Upper Fox River Basin and Wolf River Basin Volunteer Monitoring Program

Upper Fox and Wolf Basins TMDL

2022 Project Summary

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Project Summary
August 2023

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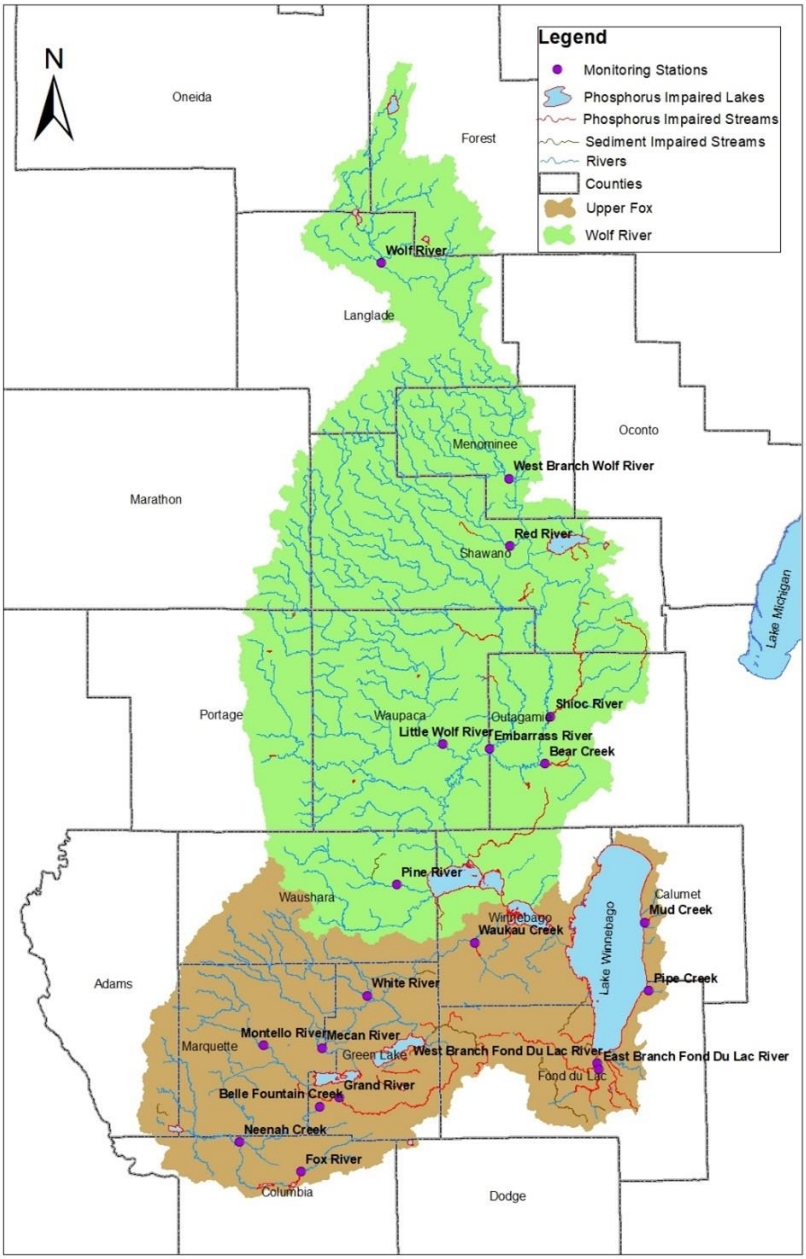
Project Summary

Project Location

The project area is located within the Upper Fox River Basin and the Wolf River Basins (UFWB) in northeast and central Wisconsin. 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 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 Upper Fox and Wolf (UFW) Volunteer Monitoring Program utilizes citizen volunteers to collect surface water samples from 20 different streams and rivers throughout the UFWB. 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 ultimately Lake Winnebago. Monitoring locations are displayed in the map to the right and more detailed location information can be found in Appendix A.

Project Background

The 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 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 UFW basin.

The UFW Volunteer Monitoring Program started in 2020 to achieve some of the monitoring objectives resulting from the TMDL. Twenty (20) 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. Monitoring locations and descriptions of why each site was chosen are 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 20 monitoring streams in the UFWB. Volunteers are trained before each sampling season by Wisconsin DNR staff to ensure reliable and accurate results are achieved each month.

