

Upper Fox and Wolf River Basins Volunteer Monitoring Program

Upper Fox and Wolf Basins TMDL

2023 Annual Report



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Project Summary

Project Location

The project area is located within the Upper Fox River and the Wolf River Basins in northeast and central Wisconsin. The Upper Fox Basin is 2,200 square miles and extends from the headwaters of the Fox River in Columbia and Adams Counties to the outlet of Lake Winnebago. The Upper Fox Basin also includes the direct drainage areas to Lake Winnebago. The Wolf River Basin is 3,700 square miles and extends from the headwaters of the Wolf River in Forest County to the Wolf River confluence with Lake Butte des Morts in Winnebago County.

The Upper Fox and Wolf River Basins (UFWB) volunteer monitoring program utilizes citizen volunteers to collect surface water samples from 24 monitoring sites on 23 different streams and rivers throughout the UFWB. There were 20 sites in 2022 and four were added in 2023 (Embarrass River at CTM M, Pigeon River, Sawyer Creek, and Waupaca River). Sampling locations are evenly distributed among the Upper Fox Basin, Wolf Basin, and Lake Winnebago region. These streams and rivers contribute nutrients and sediment to the Wolf River, Upper Fox River, and Lake Winnebago. Monitoring locations are displayed in Figure 1 and more detailed location information can be found in Appendix A.

Project Background

The U.S. Environmental Protection Agency (EPA) approved the UFWB Total Maximum Daily Load (TMDL) in 2020. Implementation of the TMDL aims to improve water quality by reducing total phosphorus (TP) and total suspended solids (TSS) in waterbodies throughout the Basins. The

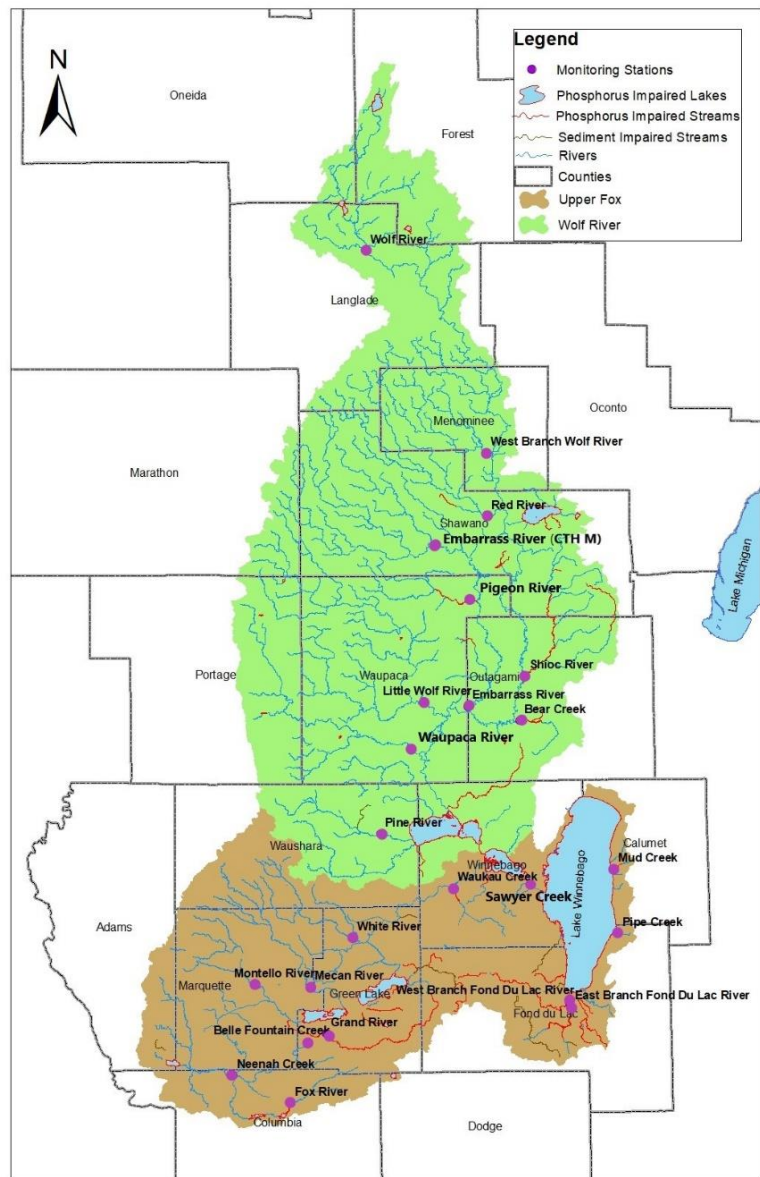


Figure 1: UFWB volunteer monitoring sites.

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TMDL identifies and quantifies the sources and necessary phosphorus and sediment reductions to reach water quality goals. To evaluate effectiveness of TMDL implementation activities, one objective of the TMDL is to evaluate long-term water quality trends within the entirety of the UFWB.

The UFWB volunteer monitoring program started in 2020 to achieve some of the monitoring objectives resulting from the TMDL. 24 sampling sites were chosen for monthly (May – October) surface water sampling. Each monitoring location was selected for the program to assess long-term water quality trends throughout the Basins. Detailed monitoring site location information is provided in Appendix A.

Given the time commitment and the spatial extent of the monitoring sites in the UFWB, the assistance of volunteers is vital to the success of the program. Volunteers serve the essential role of data collectors, as they collect monthly surface water samples across the 24 monitoring sites in the UFWB. Volunteers are trained before each sampling season by Wisconsin DNR staff to ensure reliable and accurate results are achieved each month.

Problem Statement

The waters within the UFWB are impaired due to excessive phosphorus and sediment loading. TMDL implementation focuses on restoring waters impaired by excessive sediment and/or high phosphorus concentrations. Phosphorus and sediment cause numerous impairments to waterways, including low dissolved oxygen concentrations, degraded habitat, and excessive turbidity. These impairments adversely impact fish and aquatic life, water quality, recreation, and potentially navigation.

Every two years, Sections 303(d) and 305(b) of the Clean Water Act (CWA) requires states to publish a list of all waters not meeting water quality standards and an overall report on surface water quality status of all waters in the state. All streams and rivers sampled through the UFWB volunteer monitoring program have a target median summer (May – October) TP concentration of 0.075 mg/L. No water quality criteria currently exists for TSS and TN for the streams and rivers sampled through the UFWB volunteer monitoring program.

According to the WDNR 2022 303(d) Impaired Waters list, 12 of the 23 monitoring streams sampled through the UFWB volunteer monitoring program (Bear Creek, East and West Branches of Fond du Lac River, Fox River, Grand River, Mud Creek, Pigeon River, Pipe Creek, Shioc River, Waukau Creek, Waupaca River, and Wolf River) are impaired due to high levels of total phosphorus (TP) and/or total suspended solid (TSS) levels in the water. Appendix C provides more information about the impaired monitoring streams.

Project Goals

There are two main goals for this project: (1) Increase public awareness and involvement in water quality issues by engaging residents in citizen science and (2) the collection of reliable surface water quality data to assess long-term water quality trends/success. The volunteer monitoring program aims to increase community awareness on local water quality issues and

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the impact of land use decisions around them. The focus is to raise awareness through building a volunteer base and increasing community involvement and engagement.

Through citizen science the volunteer monitoring programs goal is to collect reliable data to characterize TP, dissolved reactive phosphorus (DRP), diatom phosphorus index (sampled every 10 years starting in 2025 if sufficient funds), TSS, total nitrogen (TN), and associated chemical and physical characteristics in streams during the primary algae and aquatic plant “growing season” of May through October. The monitoring data brings focus to which streams are affected by elevated phosphorus and sediment concentrations.

It is important to note, however, that research is currently underway into the relationship between the reduction of TP, DRP, TN, and biological responses. The collection of TP, DRP, and TN will help strengthen the understanding of these relationships and effects they may have on biological responses in streams.

Additional goals of this project include:

1. Evaluate nutrient and sediment concentrations in the tributaries discharging to the Upper Fox River, Wolf River, and Lake Winnebago
2. Monitor the health of the basins overtime
3. Provide a basis for evaluation of the long-term effectiveness of implementation of the Upper Fox and Wolf Basins TMDL; are there water quality improvements in sub-basins with the implementation of best management practices?
4. Share water quality data broadly among stakeholders to collectively assess water quality

Proposed Work and Sampling Procedure

The UFWB volunteer monitoring program started in 2020 and is proposed to continue as the TMDL progresses and as funds are available. Coordination and implementation of volunteer monitoring efforts are administered by WDNR staff. Specifically, the WDNR:

- Continues to develop a well-trained volunteer base through various means of recruitment and community engagement:
 - o Volunteers are trained to follow Water Action Volunteer (WAV) (<https://wateractionvolunteers.org/>) monitoring protocol to ensure consistency is being met in each sample
 - o Volunteers collect and ship surface water samples in iced coolers to the Wisconsin State Lab of Hygiene (WSLH) for analysis of TP, DRP, TSS, and TN
 - o Volunteers collect streamflow and transparency data at the time of surface water sample collection (if able)
 - o Duplicate samples are collected at randomly selected sites throughout the sampling season (Appendix H). Duplicates are collected on the same day and at the same time as the regular sample
- Continues to provide support to volunteers as needed:
 - o Ensures safe access and suitability at each monitoring site

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- Orders, prepares, and maintains supplies for volunteers to successfully carry out monitoring activities and shipment of samples
- Fosters an open line of communication with volunteers to ensure that all stations are being monitored at the frequency outlined in the project QAPP
- Confirms that all 24 monitoring sites are monitored monthly from May to October for a total of six sampling events per year
- Compiles monthly sampling data results to share with volunteers and stakeholders
 - Records data into tables and graphs for analysis
 - Develops an annual report complete with data and figures to share with stakeholders to assess annual water quality

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2023 Sampling Season

Summary

2023 was the fourth year for the UFWB volunteer monitoring program. The program started in 2020 with 12 monitoring sites and sites have been added over the years. Most recently four sites were added in 2023 for a total of 24 monitoring sites. The sites are spread throughout the UFWB and represent the main rivers and tributaries that eventually lead to Lake Winnebago. The volunteer monitoring program started with nine volunteers, five individuals and two groups. The volunteer base has grown and in 2023 there were 14 returning volunteers and eight new ones.

The DNR coordinator trained some of the new volunteers one-on-one at their sampling site in May, this ensured volunteers were comfortable with their sampling site. This type of training will be used for future seasons because it works with volunteers' schedules, ensures they are sampling at the correct location, and allows for easy equipment drop-off. In 2023 four of the volunteers were trained this way, the remaining new volunteers had sampling experience and only required a brief walk through of the sampling process.

Returning volunteers had their supplies shipped to their house or the supplies were dropped off by the DNR coordinator. Some sampling supplies such as sample bottles, coolers, Ziploc bags, preservative acid, and DRP supplies were shipped directly to volunteers from the WSLH. Lab slips and shipping labels were created at the DNR central office and shipped to the volunteers.

In 2023 there were no missed samples, this is the first season for the UFWB volunteer monitoring program with 100% sample completeness. There was more communication from the DNR coordinator in 2023 and they were available to sample if a volunteer couldn't, which is a main reason there were no missed samples. There were also many returning volunteers who have experience and understand the importance of sampling every month. Table 1 displays the sample collection completeness percentage for each sampling site since 2020.

Sample Collection Completeness (%) – Out of 144 samples per year (6 samples/site)				
Monitoring Site	2020	2021	2022	2023
Bear Creek	33%	83%	100%	100%
Belle Fountain Creek	-	100%	67%	100%
East Branch FDL River	50%	100%	100%	100%
Embarrass River (STH 54)	33%	100%	100%	100%
Fox River	-	100%	50%	100%
Grand River	50%	100%	100%	100%
Little Wolf River	33%	100%	100%	100%
Mecan River	-	100%	67%	100%
Montello River	-	100%	67%	100%
Mud Creek	-	83%	100%	100%
Neenah Creek	-	100%	50%	100%
Pine River	-	83%	100%	100%
Pipe Creek	-	83%	100%	100%
Red River	50%	83%	100%	100%
Shioc River	33%	83%	83%	100%
Waukau Creek	50%	83%	100%	100%
West Branch FDL River	50%	100%	100%	100%
West Branch Wolf River	33%	83%	100%	100%
White River	50%	100%	100%	100%
Wolf River (CTH T)	50%	100%	100%	100%
Embarrass River (CTH M)	-	-	-	100%
Pigeon River	-	-	-	100%
Sawyer Creek	-	-	-	100%
Waupaca River	-	-	-	100%
Combined Percentage	23%	93%	89%	100%

Table 1: UFWB sample collection completeness by monitoring site.

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One volunteer took the May sample but was unable to sample for the rest of the season due to personal reasons. A volunteer from a similar program was contacted and took on the two sites for the remainder of the season. It's important for the coordinator to be available to sample if needed and understand they may need to find a back-up volunteer.

US Postal Service (USPS) Priority Mail has been the courier used since 2021 and was still used in 2023. USPS is used because it allows for more convenient package drop off for volunteers sampling in more remote areas. All shipping labels were printed and provided to volunteers at the start of the season.

Volunteers are instructed to ship water samples immediately after collection or as early as possible the next day due to the 48-hour hold time for the DRP sample. A total of 58 DRP samples (including duplicate samples), or 40%, were flagged in 2023 due to the samples exceeding the 48-hour hold time for DRP. For reference, only 27% of the DRP samples were flagged in 2022. There were multiple mailing issues this season, including coolers taking two weeks to be delivered or being delivered back to the volunteer; these issues could be a large factor as to why there were more DRP samples exceeding the hold time in 2023. The UFWB is also a large region and some of the monitoring sites are hours away from the WSLH, meaning shipping times can vary by site. We will monitor mailing issues in the future and decide if we need to change to a different shipping courier if problems persist. Although these samples were flagged by the lab for exceeding the hold time, they were still able to be processed and the results can be used. Getting samples to the lab and analyzed within 48 hours continues to be an area for improvement as shipping times can vary by carrier and shipping origin.

