

# Guidance for Improvement of Water Quality in the Montello River Watershed – Study Conclusions and Recommendations

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During this study period samples were collected from 11 sites in reservoirs (3), streams (6), and the Montello River (2) throughout the year and during a variety of flow conditions so this dataset provides a valuable representation of nutrient water quality in the Montello River watershed. A significant flood occurred during this study which resulted in poor water quality that enters our lakes and rivers during heavy events. Although this flood was not an average event, it is these large events that introduce a lot of sediments and nutrients to waterbodies; once in the aquatic system these sediments and nutrients have long-term effects.

Phosphorus was the nutrient of focus in this study. It was analyzed in samples collected from Lawrence Lake, Harris Pond, and Montello Lake. It was also analyzed at two sites in Klawitter Creek, two sites in Westfield Creek, Taggets Creek, un-named creek, and two sites in the Montello River. Soil phosphorus was measured in samples that were collected from fields located in areas of the watershed that are considered directly connected to the streams and river and where land managers were willing to participate with this study.

Based on DNR phosphorus criteria, the recommended average total phosphorus (TP) in shallow impoundments (calculated from samples collected between June 1 and September 15) should be below 40 µg/L. Average TP concentrations above this level begin to affect the type and amount of aquatic plants, algae, dissolved oxygen, fish, and other aquatic biota. The average TP calculated in Montello Lake (74 µg/L) and Harris Pond (73 µg/L) were above the proposed threshold. The average at Lawrence Lake (31 µg/L) was slightly below the threshold. Efforts should be made to reduce phosphorus in and entering Montello Lake and Harris Pond. Conscious efforts should be made to maintain Lawrence Lake at TP concentrations below 40 µg/L.

Total phosphorus (TP) concentrations are one measure of the impact to the biotic integrity of the stream. Streams with lower TP concentrations will typically have a more diverse biological community of fish, aquatic plants, and aquatic macroinvertebrates. No biological surveys were conducted in this study, but the water quality data gathered in this study suggest that the biologic communities in Klawitter Creek at sites KW02, KW03, and Unnamed Creek site UN01 are likely the most impacted.

Median baseflow TP concentrations in some of the streams exceeded the DNR phosphorus criteria for wadable streams (74 µg/L) and impoundments (40 µg/L). This occurred at both sites on Klawitter Creek KW02 (91 µg/L), KW03 (98 µg/L), and Unnamed Creek UN01 (98 µg/L). Not surprisingly, the highest median TP and soluble reactive phosphorus (SRP) concentrations occurred at all sites during runoff events. KW02, KW03, and UN01 had the highest median event concentrations (171 µg/L, 358 µg/L, 192 µg/L), and the highest maximum sampled event concentrations (596 µg/L, 865 µg/L, 1,088 µg/L), respectively.

Total phosphorus loads indicate which streams deliver the greatest mass of phosphorus to the downstream river or impoundments. (Calculation of a load includes the phosphorus concentration and volume of water). Westfield Creek site WC01 had a noticeably higher average growing season TP load (9,587 lbs/acre) than the other sites, and site WC02 had the second highest (5,773 lbs/acre). These sites both had the highest averaged growing season volumes of water (21, 317 ft<sup>3</sup> and 12,327 ft<sup>3</sup>) which dwarf the remaining sites (4,042 ft<sup>3</sup> and less).

Since a significant percent of agriculture comprises the landscape in the Montello River watershed, it was useful to evaluate how much phosphorus is leaving the fields based on the soil type, slope, and management practices used in this watershed. Many producers across the state are using a tool called SNAP-Plus to help them manage their farm nutrients by identifying which fields may need additional phosphorus for a given crop and which fields do not need more phosphorus. Reducing phosphorus applications helps to save the producers money and is good for groundwater, lake, and river water quality. SNAP-Plus results include Phosphorus Indices (PI) which is related to a level of phosphorus in the field. Fields with the highest PIs should have practices put into place to reduce phosphorus in the field. This reduction, along with implementation of best management practices that reduce soil loss should reduce in-stream phosphorus concentrations in the Montello River watershed. Although current regulations require that fields with PIs greater than 6 take steps to reduce phosphorus, all losses of phosphorus from fields to water can have a negative impact on water quality, so benefits to lakes, rivers, and groundwater can occur with any reduction in PI. Nearly all sub-watersheds (except TC01 and WC02) had some fields with PIs greater than 6.

