject to NPDES/SDS Permits MN0031879 and MN0055948, which regulate discharges from the mining/processing facility and the tailings basin system, respectively. The permitted activities under NPDES/SDS Permit MN0031879 consist of discharges from the Permittee's Keetac plant area, all mine excavations, mining waste disposal areas, plant areas, materials and equipment storage areas, and wastewater disposal facilities. The

permitted activities under NPDES/SDS Permit MN0055948 consist of discharges of process and dewatering wastewaters associated with the Keetac tailings basin system.

The Permittee has proposed an expansion to its mining and pellet production operations at the Keetac facility, which will increase production from 6.0 million short tons of pellets per year to 9.6 million short tons per year. A short ton equals 2,000 pounds. The proposed expansion exceeded the threshold for requiring mandatory environmental review. Pursuant to Minn. R. 4410.2000, subp. 3.B., the Permittee and the Minnesota Department of Natural Resources (DNR) agreed that a discretionary Environmental Impact Statement should be prepared pursuant to Minn. R. 4410.4400 subp. 8, and the DNR would be the Responsible Governmental Unit for the State of Minnesota.

B. Procedural History

On January 11, 2010, the MPCA received applications for modification of both of the Permits to address proposed mining expansion. The proposed expansion does not change the operation of the previously permitted disposal systems associated with the Keetac mine area and processing plant or the discharge of wastewater associated with the previously permitted disposal systems.

In February, 2010, the MPCA determined waters downstream from the discharges authorized by the Permits to be waters used for the production of wild rice.

In August, 2010, the MPCA staff determined that the requested modifications to the Permits should be included with the upcoming reissuance of each of the Permits.

On December 30, 2010, the DNR determined the final EIS for the proposed Keetac mine expansion to be adequate.

On June 27, 2011, the MPCA staff public noticed the draft Permits for reissuance.

On July 27, 2011, the MPCA staff extended the public comment period for the Permits to end on August 12, 2011, to account for business days lost due to the Minnesota State government service interruption that occurred in July.

On August 12, 2011, the US Environmental Protection Agency (EPA) formally requested a 30 day review of the draft Permits, starting from August 2, 2011, and ending on September 2, 2011.

On August 12, 2011, the MPCA staff extended the public comment period for the Permits to end on August 19, 2011, in response to requests for additional time to submit public comments.

On August 19, 2011, the public comment period for the draft Permits ended.

On September 2, 2011, the MPCA staff received comments from the EPA review of the draft Permits. The comments requested corrections and clarifications to the language in the draft Permits regarding the compliance schedule for sulfate.

II. DISCUSSION:

The draft permits do not authorize, and the permittee had not requested expansion of any of the permitted discharges above the volumes and mass loadings authorized under the previous permits. The substantial changes to the Permits, as compared to previous permits issued to this facility, occurred as a result of the determination that discharges from the facility impact downstream waters, which are used for the production of wild rice.

As required by federal Clean Water Act regulations, the MPCA staff performed an analysis to determine whether the discharge would have the reasonable potential to cause or contribute to a violation of any water quality standards in the receiving waters. Under the regulation, where the MPCA determines that a discharge of a particular pollutant has the reasonable potential to cause or contribute to a violation of an applicable water quality standard in a receiving water, the permit must include a water quality based effluent limit for that pollutant. This “reasonable potential” analysis results in water quality based effluent limit recommendations, which are included in the draft permits.

On February 2, 2010, the MPCA staff completed the effluent limit recommendations and associated nondegradation review for NPDES/SDS Permit MN0031879, in accordance with all state and federal regulations, as well as MPCA policies governing such reviews.

On April 7, 2011, the MPCA staff completed the effluent limits recommendations and associated nondegradation review for NPDES/SDS Permit MN0055948, in accordance with all state and federal regulations, as well as the MPCA policies governing such reviews.

Minnesota's water quality standards include a 10 mg/L sulfate limit for waters used for the production of wild rice when the rice may be susceptible to damage by high sulfate levels. The reasonable potential analysis for sulfate in the mine area discharges resulted in the inclusion of an effluent limit based on that standard. The sulfate effluent limits are 14 mg/L calendar month average and a 24 mg/L daily maximum. These effluent limits were calculated utilizing the same statistical procedures that are used to determine water quality-based effluent limitations for NPDES/SDS permits throughout Minnesota.

Because U. S. Steel is currently unable to comply with the sulfate effluent limits, the MPCA staff developed a compliance schedule based on the time required for the completion of evaluations and implementation of the final plans to attain compliance with the sulfate effluent limits. The compliance schedule was developed in accordance with the requirements of 40 CFR § 122.47, and Minn. R. 7001.0150, subp. 2 (A).

Commentors expressed a variety of concerns regarding the topics identified above. These comments are addressed in the Response to Comments document (Appendix B of Attachment 2). In response to comments made by EPA, changes were made to the draft permit, which are defined in Appendix C of Attachment 2. The following is a summary of the changes made to the draft permit: (1) the MPCA modified the tailings basin permit to include reference to the compliance schedule for non-tailings basin discharges found in the mining operations permit. (2) Interim effluent limits for sulfate were added to the permit for outfalls where full-scale treatment evaluation is approved. (3) Full-scale treatment evaluation is required for outfalls representative of wastewater type. (4) Additional monitoring requirements for selenium added to the permit.

Many of the other comments received from environmental groups and concerned citizens related to the effluent limits for sulfate, including whether the effluent limits were calculated appropriately and the assumptions used in the calculations, as well as concerns regarding the appropriate length of the compliance schedule to achieve the sulfate limits. Comments also included requests to increase the frequency of sulfate monitoring and to include additional monitoring and effluent limits for hardness and other parameters.

The issue before the Board is whether to reissue each of the two Permits as prepared by the MPCA staff. The MPCA's decision to reissue Permits is governed by Minn. R. 7001.0140 subp. 1, which states:

Subpart 1. Agency action. Except as provided in subpart 2, the agency shall issue, reissue, revoke and reissue, or modify a permit if the agency determines that the proposed permittee or permittees will, with respect to the facility or activity to be permitted, comply or will undertake a schedule of compliance to achieve compliance with all applicable state and federal pollution control statutes and rules administered by the agency, and conditions of the permit and that all applicable requirements of Minnesota Statutes, chapter 116D, and the rules adopted under Minnesota Statutes, chapter 116D, have been fulfilled. For solid waste facilities, the requirements of Minnesota Statutes, section 473.823, subdivisions 3 and 6, must also be fulfilled.

The MPCA staff believes that the requirements of Minn. R. 7001.0140 subp. 1 have been fulfilled.

III. CONCLUSIONS:

For the reasons discussed above and more fully described in the Findings of Fact, Conclusions of Law and Order, in the staff's response to comments, and in the Statement of Basis for the Mining Operations, the MPCA staff believes that Permit No. MN0031879 should be issued.

For the reasons discussed above and more fully described in the Findings of Fact, Conclusions of Law and Order, in the staff's response to comments, and in the Statement of Basis for the Tailings Basin, the MPCA staff believes that Permit No. MN0055948 should be issued.

IV. RECOMMENDATION:

The MPCA staff recommends that, in accordance with the standard and criteria set forth in Minn. R. 4410.1700, the Board vote to approve issuance of NPDES/SDS Permits MN0031879 and MN0055948 for the United States Steel Corporation, Minnesota Ore Operations – Keetac facility.

SUGGESTED STAFF RESOLUTION

Authorization to Issue NPDES/SDS Permits MN0031879 and MN0055948

BE IT RESOLVED, that the Minnesota Pollution Control Agency (MPCA) approves and adopts the attached Findings of Fact, Conclusions of Law, and Order (Attachment 1 and Attachment 2) in support of its approval of issuance of the NPDES/SDS Permits for United States Steel Corporation, Minnesota Ore Operations - Keetac Project.

BE IT FURTHER RESOLVED, that the Commissioner is authorized to do the following: (1) execute the Findings of Fact, Conclusions of Law, and Order (Attachment 1 and Attachment 2) on behalf of the MPCA; (2) issue NPDES/SDS Permits MN0031879 and MN0055948 on behalf of the MPCA; and (3) undertake all actions necessary for issuance and effectiveness of the water permit.

**STATE OF MINNESOTA
MINNESOTA POLLUTION CONTROL AGENCY**

**IN THE MATTER OF THE PROPOSAL TO
REISSUE THE NPDES/SDS
PERMIT NO. MN0031879
FOR UNITED STATES STEEL – MINNESOTA ORE OPERATIONS - KEETAC
MINING
KEEWATIN, MINNESOTA**

**FINDINGS OF FACT
CONCLUSIONS OF LAW
AND ORDER**

The above-entitled matter came before the Minnesota Pollution Control Agency (MPCA) Citizens' Board at a regular meeting held in St. Paul, Minnesota on October 25, 2011. Based on the MPCA staff review, comments and information received during the comment period, and other information in the record of the MPCA, the MPCA hereby makes the following Findings of Fact, Conclusions of Law, and Order:

FINDINGS OF FACT

This matter involves the application of United States Steel Corporation for reissuance of National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Permit No. MN0031879 for the Minnesota Ore Operations - Keetac – Mining Facility. For the purposes of these Findings, Conclusions of Law and Order, the United States Steel Corporation is referred to as U. S. Steel or the Permittee and the Minnesota Ore Operations Keetac – Mining Facility is referred to as Keetac. The permit reissuance includes: 1) a description of the proposed expansion of the taconite processing plant with which the permitted operations are associated; 2) effluent limitations based on the 10 mg/L sulfate water quality standard for “waters used for the production of wild rice,” and 3) continuation of the currently effective compliance schedule for the sulfate effluent limitations, which was added as part of a major permit modification issued on June 17, 2010. The MPCA must decide whether, under applicable statutes and rules, it should reissue the permit.

DESCRIPTION OF THE PROJECT

1. United States Steel Corporation (“U. S. Steel Corp.”) owns and operates a taconite (iron ore) mine and processing plant in Keewatin, Minnesota. The facility, U. S. Steel Corporation, Minnesota Ore Operations - Keetac (“Keetac”), produces taconite pellets for use as a primary raw ingredient at iron and steel mills.
2. Iron ore mining and taconite pellet production have been on-going at the Keetac facility since 1967. The original Phase I taconite processing plant began operation in 1969. At that time, the Keetac facility included one operating taconite production line.
3. In 1977, the Phase II expansion added a second operating line. The Phase I line was idled in December 1980 under the ownership of National Steel Pellet Corporation. U. S. Steel Corp. purchased the National Steel Corporation in 2003, including the Keetac facility.

4. Currently, there is one operational pellet producing line (Phase II) with annual production of approximately 6.0 million tons of taconite pellets per year (MTPY). The facility has proposed an expansion to its mining and pellet production operations, which will increase production from 6.0 MTPY to 9.6 MTPY. A joint state and federal Environmental Impact Statement (EIS) was completed for the proposed expansion, and was determined to be adequate by the Minnesota Department of Natural Resources on December 30, 2010.
5. The reissuance of NPDES/SDS Permit No. MN0031879 is requested to authorize continued operation of permitted disposal systems associated with the Keetac mine area and processing plant, and the discharge of wastewater associated with the permitted disposal systems.
6. The current mining facility has four surface water discharge points. The proposed expansion does not change the operation of currently permitted disposal systems associated with the Keetac mine area and processing plant, or the discharge of wastewater associated with the currently permitted disposal systems, each of which is described below.
7. The water supply treatment plant, located just north of Welcome Lake, currently discharges backwash wastewater from the sand filters on a periodic basis through culvert outfall SD001, at a rate of less than 0.010 million gallons per day (MGD), to Welcome Lake.
8. A Diversion Ditch System consisting of a series of sedimentation basins and a conveyance channel, currently discharges treated runoff from the Keetac plant area and stockpile areas, as well as overflow discharges of mine pit dewatering and runoff from a holding and treatment basin identified as Reservoir 5, at an average rate of 2.3 MGD to Welcome Creek via weir outfall SD001.
9. Mine pit dewatering from the Mesabi Chief Pit may be pumped and discharged through pipe outfall SD003, at an average rate of 5.85 MGD, to O'Brien Creek, which flows to the O'Brien Reservoir.
10. Discharges of mine pit dewatering from the Perry Pit, which includes stormwater from stripping and stockpiling activities west of the Mesabi Chief mining area, are directed through pipe outfall SD012 at rate of up to 4.32 MGD to O'Brien Creek.

APPLICABLE STANDARDS

Technology-based Treatment Standards

11. Minn. R. 7053.0225 subp. 1.A requires that all point source dischargers of industrial or other wastes shall comply with applicable federal standards, including those listed in 40 CFR pt. 401 through 469. The MPCA has determined that the specific industrial category and federal effluent limitation guidelines (Categorical Standards) applicable to this facility are those described in 40 CFR pt. 440 subp. A, for the iron ore mining and dressing point source category.
12. The facility constitutes an existing source, and is therefore not subject to the New Source Performance Standards for this industry. The Categorical Standards for Best Practicable Control Technology currently available (BPT) and Best Available Technology economically achievable (BAT) have been applied for the conditions in this permit.

13. The applicable BPT and BAT standards for mining area discharges are for Total Suspended Solids (TSS) and Total Iron, as limited in the currently effective Permit.
14. The applicable standards for the discharge of water supply treatment plant backwash water are based on the State Discharge Restrictions for pH and TSS pursuant to Minn. R. 7053.0225, as limited in the currently effective Permit.

Water Quality Standards

15. The immediate receiving waters affected by this permit reissuance include: Welcome Lake, Welcome Creek, O'Brien Creek, and the O'Brien Reservoir.
16. All waters of the state of Minnesota must be classified based on considerations of best usage in the interest of the public and in conformance with the requirements of the applicable statutes, as described in Minn. R. 7050.0140. Based on these considerations, Welcome Creek and O'Brien Creek are classified as Class 2C waters as listed in 7050.0470 subp. 4.A. items (127) and (236), respectively. According to Minn. R. 7050.0410, any listed water in part 7050.0470 is also classified as a Class 3C, 4A, 4B, 5, and 6 water. Welcome Lake and O'Brien Reservoir are not listed waters in Minn. R. 7050.0470. As detailed in Minn. R. 7050.0430, all surface waters of the state that are not listed in part 7050.0470 and that are not wetlands as defined in part 7050.0186, subp. 1a, are classified as Class 2B, 3C, 4A, 4B, 5, and 6 waters.
17. Based on the applicable classifications, the receiving waters named above are designated for use in the forms of aquatic life and recreation, industrial consumption, agriculture and wildlife, aesthetic enjoyment and navigation, and other uses.
18. In addition, the MPCA staff has made the determination that discharges from the facility reach downstream waters, which are "used for the production of wild rice" as stated in Minn. R. 7050.0224 subp. 2. The wild rice determination was made prior to the permit modification dated June 17, 2010, and no revisions to the determination were made during the permit reissuance process.
19. As required by 40 C.F.R. § 122.44(d)(1), the MPCA evaluated the proposed discharge to determine whether it has a reasonable potential to cause or contribute to an excursion above applicable water quality standards.
20. Effluent limitations have been included in the draft Permit for total sulfate based on the results of the reasonable potential analysis.
21. In addition to the numeric water quality standards for applicable use classifications, Minn. R. 7050.0185 governs nondegradation for all waters. Nondegradation review is required by the MPCA for significant new and expanding discharges as defined in Minn. R. 7050.0185 to determine whether additional controls beyond compliance with water quality standards are warranted to prevent degradation of waters of the state. For this Permit, a significant new or expanded discharge would be defined as one in which the maximum design flow expands by more than 200,000 gallons per day above the existing baseline flow, or would increase the concentration of a toxic pollutant in the receiving water by greater than one percent. No expansion of the maximum

daily design flows above the currently permitted levels is authorized by the Permit. Additionally, the EIS for the proposed Keetac expansion project indicates that water chemistry in the discharges authorized by the Permit is not anticipated to change due to continuation of similar mining and dewatering activity following the expansion. Therefore, the discharges authorized by the Permit do not constitute significant new or expanded discharges, and nondegradation review is not required for the proposed reissuance of the Permit.

22. Minn. R. 7050.0180 governs nondegradation for Outstanding Resource Value Waters (ORVWs). None of the discharges authorized by the Permit are directly to ORVWs, therefore nondegradation with regard to ORVWs under the Permit is limited to verifying that new or expanding flows are controlled to prevent degradation of downstream ORVWs. As previously discussed, permitted flows are required to remain within the range currently permitted, and changes to the chemistry of the permitted discharges are not expected to occur. Therefore, degradation of downstream ORVWs is not anticipated, and additional controls are not required pursuant to Minn. R. 7050.0180.

PROTECTION OF WATERS USED FOR THE PRODUCTION OF WILD RICE

23. The reasonable potential analysis for sulfate in the mine area discharges resulted in the inclusion of an effluent limit based on the 10 mg/L stated applicable to “waters used for the production of wild rice.” The sulfate effluent limits are 14 mg/L calendar month average and 24 mg/L daily maximum.
24. The effluent limitations for sulfate have been calculated utilizing statistical methods derived from the EPA Technical Support Document for Water Quality-Based Toxics Control. The limits are calculated assuming no dilution capacity in the receiving waters, maximum flow from the permitted discharges, and a waste load allocation of 10 mg/L sulfate based on the ambient water quality standard for waters used for the production of wild rice. Compliance with the calculated effluent limitations provides reasonable assurance that the Permittee's discharges are not causing or contributing to excursions above the water quality standard within the water bodies where the standard applies.
25. U. S. Steel is currently unable to comply with the sulfate effluent limits. Due to the complex nature of the wastewater disposal systems at the Keetac facility, a facility-wide compliance solution must be investigated that incorporates both water management and treatment solutions. The MPCA staff determined that inclusion of a compliance schedule in the permit is appropriate. Therefore, the permit reissuance includes a schedule for attaining compliance with the final effluent limitations for total sulfate on a facility-wide basis.
26. The compliance schedule in the draft Permit requires the completion of a Water Management Study and a Sulfate Reduction Strategy Study, which are required to inform the development and implementation of a Sulfate Reduction Plan. The implementation of the Sulfate Reduction Plan is required to lead to compliance with the final effluent limitations for sulfate as soon as possible. The Sulfate Reduction Plan must provide justification for the proposed timeframe for attaining compliance.

27. The schedule requires attainment of compliance as soon as possible and in no case later than August 17, 2018. The maximum term of the compliance schedule is based on potential time required for completion of evaluations by the Permittee, as well as time for implementation of any final plans for attaining compliance, including time for obtaining various regulatory approvals. The schedule does not automatically grant the maximum timeframe, but requires the MPCA approval at interim steps and requires that all interim steps proceed to compliance with final effluent limitations as soon as possible. The schedule requires the Permittee to make reductions in sulfate concentration to the extent practical prior to the end of the compliance schedule.
28. Interim requirements for the compliance schedule prior to the final attainment of compliance include completion of the Water Management Study and Sulfate Reduction Strategy Study currently underway, preparation and submittal of the Sulfate Reduction Plan, implementation of the Sulfate Reduction Plan following MPCA approval of the plan, and progress reporting. The Permit specifies maximum timeframes for completion of interim requirements. Implementation of the actions contained in the Sulfate Reduction Plan following the MPCA approval will also be enforceable actions due to implementation of the approved plan being an enforceable condition of the Permit.
29. Additional enforceable interim requirements are built into the schedule contingent upon the proposals in the Sulfate Reduction Plan. Distinct timeframes for the attainment of compliance following MPCA approval of the plan are required, and are dependent on whether or not the MPCA approves full-scale testing of treatment technology on representative outfalls prior to final implementation on all discharges. The Permit allows time for completion of such testing in the event that such a proposal is approved by the MPCA, but specifies maximum timeframes for completion of the testing, and requires that interim effluent limitations for sulfate be met at the representative outfalls following treatment evaluations. If full-scale treatment evaluation is not approved by the MPCA, the Permit requires compliance to be attained in a shorter timeframe.

REVISIONS TO THE SULFATE COMPLIANCE SCHEDULE FOLLOWING PUBLIC COMMENT PERIOD

30. The U.S. Environmental Protection Agency (EPA) requested to review the draft permit, outside of the public comment period, under federal oversight authority. The EPA submitted a comment letter to the MPCA dated September 2, 2011. Specific comments and the MPCA responses regarding the sulfate compliance schedule are discussed below. These changes were made following public notice of the Permit.
31. The EPA requested the MPCA to revise draft NPDES/SDS Permit No. MN0055948 either to incorporate by reference the compliance schedule in draft NPDES/SDS Permit No. MN0031879, or provide the same level of detail as is included in draft NPDES/SDS Permit No. MN0031879.
32. The MPCA staff modified draft NPDES/SDS Permit No. MN0055948 to include the compliance schedule contained in draft NPDES/SDS Permit No. MN0031879 by reference.
33. The EPA requested the MPCA to revise the compliance schedule so that the different paths within the compliance schedule following the MPCA approval or disapproval of treatment technology pilot studies are independent, and contain distinct enforceable actions leading to compliance with the effluent limits for sulfate.

34. The MPCA staff modified the language in draft NPDES/SDS Permit No. MN0031879 to indicate two distinct schedules, with distinct requirements for attainment of compliance with final effluent limitations for each case regarding the MPCA approval or disapproval of a request for full-scale treatment evaluation on representative outfalls.
35. The EPA requested the MPCA to revise the compliance schedule so that it is clear that the full scale treatment technology pilot studies are required for a representative outfall of each type of discharge, specifically tailings basin, dewatering pit, and Reservoir 5/sedimentation basins. The EPA asked that the MPCA staff specify that the representative dewatering pit outfall will be one included in draft NPDES/SDS Permit No. MN0031879 and therefore fall under that schedule.
36. The MPCA staff modified the compliance schedule in draft NPDES/SDS Permit No. MN0031879 to require evaluation of full-scale treatment evaluation for outfalls representative of wastewater type. The MPCA did not specify the three waste types contained in the EPA comments, due to the possibility of these waste types changing due to operational modifications, dependent on the results of the Water Management Study that is currently in progress. As an equivalent measure, the MPCA is requiring the Permittee to base any request for testing on representative outfalls on consideration of physical condition of the wastewater, wastewater chemistry, and the size/frequency of the discharge within the Sulfate Reduction Plan. The permit language has also been modified to specify compliance dates based on the type of wastewater discharged as requested.
37. The EPA stated that the schedules of compliance require successful full-scale pilot treatment of outfalls representing the various types of discharges at the facility. The EPA requested the MPCA to require interim limits for sulfate at each outfall selected for the full-scale pilot studies, effective upon completion of the testing phases specified in paragraphs 1.11, 1.12 and 1.13 of draft NPDES/SDS Permit No. MN0031879.
38. The MPCA staff modified the language to require compliance with an interim effluent limitation for total sulfate of 14 mg/L as a calendar quarter average. This effluent limitation will be applied on any outfalls for which full scale treatment evaluation is approved, following the completion of those evaluations, to ensure continued progress toward compliance with final effluent limitations.
39. The EPA requested the MPCA to correct the dates specified in the draft NPDES/SDS permits to reflect that the sulfate effluent limits shall be attained as soon as possible but no later than August 17, 2018, as opposed to the August 2019 date specified in the draft NPDES/SDS Permit No. MN0031879.
40. The MPCA staff corrected the final compliance date to require compliance with final effluent limitations as soon as possible and in no case later than August 17, 2018, for non-tailings basin discharges.
41. The revised compliance schedule language, based on EPA comments, is included in the permit document found in Attachment 3. The compliance schedule has been developed in accordance with the requirements of Minn. R. 7001.0150, subp. 2 (A) and 40 CFR § 122.47. The Permit requires that compliance with final effluent limitations be attained as soon as possible, and that completion of

interim steps result in continued progress toward compliance with final effluent limitations. Where the time between specific interim steps exceeds one year, the compliance schedule requires progress reports to be submitted to the MPCA at a minimum of every 6 months to provide details regarding the implementation of the requirements of the schedule and verify continued progress toward achieving compliance as soon as possible.

PROCEDURAL HISTORY

42. Pursuant to Minn. R. 7001.0100, a draft permit was prepared by the MPCA staff for the proposed permit reissuance.
43. The public comment period for the draft permit began on June 27, 2011, and ended on August 19, 2011. The initial 30-day comment period ended on July 27, 2011. Due to circumstances with the state government shutdown, which ran from July 1, 2011, to July 21, 2011, the comment period was extended to August 12, 2011, and a second extension was granted until August 19, 2011.
44. During the comment period, the MPCA received 2 comment letters from government agencies and received 11 comment letters from citizens.
45. The MPCA reviewed each of the comments and prepared responses to all comments received during the public comment period. Comment letters received have been hereby incorporated by reference as Appendix A to these findings. The MPCA responses to comments received are hereby incorporated by reference as Appendix B to these findings.
46. The MPCA concurs with the reasoning of MPCA staff in its Responses to Comments document (Attachment B) and adopts the reasoning by reference on these findings. The EPA comments and MPCA responses to those comments are also included in the Appendix A and Appendix B, respectively.

SELECTED COMMENTS AND MPCA RESPONSES

47. During the public comment period for the Permit, the MPCA received 179 requests for extension of the public comments period, 177 were received in substantially identical e-mails.
48. In addition to the requests for extension of the public comment periods, the MPCA received 117 comment letters regarding the Permit, 106 of which were received in substantially identical e-mails.
49. Comments received on the draft Permit centered primarily on the relationship between the Permits and a proposed expansion on mining at the Keetac facility, water quality-based effluent limitations, and a compliance schedule in the draft Permits for the application of final effluent limitations for sulfate, which are based on an ambient water quality standard for wild rice production waters.
50. In response to comments received, the MPCA staff has modified the draft Permit to clarify and improve enforceability of compliance schedule requirements.

51. The comments received on this Permit and NPDES/SDS Permit MN0055948, as well as the MPCA responses to the comments, are detailed in Appendix B.

FINAL DETERMINATION OF WHETHER TO REISSUE PERMIT

52. The MPCA finds there is jurisdiction for U. S Steel's NPDES/SDS permit reissuance in accordance with Minn. R. 7001.0100, subp. 1 which states:

Subpart 1. After a permit application is complete, the commissioner shall make a preliminary determination as to whether the permit should be issued or denied.

53. The MPCA has followed the procedures for the reissuance of the NPDES/SDS Permit according to the provisions in Minn. R. ch. 7001.

54. The MPCA's decision to reissue the NPDES/SDS Permit is governed by its permit rule, Minn. R. 7001.0140, which in part, states:

Subpart 1. Except as provided in subpart 2, the agency shall issue, reissue, revoke and reissue, or modify a permit if the agency determines that the proposed permittee or permittees will, with respect to the facility or activity to be permitted, comply or will undertake a schedule of compliance to achieve compliance with all applicable state and federal pollution control statutes and rules administered by the agency, and conditions of the permit and that all applicable requirements of Minnesota Statutes, chapter 116D, and the rules adopted under Minnesota Statutes, chapter 116D, have been fulfilled. For solid waste facilities, the requirements of Minnesota Statutes, section 473.823, subdivisions 3 and 6, must also be fulfilled.

CONCLUSIONS OF LAW

55. The MPCA is authorized and required to administer and enforce all laws relating to the pollution of the air and water of the state. Minn. Stat. chs. 115 and 116.
56. The MPCA has authority to reissuance this NPDES/SDS Permit. Minn. Stat. chs. 115 and 116 and Minn. R. chs. 7000, 7001, 7009, and 7020.
57. Under the federal Clean Water Act, the MPCA is delegated the authority from the EPA to issue NPDES permits. 33 U.S.C. §1342; Minn. Stat. § 115.03, subd. 5.
58. A draft permit for the facility was prepared and public noticed in accordance with the requirements of Minn. R. 7001.0100 and public comments on the draft permit were addressed in accordance with the MPCA rule requirements.
59. The requirements of Minn. R. ch. 7001, including Minn. R. 7001.0100 reissuance of a NPDES/SDS Permit, have been met including all applicable provisions of Minn. Stat. ch. 116D and Minn. R. ch. 4410. The MPCA determines that the Permittee will comply and will undertake the schedule of

compliance to achieve compliance with all applicable state and federal pollution control statutes and rules administered by the MPCA, and conditions of the reissued NPDES/SDS Permit.

60. The NPDES/SDS Permit contains effluent limitations and requirements that are protective of the environment and human health.
61. The findings of the MPCA justify reissuance of the NPDES/SDS Permit and do not support denial of the permit.
62. Areas where the potential for significant environmental effects may have existed have been identified and appropriate mitigation measures have been incorporated into the project design and permits. The project is expected to comply with all the MPCA standards.
63. Any findings that might properly be termed conclusions and any conclusions that might properly be termed findings are hereby adopted as such.

ORDER

The Minnesota Pollution Control Agency approves the reissuance of the National Pollutant Discharge Elimination System/State Disposal System Permit No. MN0031879 to U.S. Steel Corporation for the Minnesota Ore Operations Keetac - Mining Facility.

IT IS SO ORDERED

Commissioner Paul W. Aasen
Chair, Citizens' Board
Minnesota Pollution Control Agency

Date

**STATE OF MINNESOTA
MINNESOTA POLLUTION CONTROL AGENCY**

**IN THE MATTER OF THE PROPOSAL TO
REISSUE THE NPDES/SDS
PERMIT NO. MN0055948
FOR UNITED STATES STEEL – MINNESOTA ORE OPERATIONS – KEETAC
TAILINGS BASIN
KEEWATIN, MINNESOTA**

**FINDINGS OF FACT
CONCLUSIONS OF LAW
AND ORDER**

The above-entitled matter came before the Minnesota Pollution Control Agency (MPCA) Citizens' Board at a regular meeting held in St. Paul, Minnesota on October 25, 2011. Based on the MPCA staff review, comments and information received during the comment period, and other information in the record of the MPCA, the MPCA hereby makes the following Findings of Fact, Conclusions of Law, and Order:

FINDINGS OF FACT

This matter involves the application of United States Steel Corporation for reissuance of National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Permit No. MN0055948 for the Minnesota Ore Operations - Keetac Tailings Basin. For the purposes of these Findings, Conclusions of Law and Order, the United States Steel Corporation is referred to as U. S. Steel or the Permittee and the Minnesota Ore Operations - Keetac Tailings Basin Facility is referred to as Keetac. The permit reissuance includes: 1) a description of the proposed expansion of the taconite processing plant with which the permitted operations are associated; 2) a new outfall constructed to facilitate direct discharge of Sargent Pit dewatering, which is currently directed to other outfalls that are covered under NPDES/SDS Permit No. MN0031879; and 3) a compliance schedule to meet the sulfate effluent limits based on the 10 mg/L sulfate water quality standard for "waters used for the production of wild rice."

DESCRIPTION OF THE PROJECT

1. United States Steel Corporation ("U. S. Steel Corp.") owns and operates a taconite (iron ore) mine and processing plant in Keewatin, Minnesota. The facility, U. S. Steel Corporation, Minnesota Ore Operations - Keetac ("Keetac"), produces taconite pellets for use as a primary raw ingredient at iron and steel mills.
2. Iron ore mining and taconite pellet production have been on-going at the Keetac facility since 1967. The original Phase I taconite processing plant began operation in 1969. At that time, the Keetac facility included one operating taconite production line.

3. In 1977, the Phase II expansion added a second operating line. The Phase I line was idled in December 1980 under the ownership of National Steel Pellet Corporation. U. S. Steel Corp. purchased the National Steel Corporation in 2003, including the Keetac facility.
4. Currently, there is one operational pellet producing line (Phase II) with annual production of approximately 6.0 million tons of taconite pellets per year (MTPY). The facility has proposed an expansion to their mining and pellet production operations, which will increase production from 6.0 MTPY to 9.6 MTPY. A joint state and federal Environmental Impact Statement (EIS) was completed for the proposed expansion, and was determined to be adequate by the Minnesota Department of Natural Resources on December 30, 2010.
5. The current facility has two surface water discharge points. The proposed expansion does not change the operation of previously permitted disposal systems associated with the Keetac mine area and processing plant, or the discharge of wastewater associated with the previously permitted disposal systems as described below.
6. Reservoir 6 is a holding and treatment basin used for water storage, and contains water decanted from the tailings basin. Return water for the plant water supply is pumped from a station on Reservoir 6. This reservoir discharges through siphon outfall SD001, at a combined maximum rate of 9.4 million gallons per day (MGD), to Reservoir 2, which is a water of the state that flows to the O'Brien Diversion Channel.
7. Outfall SD005 was established to discharge water from the tailings basin to Reservoir 2 North and Welcome Creek, to Reservoir 2, at a maximum flow of approximately 23 MGD. The proposed expansion to the mining and pellet manufacturing process will result in a vertical expansion of the tailings basin, and changes to the volumes discharged to and from the tailings basin. Discharges to surface water from the tailings basin following the expansion will not exceed the pre-expansion volumes.
8. The reissuance of NPDES/SDS Permit No. MN0055948 (Permit) is requested to authorize continued operation of permitted disposal systems associated with the Keetac tailings basin and the discharge of wastewater associated with the permitted disposal systems.
9. In order to better meet the operational needs of the facility, the Permittee requested a new outfall for dewatering the Sargent Pit, which is an existing mine pit where the dewatering water is currently directed to outfall SD003 authorized under NPDES/SDS Permit No. MN0031879 (Keetac Mining).
10. While the dewatering activity is similar to other mine pit dewatering operations authorized in NPDES/SDS Permit MN0031879, due to the proposed discharge location, MPCA staff determined that the direct discharge of mine pit dewatering from the Sargent Pit to an unnamed ditch should be included in NPDES/SDS Permit No. MN0055948.
11. The immediate receiving waters affected by this permit reissuance include: Reservoir 2, Reservoir 2 North, Welcome Creek, and an unnamed ditch, which discharges to Welcome Creek.

APPLICABLE STANDARDS

Technology-based Treatment Standards

12. Minn. R. 7053.0225 subp. 1.A requires that all point source dischargers of industrial or other wastes shall comply with applicable federal standards, including those listed in 40 CFR pt. 401 through 469. The MPCA has determined that the specific industrial category and federal effluent limitation guidelines (Categorical Standards) applicable to this facility are those described in 40 CFR pt. 440 subp. A, for the iron ore mining and dressing point source category.
13. The facility constitutes an existing source, and is therefore not subject to the New Source Performance Standards for this industry. The Categorical Standards for Best Practicable Control Technology currently available (BPT) and Best Available Technology economically achievable (BAT) have been applied for the conditions in this permit.
14. The applicable BPT and BAT standards for mining area and tailings basin discharges are total Suspended Solids (TSS) and Total Iron, as limited in the currently effective Permit.

Water Quality Standards

15. All waters of the state of Minnesota must be classified based on considerations of best usage in the interest of the public and in conformance with the requirements of the applicable statutes, as described in Minn. R. 7050.0140. Based on these considerations, Welcome Creek is classified as Class 2C waters as listed in 7050.0470 subp. 4.A. item (236). According to Minn. R. 7050.0410, any listed water in part 7050.0470 is also classified as a Class 3C, 4A, 4B, 5, and 6 water. Reservoir 2, Reservoir 2 North, and the unnamed ditch leading to Welcome Creek are not listed waters in Minn. R. 7050.0470. As detailed in Minn. R. 7050.0430, all surface waters of the state that are not listed in part 7050.0470 and that are not wetlands as defined in part 7050.0186, subp. 1a, are classified as Class 2B, 3C, 4A, 4B, 5, and 6 waters.
16. Based on the applicable classifications, the receiving waters named above are designated for use in the forms of aquatic life and recreation, industrial consumption, agriculture and wildlife, aesthetic enjoyment and navigation, and other uses.
17. In addition, the MPCA staff has made the determination that discharges from the facility reaches downstream waters, which are “used for the production of wild rice” as stated in Minn. R. 7050.0224 subp. 2. The determination was made prior to the permit modification dated June 17, 2010, and no revisions to the determination were made during the permit reissuance process.
18. As required by 40 C.F.R. § 122.44(d)(1), MPCA evaluated the proposed discharge to determine whether the discharge has a reasonable potential to cause or contribute to a violation of applicable water quality standards.
19. Effluent limitations have been included in the draft Permit for total sulfate based on the results of the reasonable potential analysis.

20. In addition to the numeric water quality standards for applicable use classifications, Minn. R. 7050.0185 governs nondegradation for all waters. Nondegradation review is required by the MPCA for significant new and expanding discharges as defined in Minn. R. 7050.0185 to determine whether additional controls beyond compliance with water quality standards are warranted to prevent degradation of waters of the state. For this Permit, a significant new or expanded discharge would be defined as one in which the maximum design flow expands by more than 200,000 gallons per day above the existing baseline flow, or would increase the concentration of a toxic pollutant in the receiving water by greater than one percent. Nondegradation review has been completed for this Permit as detailed below.
21. Given that the new discharge location for Sargent Pit dewatering to the unnamed ditch represents an expansion of the facility's permitted discharge to this receiving water by more than 0.2 mgd, and an increased loading of one or more pollutants over the baseline quality in the receiving water, the discharge of dewatering effluent has been reviewed in accordance with Minn. R. 7050.0185. The review includes consideration of the quantity and quality of the proposed discharge and the potential for violating water quality standards in the receiving water. The statistical reasonable potential analysis shows that the proposed project will not impair the designated beneficial uses of the receiving waters. Sargent Pit dewatering effluent is currently directed to other pits, and discharged via outfalls permitted under NPDES/SDS Permit MN0031879, therefore the new outfall only constitutes a new or expanded discharge to the extent that it discharges to waters that do not currently receive Sargent Pit dewatering effluent. The O'Brien Diversion Channel was determined to be a water of the state that already receives the proposed discharge, therefore nondegradation review was limited to waters of the state upstream from that water body. The proposed discharge has been permitted to protect water quality standards in the water bodies upstream of the O'Brien Diversion Channel. The EIS for the proposed Keetac expansion project indicates that water chemistry in the discharge is not anticipated to change due to continuation of similar mining and dewatering activity following the expansion, therefore degradation of the O'Brien Diversion Channel and its downstream waters is not expected. Additional controls to prevent degradation in the immediate receiving waters upstream of the O'Brien Diversion Channel have not been determined to be warranted pursuant to Minn. R. 7050.0185.
22. No expansion of the maximum daily design flows above the currently permitted levels is authorized by the Permit for stations SD001 or SD005. Additionally, the water chemistry in these discharges is not anticipated to change because the Permittee has committed to install additional treatment technology on internal waste streams to maintain baseline quality as defined in Minn. R. 7050.0185. Therefore, discharges via SD001 and SD005 authorized by the Permit do not constitute significant new or expanded discharges, and nondegradation review is not required for these discharges for the proposed reissuance of the Permit.

PROTECTION OF WATERS USED FOR THE PRODUCTION OF WILD RICE

23. The reasonable potential analysis for sulfate in the mine area discharges resulted in the inclusion of an effluent limit based on the 10 mg/L stated applicable to "waters used for the production of wild rice." The sulfate effluent limits are 14 mg/L calendar month average and 24 mg/L daily maximum.

24. The effluent limitations for sulfate have been calculated utilizing statistical methods derived from the U.S. Environmental Protection Agency (EPA) Technical Support Document for Water Quality-Based Toxics Control. The limits are calculated assuming no dilution capacity in the receiving waters, maximum flow from the permitted discharges, and a waste load allocation of 10 mg/L sulfate based on the ambient water quality standard for waters used for the production of wild rice. Compliance with the calculated effluent limitations provides reasonable assurance that the Permittee's discharges are not causing or contributing to excursions above the water quality standard within the water bodies where the standard applies.
25. U. S. Steel is currently unable to comply with the sulfate effluent limits. Due to the complex nature of the wastewater disposal systems at the Keetac facility, a facility-wide compliance solution must be investigated that incorporates both water management and treatment solutions. The MPCA staff determined that inclusion of a compliance schedule in the Permit is appropriate. Therefore, the Permit reissuance includes by reference a schedule contained in NPDES/SDS Permit MN0031879 for attaining compliance with the final effluent limitations for total sulfate on a facility-wide basis.
26. The compliance schedule in the draft Permit requires the completion of a Water Management Study and a Sulfate Reduction Strategy Study, which are required to inform the development and implementation of a Sulfate Reduction Plan. The implementation of the Sulfate Reduction Plan is required to lead to compliance with the final effluent limitations for sulfate as soon as possible. The Sulfate Reduction Plan must provide justification for the proposed timeframe for attaining compliance.
27. The schedule requires attainment of compliance as soon as possible and in no case later than August 17, 2018. The maximum term of the compliance schedule is based on potential time required for completion of evaluations by the Permittee, as well as time for implementation of any final plans for attaining compliance, including time for obtaining various regulatory approvals. The schedule does not automatically grant the maximum timeframe, but requires MPCA approval at interim steps and requires that all interim steps proceed to compliance with final effluent limitations as soon as possible. The schedule requires the Permittee to make reductions in sulfate concentration to the extent practical prior to the end of the compliance schedule.
28. Interim requirements for the compliance schedule prior to the final attainment of compliance include completion of the Water Management Study and Sulfate Reduction Strategy Study currently underway, preparation and submittal of the Sulfate Reduction Plan, implementation of the Sulfate Reduction Plan following the MPCA approval of the plan, and progress reporting. The Permit specifies maximum timeframes for completion of interim requirements. Implementation of the actions contained in the Sulfate Reduction Plan following MPCA approval will also be enforceable actions due to implementation of the approved plan being an enforceable condition of the Permit.
29. Additional enforceable interim requirements are built into the schedule contingent upon the proposals in the Sulfate Reduction Plan. Distinct timeframes for the attainment of compliance following the MPCA approval of the plan are required, and are dependent on whether or not the MPCA approves full-scale testing of treatment technology on representative outfalls prior to final implementation on all discharges. The Permit allows time for completion of such testing in

the event that such a proposal is approved by the MPCA, but specifies maximum timeframes for completion of the testing, and requires that interim effluent limitations for sulfate be met at the representative outfalls following treatment evaluations. If full-scale treatment evaluation is not approved by the MPCA, the Permit requires compliance to be attained in a shorter timeframe.

REVISIONS TO THE SULFATE COMPLIANCE SCHEDULE

30. The EPA requested to review the draft permits, outside of the public comment period, under federal authority. The EPA submitted a comment letter to the MPCA dated September 2, 2011. Specific comments and the MPCA responses regarding the sulfate compliance schedule are discussed below.
31. The EPA requested the MPCA to revise draft NPDES/SDS Permit No. MN0055948 either to incorporate by reference the compliance schedule in draft NPDES/SDS Permit No. MN0031879, or provide the same level of detail as is included in draft NPDES/SDS Permit No. MN0031879.
32. The MPCA staff modified draft NPDES/SDS Permit No. MN0055948 to include the compliance schedule contained in draft NPDES/SDS Permit No. MN0031879 by reference.
33. The EPA requested the MPCA to revise the compliance schedule so that the different paths outlined in the compliance schedule following the MPCA approval or disapproval of treatment technology pilot studies are independent, and contain distinct enforceable actions leading to compliance with the effluent limits for sulfate.
34. The MPCA staff modified the language in draft NPDES/SDS Permit No. MN0055948 to indicate two distinct schedules, with distinct requirements for attainment of compliance with final effluent limitations for each case regarding MPCA approval or disapproval of a request for full-scale treatment evaluation on representative outfalls.
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36. The MPCA staff modified the compliance schedule in draft NPDES/SDS Permit No. MN0031879 to require evaluation of full-scale treatment evaluation for outfalls representative of wastewater type. The MPCA has not specified the three waste types contained in the EPA comments, due to the possibility of these waste types changing due to operational modifications, dependent on the results of the Water Management Study that is currently in progress. As an equivalent measure, the MPCA is requiring the Permittee to base any request for testing on representative outfalls on consideration of physical condition of the wastewater, wastewater chemistry, and the size/frequency of the discharge within the Sulfate Reduction Plan. The permit language has also been modified to specify compliance dates based on the type of wastewater discharged as requested.
37. The EPA stated that the schedules of compliance require successful full-scale pilot treatment of outfalls representing the various types of discharges at the facility. The EPA requested the MPCA to require interim limits for sulfate at each outfall selected for the full-scale pilot studies, effective upon

completion of the testing phases specified in paragraphs 1.5, 1.6, and 1.7 of draft NPDES/SDS Permit No. MN0055948.

38. The MPCA staff modified the language to require compliance with an interim effluent limitation for total sulfate of 14 mg/L as a calendar quarter average. This effluent limitation will be applied on any outfalls for which full scale treatment evaluation is approved, following the completion of those evaluations, to ensure continued progress toward compliance with final effluent limitations.
39. The EPA requested the MPCA to correct the dates specified in the draft NPDES/SDS permits to reflect that the sulfate effluent limits shall be attained as soon as possible but no later than August 17, 2018, as opposed to the August 2019, date specified in the draft NPDES/SDS Permit No. MN0031879. Draft NPDES/SDS Permit No. MN0055948 also appears to specify the incorrect date. Please revise the dates specified in both draft permits to correct the discrepancy.
40. The MPCA staff corrected the final compliance dates to require compliance with final effluent limitations as soon as possible and in no case later than August 17, 2018, for non-tailings basin discharges, and August 17, 2019, for tailings basin discharges.
41. The revised compliance schedule language, based on EPA comments, is included in the permit documents found in Appendix XX. The compliance schedule has been developed in accordance with the requirements of Minn. R. 7001.0150, subp. 2 (A) and 40 CFR § 122.47. The Permit requires that compliance with final effluent limitations be attained as soon as possible, and that completion of interim steps result in continued progress toward compliance with final effluent limitations. Where the time between specific interim steps exceeds one year, the compliance schedule requires progress reports to be submitted to the MPCA at a minimum of every 6 months to provide details regarding the implementation of the requirements of the schedule and verify continued progress toward achieving compliance as soon as possible.

PROCEDURAL HISTORY

42. Pursuant to Minn. R. 7001.0100, a draft permit was prepared by the MPCA staff for the proposed permit reissuance.
43. The public comment period for the draft permit began on June 27, 2011, and ended on August 19, 2011. The initial 30-day comment period ended on July 27, 2011. Due to circumstances with the state government shutdown, which ran from July 1, 2011 to July 21, 2011, the comment period was extended to August 12, 2011, and a second extension was granted until August 19, 2011.
44. During the comment period, the MPCA received 2 comment letters from government agencies and received 11 comment letters from citizens.
45. The MPCA reviewed each of the comments and prepared responses to all comments received during the public comment period. Comment letters received have been hereby incorporated by reference as Appendix A to these findings. The MPCA responses to comments received are hereby incorporated by reference as Appendix B to these findings.

46. The MPCA concurs with the reasoning of the MPCA staff in its Responses to Comments document (Attachment B) and adopts the reasoning by reference on these findings. The EPA comments and the MPCA responses to those comments are also included in the Appendix A and Appendix B, respectively.

SELECTED COMMENTS AND MPCA RESPONSES

47. During the public comment period for the Permit, the MPCA received 179 requests for extension of the public comments period, 177 were received in substantially identical e-mails.
48. In addition to the requests for extension of the public comment periods, the MPCA received 117 comment letters regarding the Permit, 106 of which were received in substantially identical e-mails.
49. Comments received on the draft Permit centered primarily on the relationship between the Permits and a proposed expansion on mining at the Keetac facility, water quality-based effluent limitations, and a compliance schedule in the draft Permits for the application of final effluent limitations for sulfate, which are based on an ambient water quality standard for wild rice production waters.
50. In response to comments received, the MPCA staff has modified the draft Permit to clarify and improve enforceability of compliance schedule requirements.
51. The comments received on this Permit and NPDES/SDS Permit MN0031879, as well as the MPCA responses to the comments, are detailed in Appendix B.

FINAL DETERMINATION OF WHETHER TO REISSUE PERMIT

52. The MPCA finds there is jurisdiction for U. S. Steel's NPDES/SDS permit reissuance in accordance with Minn. R. 7001.0100, subp. 1 which states:
- Subpart 1. After a permit application is complete, the commissioner shall make a preliminary determination as to whether the permit should be issued or denied.*
53. The MPCA has followed the procedures for the reissuance of the NPDES/SDS Permit according to the provisions in Minn. R. ch. 7001.
54. The MPCA's decision to reissue the NPDES/SDS Permit is governed by its permit rule, Minn. R.7001.0140, which in part, states:
- Subpart 1. Except as provided in subpart 2, the agency shall issue, reissue, revoke and reissue, or modify a permit if the agency determines that the proposed permittee or permittees will, with respect to the facility or activity to be permitted, comply or will undertake a schedule of compliance to achieve compliance with all applicable state and federal pollution control statutes and rules administered by the agency, and conditions of the permit and that all applicable requirements of Minnesota Statutes, chapter 116D,*

and the rules adopted under Minnesota Statutes, chapter 116D, have been fulfilled. For solid waste facilities, the requirements of Minnesota Statutes, section 473.823, subdivisions 3 and 6, must also be fulfilled.

CONCLUSIONS OF LAW

55. The MPCA is authorized and required to administer and enforce all laws relating to the pollution of the air and water of the state. Minn. Stat. chs. 115 and 116.
56. The MPCA has authority to reissuance this NPDES/SDS Permit. Minn. Stat. chs. 115 and 116 and Minn. R. chs. 7000, 7001, 7009, and 7020.
57. Under the federal Clean Water Act, the MPCA is delegated the authority from EPA to issue NPDES permits. 33 U.S.C. §1342; Minn. Stat. § 115.03, subd. 5.
58. A draft permit for the facility was prepared and public noticed in accordance with the requirements of Minn. R. 7001.0100 and public comments on the draft permit were addressed in accordance with MPCA rule requirements.
59. The requirements of Minn. R. ch. 7001, including Minn. R. 7001.0100 reissuance of a NPDES/SDS Permit, have been met including all applicable provisions of Minn. Stat. ch. 116D and Minn. R. ch. 4410. The MPCA determines that the Permittee will comply and will undertake the schedule of compliance to achieve compliance with all applicable state and federal pollution control statutes and rules administered by the MPCA, and conditions of the reissued NPDES/SDS Permit.
60. The NPDES/SDS Permit contains effluent limitations and requirements that are protective of the environment and human health.
61. The findings of the MPCA justify reissuance of the NPDES/SDS Permit and do not support denial of the permit.
62. Areas where the potential for significant environmental effects may have existed have been identified and appropriate mitigation measures have been incorporated into the project design and permits. The project is expected to comply with all MPCA standards.
63. Any findings that might properly be termed conclusions and any conclusions that might properly be termed findings are hereby adopted as such.

ORDER

The Minnesota Pollution Control Agency approves the reissuance of the National Pollutant Discharge Elimination System/State Disposal System Permit No. MN0055948 to U. S. Steel Corporation for the Minnesota Ore Operations – Keetac Tailings Basin.

IT IS SO ORDERED

Commissioner Paul W. Aasen
Chair, Citizens' Board
Minnesota Pollution Control Agency

Date

APPENDIX A

Minnesota Pollution Control Agency

United States Steel Corporation, Minnesota Ore Operations, Keetac National Pollutant Discharge Elimination System/State Disposal System Permits MN0031879 and MN0055948

LIST OF COMMENT LETTERS RECEIVED

1. Lenard Anderson, Cloquet Citizen. Letter received electronically August 12, 2011.
2. Larry Dolphin, Izaak Walton League of America. Letter received August 19, 2011.
3. Lotti Matkovits, Golden Valley Citizen, Letter received electronically August 11, 2011.
4. Kathryn Hoffman, Minnesota Center for Environmental Advocacy (MCEA), Letter received electronically August 19, 2011.
5. Kevin M. Pierard, U. S. EPA Region 5. Letter received September 2, 2011.
6. Paula Goodman Maccabee, Esq., Just Change Law Offices, WaterLegacy. Letter received electronically August 18, 2011.
7. Nick Axtell, 1854 Treaty Authority. Letter received electronically August 12, 2011.
8. Mason C and Gwen S Myers, Minnetonka Citizens, Letter received electronically August 19, 2011.
9. Susan Stewart, Mahtomedi Citizen, Letter received electronically August 18, 2011.
10. Christine Hoffman, Alexandria Citizen, Letter received electronically August 14, 2011.
11. Gale Havrilla, Silver Bay Citizen, Letter received electronically August 12, 2011.
12. Comments from Group of Concerned Citizens – Extension Request. Letters received electronically August 10, 2011, to August 20, 2011.
13. Comments from Group of Concerned Citizens. Letters received electronically August 15, 2011 to September 8, 2011.

Comments from Group of Concerned Citizens – Extension Request:

Greg Overlid, Tracy Napp, Jean Ross, Michele Nihipali, Mary Dosch, Harriet McCleary, Stephen Rossitter, Elizabeth Mullen, William Herzberg, Mikanuk "Larry D. Adams," Kim Clymer Kelly, Diane Jankord, Rose Ramsey, Maxene Linehand, Cary Anderson, Beth Lewis, Ryan Anderson, Stephen Jay, Rebecca Lucking, Jacquelin Bartosh, Steven Koschak, Jane Koschak, Jamie Hoerter, Linville Doan, Steven Tracy, Amy Gardner, Lawrence Krantz, Melinda Sueflow, Stuart Knappmiller, Frank Moe, Kay Hempel, Ann Galbraith Miller, James Dushane, Pat Stevesand, Judith Rosenblatt, Paul Schollmeier, Carolyn Clements, Kay Labanca, Sue and Mike Prom, Guy Bateman, Elinor Ogden, Brian Major, Christine Hoffman, Christopher Boldt, Nathaniel Mordal, Paulette Anholm, Roger Michael, Jim Bambenek, Kay Koelkerwestby, Madelynn Frazier, Verba Weaver, Jamie Kaiser, Jan Scofield, Margaret Klette, Robert Robbins, Jayne Johnson, Judith Stoltzfus, William Dustin, Robert Davis, Frank Verderame, Colles Larkin, Terry Hokenson, Honor Schauland, Will Tajibnapis, Andy Pearson, Margie and David Back, Leslie Limberg, Lewsi Kuhlman, Amy Rus, Matt Johansen, Patricia Liquard, Sandra Keller, Anne Uehling, Gavin Sparby, Roger Muellner, Ann Marie, Mike Conrad, Betsey Porter, Mollie Schierman, David Howd, Susan Stewart, Jeanne Piehl, Karen Brugger, Kimberly Nieman, Martin Makinen, Kim Fishburn, Jim Carlen, Carol Mockovak, Dan Iverson, Kristi Kraling, Terry McCarthy, Sharon Meister, Jane Jaspersen, John Paul Roy, Marie Digatono, James and Sara Conway, Alexander Heid, Jeffrey Kirst, Jim Scheidt, Mark Sulander, Dick Bently, Barbara Janssen, Alex Barbeau, John Schmitt, Jesse Lucking, Christopher Loch, Allan Hancock, Nan Corliss, Elizabeth Merz, Annie Gardner, Diadra Decker, Kurt Seaberg, Gladys Schmitz, SSND, Christopher Norbury, Seymour Gross, Kevin Koschak, John Viacrucis, Donald Janes, Ann Beane, Krissy Hughes, Chad Oness, Peter Veits, Mary Moriarty, Ordell Vee, David Higgins, Corinne Livesay, Rosemary Welch, Art Wilkinson, Susan Scherer, Michael Kinney, Tony Doom, Karen Matthew, Erin Strauss, Ann Mikkelsen, Mark Kassal, Sue Halligan, Elisabeth Johnson, Robert Bullis, Erik Roth, Candice Mohammad, Janice Hallman, Janice Greenfield, Gail Grabow, Alma Ronningen, Judy Nelson, Gary Rost, Mimi Gngold, Katherine Doerr, Brian Thornbjornsen, Barb Knoth, Robert Desjarlait, Sharon Fortunak, Walk Gordon, Andrea Heier, John Pegg, Kathleen Moraski, Brent Gurtek, Carol Schaaf, Loren Stoner, Karrie Vrabell, Marie Nickell, Kate Ford, Michael Rice, Rebecca Stoner, Jeffrey Masco, A Bonvouloir, Jon Damon, Catherine Chayka, Ann Herdna, Martha Krikava, Douglas Limon, Lynn Lang, Kathy Kormanik, Bryan Hansel, Sandy Dvorsky, Mark Jepson, Lotti Matkovits

Comments from Group of Concerned Citizens:

A. Bonvouloir, Allan Hancock, Analiese Miller, Ann Chemin, Ann Marie, Annie Gardner, Arnie Roos, Art Wilkinson, Barbara Janssen, Barbara Stamp, Betsey Porter, Bruce McKay, Carlos Zhingre, Carolyn Clemnts, Cheryl Dannenbring, Chris Burda, Christine Hoffman, Christopher Carlson, Corinne Livesay, David Higgins, Deborah Huskins, Diane Tuff, Dorie Reisenweber, Edjee Jonson, Edward Bouril, Erik Roth, Gail Grabow, Greg Klave, Gregory King, Guy Bateman, Harriet McCleary, Herbert Davis, Honor Schauland, Ian Johnson, Jacqueline Bartosh, James Merklings, Jan Karon, Janice Greenfield, Jenna Conley, Jim Hart, Jim Hawkins, Jody Slocum, Joe Thorne, Johann Chemin, John Bussjaeger, John Schmitt, John Viacrucis, Karen Brugger, Karen Raccio, Kay Hempel, Kay Koelkerwestby, Krissy Hughes, Kristi Kraling, Kristin Olson, Lawrence Krantz, Lea Foushee, Lewis Kuhlman, Linda Morris, Lois Norrgard, Loren Stoner, Louis Asher, Lynn Lang, M. Richardson, Margie and David Back, Mark Kowaliw, Mark Salamon, Mary Lou Wilm, Mary Smith, Mary Sueflow, Mary Thompson, Mary Zink, Mikanuk "Larry D. Adams," Mike Ferguson, Mike Link, Mike Mjelde, Nan Corliss, Nancy Conger, Ordell Vee, Paul Thompson, Retha Dooley, Robert Davis, Roberta Avidor, Robin Poppe, Roger Muellner, Rosie Neher, Ryan Anderson, Sally Fineday, Sandra Keller, Saraphine Metis, Sharon Fortunak, Terry Hokenson, Terry Williams, Tony Doom, Tracy Napp, Tyler Henkels, Verba Weaver, Vikki Howard, Wanda Ballentine, Wendy Robertson, Will Tajibnapis, William Barton, William Dustin, William Herzberg

Minnesota Pollution Control Agency

United States Steel, Minnesota Ore Operations
Keetac – Tailings Basin NPDES/SDS Permit No. MN0055948
Keetac – Mining Operations NPDES/SDS Permit No. MN0031879

RESPONSES TO COMMENTS ON THE DRAFT PERMITS

1. Comments by Leonard Anderson, Cloquet Citizen. Letter received electronically August 12, 2011.

Comment 1-1: The sulfate limit allowed in this permit is in violation of the Minnesota standard for sulfate in wild rice.

Response: The comment indicates that the final effluent limitations contained in the draft permits are not consistent with the ambient water quality standard of 10 milligrams per liter (mg/L) sulfate for the protection of wild rice production waters, and that the maximum daily effluent limitation of 24 mg/L total sulfate is simply based on the highest observed value. The effluent limitations contained in the permit are based directly on the 10 mg/L total sulfate standard, and were calculated utilizing the same statistical procedures that are used to determine water quality-based effluent limitations (WQBEL) for National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) permits throughout Minnesota. The maximum measured value of 23.4 mg/L was not used in any way to determine the appropriate effluent limitations, but rather was used as a basis for comparison to determine whether or not the discharges authorized by the permits exhibited reasonable potential to cause or contribute to an excursion above the applicable water quality standard in the receiving water body. Based on the statistical analyses that were completed, the Minnesota Pollution Control Agency (MPCA) technical staff have determined that compliance with the effluent limitations contained in the draft permits will ensure that the permittee is not causing or contributing to excursions above 10 mg/L total sulfate in the receiving waters.

Comment 1-2: It is wrong to write an agreement between United States Steel Corporation (USS). and the State of Minnesota that allows them to violate the 10 mg/L standard until August 17, 2019.

Response: The MPCA disagrees with the characterization of the permits as agreements. The permits are regulatory instruments that require compliance with applicable environmental protection requirements. MPCA also disagrees with the assertion that the permits allow U.S. Steel Corporation to violate the 10 mg/L water quality standard until 2019. This statement is incorrect, as the permits are regulatory documents that contain a schedule of compliance that requires the Permittee to comply with the final effluent limitations for sulfate as soon as possible. The permits require progress toward compliance throughout the duration of the compliance schedule, and do not automatically grant the maximum amount of time allowed by the schedule, but instead require continual progress toward compliance, and require approval of proposed timeframes by the Minnesota Pollution Control Agency (MPCA).

Comment 1-3: Fish tissue mercury should also be considered. Increased sulfate discharges will in turn increase mercury methylation and therefore increase the fish tissue mercury.

Response: The permits do not authorize discharge of additional sulfate above the nondegradation baseline under the current permits for the referenced waters. The sulfate and mercury monitoring requirements in the permits during the interim period prior to the attainment of compliance with the final effluent limitations are consistent with the MPCA policy for addressing mercury impairments, including fish tissue impairments affected by mercury methylation. The effluent limitations of 14 mg/L as a calendar month average and 24 mg/L as a daily maximum represent decreases from the current discharge concentrations; therefore it is incorrect to state that they will result in any additional degradation beyond currently observed levels. Furthermore, the compliance schedules in the draft permits require the Permittee to take actions to reduce sulfate concentrations to the extent practical as soon as possible during the interim period.

Comment 1-4: The sulfate limit in the permit should be 10 mg/L.

Response: The final effluent limitations in the draft Permits have been calculated based on a waste load allocation of 10 mg/L total sulfate, and are applied to ensure that the Permittee's discharges do not cause or contribute to excursions above the applicable ambient water quality standard for sulfate, thereby ensuring that the Permits are protective of waters used for the production of wild rice. The limits are applied with a schedule of compliance in accordance with all state and federal regulations. Therefore, the Permits have not been modified as requested in your letter.

2. Comments by Larry Dolphin, Izaak Walton League of America. Letter received August 19, 2011.

Comment 2-1: The Minnesota Division Izaak Walton League of America opposes the issuance of a permit that allows a 10 mg/L sulfate standard until August 17, 2019 and supports the comments of member Len Anderson.

Response: See responses to comment 1-1 through 1-4.

3. Comments by Lotti Matkovits, Golden Valley Citizen, Letter received electronically August 11, 2011.

Comment 3-1: The commenter opposes the issuance of the permits without imposing limits on mercury and other toxic metals.

Response: The MPCA has reviewed site-specific data from the permit applications, including effluent data for mercury and metals, and determined that the discharges do not exhibit reasonable potential to cause or contribute to an excursion above the applicable water quality standards in the receiving water body for those pollutants. This reasonable potential evaluation was completed consistent with applicable state and federal requirements and is detailed in the statement of basis documents supporting the draft permits. Furthermore, the mercury monitoring requirements in the draft permits are consistent with MPCA policy for addressing mercury impairments in receiving and downstream waters.

Comment 3-2: The commenter also requests more time to comment on the permits.

Response: The MPCA extended the original public comment period for the permits, with the final comment period closing on August 19, 2011. The information related to the Keetac expansion has previously been available for public review during the public notice of intent to major modify

NPDES/SDS Permit MN0031879, which was open from May 14, 2010, to June 14, 2010; the public comment period for the Environmental Impact Statement (EIS) scoping process, which was open from September 8, 2008 to October 8, 2008; the public comment period for the draft EIS, which was open for 45 days, ending on January 26, 2010; the public comment period for the final EIS, which was open from November 12, 2010, to December 20, 2010; and public meetings regarding the EIS on October 1, 2008, and January 11, 2010. Additionally, the public will have the opportunity to present comments regarding the proposed reissuance of the permits at the MPCA Citizens Board meeting on October 25, 2011, where the permits will be presented for final determination on the reissuance. Additional information regarding the meeting can be found on the MPCA website, at the following address: <http://www.pca.state.mn.us/index.php/about-mpca/mpca-overview/mpca-citizens-board/mpca-citizens-board.html>

4. Comments by Kathryn Hoffman, Minnesota Center for Environmental Advocacy (MCEA), Letter received electronically August 19, 2011.

Comment 4-1: MCEA requests that the MPCA Citizens Board consider the issuance of the NPDES permits.

Response: The MPCA has agreed to present the permits to the Citizens Board for final determination on the proposed reissuances, pursuant to requests received during the public comment period.

Comment 4-2: MCEA requests that changes be made to Permit MN0055948 to clarify the location and limit derivation for SD008.

Response: Page 6 of the permit lists SD008 as the sum of the outfalls associated with SD001 and SD005. This is not an additional outfall, but simply a mathematical summation of the discharge flows associated with SD001 and SD005 to ensure that the total volume discharged from the tailings basin meets federal regulations. Given that the interim and final periods referenced in the permit are associated with effluent limitations for sulfate at individual outfalls, the permit has been corrected to reflect that the monitoring and reporting requirements for SD008 are applicable during both the interim and final periods.

Comment 4-3: The compliance schedule is contrary to Minnesota law. It exceeds the maximum time period for compliance, and does not meet the statutory or regulatory definitions of a compliance schedule.

Response: The comments indicate that the compliance schedules contained in the draft permits exceed the maximum timeframe of five years allowed under Minn. R. 7052.0260 subp. 3. Please note that Minn. R. ch. 7052 applies specifically to the Lake Superior Basin. Given that the compliance schedule in the permits regulates point source discharges to the Mississippi River basin, the rules regarding compliance schedules under Minn. R. 7052.0260 are not applicable in this case. The compliance schedule has been developed in accordance with the requirements of Minn. R. 7001.0150 subp. 2.A.

The comments additionally state that the compliance schedules contained in the permits do not meet the requirements for a compliance schedule by failing to lead to compliance with applicable Minnesota Rules. The comment also states that the compliance schedules do not lead to compliance, as the schedule does not specify the means by which the limitations must be met, or

require interim benchmarks other than further study. These statements are incorrect, as the requirements of the compliance schedules are explicitly written with the requirement to attain compliance with the final effluent limitations for total sulfate contained in the permits. The requirements to complete the Water Management Study and the Sulfate Reduction Strategy Study, both currently in progress pursuant to NPDES/SDS Permit MN0031879, have the express purpose of informing the development of a Sulfate Reduction Plan that the Permittee is required to implement following MPCA review and approval to attain compliance with the final effluent limitations contained in the permits. The permits have been modified to clarify how the actions required by the compliance schedules must lead to compliance with the final effluent limitations for total sulfate.

The comments indicate that the compliance schedules in the permits fail to require interim measures that lead to compliance with the final effluent limitations, specifically stating that the interim requirements do not lead to compliance within five years, that interim reductions in pollutant load or concentration must be made to achieve compliance with final effluent limitations as soon as possible, and that the interim requirements of the schedules fail to meet the intent of the federal regulations governing compliance schedules in NPDES permits. As previously discussed, the five year maximum timeframe referenced in your comments is not applicable to the compliance schedules contained in the permits, and the schedules meet the applicable requirements under Minn. R. 7001.0150. Please note that the compliance schedules require the Permittee to continue minimizing sulfate concentrations in the discharge to the extent possible prior to the compliance date, a requirement which will be informed by the completion of the required Water Management Study and Sulfate Reduction Strategy Study currently in progress. Additionally, in response to comments received following public notice of the intent to reissue the permits, the MPCA has added requirements to comply with interim effluent limitations following completion of any approved treatment evaluations to ensure that continued progress is made toward compliance with the final effluent limitations prior to the end of the compliance schedules. Following completion of the required Water Management Study and Sulfate Reduction Strategy Study, the permits require the Permittee to implement the actions contained in an approved Sulfate Reduction Plan, which is required by permit language to lead to compliance with final effluent limitations as soon as possible. The language in the permits has been modified to clarify how implementation of the Sulfate Reduction Plan will lead to compliance with final effluent limitations.

The comments raise concern that no progress has been made toward compliance with effluent limitations based on the ambient water quality standard for sulfate in wild rice production waters. It should be noted that, as stated in the permits, the Permittee submitted plans for the Water Management Study and the Sulfate Reduction Strategy Study following modification of NPDES/SDS Permit MN0031879 on June 17, 2010, and both plans were approved by the MPCA on October 6, 2010. Both of the studies are currently in progress, as indicated by the first progress report, which was submitted in accordance with the requirements of NPDES/SDS Permit MN0031879 on April 6, 2011.

Additionally the comments correctly note that 40 CFR 122.47(a)(1) requires that compliance schedules must be written to require compliance as soon as possible. It should also be noted that the permits have been drafted to explicitly require that "Compliance with the final effluent limitations shall be attained as soon as possible, and in no case shall compliance be attained later than August 17, 2018, for non-tailings basin discharges, and August 17, 2019, for tailings basin

discharges, unless the permit is modified pursuant to 40 CFR 122.62.” Additionally, the permits do not automatically grant the maximum amount of time, but rather require approval by the MPCA of proposed timeframes for the attainment of compliance, and ongoing demonstration by the Permittee through progress reports on the implementation of the Sulfate Reduction Plan that compliance is being attained as soon as possible.

The comments further state that the schedules in the draft permits fail to lead to compliance with the applicable effluent limitations because the compliance schedules do not mandate specific solutions that must be evaluated and implemented to lead to compliance with final effluent limitations. Please note that this is the express purpose of the required Water Management Study and Sulfate Reduction Strategy, and the implementation of solutions that will result in compliance with final effluent limitations for sulfate as soon as possible is the express purpose of the required Sulfate Reduction Plan. The language in the permits has been modified to clarify the intent of these actions.

Comment 4-4: The compliance schedule is contrary to federal law.

Response: The comments indicate that MPCA has violated federal regulation by failing to enforce the ambient water quality standard for sulfate in wild rice production waters, and has exercised authority in violation of federal law by failing to require compliance as soon as possible. As previously discussed, the draft permits include schedules, which specifically require the reduction of sulfate concentrations in the permitted discharges to the extent practical prior to achieving compliance with the final effluent limitations, and require the Permittee to evaluate and implement facility-wide water management strategies and sulfate reduction options with the explicit requirement to comply with final effluent limitations based on the applicable water quality standard as soon as possible. The schedule of compliance contained in the Permits requires that compliance be attained in accordance with all federal regulations. Comments further suggest that the inclusion of language regarding collection of data and research implies that the Permittee may select this as an alternative to compliance with final effluent limitations as required by the permits. Language included in Chapter 1, Section 2 of NPDES/SDS Permit MN0031879 in no way allows the Permittee to select an alternative to compliance with the final effluent limitations in the permits unless the permits are modified in accordance with all state and federal regulations. The language has not been removed at this time.

Comment 4-5: The permits do not reflect the additional pollution burden of the proposed expansion of Keetac mining operations.

Response: The comment indicates that the permits do not require mitigation of impacts on wastewater discharges resulting from the proposed increase in mining and taconite processing activities at the Keetac facility. Please note that the draft Permits do not authorize discharge of sulfate above the nondegradation baseline established by the currently effective Permits, and the Permittee has proposed to implement the mitigation for pollutant increases indicated in the final EIS for the proposed Keetac expansion project in order to prevent the unmitigated impacts predicted by the EIS, as indicated in the applications for the permits. Although the draft permits do not require the Permittee to implement specific mitigation actions, the Permittee is required to implement actions as necessary to prevent degradation of downstream waters and comply with all rules governing nondegradation. The permits do not authorize expansion or change to the characteristics of wastewater discharges that conflict with the requirements of Minn. R.

7050.0180 and Minn. R. 7050.0185 regarding nondegradation for waters of the state, therefore the Permittee must implement mitigation to prevent degradation above currently permitted levels. Furthermore, the compliance schedules previously discussed require the Permittee to further reduce sulfate-related impacts from existing levels. Therefore the impacts on wastewater discharges from the Keetac facility as a result of the proposed mining expansion are not expected to increase from the currently permitted levels. The permits have not been changed to require additional mitigation.

Comment 4-6: The commenter states that “reasonable potential” and WQBEL calculations should be done for all receiving waters, not just immediate receiving waters.

Response: The comment states that the calculations used to determine whether or not the Keetac discharges exhibit reasonable potential to cause or contribute to an excursion above the water quality standards are incomplete, as they have not evaluated the potential to exceed water quality standards in the receiving waters downstream from those immediately receiving the discharge. This statement is incorrect, as the MPCA does evaluate the potential to exceed water quality standards in downstream water bodies. This review is the basis for inclusion of effluent limitations for total sulfate in the draft permits. The immediate receiving waters have not been determined to be waters used for the production of wild rice, however the reasonable potential to cause or contribute to excursions above the ambient water quality standard for the protection of wild rice has been evaluated specifically because of the fact that downstream receiving waters have been determined by the MPCA to be waters used for the production of wild rice. Additionally, the comments state that the reasonable potential calculations do not take into account the higher flows for the downstream receiving waters where the ambient water quality standard for the protection of wild rice would actually apply. The MPCA has taken a conservative approach by applying the effluent limitations as calculated for the immediate receiving water, as the critical low flow rate of zero in the receiving water requires the Permittee to meet the water quality standard without any allowance for dilution in the receiving water, as reflected by the waste load allocation of 10 mg/L used in the reasonable potential calculations for sulfate.

Comment 4-7: When calculating the sulfate effluent limits, MPCA should use the actual coefficient of variation (CV) from the Keetac facility, not a hypothetical CV of 0.6.

Response: The comment indicates that effluent limitations for total sulfate should be calculated utilizing a CV of 0.106 based on the current variability observed in discharges via SD005, instead of an assumed CV of 0.6, as it results in a lower effluent limitation, which MCEA believes to be more conservative. The CV is a statistical value, which describes the variability associated with treatment operations, and the default value of 0.6 taken from U.S. Environmental Protection Agency (EPA) guidance is based on typical variability of effluent concentrations when treatment processes are utilized prior to discharge. Given the likelihood that some form of treatment will be necessary in order to comply with the final effluent limitations for the outfalls currently authorized by the permits, the assumption that the variability of effluent concentrations will remain the same as observed under current operations, in which there is no treatment process in operation specifically for the reduction of sulfate, is not justified. Additionally, the assumption of higher effluent variability is a more conservative assumption, as this assumes that a lower long-term average effluent concentration must be targeted in order to ensure that the effluent waste load allocation of 10 mg/L is met. The effluent limitations for the draft permits have not been

recalculated.

Comment 4-8: Based on USS's history, MPCA should require USS to monitor its outfall effluent daily, rather than twice a month. This will result in more accurate testing and more stringent limits.

Response: The permits require that a minimum of two samples per month be collected to demonstrate compliance with sulfate limitations. This sampling frequency is consistent with the MPCA practice for water quality-based effluent limitations in NPDES/SDS permits throughout Minnesota. Although the use of a higher sampling frequency in the statistical reasonable potential calculations does result in lower effluent limitations, the lower effluent limitation does not correlate to a better environmental impact, as the waste load allocation for the discharge of pollutants and the long term average pollutant concentration following treatment do not change. Given that the additional sampling is not believed to be necessary to ensure compliance with environmental standards, the monitoring frequencies required by the draft permits have not been changed.

5. Comment by Kevin M. Pierard, U. S. EPA Region 5. Letter received September 2, 2011.

Comment 5-1: Please revise draft NPDES/SDS Permit MN0055948 either to incorporate by reference the schedule in draft NPDES/SDS Permit MN0031879, or provide the same level of detail as is included in draft Permit MN0031879.

Response: NPDES/SDS Permit MN0055948 has been modified to include the compliance schedule contained in NPDES/SDS Permit MN0031879 by reference.

Comment 5-2: Please revise the schedules so that the different compliance schedules following MPCA approval or disapproval of treatment technology pilot studies are independent, and contain distinct enforceable actions leading to compliance with the WQBEL for sulfate.

Response: The language in NPDES/SDS Permit MN0031879 has been modified to indicate two distinct schedules, with distinct requirements for attainment of compliance with final effluent limitations for each case regarding the MPCA approval or disapproval of a request for full-scale treatment evaluation on representative outfalls.

Comment 5-3: Please revise the schedules so that it is clear that the full scale treatment technology pilot studies are required for a representative outfall of each type of discharge, specifically tailings basin, dewatering pit, and Reservoir 5/sedimentation basins. Please specify that the representative dewatering pit outfall will be one included in draft NPDES/SDS Permit MN0031879 and therefore fall under that schedule.

Response: The compliance schedule has been modified in NPDES/SDS Permit MN0031879 to require evaluation of full-scale treatment evaluation for outfalls representative of wastewater type. The MPCA has not specified the three waste types contained in your comments, due to the possibility of these waste types changing due to operational modifications, dependent on the results of the Water Management Study that is currently in progress. As an equivalent measure, the MPCA is requiring the Permittee to base any request for testing on representative outfalls on consideration of physical condition of the wastewater, wastewater chemistry, and the size/frequency of the discharge within the Sulfate Reduction Plan. The permit language has also been modified to

specify compliance dates based on the type of wastewater discharged as requested.

Comment 5-4: The schedules of compliance require successful full-scale pilot treatment of outfalls representing the various types of discharges at the facility. The schedules should require interim limits for sulfate at each outfall selected for the full-scale pilot studies, effective upon completion of the testing phases specified in paragraphs 1.11, 1.12, and 1.13 of draft NPDES/SDS Permit MN0031879 and paragraphs 1.5, 1.6, and 1.7 of draft NPDES/SDS Permit MN0055948.

Response: The language has been modified to require compliance with an interim effluent limitation for total sulfate of 14 mg/L as a calendar quarter average. This effluent limitation will be applied on any outfalls for which full scale treatment evaluation is approved, following the completion of those evaluations, to ensure continued progress toward compliance with final effluent limitations.

Comment 5-5: Please correct the dates specified in the draft permits to reflect that the sulfate WQBELs shall be attained as soon as possible but no later than August 17, 2018, as opposed to the August 2019 date specified in draft NPDES/SDS Permit MN0031879 permit. Draft NPDES/SDS Permit MN0055948 also appears to specify the incorrect date. Please revise the dates specified in both draft permits to correct the discrepancy.

Response: The final compliance dates have been corrected to require compliance with final effluent limitations as soon as possible and in no case later than August 17, 2018, for non-tailings basin discharges, and August 17, 2019, for tailings basin discharges.

Comment 5-6: There is significant public interest in this facility and both of these permits. MPCA should upload the facility discharge monitoring reports (DMRs) and permit compliance status and history for both permits to EPA's Integrated Compliance Information System (ICIS) database.

Response: At this time, the MPCA is not uploading the Permittee's DMRs and compliance status to the ICIS database. The MPCA recognizes the public interest in this facility, and the associated NPDES/SDS permits, and has noted EPA's comments regarding this issue. Please note that all public information regarding NPDES/SDS Permits MN0031879 and MN0055948, as well as the Permittee's compliance with these permits, is available for inspection and copying by any person pursuant to Minn. R. 7000.1200.

Comment 5-7: The data provided with the applications indicate that selenium has been detected at several outfalls. Selenium monitoring requirements are included in the draft permits for SD009 only. At a minimum, please add a monitoring requirement for selenium at SD005 in accordance with 40 CFR §§ 122.44 and 122.48.

Response: The MPCA has added a monitoring requirement for selenium at SD005 as requested.

6. Comment by Paula Goodman Maccabee, Esq., Just Change Law Offices, WaterLegacy. Letter received electronically August 18, 2011.

Comment 6-1: The draft permits for the Keetac Mine Area and Keetac Tailings Basin result from a major expansion of mining activity requiring a comprehensive nondegradation analysis.

Response: As a point of clarification, note that expansion of industrial activity does not trigger a requirement for a nondegradation analysis. The requirement to complete a nondegradation analysis is based on an increase in permitted discharge flow. Although the Permittee has proposed an expansion to the industrial activity conducted at the Keetac facility, the MPCA has determined that a nondegradation analysis is not required for most of the changes to the operation of the permitted disposal systems and the wastewater discharges associated with those systems as a result of the proposed expansion.

The comments correctly note that the applications, which were used for the reissuance of the permits, were originally submitted with the intent to address changes to the permitted operations at the Keetac facility as a result of the proposed mining expansion. It is also correct to state that there will be an increase in the area used for stockpiling, the volume of tailings and associated process wastewater sent from the processing facility to the tailings basin, wastewater discharges from the tailings basin system and dewatering waste streams, and chemical usage associated with taconite processing. However, the proposed changes to operations regulated by permits are primarily within the range currently allowed by the permits, and therefore would not require nondegradation review. In accordance with Minnesota Rules, nondegradation review was completed to the extent that the discharges authorized by the draft Permits constitute significant new or expanded discharges, as discussed in greater detail below.

As indicated in the comments, Minn. R. 7050.0185 subp. 4 require a nondegradation analysis for any new or expanded discharge that is a significant discharge as defined in Minn. R. 7050.0185 subp. 2.G. in order for the MPCA to determine whether additional control measures can reasonably be taken to minimize the impact of the discharge on the receiving water. As detailed in Minn. R. 7050.0185 subp. 5, for discharges of industrial and other wastes, the flow rate to be used to determine whether the discharge is significant is the design maximum daily flow rate. With the exception of the Permittee's proposal to discharge dewatering effluent from the Sargent Pit directly to an unnamed ditch flowing to Reservoir 2, the maximum design discharge flow rates anticipated for this permitting action are equivalent to or lower than the currently permitted flow rates, as indicated in the applications for the permits. For that reason, nondegradation analysis was not completed for the permitted wastewater outfalls that do not meet the definition of significant new or expanded discharges. Pursuant to Minn. R. 7050.0185, a nondegradation analysis was completed for the new discharge of Sargent Pit dewatering effluent to the unnamed ditch to the extent that the new discharge will impact the receiving water bodies, as indicated in the Statement of Basis for NPDES/SDS Permit MN0055948.

The comments further indicate that WaterLegacy believes that the draft Permits will result in degradation of downstream receiving waters, including ORVWs. As discussed in greater detail in the response to Comments 6-2 and 6-3, the MPCA has verified that the draft Permits prevent degradation of downstream receiving waters as required by the provisions of Minn. R. 7050.0180-7050.0185.

Comment 6-2: The Keetac mine expansion nondegradation review should analyze potential impacts to downstream waters of outstanding resource value and Lake Superior Basin waters.

Response: As previously discussed, a nondegradation review was completed for the new discharge of Sargent Pit dewatering effluent to an unnamed ditch leading to Reservoir 2, in accordance with Minn. R. 7050.0185, and that nondegradation review for the other permitted discharges was

determined by the MPCA not to be necessary as they do not meet the definition of a significant discharge. The comment indicates that additional nondegradation review is required to address impacts to water bodies downstream of the immediate water body that are Outstanding Resource Value Waters (ORVWs) as defined in Minn. R. 7050.0180.

The comments correctly state that the MPCA is required to control new and expanded discharges upstream of an ORVW to assure no deterioration in the quality of the downstream ORVW, pursuant to Minn. R. 7050.0180 subp. 9. The comments indicate that the MPCA has failed to apply this requirement based on a discretionary decision for the permits, citing a statement from the application for NPDES/SDS Permit MN0055948 reading “MPCA personnel indicated that for the purposes of this application, the MPCA would not apply ORVW nondegradation review, but would rely on the “all waters” classification of the water bodies discharged into and nearby downstream points.” This statement should not be interpreted to mean that the MPCA has elected to selectively apply only Minn. R. 7050.0185 for nondegradation requirements applying to all waters, but rather that the MPCA has determined that the water bodies to which the nondegradation review must apply are limited to non-ORVW water bodies, specifically those between the immediate discharge and the O’Brien Diversion Channel, as discussed below.

As documented in the final EIS for the proposed Keetac mining expansion, and as indicated by the wastewater flow diagram in Appendix A, Figure 2 of the permit application for NPDES/SDS Permit MN0055948 illustrating current conditions, dewatering effluent from the Sargent Pit is currently discharged to O’Brien Creek via the Mesabi Chief Pit, as authorized by NPDES/SDS Permit MN0031879. Wastewater discharged via this outfall flows through the O’Brien Reservoir to the O’Brien Diversion Channel. The proposed direct discharge of Sargent Pit dewatering under NPDES/SDS Permit MN0055948 will also eventually discharge to the O’Brien Diversion Channel after flowing through Reservoir 2. Therefore, given that the effluent from this dewatering operation already reaches the proposed receiving waters downstream of Reservoir 2, the discharge does not constitute a new or expanded discharge to the O’Brien Diversion Channel, or any of the receiving waters downstream from that point, including the downstream ORVW water bodies. Therefore, the nondegradation analysis has been completed for the unnamed ditch to which Sargent Pit dewatering effluent will be discharged, as well as Reservoir 2, as they are the only water bodies that will be receiving a new or expanded discharge. Minn. R. 7050.0185 for Nondegradation for All Waters is the applicable rule governing nondegradation for these water bodies. Given that the proposed discharge is not a new or expanded discharge to water bodies downstream of the O’Brien Diversion Channel, the discharge is not expected to affect the water quality of downstream ORVWs, therefore additional controls to prevent degradation of downstream ORVWs pursuant to Minn. R. 7050.0180 subp. 9 are not warranted.

The comments further indicate that nondegradation analysis should be completed to determine impacts resulting from the expansion on Outstanding International Resource Waters (OIRWs) in the Lake Superior Basin due to some portions of the Keetac facility’s operations being located within the Lake Superior watershed. As discussed in the EIS for the Keetac expansion, water transfers between basins and rerouting of surface runoff as a result of mining activity are regulated by the Department of Natural Resources, and are outside the scope of the permits. Furthermore, the additional runoff to the Lake Superior Basin resulting from the additional stockpiling activities meets the definition of an expanded discharge of industrial stormwater as described in Minn. R. 7052.0310. Therefore, the MPCA has determined that the requirements to maintain best management practices for the control of industrial stormwater as detailed in the

permits are adequate to protect the water quality of the Lake Superior Basin, and further analysis beyond the potential impacts evaluated in the EIS for the proposed Keetac expansion is not required.

Comment 6-3: The Keetac Mine and Tailings Basin permits should set maximum discharge loading limits and require conditions for treatment efficacy needed to prevent degradation of Minnesota Waters.

Response: The comments indicate that the permits should require mass loading limits and internal treatment improvements in order to ensure compliance with nondegradation requirements for hardness and sulfate. The baseline flows and associated pollutant loadings described in Minn. R. 7050.0185 are not intended to be effluent limitations, but instead are triggers for the evaluation of the need for additional requirements in the event that the Permittee proposes to expand their permitted discharge in such a way that it becomes a significant discharge as defined in the rule. The draft Permits do not authorize increased pollutant loading in the permitted discharges in such a way that the permitted discharge flows and baseline effluent quality as defined under Minn. R. 7050.0185 subp. 2.C. would be exceeded, and failure to maintain discharge loading below these values is a violation of the Permits due to incorporation of nondegradation rules by reference. The Permittee has proposed installation of treatment technology to ensure compliance with nondegradation rules, and the MPCA believes that the monitoring requirements for sulfate and hardness related parameters in the draft Permits are sufficient to verify that nondegradation rules are not violated following the operational changes associated with the proposed expansion of mining activity, therefore additional limitations and monitoring requirements have not been added.

Additionally, the comments identify the requirement to comply with final effluent limitations as an outcome following additional sulfate loading. As a point of clarification, the schedules for compliance with final effluent limitations for sulfate are not related to the Permittee's proposal to install additional treatment equipment to reduce sulfate loading to the tailings basin. The Permittee will be required to maintain sulfate loading in the tailings basin discharge below the baseline quality established by Minn. R. 7050.0185 immediately, and must manage water quality in the discharge as necessary to ensure compliance with the nondegradation requirements that are incorporated by reference in the permits. The schedules of compliance included in the permits are for additional reductions that the Permittee is required to make in order to comply with final effluent limitations for sulfate that are based on ambient water quality standards for the protection of wild rice.

The comments also request evaluation of the potential for iron and mercury to degrade water quality, and indicate a request for the inclusion of effluent limitations to restrict mass loading for these parameters to ensure compliance with nondegradation rules. As previously discussed, a nondegradation review was completed in accordance with Minn. R. 7050.0185 for the proposed new direct discharge of Sargent Pit dewatering effluent, in which the MPCA determined that the monitoring requirements for mercury, and the effluent limitations and related monitoring requirements for iron, are adequate to ensure that the water quality standards for the receiving waters will be met in accordance with Minn. R. 7050.0185 subp. 3, and that additional controls to prevent degradation of the receiving waters pursuant to Minn. R. 7050.0185 subp. 4 are not warranted. For the remaining Keetac discharges, as discussed on page 4-52 of the EIS for the proposed mining expansion, water quality associated with wastewater discharges is not anticipated to change for typical parameters of concern with the exception of the impacts associated with the scrubber blowdown waste stream and the treatment of that waste stream. Given that the pollutant

concentrations for iron and mercury are expected to remain within the ranges currently observed under the Keetac facility's existing operations, and, as previously discussed, the proposed changes to wastewater flows do not trigger nondegradation review for any discharges other than the Sargent Pit dewatering outfall, the MPCA has determined that the effluent limitations for iron and the monitoring requirements for mercury are sufficient to ensure compliance with the nondegradation requirements that are incorporated by reference in the permits.

Comment 6-4: The Keetac Mine and Tailings Basin permits should impose current effluent limits for sulfate. The schedules of compliance in the draft permits are inconsistent with applicable law.

Response: The comments correctly note the rule citations describing the requirements for schedules of compliance contained in NPDES/SDS permits. The MPCA has applied the state rules and federal regulations that are detailed in the comments in the permits.

The comments indicate that there is not necessarily a connection between the Water Management Study and the Sulfate Reduction Strategy Study (Studies) that are currently in progress pursuant to the requirements of the current NPDES/SDS Permit MN0031879 and a change in sulfate effluent. This is incorrect, as the express purpose of the Studies is to inform the required development of a Sulfate Reduction Plan, which the Permittee is required to implement following MPCA review and approval. The Sulfate Reduction Plan must identify the actions that will be taken by the Permittee with the specific purpose of complying with the final effluent limitations for sulfate. The comments further indicate that the permits do not meet the requirements of state and federal law by failing to require compliance as soon as possible. Please note that the language in the permits explicitly states that "compliance with final effluent limitations shall be attained as soon as possible..." The Permits are structured to require compliance based on a series of actions that could potentially last through August of 2018 for non-tailings basin discharges, and 2019 for tailings basin discharges; however the Permittee is required to comply with the final limitations more expeditiously if possible.

The comments indicate that the MPCA must require immediate compliance with effluent limitations that are based on water quality standards adopted before July 1, 1977. However, EPA precedent indicates that compliance schedules may be allowed for discharges subject to water quality-based effluent limitations derived from standards that are new, revised, or reinterpreted after July 1, 1977. The waters downstream from the Keetac facility's discharges are not specifically named in Minnesota Rules as waters used for the production of wild rice. Based on case-specific review of the information currently available, the MPCA newly interpreted the 10 mg/L sulfate standard in Minn. R. 7050.0224 subp. 2 to be applicable to water bodies downstream from the Keetac discharges in 2010. Therefore, compliance schedules have been determined to be allowed pursuant to Minn. R. 7001.0150.

Comment 6-5: Permits for the Keetac Mine and Tailings Basin should contain WQBELs for selenium, specific conductance, hardness and mercury.

Response: The comment correctly notes that the statement of basis for NPDES/SDS Permit MN0055948 indicates that limits are included in the draft permit for selenium and specific conductance. This statement was included in error, as the MPCA policy is not to include effluent limitations based on limited data. The MPCA has reviewed the data from the permit application for NPDES/SDS Permit MN0055948, and determined that additional monitoring is warranted for selenium and specific conductance at outfall SD009, however there is not sufficient data to determine whether or not reasonable potential exists to exceed water quality standards to warrant an effluent limitation for

either of these parameters.

The comments indicate that the MPCA has maximized the potential for dilution in evaluating the reasonable potential to exceed water quality standards by applying maximum design flow in the analysis. In fact, by applying the maximum design flow for the facility's discharge, and the 7Q10 low flow condition for the receiving stream, the MPCA has maximized the potential impact of the discharge on the receiving water concentration as required for these analyses. The critical conditions utilized in these analyses effectively model the reasonable potential to exceed water quality standards in the receiving stream assuming the highest predicted pollutant concentration in the effluent, the highest flow of effluent from the outfall, and the lowest dilution potential in the receiving stream.

The comments regarding hardness indicate that the reasonable potential analysis for this parameter is inadequate due to use of maximum dilution and an incorrect water quality standard. Please note that the water quality standard of 250 mg/L for hardness referenced in the comments is not a Class 2B water quality standard, but is a Class 3B water quality standard as detailed in Minn. R. 7050.0223 subp. 3, and is one of three standards referenced in Minn. R. 7050.0220 subp. 5a.A.(8). This standard is not applicable to the receiving waters for the Keetac discharges, as all of the applicable receiving waters have a Class 3C designation, for which the applicable ambient water quality standard for hardness is 500 mg/L, as utilized in the reasonable potential calculations. As previously discussed, the reasonable potential calculations assume critical conditions that model the minimum dilution; therefore the proper conditions have been evaluated.

The comments regarding mercury suggest that effluent limitations for mercury must be included in the Permits, and recommend an effluent limitation of 6.9 ng/L for the permitted discharges, and 1.3 ng/L for any discharges to the Lake Superior Basin. Please note that reasonable potential analyses have been completed for total mercury at all outfalls authorized by the Permits utilizing a waste load allocation of 6.9 ng/L based on the applicable water quality standards for the water bodies receiving the permitted discharges. None of the permitted discharges are to the Lake Superior Basin, therefore the 1.3 ng/L standard is not applicable. As previously discussed, the critical flow conditions used in the reasonable potential analyses do not maximize dilution potential, but rather account for minimal receiving water dilution. Given that the procedures used to account for mercury water quality standards in the Permits, as described in the final EIS, have not shown reasonable potential, effluent limitations have not been included in the draft Permits. Effluent monitoring requirements have been applied in the Permits, consistent with MPCA policy and the implementation plan for the state-wide mercury Total Maximum Daily Loads.

Comment 6-6: Permits for the Keetac Mine and Tailings Basin should require additional monitoring for hardness (calcium and magnesium), aluminum and manganese and multiple monitoring sites should be required to identify impacts of mine expansion.

Response: The comments indicate that monitoring requirements should be required for calcium in the tailings basin based on nondegradation concerns as previously discussed. As previously noted, the MPCA has included monitoring requirements on the influent waste stream to the tailings basin that is anticipated to contribute to additional hardness, which is believed to be adequate to ensure that nondegradation requirements are met for discharges from the tailings basin. Therefore, additional monitoring requirements have not been included.

The comments further indicate that hardness monitoring should be required on discharges from the Keetac mining area due to anticipated increased use of magnesium chloride as a dust suppressant as a result of the increased footprint of the mine following the proposed expansion. Please note that the mechanism by which this additive contributes to hardness is from precipitation runoff. The increase in the amount of the dust suppressant applied based is anticipated to be accompanied by an equivalent increase in runoff volume, therefore the hardness concentrations observed in the currently discharges are not anticipated to be affected by the proposed expansion, therefore additional monitoring requirements have not been included in the draft Permits.

The comments indicate that aluminum monitoring must be required due to the use of aluminum chlorhydrate in the turbidity treatment system that is used for discharges via SD002. Due to the use of this additive as a flocculent, the aluminum associated with the product becomes bound to the suspended solids from the wastewater. Due to the high removal of solids associated with the turbidity treatment system, aluminum concentrations are not anticipated to increase appreciably, therefore additional monitoring has not been required.

The comments request ongoing monitoring for manganese due to measured concentrations for that parameter in the Keetac tailings basin in excess of the Minnesota Health Risk Limit (HRL), and monitoring data from other mine facilities. Please note that the HRL referenced in the comments is not a water quality standard applicable to the discharges authorized by the Permits, therefore monitoring requirements have not been included in the draft Permits based on this comparison.

The comments express concerns regarding the monitoring frequency required for the permitted discharges. Monitoring requirements have been assigned consistent with MPCA practices for NPDES/SDS permits throughout Minnesota based on consideration of the detention times for the wastewater discharges authorized by the Permits, and the variability in concentrations associated with the industrial activities at the Keetac facility. Additionally, with regard to the comments on the sampling frequency required for mercury, the quarterly sampling requirement is included based on MPCA policy for mercury monitoring for industrial discharges.

Based on review of site-specific information from the Keetac expansion EIS and the data received to support the permit reissuance process, the MPCA has determined that the monitoring requirements are sufficient to characterize the permitted disposal systems and the associated discharges.

Comment 6-7: The permit review process should address additional concerns: mercury methylation, rating of mine expansion permits as “minor,” and accessibility of public information.

Response: Your comments indicate concern that sulfate discharges from the Keetac facility will result in additional mercury methylation in receiving waters. Please note that, as previously discussed, the levels of sulfate in the permitted discharges are not authorized to exceed the currently permitted levels due to rules governing nondegradation. Furthermore, the compliance schedule for sulfate in the draft Permits requires that the Permittee further reduce sulfate loading to receiving waters, thereby further reducing the impact of sulfate on mercury methylation over the long-term. The ongoing monitoring requirements for both mercury and sulfate are consistent with MPCA policies for reducing mercury impacts in waters of the state.

Your comments regarding the process for rating NPDES permits as “major” or “minor” have been noted. Please note that the rating worksheet used by the MPCA is the same used for NPDES permits

issued by the U.S. Environmental Protection Agency (EPA), and that the EPA's ability to review NPDES/SDS permits issued by the MPCA is not affected by the permit rating.

Your comments regarding public process have been noted. Please note that all public information regarding NPDES/SDS Permits MN0031879 and MN0055948, as well as the Permittee's compliance with these permits, is available for inspection and copying by any person pursuant Minn.

R. 7000.1200. Information regarding the presentation of the draft permits for final determination by the MPCA Citizens Board will be made available online at the following address:

<http://www.pca.state.mn.us/index.php/about-mpca/mpca-overview/mpca-citizens-board/mpca-citizens-board.html>.

7. Comment by Nick Axtell, 1854 Treaty Authority. Letter received electronically August 12, 2011.

Comment 7-1: The 1854 Treaty Authority would like to see the reasonable potential analysis that was used to determine this average concentration level rather than the standard of 10 mg/L sulfate.

Response: Refer to the response to comment 1-1. In addition, the statement of basis supporting documents for each permit presents information on the reasonable potential analyses for sulfate.

Comment 7-2: The 1854 Treaty Authority is concerned with the length of time the compliance schedules will take and would like to see limitations on sulfate levels prior to the final effluent limits in 2019.

Response: Please refer to the response to comment 5-4.

8. Comment by Mason C and Gwen S Myers, Minnetonka Citizens, Letter received electronically August 19, 2011.

Comment 8-1: The permit will exceed air quality standards without treating wastewater.

Response: Comments have been noted by the MPCA, however, please note that air related comments do not pertain to the Keetac Mine and Keetac Tailings Basin permits identified in your e-mail, and the comments were received following completion of the public comment period for the air emissions permit.

Comment 8-2: The proposed permits are discouraging, given the mercury-related fish consumption restrictions on Minnesota lakes and rivers.

Response: Please refer to the responses to comments 1-3 and 3-1.

9. Comment by Susan Stewart, Mahtomedi Citizen, Letter received electronically August 18, 2011.

Comment 9-1: The commenter voices concern regarding water quality and the fragile nature of wild rice and the impact that mining operations have on these resources.

Response: Comment noted.

10. Comment by Christine Hoffman, Alexandria Citizen, Letter received electronically August 14, 2011.

Comment 10-1: The commenter voiced concerns regarding the natural resources of the area and the impact that mining activities have on the area.

Response: Comment noted.

11. Comment by Gale Havrilla, Silver Bay Citizen, Letter received electronically August 12, 2011.

Comment 11-1: Limits on mercury and other toxic metals should be set in accordance with existing regulations.

Response: Please refer to the response to comment 3-1.

Comment 11-2: The commenter is concerned about the levels of pollution in fish and wild rice in the area.

Response: Please refer to the response to comment 1-3.

12. Comments from Group of Concerned Citizens – Extension Request, Letters received electronically August 10, 2011, to August 20, 2011.

Comment 12-1: The public notices do not explain the proposed mining expansion at the Keetac facility.

Response: The Public Notice of Intent documents for each of the Permits that were distributed in accordance with Minnesota Rules on June 27, 2011, and again on July 27, 2011, when the public comment period was extended to August 12, 2011, to account for business days lost due to the Minnesota government shutdown, explicitly state “The facility has proposed an expansion to their mining and pellet production operations, which will increase production from 6.0 million short tons of pellets per year to 9.6 million short tons per year. The conditions of this permit reflect the changes associated with that expansion.” Further, the permits and the statements of basis identify the changes in permitted activities that are anticipated for each of the permits as a result of the proposed mining expansion. As a point of clarification, it should be noted that the permits do not authorize an expansion of mining, but rather authorize the operation of disposal systems and the wastewater discharges associated with those systems. The expected changes associated with the permitted wastewater operations at the Keetac facility following the mining expansion have been well documented in the EIS for the Keetac expansion project, and the conditions in the draft permits are reflective of those changes, as detailed the statements of basis.

Comment 12-2: The draft permits do not explain how the effluent limitations that have been set will be protective of water quality following the proposed mining expansion.

Response: It is not common practice to include the specific details for setting effluent limitations within the text of NPDES/SDS permits, but rather to document this information in the associated statement of basis documents. The effluent limitations that have been included in the draft permits have been calculated in consideration of water quality impacts, consistent with state and federal requirements, as well as MPCA policy for all point source discharge permits in Minnesota.

The effluent limitations have been calculated using the methodology developed from the EPA “Technical Support Document for Water Quality-based Toxics Control,” based on consideration of effluent data from the Keetac facility, the applicable ambient water quality standards for the water bodies receiving the Keetac discharges, and expected changes resulting from the Keetac expansion. The water quality considerations documented in the EIS and the statements of basis illustrate how the permits will be protective of water quality. Additionally, these documents address the basis for not including effluent limitations and monitoring requirements for the mining-related pollutants listed in your comments, based on site-specific data for the Keetac facility.

Comment 12-3: Comments were made relating to legislative action associated with the ambient water quality standard for total sulfate applicable to waters used for the production of wild rice.

Response: The MPCA wishes to clarify that the bill referenced in your comments did not result in any changes to the applicability of the current ambient water quality standards. Therefore, the draft permits do include the appropriate final effluent limitations for total sulfate based on all current state and federal regulations, and do require the Permittee to comply with the final effluent limitations based on the existing standard as soon as possible in accordance with the regulations governing compliance schedules in NPDES/SDS permits.

Comment 12-4: The commenter requested additional time to comment on the draft permits.

Response: The MPCA extended the public comment period to end on August 19, 2011, in order to allow for review of the information contained in this response. Please note that much of the information related to your comments has previously been available for public review during the public notice of intent to major modify NPDES/SDS Permit MN0031879, which was open from May 14, 2010, to June 14, 2010; the public comment period for the EIS scoping process, which was open from September 8, 2008, to October 8, 2008; the public comment period for the draft EIS, which was open for 45 days, ending on January 26, 2010; the public comment period for the final EIS, which was open from November 12, 2010, to December 20, 2010; and public meetings regarding the EIS on October 1, 2008, and January 11, 2010.

13. Comments from Group of Concerned Citizens. Letters received electronically August 15, 2011 to September 8, 2011.

Comment 13-1: The comments indicate that the draft permits does not explain how the effluent limitations that have been set will be protective of water quality following the proposed mining expansion.

Response: It is not common practice to include the specific details for setting effluent limitations within the text of NPDES/SDS permits, but rather to document this information in the associated statement of basis documents. As detailed in the statement of basis documents, the effluent limitations that have been included in the draft permits have been calculated in consideration of water quality impacts, consistent with state and federal requirements, as well as the MPCA policy for all point source discharge permits in Minnesota. The effluent limitations have been calculated using the methodology developed from the EPA “Technical Support Document for Water Quality-based Toxics Control,” based on consideration of effluent data from the Keetac facility, the applicable ambient water quality standards for the water bodies receiving the Keetac discharges, and expected changes resulting from the Keetac expansion. The water quality considerations documented in the EIS and

the statements of basis illustrate how the permits will be protective of water quality. Additionally, these documents address the basis for not including effluent limitations and monitoring requirements for the mining-related pollutants listed in the comments, based on site-specific data for the Keetac facility. Additionally, the comments indicate that the draft permits do not set limits on the total amount of pollutants that will be discharged from the Keetac facility. This is incorrect, as both the water quality and technology-based effluent limitations contained in the permits restrict the concentrations for specific pollutants that can be discharged. These limitations on effluent concentration work in conjunction with Minnesota Rules regarding nondegradation, which are included by reference in the permits, ensure that the total loading of pollutants in the discharges authorized by the permits meets all applicable state and federal regulations.