Given the spatial extent of the UFWB monitoring sites, finding volunteers in some areas of the basin is more challenging. Volunteer recruitment is one aspect of the program that consistently needs to be carried out. The DNR coordinator should continue to recruit volunteers despite having a volunteer at every stream. It would be better to have multiple volunteers at each sampling location to learn with each other and help each other collect the samples. The more volunteers that are recruited, the more the message gets out in the community, which is a main goal of the Program.

Outreach

- The UFWB Volunteer Monitoring Fact Sheet (Appendix B) was shared broadly to DNR staff and county land and water programs to help recruit volunteers
- The DNR Coordinator worked with the Fox Wolf Watershed Alliance Program Coordinator to further extend volunteer recruitment using their newsletter
- County Land and Conservation departments were contacted to assist with sample collection in 2023, multiple counties sample for this volunteer monitoring program

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Water Quality Data

Wisconsin Listing Methodology

To evaluate stream water quality and TP reductions, the WDNR follows a standard assessment procedure which accounts for sample methods, timing, variability, sample size and statistical confidence to more confidently determine whether a stream meets water quality standards. The volunteer monitoring programs TP sampling data is compared to Wisconsin’s TP water quality criteria (WQC) for streams (0.075 mg/L) by calculating the Growing Season Median (GSM) and the upper and lower 90% confidence limits of the GSM for each monitoring location. A stream is listed as impaired for TP if the lower 90% confidence limit of the GSM (May – October) TP concentration exceeds the stream WQC. The lower 90% confidence limit is used to ensure a stream exceeds the criteria with a predetermined level of confidence, before it is listed. A stream that is impaired for TP will be de-listed if the upper 90% confidence limit of the GSM TP subsequently drops below, or clearly attains, the criteria.¹ See Figure 2.

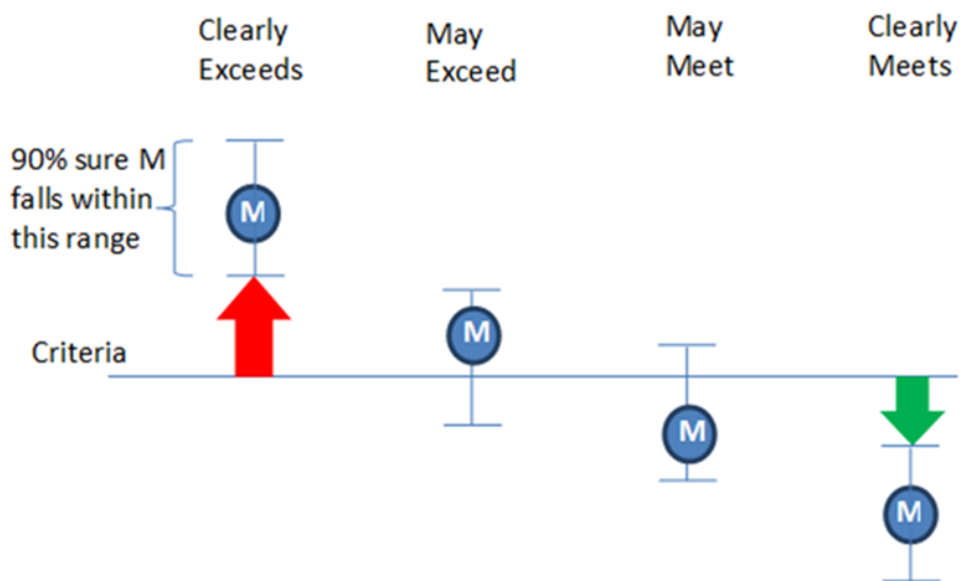


Figure 2: Wisconsin TP criteria confidence limit table. Criteria line represents the 0.075 mg/L WQC limit and M represents the GSM value.

A GSM and 90% Confidence limits were calculated for each monitoring site each year of data collection. A minimum of six samples, one per month from May – October, are needed to calculate the confidence limits. In years with less than six data points at a location, a data point from the same month from the most recent year of a full dataset should be used instead. There were no missed samples in 2023, meaning the confidence limits could be calculated with just 2023 data. The confidence limits calculated in this data summary will not be used for stream

¹ WDNR 2020. Guidelines for Monitoring for Watershed Restoration Effectiveness. Wisconsin Department of Natural Resources, Bureau of Water Quality. Madison, Wisconsin. EGAD#3200-2020-26

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listing purposes, however the data can be used for future listing assessments. A confidence interval table is provided in Appendix D.

Based on the confidence limits calculated in 2023, the relation to criteria for eleven of the monitoring streams is “Clearly Meets” (Embarrass River (STH 54, CTH M), Little Wolf River, Mekan River, Montello River, Pigeon River, Pine River, Red River, Waupaca River, West Branch Wolf River, White River, and Wolf River (CTH T)). Compared to the 2021/2022 confidence limits, there are three more streams that meet the TP WQC, but there are also four new monitoring sites in 2023. There is one stream that “May Meet”, two streams that “May Exceed”, and the remaining nine streams “Clearly Exceeds”. With only three years of data used to calculate confidence limits, they were not calculated in 2020 due to the limited data set, it will be important to monitor confidence limits in future seasons. These will help assess water quality trends over time and track progress as implementation occurs.

Total Phosphorus Analysis

TP median values are calculated every year of sampling, even if there is less than 100% sample collection. The median is calculated instead of the mean in accordance with Wisconsin Consolidated Assessment and Listing Methodology (WisCALM) protocol for streams and rivers. Median is used for datasets with high variability to ensure results are not skewed by one extremely high or low value; streams and rivers tend to have higher variability in concentrations compared to lakes where the mean is used. Table 2 displays the median TP values for each sampling location monitored from 2020-2023. Red values indicate there was less than 100% sample collection at the monitoring site for that year. These median values were calculated from only the samples collected at the monitoring site for that year, compared to the GSM which uses previous years values if there is missing data.

TP Median (mg/L)				
Monitoring Site	2020	2021	2022	2023
Bear Creek	0.072	0.145	0.168	0.171
Belle Fountain Creek	-	0.094	0.060	0.065
East Branch FDL River	0.203	0.299	0.289	0.160
Embarrass River (STH 54)	0.047	0.090	0.089	0.056
Fox River	-	0.098	0.089	0.075
Grand River	0.178	0.161	0.064	0.225
Little Wolf River	0.043	0.049	0.051	0.037
Mekan River	-	0.060	0.047	0.040
Montello River	-	0.100	0.090	0.044
Mud Creek	-	0.626	0.782	0.600
Neenah Creek	-	0.130	0.089	0.094
Pine River	-	0.050	0.042	0.037
Pipe Creek	-	0.222	0.087	0.299
Red River	0.024	0.022	0.018	0.021
Shioc River	0.320	0.243	0.812	0.344
Waukau Creek	0.143	0.092	0.131	0.103
West Branch FDL River	0.177	0.337	0.291	0.409
West Branch Wolf River	0.018	0.039	0.019	0.016
White River	0.024	0.036	0.031	0.031
Wolf River (CTH T)	0.036	0.034	0.027	0.035
Embarrass River (CTH M)	-	-	-	0.034
Pigeon River	-	-	-	0.067
Sawyer Creek	-	-	-	0.103
Waupaca River	-	-	-	0.027

Table 2: Annual Median TP values by monitoring site, red values indicate years with missing data.

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In 2023, 10 of the 24 monitoring sites had median TP values exceeding Wisconsin’s TP WQC, only one of the four new monitoring sites had a median that exceeded TP WQC. A graph of the median values for each monitoring site can be found in Appendix E. Sampling data for all parameters is found in Appendix G.

Total phosphorus is a key indicator of water quality. It is an essential nutrient for plant growth however, when excess amounts are introduced to a waterbody, water quality can decrease and lead to harmful algal blooms. The established State TP WQC for the UFWB streams is 0.075 mg/L. To evaluate stream TP concentrations, each TP sample was compared to the 0.075 mg/L TP criteria. Table 3 compares the UFWB TP samples to the State TP WQC. In 2023, 83 of 144 (58%) of TP samples met the TP criteria of 0.075 mg/L, this is a 7% increase from 2022. There were four sites added to the monitoring program in 2023, which could be a reason for the increase in TP samples meeting the WQC. 2023 also had less than average rainfall during the sampling season, when there is less rainfall there is less runoff going into waterbodies, which can reduce the phosphorus concentrations in rivers and streams.

TP Samples Below 0.075 mg/L	2020	2021	2022	2023
# Sites	12	20	20	24
# Samples Collected	31	112	106	144
# Above 0.075 mg/L	14	65	53	61
# Below 0.075 mg/L	17	47	54	83
<i>% Below 0.075 mg/L</i>	55%	42%	51%	58%

Table 3: TP samples meeting the TP WQC.

Dissolved Reactive Phosphorus Analysis

While total phosphorus is a key indicator of water quality, DRP also plays an important role in water quality. DRP is the soluble form of phosphorus and is readily available for plant and algae growth. Excessive amounts of DRP can also lead to excessive algae growth and potentially harmful algal blooms, this can cause poor water quality.

A TP sample and a DRP sample are collected during each sampling event. These samples are compared to determine the percentage of dissolved phosphorus present in the TP sample. Appendix F breaks out the TP/DRP percentages for each sample event. The red values in the table indicate the DRP concentration exceeded the TP concentration, this is due to sample variance. The bold and italicized values indicate that the DRP sample exceeded the TP WQC of 0.075 mg/L. In 2023 nine of the 24 monitoring sites had at least one DRP sample that exceeded the TP WQC. In addition to high DRP values at these monitoring sites, the percentage of DRP also consistently remains high at these sites.

Table 4 further breaks down the DRP percentages into percentage ranges. 41 of 144, or 28%, of TP samples collected in 2023 had 20 – 40% of their TP concentrations from DRP which is the most among all percentage ranges in 2023. In 2023 there were less TP samples that had 80-100% of their concentration come from DRP compared to 2022, 9% compared to 14%. The DRP percentages may be smaller in 2023 due less than average rainfall during the sampling season, this is why it’s important to sample consistently for many years to account for variability. From

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2020-2023 the category with the highest percentage of samples is 20-40%, the second highest percentage range is 60-80% at 22% of all samples taken. It will be important to monitor these percentages over time as implementation in the UFWB continues as it may teach us which types of implementation help reduce DRP concentrations in rivers and streams.

DRP Percentage of TP Ranges								
Year	# Sites	# Samples Collected	< 20% DRP	20 - 40% DRP	40 - 60% DRP	60 - 80% DRP	80 - 100% DRP	> 100% DRP
2020	12	31	0	0	7	8	11	5
2021	20	112	15	31	17	29	20	0
2022	20	106	14	37	20	21	15	0
2023	24	144	31	41	29	30	13	0
Total		393	60	109	73	88	59	5
Percent of Total			15%	28%	19%	22%	15%	1%

Table 4: DRP Percentage of TP Ranges (DRP >100% due to sample variance).

Total Suspended Solids Analysis

TSS results vary by site with no clear trend of concentrations increasing or decreasing from 2020-2023. The 2023 sampling season had less precipitation than average, which results in less runoff, yet TSS concentrations at some monitoring sites remained high. TSS results have been compared to the other parameters to identify trends, and none have been noted. There are 12 sites with four years of sampling, but the remaining 12 sites have been sampled for less time. It can be hard to identify trends after just four years of data, TSS trends will be monitored for in future seasons. TSS medians for all sites from 2020-2023 are shown in Figure 3.

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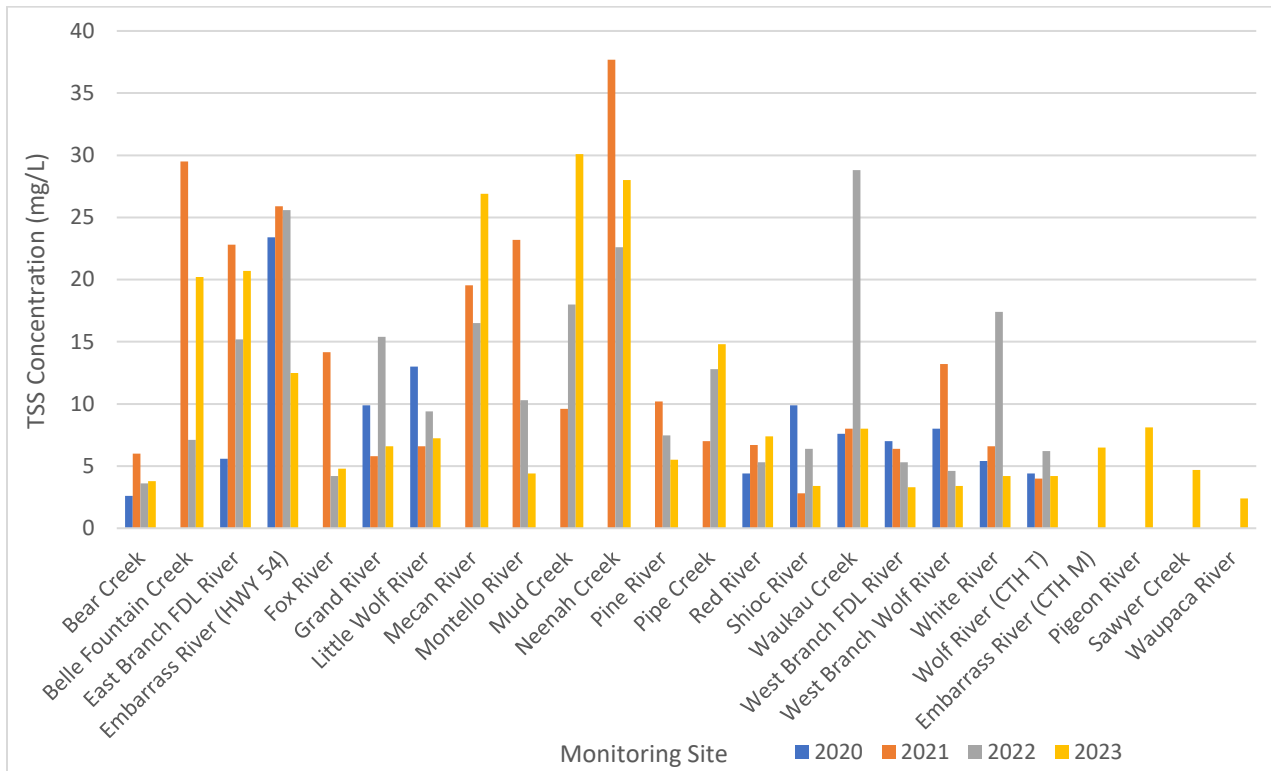


Figure 3: Median TSS concentrations for each monitoring site.

