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June 15, 2024

Meagan Sims
Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333-0017

Dear Ms. Sims:

We (the Board of Supervisors of Hancock County Soil & Water Conservation District) and our partner organizations (filing separately) request that the Board of Environmental Protection and DEP adopt Turbidity criteria for Maine waters. As a pollution control organization, **DEP needs to control all pollutants**, especially three of the most common and important ones, namely: pH, turbidity, and nutrients. This letter will focus on Turbidity and Water Clarity.

Citation of Standard: 38 MRS Article 4-A §464 1, 4.A (4). and 4.B and
38 MRS Article 4-A §465

1. **Findings; objectives; purpose.** The Legislature finds that the proper management of the State's water resources is of great public interest and concern to the State in promoting the general welfare; in preventing disease; in promoting health; in providing habitat for fish, shellfish and wildlife; as a source of recreational opportunity; and as a resource for commerce and industry.

4.A (4) Discharge of pollutants to waters of the State that imparts color, taste, turbidity, toxicity, radioactivity or other properties that cause those waters to be unsuitable for the designated uses and characteristics ascribed to their class; …

4. B All surface waters of the State shall be free of settled substances which alter the physical or chemical nature of bottom material and of floating substances, except as naturally occur, which impair the characteristics and designated uses ascribed to their class.

38 MRS Article 4-A §465 1.B, 2.B, and 3.B

1.B The aquatic life, dissolved oxygen and bacteria content of Class AA waters must be as naturally occurs, ...

2.B B. The dissolved oxygen content of Class A waters may not be less than 7 parts per million or 75% of saturation, whichever is higher, except ...

3.B B. The dissolved oxygen content of Class B waters may not be less than 7 parts per million or 75% of saturation, whichever is higher, except ...

Details of proposed change: The standard for Maine should be **clean and clear** and **free of settleable solids.** So, we propose that the standard be as naturally occurs, except where baseline data is not available, in which case turbidity should be ≤ 3 NTU, a point at which turbidity becomes visible to the un-aided eye.

We propose that 38 MRS Article 4-A §464, 4.B be modified as follows:

From 4.B 4. B All surface waters of the State shall be clean and clear and free of settled substances which alter the physical or chemical nature of bottom material and of floating substances, except as naturally occur, which impair the characteristics and designated uses ascribed to their class.

We propose that 38 MRS Article 4-A §465 1.B be amended as follows:

From: B. The aquatic life, dissolved oxygen and bacteria content of Class AA waters must be as naturally occurs, except...

To: B. The aquatic life, dissolved oxygen, pH, water clarity, and bacteria content of Class AA waters must be as naturally occurs, except...

And that §465, 2B be amended as follows

From B. The dissolved oxygen content of Class A waters may not be less than 7 parts per million or 75% of saturation, whichever is higher, except ...in identified fish spawning areas.

To: B. The dissolved oxygen content of Class A waters may not be less than 7 parts per million or 75% of saturation, whichever is higher, except ...in identified fish spawning areas. And that pH fall between 6.5-9.0, and turbidity be ≤ 3 NTU.

And that §465, 3B be amended as follows

From: B. The dissolved oxygen content of Class B waters may not be less than 7 parts per million or 75% of saturation, whichever is higher, ...April 15th and October 31st,

To: B. The dissolved oxygen content of Class B waters may not be less than 7 parts per million or 75% of saturation, whichever is higher, ...April 15th and October 31st, and that pH fall between 6.5-9.0, and turbidity be ≤ 3 NTU.

Reasons for Change:

The Maine legislature stated that Maine waters be "free of settled solids." That is the law and that should be the standard. The "clean and clear" part of the proposal is to emphasize the need for good aesthetics. This is a **narrative standard** that clearly states what state waters should look like. If water looks dirty, that should result in a DEP study to determine the nature and sources of the problem. The **numerical standards** for turbidity or water clarity will allow the Department to act, to stop the pollutant at its source, and then clean it up. The narrative and numerical standards work together to protect Maine's natural resources. The pH part of the proposal (also in red) is from another proposal for this Triennial Reivew.

Turbidity is the number one pollutant worldwide. EPA says that turbidity is the most common pollutant in the US and that it is the most common cause for waters not meeting their water quality classification. Turbidity is probably not the most important pollutant in Maine, but it is important. For instance, in Hancock County, turbidity is one of the most obvious pollutants in the Union River.

