Line 5 Wisconsin Segment Relocation Project

Wisconsin Department of Natural Resources

Docket # IP-NO-2020-2-N00471

Enbridge Reponses to DNR Information Request Dated March 10, 2023

Attachment 8

Summary of Water Quality Analysis Parameters

Chemical	WDNR: Test Methods	Enbridge Test Methods	Parameter function	Parameter assistance in water quality evaluation
Total Phosphorus	**Digestion:** 4500-P B (5)-1999 (Standard Method), 973.55 (USGS/AOAC/Other) **Colorimetric, Manual ascorbic acid:** 365.3 (EPA), 4500-P E (Standard Method), D515-88 (ASTM) **Colorimetric, Automated ascorbic acid reduction:** 365.1 (EPA), 4500-P, F, G, H (Standard Method), 973.56 (USGS/AOAC/Other) **Colorimetric, Semi−automated block digestor (TKP digestion):** 365.4 (EPA), D515-88 (ASTM), I-4610-91 (USGS/AOAC/Other)	Standard Method 4500-P F (Pace Analytical)	Phosphorus is an essential nutrient for the plants and animals that make up the aquatic food web. Phosphorus in aquatic systems occurs as organic phosphate and inorganic phosphate. Inorganic phosphorus is the form required by plants. Animals can use either organic or inorganic phosphate (5.6 Phosphorus | Monitoring & Assessment | US EPA).	Although phosphorus is an essential element for plant life, when there is too much of it in water, it can speed up eutrophication of rivers and lakes (Phosphorus and Water | U.S. Geological Survey (usgs.gov)). Even a modest increase in phosphorus can, under the right conditions, set off a whole chain of undesirable events in a stream including accelerated plant growth, algae blooms, low dissolved oxygen, and the death of certain fish, invertebrates, and other aquatic animals (5.6 Phosphorus | Monitoring & Assessment | US EPA).
Nitrogen – Total Kjeldahl	**Manual digestion 20 and distillation or gas diffusion:** 4500−Norg-B or C and 4500-NH3B (Standard Method), D3590-02(06) (ASTM), I-4515-91 (USGS/AOAC/Other) **Titration:** 4500-NH3C (Standard Method), 973.48 (USGS/AOAC/Other) **Electrode:** 4500-NH3C (Standard Method), 973.48 (USGS/AOAC/Other) **Semi-automated phenate**: 350.1, Revision 2.0 (EPA), 4500-NH3 G, 4500-NH3 H (Standard Method)	EPA 351.2, Revision 2.0 (Pace Analytical)	Kjeldahl method turns organic substances in the water into ammonium sulfate.	Nitrogen – Total Kieddahl is an important measure in environmental monitoring because excess nitrogen in water bodies can lead to harmful algal blooms and other negative impacts on aquatic ecosystems. When measured, the higher the total kjeldahl nitrogen value, the more algae blooms, the less water is clear, and the less oxygen there will be (Total Kjeldahl Nitrogen - Water Rangers).

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	Manual phenate, salicylate, or other substituted phenols in Berthelot reaction based methods: 4500-NH3F (Standard Method)			
Nitrate + Nitrite	**Cadmium reduction, Manual**: 4500-NO3-E (Standard Method), D3867-04 (ASTM) **Cadmium reduction, Automated:** 353.2, Rev. 2.0 (EPA), 4500−NO3 −F (Standard Method), D3867−04 (ASTM), I−2545−90 (USGS/AOAC/Other) **Automated hydrazine:** 4500−NO3 −H (Standard Method) **Ion Chromatography:** 300.0, Rev 2.1 and 300.1−1, Rev 1.0 (EPA), 4110 B−2000 or C−2000 (Standard Method), D4327−03 (ASTM), 993.30 (USGS/AOAC/Other **Capillary ion electrophoresis (CIE/ UV):** 4140-B (Standard Method), D6508−00(05) (ASTM), D6508, Rev. 2 (USGS/AOAC/Other)	EPA 353.2 (Pace Analytical)	Nitrates are essential plant nutrients.	Although Nitrates are necessary for plants, in excess amounts they can cause significant water quality problems. Excess nitrates can cause hypoxia and can become toxic to warm-blooded animals at higher concentrations under certain conditions (EPA).
Ammonia	**Manual distillation or gas diffusion (pH > 11):** 350.1, Rev. 2.0 (EPA), 4500−NH3B (Standard Method), 973.49 (USGS/AOAC/Other) **Titration:** 4500−NH3C (Standard Method)	EPA 350.1 (Pace Analytical)	Ammonia causes direct toxic effects on aquatic life	When ammonia is present in water at high enough levels, it is difficult for aquatic organisms to sufficiently excrete the toxicant, leading to toxic buildup in internal tissues and blood, and potentially death. Environmental factors, such as pH and temperature,