Total Nitrogen Analysis

Total nitrogen analysis may provide valuable insight to water quality as Nitrogen may have similar impacts to water quality as phosphorus. Nitrogen is commonly found and used in agricultural settings, testing for it may prove useful in assessing water quality across the UFWB. TN concentrations vary by site, there is no clear trend across the sampling seasons. For some of the sites with multiple years of data, 2023 was the year with the lowest median TN concentration, but that is not true for all sites. TN results will be analyzed in future sampling seasons for trends. Figure 4 shows the TN medians for each site from 2020-2023.

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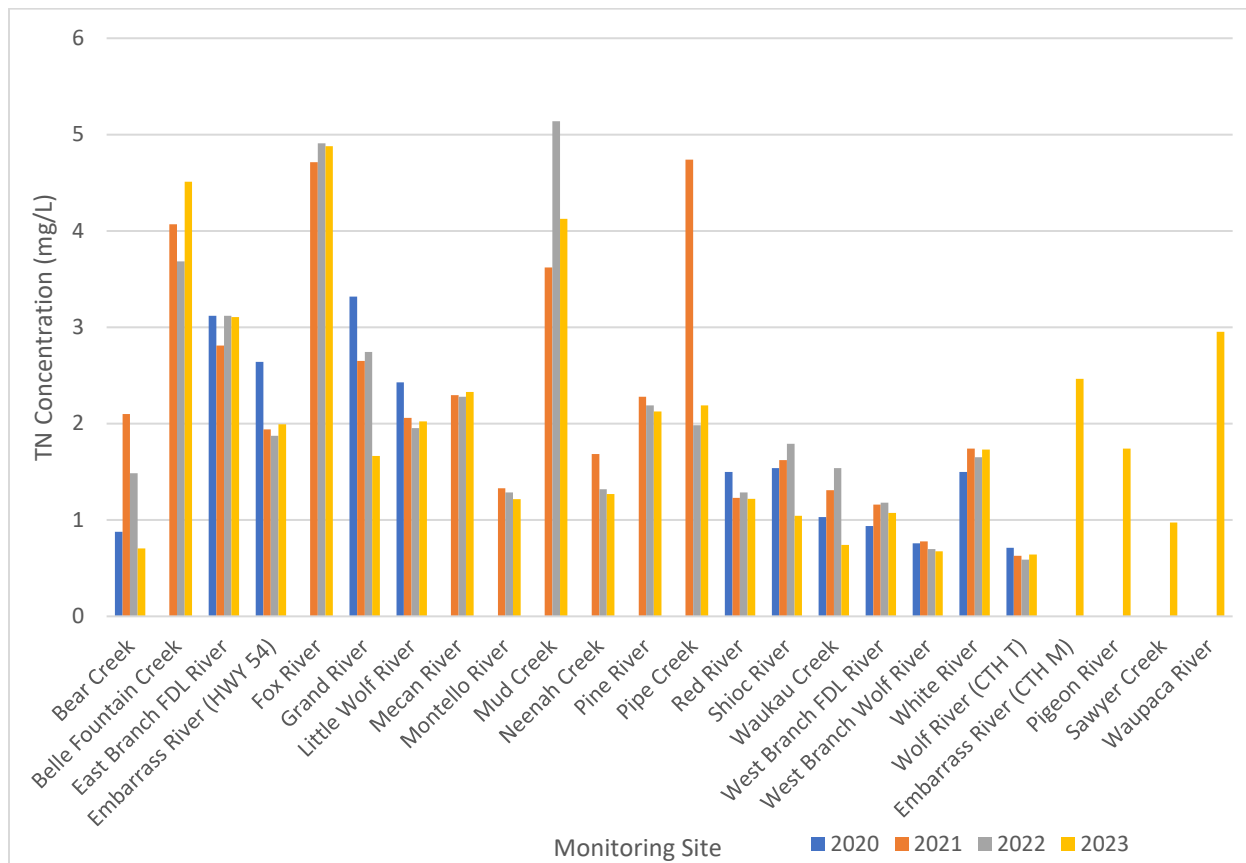


Figure 4: Median TN concentrations for each monitoring site.

Field Quality Assurance/Quality Control Duplicate Samples

To document the accuracy and precision of the field data collected by volunteers, two duplicate samples were taken as quality assurance/quality control (QA/QC) samples in 2023. In previous years 10% of the samples taken also had a duplicate sample, there were less duplicate samples in 2023 due to budget constraints. The duplicate sample locations were randomly selected from the list of sites that are monitored. These QA/QC tests document the accuracy and precision of the data collected and look at natural variability and sampling error.

Duplicate samples are collected on the same day and time as the regular samples, they are analyzed for the same parameters as the regular samples. Duplicate sample results were compared to the regular sample result and an absolute difference was calculated. The absolute difference between the two sets of samples is compared to each test’s Level of Quantification (LOQ) and is considered good data quality if the value falls below the LOQ. The absolute difference for all parameters for the 2023 duplicate samples were below the LOQ, meaning it is good quality data. Relative percent difference between the regular and duplicate samples was also calculated, the results are flagged if the percentage is greater than 30% as this indicates a variance between the two sample results. The relative percent difference for each parameter was below 30% for both duplicate samples, indicating limited variance. Duplicate sample results are in Appendix H.

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Stream Flow and Transparency

In addition to collecting surface water samples each month, volunteers collect stream flow and water transparency data. Stream flow is affected by the amount of water within a watershed and increases with rainstorms or snowmelt and decreases during dry periods. Flow defines the shape, size, and course of the stream. Streamflow and transparency data can be found in Appendix I.

Volunteers measure streamflow using a velocity-area approach, the stream needs to be wadable and two people are required. A 20 ft. length of stream is assessed, the volunteer measures the width of the stream and the water depth at numerous locations across the width. Water velocity is determined by measuring the time it takes for a tennis ball to float along the stream length.

Water transparency is collected each month with a transparency tube. Water clarity is closely tied to suspended sediment in the water and is also affected by dissolved material and algae. Transparency readings range from 0-120cm, clear water with minimal dissolved material has a reading of 120cm. In 2023, 48 of the 115 (42%) transparency readings taken were 120cm, most of these results happened in September and October. Transparency readings will be analyzed in future seasons to determine if water clarity is increasing across the UFWB.

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Key Takeaways for 2020-2023

- The number of TP samples below the State WQC of 0.075 mg/L increased in 2023, with 58% of the samples below 0.075 mg/L in 2023 compared to 51% in 2022
- Eleven of the 24 monitoring sites sampled in the UFWB “Clearly Meet” TP WQC according to their confidence limits calculated with data from 2023
- TP median values for 10 of the 24 monitoring sites exceeded the State WQC in 2023
- DRP concentrations continued to decrease in 2023, with the highest percentage of samples having 20-40% of their TP concentrations from DRP and there were less samples with 80-100% DRP concentration. The differences between the sampling years in the number of samples in each percentage range could be due to the variability in the number of samples taken during each season and the addition of monitoring sites throughout the duration of the program
 - Less precipitation in 2023 could have contributed to lower DRP concentrations, less precipitation can cause a lower conversion of particulate phosphorus to DRP and a greater uptake of DRP in plant biomass
 - Precipitation in 2023 varied across the UFWB, with much of the basin receiving three to six inches less precipitation than average
- There are no clear trends for TSS or TN concentrations, these results vary each year by site and do not show correlation with other parameters
- Transparency is closely tied to suspended sediment, dissolved material, and algae in the water, if there is more sediment the transparency will decrease. The months with the highest transparency results are September and October

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Conclusions

Data Conclusions

The UFWB volunteer monitoring program has been going for four years, meaning there is not enough data to see a definitive trend in the sampling streams. The program is still young, and trends will change throughout its existence, especially when best management practices and implementation continue in the UFWB and improve the water quality in the given watersheds. Raw data may suggest that variations in weather patterns, temperature, and time of year may have an impact on the TP, DRP, TSS, and TN concentrations. Weather varies each sampling season which is why it's important to sample consecutive years; 2023 had less than average rainfall, which can affect the median values for 2023.

Based on the data from 2020-2023 there are thirteen monitoring sites with a median TP value below the WQC of 0.075 mg/L. Appendix E contains a graph showing the median TP values for each monitoring site. This median is based on four years or less of data because multiple monitoring sites were added after the program started in 2020. From 2021-2023 the number of TP samples meeting the TP WQC of 0.075 mg/L has increased, 42% of the samples in 2021 met the WQC while 58% met the WQC in 2023. An increase of samples meeting the TP WQC can show water quality improvements, but it's important to monitor if this trend continues because water quality improvement can't be demonstrated with only a few years of data.

Dissolved phosphorus percentages have decreased over the three sampling seasons, but there are still monitoring sites with DRP results exceeding the TP WQC of 0.075 mg/L. Appendix F provides a table of the percentage of DRP making up each TP sample and Table 4 categorizes the values into percentage categories. In 2023 the DRP percentage range with the most samples was 20-40%, which is also the range with the most samples over the four sampling seasons at 28% of the total samples collected from 2020-2023. The dissolved form of phosphorus is readily available for plant uptake and contributes to harmful algal blooms, it is important best management practices focus on reducing DRP along with total phosphorus.

Total suspended solids and total nitrogen continue to have variable results and there are no trends to note from 2020-2023. These parameters do not have a State WQC and there is no criteria defined for these parameters. These parameters will continue to be monitored for and the results will be analyzed for future trends.

The data collected through the UFWB volunteer monitoring program shows there are water quality improvements that still need to be made, which means establishing best management practices in these basins is important.

Program Conclusions

The primary goal of the UFWB volunteer monitoring program is to engage the public and increase their awareness of water quality issues. In 2023, 22 volunteers, including eight new ones, collected samples across 24 monitoring sites. Some of these volunteers are part of larger organizations, making the contribution much higher. With the knowledge our past and present volunteers possess, they can teach others and be an extension of the program. Our volunteers

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can talk about their experiences and the things they have seen with others, which allows the information to be carried out to even more individuals in the area.

Volunteer recruitment has been carried out through various ways throughout the project. Two main means for volunteer recruitment were expanding outreach through Fox Wolf Watershed Alliance and outreach to County Land and Water Conservation Departments. These partnerships allowed the DNR to recruit volunteers on a bigger platform and spread awareness about the volunteer monitoring program.

The use of volunteers has proved important for success. Many volunteers are involved with the program which requires constant coordination and communication by the DNR coordinator to ensure success of the program. Communication proves to be the most important aspect of the DNR coordinator's position. The coordinator is the liaison between the volunteers and other DNR staff that are involved within the program. Without proper communication, some aspects of the program can potentially be impacted. Volunteers noted the communication from the DNR coordinator in 2023 was more than previous sampling seasons and was very helpful, particularly for the new volunteers.

The water quality data is crucial to assessing long-term trends in water quality. The water quality data can be used to determine where additional monitoring should occur when additional resources become available and target other monitoring efforts in particular watersheds. Five watersheds within the UFWB currently have 9 Key Element plans to reduce phosphorus and sediment in high loading watersheds: Bear Lake-Little Wolf River (2017), Big Green Lake (2022), Pipe Creek (2018), Shaw Creek-Little Wolf River (2019), and Weyauwega Lake-Waupaca River (2019). As implementation of these plans occur, monitoring data will be used to help track implementation progress and determine where additional data and information is needed to track progress.