Project Goals

There are two main goals for this project: (1) Increase public awareness and involvement of 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 Program aims to increase community awareness on local water quality issues and 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 Program goal is to collect reliable data to characterize TP, dissolved reactive phosphorus (DRP), diatom phosphorus index (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, and biological responses. The collection of both TP and DRP 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 basin overtime

3. Provide a basis for evaluation of the long-term effectiveness of implementation of the Upper Fox and Wolf 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 UFW Volunteer Monitoring Program kicked off 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:
    - Volunteers are trained to follow Water Action Volunteer (WAV) (https://wateractionvolunteers.org/) monitoring protocol to ensure consistency is being met in each sample
    - Volunteers collect and ship surface water samples in iced coolers to the Wisconsin State Lab of Hygiene for analysis of TP, DRP, TSS, and TN
    - Volunteers collect streamflow and transparency data at the time of surface water sample collection
    - Duplicate samples are collected randomly for 10% of the total sampling events, these samples are collected at the same time as the regular sample
- Continue to provide support to volunteers as needed
    - Ensure safe access and suitability at each monitoring station
    - Ordering, preparing, and maintaining supplies for volunteers to successfully carry out monitoring activities and shipment of samples
    - Fostering an open line of communication with volunteers to ensure that all stations are being monitored at the frequency outlined in the project QAPP
- Confirm that all 20 monitoring locations are monitored monthly from May to October for a total of 6 sampling events per year
- Compile monthly sampling data results to share with volunteers and stakeholders
    - Record data into tables and graphs for analysis
    - Develop an annual report complete with data and figures to share with interested stakeholders to assess annual water quality

Upper Fox River and Wolf River Volunteer Monitoring Program

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2022 Sampling Season

Summary

The UFW Volunteer Monitoring Program started in 2020 with five individuals and three groups of volunteers sampling 12 monitoring locations. Sampling resumed in May 2021, there were 20 monitoring locations and 16 volunteers. In 2022 the 20 monitoring sites were sampled by 14 volunteers; eight volunteers were returners and six were new.

Due to the COVID 19 pandemic, a large event water sampling training was not held. Instead, the DNR Coordinator trained new and some returning 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 and ensures they are sampling at the correct location. The DNR Coordinator trained six volunteers during the 2022 sampling season using this method.

Sampling equipment and supplies were provided to new volunteers during their training. Returning volunteers had their supplies dropped off at their house or they picked it up from the DNR office starting in April. 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 volunteer.

Due to miscommunication with volunteers who were out of town or unable to sample for other reasons, there were missed samples. A total of thirteen samples were missed across the sampling season. There was at least one sample missed each month, with August having the most missed, which was five. Overall, the sample completeness percentage of samples collected in 2022 was 89%. This percentage is based off the total number of possible samples that could be collected. Table 1 displays the sample collection completeness percentage for each sampling site.

Sample Collection Completeness (%) - Out of 120 samples per year (6 samples/site)			
Station Name	2020	2021	2022
Bear Creek	33%	83%	100%
Belle Fountain Creek	0%	100%	67%
East Branch FDL River	50%	100%	100%
Embarrass River	33%	100%	100%
Fox River	0%	100%	50%
Grand River	50%	100%	100%
Little Wolf River	33%	100%	100%
Mecan River	0%	100%	67%
Montello River	0%	100%	67%
Mud Creek	0%	83%	100%
Neenah Creek	0%	100%	50%
Pine River	0%	83%	100%
Pipe Creek	0%	83%	100%
Red River	50%	83%	100%
Shioc River	33%	83%	83%
Waukau Creek	50%	83%	100%
West Branch FDL River	50%	100%	100%
West Branch Wolf River	33%	83%	100%
White River	50%	100%	100%
Wolf River	50%	100%	100%
Combined Percentage	23%	93%	89%

Table 1: Sample Collection Completeness Percentage by year.

In 2020, the Program used FedEx Priority Overnight shipping to ship coolers to the WSLH. In 2021, shipping switched to US Postal Service (USPS) Priority Mail and USPS was still used in 2022. The switch allowed 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/shortly after collection due to the short 48 hour holding time for the DRP sample. A total of 31 DRP samples (including duplicate samples), or 27%, were flagged in 2022 due to the samples exceeding the 48-hour hold time for DRP. For reference, 70 of the 112 samples (63%) were flagged in 2021. Although these samples were flagged by the lab for exceeding the hold time, they were still able to be processed. Volunteers are reminded each sampling season to ship samples immediately after collection or as early as possible the next day. During the 2022 sampling season the number of samples analyzed past the 48-hour timeframe decreased by over 50% compared to 2021, which could be due to clearer shipping instructions for volunteers or changing the shipping carrier.