Nitrogen can also fuel algae and aquatic plant growth in an aquatic system. The United States Environmental Protection Agency (USEPA) estimated reference conditions for TN in streams in central Wisconsin to be between 0.46 and 0.71 mg/L. At all of the sample sites, nitrate+nitrite comprised the largest component of TN. Median values at all the sites in the Montello River watershed are well above natural conditions for this region with concentrations at Unnamed Creek UN01 more than four times higher than natural conditions. UN01 had higher maximum baseflow nitrate+nitrite concentrations (9.3 mg/L N, 8.6 mg/L N). These concentrations are very high for surface water and warrant concern for the private drinking water wells in this sub-watershed. At every site but KW03, the maximum observed baseflow nitrate concentrations were greater than the maximum runoff concentration, suggesting that nitrates are moving to the streams via groundwater. To reduce nitrogen transport to groundwater, in agricultural systems nutrient management that addresses the form and timing of nitrogen application should be developed and adhered to. Nitrogen should only be applied to lawns when indicated by soil tests, and septic systems should be sited as far from water bodies as possible.

Chloride concentrations indicate the presence of human activity as it is found at very low concentrations in undisturbed landscapes in this region of Wisconsin. Concentrations were similar across sites; however, were slightly higher in Westfield Creek at site WC02 during events and at Klawitter Creek at site KW02 during baseflow. The concentrations measured in this study are not known to be harmful to biota.

Water temperature is a very important factor that, in conjunction with habitat characteristics, determines what type of fish and other species may potentially exist in a stream. Westfield Creek at site WC02 had the most impacted water temperatures of the tributaries, and is classified as a warm water stream. This stream has unsuitable temperatures for cold water species like brook trout.

In summary, each impacted creek has specific issues to be addressed. Westfield Creek has three main issues of concern, temperature, loads, and yields. The first issue of concern is temperature, especially at Westfield Creek at

site WC02. According to DNR temperature classifications, this reach of Westfield Creek can only support warm water fish species. The second issue is the loads. Loads are important to consider when assessing the impact a stream has on a downstream lake or impoundment. Westfield Creek is the largest tributary to the Montello River and contributes more phosphorus, sediment, and chloride to downstream impoundments than any other stream. Yields, which are area-weighted loads, indicate which sub-watersheds are exporting the highest mass of phosphorus/sediment/chloride per unit area, and are used to focus management efforts on areas of greatest concern. Westfield Creek had the second highest total suspended sediment yield and the highest chloride yield.

In contrast to Westfield Creek, Unnamed Creek is the smallest tributary to the Montello River, and actually flows directly into Montello Lake. It had the lowest loads of any site, and hence, the least impact on downstream impoundments. The greatest issues of concern at Unnamed Creek are the phosphorus concentrations and yield, total suspended sediment yield, and nitrate concentrations. Although Unnamed Creek contributes a relatively low mass of phosphorus and sediment to Montello Lake, this sub-watershed was exporting a higher mass of phosphorus and sediment per area than any other sub-watershed. The biotic integrity of Unnamed Creek may also be hindered by high phosphorus concentrations. Nitrate concentrations at Unnamed Creek were also elevated.

Klawitter Creek, which has more flow than Unnamed but less than Westfield, also had water quality issues. The reach above the monitoring site KW03 had elevated phosphorus concentrations similar to that of Unnamed Creek, which may be impacting biotic integrity. Water temperature does not appear to be impacted, as this reach is considered to support cold water species. Elevated nitrate concentrations were observed in this reach of Klawitter Creek.

Tagatz Creek is the least impacted tributary to the Montello River. It supports cold water fish species and relative to other sites has no water quality issues of concern.

This study reveals the locations of problem concentrations and sources of phosphorus and nitrogen in the Montello River watershed. There is no reason to believe that these problems could not be mitigated with the implementation of best management practices. Agricultural inputs should be addressed throughout the watershed, with priority in the directly contributing areas and fields with high phosphorus indices (PIs). At a minimum, management of the fields that were input into SNAP-Plus should adhere to practices that reduce phosphorus, erosion, and ultimately runoff. It would be advantageous to run SNAP-Plus of all fields within this area to identify nutrient management needs and reduce unnecessary costs due to over use of fertilizers. Municipalities and residences should only use fertilizer if soils tests are conducted and fertilizer is deemed beneficial. When possible, mowed lawns should be replaced with native vegetation that does not need fertilizer.

Near shore development should also install best management practices that are designed to reduce surface runoff from impervious surfaces, reduce erosion, and reduce/eliminate nutrient addition to the landscape, especially properties located on Montello Lake where phosphorus concentrations need to be reduced if less aquatic plant growth is desired. The nature of this impoundment lends itself to abundant aquatic plant growth, but efforts to reduce nitrogen and phosphorus to the system should mitigate some of the problems.