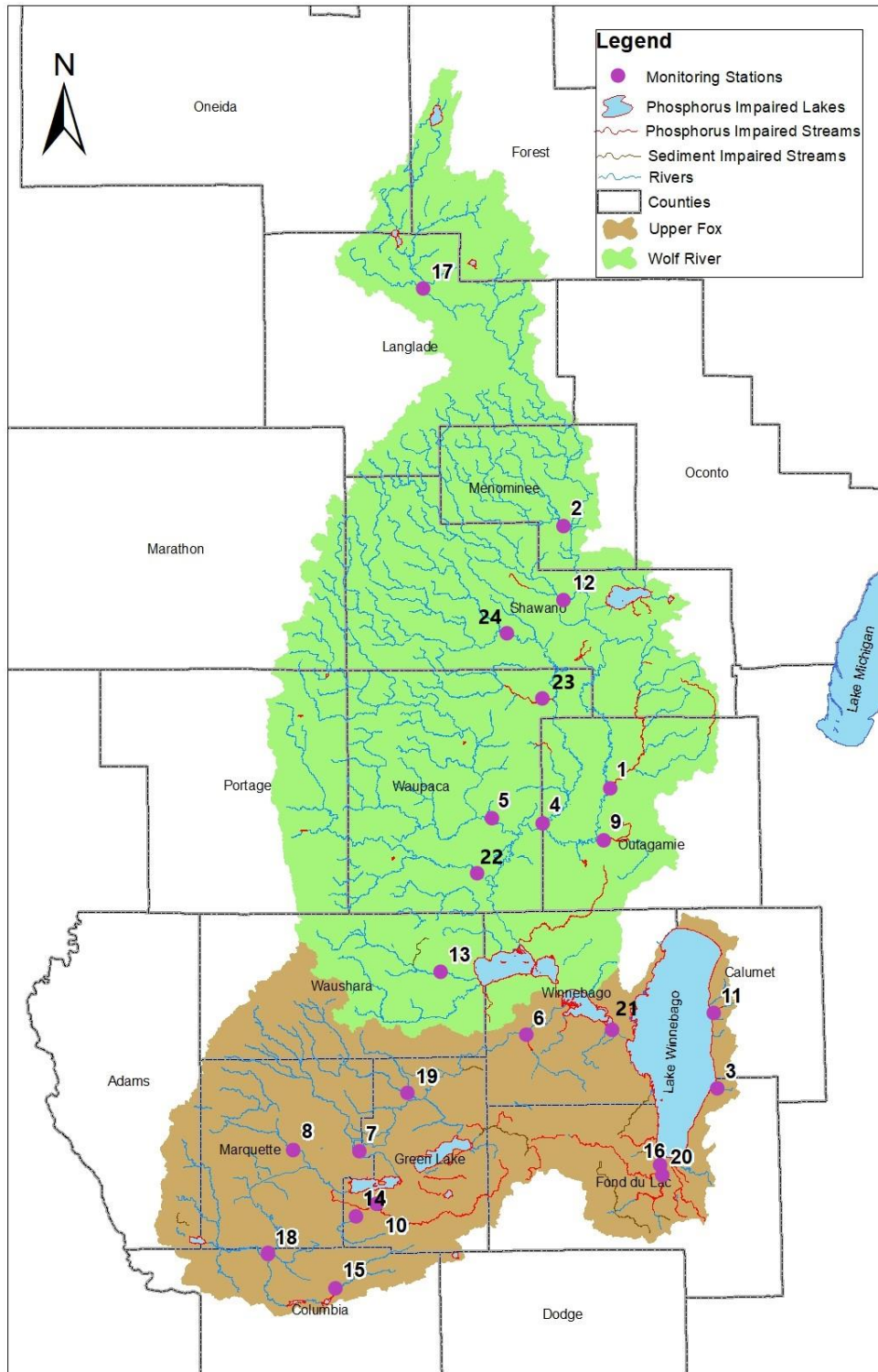
Acknowledgements

Thank you to all the volunteers, present and past, that have made the Upper Fox and Wolf River Basins Volunteer Monitoring Program possible. Thank you to the Wisconsin DNR and the WAV program for funding and support. The WAV program manages a nutrient data database, where results can be viewed for monitoring sites across the state, including the Upper Fox and Wolf River Basins volunteer monitoring sites ([WAV Data Dashboard \(wisc.edu\)](https://wisc.edu/wav)).

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Appendices

Appendix A: Upper Fox and Wolf River Basins Volunteer Monitoring Sites and TMDL Basin Boundaries



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Stream Name	SWIMS Station Name	County	SWIMS ID	Latitude	Longitude
1	Shioc River	Shioc River at STH 187	Outagamie	453030	44.464379 -88.56017
2	West Branch Wolf River	West Branch Wolf River at West Branch Rd	Menominee	403003	44.94093 -88.66435
3	Pipe Creek	Pipe Creek- 30 feet above HWY 151 Bridge	Fond du Lac	10016803	43.91841 -88.3103
4	Embarrass River	Embarrass River at New London HWY 54	Outagamie	10033493	44.405953 -88.73024
5	Little Wolf River	Little Wolf River at Royalton STH 54	Waupaca	693217	44.418276 -88.85648
6	Waukau Creek	Waukau Creek at CTH E USGS Site ID 04073970	Winnebago	713285	44.01841 -88.7854
7	Mecan River	Mecan River at CTH C	Marquette	393005	43.816794 -89.20955
8	Montello River	Montello River at 11 th St Bridge USGS Site ID 04072845	Marquette	1022879	43.82047 -89.3575
9	Bear Creek	Bear Creek at STH 76	Outagamie	453259	44.365693 -88.57791
10	Grand River	Grand River at CTH H Near Kingston, WI	Green Lake	243015	43.711983 -89.1541
11	Mud Creek	Mud Creek at Mud Creek Rd	Calumet	83121	44.05352 -88.3171
12	Red River	Red River at Maple Ave	Shawano	10014632	44.803515 -88.65981
13	Pine River	Pine River at HWY 49	Waushara	10032735	44.13583 -88.9962
14	Belle Fountain Creek	Belle Fountain Creek at CTH B	Green Lake	243028	43.704172 -89.21482
15	Fox River	Fox River at HWY 33	Columbia	10014339	43.569939 -89.27703
16	West Branch Fond du Lac River	West Branch FDL at Forest Ave	Fond du Lac	10037662	43.77697 -88.4553
17	Wolf River	Wolf River at CTH T	Langlade	343057	45.367529 -89.01287
18	Neenah Creek	Neenah Creek at CTH CM	Columbia	113070	43.631283 -89.43518
19	White River	White River at White River Rd Landing	Green Lake	10041320	43.917482 -89.07898
20	East Branch Fond du Lac River	East Branch FDL at 12 th St	Fond du Lac	10014745	43.76557 -88.4511
21	Sawyer Creek	Sawyer Creek at N Westfield Street	Winnebago	10034847	44.02862 -88.57722
22	Waupaca River	Waupaca River at River Road Weyauwega	Waupaca	693020	44.31608 -88.90498
23	Pigeon River	Pigeon River at Klemp Rd	Waupaca	693135	44.62791 -88.73169
24	Embarrass River	Embarrass River at CTH M	Shawano	593168	44.74056 -88.80111

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Appendix B: Upper Fox and Wolf River Basins Volunteer Monitoring Fact Sheet

Upper Fox & Wolf Volunteer Monitoring Fact Sheet

The EPA approved the Upper Fox-Wolf (UFW) TMDL in 2020. The TMDL identifies the need for reductions in Total Phosphorus (TP) and Total Suspended Solids (TSS) in waterbodies throughout the basin to meet water quality standards. A total of 43 streams and rivers and 19 lakes and reservoirs are impaired for excess phosphorus while a total of 19 streams and rivers are impaired for excess sediment. Phosphorus is an essential nutrient for plant growth, but can have detrimental effects on lakes, rivers, and streams when excess amounts are introduced. Common forms of pollutant delivery in these systems include surface runoff from urban and agricultural areas and discharges from wastewater treatment facilities, industrial businesses, and farms.

To assess long-term trends in water quality, 24 stream sites were chosen as part of the UFW volunteer monitoring program to collect water samples throughout the UFW basin. There were 20 sites when this program started in 2020, and four were added in 2023. The UFW volunteer monitoring program relies on volunteers to collect reliable data to assist the DNR in tracking water quality trends overtime. Volunteers collect water samples once per month, May through October. Samples are shipped to the State Lab of Hygiene in Madison and are analyzed for Total Phosphorus, Total Suspended Solids, and Total Nitrogen.

UFW BASIN QUICK FACTS

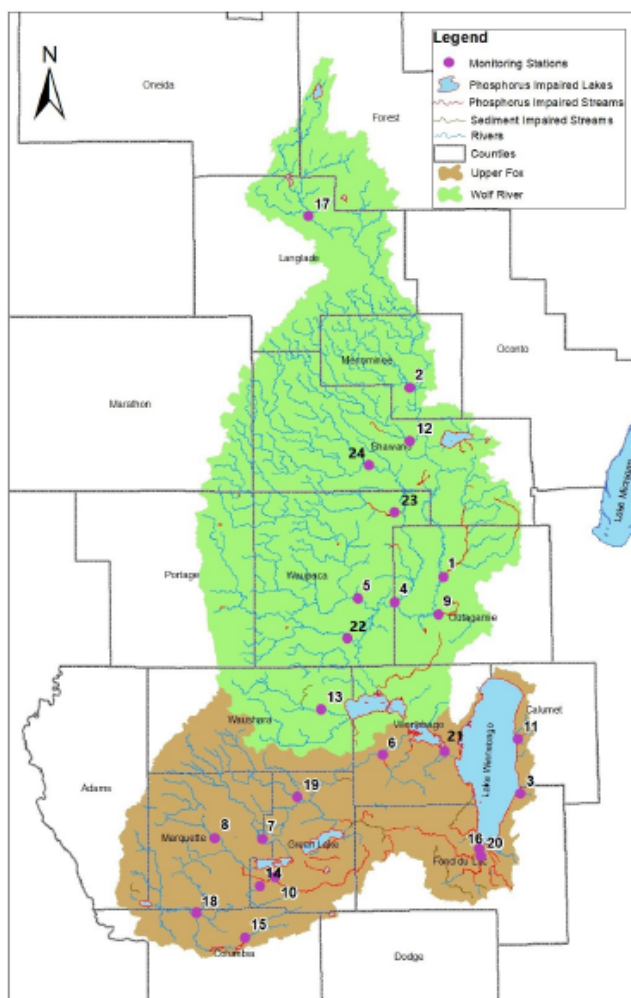
- 5,900 square mile watershed area
- Covers 18 counties
- Includes 5 Tribal Lands
- 32 Concentrated Animal Feeding Operations (CAFOs)
- 29 permitted Municipal Separate Storm Sewer System (MS4s*)
- 78 Dischargers (municipal and industrial)

Want to get involved? Contact:

Katherine Wendorf
Water Resource Management Specialist
Natural Resources Program Coordinator
T: (920) 296-5126
Katherine.wendorf@wisconsin.gov

*MS4s - municipal separate storm sewer system; municipalities with WPDES permits for stormwater management.

See Backside for exact sample locations



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24	Embarrass River	Embarrass River at CTH M	Shawano	593168	44.74056 -88.80111

SWIMS– Surface Water Integrated Monitoring System, is a Wisconsin DNR information system that houses chemistry (water, sediment), physical, and biological (macroinvertebrate, aquatic invasive species) surface water data.

Want to find out more? Visit <https://dnr.wi.gov/topic/TMDLs/FoxWolf/index.html>

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Appendix C: Impaired Monitoring Streams

Local Waterbody Name	Waters ID	WBIC	County	Start Mile	End Mile	Total Size (mi)	Date Listed	Source Category	Pollutant	Impairment	Listing Condition Category
Pipe Creek	10979	132800	Fond Du Lac	0	2.5	2.5	4/1/2020	NPS	Total Phosphorus	Degraded Biological Community	TMDL approved by EPA in 2020 (4A)
West Branch Fond Du Lac River	10990	134000	Fond Du Lac	0	26.79	26.79	4/1/2016	PS/NPS	Unknown Pollutant	Elevated Water Temperature	TMDL Needed (5A)
									Total Phosphorus	High Phosphorus Levels	TMDL approved by EPA in 2020 (4A)
Bear Creek	9791	316000	Outagamie	0.5	2	1.5	4/1/2012	PS/NPS	Total Phosphorus	High Phosphorus Levels	TMDL approved by EPA in 2020 (4A)
	9792			2	8	6	4/1/2012	NPS	Total Phosphorus	High Phosphorus Levels	
	10413	292100	Outagamie			8.4	4/1/2020	PS/NPS	Total Phosphorus	High Phosphorus Levels	
	10414		Outagamie, Waupaca			3.6	4/1/2016		Total Phosphorus	Degraded Biological Community	

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							4/1/2022	NPS	Sediment/ Total Suspended Solids	Degraded Habitat	
East Branch Fond Du Lac River	10991	135900	Fond Du Lac	0	14.5	14.5	4/1/2014	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2020 (4A)
	3990279			14.5	22.81	8.31	4/1/2018	PS/NPS	Total Phosphorus	High Phosphorus Levels	Phosphorus only (5P)
Grand River	11097	159300	Green Lake, Marquette	0	21	21	4/1/2014	PS/NPS	Total Phosphorus	Degraded Biological Community	TMDL approved by EPA in 2020 (4A)
	10702		Fond Du Lac, Green Lake, Marquette	21	43	22	4/1/2016		Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2020 (4A)
Mud Creek	10259	131600	Calumet	0	3	3	4/1/2016	NPS	Total Phosphorus	Degraded Biological Community	TMDL approved by EPA in 2020 (4A)
Shioc River	9800	316800	Outagamie, Shawano	0	27.96	27.96	4/1/2012	PS/NPS	Total Phosphorus	Degraded Biological Community, High Phosphorus Levels	TMDL approved by EPA in 2020 (4A)

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Waukau Creek	18163	140700	Winnebago	0	4.22	4.22	4/1/2014	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2020 (4A)
Fox River	5535277	117900	Columbia			7.2	4/1/2022	NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2020 (4A)
	6778560		Green Lake, Marquette			7.4		PS/NPS	Total Phosphorus	Degraded Biological Community	
Pigeon River	9711	293100	Waupaca			5.2	4/1/2014	PS/NPS	Total Phosphorus	Impairment Unknown	TMDL approved by EPA in 2020 (4A)
	8107179					3			Total Phosphorus	Impairment Unknown	
Waupaca River	315887	257400	Waupaca			15.5	4/1/2016	NPS	Unknown Pollutant	Elevated Water Temperature	TMDL needed (5a)
Wolf River- Main Stem	11237	241300	Winnebago			9.5	4/1/1998	NPS	Total Phosphorus	Low DO	TMDL approved by EPA in 2020 (4A)
									Sediment/ Total Suspended Solids	Degraded Habitat	