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	Electrode: 4500−NH3D or E (Standard Method), D1426-08 (ASTM) **Manual phenate, salicylate, or other substituted phenols in Berthelot reaction based methods**: 4500−NH3F (Standard Method) **Automated phenate, salicylate, or other substituted phenols in Berthelot reaction based methods:** 350.1, Rev. 2.0 (EPA), 4500−NH3G and 4500−NH3H (Standard Method) **Ion Chromatography:** D6919-09 (ASTM)			can affect ammonia toxicity to aquatic animals (EPA).
Dissolved Oxygen	Not specified in WI NR 219	Standard Methods 4500-AG, EPA 360.1 (Hanna Multiparameter Meter model HI98194)	Dissolved oxygen in surface water is used by all forms of aquatic life, some reliant on it (USGS).	As dissolved oxygen is used by all forms of aquatic life, it constituent typically is measured to assess the "health" of lakes and streams. Excess organic material in lakes and rivers can cause eutrophic conditions, which is an oxygen-deficient situation that can cause a water body to "die" (USGS).
Sulfate		EPA 300.0 and SW-846 Method 9056A (Pace Analytical)		Although sulfate occurs naturally in aquatic environments, when levels are elevated, it can be toxic to aquatic life in freshwater environments (Karjalainen et al., 2021).

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Total Mercury	**Cold vapor, Manual:** 245.1, Rev. 3.0 (EPA), 3112 B (Standard Method), D3223−02 (ASTM), 977.22 and I−3462−85 (USGS/AOAC/Other) **Cold vapor, Automated:** 245.2 (EPA) **Cold vapor atomic fluorescence spectrometry (CVAFS):** 245.7 Rev. 2.0 (EPA), I−4464−01 (USGS/AOAC/Other) **Purge and Trap CVAFS:** 1631E (EPA)	EPA 245.1 (Pace Analytical)	Mercury is one of the most serious contaminants because it is a potent neurological poison in fish, wildlife, and humans (USGS).	Mercury is a concern because it is absorbed easily into the food chain. The harmful methylmercury form of mercury readily crosses biological membranes and can accumulate to harmful concentrations in the exposed organism and become increasingly concentrated up the food chain (USGS).
Conductivity	Not required to be tested by certified laboratory	EPA 120.1 (Hanna Multiparameter Meter model HI98194)	Conductivity is useful as a general measure of water quality (EPA).	Significant changes (usually increases) in conductivity may indicate that a discharge or some other source of disturbance has decreased the relative condition or health of the water body and its associated biota (EPA).
pH	Not required to be tested by certified laboratory	EPA 150.2 (Hanna Multiparameter Meter model HI98194)	pH affects most chemical and biological processes in water. It is one of the most important environmental factors limiting species distributions in aquatic habitats. Different species flourish within different ranges of pH, with the optima for most aquatic organisms falling between pH 6.5-8 (EPA).	Since pH can be affected by chemicals in the water, pH is an important indicator of water that is changing chemically (USGS). U.S. EPA water quality criteria for pH in freshwater suggest a range of 6.5 to 9. Fluctuating pH or sustained pH outside this range physiologically stresses many species and can result in decreased reproduction, decreased growth, disease, or death. This can ultimately lead to reduced biological diversity in streams (EPA).

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Total Suspended Solids	Not specified in WI NR 219	EPA 160.4 Standard Methods 2540-B, 2540-C, and 2540-D (Pace Analytical)	TSS measures the amount of particulate matter floating in water (which could be organic matter, inorganic substances, and algae).	If TSS values are high, sunlight will not travel well through the water, which in turn makes it difficult for plants and algae to grow. This then reduces productivity and oxygen generation.
Chemical Oxygen Demand (COD)	**Titrimetric:** 410.3 (EPA), 5220 B or C (Standard Method), D1252−06 (ASTM), I−3560−85 and 973.46 (USGS/AOAC/Other) **Spectrophotometric, manual or automatic:** 410.4, Rev. 2.0 (EPA), 5220 D (Standard Method), D1252−06 (ASTM), I−3561−85 (USGS/AOAC/Other)	EPA 410.4 Standard Method 5220D (Pace Analytical)	COD may act as an index for determining overall water quality.	COD measures the amount of oxygen necessary to break down the organic substances that are pollutants in water. With a higher COD value in a sample, it indicates that it contains higher levels of oxidizable material. With higher COD, the water will have reduced dissolved oxygen levels.
Biological Oxygen Demand (BOD)	5210 B−2001 (Standard Method), 973.44, p. 17, 9 I−1578−78 8 Notes 10,63 (Hach Method 10360)	Hach 10360, Revision 1.2 (Pace Analytical)	BOD is a measure of the amount of oxygen required to remove waste organic matter from water in the process of decomposition by aerobic bacteria (EPA).	Determining how organic matter affects the concentration of dissolved oxygen in a stream or lake is integral to water-quality management. The waste organic matter is stabilized or made unobjectionable through its decomposition by living bacterial organisms which need oxygen to do their work (USGS).