Comment 13-2: The Keetac Air Emissions permit will allow more than 75 pounds of additional mercury to be emitted into the air.

Response: Comments have been noted by the MPCA, however, please note that these comments have no bearing on the Keetac Mine and Keetac Tailings Basin permits identified in your e-mail, and the comments were received following completion of the public comment period for the air emissions permit. As for mercury discharges associated with the discharges in the permits, please note that the mercury concentrations in the Keetac facility's wastewater discharges have not been shown to exhibit reasonable potential to cause or contribute to excursions above the ambient water quality standard for this pollutant.

Comment 13-3: The permits do not set any limits on the amount of sulfate allowed to be discharged as the Keetac facility expands.

Response: This is incorrect, due to the fact that the rules governing nondegradation incorporated in the permits require the Permittee to maintain discharge loading consistent the baseline quality authorized under the current Permits given that the Permits do not authorize expansion of discharge beyond this level. The Permittee is required to restrict sulfate loading in accordance with nondegradation requirements. Additionally, the permits require further reductions of sulfate loads in the permitted discharges in accordance with schedules of compliance, which specifically require the Permittee to make reductions in sulfate discharge concentrations to the extent practical prior to attaining compliance with final effluent limitations. It is important to note that the compliance schedules are not limited to studies, but require implementation of a Sulfate Reduction Plan, which is specifically required to result in compliance with final effluent limitations for total sulfate as soon as possible. The language in the permits has been updated to more clearly reflect the means by which the compliance schedules will lead to compliance with final effluent limitations.

APPENDIX C

Permit	Location	Original Permit Condition	Change	Comment
MN0031879	Compliance Schedule	Pilot studies use the same schedule	Two distinct schedules with requirements for attainment of compliance written into MN0031879	Performed upon request of USEPA
MN0031879	Compliance Schedule	Proposes treatment evaluation of multiple outfalls	Require full-scale treatment evaluation for outfalls representative of wastewater type	Performed upon request of USEPA
MN0031879	Compliance Schedule	No interim effluent limits	Addition of interim effluent limits within 36 months of approval of the Sulfate Reduction Plan for non-tailings basin discharges	Performed upon request of USEPA
MN0031879	Compliance Schedule	No interim effluent limits	Addition of interim effluent limits within 42 months of approval of the Sulfate Reduction Plan for representative tailings basin discharges	Performed upon request of USEPA
MN0031879	Compliance Schedule	No interim effluent limits	Interim sulfate limit for total sulfate of 14 mg/L as a calendar quarter average for outfalls where full scale treatment evaluation is approved	Performed upon request of USEPA
MN0031879	Compliance Schedule	Sulfate effluent limits to be attained as soon as possible but no later than August 17, 2019	Sulfate effluent limits to be attained as soon as possible but no later than August 17, 2018 for non-tailings basin discharges	Performed upon request of USEPA
MN0055948	Compliance Schedule	Compliance schedule only in MN0031879	Include compliance schedule from MN0031879 by reference in to MN0055948	Performed upon request of USEPA
MN0055948	Compliance Schedule	Pilot studies use the same schedule	Two distinct schedules with requirements for attainment of compliance written into MN0031879	Performed upon request of USEPA
MN0055948	Compliance Schedule	Proposes treatment evaluation of multiple outfalls	Require full-scale treatment evaluation for outfalls representative of wastewater type	Performed upon request of USEPA
MN0055948	Compliance Schedule	No interim effluent limits	Addition of interim effluent limits within 36 months of approval of the Sulfate Reduction Plan for non-tailings basin discharges	Performed upon request of USEPA
MN0055948	Compliance Schedule	No interim effluent limits	Addition of interim effluent limits within 42 months of approval of the Sulfate Reduction Plan for representative tailings basin discharges	Performed upon request of USEPA

MN0055948	Compliance Schedule	No interim effluent limits	Interim sulfate limit for total sulfate of 14 mg/L as a calendar quarter average for outfalls where full scale treatment evaluation is approved	Performed upon request of USEPA
MN0055948	Compliance Schedule	Sulfate effluent limits to be attained as soon as possible but no later than August 17, 2019	Sulfate effluent limits to be attained as soon as possible but no later than August 17, 2018 for non-tailings basin discharges	Performed upon request of USEPA
MN0055948 MN0031879	Monitoring		Additional Monitoring for selenium	

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STATE OF MINNESOTA
Minnesota Pollution Control Agency

Industrial Division

**National Pollutant Discharge Elimination System (NPDES)/
 State Disposal System (SDS) Permit MN0031879**

PERMITTEE:	United States Steel Corporation		
FACILITY NAME:	Minnesota Ore Operations – Keetac – Mining		
RECEIVING WATER:	Welcome Lake; Welcome Creek to Reservoir 2 North; Unnamed wetlands and creeks tributary to O'Brien Reservoir		
CITY OR TOWNSHIP:	Keewatin	COUNTY:	Itasca
ISSUANCE DATE:		EXPIRATION DATE:	

The state of Minnesota, on behalf of its citizens through the Minnesota Pollution Control Agency (MPCA), authorizes the Permittee to construct, install and operate a disposal system at the facility named above and to discharge from this facility to the receiving water named above, in accordance with the requirements of this permit.

The goal of this permit is to reduce pollutant levels in point source discharges and protect water quality in accordance with Minnesota and U.S. statutes and rules, including Minn. Stat. chs. 115 and 116, Minn. R. chs. 7001, 7050, 7053, 7060, 7090.3000 through 7090.3080, and the U.S. Clean Water Act.

This permit is effective on the issuance date identified above, and supersedes the previous permit that was issued for this facility on June 15, 2006. This permit expires at midnight on the expiration date identified above.

Signature: _____
 Jeff Udd, P.E. for The Minnesota Pollution Control Agency
 Acting Supervisor, Water Quality Permits Unit
 Land and Water Quality Permits Section
 Industrial Division

Submit DMRs to:

Attention: Discharge Monitoring Reports
 Minnesota Pollution Control Agency
 520 Lafayette Rd N
 St Paul, MN 55155-4194

Submit Other WQ Reports to:

Attention: WQ Submittals Center
 Minnesota Pollution Control Agency
 520 Lafayette Rd N
 St Paul, MN 55155-4194

Questions on this permit?

- For DMR and other permit reporting issues, contact:
 Belinda Nicholas, 651-757-2613.
- For specific permit requirements or permit compliance status, contact:
 John Thomas, 218-302-6616.
- General permit or NPDES program questions, contact:
 MPCA, 651-282-6143 or 1-800-657-3938.

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Facility Description

The principal activity at this facility is the open pit mining of taconite (Biwabik Iron Formation) for processing into taconite pellets. The facility consists of the United States Steel Corporation, Minnesota Ore Operations – Keetac plant area, all mine excavations, mining waste disposal areas, plant areas, materials and equipment storage areas, and wastewater disposal facilities. The facility has proposed an expansion to their mining and pellet production operations, which will increase production from 6.0 million short tons of pellets per year to 9.6 million short tons per year. The conditions of this permit reflect the changes associated with that expansion.

The plant area includes the above-mentioned shops as well as several equipment storage buildings, the general office building, the water supply treatment plant, fuel storage area, crude ore storage building, concentrator, pellet plant, various processing thickeners, laboratory, power substation, coal, concentrate and pellet stockpile areas, and the pellet rail load-out area. Yard and roof run-off from the plant area is routed either to the Bennett Pit, Welcome Lake, or to the Diversion Ditch System. The water supply treatment plant, located just north of Welcome Lake, uses potassium permanganate and potassium hydroxide for iron removal. The water treatment plant backwash wastewater from the sand filters currently discharges on a periodic basis through culvert outfall SD001, at a rate of less than 0.010 MGD, to Welcome Lake (class 2B, 3B, 4A, 4B, 5 and 6 waters). Filter backwash solids from the water treatment plant are land applied on a site within the inactive Bennett tailings basin (SW ¼ of Section 17, T57N, R21W).

Most surface drainage from mining waste disposal and excavation areas in the facility is collected in mine pit sumps and then pumped to Reservoir 5. The Bennett Pit water overflows to the Russell Pit, which is pumped at an average rate of 4.0 million gallons per day (MGD) to Reservoir 5. This treatment basin also receives surface flow from inactive stockpiles and tailings basins. Reservoir 5 also provides some make-up water for processing in the Keewatin Taconite plant. Reservoir 5 outflows through a decant control structure to the Diversion Ditch System, constructed as a series of sedimentation basins and a conveyance channel. These basins help to treat run-off from the Keewatin Taconite plant area, as well as some active and inactive stockpile areas. The ditch system discharges through weir outfall SD002 at an average rate of 2.3 MGD to Welcome Creek (class 2C, 3C, 4A, 4B, 5 and 6 waters).

Mine pit dewatering from the Mesabi Chief Pit may be pumped and discharged through pipe outfall SD003, at an average rate of 5.85 MGD, to O'Brien Creek (2C, 3C, 4A, 4B, 5 and 6 water) which flows to the O'Brien Reservoir (class 2B, 3B, 4A, 4B, 5 and 6 water). Some mining waste stockpile drainage from the northwestern side of the facility flows to unnamed wetlands and creeks tributary to O'Brien Reservoir.

Stormwater from stripping and stockpiling activities west of the Mesabi Chief mining area flows into the Perry Pit. This permit authorizes discharges of mine pit dewatering from the Perry Pit through pipe outfall SD012 at rate of up to 4.32 MGD to O'Brien Creek.

Wastewater drainage is collected in the bottom of the two coarse crushers located in the Section 18 Pit. Crusher #1 wastewater is pumped at an average rate of 2.6 MGD to Sump #1, then to Reservoir 5. Crusher #2 wastewater is pumped to the Section 18 Pit, then to Reservoir 5. A septic tank/drainfield system handles the sanitary wastewater generated at the two coarse crushers, at a rate of less than 10,000 gallons per day (gpd). Dry storage buildings, which generate no process or sanitary wastewaters, are located at the facility north of Reservoir 5, south of the coarse crushers and east of the main plant area. A shovel repair area located on the northwest side of the Russell Pit, in the NW ¼, Section 13, T57N, R22W, also generates no process or sanitary wastewaters.

The combined floor drain overflow from the concentrator and the pellet plant is routed to the Bennett Pit. This overflow may include emergency overflow process wastewater from the concentrator if a power failure occurs. All steam cleaning and floor drain wastewater from the truck shops and the plant/machine/welding shops is treated by an oil/water separator and sedimentation tank before overflowing to a drainage pipe to the Bennett Pit. Sludge from the shop areas are taken off-site for treatment or disposal. Oils removed by the oil/water separator are reclaimed for reuse.

Two recirculating wet scrubbers treat waste gas from the Phase II indurating grate-kiln. Blowdown water from these wet scrubbers is sent to a wastewater treatment system. The treatment system is used when the indurating grate-kiln is using coal as a fuel source. The wastewater treatment system includes lime addition to promote calcium sulfate (gypsum) precipitation and solids settling in an existing thickener (old indurating thickener). Solids from the thickener are dewatered using two filter presses and disposed off-site. Overflow from the thickener and filtrate from the filter presses are sent to the tailings basin. Waste station WS011 is located at the plant water make-up to the scrubber system and waste station WS012 is located on the overflow from the indurating thickener prior to being sent to the tailings basin.

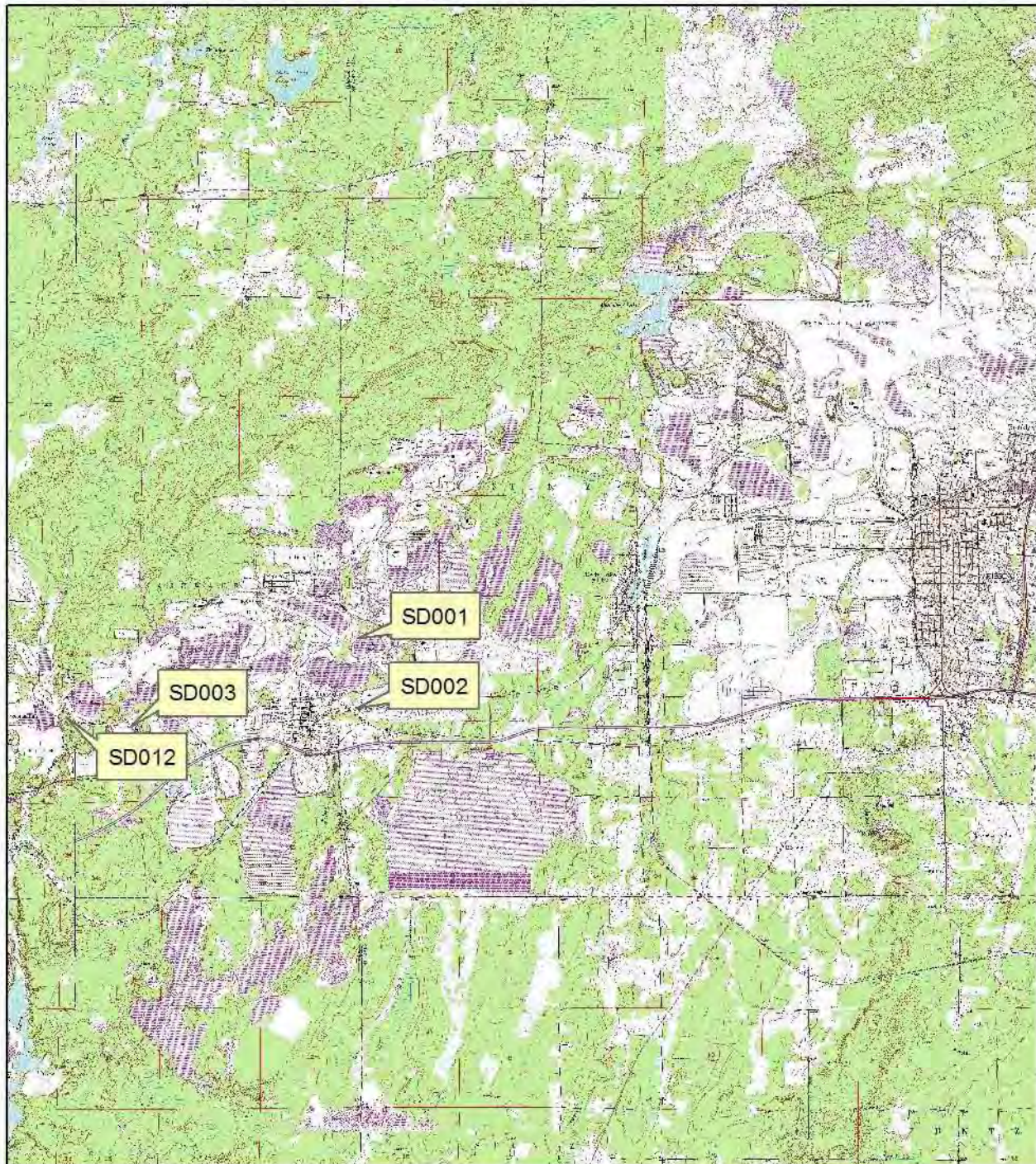
An activated sludge package plant consisting of a bar screen, comminutor, diffused aeration tank, sludge holding tank, and chlorination contact tank is used for the treatment of domestic wastewater. The sewage plant is designed to treat an average flow of 0.040 MGD with five-day carbonaceous biochemical oxygen demand (CBOD5) strength of 140 milligrams per liter (mg/l). No active dechlorination treatment is provided. The treated sanitary wastewater effluent is routed through weir station WS005 to Reservoir 5. The biosolids are transferred off-site to a permitted wastewater treatment facility.

Parallel tailings pipelines exit the north side of the concentrator and approximately follow the Diversion Ditch System east and south before crossing Highway 169 toward the Keewatin Taconite Tailings Basin Area. Segments of these pipelines do not have spill containment berms, and some leaks from pipelines north of Highway 169 may flow toward the Diversion Ditch. The tailings are pumped through the pipelines, which include three dump valve drainage points north of Highway 169. These dump valve points include detention basins and ponds used to contain tailings and process wastewater that is drained during normal maintenance and emergency shutdown situations. Dump Points 1 and 2 overflow to the Diversion Ditch System, while Dump Point 3 drains to a non-discharging infiltration basin. The tailings that do accumulate in these detention basins and ponds are typically removed every two years and hauled by truck for disposal in the Keewatin Taconite Tailings Basin, which is covered by permit MN0055948.

Chemical dust suppressants are occasionally applied on roads in the immediate plant area. Currently, magnesium chloride and lignosulfonate are used at a maximum rate of 11,000 gallons per year. This does not restrict the use of other acceptable dust suppressants at the facility.

Topographic Map of Permitted Facility

MN003189, US Steel - Keewatin Taconite Operations, Mining
St. Louis County & Itasca County, Minnesota



Map produced by: MPCA Staff, 4/15/2010
Source: USGS Nashwauk, Keewatin, Hibbing,
Pengilly, Silica, Riley Quads
Scale: 1:24,000

0 0.5 1 2 Miles



DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT**Waste Stream Stations**

<u>Station</u>	<u>Type of Station</u>	<u>Local Name</u>	<u>PLS Location</u>
WS302	Solids to Land Treatment/Application	Shop wastewater treatment sludges	
WS303	Solids to Land Treatment/Application	WTP filter backwash treatment sludges	SW Quarter of the NW Quarter of the Section 19, Township 57 North, Range 21 West

Surface Discharge Stations

<u>Station</u>	<u>Type of Station</u>	<u>Local Name</u>	<u>PLS Location</u>
SD001	Effluent To Surface Water	WTP Backwash Outfall 040	SE Quarter of the SW Quarter of the NW Quarter of Section 19, Township 57 North, Range 21 West
SD002	Effluent To Surface Water	Weir Outfall 050	NE Quarter of the NW Quarter of the NW Quarter of Section 30, Township 57 North, Range 21 West
SD003	Effluent To Surface Water	Pipe Outfall 080	SW Quarter of the NE Quarter of the NE Quarter of Section 27, Township 57 North, Range 22 West
SD012	Effluent To Surface Water	Perry Pit Dewatering	

Waste Stream Stations

<u>Station</u>	<u>Type of Station</u>	<u>Local Name</u>	<u>PLS Location</u>
WS005	Internal Waste Stream	Station 901	NW Quarter of the NW Quarter of Section 19, Township 57 North, Range 21 West
WS011	Internal Waste Stream	Plant water to scrubber system	NW Quarter of Section 19, Township 57 North, Range 21 West
WS012	Internal Waste Stream	Scrubber blowdown after treatment	NW Quarter of Section 19, Township 57 North, Range 21 West

Keewatin Taconite Operations - Mining Limits and Monitoring Requirements

DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT

The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Interim Period*

SD 001

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Quarter Average	Jan-Dec	Measurement, Instantaneous	1 x Quarter	1
Flow	Monitor Only	MG	Calendar Quarter Total	Jan-Dec	Measurement, Instantaneous	1 x Quarter	1
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Quarter	1
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Quarter	1
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Quarter	1

SD 002

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	2 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	2 x Month	
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2
Nitrogen, Ammonia, Un-ionized (as N)	0.04	mg/L	Calendar Month Average	Mar-Oct	Calculation	1 x Month	
Nitrogen, Ammonia, Un-ionized (as N)	Monitor Only	mg/L	Daily Maximum	Mar-Oct	Calculation	1 x Month	
Oil & Grease, Total Recoverable (Hexane Extraction)	0.5	mg/L	Calendar Quarter Average	Jan-Dec	Grab	1 x Quarter	1
Oil & Grease, Total Recoverable (Hexane Extraction)	5.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Quarter	1
pH	8.5	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.5	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Single Value	Jan-Dec	Grab	1 x Quarter	1
Sulfate, Total (as SO4)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO4)	Monitor Only	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	
Temperature, Water (F)	Monitor Only	Deg F	Calendar Month Average	Mar-Oct	Estimate, Instantaneous	1 x Month	
Temperature, Water (F)	Monitor Only	Deg F	Daily Maximum	Mar-Oct	Estimate, Instantaneous	1 x Month	
Turbidity	25	NTU	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Turbidity	Monitor Only	NTU	Daily Maximum	Jan-Dec	Grab	2 x Month	

Keewatin Taconite Operations - Mining Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Interim Period*

SD 003

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2
Oil & Grease, Total Recoverable (Hexane Extraction)	0.5	mg/L	Calendar Quarter Average	Jan-Dec	Grab	1 x Quarter	1
Oil & Grease, Total Recoverable (Hexane Extraction)	5.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Quarter	1
pH	8.5	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.5	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	20	mg/L	Calendar Quarter Average	Jan-Dec	Grab	1 x Quarter	1
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Quarter	1
Specific Conductance	Monitor Only	umh/cm	Single Value	Jan-Dec	Grab	1 x Quarter	1
Sulfate, Total (as SO4)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO4)	Monitor Only	mg/L	Calendar Year Maximum	Jan-Dec	Grab	2 x Month	
Turbidity	25	NTU	Calendar Month Average	Jan-Dec	Grab	1 x Month	

SD 012

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Hardness, Calcium & Magnesium, Calculated (as CaCO3)	Monitor Only	mg/L	Calendar Quarter Maximum	Jan-Dec	Grab	1 x Quarter	3
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Solids, Total Dissolved (TDS)	Monitor Only	mg/L	Calendar Quarter Maximum	Jan-Dec	Grab	1 x Quarter	3
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	

Keewatin Taconite Operations - Mining Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Interim Period*

SD 012

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Calendar Quarter Maximum	Jan-Dec	Grab	1 x Quarter	3
Sulfate, Total (as SO4)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO4)	Monitor Only	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	

WS 005

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
BOD, Carbonaceous 05 Day (20 Deg C)	3.8	kg/day	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
BOD, Carbonaceous 05 Day (20 Deg C)	25	mg/L	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
BOD, Carbonaceous 05 Day (20 Deg C)	6.0	kg/day	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
BOD, Carbonaceous 05 Day (20 Deg C)	40	mg/L	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Fecal Coliform, MPN or Membrane Filter 44.5C	200	#100ml	Calendar Month Geometric Mean	Apr-Oct	Grab	2 x Month	
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement, Continuous	1 x Day	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement, Continuous	1 x Day	
Flow	Monitor Only	mgd	Maximum Calendar Week Average	Jan-Dec	Measurement, Continuous	1 x Day	
Nitrogen, Total (as N)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	2 x Month	
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	2 x Month	
Phosphorus, Total (as P)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Phosphorus, Total (as P)	Monitor Only	mg/L	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Solids, Total Suspended (TSS)	4.5	kg/day	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Solids, Total Suspended (TSS)	30	mg/L	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Solids, Total Suspended (TSS)	6.8	kg/day	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Solids, Total Suspended (TSS)	45	mg/L	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	

WS 011

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Calcium, Total (as Ca)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	

Keewatin Taconite Operations - Mining Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Interim Period*

WS 011

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Fluoride, Total (as F)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	
pH	Monitor Only	SU	Single Value	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Single Value	Jan-Dec	Grab	1 x Month	
Sulfate, Total (as SO4)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	

WS 012

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Calcium, Total (as Ca)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Fluoride, Total (as F)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2
pH	Monitor Only	SU	Single Value	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Single Value	Jan-Dec	Grab	1 x Month	
Sulfate, Total (as SO4)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	

Period: *Limits Applicable in the Final Period*

SD 001

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Quarter Average	Jan-Dec	Measurement, Instantaneous	1 x Quarter	1
Flow	Monitor Only	MG	Calendar Quarter Total	Jan-Dec	Measurement, Instantaneous	1 x Quarter	1
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Quarter	1
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Quarter	1
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Quarter	1

Keewatin Taconite Operations - Mining Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Final Period*

SD 002

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	2 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	2 x Month	
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2
Nitrogen, Ammonia, Un-ionized (as N)	0.04	mg/L	Calendar Month Average	Mar-Oct	Calculation	1 x Month	
Nitrogen, Ammonia, Un-ionized (as N)	Monitor Only	mg/L	Daily Maximum	Mar-Oct	Calculation	1 x Month	
Oil & Grease, Total Recoverable (Hexane Extraction)	0.5	mg/L	Calendar Quarter Average	Jan-Dec	Grab	1 x Quarter	1
Oil & Grease, Total Recoverable (Hexane Extraction)	5.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Quarter	1
pH	8.5	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.5	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Single Value	Jan-Dec	Grab	1 x Quarter	1
Sulfate, Total (as SO4)	14	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO4)	24	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	
Temperature, Water (F)	Monitor Only	Deg F	Calendar Month Average	Mar-Oct	Estimate, Instantaneous	1 x Month	
Temperature, Water (F)	Monitor Only	Deg F	Daily Maximum	Mar-Oct	Estimate, Instantaneous	1 x Month	
Turbidity	25	NTU	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Turbidity	Monitor Only	NTU	Daily Maximum	Jan-Dec	Grab	2 x Month	

SD 003

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2

Keewatin Taconite Operations - Mining Limits and Monitoring Requirements

DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT

The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Final Period*

SD 003

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Oil & Grease, Total Recoverable (Hexane Extraction)	0.5	mg/L	Calendar Quarter Average	Jan-Dec	Grab	1 x Quarter	1
Oil & Grease, Total Recoverable (Hexane Extraction)	5.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Quarter	1
pH	8.5	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.5	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	20	mg/L	Calendar Quarter Average	Jan-Dec	Grab	1 x Quarter	1
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Quarter	1
Specific Conductance	Monitor Only	umh/cm	Single Value	Jan-Dec	Grab	1 x Quarter	1
Sulfate, Total (as SO4)	14	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO4)	24	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	
Turbidity	25	NTU	Calendar Month Average	Jan-Dec	Grab	1 x Month	

SD 012

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Hardness, Calcium & Magnesium, Calculated (as CaCO3)	Monitor Only	mg/L	Calendar Quarter Maximum	Jan-Dec	Grab	1 x Quarter	3
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Solids, Total Dissolved (TDS)	Monitor Only	mg/L	Calendar Quarter Maximum	Jan-Dec	Grab	1 x Quarter	3
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Calendar Quarter Maximum	Jan-Dec	Grab	1 x Quarter	3
Sulfate, Total (as SO4)	14	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO4)	24	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	

Keewatin Taconite Operations - Mining Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Final Period*

WS 005

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
BOD, Carbonaceous 05 Day (20 Deg C)	3.8	kg/day	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
BOD, Carbonaceous 05 Day (20 Deg C)	25	mg/L	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
BOD, Carbonaceous 05 Day (20 Deg C)	6.0	kg/day	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
BOD, Carbonaceous 05 Day (20 Deg C)	40	mg/L	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Fecal Coliform, MPN or Membrane Filter 44.5C	200	#100ml	Calendar Month Geometric Mean	Apr-Oct	Grab	2 x Month	
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement, Continuous	1 x Day	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement, Continuous	1 x Day	
Flow	Monitor Only	mgd	Maximum Calendar Week Average	Jan-Dec	Measurement, Continuous	1 x Day	
Nitrogen, Total (as N)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	2 x Month	
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	2 x Month	
Phosphorus, Total (as P)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Phosphorus, Total (as P)	Monitor Only	mg/L	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Solids, Total Suspended (TSS)	4.5	kg/day	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Solids, Total Suspended (TSS)	30	mg/L	Calendar Month Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Solids, Total Suspended (TSS)	6.8	kg/day	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	
Solids, Total Suspended (TSS)	45	mg/L	Maximum Calendar Week Average	Jan-Dec	8-Hour Flow Composite	2 x Month	

WS 011

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Calcium, Total (as Ca)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Fluoride, Total (as F)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	
pH	Monitor Only	SU	Single Value	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Single Value	Jan-Dec	Grab	1 x Month	
Sulfate, Total (as SO4)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	

Keewatin Taconite Operations - Mining Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Final Period*

WS 012

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Calcium, Total (as Ca)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Fluoride, Total (as F)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2
pH	Monitor Only	SU	Single Value	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Single Value	Jan-Dec	Grab	1 x Month	
Sulfate, Total (as SO4)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	1 x Month	

Notes:

- 1 -- Samples may be taken any time during each calendar quarter but must be reported on the DMR for the last month of each quarter (e.g. the sample for the first calendar quarter of Jan - Mar should be reported on the March DMR).
- 2 -- Samples may be taken any time during each calendar quarter but must be reported on the DMR for the last month of each quarter (e.g. the sample for the first calendar quarter of Jan - Mar should be reported on the March DMR). Use EPA method 1631, with clean techniques method 1669, and any revisionsto this methods.
- 3 -- Samples may be taken any time during each calendar quarter but must be reported on the DMR for the last month of each quarter (e.g. the sample for the first calendar quarter of Jan - Mar should be reported on the March DMR). The permittee may request to modify this permit after 12 months of monitoring data have been submitted to MPCA, in order to remove or modify limits or monitoring requirements.

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Chapter 1. Special Requirements

1. Compliance Schedule

Compliance Schedule for Sulfate

- 1.1 The Permittee shall meet the terms of the compliance schedule detailed below in order to attain compliance with the final effluent limitations contained in this permit and NPDES/SDS Permit MN0055948 for total sulfate.

The Permittee shall continue to work toward minimizing sulfate in the discharges to the extent practical prior to the compliance date. Compliance with the final effluent limitations shall be attained as soon as possible, and in no case shall compliance be attained later than August 17, 2018 for non-tailings basin discharges, and August 17, 2019 for tailings basin discharges, unless the permit is modified pursuant to 40 CFR 122.62.

Water Management Study

- 1.2 The Permittee has submitted a Water Management Study Plan to refine the water mass balance, and evaluate water discharge and water consumption alternatives that may lead to compliance. The Water Management Study Plan was approved by the MPCA on October 6, 2010.
- 1.3 The Water Management Study shall be completed within 18 months of MPCA approval of the Water Management Study Plan. The Permittee, upon approval from the MPCA, may make revisions to the Water Management Study Plan as new alternatives and information emerge and as deemed appropriate. The Permittee shall notify the MPCA within 14 days of completion of the Water Management Study.
- 1.4 The Permittee shall provide written progress updates on the Water Management Study to the MPCA every six months, at minimum, following MPCA approval of the Water Management Study Plan. Additional updates can be provided in the form of electronic transmittals, conference calls or meetings.
- 1.5 The Permittee shall provide the results of the Water Management Study to the MPCA within three months of completion of the Water Management Study.

Sulfate Reduction Strategy Study

- 1.6 The Permittee has submitted a Sulfate Reduction Strategy Study Plan for water quantity and quality data review, and evaluation of source control strategies and sulfate treatment technologies that may lead to compliance. The Sulfate Reduction Strategy Study Plan was approved by the MPCA on October 6, 2010.
- 1.7 The Sulfate Reduction Strategy Study shall be completed within 18 months of MPCA approval of the Sulfate Reduction Strategy Study Plan. The Permittee, upon approval from the MPCA, may make revisions to the Sulfate Reduction Strategy Study Plan as new alternatives and information emerge and as deemed appropriate. The Permittee shall notify the MPCA within 14 days of completion of the Sulfate Reduction Strategy Study.
- 1.8 The Permittee shall provide written progress updates on the Sulfate Reduction Strategy Study to the MPCA every six months, at minimum, following MPCA approval of the Sulfate Reduction Strategy Study Plan. Additional updates can be provided in the form of electronic transmittals, conference calls or meetings.
- 1.9 The Permittee shall provide the results of the Sulfate Reduction Strategy Study to the MPCA within three months of completion of the study.

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Chapter 1. Special Requirements

1. Compliance Schedule

Sulfate Reduction Plan

- 1.10 Based on the results of the Water Management Study and the Sulfate Reduction Strategy Study, and within three months of submittal of the results of both studies, the Permittee shall provide a Sulfate Reduction Plan for MPCA review and approval. The Sulfate Reduction Plan shall, at minimum, detail the actions the Permittee proposes to take in order to comply with the final effluent limitations for total sulfate at each outfall under this permit and NPDES/SDS Permit MN0055948. The actions proposed in the Sulfate Reduction Plan must lead to compliance with final effluent limitations as soon as possible, and the plan must include a schedule for implementation of the proposed actions, as well as a justification for the proposed schedule that addresses the timing associated with each of the specific actions proposed in the plan. If treatment technology for sulfate is proposed in the Sulfate Reduction Plan, applications for any necessary permit modifications, as well as plans and specifications for the proposed treatment technology shall be submitted to the MPCA along with the Plan.
- 1.11 The Sulfate Reduction Plan may include a request for evaluation of treatment effectiveness at full scale on representative outfalls prior to installation of the same technology on similar outfalls if the following conditions are met:
1. The request categorizes all permitted outfalls into groups based on similar wastewater chemistry and physical conditions.
 2. The results of the Water Management Study and Sulfate Reduction Strategy Study indicate that additional evaluation is necessary to determine treatment effectiveness at full scale for one or more of the outfall groups.
 3. The treatment technology proposed in the Sulfate Reduction Plan is the same for the representative outfalls selected as the technology proposed for the other outfalls in the same waste group, and the results of the Sulfate Reduction Strategy Study do not show a significant difference in treatment effectiveness between the representative waste stream and the other waste streams of its type.
 4. The representative outfall for each waste group has the highest volume and/or highest frequency of discharge of all outfalls in that group, and is therefore the most beneficial for evaluation.
- 1.12 Following approval of the Sulfate Reduction Plan by the MPCA, the Permittee shall complete the actions proposed in the Sulfate Reduction Plan and attain compliance with the final effluent limitations as detailed in Parts 1.13 and 1.14 of this Chapter, whichever is applicable.
- 1.13 If the approved Sulfate Reduction Plan includes approval of a request for full scale treatment evaluation pursuant to Part 1.11 of this Chapter, the Permittee shall attain compliance with final effluent limitations according to the following schedule:
1. The permitting, installation of equipment, and evaluation of treatment effectiveness on representative outfalls shall be completed within 36 months of MPCA approval of the Sulfate Reduction Plan for representative non-tailings basin discharges. The Permittee shall notify the MPCA within 14 days of completing this evaluation.
 2. The permitting, installation of equipment, and evaluation of treatment effectiveness on representative outfalls shall be completed within 42 months of MPCA approval of the Sulfate Reduction Plan for representative tailings basin discharges. The Permittee shall notify the MPCA within 14 days of completing this evaluation.
 3. Following completion of the full-scale treatment evaluation on the approved representative outfalls, the Permittee shall comply with an interim calendar quarter average effluent limitation of 14 mg/L total sulfate for all of the representative outfalls to ensure continued progress toward compliance with final effluent limitations.
 4. The Permittee shall attain compliance with final effluent limitations for total sulfate on all non-tailings basin outfalls within 30 months of completing treatment evaluations on the representative outfalls for those waste types.
 5. The Permittee shall attain compliance with final effluent limitations for total sulfate on all tailings basin outfalls within 36 months of completing treatment evaluations on the representative outfalls for those waste types.

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Chapter 1. Special Requirements

1. Compliance Schedule

- 1.14 If the approved Sulfate Reduction Plan does not include approval of a request for full scale treatment evaluation pursuant to Part 1.11 of this Chapter, the Permittee shall attain compliance with final effluent limitations according to the following schedule:
 1. The Permittee shall attain compliance with final effluent limitations for total sulfate on all non-tailings basin outfalls within 30 months of MPCA approval of the Sulfate Reduction Plan.
 2. The Permittee shall attain compliance with final effluent limitations for total sulfate on all tailings basin outfalls within 36 months of MPCA approval of the Sulfate Reduction Plan.
- 1.15 The Permittee shall provide written progress reports on the implementation of the Sulfate Reduction Plan to the MPCA every six months, at minimum, following MPCA approval of the Sulfate Reduction Plan. Additional updates can be provided in the form of electronic transmittals, conference calls or meetings.
- 1.16 The Permittee shall submit written notification of compliance to the MPCA within 14 days of completing all of the actions required for the attainment of compliance with final effluent limitations. The notification of compliance shall include a notification that installation and startup of treatment equipment has been completed, or shall include a submission of a representative effluent monitoring data set if equipment is not determined to be necessary. The MPCA will submit notification to the Permittee that final effluent limitations apply.

2. Special Requirements

Effluent Limit Study

- 2.1 The Permittee may opt to conduct a study to gather data and information that would support a total sulfate limit other than the final limitations included in this permit.
- 2.2 When cause exists according to state and federal law regarding modification of permits, this permit may be reopened for modification of effluent limitations, discharge restrictions, monitoring requirements, and or conditions of a schedule of compliance. Any modified permit conditions shall be consistent with all applicable state and federal requirements. MPCA shall comply with all procedural requirements under state and federal law prior to reopening and modifying this permit.

Chapter 2. Industrial Process Wastewater

1. Prohibited Discharges

- 1.1 This permit does not authorize the discharge of sewage, wash water, scrubber water, spills, oil, hazardous substances, or equipment/vehicle cleaning and maintenance wastewaters to ditches, wetlands or other surface waters of the state.
- 1.2 The Permittee shall prevent the routing of pollutants from the facility to a municipal wastewater treatment system in any manner unless authorized by the pretreatment standards of the MPCA and the municipal authority.
- 1.3 The Permittee shall not transport pollutants to a municipal wastewater treatment system that will interfere with the operation of the treatment system or cause pass-through violations of effluent limits or water quality standards.

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Chapter 2. Industrial Process Wastewater

2. Toxic Substance Reporting

- 2.1 The Permittee shall notify the MPCA immediately of any knowledge or reason to believe that an activity has occurred that would result in the discharge of a toxic pollutant listed in Minnesota Rules, pt. 7001.1060, subp. 4 to 10 or listed below that is not limited in the permit, if the discharge of this toxic pollutant has exceeded or is expected to exceed the following levels:
- a. for acrolein and acrylonitrile, 200 ug/L;
 - b. for 2,4-dinitrophenol and 2-methyl-4,6-dinitrophenol, 500 ug/L;
 - c. for antimony, 1mg/L;
 - d. for any other toxic pollutant listed in Minnesota Rules, pt. 7001.1060, subp. 4 to 10, 100 ug/L; or
 - e. five times the maximum concentration value identified and reported for that pollutant in the permit application. (Minnesota Rules, pt. 7001.1090, subp. 2.A)
- 2.2 The Permittee shall notify the MPCA immediately if the Permittee has begun or expects to begin to use or manufacture as an intermediate or final by-product a toxic pollutant that was not reported in the permit application under Minnesota Rules, pt. 7001.1050, subp. 2.J. (Minnesota Rules, pt. 7001.1090, subp. 2.B)

3. Hydrotest Discharges

- 3.1 The Permittee shall notify the MPCA prior to discharging hydrostatic test waters. The Permittee shall provide information necessary to evaluate the potential impact of this discharge and to ensure compliance with this permit. This information shall include:
- a. the proposed discharge dates;
 - b. the name and location of receiving waters, including city or township, county, and township/range location;
 - c. an evaluation of the impact of the discharge on the receiving waters in relation to the water quality standards;
 - d. a map identifying discharge location(s) and monitoring point(s);
 - e. the estimated average and maximum discharge rates;
 - f. the estimated total flow volume of discharge;
 - g. the water supply for the test water, with a copy of the appropriate Minnesota Department of Natural Resources (DNR) water appropriation permit;
 - h. water quality data for the water supply;
 - i. proposed treatment method(s) before discharge; and
 - j. methods to be used to prevent scouring and erosion due to the discharge.
- 3.2 This permit does not authorize the construction or installation of pipeline facilities.

4. Polychlorinated Biphenyls (PCBs)

- 4.1 PCBs, including but not limited to those used in electrical transformers and capacitors, shall not be discharged or released to the environment.

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Chapter 2. Industrial Process Wastewater

5. New Proposed Dewatering

- 5.1 The Permittee shall obtain a permit modification before discharging from a new dewatering outfall.
- 5.2 In addition to the requirements in the Permit Modifications section of this permit, the Permittee shall submit to the MPCA detailed plans and specifications for the proposed methods of achieving discharge limits for turbidity and total suspended solids, based in part upon representative water quality data for untreated wastewater and a detailed map and diagram description of the proposed design for the flow control structures, and route of the discharge to receiving waters.

6. Application for Permit Reissuance

- 6.1 The permit application shall include analytical data as part of the application for reissuance of this permit. These analyses shall be done on individual samples taken during the twelve-month period before the reissuance application is submitted.
- 6.2 The permit application shall include analytical data for at least the following parameters at monitoring station SD002:
 - a. biochemical oxygen demand, chemical oxygen demand, total organic carbon, gasoline range organics, diesel range organics, fecal coliform, ammonia, temperature;
 - b. color, fluoride, nitrate-nitrite (as nitrogen), total organic nitrogen, oil and grease, total phosphorus, chloride, sulfate, sulfide (as sulfur), surfactants, bicarbonates, alkalinity, total salinity, total dissolved solids, specific conductance;
 - c. aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, potassium, selenium, silver, sodium, strontium, thallium, tin, titanium, vanadium, zinc (all in total form) using atomic absorption (AA) furnace methods according to 40 CFR Part 136.3;
 - d. total mercury using EPA Method 1631;
 - e. gross alpha particles, radium-226, radium-228, radon-222, uranium;
 - f. PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, PCB-1260; and
 - g. a scan of constituents using EPA Methods 624 and 625, in 40 CFR Part 136.

The Permittee shall identify, in addition to those pollutants noted in Methods 624 and 625 (Appendix D, Table II), the concentrations of at least ten of the most abundant constituents of the acid and base/neutral organic fractions shown to be present by peaks on the total ion plots (reconstructed gas chromatograms) within ten percent of the nearest internal standard. Identification shall be through the use of U.S. EPA/NIH computerized library of mass spectra, with visual confirmation and potential quantification.

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Chapter 3. Domestic Wastewater (non-POTW)

1. Authorization

- 1.1 The sanitary wastewater generated at the facility shall be disposed of:
 - a. Through the activated sludge sewage treatment plant at the facility monitored by station WS005;
 - b. To portable units, and then transported from the facility for proper disposal; and/or
 - c. To permitted septic tank-drainfield systems that treat sanitary wastewater only, at a rate of less than 10,000 gallons/day each.
- 1.2 The Permittee shall prevent the introduction of the following to its domestic wastewater treatment system:
 - a. pollutants which create a fire or explosion hazard, including any discharge with a flash point less than 60 degrees C (140 degrees F);
 - b. pollutants which would cause corrosive structural damage, including any waste stream with a pH of less than 5.0;
 - c. solid or viscous pollutants which would obstruct flow;
 - d. heat that would inhibit biological activity, including any introduction of wastewater that would cause the temperature of the waste stream at the domestic wastewater treatment system to exceed 40 degrees C (104 degrees F);
 - e. pollutants which produce toxic gases, vapors, or fumes that may endanger the health or safety of workers;
 - f. non-contact cooling waters, unless there are no cost-effective alternatives; and
 - g. hazardous wastes.

The flushing or disposal of solvents and petroleum products is prohibited. Employee training shall be provided on the proper disposal of solvents and petroleum products.

2. Operator Certification

- 2.1 The Permittee shall provide a Class C state certified operator who is in direct responsible charge of the operation, maintenance and testing functions required to ensure compliance with the terms and conditions of this permit.
- 2.2 If applicable, the Permittee shall provide the appropriate number of operators with a Type IV certification to be responsible for the land application of the biosolids generated by the facility.
- 2.3 If the Permittee chooses to meet operator certification requirements through a contractual agreement, the Permittee shall provide a copy of the contract to the MPCA. The contract shall include the certified operator's name, certificate number, company name if appropriate, and evidence that the operation is being adequately supervised by a properly certified operator.
- 2.4 The Permittee shall notify the MPCA within 30 days of a change in operator certification or contract status.

3. Sanitary Sewer Extension Permit

- 3.1 The Permittee is required to obtain a Sanitary Sewer Extension Permit from the MPCA before the start of construction of any addition, extension or replacement to the sanitary sewer.

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Chapter 3. Domestic Wastewater (non-POTW)

4. Solids Management

Septage

- 4.1 Any accumulation of solids in pump stations, distribution devices, valve boxes or drop boxes shall be considered septage.
- 4.2 Septage shall be disposed of according to state, federal and local requirements.

Domestic Biosolids

- 4.3 The Permittee shall provide the information needed to comply with the biosolids requirements of Minn. R. ch. 7041 to others who treat, store, prepare or use the biosolids.
- 4.4 The Permittee shall keep records of the information necessary to show compliance with pollutant concentrations and loadings, pathogen reduction requirements, vector attraction reduction requirements and management practices as specified in Minn. R. 7041.1600, subp. 3.

Chapter 4. Metallic Mining

1. Mobile and Rail Equipment Service Areas

- 1.1 Mobile equipment and rail equipment service areas in the facility shall be operated in compliance with the following:
 - a. The Permittee shall collect and dispose of locomotive traction sand, degreasing wastes, motor oil, oil filters, oil sorbent pads and booms, transmission fluids, power steering fluids, brake fluids, coolant/antifreeze, radiator flush wastewater and spent solvents in accordance with applicable solid and hazardous waste management rules. These materials shall not be discharged to surface or ground waters of the state.
 - b. The steam-cleaning of mobile equipment and rail equipment, except for limited outdoor cleaning of large drills and shovels, shall be conducted in wash bays that drain to wastewater treatment systems that include the removal of suspended solids and flammable liquids. The only washing of mobile equipment done in outside areas shall be to remove mud and dirt that has accumulated during outside work.
 - c. The Permittee shall not use solvent-based cleaners, such as those available for brake cleaning and degreasing, to wash mobile and rail equipment unless the cleaning fluids are completely contained and not allowed to flow to surface or ground waters of the state. Soaps and detergents used in washing shall be biodegradable.
 - d. Mobile and rail equipment maintenance and repairs shall not be conducted in wash bays.
 - e. Hazardous materials shall not be stored or handled in wash bays.
 - f. The Permittee shall inspect wastewater containment systems regularly, and repair any leaks that are detected immediately.
 - g. If the Permittee discovers that recoverable amounts of petroleum products have entered wastewater containment systems, they shall be recovered immediately and reported to the MPCA.
 - h. Spill cleanup procedures shall be posted in mobile and rail equipment maintenance and repair areas.

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Chapter 5. Water Treatment

1. Residual Solids Management

- 1.1 The Permittee shall provide for the effective management and/or disposal of residual solids, or other substances resulting from treatment of potable water.
- 1.2 The Permittee shall dispose of residual solids in such a manner and at such locations that disposal practices shall not result in unlawful pollution of the air, surface water or ground water, or create nuisance conditions.

2. Waste Materials - Stockpiling

- 2.1 Stockpiling residual solids is prohibited unless authorized by the MPCA. If the Permittee proposes to stockpile residual solids, the Permittee shall submit a description of the type and amount of solids to be stockpiled and the proposed location of the stockpiles for review and approval.

3. Waste Materials - Nuisance Conditions

- 3.1 The Permittee shall notify the MPCA of any nuisance conditions, such as wind blown lime residual solids dust, immediately and take necessary actions to control and abate these conditions. (Minnesota Statutes, section 115.061)

4. Waste Materials - Land Application Restrictions

- 4.1 The Permittee shall not apply residual solids within 200 feet of any place of habitation or recreational area or within 100 feet of intermittent streams.
- 4.2 The Permittee shall apply residual solids uniformly over the entire site.
- 4.3 The Permittee shall regulate surface application rates to prevent surface runoff from the land application site.
- 4.4 The residual solids application rate shall be based on the University of Minnesota, College of Agriculture recommended application rates for Agricultural Liming Material (ALM).
- 4.5 Land application is not allowed when radium concentration in the waste product exceeds 50 pci per gram on a dry weight basis. Wastes with radium concentrations not exceeding 50 pci per gram may be land applied if the resulting radium concentration of the soil can be shown to not exceed 5 pci per gram. Testing shall be done according to nationally accepted laboratory procedures, such as the U.S. Department of Energy procedures manual.
- 4.6 Residual solids shall not be applied on any land without the owner's permission.

Chapter 6. Stormwater Management

1. Authorization

- 1.1 This chapter authorizes the Permittee to discharge stormwater associated with industrial activity in accordance with the terms and conditions of this chapter. The MPCA may initiate modification of this chapter in accordance with Minn. R. 7001.0170 and Minn. R. 7001.0190 Subp. 1 to incorporate revised requirements in response to the reissuance or modification of the General Stormwater Permit for Industrial Activity (MNG611000).

2. Prohibited Discharges

- 2.1 This permit, unless specifically authorized by another chapter, does not authorize the discharge of sewage, wash water, scrubber water, spills, oil, hazardous substances, or equipment/vehicle cleaning and maintenance wastewaters to ditches, wetlands or other surface waters of the state.
- 2.2 This permit does not authorize discharges from sites for which Environmental Assessment Worksheets or Environmental Impact Statements are required, in accordance with Minn. R. ch. 4410, until that environmental review is completed.

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Chapter 6. Stormwater Management

3. Water Quality Standards

- 3.1 The Permittee shall operate and maintain the facility and shall control runoff, including stormwater, from the facility to prevent the exceedance of water quality standards specified in Minnesota Rules, chs. 7050 and 7060.
- 3.2 The Permittee shall limit and control the use of materials at the facility that may cause exceedances of ground water standards specified in Minnesota Rules, ch. 7060. These materials include, but are not limited to, detergents and cleaning agents, solvents, chemical dust suppressants, lubricants, fuels, drilling fluids, oils, fertilizers, explosives and blasting agents.

4. Stormwater Pollution Prevention Plan

- 4.1 The Permittee shall develop and implement a Stormwater Pollution Prevention Plan (Plan) to address the specific conditions at the industrial facility. The goal of the Plan is to eliminate or minimize contact of stormwater with significant materials that may result in pollution of the runoff. If contact cannot be eliminated or reduced, stormwater that has contacted significant material should be treated before it is discharged from the site. The Plan shall apply to those areas of the facility where industrial activities occur or significant materials are stored, and stormwater runoff does not receive treatment prior to discharge via a permitted surface discharge station. In addition, the Plan should identify all areas of the facility where the necessary treatment of stormwater is addressed by a permitted surface discharge station.
- 4.2 The Plan shall be implemented at the site before the Permittee is covered under this permit.
- 4.3 The Stormwater Pollution Prevention Plan shall include a description of appropriate Best Management Practices for protection of surface and ground water quality at the facility, and a schedule for implementing the practices. The Plan shall also include the procedures to be followed by designated staff employed by the Permittee to implement the plan.
- 4.4 The Permittee shall comply with its Stormwater Pollution Prevention Plan.
- 4.5 The Permittee shall submit the Stormwater Pollution Prevention Plan to MPCA upon request.

Plan Contents

- 4.6 Complete a drainage map. The map should indicate the following items at or adjacent to the facility:
 - a. drainage areas and directions of stormwater runoff (indicated by arrows);
 - b. discharge outfalls from the site (structures that carry stormwater runoff from the facility such as ditches or storm sewers);
 - c. the name and location of waters of the state that receive facility stormwater runoff (if waters of the state are too distant from the facility to be indicated on the site map, indicate the name, direction and shortest distance to the lake, river, stream or wetland that receives runoff from your site);
 - d. areas where significant materials are exposed to stormwater;
 - e. locations of storm sewer inlets and an indication of which, if any, structures have floor drains or loading dock drains that are connected to storm sewers; and
 - f. locations and types of Best Management Practices (BMPs) currently installed at the facility to reduce or eliminate pollutants to stormwater.

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Chapter 6. Stormwater Management

4. Stormwater Pollution Prevention Plan

- 4.7 Complete an inventory of exposed significant materials. Indicate the types of significant materials handled or stored at the site that may potentially contact stormwater. The following are examples of materials that, if exposed to stormwater, must be included in the inventory:
- a. raw materials, such as fuels; solvents; petroleum products; detergents; plastic pellets; materials used in food processing or production; stockpiled sand, salt or coal;
 - b. by-products or intermediate products, such as wood dust, chips or bark; screened limestone, taconite or gravel by-product, recycled blacktop;
 - c. finished materials, such as metallic products, including scrap metal and recycled or scrap motor vehicle parts, old process equipment/machinery, taconite pellets;
 - d. waste products, such as ashes, sludge, solid and liquid waste, slag;
 - e. hazardous substances designated under section 101(14) of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA);
 - f. any chemical the facility is required to report under section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA).
- 4.8 Evaluate facility areas for exposure of significant materials to stormwater. In creating the inventory of exposed significant materials, the Permittee must, at a minimum, evaluate the following areas at the industrial site (as well as other areas where appropriate) to determine whether or not significant materials are exposed in these areas:
- a. vehicle and equipment maintenance, parking and storage areas including fueling and washing/cleaning areas, to determine if there is discolored soil in these areas as a result of fuel and lubricant leaks and spills;
 - b. liquid storage tanks and other bulk material stockpile areas;
 - c. loading and unloading areas;
 - d. outdoor manufacturing, processing or storage areas and industrial plant yards, to determine if there is discolored soil in these areas as a result of leaked or spilled solvents, fuels, or lubricants;
 - e. dust or particulate generating areas including dust collection devices that may release dust;
 - f. rooftops contaminated by industrial activity or operation of a pollution control device;
 - g. on-site waste disposal areas, such as waste ponds, dumpsters, solid waste storage or management areas; and
 - h. exposed (non-vegetated) soil areas where there is a potential for erosion to occur.

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Chapter 6. Stormwater Management

4. Stormwater Pollution Prevention Plan

- 4.9 Describe appropriate BMPs, including structural and non-structural BMPs, that will be used at the facility to minimize or eliminate pollution of stormwater at the site. The description must include an objective for each BMP, as well as a description of how to evaluate proper functioning of the BMP and any maintenance requirements of the BMP. BMPs should target significant materials and areas identified in subparts 7 and 8 of this part. The following general categories of BMPs shall be considered and one or more shall be incorporated into the facility's Plan if significant materials are exposed to stormwater on-site:
- a. Source reduction: reduce or eliminate the significant materials that are exposed to stormwater. Materials management practices should be evaluated to determine whether inventories of exposed materials can be reduced or eliminated. This can include clean-up of equipment yards, periodic checking of dust control equipment to ensure minimal accumulation of dust in the area of control equipment, removal and treatment of petroleum contaminated soil, consolidation of materials from multiple areas into one area, and training employees regarding proper handling and disposal of materials. Significant materials may also be moved indoors or covered with a tarp or structure to eliminate contact with precipitation.
 - b. Diversion: divert stormwater drainage away from exposed significant materials through use of curbing, berms, sewers or other forms of drainage control or elevate exposed significant material above surrounding drainage.
 - c. Treatment: where contact of stormwater with significant materials is unavoidable, use treatment devices to reduce the concentration and amount of pollutants in the discharge. Such devices include oil/water separators, stormwater detention/retention ponds, and vegetative swales.
- 4.10 Evaluate all discharge conveyances from the site (storm sewers, pipes, tile lines, ditches, etc.) to determine if liquids other than stormwater are being discharged from these devices. This should be done during dry weather when stormwater discharge is not occurring. The evaluation should cover sewer inlets and floor drains to determine which inlets/drains are connected to sanitary sewer lines, storm sewer lines, or septic tanks/drainage fields; appropriate methods such as dye or smoke testing or video imaging should be used to determine the source of discharges.
- The Plan must certify that discharges from the site have been evaluated for the presence of non-stormwater discharges. The certification shall indicate the date of testing, location of testing, describe the method used to determine the source of discharges and the results of testing. Discharge of non-stormwater (such as sanitary sewer or floor drain connections to storm sewers) is not authorized by this permit; before such discharge may continue, authorization under an appropriate NPDES permit must be obtained.
- 4.11 Develop a preventive maintenance program. The program must require regular inspection and maintenance of stormwater management devices (e.g. cleaning oil/water separators and catch basins), as well as inspecting and testing plant equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants (e.g. hydraulic leaks, torn bag-house filters) to surface waters.
- 4.12 Develop a spill prevention and response procedure. In order to develop this procedure, Permittees should evaluate where spills have occurred and where they have the potential to occur. Determine drainage points for potential spill areas and develop appropriate spill prevention and containment measures, should a spill occur. Detailed procedures for cleaning-up spills shall be identified and made available to appropriate personnel. If your facility has any other spill contingency plan that satisfies the above requirements, that plan may be incorporated by reference into this Plan to satisfy this requirement.
- 4.13 Develop and implement an employee training program to inform appropriate personnel of the components and goals of the Plan. Training shall address spill response, good housekeeping and materials management practices. The Plan shall identify periodic dates for such training.
- 4.14 Identify personnel responsible for managing and implementing the Plan as well as those responsible for the reporting requirements of this permit. This should include the facility contact person as indicated on the permit application. Identified personnel must be available at reasonable times of operation.

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Chapter 6. Stormwater Management

5. Temporary Protection and Permanent Cover

- 5.1 The Permittee shall provide and maintain temporary protection or permanent cover for the exposed areas at the facility.
- 5.2 Temporary protection methods are used to prevent erosion on a short-term basis, such as the placement of mulching straw, wood fiber blankets, wood chips, erosion control netting, or temporary seeding.
- 5.3 Permanent cover or final stabilization methods are used to prevent erosion, such as the placement of rip rap, sodding, or permanent seeding or planting. Permanent seeding and planting must have a uniform perennial vegetation cover of at least 70 percent density to constitute final stabilization.

6. Inspection and Maintenance

- 6.1 Site inspections shall be conducted at least once every two months throughout the calendar year. During winter months, the inspections shall be conducted during non-frozen conditions. Inspections shall be conducted by an appropriately trained personnel at the facility site, as identified in part 4.13 of this chapter. The purpose of inspections is to: 1) determine whether structural and non-structural BMPs require maintenance or changes, and 2) evaluate the completeness and accuracy of the Plan.

At least one inspection during a reporting period shall be conducted while stormwater is discharging from the facility. Inspections may be documented using an inspection form provided by the MPCA. A Storm Water Site Inspection Form is provided in the appendices section of this permit.

- 6.2 Inspections shall be documented and a copy of all documentation shall remain on the permitted site whenever Permittee staff are available on the site, and be available upon request. The inspection form developed for the General Storm Water Permit for Industrial Activity may be used for recording inspection results, and is included in the appendices section of this permit.
- 6.3 The following compliance items will be inspected, and documented where appropriate:
 - a. evaluate the facility to determine that the Plan accurately reflects site conditions as described in subpart 6 of this part, and document any inaccuracies;
 - b. evaluate the facility to determine whether new exposed materials have been added to the site since completion of the Plan, and document any new significant materials;
 - c. during the inspection conducted during the runoff event, observe the runoff to determine if it is discolored or otherwise visibly contaminated, and document observations; and,
 - d. determine if the non-structural and structural BMPs as indicated in the Plan are installed and functioning properly.
- 6.4 The Permittee shall ensure that temporary protection and permanent cover for the exposed areas at the site are maintained.
- 6.5 Indicate the date and time of the inspection as well as the name of the inspector on the inspection form.
- 6.6 When the depth of sediment collected in the final sedimentation basin above the outfall reaches one-half of the riser height, or one-half of the basin design hydraulic storage volume, the Permittee shall drain the basin and remove the sediment within sixty (60) days of discovery. No outflow from the sedimentation basin shall occur while sediment is being removed from that basin. The sediment removed from the basin shall be disposed of at a site which drains to sedimentation basin(s) at the facility.
- 6.7 If conditions are observed at the site that require changes in the Plan, such changes shall be made to the Plan prior to submission of the annual report for that calendar year.
- 6.8 The Permittee shall minimize vehicle tracking of gravel, soil or mud onto paved surfaces at the facility.

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Chapter 6. Stormwater Management

6. Inspection and Maintenance

- 6.9 If the findings of a site inspection indicate that BMPs are not meeting the objectives as identified in subpart 9 of this part, corrective actions must be initiated within 30 days and the BMP restored to full operation as soon as field conditions allow.
- 6.10 The Permittee shall remove tracked material from the road surface and return it to the facility within one (1) day of discovery so that the materials drain to sedimentation basin(s) at the facility.

7. Sedimentation Basin Design and Construction

New Sedimentation Basins

- 7.1 Sedimentation basins shall be designed by a registered professional engineer, and installed under the direct supervision of a registered professional engineer.
- 7.2 The basin shall provide at least 1800 cubic feet, per acre drained, of hydraulic storage volume below the top of the outlet riser pipe.
- 7.3 Inlet(s) and outlet(s) shall be designed to prevent short circuiting and the discharge of floating debris.
- 7.4 The inlet(s) shall be placed at an elevation at least above one-half of the basin design hydraulic storage volume.
- 7.5 The outlet(s) shall consist of a perforated riser pipe wrapped with filter fabric and covered with crushed gravel. The perforated riser pipe shall be designed to allow complete drawdown of the basin(s).
- 7.6 Permanent erosion control, such as rip rap, splash pads or gabions shall be installed at the outlet(s) to prevent downstream erosion.
- 7.7 The basins shall be designed to allow for regular removal of accumulated sediment by a backhoe or other suitable equipment.

8. Application of Chemical Dust Suppressants

- 8.1 If chemical dust suppressants are applied, the Permittee shall submit a Chemical Dust Suppressant Annual Report due 31 days after the end of each calendar year following the application of a chemical dust suppressant.
- 8.2 The Chemical Dust Suppressant Annual Report shall include:
- a record of the dates, methods, locations and amounts by volume of chemical application at the facility;
 - whether the product was applied in the preceding year; and,
 - the results of a chemical analysis of the materials applied each year.
- 8.3 If a material applied is mixed with water or another solvent before application, the chemical analysis shall be done on the aqueous or other mixture that is representative of the solution applied. This analysis shall be conducted during the same calendar year of application. This analysis shall include the parameters that may be determined by U.S. Environmental Protection Agency (EPA) Methods 624 and 625 which are described in 40 CFR Part 136.
- 8.4 Chemical dust suppressants, if used, shall not be applied within 100 feet of the surface receiving waters identified in the 'Facility Description' section of this permit. These materials also shall not be applied within 100 feet of ditches that conduct surface flow to the surface receiving waters identified on Page 1 of this permit.

9. Reporting

- 9.1 Submit a Stormwater Annual Report by March 31 of each year following permit issuance. A copy of the Stormwater Annual Report Form is provided in the appendices section of this permit.

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Chapter 6. Stormwater Management

9. Reporting

9.2 The Permittee shall, upon request of the Agency, submit within a reasonable time the information and reports that are relevant to compliance with this Chapter, including the Plan, inspection reports, annual reports, original laboratory sheets from analyses conducted on the waste stream, and BMP plans and specifications.

10. Records

10.1 The Plan shall be retained for the duration of the permit. A copy of the Plan shall remain on the permitted site whenever Permittee staff are available on the site, and be available upon request. The Permittee shall maintain the following records for the period of permit coverage:

- a. dates of inspections;
- b. findings of inspections;
- c. corrective actions taken;
- d. documentation of all changes to the Plan; and,
- e. a copy of annual reports.

11. Notification

11.1 If the Permittee discharges stormwater into a municipal storm sewer, the Permittee shall notify the operator of the municipal storm sewer of the existence of this permit.

12. Request for Termination of Stormwater Permit Coverage

12.1 All Permittees regulated by 40 CFR 122.26(b)(14)(i) through (ix) and (xi) may request termination of permit coverage by applying for the no exposure exclusion from permitting. The Permittee must submit (form provided by the Agency) a written certification that a condition of no exposure exists at the facility and that the facility meets the definition of no exposure of industrial activities and materials to storm water.

The application for the no exposure exclusion must be completed by the Permittee and sent to: MPCA, Industrial Storm Water Program, 520 Lafayette Rd N, St Paul, MN 55155-4194.

Failure to complete an accurate application will result in the facility being denied the no exposure exclusion from permitting. The facility must submit the application to the Agency once every five years.

12.2 The no exposure exclusion is conditional. The Permittee must maintain a condition of no exposure at the facility in order for the no exposure exclusion to remain applicable. In the event of any change or circumstance that causes exposure of industrial activities or materials to stormwater, the Permittee must comply with the stormwater requirements of this chapter.

12.3 The no exposure certification is non-transferrable. In the event that the facility operator changes, then the new operator must submit a new no exposure certification to the MPCA, Industrial Stormwater Program, 520 Lafayette Rd N, St Paul, MN 55155-4194.

12.4 The MPCA retains the authority to require the facility operator to comply with the requirements of this chapter, even when an industrial operator certifies no exposure, if the MPCA has determined that the discharge is contributing to the violation of, or interfering with the attainment or maintenance of water quality standards, including designated uses.

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Chapter 6. Stormwater Management

13. Definitions

- 13.1 "No exposure" means all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snow melt, and/or runoff. Industrial activities or materials include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products.
- 13.2 "Non-stormwater discharge" means any discharge not comprised entirely of stormwater discharges authorized by a NPDES permit.
- 13.3 "Runoff" means any liquid that drains over land from any part of a facility.

Chapter 7. Surface Discharge Stations

1. Requirements for Specific Stations

- 1.1 SD 001: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.
- 1.2 SD 002: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.
- 1.3 SD 003: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.
- 1.4 SD 012: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.

2. Special Requirements

Elimination of SD001

- 2.1 The Permittee currently discharges filter backwash from the Potable Water Plant via SD001. The filter backwash flows west through a ditch alongside the north side of the railroad tracks and ultimately into Welcome Lake, located on the south side of the railroad tracks, via a culvert. It is the Permittee's intent to re-route the filter backwash so that it does not discharge into Welcome Lake, if possible, by directing the waste stream to an alternative location within the facility's water system.

The Permittee shall notify the MPCA within 14 days of completing any rerouting the filter backwash stream currently discharged via SD001. The notification shall include a description of the new route for the backwash wastewater, and the final point of discharge for this wastewater. Following this notification, the MPCA may minor modify the permit to eliminate SD001 from the regulated outfalls.

During the interim period between completing the rerouting of SD001 wastewater and minor modification of the permit, the Permittee shall report No Discharge for SD001.

3. Sampling Location

- 3.1 Samples for Station SD001 shall be taken at the culvert flowing south under the railroad tracks towards Welcome Lake during a period of discharge. If a discharge from the culvert occurs at any time during the sampling quarter, a sample must be obtained for analysis.
- 3.2 Samples for Station SD002 shall be taken at the weir outfall at the old Highway 169 road crossing in the NW 1/4 of the NW 1/4 of Section 30, T57N, R21W.
- 3.3 Samples for Station SD003 shall be taken at the pipe outfall southwest of the Mesabi Chief Mine Pit.
- 3.4 Samples for SD012 shall be taken at the outfall of Perry Pit dewatering to O'Brien Creek.

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Chapter 7. Surface Discharge Stations

3. Sampling Location

3.5 Samples and measurements required by this permit shall be representative of the monitored activity.

4. Surface Discharges

4.1 Floating solids or visible foam shall not be discharged in other than trace amounts.

4.2 Oil or other substances shall not be discharged in amounts that create a visible color film.

4.3 The Permittee shall install and maintain outlet protection measures at the discharge stations to prevent erosion.

5. Winter Sampling Conditions

5.1 The Permittee shall sample flows at the designated monitoring stations including when this requires removing ice to sample the water. If the station is completely frozen throughout a designated sampling month, the Permittee shall check the "No Discharge" box on the Discharge Monitoring Report (DMR) and note the ice conditions in Comments on the DMR.

6. Discharge Monitoring Reports

6.1 The Permittee shall submit monitoring results for discharges in accordance with the limits and monitoring requirements for this station. If no discharge occurred during the reporting period, the Permittee shall check the "No Discharge" box on the Discharge Monitoring Report (DMR).

Chapter 8. Waste Stream Stations

1. Requirements for Specific Stations

1.1 WS 005: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.

1.2 WS 011: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.

1.3 WS 012: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.

2. Sampling Location

2.1 Samples for Stations WS005 shall be taken at weir station 901 following the chlorination tank.

2.2 Samples for Station WS011 shall be representative of the plant water to the scrubber system. Samples for Station WS012 shall be taken at a point representative of the treated scrubber blowdown flow to the tailings basin.

3. Sampling Frequency

3.1 Monitoring frequency for WS011 and WS012 shall be taken in accordance with the limits and monitoring requirements of this permit, including when coal is not being used as a fuel source in the Phase II indurating grate-kiln.

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Chapter 9. Total Facility Requirements

1. General Requirements

General Requirements

- 1.1 Incorporation by Reference. The following applicable federal and state laws are incorporated by reference in this permit, are applicable to the Permittee, and are enforceable parts of this permit: 40 CFR pts. 122.41, 122.42, 136, 403 and 503; Minn. R. pts. 7001, 7041, 7045, 7050, 7052, 7053, 7060, and 7080; and Minn. Stat. Sec. 115 and 116.
- 1.2 Permittee Responsibility. The Permittee shall perform the actions or conduct the activity authorized by the permit in compliance with the conditions of the permit and, if required, in accordance with the plans and specifications approved by the Agency. (Minn. R. 7001.0150, subp. 3, item E)
- 1.3 Toxic Discharges Prohibited. Whether or not this permit includes effluent limitations for toxic pollutants, the Permittee shall not discharge a toxic pollutant except according to Code of Federal Regulations, Title 40, sections 400 to 460 and Minnesota Rules 7050, 7052, 7053 and any other applicable MPCA rules. (Minn. R. 7001.1090, subp.1, item A)
- 1.4 Nuisance Conditions Prohibited. The Permittee's discharge shall not cause any nuisance conditions including, but not limited to: floating solids, scum and visible oil film, acutely toxic conditions to aquatic life, or other adverse impact on the receiving water. (Minn. R. 7050.0210 subp. 2)
- 1.5 Property Rights. This permit does not convey a property right or an exclusive privilege. (Minn. R. 7001.0150, subp. 3, item C)
- 1.6 Liability Exemption. In issuing this permit, the state and the MPCA assume no responsibility for damage to persons, property, or the environment caused by the activities of the Permittee in the conduct of its actions, including those activities authorized, directed, or undertaken under this permit. To the extent the state and the MPCA may be liable for the activities of its employees, that liability is explicitly limited to that provided in the Tort Claims Act. (Minn. R. 7001.0150, subp. 3, item O)
- 1.7 The MPCA's issuance of this permit does not obligate the MPCA to enforce local laws, rules, or plans beyond what is authorized by Minnesota Statutes. (Minn. R. 7001.0150, subp.3, item D)
- 1.8 Liabilities. The MPCA's issuance of this permit does not release the Permittee from any liability, penalty or duty imposed by Minnesota or federal statutes or rules or local ordinances, except the obligation to obtain the permit. (Minn. R. 7001.0150, subp.3, item A)
- 1.9 The issuance of this permit does not prevent the future adoption by the MPCA of pollution control rules, standards, or orders more stringent than those now in existence and does not prevent the enforcement of these rules, standards, or orders against the Permittee. (Minn. R. 7001.0150, subp.3, item B)
- 1.10 Severability. The provisions of this permit are severable and, if any provisions of this permit or the application of any provision of this permit to any circumstance are held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.
- 1.11 Compliance with Other Rules and Statutes. The Permittee shall comply with all applicable air quality, solid waste, and hazardous waste statutes and rules in the operation and maintenance of the facility.
- 1.12 Inspection and Entry. When authorized by Minn. Stat. Sec. 115.04; 115B.17, subd. 4; and 116.091, and upon presentation of proper credentials, the agency, or an authorized employee or agent of the agency, shall be allowed by the Permittee to enter at reasonable times upon the property of the Permittee to examine and copy books, papers, records, or memoranda pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit; and to conduct surveys and investigations, including sampling or monitoring, pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit. (Minn. R. 7001.0150, subp.3, item I)

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Chapter 9. Total Facility Requirements

1. General Requirements

- 1.13 Control Users. The Permittee shall regulate the users of its wastewater treatment facility so as to prevent the introduction of pollutants or materials that may result in the inhibition or disruption of the conveyance system, treatment facility or processes, or disposal system that would contribute to the violation of the conditions of this permit or any federal, state or local law or regulation.

Sampling

- 1.14 Representative Sampling. Samples and measurements required by this permit shall be conducted as specified in this permit and shall be representative of the discharge or monitored activity. (40 CFR 122.41 (j)(1))
- 1.15 Additional Sampling. If the Permittee monitors more frequently than required, the results and the frequency of monitoring shall be reported on the Discharge Monitoring Report (DMR) or another MPCA-approved form for that reporting period. (Minn. R. 7001.1090, subp. 1, item E)
- 1.16 Certified Laboratory. A laboratory certified by the Minnesota Department of Health shall conduct analyses required by this permit. Analyses of dissolved oxygen, pH, temperature and total residual oxidants (chlorine, bromine) do not need to be completed by a certified laboratory but shall comply with manufacturers specifications for equipment calibration and use. (Minn. Stat. Sec. 144.97 through 144.98 and Minn. R. 4740.2010 and 4740.2050 through 4740.2120) (Minn. R. 4740.2010 and 4740.2050 through 2120)
- 1.17 Sample Preservation and Procedure. Sample preservation and test procedures for the analysis of pollutants shall conform to 40 CFR Part 136 and Minn. R. 7041.3200.
- 1.18 Equipment Calibration: Flow meters, pumps, flumes, lift stations or other flow monitoring equipment used for purposes of determining compliance with permit shall be checked and/or calibrated for accuracy at least twice annually. (Minn. R. 7001.0150, subp. 2, items B and C)
- 1.19 Maintain Records. The Permittee shall keep the records required by this permit for at least three years, including any calculations, original recordings from automatic monitoring instruments, and laboratory sheets. The Permittee shall extend these record retention periods upon request of the MPCA. The Permittee shall maintain records for each sample and measurement. The records shall include the following information (Minn. R. 7001.0150, subp. 2, item C):
- a. The exact place, date, and time of the sample or measurement;
 - b. The date of analysis;
 - c. The name of the person who performed the sample collection, measurement, analysis, or calculation; and
 - d. The analytical techniques, procedures and methods used; and
 - e. The results of the analysis.

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Chapter 9. Total Facility Requirements

1. General Requirements

- 1.20 Completing Reports. The Permittee shall submit the results of the required sampling and monitoring activities on the forms provided, specified, or approved by the MPCA. The information shall be recorded in the specified areas on those forms and in the units specified. (Minn. R. 7001.1090, subp. 1, item D; Minn. R. 7001.0150, subp. 2, item B)

Required forms may include:

DMR Supplemental Form

Individual values for each sample and measurement must be recorded on the DMR Supplemental Form which, if required, will be provided by the MPCA. DMR Supplemental Forms shall be submitted with the appropriate DMRs. You may design and use your own supplemental form; however it must be approved by the MPCA. Note: Required summary information **MUST** also be recorded on the DMR. Summary information that is submitted **ONLY** on the DMR Supplemental Form does not comply with the reporting requirements.

- 1.21 Submitting Reports. DMRs and DMR Supplemental Forms shall be submitted to:

MPCA

Attn: Discharge Monitoring Reports
520 Lafayette Road North
St. Paul, Minnesota 55155-4194.

DMRs and DMR Supplemental Forms shall be postmarked by the 21st day of the month following the sampling period or as otherwise specified in this permit. A DMR shall be submitted for each required station even if no discharge occurred during the reporting period. (Minn. R. 7001.0150, subps. 2.B and 3.H)

Other reports required by this permit shall be postmarked by the date specified in the permit to:

MPCA

Attn: WQ Submittals Center
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

- 1.22 Incomplete or Incorrect Reports. The Permittee shall immediately submit an amended report or DMR to the MPCA upon discovery by the Permittee or notification by the MPCA that it has submitted an incomplete or incorrect report or DMR. The amended report or DMR shall contain the missing or corrected data along with a cover letter explaining the circumstances of the incomplete or incorrect report. (Minn. R. 7001.0150 subp. 3, item G)
- 1.23 Required Signatures. All DMRs, forms, reports, and other documents submitted to the MPCA shall be signed by the Permittee or the duly authorized representative of the Permittee. Minn. R. 7001.0150, subp. 2, item D. The person or persons that sign the DMRs, forms, reports or other documents must certify that he or she understands and complies with the certification requirements of Minn. R. 7001.0070 and 7001.0540, including the penalties for submitting false information. Technical documents, such as design drawings and specifications and engineering studies required to be submitted as part of a permit application or by permit conditions, must be certified by a registered professional engineer. (Minn. R. 7001.0540)

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Chapter 9. Total Facility Requirements

1. General Requirements

- 1.24 Detection Level. The Permittee shall report monitoring results below the reporting limit (RL) of a particular instrument as "<" the value of the RL. For example, if an instrument has a RL of 0.1 mg/L and a parameter is not detected at a value of 0.1 mg/L or greater, the concentration shall be reported as "<0.1 mg/L." "Non-detected," "undetected," "below detection limit," and "zero" are unacceptable reporting results, and are permit reporting violations. (Minn. R. 7001.0150, subp. 2, item B)

Where sample values are less than the level of detection and the permit requires reporting of an average, the Permittee shall calculate the average as follows:

- a. If one or more values are greater than the level of detection, substitute zero for all nondetectable values to use in the average calculation.
 - b. If all values are below the level of detection, report the averages as "<" the corresponding level of detection.
 - c. Where one or more sample values are less than the level of detection, and the permit requires reporting of a mass, usually expressed as kg/day, the Permittee shall substitute zero for all nondetectable values. (Minn. R. 7001.0150, subp. 2, item B)
- 1.25 Records. The Permittee shall, when requested by the Agency, submit within a reasonable time the information and reports that are relevant to the control of pollution regarding the construction, modification, or operation of the facility covered by the permit or regarding the conduct of the activity covered by the permit. (Minn. R. 7001.0150, subp. 3, item H)
- 1.26 Confidential Information. Except for data determined to be confidential according to Minn. Stat. Sec. 116.075, subd. 2, all reports required by this permit shall be available for public inspection. Effluent data shall not be considered confidential. To request the Agency maintain data as confidential, the Permittee must follow Minn. R. 7000.1300.

Noncompliance and Enforcement

- 1.27 Subject to Enforcement Action and Penalties. Noncompliance with a term or condition of this permit subjects the Permittee to penalties provided by federal and state law set forth in section 309 of the Clean Water Act; United States Code, title 33, section 1319, as amended; and in Minn. Stat. Sec. 115.071 and 116.072, including monetary penalties, imprisonment, or both. (Minn. R. 7001.1090, subp. 1, item B)
- 1.28 Criminal Activity. The Permittee may not knowingly make a false statement, representation, or certification in a record or other document submitted to the Agency. A person who falsifies a report or document submitted to the Agency, or tampers with, or knowingly renders inaccurate a monitoring device or method required to be maintained under this permit is subject to criminal and civil penalties provided by federal and state law. (Minn. R. 7001.0150, subp. 3, item G., 7001.1090, subps. 1, items G and H and Minn. Stat. Sec. 609.671)
- 1.29 Noncompliance Defense. It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. (40 CFR 122.41(c))
- 1.30 Effluent Violations. If sampling by the Permittee indicates a violation of any discharge limitation specified in this permit, the Permittee shall immediately make every effort to verify the violation by collecting additional samples, if appropriate, investigate the cause of the violation, and take action to prevent future violations. Violations that are determined to pose a threat to human health or a drinking water supply, or represent a significant risk to the environment shall be immediately reported to the Minnesota Department of Public Safety Duty Officer at 1(800)422-0798 (toll free) or (651)649-5451 (metro area). In addition, you may also contact the MPCA during business hours. Otherwise the violations and the results of any additional sampling shall be recorded on the next appropriate DMR or report.

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Chapter 9. Total Facility Requirements

1. General Requirements

- 1.31 Unauthorized Releases of Wastewater Prohibited. Except for conditions specifically described in Minn. R. 7001.1090, subp. 1, items J and K, all unauthorized bypasses, overflows, discharges, spills, or other releases of wastewater or materials to the environment, whether intentional or not, are prohibited. However, the MPCA will consider the Permittee's compliance with permit requirements, frequency of release, quantity, type, location, and other relevant factors when determining appropriate action. (40 CFR 122.41 and Minn. Stat. Sec 115.061)
- 1.32 Discovery of a release. Upon discovery of a release, the Permittee shall:
- a. Take all reasonable steps to immediately end the release.
 - b. Notify the Minnesota Department of Public Safety Duty Officer at 1(800)422-0798 or (651)649-5451 (metro area) immediately upon discovery of the release. You may contact the MPCA during business hours at 1(800)657-3864 or (651)296-6300 (metro area).
 - c. Recover as rapidly and as thoroughly as possible all substances and materials released or immediately take other action as may be reasonably possible to minimize or abate pollution to waters of the state or potential impacts to human health caused thereby. If the released materials or substances cannot be immediately or completely recovered, the Permittee shall contact the MPCA. If directed by the MPCA, the Permittee shall consult with other local, state or federal agencies (such as the Minnesota Department of Natural Resources and/or the Wetland Conservation Act authority) for implementation of additional clean-up or remediation activities in wetland or other sensitive areas.
 - d. Collect representative samples of the release. The Permittee shall sample the release for parameters of concern immediately following discovery of the release. The Permittee may contact the MPCA during business hours to discuss the sampling parameters and protocol. In addition, Fecal Coliform Bacteria samples shall be collected where it is determined by the Permittee that the release contains or may contain sewage. If the release cannot be immediately stopped, the Permittee shall consult with MPCA regarding additional sampling requirements. Samples shall be collected at least, but not limited to, two times per week for as long as the release continues.
 - e. Submit the sampling results as directed by the MPCA. At a minimum, the results shall be submitted to the MPCA with the next DMR.
- 1.33 Upset Defense. In the event of temporary noncompliance by the Permittee with an applicable effluent limitation resulting from an upset at the Permittee's facility due to factors beyond the control of the Permittee, the Permittee has an affirmative defense to an enforcement action brought by the Agency as a result of the noncompliance if the Permittee demonstrates by a preponderance of competent evidence:
- a. The specific cause of the upset;
 - b. That the upset was unintentional;
 - c. That the upset resulted from factors beyond the reasonable control of the Permittee and did not result from operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or increases in production which are beyond the design capability of the treatment facilities;
 - d. That at the time of the upset the facility was being properly operated;
 - e. That the Permittee properly notified the Commissioner of the upset in accordance with Minn. R. 7001.1090, subp. 1, item I; and
 - f. That the Permittee implemented the remedial measures required by Minn. R. 7001.0150, subp. 3, item J.

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Chapter 9. Total Facility Requirements

1. General Requirements

Operation and Maintenance

- 1.34 The Permittee shall at all times properly operate and maintain the facilities and systems of treatment and control, and the appurtenances related to them which are installed or used by the Permittee to achieve compliance with the conditions of the permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. The Permittee shall install and maintain appropriate backup or auxiliary facilities if they are necessary to achieve compliance with the conditions of the permit and, for all permits other than hazardous waste facility permits, if these backup or auxiliary facilities are technically and economically feasible Minn. R. 7001.0150. subp. 3, item F.
- 1.35 In the event of a reduction or loss of effective treatment of wastewater at the facility, the Permittee shall control production or curtail its discharges to the extent necessary to maintain compliance with the terms and conditions of this permit. The Permittee shall continue this control or curtailment until the wastewater treatment facility has been restored or until an alternative method of treatment is provided. (Minn. R. 7001.1090, subp. 1, item C)
- 1.36 Solids Management. The Permittee shall properly store, transport, and dispose of biosolids, septage, sediments, residual solids, filter backwash, screenings, oil, grease, and other substances so that pollutants do not enter surface waters or ground waters of the state. Solids should be disposed of in accordance with local, state and federal requirements. (40 CFR 503 and Minn. R. 7041 and applicable federal and state solid waste rules)
- 1.37 Scheduled Maintenance. The Permittee shall schedule maintenance of the treatment works during non-critical water quality periods to prevent degradation of water quality, except where emergency maintenance is required to prevent a condition that would be detrimental to water quality or human health. (Minn. R. 7001.0150. subp. 3, item F and Minn. R. 7001.0150. subp. 2, item B)
- 1.38 Control Tests. In-plant control tests shall be conducted at a frequency adequate to ensure compliance with the conditions of this permit. (Minn. R. 7001.0150. subp. 3, item F and Minn. R. 7001.0150. subp. 2, item B)

Changes to the Facility or Permit

- 1.39 Permit Modifications. No person required by statute or rule to obtain a permit may construct, install, modify, or operate the facility to be permitted, nor shall a person commence an activity for which a permit is required by statute or rule until the Agency has issued a written permit for the facility or activity. (Minn. R. 7001.0030)

Permittees that propose to make a change to the facility or discharge that requires a permit modification must follow Minn. R. 7001.0190. If the Permittee cannot determine whether a permit modification is needed, the Permittee must contact the MPCA prior to any action. It is recommended that the application for permit modification be submitted to the MPCA at least 180 days prior to the planned change.

- 1.40 Construction. No construction shall begin until the Permittee receives written approval of plans and specifications from the MPCA (Minn. Stat. Sec. 115.03(f)).

Plans, specifications and MPCA approval are not necessary when maintenance dictates the need for installation of new equipment, provided the equipment is the same design size and has the same design intent. For instance, a broken pipe, lift station pump, aerator, or blower can be replaced with the same design-sized equipment without MPCA approval.

If the proposed construction is not expressly authorized by this permit, it may require a permit modification. If the construction project requires an Environmental Assessment Worksheet under Minn. R. 4410, no construction shall begin until a negative declaration is issued and all approvals are received or implemented.

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Chapter 9. Total Facility Requirements

1. General Requirements

- 1.41 Report Changes. The Permittee shall give advance notice as soon as possible to the MPCA of any substantial changes in operational procedures, activities that may alter the nature or frequency of the discharge, and/or material factors that may affect compliance with the conditions of this permit. (Minn. R. 7001.0150, subp. 3, item M)
- 1.42 Chemical Additives. The Permittee shall receive prior written approval from the MPCA before increasing the use of a chemical additive authorized by this permit, or using a chemical additive not authorized by this permit, in quantities or concentrations that have the potential to change the characteristics, nature and/or quality of the discharge.

The Permittee shall request approval for an increased or new use of a chemical additive at least 60 days, or as soon as possible, before the proposed increased or new use.

This written request shall include at least the following information for the proposed additive:

- a. The process for which the additive will be used;
- b. Material Safety Data Sheet (MSDS) which shall include aquatic toxicity, human health, and environmental fate information for the proposed additive;
- c. A complete product use and instruction label;
- d. The commercial and chemical names and Chemical Abstract Survey (CAS) number for all ingredients in the additive (If the MSDS does not include information on chemical composition, including percentages for each ingredient totaling to 100%, the Permittee shall contact the supplier to have this information provided); and
- e. The proposed method of application, application frequency, concentration, and daily average and maximum rates of use.

Upon review of the information submitted regarding the proposed chemical additive, the MPCA may require additional information be submitted for consideration. This permit may be modified to restrict the use or discharge of a chemical additive and include additional influent and effluent monitoring requirements.

Approval for the use of an additive shall not justify the exceedance of any effluent limitation nor shall it be used as a defense against pollutant levels in the discharge causing or contributing to the violation of a water quality standard. (Minn. R. 7001.0170)

- 1.43 MPCA Initiated Permit Modification, Suspension, or Revocation. The MPCA may modify or revoke and reissue this permit pursuant to Minn. R. 7001.0170. The MPCA may revoke without reissuance this permit pursuant to Minn. R. 7001.0180.
- 1.44 TMDL Impacts. Facilities that discharge to an impaired surface water, watershed or drainage basin may be required to comply with additional permits or permit requirements, including additional restriction or relaxation of limits and monitoring as authorized by the CWA 303(d)(4)(A) and 40 CFR 122.44.l.2.i., necessary to ensure consistency with the assumptions and requirements of any applicable US EPA approved wasteload allocations resulting from Total Maximum Daily Load (TMDL) studies.
- 1.45 Permit Transfer. The permit is not transferable to any person without the express written approval of the Agency after compliance with the requirements of Minn. R. 7001.0190. A person to whom the permit has been transferred shall comply with the conditions of the permit. (Minn. R., 7001.0150, subp. 3, item N)

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Chapter 9. Total Facility Requirements

1. General Requirements

- 1.46 Facility Closure. The Permittee is responsible for closure and postclosure care of the facility. The Permittee shall notify the MPCA of a significant reduction or cessation of the activities described in this permit at least 180 days before the reduction or cessation. The MPCA may require the Permittee to provide to the MPCA a facility Closure Plan for approval.

Facility closure that could result in a potential long-term water quality concern, such as the ongoing discharge of wastewater to surface or ground water, may require a permit modification or reissuance.

The MPCA may require the Permittee to establish and maintain financial assurance to ensure performance of certain obligations under this permit, including closure, postclosure care and remedial action at the facility. If financial assurance is required, the amount and type of financial assurance, and proposed modifications to previously MPCA-approved financial assurance, shall be approved by the MPCA. (Minn. Stat. Sec. 116.07, subd. 4)

- 1.47 Permit Reissuance. If the Permittee desires to continue permit coverage beyond the date of permit expiration, the Permittee shall submit an application for reissuance at least 180 days before permit expiration. If the Permittee does not intend to continue the activities authorized by this permit after the expiration date of this permit, the Permittee shall notify the MPCA in writing at least 180 days before permit expiration.

If the Permittee has submitted a timely application for permit reissuance, the Permittee may continue to conduct the activities authorized by this permit, in compliance with the requirements of this permit, until the MPCA takes final action on the application, unless the MPCA determines any of the following (Minn. R. 7001.0040 and 7001.0160):

- a. The Permittee is not in substantial compliance with the requirements of this permit, or with a stipulation agreement or compliance schedule designed to bring the Permittee into compliance with this permit;
- b. The MPCA, as a result of an action or failure to act by the Permittee, has been unable to take final action on the application on or before the expiration date of the permit;
- c. The Permittee has submitted an application with major deficiencies or has failed to properly supplement the application in a timely manner after being informed of deficiencies.

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STATE OF MINNESOTA
Minnesota Pollution Control Agency

Industrial Division

**National Pollutant Discharge Elimination System (NPDES)/
 State Disposal System (SDS) Permit MN0055948**

PERMITTEE:	United States Steel Corporation		
FACILITY NAME:	Minnesota Ore Operations – Keetac – Tailings Basin		
RECEIVING WATER:	Reservoir 2, Welcome Creek		
CITY OR TOWNSHIP:	Keewatin	COUNTY:	Itasca
ISSUANCE DATE:		EXPIRATION DATE:	

The state of Minnesota, on behalf of its citizens through the Minnesota Pollution Control Agency (MPCA), authorizes the Permittee to construct, install and operate a disposal system at the facility named above and to discharge from this facility to the receiving water named above, in accordance with the requirements of this permit.

The goal of this permit is to reduce pollutant levels in point source discharges and protect water quality in accordance with Minnesota and U.S. statutes and rules, including Minn. Stat. chs. 115 and 116, Minn. R. chs. 7001, 7050, 7053, 7060, 7090.3000 through 7090.3080, and the U.S. Clean Water Act.

This permit is effective on the issuance date identified above, and supersedes the previous permit that was issued for this facility on March 10, 2006. This permit expires at midnight on the expiration date identified above.

Signature: _____
 Jeff Udd, P.E. for The Minnesota Pollution Control Agency
 Acting Supervisor, Water Quality Permits Unit
 Land and Water Quality Permits Section
 Industrial Division

Submit DMRs to:

Attention: Discharge Monitoring Reports
 Minnesota Pollution Control Agency
 520 Lafayette Rd N
 St Paul, MN 55155-4194

Submit Other WQ Reports to:

Attention: WQ Submittals Center
 Minnesota Pollution Control Agency
 520 Lafayette Rd N
 St Paul, MN 55155-4194

Questions on this permit?

- For DMR and other permit reporting issues, contact:
 Belinda Nicholas, 651-757-2613.
- For specific permit requirements or permit compliance status, contact:
 John Thomas, 218-302-6616.
- General permit or NPDES program questions, contact:
 MPCA, 651-282-6143 or 1-800-657-3938.

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Facility Description

The principal activity at this facility is the disposal of taconite tailings and related wastewater from the U.S. Steel Corporation – Keewatin Taconite Operations plant. The facility consists of the Keewatin Taconite tailings basin, the drainage area contributing surface run-off to the basin, and all non-sewage wastewater disposal systems within the permitted area. The facility has proposed an expansion of the mining and taconite pellet manufacturing operations at the processing plant associated with this tailings basin. The conditions of this permit reflect the changes associated with this expansion.

The tailings and related wastewater that are disposed of in the tailings basin are generated by the Keewatin Taconite plant, which is located north of Highway 169. The plant consists of a series of crushers and screens, a concentrator, and an agglomerator. The concentrator consists of a series of mills, magnetic separators, hydroseparators, hydroclones, screens, and thickeners. A flocculant is added to the concentrator tailings slurry before the thickening stage, at a maximum rate of 250,000 lbs/yr. The agglomerator receives the concentrate, which is mixed with limestone then dewatered by disc filters. The filter cake is then mixed with bentonite and formed into pellets in balling drums. The agglomerator wastewater, as well as wet scrubber, recirculating non-contact cooling water, and normal floor drain wastewater that is generated at the plant, is recirculated as process water within the plant. The make-up water for the recirculating non-contact cooling water system in the plant is treated with softening, along with chemical additives, such as corrosion inhibitors, descalers, and microbiocides are also added. Chemicals used in the wet scrubber system are added for pH control, clarification, and coagulation aid. Corrosion inhibitor/descaler chemicals are used in the vacuum seal water system. A kiln slag inhibitor chemical is used at approximately 1,175 pounds per day or 430,000 pounds per year.

The wastewater flow to the tailings basin consists only of the tailings slurry, associated concentrator process wastewater, and wet scrubber blowdown water for a total average flow rate of 20 MGD. The tailings slurry and plant process wastewater is piped under pressure from the plant across Highway 169 and is spigotted into the tailings basin. The dual tailings pipelines have several gravity flow drainage points along their route that are used during routine maintenance, winter operations, and emergency situations, such as pump failure. Dump valve drainage points 4, 5, 6W, 6E, 7, and 8 flow by gravity directly to the tailings basin. An average of 13 million long tons of dry tailings are disposed of each year in the basin. The tailings are generated from the plant thickeners. The basin is divided into several parts, principally the older Stage 1 and the active Stage 2 basins. Much of the Stage 1 basin has undergone re-vegetation. Water is occasionally pumped from Reservoir 2 to Reservoir 6 for water level maintenance, at an average rate of 814 million gallons per year. The tailings basin is principally underlain by glacial till and glaciofluvial deposits.

The interior tailings basin dikes are constructed of coarse tailings which are spigotted from the tailings pipelines. The exterior basin dikes are constructed of clay starter dikes with a coarser sand and gravel chimney drain. A decant tower on the south side of the second stage interior tailings basin drains basin wastewater to the second stage exterior pond for additional sedimentation. A decant tower on the west side of the basin area drains water from the second stage exterior to Reservoir 6 for reuse. Return water for the plant water supply is pumped from a

station on Reservoir 6. This reservoir discharges through siphon outfall SD001, at a combined maximum rate of 9.4 MGD, to Reservoir 2. Outfall SD005 was established to discharge to Reservoir 2 North and Welcome Creek, to Reservoir 2, at a maximum flow of approximately 23 MGD. The proposed expansion to the mining and pellet manufacturing process will result in a vertical expansion of the tailings basin, and changes to the volumes discharged to and from the tailings basin. Discharges to surface water from the tailings basin following the expansion will not exceed the pre-expansion volumes.

Due to the proposed discharge location, direct discharge of mine pit dewatering from the Sargent Pit to an unnamed ditch is authorized under this permit. This activity is similar to other mine pit dewatering operations authorized in NPDES/SDS Permit MN0031879.

Surface drainage from the tailings basin area, in the form of surface run-off from the exterior dikes, flows to the West Swan River, unnamed wetlands, Hay Creek to Swan Lake, Reservoir 2, Reservoir 2 North, and Welcome Creek. These are all class 2B, 3B, 4A, 4B, 5, and 6 waters, except for Welcome Creek, which is class 2C, 3C, 4A, 4B, 5, and 6 waters.

Surface water station SW001 is located at the weir outlet of Reservoir 2 and was established at the request of the Permittee. No limits are associated with this monitoring station.

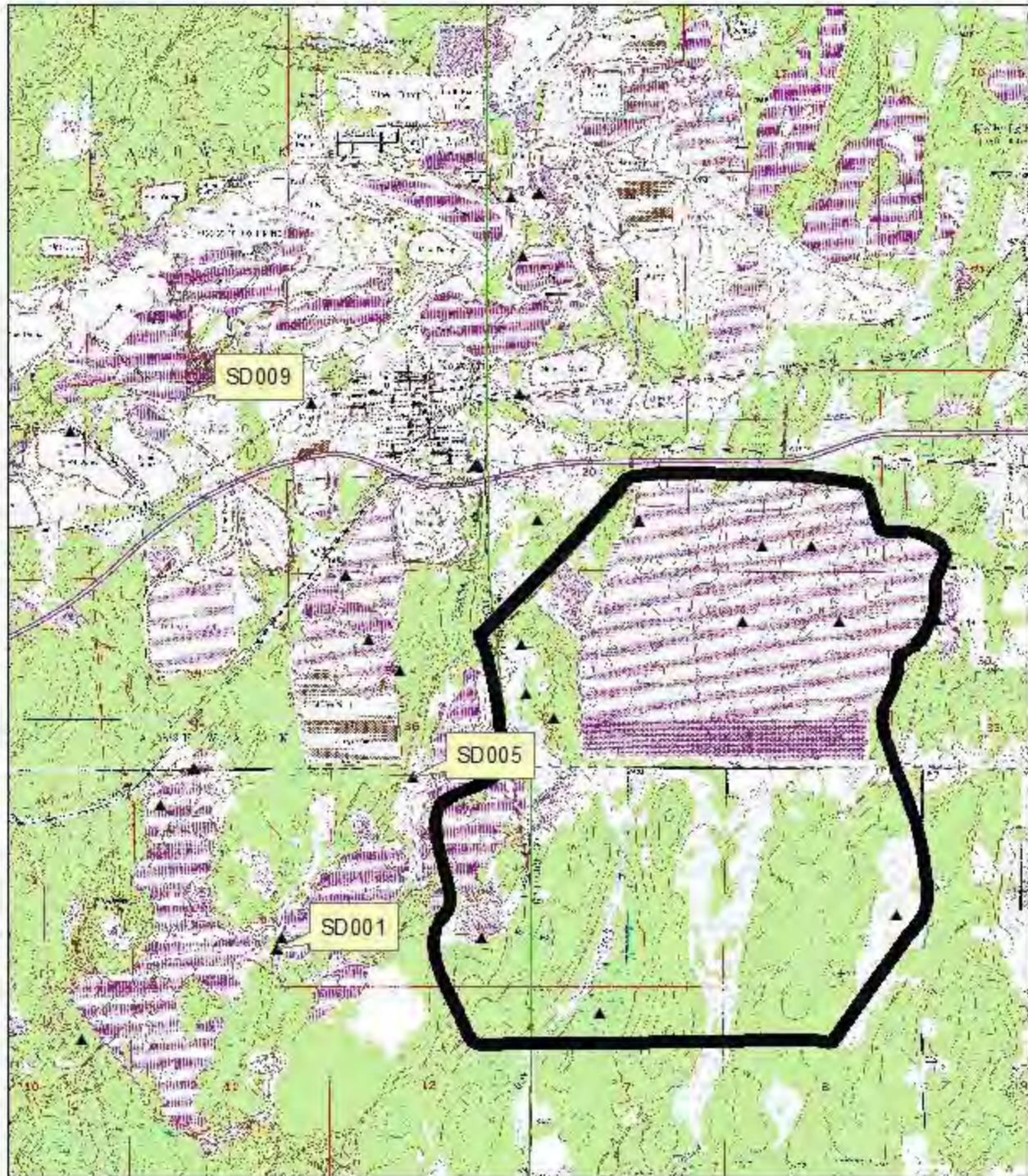
Chemical dust suppressants are occasionally used at the facility in accordance with MPCA approvals.

Repair shops and a garage are located in the Southwest ¼ of the Southeast ¼ of Section 36. Sewage generated at this site is contained in portable units and disposed of in a nearby municipal wastewater treatment facility.

The locations of the facility's tailings basin discharge sites are shown on the following page.

Topographic Map of Permitted Facility

MN0055948, United States Steel Corporation - Keetac Tailings Basin
St. Louis & Itasca County, Minnesota



Map produced by: MPCA Staff, 6/23/2011
Source: USGS Keewatin, Silica Quad
Scale: 1:50,000

0 0.25 0.5 1 Miles



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Surface Discharge Stations

<u>Station</u>	<u>Type of Station</u>	<u>Local Name</u>	<u>PLS Location</u>
SD001	Effluent To Surface Water	Siphon Outfalls 011, 012, 013	SE Quarter of Section 2, Township 56 North, Range 22 West
SD005	Effluent To Surface Water	Culvert Outfall from Reservoir 6	NE Quarter of the NE Quarter of the NW Quarter of Section 1, Township 56 North, Range 22 West
SD008	Effluent To Surface Water	Sum of outfalls 011-013, 015	SE Quarter of Section 2, Township 56 North, Range 22 West
SD009	Effluent To Surface Water	Sargent Pit Dewatering to Unnamed Ditch	

Surface Water Stations

<u>Station</u>	<u>Type of Station</u>	<u>Local Name</u>	<u>PLS Location</u>
SW001	Lake/Reservoir	Reservoir 2	NE Quarter of Section 10, Township 56 North, Range 22 West

Waste Stream Stations

<u>Station</u>	<u>Type of Station</u>	<u>Local Name</u>	<u>PLS Location</u>
WS001	Water Intake	Non-pptn water inputs to the facility	SE Quarter of Section 2, Township 56 North, Range 22 West

Keewatin Taconite Operations - Tailings Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Interim Period*

SD 001

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Estimate	1 x Month	4
Flow	Monitor Only	mgd	Calendar Month Maximum	Jan-Dec	Estimate	1 x Month	4
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Estimate	1 x Month	4
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	4
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	4
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Month	5
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	4
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	4
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	4
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	4
Specific Conductance	Monitor Only	umh/cm	Calendar Month Average	Jan-Dec	Grab	1 x Month	4
Sulfate, Total (as SO4)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	4
Sulfate, Total (as SO4)	Monitor Only	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	4

SD 005

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Estimate	1 x Week	
Flow	Monitor Only	mgd	Calendar Month Maximum	Jan-Dec	Estimate	1 x Week	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Estimate	1 x Week	
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Selenium, Total (as Se)	Monitor Only	ug/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	7
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Calendar Month Average	Jan-Dec	Grab	1 x Month	

Keewatin Taconite Operations - Tailings Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Interim Period*

SD 005

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Sulfate, Total (as SO ₄)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO ₄)	Monitor Only	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	

SD 009

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Chloride, Total	Monitor Only	mg/L	Calendar Month Maximum	Jan-Dec	Grab	1 x Month	
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	3
Nitrite Plus Nitrate, Total (as N)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	2 x Year	1
Nitrogen, Ammonia, Total (as N)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	2 x Year	1
Nitrogen, Kjeldahl, Total	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	2 x Year	1
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Selenium, Total (as Se)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	7
Solids, Total Dissolved (TDS)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	2 x Year	1
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Calendar Month Average	Jan-Dec	Grab	1 x Month	7
Sulfate, Total (as SO ₄)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO ₄)	Monitor Only	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	

Period: *Limits Applicable in the Final Period*

SD 001

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Estimate	1 x Month	4
Flow	Monitor Only	mgd	Calendar Month Maximum	Jan-Dec	Estimate	1 x Month	4

Keewatin Taconite Operations - Tailings Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Final Period*

SD 001

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Estimate	1 x Month	4
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	4
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	4
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Month	5
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	4
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	4
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	4
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	4
Specific Conductance	Monitor Only	umh/cm	Calendar Month Average	Jan-Dec	Grab	1 x Month	4
Sulfate, Total (as SO4)	14	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	4
Sulfate, Total (as SO4)	24	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	4

SD 005

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Estimate	1 x Week	
Flow	Monitor Only	mgd	Calendar Month Maximum	Jan-Dec	Estimate	1 x Week	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Estimate	1 x Week	
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	2
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Selenium, Total (as Se)	Monitor Only	ug/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	7
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Sulfate, Total (as SO4)	14	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO4)	24	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	

Keewatin Taconite Operations - Tailings Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Final Period*

SD 008

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Evaporation, Accumulated	Monitor Only	in	Calendar Month Total	Jan-Dec	Calculation	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Calculation	1 x Month	6
Precipitation	Monitor Only	in	Calendar Month Total	Jan-Dec	Measurement, Continuous	1 x Month	

SD 009

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Chloride, Total	Monitor Only	mg/L	Calendar Month Maximum	Jan-Dec	Grab	1 x Month	
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Measurement	1 x Month	
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	
Iron, Dissolved (as Fe)	1.0	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Iron, Dissolved (as Fe)	2.0	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Mercury, Total (as Hg)	Monitor Only	ng/L	Single Value	Jan-Dec	Grab	1 x Quarter	3
Nitrite Plus Nitrate, Total (as N)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	2 x Year	1
Nitrogen, Ammonia, Total (as N)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	2 x Year	1
Nitrogen, Kjeldahl, Total	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	2 x Year	1
pH	9.0	SU	Instantaneous Maximum	Jan-Dec	Grab	1 x Month	
pH	6.0	SU	Instantaneous Minimum	Jan-Dec	Grab	1 x Month	
Selenium, Total (as Se)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	7
Solids, Total Dissolved (TDS)	Monitor Only	mg/L	Single Value	Jan-Dec	Grab	2 x Year	1
Solids, Total Suspended (TSS)	20	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Solids, Total Suspended (TSS)	30	mg/L	Daily Maximum	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Calendar Month Average	Jan-Dec	Grab	1 x Month	7
Sulfate, Total (as SO4)	14	mg/L	Calendar Month Average	Jan-Dec	Grab	2 x Month	
Sulfate, Total (as SO4)	24	mg/L	Calendar Month Maximum	Jan-Dec	Grab	2 x Month	

SW 001

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	mgd	Calendar Month Average	Jan-Dec	Estimate	1 x Month	

Keewatin Taconite Operations - Tailings Limits and Monitoring Requirements

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The Permittee shall comply with the limits and monitoring requirements as specified below.