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Appendix D: Confidence Interval Table

River	TP Calculation	2021	2022	2023
Bear Creek	U90% (mg/L)	0.1678	0.2044	0.2149
	Median (mg/L)	0.117	0.168	0.171
	L90% (mg/L)	0.09297	0.1316	0.1261
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds	Clearly Exceeds
Belle Fountain Creek	U90% (mg/L)	0.11686	0.0858	0.0792
	Median (mg/L)	0.0944	0.0602	0.0645
	L90% (mg/L)	0.06939	0.0345	0.0498
	Relation to Criteria	May Exceed	May Meet	May Meet
East Branch FDL River	U90% (mg/L)	0.31633	0.3865	0.1958
	Median (mg/L)	0.296	0.2890	0.1600
	L90% (mg/L)	0.21489	0.1915	0.1242
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds	Clearly Exceeds
Embarrass River (STH 54)	U90% (mg/L)	0.09931	0.1057	0.0706
	Median (mg/L)	0.0825	0.0892	0.0558
	L90% (mg/L)	0.06145	0.0727	0.0409
	Relation to Criteria	May Exceed	May Exceed	Clearly Meets
Fox River	U90% (mg/L)	0.14288	0.1241	0.0833
	Median (mg/L)	0.09775	0.0891	0.0752
	L90% (mg/L)	0.07302	0.0541	0.0670
	Relation to Criteria	May Exceed	May Exceed	May Exceed
Grand River	U90% (mg/L)	0.18069	0.2010	0.2717
	Median (mg/L)	0.174	0.1610	0.2245
	L90% (mg/L)	0.11518	0.1210	0.1773
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds	Clearly Exceeds
Little Wolf River	U90% (mg/L)	0.05411	0.0599	0.0417
	Median (mg/L)	0.0486	0.0511	0.0366
	L90% (mg/L)	0.03603	0.0422	0.0314
	Relation to Criteria	Clearly Meets	Clearly Meets	Clearly Meets
Mecan River	U90% (mg/L)	0.06915	0.0605	0.0520
	Median (mg/L)	0.0603	0.0468	0.0399
	L90% (mg/L)	0.04103	0.0331	0.0277
	Relation to Criteria	Clearly Meets	Clearly Meets	Clearly Meets

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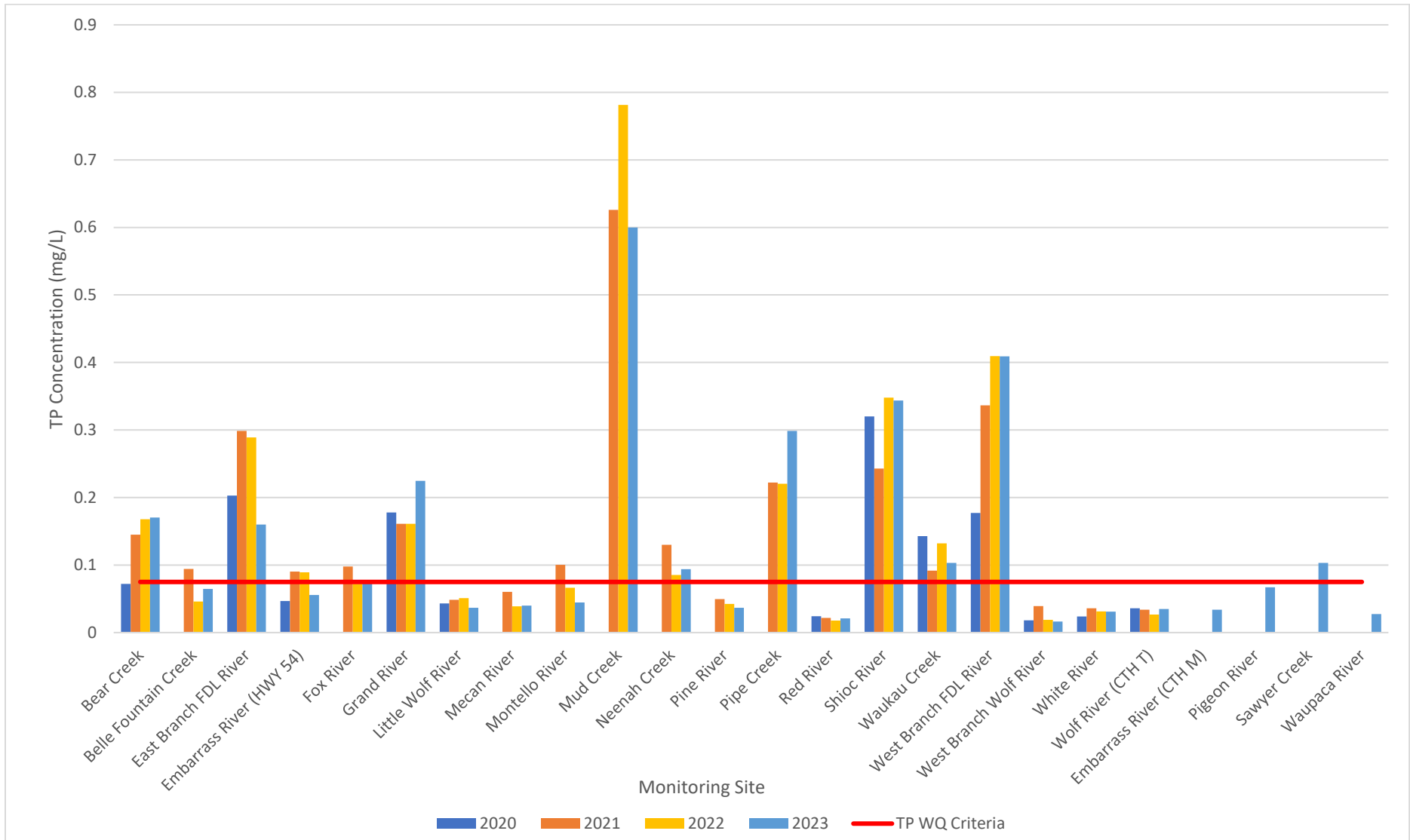
Montello River	U90% (mg/L)	0.11042	0.1099	0.0526
	Median (mg/L)	0.1002	0.0901	0.0445
	L90% (mg/L)	0.06758	0.0703	0.0363
	Relation to Criteria	May Exceed	May Exceed	Clearly Meets
Mud Creek	U90% (mg/L)	0.6824	0.9406	0.7975
	Median (mg/L)	0.6260	0.7815	0.6000
	L90% (mg/L)	0.569609575	0.6224	0.4025
	Relation to Criteria	Clearly Meets	Clearly Exceeds	Clearly Exceeds
Neenah Creek	U90% (mg/L)	0.15073	0.1098	0.1067
	Median (mg/L)	0.13	0.0892	0.0939
	L90% (mg/L)	0.10178	0.0686	0.0811
	Relation to Criteria	Clearly Exceeds	May Exceed	Clearly Exceeds
Pine River	U90% (mg/L)	0.087070636	0.0491	0.0399
	Median (mg/L)	0.0496	0.0424	0.0368
	L90% (mg/L)	0.012129364	0.0356	0.0337
	Relation to Criteria	Clearly Meets	Clearly Meets	Clearly Meets
Pipe Creek	U90% (mg/L)	0.328516516	0.2608	0.4231
	Median (mg/L)	0.2220	0.2205	0.2985
	L90% (mg/L)	0.1155	0.1802	0.1739
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds	Clearly Exceeds
Red River	U90% (mg/L)	0.02607	0.0239	0.0264
	Median (mg/L)	0.02295	0.0178	0.0211
	L90% (mg/L)	0.01859	0.0116	0.0158
	Relation to Criteria	Clearly Meets	Clearly Meets	Clearly Meets
Shioc River	U90% (mg/L)	0.37548	0.3623	0.4322
	Median (mg/L)	0.3065	0.3148	0.3435
	L90% (mg/L)	0.2364	0.2672	0.2548
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds	Clearly Exceeds
Waukau Creek	U90% (mg/L)	0.138	0.1788	0.1308
	Median (mg/L)	0.10785	0.1305	0.1032
	L90% (mg/L)	0.07286	0.0822	0.0755
	Relation to Criteria	May Exceed	Clearly Exceeds	Clearly Exceeds

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West Branch FDL River	U90% (mg/L)	0.3607	0.4996	0.6498
	Median (mg/L)	0.31	0.4095	0.4090
	L90% (mg/L)	0.19822	0.3194	0.1682
	Relation to Criteria	Clearly Exceeds	Clearly Exceeds	Clearly Exceeds
West Branch Wolf River	U90% (mg/L)	0.03794	0.0224	0.0243
	Median (mg/L)	0.0238	0.0189	0.0165
	L90% (mg/L)	0.01858	0.0153	0.0086
	Relation to Criteria	Clearly Meets	Clearly Meets	Clearly Meets
White River	U90% (mg/L)	0.03775	0.0423	0.0381
	Median (mg/L)	0.0289	0.0314	0.0310
	L90% (mg/L)	0.02435	0.0205	0.0239
	Relation to Criteria	Clearly Meets	Clearly Meets	Clearly Meets
Wolf River (CTH T)	U90% (mg/L)	0.03661	0.0300	0.0465
	Median (mg/L)	0.0343	0.0266	0.0350
	L90% (mg/L)	0.02939	0.0232	0.0235
	Relation to Criteria	Clearly Meets	Clearly Meets	Clearly Meets
Embarrass River (CTH M)	U90% (mg/L)	-	-	0.0372
	Median (mg/L)	-	-	0.0337
	L90% (mg/L)	-	-	0.0302
	Relation to Criteria	-	-	Clearly Meets
Pigeon River	U90% (mg/L)	-	-	0.0735
	Median (mg/L)	-	-	0.0671
	L90% (mg/L)	-	-	0.0606
	Relation to Criteria	-	-	Clearly Meets
Sawyer Creek	U90% (mg/L)	-	-	0.1373
	Median (mg/L)	-	-	0.1032
	L90% (mg/L)	-	-	0.0691
	Relation to Criteria	-	-	May Exceed
Waupaca River	U90% (mg/L)	-	-	0.0313
	Median (mg/L)	-	-	0.0273
	L90% (mg/L)	-	-	0.0233
	Relation to Criteria	-	-	Clearly Meets

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Appendix E: Median Total Phosphorus Concentration by Monitoring Site



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Appendix F: Percentage of Total Phosphorus Concentrations from Dissolved Reactive Phosphorus

DRP % of TP					
Monitoring Site	Month	2020	2021	2022	2023
Bear Creek	May	-	-	50%	54%
	June	-	82%	72%	65%
	July	-	71%	84%	75%
	August	-	77%	84%	76%
	September	57%	67%	78%	70%
	October	82%	74%	62%	79%
Belle Fountain Creek	May	-	29%	30%	16%
	June	-	20%	-	25%
	July	-	20%	49%	26%
	August	-	56%	-	32%
	September	-	50%	37%	45%
	October	-	63%	32%	50%
East Branch FDL River	May	-	71%	74%	67%
	June	-	61%	58%	71%
	July	-	80%	65%	75%
	August	88%	82%	81%	66%
	September	82%	78%	75%	53%
	October	90%	84%	63%	68%
Embarrass River (STH 54)	May	-	45%	47%	52%
	June	-	13%	35%	17%
	July	-	11%	10%	7%
	August	-	62%	14%	11%
	September	42%	34%	27%	25%
	October	87%	51%	51%	16%
Fox River	May	-	27%	-	35%
	June	-	50%	34%	46%
	July	-	48%	64%	53%
	August	-	62%	-	62%
	September	-	70%	-	67%
	October	-	58%	54%	53%
Grand River	May	-	61%	49%	31%
	June	-	77%	84%	77%
	July	-	83%	76%	85%
	August	98%	93%	69%	78%
	September	73%	76%	85%	85%
	October	42%	82%	52%	79%

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Little Wolf River	May	-	50%	37%	31%
	June	-	59%	39%	26%
	July	-	52%	41%	45%
	August	-	77%	47%	39%
	September	50%	43%	53%	45%
	October	132%	61%	55%	27%
Mecan River	May	-	22%	16%	15%
	June	-	18%	-	22%
	July	-	75%	12%	15%
	August	-	39%	-	23%
	September	-	59%	32%	9%
	October	-	27%	27%	34%
Montello River	May	-	31%	34%	37%
	June	-	38%	-	51%
	July	-	12%	37%	62%
	August	-	62%	-	52%
	September	-	52%	48%	56%
	October	-	29%	29%	48%
Mud Creek	May	-	87%	81%	58%
	June	-	-	80%	67%
	July	-	92%	88%	79%
	August	-	84%	84%	89%
	September	-	97%	94%	92%
	October	-	81%	93%	91%
Neenah Creek	May	-	20%	-	8%
	June	-	19%	16%	14%
	July	-	25%	15%	9%
	August	-	18%	-	10%
	September	-	7%	18%	15%
	October	-	7%	15%	12%
Pine River	May	-	-	14%	38%
	June	-	16%	35%	20%
	July	-	29%	37%	58%
	August	-	28%	45%	43%
	September	-	40%	39%	45%
	October	-	8%	61%	24%
Pipe Creek	May	-	-	20%	54%
	June	-	84%	83%	66%
	July	-	83%	7%	60%
	August	-	88%	71%	38%
	September	-	81%	45%	18%
	October	-	76%	84%	52%