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Polycyclic Aromatic Hydrocarbons (PAHs)	Not specified in WI NR 219	EPA SW-846 Methods 8270D SIM and 8270E SIM using Gas Chromatography-Mass Spectrometry (Pace Analytical)	PAHs are organic chemical compounds that naturally occur in the environment (Olayinka et al., 2018).	The presence of PAHs in surface or ground water indicates pollution. The types of PAHs present in water provide information on the derivative sources of organic contaminants (Olayinka et al., 2018).
Perfluoroalkyl and polyfluoroalkyl substances (PFAS)	Not specified in WI NR 219	EPA 537.1 (Pace Analytical)		PFASs are distributed ubiquitously in the aquatic environment. The PFASs are permanently introduced into aquatic ecosystems, which can result in a continuous exposure of those compounds for organisms downstream of the discharges. These insights indicate a long-term (chronic exposure of species in aquatic ecosystems suffering from wastewater discharge and other point and nonpoint sources of PFASs (Ahrens and Bundschuh, 2014).
Total Petroleum Hydrocarbons (TPH)	Not specified in WI NR 219. However, there are many conventional analytical methods available. The most used include infrared spectroscopy (EPA Method 418.1), gravimetry (EPA Method 1664A), gas chromatography with flame ionization detection (EPA Method 8015), gas chromatography with mass spectrometric detection (EPA Methods 8270 and 625), ultraviolet spectrophotometry, immunoassay (EPA Methods 4030 and 4035), Raman spectroscopy, and			When petroleum hydrocarbons (PHs) enter into aquatic ecosystems, they can cause great harm to organisms; they pose acute to chronic toxicity to organisms depending on their metabolism and photooxidation (Ihunwo et al., 2021). Non-bioavailable and/or hydrophobic PHs become bioavailable to several benthic organisms as they get adsorbed onto particulates and sediments. Certain aquatic

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	fluorescence spectroscopy (Adeniji, Okoh, and Okoh, 2017).			invertebrates that ingest suspended oil droplets/oil-bound particulates are highly sensitive to PHs (Kuppusamy et al., 2019).

References:

Adeniji, A.O., Okoh, O.O. and Okoh, A.I. (2017). Analytical Methods for the Determination of the Distribution of Total Petroleum Hydrocarbons in the Water and Sediment of Aquatic Systems: A Review. *Journal of Chemistry*, [online] 2017, pp.1–13. doi:https://doi.org/10.1155/2017/5178937.

Ahrens, L. and Bundschuh, M. (2014). Fate and effects of poly- and perfluoroalkyl substances in the aquatic environment: A review. *Environmental Toxicology and Chemistry*, 33(9), pp.1921–1929. doi:https://doi.org/10.1002/etc.2663.

Anon, (n.d.). *What is chemical oxygen demand (COD)? | SciMed*. [online] Available at: https://www.scimed.co.uk/education/what-is-chemical-oxygen-demand-cod/#:~:text=COD%20measures%20the%20amount%20of.

Ihunwo, O.C., Onyema, M.O., Wekpe, V.O., Okocha, C., Shahabinia, A.R., Emmanuel, L., Okwe, V.N., Lawson, C.B., Mmom, P.C., Dibofori- Orji, A.N. and Bonnail, E. (2021). Ecological and human health risk assessment of total petroleum hydrocarbons in surface water and sediment from Woji Creek in the Niger Delta Estuary of Rivers State, Nigeria. *Heliyon*, 7(8), p.e07689. doi:https://doi.org/10.1016/j.heliyon.2021.e07689.

Karjalainen, J., Mäkinen, M. and Karjalainen, A.K. (2021). Sulfate toxicity to early life stages of European whitefish (Coregonus lavaretus) in soft freshwater. *Ecotoxicology and Environmental Safety*, 208, p.111763. doi:https://doi.org/10.1016/j.ecoenv.2020.111763.

Kuppusamy, S., Maddela, N.R., Megharaj, M. and Venkateswarlu, K. (2019). Ecological Impacts of Total Petroleum Hydrocarbons. *Total Petroleum Hydrocarbons*, pp.95–138. doi:https://doi.org/10.1007/978-3-030-24035-6_5.

Olayinka, O.O., Adewusi, A.A., Olarenwaju, O.O. and Aladesida, A.A. (2018). Concentration of Polycyclic Aromatic Hydrocarbons and Estimated Human Health Risk of Water Samples Around Atlas Cove, Lagos, Nigeria. *Journal of Health and Pollution*, 8(20), p.181210. doi:https://doi.org/10.5696/2156-9614-8.20.181210.