Period: *Limits Applicable in the Final Period*

SW 001

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Estimate	1 x Month	
Solids, Total Suspended (TSS)	Monitor Only	mg/L	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Specific Conductance	Monitor Only	umh/cm	Calendar Month Average	Jan-Dec	Grab	1 x Month	
Turbidity	Monitor Only	NTU	Calendar Month Average	Jan-Dec	Grab	1 x Month	

WS 001

Parameter	Limit	Units	Limit Type	Effective Period	Sample Type	Frequency	Notes
Flow	Monitor Only	MG	Calendar Month Total	Jan-Dec	Measurement	1 x Month	8

Notes:

- 1 -- At least one sample shall be collected in each April and September.
- 2 -- Samples may be taken any time during each calendar quarter but must be reported on the DMR for the last month of each quarter (e.g. the sample for the first calendar quarter of Jan - Mar should be reported on the March DMR). Use EPA method 1631, with clean techniques method 1669, and any revisions to those methods.
- 3 -- Samples may be taken any time during each calendar quarter but must be reported on the DMR for the last month of each quarter (e.g. the sample for the first calendar quarter of Jan - Mar should be reported on the March DMR). Use EPA method 1631, with clean techniques method 1669, and any revisionsto this methods.
- 4 -- Sampling shall be conducted in accordance with Chapter 5 of this permit.
- 5 -- Sampling shall be conducted in accordance with Chapter 5 of this permit. Use EPA method 1631, with clean techniques method 1669, and any revisions to those methods.
- 6 -- Sum of annual discharge from outfalls 010, 011, 012, 013 and 015 shall not exceed the annual net precipitation at the facility as calculated according to PART I, C.8.
- 7 -- The permittee may request to modify this requirement after 12 months of monitoring data have been submitted to MPCA.
- 8 -- Volume of non-precipitation water inputs to the facility (for example, from Reservoir 2 or from Reservoir 5).

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Chapter 1. Special Requirements

1. Compliance Schedule

Compliance Schedule for Sulfate

- 1.1 The Permittee is operating under a schedule of compliance pursuant to NPDES/SDS Permit MN0031879 to attain compliance with final effluent limitations for total sulfate. The Permittee shall comply with the schedule of compliance contained in Chapter 1 of NPDES/SDS Permit MN0031879. Pursuant to that schedule, the MPCA will submit notification to the Permittee that the final effluent limitations for total sulfate contained in this permit apply.

2. Special Requirements

Effluent Limit Study

- 2.1 The Permittee may opt to conduct a study to gather data and information that would support a total sulfate limit other than the final limitations included in this permit.
- 2.2 When cause exists according to state and federal law regarding modification of permits, this permit may be reopened for modification of effluent limitations, discharge restrictions, monitoring requirements, and or conditions of a schedule of compliance. Any modified permit conditions shall be consistent with all applicable state and federal requirements. MPCA shall comply with all procedural requirements under state and federal law prior to reopening and modifying this permit.

Chapter 2. Industrial Process Wastewater

1. Prohibited Discharges

- 1.1 This permit does not authorize the discharge of sewage, wash water, scrubber water, spills, oil, hazardous substances, or equipment/vehicle cleaning and maintenance wastewaters to ditches, wetlands or other surface waters of the state.
- 1.2 The Permittee shall prevent the routing of pollutants from the facility to a municipal wastewater treatment system in any manner unless authorized by the pretreatment standards of the MPCA and the municipal authority.
- 1.3 The Permittee shall not transport pollutants to a municipal wastewater treatment system that will interfere with the operation of the treatment system or cause pass-through violations of effluent limits or water quality standards.

2. Toxic Substance Reporting

- 2.1 The Permittee shall notify the MPCA immediately of any knowledge or reason to believe that an activity has occurred that would result in the discharge of a toxic pollutant listed in Minnesota Rules, pt. 7001.1060, subp. 4 to 10 or listed below that is not limited in the permit, if the discharge of this toxic pollutant has exceeded or is expected to exceed the following levels:
 - a. for acrolein and acrylonitrile, 200 ug/L;
 - b. for 2,4-dinitrophenol and 2-methyl-4,6-dinitrophenol, 500 ug/L;
 - c. for antimony, 1mg/L;
 - d. for any other toxic pollutant listed in Minnesota Rules, pt. 7001.1060, subp. 4 to 10, 100 ug/L; or
 - e. five times the maximum concentration value identified and reported for that pollutant in the permit application. (Minnesota Rules, pt. 7001.1090, subp. 2.A)

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Chapter 2. Industrial Process Wastewater

2. Toxic Substance Reporting

- 2.2 The Permittee shall notify the MPCA immediately if the Permittee has begun or expects to begin to use or manufacture as an intermediate or final by-product a toxic pollutant that was not reported in the permit application under Minnesota Rules, pt. 7001.1050, subp. 2.J. (Minnesota Rules, pt. 7001.1090, subp. 2.B)

3. Hydrotest Discharges

- 3.1 The Permittee shall notify the MPCA prior to discharging hydrostatic test waters. The Permittee shall provide information necessary to evaluate the potential impact of this discharge and to ensure compliance with this permit. This information shall include:
- a. the proposed discharge dates;
 - b. the name and location of receiving waters, including city or township, county, and township/range location;
 - c. an evaluation of the impact of the discharge on the receiving waters in relation to the water quality standards;
 - d. a map identifying discharge location(s) and monitoring point(s);
 - e. the estimated average and maximum discharge rates;
 - f. the estimated total flow volume of discharge;
 - g. the water supply for the test water, with a copy of the appropriate Minnesota Department of Natural Resources (DNR) water appropriation permit;
 - h. water quality data for the water supply;
 - i. proposed treatment method(s) before discharge; and
 - j. methods to be used to prevent scouring and erosion due to the discharge.
- 3.2 This permit does not authorize the construction or installation of pipeline facilities.

4. Polychlorinated Biphenyls (PCBs)

- 4.1 PCBs, including but not limited to those used in electrical transformers and capacitors, shall not be discharged or released to the environment.

5. New Proposed Dewatering

- 5.1 The Permittee shall obtain a permit modification before discharging from a new dewatering outfall.
- 5.2 In addition to the requirements in the Permit Modifications section of this permit, the Permittee shall submit to the MPCA detailed plans and specifications for the proposed methods of achieving discharge limits for turbidity and total suspended solids, based in part upon representative water quality data for untreated wastewater and a detailed map and diagram description of the proposed design for the flow control structures, and route of the discharge to receiving waters.

6. Application for Permit Reissuance

- 6.1 The permit application shall include analytical data as part of the application for reissuance of this permit. These analyses shall be done on individual samples taken during the twelve-month period before the reissuance application is submitted.

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Chapter 2. Industrial Process Wastewater

6. Application for Permit Reissuance

- 6.2 The permit application shall include analytical data for at least the following parameters at monitoring station SD005:
- a. biochemical oxygen demand, chemical oxygen demand, total organic carbon, gasoline range organics, diesel range organics, fecal coliform, ammonia, temperature;
 - b. color, fluoride, nitrate-nitrite (as nitrogen), total organic nitrogen, oil and grease, total phosphorus, chloride, sulfate, sulfide (as sulfur), surfactants, bicarbonates, alkalinity, total salinity, total dissolved solids, specific conductance;
 - c. aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, molybdenum, nickel, potassium, selenium, silver, sodium, strontium, thallium, tin, titanium, vanadium, zinc (all in total form) using approved methods according to 40 CFR Part 136.3;
 - d. total mercury using EPA Method 1631;
 - e. gross alpha particles, radium-226, radium-228, radon-222, uranium;
 - f. PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, PCB-1260; and
 - g. a scan of constituents using EPA Methods 624 and 625, in 40 CFR Part 136.

The Permittee shall identify, in addition to those pollutants noted in Methods 624 and 625 (Appendix D, Table II), the concentrations of at least ten of the most abundant constituents of the acid and base/neutral organic fractions shown to be present by peaks on the total ion plots (reconstructed gas chromatograms) within ten percent of the nearest internal standard. Identification shall be through the use of U.S. EPA/NIH computerized library of mass spectra, with visual confirmation and potential quantification.

- 6.3 The Permittee shall include, as part of the application for reissuance of this permit, and updated Operating Plan for the tailings basin for the next five (5) years.

Chapter 3. Metallic Mining

1. Mine Tailings Basin

- 1.1 To summarize the status of the tailings basin, the Permittee shall submit an Annual Report by January 31 of year following permit issuance.
- 1.2 The Annual Report shall include a current map of the tailings basin area that details the dikes, berms, dams, roads and cells, as well as the current topographic and water level elevations.
- 1.3 The Annual Report for the tailings basin shall also report the annual net precipitation determined from the previous calendar year and the annual flow volume discharged via outfalls SD001 and SD005.
- 1.4 The Permittee shall conduct a detailed field survey of seepage zones from the perimeter dikes of the tailings basin during October of each year.

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Chapter 3. Metallic Mining

1. Mine Tailings Basin

- 1.5 The Annual Report shall include a Dike Seepage Survey Report. The Dike Seepage Survey Report shall summarize the field survey and include the following information:
- a. a clearly labeled map indicating the locations of the visible seepage zones;
 - b. the estimated flow rates for the seepage zones;
 - c. the specific conductance, pH and temperature values for the seepage zones;
 - d. a brief description of the changes in the nature of the seepage from previous observations; and
 - e. photographs as needed to document items a. - d.
- 1.6 The Permittee shall discharge through outfalls SD001 and SD005 no more than the annual net precipitation from the tailings basin during each calendar year. The annual net precipitation shall be determined as follows:

$$Y = (A_f * P) - (A_t * E)$$

where:

Y = annual net precipitation

A_f = area of the tailings basin plus the drainage area contributing surface runoff to the tailings basin

P = total annual precipitation

A_t = open water area of the tailings basin plus Reservoir 6, and

E = annual lake evaporation.

The total annual precipitation and the annual lake evaporation shall be based on the sum of the data reported through station SD008.

- 1.7 If the Permittee does not discharge through outfalls SD001 and SD005 the volume equivalent to the annual net precipitation in a given calendar year, then the Permittee may carry over the difference between the annual net precipitation and the actual volume discharged as a credit to the annual net precipitation for the following calendar year. Such credit may be carried over only to that calendar year immediately following the year in which not all of the allowable discharge volume was utilized.
- 1.8 The Permittee shall notify the Commissioner in writing at least 180 days in advance of any expansion of the area covered by mine tailings beyond the area enclosed by the perimeter basin dams on the date of issuance of this permit.
- 1.9 The Permittee shall notify the Commissioner in writing at least 30 days prior to the addition or modification of hydraulic relief features, such as granular blanket and filter drains, relief wells and relief trenches, other than those described in the Facility Description.
- 1.10 The Permittee shall make every effort to prevent and contain any breaks in or spills from the tailings pipeline which runs from the Keewatin Taconite plant to the tailings basin. In particular, the Permittee shall comply with the requirements of the Noncompliance, Upset Defense and Duty to Notify and Avoid Pollution requirements of the Total facility section of the permit, as well as the Tailings Spill Response Plan, should a pipeline break or spill occur.

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Chapter 3. Metallic Mining

2. Mobile and Rail Equipment Service Areas

- 2.1 Mobile equipment and rail equipment service areas in the facility shall be operated in compliance with the following:
- a. The Permittee shall collect and dispose of locomotive traction sand, degreasing wastes, motor oil, oil filters, oil sorbent pads and booms, transmission fluids, power steering fluids, brake fluids, coolant/antifreeze, radiator flush wastewater and spent solvents in accordance with applicable solid and hazardous waste management rules. These materials shall not be discharged to surface or ground waters of the state.
 - b. The steam-cleaning of mobile equipment and rail equipment, except for limited outdoor cleaning of large drills and shovels, shall be conducted in wash bays that drain to wastewater treatment systems that include the removal of suspended solids and flammable liquids. The only washing of mobile equipment done in outside areas shall be to remove mud and dirt that has accumulated during outside work.
 - c. The Permittee shall not use solvent-based cleaners, such as those available for brake cleaning and degreasing, to wash mobile and rail equipment unless the cleaning fluids are completely contained and not allowed to flow to surface or ground waters of the state. Soaps and detergents used in washing shall be biodegradable.
 - d. Mobile and rail equipment maintenance and repairs shall not be conducted in wash bays.
 - e. Hazardous materials shall not be stored or handled in wash bays.
 - f. The Permittee shall inspect wastewater containment systems regularly, and repair any leaks that are detected immediately.
 - g. If the Permittee discovers that recoverable amounts of petroleum products have entered wastewater containment systems, they shall be recovered immediately and reported to the MPCA.
 - h. Spill cleanup procedures shall be posted in mobile and rail equipment maintenance and repair areas.

Chapter 4. Stormwater Management

1. Authorization

- 1.1 This chapter authorizes the Permittee to discharge stormwater associated with industrial activity in accordance with the terms and conditions of this chapter. The MPCA may initiate modification of this chapter in accordance with Minn. R. 7001.0170 and Minn. R. 7001.0190 Subp. 1 to incorporate revised requirements in response to the reissuance or modification of the General Stormwater Permit for Industrial Activity (MNG611000).

2. Prohibited Discharges

- 2.1 This permit, unless specifically authorized by another chapter, does not authorize the discharge of sewage, wash water, scrubber water, spills, oil, hazardous substances, or equipment/vehicle cleaning and maintenance wastewaters to ditches, wetlands or other surface waters of the state.
- 2.2 This permit does not authorize discharges from sites for which Environmental Assessment Worksheets or Environmental Impact Statements are required, in accordance with Minn. R. ch. 4410, until that environmental review is completed.

3. Water Quality Standards

- 3.1 The Permittee shall operate and maintain the facility and shall control runoff, including stormwater, from the facility to prevent the exceedance of water quality standards specified in Minnesota Rules, chs. 7050 and 7060.

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Chapter 4. Stormwater Management

3. Water Quality Standards

- 3.2 The Permittee shall limit and control the use of materials at the facility that may cause exceedances of ground water standards specified in Minnesota Rules, ch. 7060. These materials include, but are not limited to, detergents and cleaning agents, solvents, chemical dust suppressants, lubricants, fuels, drilling fluids, oils, fertilizers, explosives and blasting agents.

4. Stormwater Pollution Prevention Plan

- 4.1 The Permittee shall develop and implement a Stormwater Pollution Prevention Plan (Plan) to address the specific conditions at the industrial facility. The goal of the Plan is to eliminate or minimize contact of stormwater with significant materials that may result in pollution of the runoff. If contact cannot be eliminated or reduced, stormwater that has contacted significant material should be treated before it is discharged from the site. The Plan shall apply to those areas of the facility where industrial activities occur or significant materials are stored, and stormwater runoff does not receive treatment prior to discharge via a permitted surface discharge station. In addition, the Plan should identify all areas of the facility where the necessary treatment of stormwater is addressed by a permitted surface discharge station.
- 4.2 The Plan shall be implemented at the site before the Permittee is covered under this permit.
- 4.3 The Stormwater Pollution Prevention Plan shall include a description of appropriate Best Management Practices for protection of surface and ground water quality at the facility, and a schedule for implementing the practices. The Plan shall also include the procedures to be followed by designated staff employed by the Permittee to implement the plan.
- 4.4 The Permittee shall comply with its Stormwater Pollution Prevention Plan.
- 4.5 The Permittee shall submit the Stormwater Pollution Prevention Plan to MPCA upon request.

Plan Contents

- 4.6 Complete a drainage map. The map should indicate the following items at or adjacent to the facility:
- a. drainage areas and directions of stormwater runoff (indicated by arrows);
 - b. discharge outfalls from the site (structures that carry stormwater runoff from the facility such as ditches or storm sewers);
 - c. the name and location of waters of the state that receive facility stormwater runoff (if waters of the state are too distant from the facility to be indicated on the site map, indicate the name, direction and shortest distance to the lake, river, stream or wetland that receives runoff from your site);
 - d. areas where significant materials are exposed to stormwater;
 - e. locations of storm sewer inlets and an indication of which, if any, structures have floor drains or loading dock drains that are connected to storm sewers; and
 - f. locations and types of Best Management Practices (BMPs) currently installed at the facility to reduce or eliminate pollutants to stormwater.

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Chapter 4. Stormwater Management

4. Stormwater Pollution Prevention Plan

- 4.7 Complete an inventory of exposed significant materials. Indicate the types of significant materials handled or stored at the site that may potentially contact stormwater. The following are examples of materials that, if exposed to stormwater, must be included in the inventory:
- a. raw materials, such as fuels; solvents; petroleum products; detergents; plastic pellets; materials used in food processing or production; stockpiled sand, salt or coal;
 - b. by-products or intermediate products, such as wood dust, chips or bark; screened limestone, taconite or gravel by-product, recycled blacktop;
 - c. finished materials, such as metallic products, including scrap metal and recycled or scrap motor vehicle parts, old process equipment/machinery, taconite pellets;
 - d. waste products, such as ashes, sludge, solid and liquid waste, slag;
 - e. hazardous substances designated under section 101(14) of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA);
 - f. any chemical the facility is required to report under section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA).
- 4.8 Evaluate facility areas for exposure of significant materials to stormwater. In creating the inventory of exposed significant materials, the Permittee must, at a minimum, evaluate the following areas at the industrial site (as well as other areas where appropriate) to determine whether or not significant materials are exposed in these areas:
- a. vehicle and equipment maintenance, parking and storage areas including fueling and washing/cleaning areas, to determine if there is discolored soil in these areas as a result of fuel and lubricant leaks and spills;
 - b. liquid storage tanks and other bulk material stockpile areas;
 - c. loading and unloading areas;
 - d. outdoor manufacturing, processing or storage areas and industrial plant yards, to determine if there is discolored soil in these areas as a result of leaked or spilled solvents, fuels, or lubricants;
 - e. dust or particulate generating areas including dust collection devices that may release dust;
 - f. rooftops contaminated by industrial activity or operation of a pollution control device;
 - g. on-site waste disposal areas, such as waste ponds, dumpsters, solid waste storage or management areas; and
 - h. exposed (non-vegetated) soil areas where there is a potential for erosion to occur.

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Chapter 4. Stormwater Management

4. Stormwater Pollution Prevention Plan

- 4.9 Describe appropriate BMPs, including structural and non-structural BMPs, that will be used at the facility to minimize or eliminate pollution of stormwater at the site. The description must include an objective for each BMP, as well as a description of how to evaluate proper functioning of the BMP and any maintenance requirements of the BMP. BMPs should target significant materials and areas identified in subparts 7 and 8 of this part. The following general categories of BMPs shall be considered and one or more shall be incorporated into the facility's Plan if significant materials are exposed to stormwater on-site:
- a. Source reduction: reduce or eliminate the significant materials that are exposed to stormwater. Materials management practices should be evaluated to determine whether inventories of exposed materials can be reduced or eliminated. This can include clean-up of equipment yards, periodic checking of dust control equipment to ensure minimal accumulation of dust in the area of control equipment, removal and treatment of petroleum contaminated soil, consolidation of materials from multiple areas into one area, and training employees regarding proper handling and disposal of materials. Significant materials may also be moved indoors or covered with a tarp or structure to eliminate contact with precipitation.
 - b. Diversion: divert stormwater drainage away from exposed significant materials through use of curbing, berms, sewers or other forms of drainage control or elevate exposed significant material above surrounding drainage.
 - c. Treatment: where contact of stormwater with significant materials is unavoidable, use treatment devices to reduce the concentration and amount of pollutants in the discharge. Such devices include oil/water separators, stormwater detention/retention ponds, and vegetative swales.
- 4.10 Evaluate all discharge conveyances from the site (storm sewers, pipes, tile lines, ditches, etc.) to determine if liquids other than stormwater are being discharged from these devices. This should be done during dry weather when stormwater discharge is not occurring. The evaluation should cover sewer inlets and floor drains to determine which inlets/drains are connected to sanitary sewer lines, storm sewer lines, or septic tanks/drainage fields; appropriate methods such as dye or smoke testing or video imaging should be used to determine the source of discharges.
- The Plan must certify that discharges from the site have been evaluated for the presence of non-stormwater discharges. The certification shall indicate the date of testing, location of testing, describe the method used to determine the source of discharges and the results of testing. Discharge of non-stormwater (such as sanitary sewer or floor drain connections to storm sewers) is not authorized by this permit; before such discharge may continue, authorization under an appropriate NPDES permit must be obtained.
- 4.11 Develop a preventive maintenance program. The program must require regular inspection and maintenance of stormwater management devices (e.g. cleaning oil/water separators and catch basins), as well as inspecting and testing plant equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants (e.g. hydraulic leaks, torn bag-house filters) to surface waters.
- 4.12 Develop a spill prevention and response procedure. In order to develop this procedure, Permittees should evaluate where spills have occurred and where they have the potential to occur. Determine drainage points for potential spill areas and develop appropriate spill prevention and containment measures, should a spill occur. Detailed procedures for cleaning-up spills shall be identified and made available to appropriate personnel. If your facility has any other spill contingency plan that satisfies the above requirements, that plan may be incorporated by reference into this Plan to satisfy this requirement.
- 4.13 Develop and implement an employee training program to inform appropriate personnel of the components and goals of the Plan. Training shall address spill response, good housekeeping and materials management practices. The Plan shall identify periodic dates for such training.
- 4.14 Identify personnel responsible for managing and implementing the Plan as well as those responsible for the reporting requirements of this permit. This should include the facility contact person as indicated on the permit application. Identified personnel must be available at reasonable times of operation.

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Chapter 4. Stormwater Management

5. Temporary Protection and Permanent Cover

- 5.1 The Permittee shall provide and maintain temporary protection or permanent cover for the exposed areas at the facility.
- 5.2 Temporary protection methods are used to prevent erosion on a short-term basis, such as the placement of mulching straw, wood fiber blankets, wood chips, erosion control netting, or temporary seeding.
- 5.3 Permanent cover or final stabilization methods are used to prevent erosion, such as the placement of rip rap, sodding, or permanent seeding or planting. Permanent seeding and planting must have a uniform perennial vegetation cover of at least 70 percent density to constitute final stabilization.

6. Inspection and Maintenance

- 6.1 Site inspections shall be conducted at least once every two months throughout the calendar year. During winter months, the inspections shall be conducted during non-frozen conditions. Inspections shall be conducted by an appropriately trained personnel at the facility site, as identified in part 4.13 of this chapter. The purpose of inspections is to: 1) determine whether structural and non-structural BMPs require maintenance or changes, and 2) evaluate the completeness and accuracy of the Plan.

At least one inspection during a reporting period shall be conducted while stormwater is discharging from the facility. Inspections may be documented using an inspection form provided by the MPCA. A Storm Water Site Inspection Form is provided in the appendices section of this permit.

- 6.2 Inspections shall be documented and a copy of all documentation shall remain on the permitted site whenever Permittee staff are available on the site, and be available upon request. The inspection form developed for the General Storm Water Permit for Industrial Activity may be used for recording inspection results, and is included in the appendices section of this permit.
- 6.3 The following compliance items will be inspected, and documented where appropriate:
 - a. evaluate the facility to determine that the Plan accurately reflects site conditions as described in subpart 6 of this part, and document any inaccuracies;
 - b. evaluate the facility to determine whether new exposed materials have been added to the site since completion of the Plan, and document any new significant materials;
 - c. during the inspection conducted during the runoff event, observe the runoff to determine if it is discolored or otherwise visibly contaminated, and document observations; and,
 - d. determine if the non-structural and structural BMPs as indicated in the Plan are installed and functioning properly.
- 6.4 The Permittee shall ensure that temporary protection and permanent cover for the exposed areas at the site are maintained.
- 6.5 Indicate the date and time of the inspection as well as the name of the inspector on the inspection form.
- 6.6 When the depth of sediment collected in the final sedimentation basin above the outfall reaches one-half of the riser height, or one-half of the basin design hydraulic storage volume, the Permittee shall drain the basin and remove the sediment within sixty (60) days of discovery. No outflow from the sedimentation basin shall occur while sediment is being removed from that basin. The sediment removed from the basin shall be disposed of at a site which drains to sedimentation basin(s) at the facility.
- 6.7 If conditions are observed at the site that require changes in the Plan, such changes shall be made to the Plan prior to submission of the annual report for that calendar year.
- 6.8 The Permittee shall minimize vehicle tracking of gravel, soil or mud onto paved surfaces at the facility.

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Chapter 4. Stormwater Management

6. Inspection and Maintenance

- 6.9 If the findings of a site inspection indicate that BMPs are not meeting the objectives as identified in subpart 9 of this part, corrective actions must be initiated within 30 days and the BMP restored to full operation as soon as field conditions allow.
- 6.10 The Permittee shall remove tracked material from the road surface and return it to the facility within one (1) day of discovery so that the materials drain to sedimentation basin(s) at the facility.

7. Sedimentation Basin Design and Construction

New Sedimentation Basins

- 7.1 Sedimentation basins shall be designed by a registered professional engineer, and installed under the direct supervision of a registered professional engineer.
- 7.2 The basin shall provide at least 1800 cubic feet, per acre drained, of hydraulic storage volume below the top of the outlet riser pipe.
- 7.3 Inlet(s) and outlet(s) shall be designed to prevent short circuiting and the discharge of floating debris.
- 7.4 The inlet(s) shall be placed at an elevation at least above one-half of the basin design hydraulic storage volume.
- 7.5 The outlet(s) shall consist of a perforated riser pipe wrapped with filter fabric and covered with crushed gravel. The perforated riser pipe shall be designed to allow complete drawdown of the basin(s).
- 7.6 Permanent erosion control, such as rip rap, splash pads or gabions shall be installed at the outlet(s) to prevent downstream erosion.
- 7.7 The basins shall be designed to allow for regular removal of accumulated sediment by a backhoe or other suitable equipment.

8. Application of Chemical Dust Suppressants

- 8.1 If chemical dust suppressants are applied, the Permittee shall submit a Chemical Dust Suppressant Annual Report due 31 days after the end of each calendar year following the application of a chemical dust suppressant.
- 8.2 The Chemical Dust Suppressant Annual Report shall include:
 - a. a record of the dates, methods, locations and amounts by volume of chemical application at the facility;
 - b. whether the product was applied in the preceding year; and,
 - c. the results of a chemical analysis of the materials applied each year.
- 8.3 If a material applied is mixed with water or another solvent before application, the chemical analysis shall be done on the aqueous or other mixture that is representative of the solution applied. This analysis shall be conducted during the same calendar year of application. This analysis shall include the parameters that may be determined by U.S. Environmental Protection Agency (EPA) Methods 624 and 625 which are described in 40 CFR Part 136.
- 8.4 Chemical dust suppressants, if used, shall not be applied within 100 feet of the surface receiving waters identified in the 'Facility Description' section of this permit. These materials also shall not be applied within 100 feet of ditches that conduct surface flow to the surface receiving waters identified on Page 1 of this permit.

9. Reporting

- 9.1 Submit a Stormwater Annual Report by March 31 of each year following permit issuance. A copy of the Stormwater Annual Report Form is provided in the appendices section of this permit.

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Chapter 4. Stormwater Management

9. Reporting

9.2 The Permittee shall, upon request of the Agency, submit within a reasonable time the information and reports that are relevant to compliance with this Chapter, including the Plan, inspection reports, annual reports, original laboratory sheets from analyses conducted on the waste stream, and BMP plans and specifications.

10. Records

10.1 The Plan shall be retained for the duration of the permit. A copy of the Plan shall remain on the permitted site whenever Permittee staff are available on the site, and be available upon request. The Permittee shall maintain the following records for the period of permit coverage:

- a. dates of inspections;
- b. findings of inspections;
- c. corrective actions taken;
- d. documentation of all changes to the Plan; and,
- e. a copy of annual reports.

11. Notification

11.1 If the Permittee discharges stormwater into a municipal storm sewer, the Permittee shall notify the operator of the municipal storm sewer of the existence of this permit.

12. Request for Termination of Stormwater Permit Coverage

12.1 All Permittees regulated by 40 CFR 122.26(b)(14)(i) through (ix) and (xi) may request termination of permit coverage by applying for the no exposure exclusion from permitting. The Permittee must submit (form provided by the Agency) a written certification that a condition of no exposure exists at the facility and that the facility meets the definition of no exposure of industrial activities and materials to storm water.

The application for the no exposure exclusion must be completed by the Permittee and sent to: MPCA, Industrial Storm Water Program, 520 Lafayette Rd N, St Paul, MN 55155-4194.

Failure to complete an accurate application will result in the facility being denied the no exposure exclusion from permitting. The facility must submit the application to the Agency once every five years.

12.2 The no exposure exclusion is conditional. The Permittee must maintain a condition of no exposure at the facility in order for the no exposure exclusion to remain applicable. In the event of any change or circumstance that causes exposure of industrial activities or materials to stormwater, the Permittee must comply with the stormwater requirements of this chapter.

12.3 The no exposure certification is non-transferrable. In the event that the facility operator changes, then the new operator must submit a new no exposure certification to the MPCA, Industrial Stormwater Program, 520 Lafayette Rd N, St Paul, MN 55155-4194.

12.4 The MPCA retains the authority to require the facility operator to comply with the requirements of this chapter, even when an industrial operator certifies no exposure, if the MPCA has determined that the discharge is contributing to the violation of, or interfering with the attainment or maintenance of water quality standards, including designated uses.

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Chapter 4. Stormwater Management

13. Definitions

- 13.1 "No exposure" means all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snow melt, and/or runoff. Industrial activities or materials include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products.
- 13.2 "Non-stormwater discharge" means any discharge not comprised entirely of stormwater discharges authorized by a NPDES permit.
- 13.3 "Runoff" means any liquid that drains over land from any part of a facility.

Chapter 5. Surface Discharge Stations

1. Requirements for Specific Stations

- 1.1 SD 001, SD 005, SD 008, SD 009: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.

2. Special Requirements

- 2.1 Samples shall be taken at SD001 during any and all discharge events. The time, date, and duration of each discharge event shall be submitted with the appropriate Discharge Monitoring Report.

3. Sampling Location

- 3.1 Samples for Station SD001 shall be taken at one of the four siphon outfall points which has the greatest flow at the time of sampling.
- 3.2 Samples for Station SD005 shall be taken at the culvert prior to combination with Reservoir 2 North waters, during a period of discharge from Reservoir 6. If a discharge from Reservoir 6 occurs at any time during the sampling month, a sample must be obtained for analysis.
- 3.3 Samples for SD009 shall be taken at a point representative of the discharge of dewatering effluent from Sargent Pit to the unnamed ditch.
- 3.4 Samples and measurements required by this permit shall be representative of the monitored activity.

4. Surface Discharges

- 4.1 Floating solids or visible foam shall not be discharged in other than trace amounts.
- 4.2 Oil or other substances shall not be discharged in amounts that create a visible color film.
- 4.3 The Permittee shall install and maintain outlet protection measures at the discharge stations to prevent erosion.

5. Winter Sampling Conditions

- 5.1 The Permittee shall sample flows at the designated monitoring stations including when this requires removing ice to sample the water. If the station is completely frozen throughout a designated sampling month, the Permittee shall check the "No Discharge" box on the Discharge Monitoring Report (DMR) and note the ice conditions in Comments on the DMR.

6. Discharge Monitoring Reports

- 6.1 The Permittee shall submit monitoring results for discharges in accordance with the limits and monitoring requirements for this station. If no discharge occurred during the reporting period, the Permittee shall check the "No Discharge" box on the Discharge Monitoring Report (DMR).

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Chapter 6. Surface Water Stations

1. Requirements for Specific Stations

- 1.1 SW 001: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.

2. Special Requirements

- 2.1 Station SW001 was established at the request of the Permittee.

3. Discharge Monitoring Reports

- 3.1 The Permittee shall submit monitoring results in accordance with the limits and monitoring requirements for this station. If flow conditions are such that no sample could be acquired, the Permittee shall check the "No Flow" box and note the conditions on the Discharge Monitoring Report (DMR).

4. Sampling Location

- 4.1 Samples for Station SW001 shall be taken at the weir outlet on Reservoir 2.

5. Sampling Protocol

- 5.1 All instruments used for field measurements shall be maintained and calibrated to insure accuracy of measurements.
- 5.2 Sample water shall be preserved according to lab instructions and delivered to a certified lab within the minimum holding times.

6. Winter Sampling Conditions

- 6.1 The Permittee shall sample flows at the designated monitoring stations including when this requires removing ice to sample the water. If the station is completely frozen throughout a designated sampling month, the Permittee shall check the "No Flow" box on the Discharge Monitoring Report (DMR) and note the ice conditions in Comments on the DMR.

Chapter 7. Waste Stream Stations

1. Requirements for Specific Stations

- 1.1 WS 001: Submit a monthly DMR monthly by 21 days after the end of each calendar month following permit issuance.

2. Sampling Location

- 2.1 Flow measurements for Station WS001 shall be representative of the non-precipitation inputs to the facility (for example, from Reservoir 2 and/or from Reservoir 6).

Chapter 8. Total Facility Requirements

1. General Requirements

General Requirements

- 1.1 Incorporation by Reference. The following applicable federal and state laws are incorporated by reference in this permit, are applicable to the Permittee, and are enforceable parts of this permit: 40 CFR pts. 122.41, 122.42, 136, 403 and 503; Minn. R. pts. 7001, 7041, 7045, 7050, 7052, 7053, 7060, and 7080; and Minn. Stat. Sec. 115 and 116.

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Chapter 8. Total Facility Requirements

1. General Requirements

- 1.2 Permittee Responsibility. The Permittee shall perform the actions or conduct the activity authorized by the permit in compliance with the conditions of the permit and, if required, in accordance with the plans and specifications approved by the Agency. (Minn. R. 7001.0150, subp. 3, item E)
- 1.3 Toxic Discharges Prohibited. Whether or not this permit includes effluent limitations for toxic pollutants, the Permittee shall not discharge a toxic pollutant except according to Code of Federal Regulations, Title 40, sections 400 to 460 and Minnesota Rules 7050, 7052, 7053 and any other applicable MPCA rules. (Minn. R. 7001.1090, subp.1, item A)
- 1.4 Nuisance Conditions Prohibited. The Permittee's discharge shall not cause any nuisance conditions including, but not limited to: floating solids, scum and visible oil film, acutely toxic conditions to aquatic life, or other adverse impact on the receiving water. (Minn. R. 7050.0210 subp. 2)
- 1.5 Property Rights. This permit does not convey a property right or an exclusive privilege. (Minn. R. 7001.0150, subp. 3, item C)
- 1.6 Liability Exemption. In issuing this permit, the state and the MPCA assume no responsibility for damage to persons, property, or the environment caused by the activities of the Permittee in the conduct of its actions, including those activities authorized, directed, or undertaken under this permit. To the extent the state and the MPCA may be liable for the activities of its employees, that liability is explicitly limited to that provided in the Tort Claims Act. (Minn. R. 7001.0150, subp. 3, item O)
- 1.7 The MPCA's issuance of this permit does not obligate the MPCA to enforce local laws, rules, or plans beyond what is authorized by Minnesota Statutes. (Minn. R. 7001.0150, subp.3, item D)
- 1.8 Liabilities. The MPCA's issuance of this permit does not release the Permittee from any liability, penalty or duty imposed by Minnesota or federal statutes or rules or local ordinances, except the obligation to obtain the permit. (Minn. R. 7001.0150, subp.3, item A)
- 1.9 The issuance of this permit does not prevent the future adoption by the MPCA of pollution control rules, standards, or orders more stringent than those now in existence and does not prevent the enforcement of these rules, standards, or orders against the Permittee. (Minn. R. 7001.0150, subp.3, item B)
- 1.10 Severability. The provisions of this permit are severable and, if any provisions of this permit or the application of any provision of this permit to any circumstance are held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.
- 1.11 Compliance with Other Rules and Statutes. The Permittee shall comply with all applicable air quality, solid waste, and hazardous waste statutes and rules in the operation and maintenance of the facility.
- 1.12 Inspection and Entry. When authorized by Minn. Stat. Sec. 115.04; 115B.17, subd. 4; and 116.091, and upon presentation of proper credentials, the agency, or an authorized employee or agent of the agency, shall be allowed by the Permittee to enter at reasonable times upon the property of the Permittee to examine and copy books, papers, records, or memoranda pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit; and to conduct surveys and investigations, including sampling or monitoring, pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit. (Minn. R. 7001.0150, subp.3, item I)
- 1.13 Control Users. The Permittee shall regulate the users of its wastewater treatment facility so as to prevent the introduction of pollutants or materials that may result in the inhibition or disruption of the conveyance system, treatment facility or processes, or disposal system that would contribute to the violation of the conditions of this permit or any federal, state or local law or regulation.

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Chapter 8. Total Facility Requirements

1. General Requirements

Sampling

- 1.14 Representative Sampling. Samples and measurements required by this permit shall be conducted as specified in this permit and shall be representative of the discharge or monitored activity. (40 CFR 122.41 (j)(1))
- 1.15 Additional Sampling. If the Permittee monitors more frequently than required, the results and the frequency of monitoring shall be reported on the Discharge Monitoring Report (DMR) or another MPCA-approved form for that reporting period. (Minn. R. 7001.1090, subp. 1, item E)
- 1.16 Certified Laboratory. A laboratory certified by the Minnesota Department of Health shall conduct analyses required by this permit. Analyses of dissolved oxygen, pH, temperature and total residual oxidants (chlorine, bromine) do not need to be completed by a certified laboratory but shall comply with manufacturers specifications for equipment calibration and use. (Minn. Stat. Sec. 144.97 through 144.98 and Minn. R. 4740.2010 and 4740.2050 through 4740.2120) (Minn. R. 4740.2010 and 4740.2050 through 2120)
- 1.17 Sample Preservation and Procedure. Sample preservation and test procedures for the analysis of pollutants shall conform to 40 CFR Part 136 and Minn. R. 7041.3200.
- 1.18 Equipment Calibration: Flow meters, pumps, flumes, lift stations or other flow monitoring equipment used for purposes of determining compliance with permit shall be checked and/or calibrated for accuracy at least twice annually. (Minn. R. 7001.0150, subp. 2, items B and C)
- 1.19 Maintain Records. The Permittee shall keep the records required by this permit for at least three years, including any calculations, original recordings from automatic monitoring instruments, and laboratory sheets. The Permittee shall extend these record retention periods upon request of the MPCA. The Permittee shall maintain records for each sample and measurement. The records shall include the following information (Minn. R. 7001.0150, subp. 2, item C):
 - a. The exact place, date, and time of the sample or measurement;
 - b. The date of analysis;
 - c. The name of the person who performed the sample collection, measurement, analysis, or calculation; and
 - d. The analytical techniques, procedures and methods used; and
 - e. The results of the analysis.
- 1.20 Completing Reports. The Permittee shall submit the results of the required sampling and monitoring activities on the forms provided, specified, or approved by the MPCA. The information shall be recorded in the specified areas on those forms and in the units specified. (Minn. R. 7001.1090, subp. 1, item D; Minn. R. 7001.0150, subp. 2, item B)

Required forms may include:

DMR Supplemental Form

Individual values for each sample and measurement must be recorded on the DMR Supplemental Form which, if required, will be provided by the MPCA. DMR Supplemental Forms shall be submitted with the appropriate DMRs. You may design and use your own supplemental form; however it must be approved by the MPCA.

Note: Required summary information MUST also be recorded on the DMR. Summary information that is submitted ONLY on the DMR Supplemental Form does not comply with the reporting requirements.

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Chapter 8. Total Facility Requirements

1. General Requirements

1.21 Submitting Reports. DMRs and DMR Supplemental Forms shall be submitted to:

MPCA
Attn: Discharge Monitoring Reports
520 Lafayette Road North
St. Paul, Minnesota 55155-4194.

DMRs and DMR Supplemental Forms shall be postmarked by the 21st day of the month following the sampling period or as otherwise specified in this permit. A DMR shall be submitted for each required station even if no discharge occurred during the reporting period. (Minn. R. 7001.0150, subps. 2.B and 3.H)

Other reports required by this permit shall be postmarked by the date specified in the permit to:

MPCA
Attn: WQ Submittals Center
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

1.22 Incomplete or Incorrect Reports. The Permittee shall immediately submit an amended report or DMR to the MPCA upon discovery by the Permittee or notification by the MPCA that it has submitted an incomplete or incorrect report or DMR. The amended report or DMR shall contain the missing or corrected data along with a cover letter explaining the circumstances of the incomplete or incorrect report. (Minn. R. 7001.0150 subp. 3, item G)

1.23 Required Signatures. All DMRs, forms, reports, and other documents submitted to the MPCA shall be signed by the Permittee or the duly authorized representative of the Permittee. Minn. R. 7001.0150, subp. 2, item D. The person or persons that sign the DMRs, forms, reports or other documents must certify that he or she understands and complies with the certification requirements of Minn. R. 7001.0070 and 7001.0540, including the penalties for submitting false information. Technical documents, such as design drawings and specifications and engineering studies required to be submitted as part of a permit application or by permit conditions, must be certified by a registered professional engineer. (Minn. R. 7001.0540)

1.24 Detection Level. The Permittee shall report monitoring results below the reporting limit (RL) of a particular instrument as "<" the value of the RL. For example, if an instrument has a RL of 0.1 mg/L and a parameter is not detected at a value of 0.1 mg/L or greater, the concentration shall be reported as "<0.1 mg/L." "Non-detected," "undetected," "below detection limit," and "zero" are unacceptable reporting results, and are permit reporting violations. (Minn. R. 7001.0150, subp. 2, item B)

Where sample values are less than the level of detection and the permit requires reporting of an average, the Permittee shall calculate the average as follows:

- a. If one or more values are greater than the level of detection, substitute zero for all nondetectable values to use in the average calculation.
- b. If all values are below the level of detection, report the averages as "<" the corresponding level of detection.
- c. Where one or more sample values are less than the level of detection, and the permit requires reporting of a mass, usually expressed as kg/day, the Permittee shall substitute zero for all nondetectable values. (Minn. R. 7001.0150, subp. 2, item B)

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Chapter 8. Total Facility Requirements

1. General Requirements

- 1.25 Records. The Permittee shall, when requested by the Agency, submit within a reasonable time the information and reports that are relevant to the control of pollution regarding the construction, modification, or operation of the facility covered by the permit or regarding the conduct of the activity covered by the permit. (Minn. R. 7001.0150, subp. 3, item H)
- 1.26 Confidential Information. Except for data determined to be confidential according to Minn. Stat. Sec. 116.075, subd. 2, all reports required by this permit shall be available for public inspection. Effluent data shall not be considered confidential. To request the Agency maintain data as confidential, the Permittee must follow Minn. R. 7000.1300.

Noncompliance and Enforcement

- 1.27 Subject to Enforcement Action and Penalties. Noncompliance with a term or condition of this permit subjects the Permittee to penalties provided by federal and state law set forth in section 309 of the Clean Water Act; United States Code, title 33, section 1319, as amended; and in Minn. Stat. Sec. 115.071 and 116.072, including monetary penalties, imprisonment, or both. (Minn. R. 7001.1090, subp. 1, item B)
- 1.28 Criminal Activity. The Permittee may not knowingly make a false statement, representation, or certification in a record or other document submitted to the Agency. A person who falsifies a report or document submitted to the Agency, or tampers with, or knowingly renders inaccurate a monitoring device or method required to be maintained under this permit is subject to criminal and civil penalties provided by federal and state law. (Minn. R. 7001.0150, subp.3, item G., 7001.1090, subps. 1, items G and H and Minn. Stat. Sec. 609.671)
- 1.29 Noncompliance Defense. It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit. (40 CFR 122.41(c))
- 1.30 Effluent Violations. If sampling by the Permittee indicates a violation of any discharge limitation specified in this permit, the Permittee shall immediately make every effort to verify the violation by collecting additional samples, if appropriate, investigate the cause of the violation, and take action to prevent future violations. Violations that are determined to pose a threat to human health or a drinking water supply, or represent a significant risk to the environment shall be immediately reported to the Minnesota Department of Public Safety Duty Officer at 1(800)422-0798 (toll free) or (651)649-5451 (metro area). In addition, you may also contact the MPCA during business hours. Otherwise the violations and the results of any additional sampling shall be recorded on the next appropriate DMR or report.
- 1.31 Unauthorized Releases of Wastewater Prohibited. Except for conditions specifically described in Minn. R. 7001.1090, subp. 1, items J and K, all unauthorized bypasses, overflows, discharges, spills, or other releases of wastewater or materials to the environment, whether intentional or not, are prohibited. However, the MPCA will consider the Permittee's compliance with permit requirements, frequency of release, quantity, type, location, and other relevant factors when determining appropriate action. (40 CFR 122.41 and Minn. Stat. Sec 115.061)

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Chapter 8. Total Facility Requirements

1. General Requirements

1.32 Discovery of a release. Upon discovery of a release, the Permittee shall:

- a. Take all reasonable steps to immediately end the release.
- b. Notify the Minnesota Department of Public Safety Duty Officer at 1(800)422-0798 or (651)649-5451 (metro area) immediately upon discovery of the release. You may contact the MPCA during business hours at 1(800)657-3864 or (651)296-6300 (metro area).
- c. Recover as rapidly and as thoroughly as possible all substances and materials released or immediately take other action as may be reasonably possible to minimize or abate pollution to waters of the state or potential impacts to human health caused thereby. If the released materials or substances cannot be immediately or completely recovered, the Permittee shall contact the MPCA. If directed by the MPCA, the Permittee shall consult with other local, state or federal agencies (such as the Minnesota Department of Natural Resources and/or the Wetland Conservation Act authority) for implementation of additional clean-up or remediation activities in wetland or other sensitive areas.
- d. Collect representative samples of the release. The Permittee shall sample the release for parameters of concern immediately following discovery of the release. The Permittee may contact the MPCA during business hours to discuss the sampling parameters and protocol. In addition, Fecal Coliform Bacteria samples shall be collected where it is determined by the Permittee that the release contains or may contain sewage. If the release cannot be immediately stopped, the Permittee shall consult with MPCA regarding additional sampling requirements. Samples shall be collected at least, but not limited to, two times per week for as long as the release continues.
- e. Submit the sampling results as directed by the MPCA. At a minimum, the results shall be submitted to the MPCA with the next DMR.

1.33 Upset Defense. In the event of temporary noncompliance by the Permittee with an applicable effluent limitation resulting from an upset at the Permittee's facility due to factors beyond the control of the Permittee, the Permittee has an affirmative defense to an enforcement action brought by the Agency as a result of the noncompliance if the Permittee demonstrates by a preponderance of competent evidence:

- a. The specific cause of the upset;
- b. That the upset was unintentional;
- c. That the upset resulted from factors beyond the reasonable control of the Permittee and did not result from operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or increases in production which are beyond the design capability of the treatment facilities;
- d. That at the time of the upset the facility was being properly operated;
- e. That the Permittee properly notified the Commissioner of the upset in accordance with Minn. R. 7001.1090, subp. 1, item I; and
- f. That the Permittee implemented the remedial measures required by Minn. R. 7001.0150, subp. 3, item J.

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Chapter 8. Total Facility Requirements

1. General Requirements

Operation and Maintenance

- 1.34 The Permittee shall at all times properly operate and maintain the facilities and systems of treatment and control, and the appurtenances related to them which are installed or used by the Permittee to achieve compliance with the conditions of the permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. The Permittee shall install and maintain appropriate backup or auxiliary facilities if they are necessary to achieve compliance with the conditions of the permit and, for all permits other than hazardous waste facility permits, if these backup or auxiliary facilities are technically and economically feasible Minn. R. 7001.0150. subp. 3, item F.
- 1.35 In the event of a reduction or loss of effective treatment of wastewater at the facility, the Permittee shall control production or curtail its discharges to the extent necessary to maintain compliance with the terms and conditions of this permit. The Permittee shall continue this control or curtailment until the wastewater treatment facility has been restored or until an alternative method of treatment is provided. (Minn. R. 7001.1090, subp. 1, item C)
- 1.36 Solids Management. The Permittee shall properly store, transport, and dispose of biosolids, septage, sediments, residual solids, filter backwash, screenings, oil, grease, and other substances so that pollutants do not enter surface waters or ground waters of the state. Solids should be disposed of in accordance with local, state and federal requirements. (40 CFR 503 and Minn. R. 7041 and applicable federal and state solid waste rules)
- 1.37 Scheduled Maintenance. The Permittee shall schedule maintenance of the treatment works during non-critical water quality periods to prevent degradation of water quality, except where emergency maintenance is required to prevent a condition that would be detrimental to water quality or human health. (Minn. R. 7001.0150. subp. 3, item F and Minn. R. 7001.0150. subp. 2, item B)
- 1.38 Control Tests. In-plant control tests shall be conducted at a frequency adequate to ensure compliance with the conditions of this permit. (Minn. R. 7001.0150. subp. 3, item F and Minn. R. 7001.0150. subp. 2, item B)

Changes to the Facility or Permit

- 1.39 Permit Modifications. No person required by statute or rule to obtain a permit may construct, install, modify, or operate the facility to be permitted, nor shall a person commence an activity for which a permit is required by statute or rule until the Agency has issued a written permit for the facility or activity. (Minn. R. 7001.0030)

Permittees that propose to make a change to the facility or discharge that requires a permit modification must follow Minn. R. 7001.0190. If the Permittee cannot determine whether a permit modification is needed, the Permittee must contact the MPCA prior to any action. It is recommended that the application for permit modification be submitted to the MPCA at least 180 days prior to the planned change.

- 1.40 Construction. No construction shall begin until the Permittee receives written approval of plans and specifications from the MPCA (Minn. Stat. Sec. 115.03(f)).

Plans, specifications and MPCA approval are not necessary when maintenance dictates the need for installation of new equipment, provided the equipment is the same design size and has the same design intent. For instance, a broken pipe, lift station pump, aerator, or blower can be replaced with the same design-sized equipment without MPCA approval.

If the proposed construction is not expressly authorized by this permit, it may require a permit modification. If the construction project requires an Environmental Assessment Worksheet under Minn. R. 4410, no construction shall begin until a negative declaration is issued and all approvals are received or implemented.

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Chapter 8. Total Facility Requirements

1. General Requirements

- 1.41 Report Changes. The Permittee shall give advance notice as soon as possible to the MPCA of any substantial changes in operational procedures, activities that may alter the nature or frequency of the discharge, and/or material factors that may affect compliance with the conditions of this permit. (Minn. R. 7001.0150, subp. 3, item M)
- 1.42 Chemical Additives. The Permittee shall receive prior written approval from the MPCA before increasing the use of a chemical additive authorized by this permit, or using a chemical additive not authorized by this permit, in quantities or concentrations that have the potential to change the characteristics, nature and/or quality of the discharge.

The Permittee shall request approval for an increased or new use of a chemical additive at least 60 days, or as soon as possible, before the proposed increased or new use.

This written request shall include at least the following information for the proposed additive:

- a. The process for which the additive will be used;
- b. Material Safety Data Sheet (MSDS) which shall include aquatic toxicity, human health, and environmental fate information for the proposed additive;
- c. A complete product use and instruction label;
- d. The commercial and chemical names and Chemical Abstract Survey (CAS) number for all ingredients in the additive (If the MSDS does not include information on chemical composition, including percentages for each ingredient totaling to 100%, the Permittee shall contact the supplier to have this information provided); and
- e. The proposed method of application, application frequency, concentration, and daily average and maximum rates of use.

Upon review of the information submitted regarding the proposed chemical additive, the MPCA may require additional information be submitted for consideration. This permit may be modified to restrict the use or discharge of a chemical additive and include additional influent and effluent monitoring requirements.

Approval for the use of an additive shall not justify the exceedance of any effluent limitation nor shall it be used as a defense against pollutant levels in the discharge causing or contributing to the violation of a water quality standard. (Minn. R. 7001.0170)

- 1.43 MPCA Initiated Permit Modification, Suspension, or Revocation. The MPCA may modify or revoke and reissue this permit pursuant to Minn. R. 7001.0170. The MPCA may revoke without reissuance this permit pursuant to Minn. R. 7001.0180.
- 1.44 TMDL Impacts. Facilities that discharge to an impaired surface water, watershed or drainage basin may be required to comply with additional permits or permit requirements, including additional restriction or relaxation of limits and monitoring as authorized by the CWA 303(d)(4)(A) and 40 CFR 122.44.l.2.i., necessary to ensure consistency with the assumptions and requirements of any applicable US EPA approved wasteload allocations resulting from Total Maximum Daily Load (TMDL) studies.
- 1.45 Permit Transfer. The permit is not transferable to any person without the express written approval of the Agency after compliance with the requirements of Minn. R. 7001.0190. A person to whom the permit has been transferred shall comply with the conditions of the permit. (Minn. R., 7001.0150, subp. 3, item N)

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Chapter 8. Total Facility Requirements

1. General Requirements

- 1.46 Facility Closure. The Permittee is responsible for closure and postclosure care of the facility. The Permittee shall notify the MPCA of a significant reduction or cessation of the activities described in this permit at least 180 days before the reduction or cessation. The MPCA may require the Permittee to provide to the MPCA a facility Closure Plan for approval.

Facility closure that could result in a potential long-term water quality concern, such as the ongoing discharge of wastewater to surface or ground water, may require a permit modification or reissuance.

The MPCA may require the Permittee to establish and maintain financial assurance to ensure performance of certain obligations under this permit, including closure, postclosure care and remedial action at the facility. If financial assurance is required, the amount and type of financial assurance, and proposed modifications to previously MPCA-approved financial assurance, shall be approved by the MPCA. (Minn. Stat. Sec. 116.07, subd. 4)

- 1.47 Permit Reissuance. If the Permittee desires to continue permit coverage beyond the date of permit expiration, the Permittee shall submit an application for reissuance at least 180 days before permit expiration. If the Permittee does not intend to continue the activities authorized by this permit after the expiration date of this permit, the Permittee shall notify the MPCA in writing at least 180 days before permit expiration.

If the Permittee has submitted a timely application for permit reissuance, the Permittee may continue to conduct the activities authorized by this permit, in compliance with the requirements of this permit, until the MPCA takes final action on the application, unless the MPCA determines any of the following (Minn. R. 7001.0040 and 7001.0160):

- a. The Permittee is not in substantial compliance with the requirements of this permit, or with a stipulation agreement or compliance schedule designed to bring the Permittee into compliance with this permit;
- b. The MPCA, as a result of an action or failure to act by the Permittee, has been unable to take final action on the application on or before the expiration date of the permit;
- c. The Permittee has submitted an application with major deficiencies or has failed to properly supplement the application in a timely manner after being informed of deficiencies.



**National Pollutant Discharge
Elimination System /State
Disposal System (NPDES/SDS)
Permit Program
Statement of Basis**

Permittee: United States Steel, Minnesota Ore Operations
Name: Keetac – Mining Operations
Permit Number: MN0031879

Current Permit Expiration: May 31, 2011

Public Comment Period Begins: June 27, 2011
Period Ends: August 19, 2011

Receiving Water: Welcome Lake; Welcome Creek to Reservoir 2
North; Unnamed wetlands and creeks tributary to O'Brien Reservoir

Proposed Action: Permit Reissuance

Permitting Contact
Brandon Smith
520 Lafayette Road N.
St. Paul, MN 55155
Phone: 651-757-2740
Fax: 651-296-8717

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Purpose and Participation

Purpose

This Statement of Basis outlines the principal issues related to the preparation of this permit reissuance and documents the decisions that were made in the determination of the effluent limitations and conditions of this permit.

The permit will be reissued if the Minnesota Pollution Control Agency (MPCA) determines that the proposed Permittee or Permittees will, with respect to the facility or activity to be permitted, comply or undertake a schedule to achieve compliance with all applicable state and federal pollution control statutes and rules administered by the MPCA and the conditions of the permit and that all applicable requirements of Minn. Stat. ch. 116D and the rules promulgated thereunder have been fulfilled.

More detail on all requirements placed on the facility may be found in the Permit document.

Facility Description

Background Information

Facility Location

The permitted facility includes the mining and processing operations for the U. S. Steel – Keetac facility, located to the north of Keewatin, Minnesota.

Outfall Locations

SD001: This outfall represents the discharge of filter backwash water from the potable water system to Welcome Lake. PLS coordinates are T57N, R21W, Section 19b.

SD002: The overflow discharge from Reservoir 5 treatment basin and diversion ditch treatment system is to Welcome Creek, south of Welcome Lake. PLS coordinates are T 57 N, R 21 W, Section 30b.

SD003: The Mesabi Chief dewatering outfall is located off the southwestern edge of the Mesabi Chief pit, PLS coordinates are T 57 N, R 22 W, Section 27a.

SD012: The Perry Pit dewatering outfall is located off the southwest side of the Perry Pit. PLS coordinates are T 57 N, R 22 W, Section 27b.

Changes to Facility or Operation

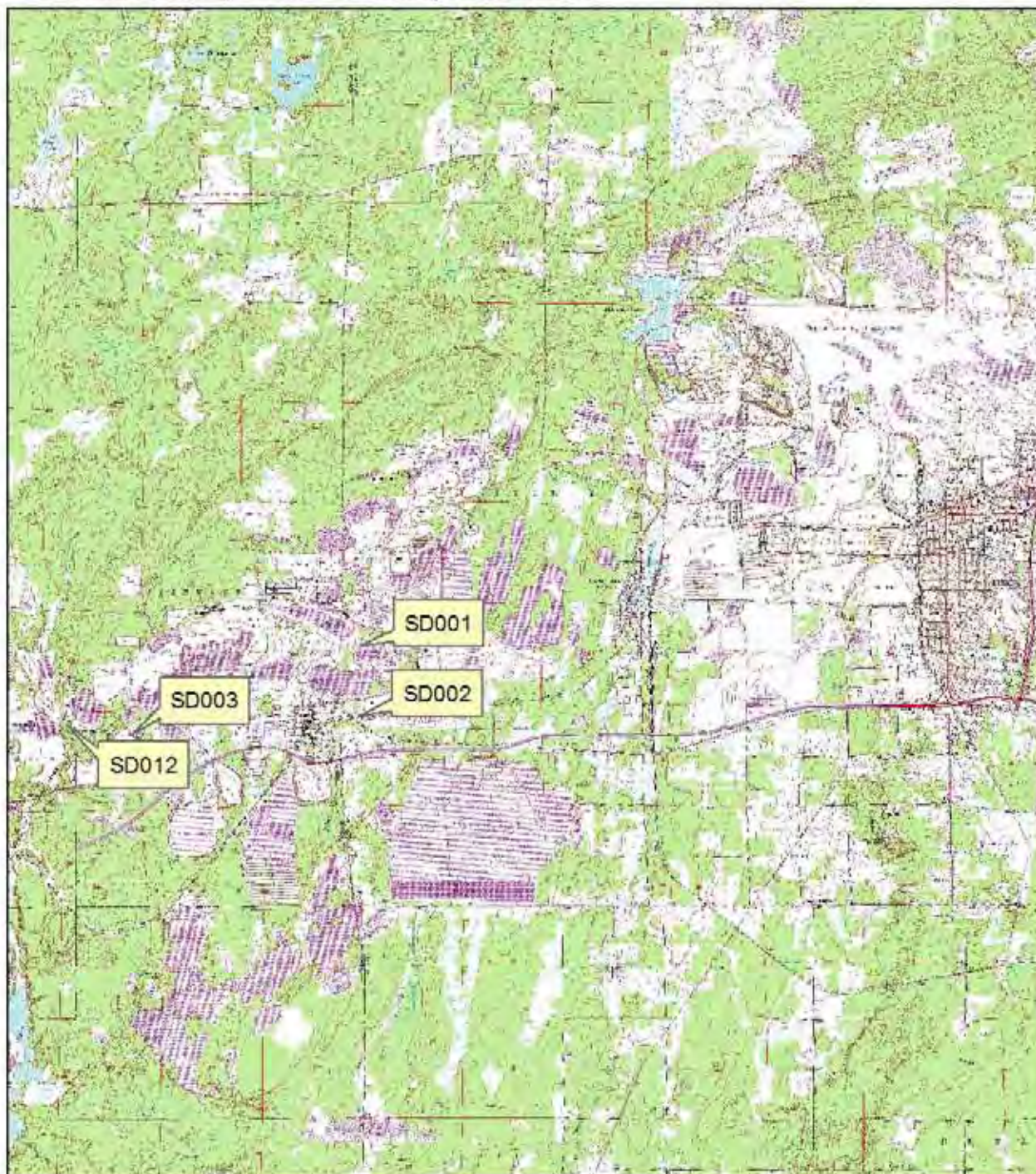
The facility has proposed an expansion of the taconite processing plant with which the permitted operations are associated.

Recent Compliance History

The Facility was inspected on May 10, 2010. No significant compliance issues were found that would affect modification of this permit.

Topographic Map of Permitted Facility

MN003189, US Steel - Keewatin Taconite Operations, Mining
St. Louis County & Itasca County, Minnesota



Map produced by: MPCA Staff, 4/15/2010
Source: USGS Nashwauk, Keewatin, Hibbing,
Pengilly, Silica, Riley Quads
Scale: 1:24,000

0 0.5 1 2 Miles



Receiving Waters

Use Classification

The receiving waters affected by this permit reissuance include Welcome Lake, Welcome Creek, O'Brien Creek, and the O'Brien Reservoir.

All waters of the state of Minnesota must be classified based on considerations of best usage in the interest of the public and in conformance with the requirements of the applicable statutes, as described in Minn. R. 7050.0140. Based on these considerations, Welcome Creek and O'Brien Creek are classified as Class 2C waters as listed in Minn. R. 7050.0470 subp. 4.A. items (127) and (236), respectively. According to Minn. R. 7050.0410, any listed water in Minn. R. 7050.0470 is also classified as a Class 3C, 4A, 4B, 5, and 6 water.

Welcome Lake and O'Brien Reservoir are not listed waters in Minn. R. 7050.0470. As detailed in Minn. R. 7050.0430, all surface waters of the state that are not listed in Minn. R. 7050.0470 and that are not wetlands as defined in Minn. R. 7050.0186, subp. 1a, are classified as Class 2B, 3C, 4A, 4B, 5, and 6 waters.

Based on the applicable classifications, the receiving waters named above are designated for use in the forms of aquatic life and recreation, industrial consumption, agriculture and wildlife, aesthetic enjoyment and navigation, and other uses.

Impairments

Minnesota is required to maintain a list of impaired waters, pursuant to Section 303(d) of the Federal Clean Water Act. Impairments have been identified in the receiving waters affected by this permit modification for mercury. Permit conditions with regard to mercury for this permit modification are discussed later in this statement of basis.

Proposed Permit Effluent Limits

The MPCA may develop effluent limitations based on Minnesota state water quality standards for the receiving water use classification, federal categorical standards applicable to specific industrial categories, or combination of these standards to regulate discharge of industrial wastewater. In addition, the MPCA may derive standards that are specific to a particular discharge. These standards may be based on toxicity studies, best professional judgment analysis, technology based standards, and in some instances standards developed by other U.S. states or regulatory agencies. Minnesota Rules and the U.S. Code of Federal Regulations (CFR) require that the MPCA categorize industrial dischargers consistent with the U.S. Environmental Protection Agency federal categorical standards, and state standards if appropriate.

Technology Based Effluent Limits

Minn. R. 7053.0225 subp. 1.A requires that all point source dischargers of industrial or other wastes shall comply with applicable federal standards, including those listed in 40 CFR pt. 401 through 469. The MPCA has determined that the specific industrial category and federal effluent limitation guidelines (Categorical Standards) applicable to this facility are those described in 40 CFR pt. 440 subp. A, for the iron ore mining and dressing point source category. The facility constitutes an existing source, and is therefore not subject to the New Source Performance Standards for this industry. The Categorical Standards for Best Practicable Control Technology currently available (BPT) and Best Available Technology economically achievable (BAT) have been applied for the conditions in this permit. These standards, along with Minnesota State Water Discharge Restrictions, have been used to develop the effluent limitations for discharge via permitted outfalls as summarized in the tables below.

Table – Technology-Based Effluent Limitations Proposed for NPDES/SDS Permit No. MN0031879, Surface Discharge Station SD001: Water Treatment Plant Backwash

<i>Effluent Characteristic</i>	<i>Effluent Limitation</i>	<i>Basis</i>
pH	6.0 Standard Units (SU) Instantaneous Minimum; 9.0 SU Instantaneous Maximum	Minn. R. 7053.0225 subp. 1.B.
Total Suspended Solids	30 mg/L Daily Maximum	Minn. R. 7053.0225 subp. 1.B.

Pursuant to Minn. R. 7053.0225, given that effluent limitations have not been promulgated for treatment plant backwash under 40 CFR 440, Minnesota State Water Discharge Restrictions are applied to ensure adequate treatment is achieved prior to discharge via SD001.

Table – Technology-Based Effluent Limitations Proposed for NPDES/SDS Permit No. MN0031879, Surface Discharge Stations SD002 and SD003

<i>Effluent Characteristic</i>	<i>Effluent Limitation</i>	<i>Basis</i>
Iron, dissolved (as Fe)	1.0 mg/L Calendar Month Average, 2.0 mg/L Daily Maximum	40 CFR § 440.12(a), 40 CFR § 440.13(a)
Total Suspended Solids	20 mg/L Calendar Month Average, 30 mg/L Daily Maximum	40 CFR § 440.12(a)

Effluent from SD002 and SD003 consists primarily of industrial stormwater and mine drainage as described in 40 CFR pt. 440. Effluent limitations have been included for total dissolved iron and total suspended solids to ensure that treatment requirements based on BAT and BPT considerations are achieved. Effluent limitations for pH based on water quality considerations have been determined to be more restrictive than the applicable limitations based on BAT and BPT.

Table – Technology-Based Effluent Limitations Proposed for NPDES/SDS Permit No. MN0031879, Surface Discharge Station SD012: Perry Pit Dewatering

<i>Effluent Characteristic</i>	<i>Effluent Limitation</i>	<i>Basis</i>
pH	6.0 Standard Units (SU) Instantaneous Minimum; 9.0 SU Instantaneous Maximum	40 CFR § 440.12(a)
Iron, dissolved (as Fe)	1.0 mg/L Calendar Month Average, 2.0 mg/L Daily Maximum	40 CFR § 440.12(a), 40 CFR § 440.13(a)
Total Suspended Solids	20 mg/L Calendar Month Average, 30 mg/L Daily Maximum	40 CFR § 440.12(a)

Effluent from SD012 consists of mine drainage from Perry Pit, which receives surface runoff from stripping and stockpiling activities associated with mining from Keetac operations. Therefore, effluent limitations have been included to reflect BAT and BPT for this waste stream.

Table – Technology-Based Effluent Limitations Proposed for NPDES/SDS Permit No. MN0031879, Waste Stream Station WS005: Internal Waste Stream

<i>Effluent Characteristic</i>	<i>Effluent Limitation</i>	<i>Basis</i>
Carbonaceous	25 mg/L, 3.8 kg/day Calendar Month Average;	Minn. R. 7053.0215 subp. 1
Biochemical Oxygen Demand, 5 Day	40 mg/L, 6.0 kg/day Daily Maximum	
Fecal Coliform	200 Organisms/100 mL Geometric Mean	Minn. R. 7053.0215
pH	6.0 Standard Units (SU) Instantaneous Minimum; 9.0 SU Instantaneous Maximum	Minn. R. 7053.0215
Total Suspended Solids	30 mg/L, 4.5 kg/day Calendar Month Average;	Minn. R. 7053.0215
	45 mg/L, 6.8 kg/day Daily Maximum	

WS005 consists of treated effluent from an activated sludge package plant that commingles with pit drainage effluent prior to discharge. To ensure adequate treatment is applied prior to discharge as required by Minn. R. 7053.0215, the permit requires that effluent limitations for discharges of sewage are met prior to commingling with other waste sources.

Water Quality Based Limits

Effluent limitations based on Minnesota state water quality standards for the receiving water use classifications previously discussed have been included in the permit for surface discharge stations SD002, SD003, and SD012.

The MPCA has made the determination that, based on the information available at the time of this permit modification, sulfate from the facility's discharges via SD002, SD003, and SD012 reaches waters that are used for the production of wild rice. Pursuant to Minn. R. 7050.0224 subp. 2, the available information at the time of this permit modification, and currently established permitting policies, the MPCA is including final effluent limitations for total sulfate based on a water quality standard of 10 mg/L total sulfate for these outfalls. The effluent limitations and associated reasonable potential calculations are detailed for each outfall in this section. The calculations are based on a zero-dilution factor, due to the fact that the receiving waters are above the currently supported water quality standard of 10 mg/L sulfate.

Table – Water Quality-Based Effluent Limitations Proposed for NPDES/SDS Permit No. MN0031879, Surface Discharge Station SD002: Weir Outfall

<i>Effluent Characteristic</i>	<i>Effluent Limitation</i>	<i>Basis</i>
Ammonia, Unionized	0.04 mg/L Calendar Month Average	Minn. R. 7050.0222 subp. 5
Oil and Grease	0.5 mg/L Calendar Quarter Average; 5.0 mg/L Daily Maximum	Minn. R. 7050.0222 Subp. 5
pH	6.5 Standard Units (SU) Instantaneous Minimum; 8.5 SU Instantaneous Maximum	Minn. R. 7050.0222 subp. 5, Minn. R. 7050.0224 subp. 2
Total Sulfate	14 mg/L Calendar Month Average, 24 mg/L Daily Maximum	Minn. R. 7050.0224 subp. 2, in combination with currently available information
Turbidity	25 Nephelometric Turbidity Units Calendar Month Average	Minn. R. 7050.0222 subp. 5

Effluent limitations are included for the parameters listed in the table above based on reasonable potential analyses completed during previous permit actions. Reasonable potential analysis completed utilizing data collected for mercury and specific conductance indicated that effluent limitations were not necessary for those parameters, as detailed in the following table.

Table – Reasonable Potential Calculations for SD002

PARAMETER	Hg (ng/l)	Sp. Conductance (µmhos/cm)
Maximum measured effluent value	1.9	784
Projected effluent quality (PEQ) @ n data points	2.66 (18)	784 (38)
Plant design flow (mgd)	15.1	15.1
Receiving water design flow (mgd)	0	0
Background concentration	0	0
Continuous standard (cs)	6.9	700
Maximum standard (ms)	2400	
Final acute value (FAV)	4900	
Mass Balance - cs	6.9	700
Mass Balance - ms	2400	
Coefficient Of Variation (CV)	0.64	0.19
Long Term Average: LTA cs	5.31	924.78
LTA ms	732.48	
Preliminary Effluent Limit (PEL): Daily Maximum	17.4	1395
Monthly Average	10	1137
Reasonable Potential PEQ>PEL (Dmax/FAV)	No	No

**Table – Water Quality-Based Effluent Limitations Proposed for NPDES/SDS Permit No. MN0031879,
Surface Discharge Station SD003: Mesabi Chief Pit Dewatering**

Effluent Characteristic	Effluent Limitation	Basis
Oil and Grease	0.5 mg/L Calendar Quarter Average; 5.0 mg/L Daily Maximum	Minn. R. 7050.0222 subp. 5
pH	6.5 Standard Units (SU) Instantaneous Minimum; 8.5 SU Instantaneous Maximum	Minn. R. 7050.0222 subp. 5, Minn. R. 7050.0224 subp. 2
Total Sulfate	14 mg/L Calendar Month Average, 24 mg/L Daily Maximum	Minn. R. 7050.0224 subp. 2, in combination with currently available information

Effluent limitations are included for the parameters listed in the table above based on reasonable potential analyses completed during previous permit actions. Reasonable potential analysis completed utilizing data collected for mercury and specific conductance indicated that effluent limitations were not necessary for those parameters, as detailed in the following table.

Table – Reasonable Potential Calculations for SD003

PARAMETER	Hg (ng/l)	Sp. Conductance (µmhos/cm)
Maximum measured effluent value	5.2	702
Projected effluent quality (PEQ) @ n data points	7.28 (18)	702 (39)
Plant design flow (mgd)	5.85	5.85
Receiving water design flow (mgd)	0	0
Background concentration	0	0
Continuous standard (cs)	6.9	700
Maximum standard (ms)	2400	
Final acute value (FAV)	4900	
Mass Balance - cs	6.9	700
Mass Balance - ms	2400	
Coefficient Of Variation (CV)	0.62	0.15
Long Term Average: LTA cs	5.34	939.41
LTA ms	746.94	
Preliminary Effluent Limit (PEL): Daily Maximum	17.1	1309
Monthly Average	10	1109
Reasonable Potential PEQ>PEL (Dmax/FAV)	No	No

Table – Water Quality-Based Effluent Limitations Proposed for NPDES/SDS Permit No. MN0031879, Surface Discharge Station SD012: Perry Pit Dewatering

<i>Effluent Characteristic</i>	<i>Effluent Limitation</i>	<i>Basis</i>
Total Sulfate	14 mg/L Calendar Month Average, 24 mg/L Daily Maximum	Minn. R. 7050.0224 subp. 2, in combination with currently available information

With the exception of bicarbonate alkalinity, reasonable potential analyses completed during a permit modification in 2010 were used to determine the need for water quality-based effluent limitations due to the fact that the data are still representative of Perry Pit effluent quality. Effluent limitations are included for total sulfate based on those reasonable potential calculations.

As described in the previous permit, reasonable potential for bicarbonate alkalinity was recalculated following representative monitoring by the Permittee. Based on the new information collected, an effluent limitation for bicarbonates is not warranted in this permit reissuance, as indicated in the table below.

Table – Reasonable Potential Calculations for SD012

PARAMETER	Hardness (mg/L)	TDS (mg/L)	Bicarb (meq/L)	Sp. Cond. (µmhos/c m)	Hg (ng/L)	Sulfate (mg/l)
Maximum measured effluent value	256	345	3.86	702	1.7	23.4
Projected effluent quality (PEQ) @ n data points	780 (3)	1035 (3)	5.404 (14)	842.4 (38)	4.42 (4)	60.84 (4)
Plant design flow (mgd)	4.32	4.32	4.32	4.32	4.32	4.32
Receiving water design flow (mgd)	0	0	0	0	0	0
Background concentration	0	0	0	0	0	0
Continuous standard (cs)	500	700	5	1000	6.9	10
Maximum standard (ms)					2400	-
Final acute value (FAV)					4900	-
Mass Balance - cs	500	700	5	1000	6.9	10
Mass Balance - ms					2400	-
Coefficient Of Variation (CV)	0.6	0.6	0.45	0.6	0.6	0.6
Long Term Average: LTA cs	390	546	4.15	780	5.4	7.8
LTA ms					771	-
Preliminary Effluent Limit (PEL): Daily Maximum	1215	1701	10.21	2430	17	24
Monthly Average	701	982	6.57	1403	10	14
Reasonable Potential PEQ>PEL (Dmax/FAV)	No	No	No	No	No	Yes

Additional Requirements

Compliance Schedule

The permit reissuance includes a schedule for attaining compliance with the final effluent limitations for total sulfate. The schedule requires attainment of compliance as soon as possible and in no case later than August 17, 2019. The term of the compliance schedule is based on the time required for completion of evaluations by the Permittee, as well as time for implementation of any final plans for attaining compliance, including time for obtaining various regulatory approvals. The compliance schedule has been developed in accordance with the requirements of 40 CFR § 122.47.

Nondegradation and Anti-Backsliding

Anti-Backsliding

The effluent limitations contained in this permit modification are not less stringent than the effluent limitations in the existing permit, in accordance with the antibacksliding requirements found in 40 CFR § 122.44(l) and Minn. R. 7053.0275.

Nondegradation

In accordance with the MPCA rules regarding nondegradation for all waters, the design flow of the facility as of January 1, 1988, and associated mass loading are the baseline design flow and mass loading. This baseline flow and mass loading are used to determine whether nondegradation review is required for any change in the discharge. Additional volume and pollutant loading associated with the discharge of Perry Pit dewatering effluent was reviewed in accordance with Minn. R. 7050.0185 as part of a permit modification completed on June 17, 2010, including consideration of the quantity and quality of the proposed discharge and the potential for violating water quality standards in the receiving water.

The Permittee has not proposed expansion of any permitted discharges above the volumes and mass loadings authorized under previous permit actions.



**National Pollutant Discharge
Elimination System /State
Disposal System (NPDES/SDS)
Permit Program
Statement of Basis**

Permittee: United States Steel, Minnesota Ore Operations
Name: Keetac – Tailings Basin
Permit Number: MN0055948

Current Permit Expiration: February 28, 2011

Public Comment Period Begins: June 27, 2011
Period Ends: August 19, 2011

Receiving Water: Reservoir 2; Welcome Creek

Proposed Action: Permit Reissuance

Permitting Contact
Brandon Smith
520 Lafayette Road N.
St. Paul, MN 55155
Phone: 651-757-2740
Fax: 651-296-8717

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Purpose and Participation

Purpose

This Statement of Basis outlines the principal issues related to the preparation of this permit reissuance and documents the decisions that were made in the determination of the effluent limitations and conditions of this permit.

The permit will be reissued if the Minnesota Pollution Control Agency (MPCA) determines that the proposed Permittee or Permittees will, with respect to the facility or activity to be permitted, comply or undertake a schedule to achieve compliance with all applicable state and federal pollution control statutes and rules administered by the MPCA and the conditions of the permit and that all applicable requirements of Minn. Stat. ch. 116D and the rules promulgated thereunder have been fulfilled.

More detail on all requirements placed on the facility may be found in the Permit document.

Facility Description

Background Information

Facility Location

The permitted facility includes the tailings basin and Sargent Pit dewatering operations for the U. S. Steel – Keetac facility, located to the north of Keewatin, Minnesota.

Outfall Locations

SD001: Four siphon outfalls to Reservoir 2. This outfall is used as an emergency discharge to maintain the integrity of the dike system. The outfalls are located at the southwestern edge of Reservoir 6, at PLS coordinates T 56 N, R 22 W, Section 2.

SD005: Weir outfall to Reservoir 2 North/Welcome Creek. This is the primary outfall for discharges from the tailings basin system. The outfall is located at the northeastern edge of Reservoir 6, at PLS coordinates T 56 N, R 22 W, Section 1.

SD008: Combination of discharges from SD001 and SD005. This station is for compliance reporting purposes only.

SD009: Sargent Pit dewatering outfall to unnamed ditch, leading to Welcome Creek. This will be a new outfall constructed to facilitate direct discharge of Sargent Pit dewatering, which is currently directed to other outfalls that are covered under NPDES/SDS Permit MN0031879. The outfall will be located at the edge of the Sargent Pit, at PLS coordinates T 57 N, R 22 W, Section 26.

Changes to Facility or Operation

The facility has proposed an expansion of the taconite processing plant with which the permitted operations are associated. As a result, the rate of tailings deposition to the tailings basin will be increased. An increase in the discharge rate of process wastewaters from the tailings basin is not expected to exceed the volumes already permitted.

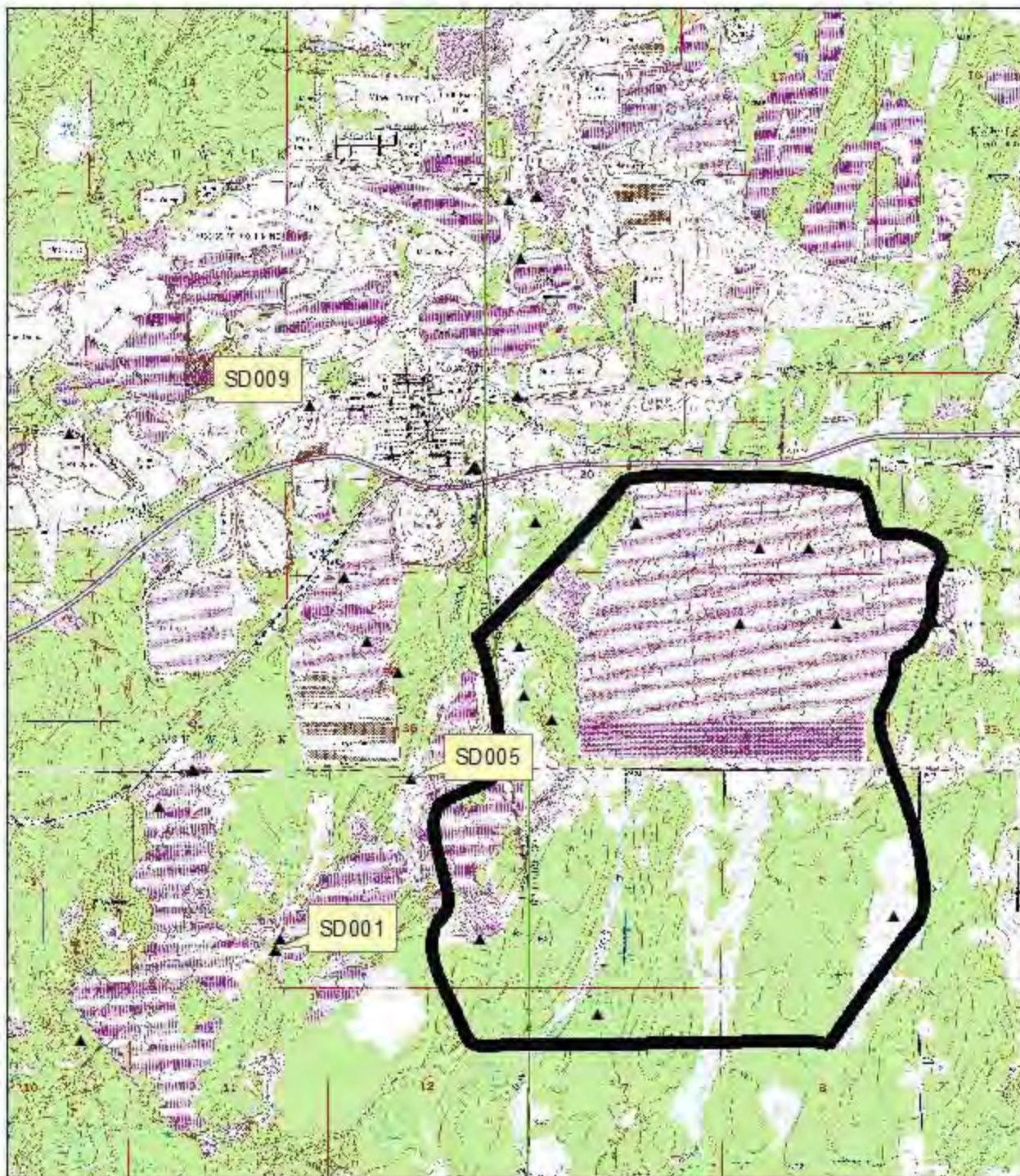
The facility is proposing to discharge dewatering effluent from the Sargent Pit directly to surface water. This discharge is discussed later in this statement of basis.

Recent Compliance History

The Facility was inspected on May 10, 2010. No significant compliance issues were found that would affect reissuance of this permit.

Topographic Map of Permitted Facility

MN0055948, United States Steel Corporation - Keetac Tailings Basin
St. Louis & Itasca County, Minnesota



Map produced by: MPCA Staff, 6/23/2011
Source: USGS Keewatin, Silica Quad
Scale: 1:50,000

0 0.25 0.5 1 Miles



Receiving Waters

Use Classification

The receiving waters affected by this permit reissuance include Reservoir 2, Reservoir 2 North, Welcome Creek, and an unnamed ditch, which discharges to Welcome Creek.

All waters of the state of Minnesota must be classified based on considerations of best usage in the interest of the public and in conformance with the requirements of the applicable statutes, as described in Minn. R. 7050.0140. Based on these considerations, Welcome Creek is classified as Class 2C waters as listed in Minn. R. 7050.0470 subp. 4.A. item (236). According to Minn. R. 7050.0410, any listed water in part 7050.0470 is also classified as a Class 3C, 4A, 4B, 5, and 6 water.

Reservoir 2, Reservoir 2 North, and the unnamed ditch leading to Welcome Creek are not listed waters in Minn. R. 7050.0470. As detailed in Minn. R. 7050.0430, all surface waters of the state that are not listed in part 7050.0470 and that are not wetlands as defined in part Minn. R. 7050.0186, subp. 1a, are classified as Class 2B, 3C, 4A, 4B, 5, and 6 waters.

Based on the applicable classifications, the receiving waters named above are designated for use in the forms of aquatic life and recreation, industrial consumption, agriculture and wildlife, aesthetic enjoyment and navigation, and other uses.

Impairments

Minnesota is required to maintain a list of impaired waters, pursuant to Section 303(d) of the Federal Clean Water Act. Impairments have been identified in the receiving waters affected by this permit reissuance for mercury. Permit conditions with regard to mercury for this permit modification are discussed later in this statement of basis.

Proposed Permit Effluent Limits

The MPCA may develop effluent limitations based on Minnesota state water quality standards for the receiving water use classification, federal categorical standards applicable to specific industrial categories, or combination of these standards to regulate discharge of industrial wastewater. In addition, the MPCA may derive standards that are specific to a particular discharge. These standards may be based on toxicity studies, best professional judgment analysis, technology based standards, and in some instances standards developed by other U.S. states or regulatory agencies. Minnesota Rules and the U.S. Code of Federal Regulations (CFR) require that the MPCA categorize industrial dischargers consistent with the U.S. Environmental Protection Agency federal categorical standards, and state standards if appropriate.

Technology Based Effluent Limits

Minn. R. 7053.0225 subp. 1.A requires that all point source dischargers of industrial or other wastes shall comply with applicable federal standards, including those listed in 40 CFR pt. 401 through 469. The MPCA has determined that the specific industrial category and federal effluent limitation guidelines (Categorical Standards) applicable to this facility are those described in 40 CFR pt. 440 subp. A, for the iron ore mining and dressing point source category. The facility constitutes an existing source, and is therefore not subject to the New Source Performance Standards for this industry. The Categorical Standards for Best Practicable Control Technology currently available (BPT) and Best Available Technology economically achievable (BAT) have been applied for the conditions in this permit. These standards have been used to develop the effluent limitations for discharge of process wastewaters and dewatering effluent summarized in the tables below.

Table – Technology-Based Effluent Limitations Proposed for NPDES/SDS Permit No. MN0055948, Surface Discharge Stations SD001: Siphon Outfalls to Reservoir 2 and SD005: Weir Outfall to Reservoir 2 North

<i>Effluent Characteristic</i>	<i>Effluent Limitation</i>	<i>Basis</i>
pH	6.0 Standard Units (SU) Instantaneous Minimum; 9.0 SU Instantaneous Maximum	40 CFR § 440.12(c)(2)
Iron, dissolved (as Fe)	1.0 mg/L Calendar Month Average, 2.0 mg/L Daily Maximum	40 CFR § 440.12(c)(2), 40 CFR § 440.13(c)(2)
Total Suspended Solids	20 mg/L Calendar Month Average, 30 mg/L Daily Maximum	40 CFR § 440.12(c)(2)

Stations SD001 and SD005 are both discharges of process wastewater from Reservoir 6 to surface water. Both constitute discharges of process wastewaters from a mill that employs magnetic and physical methods to beneficiate iron ore in the Mesabi Range. Therefore, pursuant to 40 CFR §§ 440.12(c) and 440.13(c), the allowable discharges from these outfalls are limited to the volume associated with the net accumulation of annual precipitation when annual precipitation exceeds evaporation. Compliance with this requirement is monitored for the combination of flows from SD001 and SD005 and reported via station SD008, along with the annual precipitation and annual evaporation.

Table – Technology-Based Effluent Limitations Proposed for NPDES/SDS Permit No. MN0055948, Surface Discharge Station SD009: Sargent Pit Dewatering to Unnamed Ditch

<i>Effluent Characteristic</i>	<i>Effluent Limitation</i>	<i>Basis</i>
pH	6.0 Standard Units (SU) Instantaneous Minimum; 9.0 SU Instantaneous Maximum	40 CFR § 440.12(a)
Iron, dissolved (as Fe)	1.0 mg/L Calendar Month Average, 2.0 mg/L Daily Maximum	40 CFR § 440.12(a), 40 CFR § 440.13(a)
Total Suspended Solids	20 mg/L Calendar Month Average, 30 mg/L Daily Maximum	40 CFR § 440.12(a)

Water Quality Based Effluent Limits

Stations SD001, SD005, and SD009 have been evaluated to determine the need for effluent limitations to protect the receiving waters for the use classifications previously discussed. Water quality-based effluent limitations have been included for the permit reissuance as discussed below.

The MPCA has made the determination that, based on the information available at the time of this permit reissuance, sulfate from the facility's discharges via SD001, SD005, and SD009 reaches waters that are used for the production of wild rice. Pursuant to Minn. R. 7050.0224 subp. 2, the available information at the time of this permit reissuance, and currently established permitting policies, the MPCA is including final effluent limitations for total sulfate based on a water quality standard of 10 mg/L total sulfate for these outfalls. The effluent limitations and associated reasonable potential calculations are detailed in the two tables below. The calculations are based on a zero-dilution factor, due to the fact that the receiving waters are above the currently supported water quality standard of 10 mg/L sulfate.

Discharges from the tailings basin were evaluated for reasonable potential for water quality parameters as directed by MPCA permitting policy. The discharge indicates reasonable potential for sulfate as previously discussed. None of the additional parameters evaluated indicated reasonable potential to exceed water quality standards in the receiving waters.

Table – Reasonable Potential Calculations for SD001 and SD005

PARAMETER	<u>SO4</u> <u>AQ.</u> <u>LIFE</u> (mg/l)	<u>SO4</u> <u>WILD</u> <u>RICE</u> (mg/l)	<u>SPEC.</u> <u>COND.</u> (umohm s/cm)	<u>HG</u> (ng/l)	<u>CL-</u> <u>AQ. LIFE</u> (mg/l)	<u>CL-</u> <u>CLASS 3</u> (mg/l)
Maximum measured effluent value	137	137	958	2.4	24.8	24.8
Projected effluent quality (PEQ) @ n data points	1 (47)	1 (47)	1 (47)	4 (10)	154 (1)	154 (1)
Plant design flow (mgd)	23	23	23	23	23	23
Receiving water design flow (mgd)	0	0	0	0	0	0
Background concentration	0	0	0	6.9	0	0
Continuous standard (cs) @302 Hd	1210	10	1000	6.9	230	250
Maximum standard (ms) @ 302 Hd	1452	Na	Na	2400	860	Na
Final acute value (FAV) @ 302 Hd	2904	Na	Na	4900	1720	Na
Mass Balance – cs	1210	10	1000	6.9	230	250
Mass Balance - ms	1452	-	-	2400	860	-
Coefficient Of Variation (CV)	0.6	0.6	0.1763	0.6	0.6	0.6
Long Term Average: LTA cs	638.2	7.802 9	928.3732	5.384 0	121.3	195.0737
LTAs	466	-	-	771	276	-
Preliminary Effluent Limit (PEL): Daily Maximum	1452	24.3	1373.3	16.8	378	1607.5
Monthly Average	838	14.0	1130	9.7	218	350.7
Reasonable Potential PEQ>PEL (Dmax/FAV)	No	Yes	No	No	No	No

The proposed discharge of Sargent Pit dewatering effluent to an unnamed ditch was evaluated for the potential to exceed water quality standards. The reasonable potential calculations for this discharge are summarized in the table below.

Table – Reasonable Potential Calculations for SD009

PARAMETER	BA (ug/l)	SE (ug/l)	CL- AQ. LIFE (mg/l)	CL- CLASS 3 (mg/l)	SO4 AQ. LIFE (mg/l)	SO4 WILD RICE (mg/l)	AS (ug/l)	HG (ng/l)	SP. COND (umhos/ cm)
Maximum measured effluent value	35.6	2.9	8.84	8.84	113	113	12.6	1.2	660
Projected effluent quality (PEQ) @ n data points	220.7 (1)	17.98 (1)	55 (1)	55 (1)	700.6 (1)	700.6 (1)	32.8 (1)	7 (1)	4092 (1)
Plant design flow (mgd)	4.75	4.75	4.75	4.75	4.75	4.75	4.75	4.75	4.75
Receiving water design flow (mgd)	0	0	0	0	0	0	0	0	0
Background concentration	0	0	0	0	0	0	0	0	0
Continuous standard (cs) @331 Hd	683	5	230	250	908	10	53	6.9	1000
Maximum standard (ms) @ 331 Hd	2758	20	860	Na	1090	Na	360	2400	Na
Final acute value (FAV) @ 331 Hd	5516	40	1720	Na	2179	Na	720	4900	Na
Mass Balance – cs	683	5	230	250	908	10	53	6.9	1000
Mass Balance - ms	2758	20	860	-	1090	-	360	2400	-
Coefficient Of Variation (CV)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Long Term Average: LTA cs	360.2	2.64	121.31	195.07	478.9	7.803	28	5.384	780.295
LTAs	885.6	6.42	276.14	-	350.0	-	115.6	771	-
Preliminary Effluent Limit (PEL): Daily Maximum	1122	8.2	378	607.5	1090	24.3	87	16.8	2430.1
Monthly Average	647.6	5	218	350.7	629	14.0	50	9.7	1403
Reasonable Potential PEQ>PEL (Dmax/FAV)	No	Yes	No	No	No	Yes	No	No	Yes

The discharge of Sargent Pit dewatering effluent indicated reasonable potential for sulfate as previously discussed. In addition, reasonable potential to exceed water quality standards for selenium and specific conductance was identified; however this indication is based on a limited data set. Therefore, effluent limitations have not been included for the reissuance of this permit; however monitoring requirements have been included to provide additional detail regarding these pollutants as discussed in greater detail later in this statement of basis.

Additional Requirements

Compliance Schedule

The permit reissuance includes a schedule for attaining compliance with the final effluent limitations for total sulfate. The schedule requires attainment of compliance as soon as possible and in no case later than August 17, 2020. The term of the compliance schedule is based on the time required for completion of evaluations by the Permittee, as well as time for implementation of any final plans for attaining compliance, including time for obtaining various regulatory approvals. The compliance schedule has been developed in accordance with the requirements of 40 CFR § 122.47.

Monitoring for Selenium and Specific Conductance

The permit contains effluent limitations for selenium and specific conductance and previously discussed. However, these effluent limitations have been calculated based on a single data point, which may or may not be representative of the actual discharge conditions. The permit includes a requirement to monitor the discharge from Sargent Pit monthly for selenium and specific conductance, and discharges from the tailings basin monthly for selenium. After accumulating a data set that represents at least 12 data points, and characterizes the seasonal variability of these discharges, the Permittee has the option of requesting reduction or elimination of monitoring for these parameters based on a revised reasonable potential analysis.

Nondegradation and Anti-Backsliding

Anti-Backsliding

The effluent limitations contained in this permit modification are not less stringent than the effluent limitations in the existing permit, in accordance with the antibacksliding requirements found in 40 CFR § 122.44(l) and Minn. R. 7053.0275.

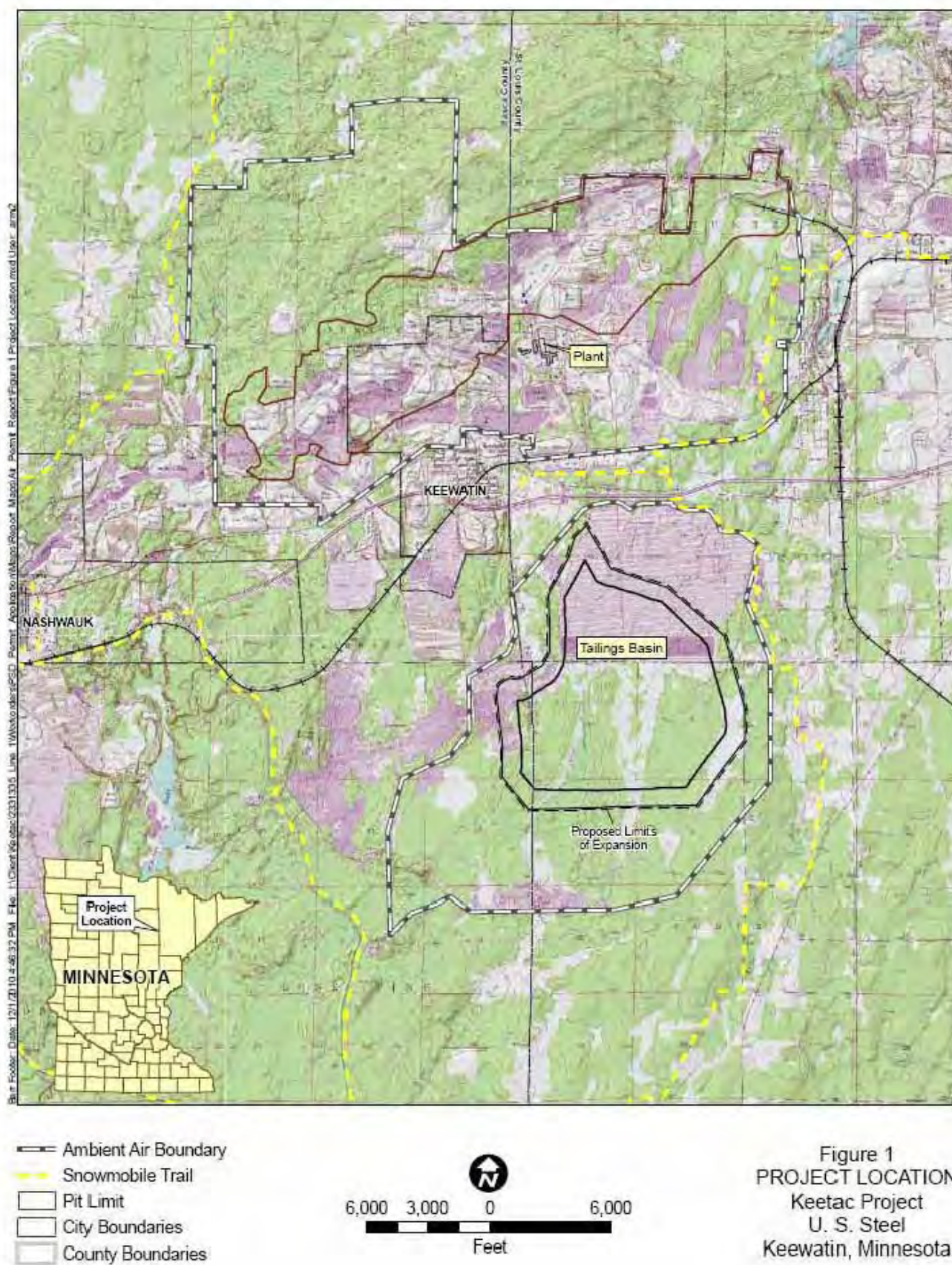
Nondegradation

In accordance with the MPCA rules regarding nondegradation for all waters, the design flow of the facility as of January 1, 1988, and associated mass loading are the baseline design flow and mass loading. This baseline flow and mass loading are used to determine whether nondegradation review is required for any change in the discharge.

Given that the new discharge location for Sargent Pit dewatering to the unnamed ditch represents an expansion of the facility's permitted discharge to this receiving water by more than 0.2 mgd, and an increased loading of one or more pollutants over the baseline quality in the receiving water, the discharge of dewatering effluent has been reviewed in accordance with Minn. R. 7050.0185. The review includes consideration of the quantity and quality of the proposed discharge and the potential for violating water quality standards in the receiving water. The statistical reasonable potential analysis discussed previously in this Statement of Basis shows that the proposed project will not impair the designated beneficial uses of the receiving waters. The results of the analysis, including the water quality-based effluent limits for sulfate, selenium, and specific conductance have been included in this modified permit to ensure continued protection of existing beneficial uses.

The permit contains conditions for installation of treatment technology to ensure that sulfate loading associated with inputs to the tailings basin complies with nondegradation requirements following expansion of the facility's taconite processing operations.

The Permittee has provided information for the proposed Sargent Pit dewatering as required under the provisions of the nondegradation rule. Using the information provided and all available data, the MPCA is required to determine appropriate effluent limitations protective of existing beneficial uses and determine whether additional controls can reasonably be taken to minimize the potential for impact on receiving waters. The discharge restrictions and monitoring requirements included in this permit have been designed to maintain water quality and preserve designated beneficial uses of the receiving waters. Additional controls beyond these measures are not warranted. Effluent monitoring and reporting requirements ensure ongoing compliance with the discharge permit conditions. Monitoring without numerical effluent limits is included for those parameters that do not have a reasonable potential to exceed water quality standards.



WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 3

Discharge Monitoring Reports, Bulk Exports for Keetac Permits MN0031879, MN0055948
Sulfate and Specific Conductance, 2018-2024.