First, some background. Turbidity and water clarity are optical properties of water and are opposites. For instance, water that is "turbid" may have suspended particles that cause poor clarity and low visibility. Turbidity is often measured in NTU but may appear in older literature as JTU (the two are roughly equivalent when the sample value is greater than 25 NTU). Visibility is often measured in deep water using a Secchi disk, or in shallow water using a turbidity tube. The maximum clarity in a 120 cm-long turbidity tube is 120 cm.

In a review document, the European Inland Fisheries Advisory Commission (1965) ***European Inland Fisheries Advisory Committee, Working Party on Water Quality Criteria for European Freshwater Fish, Report on Finely Divided Solids and Inland Fisheries,*** examined the effects of turbidity on fish and fisheries. EIFAC lumped the effects into four categories: (1) turbidity has direct effects on fish, causing irritation and clogging of gills, and visual impairment that can prevent effective feeding and interference with obstruction avoidance, (2) particles have direct effect effects on reproduction when they adhere to fish eggs and interfere with the development of eggs or larvae by limiting oxygen uptake and waste removal, (3) turbidity modifies behavior and movement, especially feeding, spawning and migration, and (4) reduces food abundance by causing sediment embeddedness and by degrading habitat quality. Invertebrate abundances and diversity also respond strongly to moderate turbidity (Bash, J, C Berman & S Bolton. 2001. ***Effects of turbidity and suspended solids on Salmonids***, University of Washington Center for Streamside Studies. Turbidity and light penetration are important variables that influence abundance and distribution of aquatic plants (Rhul, H & N Rybicki (2010) ***Long-term Reductions in Anthropogenic Nutrients Link to Improvements in Chesapeake Bay Habitats***) including plankton (Cloern, J (1987) ***Turbidity as a Control on Phytoplankton Biomass and Productivity in Estuaries***). Eelgrass and other submerged aquatic plants are keystone species in wetland margins and coastal zones. Aquatic plants are extremely sensitive to poor light penetration and to smothering by sediment deposition (Sweitlik, W (2011) ***Draft Criteria for Suspended and Bedded Solids***, US EPA. Turbidity is of critical importance because it has impacts at an ecosystem level.

The effects of sediment on biological communities are a function of duration, intensity, frequency of exposure, life stage, sensitivity of the species of interest, particle characteristics such as size and angularity, type of particle (organic or mineral), natural background conditions, availability of refugia, and interaction with co-stressors such as water temperature, invasive species, and toxic substances (Bash et al. 2001). Thus, turbidity alone without a context, or turbidity that is measured only infrequently is impossible to evaluate. EPA recommends that states use models that consider this complexity and situation-specific conditions when establishing regulatory water quality standards (Sweitlik 2011). EPA guidance documents to states recommends a dose-response model like that of Newcombe & Jensen (1996) ***Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact*** which was developed for fish conservation. Other dose-response models have been developed for macroinvertebrates and aquatic plants (Newcombe (1997) ***Channel Suspended Sediment and Fisheries: A Concise Guide to Impacts,*** Ministry of the Environment, Victoria, British Columbia, Woockman (2012) ***Characterizing the Concentration, Duration and Frequency of Turbid Events in Tennessee Streams: Potential for Macroinvertebrate Impairment***. Master's thesis, University of Tennessee).

EPA's water quality standards are found in: EPA (1986) ***Quality Criteria for Water***. Office of Water Regulation and Standards, Washington D.C. EPA report number 440/5-86-001 which states:

> *"Freshwater Aquatic Life - Combined effect of color and turbidity should not change the compensation point more than 10 percent from its seasonally established norm, nor should such a change take place in more than 10 percent of the biomass of photosynthetic organisms below the compensation point."*

This discusses the "compensation point." The light compensation point is an important ecological concept, but it is hard to measure, and the compensation point varies by time of day and seasonally (the angle of the sun). The following is from B Williams ***Light and the Compensation Depth*** Marine Ecology, https://www.briangwilliams.us/marine-ecology/light-and-the-compensation-depth.html

> Photosynthesis is confined to the illuminated surface zone of the sea, and a useful measure of the extent of this productive layer is the compensation depth, i.e. the depth at which the rate of production of organic material by photosynthesis exactly balances the rate of breakdown of organic material by plant respiration. Below the compensation depth there is no net production. The compensation depth obviously varies continually with changes of illumination and must be defined with respect to time and place. In clear water in the tropics, the noon compensation depth may be well below 100 m throughout the year. In high latitudes in summer, the noon compensation depth commonly lies somewhere between 10 and 60 m, reducing to zero during the winter months when virtually no production occurs.