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Red River	May	-	-	23%	0%
	June	-	33%	33%	33%
	July	-	82%	22%	30%
	August	85%	65%	41%	32%
	September	89%	27%	30%	40%
	October	180%	26%	-	ND
Shioc River	May	-	-	58%	50%
	June	-	78%	81%	67%
	July	-	59%	78%	88%
	August	-	79%	79%	92%
	September	53%	82%	56%	81%
	October	70%	75%	-	79%
Waukau Creek	May	-	47%	17%	40%
	June	-	78%	45%	68%
	July	-	-	74%	78%
	August	46%	67%	69%	77%
	September	74%	29%	38%	70%
	October	68%	53%	0%	37%
West Branch FDL River	May	-	80%	77%	72%
	June	-	85%	79%	81%
	July	-	64%	84%	87%
	August	80%	83%	87%	89%
	September	101%	78%	71%	81%
	October	96%	86%	71%	72%
West Branch Wolf River	May	-	-	30%	35%
	June	-	23%	28%	0%
	July	-	39%	26%	0%
	August	-	5%	43%	43%
	September	134%	35%	36%	43%
	October	98%	19%	39%	11%
White River	May	-	30%	27%	14%
	June	-	33%	20%	18%
	July	-	38%	36%	16%
	August	63%	35%	29%	28%
	September	122%	33%	40%	ND
	October	71%	38%	37%	39%
Wolf River (CTH T)	May	-	14%	31%	9%
	June	-	26%	31%	0%
	July	-	26%	27%	23%
	August	51%	12%	19%	15%
	September	71%	25%	29%	31%
	October	74%	40%	24%	11%

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Embarrass River (CTH M)	May	-	-	-	30%
	June	-	-	-	22%
	July	-	-	-	18%
	August	-	-	-	27%
	September	-	-	-	24%
	October	-	-	-	35%
Pigeon River	May	-	-	-	26%
	June	-	-	-	30%
	July	-	-	-	31%
	August	-	-	-	20%
	September	-	-	-	19%
	October	-	-	-	20%
Sawyer Creek	May	-	-	-	36%
	June	-	-	-	58%
	July	-	-	-	80%
	August	-	-	-	66%
	September	-	-	-	49%
	October	-	-	-	61%
Waupaca River	May	-	-	-	34%
	June	-	-	-	33%
	July	-	-	-	60%
	August	-	-	-	48%
	September	-	-	-	54%
	October	-	-	-	22%

Red percentages indicate the DRP concentration exceeded the TP concentration (DRP >100%)

Italicized and bold percentages indicate the DRP sample concentration was above the 0.075 mg/L criteria

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Appendix G: 2020-2023 Sampling Data

TP (mg/L)					
Stream Name	Month	2020	2021	2022	2023
Bear Creek	May	-	-	0.0871	0.0686
	June	-	0.324	0.167	0.162
	July	-	0.163	0.217	0.179
	August	-	0.145	0.194	0.203
	September	0.0576	0.117	0.169	0.152
	October	0.0867	0.106	0.0686	0.291
Belle Fountain Creek	May	-	0.0969	0.056	0.11
	June	-	0.143	-	0.0614
	July	-	0.132	0.036	0.0676
	August	-	0.0919	-	0.0714
	September	-	0.0726	0.0643	0.0552
	October	-	0.0437	0.0301	0.0383
East Branch FDL River	May	-	0.298	0.318	0.159
	June	-	0.299	0.445	0.223
	July	-	0.501	0.507	0.283
	August	0.203	0.405	0.254	0.161
	September	0.208	0.296	0.26	0.129
	October	0.129	0.191	0.0572	0.145
Embarrass River (STH 54)	May	-	0.0761	0.0914	0.0931
	June	-	0.122	0.0887	0.0527
	July	-	0.144	0.0897	0.067
	August	-	0.0918	0.101	0.0588
	September	0.0633	0.0889	0.081	0.027
	October	0.0298	0.0674	0.0263	0.0323
Fox River	May	-	0.173	-	0.0778
	June	-	0.0895	0.169	0.0588
	July	-	0.209	0.0722	0.057
	August	-	0.106	-	0.0821
	September	-	0.0706	-	0.091
	October	-	0.0469	0.0321	0.0725
Grand River	May	-	0.24	0.149	0.0767
	June	-	0.208	0.184	0.147
	July	-	0.174	0.237	0.235
	August	0.178	0.148	0.16	0.296
	September	0.11	0.0666	0.162	0.223
	October	0.229	0.0705	0.0382	0.226
Little Wolf River	May	-	0.0515	0.0555	0.0447
	June	-	0.0566	0.0545	0.041
	July	-	0.0658	0.0476	0.032

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	August	-	0.0457	0.0581	0.0391
	September	0.0664	0.0323	0.038	0.021
	October	0.02	0.0384	0.0201	0.034
Mecan River	May	-	0.0708	0.0482	0.0474
	June	-	0.0855	-	0.0266
	July	-	0.0498	0.0454	0.0502
	August	-	0.074	-	0.0323
	September	-	0.0314	0.0323	0.0756
	October	-	0.0326	0.0312	0.0218
Montello River	May	-	0.122	0.0838	0.0476
	June	-	0.104	-	0.0628
	July	-	0.123	0.107	0.0539
	August	-	0.0964	-	0.0413
	September	-	0.0452	0.0492	0.0292
	October	-	0.0611	0.0278	0.0298
Mud Creek	May	-	0.694	0.291	0.0929
	June	-	-	0.348	0.375
	July	-	0.626	0.88	0.482
	August	-	0.597	0.751	0.774
	September	-	0.728	0.815	0.997
	October	-	0.51	0.812	0.718
Neenah Creek	May	-	0.131	-	0.111
	June	-	0.143	0.0914	0.064
	July	-	0.177	-	0.0967
	August	-	0.126	-	0.0911
	September	-	0.129	0.0852	0.0981
	October	-	0.067	0.038	0.0581
Pine River	May	-	-	0.0614	0.036
	June	-	0.0908	0.0373	0.0317
	July	-	0.0438	0.0435	0.0378
	August	-	0.0496	0.0466	0.0464
	September	-	0.0364	0.0412	0.0376
	October	-	0.173	0.028	0.034
Pipe Creek	May	-	-	0.183	0.0814
	June	-	0.205	0.299	0.415
	July	-	0.154	0.137	0.356
	August	-	0.31	0.226	0.241
	September	-	0.222	0.215	0.672
	October	-	0.561	0.306	0.221
Red River	May	-	-	0.0361	0.031
	June	-	0.0408	0.0309	0.0366
	July	-	0.0218	0.0192	0.018

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	August	0.0243	0.0241	0.0153	0.0211
	September	0.0255	0.0144	0.0163	0.016
	October	0.0142	0.0203	0.01	ND
Shioc River	May	-	-	0.209	0.135
	June	-	0.243	0.404	0.31
	July	-	0.194	0.393	0.449
	August	-	0.658	0.348	0.567
	September	0.275	0.338	0.264	0.331
	October	0.365	0.198	-	0.356
Waukau Creek	May	-	0.0917	0.129	0.0695
	June	-	0.18	0.0984	0.14
	July	-	-	0.132	0.187
	August	0.143	0.124	0.168	0.123
	September	0.0432	0.0772	0.285	0.0833
	October	0.247	0.0424	0.0537	0.0796
West Branch FDL River	May	-	0.338	0.462	0.128
	June	-	0.452	0.479	0.245
	July	-	0.856	0.462	0.533
	August	0.31	0.335	0.357	0.504
	September	0.177	0.204	0.252	1.23
	October	0.114	0.125	0.112	0.314
West Branch Wolf River	May	-	-	0.0252	0.0134
	June	-	0.0435	0.0222	0.0302
	July	-	0.0238	0.0248	0.0195
	August	-	0.0691	0.0151	0.0116
	September	0.0188	0.00988	0.0155	0.0107
	October	0.0178	0.0393	0.0111	0.043
White River	May	-	0.044	0.0535	0.0457
	June	-	0.0729	0.0556	0.031
	July	-	0.0289	0.0376	0.0325
	August	0.0238	0.0433	0.0177	0.0187
	September	0.0211	0.0168	0.0252	ND
	October	0.0326	0.0196	0.0144	0.0164
Wolf River (CTH T)	May	-	0.041	0.0354	0.0701
	June	-	0.0454	0.0258	0.0263
	July	-	0.0343	0.0267	0.0306
	August	0.036	0.0299	0.0351	0.0394
	September	0.036	0.0213	0.0265	0.0207
	October	0.0249	0.0335	0.0216	0.0543
Embarrass River (CTH M)	May	-	-	-	0.0342
	June	-	-	-	0.0398
	July	-	-	-	0.0307

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	August	-	-	-	0.0439
	September	-	-	-	0.0332
	October	-	-	-	0.0289
Pigeon River	May	-	-	-	0.0511
	June	-	-	-	0.0673
	July	-	-	-	0.0668
	August	-	-	-	0.078
	September	-	-	-	0.0674
	October	-	-	-	0.0514
Sawyer Creek	May	-	-	-	0.0408
	June	-	-	-	0.109
	July	-	-	-	0.203
	August	-	-	-	0.131
	September	-	-	-	0.0715
	October	-	-	-	0.0974
Waupaca River	May	-	-	-	0.0293
	June	-	-	-	0.0253
	July	-	-	-	0.0347
	August	-	-	-	0.0324
	September	-	-	-	0.0166
	October	-	-	-	0.0237

DRP (mg/L)					
Stream Name	Month	2020	2021	2022	2023
Bear Creek	May	-	-	0.0438	0.0369
	June	-	0.267	0.121	0.106
	July	-	0.116	0.183	0.135
	August	-	0.112	0.162	0.155
	September	0.033	0.0785	0.132	0.107
	October	0.071	0.0783	0.0422	0.229
Belle Fountain Creek	May	-	0.0279	0.0169	0.0174
	June	-	0.0292	-	0.0154
	July	-	0.0263	0.0176	0.0173
	August	-	0.0512	-	0.0226
	September	-	0.036	0.0238	0.0248
	October	-	0.0277	0.00975	0.0191
East Branch FDL River	May	-	0.211	0.235	0.106
	June	-	0.183	0.256	0.158
	July	-	0.399	0.329	0.213
	August	0.179	0.331	0.205	0.107
	September	0.17	0.231	0.195	0.0688
	October	0.116	0.161	0.036	0.0988

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Embarrass River (STH 54)	May	-	0.0345	0.0434	0.0485
	June	-	0.0159	0.031	0.00903
	July	-	0.0162	0.00853	0.0046
	August	-	0.0567	0.0145	0.00658
	September	0.0264	0.0301	0.0219	0.00665
	October	0.0258	0.0344	0.0133	0.00511
Fox River	May	-	0.0471	-	0.0273
	June	-	0.0446	0.0567	0.0271
	July	-	0.101	0.0462	0.03
	August	-	0.0654	-	0.0508
	September	-	0.0494	-	0.0606
	October	-	0.0271	0.0174	0.0382
Grand River	May	-	0.147	0.0723	0.0234
	June	-	0.16	0.154	0.113
	July	-	0.144	0.179	0.199
	August	0.174	0.138	0.11	0.231
	September	0.0808	0.0503	0.137	0.19
	October	0.0965	0.0579	0.0198	0.178
Little Wolf River	May	-	0.0259	0.0204	0.0138
	June	-	0.0332	0.021	0.0106
	July	-	0.034	0.0193	0.0145
	August	-	0.035	0.0273	0.0151
	September	0.0335	0.0319	0.02	0.0095
	October	0.0263	0.0236	0.0111	0.00915
Mecan River	May	-	0.0158	0.00751	0.0069
	June	-	0.0155	-	0.00572
	July	-	0.0373	0.00547	0.00744
	August	-	0.0291	-	0.00739
	September	-	0.0186	0.0102	0.00653
	October	-	0.00875	0.00854	0.00732
Montello River	May	-	0.038	0.0285	0.0178
	June	-	0.04	-	0.0321
	July	-	0.0149	0.0394	0.0336
	August	-	0.0593	-	0.0214
	September	-	0.0236	0.0235	0.0163
	October	-	0.0176	0.008	0.0143
Mud Creek	May	-	0.606	0.236	0.054
	June	-	-	0.278	0.25
	July	-	0.573	0.774	0.383
	August	-	0.501	0.634	0.69
	September	-	0.704	0.766	0.918
	October	-	0.414	0.752	0.654

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Neenah Creek	May	-	0.0264	-	0.00836
	June	-	0.0266	0.0145	0.00907
	July	-	0.0435	-	0.0091
	August	-	0.023	-	0.00866
	September	-	0.00846	0.015	0.0146
	October	-	0.00451	0.00578	0.00683
Pine River	May	-	-	0.00838	0.0136
	June	-	0.0146	0.013	0.0064
	July	-	0.0129	0.0163	0.0218
	August	-	0.014	0.0209	0.0198
	September	-	0.0145	0.0162	0.0171
	October	-	0.0146	0.017	0.00819
Pipe Creek	May	-	-	0.0369	0.044
	June	-	0.173	0.249	0.275
	July	-	0.128	0.01	0.212
	August	-	0.272	0.161	0.0926
	September	-	0.18	0.0976	0.122
	October	-	0.425	0.258	0.114
Red River	May	-	-	0.00832	ND
	June	-	0.0134	0.0103	0.012
	July	-	0.0178	0.00418	0.00543
	August	0.0207	0.0157	0.0062	0.00677
	September	0.0228	0.00386	0.00496	0.00634
	October	0.0256	0.00531	ND	ND
Shioc River	May	-	-	0.121	0.0674
	June	-	0.189	0.327	0.207
	July	-	0.114	0.306	0.394
	August	-	0.523	0.274	0.522
	September	0.147	0.278	0.148	0.267
	October	0.257	0.149	-	0.281
Waukau Creek	May	-	0.0433	0.0223	0.0281
	June	-	0.14	0.0445	0.0945
	July	-	-	0.0971	0.145
	August	0.0659	0.0832	0.116	0.0943
	September	0.032	0.0226	0.108	0.0583
	October	0.167	0.0223	ND	0.0294
West Branch FDL River	May	-	0.269	0.357	0.092
	June	-	0.383	0.379	0.199
	July	-	0.552	0.39	0.463
	August	0.249	0.277	0.312	0.451
	September	0.179	0.159	0.18	0.991
	October	0.11	0.107	0.0797	0.227