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947

Facility	A		B		C		D		E		F		G		H		I		J	K		L		M		N		O		P		Q		R		S		T		U		V																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
	Preferred Id	Permit Action	Station	Station Description	Year	Month	Day	Mon	Tue	Wed	Thurs	Paramter	Limit	Non-detect	Rpt V	Units	Limit	V	Nc	Watershed	Huc8 Cd	Huc12	Nai	Longitude	Latitude	Mon	End Date																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
1	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	March	03/31/2018	Specific Conductance							750	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2018																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
2	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	June	06/30/2018	Specific Conductance							721	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2018																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
3	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	September	09/30/2018	Specific Conductance							716	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2018																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
4	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	December	12/31/2018	Specific Conductance							729	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2018																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
5	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	March	03/31/2019	Specific Conductance							755	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2019																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
6	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	June	06/30/2019	Specific Conductance							767	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2019																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
7	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	September	09/30/2019	Specific Conductance							713	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2019																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
8	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	December	12/31/2019	Specific Conductance							731	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2019																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
9	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	March	03/31/2020	Specific Conductance							786	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2020																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
10	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	June	06/30/2020	Specific Conductance							818	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2020																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
11	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	September	09/30/2020	Specific Conductance							781	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2020																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
12	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	December	12/31/2020	Specific Conductance							733	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2020																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
13	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2021	March	03/31/2021	Specific Conductance							767	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2021																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
14	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2021	June	06/30/2021	Specific Conductance							762	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2021																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
15	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2021	September	09/30/2021	Specific Conductance							780	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2021																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
16	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2021	December	12/31/2021	Specific Conductance							810	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2021																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
17	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2022	March	03/31/2022	Specific Conductance							783	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2022																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
18	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2022	June	06/30/2022	Specific Conductance							826	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2022																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
19	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2022	September	09/30/2022	Specific Conductance							792	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2022																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
20	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2022	December	12/31/2022	Specific Conductance							811	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2022																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
21	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2023	March	03/31/2023	Specific Conductance							844	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2023																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
22	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2023	June	06/30/2023	Specific Conductance							881	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2023																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
23	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2023	September	09/30/2023	Specific Conductance							823	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2023																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
24	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2023	December	12/31/2023	Specific Conductance							820	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2023																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
25	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2024	March	03/31/2024	Specific Conductance							810	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2024																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
26	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2024	June	06/30/2024	Specific Conductance							831	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2024																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
27	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2024	September	09/30/2024	Specific Conductance							932	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2024																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
28	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2024	December	12/31/2024	Specific Conductance							812	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2024																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
56	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	June	06/30/2024	Specific Conductance			732	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2024	
57	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	September	09/30/2024	Specific Conductance			775	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2024	
58	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	December	12/31/2024	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2024	
59	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	March	03/31/2018	Specific Conductance			492	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2018	
60	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	June	06/30/2018	Specific Conductance			484	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2018	
61	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	September	09/30/2018	Specific Conductance			481	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2018	
62	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	December	12/31/2018	Specific Conductance			444	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2018	
63	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	March	03/31/2019	Specific Conductance			483	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2019	
64	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	June	06/30/2019	Specific Conductance			481	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2019	
65	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	September	09/30/2019	Specific Conductance			480	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2019	
66	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	December	12/31/2019	Specific Conductance			453	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2019	
67	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	March	03/31/2020	Specific Conductance			489	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2020	
68	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	June	06/30/2020	Specific Conductance			480	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2020	
69	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	September	09/30/2020	Specific Conductance			489	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2020	
70	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	December	12/31/2020	Specific Conductance			455	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2020	
71	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	March	03/31/2021	Specific Conductance			486	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2021	
72	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	June	06/30/2021	Specific Conductance			472	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2021	
73	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	September	09/30/2021	Specific Conductance			460	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2021	
74	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	December	12/31/2021	Specific Conductance			459	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2021	
75	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	March	03/31/2022	Specific Conductance			481	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2022	
76	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	June	06/30/2022	Specific Conductance			501	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2022	
77	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	September	09/30/2022	Specific Conductance			493	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2022	
78	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	December	12/31/2022	Specific Conductance			482	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2022	
79	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	March	03/31/2023	Specific Conductance			517	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2023	
80	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	June	06/30/2023	Specific Conductance			512	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2023	
81	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	September	09/30/2023	Specific Conductance			515	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2023	
82	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	December	12/31/2023	Specific Conductance			506	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2023	
83	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	March	03/31/2024	Specific Conductance			517	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2024	
84	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	June	06/30/2024	Specific Conductance			497	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2024	
85	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	September	09/30/2024	Specific Conductance			482	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2024	
86	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	December	12/31/2024	Specific Conductance			486	umhos/cm	CalQtrMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2024	
87	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	January	01/31/2018	Specific Conductance			833	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2018	
88	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	February	02/28/2018	Specific Conductance			794	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2018	
89	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	March	03/31/2018	Specific Conductance			869	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2018	
90	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	April	04/30/2018	Specific Conductance			883	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2018	
91	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	May	05/31/2018	Specific Conductance			806	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2018	
92	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	June	06/30/2018	Specific Conductance			751	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2018	
93	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	July	07/31/2018	Specific Conductance			757	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2018	
94	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	August	08/31/2018	Specific Conductance			725	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2018	
95	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	September	09/30/2018	Specific Conductance			714	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2018	
96	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	October	10/31/2018	Specific Conductance			706	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2018	
97	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	November	11/30/2018	Specific Conductance			750	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2018	
98	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	December	12/31/2018	Specific Conductance			825	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2018	
99	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	January	01/31/2019	Specific Conductance			788	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2019	
100	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	February	02/28/2019	Specific Conductance			850	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2019	
101	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	March	03/31/2019	Specific Conductance			862	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2019	
102	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	April	04/30/2019	Specific Conductance			886	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2019	
103	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	May	05/31/2019	Specific Conductance			786	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2019	
104	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	June	06/30/2019	Specific Conductance			824	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2019	
105	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	July	07/31/2019	Specific Conductance			777	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2019	
106	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	August	08/31/2019	Specific Conductance			734	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2019	
107	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	September	09/30/2019	Specific Conductance			819	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2019	
108	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011</																		

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
111	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	January	01/31/2020	Specific Conductance			879	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2020	
112	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	February	02/29/2020	Specific Conductance			920	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/29/2020	
113	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	March	03/31/2020	Specific Conductance			926	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2020	
114	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	April	04/30/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2020	
115	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	May	05/31/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2020	
116	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	June	06/30/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2020	
117	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	July	07/31/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2020	
118	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	August	08/31/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2020	
119	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	September	09/30/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2020	
120	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	October	10/31/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2020	
121	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	November	11/30/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2020	
122	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	December	12/31/2020	Specific Conductance			870	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2020	
123	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	January	01/31/2021	Specific Conductance			870	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2021	
124	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	February	02/28/2021	Specific Conductance			837	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2021	
125	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	March	03/31/2021	Specific Conductance			920	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2021	
126	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	April	04/30/2021	Specific Conductance			842	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2021	
127	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	May	05/31/2021	Specific Conductance			806	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2021	
128	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	June	06/30/2021	Specific Conductance			794	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2021	
129	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	July	07/31/2021	Specific Conductance			843	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2021	
130	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	August	08/31/2021	Specific Conductance			880	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2021	
131	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	September	09/30/2021	Specific Conductance			789	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2021	
132	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	October	10/31/2021	Specific Conductance			850	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2021	
133	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	November	11/30/2021	Specific Conductance			846	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2021	
134	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	December	12/31/2021	Specific Conductance			948	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2021	
135	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	January	01/31/2022	Specific Conductance			926	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2022	
136	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	February	02/28/2022	Specific Conductance			997	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2022	
137	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	March	03/31/2022	Specific Conductance			981	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2022	
138	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	April	04/30/2022	Specific Conductance			916	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2022	
139	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	May	05/31/2022	Specific Conductance			845	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2022	
140	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	June	06/30/2022	Specific Conductance			789	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2022	
141	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	July	07/31/2022	Specific Conductance			757	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2022	
142	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	August	08/31/2022	Specific Conductance			630	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2022	
143	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	September	09/30/2022	Specific Conductance			774	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2022	
144	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	October	10/31/2022	Specific Conductance			749	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2022	
145	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	November	11/30/2022	Specific Conductance			758	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2022	
146	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	December	12/31/2022	Specific Conductance			809	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2022	
147	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	January	01/31/2023	Specific Conductance			882	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2023	
148	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	February	02/28/2023	Specific Conductance			440	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2023	
149	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	March	03/31/2023	Specific Conductance			1022	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2023	
150	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	April	04/30/2023	Specific Conductance			1009	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2023	
151	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	May	05/31/2023	Specific Conductance			885	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2023	
152	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	June	06/30/2023	Specific Conductance			784	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2023	
153	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	July	07/31/2023	Specific Conductance			750	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2023	
154	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	August	08/31/2023	Specific Conductance			763	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2023	
155	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	September	09/30/2023	Specific Conductance			779	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2023	
156	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	October	10/31/2023	Specific Conductance			845	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2023	
157	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	November	11/30/2023	Specific Conductance			809	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2023	
158	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	December	12/31/2023	Specific Conductance			891	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2023	
159	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	January	01/31/2024	Specific Conductance			985	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2024	
160	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	February	02/29/2024	Specific Conductance			987	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/29/2024	
161	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	March	03/31/2024	Specific Conductance			976	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2024	
162	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	April	04/30/2024	Specific Conductance			946	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2024	
163	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water																	

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
166	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	August	06/31/2024	Specific Conductance			866	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2024	
167	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	September	09/30/2024	Specific Conductance			817	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2024	
168	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	October	10/31/2024	Specific Conductance			888	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2024	
169	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	November	11/30/2024	Specific Conductance			888	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2024	
170	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	December	12/31/2024	Specific Conductance			965	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2024	
171	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	January	01/31/2018	Specific Conductance			2171	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2018	
172	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	February	02/28/2018	Specific Conductance			2202	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2018	
173	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	March	03/31/2018	Specific Conductance			2044	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2018	
174	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	April	04/30/2018	Specific Conductance			2234	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2018	
175	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	May	05/31/2018	Specific Conductance			2085	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2018	
176	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	June	06/30/2018	Specific Conductance			2662	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2018	
177	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	July	07/31/2018	Specific Conductance			2188	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2018	
178	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	August	08/31/2018	Specific Conductance			2058	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2018	
179	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	September	09/30/2018	Specific Conductance			2134	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2018	
180	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	October	10/31/2018	Specific Conductance			2219	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2018	
181	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	November	11/30/2018	Specific Conductance			2070	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2018	
182	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	December	12/31/2018	Specific Conductance			2241	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2018	
183	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	January	01/31/2019	Specific Conductance			2241	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2019	
184	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	February	02/28/2019	Specific Conductance			1685	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2019	
185	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	March	03/31/2019	Specific Conductance			2163	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2019	
186	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	April	04/30/2019	Specific Conductance			2230	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2019	
187	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	May	05/31/2019	Specific Conductance			2268	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2019	
188	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	June	06/30/2019	Specific Conductance			2027	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2019	
189	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	July	07/31/2019	Specific Conductance			2369	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2019	
190	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	August	08/31/2019	Specific Conductance			1412	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2019	
191	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	September	09/30/2019	Specific Conductance			2715	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2019	
192	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	October	10/31/2019	Specific Conductance			1722	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2019	
193	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	November	11/30/2019	Specific Conductance			2771	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2019	
194	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	December	12/31/2019	Specific Conductance			2011	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2019	
195	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	January	01/31/2020	Specific Conductance			3292	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2020	
196	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	February	02/29/2020	Specific Conductance			2859	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/29/2020	
197	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	March	03/31/2020	Specific Conductance			2988	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2020	
198	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	April	04/30/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2020	
199	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	May	05/31/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2020	
200	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	June	06/30/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2020	
201	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	July	07/31/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2020	
202	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	August	08/31/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2020	
203	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	September	09/30/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2020	
204	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	October	10/31/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2020	
205	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	November	11/30/2020	Specific Conductance				umhos/cm	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2020	
206	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	December	12/31/2020	Specific Conductance			2207	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2020	
207	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	January	01/31/2021	Specific Conductance			2109	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2021	
208	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	February	02/28/2021	Specific Conductance			1181	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2021	
209	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	March	03/31/2021	Specific Conductance			2150	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2021	
210	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	April	04/30/2021	Specific Conductance			2125	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2021	
211	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	May	05/31/2021	Specific Conductance			2518	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2021	
212	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	June	06/30/2021	Specific Conductance			2759	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2021	
213	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	July	07/31/2021	Specific Conductance			3383	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2021	
214	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	August	08/31/2021	Specific Conductance			3234	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2021	
215	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	September	09/30/2021	Specific Conductance			2293	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2021	
216	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	October	10/31/2021	Specific Conductance			3567	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2021	
217	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	November	11/30/2021	Specific Conductance			3275	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827		

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
221	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	March	03/31/2022	Specific Conductance			3830	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2022	
222	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	April	04/30/2022	Specific Conductance			2800	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2022	
223	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	May	05/31/2022	Specific Conductance			3280	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2022	
224	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	June	06/30/2022	Specific Conductance			3049	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2022	
225	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	July	07/31/2022	Specific Conductance			3676	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2022	
226	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	August	08/31/2022	Specific Conductance			3873	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2022	
227	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	September	09/30/2022	Specific Conductance			3608	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2022	
228	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	October	10/31/2022	Specific Conductance			2455	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2022	
229	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	November	11/30/2022	Specific Conductance			1500	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2022	
230	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	December	12/31/2022	Specific Conductance			2987	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2022	
231	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	January	01/31/2023	Specific Conductance			2945	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2023	
232	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	February	02/28/2023	Specific Conductance			4312	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2023	
233	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	March	03/31/2023	Specific Conductance			3747	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2023	
234	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	April	04/30/2023	Specific Conductance			2618	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2023	
235	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	May	05/31/2023	Specific Conductance			2861	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2023	
236	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	June	06/30/2023	Specific Conductance			2710	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2023	
237	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	July	07/31/2023	Specific Conductance			2845	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2023	
238	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	August	08/31/2023	Specific Conductance			3239	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2023	
239	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	September	09/30/2023	Specific Conductance			3273	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2023	
240	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	October	10/31/2023	Specific Conductance			2736	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2023	
241	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	November	11/30/2023	Specific Conductance			2856	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2023	
242	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	December	12/31/2023	Specific Conductance			2552	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2023	
243	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	January	01/31/2024	Specific Conductance			2215	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2024	
244	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	February	02/29/2024	Specific Conductance			2439	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/29/2024	
245	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	March	03/31/2024	Specific Conductance			2223	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2024	
246	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	April	04/30/2024	Specific Conductance			2856	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2024	
247	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	May	05/31/2024	Specific Conductance			1795	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2024	
248	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	June	06/30/2024	Specific Conductance			2890	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2024	
249	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	July	07/31/2024	Specific Conductance			3318	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2024	
250	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	August	08/31/2024	Specific Conductance			3536	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2024	
251	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	September	09/30/2024	Specific Conductance			2711	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2024	
252	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	October	10/31/2024	Specific Conductance			2673	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2024	
253	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	November	11/30/2024	Specific Conductance			2966	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2024	
254	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	December	12/31/2024	Specific Conductance			2966	umhos/cm	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2024	
255	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	January	01/31/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2018	
256	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	February	02/28/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2018	
257	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	March	03/31/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2018	
258	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	April	04/30/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2018	
259	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	May	05/31/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2018	
260	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	June	06/30/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2018	
261	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	July	07/31/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2018	
262	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	August	08/31/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2018	
263	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	September	09/30/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2018	
264	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	October	10/31/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2018	
265	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	November	11/30/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2018	
266	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	December	12/31/2018	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2018	
267	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	January	01/31/2019	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2019	
268	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	February	02/28/2019	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2019	
269	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	March	03/31/2019	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2019	
270	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	April	04/30/2019	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2019	
271	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	May	05/31/2019	Specific Conductance				mmh/cm	CalMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2019	
272	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012																	

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
276	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	October	10/31/2019	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2019	
277	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	November	11/30/2019	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2019	
278	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	December	12/31/2019	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2019	
279	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	January	01/31/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2020	
280	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	February	02/29/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/29/2020	
281	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	March	03/31/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2020	
282	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	April	04/30/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2020	
283	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	May	05/31/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2020	
284	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	June	06/30/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2020	
285	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	July	07/31/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2020	
286	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	August	08/31/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2020	
287	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	September	09/30/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2020	
288	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	October	10/31/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2020	
289	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	November	11/30/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2020	
290	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	December	12/31/2020	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2020	
291	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	January	01/31/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2021	
292	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	February	02/28/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2021	
293	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	March	03/31/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2021	
294	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	April	04/30/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2021	
295	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	May	05/31/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2021	
296	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	June	06/30/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2021	
297	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	July	07/31/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2021	
298	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	August	08/31/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2021	
299	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	September	09/30/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2021	
300	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	October	10/31/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2021	
301	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	November	11/30/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2021	
302	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	December	12/31/2021	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2021	
303	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	January	01/31/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2022	
304	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	February	02/28/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2022	
305	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	March	03/31/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2022	
306	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	April	04/30/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2022	
307	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	May	05/31/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2022	
308	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	June	06/30/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2022	
309	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	July	07/31/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2022	
310	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	August	08/31/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2022	
311	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	September	09/30/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2022	
312	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	October	10/31/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2022	
313	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	November	11/30/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2022	
314	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	December	12/31/2022	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2022	
315	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	January	01/31/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2023	
316	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	February	02/28/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2023	
317	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	March	03/31/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2023	
318	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	April	04/30/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2023	
319	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	May	05/31/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2023	
320	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	June	06/30/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2023	
321	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	July	07/31/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2023	
322	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	August	08/31/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2023	
323	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	September	09/30/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2023	
324	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	October	10/31/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2023	
325	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	November	11/30/2023	Specific Conductance				mmh/cm	CalMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2023	
326	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon																	

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
331	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	May	05/31/2024	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2024	
332	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	June	06/30/2024	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2024	
333	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	July	07/31/2024	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2024	
334	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	August	08/31/2024	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2024	
335	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	September	09/30/2024	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2024	
336	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	October	10/31/2024	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2024	
337	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	November	11/30/2024	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2024	
338	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	December	12/31/2024	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2024	
339	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	January	01/31/2018	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2018	
340	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	February	02/28/2018	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2018	
341	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	March	03/31/2018	Specific Conductance			779	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2018	
342	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	April	04/30/2018	Specific Conductance			837	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2018	
343	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	May	05/31/2018	Specific Conductance			585	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2018	
344	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	June	06/30/2018	Specific Conductance			716	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2018	
345	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	July	07/31/2018	Specific Conductance			707	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2018	
346	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	August	08/31/2018	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2018	
347	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	September	09/30/2018	Specific Conductance			772	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2018	
348	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	October	10/31/2018	Specific Conductance			684	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2018	
349	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	November	11/30/2018	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2018	
350	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	December	12/31/2018	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2018	
351	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	January	01/31/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2019	
352	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	February	02/28/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2019	
353	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	March	03/31/2019	Specific Conductance			749	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2019	
354	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	April	04/30/2019	Specific Conductance			861	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2019	
355	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	May	05/31/2019	Specific Conductance			749	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2019	
356	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	June	06/30/2019	Specific Conductance			739	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2019	
357	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	July	07/31/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2019	
358	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	August	08/31/2019	Specific Conductance			718	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2019	
359	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	September	09/30/2019	Specific Conductance			722	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2019	
360	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	October	10/31/2019	Specific Conductance			731	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2019	
361	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	November	11/30/2019	Specific Conductance			766	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2019	
362	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	December	12/31/2019	Specific Conductance			795	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2019	
363	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	January	01/31/2020	Specific Conductance			799	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2020	
364	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	February	02/29/2020	Specific Conductance			837	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/29/2020	
365	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	March	03/31/2020	Specific Conductance			913	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2020	
366	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	April	04/30/2020	Specific Conductance			793	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2020	
367	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	May	05/31/2020	Specific Conductance			749	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2020	
368	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	June	06/30/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2020	
369	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	July	07/31/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2020	
370	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	August	08/31/2020	Specific Conductance			787	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2020	
371	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	September	09/30/2020	Specific Conductance			781	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2020	
372	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	October	10/31/2020	Specific Conductance			759	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2020	
373	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	November	11/30/2020	Specific Conductance			771	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2020	
374	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	December	12/31/2020	Specific Conductance			813	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2020	
375	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2021	January	01/31/2021	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2021	
376	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2021	February	02/28/2021	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2021	
377	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2021	March	03/31/2021	Specific Conductance			873	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2021	
378	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2021	April	04/30/2021	Specific Conductance			762	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2021	
379	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2021	May	05/31/2021	Specific Conductance			785	mmh/cm	CaMoAlv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2021	
380	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2021	June	06/30/2021	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2021	
381	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2021	July	07/31/2021	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2021	
382	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2021	August	08/31/2021	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.37		

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Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
386	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2021	December	12/31/2021	Specific Conductance				859	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2021	
387	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	January	01/31/2022	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2022	
388	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	February	02/28/2022	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2022	
389	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	March	03/31/2022	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2022	
390	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	April	04/30/2022	Specific Conductance				678	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2022	
391	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	May	05/31/2022	Specific Conductance				765	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2022	
392	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	June	06/30/2022	Specific Conductance				731	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2022	
393	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	July	07/31/2022	Specific Conductance				722	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2022	
394	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	August	08/31/2022	Specific Conductance					mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2022	
395	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	September	09/30/2022	Specific Conductance				728	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2022	
396	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	October	10/31/2022	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2022	
397	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	November	11/30/2022	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2022	
398	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	December	12/31/2022	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2022	
399	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	January	01/31/2023	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2023	
400	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	February	02/28/2023	Specific Conductance				854	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2023	
401	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	March	03/31/2023	Specific Conductance				954	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2023	
402	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	April	04/30/2023	Specific Conductance				1028	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2023	
403	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	May	05/31/2023	Specific Conductance				745	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2023	
404	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	June	06/30/2023	Specific Conductance				725	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2023	
405	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	July	07/31/2023	Specific Conductance				736	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2023	
406	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	August	08/31/2023	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2023	
407	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	September	09/30/2023	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2023	
408	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	October	10/31/2023	Specific Conductance				808	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2023	
409	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	November	11/30/2023	Specific Conductance				823	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2023	
410	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	December	12/31/2023	Specific Conductance				866	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2023	
411	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	January	01/31/2024	Specific Conductance				890	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2024	
412	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	February	02/29/2024	Specific Conductance				922	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/29/2024	
413	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	March	03/31/2024	Specific Conductance				957	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2024	
414	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	April	04/30/2024	Specific Conductance				882	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2024	
415	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	May	05/31/2024	Specific Conductance				922	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2024	
416	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	June	06/30/2024	Specific Conductance				883	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2024	
417	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	July	07/31/2024	Specific Conductance				828	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2024	
418	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	August	08/31/2024	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2024	
419	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	September	09/30/2024	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2024	
420	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	October	10/31/2024	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2024	
421	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	November	11/30/2024	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2024	
422	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	December	12/31/2024	Specific Conductance				797	mmh/cm	CaI0Ma0Vg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2024	
423																							
424	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	January	01/31/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2018	
425	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	February	02/28/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2018	
426	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	March	03/31/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2018	
427	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	April	04/30/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2018	
428	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	May	05/31/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2018	
429	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	June	06/30/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2018	
430	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	July	07/31/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2018	
431	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	August	08/31/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2018	
432	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	September	09/30/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2018	
433	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	October	10/31/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2018	
434	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	November	11/30/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2018	
435	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	December	12/31/2018	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2018	
436	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	January	01/31/2019	Specific Conductance					mmh/cm	CaI0Ma0Vg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2019	
437	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019																	

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U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
441	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	June	06/30/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2019	
442	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	July	07/31/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2019	
443	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	August	08/31/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2019	
444	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	September	09/30/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2019	
445	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	October	10/31/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2019	
446	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	November	11/30/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2019	
447	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	December	12/31/2019	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2019	
448	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	January	01/31/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2020	
449	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	February	02/29/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/29/2020	
450	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	March	03/31/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2020	
451	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	April	04/30/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2020	
452	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	May	05/31/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2020	
453	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	June	06/30/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2020	
454	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	July	07/31/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2020	
455	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	August	08/31/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2020	
456	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	September	09/30/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2020	
457	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	October	10/31/2020	Specific Conductance				mmh/cm	CaMoAlv	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2020	</

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
496	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	January	01/31/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2024	
497	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	February	02/29/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/29/2024	
498	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	March	03/31/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2024	
499	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	April	04/30/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2024	
500	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	May	05/31/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2024	
501	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	June	06/30/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2024	
502	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	July	07/31/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2024	
503	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	August	08/31/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2024	
504	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	September	09/30/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2024	
505	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	October	10/31/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2024	
506	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	November	11/30/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2024	
507	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	December	12/31/2024	Specific Conductance				mmh/cm	CaMoAlgV	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2024	
508	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2018	January	01/31/2018	Specific Conductance			743	mmh/cm	CaMoAlgV	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	01/31/2018	
509	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2018	February	02/28/2018	Specific Conductance			649	mmh/cm	CaMoAlgV	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	02/28/2018	
510	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2018	March	03/31/2018	Specific Conductance			649	mmh/cm	CaMoAlgV	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	03/31/2018	
511	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2018	April	04/30/2018	Specific Conductance			653	mmh/cm	CaMoAlgV	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	04/30/2018	
512	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2018	May	05/31/2018	Specific Conductance			563	mmh/cm	CaMoAlgV	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	05/31/2018	

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
551	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2021	August	08/31/2021	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	08/31/2021	
552	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2021	September	09/30/2021	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	09/30/2021	
553	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2021	October	10/31/2021	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	10/31/2021	
554	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2021	November	11/30/2021	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	11/30/2021	
555	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2021	December	12/31/2021	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	12/31/2021	
556	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	January	01/31/2022	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	01/31/2022	
557	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	February	02/28/2022	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	02/28/2022	
558	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	March	03/31/2022	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	03/31/2022	
559	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	April	04/30/2022	Specific Conductance			525	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	04/30/2022	
560	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	May	05/31/2022	Specific Conductance			613	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	05/31/2022	
561	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	June	06/30/2022	Specific Conductance			590	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	06/30/2022	
562	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	July	07/31/2022	Specific Conductance			600	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	07/31/2022	
563	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	August	08/31/2022	Specific Conductance			591	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	08/31/2022	
564	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	September	09/30/2022	Specific Conductance			572	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	09/30/2022	
565	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	October	10/31/2022	Specific Conductance			579	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	10/31/2022	
566	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	November	11/30/2022	Specific Conductance			428	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	11/30/2022	
567	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2022	December	12/31/2022	Specific Conductance			466	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	12/31/2022	
568	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	January	01/31/2023	Specific Conductance			729	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	01/31/2023	
569	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	February	02/28/2023	Specific Conductance			803	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	02/28/2023	
570	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	March	03/31/2023	Specific Conductance			724	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	03/31/2023	
571	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	April	04/30/2023	Specific Conductance			716	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	04/30/2023	
572	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	May	05/31/2023	Specific Conductance			628	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	05/31/2023	
573	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	June	06/30/2023	Specific Conductance			683	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	06/30/2023	
574	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	July	07/31/2023	Specific Conductance			673	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	07/31/2023	
575	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	August	08/31/2023	Specific Conductance			667	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	08/31/2023	
576	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	September	09/30/2023	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	09/30/2023	
577	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	October	10/31/2023	Specific Conductance			971	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	10/31/2023	
578	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	November	11/30/2023	Specific Conductance			838	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	11/30/2023	
579	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2023	December	12/31/2023	Specific Conductance			838	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	12/31/2023	
580	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	January	01/31/2024	Specific Conductance			671	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	01/31/2024	
581	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	February	02/29/2024	Specific Conductance			705	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	02/29/2024	
582	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	March	03/31/2024	Specific Conductance			724	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	03/31/2024	
583	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	April	04/30/2024	Specific Conductance			706	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	04/30/2024	
584	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	May	05/31/2024	Specific Conductance			715	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	05/31/2024	
585	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	June	06/30/2024	Specific Conductance			783	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	06/30/2024	
586	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	July	07/31/2024	Specific Conductance			680	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	07/31/2024	
587	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	August	08/31/2024	Specific Conductance			649	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	08/31/2024	
588	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	September	09/30/2024	Specific Conductance			721	mmh/cm	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	09/30/2024	
589	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	October	10/31/2024	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	10/31/2024	
590	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	November	11/30/2024	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	11/30/2024	
591	US Steel Corp - Tailings	MN0055948	IND20110001	SW 001	Reservoir 2	2024	December	12/31/2024	Specific Conductance				mmh/cm	CaIMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1050029	47.3457354	12/31/2024	
592	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	January	01/31/2018	Sulfate, Total (as SO4)			118	mg/L	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2018	
593	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	January	01/31/2018	Sulfate, Total (as SO4)			124	mg/L	CaIMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2018	
594	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	February	02/28/2018	Sulfate, Total (as SO4)			126	mg/L	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/28/2018	
595	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	February	02/28/2018	Sulfate, Total (as SO4)			128	mg/L	CaIMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/28/2018	
596	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	March	03/31/2018	Sulfate, Total (as SO4)			119	mg/L	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2018	
597	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	March	03/31/2018	Sulfate, Total (as SO4)			124	mg/L	CaIMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2018	
598	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	April	04/30/2018	Sulfate, Total (as SO4)			99.4	mg/L	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2018	
599	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	April	04/30/2018	Sulfate, Total (as SO4)			117	mg/L	CaIMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2018	
600	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	May	05/31/2018	Sulfate, Total (as SO4)			124	mg/L	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2018	
601	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	May	05/31/2018	Sulfate, Total (as SO4)			128	mg/L	CaIMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2018	
602	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	June	06/30/2018	Sulfate, Total (as SO4)			127	mg/L	CaIMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2018	
603	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018																

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
606	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	August	08/31/2018	Sulfate, Total (as SO4)			120	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2018	
607	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	August	08/31/2018	Sulfate, Total (as SO4)			128	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2018	
608	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	September	09/30/2018	Sulfate, Total (as SO4)			123	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2018	
609	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	September	09/30/2018	Sulfate, Total (as SO4)			124	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2018	
610	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	October	10/31/2018	Sulfate, Total (as SO4)			117	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2018	
611	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	October	10/31/2018	Sulfate, Total (as SO4)			125	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2018	
612	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	November	11/30/2018	Sulfate, Total (as SO4)			124	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2018	
613	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	November	11/30/2018	Sulfate, Total (as SO4)			125	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2018	
614	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	December	12/31/2018	Sulfate, Total (as SO4)			120	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2018	
615	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2018	December	12/31/2018	Sulfate, Total (as SO4)			125	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2018	
616	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	January	01/31/2019	Sulfate, Total (as SO4)			132	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2019	
617	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	January	01/31/2019	Sulfate, Total (as SO4)			137	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2019	
618	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	February	02/28/2019	Sulfate, Total (as SO4)			129	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/28/2019	
619	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	February	02/28/2019	Sulfate, Total (as SO4)			132	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/28/2019	
620	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	March	03/31/2019	Sulfate, Total (as SO4)			114	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2019	
621	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	March	03/31/2019	Sulfate, Total (as SO4)			130	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2019	
622	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	April	04/30/2019	Sulfate, Total (as SO4)			123	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2019	
623	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	April	04/30/2019	Sulfate, Total (as SO4)			134	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2019	
624	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	May	05/31/2019	Sulfate, Total (as SO4)			133	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2019	
625	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	May	05/31/2019	Sulfate, Total (as SO4)			136	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2019	
626	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	June	06/30/2019	Sulfate, Total (as SO4)			135	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2019	
627	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	June	06/30/2019	Sulfate, Total (as SO4)			137	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2019	
628	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	July	07/31/2019	Sulfate, Total (as SO4)			132	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2019	
629	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	July	07/31/2019	Sulfate, Total (as SO4)			134	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2019	
630	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	August	08/31/2019	Sulfate, Total (as SO4)			124	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2019	
631	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	August	08/31/2019	Sulfate, Total (as SO4)			125	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2019	
632	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	September	09/30/2019	Sulfate, Total (as SO4)			114	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2019	
633	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	September	09/30/2019	Sulfate, Total (as SO4)			117	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2019	
634	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	October	10/31/2019	Sulfate, Total (as SO4)			115	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2019	
635	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	October	10/31/2019	Sulfate, Total (as SO4)			117	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2019	
636	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	November	11/30/2019	Sulfate, Total (as SO4)			130	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2019	
637	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	November	11/30/2019	Sulfate, Total (as SO4)			132	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2019	
638	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	December	12/31/2019	Sulfate, Total (as SO4)			126	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2019	
639	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2019	December	12/31/2019	Sulfate, Total (as SO4)			129	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2019	
640	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	January	01/31/2020	Sulfate, Total (as SO4)			131	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2020	
641	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	January	01/31/2020	Sulfate, Total (as SO4)			132	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2020	
642	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	February	02/29/2020	Sulfate, Total (as SO4)			136	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/29/2020	
643	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	February	02/29/2020	Sulfate, Total (as SO4)			136	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/29/2020	
644	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	March	03/31/2020	Sulfate, Total (as SO4)			133	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2020	
645	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	March	03/31/2020	Sulfate, Total (as SO4)			140	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2020	
646	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	April	04/30/2020	Sulfate, Total (as SO4)			126	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2020	
647	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	April	04/30/2020	Sulfate, Total (as SO4)			135	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2020	
648	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	May	05/31/2020	Sulfate, Total (as SO4)			148	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2020	
649	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	May	05/31/2020	Sulfate, Total (as SO4)			150	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2020	
650	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	June	06/30/2020	Sulfate, Total (as SO4)			136	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2020	
651	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	June	06/30/2020	Sulfate, Total (as SO4)			140	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2020	
652	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	July	07/31/2020	Sulfate, Total (as SO4)			142	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2020	
653	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	July	07/31/2020	Sulfate, Total (as SO4)			146	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2020	
654	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	August	08/31/2020	Sulfate, Total (as SO4)			132	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2020	
655	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	August	08/31/2020	Sulfate, Total (as SO4)			136	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2020	
656	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050	2020	September	09/30/2020	Sulfate, Total (as SO4)			144	mg/L	CalMoAvG	N	Mississippi River - Grand Rapids (07010103)	7010103					

Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2020	November	11/30/2020	Sulfate, Total (as SO4)		141	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2020	
661	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2020	December	12/31/2020	Sulfate, Total (as SO4)		132	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2020	
662	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2020	December	12/31/2020	Sulfate, Total (as SO4)		135	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2020	
663	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	January	01/31/2021	Sulfate, Total (as SO4)		141	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2021	
664	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	January	01/31/2021	Sulfate, Total (as SO4)		145	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2021	
665	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	February	02/28/2021	Sulfate, Total (as SO4)		141	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/28/2021	
666	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	February	02/28/2021	Sulfate, Total (as SO4)		146	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/28/2021	
667	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	March	03/31/2021	Sulfate, Total (as SO4)		135	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2021	
668	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	March	03/31/2021	Sulfate, Total (as SO4)		139	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2021	
669	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	April	04/30/2021	Sulfate, Total (as SO4)		134	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2021	
670	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	April	04/30/2021	Sulfate, Total (as SO4)		134	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2021	
671	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	May	05/31/2021	Sulfate, Total (as SO4)		147	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2021	
672	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	May	05/31/2021	Sulfate, Total (as SO4)		147	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2021	
673	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	June	06/30/2021	Sulfate, Total (as SO4)		146	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2021	
674	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	June	06/30/2021	Sulfate, Total (as SO4)		148	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2021	
675	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	July	07/31/2021	Sulfate, Total (as SO4)		151	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2021	
676	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	July	07/31/2021	Sulfate, Total (as SO4)		157	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2021	
677	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	August	08/31/2021	Sulfate, Total (as SO4)		144	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2021	
678	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	August	08/31/2021	Sulfate, Total (as SO4)		144	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2021	
679	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	September	09/30/2021	Sulfate, Total (as SO4)		135	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2021	
680	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	September	09/30/2021	Sulfate, Total (as SO4)		142	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2021	
681	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	October	10/31/2021	Sulfate, Total (as SO4)		135	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2021	
682	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	October	10/31/2021	Sulfate, Total (as SO4)		140	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2021	
683	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	November	11/30/2021	Sulfate, Total (as SO4)		143	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2021	
684	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	November	11/30/2021	Sulfate, Total (as SO4)		148	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2021	
685	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	December	12/31/2021	Sulfate, Total (as SO4)		146	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2021	
686	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2021	December	12/31/2021	Sulfate, Total (as SO4)		146	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2021	
687	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	January	01/31/2022	Sulfate, Total (as SO4)		145	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2022	
688	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	January	01/31/2022	Sulfate, Total (as SO4)		146	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2022	
689	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	February	02/28/2022	Sulfate, Total (as SO4)		146	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/28/2022	
690	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	February	02/28/2022	Sulfate, Total (as SO4)		146	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/28/2022	
691	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	March	03/31/2022	Sulfate, Total (as SO4)		141	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2022	
692	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	March	03/31/2022	Sulfate, Total (as SO4)		145	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2022	
693	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	April	04/30/2022	Sulfate, Total (as SO4)		152	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2022	
694	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	April	04/30/2022	Sulfate, Total (as SO4)		158	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2022	
695	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	May	05/31/2022	Sulfate, Total (as SO4)		155	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2022	
696	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	May	05/31/2022	Sulfate, Total (as SO4)		167	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2022	
697	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	June	06/30/2022	Sulfate, Total (as SO4)		154	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2022	
698	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	June	06/30/2022	Sulfate, Total (as SO4)		155	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2022	
699	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	July	07/31/2022	Sulfate, Total (as SO4)		151	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2022	
700	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	July	07/31/2022	Sulfate, Total (as SO4)		151	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2022	
701	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	August	08/31/2022	Sulfate, Total (as SO4)		153	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2022	
702	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	August	08/31/2022	Sulfate, Total (as SO4)		153	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2022	
703	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	September	09/30/2022	Sulfate, Total (as SO4)		149	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2022	
704	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	September	09/30/2022	Sulfate, Total (as SO4)		149	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2022	
705	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	October	10/31/2022	Sulfate, Total (as SO4)		147	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2022	
706	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	October	10/31/2022	Sulfate, Total (as SO4)		150	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2022	
707	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	November	11/30/2022	Sulfate, Total (as SO4)		132	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2022	
708	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	November	11/30/2022	Sulfate, Total (as SO4)		139	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2022	
709	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	December	12/31/2022	Sulfate, Total (as SO4)		129	mg/L	CalMoAvc	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2022	
710	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2022	December	12/31/2022	Sulfate, Total (as SO4)		136	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek				

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
716	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	March	03/31/2023	Sulfate, Total (as SO4)		132	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2023	
717	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	March	03/31/2023	Sulfate, Total (as SO4)		138	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2023	
718	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	April	04/30/2023	Sulfate, Total (as SO4)		149	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2023	
719	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	April	04/30/2023	Sulfate, Total (as SO4)		165	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2023	
720	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	May	05/31/2023	Sulfate, Total (as SO4)		151	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2023	
721	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	May	05/31/2023	Sulfate, Total (as SO4)		156	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2023	
722	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	June	06/30/2023	Sulfate, Total (as SO4)		139	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2023	
723	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	June	06/30/2023	Sulfate, Total (as SO4)		148	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2023	
724	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	July	07/31/2023	Sulfate, Total (as SO4)		142	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2023	
725	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	July	07/31/2023	Sulfate, Total (as SO4)		144	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2023	
726	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	August	08/31/2023	Sulfate, Total (as SO4)		147	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2023	
727	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	August	08/31/2023	Sulfate, Total (as SO4)		157	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2023	
728	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	September	09/30/2023	Sulfate, Total (as SO4)		126	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2023	
729	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	September	09/30/2023	Sulfate, Total (as SO4)		130	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2023	
730	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	October	10/31/2023	Sulfate, Total (as SO4)		133	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2023	
731	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	October	10/31/2023	Sulfate, Total (as SO4)		134	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2023	
732	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	November	11/30/2023	Sulfate, Total (as SO4)		151	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2023	
733	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	November	11/30/2023	Sulfate, Total (as SO4)		159	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2023	
734	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	December	12/31/2023	Sulfate, Total (as SO4)		139	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2023	
735	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2023	December	12/31/2023	Sulfate, Total (as SO4)		140	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2023	
736	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	January	01/31/2024	Sulfate, Total (as SO4)		156	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2024	
737	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	January	01/31/2024	Sulfate, Total (as SO4)		160	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	01/31/2024	
738	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	February	02/29/2024	Sulfate, Total (as SO4)		149	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/29/2024	
739	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	February	02/29/2024	Sulfate, Total (as SO4)		149	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	02/29/2024	
740	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	March	03/31/2024	Sulfate, Total (as SO4)		142	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2024	
741	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	March	03/31/2024	Sulfate, Total (as SO4)		144	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	03/31/2024	
742	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	April	04/30/2024	Sulfate, Total (as SO4)		149	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2024	
743	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	April	04/30/2024	Sulfate, Total (as SO4)		151	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	04/30/2024	
744	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	May	05/31/2024	Sulfate, Total (as SO4)		160	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2024	
745	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	May	05/31/2024	Sulfate, Total (as SO4)		161	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	05/31/2024	
746	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	June	06/30/2024	Sulfate, Total (as SO4)		180	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2024	
747	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	June	06/30/2024	Sulfate, Total (as SO4)		182	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	06/30/2024	
748	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	July	07/31/2024	Sulfate, Total (as SO4)		191	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2024	
749	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	July	07/31/2024	Sulfate, Total (as SO4)		202	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	07/31/2024	
750	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	August	08/31/2024	Sulfate, Total (as SO4)		168	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2024	
751	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	August	08/31/2024	Sulfate, Total (as SO4)		174	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	08/31/2024	
752	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	September	09/30/2024	Sulfate, Total (as SO4)		168	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2024	
753	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	September	09/30/2024	Sulfate, Total (as SO4)		171	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	09/30/2024	
754	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	October	10/31/2024	Sulfate, Total (as SO4)		167	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2024	
755	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	October	10/31/2024	Sulfate, Total (as SO4)		169	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	10/31/2024	
756	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	November	11/30/2024	Sulfate, Total (as SO4)		166	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2024	
757	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	November	11/30/2024	Sulfate, Total (as SO4)		166	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	11/30/2024	
758	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	December	12/31/2024	Sulfate, Total (as SO4)		169	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2024	
759	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 002	Weir Outfall 050		2024	December	12/31/2024	Sulfate, Total (as SO4)		172	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0669907	47.3989872	12/31/2024	
760												141										
761	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2018	January	01/31/2018	Sulfate, Total (as SO4)		49.7	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2018	
762	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2018	January	01/31/2018	Sulfate, Total (as SO4)		49.7	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2018	
763	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2018	February	02/28/2018	Sulfate, Total (as SO4)		51.2	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2018	
764	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2018	February	02/28/2018	Sulfate, Total (as SO4)		54.6	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2018	
765	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2018	March	03/31/2018	Sulfate, Total (as SO4)		50.2	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2018	
766	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2018	March	03/31/2018	Sulfate, Total (as SO4)		52.2	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2018	
767	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	</																

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
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Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
771	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	June	06/30/2018	Sulfate, Total (as SO4)			57	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2018	
772	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	June	06/30/2018	Sulfate, Total (as SO4)			59.1	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2018	
773	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	July	07/31/2018	Sulfate, Total (as SO4)			56.6	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2018	
774	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	July	07/31/2018	Sulfate, Total (as SO4)			59.5	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2018	
775	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	August	08/31/2018	Sulfate, Total (as SO4)			55.3	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2018	
776	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	August	08/31/2018	Sulfate, Total (as SO4)			55.5	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2018	
777	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	September	09/30/2018	Sulfate, Total (as SO4)			55.7	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2018	
778	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	September	09/30/2018	Sulfate, Total (as SO4)			56.7	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2018	
779	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	October	10/31/2018	Sulfate, Total (as SO4)			61.1	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2018	
780	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	October	10/31/2018	Sulfate, Total (as SO4)			61.6	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2018	
781	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	November	11/30/2018	Sulfate, Total (as SO4)			62.3	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2018	
782	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	November	11/30/2018	Sulfate, Total (as SO4)			62.3	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2018	
783	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	December	12/31/2018	Sulfate, Total (as SO4)			53.8	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2018	
784	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2018	December	12/31/2018	Sulfate, Total (as SO4)			55.5	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2018	
785	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	January	01/31/2019	Sulfate, Total (as SO4)			51.7	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2019	
786	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	January	01/31/2019	Sulfate, Total (as SO4)			52	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2019	
787	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	February	02/28/2019	Sulfate, Total (as SO4)			51.4	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2019	
788	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	February	02/28/2019	Sulfate, Total (as SO4)			53.5	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2019	
789	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	March	03/31/2019	Sulfate, Total (as SO4)			52.7	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2019	
790	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	March	03/31/2019	Sulfate, Total (as SO4)			55.9	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2019	
791	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	April	04/30/2019	Sulfate, Total (as SO4)			63.2	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2019	
792	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	April	04/30/2019	Sulfate, Total (as SO4)			70.3	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2019	
793	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	May	05/31/2019	Sulfate, Total (as SO4)			71.3	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2019	
794	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	May	05/31/2019	Sulfate, Total (as SO4)			77.3	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2019	
795	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	June	06/30/2019	Sulfate, Total (as SO4)			59.3	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2019	
796	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	June	06/30/2019	Sulfate, Total (as SO4)			59.3	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2019	
797	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	July	07/31/2019	Sulfate, Total (as SO4)			55	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2019	
798	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	July	07/31/2019	Sulfate, Total (as SO4)			55	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2019	
799	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	August	08/31/2019	Sulfate, Total (as SO4)			59.3	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2019	
800	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	August	08/31/2019	Sulfate, Total (as SO4)			63.5	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2019	
801	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	September	09/30/2019	Sulfate, Total (as SO4)			62.2	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2019	
802	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	September	09/30/2019	Sulfate, Total (as SO4)			64.6	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2019	
803	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	October	10/31/2019	Sulfate, Total (as SO4)			68.9	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2019	
804	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	October	10/31/2019	Sulfate, Total (as SO4)			73.1	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2019	
805	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	November	11/30/2019	Sulfate, Total (as SO4)			62.9	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2019	
806	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	November	11/30/2019	Sulfate, Total (as SO4)			67.9	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2019	
807	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	December	12/31/2019	Sulfate, Total (as SO4)			51.2	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2019	
808	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2019	December	12/31/2019	Sulfate, Total (as SO4)			53.3	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2019	
809	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	January	01/31/2020	Sulfate, Total (as SO4)			56.4	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2020	
810	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	January	01/31/2020	Sulfate, Total (as SO4)			58.8	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2020	
811	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	February	02/29/2020	Sulfate, Total (as SO4)			56.1	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/29/2020	
812	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	February	02/29/2020	Sulfate, Total (as SO4)			56.3	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/29/2020	
813	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	March	03/31/2020	Sulfate, Total (as SO4)			56.8	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2020	
814	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	March	03/31/2020	Sulfate, Total (as SO4)			57.6	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2020	
815	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	April	04/30/2020	Sulfate, Total (as SO4)			61.4	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2020	
816	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	April	04/30/2020	Sulfate, Total (as SO4)			64.9	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2020	
817	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	May	05/31/2020	Sulfate, Total (as SO4)			59.2	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2020	
818	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	May	05/31/2020	Sulfate, Total (as SO4)			59.6	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2020	
819	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	June	06/30/2020	Sulfate, Total (as SO4)			62.7	mg/L	CaIcMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2020	
820	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2020	June	06/30/2020	Sulfate, Total (as SO4)			69.4	mg/L	CaIcYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2020	
821	United States Steel Corp - Keetac	MN0031879	IND20120																			

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
826	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2020	September	09/30/2020	Sulfate, Total (as SO4)		62.8	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2020	
827	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2020	October	10/31/2020	Sulfate, Total (as SO4)		63.9	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2020	
828	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2020	October	10/31/2020	Sulfate, Total (as SO4)		66.1	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2020	
829	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2020	November	11/30/2020	Sulfate, Total (as SO4)		62.6	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2020	
830	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2020	November	11/30/2020	Sulfate, Total (as SO4)		63.1	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2020	
831	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2020	December	12/31/2020	Sulfate, Total (as SO4)		59.2	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2020	
832	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2020	December	12/31/2020	Sulfate, Total (as SO4)		59.4	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2020	
833	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	January	01/31/2021	Sulfate, Total (as SO4)		60.8	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2021	
834	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	January	01/31/2021	Sulfate, Total (as SO4)		61.6	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2021	
835	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	February	02/28/2021	Sulfate, Total (as SO4)		60.9	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2021	
836	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	February	02/28/2021	Sulfate, Total (as SO4)		61.4	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2021	
837	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	March	03/31/2021	Sulfate, Total (as SO4)		62.6	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2021	
838	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	March	03/31/2021	Sulfate, Total (as SO4)		64.7	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2021	
839	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	April	04/30/2021	Sulfate, Total (as SO4)		69.8	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2021	
840	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	April	04/30/2021	Sulfate, Total (as SO4)		74.3	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2021	
841	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	May	05/31/2021	Sulfate, Total (as SO4)		66.1	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2021	
842	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	May	05/31/2021	Sulfate, Total (as SO4)		70	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2021	
843	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	June	06/30/2021	Sulfate, Total (as SO4)		66.4	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2021	
844	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	June	06/30/2021	Sulfate, Total (as SO4)		70	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2021	
845	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	July	07/31/2021	Sulfate, Total (as SO4)		68.2	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2021	
846	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	July	07/31/2021	Sulfate, Total (as SO4)		70.7	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2021	
847	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	August	08/31/2021	Sulfate, Total (as SO4)		65.3	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2021	
848	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	August	08/31/2021	Sulfate, Total (as SO4)		67	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2021	
849	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	September	09/30/2021	Sulfate, Total (as SO4)		74.2	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2021	
850	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	September	09/30/2021	Sulfate, Total (as SO4)		84.3	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2021	
851	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	October	10/31/2021	Sulfate, Total (as SO4)		69.5	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2021	
852	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	October	10/31/2021	Sulfate, Total (as SO4)		72.3	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2021	
853	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	November	11/30/2021	Sulfate, Total (as SO4)		69.4	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2021	
854	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	November	11/30/2021	Sulfate, Total (as SO4)		73.3	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2021	
855	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	December	12/31/2021	Sulfate, Total (as SO4)		65.5	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2021	
856	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2021	December	12/31/2021	Sulfate, Total (as SO4)		68.8	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2021	
857	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	January	01/31/2022	Sulfate, Total (as SO4)		65.3	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2022	
858	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	January	01/31/2022	Sulfate, Total (as SO4)		66	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2022	
859	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	February	02/28/2022	Sulfate, Total (as SO4)		63.8	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2022	
860	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	February	02/28/2022	Sulfate, Total (as SO4)		64	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2022	
861	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	March	03/31/2022	Sulfate, Total (as SO4)		66.6	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2022	
862	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	March	03/31/2022	Sulfate, Total (as SO4)		68	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2022	
863	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	April	04/30/2022	Sulfate, Total (as SO4)		73.7	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2022	
864	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	April	04/30/2022	Sulfate, Total (as SO4)		76.5	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2022	
865	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	May	05/31/2022	Sulfate, Total (as SO4)		61.3	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2022	
866	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	May	05/31/2022	Sulfate, Total (as SO4)		72.6	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2022	
867	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	June	06/30/2022	Sulfate, Total (as SO4)		71.8	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2022	
868	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	June	06/30/2022	Sulfate, Total (as SO4)		72.2	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2022	
869	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	July	07/31/2022	Sulfate, Total (as SO4)		71.7	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2022	
870	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	July	07/31/2022	Sulfate, Total (as SO4)		72.2	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2022	
871	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	August	08/31/2022	Sulfate, Total (as SO4)		73.6	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2022	
872	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	August	08/31/2022	Sulfate, Total (as SO4)		76	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2022	
873	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	September	09/30/2022	Sulfate, Total (as SO4)		66.2	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2022	
874	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	September	09/30/2022	Sulfate, Total (as SO4)		66.5	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2022	
875	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	October	10/31/2022	Sulfate, Total (as SO4)		61.1	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2022	
876	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080		2022	October	10/31/2022	Sulfate, Total (as SO4)		61.8	mg/L	CaYrMax								

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
881	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	January	01/31/2023	Sulfate, Total (as SO4)			62.1	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2023	
882	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	January	01/31/2023	Sulfate, Total (as SO4)			65	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2023	
883	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	February	02/28/2023	Sulfate, Total (as SO4)			60.6	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2023	
884	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	February	02/28/2023	Sulfate, Total (as SO4)			61.1	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/28/2023	
885	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	March	03/31/2023	Sulfate, Total (as SO4)			64.2	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2023	
886	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	March	03/31/2023	Sulfate, Total (as SO4)			67.1	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2023	
887	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	April	04/30/2023	Sulfate, Total (as SO4)			66.1	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2023	
888	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	April	04/30/2023	Sulfate, Total (as SO4)			73.4	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2023	
889	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	May	05/31/2023	Sulfate, Total (as SO4)			69.2	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2023	
890	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	May	05/31/2023	Sulfate, Total (as SO4)			69.8	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2023	
891	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	June	06/30/2023	Sulfate, Total (as SO4)			67.1	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2023	
892	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	June	06/30/2023	Sulfate, Total (as SO4)			68.3	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2023	
893	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	July	07/31/2023	Sulfate, Total (as SO4)			66.3	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2023	
894	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	July	07/31/2023	Sulfate, Total (as SO4)			68.8	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2023	
895	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	August	08/31/2023	Sulfate, Total (as SO4)			63.5	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2023	
896	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	August	08/31/2023	Sulfate, Total (as SO4)			63.5	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2023	
897	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	September	09/30/2023	Sulfate, Total (as SO4)			62.4	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2023	
898	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	September	09/30/2023	Sulfate, Total (as SO4)			64.9	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2023	
899	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	October	10/31/2023	Sulfate, Total (as SO4)			67.6	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2023	
900	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	October	10/31/2023	Sulfate, Total (as SO4)			72.5	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2023	
901	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	November	11/30/2023	Sulfate, Total (as SO4)			70.5	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2023	
902	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	November	11/30/2023	Sulfate, Total (as SO4)			72.9	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2023	
903	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	December	12/31/2023	Sulfate, Total (as SO4)			56.7	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2023	
904	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2023	December	12/31/2023	Sulfate, Total (as SO4)			60	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2023	
905	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	January	01/31/2024	Sulfate, Total (as SO4)			66.8	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2024	
906	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	January	01/31/2024	Sulfate, Total (as SO4)			70.1	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	01/31/2024	
907	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	February	02/29/2024	Sulfate, Total (as SO4)			64	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/29/2024	
908	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	February	02/29/2024	Sulfate, Total (as SO4)			66.5	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	02/29/2024	
909	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	March	03/31/2024	Sulfate, Total (as SO4)			59.5	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2024	
910	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	March	03/31/2024	Sulfate, Total (as SO4)			60.6	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	03/31/2024	
911	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	April	04/30/2024	Sulfate, Total (as SO4)			65.6	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2024	
912	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	April	04/30/2024	Sulfate, Total (as SO4)			65.6	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	04/30/2024	
913	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	May	05/31/2024	Sulfate, Total (as SO4)			71.3	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2024	
914	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	May	05/31/2024	Sulfate, Total (as SO4)			71.9	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	05/31/2024	
915	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	June	06/30/2024	Sulfate, Total (as SO4)			80.5	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2024	
916	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	June	06/30/2024	Sulfate, Total (as SO4)			80.8	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	06/30/2024	
917	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	July	07/31/2024	Sulfate, Total (as SO4)			73.7	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2024	
918	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	July	07/31/2024	Sulfate, Total (as SO4)			75.9	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	07/31/2024	
919	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	August	08/31/2024	Sulfate, Total (as SO4)			80	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2024	
920	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	August	08/31/2024	Sulfate, Total (as SO4)			81	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	08/31/2024	
921	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	September	09/30/2024	Sulfate, Total (as SO4)			74.7	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2024	
922	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	September	09/30/2024	Sulfate, Total (as SO4)			75.8	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	09/30/2024	
923	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	October	10/31/2024	Sulfate, Total (as SO4)			62	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2024	
924	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	October	10/31/2024	Sulfate, Total (as SO4)			63.3	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	10/31/2024	
925	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	November	11/30/2024	Sulfate, Total (as SO4)			63.1	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2024	
926	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	November	11/30/2024	Sulfate, Total (as SO4)			63.1	mg/L	CaYrMax	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	11/30/2024	
927	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	December	12/31/2024	Sulfate, Total (as SO4)				mg/L	CaMoAvg	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2024	
928	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 003	Pipe Outfall 080	2024	December	12/31/2024	Sulfate, Total (as SO4)				mg/L	CaYrMax	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1179698	47.3960788	12/31/2024	
929	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	January	01/31/2018	Sulfate, Total (as SO4)			27.9	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2018	
930	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	January	01/31/2018	Sulfate, Total (as SO4)			28.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2018	
931	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	February	02/28/2018	Sulfate, Total (as SO4)			27.4	mg/L	CaMoAvg	N	Mississippi River - Grand Rapids (070						

Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	April	04/30/2018	Sulfate, Total (as SO4)	26.6	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	04/30/2018			
936	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	April	05/31/2018	Sulfate, Total (as SO4)	26.2	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	05/31/2018			
938	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	May	05/31/2018	Sulfate, Total (as SO4)	26.3	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	05/31/2018			
939	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	June	06/30/2018	Sulfate, Total (as SO4)	25.7	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	06/30/2018			
940	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	June	06/30/2018	Sulfate, Total (as SO4)	25.7	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	06/30/2018			
941	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	July	07/31/2018	Sulfate, Total (as SO4)	24.2	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	07/31/2018			
942	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	July	07/31/2018	Sulfate, Total (as SO4)	24.5	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	07/31/2018			
943	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	August	08/31/2018	Sulfate, Total (as SO4)	23	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	08/31/2018			
944	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	August	08/31/2018	Sulfate, Total (as SO4)	24.8	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	08/31/2018			
945	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	September	09/30/2018	Sulfate, Total (as SO4)	21.6	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	09/30/2018			
946	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	September	09/30/2018	Sulfate, Total (as SO4)	21.7	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	09/30/2018			
947	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	October	10/31/2018	Sulfate, Total (as SO4)	22.7	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	10/31/2018			
948	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	October	10/31/2018	Sulfate, Total (as SO4)	23	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	10/31/2018			
949	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	November	11/30/2018	Sulfate, Total (as SO4)	22.1	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	11/30/2018			
950	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	November	11/30/2018	Sulfate, Total (as SO4)	22.8	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	11/30/2018			
951	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	December	12/31/2018	Sulfate, Total (as SO4)	21.2	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	12/31/2018			
952	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2018	December	12/31/2018	Sulfate, Total (as SO4)	21.4	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	12/31/2018			
953	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	January	01/31/2019	Sulfate, Total (as SO4)	24.9	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	01/31/2019			
954	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	January	01/31/2019	Sulfate, Total (as SO4)	25.2	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	01/31/2019			
955	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	February	02/28/2019	Sulfate, Total (as SO4)	25.1	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	02/28/2019			
956	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	February	02/28/2019	Sulfate, Total (as SO4)	25.3	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	02/28/2019			
957	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	March	03/31/2019	Sulfate, Total (as SO4)	25.8	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	03/31/2019			
958	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	March	03/31/2019	Sulfate, Total (as SO4)	26.2	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	03/31/2019			
959	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	April	04/30/2019	Sulfate, Total (as SO4)	25.9	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	04/30/2019			
960	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	April	04/30/2019	Sulfate, Total (as SO4)	26.5	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	04/30/2019			
961	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	May	05/31/2019	Sulfate, Total (as SO4)	23.8	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	05/31/2019			
962	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	May	05/31/2019	Sulfate, Total (as SO4)	24.1	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	05/31/2019			
963	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	June	06/30/2019	Sulfate, Total (as SO4)	24.1	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	06/30/2019			
964	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	June	06/30/2019	Sulfate, Total (as SO4)	24.2	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	06/30/2019			
965	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	July	07/31/2019	Sulfate, Total (as SO4)	22.3	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	07/31/2019			
966	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	July	07/31/2019	Sulfate, Total (as SO4)	22.6	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	07/31/2019			
967	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	August	08/31/2019	Sulfate, Total (as SO4)	22.5	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	08/31/2019			
968	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	August	08/31/2019	Sulfate, Total (as SO4)	22.8	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	08/31/2019			
969	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	September	09/30/2019	Sulfate, Total (as SO4)	20.1	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	09/30/2019			
970	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	September	09/30/2019	Sulfate, Total (as SO4)	20.8	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	09/30/2019			
971	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	October	10/31/2019	Sulfate, Total (as SO4)	19.7	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	10/31/2019			
972	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	October	10/31/2019	Sulfate, Total (as SO4)	20.1	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	10/31/2019			
973	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	November	11/30/2019	Sulfate, Total (as SO4)	20.9	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	11/30/2019			
974	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	November	11/30/2019	Sulfate, Total (as SO4)	21.5	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	11/30/2019			
975	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	December	12/31/2019	Sulfate, Total (as SO4)	20.8	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	12/31/2019			
976	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2019	December	12/31/2019	Sulfate, Total (as SO4)	20.9	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	12/31/2019			
977	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	January	01/31/2020	Sulfate, Total (as SO4)	24.7	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	01/31/2020			
978	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	January	01/31/2020	Sulfate, Total (as SO4)	25.2	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	01/31/2020			
979	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	February	02/29/2020	Sulfate, Total (as SO4)	25.4	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	02/29/2020			
980	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	February	02/29/2020	Sulfate, Total (as SO4)	25.5	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	02/29/2020			
981	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	March	03/31/2020	Sulfate, Total (as SO4)	25.4	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	03/31/2020			
982	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	March	03/31/2020	Sulfate, Total (as SO4)	25.8	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	03/31/2020			
983	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	April	04/30/2020	Sulfate, Total (as SO4)	27.8	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	04/30/2020			
984	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	April	04/30/2020	Sulfate, Total (as SO4)	28.1	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	04/30/2020			
985	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	May	05/31/2020	Sulfate, Total (as SO4)	24.6	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	05/31/2020			
986	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	May	05/31/2020	Sulfate, Total (as SO4)	24.7	mg/L	CalMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	05/31/2020			
987	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	June	06/30/2020	Sulfate, Total (as SO4)	24.7	mg/L	CalMoAv	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.980353	06/30/2020			
988	United States Steel Corp - Keetac	MN0031879	IND20120003																			

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
991	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	August	08/31/2020	Sulfate, Total (as SO4)			23.9	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2020	
992	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	August	08/31/2020	Sulfate, Total (as SO4)			23.9	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2020	
993	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	September	09/30/2020	Sulfate, Total (as SO4)			21.3	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2020	
994	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	September	09/30/2020	Sulfate, Total (as SO4)			21.5	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2020	
995	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	October	10/31/2020	Sulfate, Total (as SO4)			21.9	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	10/31/2020	
996	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	October	10/31/2020	Sulfate, Total (as SO4)			22.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	10/31/2020	
997	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	November	11/30/2020	Sulfate, Total (as SO4)			21.5	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	11/30/2020	
998	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	November	11/30/2020	Sulfate, Total (as SO4)			21.6	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	11/30/2020	
999	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	December	12/31/2020	Sulfate, Total (as SO4)			22.6	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2020	
1000	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2020	December	12/31/2020	Sulfate, Total (as SO4)			24	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2020	
1001	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	January	01/31/2021	Sulfate, Total (as SO4)			26.2	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2021	
1002	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	January	01/31/2021	Sulfate, Total (as SO4)			26.5	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2021	
1003	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	February	02/28/2021	Sulfate, Total (as SO4)			26.1	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	02/28/2021	
1004	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	February	02/28/2021	Sulfate, Total (as SO4)			26.3	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	02/28/2021	
1005	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	March	03/31/2021	Sulfate, Total (as SO4)			26	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2021	
1006	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	March	03/31/2021	Sulfate, Total (as SO4)			26	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2021	
1007	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	April	04/30/2021	Sulfate, Total (as SO4)			24.8	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	04/30/2021	
1008	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	April	04/30/2021	Sulfate, Total (as SO4)			25.3	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	04/30/2021	
1009	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	May	05/31/2021	Sulfate, Total (as SO4)			21.8	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	05/31/2021	
1010	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	May	05/31/2021	Sulfate, Total (as SO4)			22.1	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	05/31/2021	
1011	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	June	06/30/2021	Sulfate, Total (as SO4)			22.5	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2021	
1012	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	June	06/30/2021	Sulfate, Total (as SO4)			22.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2021	
1013	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	July	07/31/2021	Sulfate, Total (as SO4)			24.1	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	07/31/2021	
1014	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	July	07/31/2021	Sulfate, Total (as SO4)			24.5	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	07/31/2021	
1015	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	August	08/31/2021	Sulfate, Total (as SO4)			23.9	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2021	
1016	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	August	08/31/2021	Sulfate, Total (as SO4)			24.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2021	
1017	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	September	09/30/2021	Sulfate, Total (as SO4)			22	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2021	
1018	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	September	09/30/2021	Sulfate, Total (as SO4)			22	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2021	
1019	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	October	10/31/2021	Sulfate, Total (as SO4)			23.1	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	10/31/2021	
1020	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	October	10/31/2021	Sulfate, Total (as SO4)			23.3	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	10/31/2021	
1021	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	November	11/30/2021	Sulfate, Total (as SO4)			22.5	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	11/30/2021	
1022	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	November	11/30/2021	Sulfate, Total (as SO4)			23	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	11/30/2021	
1023	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	December	12/31/2021	Sulfate, Total (as SO4)			22.8	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2021	
1024	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2021	December	12/31/2021	Sulfate, Total (as SO4)			22.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2021	
1025	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	January	01/31/2022	Sulfate, Total (as SO4)			24.5	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2022	
1026	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	January	01/31/2022	Sulfate, Total (as SO4)			24.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2022	
1027	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	February	02/28/2022	Sulfate, Total (as SO4)			24.7	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	02/28/2022	
1028	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	February	02/28/2022	Sulfate, Total (as SO4)			24.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	02/28/2022	
1029	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	March	03/31/2022	Sulfate, Total (as SO4)			25.7	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2022	
1030	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	March	03/31/2022	Sulfate, Total (as SO4)			26.1	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2022	
1031	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	April	04/30/2022	Sulfate, Total (as SO4)			26.1	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	04/30/2022	
1032	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	April	04/30/2022	Sulfate, Total (as SO4)			26.5	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	04/30/2022	
1033	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	May	05/31/2022	Sulfate, Total (as SO4)			27.5	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	05/31/2022	
1034	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	May	05/31/2022	Sulfate, Total (as SO4)			27.9	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	05/31/2022	
1035	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	June	06/30/2022	Sulfate, Total (as SO4)			26.7	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2022	
1036	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	June	06/30/2022	Sulfate, Total (as SO4)			26.7	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2022	
1037	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	July	07/31/2022	Sulfate, Total (as SO4)			26	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	07/31/2022	
1038	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	July	07/31/2022	Sulfate, Total (as SO4)			26	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	07/31/2022	
1039	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	August	08/31/2022	Sulfate, Total (as SO4)			26.5	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2022	
1040	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	August	08/31/2022	Sulfate, Total (as SO4)			26.5	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2022	
1041	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	September	09/30/2022	Sulfate, Total (as SO4)			23.7	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3		

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1046	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	November	11/30/2022	Sulfate, Total (as SO4)			24.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	11/30/2022	
1047	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	December	12/31/2022	Sulfate, Total (as SO4)			24.9	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2022	
1048	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2022	December	12/31/2022	Sulfate, Total (as SO4)			25	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2022	
1049	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	January	01/31/2023	Sulfate, Total (as SO4)			25.3	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2023	
1050	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	January	01/31/2023	Sulfate, Total (as SO4)			25.6	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2023	
1051	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	February	02/28/2023	Sulfate, Total (as SO4)			24.6	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	02/28/2023	
1052	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	February	02/28/2023	Sulfate, Total (as SO4)			24.9	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	02/28/2023	
1053	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	March	03/31/2023	Sulfate, Total (as SO4)			25.9	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2023	
1054	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	March	03/31/2023	Sulfate, Total (as SO4)			25.9	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2023	
1055	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	April	04/30/2023	Sulfate, Total (as SO4)			26.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	04/30/2023	
1056	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	April	04/30/2023	Sulfate, Total (as SO4)			26.6	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	04/30/2023	
1057	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	May	05/31/2023	Sulfate, Total (as SO4)			25.7	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	05/31/2023	
1058	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	May	05/31/2023	Sulfate, Total (as SO4)			26.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	05/31/2023	
1059	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	June	06/30/2023	Sulfate, Total (as SO4)			26	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2023	
1060	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	June	06/30/2023	Sulfate, Total (as SO4)			26.5	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2023	
1061	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	July	07/31/2023	Sulfate, Total (as SO4)			27.7	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	07/31/2023	
1062	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	July	07/31/2023	Sulfate, Total (as SO4)			28.4	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	07/31/2023	
1063	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	August	08/31/2023	Sulfate, Total (as SO4)			26.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2023	
1064	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	August	08/31/2023	Sulfate, Total (as SO4)			26.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2023	
1065	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	September	09/30/2023	Sulfate, Total (as SO4)			23.4	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2023	
1066	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	September	09/30/2023	Sulfate, Total (as SO4)			23.6	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2023	
1067	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	October	10/31/2023	Sulfate, Total (as SO4)			22.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	10/31/2023	
1068	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	October	10/31/2023	Sulfate, Total (as SO4)			23	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	10/31/2023	
1069	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	November	11/30/2023	Sulfate, Total (as SO4)			24.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	11/30/2023	
1070	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	November	11/30/2023	Sulfate, Total (as SO4)			24.3	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	11/30/2023	
1071	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	December	12/31/2023	Sulfate, Total (as SO4)			23	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2023	
1072	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2023	December	12/31/2023	Sulfate, Total (as SO4)			23	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2023	
1073	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	January	01/31/2024	Sulfate, Total (as SO4)			25	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2024	
1074	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	January	01/31/2024	Sulfate, Total (as SO4)			26.6	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	01/31/2024	
1075	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	February	02/29/2024	Sulfate, Total (as SO4)			24.6	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	02/29/2024	
1076	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	February	02/29/2024	Sulfate, Total (as SO4)			25.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	02/29/2024	
1077	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	March	03/31/2024	Sulfate, Total (as SO4)			23.3	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2024	
1078	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	March	03/31/2024	Sulfate, Total (as SO4)			24.7	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	03/31/2024	
1079	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	April	04/30/2024	Sulfate, Total (as SO4)			23	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	04/30/2024	
1080	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	April	04/30/2024	Sulfate, Total (as SO4)			23	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	04/30/2024	
1081	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	May	05/31/2024	Sulfate, Total (as SO4)			21.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	05/31/2024	
1082	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	May	05/31/2024	Sulfate, Total (as SO4)			22	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	05/31/2024	
1083	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	June	06/30/2024	Sulfate, Total (as SO4)			24.3	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2024	
1084	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	June	06/30/2024	Sulfate, Total (as SO4)			25.1	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	06/30/2024	
1085	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	July	07/31/2024	Sulfate, Total (as SO4)			22.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	07/31/2024	
1086	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	July	07/31/2024	Sulfate, Total (as SO4)			22.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	07/31/2024	
1087	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	August	08/31/2024	Sulfate, Total (as SO4)			22	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2024	
1088	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	August	08/31/2024	Sulfate, Total (as SO4)			22	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	08/31/2024	
1089	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	September	09/30/2024	Sulfate, Total (as SO4)			20.4	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2024	
1090	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	September	09/30/2024	Sulfate, Total (as SO4)			20.9	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	09/30/2024	
1091	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	October	10/31/2024	Sulfate, Total (as SO4)			21.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	10/31/2024	
1092	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	October	10/31/2024	Sulfate, Total (as SO4)			22.1	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	10/31/2024	
1093	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	November	11/30/2024	Sulfate, Total (as SO4)			22.7	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	11/30/2024	
1094	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	November	11/30/2024	Sulfate, Total (as SO4)			24.3	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	11/30/2024	
1095	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	December	12/31/2024	Sulfate, Total (as SO4)			24.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2024	
1096	United States Steel Corp - Keetac	MN0031879	IND20120003	SD 012	Perry Pit Dewatering	2024	December	12/31/2024	Sulfate, Total (as SO4)			24.8	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1278287	47.3980353	12/31/2024	

Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1101	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	May	05/31/2018	Sulfate, Total (as SO4)			103	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2018	
1102	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	June	06/30/2018	Sulfate, Total (as SO4)			94.6	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2018	
1103	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	July	07/31/2018	Sulfate, Total (as SO4)			94.8	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2018	
1104	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	August	08/31/2018	Sulfate, Total (as SO4)			91.3	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2018	
1105	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	September	09/30/2018	Sulfate, Total (as SO4)			91.4	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2018	
1106	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	October	10/31/2018	Sulfate, Total (as SO4)			94.1	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2018	
1107	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	November	11/30/2018	Sulfate, Total (as SO4)			102	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2018	
1108	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2018	December	12/31/2018	Sulfate, Total (as SO4)			101	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2018	
1109	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	January	01/31/2019	Sulfate, Total (as SO4)			109	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2019	
1110	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	February	02/28/2019	Sulfate, Total (as SO4)			120	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2019	
1111	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	March	03/31/2019	Sulfate, Total (as SO4)			118	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2019	
1112	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	April	04/30/2019	Sulfate, Total (as SO4)			126	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2019	
1113	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	May	05/31/2019	Sulfate, Total (as SO4)			102	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2019	
1114	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	June	06/30/2019	Sulfate, Total (as SO4)			110	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2019	
1115	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	July	07/31/2019	Sulfate, Total (as SO4)			102	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2019	
1116	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	August	08/31/2019	Sulfate, Total (as SO4)			97.2	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2019	
1117	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	September	09/30/2019	Sulfate, Total (as SO4)			111	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2019	
1118	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	October	10/31/2019	Sulfate, Total (as SO4)			95.9	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2019	
1119	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	November	11/30/2019	Sulfate, Total (as SO4)			106	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2019	
1120	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2019	December	12/31/2019	Sulfate, Total (as SO4)			106	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2019	
1121	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	January	01/31/2020	Sulfate, Total (as SO4)			112	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2020	
1122	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	February	02/29/2020	Sulfate, Total (as SO4)			120	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/29/2020	
1123	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	March	03/31/2020	Sulfate, Total (as SO4)			128	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2020	
1124	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	April	04/30/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2020	
1125	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	May	05/31/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2020	
1126	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	June	06/30/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2020	
1127	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	July	07/31/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2020	
1128	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	August	08/31/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2020	
1129	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	September	09/30/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2020	
1130	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	October	10/31/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2020	
1131	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	November	11/30/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2020	
1132	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2020	December	12/31/2020	Sulfate, Total (as SO4)			110	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2020	
1133	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	January	01/31/2021	Sulfate, Total (as SO4)			105	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2021	
1134	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	February	02/28/2021	Sulfate, Total (as SO4)			109	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2021	
1135	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	March	03/31/2021	Sulfate, Total (as SO4)			120	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2021	
1136	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	April	04/30/2021	Sulfate, Total (as SO4)			109	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2021	
1137	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	May	05/31/2021	Sulfate, Total (as SO4)			108	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2021	
1138	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	June	06/30/2021	Sulfate, Total (as SO4)			114	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2021	
1139	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	July	07/31/2021	Sulfate, Total (as SO4)			114	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2021	
1140	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	August	08/31/2021	Sulfate, Total (as SO4)			122	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2021	
1141	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	September	09/30/2021	Sulfate, Total (as SO4)			119	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2021	
1142	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	October	10/31/2021	Sulfate, Total (as SO4)			128	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2021	
1143	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	November	11/30/2021	Sulfate, Total (as SO4)			126	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2021	
1144	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2021	December	12/31/2021	Sulfate, Total (as SO4)			128	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2021	
1145	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	January	01/31/2022	Sulfate, Total (as SO4)			142	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2022	
1146	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	February	02/28/2022	Sulfate, Total (as SO4)			134	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2022	
1147	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	March	03/31/2022	Sulfate, Total (as SO4)			140	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2022	
1148	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	April	04/30/2022	Sulfate, Total (as SO4)			133	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2022	
1149	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	May	05/31/2022	Sulfate, Total (as SO4)			108	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2022	
1150	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	June	06/30/2022	Sulfate, Total (as SO4)			102	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2022	
1151	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	July	07/31/2022	Sulfate, Total (as SO4)			98.3	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2022	
1152	United States Steel Corp - Keetac	MN0031879																				

Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
1156	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2022	December	12/31/2022	Sulfate, Total (as SO4)				98	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2022	
1157	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	January	01/31/2023	Sulfate, Total (as SO4)				108	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2023	
1158	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	February	02/28/2023	Sulfate, Total (as SO4)				116	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2023	
1159	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	March	03/31/2023	Sulfate, Total (as SO4)				127	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2023	
1160	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	April	04/30/2023	Sulfate, Total (as SO4)				132	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2023	
1161	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	May	05/31/2023	Sulfate, Total (as SO4)				111	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2023	
1162	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	June	06/30/2023	Sulfate, Total (as SO4)				94.6	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2023	
1163	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	July	07/31/2023	Sulfate, Total (as SO4)				97.5	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2023	
1164	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	August	08/31/2023	Sulfate, Total (as SO4)				92.8	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2023	
1165	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	September	09/30/2023	Sulfate, Total (as SO4)				94	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2023	
1166	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	October	10/31/2023	Sulfate, Total (as SO4)				102	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2023	
1167	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	November	11/30/2023	Sulfate, Total (as SO4)				108	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2023	
1168	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2023	December	12/31/2023	Sulfate, Total (as SO4)				106	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2023	
1169	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	January	01/31/2024	Sulfate, Total (as SO4)				118	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2024	
1170	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	February	02/29/2024	Sulfate, Total (as SO4)				124	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/29/2024	
1171	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	March	03/31/2024	Sulfate, Total (as SO4)				120	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2024	
1172	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	April	04/30/2024	Sulfate, Total (as SO4)				125	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2024	
1173	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	May	05/31/2024	Sulfate, Total (as SO4)				117	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2024	
1174	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	June	06/30/2024	Sulfate, Total (as SO4)				129	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2024	
1175	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	July	07/31/2024	Sulfate, Total (as SO4)				122	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2024	
1176	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	August	08/31/2024	Sulfate, Total (as SO4)				117	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2024	
1177	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	September	09/30/2024	Sulfate, Total (as SO4)				110	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2024	
1178	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	October	10/31/2024	Sulfate, Total (as SO4)				120	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2024	
1179	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	November	11/30/2024	Sulfate, Total (as SO4)				121	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2024	
1180	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 011	Plant water to scrubber system	2024	December	12/31/2024	Sulfate, Total (as SO4)				124	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2024	
1181	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	January	01/31/2018	Sulfate, Total (as SO4)				1010	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2018	
1182	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	February	02/28/2018	Sulfate, Total (as SO4)				1030	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2018	
1183	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	March	03/31/2018	Sulfate, Total (as SO4)				939	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2018	
1184	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	April	04/30/2018	Sulfate, Total (as SO4)				982	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2018	
1185	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	May	05/31/2018	Sulfate, Total (as SO4)				919	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2018	
1186	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	June	06/30/2018	Sulfate, Total (as SO4)				1420	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2018	
1187	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	July	07/31/2018	Sulfate, Total (as SO4)				993	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2018	
1188	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	August	08/31/2018	Sulfate, Total (as SO4)				877	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2018	
1189	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	September	09/30/2018	Sulfate, Total (as SO4)				972	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2018	
1190	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	October	10/31/2018	Sulfate, Total (as SO4)				1070	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2018	
1191	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	November	11/30/2018	Sulfate, Total (as SO4)				938	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2018	
1192	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2018	December	12/31/2018	Sulfate, Total (as SO4)				1020	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2018	
1193	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	January	01/31/2019	Sulfate, Total (as SO4)				924	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2019	
1194	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	February	02/28/2019	Sulfate, Total (as SO4)				606	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2019	
1195	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	March	03/31/2019	Sulfate, Total (as SO4)				975	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2019	
1196	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	April	04/30/2019	Sulfate, Total (as SO4)				975	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2019	
1197	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	May	05/31/2019	Sulfate, Total (as SO4)				820	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2019	
1198	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	June	06/30/2019	Sulfate, Total (as SO4)				854	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2019	
1199	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	July	07/31/2019	Sulfate, Total (as SO4)				1110	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2019	
1200	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	August	08/31/2019	Sulfate, Total (as SO4)				561	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2019	
1201	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	September	09/30/2019	Sulfate, Total (as SO4)				1320	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2019	
1202	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	October	10/31/2019	Sulfate, Total (as SO4)				661	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2019	
1203	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	November	11/30/2019	Sulfate, Total (as SO4)				1290	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2019	
1204	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2019	December	12/31/2019	Sulfate, Total (as SO4)				810	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2019	
1205	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	January	01/31/2020	Sulfate, Total (as SO4)				1770	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2020	
1206	United States Steel Corp - Keetac	MN																					

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1211	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	July	07/31/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2020	
1212	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	August	08/31/2020	Sulfate, Total (as SO4)					SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2020	
1213	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	September	09/30/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2020	
1214	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	October	10/31/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2020	
1215	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	November	11/30/2020	Sulfate, Total (as SO4)				mg/L	SingleVal	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2020	
1216	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2020	December	12/31/2020	Sulfate, Total (as SO4)			1050	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2020	
1217	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	January	01/31/2021	Sulfate, Total (as SO4)			1040	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2021	
1218	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	February	02/28/2021	Sulfate, Total (as SO4)			324	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2021	
1219	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	March	03/31/2021	Sulfate, Total (as SO4)			977	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2021	
1220	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	April	04/30/2021	Sulfate, Total (as SO4)			1040	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2021	
1221	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	May	05/31/2021	Sulfate, Total (as SO4)			1240	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2021	
1222	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	June	06/30/2021	Sulfate, Total (as SO4)			1450	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2021	
1223	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	July	07/31/2021	Sulfate, Total (as SO4)			1950	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2021	
1224	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	August	08/31/2021	Sulfate, Total (as SO4)			1790	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2021	
1225	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	September	09/30/2021	Sulfate, Total (as SO4)			1040	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2021	
1226	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	October	10/31/2021	Sulfate, Total (as SO4)			1850	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2021	
1227	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	November	11/30/2021	Sulfate, Total (as SO4)			1540	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2021	
1228	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2021	December	12/31/2021	Sulfate, Total (as SO4)			839	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2021	
1229	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	January	01/31/2022	Sulfate, Total (as SO4)			2260	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2022	
1230	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	February	02/28/2022	Sulfate, Total (as SO4)			2220	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2022	
1231	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	March	03/31/2022	Sulfate, Total (as SO4)			2030	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2022	
1232	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	April	04/30/2022	Sulfate, Total (as SO4)			1340	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2022	
1233	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	May	05/31/2022	Sulfate, Total (as SO4)			1700	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2022	
1234	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	June	06/30/2022	Sulfate, Total (as SO4)			1370	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2022	
1235	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	July	07/31/2022	Sulfate, Total (as SO4)			1940	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2022	
1236	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	August	08/31/2022	Sulfate, Total (as SO4)			1700	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2022	
1237	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	September	09/30/2022	Sulfate, Total (as SO4)			1800	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2022	
1238	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	October	10/31/2022	Sulfate, Total (as SO4)			1100	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2022	
1239	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	November	11/30/2022	Sulfate, Total (as SO4)			1550	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2022	
1240	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2022	December	12/31/2022	Sulfate, Total (as SO4)			1370	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2022	
1241	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	January	01/31/2023	Sulfate, Total (as SO4)			1320	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2023	
1242	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	February	02/28/2023	Sulfate, Total (as SO4)			1982	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/28/2023	
1243	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	March	03/31/2023	Sulfate, Total (as SO4)			1420	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2023	
1244	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	April	04/30/2023	Sulfate, Total (as SO4)			1260	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2023	
1245	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	May	05/31/2023	Sulfate, Total (as SO4)			2200	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2023	
1246	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	June	06/30/2023	Sulfate, Total (as SO4)			1260	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2023	
1247	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	July	07/31/2023	Sulfate, Total (as SO4)			1400	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2023	
1248	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	August	08/31/2023	Sulfate, Total (as SO4)			1640	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2023	
1249	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	September	09/30/2023	Sulfate, Total (as SO4)			1480	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	09/30/2023	
1250	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	October	10/31/2023	Sulfate, Total (as SO4)			1230	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	10/31/2023	
1251	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	November	11/30/2023	Sulfate, Total (as SO4)			1550	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	11/30/2023	
1252	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2023	December	12/31/2023	Sulfate, Total (as SO4)			1120	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	12/31/2023	
1253	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	January	01/31/2024	Sulfate, Total (as SO4)			935	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	01/31/2024	
1254	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	February	02/29/2024	Sulfate, Total (as SO4)			1040	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	02/29/2024	
1255	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	March	03/31/2024	Sulfate, Total (as SO4)			1000	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	03/31/2024	
1256	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	April	04/30/2024	Sulfate, Total (as SO4)			1380	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	04/30/2024	
1257	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	May	05/31/2024	Sulfate, Total (as SO4)			698	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	05/31/2024	
1258	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	June	06/30/2024	Sulfate, Total (as SO4)			1050	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	06/30/2024	
1259	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	July	07/31/2024	Sulfate, Total (as SO4)			1470	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	07/31/2024	
1260	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	August	08/31/2024	Sulfate, Total (as SO4)			1770	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0626719	47.4138827	08/31/2024	
1261	United States Steel Corp - Keetac	MN0031879	IND20120003	WS 012	Scrubber blowdown after treatment	2024	September	09/30/2024	Sulfate, Total (as SO4)			1320	mg/L	SingleVal	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek				

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1266	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	January	01/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2018		
1267	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	February	02/28/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2018		
1268	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	February	02/28/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2018		
1269	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	March	03/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2018		
1270	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	March	03/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2018		
1271	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	April	04/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2018		
1272	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	April	04/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2018		
1273	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	May	05/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2018		
1274	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	May	05/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2018		
1275	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	June	06/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2018		
1276	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	June	06/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2018		
1277	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	July	07/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2018		
1278	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	July	07/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2018		
1279	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	August	08/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2018		
1280	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	August	08/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2018		
1281	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	September	09/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2018		
1282	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	September	09/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2018		
1283	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	October	10/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2018		
1284	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	October	10/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2018		
1285	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	November	11/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2018		
1286	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	November	11/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2018		
1287	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	December	12/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2018		
1288	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2018	December	12/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2018		
1289	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	January	01/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2019		
1290	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	January	01/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2019		
1291	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	February	02/28/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2019		
1292	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	February	02/28/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2019		
1293	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	March	03/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2019		
1294	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	March	03/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2019		
1295	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	April	04/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2019		
1296	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	April	04/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2019		
1297	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	May	05/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2019		
1298	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	May	05/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2019		
1299	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	June	06/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2019		
1300	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	June	06/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2019		
1301	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	July	07/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2019		
1302	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	July	07/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2019		
1303	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	August	08/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2019		
1304	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	August	08/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2019		
1305	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	September	09/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2019		
1306	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	September	09/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2019		
1307	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	October	10/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2019		
1308	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	October	10/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2019		
1309	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	November	11/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2019		
1310	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	November	11/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2019		
1311	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	December	12/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2019		
1312	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2019	December	12/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2019		
1313	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	January	01/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2020		
1314	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	January	01/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2020		
1315	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	February	02/29/2020</														

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1321	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	May	05/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2020	
1322	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	May	05/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2020	
1323	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	June	06/30/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2020	
1324	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	June	06/30/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2020	
1325	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	July	07/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2020	
1326	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	July	07/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2020	
1327	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	August	08/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2020	
1328	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	August	08/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2020	
1329	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	September	09/30/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2020	
1330	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	September	09/30/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2020	
1331	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	October	10/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2020	
1332	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	October	10/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2020	
1333	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	November	11/30/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2020	
1334	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	November	11/30/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2020	
1335	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	December	12/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2020	
1336	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2020	December	12/31/2020	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2020	
1337	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	January	01/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2021	
1338	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	January	01/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2021	
1339	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	February	02/28/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2021	
1340	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	February	02/28/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2021	
1341	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	March	03/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2021	
1342	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	March	03/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2021	
1343	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	April	04/30/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2021	
1344	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	April	04/30/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2021	
1345	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	May	05/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2021	
1346	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	May	05/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2021	
1347	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	June	06/30/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2021	
1348	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	June	06/30/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2021	
1349	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	July	07/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2021	
1350	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	July	07/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2021	
1351	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	August	08/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2021	
1352	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	August	08/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2021	
1353	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	September	09/30/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2021	
1354	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	September	09/30/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2021	
1355	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	October	10/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2021	
1356	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	October	10/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2021	
1357	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	November	11/30/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2021	
1358	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	November	11/30/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2021	
1359	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	December	12/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2021	
1360	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2021	December	12/31/2021	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2021	
1361	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	January	01/31/2022	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2022	
1362	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	January	01/31/2022	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2022	
1363	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	February	02/28/2022	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2022	
1364	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	February	02/28/2022	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2022	
1365	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	March	03/31/2022	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2022	
1366	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	March	03/31/2022	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2022	
1367	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	April	04/30/2022	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2022	
1368	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	April	04/30/2022	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2022	
1369	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	May	05/31/2022	Sulfate, Total (as SO4)				mg/L	CaMoAl	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2022	
1370	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	May	05/31/2022</														

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1376	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	August	08/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2022	
1377	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	September	09/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2022	
1378	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	September	09/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2022	
1379	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	October	10/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2022	
1380	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	October	10/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2022	
1381	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	November	11/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2022	
1382	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	November	11/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2022	
1383	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	December	12/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2022	
1384	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2022	December	12/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2022	
1385	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	January	01/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2023	
1386	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	January	01/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2023	
1387	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	February	02/28/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2023	
1388	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	February	02/28/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/28/2023	
1389	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	March	03/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2023	
1390	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	March	03/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2023	
1391	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	April	04/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2023	
1392	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	April	04/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2023	
1393	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	May	05/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2023	
1394	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	May	05/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2023	
1395	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	June	06/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2023	
1396	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	June	06/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2023	
1397	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	July	07/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2023	
1398	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	July	07/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2023	
1399	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	August	08/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2023	
1400	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	August	08/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2023	
1401	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	September	09/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2023	
1402	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	September	09/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	09/30/2023	
1403	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	October	10/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2023	
1404	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	October	10/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	10/31/2023	
1405	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	November	11/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2023	
1406	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	November	11/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	11/30/2023	
1407	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	December	12/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2023	
1408	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2023	December	12/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2023	
1409	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	January	01/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2024	
1410	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	January	01/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	01/31/2024	
1411	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	February	02/29/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/29/2024	
1412	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	February	02/29/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	02/29/2024	
1413	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	March	03/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2024	
1414	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	March	03/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	03/31/2024	
1415	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	April	04/30/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2024	
1416	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	April	04/30/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	04/30/2024	
1417	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	May	05/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2024	
1418	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	May	05/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	05/31/2024	
1419	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	June	06/30/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2024	
1420	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	June	06/30/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	06/30/2024	
1421	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	July	07/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2024	
1422	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	July	07/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	07/31/2024	
1423	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	August	08/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2024	
1424	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	August	08/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	08/31/2024	
1425	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	September	09/30/2024</														

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1431	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	December	12/31/2024	Sulfate, Total (as SO4)				mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2024	
1432	US Steel Corp - Tailings	MN0055948	IND20110001	SD 001	Siphon Outfalls 011, 012, 013	2024	December	12/31/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0916992	47.3598656	12/31/2024	
1433	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	January	01/31/2018	Sulfate, Total (as SO4)				mg/L	CaMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2018	
1434	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	January	01/31/2018	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2018	
1435	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	February	02/28/2018	Sulfate, Total (as SO4)				mg/L	CaMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2018	
1436	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	February	02/28/2018	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2018	
1437	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	March	03/31/2018	Sulfate, Total (as SO4)			97	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2018	
1438	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	March	03/31/2018	Sulfate, Total (as SO4)			100	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2018	
1439	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	April	04/30/2018	Sulfate, Total (as SO4)			105	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2018	
1440	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	April	04/30/2018	Sulfate, Total (as SO4)			106	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2018	
1441	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	May	05/31/2018	Sulfate, Total (as SO4)			73.5	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2018	
1442	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	May	05/31/2018	Sulfate, Total (as SO4)			73.5	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2018	
1443	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	June	06/30/2018	Sulfate, Total (as SO4)			90.9	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2018	
1444	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	June	06/30/2018	Sulfate, Total (as SO4)			90.9	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2018	
1445	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	July	07/31/2018	Sulfate, Total (as SO4)			87.6	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2018	
1446	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	July	07/31/2018	Sulfate, Total (as SO4)			87.6	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2018	
1447	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	August	08/31/2018	Sulfate, Total (as SO4)				mg/L	CaMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2018	
1448	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	August	08/31/2018	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2018	
1449	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	September	09/30/2018	Sulfate, Total (as SO4)			77.4	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2018	
1450	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	September	09/30/2018	Sulfate, Total (as SO4)			77.4	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2018	
1451	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	October	10/31/2018	Sulfate, Total (as SO4)			89.2	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2018	
1452	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	October	10/31/2018	Sulfate, Total (as SO4)			89.2	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2018	
1453	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	November	11/30/2018	Sulfate, Total (as SO4)				mg/L	CaMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2018	
1454	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	November	11/30/2018	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2018	
1455	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	December	12/31/2018	Sulfate, Total (as SO4)				mg/L	CaMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2018	
1456	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2018	December	12/31/2018	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2018	
1457	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	January	01/31/2019	Sulfate, Total (as SO4)				mg/L	CaMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2019	
1458	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	January	01/31/2019	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2019	
1459	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	February	02/28/2019	Sulfate, Total (as SO4)				mg/L	CaMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2019	
1460	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	February	02/28/2019	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2019	
1461	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	March	03/31/2019	Sulfate, Total (as SO4)			122	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2019	
1462	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	March	03/31/2019	Sulfate, Total (as SO4)			124	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2019	
1463	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	April	04/30/2019	Sulfate, Total (as SO4)			113	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2019	
1464	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	April	04/30/2019	Sulfate, Total (as SO4)			121	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2019	
1465	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	May	05/31/2019	Sulfate, Total (as SO4)			97.1	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2019	
1466	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	May	05/31/2019	Sulfate, Total (as SO4)			97.1	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2019	
1467	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	June	06/30/2019	Sulfate, Total (as SO4)			100	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2019	
1468	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	June	06/30/2019	Sulfate, Total (as SO4)			100	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2019	
1469	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	July	07/31/2019	Sulfate, Total (as SO4)				mg/L	CaMoAve	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2019	
1470	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	July	07/31/2019	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2019	
1471	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	August	08/31/2019	Sulfate, Total (as SO4)			96.1	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2019	
1472	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	August	08/31/2019	Sulfate, Total (as SO4)			96.1	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2019	
1473	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	September	09/30/2019	Sulfate, Total (as SO4)			95.5	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2019	
1474	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	September	09/30/2019	Sulfate, Total (as SO4)			95.6	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2019	
1475	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	October	10/31/2019	Sulfate, Total (as SO4)			92.3	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2019	
1476	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	October	10/31/2019	Sulfate, Total (as SO4)			97.5	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2019	
1477	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	November	11/30/2019	Sulfate, Total (as SO4)			104	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2019	
1478	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	November	11/30/2019	Sulfate, Total (as SO4)			104	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2019	
1479	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	December	12/31/2019	Sulfate, Total (as SO4)			102	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2019	
1480	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2019	December	12/31/2019	Sulfate, Total (as SO4)			105	mg/L	CaMoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2019	
1481	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2020	January	01/31/2020	Sulfate, Total (as SO4)			112	mg/L	CaMoAve	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2020	
1482																						

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1486	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	March	03/31/2020	Sulfate, Total (as SO4)		125	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2020	
1487	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	April	04/30/2020	Sulfate, Total (as SO4)		102	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2020	
1488	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	April	04/30/2020	Sulfate, Total (as SO4)		107	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2020	
1489	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	May	05/31/2020	Sulfate, Total (as SO4)		110	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2020	
1490	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	May	05/31/2020	Sulfate, Total (as SO4)		110	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2020	
1491	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	June	06/30/2020	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2020	
1492	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	June	06/30/2020	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2020	
1493	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	July	07/31/2020	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2020	
1494	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	July	07/31/2020	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2020	
1495	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	August	08/31/2020	Sulfate, Total (as SO4)		104	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2020	
1496	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	August	08/31/2020	Sulfate, Total (as SO4)		106	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2020	
1497	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	September	09/30/2020	Sulfate, Total (as SO4)		96	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2020	
1498	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	September	09/30/2020	Sulfate, Total (as SO4)		96.8	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2020	
1499	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	October	10/31/2020	Sulfate, Total (as SO4)		95.6	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2020	
1500	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	October	10/31/2020	Sulfate, Total (as SO4)		95.7	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2020	
1501	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	November	11/30/2020	Sulfate, Total (as SO4)		96.6	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2020	
1502	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	November	11/30/2020	Sulfate, Total (as SO4)		97.9	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2020	
1503	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	December	12/31/2020	Sulfate, Total (as SO4)		103	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2020	
1504	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2020	December	12/31/2020	Sulfate, Total (as SO4)		104	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2020	
1505	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	January	01/31/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2021	
1506	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	January	01/31/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2021	
1507	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	February	02/28/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2021	
1508	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	February	02/28/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2021	
1509	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	March	03/31/2021	Sulfate, Total (as SO4)		112	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2021	
1510	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	March	03/31/2021	Sulfate, Total (as SO4)		120	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2021	
1511	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	April	04/30/2021	Sulfate, Total (as SO4)		107	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2021	
1512	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	April	04/30/2021	Sulfate, Total (as SO4)		107	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2021	
1513	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	May	05/31/2021	Sulfate, Total (as SO4)		110	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2021	
1514	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	May	05/31/2021	Sulfate, Total (as SO4)		112	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2021	
1515	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	June	06/30/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2021	
1516	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	June	06/30/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2021	
1517	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	July	07/31/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2021	
1518	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	July	07/31/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2021	
1519	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	August	08/31/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2021	
1520	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	August	08/31/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2021	
1521	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	September	09/30/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2021	
1522	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	September	09/30/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2021	
1523	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	October	10/31/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2021	
1524	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	October	10/31/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2021	
1525	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	November	11/30/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2021	
1526	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	November	11/30/2021	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2021	
1527	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	December	12/31/2021	Sulfate, Total (as SO4)		131	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2021	
1528	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2021	December	12/31/2021	Sulfate, Total (as SO4)		131	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2021	
1529	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2022	January	01/31/2022	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2022	
1530	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2022	January	01/31/2022	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2022	
1531	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2022	February	02/28/2022	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2022	
1532	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2022	February	02/28/2022	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2022	
1533	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2022	March	03/31/2022	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2022	
1534	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2022	March	03/31/2022	Sulfate, Total (as SO4)			mg/L	CaI MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2022	
1535	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2022	April	04/30/2022	Sulfate, Total (as SO4)		105	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2022	
1536	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015		2022	April	04/30/2022	Sulfate, Total (as SO4)		123	mg/L	CaI MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2022	
1537	US Steel Corp - Tailings	MN0055948	IND2011000																			

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
1541	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	July	07/31/2022	Sulfate, Total (as SO4)			95.1	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2022	
1542	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	July	07/31/2022	Sulfate, Total (as SO4)			95.5	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2022	
1543	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	August	08/31/2022	Sulfate, Total (as SO4)				mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2022	
1544	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	August	08/31/2022	Sulfate, Total (as SO4)				mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2022	
1545	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	September	09/30/2022	Sulfate, Total (as SO4)				mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2022	
1546	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	September	09/30/2022	Sulfate, Total (as SO4)			93.6	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2022	
1547	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	October	10/31/2022	Sulfate, Total (as SO4)				mg/L	CaI	MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2022	
1548	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	October	10/31/2022	Sulfate, Total (as SO4)				mg/L	CaI	MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2022	
1549	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	November	11/30/2022	Sulfate, Total (as SO4)				mg/L	CaI	MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2022	
1550	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	November	11/30/2022	Sulfate, Total (as SO4)				mg/L	CaI	MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2022	
1551	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	December	12/31/2022	Sulfate, Total (as SO4)				mg/L	CaI	MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2022	
1552	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2022	December	12/31/2022	Sulfate, Total (as SO4)				mg/L	CaI	MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2022	
1553	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	January	01/31/2023	Sulfate, Total (as SO4)				mg/L	CaI	MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2023	
1554	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	January	01/31/2023	Sulfate, Total (as SO4)				mg/L	CaI	MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2023	
1555	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	February	02/28/2023	Sulfate, Total (as SO4)			106	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2023	
1556	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	February	02/28/2023	Sulfate, Total (as SO4)			106	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/28/2023	
1557	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	March	03/31/2023	Sulfate, Total (as SO4)			126	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2023	
1558	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	March	03/31/2023	Sulfate, Total (as SO4)			136	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2023	
1559	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	April	04/30/2023	Sulfate, Total (as SO4)			111	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2023	
1560	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	April	04/30/2023	Sulfate, Total (as SO4)			133	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2023	
1561	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	May	05/31/2023	Sulfate, Total (as SO4)			86.1	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2023	
1562	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	May	05/31/2023	Sulfate, Total (as SO4)			87.5	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2023	
1563	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	June	06/30/2023	Sulfate, Total (as SO4)			89	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2023	
1564	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	June	06/30/2023	Sulfate, Total (as SO4)			90.4	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2023	
1565	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	July	07/31/2023	Sulfate, Total (as SO4)			91.1	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2023	
1566	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	July	07/31/2023	Sulfate, Total (as SO4)			91.1	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2023	
1567	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	August	08/31/2023	Sulfate, Total (as SO4)				mg/L	CaI	MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2023	
1568	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	August	08/31/2023	Sulfate, Total (as SO4)				mg/L	CaI	MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	08/31/2023	
1569	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	September	09/30/2023	Sulfate, Total (as SO4)				mg/L	CaI	MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2023	
1570	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	September	09/30/2023	Sulfate, Total (as SO4)				mg/L	CaI	MoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	09/30/2023	
1571	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	October	10/31/2023	Sulfate, Total (as SO4)			98.7	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2023	
1572	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	October	10/31/2023	Sulfate, Total (as SO4)			98.7	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2023	
1573	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	November	11/30/2023	Sulfate, Total (as SO4)			102	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2023	
1574	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	November	11/30/2023	Sulfate, Total (as SO4)			102	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2023	
1575	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	December	12/31/2023	Sulfate, Total (as SO4)			95.1	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2023	
1576	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2023	December	12/31/2023	Sulfate, Total (as SO4)			97.9	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2023	
1577	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	January	01/31/2024	Sulfate, Total (as SO4)			112	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2024	
1578	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	January	01/31/2024	Sulfate, Total (as SO4)			112	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	01/31/2024	
1579	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	February	02/29/2024	Sulfate, Total (as SO4)			118	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/29/2024	
1580	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	February	02/29/2024	Sulfate, Total (as SO4)			120	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	02/29/2024	
1581	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	March	03/31/2024	Sulfate, Total (as SO4)			117	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2024	
1582	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	March	03/31/2024	Sulfate, Total (as SO4)			117	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	03/31/2024	
1583	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	April	04/30/2024	Sulfate, Total (as SO4)			123	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2024	
1584	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	April	04/30/2024	Sulfate, Total (as SO4)			123	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	04/30/2024	
1585	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	May	05/31/2024	Sulfate, Total (as SO4)			122	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2024	
1586	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	May	05/31/2024	Sulfate, Total (as SO4)			123	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	05/31/2024	
1587	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	June	06/30/2024	Sulfate, Total (as SO4)			123	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2024	
1588	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	June	06/30/2024	Sulfate, Total (as SO4)			133	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	06/30/2024	
1589	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	July	07/31/2024	Sulfate, Total (as SO4)			111	mg/L	CaI	MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2024	
1590	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	July	07/31/2024	Sulfate, Total (as SO4)			112	mg/L	CaI	MoMa	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	07/31/2024	

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U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1596	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	October	10/31/2024	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	10/31/2024	
1597	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	November	11/30/2024	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2024	
1598	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	November	11/30/2024	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	11/30/2024	
1599	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	December	12/31/2024	Sulfate, Total (as SO4)			136	mg/L	CaI MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2024	
1600	US Steel Corp - Tailings	MN0055948	IND20110001	SD 005	Weir Outfall 015	2024	December	12/31/2024	Sulfate, Total (as SO4)			136	mg/L	CaI MoA	N	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.0773655	47.3710275	12/31/2024	
1601													105									
1602	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	January	01/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2018	
1603	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	January	01/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2018	
1604	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	February	02/28/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2018	
1605	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	February	02/28/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2018	
1606	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	March	03/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2018	
1607	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	March	03/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2018	
1608	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	April	04/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2018	
1609	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	April	04/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2018	
1610	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	May	05/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2018	
1611	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	May	05/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2018	
1612	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	June	06/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2018	
1613	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	June	06/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2018	
1614	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	July	07/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2018	
1615	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	July	07/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2018	
1616	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	August	08/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2018	
1617	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	August	08/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2018	
1618	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	September	09/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2018	
1619	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	September	09/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2018	
1620	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	October	10/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2018	
1621	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	October	10/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2018	
1622	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	November	11/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2018	
1623	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	November	11/30/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2018	
1624	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	December	12/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2018	
1625	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2018	December	12/31/2018	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2018	
1626	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	January	01/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2019	
1627	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	January	01/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2019	
1628	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	February	02/28/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2019	
1629	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	February	02/28/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2019	
1630	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	March	03/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2019	
1631	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	March	03/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2019	
1632	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	April	04/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2019	
1633	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	April	04/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2019	
1634	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	May	05/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2019	
1635	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	May	05/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2019	
1636	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	June	06/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2019	
1637	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	June	06/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2019	
1638	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	July	07/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2019	
1639	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	July	07/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2019	
1640	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	August	08/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2019	
1641	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	August	08/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2019	
1642	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	September	09/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2019	
1643	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	September	09/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2019	
1644	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	October	10/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2019	
1645	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	October	10/31/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2019	
1646	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	November	11/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2019	
1647	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2019	November	11/30/2019	Sulfate, Total (as SO4)				mg/L	CaI MoA	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	4		

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1651	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	January	01/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2020		
1652	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	February	02/29/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/29/2020		
1653	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	February	02/29/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/29/2020		
1654	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	March	03/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2020		
1655	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	March	03/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2020		
1656	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	April	04/30/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2020		
1657	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	April	04/30/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2020		
1658	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	May	05/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2020		
1659	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	May	05/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2020		
1660	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	June	06/30/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2020		
1661	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	June	06/30/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2020		
1662	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	July	07/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2020		
1663	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	July	07/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2020		
1664	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	August	08/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2020		
1665	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	August	08/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2020		
1666	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	September	09/30/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2020		
1667	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	September	09/30/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2020		
1668	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	October	10/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2020		
1669	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	October	10/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2020		
1670	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	November	11/30/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2020		
1671	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	November	11/30/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2020		
1672	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	December	12/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2020		
1673	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2020	December	12/31/2020	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2020		
1674	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	January	01/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2021		
1675	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	January	01/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2021		
1676	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	February	02/28/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2021		
1677	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	February	02/28/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2021		
1678	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	March	03/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2021		
1679	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	March	03/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2021		
1680	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	April	04/30/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2021		
1681	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	April	04/30/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2021		
1682	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	May	05/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2021		
1683	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	May	05/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2021		
1684	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	June	06/30/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2021		
1685	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	June	06/30/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2021		
1686	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	July	07/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2021		
1687	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	July	07/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2021		
1688	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	August	08/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2021		
1689	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	August	08/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2021		
1690	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	September	09/30/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2021		
1691	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	September	09/30/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2021		
1692	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	October	10/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2021		
1693	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	October	10/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2021		
1694	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	November	11/30/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2021		
1695	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	November	11/30/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2021		
1696	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	December	12/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2021		
1697	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2021	December	12/31/2021	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2021		
1698	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	January	01/31/2022	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2022		
1699	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	January	01/31/2022	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2022		
1700	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	February	02/28/2022	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2022		
1701	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	February	02/28/2022	Sulfate, Total (as SO4)				mg/L	CaI MoMa Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2022		
1702	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	March	03/31/2022	Sulfate, Total (as SO4)													

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1706	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	May	05/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2022	
1707	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	May	05/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2022	
1708	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	June	06/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2022	
1709	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	June	06/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2022	
1710	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	July	07/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2022	
1711	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	July	07/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2022	
1712	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	August	08/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2022	
1713	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	August	08/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2022	
1714	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	September	09/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2022	
1715	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	September	09/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2022	
1716	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	October	10/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2022	
1717	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	October	10/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2022	
1718	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	November	11/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2022	
1719	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	November	11/30/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2022	
1720	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	December	12/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2022	
1721	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2022	December	12/31/2022	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2022	
1722	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	January	01/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2023	
1723	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	January	01/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2023	
1724	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	February	02/28/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2023	
1725	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	February	02/28/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/28/2023	
1726	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	March	03/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2023	
1727	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	March	03/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2023	
1728	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	April	04/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2023	
1729	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	April	04/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2023	
1730	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	May	05/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2023	
1731	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	May	05/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2023	
1732	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	June	06/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2023	
1733	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	June	06/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2023	
1734	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	July	07/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2023	
1735	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	July	07/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	07/31/2023	
1736	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	August	08/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2023	
1737	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	August	08/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2023	
1738	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	September	09/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2023	
1739	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	September	09/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2023	
1740	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	October	10/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2023	
1741	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	October	10/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2023	
1742	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	November	11/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2023	
1743	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	November	11/30/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2023	
1744	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	December	12/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2023	
1745	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2023	December	12/31/2023	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2023	
1746	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	January	01/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2024	
1747	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	January	01/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	01/31/2024	
1748	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	February	02/29/2024	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/29/2024	
1749	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	February	02/29/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	02/29/2024	
1750	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	March	03/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2024	
1751	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	March	03/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	03/31/2024	
1752	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	April	04/30/2024	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2024	
1753	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	April	04/30/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	04/30/2024	
1754	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	May	05/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2024	
1755	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	May	05/31/2024	Sulfate, Total (as SO4)				mg/L	CalMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	05/31/2024	
1756	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	June	06/30/2024	Sulfate, Total (as SO4)				mg/L	CalMoAa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	06/30/2024	
1757	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	June	06/30/202														

MPCA Online Discharge Monitoring Reports (2025 Bulk Export of Data from 2018-2024)
U.S. Steel Corp - Keetac Permits MN0031879 and MN0055947
Specific Conductance and Sulfate

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1761	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	August	08/31/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	08/31/2024	
1762	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	September	09/30/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2024	
1763	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	September	09/30/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	09/30/2024	
1764	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	October	10/31/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2024	
1765	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	October	10/31/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	10/31/2024	
1766	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	November	11/30/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2024	
1767	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	November	11/30/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	11/30/2024	
1768	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	December	12/31/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2024	
1769	US Steel Corp - Tailings	MN0055948	IND20110001	SD 009	Sargent Pit Dewatering to Unnamed	2024	December	12/31/2024	Sulfate, Total (as SO4)				mg/L	CaMoMa	Y	Mississippi River - Grand Rapids (07010103)	7010103	Hay Creek	-93.1146999	47.3986848	12/31/2024	

WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 4

EPA, NEIC Civil Investigation Report, U.S. Steel – Keetac,
Keewatin, Minnesota, 55753, October 2022.