The light compensation point is not easy to measure and that makes it undesirable as a regulatory standard. We suggest using visibility and NTU standards instead.

What is needed to reduce a compensation point by 10%? Sometimes, small changes in turbidity lead to large decreases in productivity, such as this from Oregon DEQ:

> Modeled relationships between turbidity, light extinction, and productivity indicate that small increases in turbidity of less than 5 NTU would result in minor (3-13%) reduction in benthic algal productivity in a stream 0.5 meters deep.

What about other aquatic values and uses? From Sweitlik (2011) ***Draft Criteria for Suspended and Bedded Sediments***, EPA, Washington DC.

> For other types of designated uses such as boating, fishing, swimming, wading, aesthetics and hunting, a variety of factors contribute to the recreational quality of a water body (Parametrix, 2003). Visual factors such as color and clarity are important along with perceived changes in these factors. The ability to use water safely- to be able to see what is there- is also important. The National Academy of Sciences (NAS/NAE, 1973) recommended that waters used for bathing and swimming should have sufficient clarity to allow for the detection of subsurface hazards or submerged objects and for locating swimmers in danger of drowning. The National Technical Advisory Committee (NTAC) in 1968 recommended that clarity should be such that a secchi disk is visible at minimum depth of four feet given its conclusion that clarity in recreational waters is highly desirable from the standpoint of visual appeal, recreational opportunity, enjoyment and safety (Parametrix, 2003).

Same idea on aquatic uses, but from a different source, from NAS (1972) ***Water Quality Criteria***, report on draft water quality criteria for EPA, National Academy of Sciences Press.

> "Turbid water interferes with recreational use and aesthetic enjoyment of water. Turbid waters can be dangerous for swimming, especially if diving facilities are provided, because of the possibility of unseen submerged hazards and the difficulty in locating swimmers in danger of drowning. The less turbid the water the more desirable it becomes for swimming and other water contact sports."

Another standard use for water bodies is as a source of drinking water. Turbidity has a strong influence on the drinkability of water and the cost of treating water. The following is from USGS website: https://www.usgs.gov/special-topics/water-science-school/science/turbidity-and-water

> Excessive turbidity, or cloudiness, in drinking water is aesthetically unappealing, and may also represent a health concern. Turbidity can provide food and shelter for pathogens. If not removed, the causes of high turbidity can promote regrowth of pathogens in the water, leading to waterborne disease outbreaks, which have caused significant cases of intestinal sickness throughout the United States and the world. Although turbidity is not a direct indicator of health risk, numerous studies show a strong relationship between removal of turbidity and removal of protozoa. The particles of turbidity provide "shelter" for microbes by reducing their exposure to attack by disinfectants. Microbial attachment to particulate material has been considered to aid in microbe survival. Fortunately, traditional water treatment processes have the ability to effectively remove turbidity when operated properly.

In addition to pathogens, turbidity creates a problem for city water supplies by exceeding the capacity of existing plants filtration systems, causing shut downs, and potentially enormous investment in technological upgrades. This is from Oregon Dept of Environmental Quality (2014) ***Water Quality Standards: Turbidity Technical Review***, Chapter 5.

> Systems using slow sand filtration or similar technologies will usually need to shut down when turbidities exceed 5 NTU (National Drinking Water Clearinghouse 1996). Some systems in Oregon with frequent high turbidity install advanced filtration systems that can treat water with turbidity higher than 50 or 100 NTU, but these systems are expensive and may not be affordable for all small PWSs. (Public Water Systems)

So, for waters that are supposed to be fishable, swimmable, and drinkable, small amounts of turbidity make them undesirable. This is why a proposal to use "clean, clear, and free of settleable solids" makes sense.