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West Branch Wolf River	May	-	-	0.00761	0.00473
	June	-	0.0101	0.00616	ND
	July	-	0.00931	0.00653	ND
	August	-	0.00338	0.00654	0.00504
	September	0.0251	0.00344	0.0056	0.00455
	October	0.0174	0.00754	0.00438	0.00483
White River	May	-	0.013	0.0145	0.00622
	June	-	0.0244	0.0109	0.00556
	July	-	0.011	0.0135	0.00517
	August	0.015	0.0151	0.00519	0.00518
	September	0.0258	0.00552	0.00996	ND
	October	0.0232	0.00739	0.00531	0.00639
Wolf River (CTH T)	May	-	0.00579	0.0109	0.00603
	June	-	0.0118	0.00794	ND
	July	-	0.00879	0.00732	0.00703
	August	0.0182	0.00368	0.00668	0.00591
	September	0.0254	0.00528	0.00759	0.0065
	October	0.0184	0.0135	0.00519	0.00585
Embarrass River (CTH M)	May	-	-	-	0.0102
	June	-	-	-	0.0087
	July	-	-	-	0.00553
	August	-	-	-	0.0119
	September	-	-	-	0.00812
	October	-	-	-	0.0101
Pigeon River	May	-	-	-	0.0133
	June	-	-	-	0.0204
	July	-	-	-	0.0206
	August	-	-	-	0.0153
	September	-	-	-	0.0126
	October	-	-	-	0.0105
Sawyer Creek	May	-	-	-	0.0146
	June	-	-	-	0.0633
	July	-	-	-	0.163
	August	-	-	-	0.0863
	September	-	-	-	0.0353
	October	-	-	-	0.0596
Waupaca River	May	-	-	-	0.00986
	June	-	-	-	0.00843
	July	-	-	-	0.0209
	August	-	-	-	0.0154
	September	-	-	-	0.00899
	October	-	-	-	0.0052

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TSS (mg/L)					
Stream Name	Month	2020	2021	2022	2023
Bear Creek	May	-	-	5.4	3.8
	June	-	7.4	4.75	10.3
	July	-	6.2	2.6	4.8
	August	-	4.6	2.6	2.8
	September	2.6	6	4.6	2.4
	October	ND	5.4	2.6	ND
Belle Fountain Creek	May	-	32	8.2	25
	June	-	42.6	-	19.4
	July	-	44.6	6	14.2
	August	-	14.6	-	22
	September	-	24.4	13.2	21
	October	-	27	3.8	2.8
East Branch FDL River	May	-	29.6	13.8	4.8
	June	-	56.6	60.8	25
	July	-	30	69	42.6
	August	5.6	16	14.8	18.8
	September	21	13.8	15.6	22.6
	October	4	8.8	3.8	12.6
Embarrass River (STH 54)	May	-	16	14	5.8
	June	-	44.8	23.2	15.2
	July	-	44.8	47.2	19
	August	-	17.4	28	22.8
	September	44	23.2	28.4	9.8
	October	2.8	28.6	2	5.25
Fox River	May	-	55.7	-	7
	June	-	19.2	44.5	4.6
	July	-	35.4	4.2	4.4
	August	-	9.14	-	5
	September	-	4.8	-	6
	October	-	3.2	2.8	4.2
Grand River	May	-	25.4	18.4	15.6
	June	-	23	3.6	ND
	July	-	2.4	15.4	10.6
	August	ND	5.8	43.2	6.6
	September	2	ND	5	2.6
	October	17.8	4.4	ND	3.4
Little Wolf River	May	-	10.3	9.8	9.4
	June	-	7.4	10.8	10.2
	July	-	8.2	9	4.6

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	August	-	5.8	9.8	8.2
	September	24	5.2	6.4	4.8
	October	2	5.4	2.8	6.25
Mecan River	May	-	46.5	25	26
	June	-	33.4	-	11.6
	July	-	23.3	23.4	127
	August	-	7.4	-	27.8
	September	-	15.8	9.6	88.5
	October	-	9.2	9.6	7.8
Montello River	May	-	43.8	8.8	10.6
	June	-	33.6	-	7.4
	July	-	16.6	5.2	3
	August	-	12	-	2.4
	September	-	24.2	20	4.2
	October	-	22.2	11.8	4.6
Mud Creek	May	-	9.6	13	3
	June	-	-	13.4	35.6
	July	-	18.4	38	46.8
	August	-	17.6	28.8	53
	September	-	7.4	22	24.6
	October	-	4.4	14	13.3
Neenah Creek	May	-	35.8	-	49.6
	June	-	60	24.8	21.2
	July	-	43.6	-	29.6
	August	-	20.4	-	26.4
	September	-	39.6	20.4	37
	October	-	23.6	10.8	15.2
Pine River	May	-	-	5	3.2
	June	-	17	6.75	6.4
	July	-	10.2	12	3.4
	August	-	12.4	8.2	6.5
	September	-	2.6	9.8	4.6
	October	-	3.6	2.4	7
Pipe Creek	May	-	-	8.6	2.8
	June	-	7	3.6	16.6
	July	-	3.2	23.4	13
	August	-	5.4	7.2	17.1
	September	-	17.6	19.3	330
	October	-	10.6	17	11
Red River	May	-	-	6.2	5
	June	-	11.2	4.4	9.8
	July	-	ND	ND	ND

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	August	ND	2.2	ND	ND
	September	4.4	ND	ND	ND
	October	ND	ND	ND	ND
Shioc River	May	-	-	3.4	10
	June	-	2.8	12	2
	July	-	7.6	8.2	9.78
	August	-	4.6	3.4	2.2
	September	14.8	2	6.4	3.4
	October	5	2.6	-	ND
Waukau Creek	May	-	8.6	75.8	19.8
	June	-	5.8	46.8	4.2
	July	-	-	5.4	9.6
	August	7.4	8	6.6	4.8
	September	7.6	38.2	133	6.6
	October	117	7.2	10.8	9.4
West Branch FDL River	May	-	7	2.4	3.2
	June	-	6.2	10.8	3.4
	July	-	19.8	7.43	5.4
	August	12	5.8	3.2	2
	September	7	6.6	15.4	16.4
	October	5	2.4	2.2	3.2
West Branch Wolf River	May	-	-	5.6	ND
	June	-	5	4.6	3.4
	July	-	9.2	6.4	3.4
	August	-	17.2	2.6	ND
	September	ND	ND	2.2	2.2
	October	8	26	ND	20.6
White River	May	-	22	21.6	24.2
	June	-	6	35.4	18
	July	-	7.6	17.4	4.2
	August	6.8	7.2	3.2	2
	September	4	3	5	ND
	October	ND	4.8	ND	2.8
Wolf River (CTH T)	May	-	7.2	6.2	6.4
	June	-	26.2	3.8	3.2
	July	-	4.4	ND	4.2
	August	4.4	3.2	6.4	8.4
	September	4.6	3	4	2.4
	October	2.6	3.6	47.6	ND
Embarrass River (CTH M)	May	-	-	-	6.2
	June	-	-	-	6.8
	July	-	-	-	6

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	August	-	-	-	8.67
	September	-	-	-	7.8
	October	-	-	-	5
Pigeon River	May	-	-	-	8
	June	-	-	-	10.2
	July	-	-	-	8.2
	August	-	-	-	7.6
	September	-	-	-	11.2
	October	-	-	-	8
Sawyer Creek	May	-	-	-	4.8
	June	-	-	-	8.8
	July	-	-	-	3.2
	August	-	-	-	4.4
	September	-	-	-	5
	October	-	-	-	4.6
Waupaca River	May	-	-	-	2.8
	June	-	-	-	2.6
	July	-	-	-	2
	August	-	-	-	ND
	September	-	-	-	ND
	October	-	-	-	2.2

TN (mg/L)					
Stream Name	Month	2020	2021	2022	2023
Bear Creek	May	-	-	1.49	1.85
	June	-	1.29	1.66	0.999
	July	-	2.1	1.21	0.883
	August	-	2.59	0.888	0.527
	September	0.99	2.34	1.48	0.505
	October	0.763	1.76	1.74	0.521
Belle Fountain Creek	May	-	4.05	3.7	4.52
	June	-	3.81	-	4.59
	July	-	4.35	4.13	4.5
	August	-	3.11	-	3.58
	September	-	4.09	3.67	4.59
	October	-	4.31	3.66	3.73
East Branch FDL River	May	-	2.91	2.53	3.22
	June	-	5.46	2.97	3.92
	July	-	2.71	5.71	3.4
	August	3.51	2.48	3.27	2.57
	September	2.26	2.64	2.81	1.86
	October	3.12	3.14	3.78	2.99

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Embarrass River (STH 54)	May	-	2.03	1.58	1.37
	June	-	1.85	1.78	2.1
	July	-	1.83	1.97	1.82
	August	-	1.34	2.02	1.89
	September	2.88	2.47	1.76	2.14
	October	2.4	2.05	2.41	2.36
Fox River	May	-	4.56	-	5.23
	June	-	5.51	4.25	5.23
	July	-	2.21	5.08	4.94
	August	-	4.87	-	4.82
	September	-	4.43	-	4.42
	October	-	4.91	4.91	4.6
Grand River	May	-	3.61	2.77	4
	June	-	1.64	2.72	2.35
	July	-	1.86	2.12	1.08
	August	2.07	2.57	1.97	1.11
	September	3.32	2.73	3.04	1.23
	October	3.94	3.94	3.24	2.1
Little Wolf River	May	-	2.11	1.62	2
	June	-	2.01	2.08	2.31
	July	-	1.98	1.86	1.74
	August	-	1.84	2.05	1.85
	September	2.31	2.34	1.86	2.05
	October	2.55	2.14	2.56	2.2
Mecan River	May	-	2.34	2.22	2.08
	June	-	1.9	-	2.29
	July	-	2.25	2.25	2.37
	August	-	1.28	-	2.09
	September	-	2.56	2.31	2.62
	October	-	2.42	2.38	2.84
Montello River	May	-	1.8	1.4	1.66
	June	-	1.73	-	2.18
	July	-	1.16	1.17	0.874
	August	-	1.23	-	0.682
	September	-	1.08	1.01	0.766
	October	-	1.43	1.87	1.56
Mud Creek	May	-	3.27	2.56	2.83
	June	-	-	16.2	17.4
	July	-	3.62	5.56	5.32
	August	-	2.35	3.82	2.93
	September	-	5.01	4.72	5.41
	October	-	4.02	7.18	0.972

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Neenah Creek	May	-	1.78	-	1.5
	June	-	1.64	2.07	1.28
	July	-	1.95	-	1.09
	August	-	1.25	-	0.949
	September	-	1.54	1.27	1.26
	October	-	1.73	1.32	1.36
Pine River	May	-	-	2.22	2.22
	June	-	2.09	2.18	2.27
	July	-	2.28	2.2	1.89
	August	-	1.97	1.89	1.77
	September	-	2.3	2.09	2.03
	October	-	2.39	2.28	2.33
Pipe Creek	May	-	-	1.84	8.96
	June	-	1.22	12	38.2
	July	-	8.14	7.03	1.72
	August	-	4.74	2.1	1.1
	September	-	2.28	1.59	2.66
	October	-	4.92	1.87	1.07
Red River	May	-	-	1.26	1.48
	June	-	1.22	1.31	1.03
	July	-	1.23	1.06	0.973
	August	1.38	2.28	1.15	1.11
	September	1.5	1.23	1.34	1.33
	October	2.2	1.62	1.57	1.54
Shioc River	May	-	-	1.79	1.74
	June	-	1.62	1.71	1.22
	July	-	2.75	1.13	1.04
	August	-	1.8	1.86	1.05
	September	1.74	1.41	2.74	0.736
	October	1.34	1.59	-	0.773
Waukau Creek	May	-	1.31	1.37	1.52
	June	-	0.916	2.48	1.17
	July	-	-	1.26	0.88
	August	0.964	1.41	1.54	0.606
	September	1.03	1.24	4.6	0.397
	October	1.84	1.36	1.21	0.47
West Branch FDL River	May	-	1.18	1.21	0.792
	June	-	2.01	1.32	1.03
	July	-	1.46	1.2	1.12
	August	1.23	1.14	1.09	0.986
	September	0.938	1.03	1.16	1.57
	October	0.911	0.799	0.777	1.39