United States Environmental Protection Agency
Office of Enforcement and Compliance Assurance
Office of Criminal Enforcement, Forensics and Training

National Enforcement Investigations Center

NEIC

NEICVP1482E01

NEIC CIVIL INVESTIGATION REPORT

U.S. Steel - Keetac

Keewatin, Minnesota, 55753

Investigation Dates:

October 25-28, 2022

Solter,
Michael

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Solter, Michael
Date: 2022.12.14
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Mike Solter, Project Manager, NEIC

Authorized for Release by:

Linda TeKrony

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Linda TeKrony, Field Branch Chief (Acting), NEIC

Report Prepared for:

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APPENDICES (*NEIC-created)

A	U.S. Steel - Keetac NPDES Permit MN0031879 – Mine Operations (41 pages)
B	U.S. Steel - Keetac NPDES Permit MN0055948 – Tailings (34 pages)
C	Minnesota Pollution Control Agency Inspection Report from June 15, 2017, Inspection (14 pages)
D	Minnesota Pollution Control Agency June 2019 Stipulation agreement with Penalty (13 pages)
E	Minnesota Pollution Control Agency June 5, 2020 Administrative Penalty Order (8 pages)
F	Facility Description from Mine NPDES Renewal Application MN0031879, March 4, 2016 (8 pages)
G	NEIC Field Photographs - U.S. Steel - Keetac (19 pages) *
H	Production Chemical Use Records, 2019-2021 (2 pages)
I	Facility Description from Tailings Basin NPDES Renewal Application MN0055948 2016 (8 pages)
J	U.S. Steel - Keetac Water Flow Schematic (1 page)
K	Water Balance Diagram, 2011-2012 (1 page)
L	Water Management Study Report FINAL, July 2012 (132 pages)
M	Sulfate Reduction Strategy Study Report FINAL, July 2012 (123 pages)
N	Final Sulfate Reduction Plan, October 5, 2012 (18 pages)
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P	FINAL BioteQ Technical Feasibility Evaluation, December 19, 2014 (24 pages)
Q	BioteQ - USS Keetac Sulf-IX Pilot Report FINAL (23 pages)
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V	Minnesota 2016 Session Law, Ch165 (1 page)
W	Minnesota Attorney General Letter to EPA, August 12, 2016 (5 pages)

X	Schedule of Compliance Termination Letter, January 12, 2017 (1 page)
Y	February 16, 2022, Letter to MPCA Commissioner Regarding Minnesota Sulfate Laws (9 pages) *
Z	Wastewater Treatment Plant Sampling Permit Modification Request (18 pages)
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CC	U.S. Steel - Keetac MN0031879 Discharge Monitoring Reports, January 2019-September 2022 (Sulfate Highlights) (434 pages) *
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EE	Email on Wastewater Treatment Plant Sampling Procedure (2 pages)
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**This Contents page shows all the sections contained in this report
and provides a clear indication of the end of this report.**

INVESTIGATION OVERVIEW

PROJECT OBJECTIVE

At the request of U.S. Environmental Protection Agency (EPA) Region 5 (Region), EPA's National Enforcement Investigations Center (NEIC) conducted a Clean Water Act (CWA) compliance investigation of the U.S. Steel - Keetac taconite mine located at 1 Mine Road in Keewatin, Minnesota. The investigation assessed U.S. Steel - Keetac's compliance with federal environmental statutes and permit requirements. The specific areas of focus for the inspection included:

- Sanitary wastewater and process wastewater generation, collection and treatment systems, sampling points, and outfalls.
- Stormwater pollution management controls, such as drainage and collection systems, treatment, sampling points, and outfalls.
- Evaluation of on-site sampling and testing procedures for wastewater.
- Operations under National Pollution Discharge Elimination System (NPDES/State Disposal System (SDS) permits MN0031879 and MN0055948.
- Site storm water pollution prevention plan (SWPPP).

NEIC personnel also documented activities and conditions that, although not specifically regulated, may have impacted, or could potentially impact, the environment. Investigation activities included the following:

- Interviewing mine personnel and management responsible for operations, maintenance, monitoring, and reporting for the facility.
- Reviewing documents relevant to the facility's operations and self-monitoring programs.
- Visually inspecting the physical control structures, discharge locations, and monitoring points of the facility systems.
- Observing and documenting operations of the mine including all site operations.

Table 1 lists the project team members.

Table 1. PROJECT TEAM MEMBERS		
Team Member	Organization	Project Role
Mike Solter	NEIC	Project manager
Kristine Andersen	NEIC	Field team member

Table 1. PROJECT TEAM MEMBERS		
Team Member	Organization	Project Role
Trent Rainey	NEIC	Field team member
REGIONAL AND OTHER CONTACTS		
Jake Berger	EPA Region 5	Regional field team member
Matthew Schulte	EPA Region 5	Regional field team member

FACILITY CONTACT INFORMATION

Table 2 lists the primary facility contacts.

Table 2. FACILITY CONTACT INFORMATION		
Name, Title	Title	Email Address
Chrissy Bartovich	Environmental Director	clbartovich@uss.com
Tishie Woodwell	Vice President, Environmental	twoodwell@uss.com
Tom Moe	Environmental Engineer	tmoe@uss.com
Eric Williams	HQ Manager - Water	ewilliams@uss.com

FACILITY OVERVIEW

U.S. Steel - Keetac is a taconite (iron ore) mine (EPA Registry Identification No. 110008797864). The U.S. Steel - Keetac facility is one of two large-scale taconite mines owned by U.S. Steel located in Minnesota, with an approximate net annual production capability of 6 million net tons of pellets. The facility employs approximately 416 individuals (though some are shared with the other U.S. Steel location) and produces taconite pellets for steel manufacturing at locations throughout the United States.

The overall facility holds two minor NPDES/SDS permits, one for the taconite mining operations (MN0031879) and one for the tailings operations (MN0055948). Water covered by permit MN0031879 is either reused, directly discharged through permitted outfalls, or discharged to the tailings area operated under permit MN0055948. Permit MN0055948 covers water from the tailings area that is generally treated then sent back to the mining operations area for reuse in the areas covered under permit MN0031879 or discharged through the permitted outfalls. The respective NPDES/SDS permits describe the outfalls and water use in detail.

Permit MN0031879 (listed in the permit as “Keewatin Taconite Operations – Mining”) covers discharges from mine excavations, mining waste disposal areas, plant areas, materials and equipment storage areas, and wastewater disposal facilities (**Appendix A**). In addition to these areas, the operations areas include several equipment storage buildings; the general office building; the water supply treatment plant; fuel storage areas; the crude ore storage building; the concentrator; the pellet plant; various processing thickeners; the laboratory; the power substation; coal, concentrate, and pellet stockpile areas; and the pellet rail load-out area.

Permit MN0055948 (listed in the permit as “Keewatin Taconite Operations – Tailings”) covers discharges from the taconite tailings basin, the drainage area contributing surface runoff to the basin, and all non-sewage wastewater disposal systems within the permitted area (**Appendix B**). The tailings operations include multiple water systems to either discharge water or reintroduce water to the mining operations portions of the facility.

U.S. Steel - Keetac was last inspected for compliance with the Clean Water Act (CWA) on June 15, 2017, by representatives of the State of Minnesota Pollution Control Agency (MPCA) (**Appendix C**). According to the EPA Enforcement and Compliance History Online (ECHO) database, the facility received two formal enforcement actions for violations of the Clean Water Act, one settled on June 21, 2019, with a penalty of \$16,500, and one settled on June 5, 2020, with a penalty of \$17,550. The June 21, 2019, settlement agreement specifically settles violations discovered during the June 15, 2017, inspection, and other unauthorized discharges of material (the settlement agreement appears to reference inspection date incorrectly as June 15, 2016, (**Appendix D**, page 3). The second penalty is related to unauthorized discharges from stockpile A reported on August 28, 2019, and September 18, 2019 (**Appendix E**).

According to the EPA Envirofacts database, this facility has the following North American Industry Classification System (NAICS) code (**Table 3**):

Table 3. APPLICABLE NAICS CODE	
NAICS Code	Description
212210	Iron Ore Mining

FACILITY OPERATIONS SUMMARY

Mining Operations

The facility provided a full description of its mining activities in its mine permit renewal application (**Appendix F**). Following is a description of the mining operations based on observations and discussions with the facility representatives and the application. The facility is an active mine, and the actual operations are changed regularly based on the needs of U.S. Steel at the time of operation.

The Keetac mine and plant facility consists of mining excavation, mining waste rock disposal, a processing plant, materials and equipment storage areas, a water treatment facility, and wastewater treatment and disposal facilities. The principal activities at the facility are the open-pit mining of taconite (Biwabik Iron Formation) and the associated processing of mined taconite to produce taconite pellets.

Most surface drainage and groundwater dewatering from mining waste disposal and excavation areas in the eastern half of the facility are collected in mine pit sumps and then pumped to

Carlz Pit. These mine pit sumps include those from Bennett, Russell, Section 18, and Stevenson Pits.

Water from the Bennett, Russell, Section 18, and Stevenson Pit sumps (overflow) is routed to Carlz Pit via pump stations in Section 18 and Russell Pits (**Appendix G**, photos PA250003, PA250004, and PA250005).

Water from Carlz Pit may then be used as makeup water in the plant via a lift pump that carries water from Carlz Pit to the Wolf Hill head tank (**Appendix G**, photo PA250006).

Dewatering from Sargent Pit has the capability of routing to Russell Pit (**Appendix G**, photo PA250001), and Sargent Pit may also pump to Mesabi Chief Pit, which is directly linked to outfall SD-003, located at O'Brien Creek (**Appendix G**, photos PA250002 and PA250008).

On the west side of the pit operations, Perry Pit discharges directly through outfall SD-012 (**Appendix G**, photos PA250009 and PA250010).

Domestic sanitary wastewater is treated on-site by an activated sludge package plant. Treated effluent is discharged through outfall WS005 (treated domestic wastewater effluent) to Bennett Pit. The treatment system consists of a bar screen, comminutor, diffused aeration tank, sludge holding tank, and chlorination contact tank. The sewage plant is designed to treat 40,000 gallons per day (GPD) of sanitary wastewater with a 5-day carbonaceous biochemical oxygen demand (CBOD5) influent strength of 140 milligrams per liter (mg/L). Facility representatives stated that the flow rate currently averages 25,000 GPD (**Appendix G**, photos PA260025-PA260028). Bio-solids from this treatment process are transferred off-site by a licensed waste hauler to a permitted wastewater treatment facility.

Process wastewater is produced and collected in the bottom of two coarse crushers located in Section 18 Pit. Crusher #1 and crusher #2 process wastewater is pumped to sump #1 and then to the Section 18 Pit sump. A septic holding tank stores the sanitary wastewater generated in the pit areas. This sanitary wastewater is hauled to the on-site wastewater treatment facility.

The combined floor drain overflow from the concentrator and the pellet plant is routed to Bennett Pit, which discharges to Russell Pit, and then is pumped to Carlz Pit. The floor drain overflow may include emergency overflow process wastewater from the concentrator if a power failure occurs.

All steam-cleaning and floor drain wastewater from the truck shops and the plant/machine/welding shops is treated by an oil/water separator and sedimentation tank prior to overflowing to a drainage pipe to Bennett Pit. Sludge from the shop areas is taken off-site by a licensed

waste hauler for treatment or disposal. Oils removed from the oil/water separator are transported off-site for disposal or reuse.

A single fueling point located near the primary crushers in the mining pit area consists of twin 25,000-gallon diesel tanks (**Appendix G**, photo PA260032). This area is used for fueling heavy equipment used in the mine pit areas. An additional fueling point is located near the plant area and consists of a single 10,000-gallon diesel tank (**Appendix G**, photo PA260034). The final fueling location is next to the “new truck shop” and consists of an underground gasoline storage tank that is connected to the small vehicle fuel pumps (**Appendix G**, photo PA260038).

The concentrator plant on the mining operations side is the primary contributor of tailings and water to the tailings basin. Process water is introduced to the plant in part as makeup and clean water from the Wolf Hill head tank (**Appendix G**, photo PA270053). The remainder of the water used in processing is recirculated through the facility. The concentrator consists of a series of mills, magnetic separators, hydro separators, hydro clones, screens, and thickeners (**Appendix G**, photos PA270041-PA270047 and PA270049). A flocculent is added to the concentrator tailings slurry before the thickening stage. The agglomerator receives the concentrate, which is mixed with limestone/dolomite and then dewatered by disc filters. The filter cake is then mixed with bentonite and formed into pellets in balling drums. The agglomerator wastewater, as well as wet scrubber wastewater, recirculating non-contact cooling water, and normal floor drain wastewater that is generated at the plant, is recirculated as process water within the plant.

Two recirculating wet scrubbers treat waste gas from the existing indurating grate-kiln used to fire the concentrate and bentonite mixed pellets. Blowdown water from these wet scrubbers is sent to a wastewater treatment system. Chemicals used in the wet scrubber system include calcium hydroxide for pH control and as a clarification/coagulation aid. Diluted hydrochloric acid is used to clean pH probes. Two types of lime descaler are used to clean lime deposits. The wastewater from the scrubber system is mixed with the tailings slurry in the tailings sump (**Appendix G**, photo PA270051)

The majority of plant wastewater is combined with waste tailings and discharged to the tailings basin system as tailings slurry. Waters discharged in the slurry include treated blowdown water from two recirculating wet scrubbers. The wastewater treatment system includes lime addition (**Appendix G**, photo PA270056) to promote calcium sulfate (gypsum) precipitation and solids settling in an existing thickener (old indurating thickener). Solids from the thickener are dewatered using two filter presses (**Appendix G**, photo PA270057) and disposed of off-site. Overflow from the thickener and filtrate from the filter presses are sent to the tailings basin within the slurry. The discharges from the tailings basin system are subject to permit MN0055948. The surface water discharges associated with the tailings basin system ultimately flow into Reservoir 2.

Ten settling basins surround the production area and eventually discharge into Welcome Creek through outfall SD-002 (**Appendix G**, photo PA260015). Flows that enter the 10 settling basins are:

- Overflows from the Wolf Hill head tank.
- Runoff from the plant area, as well as some active and inactive waste rock stockpile areas, that are routed directly to the 10 settling basins.
- Water from the pellet dust control operations (**Appendix G**, photos PA260011 and PA260012).
- Ancillary tailings pipeline discharges. Two parallel tailings pipelines exit the north side of the concentrator and approximately follow the 10 settling basins prior to crossing Highway 169 toward the tailings basin. Segments of these pipelines do not have spill containment berms, and some leaks from pipelines north of Highway 169 may flow toward the 10 settling basins. The tailings are pumped through the pipelines, which include three dump valve drainage points north of Highway 169. These dump-valve points include detention basins and ponds used to contain tailings and process wastewater that is drained from the pipeline(s) during line change-over, normal maintenance, and emergency shutdowns. Dump points 1 and 2 overflow to the 10 settling basins, while dump point 3 drains into a non-discharging infiltration basin.

The potable water treatment plant is located just north of Welcome Lake. The water treatment plant backwash wastewater from the sand filters is periodically discharged through a culvert through outfall SD-001 to Welcome Lake (**Appendix G**, photos PA260030 and PA260031). The plant uses potassium permanganate for iron removal and sodium hydroxide for pH balancing.

Some additional discharge from mining waste rock stockpile drainage flows to unnamed wetlands and creeks.

The facility occasionally applies dust suppressants to roads in the plant and mine area. A usage report for 2019-2021 indicated that the facility used 4,306 gallons of magnesium chloride in the plant area in June 2019 and 4,306 gallons of calcium chloride in the mining area in July 2021 (**Appendix H**). No usage of dust suppressant chemicals was reported in 2020. Water trucks are also used for dust control on roads and within the plant area. These trucks are filled at water fill stations that utilize mine dewatering water as their source of water.

Dry storage buildings are located north and east of the processing facilities. A shovel repair area is located on the northwest side of Russell Pit. Neither of these areas generate process or sanitary wastewaters.

Tailings Management

The facility provided a full description of the tailings basin operational activities in its tailings basin permit renewal application (**Appendix I**). Following is a description of the tailings basin operation based on observations and discussions with the facility representatives and the application. There are significant overlaps with the previously described mine operations.

The tailings basin facility provides the primary method of process water treatment as well as most makeup water for the plant process. The system consists of the inner tailings basin, outer tailings basin, 2nd stage pond, Reservoir 6, a small maintenance building, the drainage areas contributing surface runoff to these basins/reservoirs, and all non-sewage wastewater disposal systems contributing flow to the tailings discharge.

The tailings and related process water treated in the tailings basin are generated by the mine operations permitted under permit MN0031879.

The process water flow to the tailings basin consists of the tailings slurry and the associated process water. The average tailings slurry flow rate is 20-25 million gallons per day (MGD). The tailings slurry and plant process water are pressurized using a series of inline pumps in the plant (**Appendix G**, photo PA270052) and then piped under pressure from the plant across Highway 169, where the slurry is sprayed into the tailings basin (**Appendix G**, photo PA260018). The dual tailings pipelines have several gravity flow drainage points along their route that are used during routine maintenance, winter operations, and emergency situations such as pump failure.

The tailings basin is divided into two parts, the inner tailings basin and the outer tailings basin. The tailings slurry is discharged into the inner tailings basin via a spigot system such that coarse tails are deposited near the outer areas (used to build the containment dike) and fine tails are deposited further from the outer edge and settle out within the tailings pond. The elevation of the inner tailings basin increases with time, as tailings settle within the pond and increase the pond bottom elevation.

Water discharges from the inner tailings basin via a decant structure (**Appendix G**, photo PA260017) into the outer tailings basin, where it flows to the 2nd stage pond for additional sedimentation. The outer tailings basin dikes are constructed of clay starter dikes with a coarser sand and gravel chimney drain. The tailings basin (outer and inner) is principally underlain by glacial till and glaciofluvial deposits.

Water from the 2nd stage pond is moved to Reservoir 6 via a structure located in the southwest corner. Most of the water routed into Reservoir 6 is re-circulated back to the plant as makeup water via a pump house to the Wolf Hill head tank (**Appendix G**, photos PA260020 and

PA250007). Surface water from Reservoir 6 discharges through outfall SD005 (**Appendix G**, photo PA260016) into a drainage swale and then into Reservoir 2.

Depending on water elevations, water can flow in reverse through the drainage swale, which will convey water from Reservoir 2 North into Reservoir 6. Reservoir 2 North also receives water from Welcome Creek.

At the time of the inspection, water was being pumped from Reservoir 2 to Reservoir 6 for water-level maintenance (**Appendix G**, photo PA260022).

Reservoir 6 is equipped with emergency overflow to Reservoir 2 via siphon outlet SD001 (**Appendix G**, photo PA260021). This discharge point is above the typical water elevation in Reservoir 6; discharge monitoring reports (DMRs) that the NEIC field team reviewed during the inspection indicate this location has not discharged in the last 3 years.

Surface water monitoring station SW001 is located at the weir outlet of Reservoir 2; no permit limits are associated with the SW001 monitoring station (**Appendix G**, photo PA260023).

Per the permit renewal application, precipitation that falls on the outer edge of the exterior tailings basin dike flows as surface runoff away from the basin and may discharge to various surface waters, including West Swan River, unnamed wetlands, Hay Creek, Reservoir 2, Reservoir 2 North, and Welcome Creek.

A usage report from 2019-2021 indicated that the facility used 8,337 gallons of magnesium chloride in the tailings basin area in July 2019 and 10,000 gallons of calcium chloride in the tailings area in July 2021; both the calcium chloride and magnesium chloride were used as dust suppressants (**Appendix H**).

Repair shops and a garage are located to the north of the main tailings basin, and vehicle and/or equipment maintenance is conducted indoors.

Portable toilets are used in the tailings basin operational area, and sewage is disposed of by properly licensed waste haulers.

A diagram showing the complete water flow under both permits MN0031879 and MN0055948 is included in **Appendix J**. The diagram shows the closely interrelated nature of the water management operations. **Appendix K** also shows a more detailed water balance diagram, but the information is from 2011/2012.

Closures

The facility has had several substantial shutdowns, primarily for economic reasons. During extended shutdowns, environmental staff continue monitoring operations required by the permit, and dewatering operations continue due to costs and time required to dewater flooded areas. Staff indicated the following closure time frames:

- December 7, 2008-December 27, 2009
- May 17, 2015-March 5, 2017
- April 19, 2020-December 14, 2020

Sulfate Reduction Operations

Per the permit requirements, the facility tested multiple strategies to reduce sulfate discharges from the operations per the compliance schedule contained in permit MN0031879. U.S. Steel - Keetac evaluated multiple technologies to determine the most effective strategies for sulfate reduction in its discharges.

The facility first performed a full water management study in July 2012 and used that study, in part, as the basis for the evaluation/development of sulfate reduction strategies (**Appendix L**). In addition to the water management study, the facility developed a report on possible strategies for sulfate reduction in July 2012 (**Appendix M**). The purpose of the combined reports was to develop the October 2012 sulfate reduction plan (**Appendix N**) that included the proposed actions that U.S. Steel - Keetac would take to comply with the final effluent limitations included in their permits.

In March 2014, U.S. Steel - Keetac submitted a revision to the October 2012 sulfate reduction plan (**Appendix O**). In the revision, U.S. Steel states:

In January 2013, approximately three months following submission of the SRP, MPCA informed U. S. Steel that the SRP could not be approved as written. The main reason for MPCA's rejection of the SRP was that wild rice was found to be present in various segments of Swan River downstream of Swan Lake, even though none of the Swan River downstream of Swan Lake had or has yet been officially designated as waters used for the production of wild rice. This same situation holds true for Hay Lake and Hay Creek, which have yet to be officially designated as waters used for the production of wild rice. U. S. Steel maintains that unless a specific water body/stream reach is officially designated as waters used for the production of wild rice, the Class 4A wild rice sulfate standard does not apply.

U.S. Steel further stated that the goal of the revised submission, in part, was to provide an update to a November 2013 submission, which, in turn, was a revision of the original submission with changes requested by MPCA.

During the inspection, U.S. Steel - Keetac provided the inspection team with a technical feasibility study on the use of a pilot-scale BioteQ ion exchange technology combined with treatment of nanofiltration retentate using lime softening and Sulf-IX (**Appendices P and Q**).

In December 2014, U.S. Steel - Keetac applied to MPCA for site-specific standards for Hay Lake, Hay Creek, Swan Lake (including Swan Lake, southwest bay), and Swan River (Swan Lake outlet to confluence with Snowball Creek). This application did not specify the desired level for the site-specific criteria but asked for the current 10 mg/L standard to be withdrawn, and for a site-specific level to be established (**Appendix R**).

In 2016, U.S. Steel - Keetac conducted an on-site pilot study of a GE Water & Process Technologies ZeeWeed 1500 and nanofiltration system. The pilot system was operated from August to October 2016 and was set up to remove sulfate from Welcome Creek (**Appendix G**; photo PA260014 shows the location of the pilot study). The full report on the study is included as **Appendix S**.

In August 2022, the facility applied to MPCA for a sulfate site-specific standard at Hay Lake (located downstream from the Keetac mine operations). In its application letter (**Appendix T**), the facility stated that it had previously submitted requests to the MPCA for site-specific standards and that the current application is an update to:

The Application for Site-Specific Sulfate Standard(s) for Hay Lake, Hay Creek, Swan Lake (including Swan Lake Southwest Bay), and Swan River (Swan Lake outlet to confluence with Snowball Creek), submitted in December 2014 with MPCA acknowledgement of receipt on December 29, 2014. To date, the MPCA has not acted on this application for Keetac. U. S. Steel requests the MPCA approve and implement this revised request for a sulfate site-specific standard of 79 mg/L at Hay Lake, which will replace the existing Class 4A sulfate standard of 10 mg/L. The site-specific standard is being requested in accordance with Minn Rules, part 7050.0220, subpart 7.

The facility does not currently use any sulfate reduction strategies but continues to monitor for sulfate in its discharges per the permit requirements. The facility removed the sulfate treatment systems that were installed on-site because MPCA and the Minnesota state legislature passed a series of rules and laws requiring additional evaluation of sulfate impacts on wild rice production and growth.

In 2015, the Minnesota state legislature passed a law, in part, prohibiting MPCA from requiring permitted facilities “to expend money for design or implementation of sulfate treatment technologies or other forms of sulfate mitigation.” **See Appendix U**, page 144.

In 2016, the state of Minnesota passed a law stating, in part, that the “final sulfate limits resulting from implementation of the wild rice water quality standard in Minnesota Rules, part

7050.0224, subpart 2, are no longer valid; and (2) any compliance schedule permit conditions related to those final limits are no longer valid.” See **Appendix V**.

On August 12, 2016, the attorney general of the state of Minnesota sent a letter to the EPA stating their belief that the laws passed by the state did not interfere with MPCA’s ability to implement the NPDES program (**Appendix W**).

Further, on January 12, 2017, the MPCA sent a letter to U.S. Steel stating, in part, that the facility had completed the requirements of its schedule of compliance and that the associated schedule of compliance was terminated (**Appendix X**).

On February 16, 2022, the EPA Region 5 Administrator sent a letter to the commissioner of MPCA stating, in part, “that the session laws (from 2015 and 2016) constitute a non-substantial change to Minnesota’s NPDES program and are inconsistent with the Clean Water Act (CWA). EPA therefore disapproves the program revision affected by these laws as an improper modification to MPCA’s authority to implement the NPDES program.” See **Appendix Y**.

Permit Modification Requests

In September 2017, the facility requested a modification to permit MN0031879 to change the monitoring requirements at the wastewater treatment facility from an 8-hour-flow-based composite sample to a once-per-week grab sample (**Appendix Z**).

In March 2021, the facility applied to have selenium monitoring removed from the tailings basin permit because the original permit stated that “the permittee may request to modify this requirement after 12 months of monitoring data have been submitted to the MPCA.” See **Appendix AA**.

In August 2021, MPCA responded to both requests for permit modifications: “Each of the modification requests were submitted after the permits expired. At this time, the MPCA cannot make modifications to expired permits without reissuing the entire permit. We will consider these change requests during the permit reissuance process.” See **Appendix BB**. Facility representatives stated that MPCA has not provided the facility with an estimated timeline for reissuing the permits.

FIELD ACTIVITIES SUMMARY

NEIC conducted the field inspection from October 25-28, 2022. An opening conference was held on October 25, 2022, during which credentials were presented to facility contacts listed in Table 2 of this report. NEIC was joined on the inspection by Jake Berger and Matthew Schulte from EPA Region 5. During the inspection, the NEIC inspection team reviewed monitoring

reports, laboratory sampling data, training records, production records, process flow diagrams, and self-reported noncompliance notifications and interviewed personnel at the facility. In addition, NEIC conducted a walk-through inspection of the entire mining and tailings operations.

INVESTIGATION OBSERVATIONS

NEIC identified the following observations during the Clean Water Act compliance inspection. NEIC field team members discussed all observations with facility representatives during the closeout meeting, unless otherwise noted in the observation description.

These observations are not final compliance determinations. EPA Region 5 will make the final compliance determinations based on its review of this report and other technical, regulatory, and facility information.

Observation 1
Observation Summary: U.S. Steel - Keetac had multiple exceedances of permitted sulfate limits.
Citation: NPDES/SDS Permit MN0031879, Chapter 1, Part 1.1 – <i>The Permittee shall meet the terms of the compliance schedule detailed below in order to attain compliance with the final effluent limitations contained in this permit and NPDES/DES Permit MN055948 for total sulfate. The permittee shall continue to work toward minimizing sulfate in the discharges to the extent practical prior to the compliance date. Compliance with the final effluent limitations shall be attained as soon as possible, and in no case shall compliance be attained later than August 17, 2018, for non-tailings basin discharges, and August 17, 2019, for tailings basin discharges unless the permit is modified pursuant to 40 CFR 122.62.</i>
Evidence: Appendix CC – U.S. Steel - Keetac MN0031879 Discharge Monitoring Reports, January 2019-September 2022 (Sulfate Highlights) Appendix DD – U.S. Steel - Keetac MN0055948 Discharge Monitoring Reports, January 2019-September 2022 (Sulfate Highlights) Appendix A – U.S. Steel - Keetac NPDES Permit MN0031879 – Mine Operations Appendix B – U.S. Steel - Keetac NPDES Permit MN0055948 – Tailings
Description of Observation: NEIC review of DMRs (Appendices CC and DD) provided by the facility showed multiple exceedances of sulfate limits based on the final effluent limits provided in both permits for the facility. Permit MN0031879 (Appendix A) has final sulfate limits of 14 mg/L monthly average and 21 mg/L monthly maximum. A review of the monthly DMRs for permit MN0031879 from January 2019 through September 2022 showed the following total exceedances of sulfate limits under the permit: 1) 135 calendar month average exceedances 2) 118 calendar month maximum exceedances These exceedances do not show as violations in ECHO because the system identifies the sulfate limits as “REPORT.” DMRs prior to January 2019 were not reviewed as part of this inspection. Note: Appendix CC includes some duplicate DMRs because the facility filed amended DMRs in some instances.

Observation 1

Permit MN0055948 (**Appendix B**) has final sulfate limits of 14 mg/L monthly average and 21 mg/L monthly maximum. A review of the monthly DMRs for permit MN0055948 from September 2019 through September 2022 showed the following total exceedances of sulfate limits under the permit:

- 1) 23 calendar month average exceedances
- 2) 23 calendar month maximum exceedances

These exceedances do not show as violations in ECHO because the system identifies the sulfate limits as "REPORT." Sulfate limits were not applicable until after August 17, 2019, for permit MN0055948.

Note: **Appendix DD** includes some duplicate DMRs because the facility filed amended DMRs in some instances.

Observation 2

Observation Summary: U.S. Steel - Keetac did not collect permit-required samples.

Citation:

NPDES/SDS Permit MN0055948, Limits and Monitoring Requirements – *The Permittee shall comply with the limits and monitoring requirements as specified below... Period: Limits applicable in the Final Period – SD 005, Sulfate, Total (as SO₄)... 2 x Month*

Evidence:

Appendix B – U.S. Steel - Keetac NPDES Permit MN0055948 – Tailings

Appendix DD – U.S. Steel - Keetac MN0055948 Discharge Monitoring Reports, January 2019-September 2022 (Sulfate Highlights)

Description of Observation: NPDES/SDS permit MN0055948 (**Appendix B**) requires once-per-month sampling for iron dissolved (as Fe), pH, selenium total (as Se), total suspended solids (TSS), specific conductance, and twice-per-month sampling for sulfate, total (as SO₄).

In August 2022, no samples were collected from outfall SD-005 even though a discharge was occurring. The facility stated on the DMR, "Only limited discharge was observed through SD-005 during August 2022. Flow was observed and measured on 8/19/22 and a sampling event was planned for 8/23/22 but by then the discharge had gone to zero, as was the case for the balance of August. As a result, constituent monitoring was not possible." See **Appendix DD**, page 319.

In September 2022, only one sulfate sample was collected from outfall SD-005. The facility stated in the DMR, "Discharge through SD005 was limited to a portion of one week during September 2022. Therefore, it was not possible to collect a 2nd sulfate sample as required by permit." See **Appendix DD**, page 326.

Note: This observation is based on documents received from the facility and was reviewed following the on-site inspection and not discussed with the facility representatives during the closing conference.

Observation 3

Observation Summary: WS005 composite sampling is not flow-proportioned.

Observation 3
Citation: NPDES/SDS Permit MN0031879, Limits and Monitoring Requirements – <i>The Permittee shall comply with the limits and monitoring requirements as specified below... Period: Limits applicable in the Final Period – WS 005: Treated Domestic Effluent,... 8-Hour Flow Composite</i>
Evidence: Appendix A – U.S. Steel - Keetac NPDES Permit MN0031879 – Mine Operations Appendix EE – Email on Wastewater Treatment Plant Sampling Procedure Appendix C – Minnesota Pollution Control Agency Inspection Report from June 15, 2017, Inspection Appendix Z – Wastewater Treatment Plant Sampling Permit Modification Request
Description of Observation: Permit MN0031879 (Appendix A) requires sampling from WS005, the treated domestic wastewater effluent. The permit specifies that biochemical oxygen demand (BOD), carbonaceous; phosphorus, total; and solids, total suspended are to be collected as 8-hour flow composite samples. The facility currently collects these samples as 8-hour time composites, with facility representatives stating, “The flows from the facility are relatively stable so a time weighted sample is appropriate.” See Appendix EE. This same observation is in the report on the MPCA inspection conducted June 15, 2017 (Appendix C). The facility requested a modification to the permit to allow for weekly grab samples, but the request occurred after the permit expired (Appendix Z).
Observation 4
Observation Summary: The SWPPP lacks a procedure for sheening management in secondary containment of aboveground storage tank and pit refueling areas.
Citation: NPDES/SDS Permit MN0031879, Chapter 6, Section 4.9 – <i>Describe appropriate BMPs, including structural and non-structural BMPs, that will be used at the facility to minimize or eliminate pollution of stormwater at the site. The description must include an objective for each BMP, as well as a description of how to evaluate proper functioning of the BMP and any maintenance requirements of the BMP.</i>
Facility SWPPP, Section 7.2, Eliminating and Reducing Exposure, and Section 7.8, Spill Prevention and Response
Evidence: Appendix A – U.S. Steel Keetac NPDES Permit MN0031879 – Mine Operations Appendix FF – U.S. Steel - Keetac Storm Water Pollution Prevention Plan, Revision 14, October 7, 2019 Appendix G – NEIC Field Photographs - U.S. Steel - Keetac
Description of Observation: Permit MN0031879 (Appendix A) requires a description of all the best management practices (BMPs) that will be used to minimize or eliminate pollution at the site as part of the facility’s SWPPP. Page 18 of the SWPPP includes a description of the

Observation 4

aboveground storage tanks, including statements that the secondary containment is drained after significant rainfalls after inspection for sheening (**Appendix FF**).

Discussions with facility representatives revealed that U.S. Steel- Keetac has no standard for determining the appropriate control in the event sheen is discovered in secondary containment. The facility further stated that if the sheen is “bad enough,” a contractor will be called to remove the contaminated water, but if it is “not too bad,” it will be discharged.

During the inspection, NEIC inspectors observed a sheen on the water in the secondary containment of both aboveground storage tank locations (**Appendix G**, photo PA260033 and PA260035), but did not observe a discharge of the secondary containment water during the inspection.

Observation 5

Observation Summary: Chemical containers were stored and exposed to potential stormwater runoff.

Citation:

NPDES/SDS Permit MN0031879, Chapter 6, Section 4.1 – *The Permittee shall develop and implement a Stormwater Pollution Prevention Plan (Plan) to address the specific conditions at the industrial facility. The goal of the Plan is to eliminate or minimize contact of stormwater with significant materials that may result in pollution of the runoff.*

NPDES/SDA Permit MN0055948, Chapter 4, Section 4.1 – *The Permittee shall develop and implement a Stormwater Pollution Prevention Plan (Plan) to address the specific conditions at the industrial facility. The goal of the Plan is to eliminate or minimize contact of stormwater with significant materials that may result in pollution of the runoff. If contact cannot be eliminated or reduced, stormwater that has contacted significant material should be treated before it is discharged from the site. The Plan shall apply to those areas of the facility where industrial activities occur or significant materials are stored, and stormwater runoff does not receive treatment prior to discharge via a permitted surface discharge station.*

Facility SWPPP, Section 7.2, Eliminating and Reducing Exposure

Facility SWPPP BMP 2 – *The hazardous / non-hazardous waste storage area is a curbed 3-sided building with a roof. The building is designated for the storage of properly labeled barrels containing waste oil, hazardous, and non-hazardous waste materials waiting to be removed from the site by vendors.*

Facility SWPPP BMP 14 – *Good housekeeping practices employed include: to the extent practical, significant materials shall be stored in areas not exposed to precipitation or runoff.*

Evidence:

Appendix A – U.S. Steel Keetac NPDES Permit MN0031879 – Mine Operations

Appendix B – U.S. Steel Keetac NPDES Permit MN0055948 – Tailings

Appendix G – NEIC Field Photographs - U.S. Steel - Keetac

Appendix GG – Diesel Exhaust Fluid Safety Data Sheet

Appendix FF – U.S. Steel - Keetac Storm Water Pollution Prevention Plan, Revision 14, October 7, 2019

Observation 5

Description of Observation: Both permits for the facility require the development of storm water pollution protection plans “to address the specific conditions at the industrial facility. The goal of the Plan is to eliminate or minimize contact of stormwater with significant materials that may result in pollution of the runoff.” See **Appendices A and B**.

NEIC inspectors observed a container of diesel exhaust fluid (DEF) on an access road near the south side of the tailings basin, between the primary tailings basin and outer tailings basin/second stage pond (**Appendix G**, photo PA260019). At the time of the inspection, the container had no storm water protection or secondary containment. The safety data sheet for DEF states that the secondary containment is not specified, but to prevent entry to sewers and public waters (**Appendix GG**).

The facility SWPPP states that hazardous and non-hazardous materials shall be stored in the curbed three-sided building with roof pending removal by vendors (**Appendix FF**). During the inspection, NEIC inspectors observed an unprotected, unlabeled, partially full container stored with empty containers (**Appendix G**, photo PA260037).

Inspectors also observed oil/fluid totes stored outside of the “old truck shop” that were exposed to stormwater and had no secondary containment (**Appendix G**, photo PA260039).

Observation 6

Observation Summary: Spilled fuel was observed on the ground outside of secondary containment in the plant fueling area.

Citation:

NPDES/SDS Permit MN0031879, Chapter 6, Section 4.1 – *The Permittee shall develop and implement a Stormwater Pollution Prevention Plan (Plan) to address the specific conditions at the industrial facility. The goal of the Plan is to eliminate or minimize contact of stormwater with significant materials that may result in pollution of the runoff.*

Facility SWPPP, Section 7.8, Spill Prevention and Response**Evidence:**

Appendix G – NEIC Field Photographs - U.S. Steel - Keetac

Description of Observation: NEIC inspectors observed significant evidence of un-remediated fuel spills on the ground outside of the secondary containment area for the fueling point. The spill evidence is in the area where vehicles would normally pull up to for fueling (**Appendix G**, photo PA260036).

Observation 7

Observation Summary: The facility provided a list of self-reported non-compliance events associated with the mine operations area. The facility did not report any non-compliance events associated with the tailings areas.

Citation: N/A**Evidence:**

Appendix HH – Facility-Reported Permit Noncompliance Summary, 2017-2022

Observation 7

Description of Observation: The facility provided NEIC a summary of self-reported non-compliance events associated with the mining operations areas from 2017-2022 (**Appendix HH**).

The facility did not submit any self-reported non-compliance events associated with the tailings areas.

WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 5

EPA, *In re U.S. Steel Corp. Keetac Mining Operations and Tailings Basin*,
Notice of Violation, May 15, 2024.

IN THE MATTER OF:	)	
	)	
United States Steel Corporation	)	
Keetac Mining Operations and Tailings Basin	)	NOTICE OF VIOLATION
Keewatin, Minnesota	)	
	)	
	)	
	)	

The U.S. Environmental Protection Agency (EPA) is issuing this Notice of Violation (NOV) under Section 309(a)(1) of the Clean Water Act (CWA), 33 U.S.C. § 1319(a)(1). EPA finds that United States Steel Corporation (US Steel) has violated Section 301(a) of the CWA, 33 U.S.C. § 1311(a), at its Keetac iron ore mine, in Keewatin, Minnesota, as follows:

The Clean Water Act and National Pollutant Discharge Elimination System (NPDES) Permits

1. The CWA is the primary federal statute regulating the protection of the nation's waters. The CWA aims to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a).
2. Consistent with that objective, Section 301(a) of the CWA, 33 U.S.C. § 1311(a), prohibits the discharge of any pollutant into a water of the United States by any person except, *inter alia*, in compliance with a National Pollutant Discharge Elimination System (NPDES) permit issued pursuant to Section 402 of the CWA, 33 U.S.C. § 1342.
3. Section 402 of the CWA, 33 U.S.C. § 1342, authorizes states to request approval from EPA to administer their own NPDES permit programs for discharges into waters of the United States within their jurisdictions.
4. Either EPA or an approved State may initiate revision of the approved state's NPDES permit program. 40 C.F.R. § 123.62(a). A revision of a state's NPDES permit program becomes effective upon EPA's approval. *Id.* § 123.62(b)(4).
5. Pursuant to Section 402 of the CWA, 33 U.S.C. § 1342, the State of Minnesota requested approval from EPA to administer its own NPDES permit program for discharges into waters of the United States within Minnesota, and such approval was granted by EPA on June 30, 1974. *See* 39 Fed. Reg. 26,061 (July 16, 1974). Violation of an NPDES permit issued by Minnesota under the State's NPDES permit program is a violation of Section 301(a) of the CWA, 33 U.S.C. § 1311(a).

Minnesota's Water Quality Standards for NPDES Permits

6. Section 303 of the CWA requires states to adopt water quality standards, subject to EPA's approval. 33 U.S.C. § 1313. Water quality standards serve as the basis for determining NPDES permit effluent limitations for pollutants that are not specifically addressed in the effluent guidelines or for pollutants for which the effluent guidelines are not stringent enough to protect desired water uses. *See* 42 Fed. Reg. 56,786, 56,786-87 (Oct. 28, 1977).
7. Pursuant to Section 303 of the CWA, in 1973 Minnesota promulgated a sulfate water quality standard of 10 milligrams per liter (mg/L), which is applicable to waters used for the production of wild rice. *See* Minn. R. 7050.0224, subp. 2. EPA approved Minnesota's sulfate water quality standard in 1977. *See* 42 Fed. Reg. 56,786, 56,789 (Sept. 9, 1977).
8. Section 301(b)(1)(C) of the CWA and its implementing regulations require that NPDES permits include requirements necessary to achieve a state's approved water quality standards. 33 U.S.C. § 1311(b)(1)(C); 40 C.F.R. §§ 122.44(d)(1)-(5), 123.25(a)(15).
9. In 2011, the Minnesota state legislature passed a law directing the Minnesota Pollution Control Agency (MPCA) to update the sulfate wild rice water quality standard of 10 mg/L, as per Minn. Laws 2011, 1st Spec. Sess., Chapter 2, Article 4, Section 32. To date, MPCA has not updated the sulfate water quality standard.
10. In 2015, the Minnesota state legislature passed a law prohibiting MPCA from, among other things, requiring NPDES permittees "to expend money for design or implementation of sulfate treatment technologies or other forms of sulfate mitigation," and set 2018 as the deadline for MPCA to update the sulfate wild rice standard. Minn. Laws 2015, 1st Spec. Sess., Chapter 4, Article 4, Section 136(a)(1)(i), (c) (2015 Sulfate Law).
11. In 2016, the Minnesota state legislature passed another law declaring that "final sulfate limits resulting from implementation of the wild rice water quality standard . . . are no longer valid; and any compliance schedule permit conditions related to those final limits are no longer valid." Minn. Laws 2016, Chapter 165, Section 1 (a) (2016 Sulfate Law).
12. On February 16, 2022, EPA sent a letter to MPCA stating that the 2015 Sulfate Law and the 2016 Sulfate Law "are inconsistent with the Clean Water Act (CWA)," and therefore "EPA . . . disapproves the program revision affected by these laws as an improper modification to MPCA's authority to implement the NPDES program." EPA's letter further explained that, as a result, "the effluent limits and permit compliance schedules invalidated by the 2016 Sulfate Law remain subject to any federal enforcement and citizen action as provided for under the CWA."
13. To date, the State of Minnesota has not submitted any proposed revisions to its sulfate water quality standard for EPA's approval. Accordingly, the 10 mg/L sulfate standard remains in effect for CWA permitting and enforcement purposes.

Factual Allegations

14. US Steel owns and operates the Keetac taconite iron ore mining operations and tailings basin at 1 Mine Road in Keewatin, Minnesota (Facility), which began operating in 1967.
15. According to US Steel's website, the Facility can produce about 6 million tons of iron ore pellets each year. These iron-containing pellets are used to make steel.
16. MPCA issued NPDES Permit No. MN0031879 to US Steel for discharges from the Facility's mining operations (Mining Operations Permit) under Section 402 of the CWA, 33 U.S.C. § 1342. The Mining Operations Permit became effective on November 15, 2011, and was later modified on September 4, 2015. MPCA also issued US Steel NPDES Permit No. MN0055948 for discharges from the Facility's tailings basin (Tailings Basin Permit) under Section 402 of the CWA, 33 U.S.C. § 1342. The Tailings Basin Permit became effective on November 15, 2011.
17. The Mining Operations Permit and the Tailings Basin Permit both expired on October 31, 2016, but have been administratively continued by MPCA and continue to authorize and govern wastewater discharges from the Facility's mining operations and tailings basin.
18. The Mining Operations Permit authorizes discharges from Outfall SD 002 into Welcome Lake, from Outfall SD 003 into O'Brien Reservoir, and from Outfall SD 012 into O'Brien Creek. The Tailings Basin Permit authorizes discharges from Outfall SD 005 into Welcome Creek.
19. In 2010, before issuance of the Mining Operations Permit and Tailings Basin Permit, MPCA determined that discharges from US Steel's mining operations and tailings basin reach downstream waters "used for the production of wild rice" as stated in Minn. R. 7050.0224, subp. 2, including Hay Lake.
20. MPCA's Impaired Waters List includes waters in the State that fail to meet water quality standards under the CWA and is updated once every two years. MPCA's 2022 Impaired Waters List identifies Hay Lake as impaired due to sulfate.
21. At all times relevant to this NOV, US Steel was authorized to discharge pollutants from the Facility to waters of the United States only in compliance with the specific terms and conditions of the Mining Operations Permit and the Tailings Basin Permit.
22. The Mining Operations Permit and the Tailings Basin Permit both contain interim and final effluent requirements for total sulfate. During the "Interim Period," US Steel is required to monitor for sulfate concentration twice per month. During the "Final Period," US Steel is subject to total sulfate effluent limits of 14 mg/L as a calendar month average concentration, and 24 mg/L as a calendar month maximum concentration.
23. Chapter 1, Section 1.1 of the Mining Operations Permit states that "[t]he Permittee shall

meet the terms of the compliance schedule detailed below in order to attain compliance with the final effluent limitations contained in this permit and [the Tailings Basin Permit] for total sulfate. The Permittee shall continue to work toward minimizing sulfate in the discharges to the extent practical prior to the compliance date. Compliance with the final effluent limitations shall be attained as soon as possible, and in no case shall compliance be attained later than August 17, 2018 for non-tailings basin discharges, and August 17, 2019 for tailings basin discharges, unless the permit is modified pursuant to 40 CFR 122.62.” Therefore, the “Final Period” of compliance began on August 17, 2018, for the mining operations discharges, and August 17, 2019, for the tailings basin discharges.

24. The Mining Operations Permit and the Tailings Basin Permit require US Steel to complete effluent sampling and analysis each month. These data are reported in monthly Discharge Monitoring Reports prepared by US Steel and submitted to MPCA.
25. From October 25, 2022, to October 28, 2022, EPA conducted a CWA inspection of the Facility.
26. During EPA’s inspection, EPA requested US Steel’s Discharge Monitoring Reports for the mining operations discharges and the tailings basin discharges from January 2019 to September 2022.
27. EPA’s review of the Discharge Monitoring Reports for the mining operations discharges found 135 exceedances of the Mining Operations Permit’s monthly average sulfate effluent limit of 14 mg/L between January 1, 2019, and September 30, 2022. EPA’s review found 118 exceedances of the Mining Operation Permit’s monthly maximum sulfate limit of 24 mg/L for this same period. These exceedances are listed in Appendix 1.
28. EPA’s review of the Discharge Monitoring Reports for the tailings basin discharges found 23 exceedances of the Tailings Basin Permit’s monthly average sulfate effluent limit of 14 mg/L between September 1, 2019, to September 30, 2022. EPA’s review found 23 exceedances of the Tailings Basin Permit’s monthly maximum sulfate concentration limit of 24 mg/L for this same period. These exceedances are listed in Appendix 2.

Violations

29. Each instance in which US Steel discharged sulfate in amounts exceeding the final sulfate effluent limits contained in the Mining Operations Permit or the Tailings Basin Permit is a violation of NPDES Permit No. MN0031879 or NPDES Permit No. MN0055948, respectively. Therefore, as described in Paragraph 27 and Paragraph 28 above, US Steel has violated the terms of these permits a total of 299 times.
30. US Steel’s failure to comply with the final effluent limits in the Mining Operations and Tailings Basin Permits at the Facility is a violation of Section 301(a) of the CWA, 33 U.S.C. § 1311(a).

**MICHAEL
HARRIS**

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Date: 2024.05.15
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Michael D. Harris
Division Director
Enforcement and Compliance Assurance Division

Appendix 1: Exceedances of sulfate limits at the US Steel – Keetac Mining Operations (NPDES Permit No. MN0031879); January 1, 2019, to September 30, 2022. NPDES Permit No. MN0031879 has an average sulfate concentration limit of 14 mg/L and a maximum sulfate concentration limit of 24 mg/L.

Monitoring Period End Date	Parameter	Outfall	Average Concentration (mg/L)	Maximum Concentration (mg/L)
1/31/2019	Sulfate, Total (as SO ₄)	SD 002	132	137
1/31/2019	Sulfate, Total (as SO ₄)	SD 003	51.7	52
1/31/2019	Sulfate, Total (as SO ₄)	SD 012	24.9	25.2
2/28/2019	Sulfate, Total (as SO ₄)	SD 002	128.5	132
2/28/2019	Sulfate, Total (as SO ₄)	SD 003	51.4	53.5
2/28/2019	Sulfate, Total (as SO ₄)	SD 012	25.1	25.3
3/31/2019	Sulfate, Total (as SO ₄)	SD 002	114.2	130
3/31/2019	Sulfate, Total (as SO ₄)	SD 003	52.7	55.9
3/31/2019	Sulfate, Total (as SO ₄)	SD 012	25.8	26.2
4/30/2019	Sulfate, Total (as SO ₄)	SD 002	123	134
4/30/2019	Sulfate, Total (as SO ₄)	SD 003	63.2	70.3
4/30/2019	Sulfate, Total (as SO ₄)	SD 012	25.9	26.5
5/31/2019	Sulfate, Total (as SO ₄)	SD 002	133	136
5/31/2019	Sulfate, Total (as SO ₄)	SD 003	71.3	77.3
5/31/2019	Sulfate, Total (as SO ₄)	SD 012	23.8	24.1
6/30/2019	Sulfate, Total (as SO ₄)	SD 002	135	137
6/30/2019	Sulfate, Total (as SO ₄)	SD 003	59.3	59.3

6/30/2019	Sulfate, Total (as SO ₄)	SD 012	24.1	24.2
7/31/2019	Sulfate, Total (as SO ₄)	SD 002	132	134
7/31/2019	Sulfate, Total (as SO ₄)	SD 003	55	55
7/31/2019	Sulfate, Total (as SO ₄)	SD 012	22.3	Below Limit
8/31/2019	Sulfate, Total (as SO ₄)	SD 002	124	125
8/31/2019	Sulfate, Total (as SO ₄)	SD 003	59.3	63.5
8/31/2019	Sulfate, Total (as SO ₄)	SD 012	22.5	Below Limit
9/30/2019	Sulfate, Total (as SO ₄)	SD 002	114	117
9/30/2019	Sulfate, Total (as SO ₄)	SD 003	62.2	64.6
9/30/2019	Sulfate, Total (as SO ₄)	SD 012	20.1	Below Limit
10/31/2019	Sulfate, Total (as SO ₄)	SD 002	114.5	117
10/31/2019	Sulfate, Total (as SO ₄)	SD 003	68.9	73.1
10/31/2019	Sulfate, Total (as SO ₄)	SD 012	19.7	Below Limit
11/30/2019	Sulfate, Total (as SO ₄)	SD 002	129.5	132
11/30/2019	Sulfate, Total (as SO ₄)	SD 003	62.9	67.9
11/30/2019	Sulfate, Total (as SO ₄)	SD 012	20.9	Below Limit
12/31/2019	Sulfate, Total (as SO ₄)	SD 002	125.5	129
12/31/2019	Sulfate, Total (as SO ₄)	SD 003	51.2	53.3
12/31/2019	Sulfate, Total (as SO ₄)	SD 012	20.8	Below Limit
1/31/2020	Sulfate, Total (as SO ₄)	SD 002	130.5	132
1/31/2020	Sulfate, Total (as SO ₄)	SD 003	56.4	58.8

1/31/2020	Sulfate, Total (as SO ₄)	SD 012	24.7	25.2
2/29/2020	Sulfate, Total (as SO ₄)	SD 002	135.5	136
2/29/2020	Sulfate, Total (as SO ₄)	SD 003	56.1	56.3
2/29/2020	Sulfate, Total (as SO ₄)	SD 012	25.4	25.5
3/31/2020	Sulfate, Total (as SO ₄)	SD 002	133	140
3/31/2020	Sulfate, Total (as SO ₄)	SD 003	56.8	57.6
3/31/2020	Sulfate, Total (as SO ₄)	SD 012	25.4	25.8
4/30/2020	Sulfate, Total (as SO ₄)	SD 002	126	135
4/30/2020	Sulfate, Total (as SO ₄)	SD 003	61.4	64.9
4/30/2020	Sulfate, Total (as SO ₄)	SD 012	27.8	28.1
5/31/2020	Sulfate, Total (as SO ₄)	SD 002	148	150
5/31/2020	Sulfate, Total (as SO ₄)	SD 003	59.2	59.6
5/31/2020	Sulfate, Total (as SO ₄)	SD 012	24.6	24.7
6/30/2020	Sulfate, Total (as SO ₄)	SD 002	135.5	140
6/30/2020	Sulfate, Total (as SO ₄)	SD 003	62.7	69.4
6/30/2020	Sulfate, Total (as SO ₄)	SD 012	24.7	25.2
7/31/2020	Sulfate, Total (as SO ₄)	SD 002	141.5	146
7/31/2020	Sulfate, Total (as SO ₄)	SD 003	66.7	72.7
7/31/2020	Sulfate, Total (as SO ₄)	SD 012	25.2	25.2
8/31/2020	Sulfate, Total (as SO ₄)	SD 002	132	136
8/31/2020	Sulfate, Total (as SO ₄)	SD 003	68.8	69.7

8/31/2020	Sulfate, Total (as SO ₄)	SD 012	23.9	Below Limit
9/30/2020	Sulfate, Total (as SO ₄)	SD 002	144	148
9/30/2020	Sulfate, Total (as SO ₄)	SD 003	61.9	62.8
9/30/2020	Sulfate, Total (as SO ₄)	SD 012	21.3	Below Limit
10/31/2020	Sulfate, Total (as SO ₄)	SD 002	142.5	145
10/31/2020	Sulfate, Total (as SO ₄)	SD 003	63.9	66.1
10/31/2020	Sulfate, Total (as SO ₄)	SD 012	21.9	Below Limit
11/30/2020	Sulfate, Total (as SO ₄)	SD 002	139.5	141
11/30/2020	Sulfate, Total (as SO ₄)	SD 003	62.6	63.1
11/30/2020	Sulfate, Total (as SO ₄)	SD 012	21.5	Below Limit
12/31/2020	Sulfate, Total (as SO ₄)	SD 002	131.5	135
12/31/2020	Sulfate, Total (as SO ₄)	SD 003	59.2	59.4
12/31/2020	Sulfate, Total (as SO ₄)	SD 012	22.6	Below Limit
1/31/2021	Sulfate, Total (as SO ₄)	SD 002	141	145
1/31/2021	Sulfate, Total (as SO ₄)	SD 003	60.8	61.6
1/31/2021	Sulfate, Total (as SO ₄)	SD 012	26.2	26.5
2/28/2021	Sulfate, Total (as SO ₄)	SD 002	140.5	146
2/28/2021	Sulfate, Total (as SO ₄)	SD 003	60.9	61.4
2/28/2021	Sulfate, Total (as SO ₄)	SD 012	26.1	26.3
3/31/2021	Sulfate, Total (as SO ₄)	SD 002	135	139
3/31/2021	Sulfate, Total (as SO ₄)	SD 003	62.6	64.7

3/31/2021	Sulfate, Total (as SO ₄)	SD 012	26	26
4/30/2021	Sulfate, Total (as SO ₄)	SD 002	134	134
4/30/2021	Sulfate, Total (as SO ₄)	SD 003	69.8	74.3
4/30/2021	Sulfate, Total (as SO ₄)	SD 012	24.8	25.3
5/31/2021	Sulfate, Total (as SO ₄)	SD 002	146.5	147
5/31/2021	Sulfate, Total (as SO ₄)	SD 003	66.1	70
5/31/2021	Sulfate, Total (as SO ₄)	SD 012	21.8	Below Limit
6/30/2021	Sulfate, Total (as SO ₄)	SD 002	145.5	148
6/30/2021	Sulfate, Total (as SO ₄)	SD 003	66.4	70
6/30/2021	Sulfate, Total (as SO ₄)	SD 012	22.5	Below Limit
7/31/2021	Sulfate, Total (as SO ₄)	SD 002	151	157
7/31/2021	Sulfate, Total (as SO ₄)	SD 003	68.2	70.7
7/31/2021	Sulfate, Total (as SO ₄)	SD 012	24.1	24.5
8/31/2021	Sulfate, Total (as SO ₄)	SD 002	143.5	144
8/31/2021	Sulfate, Total (as SO ₄)	SD 003	65.3	67
8/31/2021	Sulfate, Total (as SO ₄)	SD 012	23.9	24.2
9/30/2021	Sulfate, Total (as SO ₄)	SD 002	135	142
9/30/2021	Sulfate, Total (as SO ₄)	SD 003	74.2	84.3
9/30/2021	Sulfate, Total (as SO ₄)	SD 012	22	Below Limit
10/31/2021	Sulfate, Total (as SO ₄)	SD 002	135	140
10/31/2021	Sulfate, Total (as SO ₄)	SD 003	69.5	72.3

10/31/2021	Sulfate, Total (as SO ₄)	SD 012	23.1	Below Limit
11/30/2021	Sulfate, Total (as SO ₄)	SD 002	143	148
11/30/2021	Sulfate, Total (as SO ₄)	SD 003	69.4	73.3
11/30/2021	Sulfate, Total (as SO ₄)	SD 012	22.5	Below Limit
12/31/2021	Sulfate, Total (as SO ₄)	SD 002	146	146
12/31/2021	Sulfate, Total (as SO ₄)	SD 003	65.5	68.8
12/31/2021	Sulfate, Total (as SO ₄)	SD 012	22.8	Below Limit
1/31/2022	Sulfate, Total (as SO ₄)	SD 002	144.5	146
1/31/2022	Sulfate, Total (as SO ₄)	SD 003	65.3	66
1/31/2022	Sulfate, Total (as SO ₄)	SD 012	24.5	24.8
2/28/2022	Sulfate, Total (as SO ₄)	SD 002	145.5	146
2/28/2022	Sulfate, Total (as SO ₄)	SD 003	63.8	64
2/28/2022	Sulfate, Total (as SO ₄)	SD 012	24.7	24.8
3/31/2022	Sulfate, Total (as SO ₄)	SD 002	141	145
3/31/2022	Sulfate, Total (as SO ₄)	SD 003	66.6	68
3/31/2022	Sulfate, Total (as SO ₄)	SD 012	25.7	26.1
4/30/2022	Sulfate, Total (as SO ₄)	SD 002	151.5	158
4/30/2022	Sulfate, Total (as SO ₄)	SD 003	73.7	76.5
4/30/2022	Sulfate, Total (as SO ₄)	SD 012	26.1	26.5
5/31/2022	Sulfate, Total (as SO ₄)	SD 002	154.5	167
5/31/2022	Sulfate, Total (as SO ₄)	SD 003	61.3	72.6

5/31/2022	Sulfate, Total (as SO ₄)	SD 012	27.5	27.9
6/30/2022	Sulfate, Total (as SO ₄)	SD 002	154	155
6/30/2022	Sulfate, Total (as SO ₄)	SD 003	71.8	72.2
6/30/2022	Sulfate, Total (as SO ₄)	SD 012	26.7	26.7
7/31/2022	Sulfate, Total (as SO ₄)	SD 002	151	151
7/31/2022	Sulfate, Total (as SO ₄)	SD 003	71.7	72.2
7/31/2022	Sulfate, Total (as SO ₄)	SD 012	26	26
8/31/2022	Sulfate, Total (as SO ₄)	SD 002	152.5	153
8/31/2022	Sulfate, Total (as SO ₄)	SD 003	73.6	76
8/31/2022	Sulfate, Total (as SO ₄)	SD 012	26.5	26.5
9/30/2022	Sulfate, Total (as SO ₄)	SD 002	148.5	149
9/30/2022	Sulfate, Total (as SO ₄)	SD 003	66.2	66.5
9/30/2022	Sulfate, Total (as SO ₄)	SD 012	23.7	25.2

Appendix 2: Exceedances of sulfate limits at the US Steel – Keetac Tailings Basin (NPDES Permit No. MN0055948); September 1, 2019, to September 30, 2022. NPDES Permit No. MN0055948 has an average sulfate concentration limit of 14 mg/L and a maximum sulfate concentration limit of 24 mg/L.

Monitoring Period End Date	Parameter	Outfall	Average Concentration (mg/L)	Maximum Concentration (mg/L)
9/30/2019	Sulfate, Total (as SO ₄)	SD 005	95.5	95.6
10/31/2019	Sulfate, Total (as SO ₄)	SD 005	92.3	97.5
11/30/2019	Sulfate, Total (as SO ₄)	SD 005	103.5	104
12/31/2019	Sulfate, Total (as SO ₄)	SD 005	102	105
1/31/2020	Sulfate, Total (as SO ₄)	SD 005	115	115
2/29/2020	Sulfate, Total (as SO ₄)	SD 005	123	130
3/31/2020	Sulfate, Total (as SO ₄)	SD 005	124.5	125
4/30/2020	Sulfate, Total (as SO ₄)	SD 005	102	107
5/31/2020	Sulfate, Total (as SO ₄)	SD 005	110	110
8/31/2020	Sulfate, Total (as SO ₄)	SD 005	103.5	106
9/30/2020	Sulfate, Total (as SO ₄)	SD 005	96	96.8
10/31/2020	Sulfate, Total (as SO ₄)	SD 005	95.6	95.7
11/30/2020	Sulfate, Total (as SO ₄)	SD 005	96.6	97.9
12/31/2020	Sulfate, Total (as SO ₄)	SD 005	102.5	104
3/31/2021	Sulfate, Total (as SO ₄)	SD 005	112	120
4/30/2021	Sulfate, Total (as SO ₄)	SD 005	106.5	107
5/31/2021	Sulfate, Total (as SO ₄)	SD 005	109.5	112

12/31/2021	Sulfate, Total (as SO ₄)	SD 005	131	131
4/30/2022	Sulfate, Total (as SO ₄)	SD 005	105.2	123
5/31/2022	Sulfate, Total (as SO ₄)	SD 005	94.9	102
6/30/2022	Sulfate, Total (as SO ₄)	SD 005	95.4	95.6
7/31/2022	Sulfate, Total (as SO ₄)	SD 005	95.1	95.5
9/30/2022	Sulfate, Total (as SO ₄)	SD 005	93.6	93.6

WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 6

EPA, Letter to C. Bartovich, U.S. Steel Environmental Director, re
Notice of Clean Water Act Violations, May 14, 2024.



REGION 5

CHICAGO, IL 60604

May 14, 2024

Chrissy Bartovich
Environmental Director
Minnesota Ore Operations
United States Steel Corporation
P.O. Box 417
Mt. Iron, Minnesota 55768

Subject: Notice of Clean Water Act Violations, United States Steel Corporation - Keetac Mining Operations and Keetac Tailings Basin

Dear Chrissy Bartovich:

The U.S. Environmental Protection Agency, Region 5 (EPA) has identified violations of the Clean Water Act (CWA) by United States Steel Corporation (US Steel) at the Keetac Mining Operations and Tailings Basin located in Keewatin, Minnesota (Facility). Specifically, EPA has found that US Steel has violated federally enforceable sulfate effluent limits required by the Facility's National Permit Discharge Elimination System (NPDES) permits.

Under Section 309 of the CWA, the EPA has several enforcement options to resolve the alleged violations including issuing an administrative compliance order, issuing an administrative penalty order and bringing a judicial action. The EPA would like to reach an agreement under which US Steel will bring the Facility into compliance with the CWA.

If US Steel would like to confer with the EPA about this letter and the attached Notice of Violation (NOV), you should make the request within 10 calendar days following receipt of this letter. We should hold any conference within 30 calendar days following receipt of this letter. In addition, to make the conference more productive, we encourage you to submit responsive information prior to the conference date. Please plan for your Facility's technical and management personnel to attend the conference to discuss compliance measures and commitments. US Steel may have an attorney at this conference.

The statements in this letter and the NOV are for notification and are not final EPA positions.

If you submit additional information to the EPA in response to this letter, you may assert a claim of business confidentiality under 40 C.F.R. Part 2, Subpart B. Information subject to a

business confidentiality claim is available at 40 C.F.R. Part 2, Subpart B. If you do not assert a business confidentiality claim when you submit the information, the EPA may make this information available to the public without further notice.

If you would like to schedule a meeting to discuss the NOV or if you have any questions, the EPA contact on this matter is Jake Berger who can be reached at (312) 353-8024 or berger.jake@epa.gov, or your legal counsel may contact Jolie McLaughlin at (312) 886-4179 or mclaughlin.jolie@epa.gov.

Sincerely,

**MICHAEL
HARRIS**

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Michael D. Harris
Division Director
Enforcement and Compliance Assurance Division

Enclosure: Clean Water Act Notice of Violation

WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 7

EPA, Letter to MPCA Commissioner Kessler re Minnesota laws revising
MPCA's authority to regulate sulfate in NPDES permits, Feb. 16, 2022.



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

Katrina Kessler, Commissioner
Minnesota Pollution Control Agency
520 Lafayette Road North
Saint Paul, Minnesota 55155-4194

Re: Minnesota's laws revising the Minnesota Pollution Control Agency's (MPCA) authority to regulate sulfate in NPDES permits

Dear Ms. Kessler:

I am writing regarding the U.S. Environmental Protection Agency's (EPA) review of two Minnesota session laws which, among other effects, impact MPCA's authority to include sulfate controls in National Pollutant Discharge Elimination System (NPDES) permits for discharges into wild rice production waters. Based on our review, we have determined that the session laws constitute a non-substantial change to Minnesota's NPDES program and are inconsistent with the Clean Water Act (CWA). EPA therefore disapproves the program revision affected by these laws as an improper modification to MPCA's authority to implement the NPDES program.

EPA has authority to review statutory or regulatory modifications of a state NPDES program under 40 C.F.R. § 123.62(a), which provides that EPA may initiate a program revision when necessary, including when the controlling state statutory or regulatory authority is modified or supplemented. Our review focused on two Minnesota laws¹: the "2015 Sulfate Law," Minn. Laws 2015, 1st Spec. Sess., Chapter 4, Article 4, Section 136 at (a)(1)(i)² [hereafter 2015 Sulfate Law]; and the "2016 Sulfate Effluent Compliance Law," Minn. Laws 2016, Chapter 165, Section 1 at (a) [hereafter 2016 Sulfate Law]. The details of our review are found in Enclosure A. EPA appreciates Minnesota's assistance with our review, including the Minnesota Attorney General's August 12, 2016 statement (*see* Enclosure B) and a February 11, 2021 meeting between EPA and MPCA.

As described in Enclosure A, our review found that the 2015 Sulfate Law and 2016 Sulfate Law: 1) limited MPCA's ability to include sulfate water quality-based effluent limits in NPDES permits that are required to comply with Minnesota's federally-approved sulfate water quality standard (WQS); and 2) invalidated sulfate effluent limits in any existing state permits,

¹ EPA did not review a third similar 2011 Minnesota law, Minn. Laws 2011, 1st Spec. Sess., Chapter 2, Article 4, Section 32 at (e), because that law's curtailment of sulfate controls in permits was limited to the "extent allowable under the Clean Water Act," and thus does not appear to have modified Minnesota's approved NPDES program.

² EPA's review and its findings in this letter are limited to the 2015 law's prohibition on permittee expenditures related to sulfate and do not extend to the remainder of the law which was not related to the Minnesota's approved CWA 402 program. We note that the 2015 Sulfate Law was amended by 2017 Minn. Laws Chapter 93, Article 2, Section 149 at (c) but not the clause reviewed by EPA.

respectively. Because the session laws both limit MPCA's authority to implement its approved NPDES program and improperly modify a facility's existing permit in contravention of the CWA, they constitute an improper modification to MPCA's authority to implement the NPDES program. 40 C.F.R. § 123.62(b)(3). As a result, the effluent limits and permit compliance schedules invalidated by the 2016 Sulfate Law remain subject to any federal enforcement and citizen action as provided for under the CWA. *See* 33 U.S.C. § 1319; 33 U.S.C. § 1365(a)(1).

Accordingly, EPA expects that MPCA's NPDES permits will include effluent limitations to meet all federally-approved WQS as required by the CWA, federal regulations, and EPA-approved Minnesota laws and rules. To this end, EPA urges MPCA to work with State lawmakers in resolving this matter.

Please contact me if you wish to discuss this matter, or your Assistant Commissioner for Water Policy and Agriculture can contact Tera Fong, Water Division Director, at fong.tera@epa.gov or (312) 886-6735.

Sincerely,

DEBRA
SHORE

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Debra Shore
Regional Administrator & Great Lakes National Program Manager

Enclosures

Enclosure A: A Review of Two Minnesota Sulfate Session Laws

The Clean Water Act (CWA) and federal regulations require states with approved National Pollutant Discharge Elimination System (NPDES) programs to maintain the authority needed to administer their programs in accordance with the CWA at all times. *See* 33 U.S.C. § 1342(c)(2); 40 C.F.R. § 123.63(a). Two Minnesota sulfate session laws -- Minn. Laws 2015, 1st Spec. Sess., Chapter 4, Article 4, Section 136 at (a)(1)(i) [hereafter 2015 Sulfate Law] and Minn. Laws 2016, Chapter 165, Section 1 at (a) [hereafter 2016 Sulfate Law] -- curtail the implementation of Minnesota's sulfate water quality standard (WQS) for wild rice producing waters in state issued NPDES permits. Because these two laws are not consistent with the CWA and its implementing regulations, they constitute an improper modification of Minnesota's approved NPDES program.

The CWA requires states to adopt WQSs subject to approval by the U.S. Environmental Protection Agency (EPA), which remain in effect unless and until EPA approves their modification. 33 U.S.C. § 1313(a) and (c); 40 C.F.R. § 131.21(a) and (e). Consistent with these authorities, Minnesota promulgated a sulfate WQS of 10 milligrams per liter (mg/L) applicable to waters utilized for the production of wild rice. *See* Minn. R. 7050.0224, subp. 2. Subsequently, EPA approved Minnesota's sulfate WQS. *See* 42 *Fed. Reg.* 56786, 56789 (Sept. 9, 1977). The CWA requires that NPDES permits include any requirements necessary to achieve the state's approved WQS. 33 U.S.C. § 1311(b)(1)(C); 40 C.F.R. § 122.44(d)(1) and (5), made applicable to state programs at 40 C.F.R. § 123.25(a)(15).

Minnesota's 2015 Sulfate Law and 2016 Sulfate Law revise the Minnesota Pollution Control Agency's (MPCA) authority to issue NPDES permits that are protective of Minnesota's federally approved sulfate WQS in at least two significant ways.

First, the 2015 Sulfate Law prevents MPCA from issuing permits that are protective of Minnesota's applicable federally approved sulfate WQS. This law provides in pertinent part, that "the agency shall not require [NPDES] permittees to expend money for design or implementation of sulfate treatment technologies or other forms of sulfate mitigation." Minn. Laws 2015, 1st Spec. Sess., Chapter 4, Article 4, Section 136 at (a)(1)(i). This law prevents MPCA from including effluent limits in NPDES permits that are needed to achieve Minnesota's federally approved sulfate WQS as required by 40 C.F.R. § 122.44(d)(1), on the basis that MPCA "has determined that the Wild Rice Standard is in need of substantial revision and therefore imprudent to apply."¹ Minnesota, however, has not revised the sulfate WQS and the sulfate WQS remains effective for CWA permitting purposes. Therefore, Minnesota's 2015 Sulfate Law is effectively a legislative limit upon MPCA's authority to issue NPDES permits that include effluent limits necessary to meet WQSs, 33 U.S.C. § 1311(b)(1)(C).

¹ *See* Letter from Lori Swanson, Minnesota Attorney General, to Tinka Hyde, Director, Water Division Region 5, August 12, 2016 [found at Enclosure B], at 4: "MPCA believes that it would be unreasonable for it to enforce the sulfate standard in existing permits because requiring compliance with the Standard would result in the expenditure of resources that may ultimately prove unnecessary. MPCA has advised EPA that it is 'pursuing options to reissue delayed mining NPDES permits quickly once there is a revised Wild Rice Standard [citation omitted] The above-described legislative restriction is strictly limited to the Wild Rice Standard, does not affect other water quality standards or MPCA's authority to enforce those standards, and is only in place until no later than January 15, 2018. In any event, as discussed above, MPCA has determined that the Wild Rice Standard is in need of substantial revision and therefore imprudent to apply.'"

Second, the 2016 Sulfate Law invalidates sulfate effluent limits in existing NPDES permits. In particular, the 2016 Sulfate Law provides that for NPDES permits meeting certain requirements:

- (1) the final sulfate limits resulting from implementation of the wild rice water quality standard in Minnesota Rules, part 7050.0224, subpart 2, are no longer valid; and
- (2) any compliance schedule permit conditions related to those final limits are no longer valid.

Minn. Laws 2016, Chapter 165, Section 1 at (a). According to the Minnesota Attorney General, the 2016 Sulfate Effluent Compliance Law aimed to remove effluent limits and a related schedule of compliance from the U.S. Steel Keetac facility.¹ Thus the 2016 Sulfate Law invalidated both the sulfate water quality-based effluent limits and compliance schedule related to those limits in contravention of the CWA and federal regulations. These include those federal requirements that NPDES permits include effluent limits necessary to achieve federally approved WQSs and incorporate schedules of compliance requirements where authorized under federal and state law. *See* 40 C.F.R. §§ 122.44(d)(1) and (5).² The 2016 law also circumvents federal regulations for modifying or revoking and reissuing permits (40 C.F.R. § 124.5(c)); public notice and comment procedures for permits (40 C.F.R. § 124.10); EPA's permit review (40 C.F.R. § 123.44); and the *Memorandum of Agreement between EPA and MPCA for the Approval of the State NPDES Permit Program*.³

Therefore, the 2016 Sulfate Law is a legislative limit upon MPCA's authority to issue NPDES permits that include effluent limits necessary to meet WQSs, 33 U.S.C. § 1311(b)(1)(C), and to implement permitting procedures consistent with the CWA, 33 U.S.C. § 1342(b)(3) and (4). Accordingly, the NPDES permit effluent limits and compliance schedules, invalidated by that law, remain subject to any federal enforcement and citizen action as provided for under the CWA. *See* 33 U.S.C. § 1319; 33 U.S.C. § 1365(a)(1).

¹ Letter from Lori Swanson, Attorney General, State of Minnesota, to Tinka Hyde, Division Director, U.S. EPA (August 12, 2016).

² 40 C.F.R. 124.5(c) (*Applicable to State programs, see 40 CFR 123.25 (NPDES), 145.11 (UIC), 233.26 (404), and 271.14 (RCRA)*).

(1) If the Director tentatively decides to modify or revoke and reissue a permit under [40 CFR 122.62](#) (NPDES), 144.39 (UIC), 233.14 (404), or 270.41 (other than § 270.41(b)(3)) or § 270.42(c) (RCRA), he or she shall prepare a draft permit under § 124.6 incorporating the proposed changes. The Director may request additional information and, in the case of a modified permit, may require the submission of an updated application. In the case of revoked and reissued permits, other than under [40 CFR 270.41\(b\)\(3\)](#), the Director shall require the submission of a new application. In the case of revoked and reissued permits under [40 CFR 270.41\(b\)\(3\)](#), the Director and the permittee shall comply with the appropriate requirements in [40 CFR part 124](#), subpart G for RCRA standardized permits.

(2) In a permit modification under this section, only those conditions to be modified shall be reopened when a new draft permit is prepared. All other aspects of the existing permit shall remain in effect for the duration of the unmodified permit. When a permit is revoked and reissued under this section, the entire permit is reopened just as if the permit had expired and was being reissued. During any revocation and reissuance proceeding the permittee shall comply with all conditions of the existing permit until a new final permit is reissued.

³ *See Memorandum of Agreement Between the United States Environmental Protection Agency and the Minnesota Pollution Control Agency for the Approval of the State NPDES Permit Program* (May 7, 1974), Section II, Agreement, Sections 124.44(d) (Schedule of Compliance in Issued NPDES Permits); and 124.72 (Modification, Suspension and Revocation of NPDES Permits).

Enclosure B: Minnesota Attorney General August 12, 2016 Letter



OFFICE OF THE ATTORNEY GENERAL
State of Minnesota
ST. PAUL, MN 55155

LORI SWANSON
ATTORNEY GENERAL

August 12, 2016

Tinka Hyde
Director, Water Division
United States Environmental Protection Agency
Regional Administrator
77 West Jackson Boulevard
Chicago, IL 60604-3590

VIA U.S. MAIL AND E-MAIL

Re: MPCA's Legal Authority to Implement its Authorized NPDES Program

Dear Director Hyde:

On April 5, 2016, you requested the Minnesota Pollution Control Agency ("MPCA") "provide an updated Attorney General's statement to explain whether the current scope of MPCA's authority remains adequate to issue permits in compliance with all applicable [Clean Water Act] requirements, including whether MPCA continues to have adequate authority to implement all of its federally approved water quality standards consistent with [Clean Water Act] Section 301(b)(1)(C)." You stated that legislation enacted in 2015 by the Minnesota Legislature "appears to modify and/or revise the authority of the State to administer its [National Pollutant Discharge Elimination System] program and implement its federally approved water quality standards." On June 28, 2016, you sent MPCA a second request to "provide an additional updated Attorney General's statement to explain whether the current scope of MPCA's authority remains adequate to enforce all conditions in those [National Pollutant Discharge Elimination System] permits to which the law is expected to apply." You reference legislation enacted by the Minnesota Legislature in 2016 and state it "appears to invalidate water quality based effluent limits and compliance schedules for sulfate that were included in certain [National Pollutant Discharge Elimination System] permits issued by the MPCA." You requested the Attorney General statements be provided by August 12, 2016.

I provide the following in response to both requests.

As you are aware, the Clean Water Act ("CWA") requires States to adopt water quality standards. See 33 U.S.C. § 1313(a). Pursuant to the CWA, Minnesota adopted such water quality standards in 1973, which are codified as Minn. R. ch. 7050. The U.S. Environmental

Tinka Hyde
Director, Water Division
United States Environmental Protection Agency
August 12, 2016
Page 2

Protection Agency ("EPA") approved these standards in 1977, including the sulfate standard applicable to "waters used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels," which is codified as Minn. R. 7050.0224, subp. 2 ("Wild Rice Standard" or "Standard"). See 42 *Federal Register* 56786-03. Minnesota is the only State that has adopted a water quality standard for sulfate relating to waters containing wild rice. MPCA has expansive authority to issue and enforce National Pollutant Discharge Elimination System ("NPDES") permits. See Minn. Stat. chs. 115 and 116; Minn. R. chs. 7050, 7052 and 7053.

Under the CWA, "water quality standards should, wherever attainable, provide water quality for the protection and propagation of fish, shellfish and wildlife and for recreation in and on the water and take into consideration their use and value of public water supplies, propagation of fish, shellfish and wildlife, recreation in and on the water, and agriculture, industrial and other purposes including navigation." See 40 C.F.R. § 131.2. The CWA further directs that the "State shall from time to time, but at least once every three years, hold public hearings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards." See 40 C.F.R. § 131.20. Once approved by the EPA, a State standard will continue in effect unless EPA approves a change. See 40 C.F.R. § 131.21(e). Neither the CWA nor its regulations, however, address what a State should do if it determines that an existing standard is in need of material revision and significant expenditures would unnecessarily be required of permittees to comply with the existing deficient standard.

The history of the Wild Rice Standard is described in *Minnesota Chamber of Commerce v. Minnesota Pollution Control Agency*, No. A12-0950, 2012 WL 6554544 (Minn. Ct. App. Dec. 17, 2012) ("MCC"). MPCA applied the Wild Rice Standard for the first time in 1975 to set a wastewater discharge sulfate limit for the Minnesota Power Clay Boswell steam power plant facility. *Id.* at 2. In 2009 and 2010, MPCA began taking steps to apply the Standard in the mining areas of northern Minnesota. *MCC* at 2. MPCA began a process to determine *where* the Wild Rice Standard should be enforced by asking certain mining companies to conduct surveys to detect the presence of wild rice in waters to which their facilities discharge wastewater to determine whether they are subject to the Wild Rice Standard for future permitting actions. *Id.* For the first time since 1975, in 2010 MPCA relied upon the Wild Rice Standard to set a discharge limitation in a permit for U.S. Steel. *Id.* MPCA's interpretation of the Wild Rice Standard as applicable to protect natural (uncultivated) wild rice was challenged in the *MCC* case. *Id.* At around the same time, related concerns were raised by MPCA and others regarding the accuracy of the science behind the Standard and how to define "waters used for production of wild rice." See <https://www.pca.state.mn.us/sites/default/files/wq-s6-40b.pdf>.

In response to these concerns, the Minnesota Legislature enacted legislation appropriating money and requiring MPCA to "adopt and implement a wild rice research plan using the money appropriated to contract with appropriate scientific experts." Minn. Laws 2011, 1st Spec. Sess., Chapter 2, Article 4, Section 32 at (d) ("2011 Wild Rice Legislation"). This

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Director, Water Division
United States Environmental Protection Agency
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legislation temporarily restricted MPCA from requiring permittees “to expend funds for design and implementation of sulfate treatment technologies,” but provided for an exception if necessary to comply with “federal law.” *Id.* The 2011 Wild Rice Legislation further provided that “nothing shall prevent the [MPCA] from including in a schedule of compliance a requirement to monitor sulfate concentrations in discharges and, if appropriate, based on site-specific conditions, a requirement to implement a sulfate minimization plan to avoid or minimize sulfate concentrations during periods when wild rice may be susceptible to damage.” *Id.* Based in part on the 2011 legislation, the *MCC* decision concluded that the issues raised in the case were moot. *MCC* at 9.

After receiving the funding from the 2011 Wild Rice Legislation, the MPCA contracted with the University of Minnesota to research how sulfate affects wild rice. See <https://www.pca.state.mn.us/water/wild-rice-sulfate-standard-study>. The research was based on a scientific protocol developed in 2010-2011 by the MPCA in consultation with your agency, Minnesota Tribes, and the Minnesota Department of Natural Resources as well as input from interested and affected stakeholders. *Id.*

In 2014, MPCA published the initial results of its research, which demonstrated that sulfate is not directly toxic to wild rice, but it can be converted into sulfide, which is toxic. The research supported material revisions to the Standard. See “Wild Rice Sulfate Standard Study Preliminary Analysis” at <https://www.pca.state.mn.us/sites/default/files/wq-s6-42w.pdf>; See also “Wild rice study reveals more questions for state officials,” at <https://www.nprnews.org/story/2014/03/12/wild-rice-study>. The study found that the presence of iron in the water may mitigate the conversion of sulfate to sulfide. The research also found instances where higher levels of sulfate in waters did not result in high levels of the toxic sulfide. See <https://www.pca.state.mn.us/sites/default/files/wqetc>. The Study determined that site-specific standards may be needed for some waters particularly where sulfate is more efficiently converted to sulfide and/or sediment iron levels are not sufficient to mitigate sulfide concentrations. *Id.*

In December 2014, MPCA sought feedback on a preliminary proposed permit that required U.S. Steel to comply with the existing Standard at its “Minntac” facility. See <https://timberjay.com/stories/us-steel-fighting-strict-pollution-rules,11955>.

In the 2015 legislative session, Minn. Laws 2015, 1st Spec. Sess., Chapter 4, Article 4, Section 136 (“2015 Wild Rice Legislation”) was enacted. The 2015 Wild Rice Legislation prohibits MPCA from taking any actions to implement the standard that would require a permittee “to expend money for design or implementation of sulfate treatment technologies or other forms of sulfate mitigation.” *Id.* at (a)(1). The legislation did not provide an exception for enforcement necessary to comply with federal law as the 2011 legislation did, but the 2011 Wild Rice Legislation was not repealed. *Id.* The 2015 legislation requires MPCA to complete rulemaking to promulgate a new Wild Rice standard by January 15, 2018. *Id.* at (c). In 2016, the Legislature enacted a statute that essentially applied the substance of the 2015 legislation to

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the U.S. Steel Keetac facility, which was subject to a "schedule of compliance" requiring it to take actions necessary to comply with the Standard. Minn. Laws 2016, Ch. 165, sec. 1. The legislation does not apply or restrict the issuance, reissuance or enforcement of any future permits. MPCA has advised this Office that the Keetac facility is idled.

Minnesota Governor Mark Dayton signed the 2011, 2015 and 2016 legislation relating to the revision of the Wild Rice Standard. He publically stated that the Standard is "antiquated" and "not even based on current science directly related to the conditions we're trying to deal with." See <http://www.mprnews.org/story/2015/03/25/mpca-wild-rice>. MPCA similarly has stated that "using the same limit for every river or lake where wild rice grows doesn't make sense, because many factors influence whether wild rice will thrive." See <http://www.mprnews.org/story/2015/03/25/mpca-wild-rice>. MPCA has also stated that "[n]o single sulfate value would be protective of wild rice at all sites." Based on its research, MPCA is developing an equation to calculate appropriate values on a site-by-site basis, reflecting its expert conclusion that higher levels of iron can lead to less sulfide, and higher levels of organic carbon can lead to more sulfide. See <https://www.pca.state.mn.us/sites/default/files/wq-s6-43k.pdf>. In March of 2015, MPCA "announced that it wants to eliminate the current standard of 10 milligrams of sulfate per liter of water in wild rice waters, and begin to apply different standards to different waters based on their chemical makeup." See <https://www.minnpost.com/environment/2015/05/despite-pressure-lower-minntac-sulfate-emissions-status-quo-could-last-awhile>.

MPCA believes that it has made significant progress towards completion of the scientific studies regarding a new Wild Rice Standard and states it will commence the formal rulemaking process soon. See <https://www.pca.state.mn.us/sites/default/files/wq-rule4-15a.pdf>. The CWA provides States with the authority to revise water quality standards. 40 C.F.R. § 131.20. MPCA, on behalf of the State of Minnesota, is exercising this authority regarding the Wild Rice Standard, based on its scientific evidence indicating that the existing standard requires substantial revision. MPCA believes it would be unreasonable for it to enforce the sulfate standard in existing permits because requiring compliance with the Standard would result in the expenditure of resources that may ultimately prove unnecessary. MPCA has advised EPA that it is "pursuing options to reissue delayed mining NPDES permits quickly once there is a revised Wild Rice Standard." See July 13, 2016 letter from MPCA to EPA. MPCA has apprised this Office that it is "evaluating each site to determine what data could be gathered during this interim period to ensure [it] ha[s] all data necessary to move expeditiously on reissuances once there is a revised wild rice standard."

The above-described legislative restriction is strictly limited to the Wild Rice Standard, does not affect other water quality standards or MPCA's authority to enforce those standards, and is only in place until no later than January 15, 2018. In any event, as discussed above, MPCA has determined that the Wild Rice Standard is in need of substantial revision and therefore imprudent to apply.

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MPCA also believes that it has adequate authority to revise the applicable Standard, and once the Standard is revised (subject to EPA approval), it will have full and unrestricted authority to enforce the Standard. Accordingly, under these unique circumstances, and in accordance with MPCA's expert opinion regarding the deficiencies of the current Standard, I agree with MPCA that it has adequate authority to implement federal law by revising the current Standard that MPCA believes is deficient and then enforcing it as modified.

This analysis is supported by court decisions holding that the CWA is to be given a reasonable interpretation which is not parsed and dissected with the meticulous technicality applied in testing other statutes and instruments. *See Envtl. Def. Fund, Inc. v. Costle*, 657 F.2d 275, 292 (D.C. Cir. 1981). The EPA has the ability to be flexible with regard to revision of State water quality standards, and has exercised this discretion in other cases.

Indeed, if a State fails to fix a deficient water quality standard, 40 C.F.R. § 131.22 requires EPA to replace it with a federal standard in 90 days, but EPA's decision to delay replacement was upheld when EPA reasonably provided Montana more time to modify a deficient standard. *See American Wildlands v. Browner*, 94 F. Supp. 2d 1550, 1165 (D. Colorado 2000) (Montana's stated intention given weight in decision upholding EPA's decision to allow Montana extra time to submit an amended water quality standard). Minnesota's legislation does not allow substantially more time for MPCA to revise the Wild Rice Standard than was allowed for Montana to complete its revision. *Id.* The D.C. Circuit has also recognized that sometimes "it is logical that EPA should refrain from acting until the states have completed an initial effort to update the standards as they deem appropriate." *See Envtl. Def. Fund, Inc. v. Costle*, 657 F.2d 275, 294 (D.C. Cir. 1981) ("EPA's task of determining the need for revised or new salinity standards to meet the Act's requirements would be greatly simplified by its temporary deference.")

Based on the above facts and circumstances of this matter and legal analysis, including the representations of MPCA and the deference owed to its expertise regarding the subject Standard, it is my opinion that the laws of the State of Minnesota provide adequate authority for MPCA to carry out the program elements in 33 U.S.C. § 1342 pertaining to water quality standards.

Sincerely,

A handwritten signature in black ink, appearing to read "Lori Swanson", written over a horizontal line.

LORI SWANSON
Attorney General

WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 8

MPCA, Denial of U.S. Steel Application for a Sulfate Site-Specific Standard for Hay Lake,
February 14, 2024.

February 14, 2024

VIA EMAIL

Chrissy Bartovich
U.S. Steel Corporation
Minnesota Ore Operations
PO Box 417
Mountain Iron, MN 55768

RE: Application for a Sulfate Site-Specific Standard for Hay Lake (AUID 31-0037-00), located downstream of the U.S. Steel – Keetac (Keetac)

Dear Chrissy Bartovich:

The Minnesota Pollution Control Agency (MPCA) received United States Steel Corporation's (U.S. Steel) application for a sulfate site-specific standard (SSS) for Hay Lake, dated August 17, 2022. This request seeks to modify the applicable Class 4A sulfate water quality standard for the protection of wild rice in Hay Lake from the statewide 10 milligrams per liter (mg/L) standard to a site-specific standard of 79 mg/L.

The MPCA reviewed the application for conformity with applicable regulations, scientific defensibility, and appropriateness for the site-specific context of Hay Lake. The application fulfills the required site-specific standard submission process but does not contain sufficient information to justify a modification to the existing wild rice standard. Therefore, the MPCA denies the sulfate site-specific standard request and has determined that the application is not suitable for approval and submission to U.S. Environmental Protection Agency (EPA) for final review.

Consistent with federal regulations (40 C.F.R. § 131.11) and state rules (Minn. R. 7050.0220, subp. 7), the application is insufficient because it does not demonstrate that the wild rice beneficial use will be protected at the proposed sulfate standard, the method used to derive the sulfate standard is not scientifically defensible, and the proposed sulfate standard is not demonstrated to be more appropriate than the currently applicable statewide standard.

During a conference call with U.S. Steel on November 27, 2023, MPCA shared its decision and feedback regarding the company's SSS application for Hay Lake. The following written comments provide more information about the MPCA's review of the Hay Lake SSS application and the basis for the Agency decision to deny the SSS request. The issues outlined below address broad themes and do not represent a comprehensive listing of MPCA's concerns on all aspects of the application. If U.S. Steel chooses to continue to pursue a SSS for Hay Lake, working to resolve these issues will be foundational in developing a sound application.

Issue 1: Insufficient data are presented to demonstrate the beneficial use is protected (40 C.F.R. § 131.11(a)(1)).

Applications for a SSS must demonstrate that the proposed numeric standard will protect the beneficial use. For a SSS request from the Class 4A sulfate water quality standard for waters used for production of wild rice (Minn. R. 7050.0224, subp. 2.), the applicant must articulate how the proposed standard will protect the wild rice beneficial use. This requires a demonstration that the waterbody will maintain a wild rice population that is productive, meaning the proposed sulfate standard allows for the continued generation of wild rice biomass into the future.

An approach recognized by the MPCA to make this demonstration is to apply the current ambient sulfate concentration as the proposed standard, if and only if the wild rice population is shown to be “productive” over the long-term and is not trending towards local extirpation. This method would need to include long-term data collection on wild rice population metrics, such as abundance and density, that yield valuable insight into productivity trends and potential boom-bust cycles in the waterbody of interest. The presence of any amount of wild rice in sporadic years does not, in and of itself, constitute sufficient evidence of a long-term, self-sustaining wild rice population.

U.S. Steel’s SSS application does not include sufficient information to demonstrate that the wild rice beneficial use is met, or will be met, in Hay Lake at the proposed numeric sulfate value. The wild rice population monitoring data from field surveys spanning 2009-2012, 2014, and 2021, are discontinuous and do not show a clear and consistent picture of wild rice health in Hay Lake (see section 3.2 of the application). The data from 2009-2012 and 2014 show varying degrees of spatial extent, density, and water levels, as expected given known annual variability in wild rice’s population growth. However, the most recent year of data, 2021, documents no wild rice after July. U.S. Steel acknowledges that hydrologic changes from documented upstream beaver activity is a contributing factor to the observed variable wild rice abundance, especially the years with low or absent wild rice. The limited extent of provided data and analysis are not sufficient to enable MPCA to identify a possible population trend or to ascertain whether such variations, especially the years of sparse or absent wild rice, are primarily due to natural cyclicity or anthropogenic causes.

U.S. Steel asserts that the presence of wild rice over a decade ago is evidence enough that the wild rice population is productive and that the beneficial use is met. However, providing historical documentation of wild rice presence and articulating a general expectation that it will be present into the future does not, by itself, establish that the beneficial use is protected. Further reflection on the condition and robustness (level of production and resilience of the population) of wild rice in Hay Lake is necessary to demonstrate that the beneficial use is protected.

Given the wild rice data provided in the application, MPCA is unable to determine with certainty that the wild rice beneficial use is currently being met. Further, because the application does not demonstrate that the wild rice beneficial use is currently met in Hay Lake, it is not possible to demonstrate that U.S. Steel’s proposed sulfate standard will protect the beneficial use in the future.

Issue 2: Proposed sulfate standard derivation method must be scientifically defensible (40 C.F.R. § 131.11(b)(1)(iii)).

In the Hay Lake SSS application, U.S. Steel derives a sulfate standard of 79 mg/L that relies exclusively on the sediment-based equation from MPCA's 2018 rulemaking effort to revise the sulfate water quality standard for waters used for production of wild rice. However, the equation output is a prediction, based on geochemical relationships, of the sulfate concentration at which wild rice is likely protected from harm due to elevated sulfate and the associated accumulation of sulfide in the sediment porewaters, but it neither reflects any on-site biological observations nor considers the long-term ecological production of the waterbody's wild rice population. Thus, MPCA does not support the use of this equation as the primary means to determine the proposed sulfate standard because it does not directly link to a demonstration of wild rice health and therefore cannot show beneficial use attainment (40 C.F.R. § 131.11(a)(1)). Additionally, the use of the sediment-based equation may return sulfate concentration values that are thought to be generally unsupportive of wild rice, at least in some environments, as evidenced by growth experiments in mesocosms, and recent concerns have emerged that suggest the degree of protection against sulfide that is afforded by iron may not be as great as originally conceived.

Further, the Hay Lake SSS application does not include consideration of recent publications and updated scientific understanding of wild rice ecology. An applicant for a sulfate SSS should engage with the current state of wild rice science, reflect upon important recent scientific literature and reports, and identify whether their efforts are consistent with current knowledge about wild rice and suggested approaches to analyzing population robustness. This effort is necessary to establish a proposed standard that is derived through scientifically defensible methods and is scientifically sound itself. A list of important references (not exhaustive) is included as an attachment to this letter.

The derivation and analysis of the proposed sulfate SSS exclusively focuses on defining the magnitude (79 mg/L). The Hay Lake SSS application does not consider or mention the duration and frequency of the SSS, which are required elements of a water quality standard.

Lastly, the Hay Lake SSS application does not provide other lines of evidence to indicate that the proposed sulfate value will be protective of wild rice.

For these reasons, MPCA finds the method used to derive the proposed site-specific sulfate standard for Hay Lake to be scientifically indefensible.

Issue 3: Proposed sulfate standard must be demonstrated to be more appropriate than currently applicable standard (Minn. R. 7050.0220, subp. 7).

Minn. R. 7050.0220, subp. 7, authorizes the MPCA to approve a SSS where specific conditions in a waterbody indicate that a site-specific water quality standard is "more appropriate" than the currently applicable statewide standard.

The application should explain why a modified standard is more appropriate than the statewide standard. As submitted, the Hay Lake SSS application lacks adequate description and analysis on the matter of whether conditions in Hay Lake are unique and justify the application of a site-specific modification of the sulfate standard, i.e., what exceptional circumstances would allow wild rice to thrive and the beneficial use to be protected under a less stringent standard at this location.

Other comments:

1. The application does not include a review of all relevant historical data and information covering Hay Lake's wild rice population and sulfate concentrations. Meaningful reflection on how sulfate concentrations have changed in concert with wild rice would provide valuable background knowledge and is also critical in understanding the context of the current variations in sulfate concentrations and wild rice productivity.
2. The application should not seek to influence how effluent limits for the Keetac tailings basin would be determined. The MPCA requests that any subsequent site-specific standard application not contain any effluent limit determination for National Pollutant Discharge Elimination System/ State Discharge System (NPDES/SDS) permit holders, as it is outside the scope of a water quality standard action. It is the MPCA's responsibility to determine whether effluent limitations are needed in permits, not the site-specific standard applicant. Consistent with Minn. R. 7050. Subp. 7(c), any effluent limit determined to be necessary based on a modified standard shall only be required after the discharger has been given notice of the specific proposed effluent limits and an opportunity to request a hearing, as provided in Minn. R. 7000.1800. Additionally, any new or revised effluent limitation in a NPDES/SDS discharge permit is subject to public notification and comment during the re-issuance of that permit, and EPA has final authority to review effluent limitations.

The MPCA appreciates the considerable effort undertaken to develop a SSS application and hopes these comments provide greater clarity. U.S. Steel may submit a future SSS application should it compile the additional information, data, and justification needed to support an appropriate sulfate SSS for Hay Lake that protects the wild rice beneficial use. If you have follow-up questions, please reach out to me at paul.pestano@state.mn.us or 651-757-2090.

Sincerely,

Paul Pestano

This document has been electronically signed.

Paul Pestano
Manager
Water Assessment Section
Environmental Analysis and Outcomes Division

PP:rjp

cc: See next page.

cc: Eric Williams, U.S. Steel Corporation (electronic)
Tom Moe, U.S. Steel Corporation (electronic)
Nicole Everson, U.S. Steel Corporation (electronic)
Dana Vanderbosch, MPCA
Darin Broton, MPCA
Todd Biewen MPCA
Courtney Ahlers-Nelson, MPCA
Doug Wetzstein, MPCA
Tanya Maurice, MPCA

Important references (not exhaustive):

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- Vogt, D. J. (2023). *Wild Rice Monitoring and Abundance in the 1854 Ceded Territory (1998-2022)*. 1854 Treaty Authority. <https://www.1854treatyauthority.org/management/biological-resources/fisheries/reports.html?id=281&task=document.viewdoc>.

WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 9

MPCA Brief, *In re Sulfate Site-Specific Standard for Hay Lake*, Oct. 11, 2024 (excerpt).

STATE OF MINNESOTA

IN COURT OF APPEALS

Application for a Sulfate Site-Specific Standard for Hay Lake (AUID 31-0037-00),
located downstream of the U.S. Steel – Keetac (Keetac).

RESPONDENT MINNESOTA POLLUTION CONTROL AGENCY'S BRIEF

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F. The MPCA Cannot Move Forward With U.S. Steel’s Application.

On November 27, 2023, the MPCA held a conference call with U.S. Steel. Add.0001; R.3 at MPCA000008. The agency stated that it was unable to approve U.S. Steel’s request for a sulfate site-specific standard for Hay Lake due to insufficient information and provided feedback on the deficiencies in the application. *Id.* On February 14, 2024, the MPCA followed up with a letter summarizing the parties’ discussion and provided additional written information regarding the agency’s decision. *Id.*

1. The application’s data does not meet federal and state water quality standard requirements.

The agency noted that U.S. Steel’s application failed to comply with three critical requirements for water quality standards. First, U.S. Steel did not provide enough data to show that the beneficial use—i.e. the production of wild rice—will be protected at 79 mg/L as required by federal law. Add.0002; R.3 at MPCA000009; 40 C.F.R. § 131.11(a)(1). The field survey data provided covered six of the last fourteen years and only two in the last ten. R.32 at MPCA000736-737. A chart showing the discontinuous and incomplete nature of U.S. Steel’s data is below.