While most Maine rivers generally have little obvious turbidity, this is not true of the Union River in Ellsworth. The West Branch is rated by Beginning with Habitat as a Region of Statewide Ecological Significance for its excellent water quality, scenic value, recreational value, and support for endangered species. But the lower river is a mess. It has two dams that are owned and operated by Brookfield Hydro. The large changes in water level in Graham Lake causes erosion at high water (cutting into the lake shore) and at low water (resuspending eroded sediments from large and exposed mud flats). The periods of poor water quality are in the spring (high water) and late summer – fall (low water), with good water quality in mid-summer and winter (Whiting 2017, 2018).

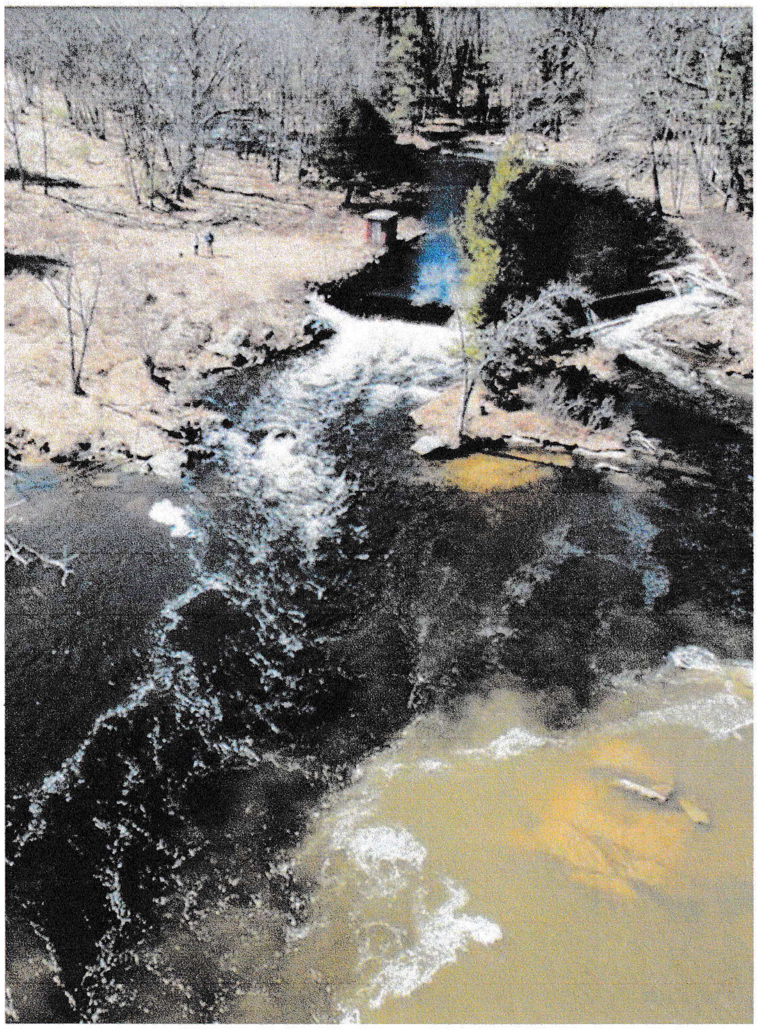

Figure 1. Photo of the confluence of Branch Lake Stream with the Union River in Ellsworth, Maine. Branch Lake is the drinking water supply for Ellsworth and is clean and clear. The Union River is the muddy water on the bottom right. It is neither clean, nor clear.

Photo by B Ciccotelli.

In my experience, the relationship between turbidity measured in NTU and visibility as measured in cm in a turbidity tube is good and dependable (at least in the Union River). Figure 2, below shows an exponential relationship. In my opinion, good water quality is NTU under 3 and visibility over 120 cm (the top of a normal large turbidity tube).