Given the spatial extent of the UFW monitoring locations, 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 Program 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

- An Upper Fox and Wolf Volunteer Monitoring Fact Sheet (Appendix B) was shared broadly to help recruit volunteers
- The DNR Coordinator worked with the Fox Wolf Watershed Alliance Program Coordinator to further extend volunteer recruitment
- An outreach article was featured in the Green Lake WAV newsletter to attract volunteers to sample sites in the Green Lake County area
- County Land and Conservation departments were contacted to assist with sample collection in 2022, Langlade County staff sampled the Wolf River site

Water Quality Data

Assessing Water Quality

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 Volunteer Monitoring Program have a target median summer (May – October) TP concentration of 0.075 mg/L. Since no water quality criteria currently exists for TSS and TN for the streams and rivers sampled through the UFW Volunteer Monitoring Program, the water quality assessment in this report will focus on Phosphorus.

According to the WDNR 2022 303(d) Impaired Waters list, 10 of the 20 monitoring streams sampled through the UFW Volunteer Monitoring Program (Bear Creek, East and West Branches of Fond du Lac River, Grand River, Mud Creek, Pigeon River, Pipe Creek, Red River, Shioc River, and Waukau Creek) 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.

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 Program's TP sampling data is compared to Wisconsin's TP standard 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 water quality standard. The lower 90% confidence limit is used to ensure a stream exceeds the standard 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 standard.[1] See Figure 1.

[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

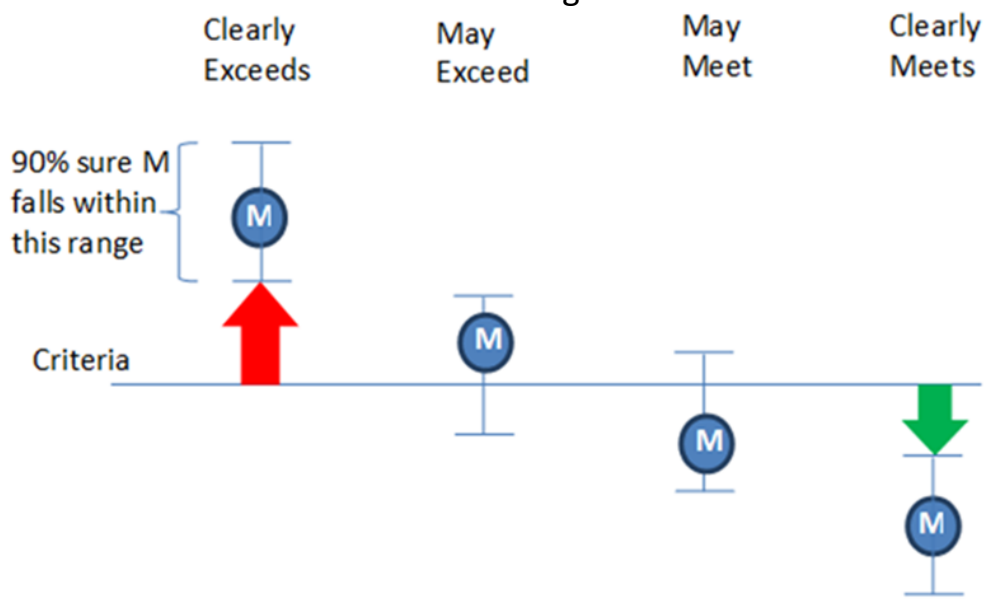


Figure 1: Wisconsin TP criteria confidence limit table. Criteria line represents the 0.075 mg/L water quality criteria limit and M represents the GSM value.

A GSM and 90% Confidence limits were calculated for each monitoring location using data points across 2020-2022. For stream listing purposes, a minimum of 6 samples, one per month from May – October, are needed to calculate the confidence limits. The confidence limits calculated in this data summary will not be used for stream listing purposes. Due to the lack of a full dataset at some sites, the 2021 and 2022 sampling data was combined to calculate one confidence limit. A confidence interval table is provided in Appendix D.

Based on the confidence limits calculated, seven streams were in the “Clearly Exceeds” category, five streams were in the “May Exceed” category, and eight were in the “Clearly Meets” category. In future sampling seasons, the confidence intervals will help assess water quality trends over time and track progress as Implementation proceeds.

Total Phosphorus and Dissolved Reactive Phosphorus Analysis

Although sample collection was less than 100% at some monitoring locations in 2022, TP yearly median values were still calculated. These calculations do not consider variations in temperature, precipitation, or implementation of best management practices. Table 2 displays the median TP values for each sampling location monitored in 2020, 2021, and 2022. Red values indicate there was less than 100% sample collection at the monitoring site. These median values were calculated from only the samples collected at the monitoring site for that year even if samples were missed. In 2020, all streams sampled had more than one missed sample while in 2022 there were only six streams with at least one missed sample. In 2022, 11 of the 20 monitoring streams had median TP values exceeding the State water quality standard, including 4 streams that had at least one missed sample. Therefore, these values may not be a proper representation of the true yearly median TP values.