Summary Chart of U.S. Steel’s Wild Rice Monitoring Outcomes

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Wild Rice Density	>75%	25%-50%	0%	10%-50%	N/A	>75%	N/A	N/A	N/A	N/A	N/A	N/A	0%	N/A

See MPCA000736-37

MPCA Add.001.

A. Federal Law Requires That the MPCA Apply the Sulfate Standard to Hay Lake.

U.S. Steel argues that the MPCA exceeded its statutory authority by applying the Sulfate Standard to Hay Lake. Br. at 36-39. Specifically, U.S. Steel asserts that the MPCA designated approximately 2,400 lakes throughout the state as subject to the Sulfate Standard without engaging in formal rulemaking. *Id.* But the MPCA did not rely on its “preliminary” list of lakes that may be subject to the Sulfate Standard. *See* Br. at 20 n.16. The MPCA applied the Sulfate Standard to Hay Lake because it is required to under federal law.

As mentioned above, the EPA approved the Sulfate Standard in 1973. *See supra* n.9. This means it is a federally enforceable water quality standard until amended or removed by the EPA. 40 C.F.R. § 131.21(e). Further, in 2020, the *EPA* (not the MPCA) listed Hay Lake as impaired under the Sulfate Standard.²⁵ 33 U.S.C. § 1313(d);²⁶ R.123 at MPCA005616 (line 3007). Once a waterbody is listed as impaired for a pollutant by the EPA, states enforcing the CWA must take steps, such as developing additional criteria, to bring the impaired water back into compliance with the applicable water quality standard.

same time it was reviewing U.S. Steel’s application, the agency could not apply the Framework to the application due to the inadequate and missing information. *See* Add.0001-05; R.3.

²⁵ *See Attachment 1: Waters Added by U.S. EPA to the Minnesota 2020 Impaired Waters List*, EPA, https://www.epa.gov/system/files/documents/2021-11/2_attachment-1_cl_final-list-of-32-waters.pdf

²⁶ A waterbody is “impaired” when required existing pollution controls alone will not help the waterbody meet its applicable water quality standards. 33 U.S.C. § 1313(d)(1)(A).

33 U.S.C. § 1313(d)(1)(C). Hay Lake remains on the state’s EPA-approved impaired waters list. *See* R.123 at MPCA005616 (line 3007).

In other words, the MPCA has no choice but to apply the Sulfate Standard to Hay lake. Further, any state legislation that purports to prevent the MPCA from doing so is preempted by the MPCA’s obligations under the CWA. *See Hous. and Redev. Auth. of Duluth v. Lee*, 832 N.W.2d 868, 873 (Minn. Ct. App. 2013) (“[S]tate law is preempted to the extent that it actually conflicts with federal law.”); *see, e.g.*, R.130 at MPCA009139 (EPA letter stating the 2015 and 2016 session laws, to the extent they prevent the MPCA from implementing the state’s NPDES program, are impermissible limitations on federally enforceable laws).

B. The MPCA Did Not Change the Sulfate Standard’s Beneficial Use.

Similarly, U.S. Steel argues that the MPCA exceeded its statutory authority by creating a “new” beneficial use for the Sulfate Standard in the Framework without undergoing rulemaking. Br. at 45. This argument also lacks merit.²⁷

The MPCA’s February 14 letter identifies the same beneficial use that has been in place since the Sulfate Standard’s inception in 1973.²⁸ *Compare* Add.0002; R.3 at MPCA000009 (Applicants must show “the waterbody will maintain a wild rice population that is *productive*, meaning the proposed sulfate standard allows for the continued

²⁷ The Court should disregard U.S. Steel’s assertion that the Sulfate Standard’s beneficial use conflicts or is inconsistent with the 2011 Law’s directive for the MPCA to promulgate rules governing “waters containing natural beds of wild rice.” As explained above, federal law requires that the MPCA apply the Sulfate Standard and its EPA-approved beneficial use to Hay Lake. *See* arg. § II(A).

²⁸ *See supra* n.10.

generation of wild rice biomass into the future.”) *with* R.107 at MPCA004949 (In the 1970s, “production” “describe[d] the amount of rice harvested *or* yielded from both natural beds of wild rice [and] cultivated paddies.”) (emphasis added). Since that time, this beneficial use has applied to waters with naturally occurring wild rice, as well as those in which wild rice is cultivated. *See* R.107 at MPCA004949 (“Natural lakes and streams with wild rice beds, as well as commercial paddies, were collectively described as wild rice production areas.”). This is the same beneficial use the EPA applied to Hay Lake when adding it to the impaired waters list in 2020. *See* R.123 at MPCA5616 (line 3007’s “affected designated use”). MPCA’s acknowledgement of the ambiguous nature of the phrase “production of wild rice” does not mean the agency has altered its longstanding interpretation. *See, e.g.,* R.107 at MPCA004949 (MPCA’s proposal to rephrase “water use for production of wild rice” with “wild rice water” “without changing the concept of the use or whether it applies. The change only modernizes the language, given that the word ‘production’ has different connotations today than it did historically.”). Rather, the MPCA has discussed ways to explain, in more easily understood terms, the Sulfate Standard’s beneficial use, which does not run afoul of its rulemaking responsibilities. *See Logic Tech. Dev. LLC*, 84 F.4th at 553 (“Reasoned disagreement among civil servants is the stuff of good government, not APA violations.”).

In declining to pursue U.S. Steel’s proposed site-specific sulfate standard, the MPCA applied the same beneficial use that has applied to the Sulfate Standard since the 1970s. The agency’s decision does not exceed its statutory authority nor constitute unpromulgated rulemaking.

CONCLUSION

For the foregoing reasons, the court should affirm the MPCA's decision not to pursue U.S. Steel's proposed site-specific sulfate standard for Hay Lake.

Dated: October 11, 2024

Respectfully submitted,

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WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 10

MPCA, Protecting Wild Rice Waters, September 2025.

Protecting wild rice waters

SECTION MENU ▾

Wild rice is an important part of the biological community in many Minnesota lakes, streams, and wetlands. Wild rice is also a cultural resource to many, particularly members of the Dakota and Ojibwe Tribal Nations



in Minnesota, and it is an important economic resource to those who harvest and market it. Minnesota recognizes wild rice as its official state grain.

Wild rice is found primarily in low-sulfate waters. Sulfate is a naturally occurring chemical and can also be found in discharges from mining operations, wastewater treatment plants, and industrial facilities.

The MPCA is currently working to fully implement a water quality standard to protect wild rice from excess sulfate. The standard, 10 mg/L sulfate, which was adopted in 1973, applies to [“waters used for production of wild rice.”](#) The agency is also working with permittees, researchers, tribal partners, other

levels of government, as well as the public to investigate ways to protect wild rice.

History

The MPCA has sponsored studies on how sulfate affects wild rice. Research projects in 2012-2013, including a field survey, laboratory experiments, and mesocosm (outdoor growth tank) experiments, helped to inform a 2017 proposal to amend the existing sulfate water quality standard. This rulemaking attempt was ultimately unsuccessful. Consequently, the 1973 sulfate water quality standard remains in effect. MPCA is committed to implementing this standard.

Implementation

The 10 mg/L sulfate water quality standard is designed to protect wild rice and applies in specific waters called “waters used for production of wild rice” ([Minn. R. 7050.0224](#)).

Where the standard applies. The MPCA has developed a list of approximately 2,400 waters used for production of wild rice. This list was developed from multiple sources of information — biological monitoring data, survey databases, and various inventories — to determine where the wild rice beneficial use has been, or could be, attained.



Wild rice producing waters

This online search tool will assist in identifying waters used for production of wild rice, as well as in identifying facilities that require a permit review because they are located in a watershed upstream or partially upstream of such waters.

[Open tool](#)

NPDES/SDS permitting

The MPCA is continuing to work with permittees, the public, and state, local, federal partners, and tribal nations to develop ways to protect this important Minnesota resource through implementation of the long-standing 10 mg/L sulfate standard via monitoring, assessment, and permitting.

- The MPCA held an [informational meeting](#) (May 24, 2023) for representatives of NPDES/SDS permitted facilities, to discuss where the standard applies and how the standard would be considered in NPDES/SDS permits.
- In a [follow-up meeting](#) (June 28, 2023) we discussed options if a facility can't meet a permit limit and the framework for developing site-specific sulfate standards to protect waters used for production of wild rice.
- In the [final meeting in the series](#) (Sept. 27, 2023), MPCA staff responded to NPDES/SDS permit-related questions received during the feedback periods, and leaders from the University of Minnesota Duluth Natural Resources Research Institute provided information about their sulfate treatment technology research.
- [Minnesota Wild Rice Sulfate Water Quality Standard NPDES/SDS wastewater permit implementation \(wq-wwprm1-42\)](#)

- [Procedures for implementing the Class 4A Wild Rice Sulfate Standards in NPDES wastewater permits in Minnesota \(wq-wwprm2-109\)](#)

Impaired waters

In the [2024 Impaired Waters List](#), MPCA identified a total of 43 waterbodies (56 assessment units) as impaired due to measured sulfate levels in excess of 10 mg/L.

Site-specific standards

- [Framework for developing and evaluating site-specific sulfate standards for the protection of wild rice \(wq-s6-66a\)](#) (December 2023)

More information

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U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 11

Moyle JB (1944) Wild rice in Minnesota. *J. Wildlife Management* 8(3):177-84.

WILD RICE IN MINNESOTA

John B. Moyle

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Wild rice (*Zizania aquatica*) is an aquatic grass of the Tribe Zizanieae which produces grain valued as food for waterfowl and as a table delicacy for mankind. It is a native plant and not the ancestor of the cultivated rice of commerce. Wild rice grows throughout the eastern half of the United States and adjoining portions of Canada (Hitchcock, 1935), but is more abundant in central and northern Minnesota than in other parts of its range. Minnesota wild rice stands are autumn feeding grounds for waterfowl on the Mississippi flyway. Martin and Uhler (1939) report that this rice formed 5.10 per cent of the food in the stomachs of many game ducks taken in the eastern United States, and Morse (1941) found it made more than 50 per cent of the food for wild ducks on some Minnesota lakes in autumn. Wild rice has long been gathered for food by the Minnesota Indians and at present is harvested in considerable amounts by both Indians and whites.

ECOLOGY OF WILD RICE

Wild rice grows in shallow lakes and along streams in water 1 to 3 feet deep. The seeds, buried in the bottom mud since the preceding autumn, germinate in May and June to produce ribbon-like submerged leaves. By late June and July these leaves have grown to float on the water surface. The blossom stalks emerge during the first 2 weeks in July, and when a few inches above the surface begin to flower; the stalks continue

to grow until the grains are nearly mature. At the time of ripening, in late August and September, the "straw" extends 2 to 8 feet above the water. Each stalk produces a terminal panicle of unisexual spikelets—pistillate on the upper ascending branches and staminate on the lower spreading branches. The pistillate portion matures from the top downward and about 10 days are required for the ripening of all the seeds. Around each kernel is a hull of the persistent palea and awned lemma. When fully mature, the entire spikelet disarticulates from the pedicle, drops into the water, and settles into the bottom mud. Most wild rice plants have but one stalk with a terminal panicle or "head," but stooling may occur in shallow water when an individual plant will produce five or six stalks.

Wild rice usually grows in nearly pure stands. The lakes producing this crop show marked seasonal differences: in spring they are expanses of open water, in midsummer covered with a mat of floating leaves, and in late August and September resemble fields of cultivated grain. The vegetational complex of wild rice stands is essentially one of annual development. The aquatic plants usually associated with this grass begin growth each season from seeds, winter buds, or other types of propagules. Rooted perennials are uncommon. In Minnesota the most common aquatics associated with wild rice are bushy pondweed (*Najas flexilis*), coontail (*Ceratophyllum demersum*), duckweeds

(*Lemna minor*, *L. trisulca* and *Spirodela polyrhiza*), bladderwort (*Utricularia macrorhiza*), and a pondweed (*Potamogeton zosteriformis*). The bushy pondweed is especially abundant in some stands and, like the wild rice itself, is avidly eaten by waterfowl (Morse, 1941).

In Minnesota, the chemical nature of the water seems to be the principal factor affecting the natural distribution of wild rice. This crop tolerates the entire carbonate (total alkalinity) range of Minnesota waters (5 to 250 p.p.m.), but is intolerant of sulphates. No large stands of rice occur in waters having a SO_4 content greater than 10 p.p.m., and rice generally is absent from water with more than 50 p.p.m. Best growth is made in carbonate waters having total alkalinity greater than 40 p.p.m. Most Minnesota wild rice stands are on mucky soils over gravel or sand. The crop grows best in lakes having some water moving through and often is lacking from stagnant lakes and pools, especially bog lakes with dark brown water. It is frequent along streams and at lake inlets and outlets.

THE CROP AND ITS HARVEST

Surveys in 1940-42 showed at least 15,000 acres of wild rice in stands of 5 acres or more; the total probably would approach 30,000 acres if all smaller stands were considered. The stands vary from small patches fringing lakes and creeks to nearly 1,000 acres in some large shallow lakes; about 150 are large enough to warrant harvesting. The principal stands of more than 500 acres each are in Nett Lake, Koochiching County; Upper and Lower Rice lakes, Clearwater County; Star Lake, Otter-

tail County; Lake Minnewawa, Aitkin County; and Big Rice Lake, Cass County.

The Minnesota harvest (calculated from returns by about 10 per cent of the harvesters), was 1,586,000 pounds, or 793 tons of parched or processed grain, in the bumper crop of 1940. In 1941 only 20,000 pounds were taken but in 1942 the harvest was 337,000 pounds, about 75 per cent of normal (estimated annual production of processed rice about 500,000 pounds). The poundage of non-processed grain was 2.5 times the foregoing figures. In 1940, 2,500 persons were engaged in the harvest. In most years the grain has a gross sales value between \$100,000 and \$400,000. The price paid on the stands for non-processed rice in 1940 to 1943, was 5 to 12 cents a pound. During the same period processed rice brought 20 to 40 cents a pound on the stands and retailed in Minnesota at 40 to 60 cents per pound. In addition to the processed rice sold for table use, considerable amounts of non-processed grain are purchased by aquatic nurseries and sold to sportsmen for planting as a waterfowl attraction.

HISTORY OF RICE HARVEST

Wild rice has long been harvested by the Minnesota Indians and prior to the coming of the white man was one of their staple foods. Before 1800, most of the stands were controlled by the Sioux; the Chippewas, now the bulk of the state's Indian population, then inhabited only the north shore of Lake Superior. The earlier and more general use of firearms by the Chippewas and the pressure of white settlement on both tribes, allowed the Chippewas to gain control of most of the wild rice be-

tween 1820 and 1860. Later these Indians were settled on reservations, most of which included or were close to the more important rice stands, and until recent years they have harvested most of the grain. At present, about one-third of the licensed harvesters are of Indian blood. In 1888 it was estimated that wild rice comprised a quarter of the food of the Winnibigoshish, Cass, and Leech Lake Chippewa bands (U. S. Supreme Court Transcript, 1922, p. 160). Estimates of the harvest between 1861 and 1909 by Indian agents (Jenks, 1898; Winchell, 1911) suggest that probably not more than 6,000 or 7,000 bushels were harvested each year by the Indians and in most years the harvest was considerably less. At least twice as much wild rice probably now is harvested annually as was taken formerly by the Indians.

HARVESTING AND PROCESSING

The primitive Indian method of harvesting, as related by Jenks (1898) and as described to the writer by older Chippewas, involved sheaving or tying the standing heads. The standing sheaves then remained on rice beds until all of the kernels matured. The harvester then would pole through the stand, bend the sheaves over the edge of the canoe, untie the heads, and knock off the grains with a short flail. When a boatload was gathered, it was taken ashore, spread on blankets for a day or two to dry, and then heated and stirred in a large iron kettle until the hulls were brown and brittle. Often the heating was continued until most of the grains were popped. This heating process is called parching. Threshing was accomplished by dancing on or beating

the grains with poles until the parched hulls were loosened. The grain was then separated from the hulls by winnowing. In recent years, binding the heads into sheaves has been abandoned, both because of the labor involved and of the ease with which such rice can be pilfered by less industrious harvesters. Rice now is harvested by poling a narrow flat-bottomed boat through the ripening stand and knocking the ripe grains into the boat. Harvesting is generally a family affair. The man usually stands in the rear to shove the push-pole and the woman, seated in the middle, gathers armfuls of the stalks with aid of a tapered stick 2 to 3 feet long, bends the heads over the edge of the boat, and taps them lightly with a similar stick to remove the ripened grain. Since the heads ripen over a 10-day period and the kernels fall as they ripen, each stand must be harvested several times to get even a small percentage of the crop. Stands usually are harvested four times at 2-day intervals.

The primitive processing now is used by only a few of the older Indians. Most of the rice is processed with simple homemade machines. A common device for parching consists of a steel oil barrel rotated over a low wood fire on a central iron shaft through the barrel that terminates in a crank. Threshing is done with another barrel fixed horizontally on a platform; centered in this barrel is a revolving shaft carrying eccentric paddles shod with pieces of old automobile tire casing. On the end of the shaft is a pulley, belted to a gasoline engine or to the rear wheel of a jacked-up automobile. The hulls are removed as the grains are thrown back and forth against the paddles. An ordinary farm

fanning mill is commonly used for winnowing. In the larger ricing camps there usually is a division of labor and certain individuals spend most of their time at processing the grain.

Much of the wild rice now harvested is sold to commercial processors as it comes from the stands. These firms have developed better mechanical means for processing the grain and can produce a more uniform finished article. The rice usually is heated only until the hulls are brittle enough to thresh and the grains not popped, as often occurs in hand processing. Popped grains tend to fragment and make a less attractive product. Machines for harvesting wild rice have been devised but are no longer allowed on Minnesota stands because the harvesting is being maintained as a self-perpetuating hand industry. A harvester used with some success is a flat-bottomed motorboat with a mechanically-operated reel on the front, similar to that of a grain binder, to knock the grains from the heads into the boat.

VARIABILITY OF WILD RICE

Two kinds of wild rice have long been recognized by plant taxonomists: a tall, robust, wide-leafed type (*Zizania aquatica*) and a shorter, narrow-leafed rice *Z. aquatica* var. *angustifolia* (Hitchcock, 1935). In Minnesota stands much of the material appears to be intermediate, although both varieties can be found. Plants fitting both descriptions frequently occur in a single stand. In general, var. *angustifolia* is commoner in the softer waters of northeastern Minnesota (total alkalinity less than 50 p.p.m.) and the taller *Zizania aquatica* is more characteristic of the harder waters of the southern and western parts of the wild rice area.

Distinct strains of wild rice occur in many Minnesota beds, and an experienced buyer often can tell from a sample of grain the stand which produced it. Detailed examination of the more important stands in 1940, 1941, and 1942 showed them to differ markedly in the average size and number of kernels per head, and these characteristics were fairly constant from year to year. This is generally recognized by harvesters of wild rice and some areas, such as Nett Lake and Lake Minnewawa, have long been famous for the large kernels produced.

The length of the kernel or spikelet, from base of spikelet to base of awn, commonly varies from 6 to 20 mm. The averages, for length of kernel, from 85 stands were as follows:

Average length, millimeters	Number of stands
8	2
9	3
10	2
11	9
12	10
13	14
14	14
15	18
16	5
17	1
18	7

The average length of kernels for all stands was 13.6 mm. Strains with kernels 15 to 18 mm. long are sold by aquatic nurseries as "giant wild rice," and those shorter than 10 mm. are known as "bird or river rice." The average number of kernels per head was 15 to 212 on the 50 stands examined:

Average kernels per head	Number of stands
15 to 50	17
51 to 100	18
101 to 150	14
151 or more	1

The grains and grain scars on a dozen or more typical heads from each stand were counted. The leaves varied from

under 10 mm. to about 30 mm. in width. Variation also occurs in the length of awn and color of the heads. Most maturing heads are green but nearly every stand has a sprinkling of purplish heads; the grain produced by the two color phases, however, is identical. The height of mature stands above the water surface was 2 to 8 feet.

Different stands exhibited nearly every combination of these variable characteristics, but the shorter, narrow-leaved rice generally produces fewer and larger grains than the taller, wide-leaved type. All stands producing grains that averaged 18 mm. in length had panicles with fewer than 50 kernels and had or approached the growth form of var. *angustifolia*. This type is most valued by the harvester because the large grains and short straw facilitate harvesting from a boat.

There is considerable variation in the number of days required to mature the crop. The first stands begin to ripen about August 18 and the last about September 12; most of them begin between August 24 and September 3, the greatest number usually ripening about September 5. Since about 10 days are required to complete the ripening, most of the harvesting occurs between August 25 and September 12. Ripening dates are fairly constant and do not vary more than 2 or 3 days in any stand over a period of years. The first to ripen has both short straw and small grains; the taller rice and that with more grains per head, generally is later.

The most distinct strains are found either in small isolated stands or in the large continuous stands of the general rice area; their natural development may be attributed to self-pollination over a long period of years. The age of

most Minnesota stands is not known, but harvesting has been carried on regularly in some large beds for at least 100 years.

CROP FLUCTUATIONS AND FAILURES

On the basis of harvest data for 24 years at Nett Lake in Koochiching County, for 21 years at Platte and Sullivan lakes in Morrison County, and for shorter periods on other waters,¹ the harvest during any 4 years is likely to fail once, and to produce one bumper and two fair crops. Jenks (1898) gathered considerable evidence on harvest failures and reached the same conclusion as to their frequency. Failure results mainly from high water during June and July. The best crops occur in years of sub-normal rainfall with receding water levels. Comparison of the water levels in 1940 (bumper crop) and in 1941 (poor crop) shows that a water stage 12 inches or more above normal during the period from May 15 to July 1 caused a failure and a stage 6 inches above normal reduced the harvest on some stands by more than half. Lake Minnewawa, Aitkin County, had a water stage 6 to 8 inches higher in 1941 than in 1940 and suffered a reduction in harvest from 60 tons to less than one ton.² Continued high water when the plants have only submerged leaves results in such weak, attenuated growth that the plants are easily destroyed by

¹ Data for Nett Lake from memorandum by S. D. Walker to M. L. Burns, Acting Superintendent, Consolidated Chippewa Agency, Cass Lake, Minnesota, Sept. 15, 1939. Data for Platte and Sullivan Lake from Walter Zak, Hillman, Minnesota (letter, Dec. 29, 1941).

² William Simpson (letter Sept. 11, 1941) to the Division of Drainage and Waters, Minnesota Department of Conservation.

wave action and adverse weather (Chambliss, 1940). This phenomenon is locally known as "drowning." Heavy wind, hail, and rain storms while the kernels are maturing also bring about failure or reduction of the harvest by lodging and uprooting the plants.

In some years many of the rice flowers do not set grains. The cause is unknown but usually is attributed to hot, dry weather when the plants are in flower. Eleven of the 14 stands observed in detail during 1941 produced heads on which less than 50 per cent of the spikelets matured. Rice harvested from such stands is light in weight and the sterile grains must be removed by water flotation before it can be processed.

The army worm (*Agrotis* sp.) occasionally destroys limited amounts of wild rice near shores by feeding on the maturing grains, and a few grains sometimes are infected with ergot. Stands in southern Minnesota have been destroyed by German carp, and muskrats frequently gnaw off the stems at the waterline.

YIELD AND HARVEST

In 1941 an estimate of the total yield was made on 14 stands. Two to 11 representative sample areas were selected on each and delimited by floating wooden hoops, each enclosing an area of 11.5 square feet. The number of areas sampled depended upon the size and the uniformity of the stand. On each area, all panicles were removed and bagged for study. To obtain the total yield per unit area, the following data were obtained from these collections: (1) the average number of panicles per square foot, (2) average number of grains and grain scars per panicle, (3) average

weight of dry grain per square foot, and (4) percentage of sterile spikelets. The 1941 harvest on most stands was regarded as a failure, but all 14 stands produced some rice and averaged 168 (50 to 401) pounds of processed rice per acre.

All these stands were open to harvesting but only two were harvested: Upper Rice Lake in Clearwater County with a total production of 401 pounds per acre, and Big Rice Lake in Cass County with 323 pounds per acre. Harvesting was attempted on some others but abandoned. It seems, therefore, that unless a stand produces more than 300 pounds of processed rice (or 750 pounds non-processed) per acre, hand harvesting is not profitable.

The long record of harvest data for Nett Lake showed the harvest there has varied from 6 to 43 tons, averaging about 15 tons. The stand usually comprises about 800 acres of harvestable rice and has, therefore, an average yield of 37.5 pounds per acre. In contrast, the total production in 1941 (poor crop) was 185 pounds. A crude estimate of the average on all stands can be gained by dividing the average annual take per licensed harvester by the number of acres allotted to him for harvesting. The average allotment is about 10 acres; the average take for 1940 was 393 pounds and for 1942 was 315 pounds. This suggests the usual amount taken as between 30 and 40 pounds of processed rice per acre. Stewart (1926) carefully checked the harvest on a 2,000 acre Minnesota stand and found 50 pounds of processed rice per acre taken in 1924, a good crop year.

Several factors are involved in the marked difference between total yield

and total harvest; most important are incomplete harvesting of individual heads by hand methods and incomplete coverage of the stands by the harvesters. Since several of the best Minnesota stands are known to have been harvested by hand for at least a century, it is evident that such harvesting does no damage to them and leaves most of the grain for waterfowl and reseeding.

PROPAGATION OF WILD RICE

Because of its obvious value as an attraction for waterfowl, wild rice has been planted in many waters where it did not occur naturally. Some plantings have succeeded, but more have failed. Of eight made in the wild rice area of northern Minnesota during 1940, four produced good crops, three fair crops, and one failed the following year. Three other plantings during 1940 in waters high in sulphates failed completely. Two earlier seedings in the wild rice area produced fair crops the first year but failed thereafter. Miller (1943) examined the results of 50 plantings of wild rice in Michigan and found that 74 per cent of them failed to become permanent.

The conditions that appear most conducive to success of wild rice in Minnesota are: (1) clear water, 1 to 3 feet deep, with total alkalinity greater than 40 p.p.m. and SO_4 concentration less than 10 p.p.m.; (2) organic soil 6 inches or more in depth, preferably with some calcareous material such as snail shells; (3) some movement of water through the area; (4) fluctuation of water level less than 6 inches throughout the growing season; and (5) absence of carp. Almost all such waters within the wild rice area now have rice, and planting is

usually advisable only when stands have been destroyed by drought or a long period of fluctuating water levels.

Since wild rice is available as waterfowl food only for about a month and provides good shelter for only about 2 months each year, it is less desirable as a food species than the pondweeds (*Potamogeton*) and less desirable for cover than the perennial bulrushes (*Scirpus*). It does, however, provide much excellent food during the autumn waterfowl migration and therefore is one of the most effective aquatic plants to attract and concentrate waterfowl.

Wild rice seed should be kept cool and moist from the time it is harvested until planted; two methods of storage have been found to be effective. It can be stored in double burlap sacks encased in cages of chicken wire and submerged in a lake; the wire excludes muskrats, which have a great liking for the seed. Seed also can be stored in a cool root cellar in double burlap sacks, so arranged that water from melting ice will drip upon the sacks continuously and keep the seed moist.

Planting is best done from a boat or canoe. The seed should be scattered over the surface of waters that are 1 to 3 feet deep in depth. All good seeds will sink to the bottom immediately. The best rate for seeding is about 1 bushel per acre or, in small areas, a large handful to an area 6 by 6 feet. Preferably, plantings should be made a short time before ice forms in fall or as soon as the ice breaks up in spring.

SUMMARY

Minnesota contains more than 15,000 acres of wild rice (*Zizania aquatica*) growing in shallow lakes and along

streams in the northern and central parts of the state. This native, unimproved grain exhibits considerable variation in the size and number of kernels per head and in other characteristics, and it tends to develop local strains.

The crop, in addition to having value for waterfowl, provides an average annual harvest of about 500,000 pounds of processed rice. Up to 2,500 persons, about one-third of Indian blood, engage annually in the harvesting and the grain usually has an annual value of \$100,000 to \$400,000. The grain is harvested by hand methods similar to those long used by the Minnesota Indians. Simple mechanical procedures have now largely replaced hand labor for parching the grain and removing the hulls.

On any stand the harvest will fail, on the average, one year in four, the principal cause being a high water level during May and June. Sufficient grain for reseeding usually is produced in years of harvest failure.

The few data available suggest that often as little as one tenth of the crop on a stand is taken by hand harvesting leaving most of the grain for waterfowl and reseeding. When total production, calculated as processed rice, is below 300 pounds per acre, hand harvesting usually is unprofitable. The average harvest in Minnesota is about 30 to 40 pounds per acre (processed rice).

Wild rice, is more of an attraction

than a staple food plant for waterfowl, and shows marked preference for certain habitat conditions; unless these conditions are supplied plantings are apt to fail.

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WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 12

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Iron sulfide formation on root surfaces controlled by the life cycle of wild rice (*Zizania palustris*)

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Abstract Iron sulfide plaques have been observed on roots of wild rice (*Zizania palustris*) and other wetland plants grown in sulfur-impacted freshwater ecosystems, but the mechanism of their formation and ramifications for plants have not been investigated. We exposed a model annual wetland plant, *Zizania palustris*, to elevated sulfate concentrations (3.1 mM) and quantified the development of iron oxide and iron sulfide precipitates on root surfaces throughout the plant life cycle. During the onset of seed production,

root surfaces amended with sulfate transitioned within 1 week from iron (hydr)oxide plaques to iron sulfide plaques. During the same week, Fe(III) decreased on roots of plants not amended with sulfate but FeS did not accumulate. Prior to FeS accumulation, sulfate-amended plants had taken up the same amount of N as unamended plants. After FeS accumulation, total plant nitrogen did not increase further on sulfate-amended plants, indicating a cessation in nitrogen uptake, whereas total plant N continued to increase in unamended plants. Sulfate-amended plants produced fewer and lighter seeds with less nitrogen than unamended plants. FeS precipitation on roots may be associated with elevated sulfide and inhibited nitrogen uptake before the end of the plant's life cycle, thus affecting the populations of this annual aquatic plant. We propose a mechanism by which a physiologically-induced decline in radial oxygen loss near the end of a plant's life cycle initiates a precipitous decline in redox potential at the root surface and in adjacent porewater, initiating accumulation of iron sulfide plaques. These plaques could be an important locus for iron sulfide accumulation in wetland sediments.

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Keywords Root plaques · Radial oxygen loss · Iron–sulfur cycling · *Zizania palustris* · Electron accepting buffer

Introduction

Introduction of sulfate to low-sulfate freshwater ecosystems and subsequent reduction to sulfide can induce eutrophication, enhance methylmercury production, and decimate populations of sensitive aquatic plant species (Caraco et al. 1989; Gilmour et al. 1992; Smolders et al. 2003). Field observations have correlated elevated sulfide concentrations in sediment with population declines and decreased density of some aquatic plants (Myrbo et al. 2017; Pulido et al. 2012; Smolders et al. 2003). Black iron sulfide (FeS) plaques have been observed on the roots of aquatic plants grown with elevated sulfide in several sulfur addition experiments (Gao et al. 2003; Jacq et al. 1991; Koch and Mendelssohn 1989) including our outdoor mesocosm experiment with self-perpetuating wild rice (*Zizania palustris*) populations (Pastor et al. 2017); however, little is known about conditions conducive to iron sulfide precipitation on roots and the mechanism by which it occurs.

Roots of aquatic plants create redox interfaces that are hot spots for cycling of nitrogen, sulfur, iron, and other metals (Soana et al. 2015; Schmidt et al. 2011; Lee and McNaughton 2004). Many aquatic plants transport oxygen from the atmosphere to the roots through porous tissue called aerenchyma (Armstrong and Armstrong 2005). Radial oxygen loss from roots reacts with ferrous iron in sediment to form iron (hydr)oxide plaques at the interface of the oxidized root surface and the reduced sediment (Christensen and Sand-Jensen 1998; Mendelssohn and Postek 1982; Snowden and Wheeler 1995). Together, radial oxygen loss and iron (hydr)oxide plaques provide a supply of electron accepting compounds at the root surface, hereafter referred to as an electron accepting buffer. This buffer may inhibit sulfide formation and precipitation in several ways. The release of oxygen by plant roots may reoxidize sulfide and inhibit sulfate reduction (Holmer et al. 1998). In addition, Fe(III) can oxidize sulfide, and the reduction of Fe(III) to Fe(II) may outcompete sulfate reduction (Roden and Wetzel 1996; Hansel et al. 2015). Others have observed increased FeS precipitation on roots and in sediments shortly after plant senescence (Jacq et al. 1991; Giblin and Howarth 1984), suggesting a decrease in the strength of the electron accepting buffer. However, the timing of sulfide interactions with iron on root surfaces, particularly in relation to the life cycle of the plants, remains largely unexplored.

To explore these processes, we subjected wild rice, *Zizania palustris*, an annual plant that forms large monotypic stands in the lakes and rivers of Minnesota, Wisconsin, northern Michigan, and Ontario, to enhanced sulfate concentrations. Although radial oxygen loss has not been directly quantified in wild rice, aerenchyma tissue and root surface iron oxides have been studied and documented in this species (Stover 1928; Jorgenson et al. 2012). In a previous mesocosm experiment with wild rice, increasing concentrations of porewater sulfide decreased vegetative biomass production only slightly, but strongly decreased annual seed production, leading to population declines in subsequent years (Pastor et al. 2017). Hydroponics experiments have demonstrated that sulfide reduces nutrient uptake in wetland plants (Joshi et al. 1975; Koch and Mendelssohn 1989) through inhibition of metallo-enzymes in the electron transport chain and subsequent inhibition of ATP production required for nutrient transport (Allam and Hollis 1972; Koch et al. 1990; Martin and Maricle 2015). It is not well understood why the seed production life stage of wild rice is especially vulnerable to sulfide, but decreased seed production may be associated with the timing of favorable conditions for sulfate reduction and concomitant FeS accumulation on roots.

To identify the drivers of FeS formation on the root surfaces, we tested the hypothesis that surface water sulfate loading induces FeS formation on roots. To investigate the implications of FeS root plaques for nitrogen uptake during seed production, we explored the timing of FeS formation on wild rice roots. We exposed wild rice plants to elevated surface water sulfate and quantified the speciation of iron and sulfur on root surfaces and in rooting-zone porewater during reproductive life stages. Throughout the life cycle of the plant, we also monitored growth and seed production.

Methods

Sediment was collected from Rice Portage Lake (MN Lake ID 09003700, 46.703810, – 92.682921) on the Fond du Lac Band of Lake Superior Chippewa Reservation in Carlton County, Minnesota on 5/15/15 and placed in a 400 L polyethylene stock tank (High Country Plastics) where it was homogenized by

shovel. Initial total carbon in the sediment was $14.8 \pm 1.70\%$ and initial total nitrogen was $1.12 \pm 0.13\%$ by dry weight. Eighty 4 L plastic pails were then filled with 3 L of the sediment. Each 4 L pail was placed inside a 20 L bucket that was filled with 12 L of groundwater from an on-site well to provide a 12–15 cm water column. In each pail, two seeds that were harvested in 2014 from Swamp Lake on the Grand Portage Reservation (MN Lake ID 16000900, 47.951856, – 89.856844) were planted on 5/15/15 (Julian day 135).

Forty randomly chosen buckets were amended with sulfate and forty were left unamended. On 6/3/15, the forty amended buckets received an aliquot of stock solution (5.15 g of Na_2SO_4 dissolved in 200 mL of deionized water) to result in 300 mg L^{-1} (3.1 mM) sulfate. We hereafter refer to all porewater, sediment, and plants in these buckets as “amended”. This concentration is close to the EPA secondary standard for drinking water, 250 mg L^{-1} (2.6 mM), intended to prevent laxative effects and an unpleasant taste. Although northeastern Minnesota generally has sulfate concentrations less than 10 mg L^{-1} (0.1 mM), concentrations of sulfate higher than 2.6 mM are found in some Minnesota waters, either naturally from geologic sources or from anthropogenic inputs (Myrbo et al. 2017). A sulfate concentration of 3.1 mM caused wild rice populations to go extinct within 5 years in previous mesocosm experiments with the same sediment (Pastor et al. 2017). The overlying water was sampled twice throughout the trial and re-adjusted to 3.1 mM SO_4 by adding additional Na_2SO_4 stock solution on 7/10/15. Unamended buckets had an average surface water sulfate concentration of $0.15 \pm 0.01 \text{ mM}$ when sampled on 6/23/15, consistent with the concentration of sulfate in groundwater from the on-site well. This is only slightly above observations of Moyle (1944) that wild rice grows best in waters less than 10 mg L^{-1} sulfate. We hereafter refer to all porewater, sediment, and plants in these buckets as “unamended.” Shoots were thinned on 6/23/15 to one plant per bucket. Shoot height ranged from 10 to 20 cm and the tallest, most robust shoot in each bucket was left in place.

The annual life cycle of wild rice begins with emergence from the sediment and water column in June, continues with vegetative growth in July, followed by flowering and seed production in August, and ends with the shedding of seeds and death of the

plant from late August to late September. Seeds overwinter in the sediment until they germinate in May (Grava and Raisanen 1978; Sims et al. 2012). Four plants were harvested every 2 weeks from randomly chosen amended and unamended buckets beginning at the onset of flowering (7/9/15, day 190) and continuing to the onset of seed production (8/20/15, day 232), after which plants were harvested weekly until senescence (9/22/15, day 265). The first seeds were collected on 8/20/15 (day 232) but were unripe and not yet filled. Mature seeds were not produced until 1 week after the start of seed production (day 239). On the last sample date (day 265) seeds were collected but were unfilled. Stems and leaves were no longer green, indicating that the plants had senesced. Of the four amended replicates sampled on this date, two plants did not produce seeds. Thus, “mature seed production” refers to seeds produced between Julian days 239–253.

Each plant was removed from the sediment and immediately rinsed in buckets of deoxygenated water continuously bubbled with a rapid stream of molecular nitrogen. If seeds were present, they were removed prior to sampling the plant and saved for separate analysis. While submerged in deoxygenated water, the stem was cut just above the root ball so that the shoots could be saved for mass and N analysis. The still submerged roots were then placed in jars full of deoxygenated water, which were immediately placed in a plastic bag flushed with molecular nitrogen and transported to an oxygen-free glove box (Coy Lab Products, 97.5% N_2 , 2.5% H_2). In the glove box, the roots were cleaned of sediment and all organic matter except living wild rice roots prior to removing a 1–2 g section of wet root mass for acid volatile sulfide (AVS) and iron analysis.

The plants and seeds were rinsed with deionized water and dried in paper bags for 7 days at 65°C . The dried plants were weighed, placed in polycarbonate vials with stainless steel balls, and shaken in a SPEX 800 M mixer mill until the samples were in a powdered form. Seeds were counted, weighed, and powdered using the same method. The samples were transferred to glass vials and dried again overnight at 65°C with caps loosely covering the vials. Samples were quantified for total N on an elemental analyzer coupled to a Finnigan Delta Plus XP isotope ratio monitoring mass spectrometer.

Sediment was collected at the beginning and end of the growing season. Immediately after sediment homogenization (5/15/15), five replicate samples were placed in jars and analyzed for AVS and simultaneously extracted iron. At the end of the growing season (9/22/15), a 7 cm diameter sediment core was collected from the top 10 cm of each bucket prior to root sampling. Jars were filled completely with sediment and placed in a plastic bag filled with nitrogen to prevent oxidation during transport to a glove box. In the glove box, sediment was homogenized and allocated for AVS and iron extraction.

From both sediment and roots, AVS and iron were extracted simultaneously from a 1–3 g wet sample (0.1–0.5 g dry) using 7.5 mL 1 N HCl for 4 h using a modified diffusion method (Brouwer and Murphy 1994). During a room temperature acid incubation with gentle mixing, sulfide was trapped in an inner vial containing 3 mL Sulfide Antioxidant Buffer (SAOB) and subsequently quantified using a ThermoScientific sulfide ion-selective electrode with a detection limit of 0.01 mmol L^{-1} . After the extraction, two aliquots of the 1 N HCl extracts were used for iron quantification. Ferrous iron was immediately quantified colorimetrically using the phenanthroline method on a HACH DR5000 UV–Vis spectrophotometer (Greenberg et al. 1992), and weak acid extractable iron (sum of Fe(II) + Fe(III) concentrations, hereafter referred to as “total extractable iron”) was quantified using a Varian fast sequential flame atomic absorption spectrometer with an acetylene torch.

A subset of roots was tested for chromium(II)-reducible sulfur (CRS) to determine whether AVS included all total reduced inorganic sulfur on the roots. A diffusion-based CRS method was used, which can fully extract all amorphous iron sulfide and pyrite and can partially extract elemental sulfur (Burton et al. 2008). The same sampling apparatus was used for extraction of AVS and CRS (see Burton et al. 2008 Fig. 1 for a diagram of the sampling apparatus). Chromic acid for CRS analysis was prepared according to Burton et al. (2008). Inside an oxygen-free glove box, a section of root from a plant previously analyzed for AVS was placed in the analysis bottle. An inner vial containing SAOB was also placed inside the bottle prior to sealing. Bottles were removed from the glove box and injected with chromic acid with no oxygen exposure. CRS was extracted for 48 h and quantified using a ThermoScientific sulfide ion-selective electrode.

One day prior to each root sampling date, the porewater was sampled for sulfide, sulfate, iron, and pH. First, pH was measured in situ with a ThermoScientific Orion pH electrode at a depth of 5 cm below the sediment surface and 2 cm from the stem of the wild rice plant. Porewater was collected using 5 cm length, 2 mm diameter tension lysimeter filters (Seeborg-Elverfeldt et al. 2005) (Rhizons) attached with a hypodermic needle to an evacuated, oxygen-free serum bottle sealed with a 20 mm thick butyl-rubber stopper (Bellco Glass, Inc). The entire filter end of the Rhizon was inserted vertically into the sediment just below the surface. The goal was to draw water from approximately the upper 5 cm of sediment without drawing surface water. The filter was placed with minimal jostling to avoid creating a cavity around the filter that would allow surface water to enter the sediment and contaminate the porewater. The Rhizon was placed approximately 2 cm away from the stem of the wild rice plant and on the opposite side from where pH was measured (Supplementary Fig. S1).

Porewater sulfide samples were drawn into 50-mL serum bottles preloaded with 0.2% 1 M ZnAc and 0.2% 6 M NaOH to preserve sulfide. Sulfide bottles were left to fill overnight, then stored at 4°C in the sealed serum bottles used for sample collection for approximately 30 days before sulfide was quantified. Samples for porewater sulfate analysis were withdrawn from sulfide sampling bottles and filtered through a Dionex 1 cc metal cartridge and a $0.45 \mu\text{m}$ polyethersulfone filter approximately 3 months after they were collected. Porewater iron was collected in 8 mL serum bottles preloaded with 40% deionized water, 40% phenanthroline, 20% acetate buffer, and 1% concentrated hydrochloric acid. Iron bottles were filled until the solution turned light red, approximately 10 min. If the solution turned red before 8 mL were collected, samples were diluted with deionized water to bring the total solution to 8 mL. Iron samples were quantified within 2 h of sampling. Iron and sulfide in porewater were quantified colorimetrically using the phenanthroline and methylene blue methods, respectively, on a HACH DR5000 UV–Vis spectrophotometer (Greenberg et al. 1992). Sulfate was quantified using a Dionex ICS-1100 Integrated IC system (AS-DV Autosampler) (Greenberg et al. 1992). The saturation index was calculated to determine if the porewater was saturated with respect to iron sulfide (Eq. 1, $K_{\text{sp}} = 10^{-2.95}$)

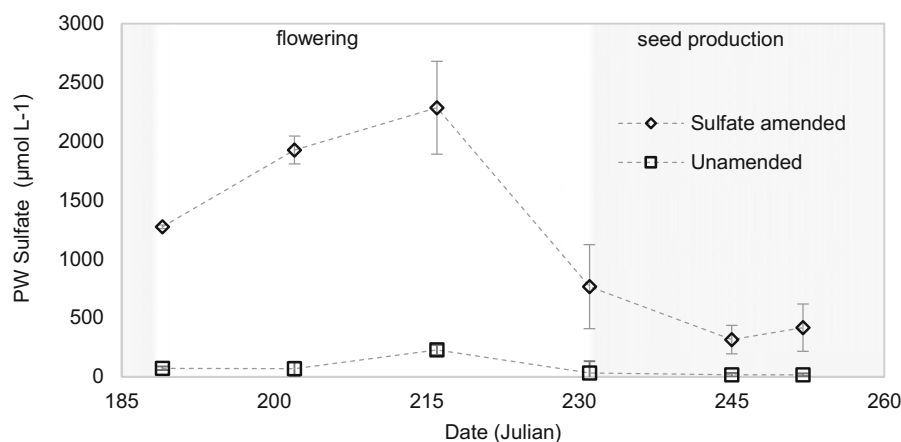


Fig. 1 Seasonal measurements of porewater sulfate concentrations 2 cm from the root surface. Diamonds depict amended plants while squares depict unamended plants. Error bars show one standard deviation around the mean. Shading represents

different life stages. Shading on left side of figure represents pre-flowering, unshaded represents flowering, and shading on right represents seed production

(Stumm and Morgan 1996). A positive saturation index indicates oversaturation and a thermodynamic force to drive precipitation, and a negative value indicates undersaturation (and potential dissolution).

$$SI = \log \frac{IAP}{K_{sp}} \text{ where } IAP = \frac{[Fe^{2+}][HS^{-}]}{[H^{+}]} \quad (1)$$

Geochemical parameters and measured attributes of plants were analyzed using repeated measures analysis of variance to determine differences between amended and unamended treatments over the course of the growing season. Analyses were performed with a repeated measures ANOVA because although individual plants were harvested on each date, each sampling date was not independent of the prior sample dates. A paired *t* test was used to determine differences between AVS and CRS concentrations on subsamples from the same roots. Analyses were performed using the statistical software SAS. Logarithmic transformations were used when data was non-normal. Data are available at the Data Repository for the University of Minnesota (<https://doi.org/10.13020/D68W98>).

Results

Porewater sulfate and sulfide

Immediately before sulfate was added to amended buckets on Julian day 154, porewater sulfate

concentrations were near $40 \mu\text{mol L}^{-1}$. By the start of flowering (day 185), sulfate concentrations in amended porewater were over $1200 \mu\text{mol L}^{-1}$, 30 times higher than the initial concentration (Fig. 1). Sulfate concentrations continued to rise for the first 30 days of flowering (until day 217), peaking at nearly $2300 \mu\text{mol L}^{-1}$. Over a 4 week period (days 217–245) surrounding the onset of seed production, sulfate concentrations in amended porewater decreased by 86% to $315 \mu\text{mol L}^{-1}$. Sulfate concentrations in unamended porewater were about $70 \mu\text{mol L}^{-1}$ at the start of flowering, roughly double the initial concentrations. Sulfate concentrations peaked at $230 \mu\text{mol L}^{-1}$ in unamended buckets on the same day as in amended buckets. During the same period that sulfate concentrations declined in amended porewater (days 217–245), sulfate concentrations in unamended buckets decreased by a similar proportion, 91%, to $20 \mu\text{mol L}^{-1}$. Porewater sulfide did not differ between amended and unamended treatments (Supplementary Fig. S2). Concentrations averaged between 1 to $5 \mu\text{mol L}^{-1}$ during flowering and increased to an average of 8– $17 \mu\text{mol L}^{-1}$ at the start of seed production. Amended rhizospheres had a higher average sulfide concentration than unamended rhizospheres during seed production, but variability was high on the days porewater sulfide was elevated. Porewater sulfide concentrations decreased near the end of seed production and rose slightly at senescence.

Acid volatile sulfur on root surfaces

When grown in sediment with sulfate-amended overlying water (3.1 mM), amended plants developed a black coating on their root surfaces by the beginning of seed production on Julian day 231 (Fig. 2). The black precipitate started just above the root ball and extended along the entire length of the roots in the sediments. Adventitious roots that grew at the surface of the sediment, however, remained white, the natural color of wild rice root tissue. Unamended plants, grown in sediment with low concentrations of sulfate in overlying water (0.15 mM), developed amber coatings characteristic of iron (hydr)oxides over the same time period.

Roots of amended plants began accumulating AVS during the flowering stage (Julian days 190–230) of the life cycle (Fig. 3a). The rate of AVS accumulation abruptly accelerated during the seed production stage (days 231–252) from



Fig. 2 Sulfate-amended (left) and unamended (right) roots. Sulfate-amended (3.1 mM sulfate in surface water) root has black color extending from about 0.5 cm above the root ball down to the tips of the roots. Unamended (0.15 mM sulfate in surface water) root has amber color characteristic of iron (hydr)oxides, especially in the 2–3 cm below root ball. The photograph was taken during senescence in October, 2014 from a pilot experiment, but color is typical of roots in this experiment. (Color figure online)

approximately $2 \mu\text{mol g}^{-1} \text{day}^{-1}$ to over $15 \mu\text{mol g}^{-1} \text{day}^{-1}$. During the seed production stage, amended roots accumulated up to 100 times more AVS than unamended roots, reaching a maximum mean concentration of $298 \pm 74 \mu\text{mol g}^{-1} \text{dw}$ at the end of seed production. In contrast, AVS on unamended roots remained at $3.2 \pm 1.7 \mu\text{mol g}^{-1} \text{dw}$ throughout the season (Fig. 3b). Between the end of seed production and final senescence (day 265), AVS concentrations on amended roots remained elevated or decreased slightly.

Although AVS concentration in amended sediment increased by one order of magnitude over the life cycle ($0.5\text{--}5 \mu\text{mol g}^{-1} \text{dw}$, Supplementary Fig. S3), sediment contained approximately 50 times less AVS per gram than the roots. Concentrations of chromium reducible sulfur on both amended and unamended roots did not differ from AVS concentrations on the same roots during seed production, indicating that crystalline forms of FeS did not make up a significant proportion of reduced sulfur (paired *t* test, $p = 0.27$, $t = 0.63$, $n = 20$).

Iron speciation on root surfaces

During flowering, concentrations of Fe(III) and Fe(II) were similar between amended and unamended roots (Fig. 3). During seed production, the redox state of iron was altered by the presence of sulfate. Concentrations of Fe(II) were much higher on amended roots compared to unamended roots ($p < 0.001$, $F = 19.1$, $df = 1, 31$), despite no significant difference in concentrations of Fe(III) between treatments. During the first week of seed production (between days 232 and 239), the concentration of ferric iron on amended roots decreased by 86%, from 233 ± 135 to $31.7 \pm 30.4 \mu\text{mol g}^{-1} \text{dw}$ while ferric iron on unamended roots decreased by 67%, from 438 ± 208 to $144 \pm 131 \mu\text{mol g}^{-1} \text{dw}$. This abrupt reduction of Fe(III) occurred the same week that the rate of net AVS accumulation increased on amended roots (Fig. 2). Following this transition, Fe(II) concentrations continued to increase (doubled) on amended roots but did not change on unamended roots.

Saturation index in porewater

Although the amended and unamended plants had significant differences in the speciation of solid-phase sulfur and iron on roots, the saturation index of FeS in the sediment porewater 2 cm away from the roots was

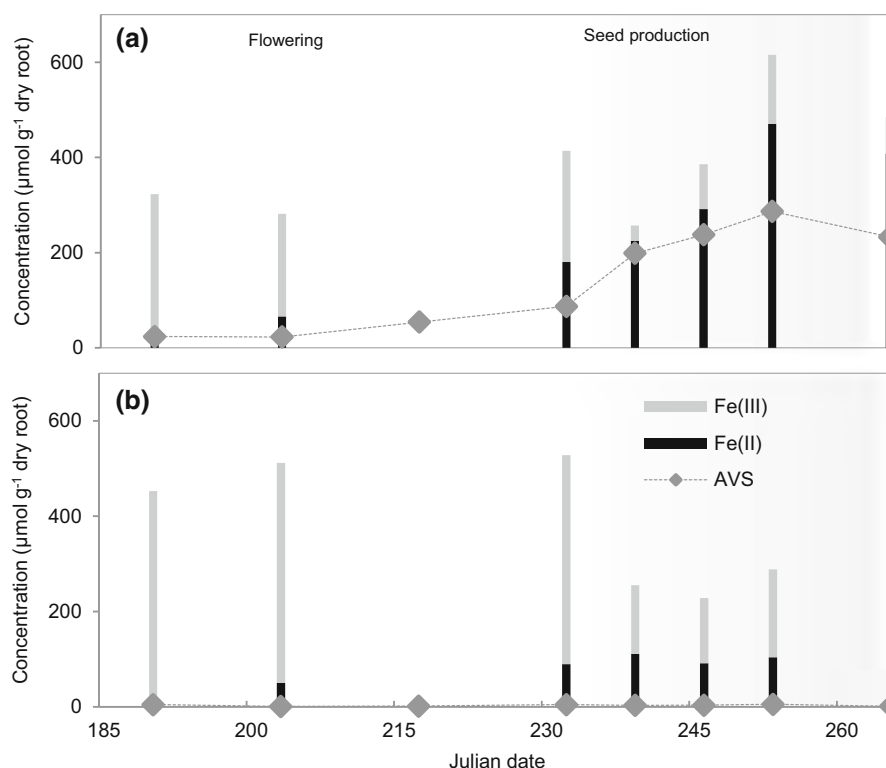


Fig. 3 Seasonal variations in iron speciation and root AVS for **a** sulfate-amended and **b** unamended conditions, and effective E_H on root surfaces. The gray bars in panels **a** and **b** indicate ferric iron and the black bars represents ferrous iron. Root AVS

concentrations are shown by gray diamonds. Error bars are omitted for clarity, but standard deviation is on average 33% of the mean

not affected significantly by sulfate amendment ($p = 0.177$, $F = 2.68$, $df = 1,4$) and remained, on average, near zero but mostly negative (-1.4 ± 0.3 to 0.1 ± 1.0) throughout the life cycle (Supplementary Table S1).

Effects on plants

The transition of plants from the vegetative growth stage to the flowering and seed production stages of the life cycle coincided with the onset of a yellowing and senescence of leaves beginning the third week of August (around day 232). Amended plants, all of which developed FeS plaques on roots, produced fewer seeds ($p = 0.067$, $F = 5.00$, $df = 1,6$, Fig. 4) with less nitrogen ($p = 0.052$, $F = 5.84$, $df = 1,6$) and smaller mass ($p = 0.069$, $F = 4.88$, $df = 1,6$). During flowering, total plant N was similar between amended and unamended plants. But, during the subsequent seed production stage, total plant N continued to

increase in the unamended plants, but not in the amended plants ($p = 0.084$, $F = 4.27$, $df = 1,6$).

Discussion

We observed rapid shifts in sulfur and iron speciation at the surface of wild rice roots during the plant life cycle that differed depending on sulfate amendment. At the onset of leaf senescence and seed production, sulfate concentrations in the porewater decreased. This was followed shortly by decreased Fe(III) concentrations on the root surface as well as increased, but highly variable, dissolved sulfide concentrations in porewater. At this stage, solid phase-sulfide increased clearly and consistently on roots of amended plants, but not on unamended plants. The rapid development of FeS plaques was concomitant with the development of fewer filled seeds with lower nitrogen contents. Total plant nitrogen continued to

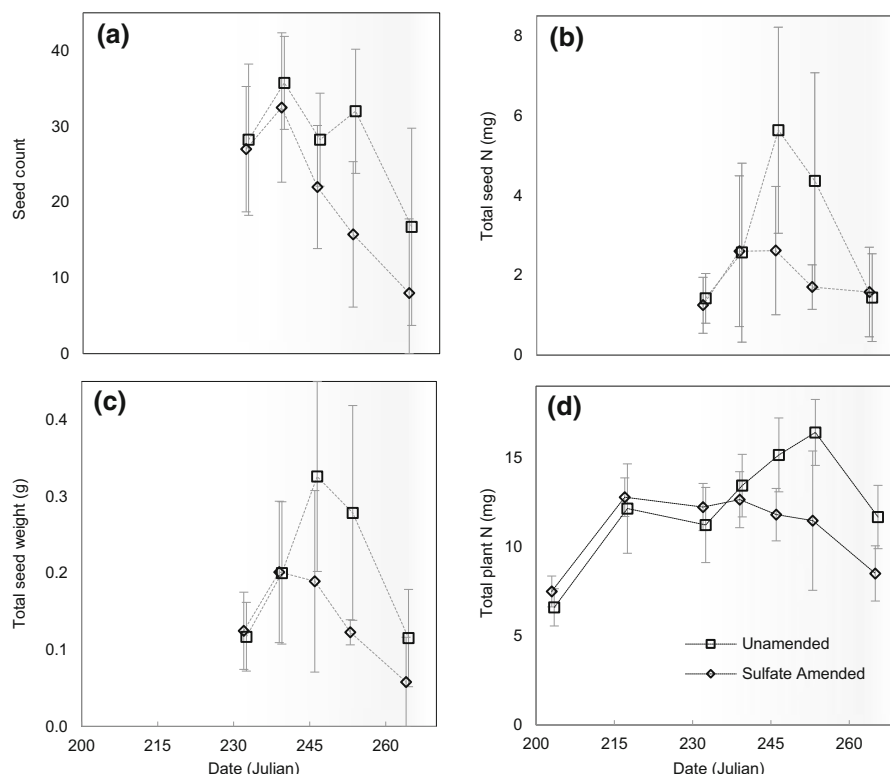


Fig. 4 Plant response in sulfate-amended and unamended conditions; **a** seed count. **b** Total seed mass. **c** Total mass of nitrogen in seeds, **d** total plant nitrogen, calculated by summing nitrogen from seeds, stems, and leaves. Diamonds represent

plants grown in surface water with 3.1 mM sulfate and squares represent unamended plants. The shaded background represents the seed production life stage. Error bars represent one standard deviation of four replicates

increase in unamended plants but not in amended plants. The strong divergence between amended and unamended plants in total plant nitrogen and precipitation of FeS suggests a feedback between sulfur biogeochemistry on or near the root surface and plant nutrient uptake.

Sulfate amendments led to more reduced conditions and a more rapid development of iron sulfide precipitate on root surfaces, clearly confirming our hypothesis that surface water sulfate induces FeS accumulation on roots. In the absence of elevated sulfate, unamended plants filled out their seeds even when redox potential declined (Fig. 3, Supplementary Fig S4). In previous experiments with self-sustaining populations of wild rice (Pastor et al. 2017), elevated sulfate had little effect on total vegetative growth of adult plants but was associated with a decrease in the number and weights of seeds produced by mature plants at the late stages of the life cycle. FeS accumulates on roots during the last stages of wild rice's life cycle in which nitrogen taken up by the plant

is allocated exclusively to panicles and seeds (Grava and Raisanen 1978; Sims et al. 2012). Porewater sulfide, which is known to decrease nitrogen uptake in plants, increased simultaneously with FeS on roots of amended plants. However, porewater sulfide was variable and increased in both amended and unamended rhizospheres, whereas FeS only increased on amended roots. Nitrogen uptake continued through the seed production phase of unamended plants but not in amended plants, which contained FeS plaques. FeS on roots may be a symptom of elevated porewater sulfide or further exacerbate its effects; our experiment was not able to distinguish between these possibilities. Regardless, the presence of root surface FeS strongly suggests that during seed production, a plant-induced reversal in the flow of electrons occurred: from a net flow of e-accepting capacity away from the root, sustaining Fe(III) in the rhizosphere, to a net flow of e-towards the root, reducing Fe(III) and introducing S(II).

The decline in nitrogen uptake and seed production concomitant with the initiation of FeS plaque precipitation on roots and porewater sulfide accumulation may explain the disproportionate effect of sulfate on seeds compared with its negligible effect on cumulative vegetative biomass prior to flowering and seed production. We suggest that plants are especially vulnerable to sulfide during seed production, because a seasonal decrease in root surface redox potential is compromised by further sulfide-induced depletion of the electron accepting buffer capacity of iron (hydr)oxides. The oxidation states of the amended and unamended root surfaces diverged during the transition from flowering to seed production (Supplementary Fig. S4), suggesting that root surface redox potential is, in part, controlled by a physiological mechanism tied to the plant's life cycle.

We hypothesize a pathway for how the living wild rice roots transition from iron (hydr)oxide plaques to iron sulfide plaques over the growing season (Fig. 5). Initially, conditions in the rooting zone are oxic, likely from radial oxygen loss (Fig. 5, stage [1]), as evidenced by precipitation of iron (hydr)oxides that accumulate equally on both amended and unamended root surfaces. At this initial stage, the root is protected from the electrons contained in sulfide and other reduced species by an ongoing supply of electron

accepting inputs, composed of both oxygen from roots and iron (hydr)oxide coatings on roots (Holmer et al. 1998; Roden and Wetzel 1996). Sulfide encountering the iron (hydr)oxide buffer is oxidized or precipitates with iron while the electron accepting buffer is maintained. In amended conditions, some of this electron accepting buffer may be consumed (Fig. 5, stage [2]) during the flowering stage, allowing dissolved sulfide to penetrate nearer to the root surface. A decrease in radial oxygen loss near the onset of seed production, as vegetative growth ceases and leaves senesce, allows dissolved sulfide to reach the root surface. Sulfide exposure may further suppress radial oxygen loss by inducing suberization, the thickening of cell walls that prevents exchange of dissolved gases across the root (Armstrong and Armstrong 2005). After radial oxygen loss is suppressed, the electron accepting buffer capacity of iron (hydr)oxides can no longer be maintained and the remaining quantity of iron (hydr)oxides is then rapidly reduced due to a net decrease in the supply of electron acceptors to the rooting zone. A decrease in radial oxygen is likely tied to the end of the vegetative growth stage of the life cycle because both the amended and the unamended root surfaces simultaneously experience a loss of Fe(III) and a decline in porewater sulfate concentrations. Concentrations of

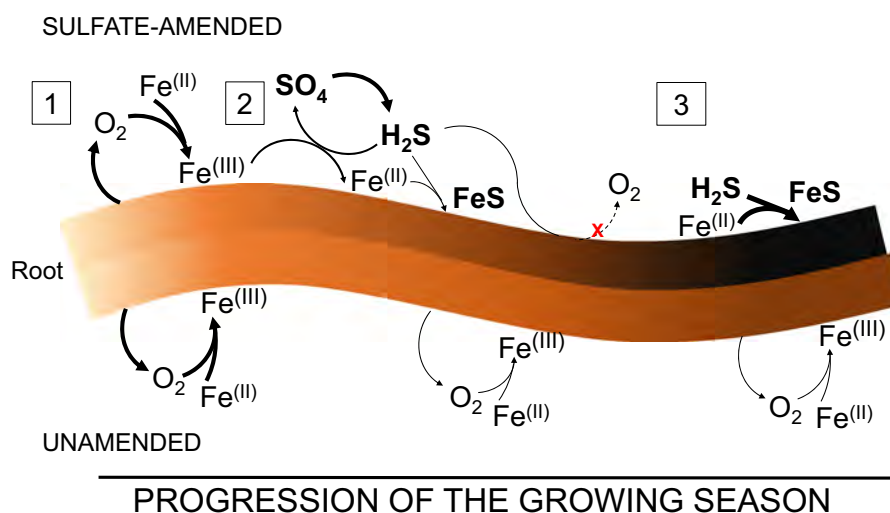


Fig. 5 Proposed mechanism of iron sulfide formation on wild rice roots exposed to elevated sulfate concentrations. Reactions depicted above the root occur on sulfate-amended root surfaces, and reactions depicted below the root occur on unamended root surfaces. Roots are protected by iron (hydr)oxides [1], but these iron (hydr)oxides are reduced by sulfide [2]. Exposure of roots to

sulfide may induce suberization, the thickening of root cell walls, which leads to decreased radial oxygen loss. Root surface anoxia accelerates the precipitation of iron sulfides [3]. In unamended roots, radial oxygen loss creates iron (hydr)oxides that remain present the entire growing season but decrease slightly in response to the life-cycle. (Color figure online)

root Fe(III) and porewater sulfate remained low in unamended plants for the rest of the growing season. But, as the amended root surface shifts toward reducing conditions, sulfide almost exclusively precipitates with reduced iron rather than being re-oxidized (Fig. 5, stage [3]). In our amended buckets, rapid accumulation of root Fe(II), root AVS, and porewater sulfide occurred within a 1–2 week period during seed production immediately following the precipitous decline of porewater sulfate and root surface Fe(III). In unamended buckets, root Fe(II) and AVS did not accumulate further, and while porewater sulfide increased, it was highly variable.

The most likely explanation for a redox transition at both the unamended and amended roots is a decrease in radial oxygen loss at the end of the vegetative growth stage when the leaves begin to senesce. Many mechanisms of rhizosphere oxidation have been described, including diffusion of atmospheric oxygen (Armstrong 1980), advection induced by temperature and vapor gradients (Dacey 1980) and Venturi-induced convection (Armstrong et al. 1992). Several studies have observed a correlation between light and rhizosphere oxygenation on diurnal time scales (Lee and Dunton 2000; Pedersen et al. 2004; Jensen et al. 2005), suggesting that some, if not most, radial oxygen loss may be photosynthetically derived. It has been previously suggested that accumulation of FeS occurs on white rice (*Oryza sativa*) roots only after plant senescence because dead roots no longer oxidize the rhizosphere (Jacq et al. 1991). However, as the plant approaches senescence, oxygen transport to the roots may decrease due to lower photosynthesis rates, subsequently slowing the regeneration of the electron accepting buffer of the root surface (Biswas and Choudhuri 1980). We observed a decrease in redox around the time that plants started to yellow and show early signs of senescence, consistent with a life-cycle-induced decline in radial oxygen loss.

Despite the rapid accumulation of FeS on roots in amended plants, the saturation index in sediment 2 cm from the roots remained relatively low, suggesting that the most severe decline in redox potential was confined to near the root surface. The Fe(II) in the FeS plaques may have come from the reduction of iron (hydr)oxides previously accumulated on the root surface. On the other hand, the sulfide in FeS plaques must have been supplied from a source external to the root. Although experimental conditions may have

impacted the timing of sulfate intrusion to the rooting zone, porewater sulfate concentrations were already well above the half saturation constant for biological sulfate reduction at the start of flowering (Pallud and Van Cappellen 2006), making it unlikely that the redox transition occurred from a delay in sulfate availability and reduction at the root surface. Once leaf senescence began, porewater sulfate concentrations ($\sim 2000 \mu\text{mol L}^{-1}$) declined by more than 80% followed by rapid accumulation of porewater sulfide (from ~ 2 to $12 \mu\text{mol L}^{-1}$) and AVS on the root surfaces ($\sim 300 \mu\text{mol g}^{-1}$). Adjacent porewater sulfide was relatively low compared to the amount of sulfur in the porewater sulfate and root AVS pools. This suggests that a large amount of sulfur passes through the porewater sulfide pool very quickly, a scenario consistent with our proposed mechanism by which sulfide near the root surface is either oxidized by the electron accepting buffer or precipitated with Fe(II). Sediment AVS ($5 \mu\text{mol g}^{-1}$) was a larger component of overall solid-phase S accumulation due to its larger mass, but did not, apparently, experience the concentrated introduction of sulfide in the same way as roots. The rapid and concentrated accumulation of iron sulfide on roots in the setting of undersaturated porewater suggests an overwhelmingly plant-dominated geochemical niche very close to the root surface.

Beyond affecting wild rice populations, the mechanism behind the rapid accumulation of FeS on roots has implications for the fate of iron and sulfide in wetland sediments. Vegetated sediment in white rice paddies (Jacq et al. 1991) and in riparian wetlands containing *Phragmites australis* and *Zizania latifolia* (Choi et al. 2006) has higher concentrations of FeS than non-vegetated sediment. Significant accumulation of FeS on white rice roots has been observed after senescence (Jacq et al. 1991), likely because decaying root material stimulates iron and sulfate reduction. When roots coated with FeS decompose, the FeS becomes incorporated into the bulk sediment. Due to the concentrated introduction of both electron donors and acceptors to the subsurface, each generation of an annual plant is effectively a “pump” for the incorporation of FeS precipitate into the sediment. In dense stands of aquatic plants, annual contributions of FeS from roots could significantly alter the geochemistry of the sediment within years to decades. If FeS plaques occur concomitantly with population declines in

wetland plants, the plant-induced sulfur pump may only last a few generations but would have implications for changes in species composition in wetland plant communities. Understanding the rates of the distinctly plant-induced sulfur pump and the short- and long-term interactions of near-root processes with bulk sediment could help to predict how the distribution of wetland vegetation and sulfur accumulation change in response to a perturbation in surface water sulfate concentrations.

The results of this study may provide a mechanistic link between observed sulfide toxicity in lab hydroponic experiments (Koch et al. 1990; Koch and Mendelssohn 1989; Pastor et al. 2017) and empirical evidence of sulfur-induced population declines of wetland plants (Lamers et al. 2002; Myrbo et al. 2017; Pastor et al. 2017; Pulido et al. 2012; Smolders et al. 2003). Our observation that sulfur cycling is altered *during* the life cycle rather than after senescence allows for the possibility of rapid feedbacks between sediment and porewater geochemistry on the one hand and annual plant populations on the other. Understanding the timing of when electron accepting buffers are present or absent and how that correlates with the plant life cycle can provide insight into how populations of wild rice and other aquatic plant species will respond to perturbations in sulfur loading to ecosystems.

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Author contributions SL-H and BD collected and analyzed samples. SL-H performed statistical analyses with guidance from JP. All authors contributed to interpreting the data and writing the manuscript.

Compliance with ethical standards

Conflict of interest The authors declare no competing financial interests.

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WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 13

Johnson NW, Pastor J, Swain EB (2019) Cumulative sulfate loads shift porewater to sulfidic conditions in freshwater wetland sediment. *Environmental Toxicology and Chemistry* 38(6):1231-1244.

Cumulative Sulfate Loads Shift Porewater to Sulfidic Conditions in Freshwater Wetland Sediment

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Abstract: It is well established that sulfide can be toxic to rooted aquatic plants. However, a detailed description of the effects of cumulative sulfate loads on sulfide and iron (Fe) porewater geochemistry, plant exposure, and ecological response is lacking. Over 4 yr, we experimentally manipulated sulfate loads to self-perpetuating wild rice (*Zizania palustris*) populations and monitored increases in the ratio of sulfur (S) to Fe in sediment across a range of sulfide loading rates driven by overlying water sulfate. Because natural settings are complicated by ongoing Fe and S loads from surface and groundwater, this experimental setting provides a tractable system to describe the impacts of increased S loading on Fe–S porewater geochemistry. In the experimental mesocosms, the rate of sulfide accumulation in bulk sediment increased linearly with overlying water sulfate concentration up to 300 $\mu\text{g-SO}_4 \text{ cm}^{-3}$. Seedling survival at the beginning of the annual life cycle and seed mass and maturation at the end of the annual life cycle all decreased at porewater sulfide concentrations between 0.4 and 0.7 $\mu\text{g cm}^{-3}$. Changes to porewater sulfide, plant emergence, and plant nutrient uptake during seed production were closely related to the ratio of S to Fe in sediment. A mass balance analysis showed that porewater sulfide remained a small and relatively transient phase compared to sulfate in the overlying water and Fe in the sediment solid phase. The results illuminate the evolution of the geochemical setting and timescales over which 4 yr of cumulative sulfate loading resulted in a wholesale shift from Fe-dominated to sulfide-dominated porewater chemistry. This shift was accompanied by detrimental effects to, and eventual extirpation of, self-perpetuating wild rice populations. *Environ Toxicol Chem* 2019;38:1231–1244. © 2019 The Authors. Environmental Toxicology and Chemistry published by Wiley Periodicals, Inc. on behalf of SETAC.

Keywords: Sulfide; Porewater; Wetland sediment; Rooting zone; Wild rice

INTRODUCTION

The introduction of sulfate to freshwater ecosystems can alter the processing of nitrogen (N), phosphorus (P), iron (Fe), mercury, carbon (C), and other elements (Ardon et al. 2013; Myrbo et al. 2017b), thereby enhancing eutrophication (Lamers et al. 1998) and greenhouse gas emissions (Helton et al. 2014), changing contaminant transformations and mobility (Besser et al. 1996; Jeremiason et al. 2006) and the life cycles of vegetative and benthic organisms (Wang and Chapman 1999; Lamers et al. 2013; Hopfensperger et al. 2014). Because sulfate is a terminal electron acceptor capable of driving heterotrophic

anaerobic microbial metabolism (Weston et al. 2011; Myrbo et al. 2017b), rooted freshwater plants and other sediment-dwelling organisms are affected when sulfate is converted to sulfide in anoxic sediments (Bagarinao 1992; Lamers et al. 2013; Pastor et al. 2017). Changes in sulfate loads to freshwater ecosystems occur because of hydrologic modification in coastal zones, increased atmospheric sulfur (S), municipal and industrial wastewater inputs, and differences in wetting/drying cycles induced by climate change (Driscoll et al. 2001; Craft et al. 2009; Hao et al. 2014; Schoepfer et al. 2014). These changed sulfate loads have had ecological consequences including shifts in vegetation, accelerated eutrophication, toxicity to benthic organisms, increased organic matter mineralization in sediment, and increased mercury methylation (Lamers et al. 2002; Smolders et al. 2003; Li et al. 2009; Neubauer 2013; Kinsman-Costello et al. 2015; Myrbo et al. 2017b).

In wetland plants, dissolved sulfide interrupts metalloenzymes in the electron transport chain and disrupts the ability to take up nutrients (Joshi et al. 1975; Koch et al. 1990;

This article contains online-only Supplemental Data.

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Martin and Maricle 2015). In contrast, solid-phase sulfides are inert and nontoxic to organisms (Morse et al. 2007). The extent to which microbial sulfate reduction can increase sulfide concentrations in sediment porewaters to toxic levels depends, in part, on the quantity of reactive metals available to precipitate with sulfide, thus removing sulfide from porewaters (Wang and Chapman 1999; Heijs et al. 1999; Pollman et al. 2017). Iron, often the most abundant metal in aquatic sediment, has been identified as having an ameliorating effect on the impacts of sulfide loading to aquatic plants in both experimental (Van der Welle et al. 2006) and natural (Schoepfer et al. 2014) settings. The amount of sulfide in sediment, relative to the quantity of Fe, has been termed “degree of sulfidation”, and this framework has been used extensively to understand the current and paleolimnological implications of S and Fe cycling (Morse and Luther 1999; Wijsman et al. 2001). More recently, Schoepfer et al. (2014), van der Welle et al. (2007), and Julian et al. (2017) have studied the balance of Fe and S loads specifically in freshwater systems impacted by sulfate from agricultural pollution and seawater intrusion.

Hydroponic and short-term mesocosm experiments, involving the direct (and often continuous) injection of sulfide or Fe to aquatic media or sediment (compiled in Lamers et al. 2013), have been widely used to identify mechanisms of sulfide's toxicity to plants (Koch and Mendelssohn 1989; Martin and Maricle 2015). However, these typically short-term experiments are not conducive to examining natural processes related to coupled Fe and S cycling that occur during natural loading to intact aquatic sediment. Several field studies at sulfate-impacted freshwater systems have interpreted the vegetative and in situ porewater chemistry implications of S loading in the framework of degree of sulfidation (Burton et al. 2006; Morse et al. 2007; Hopfensperger et al. 2014; Schoepfer et al. 2014; Julian et al. 2017). Studies in natural settings, however, typically cannot control conditions in a manner conducive to a detailed evaluation of evolving sediment sulfide in response to altered sulfate loading. Long-term (e.g., multiyear) mesocosm studies employing a slow and continuous production of sulfide in sediments (Lamers et al. 1998; Howes et al. 2005; van der Welle et al. 2006; Geurts et al. 2009) are most conducive to investigating the progressive depletion of reactive Fe in a setting analogous to natural wetlands with enhanced sulfate loads. No studies of this nature, however, have described in detail the evolution of toxic, sulfide-rich, geochemical conditions in porewater over the entire timescale needed for increased sulfide production to overwhelm the loading of Fe to sediment in a natural setting.

The objective of the present study was to test the impacts of sulfate loading on Fe geochemistry and the population dynamics of an annual freshwater wetland species, wild rice (*Zizania palustris* L.). Wild rice grows in thick monotypic stands mostly confined to shallow lakes and rivers of the Lake Superior region in North America (Day and Lee 1990) and is usually found in waters with sulfate concentrations $<10\text{ mg L}^{-1}$ (Moyle 1944). Sulfate-poor freshwater ecosystems have experienced increases in surface water sulfate in response to elevated rainwater sulfate over the past century (Driscoll et al. 2001). More recently, wild rice and other freshwater aquatic plants have become threatened by increases to sulfate loading from agricultural and

industrial discharges (Lens et al. 1998; Orem et al. 2011; Berndt et al. 2016), which can elevate surface water sulfate significantly above natural levels and those elevated from acid rain. Hydroponic, mesocosm, and field results have shown that porewater sulfide is toxic to wild rice at levels near $0.3\text{ }\mu\text{g cm}^{-3}$ (Pastor et al. 2017) and that sediment Fe is a key factor controlling the presence of wild rice in field conditions (Myrbo et al. 2017a; Pollman et al. 2017). However, the evolution of sediment geochemistry in response to altered S loads has not been described in detail. The present study was conducted in outdoor mesocosms containing self-perpetuating wild rice populations growing in natural wild rice sediment. The experimental design allowed for a precise manipulation of the loading rate of S to continuously inundated sediment by controlled concentrations of sulfate in the overlying water (Pastor et al. 2017). The temporal and spatial evolution of porewater geochemistry, solid-phase geochemistry, and impacts to the self-perpetuating wild rice populations were quantified over 4 yr. The present results interpret how the interannual increases in porewater sulfide in mesocosm sediment correspond to the loading of sulfate from surface water and contextualize the geochemical setting in which detrimental effects to, and eventually extirpation of, wild rice was observed.

METHODS

Sulfate amendments to the overlying water of wild rice tank mesocosms described by Pastor et al. (2017) began in the summer of 2011 and continued through 2015 at 5 different amendment levels: nominally approximately 0, 50, 100, 150, and $300\text{ mg-SO}_4\text{ L}^{-1}$. This range is well above that found in remote regional streams impacted only by atmospheric S sources but spans that found in Minnesota surface waters (Myrbo et al. 2017b), some of which are impacted by neutral pH mining-influenced water (Berndt et al. 2016). This range of sulfate also encompasses the US Environmental Protection Agency's (USEPA's) 250 mg L^{-1} secondary drinking water standard and the existing 10 mg L^{-1} standard to protect wild rice in the state of Minnesota (Myrbo et al. 2017a). Methods of maintaining the mesocosms are described in detail by Pastor et al. (2017). Briefly, 6 replicate tanks at 5 sulfate amendment levels were maintained using polyethylene stock tanks (0.75 m^2 area, 61 cm depth) containing a 10-cm-thick layer of sediment rich in organic matter (15% C, 1.1% N, 1.5% Fe, 0.005% S) from a local wild rice water body and a 23-cm-deep overlying water column. Water and sulfate levels in mesocosms were maintained by weekly additions of well water averaging 8 to 10 mg L^{-1} sulfate, 0.17 mg L^{-1} Fe, and $<0.05\text{ mg L}^{-1}$ N and P. When necessary (approximately every 2 wk during the growing season), sodium sulfate stock solution was added to each of the 30 experimental mesocosms to account for rain water dilution, evaporation, and flux of sulfate into sediment. The exact concentrations of overlying water in sulfate-amended tanks are slightly less than the targeted nominal concentrations because of rainfall and other factors, whereas the overlying water of control tanks (no extra sulfate addition) averaged approximately 8 mg/L because of sulfate in well

water. The exact overlying water sulfate concentrations over the 4 yr are reported in Pastor et al. (2017).

Sample collection

During each of the summers from 2012 to 2015, passive porewater equilibrators (peepers) were deployed to make depth-profile porewater measurements in mesocosms. During the summer of 2012 and 2013, peepers were deployed in 2 mesocosms at each of 4 sulfate treatment levels (control, 50, 150, and 300 mg L⁻¹). In 2014 and 2015, peepers were deployed in to mesocosms at all 5 treatment levels. During each of the 4 experimental yr, depth profiles of porewater chemistry were collected with peepers in early summer (June) and late summer (August). Sediment cores were collected in 2013 and 2015 during peeper retrieval in locations coincident with peepers, sectioned into 1- to 3-cm intervals, and frozen for preservation. Cores were collected with a 2.5-cm-diameter, thin-walled polycarbonate manual piston corer to minimize disturbance and preserve sediment structure during collection. Cores and porewater sampling locations were targeted to remain at least 5 to 10 cm away from wild rice stems and roots.

Peepers similar to those described in Teasdale et al. (1995) were constructed of 0.5-inch-thick, 24 × 6-inch acrylic sheet plastic beveled at one end and milled to contain 35 wells that were 1 cm deep and spaced 1.56 cm apart. Large-diameter (~12 inch) circular filter paper (0.45 μm polyethersulfone; Supor; Pall Life Sciences) and a protective nylon mesh (200-μm openings; Industrial Netting) were cut to fit over the wells and secured in place using a face plate with openings corresponding to each well. Small stainless steel machine screws were used to seal the face plate tightly against the filter paper and prevent water from bypassing filter material. Peepers were assembled in the laboratory while submerged in distilled water to avoid any bubbles. They were then immediately placed in an upright container filled with distilled water that was purged of oxygen by a continuous flow of N through a fine bubble diffuser. After 4 to 6 d, the peepers were transported to the field mesocosms in deoxygenated water, inserted into the sediment, and secured to the edge of the mesocosms with nylon string. Following a 2- to 3-wk deployment (Fisher and Reddy 2001), peepers were removed from the sediment and submerged in water purged of oxygen during the brief (<2 min) transport to a processing station. Mud was quickly removed from the filter paper surface with distilled water, and the tops of wells were quickly dried with Kimwipes before the peeper was placed into a N-filled bag for sample extraction (Koretsky et al. 2008). Beginning with the deepest well, samples were extracted from each peeper by puncturing the N-filled bag, nylon mesh, and filter paper with a hypodermic needle affixed to a polypropylene syringe barrel. The extracted sample was immediately injected into vials preloaded with reagents for Fe and sulfide analysis. pH was measured immediately (within 30 s) on a separate sample aliquot prior to degassing of carbon dioxide from the sample. A final aliquot of porewater sample for anion analysis was filtered through a cation exchange filter

(Dionex; OnGuard II-M) to remove Fe, acidified with 0.25% concentrated hydrochloric acid, and purged with a slow stream of N for 10 min to remove dissolved inorganic sulfide. Although all anion samples were acidified, only those with a noticeable colorimetric response for sulfide were purged with N. The entire extraction and preservation process for 12 to 16 wells in a single peeper profile typically took less than 45 min, during most of which the peeper was under a N atmosphere.

Analytical methods

Sulfate was measured on a Dionex ICS-1100 ion chromatograph (Thermo Scientific AS22 IonPac 4 × 250-mm anion exchange column) using the Chromeleon software for peak integration. Sulfide and ferrous Fe were quantified spectrophotometrically using the methylene blue method (Eaton et al. 2005a) as implemented with Hach sulfide reagents (method 4500 S2-D) and the phenanthroline method (Eaton et al. 2005b), respectively. The sulfide method quantifies all dissolved sulfide (both H₂S and HS⁻) and is therefore not sensitive to pH. Sulfide was quantified within 1 h of collection on a field spectrophotometer, and Fe was stored on ice and transported to the laboratory for quantification within 4 h of collection. A Thermo Orion epoxy pH electrode, with temperature correction calibrated in the field immediately prior to sample measurements was used to measure pH. The detection and reporting limits for each dissolved analyte are summarized in Supplemental Data, Table SI-1.

Frozen sediment samples were used to quantify acid volatile sulfides (AVSs) immediately after thawing using a strong acid digestion (9 N hydrochloric acid [HCl] + stannous chloride; Eaton et al. 2005a). A separate, homogenized, and split aliquot was used to quantify solid content and loss on ignition as a proxy for C content (Dean 1974). Iron in the solid phase was extracted from freeze-dried sediment using a weaker acid digestion (0.5 N HCl), as outlined in Myrbo et al. (2017a), and quantified on an Elan 3000 inductively coupled plasma mass spectrometer using a customized standard from Inorganic Ventures. For a subset of sediment samples from the mesocosms, Fe speciation and quantity were investigated using paired weak acid digestions (0.5 N HCl) in which both ferrous and total Fe were quantified with a strong acid digestion (aqua regia) for total Fe. A sequential extraction on the same subset of samples was also used to quantify recalcitrant (pyrite) phases that resist extraction with weaker methods. For these samples, sulfide was extracted sequentially with 0.5 N HCl (paired with Fe speciation [Myrbo et al. 2017a]), 9 N HCl with stannous chloride (Eaton et al. 2005a), and chromium reducible S (Fossing and Jørgensen 1989) and captured for spectrophotometric quantification in 0.2 M zinc actinium using a modified diffusion method (Brouwer and Murphy, 1994) sequentially.

Data analysis

Depth-dependent estimates for porosity and bulk density were made from solid content and loss on ignition

measurements on sediment samples from intact cores using the relationship outlined in Gosselink et al. (1984). The depth-integrated mass of S over depth was calculated by integrating the product of concentration and porosity (for dissolved phase) or concentration and bulk density (for solid phase). In most cases, experimental quantities are aggregated over all 4 experimental yr (porewater sulfate mass, porewater sulfide concentration, solid-phase sulfide) so that each experimental treatment level had 8 replicates during each season (June and August), providing a basis for statistical comparisons. In cases where significant changes in experimental quantities occurred over time (porewater Fe mass, porewater sulfide mass, solid-phase sulfide), results are presented as the average of duplicate measurements. In these cases, regressions of average measurements versus treatment level or time are used in the interpretation rather than analysis of variance (ANOVA) statistics.

The maximum rate of diffusion-driven flux was estimated from porewater observations by identifying the largest change in sulfate concentration between adjacent peeper wells and multiplying this gradient by an effective diffusion coefficient by adjusting molecular diffusion for porosity (Boudreau 1996). Significant differences in the main effects of treatment level and year on sulfide and Fe mass in porewater were evaluated using 2-way ANOVA with repeated measures in SigmaPlot for each season. For sulfate, measurements from all experimental years were aggregated, and the effects of treatment level and season were evaluated using 2-way ANOVA with repeated measures. Linear regressions using Pearson's correlation test on the average of sulfate porewater mass for all experimental years were used to evaluate the significance of the relationship with overlying water sulfate and time.

The slope of a linear regression of sediment AVS versus year was used to provide an estimate for the rate of annual accumulation of solid-phase sulfide and to make an estimate for the S:Fe ratio in sediment during years in which sediment cores were not collected. Plant emergence, juvenile survival, filled seed ratio, seed mass, and total biomass data reported in Pastor et al. (2017) were normalized to observations in the control mesocosms during each year to place all observations (from different years) on a consistent basis for comparison to the accumulating solid-phase and porewater sulfide. In most cases, the mass of sulfate in sediment porewater is expressed in terms of "sulfate as S" ($96 \text{ mg sulfate} = 32 \text{ mg sulfate as S}$) to facilitate stoichiometric comparisons with sulfide quantities in sediment. Surface water sulfate concentrations are expressed "as sulfate" to maintain consistency with prior work on S impacts to wild rice ecosystems (Pastor et al. 2017; Myrbo et al. 2017b).

RESULTS

Constant mass of sulfate in porewater

In porewater near the sediment–water interface, sulfate was consistently elevated at concentrations approaching those present in the overlying water and depleted below 2 to 5 cm (Figure 1A). This pattern unambiguously indicates a supply of sulfate from the

overlying water and is consistent with the reduction of sulfate to sulfide in anoxic sediments. Sulfate mass in porewater was strongly correlated with overlying water sulfate concentration in amended mesocosms (Figure 1B; $p < 0.01$, regression coefficient provided in Supplemental Data, Table SI-2). The mass of sulfate (presented as mass of S) in the top 10 cm of sediment porewater (Figure 1B) ranged from <5 to $>75 \mu\text{g-S cm}^{-2}$ and did not differ significantly (at each sulfate amendment level) over the course of the 4-yr experiment ($p > 0.3$ for regression with year; data not shown). Concentrations of sulfate in porewater and surface water were more variable in June, owing to less consistent sulfate amendments and rainwater dilution, though the overall mass of sulfate in porewater was not significantly different in June relative to August ($p = 0.55$).

The observed maximum spatial gradient in porewater sulfate provides an estimate for the maximum diffusive flux of sulfate into sediment. Consistent with the overall mass of sulfate in mesocosm porewater, these estimates for diffusive mass flux of sulfate into sediment (presented as S mass flux) were almost perfectly correlated with overlying water sulfate (Figure 1C; $p < 0.001$, June and August, regression coefficients provided in Supplemental Data, Table SI-2). Although surface water concentrations were, on average, slightly lower during August (by $\sim 15\%$), maximum observed sulfate gradients, and hence estimated diffusive fluxes, were significantly ($p < 0.005$) higher in August than June.

Cumulative increases in porewater sulfide, decreases in porewater Fe

Sulfide concentrations were highest in the top 3 to 5 cm of sediment porewater in all sulfate-amended tanks at locations coincident with steep spatial gradients in sulfate concentration (Figure 2A). In later years of the experiment, maximum porewater sulfide concentrations exceeded 5 to $10 \mu\text{g cm}^{-3}$ in tanks amended with 300 mg L^{-1} sulfate in overlying water. Depth-integrated porewater sulfide mass in the top 10 cm of sediment showed clear patterns both with overlying water sulfate and progressively over the 4-yr study (Figure 2C and D). During August, porewater sulfide mass increased with overlying water sulfate during every year of the study (regressions included in Supplemental Data, Figure SI-1). Increases from year to year in porewater sulfide mass were largest during August in the tanks with 150 and 300 mg L^{-1} sulfate in overlying water, but porewater sulfide mass of tanks amended with only 10 and 50 mg L^{-1} sulfate in overlying water also experienced consistent interannual increases in August porewater sulfide mass. During August, depth-integrated porewater sulfide mass was $<0.4 \mu\text{g cm}^{-2}$ in tanks without sulfate amendment during all years of the experiment, but porewater sulfide mass in sediment subject to the highest sulfate amendments progressively increased to $25 \mu\text{g cm}^{-2}$ over the 4-yr experiment.

Dissolved Fe concentration in porewater increased with distance from the sediment–water interface to $>25 \mu\text{g cm}^{-3}$ at depths $>5 \text{ cm}$ (Figure 2B) in porewaters without sulfate amendment. In mesocosms with $>50 \text{ mg L}^{-1}$ sulfate in the overlying water, porewater Fe was lower, especially in the

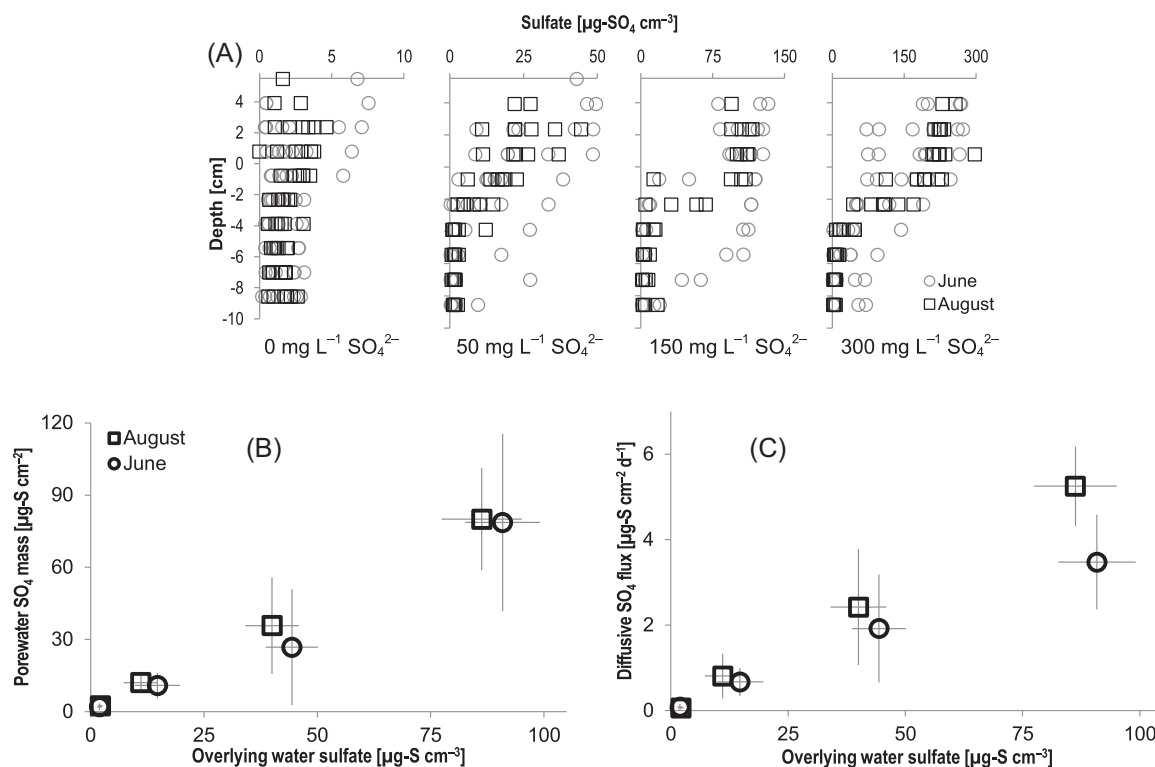


FIGURE 1: (A) Depth profiles of porewater sulfate concentrations (as sulfate) in sulfate-amended mesocosm sediment in June and August. Data compiled for all years between 2012 and 2015. (B) Depth-integrated porewater sulfate mass (as sulfur) between 0 and 10 cm versus overlying water sulfate (as sulfur). (C) Estimated maximum diffusive sulfate mass flux (as sulfur) versus overlying water sulfate (as sulfur). Sulfate labels in (A) refer to nominal overlying water concentration (as sulfate) applied during experiments. Vertical error bars in (B) and (C) represent 1 standard deviation from the mean of 8 replicate measurements for each amendment level, aggregated over 4 experimental yr. Horizontal error bars in (B) and (C) represent 1 standard deviation from the mean of biweekly measurements of overlying water sulfate concentration during June and August, aggregated over 4 experimental yr.

surface 5 cm of sediment where sulfide concentrations were elevated. Interannual comparisons showed progressive depletion of depth-integrated porewater Fe mass, especially in the heavily sulfate-amended mesocosms (Figure 2E and F). Depth-integrated porewater Fe mass ranged from 70 to $100 \mu\text{g cm}^{-2}$ in the tanks without sulfate amendment to 2 to $20 \mu\text{g cm}^{-2}$ in the tanks with the highest sulfate amendments. The observed patterns showed increases in porewater sulfide mass and decreases in porewater Fe mass both with increasing overlying sulfate and over the course of the 4-yr study. This strongly suggests that, especially in the tanks receiving the highest sulfate loads, a progressive depletion in the Fe available to complex with dissolved sulfide caused increases in porewater dissolved sulfide.

Seasonal differences in porewater geochemistry are of interest because specific life stages of wild rice appear to be impacted by porewater sulfide. The seedling phase in spring and the seed production phase in late summer are impacted by sulfide, but sulfide only weakly affected the period of vegetation growth in between (Pastor et al. 2017; LaFond-Hudson et al. 2018). During August, the porewater sulfide mass was 2 to 7 times higher than during June at the highest 2 sulfate treatment levels; however, concentrations in June were more variable and not as consistently related to surface water sulfate

(Supplemental Data, Figure SI-1). Porewater Fe mass was significantly lower during August in all sulfate addition treatments, consistent with the pattern of elevated sulfide during August and the insolubility of Fe–sulfide solid phases. The seasonal differences in porewater sulfide and Fe mass (Figure 2) between June and August suggest that the sediment is experiencing faster rates of sulfate reduction during warmer temperatures in mid-August (18.5°C average) relative to early June (11.7°C average). It is also possible that faster rates of sulfate transport (Figure 1C) enabled faster diffusion under warmer conditions or that the development of sulfate-reducing biomass led to faster rates of sulfate reduction later in the growing season.

The increases in porewater sulfide mass between June and August (of $10\text{--}20 \mu\text{g cm}^{-2}$ at the highest amendment level) show that inputs of sulfide to sediment porewater are occurring at a (net) rate faster than removal through oxidation or Fe–sulfide precipitation. This is consistent with a progressive increase in oversaturation of FeS in sediment porewater through the summer (ion activity product; Supplemental Data, Figure SI-2). A more rapid input of dissolved sulfide later in the summer would increase the driving force for FeS precipitation. The consistent relationship between Fe and sulfide in porewater observed during August was likely attributable to the

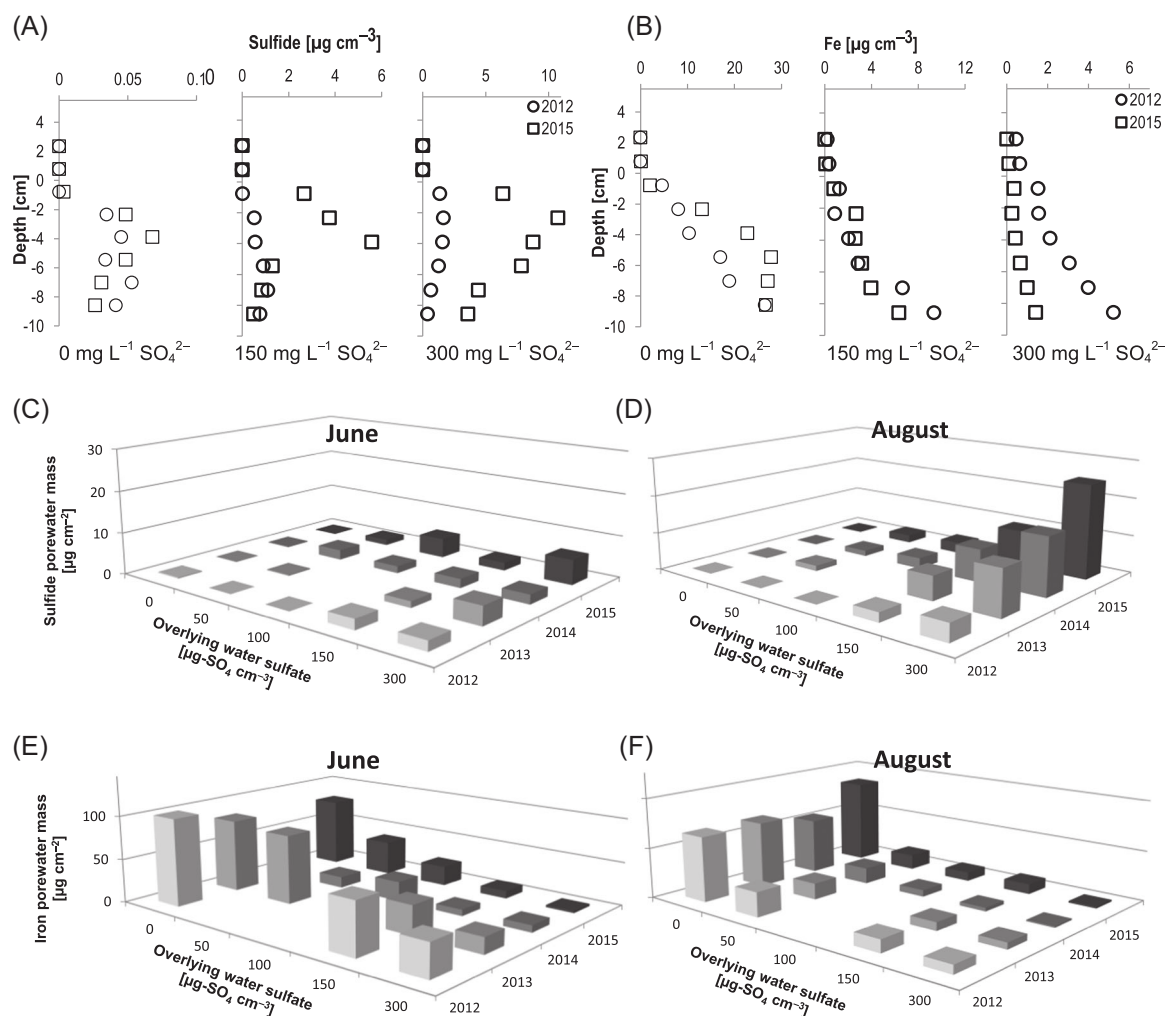


FIGURE 2: Depth profiles of mean porewater (A) sulfide and (B) iron in mesocosm sediment at 3 sulfate amendment levels (0, 150, 300 mg L^{-1}) in August 2012 and August 2015. Values are the mean of 2 replicate measurements. Depth-integrated mass of porewater (C,D) sulfide and (E,F) iron in sediment between 0 and 10 cm for all sulfate amendment levels during all years in June (C,E) and August (D,F). Overlying water sulfate labels refer to nominal overlying water concentration (as sulfate) applied during experiments.

consistent, thermodynamically driven process of FeS precipitation driven by oversaturation. The more variable dissolved Fe and sulfide concentrations in June and the less significant relationships of dissolved sulfide to overlying water sulfate are consistent with less sulfide-driven thermodynamic constraints on porewater Fe and sulfide when the introduction of sulfide is slower or more variable earlier in the summer.

Cumulative increases in solid-phase sulfide

Sulfide in the sediment solid phase (extracted with 9 N HCl) began uniformly low at the outset of the experiment ($\sim 80 \mu\text{g g}^{-1}$, or $212 \mu\text{g cm}^{-2}$) and increased to $>4000 \mu\text{g g}^{-1}$ in surficial sediment after 4 yr in the most heavily sulfate-amended sediment (Figure 3A and B). Regressions of sediment sulfide against year suggest that, on average, over the first 4 yr of sulfate amendments to mesocosms, sulfide is accumulating in sediment linearly with time (Figure 3C; regression coefficients provided in Supplemental Data, Table SI-2) and at faster rates in proportion to overlying sulfate concentrations (Figure 3D). Approximately

$22 \mu\text{g cm}^{-2} \text{ yr}^{-1}$ of sulfide accumulated in the top 10 cm of the sediment solid phase for every $\mu\text{g cm}^{-3}$ of sulfate (as S) present in the overlying water (Figure 3D). Even in experimental mesocosms receiving no sulfate amendments to the overlying water, the sulfate present in the overlying well water (averaging 5–10 mg L^{-1} as sulfate) led to increases in sediment sulfide. In sediment amended with 300 mg L^{-1} sulfate, depth-integrated sulfide mass in the sediment solid phase exceeded $4000 \mu\text{g-S cm}^{-2}$ after only 2 yr of amendment, whereas sediment amended with 150 mg L^{-1} sulfate reached $4000 \mu\text{g-S cm}^{-2}$ after 4 yr (Figure 3C).