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West Branch Wolf River	May	-	-	0.718	0.708
	June	-	0.777	0.772	0.931
	July	-	0.652	0.681	0.544
	August	-	0.926	0.546	0.577
	September	0.623	0.588	0.561	0.643
	October	0.892	0.997	0.847	1.08
White River	May	-	1.88	1.57	1.95
	June	-	1.4	1.87	1.55
	July	-	1.6	1.46	1.32
	August	1.38	1.43	1.55	1.48
	September	1.95	1.97	1.73	1.91
	October	1.5	2.43	2.09	2.38
Wolf River (CTH T)	May	-	0.657	0.656	0.912
	June	-	0.658	0.577	0.64
	July	-	0.601	0.602	0.64
	August	0.755	0.566	0.652	0.639
	September	0.711	0.556	0.552	0.641
	October	0.642	0.858	0.51	0.793
Embarrass River (CTH M)	May	-	-	-	2.07
	June	-	-	-	2.49
	July	-	-	-	2
	August	-	-	-	2.44
	September	-	-	-	2.7
	October	-	-	-	2.89
Pigeon River	May	-	-	-	1.7
	June	-	-	-	2.19
	July	-	-	-	1.8
	August	-	-	-	1.46
	September	-	-	-	1.72
	October	-	-	-	1.76
Sawyer Creek	May	-	-	-	3.48
	June	-	-	-	5.6
	July	-	-	-	0.832
	August	-	-	-	1.08
	September	-	-	-	0.866
	October	-	-	-	0.665
Waupaca River	May	-	-	-	3.13
	June	-	-	-	2.78
	July	-	-	-	2.52
	August	-	-	-	2.45
	September	-	-	-	3.15
	October	-	-	-	3.91

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ND indicates sample concentration was not detected

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Appendix H: Duplicate Sample Data

Monitoring Location	Date	Parameter	Duplicate Sample	Regular Sample	Absolute Difference		Relative Percent Difference
Montello River at 11th St.	9/22/2022	PHOSPHATE ORTHO DISS	0.0241	0.0235	0.0006	MG/L	2.52
	9/22/2022	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	6.8	20	-13.2	MG/L	-98.51
	9/22/2022	PHOSPHORUS TOTAL	0.0589	0.0492	0.0097	MG/L	17.95
	9/22/2022	NITROGEN TOTAL	1.08	1.01	0.07	MG/L	6.70
West Branch Fond Du Lac River Immediately below 12th St.	9/20/2022	PHOSPHATE ORTHO DISS	0.182	0.18	0.002	MG/L	1.10
	9/20/2022	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	19.4	15.4	4	MG/L	22.99
	9/20/2022	PHOSPHORUS TOTAL	0.254	0.252	0.002	MG/L	0.79
	9/20/2022	NITROGEN TOTAL	1.16	1.16	0	MG/L	0.00
White River - White River Rd Landing	8/24/2022	PHOSPHATE ORTHO DISS	0.00513	0.00519	-0.00006	MG/L	-1.16
	8/24/2022	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	3	3.2	-0.2	MG/L	-6.45
	8/24/2022	PHOSPHORUS TOTAL	0.0177	0.0177	0	MG/L	0.00
	8/24/2022	NITROGEN TOTAL	1.55	1.55	0	MG/L	0.00
Little Wolf River - HWY 54	8/17/2022	PHOSPHATE ORTHO DISS	0.0267	0.0273	-0.0006	MG/L	-2.22
	8/17/2022	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	10.4	9.8	0.6	MG/L	5.94
	8/17/2022	PHOSPHORUS TOTAL	0.0584	0.0581	0.0003	MG/L	0.52
	8/17/2022	NITROGEN TOTAL	2.06	2.05	0.01	MG/L	0.49
Wolf River at CTH T	8/16/2022	PHOSPHATE ORTHO DISS	0.00705	0.00668	0.00037	MG/L	5.39
	8/16/2022	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	7.6	6.4	1.2	MG/L	17.14
	8/16/2022	PHOSPHORUS TOTAL	0.0449	0.0351	0.0098	MG/L	24.50
	8/16/2022	NITROGEN TOTAL	0.753	0.652	0.101	MG/L	14.38
Mud Creek - Mud Creek Rd	7/26/2022	PHOSPHATE ORTHO DISS	0.466	0.774	-0.308	MG/L	-49.68
	7/26/2022	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	34.2	38	-3.8	MG/L	-10.53
	7/26/2022	PHOSPHORUS TOTAL	0.529	0.88	-0.351	MG/L	-49.82
	7/26/2022	NITROGEN TOTAL	1.9	5.56	-3.66	MG/L	-98.12

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Bear Creek- STH 76	6/13/2022	PHOSPHATE ORTHO DISS	0.12	0.121	-0.001	MG/L	-0.83
	6/13/2022	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	4.4	4.75	-0.35	MG/L	-7.65
	6/13/2022	PHOSPHORUS TOTAL	0.161	0.167	-0.006	MG/L	-3.66
	6/13/2022	NITROGEN TOTAL	1.64	1.66	-0.02	MG/L	-1.21
Pipe Creek - 30 ft Above HWY 151 Bridge	6/14/2023	PHOSPHATE ORTHO DISS	0.277	0.275	0.002	MG/L	0.72
	6/14/2023	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	16.8	16.6	0.2	MG/L	1.20
	6/14/2023	PHOSPHORUS TOTAL	0.417	0.415	0.002	MG/L	0.48
	6/14/2023	NITROGEN TOTAL	38.3	38.2	0.1	MG/L	0.26
West Branch FDL on Forest Ave	8/21/2023	PHOSPHATE ORTHO DISS	0.453	0.451	0.002	MG/L	0.44
	8/21/2023	RESIDUE TOTAL NFLT (TOTAL SUSPENDED SOLIDS)	2.2	2	0.2	MG/L	9.52
	8/21/2023	PHOSPHORUS TOTAL	0.504	0.504	0	MG/L	0.00
	8/21/2023	NITROGEN TOTAL	0.98	0.986	-0.006	MG/L	-0.61

Highlighted cells indicate variance (relative percent difference >30%) between regular and duplicate sample results

Mud Creek at Mud Creek Road duplicate (7/26/2022) was taken on a different day than original sample, disregard as duplicate sample

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Appendix I: Stream Flow and Transparency Data

Stream Name	Month	Stream Flow (CFS)				Transparency (CM)			
		2020	2021	2022	2023	2020	2021	2022	2023
Bear Creek	May	-	-	-	-	-	-	120	120
	June	-	4.67	-	-	-	82.9	-	75
	July	-	40.7	-	-	-	93.7	-	120
	August	-	-	-	-	-	91	120	120
	September	-	64.2	-	-	-	72	100	120
	October	6.5	-	-	-	106	99	-	120
Belle Fountain Creek	May	-	-	-	-	-	55	120	75
	June	-	-	-	-	-	56	-	60
	July	-	-	-	-	-	62	-	45
	August	-	-	-	-	-	77	-	120
	September	-	-	-	-	-	74	-	40
	October	-	-	-	-	-	120	-	95
East Branch FDL River	May	-	10.76	38.12	22.2	-	-	39.7	71.85
	June	-	-	93.1	17.85	-	12.2	10.7	22.6
	July	-	11.28	-	14	-	17.9	12.8	17
	August	0.6	-	15.9	11.8	60	28.2	27.4	27.9
	September	420	10.8	-	12.1	34	25.66	27.3	26.2
	October	19.06	0.65	11.2	7.3	80.6	50.3	79	26.6
Embarrass River (STH 54)	May	-	-	-	-	-	43	40.5	116
	June	-	-	-	-	-	18	31.2	59.2
	July	-	-	-	-	-	34.2	43.2	42
	August	-	-	-	-	-	45.5	42.5	36.2
	September	-	-	-	-	62.5	48	125	69.5
	October	-	-	-	-	-	81	66.2	112
Fox River	May	-	-	-	-	-	56	-	90
	June	-	-	-	-	-	72.5	-	120
	July	-	-	-	-	-	53.5	49.5	120

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	August	-	-	-	-	-	90	-	120
	September	-	-	-	-	-	120	-	120
	October	-	-	-	-	-	100	120	120
Grand River	May	-	-	-	-	-	76.5	-	120
	June	-	-	-	-	-	120	120	105
	July	-	-	-	-	-	120	-	95
	August	-	-	-	-	120	102	-	120
	September	-	-	-	-	120	120	120	100
	October	-	-	-	-	120	120	120	95
Little Wolf River	May	-	-	-	-	-	94.2	95.6	120
	June	-	-	-	-	-	111.5	65	120
	July	-	-	-	-	-	96.4	100.1	120
	August	-	-	-	-	-	-	98.5	120
	September	-	-	-	-	74	120	107	120
	October	-	-	-	-	-	120	125	120
Mecan River	May	-	-	-	-	-	52	81	88
	June	-	-	-	-	-	74	-	103
	July	-	-	-	-	-	66	72	65
	August	-	-	-	-	-	93	-	120
	September	-	-	-	-	-	94	-	110
	October	-	-	-	-	-	118	-	120
Montello River	May	-	-	-	-	-	84	120	120
	June	-	-	-	-	-	77	-	120
	July	-	-	-	-	-	-	52	120
	August	-	-	-	-	-	98	-	120
	September	-	-	-	-	-	90	-	120
	October	-	-	-	-	-	97	-	120
Mud Creek	May	-	1.18	1.3	8.18	-	-	23.6	79.3
	June	-	-	15.1	-	-	-	30.5	22
	July	-	0	1.4	-	-	31	13.46	-

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	August	-	-	0.6	0	-	29.65	9.96	17
	September	-	-	0.053	0	-	32.5	19.16	26.8
	October	-	-	-	0	-	111.45	22.5	39
Neenah Creek	May	-	-	-	-	-	56	-	33
	June	-	-	-	-	-	35	-	46
	July	-	-	-	-	-	27.5	-	36
	August	-	-	-	-	-	51	-	35
	September	-	-	-	-	-	28	120	40
	October	-	-	-	-	-	55	60	57
Pine River	May	-	-	-	-	-	-	88	120
	June	-	-	-	-	-	-	76.8	100
	July	-	-	-	-	-	66	50	120
	August	-	-	-	-	-	75	58	85
	September	-	-	-	-	-	120	90	80
	October	-	-	-	-	-	120	120	75
Pipe Creek	May	-	-	-	-	-	0	-	-
	June	-	-	-	-	-	8.58	-	-
	July	-	-	-	-	-	-	-	-
	August	-	-	-	-	-	-	-	-
	September	-	-	-	-	-	-	-	-
	October	-	-	-	-	-	-	-	-
Red River	May	-	-	-	-	-	-	99	-
	June	-	-	-	-	-	-	120	120
	July	-	-	-	-	-	-	120	120
	August	209.76	-	-	-	120	120	120	-
	September	-	-	-	-	120	120	120	-
	October	93	-	-	-	120	120	120	-
Shioc River	May	-	-	-	-	-	-	-	120
	June	-	-	-	-	-	-	-	-
	July	-	-	-	-	-	95	-	-

Upper Fox and Wolf River Basins Volunteer Monitoring Program 2023 Annual Report

	August	-	-	-	-	-	54	-	120
	September	-	-	-	-	-	120	-	120
	October	-	-	-	-	51	120	-	108
Waukau Creek	May	-	44.3	-	-	-	115	20	25
	June	-	21.1	-	-	-	89.4	-	44
	July	-	-	-	-	-	-	-	49
	August	-	-	-	-	60.8	95.4	27	62
	September	-	-	-	-	75.4	53.4	-	32
	October	-	-	-	-	39.2	60.8	57.2	48
West Branch FDL River	May	-	-	-	-	-	54.2	120	120
	June	-	-	-	-	-	52.45	52.1	37.5
	July	-	-	-	-	-	51.88	46.3	77.3
	August	-	-	-	-	76	79.26	72.4	120
	September	-	-	-	-	95	83.93	43	25.6
	October	-	-	-	-	105.3	120	90.4	97
West Branch Wolf River	May	-	-	-	-	-	-	120	120
	June	-	-	-	-	-	115	120	120
	July	-	-	-	-	-	110	120	-
	August	-	-	-	-	-	92.5	120	-
	September	-	-	-	-	120	120	120	120
	October	-	-	-	-	67.4	120	120	-
White River	May	-	-	-	102.9	-	56	70	60
	June	-	-	-	61.4	-	108	-	-
	July	-	-	-	-	-	120	-	-
	August	-	-	-	56.97	120	72	-	-
	September	-	-	-	-	120	120	102.5	-
	October	-	-	-	61.78	120	120	120	-
Wolf River (CTH T)	May	-	-	-	-	-	-	-	-
	June	-	-	-	-	-	-	-	-
	July	-	-	-	-	-	-	-	-

Upper Fox and Wolf River Basins Volunteer Monitoring Program 2023 Annual Report

	August	-	-	-	-	109	-	-	-
	September	-	-	-	-	-	-	-	120
	October	-	-	-	-	95	-	-	-
Embarrass River (CTH M)	May	-	-	-	-	-	-	-	115
	June	-	-	-	-	-	-	-	110
	July	-	-	-	-	-	-	-	120
	August	-	-	-	-	-	-	-	100
	September	-	-	-	-	-	-	-	-
	October	-	-	-	-	-	-	-	-
Pigeon River	May	-	-	-	-	-	-	-	-
	June	-	-	-	-	-	-	-	89
	July	-	-	-	-	-	-	-	110.4
	August	-	-	-	-	-	-	-	100
	September	-	-	-	-	-	-	-	81.5
	October	-	-	-	-	-	-	-	90
Sawyer Creek	May	-	-	-	-	-	-	-	115
	June	-	-	-	-	-	-	-	56.4
	July	-	-	-	-	-	-	-	120
	August	-	-	-	-	-	-	-	98
	September	-	-	-	-	-	-	-	118
	October	-	-	-	-	-	-	-	113.2
Waupaca River	May	-	-	-	-	-	-	-	120
	June	-	-	-	-	-	-	-	120
	July	-	-	-	-	-	-	-	120
	August	-	-	-	-	-	-	-	120
	September	-	-	-	-	-	-	-	120
	October	-	-	-	-	-	-	-	120