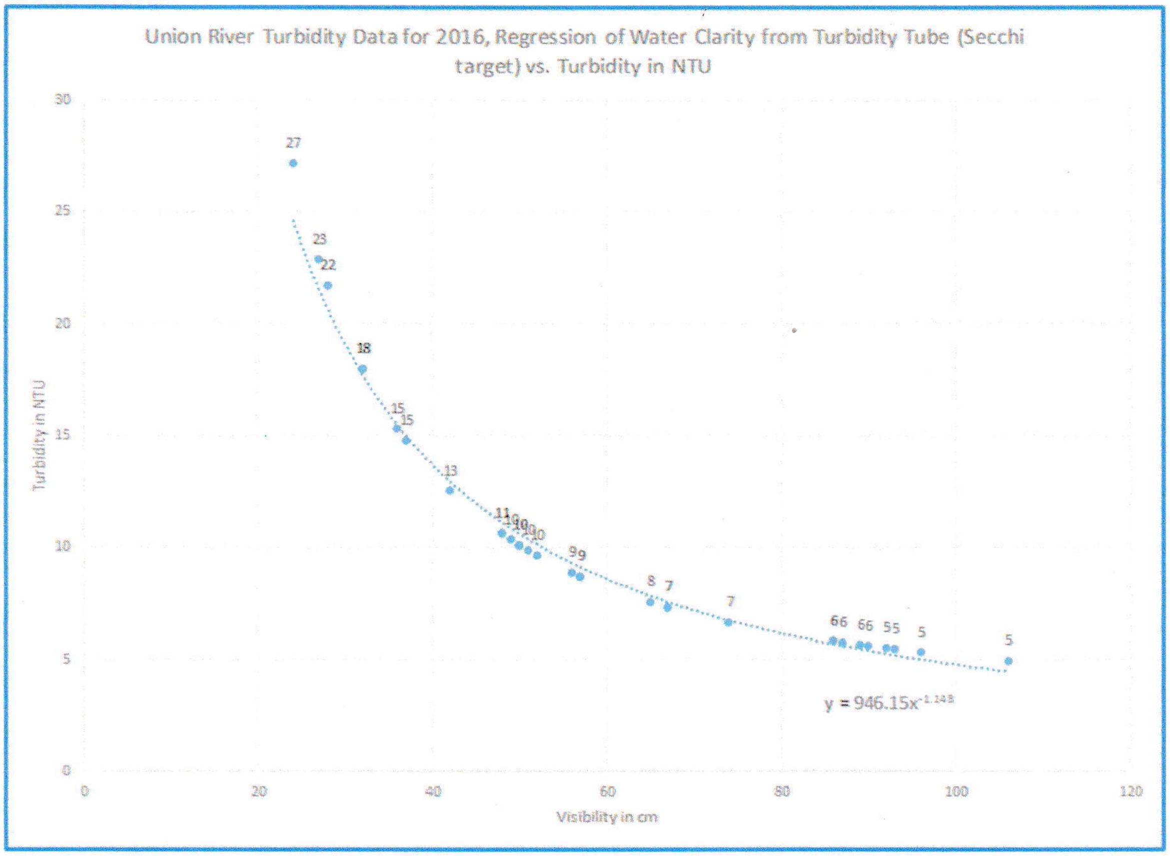

Figure 2. From Whiting, data from the Union River, a regression of turbidity measured in NTU by a phone app, Hydrocolor, against visibility as measured by a turbidity tube. A turbidity of 3 NTU is around 120 cm of visibility. EPA's draft criteria for swimming is a Secchi depth of 4 feet (Sweitlik (2011) which is 122 cm).

During the relicensing of the Brookfield dams in Ellsworth, FERC asked DEP to review the application for the EPA "Clean Water Certification" process. The dams failed that certification, but turbidity was not an issue because DEP "has no water quality criteria for turbidity." The dams failed due to some dissolved oxygen issues, poor macroinvertebrate outcomes, and the large water level drawdowns dewatered too much of Graham Lake's littoral zone. It is absurd that a Clean Water Certification process cannot deal with dirty water. **If DEP has no water quality criteria for a common pollutant like suspended dirt, then it needs to adopt one** as soon as possible.

Financial Impact: Unknown. Turbidity is already not allowed by Maine's narrative criteria, it is just not currently enforceable. Maine's water bodies should be "free of settleable solids" that could impact visibility and embeddedness of lake and stream bottoms. Polluters might have to change the way they operate in order to not muddy state waters, but that will save money for municipalities and other publicly owned water supplies. Wildlife will benefit and public uses of water resources are protected. So, the trade-off benefits the public.

We think DEP and the BEP should support strict turbidity regulation that benefits the public, fisheries and wildlife, and supports federally protected treaty fishing rights.

Sincerely,

Mark Whiting, Chair
Board of Supervisors, HCSWCD

Attachments: Two Union River turbidity studies