Sulfate reduction rates in sediment are not typically proportional to sulfate at concentrations above 50 to 200 mg L^{-1} (as sulfate; Pallud and Van Cappellen 2006). However, the linear relationship between solid-phase sulfide accumulation rate and overlying water sulfate suggests that in these mesocosm sediments the accumulation of sulfide in the solid phase continued to be (at least in part) limited by the supply of sulfate up to approximately 300 mg L^{-1} (as sulfate) in surface waters. In heavily amended mesocosms, the zone of sulfate reduction in

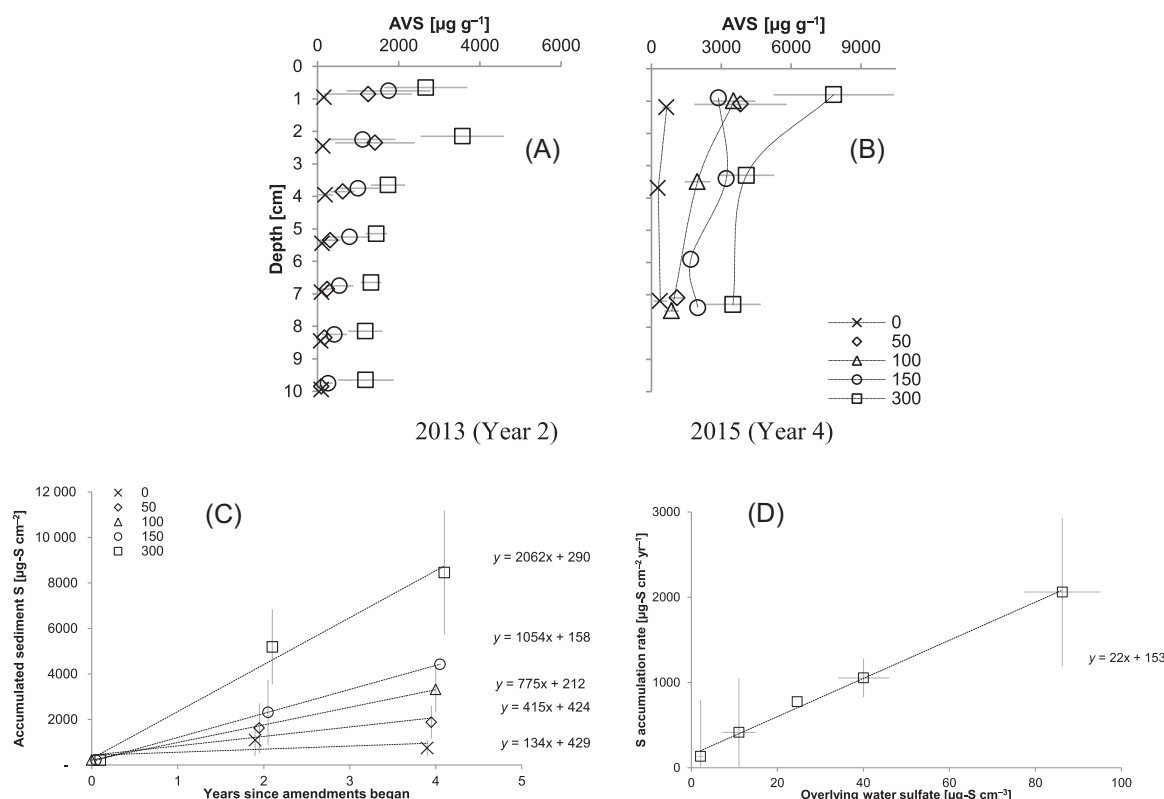


FIGURE 3: Depth profiles of sediment sulfide concentration (extracted with 9 N HCl + stannous chloride) in sulfate-amended mesocosm sediment in (A) August 2013 and (B) 2015. Error bars represent 1 standard deviation from the mean of triplicate measurements at each depth. Depth-integrated sediment sulfide mass between 0 and 10 cm: (C) depth-integrated mass over 4 yr and (D) annual sulfide accumulation rate versus overlying water sulfate. Symbols in (A–C) refer to nominal overlying water concentration (as mg sulfate L^{-1}) applied during experiments. In (C) error bars represent 1 standard deviation from the mean of sulfide mass estimates from triplicate depth profiles. In (D) vertical error bars represent the 95% confidence interval in the slopes of regressions in (C); horizontal error bars represent 1 standard deviation in biweekly measurements of overlying water sulfate concentration during June and August aggregated over 4 experimental yr.

sediment may have expanded in response to overlying water sulfate amendments (Figure 1A), thereby creating an opportunity for a net increase in the depth-integrated (areal) rate of sulfate reduction and Fe sulfide accumulation, even above approximately 100 mg L^{-1} overlying water sulfate.

Cumulative increase in solid-phase S:Fe ratio

Iron concentration in the surface 10 cm of the mesocosm sediment solid phase (extracted with 0.5 M HCl) averaged 144 (± 20) $\mu\text{mol g}^{-1}$ (Supplemental Data, Table SI-4). This equates to a depth-integrated Fe mass of 305 (± 61) $\mu\text{mol-Fe cm}^{-2}$. Over the course of the 4-yr study and across a 2-orders of magnitude range in sulfate loading rate, sulfide in sediment porewater began to build up as the stoichiometric quantity of sulfide approached that of Fe in the solid phase (Figure 4A and B). The trend of increasing porewater sulfide with S:Fe ratio was particularly stark during August when average porewater sulfide in the surface 7 cm of sediment ranged from 1 to 8 $\mu\text{g cm}^{-3}$ in mesocosms during years when the S:Fe ratio exceeded 0.2 to 0.5 in the sediment solid phase. In June, concentrations of porewater sulfide were also low ($<0.1 \mu\text{g cm}^{-3}$) in mesocosms with low S:Fe ratios (<0.5), but sulfide increased considerably

($>0.5 \mu\text{g cm}^{-3}$) in mesocosms with S:Fe ratios exceeding 0.2 to 0.5. Analogous trends were present in the relationship between S:Fe ratio and dissolved ferrous Fe (Figure 4C and D). Adverse effects to wild rice have been observed at both the early and late life stages of wild rice's annual life cycle (LaFond-Hudson et al. 2018). It is, therefore, notable that a similar threshold in S:Fe ratio was related to higher porewater sulfide during both June and August because the processes that control porewater sulfide may differ between seasons.

Although sulfate remained in the overlying water during experiments, Fe was always below detection limits in overlying water ($<100 \mu\text{g L}^{-1}$). An average addition of 178 L yr^{-1} well water with a maximum observed concentration of 0.6 $\mu\text{g cm}^{-3}$ would have increased the extractable Fe content of sediment in mesocosms by $<0.4\%$ over the course of the 4-yr study ($18 \mu\text{g cm}^{-2} \text{yr}^{-1}$), assuming all the Fe from the well water went into the 0.5 N extractable phase. On average, $>85\%$ of loosely bound (0.5 N HCl) Fe was found to be in the reduced (ferrous) form at all sediment depths (Supplemental Data, Table SI-4). Assuming a 1:1 stoichiometry in amorphous FeS, approximately 10 000 $\mu\text{g-S cm}^{-2}$ of sulfide would be needed to bind all extractable Fe into insoluble FeS complexes in the top 10 cm of sediment.

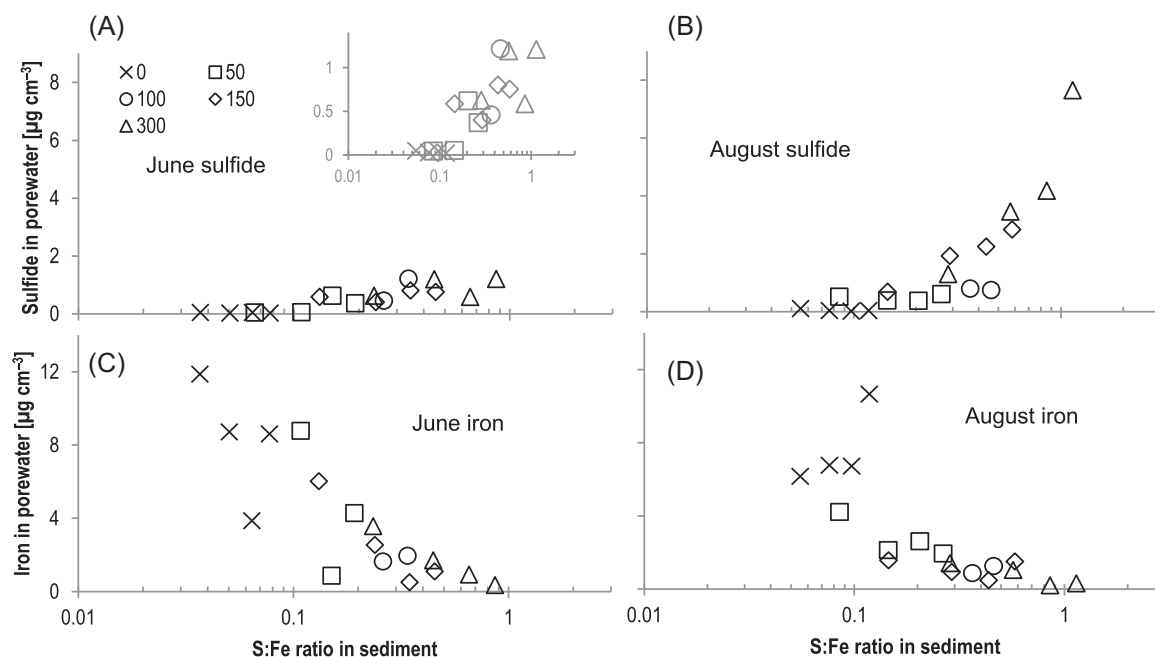


FIGURE 4: Porewater concentration of (A,B) sulfide and (C,D) iron versus the S:Fe molar ratio in sediment during (left) June and (right) August over the course of continuous sulfate loading to sediment in mesocosms. Each point on the graphics corresponds to the average of measurements (top 7 cm of sediment) made during a single season for individual years. Symbols refer to nominal overlying water concentration (as mg sulfate L^{-1}) applied during experiments.

Chromium reduction of sediment S typically extracted <15% additional S from the sediment following 9 N acid extractions in heavily S-amended tanks. A weaker extraction, using 0.5 N acid, quantified S at levels similar to the 9 N acid (Supplemental Data, Table SI-4). These sequential extractions suggest that most of the new, solid-phase inorganic S is present as amorphous or weakly bound monosulfur FeS complexes. For the present analysis, the accumulation of sulfide mass in the sediment solid phase was quantified by normalizing AVS (9 N HCl + stannous chloride) by the pool of ferrous Fe extracted with a 0.5 N acid digestion. Total aqua regia-extractable Fe was 15 to 40% higher than the 0.5 N acid Fe for heavily sulfate-amended mesocosms and 70 to 120% higher than the 0.5 N acid Fe for control mesocosms (Supplemental Data, Figure SI-3). Though the exact nature of the pool of solid-phase Fe and its reactivity toward sulfide was not investigated in detail, the S:Fe ratio chosen for weakly bound FeS (analogous to degree of sulfidation) was used as a means of characterizing the accumulation of S under different loading rates.

Cumulative impacts on plant growth and reproduction

Early in wild rice's annual life cycle, plant emergence and juvenile survival decreased during years when porewater sulfide concentrations during June averaged $>0.4 \mu\text{g cm}^{-3}$ in the top 7 cm of sediment (Figure 5A and C). These results are consistent with the range of sulfide concentrations at which wild rice seedling growth is stunted in hydroponic experiments with wild rice (Pastor et al. 2017) and in the range of those measured for other sensitive freshwater wetland plants (Lamers

et al. 2013). These concentrations are well below those reported to be toxic by Fort et al. (2017) in hydroponic experiments. The seedlings in the Fort et al. (2017) experiment (maximum age 21 d) were allowed to emerge into ambient air above the water, whereas the seedlings in the Pastor et al. (2017) experiment (maximum age 17 d) were maintained under water. The greater tolerance of wild rice to sulfide observed by Fort et al. (2017) may be the result of the seedlings' access to atmospheric oxygen, which would allow the internal detoxification of absorbed sulfide by S dioxygenase (SDO; Krüssel et al. 2014). The activity of SDO is limited by oxygen availability. In nature, 21-d-old wild rice seedlings have typically not emerged into the atmosphere (Fort et al. 2017) but are not uniformly subject to sulfide exposure of all tissue (Pastor et al. 2017).

Later in the life cycle, decreases (relative to the control mesocosms) in filled seed ratio, filled seed mass, and total biomass were observed in mesocosms during years when porewater sulfide concentrations during August exceeded $0.7 \mu\text{g cm}^{-3}$ in the surface 7 cm of sediment (Figure 4E, G, and I). Effects on later life stages of wild rice were observed at higher porewater sulfide concentrations than those known to be toxic to seedlings. However, effects on later life stages may be realized as a result of inhibition of N uptake as Fe sulfide precipitates accumulate on roots and sulfide erodes an oxidized Fe barrier around the root, allowing sulfide to penetrate closer to root surfaces (LaFond-Hudson et al. 2018).

Across a range of sulfate-loading rates (<200 – $2000 \mu\text{g S cm}^{-2} \text{ yr}^{-1}$) and times needed to titrate uncomplexed Fe in sediment, the S:Fe ratio was consistently related to biological responses in wild rice plants (Figure 4B, D, F, H, and J). Though

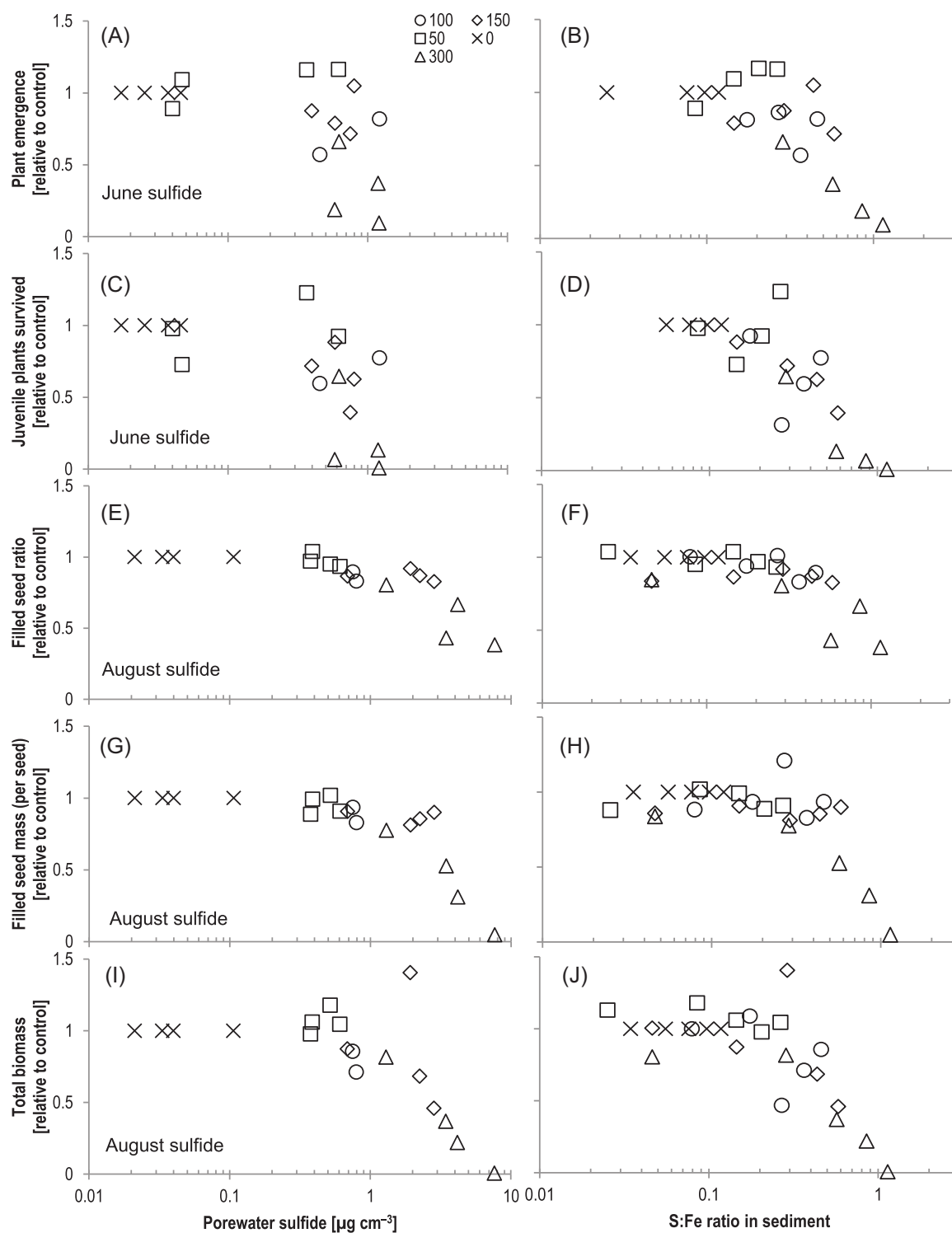


FIGURE 5: Impacts of sulfide in (left) porewater and (right) sediment solid phase to wild rice reproduction/growth including (A,B) emergence, (C,D) juvenile survival, (E,F) filled seed ratio, (G,H) filled seed mass, and (I,J) total biomass. Each point on the graphics corresponds to the average of measurements made at one treatment level during each year. Symbols refer to nominal overlying water concentration (as mg sulfate L⁻¹) applied during experiments.

effects on wild rice populations observed in June and August occurred when different sulfide levels were present in sediment, molar S:Fe ratios between 0.3 and 0.6 in the sediment solid phase are consistently associated with rapid declines in

plant growth and reproductive ability in this mesocosm system with limited inputs of external Fe. This suggests that the S:Fe ratio is important in defining geochemical conditions in sediment that impact wild rice during both spring and summer,

even if different thermodynamic and kinetic processes control porewater sulfide in different seasons. Others have suggested that bulk sediment geochemistry is decoupled from wild rice rooting-zone geochemistry because of radial oxygen loss, root exudates, and consequent microbial niches near and on root surfaces (Jacq et al. 1991; Emerson et al. 1999; LaFond-Hudson et al. 2018). However, the bulk quantities of Fe and sulfide in the solid phase and porewater provide the boundary condition in which near-root processes occur, and the solid-phase S:Fe ratio appears to be an important factor even if near-root processes introduce additional complexity.

Porewater sulfide in relation to bulk sediment and surface water

In the experimental mesocosms described in the present study, the sediment solid phase accumulated a net quantity of 1000 to 2000 $\mu\text{g S cm}^{-2} \text{ yr}^{-1}$ in the highest 2 amendment levels, and a stoichiometrically equivalent quantity of uncomplexed (by sulfide) Fe was bound into AVS (Table 1, rows 1 and 2). However, only 2 to 20 $\mu\text{g S cm}^{-2}$ were present as dissolved sulfide in the sediment porewater during August of the experiment's fourth year, the most sulfidic conditions observed (Table 1, rows 3). Porewater sulfate mass (30–70 $\mu\text{g SO}_4$ as S cm^{-2} at the highest 2 amendment levels) was constant over the course of the 4-yr study but small relative to the quantity of sulfate present in the approximately 23 cm of overlying water of the experimental mesocosms (Table 1, rows 4 and 5). Across more complex, hydrologically dynamic natural settings with a balance between ongoing Fe and S loads, the specific quantities involved will differ; however, in many sulfate-impacted freshwaters, the relative magnitude of porewater sulfide mass is likely to be much smaller than solid-phase sulfide mass or mass of sulfate in the overlying water. Although critically important for defining conditions toxic to wild rice and other aquatic plants, porewater sulfide is itself a small phase relative to the ultimate reactants that produce AVS in sediment: sulfate in the overlying water and Fe in the sediment solid phase. In contrast to overlying water sulfate quantity and relatively large cumulative interannual increases in solid-phase sulfide, the small size

of the porewater sulfide pool relative to other phases involved may make it susceptible to the seasonal changes observed in the mesocosms.

Discussion

Impacts of plants on S accumulation

The maximum sulfate flux into sediment, estimated from diffusion and observed sulfate profiles, ranged from <1 to $5 \mu\text{g-S cm}^{-2} \text{ d}^{-1}$ in sulfate-amended tanks. If the ice-free season of approximately 180 d is used as an estimate of the time conducive to sulfate diffusion into and accumulation within sediment, net annual diffusion-driven sulfate transport to sediment is between 100 and $850 \mu\text{g-S cm}^{-2} \text{ yr}^{-1}$. This is roughly half the observed solid-phase sulfide accumulation rates. Therefore, an additional transport mechanism besides diffusion is leading to S accumulation in the sediment solid phase. Evapotranspiration could have drawn sulfate-amended water into the rooting zone and increased the rate of S loading to sediment beyond transport by molecular diffusion. Evaporation rates of 0.2 to 0.6 cm d^{-1} have been found for wetland plants in the region (Lott and Hunt 2001). An evaporation-driven advective flux of surface water into sediment is alone sufficient to explain the mass accumulation of S in the sediment solid phase (Table 1, rows 6; $0.3 \text{ cm d}^{-1} \times 50 \mu\text{g-S as SO}_4 \text{ cm}^{-3} = 15 \mu\text{g-S cm}^{-2} \text{ d}^{-1}$ for $150 \text{ mg sulfate L}^{-1}$ overlying water). The balance between advective and diffusive transport of sulfate into sediment cannot be discerned from our experiments; however, both occur at a rate proportional to overlying water sulfate.

Wild rice and other wetland plants can release oxygen to the rooting zone and sometimes decrease the accumulation of sulfide in sediment (e.g., Koretsky et al. 2008; Myrbo et al. 2017b). Observations in rooted and unrooted locations in the same mesocosms reported by Myrbo et al. (2017b) suggest that the rooting zone of the rice could facilitate subsurface sulfate cycling through the oxidation of AVS in the sediment solid phase. However, interannual increases of solid-phase S of 200 and $2000 \mu\text{g-S cm}^{-2} \text{ yr}^{-1}$ (Table 1) mean that a net accumulation of S in sediment occurred, even despite some subsurface reoxidation of sulfide. In these mesocosms, plants were

TABLE 1: Quantities, accumulation, and fluxes of sulfur (S) in porewater and solid phases in experimental mesocosms

		Overlying water SO_4	
		50 mg L^{-1}	300 mg L^{-1}
1	Fe(II) mass in solid phase ($\mu\text{g cm}^{-2}$ [as S]) ^a	10 000	10 000
2	S(II) accumulation in solid phase ($\mu\text{g-S cm}^{-2} \text{ yr}^{-1}$)	400	2000
3a	S(II) mass in porewater (June) ($\mu\text{g-S cm}^{-2}$)	1.2	4.5
3b	S(II) mass in porewater (August) ($\mu\text{g-S cm}^{-2}$)	2.2	18
3c	S(II) accumulation in porewater (June–August) ^b ($\mu\text{g-S cm}^{-2}$)	1	13.5
4	SO_4 mass porewater (June and August) ($\mu\text{g-S cm}^{-2}$)	8	70
5	SO_4 mass in overlying water ($\mu\text{g-S cm}^{-2}$) ^c	390	2300
6a	SO_4 flux estimated from diffusion ($\mu\text{g-S cm}^{-2} \text{ yr}^{-1}$) ^d	150	850
6b	SO_4 flux potential from advection ($\mu\text{g-S cm}^{-2} \text{ yr}^{-1}$) ^d	400	2400

^aMass of Fe (as S) estimated assuming a 1:1 stoichiometry for FeS.

^bAssuming 80-d accumulation between early June and late August.

^cFor 23-cm overlying water column.

^dAssuming 180 d of ice-free time conducive to diffusive transport for 0.3 cm d^{-1} advective flow induced by transpiration for a 90-d growing season.

thinned to a density that prevented significant competition for nutrients. This limited density may have reduced the ability of plants to oxidize the rhizosphere relative to thicker natural stands.

The net accumulation of between 6 and 13 $\mu\text{g-S cm}^{-2}$ in sediment porewater between June and August also suggests changes in the balance between sulfide oxidation and sulfate reduction processes over wild rice's annual life cycle (LaFond-Hudson et al. 2018). Radial oxygen loss should be highest during the portion of the growing season when growth and photosynthesis are greatest. For wild rice, this happens in June and July. Growth and photosynthesis decline in mid-August when resources in the stems and leaves are transferred to flowers and seeds (Sims et al. 2012). Consistent with this phenology of growth, there was significantly greater porewater sulfide in August compared to June in the mesocosm sediment amended with 150 and 300 mg L^{-1} overlying water sulfate. Changes to plant-induced oxygen inputs to sediment cannot be easily separated from increased biological activity or more rapid diffusion under warmer August conditions, but both would be expected to result in a shift toward more reducing conditions later in the summer.

Implications of Fe speciation in sulfate-impacted sediment

Iron in the solid phase was not quantified each year; however, the observed annual patterns of dissolved Fe and sulfide are consistent with a depletion in the activity of ferrous Fe that has not been sequestered to insoluble and stable Fe sulfide complexes. In some cases the quantity of Fe in sediment porewater could be limited by Fe(III) reduction. However, the relatively small amount of labile (0.5 N) oxidized Fe extracted from sediment (Supplemental Data, Table SI-4) and Fe(III)'s low solubility under neutral pH conditions (6.2–7.4) suggest that the main control on porewater Fe in the sulfate-amended mesocosm sediment is the inputs of dissolved sulfide. The solid-phase Fe measured in the present study (extracted with 0.5 N acid extractable Fe) may not have precisely reflected the total quantity of Fe available to react with sulfide. Indeed, 30 to 120% additional Fe was extracted with aqua regia compared to 0.5 N HCl, suggesting that an additional, more recalcitrant Fe pool is present. The large and consistent increases in porewater sulfide at S:Fe ratios of near 0.5 (based on 0.5 N acid Fe), however, suggest that some Fe extracted with even the weak acid was not available to efficiently remove dissolved sulfide. Reaction rates of solid-phase Fe with dissolved sulfide can be slow depending on the nature of Fe phases (Wan et al. 2017).

Reduced S was extracted routinely in the present study using 9 N HCl with stannous chloride (Eaton et al. 2005a), a stronger extraction than the 1 N HCl employed in a USEPA draft standard method (Allen et al. 1991). A significant fraction of chromium-reducible S (20–70%; Supplemental Data, Table SI-4) was found in sediment from the tanks without sulfate amendment, possibly as a result of aged FeS minerals present in native, unamended sediment. However, little additional S

was extracted with chromic acid from mesocosm sediment that had received large experimental sulfate additions, suggesting that most recent S accumulation was in a labile phase accessed by both 0.5 and 9 N acid extractions (Supplemental Data, Table SI-4). The nature of the Fe pools present in natural settings would need to be investigated across a wider variety of geologic and hydrologic conditions and utilizing a larger suite of extraction methods to understand the significance of the thresholds of S:Fe ratios that lead to increased porewater sulfide in the mesocosm conditions of the present study.

Implications of S accumulation in natural systems

The nearly static quantity of Fe in the present study provides a convenient and tractable system to describe the impacts of a change in S loading on porewater geochemistry. Natural settings, however, have ongoing Fe loads from surface water and groundwater that compete stoichiometrically with ongoing S loads to determine the net S:Fe ratio in surficial sediment. A more thorough analysis, via modeling or detailed observations in a variety of S- and Fe-loading scenarios, would be needed to constrain the importance of ongoing sulfate loads, Fe loads, and sediment accumulation rates in determining S:Fe ratios in a natural setting. The quantity of sulfide in the solid phase (AVS) was highest in surface 0- to 5-cm sediment at all sulfate amendment levels, showing that sulfide accumulates most rapidly in the surficial sediment where sulfate reduction is most rapid. Because sulfate was almost completely depleted at depths >5 cm, the elevated AVS concentrations at depths <5 cm suggest that significant mixing of surficial sediment with sediment from lower depths occurred in these mesocosms. The present analysis integrated S and Fe mass over the top 10 cm of sediment to facilitate consistent stoichiometric comparisons in the simplified mesocosm system. However, there were variations in the S:Fe ratio over the top 10 cm of sediment, and the distribution in a natural setting would depend on the source of Fe and S to surficial sediment (groundwater vs surface water). In addition, the relevant depth for assessing S:Fe ratios and porewater sulfide could be different for different wetland plants. The results observed in the present simplified system are useful to understand how porewater geochemistry evolved over time in the context of a range of loading rates and accumulations of S mass in sediment. However, in natural settings the specific quantities, net loading rates, and times related to porewater sulfide accumulation and biological effects are likely to differ from these controlled observations.

In a broad survey of sediment chemistry in natural wild rice stands, sediment C, surface water sulfate, and sediment extractable Fe (0.5 N HCl) were used to predict porewater sulfide (Pollman et al. 2017). The inclusion of solid-phase AVS (or the difference between extractable Fe and AVS) did not improve the model performance appreciably. The Pollman et al. (2017) field data set was composed mostly of freshwater sediment from ecosystems relatively low in sulfate, with consequently low S:Fe ratios in sediment. In a large data set with typically great stoichiometric excess of Fe over sulfide, it is understandable

that the quantity of sulfide in sediment did not rise to the top as an important variable. However, an analysis that included only sediments with relatively large S:Fe ratios may conclude that sediment AVS, in addition to sediment Fe, is consequential in controlling porewater sulfide. An analysis of, for instance, the upper quartile of sediment S:Fe ratios would be especially relevant because these sites are likely the ones most at risk of experiencing a buildup in porewater sulfide in response to additional sulfate loads.

The observation that sulfate did not increase in sediment porewater over the course of the experiments suggests that in this system sufficient C and Fe were both present in sediment to continue driving the reduction of sulfate to sulfide and the removal of sulfide from the dissolved phase, thereby maintaining the flow of sulfate from the overlying water. If C had become limiting before Fe, sulfide would continue to be removed from porewater by excess Fe and an increase in porewater sulfate would be expected as a result of continued diffusion and a lack of electron donors to drive the reduction of porewater sulfate. If Fe had become limiting before C, porewater sulfide would be expected to build up in the absence of a process to remove it from solution and lower its activity. Eventually, porewater sulfide would increase to levels sufficient to cause upward diffusion and oxidation of sulfide near the oxidized sediment–water interface. In this case of excess C relative to Fe, a finite pool of S could continue to cycle in the dissolved phase of the sediment between sulfate near the surface and sulfide at deeper depths.

CONCLUSIONS

The sediment Fe buffer against a buildup in dissolved sulfide during continuous sulfate loading was overwhelmed relatively quickly (2–4 yr) in experimental mesocosms with 300 and 150 mg L⁻¹ sulfate in overlying water. Across a range of sulfate-loading rates, conditions in sediment porewater shifted from Fe-rich (>2–5 µg cm⁻³) toward sulfidic (>0.5–2 µg cm⁻³) as S:Fe ratios (as defined by the weak acid extract used in the present study) approached 0.5. Though different sulfide concentrations were present in June and August, S:Fe ratios approaching 0.5 were consistently associated with effects in both early and late stages of wild rice's annual growth and reproductive life cycle. The quantity of uncomplexed Fe (low S:Fe ratio) appears to be important in defining porewater sulfide and consequent effects on wild rice under both spring and summer conditions.

The net S loading rates to the sediment (<200 to >2000 µg-S cm⁻² yr⁻¹) across the overlying water sulfate amendments in the present study (8–300 mg L⁻¹ as sulfate) were proportional to overlying water sulfate. Approximately 22 µg-S cm⁻² yr⁻¹ accumulated in the sediment solid phase for every µg of S per cm⁻³ of sulfate (as S) present in the overlying water. Eventually, in the absence of significant external Fe inputs, the supply of Fe in the tanks with <10 and 50 mg L⁻¹ sulfate in the overlying water would be expected to be overwhelmed by external sulfate loads. The simple linear trends for sulfide accumulation rate in this experiment suggest that this might occur in 10 to

35 yr for the 50 and approximately 10 mg L⁻¹ overlying water sulfate, respectively. Analyses of natural systems, however, should consider external loads of Fe, the potential for oxidation of sulfide, and rates of sediment burial (or mobility) to constrain the time frame of impacts attributable to an increase in S loading. In addition, efforts to predict dissolved sulfide from bulk sediment and water parameters should account for the fact that, although ultimately driven by the quantities of Fe, S, and C, the concentration of porewater sulfide is a relatively small phase, potentially subject to seasonal variability, compared with solid-phase Fe and S.

The results from the present mesocosms are not entirely equivalent to natural settings with ongoing loads of Fe and complex hydrologic conditions. They do, however, provide an opportunity to examine in detail some of the mechanisms involved in the dynamic relationship among surface water chemistry, sediment geochemistry, and the health and reproduction of sensitive freshwater organisms following a change in S loading. In addition to toxicity to wild rice, many other aquatic species are sensitive to sulfide (Kinsman-Costello et al. 2015), and the present results could help us to understand and develop management strategies to alleviate the ecological effects of increased S loading (Geurts et al. 2009; Greaver et al. 2012). The results illuminate more fully an evolving geochemical setting in which cumulative S loading over a 4-yr mesocosm study resulted in a wholesale shift from Fe-dominated to sulfide-dominated porewater chemistry. This shift was accompanied by detrimental effects to and eventually extirpation of self-perpetuating wild rice populations.

Supplemental Data—The Supplemental Data are available on the Wiley Online Library at DOI: 10.1002/etc.4410.

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Data Accessibility—The present study contains supplemental online material. Readers interested in data can contact N. Johnson (nwjohnso@d.umn.edu).

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WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 14

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Interactions between sulfide and reproductive phenology of an annual aquatic plant, wild rice (*Zizania palustris*)

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ABSTRACT

Aquatic plants live in anoxic sediments that favor formation of hydrogen sulfide, a known phytotoxin. We investigated how the phenology of reproductive life stages of wild rice (*Zizania palustris* Poaceae), an annual aquatic graminoid, is influenced by rooting zone sulfur geochemistry in response to elevated sulfate and sulfide. In addition, we characterized how redox conditions in the rooting zone change throughout reproduction to determine if they are tied to plant life stage. The redox conditions in sediment decreased just prior to flowering, and again just prior to seed production for all plants, allowing sulfide to accumulate at the root surface of sulfate-amended plants. Plants exposed to sulfide initiated seed production later than unamended plants. Sulfide appears to slow plant development in a way that gives the plant less time to allocate nutrients to seeds before senescence. The impact of sulfide in delaying reproductive life stages of wild rice and changing seasonal rooting zone biogeochemistry could extend to other plant species and additional chemical species that change mobility with redox potential, such as phosphate, manganese, mercury, and other metals.

1. Introduction

Many aquatic plants grow in sediments with low redox potential that favors formation of toxic reduced compounds like sulfide. To cope with these conditions, some aquatic plants transport oxygen to the roots through hollow aerenchyma tissue, release it into the rhizosphere, and form iron oxide plaques on root surfaces (Stover, 1928; Mendelssohn et al., 1995; Colmer, 2003; Jorgenson et al., 2012). The released oxygen and iron oxides may protect roots from dissolved sulfide species (Trollenier, 1988; Van der Welle et al., 2007; Schmidt et al., 2011; Soana and Bartoli, 2013). Many wetland plants, including wild rice, are vulnerable to dissolved sulfide (Koch and Mendelssohn, 1989; Carlson et al., 1994; Lamers et al. 1998; Pastor et al., 2017). Wild rice (*Zizania palustris*, Poaceae), an annual aquatic graminoid which forms large monotypic stands in lakes of the Western Lake Superior region, is especially sensitive during the seedling and seed production life stages, suggesting that the ability to withstand sulfide varies throughout their life cycle (Pastor et al., 2017; LaFond-Hudson et al., 2018).

Plants growing in nutrient-limited conditions sometimes experience ontogenetic drift, a phenomenon in which morphological development through successive life stages is slowed (McConnaughay and Coleman, 1999; Sims et al., 2012). Because the allocation of biomass to different

tissues changes throughout a plant's life cycle, delayed development has sometimes been misdiagnosed as morphological plasticity in experiments in which plants are normalized by date or age, rather than size or life stage (Coleman et al., 1994). Nitrogen is the limiting nutrient to wild rice (Sims et al., 2012) and its uptake is tied to specific life stages (Grava and Raisanen, 1978). About 30 % of nitrogen is taken up during early vegetative growth, 50 % is taken up during the growth of the stem until flowering, and 20 % is taken up during seed production (Grava and Raisanen, 1978). Dissolved sulfide inhibits nutrient uptake (Allam and Hollis, 1972; Koch et al., 1990; Martin and Maricle, 2015). If nitrogen uptake in wild rice is inhibited or slowed by sulfide, it may slow the rate at which the plant progresses through subsequent life stages and limit the quantity of N uptake available for seed production.

Near the end of an annual plant's life cycle when plants allocate resources from leaves into flowers and seeds, photosynthesis declines and radial oxygen loss from roots may also decrease, creating favorable conditions for reduction of iron oxides and sulfate (Schmidt et al., 2011). Several mechanisms for maintaining radial oxygen loss from roots have been described, including pressure gradients that actively pump oxygen from new leaves, through roots, to old leaves (Dacey, 1980; Armstrong, 1980; Armstrong et al., 1992); and production and transport as a byproduct of photosynthesis (Marzocchi et al., 2019).

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Table 1

Descriptions of the life stages of wild rice and the range of dates for each life stage in which at least one *Zizania palustris* plant was observed (initially $n = 64$, followed by incrementally smaller sample sizes due to destructive sampling). Ranges are described for plants grown in water amended with 300 mg L⁻¹ sodium sulfate or grown in water unamended, with background sulfate concentrations of ~8–14 mg L⁻¹. Life stages 1 through 3 pertain to seedling and early emergent stages that did not develop iron sulfide plaques on roots. Designation and description of life stages from Grava and Raisanen (1978) and Sims et al. (2012).

Lifestage Name	Lifestage Number	Characteristics	Dates Observed	
			Amended	Unamended
Mid tillering	4	Tiller (main stem) grows more than one leaf	210-235	210-222
Jointing	5	Internodes elongate	210-240	210-240
Boot	6	Panicles emerge from stems	235-249	235-245
Early flowering	7	A few flowers bloom, some not yet emerged	235-245	235-245
Mid flowering	8	Most flowers bloom	235-249	235-245
Late flowering	9	Most panicles empty, few flowers still bloom	235-249	235-249
Seed production	10	Seed hull develops, seed filling occurs	240-263	235-263
Seed maturity	11	Filled, ripe seeds present, a few dropped	255-263	255-263
Senescence	12	All seeds dropped, green tissues disappear	280	280

Although the exact mechanism of radial oxygen loss in wild rice is not yet known, the aforementioned mechanisms may be inhibited by the senescence of leaves during reproduction. We previously reported a decline in the redox potential of root surfaces during the seed production life stage (LaFond-Hudson et al., 2018). In plants grown in sediment without sulfur amendment, iron oxide plaques on root surfaces decreased, but in sulfate-amended plants, iron oxide plaques transitioned to iron sulfide, which further accumulated on root surfaces and coincided with production of fewer, smaller seeds with less nitrogen relative to unamended plants. In plants exposed to sulfide, the total uptake of nitrogen ceased during the onset of iron sulfide plaque formation and thickening while unamended plants continued to accumulate nitrogen in seeds (LaFond-Hudson et al., 2018). In this paper, we specifically explore the relationship between sulfur geochemistry and phenology of life stages, as both may control each other through interactions that culminate in the redox potential of root surfaces. We use wild rice (*Zizania palustris*, Poaceae) as our model organism to investigate connections between sulfide and iron geochemistry in the rhizosphere and reproductive phenology and ontogeny. Because wild rice is an annual plant, the ontogeny of development is equivalent to the annual phenology. So in this case, the two words are synonymous, except that ontogeny has the connotation of development whereas phenology has the connotation of seasonality.

Wild rice is a culturally, economically, and ecologically important macrophyte that is harvested for its grain (Fond du Lac Band of Lake Superior Chippewa, 2018). An advantage of using an annual plant is the relatively simple life cycle; root and shoot growth starts over each year, photosynthesis declines and vegetative structures senesce during the transition from vegetative to reproductive life stages, and seeds are produced at the end of the growing season just prior to death. In addition, standard markers of transitions in life cycle stages for wild rice have been established in prior research in the context of nutrient limitation (Grava and Raisanen, 1978; Sims et al., 2012).

Motivated by acute and population-level impacts of sulfide on aquatic plants, we compare the ontogenetic progression of life stages with the development of iron sulfide plaques throughout the life cycle of wild rice. Sulfide may slow ontogenetic development, but plant life stage may in turn control rhizosphere redox conditions and the amount of sulfur present as reactive sulfide. To investigate these geochemical and phenological interactions, we quantify the timing and length of life stages and seed production along with the concurrent accumulation of iron sulfide plaques.

2. Methods

2.1. Experimental design

Individual wild rice plants were grown outside in polyethylene

buckets, 32 of which were amended with 300 mg L⁻¹ sulfate and 32 of which were left unamended. Although many lakes and rivers in central and northern Minnesota have concentrations of sulfate lower than 10 mg L⁻¹, several current and former wild rice lakes and rivers have sulfate concentrations near or above 300 mg L⁻¹. Additionally, 300 mg L⁻¹ is close to the EPA secondary standard for drinking water and is a concentration we have used in several prior sulfate-addition experiments with wild rice. Sediment was collected on 01-Jun-2016 from Rice Portage Lake (MN Lake ID 09003700, 46.7038, -92.6829) on the Fond du Lac Band of Lake Superior Chippewa Reservation in Carlton County, Minnesota. This lake is a productive and unpolluted wild rice lake with little or no settlement along its shores and its sediment is organic-rich mud. The sediment was not sieved, but thoroughly homogenized and loaded into 4 L plastic pails that were set inside 12 L buckets (see LaFond-Hudson et al., 2018) on 25-Jun-2016. Water was added from a nearby well (sulfate concentration ranging from 8 to 14 mg L⁻¹) to provide a 12–15 cm water column. Two wild rice seeds obtained from Rice Portage Lake were planted in each bucket on 26-Jun-2016 (Julian day 177). All buckets had at least one seedling by 28-Jun-2016 (day 179), and the lesser robust plant of the two was removed a week later. Half of the buckets had sodium sulfate added on 28-Jun-2016 and 05-Aug-2016 (days 179, 217) to maintain surface water sulfate concentrations of 300 mg L⁻¹. Plants remained outside for the entire duration of the experiment. Further details on the maintenance of buckets can be found in LaFond-Hudson et al. (2018).

2.2. Sampling methods

To compare changes in pace of progressions through the life cycle, we examined initiation of life stages from a subset of plants that completed their entire life cycle through seed production. We define initiation as the first date a plant was observed to be in a life stage. Life stages were identified visually and nondestructively according to the descriptions codified by Grava and Raisanen (1978) and further subdivided by Sims et al. (2012).

Our observations of the phenology of wild rice began with mid tillering, a life stage in which the main stem, the tiller, grows more than one leaf above the surface of the water (Table 1). Prior life stages include emergence of the seedling from sediment (life stage 0), the floating leaf stage (life stage 1), the first aerial leaf (life stage 2), and the formation of the tiller, the main stem that will eventually produce flowers and seeds (life stage 3). We started observations with mid tillering (life stage 4) because it is the last vegetative growth stage before reproductive life stages. After mid tillering, the internodes of the tiller elongate (jointing, life stage 5) and the panicles emerge (boot, life stage 6) in preparation for flowering (life stages 7–9). Flowering is broken into early (7), mid (8), and late (9) flowering by the proportion of flowers emerged and blooming. Once flowers have finished blooming, a

seed hull develops and seed production begins (life stage 10). Filled seeds start to drop once they reach maturity (life stage 11), and senescence is reached once all seeds have dropped and leaves have turned completely yellow (life stage 12). Life stages of each plant and date were recorded eight times during the growing season.

When at least half of the plants were in a specific life stage, four sulfate-amended plants and four unamended plants in that life stage were destructively harvested to determine root surface geochemistry. When the plants entered the seed production life stage, harvests were made on three separate dates, each approximately a week apart, spanning the duration of the seed production life stage. Sampling at a more frequent temporal resolution during seed production enabled us to make detailed observations of the accumulation of iron sulfide (or lack thereof) on the roots during a potentially critical time for sulfide exposure.

2.3. Biological and chemical analysis

On each sampling date, the same eight plants that were harvested were separated into aboveground vegetative tissue, seed tissue, and root tissue according to LaFond-Hudson et al. (2018). Vegetative tissue and seed tissues were dried for seven days at 65 °C and weighed. Total N concentrations were determined with a Thermo Electron Flash EA 1112 CHNS Analyzer. Fresh roots were analyzed for acid volatile sulfide (AVS) and weak acid extractable iron the same day plants were harvested, taking great care to avoid exposure to oxygen (LaFond-Hudson et al., 2018). Iron and acid volatile sulfur (AVS) were simultaneously extracted from entire roots using 1 M deoxygenated HCl for four hours. AVS was volatilized and trapped in a sulfide antioxidant buffer (SAOB) using a modified diffusion method (Brouwer and Murphy, 1994). AVS was quantified using a sulfide-selective electrode. Iron was extracted into the 1 M HCl and analyzed for total extractable iron and Fe(II). Fe (III) was estimated from the difference between total iron and Fe(II). Total iron was quantified using a Varian fast sequential flame atomic absorbance spectrometer with an acetylene torch. Fe(II) was quantified on the day of extraction using the phenanthroline method on the spectrophotometer. After extraction, roots were dried at 38 °C for 24 h to determine dry mass.

2.4. Data analysis

Data are publicly available in the Data Repository of University of Minnesota (DRUM) and can be accessed at <https://conservancy.umn.edu/handle/11299/208579>. We used a two-sample *t*-test to compare differences between sulfate-amended and unamended conditions for seed measurements and root sulfide. Because we sampled destructively to measure root surface sulfide and iron, dates for the initiation of early reproductive life stages contain a larger sample size relative to the seed production life stage. Conclusions about the initiation of life stages between treatments are based only on the subset of plants that reached seed production in this experiment, and thus are not influenced by changes in sample size. For this subset of plants, we calculate the cumulative distribution of the date on which each life stage was initiated by summing the number of plants that are at or beyond the life stage. We also calculated the duration of seed stage for each plant in this subset using the difference between the first day we observed filled seeds and the first day we observed dropped or missing seeds. In many plants, seed production ended artificially early due to our destructive sampling design. In these cases, we used the harvest date as the end date in our calculation of duration and refer to the resulting value as “experimental duration”. We investigated correlations between experimental duration and yield of seed production (seed count, seedhead mass, and seedhead nitrogen mass) to understand progression in seed development within the seed production life stage. We used these linear relationships to infer the seed yield at “true duration”, which we define as the probable duration of seed production if plants were not

harvested. For true duration, we use the average last date seeds were observed in parallel wild rice experiments. These parallel experiments occurred in the same year, used the same sediment and tested sulfate-addition but did not use destructive sampling (Table S1).

The effective redox potential at the root surface was calculated using a modified Nernst equation (Stumm and Morgan, 2012).

$$p\varepsilon = p\varepsilon^{\circ} + \frac{1}{n} \log \frac{\{ox\}}{\{red\}} \quad (1)$$

$$p\varepsilon = 16 - 3pH + \log \frac{\{Fe(III)\}}{\{Fe(II)\}} \quad (2)$$

$$E_h^* = \frac{2.3RTp\varepsilon}{F} \quad (3)$$

While not strictly representative of the activity in solution, we use root surface Fe(III) and Fe(II) as a proxy for the activity of oxidized and reduced Fe in the rooting zone. Because the system is dynamic, root surface (solid-phase) quantities likely mirror the activity of iron in solution enough to draw general conclusions about the direction of the flow of electrons.

3. Results

3.1. Sulfide effects on phenology

When life stage observations began (Julian day 210), unamended plants were ahead by nearly a full life stage (mean life stage of 4.5 ± 0.5 unamended compared with mean life stage of 3.8 ± 0.6 amended, $p < 0.01$, two-sample *t* test), indicating that vegetative growth life stages were delayed by sulfate amendment. Most amended plants initiated jointing later than unamended plants (mean Julian day 217 ± 9 unamended, mean Julian day 226 ± 9 amended, $p = 0.005$, $n = 17$), but both treatments initiated the boot stage at similar times (mean Julian day 237 ± 3 for both, Fig. 1a, b). Because the boot stage occurs quickly, our temporal resolution may not have captured any differences in timing if they existed. From days 220–235, about half of the unamended plants initiated mid flowering, compared to only a quarter of amended plants (Fig. 1c). During the same time frame, one third of unamended plants initiated seed production, compared to no amended plants (Fig. 1d). Eight days later, day 243, a comparable number of amended plants entered seed production. Amended plants entered seed production during a narrower range of time, with ~75 % of plants reaching this life stage between days 240–250 (mean Julian day 247 ± 5), while the initiation of seed production was spread over a 2 week window for unamended plants (244 ± 7 days). Due to the destructive sampling required by our experimental design, we were unable to quantify the end date of seed production in this experiment, but we estimated the end date of seed production from parallel, non-destructive experiments involving sulfate-addition to wild rice mesocosms. The final date of seed collection was consistently close to day 260 for several years and experiments (Table S1). Using day 260 as the final date of seed production, we estimated a 20 % decrease in the true duration of seed production in amended plants compared to the unamended plants.

3.2. Seed production and vegetative biomass

Sulfate amended plants produced 33 % fewer seeds ($p = 0.03$), 50 % less total seedhead mass ($p = 0.01$), and 40 % total seedhead nitrogen ($p = 0.02$) compared to unamended plants (Table 2). Individual seeds were smaller by 33 % ($p = 0.02$), but individual seed N mass did not differ significantly between treatments. Sulfate amended plants had lower vegetative biomass (leaves and stems) during late flowering ($p < 0.01$, $n = 4$), but not prior life stages (Fig. S1). The experimental duration of seed production, calculated from the difference between

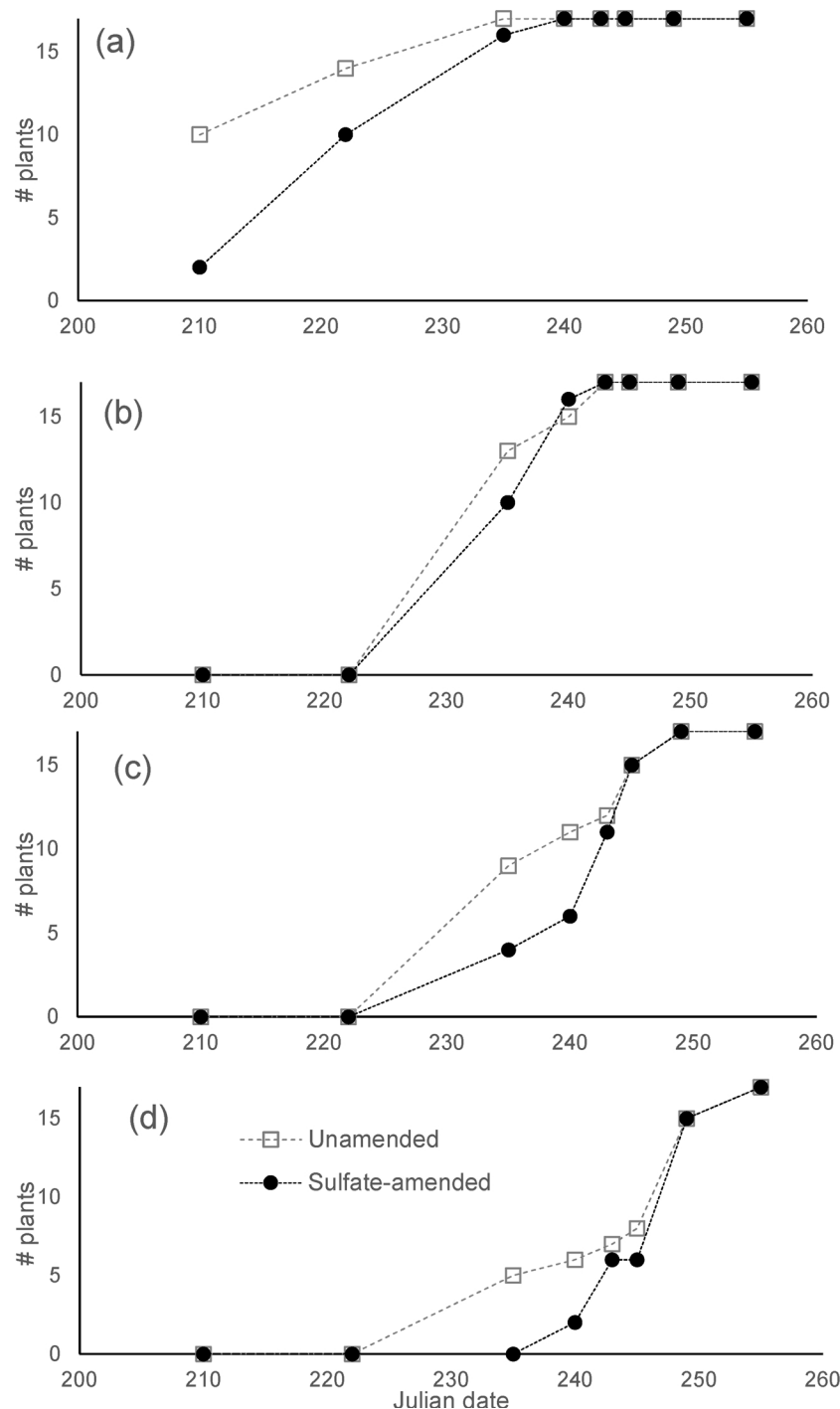


Fig. 1. Cumulative frequency of sulfate-amended (300 mg L^{-1} , filled circles) and unamended plants (open squares) that have initiated a) jointing, life stage 5, when internodes elongate just prior to reproduction, b) boot, life stage 6, when panicles emerge, c) mid flowering, life stage 8, when most flowers bloom, and d) seed production, life stage 10, when seed filling occurs.

first day seeds were observed and the day the plant was destructively sampled, was positively correlated with more filled seeds ($p = 0.027$), greater seed mass ($p = 0.042$), and more seed nitrogen ($p = 0.012$, Fig. 2).

3.3. Root geochemistry

Concentrations of AVS on amended root surfaces were one to two orders of magnitude higher than on unamended root surfaces during jointing, boot, mid flowering, and seed production (Table 2, Fig. S2).

Porewater sulfate decreased from mid flowering until senescence, indicating that sulfate-amended plants were likely exposed to sulfide as a consequence of sulfate reduction (Fig. S3). On amended roots, AVS increased from about $10 \mu\text{mol g}^{-1}$ to about $65 \mu\text{mol g}^{-1}$ between jointing and boot. Concentrations of root surface sulfide then remained around $65 \mu\text{mol g}^{-1}$ until seed production. The AVS concentration doubled during seed production (life stages 10–11). On unamended roots, the concentration of sulfide steadily increased from 0.5 to $5 \mu\text{mol g}^{-1}$, with the highest concentrations occurring during seed production. However, roots were not visibly black on unamended plants. Decreases

Table 2
Comparisons of acid volatile sulfide (AVS) concentration on root surfaces ($\mu\text{g g}^{-1}$) and of seed measurements in sulfate-amended (300 mg L^{-1}) and unamended conditions using a two-sample *t* test. AVS concentrations are compared during four reproductive life stages. The average for each treatment is reported with the standard deviation in parentheses ($n = 4$ for AVS during jointing, boot, and flowering; $n = 12$ for AVS during seed production, $n = 10$ – 12 for seed measurements; not all replicate plants had seeds).

Reproductive life stage	Sulfate-amended	Unamended	P value
Jointing	9.7 (± 3.7)	0.6 (± 0.3)	$P < 0.01$
Boot	64.9 (± 39.7)	1.4 (± 0.2)	$P = 0.05$
Mid flowering	68.9 (± 42.9)	2.6 (± 0.5)	$P = 0.03$
Seed production	144.8 (± 61.6)	3.3 (± 0.8)	$P < 0.01$
Seed Measurements			
Filled seed count (# per plant)	10.5 (± 7.3)	16 (± 7.1)	$P = 0.03$
Total seedhead mass (g)	0.14 (± 0.07)	0.28 (± 0.16)	$P = 0.01$
Total seedhead N mass (mg)	3.05 (± 1.36)	4.93 (± 2.28)	$P = 0.02$
Individual seed mass (mg)	11.1 (± 3.27)	15.26 (± 4.75)	$P = 0.02$
Individual seed N mass (mg)	0.26 (± 0.15)	0.28 (± 0.08)	$P = 0.38$
Seed N %	2.28 (± 0.63)	1.89 (± 0.48)	$P = 0.06$

in effective redox potential (E_h^*), calculated from the ratio of Fe(III) to Fe(II) at root surfaces (Fig. 3, Fig. S4), occurred near both amended and unamended root surfaces between boot and jointing (life stage 5–6) and at the end of flowering (life stage 8–9). During seed production, the effective redox potential decreased more steeply at amended root surfaces.

4. Discussion

The phenology of seed production was delayed in sulfate-amended plants, suggesting ontogenetic drift induced by sulfide. Across both amended and unamended conditions, seedhead mass, seed number, and seedhead N mass correlated with length in the seed production life stage. In the presence of sulfate, delayed seed production and lower seed N uptake both co-occurred with a precipitous drop in redox potential and rapid accumulation of sulfide on roots.

In a natural setting, plants with a delayed start to seed production would have to compensate by either increasing N uptake rate or delaying senescence until a later calendar date. In our experiment, sulfate-amended plants contained less seedhead nitrogen than unamended plants, so the N uptake rate likely did not increase much, if at all. Our experimental design, requiring destructive sampling during seed production, was unable to test the completion of the seed production life stage. To address these limitations, we examined average end dates of seed production in parallel wild rice experiments. The date of last seed collection happened at similar dates or even earlier dates for sulfate-amended plants in these other experiments (Table S1). Thus, it seems likely that sulfate-amended plants do not extend the seed production life stage to compensate for a delay in the initiation of seed production and have a shorter true duration of seed production. Because the seed production yield (number of filled seeds, seedhead mass, seedhead nitrogen) is positively and linearly correlated with experimental duration of seed production (Fig. 2), we suggest that the implications of delayed initiation without delayed completion of seed production are lower reproductive outputs by plants.

The curious timing of iron sulfide precipitation on root surfaces coincident with the beginning of seed production suggests that plants

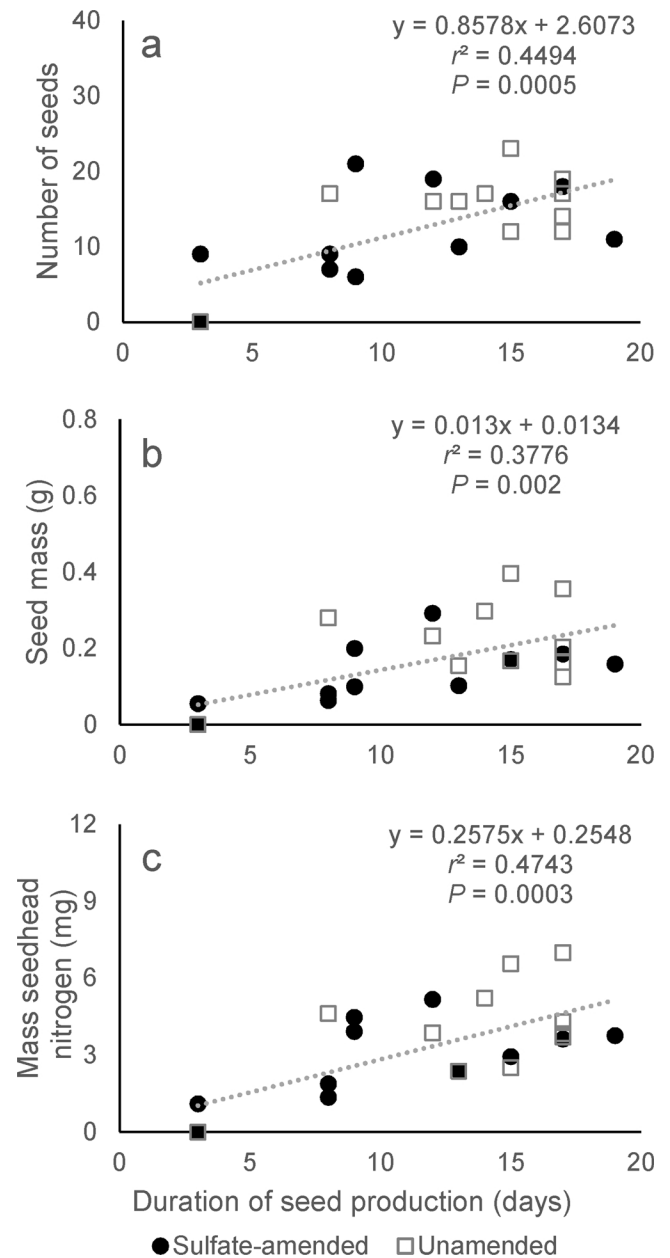


Fig. 2. Relationship between the experimental duration of seed production (days) and a) filled seed count, b) seedhead mass (g), and c) seedhead nitrogen (mg). Filled circles indicate sulfate-amended plants (300 mg L^{-1}) and open squares indicate unamended plants. End dates of duration for each plant were determined either by the date they entered seed maturity or by harvest date if they were harvested before reaching seed maturity.

influence the geochemistry of the sediments and that this influence changes during the plant's life cycle. The redox potential at the root surface, calculated from the ratio of Fe(III):Fe(II), decreased from jointing to boot (life stage 5–6), and again at the end of flowering (life stage 8–9). AVS concentrations increased on amended roots at the same life stages that redox declined. During seed production, the redox potential of amended and unamended plants diverged as the redox potential declined precipitously in amended plants. These decreases in redox potential reflect a net flow of electrons toward the plant root surfaces, suggesting a loss in the oxidizing capacity of the root surface. Transitions into new reproductive life stages are plausible times for plants to reallocate resources from photosynthetic tissues to reproductive tissues (Grava and Raisanen, 1978; McConnaughay and

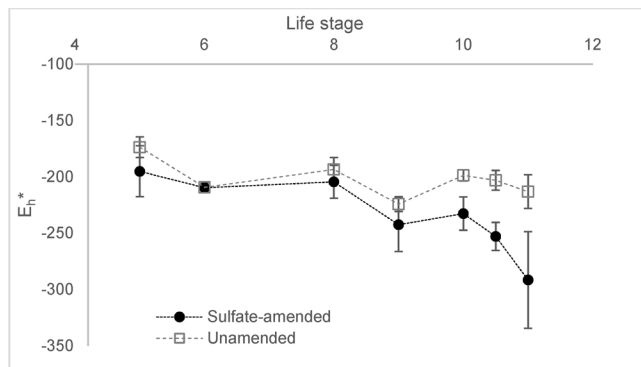


Fig. 3. Effective redox potential calculated from Fe(III) and Fe(II) concentration on roots amended with sulfate (300 mg L⁻¹, filled circles) or left unamended (open squares). Error bars show one standard deviation ($n = 4$). Life stages were assigned as 10, 10.5, and 11 for Julian dates 252, 257, and 264 respectively to show chronological progression in E_h^* during seed production and maturity.

Coleman, 1999; Sims et al., 2012). Experiments with white rice (*Oryza sativa*), a closely related plant, have shown changes from iron oxide to iron sulfide in rhizosphere sediment as the plant entered flowering (Schmidt et al., 2011). We suggest that the change in redox conditions of the root surface at reproductive life stage transitions could be explained by a decrease in radial oxygen loss tied to the life stage of the plant, creating conditions conducive to iron sulfide formation in environments with elevated sulfur.

Plants concomitantly control and are controlled by sulfide. During vegetative growth life stages, plants maintain low sulfide in the rooting zone by releasing O₂ and accumulating Fe(III). However, at key reproductive life stage transitions, excess sulfide appears to overwhelm the plant's ability to oxidize the rhizosphere. The geochemical consequences of both life stage transition and excess sulfide are a precipitous drop in Fe(III):Fe(II) ratio and an accumulation of solid-phase sulfur on roots. The ecological consequences of life stage transitions in the presence of excess sulfide are a delay in reproductive phenology and a decrease in N uptake to seeds. Slower development rates in the presence of sulfide may delay life stage transitions and the geochemical consequences of these life stage transitions for redox potential. Our experimental design was not able to directly determine if redox potential decreased at a later date due to delayed phenology in amended plants. However, our observations do provide evidence that the net effect of sulfide-induced ontogenetic drift is shortened and decreased seed production. This finding hints at a phenological mechanism underlying sulfide-induced inhibition of nitrogen uptake observed in prior work (LaFond-Hudson et al., 2018). Considering that seedlings also experience high mortality when exposed to sulfide, 50 % less total seed mass in the presence of elevated sulfide may lead to rapid population declines, as has been previously observed in a mesocosm experiment (Pastor et al., 2017). Additionally, decreased density of plants in subsequent generations may lead to lower oxygen fluxes into sediment and exacerbate redox conditions that favor production of sulfide.

Sulfide inhibition of nutrient uptake has been demonstrated in other plants (Koch et al., 1990; Martin and Maricle, 2015), as has ontogenetic drift (McConaughay and Coleman, 1999; Sims et al., 2012), so other freshwater annual aquatic plant populations may face similar reproductive challenges if exposed to sulfide. Additionally, sulfide and iron interact with nutrients besides nitrogen. Iron plaques can adsorb phosphorus and metals, controlling their availability for uptake (St-Cyr and Campbell, 1996; Christensen and Sand-Jensen, 1998). Reduction of iron plaques in the presence of sulfide may affect uptake of both macro- and micronutrients. Some studies have investigated changes in radial oxygen loss over the growing season in perennial aquatic plants (Soana and Bartoli, 2013, 2014). However, because perennial plants may have

different life cycle patterns of radial oxygen loss, the ways sulfide might interact with phenology or reproduction of perennial aquatic plants remains unknown. Clarifying how sulfide interacts with nutrients in rhizospheres of both annual and perennial plants may be important for understanding how wetlands or vegetated littoral zones respond to elevated sulfide conditions on an ecosystem level.

Redox conditions at root surfaces are closely tied to wild rice phenology. Sulfide, through delaying phenology, has the potential to control the timing of changes in redox conditions. By changing the timing and duration of reproductive life stages, sulfide's effects on phenology likely play a role in decreased survival of wild rice populations.

CRedit authorship contribution statement

Sophia LaFond-Hudson: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing - original draft, Visualization. **Nathan W. Johnson:** Conceptualization, Supervision, Writing - review & editing, Funding acquisition. **John Pastor:** Conceptualization, Supervision, Writing - review & editing, Funding acquisition. **Brad Dewey:** Conceptualization, Methodology, Investigation, Data curation, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no conflict of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.aquabot.2020.103230>.

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WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 15

LaFond-Hudson S, Johnson NW, Pastor J, Dewey B (2022) Sulfur geochemistry destabilizes population oscillations of wild rice (*Zizania palustris*).
J. Geophysical Research Biogeosciences 10.1029.

JGR Biogeosciences



RESEARCH ARTICLE

10.1029/2022JG006809

Key Points:

- Populations exposed to elevated sulfate went extinct in 6 years, overriding interannual biomass oscillations
- Iron addition and litter removal slightly alleviated sulfide toxicity but did not prevent population extinction
- Stability of oscillating populations can be evaluated with only a few years' data using an eigenvalue

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Writing – original draft: Sophia LaFond-Hudson

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Sulfur Geochemistry Destabilizes Population Oscillations of Wild Rice (*Zizania palustris*)

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Abstract Elevated inputs of sulfate to freshwater systems can increase sulfide concentrations in anoxic soils and subsequently destabilize aquatic plant populations, but the interactions between sulfate, other geochemical cycles, and interannual plant population cycles are poorly understood. Increased sulfate loading increases mineralization of nitrogen from litter, but the sulfide produced during this process can limit nitrogen uptake by plants. In some cases, iron may mitigate sulfide's impacts on plants by precipitating iron sulfide. We examined the interannual effects of sulfate loading on mesocosm populations of wild rice, an emergent aquatic plant that undergoes population oscillations and is sensitive to sulfide. Using experimental mesocosms with self-perpetuating populations, we investigated how population dynamics respond to manipulations of surface water sulfate (10 mg L⁻¹ or 300 mg L⁻¹), sediment iron (4.3 mg g⁻¹ or 10.9 mg g⁻¹ dry weight), and shoot litter (present or removed). Populations exposed to constant 10 mg L⁻¹ sulfate concentrations had stable biomass oscillations of approximately 3-year periods, consistent with previous studies that demonstrated litter-driven oscillations in nitrogen availability. Populations exposed to 300 mg L⁻¹ sulfate concentrations produced fewer and smaller seeds and declined to extinction in 6 years or less. We did not find a strong effect of iron loading or litter removal on wild rice biomass or seed production. Our observations show the potential of elevated surface water sulfate to rapidly destabilize wild rice populations under varying iron and organic carbon concentrations.

Plain Language Summary Plants that naturally grow in freshwater do not survive well if the water contains elevated concentrations of sulfate. Sulfate reduction produces sulfide that subsequently inhibits the uptake of nitrogen, an essential plant nutrient. Some annual plants go through boom-bust cycles with years alternating between high and low biomass because nitrogen takes more than a year to be released from dead plant matter. We investigated the combined effect of sulfate and natural biomass cycles on the stability of wild rice populations by growing plants in large tanks and exposing them to high-sulfate and low-sulfate concentrations, high and low iron concentrations, and with plant matter from the previous growing season either returned or removed. Nearly all plant populations exposed to high sulfate had died by 6 years into the experiment, regardless of iron concentration or litter removal. We show a method to analyze population stability with just a few years of data.

1. Introduction

Northern wild rice (*Zizania palustris*) is one of four species in the genus *Zizania*, which are the only native aquatic grains in North America. The range of northern wild rice (hereafter wild rice) is centered across the Great Lakes region and is most abundant in the rivers and lakes of the watersheds of Lakes Superior and Michigan in northern Minnesota, Wisconsin, and Ontario. Wild rice beds are usually very large (tens or hundreds of hectares) and monotypic. Because of its widespread distribution and tendency to form large monotypic stands, wild rice has great potential to control the quality of waters draining into Lakes Superior and Michigan and influence the food supply for waterfowl, muskrats, and other members of the food web. In addition, harvesting and eating wild rice are essential traditional practices that provide food sovereignty and well-being for the native Ojibway people of the watersheds of Lakes Superior and Michigan (Fond du Lac Band of Lake Superior Chippewa, 2018). Therefore, the productivity, perpetuation, and restoration of wild rice are of great ecological and cultural significance.

Production of wild rice biomass is limited by the supply of nitrogen from decomposing plant litter, sediment organic matter, and hydrologic inputs (Pastor & Walker, 2006; Sims et al., 2012; Walker et al., 2006, 2010). Because it is an annual plant, wild rice's nitrogen requirements must be fully supported by uptake during each year. Over 60% of nitrogen uptake happens during a 2-week window in early summer (Grava & Raisanen, 1978;

Sims et al., 2012). Nitrogen, however, is not released from the previous year's litter until later in summer or even the following year (Hildebrandt et al., 2012; Sain, 1984; Walker et al., 2010). In fact, there is considerable microbial immobilization of nitrogen into fresh litter during the period when the demands of wild rice growth for nitrogen are greatest (Hildebrandt et al., 2012; Walker et al., 2010). The coincidence of microbial nitrogen immobilization with the period of rapid nitrogen uptake causes wild rice biomass and litter production to cycle with a period of approximately 4 years (Pastor & Walker, 2006; Walker et al., 2010).

Inputs of sulfate from bedrock weathering, mine drainage, and agriculture enhance sulfide production in natural wild rice ecosystems (Bailey et al., 2017; Lamers et al., 2013; Myrbo et al., 2017a). Wild rice production appears to be adversely impacted by sulfide in the vicinity of its rooting zone. The survival of juvenile seedlings and weights of seeds decrease with increased hydrogen sulfide concentrations in wild rice's rooting zone in aquatic sediments (Pastor et al., 2017). The production of sulfide may be coupled to increased litter deposited in sediment during productive years of the wild rice population cycle. These large litter cohorts could reduce sediment redox potential (Eh) by providing additional labile carbon to support additional bacterial growth and hence oxygen demand the following year, thereby enhancing the potential for reduction of sulfate to sulfide (Azam et al., 1991; Gao et al., 2003, 2004).

Other biogeochemical reactions in the sediments may impede the bioavailability of sulfide to wild rice roots. The most important reaction is precipitation of sulfide with reduced iron (Morse et al., 1987). In both mesocosm and lake studies (Bailey et al., 2017; Myrbo et al., 2017a), iron in sediments appear to exert a strong control on the accumulation of dissolved sulfide in sediments. Bulk sediment iron content is strongly associated with lower porewater sulfide in field conditions and mitigates sulfide toxicity to macrophytes in other aquatic ecosystems (Lamers et al., 2002; Ruiz-Halpern et al., 2008; Van der Welle et al., 2007).

However, iron sulfide can precipitate on roots of mature plants and is associated with impaired nitrogen uptake and inhibited seed production (LaFond-Hudson et al., 2018, 2020a). Plant-mediated gas transport of oxygen from the atmosphere into the rhizosphere allows formation of iron oxides on root surfaces, and oxygen fluxes are typically highest when plants are photosynthetically active (Blossfeld et al., 2011; Han et al., 2018; Marzocchi et al., 2019). As observed on many emergent macrophytes, iron oxide forms on wild rice roots as the plant grows (Jorgenson et al., 2012; Mendelsohn et al., 1995; Sundby et al., 1998). At maturity and the start of seed production, however, root plaques transition from iron oxide to iron sulfide if porewater sulfate is abundant (LaFond-Hudson et al., 2018). We have imaged iron sulfide plaques and quantified plaque iron and sulfide concentrations from plants grown in mesocosms with 300 mg L⁻¹ sulfate (Pastor et al., 2017) and have visually observed black root plaques in the field at lower sulfate concentrations (unpublished data). Plants that accumulate greater concentrations of iron sulfide plaques have lower seed nitrogen mass (LaFond-Hudson et al., 2018, 2020a).

There are, therefore, complex and as yet poorly understood couplings among biomass and litter cycles, nitrogen availability, sulfide inhibition of seed production, control of sulfide concentrations in sediments by iron and litter, and precipitation of iron sulfide on roots during seed production. Here, we investigate how litter-driven population oscillations interact with sulfate geochemistry in wild rice using controlled mesocosm experiments that allow us to scale rhizosphere geochemistry-plant physiology interactions from individual plants to an entire population for several generations. In our mesocosms, we elevated geochemical inputs of sulfate and iron and manipulated carbon through the presence or absence of litter. We investigated: (a) the patterns of biomass oscillations in high-sulfate and low-sulfate conditions, and (b) whether litter and iron enhance or alleviate sulfate's effects on biomass oscillations through the production and precipitation of sulfide.

2. Methods

2.1. Experimental Design

The interactions of sulfate, iron, and litter in wild rice sediment and their effect on wild rice population dynamics were studied using 40 mesocosms. Polyethylene stock tanks (High Country Plastics 400 L, 132 × 78 × 61 cm) were used to assemble the mesocosms (Figure 1). Sediment in the tanks was taken from Rice Portage Lake (MN Lake ID 09003700, 46.7038, -92.6829) on the Fond du Lac Band of Lake Superior Ojibway Reservation in Carlton County, Minnesota (Table 1). This lake is a productive wild rice lake with little surrounding development and its sediment has been used successfully to grow wild rice in previous experiments (Pastor et al., 2017). Sediment was homogenized before it was added to the tanks. Clean sand (10 cm) was added to the bottom of the

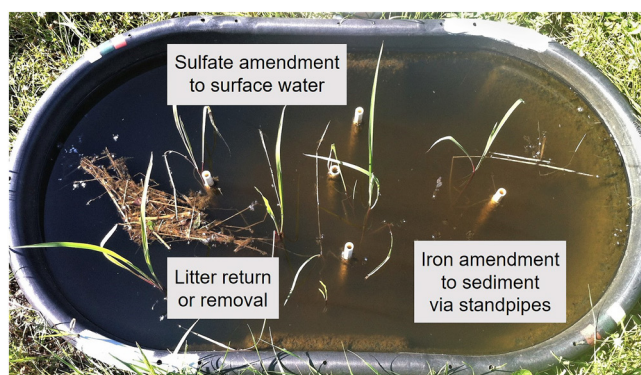


Figure 1. Picture of a mesocosm showing the application of sulfate, iron, and litter treatments. The center standpipe was used to moderate the water level after rain events. The other four standpipes connect to a ring of perforated PVC pipes in the sediment to allow release of iron(II) chloride. Sulfate was applied as sodium sulfate several times over each growing season to maintain surface water concentrations near 300 mg L^{-1} sulfate. Litter was weighed at the end of each growing season, and either returned to the mesocosms, or permanently removed.

tanks before 50 L of lake sediment were placed in each tank, resulting in a sediment depth of about 10 cm on top of 10 cm of sand. Water levels were maintained at 22 cm with a drain standpipe during precipitation and well water additions to account for evaporation. These depths of sand, sediment, and water represent typical wild rice rooting depth and water column heights in the field and have been used in several wild rice mesocosm experiments previously (Hildebrandt et al., 2012; Pastor et al., 2017; Walker et al., 2010).

To test the effects and interactions of sulfate, iron, and litter, we used a factorial design with five replicates for each of eight combinations of elevated or background sulfate, elevated or background iron, and the presence or absence of litter (Figure 1). These combinations were randomly assigned to the tanks in the first year of the experiment. For high-sulfate treatments, enough sodium sulfate was added to the surface water to bring the sulfate concentration to a target level of 300 mg L^{-1} . Surface water sulfate concentrations were tested weekly and sodium sulfate was added as required to maintain concentrations at the target level of 300 mg L^{-1} throughout the growing season for the duration of the experiment. The low-sulfate tanks were filled with water from an on-site well with concentrations around 10 mg L^{-1} and received no additional sulfate additions except for precipitation, which averaged $2.3 \pm 1.5 \text{ mg L}^{-1}$ sulfate. The sulfate concentrations in the low-sulfate tanks averaged around 7 mg L^{-1} over several years (Pastor et al., 2017). The

low-sulfate conditions for our experiment are still higher than the median sulfate concentration of Minnesota wild rice waters, 1.8 mg L^{-1} (Myrbo et al., 2017a), but is just below Minnesota's protective sulfate standard for wild rice waters. At 300 mg L^{-1} , our high-sulfate treatment is close to the EPA's secondary standard for sulfate in drinking water (250 mg L^{-1}) and represents surface water concentrations of a few lakes and rivers in Minnesota that contain wild rice (Myrbo et al., 2017a). Prior to both sulfate and iron amendment, sediment iron was extracted from homogenized sediment samples using 1 M HCl and quantified on a Varian fast sequential flame atomic absorption spectrometer with an acetylene torch (Federation & Association, 2005). The sediment initially contained $77 \text{ } \mu\text{mol Fe g}^{-1}$ dry weight (Table 1), 85% of which was Fe(II) (Phenanthroline method, see Section 2.2). Each iron-amended tank received 96 g Fe^{2+} , bringing total iron concentrations up to approximately $196 \text{ } \mu\text{mol Fe g}^{-1}$, or 10.9 mg g^{-1} dry weight. This amendment level aimed to noticeably increase iron concentrations without causing iron toxicity (Kinsman-Costello et al., 2015). Iron was applied gradually in four separate aliquots during the first growing season. For each addition, $75 \text{ g FeCl} \cdot 4\text{H}_2\text{O}$ was dissolved in 400 mL well water and added directly into the sediment through PVC standpipes connected to a buried perforated PVC ring. The

standpipes and ring were flushed with 100 mL of tank water immediately after the iron(II) chloride was injected. Samples of pore water iron were taken several times over the course of the first growing season in 10 points distributed across the tank to ensure that the iron loading was distributed evenly. Noniron tanks did not receive additional iron except for occasional well water that contained 0.17 mg L^{-1} Fe. Noniron tanks did not have a buried PVC ring, but all mesocosms had a center standpipe draining into an external bucket to restore the water level after rain events.

To test the effect of shoot litter cohorts on sulfide production, shoot litter produced by the wild rice population was retained in half the tanks and removed from the remaining tanks. Litter removal was chosen as the experimental treatment rather than litter addition because in typical freshwater, organic-rich wild rice habitats, sulfide production is generally limited by sulfate rather than organic carbon, so increasing litter may have had little effect. Only aboveground litter was removed for two reasons: (a) to minimize sediment disturbance, and (b) to focus on litter effects on sulfide production. Litter-driven biomass oscillations are driven primarily by recalcitrant root litter (Walker et al., 2010), so aboveground litter manipulation was not

Table 1
Initial Bulk Sediment Physical and Chemical Characteristics

Sediment property	Value
Porosity	0.87
Bulk density	0.29 g cm^{-3}
Percent solids	30
Solid-phase acid volatile sulfide (AVS)	$0.346 \pm 0.054 \text{ } \mu\text{mol g}^{-1}$
Solid-phase extractable iron	$76.7 \pm 5.1 \text{ } \mu\text{mol g}^{-1}$
Solid-phase ferrous iron	$65.2 \pm 4.8 \text{ } \mu\text{mol g}^{-1}$
Porewater sulfide	$0.659 \pm 0.239 \text{ } \mu\text{mol L}^{-1}$
Porewater ferrous iron	$435 \pm 200 \text{ } \mu\text{mol L}^{-1}$
Initial solid phase S:Fe ratio	0.00450
Initial porewater $\Sigma\text{S}^{2-}:\text{Fe}^{2+}$ ratio	0.0015

Note. Sulfide was measured from initial sediment and porewater iron is an average from fall measurements in tanks unamended with iron.

expected to disrupt interannual cycles. Initial organic carbon content of the sediment was $14.8 \pm 1.7\%$ by dry weight (Pastor et al., 2017).

2.2. Geochemical Sampling and Analysis

In 2019 (year 5 of study), passive diffusion samplers (peepers) were installed in the tanks during vegetative growth (July) and seed production (September) to obtain porewater measurements from discrete depths in the top six cm of sediment. The peepers were placed in deionized water that was bubbled with nitrogen for 1 week prior to installation (Johnson et al., 2019). The peepers were transported to mesocosms in degassed water and installed in three tanks for each treatment. Each peeper contained four wells, the top of which was in the flocculant litter layer at the sediment surface and the bottom of which was approximately six cm below the sediment surface. Two weeks after peepers were installed, each peeper was removed and quickly placed in a large, resealable plastic bag purged with nitrogen gas to keep porewater anoxic during porewater extraction. Approximately 6 mL of porewater from each well was extracted with a syringe and allocated for immediate sulfide and iron measurements in vials preloaded with reagents. A separate aliquot was used to measure pH within 30 s.

Iron(II) and sulfide were quantified colorimetrically using the phenanthroline and methylene blue methods, respectively, on a HACH DR5000 UV-Vis spectrophotometer (Federation & Association, 2005). The pH of the pore water was measured by placing a calibrated ThermoScientific Orion pH electrode in porewater immediately after it was extracted from peepers.

2.3. Biological Sampling and Analysis

Seedlings usually began to germinate around mid-May. When seedlings grew to the water surface, populations in each mesocosm were thinned to approximately 30 plants per tank, which is the optimal density to limit competition and minimize overlapping rhizospheres (Lee, 2002). In August, as plants began to flower, six plants from each tank were randomly selected and tagged. Seed data were collected from these six plants and extrapolated to the total number of plants in the tank. Seeds from the remaining plants were left in the tank to reseed the sediment for the next year. Seeds were sorted as filled or unfilled by visual inspection, counted, and dried at 65 °C and weighed to determine seed mass. After all plants had completely senesced in October, all aboveground biomass was removed and weighed with a small subsample dried at 65 °C and weighed for moisture correction. The litter that was not dried was returned to the mesocosms assigned to retain litter within a few days.

2.4. Data Analysis

The data collected in this experiment are available at the Digital Repository for University of Minnesota (LaFond-Hudson et al., 2020b). Porewater data collected from peepers were examined to understand how porewater sulfide to iron ratios and saturation with respect to FeS were changed 5 years after geochemical manipulation. A three-way ANOVA was used to test the effect of each geochemical manipulation (sulfate, iron, litter). Repeated measures ANOVAs were used to determine the effect of time, sulfate addition, iron addition, and litter removal on biological traits and porewater measurements. Data were checked for normality and heteroscedasticity using R's standard diagnostic plots and for sphericity using the ez R package (Lawrence, 2016), which provides sphericity corrections in the case of violated assumptions. For porewater data, nondetects (12% of samples) and lost samples (11%) were removed. Zeros were not removed in biological data, as these were true absences of plant or seed tissue. Including zeros in biological data resulted in large variance under high-sulfate conditions, making it harder to detect differences between treatments using ANOVA tests. However, averages calculated including zeros (extinction of the population) represent the effects of high sulfate more completely than removing zeros.

To test the propensity of the population to oscillate in high-sulfate and low-sulfate conditions, we regressed the change in vegetative biomass ($B(t) - B(t - 1)$) against the vegetative biomass from the previous year ($B(t - 1)$). A negative slope of this regression indicates that high productivity 1 year leads to lower productivity the following year and, conversely, that years with low productivity are followed by years with higher productivity (Walker et al., 2010). The slope of this line is $\partial(dB/dt)/\partial B$, which is effectively an eigenvalue of system. A critical value of -1 of this eigenvalue defines a Hopf bifurcation giving birth to stable limit cycles (Pastor & Walker, 2006; Strogatz, 1994; Walker et al., 2010). A slope of -1 or more negative indicates propensity for stable oscillations,

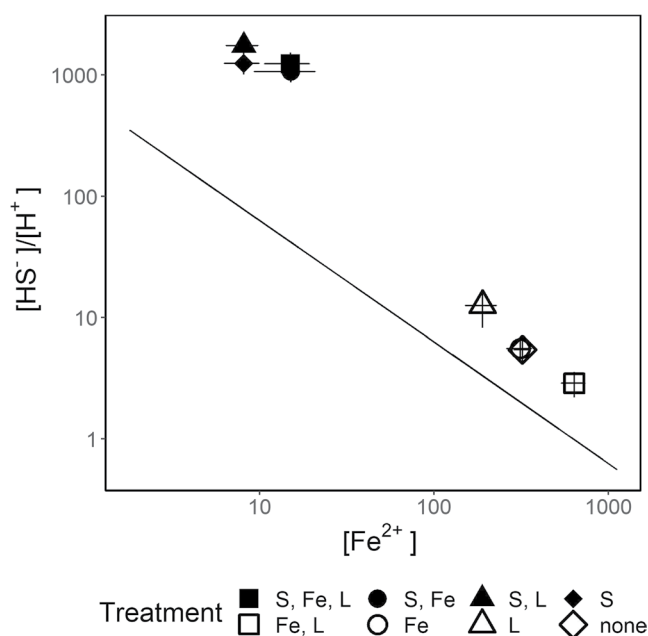


Figure 2. Comparison of ferrous iron ($\mu\text{mol L}^{-1}$) and sulfide concentrations (both sulfide and H^+ in mol L^{-1}) in sediment porewater after 5 years of sulfate amendment (S), iron amendment (Fe), and litter retention (L). Data points represent average porewater measurements for each treatment ($n = 12\text{--}30$; most $n = 24$). Error bars represent the standard error around the mean. Porewater was collected 2, 4, and 6 cm below the sediment surface using peepers. Open symbols are for mesocosms with background sulfate concentrations and closed symbols are for mesocosms with nominal sulfate concentrations of 300 mg L^{-1} in overlying water. The line depicts the ion activity product at saturation for iron and bisulfide at pH 7.0 ($\log K_{\text{sp}} = -3.2$). Porewater pH in elevated sulfate mesocosms ranged from 6.85 to 8.56 with a mean of 7.33 while porewater pH in low-sulfate mesocosms averaged ranged from 6.18 to 8.83 with a mean of 6.67.

while a slope between -1 and 0 indicates dampened oscillations (Walker et al., 2010). Dampened oscillations will eventually converge on a stable value of biomass, which may include zero (extinction). When no biomass is produced the following year, the population is at the boundary line $y = -x$ and the population is extinct. Vegetative biomass, rather than total biomass (vegetative + seeds), was used in this analysis because asynchrony in nitrogen mineralization and nitrogen uptake is expected to affect plants most during vegetative growth (Grava & Raisanen, 1978; Walker et al., 2010).

3. Results

3.1. Geochemical Context

Both high-sulfate and low-sulfate conditions contained sulfide and iron concentrations that favored precipitation of FeS (ion activity product $> K_{\text{sp}}$, Figure 2) in the fifth year of the study. Sulfate amendments to the surface water increased porewater sulfide and pH, and decreased porewater ferrous iron concentrations ($p < 0.001$ for all, Table 2). Sulfate addition raised porewater sulfide from an average of $4 \mu\text{mol L}^{-1}$ in unamended tanks to $110 \mu\text{mol L}^{-1}$ and lowered porewater ferrous iron concentrations by a similar order of magnitude, from 309 to $12 \mu\text{mol L}^{-1}$. The pH in high-sulfate mesocosms was 0.65 units higher than in low-sulfate conditions ($7.32, 6.67$). Iron amendment increased porewater ferrous iron concentrations by approximately $70\text{--}80\%$ ($p < 0.001$, Table 2) but did not notably change sulfide or pH. Litter removal did not significantly change sulfur or iron geochemistry.

3.2. Geochemical Effects on Biomass and Reproduction

All measured traits of wild rice growth and reproduction changed with time (Table 3). Sulfate addition strongly and consistently decreased all measured traits of wild rice growth (Table 3). The main effects of iron addition and litter removal were much weaker and inconsistent relative to sulfate addition, therefore we examined how iron and litter affected wild rice growth and reproduction using separate repeated measures ANOVAs for the high and low sulfur populations, respectively.

Total aboveground biomass density (hereafter referred to as biomass) was similar between high-sulfate and low-sulfate populations during the first year of the experiment (100 g m^{-2}), but biomass in high-sulfate populations declined to less than 5 g m^{-2} during the subsequent 5 years (Figure 3). In 2017, 4 years into the experiment, 8 out of the 20 populations receiving high sulfate loads produced no biomass regardless of iron addition and litter removal. Seven populations recovered partially in 2018, possibly from the germination of seeds from previous years buried in the sediment, but by 2019, 16 out of these 20 populations produced no biomass. In low-sulfate

Table 2

The Effect of Five Years of Sulfate, Iron, and Litter Additions on Porewater Concentrations of Sulfide and Iron, Porewater pH, and the Saturation Index With Respect to FeS Calculated From the Former Three Measurements in 2019 (Three-Way ANOVA)

Variable	Sulfate	Iron	Litter	Significant interactions
Porewater sulfide	$p < 0.001$	$p = 0.53$	$p = 0.64$	$\text{S} \times \text{Fe}$, $\text{Litter} \times \text{Fe}$, $\text{S} \times \text{Litter} \times \text{Fe}$
Porewater iron	$p < 0.001$	$p < 0.001$	$p = 0.16$	
Porewater pH	$p < 0.001$	$p = 0.64$	$p = 0.57$	$\text{S} \times \text{Litter} \times \text{Fe}$
Saturation index of FeS	$p < 0.001$	$p = 0.19$	$p = 0.96$	

Note. Significant interactions (in bold) refer to combinations of sulfate, iron, and/or litter that are significant at $p < 0.05$.

Table 3

Repeated Measures ANOVA Testing the Influence of Sulfate Amendment, Iron Amendment, and Litter Removal on Wild Rice Growth and Reproduction for 2014–2020

Trait	Year	Sulfate	Iron	Litter	Significant interactions
Vegetative biomass	$p < 0.001$	$p < 0.001$	$p = 0.81$	$p = 0.44$	$S \times L \times Fe \times Year$, $S \times L \times Year$, $S \times Year$, $Fe \times Year$
Population seed mass	$p < 0.001$	$p < 0.001$	$p = 0.59$	$p = 0.09$	$S \times L \times Year$, $S \times Year$
Filled seed ratio	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p = 0.25$	$S \times Year$
Mass per filled seed	$p < 0.001$	$p < 0.001$	$p = 0.002$	$p = 0.40$	$S \times Year$, $Fe \times Year$
Total biomass	$p < 0.001$	$p < 0.001$	$p = 0.71$	$p = 0.23$	$S \times Fe \times L \times Year$, $S \times L \times Year$, $S \times Year$
High-sulfate conditions					
Vegetative biomass	$p < 0.001$	–	$p = 0.82$	$p = 0.83$	$L \times Year$, $Fe \times L \times Year$, $Fe \times Year$
Population seed mass	$p < 0.001$	–	$p = 0.28$	$p = 0.67$	
Filled seed ratio	$p < 0.001$	–	$p = 0.01$	$p = 0.42$	
Mass per filled seed	$p < 0.001$	–	$p = 0.04$	$p = 0.20$	
Total biomass	$p < 0.001$	–	$p = 0.74$	$p = 0.97$	$L \times Year$, $Fe \times L \times Year$
Low-sulfate conditions					
Vegetative biomass	$p < 0.001$	–	$p = 0.68$	$p = 0.30$	$Fe \times Year$
Population seed mass	$p < 0.001$	–	$p = 0.82$	$p = 0.08$	
Filled seed ratio	$p < 0.001$	–	$p = 0.01$	$p = 0.41$	$Fe \times Year$
Mass per filled seed	$p < 0.001$	–	$p = 0.02$	$p = 0.86$	$Fe \times Year$
Total biomass	$p < 0.001$	--	$p = 0.82$	$p = 0.18$	

Note. Bold values highlight p -values < 0.05 . Separate tests for high-sulfate and low-sulfate conditions are also included. Interactions are listed if significance is $p < 0.05$.

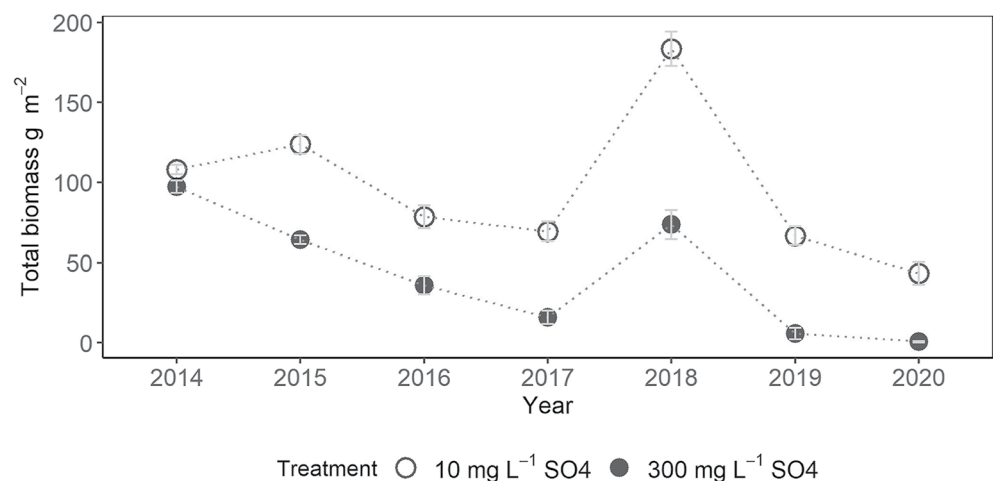


Figure 3. Annual average aboveground biomass (total) density (g m^{-2}) in populations grown in high sulfate (300 mg L^{-1} , filled circles) and low sulfate (10 mg L^{-1} , empty circles) in the overlying water. Error bars depict the standard error around the mean ($n = 20$).

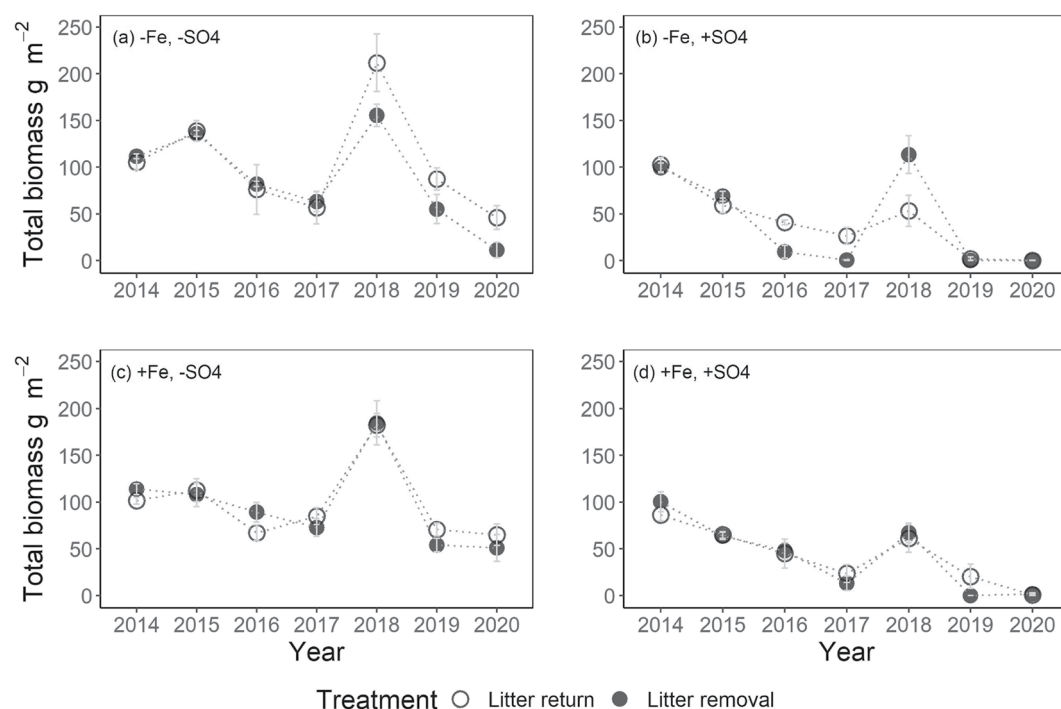


Figure 4. Annual average aboveground biomass (total) density (g m^{-2}) in populations grown with the previous year's aboveground litter returned (empty circles) or removed (filled circles). Populations were treated with combinations of low sulfate ($-\text{SO}_4$, 10 mg L^{-1} ; a, c) or high sulfate ($+\text{SO}_4$, 300 mg L^{-1} ; b, d) and low iron ($-\text{Fe}$, 4.3 mg g^{-1} ; a, b) or high iron ($+\text{Fe}$, 10.9 mg g^{-1} ; c, d). Error bars depict the standard error around the mean ($n = 5$).

conditions, populations showed a stable 3-year cycle of biomass (Figure 3) that oscillated between about 50 and 175 g m^{-2} on average, with peaks in the second and fifth growing season (2015 and 2018).

When biomass was examined separately in high-sulfate and low-sulfate treatments, populations grown in low sulfate were not affected by iron, litter, or their interaction (Figures 4a and 4c). Populations grown in high sulfate were not consistently influenced by iron and litter but were affected by interactions between iron, litter, and year (Table 3). In high-sulfate conditions, litter removal amplified oscillations in the treatments that did not receive iron addition, with lower biomass in years 3–4 of the experiment and higher biomass in year 5 compared to the populations with litter return (Figure 4b). In high-sulfate treatments that received additional iron, no differences in biomass were observed between litter removal and litter return (Figure 4d).

The proportion of filled seeds, individual seed mass, and population seed mass approached zero after six generations in high-sulfate conditions, while the same seed traits remained constant in low-sulfate conditions (Figure 5, seed mass not shown). Sulfate-amended populations that received iron amendment had a 20% higher filled seed ratio for 2015–2017 ($p = 0.01$, Table 3 and Figure 5b), but the effect of iron diminished in 2018 and 2019. In high-sulfate conditions, iron increased the average individual seed mass by approximately 40% in 2016 and by 20–30% in 2017–2018 ($p = 0.04$, Table 3 and Figure 5d). By 2020, only two sulfate-amended populations produced seeds; both also received iron amendment. In low-sulfate conditions, the proportion of filled seeds and average mass per filled seed were slightly increased by iron amendment (Figures 5a, 5c and Table 3). Litter removal did not affect any seed traits (Table 3).

3.3. Stability of Population Cycles

Changes in vegetative biomass from 1 year to the next were regressed against the biomass of the previous year to examine population oscillations for stability (Walker et al., 2010). All treatments with low sulfate were aggregated to compare to all treatments exposed to elevated sulfate since iron and litter manipulations had little effect in comparison to sulfate. In low-sulfate conditions, biomass oscillations are stable, as indicated by the slope of -1.3 for years 2015–2018 (Figure 6a) and a consistent annual biomass production between 50 and 125 g m^{-2} .

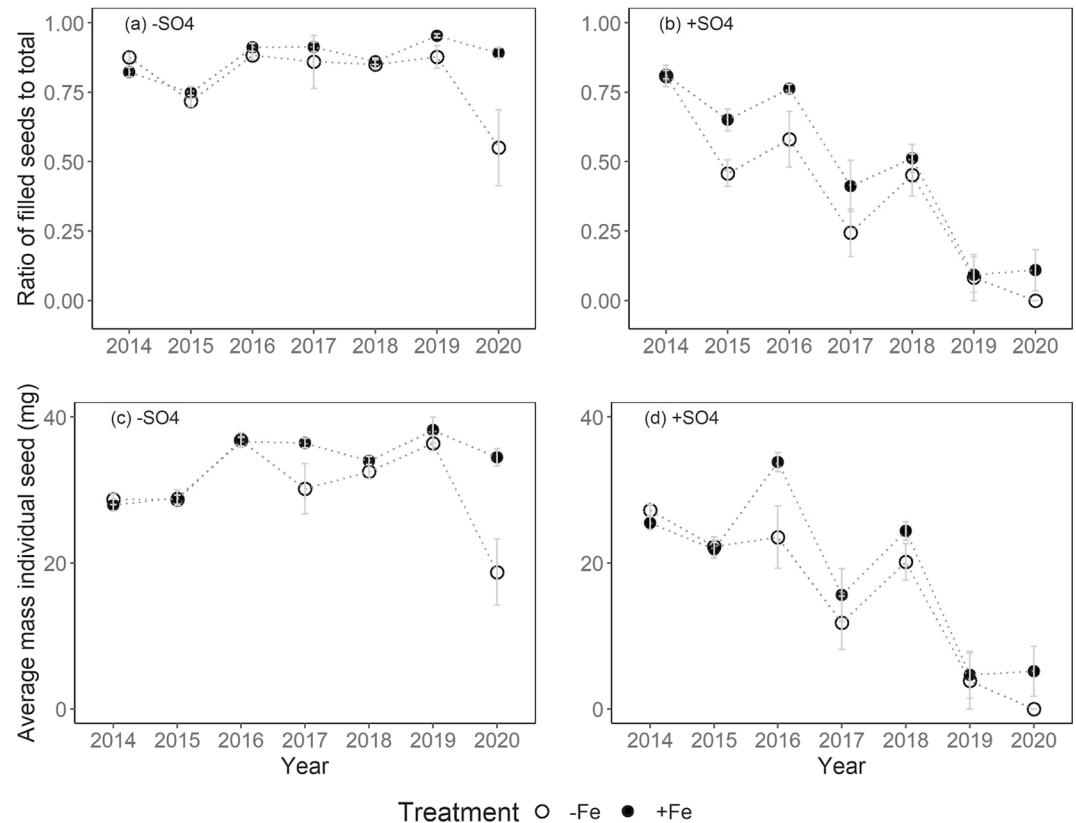


Figure 5. Effects of iron addition (+Fe, 10.9 mg g⁻¹; -Fe, 4.3 mg g⁻¹) on the ratio of filled seeds to total seeds (includes empty husks; a, b) and on average individual seed mass (c), (d) in 10 and 300 mg L⁻¹ sulfate. Error bars depict the standard error around the mean ($n = 10$).

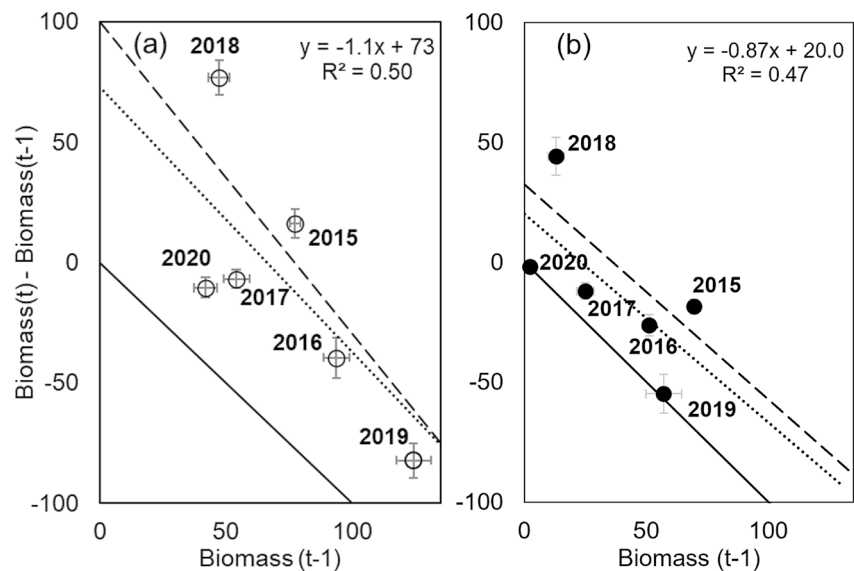


Figure 6. The relationship between average year-on-year change in vegetative biomass (g m⁻²) to the previous year's vegetative biomass in (a) 10 mg L⁻¹ sulfate and (b) 300 mg L⁻¹ sulfate. Error bars show the standard error. The slope of the dashed line represents $\partial(B)/\partial t$ and is calculated from populations in 2015–2018, representing approximately one population cycle. The dotted line also represents $\partial(B)/\partial t$ and is calculated from 2015 to 2020, to show the stability after 1.5 population cycles. The solid line represents extinction, when all biomass from the previous year is lost.

This slope is nearly identical to the slopes found a previous experiment (-1.04 to -1.20) that showed wild rice undergoes litter-driven productivity cycles (Walker et al., 2010). When data from 2019 to 2020 are included in this analysis, the slope is -1.1 , still representing stable oscillations. The present experiments and those of Walker et al. (2010) were done during different time periods and in different wild rice populations. Therefore, the two experiments provide independent corroboration of one another.

In high-sulfate conditions, a slope of -0.9 for year 2015–2018 indicates dampened oscillations (Figure 6b). Biomass decreased every year except for 2018, when the populations partially recovered. From 2018 to 2019, almost all points from sulfate-amended mesocosms fell on the boundary line $y = -x$, indicating that populations lost the entirety of the biomass produced during 2018 and produced no new biomass in 2019 (Figures 6b and 3). The data point for 2020 is near zero, indicating two consecutive years of extinct populations. The trajectory of mean biomass over time decreases in the presence of sulfate under our experimental conditions (Figure 3) and oscillations were dampened. In low-sulfate concentrations, biomass peaked in 2015 and 2018, demonstrating a 3-year cycle. Elevated sulfide produced in tanks with high-sulfate concentrations extinguished the population cycle which persisted in tanks with low-sulfate concentrations.

4. Discussion

Elevating surface water sulfate to 300 mg L^{-1} led mesocosm populations of wild rice to extinction in six growing seasons. This study adds to the growing body of literature describing the impacts of sulfate loading and subsequent sulfide exposure on wild rice, including lower rates of seedling survival, delayed phenology, impaired seed production, and declining biomass (Johnson et al., 2019; LaFond-Hudson et al., 2020a; Pastor et al., 2017). In conjunction, field observations both recently as well as decades ago show that wild rice presence becomes increasingly unlikely with elevated surface water sulfate and porewater sulfide (Moyle, 1945; Myrbo et al., 2017a). Statistical modeling of environmental parameters associated with wild rice presence has suggested that iron and organic carbon play the strongest role in controlling sulfide's effects on wild rice populations (Pollman et al., 2017), and similar conclusions have been reached about other sensitive aquatic plant species growing in freshwater wetlands with increasing sulfate loads (Lamers et al., 2002; Van der Welle et al., 2007). In our study, iron addition and organic carbon removal did not limit sulfide accumulation in sediment enough to stabilize wild rice populations.

In anoxic freshwater systems, sulfide production is generally limited by the supply of sulfate, whereas in marine systems or other systems with high sulfate, sulfide production is generally limited by the supply of organic matter (Ruiz-Halpern et al., 2008). Wild rice naturally grows in low-sulfate, organic-rich habitats (Myrbo et al., 2017a), meaning sulfate is the likely limiting factor for sulfide production. In mesocosms with elevated sulfate, litter removal alone did not appear to decrease sulfide concentrations and instead led to slightly faster population decline. It is possible that litter removal decreased the availability of macronutrients or micronutrients, such as nitrogen, potassium, or iron that might be replenished in natural ecosystems with more hydrologic connectivity. Notably, for populations with sulfate added and litter removed, population biomass declined faster in populations with ambient iron compared to populations receiving iron addition (Figures 4b and 4d). Another possibility is that in the litter return treatments, sulfate addition increased rates of litter decomposition and nutrient availability (Myrbo et al., 2017b). Under the conditions in this study and previous studies (Pastor et al., 2017), sulfide's inhibition of nitrogen uptake influenced population biomass more strongly than sulfate-enhanced nutrient mineralization, but the interactions of these two processes warrant further study.

In the presence of excess uncomplexed Fe(II), sulfide reacts quickly with iron, forming relatively stable iron sulfide solid phases. The ratio of sulfur to iron or similar metrics related to the degree of pyritization can be used to determine the capacity of sediment to precipitate iron sulfide and keep porewater sulfide concentrations low (Johnson et al., 2019; Julian et al., 2017). We added iron only during the first growing season of the experiment, making this treatment a pulse (one time) rather than a press (ongoing). In contrast, our sulfate and litter manipulations were maintained throughout the experiment. This decision was made to avoid Fe^{2+} toxicity to the plants (Kinsman-Costello et al., 2015; Sahrawat, 2005) and likely contributed to our findings of little alleviation of sulfide toxicity by iron compared to other studies with freshwater vegetation in environments with natural differences in groundwater upwelling of iron (Lamers et al., 2002) or seagrasses in experiments with monthly iron addition (Ruiz-Halpern et al., 2008). We observed some mitigation of sulfide's effects on seed production by

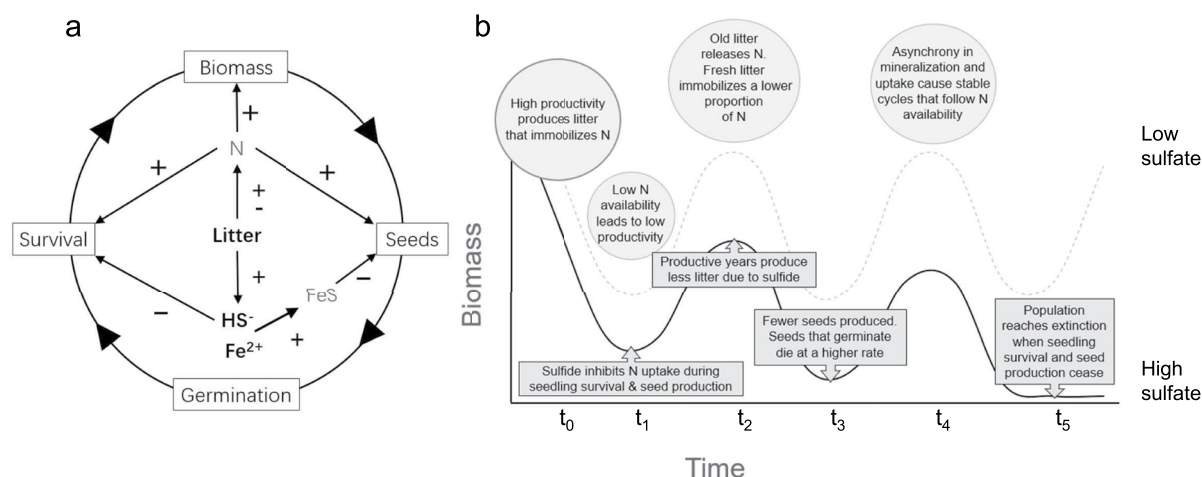


Figure 7. A conceptual model synthesizing the interactions of sulfur, iron, and litter during the life cycle of wild rice (a), and the effect of sulfur on interannual biomass cycles of wild rice (b) based on this study, Walker et al. (2010), and LaFond-Hudson et al. (2018). In (a), the (+) and (−) symbols in (a) represent positive or negative relationships between geochemical constituents and plant traits. In (b), the top, dashed line represents low-sulfate conditions, and the lower, solid line represents conditions with elevated sulfate loading. Time intervals ($t_0 - t_5$) do not represent consecutive years, because time between peaks is typically 3–5 years for wild rice.

iron in the first 4 years of the experiment, but iron's effect diminished by 2018 and 2019 (Figure 5) and porewater measurements in 2019 confirmed that iron concentrations were low in all elevated sulfate treatments, regardless of whether the mesocosms received additional iron (Figure 2).

The effect of sulfur on wild rice population dynamics is further complicated by oscillations due to a lag in nitrogen mineralization from litter relative to the timing of nitrogen uptake during the life cycle (Walker et al., 2010). We present a conceptual model built on the synthesis of previous work elucidating the connection between nitrogen and biomass cycles (Pastor & Walker, 2006; Walker et al., 2010); connections between sulfate, biomass, and seed production (Johnson et al., 2019; LaFond-Hudson et al., 2018; Pastor et al., 2017); and the present study which explores the role of sulfate and biomass cycles (Figure 7). Within each life cycle, nitrogen controls plant growth, and seed production (Grava & Raisanen, 1978). Litter immobilizes then slowly mineralizes nitrogen, leading to alternating negative and positive effects on nitrogen availability (Walker et al., 2010, Figure 7a). When sulfate is added to the system, production of sulfide directly decreases seedling survival and seed production (Figure 7a and Pastor et al., 2017). Iron precipitates sulfide into less-reactive iron sulfide, potentially alleviating some of the effects of sulfide on seedling survival and seed production, although iron sulfide also accumulates on root surfaces concomitant with decreased seed nitrogen (LaFond-Hudson et al., 2018). As the life cycle repeats each year (Figure 7a), these geochemistry-plant interactions lead to different interannual trajectories depending on the level of sulfate present in the system (Figure 7b). In low-sulfate conditions, high biomass production 1 year leads to an above average amount of litter that immobilizes nitrogen and decreases nitrogen availability in the following year(s) (Figure 7b, t_0, t_1). The lower nitrogen availability creates competition among seedlings for scarce nitrogen, leading to diminished biomass and seed production. As litter slowly decays, it releases nitrogen during subsequent years (Figure 7b t_2), and thereby increases seedling survival, biomass, and seed production. Alternating nitrogen availability leads to stable biomass cycles in low-sulfate environments (Figures 3 and 7b, t_4 etc.). At the levels of experimental sulfate addition we used, sulfur impacts overwhelmed the effects of litter-controlled N availability, causing the populations to quickly decrease (Figures 3 and 7b, t_3). When constant sulfate loading sustains declines in seedling survival and seed production, both germination and population biomass decline, eventually to extinction (Figure 7b, t_5).

Although we examined complicated interactions among sulfur, iron, organic carbon, nitrogen, and plant cycles, the mesocosms we used in this study are a relatively simple system containing only one species, homogenized sediment across mesocosms, and little hydrological mixing or external nutrient inputs. Projects that manage or restore plant populations in aquatic ecosystems occur in systems affected by interactions between geochemistry, surface and groundwater hydrology, and competing ecological communities. Many such projects monitor biomass annually, but traditional time series analyses require lengthy monitoring periods. When the monitoring period is

too short to detect population oscillations with a time series analysis, it may be insightful to use annual biomass data from one or two population cycles to calculate and analyze eigenvalues that describe the population's stability. In our experiment, we calculated and analyzed eigenvalues from less than two population cycles and our eigenvalue for populations in low-sulfate conditions corresponded closely to the results of Walker et al. (2010). Even though these were different experiments done during nonoverlapping time periods, the two experiments corroborate one another and strongly suggest that wild rice populations unimpeded by sulfate loadings oscillate stably with an approximate period of 4 years. Additionally, these findings are consistent with observations in some regional lakes and rivers containing wild rice stands (Vogt, 2021). This method is general enough to be applied analogously to data from other field studies and may be useful for identifying at-risk populations or determining whether management and restoration of an oscillating population is effective.

Only some aquatic plants experience population oscillations; however, many are limited by nitrogen and experience sustained or occasional exposure to sulfide, for example, the salt marsh species *Spartina alterniflora* (Mendelssohn & Morris, 2000). Estuarine wetlands receive sulfate from tidal inputs and interannual changes in precipitation can lead to wide variations in interannual nitrogen loading and sulfate intrusion (Sinha & Michalak, 2016). Understanding how plants respond to sulfate and sulfide under fluctuating nitrogen availability may be critical for understanding wetland vegetation dynamics. Perhaps species with different patterns of nitrogen uptake compared to wild rice can be more resilient to sulfide exposure, or plants with greater sulfide tolerance benefit more from increased sulfur-mediated nutrient availability.

5. Conclusion

This study demonstrates the importance of both litter-driven biomass oscillations and sulfate concentrations to population trajectories over several generations and corroborates studies that investigated these processes separately (Johnson et al., 2019; Pastor et al., 2017; Walker et al., 2010). Our observations show predictable and stable biomass oscillations in systems with less than 10 mg L⁻¹ sulfate in surface water and rapid population declines in systems with surface water sulfate elevated to 300 mg L⁻¹. Although population biomass did oscillate in elevated sulfate conditions, oscillations were unstable and less predictable than in low-sulfate conditions. This work aggregates well-understood rhizosphere and geochemical processes to interpret the effects realized at a population scale. We did not find consistent or sustained contributions of iron or litter to stability of wild rice populations. Instead, interactions between sulfate, litter, and iron in this study point to complex couplings among plant life cycles, nutrient availability, and iron and sulfur cycling that become manifest over several generations through at least one population cycle. We conclude that both geochemical context and plant life cycle patterns play a considerable role in determining the stability of oscillating plant populations.

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

Data Availability Statement

Data are publicly available at the Digital Repository for University of Minnesota at <https://doi.org/10.13020/cq0g-r486> and are cited within the data analysis section of the methods.

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WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 16

Tedrow O, and Lee P (2022) Use of Wild Rice (*Zizania palustris L.*) in paddy-scale bioassays for assessing potential use of mining-influenced water for irrigation. *Mine Water and the Environment* 41:938-953.



Use of Wild Rice (*Zizania palustris* L.) in Paddy-Scale Bioassays for Assessing Potential Use of Mining-Influenced Water for Irrigation

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Abstract

As surface water resources become more intensely used, and occasionally non-useable, consideration of non-conventional water resources for anthropogenic use has become more prevalent. Potentially critical non-conventional water sources include flooded mine-pit lakes. However, water in these lakes can contain potentially problematic concentrations of contaminants of concern. We evaluated the potential use of elevated sulphate (SO_4) mining-influenced waters with low to non-detect metals concentrations for irrigation of wild rice (*Zizania palustris* L.; WR), a culturally and economically important species. Two flow-through in-situ paddies were developed adjacent to two mine-pit lakes with differing chemical water characteristics; specifically, Pit A contained $\approx 350 \text{ mg SO}_4 \text{ L}^{-1}$ and Pit C contained $\approx 1350 \text{ mg SO}_4 \text{ L}^{-1}$. Throughout the course of multiple consecutive growing seasons, no adverse WR responses to these mining-influenced water exposures were observed. Based on data and observations from this study, potential use of mining-influenced waters containing elevated SO_4 as the primary contaminant for appropriate irrigation purposes is supported. However, site-specific conditions and potential environmental risks must be considered prior to use of mining-influenced waters for anthropogenic applications.

Keywords Water resources · Sulfate · Sulfide mining

Introduction

Mining activities throughout the world influence water quality even as water shortages become increasingly more common in many locations (Miller 2006; Northey et al. 2013; Liu et al. 2021). As such, strategies are being developed to identify beneficial mining-influenced water use and reuse opportunities (Apostu et al. 2020; Doupe’ and Lymbery 2005; Gunson et al. 2012; Jones 2012; McCullough et al. 2020; Schultze 2012; Schultze et al. 2022) including aquaculture (Axler et al. 1992, 1996; McNaughton and Lee 2004), recreational and industrial uses (McCullough and Lund 2006), irrigation of some crops (Annandale et al. 2002, 2009, 2017, 2018, 2019, 2021), and sources of potable water

(APUC 2021; VPUC 2020). However, mining-influenced water can be associated with concentrations of potentially toxic elements which may be of concern in areas of use (Doupe’ and Lymbery 2005; Gerdol et al. 2018; Herbert et al. 2015; Karanthis and Johnson 2003; Khan et al. 2005; Kumar et al. 2009; McCullough and Lund 2006; Miller et al. 1996; Nordstrom 2011).

Concentrations of potentially toxic elements such as Al, Cu, and Zn found in other locations (Nordstrom 2011) are not observed in most mining-influenced waters in Minnesota (MN, USA). Instead, sulphate (SO_4) from mining activities entering wild rice (WR) waters is the primary concern in MN. Use of WR in aquatic bioassays has increased in recent years in an effort to better understand how exposures of SO_4 ($> 10 \text{ mg L}^{-1}$; current MN WR water quality criterion) may influence phenology, distribution, and productivity. Laboratory, and small-scale field, investigations have focused on measuring responses of WR to well-defined exposures of SO_4 and hydrogen sulphide (H_2S) associated with mining-influenced waters (Fort et al. 2014, 2017; Pastor et al. 2017; LaFond-Hudson et al. 2018, 2020). Development and use of these paddy-scale bioassays was critical to better understanding larger-scale and longer-term in-situ responses of

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WR to exposures of elevated SO_4 (≈ 350 and 1350 mg L^{-1}) in mining-influenced waters under a more realistic scenario. Critically, these paddies represent, on a smaller-scale, commercial paddy WR production.

WR Water Review

Various surveys have examined water quality in lake-grown WR. In a survey of WR lakes in MN and Ontario, Lee (1979) observed that most lakes supporting WR had an average alkalinity of $\approx 40 \text{ mg L}^{-1}$, and average pH values of ≈ 6.9 . Pip (1984) examined the distribution of 59 species of aquatic macrophytes in Manitoba, including WR, concluding that SO_4 concentrations were of minor importance for WR distribution. Pillsbury and McGuire (2009) attributed losses of WR in MN and Wisconsin to increased ammonia, pH, water depth, and residential and agricultural developments in study areas. Jorgenson et al. (2013a) showed that WR could grow in waters with seasonal total P concentrations reaching $1500 \mu\text{g L}^{-1}$. Although WR distribution may be at least correlated to water chemistry, WR also influences chemical characteristics of water in which it lives. Lee and McNaughton (2004) showed that water surrounding WR stands contained lower SO_4 , and higher conductivity, Ca, and Fe concentrations than adjacent open-water areas.

One concern with use of some mining-influenced waters for WR irrigation is exposure to potentially toxic elements. Bioassays conducted by Lee and Hughes (1998) determined concentrations ($\geq 1.0 \text{ mg L}^{-1}$) of Al, Cd, Cu, Hg, and Pb in water that were detrimental to early WR development. An additional concern with using mining-influenced water for WR irrigation is a possible effect from SO_4 (Moyle 1944, 1945, 1956). Moyle documented WR was primarily found in waters with a SO_4 concentration of less than 10 mg L^{-1} . However, WR was also observed growing in waters ranging from $2\text{--}>200 \text{ mg SO}_4 \text{ L}^{-1}$ (Lee and Hughes 2000; Lee and Stewart 1981; Moyle 1945; Paulishyn and Stewart 1970; Rogalski et al. 1971). In a comprehensive field study completed by the MN Pollution Control Agency (MPCA) during 2011–2013, WR was observed growing in surface waters ranging from $<0.5\text{--}838 \text{ mg SO}_4 \text{ L}^{-1}$. More recent microcosm studies concluded aqueous SO_4 may not be a primary chemical characteristic adversely influencing WR phenology; rather, pore water (PW) H_2S may be more adversely influential on WR plant development (Myrbo et al. 2017; Pastor et al. 2017; LaFond-Hudson et al. 2018, 2020). Fort et al. (2017) concluded that iron (II) complexation with sulphide may decrease adverse WR responses to these sulphide exposures. In a bucket-style mesocosm study in MN, LaFond-Hudson et al. (2018, 2020) inferred FeS coatings on WR roots may have resulted in decreased plant height, dry weight biomass (DWB), decreased overall developmental rate, and seed characteristics including per-plant

productivity. It was hypothesized that more realistic assessments of the importance of SO_4 and H_2S exposures to WR could be achieved using paddy-scale bioassays and longer-term in-situ exposures of elevated SO_4 (≈ 350 and $1,350 \text{ mg L}^{-1}$) in mining-influenced waters. Detailed descriptions of WR paddy cultivation include Oelke (2006), Oelke et al. (1982, 1997), and Marcum and Porter (2006), with foci on nutrient amount and timing requirements (Grava 1977; Grava and Raisanen 1978; Grava and Rose 1975; Oelke et al. 1982, 1997; Sims et al. 2012a, b). Nitrogen deficiency has been suggested as a particular problem for growing WR in mining-influenced sediments (Tedrow 2020; Tedrow and Lee 2021).

Materials and Methods

Paddy Design, and Inflow/Outflow and Substrate Sampling

In an effort to quantify influences of elevated SO_4 from mining-influenced waters on WR growth and development, flow-through WR paddies were constructed adjacent to two mine pit lakes $\approx 2.5 \text{ km}$ apart (Paddy A adjacent to Pit A; Paddy C adjacent to Pit C). Water contained within the two pits is sufficiently different to encompass a range of aqueous SO_4 [$\approx 350 \text{ mg L}^{-1}$ (Pit A) to $1,350 \text{ mg L}^{-1}$ (Pit C)] theorized to adversely influence WR distribution, phenology, and productivity. Water depth (Thomas and Stewart 1969) and competing vegetation were mitigated as adverse influence variables (Vicario and Halstead 1968; Stevenson and Lee 1987; Elakovich and Wooten 1989; Quayyum et al. 1999; Tucker et al. 2011).

Wild rice (WR; *Zizania palustris* L.) was chosen as the aquatic test species for this work due to its cultural and economic importance to the NE region of MN; and for its overall phenology. WR is an aquatic annual, and therefore must produce viable seeds each year to have re-growth the following year. Initiating/planting paddies of WR is also made simpler by this fact—broadcasting grain is less resource intensive than individual cutting, rhizome, or root-ball planting. Additionally, potential vegetation management (removal of competing vegetation; adding viable seed; substrate nutrient management) was simplified through use of this annual aquatic grain.

Paddy A (initiated May 2017; $\approx 55 \text{ m}^2$ surface area) and Paddy C (initiated May 2018; $\approx 150 \text{ m}^2$ surface area) were constructed using onsite materials as impermeable perimeter berms, with an impermeable liner as the base. Average substrate and water depths at initial seed distribution were ≈ 25 and 25 cm in Paddy A, and 46 and 33 cm in Paddy C. Source seeds were harvested from lakes in northern MN, and were broadcast at a rate of $\approx 56 \text{ kg ha}^{-1}$ (wet weight) in

each paddy—approximately one Kg in Paddy A, and 2.5 kg in Paddy C. In an effort to ensure viable WR seed would be present in Paddy A substrate during winter months, additional seed was broadcast (0.45 kg; one lb.) throughout Paddy A during October 2017. As a result of observed spring 2018 WR germination in Paddy A, no additional WR seed was broadcast in either paddy—Paddy C only received WR seed in May 2018 for initial seeding. Paddies were visited approximately weekly during their respective growing seasons; Fig. 1 details typical Paddy A temporal observations during 2017–2019 growing seasons; Fig. 2 details typical Paddy C temporal observations during 2018–2019 growing seasons.

Unlike commercial WR paddies, neither of these paddies were drained at the end of, or between, growing seasons. Inflow water from their respective pits was maintained until freeze-up, and was re-initiated in late-March/early-April each year; no nutrients (fertilizer) were amended to substrate in either paddy. The planted area of each paddy was

delineated into one-square-meter quadrats for randomized substrate, plant, and seed sampling purposes. Water was directly sampled from the inflow and outflow of each paddy once per growing season during harvest. Water samples were delivered to Pace Analytical Laboratories (Pace) in Virginia, MN. Substrate samples from the top 10 cm of each paddy were obtained from randomly selected quadrats using a 4.8 cm internal diameter sediment core sleeve. All substrate samples were frozen and delivered to the Lakehead University Environmental Laboratory (LUEL; Lakehead University, Thunder Bay, ON, Canada).

Pore Water Sampling

Pore water (PW) characteristic samples were obtained approximately every 30 days from inflow, middle, and outflow areas within each paddy throughout each growing season. Two PW sampling methods were used during this study: diffusion-based peepers and Rhizons. At least 50 mL

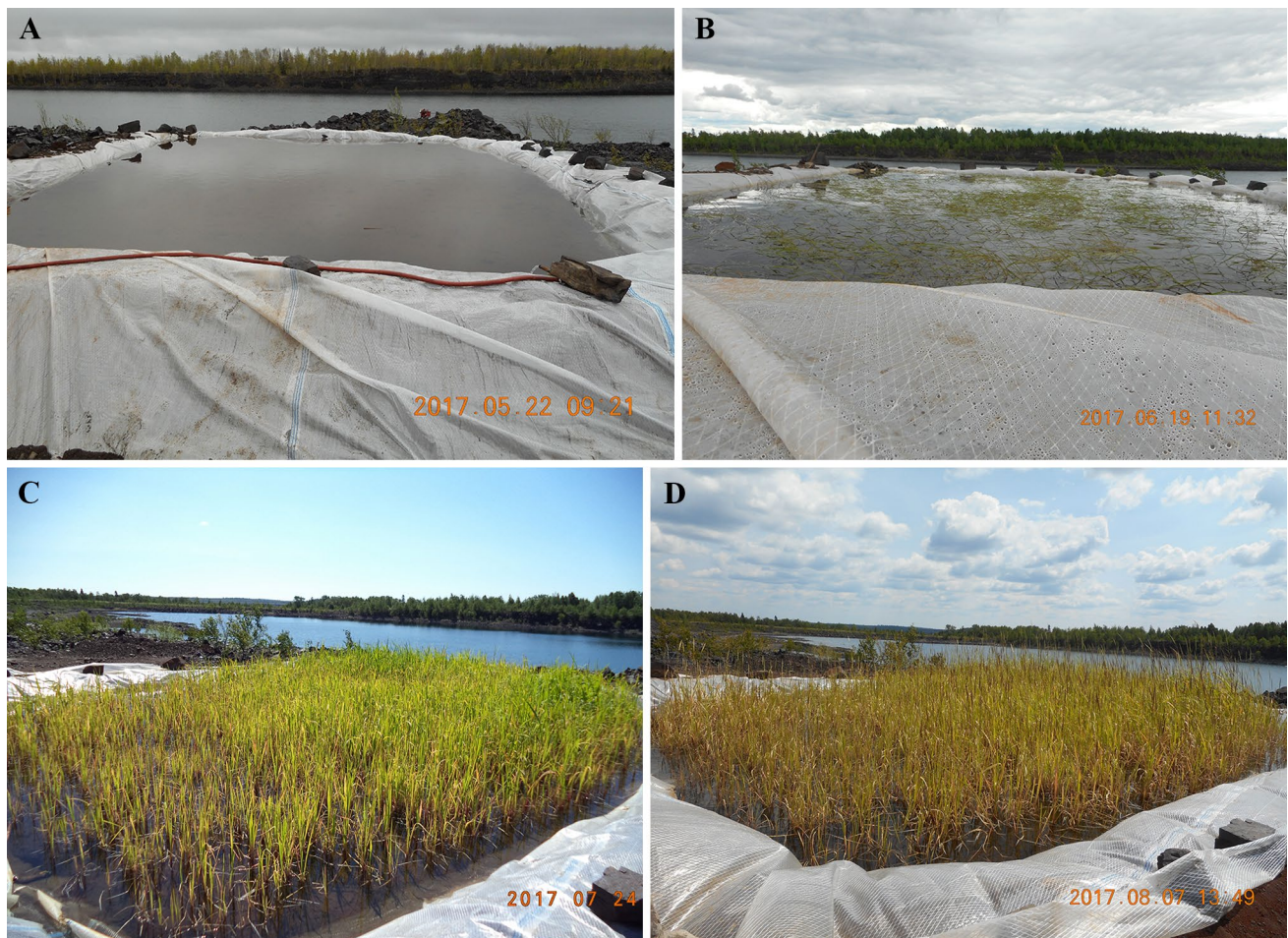


Fig. 1 Paddy A. Images represent typical temporal WR phenological observations during 2017–2019 growing seasons: **A** seed distribution date and approximate yearly germination (2017-05-22); **B** floating

leaf (2017-06-19); **C** aerial, flowering, seed production (2017-07-24); and **D** filled seeds throughout (2017-08-07). Yearly harvest occurred in August

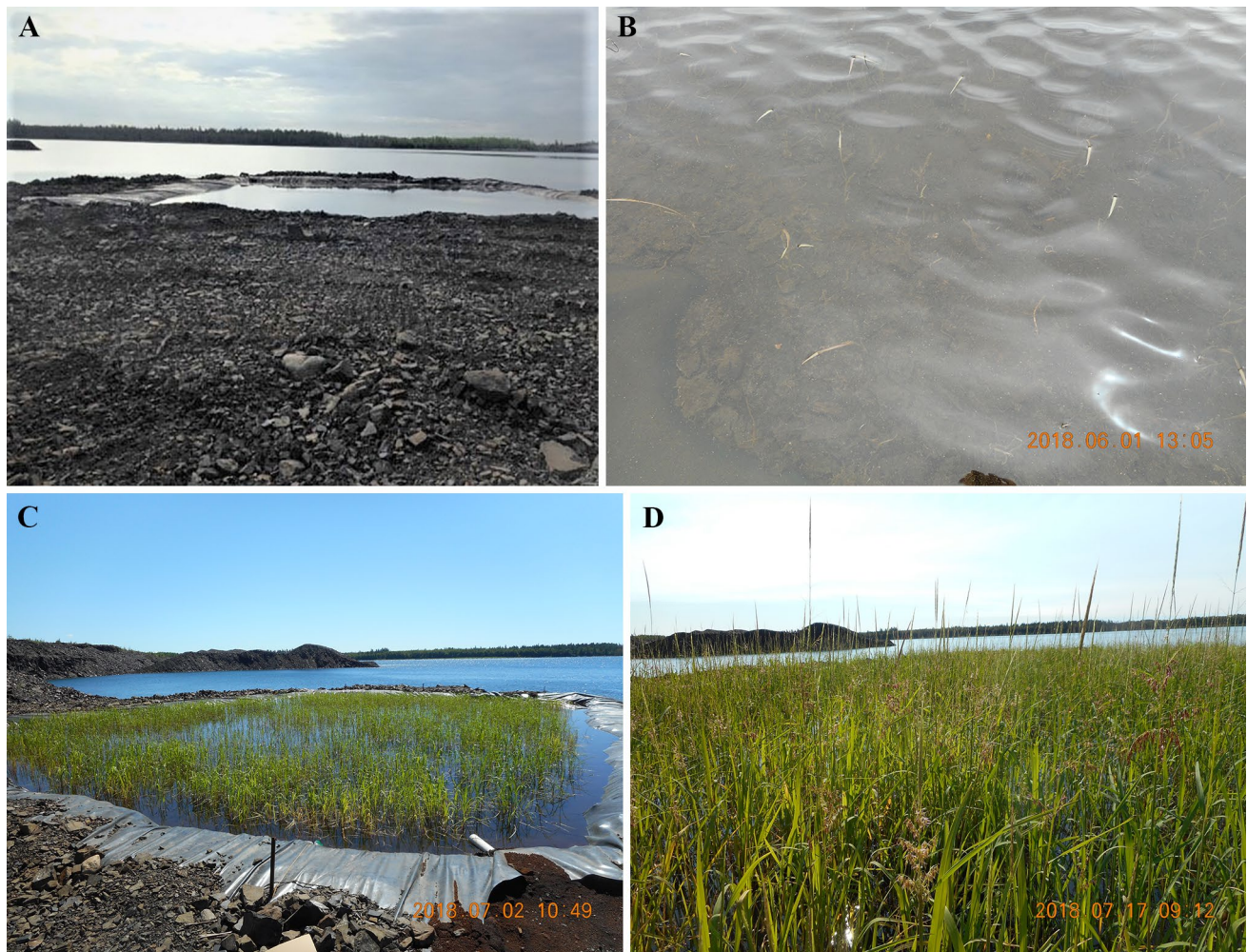


Fig. 2 Paddy C. Images represent typical WR phenological observations during 2018 and 2019 growing seasons: **A** seed distribution date and approximate yearly germination (2018-05-22); **B** floating leaf

(2018-06-01); **C** aerial (2018-07-02); and **D** flowering and seed production (2018-07-17). Yearly harvest occurred in August

were required for H_2S concentration determination. All PW samples were delivered to Pace. Field measurements of pH, dissolved oxygen, temperature, and specific conductance were obtained immediately prior to PW sampling from at least the inflow and outflow of each paddy using a calibrated YSI® ProPlus® or a Hach® MS5 HydroLab®.

Diffusion-based peepers were 50 mL centrifuge tubes with a 0.45 μm pore-size filter sealed to the cap, filled (no headspace) with deoxygenated double-distilled water (Hesslein 1976; Teasdale et al. 1995; Azcue et al. 1996; LaForce et al. 2000; Jacobs 2002; Jorgenson 2013; Peijnenburg et al. 2014). These peepers were prepared and maintained under nitrogen headspace for ≈ 14 d prior to deployment; and transported to field sites in sealed nitrogen-purged and -filled bags. Rhizons are filter assemblies (0.12–0.18 μm pore-size) used for PW aspiration into the sample container protected from atmospheric exposure.

All peepers and Rhizon assemblies were deployed at a 10 cm substrate depth. A mixture of sodium hydroxide and zinc acetate (C&G Containers) was used as the preservative for PW H_2S samples.

Initially, Rhizons were attached to peepers with an aspiration tube connected and anchored on the paddy berm. Pore water was aspirated into the sample container, immediately prior to peeper retrieval. This avoided substrate disturbance prior to PW aspiration. New Rhizon assemblies were used for each peeper re-deployment. However, due to Rhizon filter pore size limitations, clogging was an observed problem, periodically resulting in lower than required sample volume. Due to filter clogging and subsequent periodic insufficient sample volumes, use of Rhizons was discontinued following 2018. Diffusion-based peepers were used to capture PW characteristics throughout the 2019 growing season.

Plant and Seed Sampling

Groups of plants were sampled from randomly selected quadrats in Paddy A during 2018 and 2019, and the stem count was completed in a 0.1 m² area inside each selected quadrat. Stem density in Paddy C was $\approx 1/10$ of Paddy A; therefore, all individual stems were counted, and random plants were sampled, from randomly selected quadrats during 2018 and 2019. Following observation of filled seeds, plant and seed samples were harvested from randomly selected quadrats in both paddies typically on the same date. However, due to repeated extensive goose herbivory in Paddy C during 2019, plants were sampled on Aug. 01, and seeds were sampled on Aug. 23, 2019.

On July 10, 2018, during the early flowering stage, whole WR plants (including roots) were harvested from randomly selected quadrats within each paddy. Roots were rinsed in paddy surface water to remove substrate and other materials. Plants were stored refrigerated in Ziploc[®] bags, transported to LUEL, and prepared for scanning electron microscope (SEM) and energy dispersive x-ray (EDX) characterization. SEMs were obtained from root surface areas visually suspect of (1) typical root tissue; and (2) iron-containing coatings [Fe (III) O-(OH) and FeS]. Points for EDX characterization were chosen based on visual appearance and SEM imagery of the WR root surface. SEM–EDX characterization was completed at Lakehead University Instrumentation Laboratory (LUIL; Lakehead Univ, Thunder Bay, ON, Canada) as described in Jorgenson et al. (2013).

Laboratory Analytical Methods

Quality assurance/quality controls (QA/QC) for water samples characterized by Pace included reference standards, matrix spikes, and conformed to The National Environmental Laboratory Accreditation Conference (NELAC) Standards and the Pace Quality Assurance Manual. QA/QC field-sampling practices included collection of field blank and duplicate inflow and outflow water samples. Analytical methods for water and PW conformed to NELAC Standards and followed those described in Pace (2020a, b). Specifically, Al, B, Ca, Fe, Mg, Mn, and Na in water and Fe in PW were measured using ICP-OES (EPA 200.7); and Cu was measured using ICP-MS (EPA 200.8) following acidification to pH < 2.0 using trace metal grade HNO₃. Chloride (Cl) and SO₄ were separated from non-chemically-preserved samples through a series of ion-selective columns and measured using IC (method 300.0). Samples for sulfide (as H₂S) were preserved using a sodium hydroxide and zinc acetate mixture (C&G Containers) and were measured according to Standard Method 4500-S2-G.

All substrate, plant, and seed sample analyses were completed at LUEL, a Canadian Association of Laboratory

Accreditation (CALA) ISO 17025 accredited laboratory. Preparation and analytical procedures for substrate, plant, and seed samples reference Forest Canada, ASTM, American Soil and Plant Council, and/or USEPA methods; the LUEL Quality Assurance Manual; and followed those described in Lee and McNaughton (2004). All analyses followed standard operating procedures and included blank, quality control, and replicate samples. Substrate samples were collected using new 4.5 cm internal-diameter cellulose acetate butyrate sediment core sleeves. As a result of observed variability between substrate samples, laboratory (LUEL) replicate samples were used in place of field duplicate samples. Total nitrogen (when possible) was measured on dry substrate using a combustion ELVario cube carbon-hydrogen–nitrogen–sulphur analyzer. Loss on ignition (LOI) was measured by drying 20 mL of substrate at 80 °C, weighing, ashing at 600 °C, and re-weighing. Substrate pH was measured as a 1:1 substrate:deionized water mixture using a Mettler Toledo meter with an InLinePro pH sensor. Bulk density was measured by weighing 20 mL of wet substrate, drying at 80 °C, and re-weighing. Phosphate was determined using the BRAY P2 method—Al and Fe phosphates are dissolved in ammonium fluoride and measured colorimetrically using a SKALAR analyzer. Al, Cu, Fe, Mn, S, and Zn were extracted in 0.1 N trace metal grade HCl, while Ca, K, Mg, and Na were extracted in ammonium-acetate at pH 7.0; all of which were measured using ICP. Substrate samples were processed as wet samples to better represent field conditions. Measured analyte concentrations were corrected for bulk density. Plant, or seed, biomass (≥ 0.5 g) was digested using a CEM Mars Express microwave in Express Teflon closed vessels in one mL of HNO₃ and three mL of trace metal grade HCl and diluted using 25 mL of deionized water. Total P, Al, Ca, Cu, Fe, Mg, Mn, Na, S, and Zn in this dilution were measured using a Varian ICP-AES. Total N was measured using a SKALAR analyzer following microwave digestion and concentration in trace metal grade H₂SO₄ catalyzed with a metal sulphate.

Statistical Analyses

All surface water, substrate, WR plant and seed, and PW data were organized using Microsoft[®] Excel[®] or SigmaPlot-SigmaStat[®] v14.0 (Systat Software, Inc.) for table and graphical representation. Statistical analyses and treatment of WR plant data were completed using SigmaPlot-SigmaStat[®] v14.0. t-Tests or one-way analysis of variance (ANOVA) were used to compare two or more groups; specifically, WR stem density, stem height, shoot DWB, seed production, and seed DWB. Holm-Sidak multiple comparison was used to discern significant differences between three or more groups if data met assumptions of normal distribution and equal variance. Data were natural logarithmic transformed if

normal distribution and/or equal variance assumptions were not met. If data transformation failed to correct non-normal distribution and/or variance inequality, raw data were used for statistical treatment, followed by ANOVA on ranks between three or more groups and Dunn's multiple comparison to discern significant differences between groups. A Mann–Whitney Rank Sum test was used to discern significant differences between groups used for t-test comparisons when data were not corrected for non-normal distribution or variance inequality through natural logarithmic transformation. Non-transformed data were used for table and figure display purposes.

Results

Water, Substrate, and Pore Water Characteristics

Characteristics of Paddy A and C inflow and outflow waters remained similar between 2017–2019 growing seasons (Table 1; Supplemental Table S-1). In particular, aqueous SO_4 , calcium, and magnesium remained similar between and during growing seasons, and between inflow and outflow of each respective paddy. Concentrations of Al, Cd, Cu, Hg, and Pb in Pit A water have been at or below detection limit ($< 1\text{--}5\text{ }\mu\text{g L}^{-1}$); in the case of Hg less than 1.0 ng L^{-1} . Pit C water Hg concentrations have been $< 2.0\text{ ng L}^{-1}$ (Table S-1). These concentrations are approximately three orders of magnitude less than those resulting in toxicity to WR (Lee and Hughes 1998; Supplemental Figs S-1 and S-2); and not likely to result in adverse WR responses. Measured substrate characteristics from Paddies A and C are listed in Table 2. General decreases in plant nutrient elements were

observed in each paddy; in particular, ammonium decreased six- and twelve- fold in Paddy A and C substrate, respectively, since initiation. Variability was observed between diffusion-based peepers and Rhizon H_2S concentrations in both paddies. Average Paddy A and C peeper PW characteristics are listed in Table 3 (Paddy A and C peeper and Rhizon data available in Supplemental Tables S-2–4 and 5–6, respectively). Average Paddy A H_2S concentrations ranged from $< 0.078\text{--}1.58\text{ mg L}^{-1}$ in peeper samples. Average Paddy C PW H_2S concentrations ranged from 0.337 to 2.528 mg L^{-1} in peeper samples. Notably, H_2S exceeded the suggested 0.165 mg L^{-1} protective level (MPCA March 2015) for WR in nearly all PW samples by several fold.

Wild Rice Phenology and Productivity

Wild rice phenological development was similar between 2017–2019 growing seasons for Paddy A (Fig. 1) and 2018–2019 growing seasons for Paddy C (Fig. 2). Dates on which specific WR phenological stages were observed in Paddies A and C are listed in Tables 4, 5, respectively. Plant and seed harvest dates for each paddy were typically the same date during each growing season, and within the same two weeks of August between growing seasons indicating no identifiable adverse influences on WR temporal phenological development within or between growing seasons from Pit A or C water-associated exposures under these conditions.

One-way ANOVAs were used to discern differences between stem density, stem height, shoot DWB, seeds per panicle, and seed DWB in Paddy A (Fig. 3). Wild rice stem density throughout the paddy differed significantly between growing seasons ($F_{(2,40)} = 365.362\text{ }p < 0.001$). Specifically, stem density increased by $\approx 10\times$ between 2017 and 2018,

Table 1 Paddy A and C inflow and outflow characteristics

	Paddy A						Paddy C			
	Inflow			Outflow			Inflow		Outflow	
	2017 (n=9)	2018 (n=5)	2019 (n=6)	2017 (n=9)	2018 (n=5)	2019 (n=6)	2018 (n=5)	2019 (n=6)	2018 (n=5)	2019 (n=6)
pH (SU)	8.3±0.2	8.4±0.1	8.2±0.2	8.5±0.2	8.0±0.2	8.0±0.1	8.4±0.1	8.4±0.1	8.4±0.1	8.3±0.1
Cond. ($\mu\text{S cm}^{-1}$)	1235±149	1202±24	1157±26	1252±154	1195±28	1133±77	2593±100	2585±128	2543±146	2576±139
Alk. (mg L^{-1})	329	288	354	328	310	364	461	554	487	556
Ca	50	47	43	49	46	40	29	31	32	32
Mg	134	126	119	131	130	121	383	369	405	380
Na	32	28	25	32	30	25	53	49	54	50
SO_4	403	368	359	405	370	360	1,310	1,270	1,340	1,290
Cu ($\mu\text{g L}^{-1}$)	NM	1.8	BD	NM	1.3	BD	2.1	BD	2.3	1.1
Mn	NM	25	32	NM	42	14	20	25	79	68

pH and conductance measured monthly (avg ± one SD). Alk. through Mn measured at season harvest. Units for Alk. through SO_4 are mg L^{-1} ; Cu and Mn are $\mu\text{g L}^{-1}$ ($n = 1$ for each inflow-outflow sampling event per location)

NM not measured, BD below detection limit

Table 2 Substrate characteristics during WR harvest events (avg $\pm$ one SD). Units for NH_3 through Na are $\mu\text{g g}^{-1}$

	Source (n = 1)	Paddy A			Paddy C	
		2017 (n = 3)	2018 (n = 3)	2019 (n = 11)	2018 (n = 3)	2019 (n = 8)
Total N (%)	NM	0.2 $\pm$ 0.1	0.2 $\pm$ NC	0.4 $\pm$ 0.2	0.1 $\pm$ NC	0.8 $\pm$ 0.3
LOI	12.3	8.2 $\pm$ 3.8	NM	16.5 $\pm$ 6.2	5.0 $\pm$ 1.1	27 $\pm$ 10
pH (SU)	6.6	5.8 $\pm$ 0.1	7.6 $\pm$ 0.1	7.0 $\pm$ 0.2	7.4 $\pm$ 0.1	6.9 $\pm$ 0.1
Bulk Density (g cm^{-3})	0.4	0.3 $\pm$ 0.1	0.5 $\pm$ 0.1	0.6 $\pm$ 0.1	0.2 $\pm$ NC	0.3 $\pm$ 0.1
$\text{NH}_3 + \text{NH}_4\text{-N}$ ($\mu\text{g g}^{-1}$)	24.8	14.7 $\pm$ 5.4	18.1 $\pm$ 4.9	3.4 $\pm$ 1.2	6.2 $\pm$ 1.2	1.5 $\pm$ 0.5
PO_4	5.1	2.0 $\pm$ 0.5	6.8 $\pm$ 2.6	1.5 $\pm$ 0.7	0.7 $\pm$ 0.1	0.6 $\pm$ 0.3
Al	357	149 $\pm$ 31	382 $\pm$ 26	112 $\pm$ 43	86 $\pm$ 5	39 $\pm$ 17
Cu	2.1	1.0 $\pm$ 0.2	3.1 $\pm$ 0.3	0.4 $\pm$ 0.4	0.7 $\pm$ 0.1	0.1 $\pm$ 0.1
Fe	1,819	296 $\pm$ 45	1013 $\pm$ 106	2,181 $\pm$ 856	222 $\pm$ 5	803 $\pm$ 217
Mn	267	47 $\pm$ 22	75 $\pm$ 17	40 $\pm$ 31	27 $\pm$ 1	12 $\pm$ 7
S	214	115 $\pm$ 28	178 $\pm$ 9	240 $\pm$ 216	175 $\pm$ 26	97 $\pm$ 62
Zn	7.0	2.1 $\pm$ 0.3	5.3 $\pm$ 0.7	1.8 $\pm$ 0.9	1.0 $\pm$ 0.1	0.4 $\pm$ 0.2
Ca	3,235	1,031 $\pm$ 421	1468 $\pm$ 277	766 $\pm$ 225	271 $\pm$ 48	172 $\pm$ 72
K	86	37 $\pm$ 6	59 $\pm$ 23	21 $\pm$ 7	11 $\pm$ 3	6 $\pm$ 3
Mg	1,246	573 $\pm$ 202	716 $\pm$ 136	294 $\pm$ 80	359 $\pm$ 61	156 $\pm$ 52
Na	23	42 $\pm$ 18	59 $\pm$ 12	24 $\pm$ 6	29 $\pm$ 3	11 $\pm$ 4

NM not measured, NC not calculable

Table 3 Paddy A and C peeper H_2S data (mg L^{-1} ; avg $\pm$ one SD; n = 3 for each sampling event at each location)

Paddy A		Paddy C	
Jul. 31, 2017	BD	NM	NM
Aug. 31	0.421 $\pm$ 0.122	NM	NM
Sept. 29	0.715 $\pm$ 0.245	NM	NM
Oct. 27	0.427 $\pm$ 0.193	NM	NM
Jun. 01, 2018	0.287 $\pm$ 0.051	NM	NM
Jul. 02	0.929 $\pm$ 0.682	Jul. 02, 2018	0.485 $\pm$ 0.190
Aug. 02	0.484 $\pm$ 0.332	Aug. 02	0.337 $\pm$ 0.049
Aug. 30	0.773 $\pm$ 0.202	Aug. 30	0.402 $\pm$ 0.069
Oct. 01	1.05 $\pm$ 0.086	Oct. 01	0.422 $\pm$ 0.079
Jun. 04, 2019	1.14 $\pm$ 1.094	Jun. 04, 2019	0.903 $\pm$ 0.585
Jul. 02	0.469 $\pm$ 0.182	Jul. 02	0.562 $\pm$ 0.132
Aug. 01	1.50 $\pm$ 1.091	Aug. 01	2.528 $\pm$ 2.477
Sept. 03	1.58 $\pm$ 0.748	Sept. 03	0.565 $\pm$ 0.098
Oct. 03	0.896 $\pm$ 0.462	Oct. 03	0.930 $\pm$ 0.120

BD below detection limit (0.078 mg L^{-1}), NM not measured

and remained at this density through 2019. Paired comparison tests indicated that, the average 2019 stem density was statistically higher than in 2017 ($p < 0.001$), but was not significantly different from 2018 ($p = 0.106$). Average 2018 stem heights were significantly higher ($F_{(2,68)} = 8.560$ $p < 0.001$) than both 2017 ($p = 0.016$) and 2019 ($p = < 0.001$), with a concurrent statistical decrease in 2019 shoot DWB ($t_{(21)} = 4.568$ $p < 0.001$). No statistical difference ($F_{(2,26)} = 5.615$ $p = 0.010$) was identified

between average seeds per panicle between 2017 and 2018 ($p = 1.000$), despite the $\approx 10\times$ increase in stem density. However, paired comparison tests indicated that the average number of seeds per panicle during 2019 was significantly higher than in 2017 ($p = 0.046$) and 2018 ($p = 0.030$). t-Tests indicated no statistical difference between seed DWB between 2017 and 2019 growing seasons ($t_{(13)} = 1.467$ $p = 0.166$).

T-tests were used to discern differences between WR stem density, stem height, shoot DWB, seeds per panicle, and seed DWB in Paddy C (Fig. 4). On July 09, 2019, goose herbivory was observed throughout the paddy. Also documented on this date were initial observations of flowering; male flowers were present on several plants throughout this paddy. Despite extensive and repeated goose herbivory, t-test indicated no statistical difference between average 2018 and 2019 stem density ($t_{(22)} = -0.877$ $p = 0.390$). However, the 2019 average stem height was significantly less than in 2018 ($t_{(34)} = 11.995$ $p < 0.001$). Additionally, the average WR shoot DWB ($t_{(19)} = 16.971$ $p < 0.001$) and seeds per panicle ($t_{(16)} = 8.060$ $p < 0.001$) were significantly less than in 2018. Due to a freezer failure in 2018, all harvested seeds were lost. Therefore, average 2019 Paddy C seed DWB was contrasted to average 2017 and 2019 Paddy A seed DWB. ANOVA indicated that the average 2019 Paddy C seed DWB was significantly less than the average 2017 Paddy A seed DWB ($F_{(2,20)} = 8.679$ $p = 0.002$). Significantly decreased stem height, seed production, shoot DWB, and seed DWB during 2019 is likely resultant from extensive and repeated goose herbivory.

Table 4 Paddy A wild rice phenology as observed during 2017–2019 growing seasons. Phenological development stages as used by Oelke et al. (1982)

Stages of Wild Rice			Date of Stage Observation (Approximate Growing Days)		
Development		*Oelke et al. (1982)	2017	2018	2019
Veg. Growth Phase ↑	Germination	0	Jun. 01 (0)	May 17 (0)	May 07 (0)
	Emergence	12	Jun. 05 (4)	May 22 (5)	May 22 (15)
	Floating Leaf	29	Jun. 12 (11)	May 29 (12)	May 30 (23)
	Aerial Leaf	39	Jun. 19 (18)	Jun. 01 (15)	Jun. 04 (28)
	Early Tillering	49	Jul. 03 (32)	Jul. 02 (46)	Jul. 02 (56)
Reprod. Growth Phase ↑	Jointing	67	Jul. 11 (40)	Jul. 02 (46)	Jul. 18 (72)
	Boot	75	Jul. 17 (47)	Jul. 10 (54)	Jul. 18 (72)
	Early Flowering	83	Jul. 24 (54)	Jul. 10 (54)	Jul. 18 (72)
	Mid Flowering	91	Jul. 31 (61)	Jul. 17 (61)	Jul. 18 (72)
	Grain Formation	105	Aug. 07 (68)	Aug. 07 (83)	Jul. 26 (80)
	Maturity / Harvest	121	Aug. 31 (92)	Aug. 16 (91)	Aug. 23 (108)

*Days from germination; from Oelke et al. (1982) – WR plant development (K2 variety) Aitkin County, MN, USA

One-way ANOVAs were used to discern differences between Paddy A and Paddy C WR stem density, stem height, shoot DWB (Fig. 5). Average stem density in Paddy A (2017, 2018, 2019) was statistically higher ($F_{4,60}=451$; $p<0.001$) than Paddy C in 2018 ($p<0.001$) and 2019 ($p<0.001$) in all growing seasons. With the exception of Paddy A (2018), average stem height in Paddy C (2018) was statistically higher than other growing seasons ($p<0.001$). Despite higher stem height, average Paddy C (2018) shoot DWB was not significantly different from Paddy A (2018) ($p=0.636$), but was statistically higher than other growing seasons ($p<0.001$).

Plant and Seed Characteristics

Chemical characteristics of WR plant and seed samples from both paddies are listed in Table 6. With the exception of Ca and Zn, which were higher in plants harvested in 2019 than 2018, chemical characteristics of WR between growing seasons in Paddy A were similar; specifically, total plant N averaged 0.74% (± 0.10) for each season. Shoots of plants harvested in 2019 from Paddy C contained higher concentrations of N, P, and S than in 2018, potentially due to nutrient uptake into plant tissues and internodal re-growth following herbivory prior to plant harvest. Regardless of surface water, substrate, PW, or plant tissue characteristics,

seed characteristics were similar between growing seasons. Percent N and S content of seeds harvested from Paddy A during 2017 averaged 1.24 (± 0.12) and 0.12 (± 0.013), respectively. The average percent N content of seeds harvested in 2019 significantly increased to 1.55 (± 0.05) ($t_{13}=-5.411$; $p=0.0002$); the average percent S content remained at 0.12 (± 0.004). During 2019, t-tests indicated that seeds harvested from Paddy C contained significantly higher concentrations of N ($t_{10}=-4.116$ $p=0.002$) and S ($t_{10}=-3.449$ $p=0.006$) when contrasted to seeds harvested from Paddy A. No significant difference was identified between concentrations of P ($t_{10}=-0.175$ $p=0.865$) or K ($t_{10}=0.376$ $p=0.715$) in Paddy C seeds contrasted to Paddy A seeds. Despite goose herbivory in Paddy C, harvested plants appeared generally healthy (no observations of nutrient deficiencies or WR diseases), seeds had been filled, and overall WR did not appear to have been adversely influenced by chemical characteristics of Pit C water or water-associated exposures under these conditions.

SEM–EDX WR Root-Surface Characterization

Surfaces of WR roots harvested during July 2018 were characterized by SEM and EDX as described by Jorgenson et al. (2013). Points chosen for EDX characterization were selected based on visual appearances: white appearance may

Table 5 Paddy C wild rice phenology as observed during 2018 and 2019 growing seasons. Phenological development stages as used by Oelke et al. (1982)

Stages of Wild Rice Development		*Oelke et al. (1982)	Date of stage observation (approximate growing days)	
			2018	2019
Veg. Growth Phase ↑	Germination	0	May 26 (0)	May 07 (0)
	Emergence	12	Jun. 01 (6)	May 07 (0)
	Floating Leaf	29	Floating leaf and initial aerial stages not documented.	May 22 (15)
	Aerial Leaf	39		Jun. 04 (28)
	Early Tillering	49	Jul. 02 (37)	[§] Jul. 02 (56)
Reprod. Growth Phase ↑	Jointing	67	Jul 10 (45)	^{§§} Jul. 09 (63)
	Boot	75	Jul 10 (45)	^{§§} Jul. 09 (63)
	Early Flowering	83	Jul. 13 (48)	^{§§} Jul. 09 (63)
	Mid Flowering	91	Jul 17 (58)	^{§§§} Jul. 26 (80)
	Grain Formation	105	Aug. 02 (76)	Aug. 23 (108)
	Maturity / Harvest	121	Aug. 15 (87)	(Plant, seed harvest)

*Days from germination; from Oelke et al. (1982)—WR plant development (K2 variety) Aitkin County, MN, USA

[§]Goose herbivory first observed

^{§§}Extensive goose herbivory; first flowering observed

^{§§§}Additional, extensive goose herbivory observed; early seed formation observed on some remaining WR

be more indicative of typical root tissue; orange appearance may be more indicative of Fe (III) oxide/hydroxide coating. Neither Paddy A nor Paddy C plants contained identifiable root coatings indicative of FeS (supplemental Figs S-3 and S-4). However, visual appearance of most roots on WR plants was likely indicative of iron (III) oxy / hydroxide coatings. On Paddy A plants, C, O, and Ca were dominant elements in areas suspect of typical root tissue; and C, O, and Fe were dominant elements in areas suspect of Fe (III) oxide/hydroxide coatings. On Paddy C plants, C, O, S, and at times K, were dominant elements in areas suspect of typical root tissue; and C, O, and Fe (at times, multi-peak) were dominant elements in areas suspect of Fe (III) oxide/hydroxide root coatings. Despite aqueous SO₄, PW H₂S, and dissolved PW Fe concentrations all theoretically conducive to FeS complexation, neither visual appearance nor EDX-characterization of root coatings were indicative of FeS. However, during and following WR plant and seed harvest events, black coatings on roots were observed in both paddies. These coatings closely resemble FeS root coatings inferred and described by LaFond-Hudson et al. (2018, 2020) near/at growing season conclusion. Their observations and concluded rationale for FeS root coatings tend to represent phenological life stages of WR—near seed abscission from pedicels, root radial oxygen loss (ROL) ceases allowing for conditions more favorable to FeS complexation to occur. Additional surface characterization of black-appearing WR

roots in the current study was not pursued due to the similarity with those described by LaFond-Hudson et al. (2018, 2020) as likely FeS. Throughout growing seasons, WR plants appeared healthy, were productive, and observations of Fe-containing root coatings appeared more representative of WR phenological stage and root ROL than overlying water, pore water, or substrate characteristics.

Discussion

Primary concerns influencing use of mining-influenced waters for irrigation are sufficiently high concentrations of potentially toxic elements and SO₄ concentrations. Mining-influenced waters used for the current study did not contain sufficiently high concentrations of elements such as As, Cu, Ni, Fe, Pb, Cd, Hg, and/or Zn to be considered potentially problematic (Lee and Hughes 1998). However, aqueous SO₄ concentrations (Table 2) were higher than 1) the MN SO₄ water quality criterion for WR (10 mg L⁻¹), and 2) concentrations suggested to be problematic for WR in general (Myrbo et al. 2017; Pastor et al. 2017; LaFond-Hudson et al. 2018). Since no adverse responses from WR were observed in the current study, the overall focus shifted to plant and seed characteristics and substrate nutrient availabilities. Tedrow and Lee (2021) successfully grew WR to maturity in mining- and non-mining- influenced lake sediments. Time

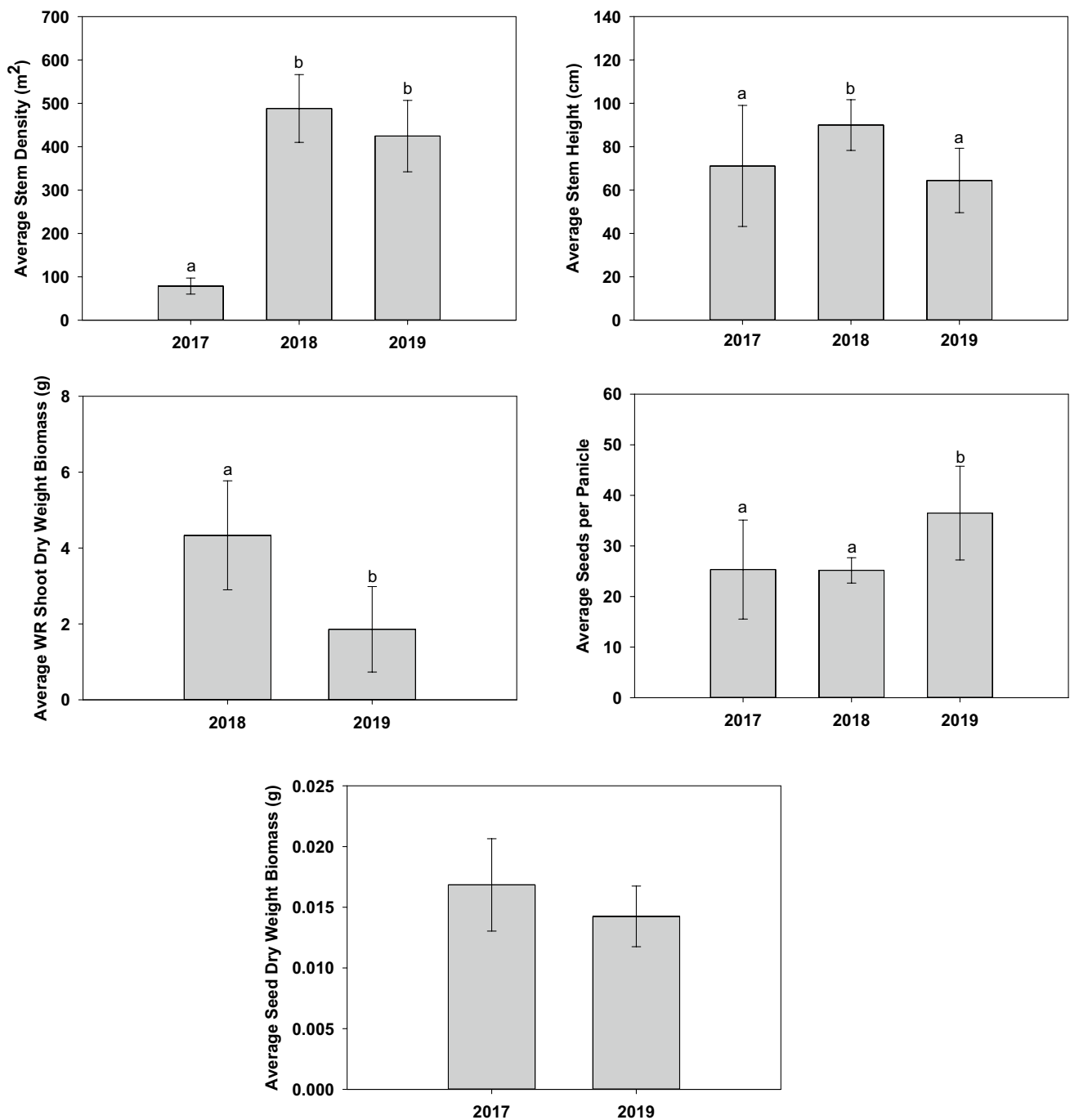


Fig. 3 Paddy A average stem density, stem height, shoot dry weight biomass, filled seeds per panicle, and seed dry weight biomass. No plant samples were obtained during 2017. All seeds harvested dur-

ing 2018 were lost due to a freezer failure. Error bars represent one standard deviation. Differing letters (a and b) indicate statistical significance at alpha 0.05

to maturity was the same for all plants but height and DWB were lower for plants grown in mining sediments. The size difference was attributed to lower concentrations of ammonium in mining-influenced sediments than the reference sediment. Seed chemical characteristics between all exposures were similar and not necessarily reflective of respective

sediment characteristics. Physical plant characteristics such as overall size and productivity were primary differences between these sediment exposures, more likely a result of multi-fold lower concentrations of ammonium in these mining-influenced sediments than the reference sediment.

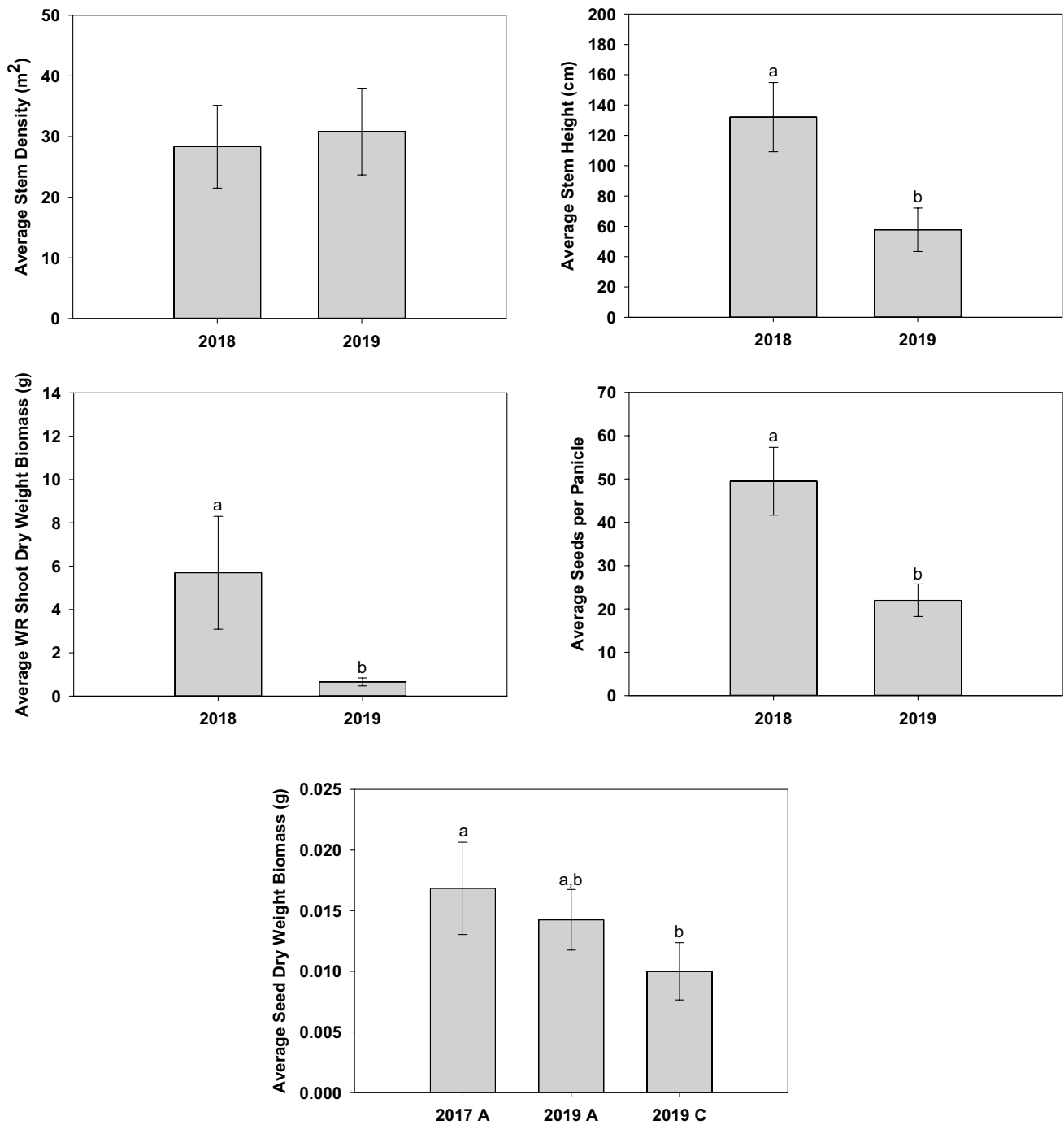


Fig. 4 Paddy C average stem density, stem height, shoot dry weight biomass, filled seeds per panicle, and seed dry weight biomass. All seeds harvested during 2018 were lost due to a freezer failure. Error

bars represent one standard deviation. Differing letters (a and b) indicate statistical significance at alpha 0.05

Wild Rice Responses

In previous microcosm and bucket-style studies, WR tended to grow more slowly, decrease in overall size, be less productive, and generally fail to thrive specifically in exposures of $300 \text{ mg SO}_4 \text{ L}^{-1}$ (Pastor et al. 2017; LaFond-Hudson et al.

2018). In the current study, SO_4 exposure concentrations exceeded these previous studies by $\approx 50 \text{ mg L}^{-1}$ (Pit A water) and $1,050 \text{ mg L}^{-1}$ (Pit C water). Hydrogen sulfide is known to be toxic to aquatic plants in concentrations ranging from $0.4\text{--}11.0 \text{ mg L}^{-1}$ (Armstrong and Armstrong 2005; Lamers et al. 2013). In both paddies, concentrations of pore water

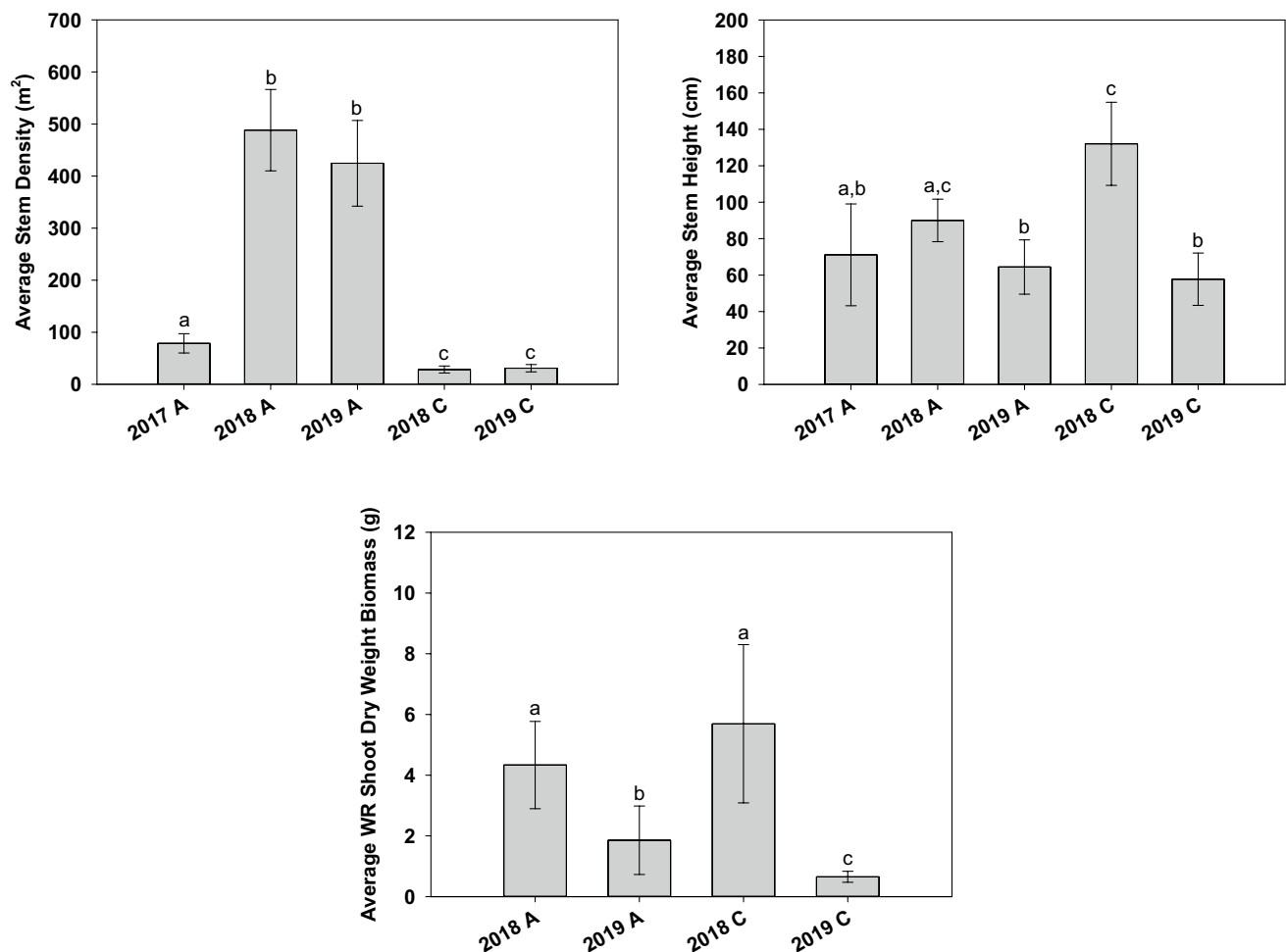


Fig. 5 Comparison between average Paddy A and C stem density, stem height, and shoot dry weight biomass. Error bars represent one standard deviation. Differing letters (a, b, c) indicate statistical significance at alpha 0.05

H₂S routinely exceeded the MPCA-suggested 0.165 mg L⁻¹ (MPCA 2015) protective level by multiple-fold. Despite these exposures, no adverse WR responses were observed (decreased size and/or productivity; delayed development) that could be attributable to SO₄- or H₂S- specific exposures.

In October 2017, an additional 0.45 kg of WR seed was amended to Paddy A to ensure viable WR would be present immediately prior to freeze-up and would have the chance to overwinter in Paddy A. WR stem density increased $\approx 10\times$ between 2017 and 2018/2019 in Paddy A. WR stem density in Paddy C ranged from 18 to 41 stems m⁻² and did not statistically differ between 2018 and 2019; and was 50–90% lower than Paddy A stem density in 2017–2019. Paddy A germination in Spring 2018 verified viable WR seed could overwinter in Pit A water; therefore, no additional WR seed was amended to Paddy C. In the absence of a significant stem density decrease in either paddy between growing seasons, SO₄ does not appear to be detrimental for

WR germination. Increased stem density in Paddy A is more likely a result of viable seed amendment in October 2017.

Wild Rice Development

In addition to concerns about adverse influences from SO₄ on WR distribution, density, and productivity, specific developmental delays have been documented. LaFond-Hudson et al. (2018, 2020) concluded that an observed decrease in developmental rate(s) beginning during vegetative growth phase, and promulgated through reproductive maturity, was in response to exposures of 300 mg SO₄ L⁻¹. Although the observed delay was only a few days, the difference was significant between specific treatment groups. In the current study, although differences existed between dates of phenological stages observation, this difference cannot be attributed to SO₄ exposure alone. Time between paddy inspections and subjective assessments of phenological development stages (Oelke et al. 1982; Sims et al. 2012a,

Table 6 Characteristics of shoot and seed tissue (avg $\pm$ one SD). Units for total N through Fe are %; Al through Zn are $\mu\text{g g}^{-1}$

	*Rat River Bay		Paddy A				Paddy C		
	Shoots	Seeds	Shoots		Seeds		Shoots		Seeds
	2018 (n=3)	2018 (n=24)	2018 (n=12)	2019 (n=11)	2017 (n=9)	2019 (n=6)	2018 (n=12)	2019 (n=9)	2019 (n=6)
Total N (%)	0.83 $\pm$ 0.04	1.19 $\pm$ 0.12	0.68 $\pm$ 0.08	0.75 $\pm$ 0.09	1.24 $\pm$ 0.12	1.55 $\pm$ 0.090	0.74 $\pm$ 0.34	1.89 $\pm$ 0.31	1.86 $\pm$ 0.10
P	0.10 $\pm$ 0.01	0.32 $\pm$ 0.02	0.13 $\pm$ 0.02	0.08 $\pm$ 0.02	NM	0.243 $\pm$ 0.028	0.10 $\pm$ 0.03	0.25 $\pm$ 0.16	0.25 $\pm$ 0.03
K	0.49 $\pm$ 0.07	0.42 $\pm$ 0.08	1.50 $\pm$ 0.23	1.18 $\pm$ 0.39	NM	0.361 $\pm$ 0.024	2.37 $\pm$ 0.49	2.18 $\pm$ 0.42	0.35 $\pm$ 0.05
S	0.09 $\pm$ 0.01	0.11 $\pm$ 0.01	0.30 $\pm$ 0.07	0.46 $\pm$ 0.1	0.12 $\pm$ 0.01	0.118 $\pm$ 0.010	0.31 $\pm$ 0.06	0.90 $\pm$ 0.17	0.14 $\pm$ 0.01
Ca	1.14 $\pm$ 0.05	0.02 $\pm$ 0.01	0.59 $\pm$ 0.32	1.73 $\pm$ 0.81	NM	0.038 $\pm$ 0.006	0.16 $\pm$ 0.03	0.32 $\pm$ 0.22	0.04 $\pm$ 0.01
Mg	0.23 $\pm$ 0.03	0.10 $\pm$ 0.01	0.36 $\pm$ 0.05	0.37 $\pm$ 0.03	NM	0.102 $\pm$ 0.008	0.43 $\pm$ 0.09	0.78 $\pm$ 0.13	0.12 $\pm$ 0.02
Na	0.60 $\pm$ 0.06	0.01 $\pm$ 0.01	0.50 $\pm$ 0.08	0.48 $\pm$ 0.10	NM	0.004 $\pm$ 0.001	0.42 $\pm$ 0.11	0.67 $\pm$ NC	0.01 $\pm$ 0.01
Fe	0.12 $\pm$ 0.02	0.01 $\pm$ 0.01	0.10 $\pm$ 0.04	0.32 $\pm$ 0.20	NM	0.020 $\pm$ 0.003	0.10 $\pm$ 0.02	0.11 $\pm$ 0.08	0.01 $\pm$ 0.01
Al ($\mu\text{g g}^{-1}$)	804 $\pm$ 136	22 $\pm$ 35	80 $\pm$ 37	248 $\pm$ 314	NM	7 $\pm$ 3	235 $\pm$ 57	172 $\pm$ 146	6 $\pm$ 1
Cu	19 $\pm$ 15	5 $\pm$ 2	1.5 $\pm$ 0.3	2.2 $\pm$ 0.7	NM	4.4 $\pm$ 0.8	1.4 $\pm$ 0.4	2.4 $\pm$ 1.1	4.2 $\pm$ 0.9
Mn	1434 $\pm$ 122	25 $\pm$ 7	1199 $\pm$ 406	586 $\pm$ 256	NM	33 $\pm$ 7	333 $\pm$ 81	1664 $\pm$ 869	37 $\pm$ 12
Zn	21 $\pm$ 3	32 $\pm$ 8	9.6 $\pm$ 1.2	22 $\pm$ 11	NM	25 $\pm$ 2	8.3 $\pm$ 2.2	12.1 $\pm$ 5.9	11.5 $\pm$ 2.7

*Non-mining/-SO₄ influenced site; data from Tedrow and Lee (2021)

NM not measured

b) are also potential reasons for observed temporal development differences; and must be ruled-out as causative prior to considering SO₄ as the reason for developmental delay. Phenological development of WR in both paddies followed typical temporal patterns (Tables 4, 5).

Plant and Seed Tissue Chemistry

Nutrient element concentrations of WR plant tissue have been reported by Hildebrandt et al. (2012), with total N (%) in shoot tissue reported as 0.85. In the current study, Paddy A WR shoot N (%) was 0.68 and 0.75 in 2018 and 2019; and Paddy C WR shoot N (%) was 0.74 and 1.89 in 2018 and 2019, respectively. The higher Paddy C WR % plant tissue N in 2019 may be attributed to N uptake and internodal re-growth, a response to repeated goose herbivory throughout the paddy (Weir and Dale 1960). Following observation of goose herbivory, netting was installed around Paddy C to exclude waterfowl. LaFond-Hudson et al. (2020) reported WR seed N (%) content of 1.89 for non-SO₄ exposed WR, and 2.28 for SO₄ exposed (300 mg L⁻¹) WR. In the current study, seeds harvested from Paddy A WR were 1.24 and 1.55% N in 2017 and 2019, respectively. Seeds harvested from Paddy C WR contained 1.86% N in 2019. These values are close to the N content of non-SO₄ amended WR reported by LaFond-Hudson et al. (2020). Additionally, average seed DWB was similar between non-SO₄ amended WR (15.26 mg; LaFond-Hudson et al. 2020) and Paddy A WR (15.00 mg). These data indicate a lack of measurable influence of aqueous SO₄ in determining specific seed characteristics of WR grown in Pit A and C waters.

Nutrient Limitations

As detailed in Day and Lee (1989), Lee (2002), Lee and McNaughton (2004), Oelke (1982, 1997), and Sims (2012a, b), sufficiently high nutrients such as ammonium and P are of critical importance to WR growth, development, and distribution; specifically, during early- and mid- season phenology. In the current study, a general decrease in substrate ammonium has been observed in each paddy between growing seasons. In the absence of other adversely influential factors, we can likely expect WR plants to decrease in density, biomass, productivity, or a combination of these and other characteristics as a result of decreased and decreasing ammonium bioavailability. This effect from N depletion on WR productivity was documented by Keenan and Lee (1988). In their study, after five years of intensive cultivation of WR in a northwestern Ontario lake, % N levels in the sediment had decreased from 1.5 to 0.2 with corresponding declines in WR productivity. Only after the lake remained fallow for two years was commercial WR production again feasible. A similar ammonium trend may be developing in paddies used in the current study. Walker et al. (2006, 2010) documented N sequestration in accumulated WR plant and root litter, concluding that decreases in WR density, distribution, and productivity may be attributed to N limitation as a result of litter sequestration. In the current study, this may be a developing condition based on decreased substrate ammonium and observed WR plant litter in each paddy. Inflow water pH ($\approx$ 8.3) to each paddy is sufficiently high to decrease some elemental nutrient bioavailabilities such as Fe and Cu. However, this may be unlikely due to substrate pH

typically slightly acidic to circumneutral (5.8–7.6). Therefore, the potential for decreased WR density, distribution, and productivity exists resulting from bioavailable N limitation and/or deficiency.

Conclusions

The current study provided critical support for potential use of mining-influenced waters for WR irrigation. Throughout multiple consecutive growing seasons, WR was grown in paddy-scale in-situ exposures of mining-influenced waters of substantially different chemical characteristics. In this current study, WR did not adversely respond to these exposures, and in both paddies developed and produced viable seed. Based on data and observations obtained during this study, overlying water characteristics such as aqueous SO_4 appeared to play a less important role in WR phenology, distribution, and productivity, than previously suggested. In the current study, any differences between multiple measured WR characteristics were associated with substrate nutrient availability. Additionally, no adverse effects from H_2S were observed; and observed increases in S in Paddy A were correlated to increases in Fe. If additional significant adverse WR responses are observed, elements becoming more concentrated in paddy substrate will be investigated as potential sources of those responses.

Development and use of these paddy-scale bioassays allowed more accurate and field-relevant predictions of responses of WR to exposures of mining-influenced waters with elevated SO_4 . Continued research will focus on substrate nutrient-element amendment in these paddies to help verify or refute potential adverse WR influences due to substrate nutrient depletion. These data would help to inform water use decisions less focused on characteristics of overlying water and more focused on substrate nutrient bioavailability. More broadly, the current study provides some refutation of the concern specific to SO_4 adversely influencing WR phenology in general. Research on Fe- H_2S toxicity mitigation and use of WR for phytoremediation of mine influenced water are important and relevant subjects that would be best answered by the paddy approach used in this study. Further study is also required to discern influences on WR from water depth increases, herbivory, and other organisms such as *Apamea apamiformis* (wild rice worm) within these paddies.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10230-022-00908-0>.

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WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 17

U.S. Steel, Application for Sulfate Site-Specific Standard, August 2022 (excerpt).



U. S. Steel Corporation
Minnesota Ore Operations
P.O. Box 417
Mt. Iron, MN 55768

August 17, 2022

Catherine Neuschler
Minnesota Pollution Control Agency (MPCA)
Environmental Analysis & Outcomes Division
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

Re: Application for a Sulfate Site-Specific Standard for Hay Lake (AUID 31-0037-00), Located Downstream of the U. S. Steel – Keetac (Keetac)

Dear Ms. Neuschler:

Please find attached an application for a sulfate site-specific standard for Hay Lake, located downstream of the Keetac facility. This submittal is an update to the *Application for Site-Specific Sulfate Standard(s) for Hay Lake, Hay Creek, Swan Lake (including Swan Lake Southwest Bay), and Swan River (Swan Lake outlet to confluence with Snowball Creek)*, submitted in December 2014 with MPCA acknowledgement of receipt on December 29, 2014. To date, the MPCA has not acted on this application for Keetac. U. S. Steel requests the MPCA approve and implement this revised request for a sulfate site-specific standard of 79 mg/L at Hay Lake, which will replace the existing Class 4A sulfate standard of 10 mg/L. The site-specific standard is being requested in accordance with Minn Rules, part 7050.0220, subpart 7.

The application shows that the proposed sulfate site-specific standard of 79 mg/L is protective of the Class 4A narrative standard found in Minnesota Rules, part 7050.0224, subpart 2, which requires that the "quality of Class 4A waters of the state must be such as to permit their use for irrigation without significant damage or adverse effects upon any crops or vegetation usually grown in the waters or area."

U. S. Steel developed the enclosed application in support of its conclusion that Keetac's discharges will not exceed the proposed site-specific standard and that the proposed site-specific standard will not result in inhibition or injurious effects to wild rice growth. Furthermore, no discharge limits for sulfate are necessary to protect the growth of wild rice in Hay Lake at the proposed site-specific standard in the National Pollutant Discharge Elimination System (NPDES) / State Disposal System (SDS) Permits for Keetac's mining area and tailings basin (No. MN0031879 and No. MN0055948, respectively).

A hard copy of this request will also be sent. If you have any questions or need additional information regarding this request, please feel free to contact me at (218) 749-7364 or clbartovich@uss.com.

Sincerely,

A handwritten signature in blue ink that reads "Chrissy Bartovich".

Chrissy Bartovich
Environmental Director
U. S. Steel – Minnesota Ore Operations

cc: MPCA Water Quality Submittals Center
Richard Clark, MPCA
Jeff Udd, MPCA
Eric Williams, U. S. Steel
Tom Moe, U. S. Steel



Application for Sulfate Site-Specific Standard

Hay Lake

Prepared for
United States Steel Corporation

August 2022

1 Introduction

U. S. Steel developed this report to support its request for a sulfate site-specific standard for Hay Lake (AUID 31-0037-00), to show that current discharges will not exceed the site-specific standard and that limitations on the discharges from U. S. Steel's Keetac mining area and tailings basin are not necessary to protect the growth of wild rice in Hay Lake at the proposed sulfate site-specific standard.

Regarding the site-specific standard request, U. S. Steel developed this document in accordance with Minnesota Rules, part 7050.0220, subpart 7. A scientifically sound approach to developing the site-specific standard was used to derive a sulfate concentration of 79 mg/L. This calculated sulfate site-specific standard will apply at Hay Lake, which is located downstream of all active outfalls associated with U. S. Steel's Keetac facility, and will replace the existing Class 4A sulfate standard of 10 mg/L.

A summary of the proposed change is shown in Table 1-1. As this report details, the proposed site-specific standard will be protective of the Class 4A use and will not result in inhibition or injurious effects to wild rice growth.

Table 1-1 Site-Specific Standard Request Included in this Application

Waterbody	Current Sulfate Standard	Proposed Sulfate Site-Specific Standard
Hay Lake (AUID 31-0037-00)	<i>Numeric:</i> 10 mg/L <i>Narrative:</i> "The quality of class 4A waters of the state must be such as to permit their use for irrigation without significant damage or adverse effects upon any crops or vegetation usually grown in the waters or area."	<i>Numeric:</i> 79 mg/L <i>Narrative:</i> No change

The Keetac facility mining area, tailings basin, and receiving waters are shown on Figure 1. The tailings basin, which receives tailings from the Keetac taconite mining and processing facility, has a footprint of approximately 6,500 acres and includes a perimeter dike surrounding the basin over a length of 8.25 miles.

Water from the mining area and from the tailings basin leaves the sites as authorized surface discharges, as shown in Figure 1. The mining area discharge from SD002 and the tailings basin discharge from SD005 flow through a series of unlisted reservoirs and creeks before entering Hay Creek, which leads to Hay Lake. The mining area discharges from SD003 and SD012 flow through the O'Brien Diversion Channel into Hay Creek and then Hay Lake. Hay Lake is unlisted and thus is classified under the default designated beneficial use Classes 2B, 3, 4A, 4B, 5, and 6 (Minnesota Rules, part 7050.0415, subpart 4).

U. S. Steel conducted RPAs using both the USEPA's statistical method and the MPCA's statistical method. These analyses show that, with respect to protecting the growth of wild rice in Hay Lake, discharges from the existing Keetac permitted outfalls will be able to maintain concentrations of sulfate below the

3 Existing Water Quality and Hydrology of Wild Rice in Hay Lake

This section discusses the existing sulfate water quality in Hay Lake and summarizes hydrologic and wild rice observations in Hay Lake from studies conducted by U. S. Steel.

Since Hay Lake is an unlisted lake per Minnesota Rules, part 7050.0415, the general unlisted designated beneficial uses and associated water quality standards apply to Hay Lake, including Classes 2B, 3, 4A, 4B, 5, and 6 (Minnesota Rules, part 7050.0415, subpart 4). These designated beneficial uses are the same as those general classification applied to all waters of the state in Minnesota Rules, part 7050.0415, subpart 2, which verifies that these are the correct classes to apply to Hay Lake. This request focuses on a site-specific standard for sulfate that applies to the numeric Class 4A standard of 10 mg/L (Minnesota Rules 7050.0224, subpart 2) and the numeric interpretation of the narrative standard (Minnesota Rules, part 7050.0224, subpart 2).

3.1 Hay Lake Water Quality

Sulfate water quality data for Hay Lake is summarized in Table 3-1. Hay Lake is shown in Figure 1 and Figure 2. Various sources were used to compile sulfate surface water quality data in Hay Lake, including U. S. Steel's past studies and MPCA's surface water data access tool. Based on the dataset of 55 samples collected between June 23, 2009 and October 27, 2021, the average sulfate concentration in Hay Lake is 34 mg/L. There were no instances where the sulfate concentration exceeded the proposed sulfate site-specific standard of 79 mg/L. Therefore, Hay Lake is already achieving the sulfate site-specific standard and the discharges, which were present during the time this data was collected, did not cause or contribute to sulfate concentrations greater than the proposed sulfate site-specific standard of 79 mg/L.

Table 3-1 Hay Lake Sulfate Water Quality Summary

Waterbody Name	Sulfate Concentration (mg/L)			No. of Samples
	Minimum	Average	Maximum	
Hay Lake (31-0037-00) ^[1]	10	32	78	55

[1] Sulfate data for Hay Lake was collected between June 23, 2009, and October 27, 2021. See references (9); (10); (11); (12); (13) for data sources.

3.2 Hydrologic and Wild Rice Observations in Hay Lake

Several studies have been conducted in Hay Lake to evaluate hydrologic conditions, wild rice presence, and wild rice density. The results of these studies, summarized in Table 3-2, have shown abundant wild rice populations in most years. See Appendix B for the complete studies.

Water depth is one factor controlling the location of the presence of wild rice in the lake. Fluctuations in water levels influence wild rice populations; well-documented beaver activity is assumed to contribute to these fluctuations in Hay Lake. Wild rice occurs primarily along the perimeter of Hay Lake, where water depth is shallow. Where the lake is deepest, from 6 to 12 feet in depth, wild rice is not present. Further, as

Survey Date	Hydrologic Monitoring Outcome	Wild Rice Monitoring Outcome
August 2012 (conducted by Barr Engineering Co.)	- Water levels were monitored monthly from April 25 through October 24, 2012 using a staff gage. - When 2012 monitoring activities began, the water level was approximately one foot lower than the elevation observed in May 2011. - The elevation of the lake rose by 0.71 feet between April 26, 2012 and June 26, 2012. - Between June 26, 2012 and August 17, 2012, the water level dropped 1.45 feet.	- Density 3 wild rice (25-50% coverage) observed along northwest perimeter. - Density 2 wild rice (10-25% coverage) observed along the remaining perimeter. - Average stem density in sampling grids were between 8.0 to 20.8 stems per 0.5 m².
August 2014 (conducted by Barr Engineering Co.)	Not observed.	Density 5 wild rice (>75% coverage) observed along the perimeter.
May through October 2021 (conducted by NTS)	Water level increased slightly throughout the year.	- In June, early wild rice growth was noted at floating leaf stage. - In July, wild rice was found to be aerial but sparse. - No wild rice was observed after July.

The evaluation of chemical conditions at Hay Lake, as well as the historical presence of wild rice and the geomorphological conditions that encourage wild rice growth indicate that Hay Lake supports the presence of wild rice. Wild rice growth has historically been present on Hay Lake and is expected to continue to be present on Hay Lake in the future. These reasons support that a site-specific standard of 79 mg/L would be protective of the wild rice growing on Hay Lake.

Table 5-4 Estimated Sulfate Concentration in Reservoir 2, Leaving Reservoir 2, and Entering Hay Lake Based on Monitoring Data and Mass Balance Calculations

Data Set	Sulfate (mg/L)
Input into Reservoir 2 (from SD002 and SD005; mass balance approach)	100.38
SW001 2017 data (n = 12)	52.46
SW001 2018 data (n = 12)	54.34
SW001 2019 data (n = 12)	63.25
SW001 2020 data (n = 12)	50.65
SW001 2021 data (n = 5) ^[1]	81.52
SW001 2022 data (n = 2) ^[2]	68.35
Output from Reservoir 2 (Average of Annual Averages (n = 5))	66.76
Output from Reservoir 2 (SW001 2017-2022 data (n = 55))	64.59
Input into Hay Lake	47.63

[1] There was no outflow from Reservoir 2 from July 2021 through December 2021.

[2] There was no outflow from Reservoir 2 from January 2022 through March 2022; flow and concentration data available from April and May 2022.

For water leaving Reservoir 2, the resulting five-year sulfate averages of 66.76 mg/L (average of individual year averages) and 64.59 mg/L (average of monthly concentrations) are below the proposed sulfate site-specific standard of 79 mg/L. The results of the mass balance and results verification evaluation indicate there is some sulfate removal occurring in Reservoir 2. Sulfate inputs average 100.38 mg/L while outputs average as low as 64.59 mg/L. Sulfate loss also occurs in the Hay Creek watershed as the input to Hay Lake is estimated to be about 48 mg/L, well below the measured average sulfate concentrations at SW-001 (includes discharge from SD002 and SD005), as well as SD003 and SD012. It can be thus assumed that compliance with the proposed sulfate site-specific standard at SW001 will result in compliance with the site-specific protective value of 79 mg/L at Hay Lake. This is supported by the fact that the estimated sulfate concentration entering Hay Lake is 47.63 mg/L, even further below the proposed sulfate site-specific standard.

Field Report

Hay Lake/Hay Creek Wild Rice and Stream Conditions Survey

Date: 15 September 2009

Staff: Michael Crotteau, DNR-Water/L&M, Grand Rapids

Purpose: To verify the occurrence, density and health of wild rice in Hay Creek and determine geomorphic or other controls (i.e. beaver dams) that affect water level in Hay Lake.

Location: Hay Lake (31-37W) (UTMX 492455, UTM Y 5236990) and outlet of Hay Lake and Hay Creek downstream to Swan Lake.

Description: Traveled from the east-southeast side of Hay Lake to the outlet of the lake where Hay Creek exits. Observations were made from an inflatable kayak for approximately 1.4 miles downstream of Hay Lake.

Hay Lake – Water level was high. Water level elevation equipment was not available; therefore, no elevation was recorded. A loon and bald eagle were present as well as a 14-foot boat on the south side of the lake. A beaver lodge was present on the south side of the lake. Approximately 3 acres of wild rice was present in medium to abundant density. However, the crop was severely damaged (rotten) and appeared to be un-harvestable (see photos 1-12). This is more than likely due primarily to an increase in water level in the lake due to beaver activity (see below). The outside edge of the wild rice (lake-side) was 4 - 5 feet in depth.

Hay Creek – Water level was very high, though no elevation was captured. Wild rice was abundant at the outlet of the lake (mid-channel) with cattails bounding the shore margins (see photo 13). The crop, like the lake, was very un-healthy and had virtually no seeds. From the outlet to approximately 0.6 miles downstream, wild rice was present, but sparse and unhealthy (see photo 14). At 0.6 miles downstream of the outlet, an area of moderate wild rice density was encountered that was approximately 200 feet in channel length (see photo 16). Wild rice abundance dropped off to sparse after this section.

A beaver dam (BD 1) was encountered 0.66 miles downstream from the lake outlet; however, the dam was nearly at grade and created virtually no head drop from upstream to downstream (see photo 17). Approximately 0.84 miles downstream from the lake outlet, another beaver dam (BD 2) was encountered (see photo 20). This beaver dam was the controlling factor of stream and lake levels in Hay upstream and created a two to three foot head drop from upstream to downstream (see photo 21). Two meanders downstream (0.1 from BD2, 0.94 miles from lake), another beaver dam (BD 3) was encountered creating another one foot head drop in the stream (see photos 22). The last full stream width beaver dam (BD 4) was 1.08 miles downstream of the lake outlet and created an approximate 1.5 foot head drop in the creek

HAY LAKE - HAY CREEK WILD RICE SURVEY, 15 SEPT 2009



Wild rice and lily pads approaching Hay Creek outlet



Unhealthy wild rice stalk



Hay Lake wild rice



Hay Lake wild rice looking northwest to Hay Creek inlet

HAY LAKE - HAY CREEK WILD RICE SURVEY, 15 SEPT 2009



Hay Lake wild rice - very unhealthy/rotten



Hay Lake wild rice



Hay Lake wild rice - very unhealthy/rotten



Wild rice and cattails approaching Hay Creek outlet



Photograph H-13. Hay Lake, August 4, 2011.



Photograph H-14. Hay Lake, August 4, 2011.



Photograph H-15. Hay Lake, August 16, 2011.



Photograph H-16. Hay Lake, August 16, 2011.



Photograph H-17. Hay Lake, August 16, 2011.



Photograph H-18. Hay Lake, August 16, 2011.

Appendix C

Hay Lake - Sediment and Water Quality Monitoring Results Summary and Evaluation

Composite Sample Monitoring Results						Calculated Site-Specific Sulfate (mg/L) <i>(based on previously proposed multiple binary logistic regression (MBLR) equations)</i>
Location ID	Sample Date	Sediment Total Organic Carbon (TOC) ⁽¹⁾ (%)	Sediment Total Extractable Iron (TEFe) (mg/kg)	Porewater Sulfate (mg/L)	Porewater Sulfide (mg/L)	2018 MPCA Proposed MBLR Equation ⁽²⁾ sulfate = 0.0000854 x TOC ^{-1.041} x TEF _e ^{1.637} sulfide protective threshold = 120 µg/L
HL-1	5/24/2021	1.81	9,370	--	--	146
HL-1	6/21/2021	2.29	9,740	< 1.0	< 0.10	122
HL-1	7/27/2021	1.38	13,400	1.1	< 0.10	348
HL-1	8/24/2021	1.71	10,900	< 1.0	0.113	199
HL-1	9/28/2021	1.65	10,100	< 1.0	< 0.10	182
HL-1	10/27/2021	--	--	< 1.0	< 0.10	--
HL-2	5/24/2021	5.03	22,700	--	--	215
HL-2	6/21/2021	5.80	10,700	< 1.0	< 0.10	54
HL-2	7/27/2021	2.94	13,800	< 1.0	< 0.10	166
HL-2	8/24/2021	2.54	9,450	24.8	< 0.10	104
HL-2	9/28/2021	2.78	6,800	20.0	< 0.10	55
HL-2	10/27/2021	--	--	1.9	0.19	--
HL-3	5/24/2021	8.06	21,400	--	--	119
HL-3	6/21/2021	8.43	19,500	< 1.0	0.112	98
HL-3	7/27/2021	5.67	22,300	< 1.0	0.106	184
HL-3	8/24/2021	6.41	13,800	5.4	< 0.10	74
HL-3	9/28/2021	2.79	17,400	15.7	< 0.10	257
HL-3	10/27/2021	--	--	< 1.0	< 0.10	--
HL-4	5/24/2021	7.05	16,400	--	--	89
HL-4	6/21/2021	9.80	18,700	1.5	0.383	78
HL-4	7/27/2021	6.62	14,700	< 1.0	0.331	79
HL-4	8/24/2021	6.06	10,900	< 1.0	0.568	53
HL-4	9/28/2021	4.75	13,900	2.8	0.141	102
HL-4	10/27/2021	--	--	< 1.0	0.316	--
HL-5	5/24/2021	3.11	19,100	--	--	267
HL-5	6/21/2021	4.34	19,400	< 1.0	< 0.10	194
HL-5	7/27/2021	2.99	26,700	< 1.0	< 0.10	481
HL-5	8/24/2021	3.56	20,400	< 1.0	0.124	258
HL-5	9/28/2021	2.92	19,100	< 1.0	< 0.10	285
HL-5	10/27/2021	--	--	< 1.0	0.133	--

(1) Average value of the 9060A double run total organic carbon (TOC) analysis.

(2) Reference: MPCA. *Letter to Chief Administrative Law Judge Tammy L. Pust Re: In the Matter of the Proposed Rules of the Pollution Control Agency Amending the Sulfate Water Quality Standard Applicable to Wild Rice and Identification of Wild Rice Waters* . March 28, 2018. OAH Docket # 80-9003-34519, Revisor ID #4324.

(3) Procedure for determining wild rice sulfate standard based on 20th percentile of calculated values as described in MPCA March 28, 2019 letter response to Report of the Chief Administrative Law Judge.

Potential Site-Specific Wild Rice Sulfate Standard (mg/L)
2018 20th Percentile Procedure ⁽³⁾
79

WaterLegacy September 22, 2025 Comments on U.S. Steel Corp NPDES/SDS Permits for
Keetac Mining Area (MN0031879) and Keetac Tailings Basin (MN0055948) and on
U.S. Steel Corp Application for Variance from Wild Rice Sulfate Standard

EXHIBIT 18

Hay Lake Porewater Sulfide Monitoring Results Summary and Evaluation Table
with MPCA July 2017 SONAR Pages.

Hay Lake Porewater Sulfide Monitoring Results Summary and Evaluation				
Composite Sample Monitoring Results			Evaluation	
Location ID	Sample Date	Porewater Sulfide (mg/L)	"Protective" Sulfide Limit (mg/L)	Exceed Sulfide Threshold
HL-1	6/21/2021	< 0.10	0.120	no
HL-1	7/27/2021	< 0.10	0.120	no
HL-1	8/24/2021	0.113	0.120	
HL-1	9/28/2021	< 0.10	0.120	no
HL-1	10/27/2021	< 0.10	0.120	no
HL-2	6/21/2021	< 0.10	0.120	no
HL-2	7/27/2021	< 0.10	0.120	no
HL-2	8/24/2021	< 0.10	0.120	no
HL-2	9/28/2021	< 0.10	0.120	no
HL-2	10/27/2021	0.19	0.120	YES
HL-3	6/21/2021	0.112	0.120	
HL-3	7/27/2021	0.106	0.120	
HL-3	8/24/2021	< 0.10	0.120	no
HL-3	9/28/2021	< 0.10	0.120	no
HL-3	10/27/2021	< 0.10	0.120	no
HL-4	6/21/2021	0.383	0.120	YES
HL-4	7/27/2021	0.331	0.120	YES
HL-4	8/24/2021	0.568	0.120	YES
HL-4	9/28/2021	0.141	0.120	YES
HL-4	10/27/2021	0.316	0.120	YES
HL-5	6/21/2021	< 0.10	0.120	no
HL-5	7/27/2021	< 0.10	0.120	no
HL-5	8/24/2021	0.124	0.120	YES
HL-5	9/28/2021	< 0.10	0.120	no
HL-5	10/27/2021	0.133	0.120	YES

Data in this exhibit is derived from the U.S. Steel Site-Specific Standard Application at MPCA002445, which is Exhibit 17 in WaterLegacy's comments on the U.S. Steel Keetac mining area and tailings basin permits. Orange rows reflect Hay Lake porewater sulfide exceeding MPCA's sulfide toxicity threshold of 120 µg/L (0.120 mg/L), and yellow rows reflect Hay Lake porewater exceeding MPCA's identified sulfide level of 100 µg/L (0.100 mg/L) where wild rice cover declines. An excerpt of MPCA's July 2017 SONAR specifying these thresholds is copied from the administrative record *In re Site-Specific Standard for Hay Lake* and provided on the following pages.



STATEMENT OF NEED AND REASONABLENESS

Amendment of the sulfate water quality standard applicable to wild rice and identification of wild rice waters.

Minn. R. chapters 7050 and 7053

**Minnesota Pollution Control Agency
Environmental Analysis and Outcomes Division
July 2017**

106 µg/L is most defensible. Additional discussion of the MPCA's selection of EC10 is provided in the TSD.

The MPCA also calculated EC10 values from the mesocosm experiments described in Pastor et al., 2017, which yielded two statistically-significant effects of sulfide on wild rice, (1) percent filled, or viable, seeds and (2) number of plants that emerged in the spring. Calculation of EC10 values from linear regressions yields EC10 values of 228 and 121 µg/L, respectively. All of these point estimates of EC10 concentrations have confidence intervals within which the true EC10 value is likely to fall. For the mesocosm data in particular, the 95% confidence intervals are relatively wide.

The peer review panel (Exhibit 9, page 6) also noted that “the field survey provides some of the best data that the MPCA has available to investigate the relationship between wild rice and surface water sulfate levels. These data also offer a means of determining sulfide levels that are protective of wild rice. Much more analysis should be done on this data set.” One particular member of the panel also noted (Exhibit 9, pp. F36-37) that a visual estimate of the field survey data “indicates that the cover of wild rice declines at porewater sulfide concentrations above about 0.1 mg/L (100 µg/L)”.

The MPCA therefore evaluated the field data in order to derive a protective sulfide concentration. The field data comes from a survey of 108 water bodies, of which 96 water bodies had sufficient water transparency to support wild rice. In order to develop the protective level of sulfide, the MPCA looked at the porewater sulfide concentrations and the presence or absence of wild rice. Most of the data analysis was done on the 96 water bodies with appropriate water clarity, since it is not reasonable to calculate a protective sulfide concentration with data from sites that would not support wild rice no matter how low the sulfide concentration is.¹²

Following the observation from the peer reviewer, the MPCA did a simple visual analysis of the data, looking for a sulfide level at which there was a noticeable reduction in the proportion of sites with wild rice present. The data were examined for such a threshold by calculating the average proportion of sites with rice above any given sulfide concentration, and the pattern examined without any statistical analysis. This showed that the percentage of sites with wild rice declines as sulfide increases, but the decline is relatively slow until the sulfide concentration exceeds 120 µg/L, where there is a notable drop in the percentage of sites with wild rice present. While a small uptick in the proportion of sites with wild rice occurs between 130-150 µg/L, the percentages never return to the 60% or greater that are observed below 120 µg/L. This can be seen with reference to Figure 2 from the TSD.

¹² Note: Although wild rice was not present at all 96 sites, the MPCA included them in the survey because elevated sulfide could be the reason for the absence of wild rice.