Median	TP (mg/L)		
Stream Name	2020	2021	2022
Bear Creek	*0.07215*	*0.145*	*0.168*
Belle Fountain Creek		0.0944	*0.06015*
East Branch FDL River	*0.203*	0.2985	*0.289*
Embarrass River	*0.04655*	0.09035	*0.0892*
Fox River		0.09775	*0.0891*
Grand River	*0.178*	0.161	*0.0643*
Little Wolf River	*0.0432*	0.0486	*0.05105*
Mecan River		0.0603	*0.0468*
Montello River		0.1002	*0.0901*
Mud Creek		*0.626*	*0.7815*
Neenah Creek		0.13	*0.0892*
Pine River		*0.0496*	*0.04235*
Pipe Creek		*0.222*	*0.087*
Red River	*0.0243*	*0.0218*	*0.01775*
Shioc River	*0.32*	*0.243*	*0.812*
Waukau Creek	*0.143*	*0.0917*	*0.1305*
West Branch FDL River	*0.177*	0.3365	*0.291*
West Branch Wolf River	*0.0183*	*0.0393*	*0.01885*
White River	*0.0238*	0.0361	*0.0314*
Wolf River	*0.036*	0.0339	*0.0266*

Table 2: Yearly Median TP values by sampling location. Red values indicate years with missing data.

Total Phosphorus is a key indicator of water quality. It is an essential nutrient for plant growth and when excess amounts are introduced to a waterbody, water quality can decrease and lead to harmful algal blooms. The established State Water Quality Standard for the UFW streams is 0.075 mg/L. To evaluate stream TP concentrations, each TP sample was compared to the 0.075 mg/L TP standard. Table 3 compares the TP samples collected in 2020, 2021, and 2022 to the State Water Quality standard. In 2022, 54 of 106 (51%) of TP samples met the State water quality standard. In 2021, 42% of samples collected met the state water quality standard.

TP Samples Below 0.075 mg/L	2020	2021	2022
# Sites	12	20	20
# Samples Collected	31	112	106
# Above 0.075 mg/L	14	65	53
# Below 0.075 mg/L	17	47	54
% Below 0.075 mg/L	**55%**	**42%**	**51%**

Table 3:TP samples meeting the State Water Quality standard.

While 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 harmful algal blooms and 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 P present in the TP sample. Appendix E breaks out the TP/DRP percentages for each sample event. The red values in the table indicate the DRP concentration exceeded the TP concentration. These values were not included in the average and median percentage calculations for each monitoring site.

The highlighted values in the Appendix E table indicate that the DRP sample exceeded the TP State Water Quality standard. Eight of the 20 monitoring sites had at least one DRP sample exceeding the TP State water quality standard. Eight of these streams are listed on the 303(d) Impaired Waters List. In addition to high DRP values in these impaired streams, the percentage of dissolved P in the TP sample also consistently remains high compared to monitoring streams that are not impaired.

Table 4 further breaks down the DRP percentages in the Appendix E table into percentage ranges. 37 of 106, or 35%, of TP samples collected in 2022 had 20 – 40% of their TP concentrations from DRP which is the most among all percentage ranges in 2022. In 2021, 19 of the 112 (17%) TP samples had 80 – 100% of their concentrations from DRP compared to only 15 of 106 (14%) of TP samples in 2022. The differences between the three seasons in the number of samples in each percentage range could be due to the variability in the number of samples taken during each season. All the sites were sampled in 2022, but the percent complete in 2022 was 4% less than in 2021. In 2022 two sites had a 50% completion percentage and three sites had a 67% completion percentage.

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	13	37	20	21	15	0
Total		249	28	68	44	58	46	5

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

The relationship between total phosphorus and dissolved reactive phosphorus will continue to be assessed as additional data is collected through the monitoring program. In addition to assessing the relationship between TP and DRP, total nitrogen analysis may provide valuable insight to water quality as Nitrogen may have similar impacts to water quality as Phosphorus does. Nitrogen is commonly found and used in agricultural settings, so testing for it may prove useful in assessing water quality across the UFWB. At this point in the Program, the median TP and TN values do not correlate with each other as closely as TP and DRP. Sampling data is in Appendix F. Additional data across all parameters will be useful as the program continues.

Field Quality Assurance/Quality Control Duplicate Samples

To document the accuracy and precision of the field data collected by volunteers, ten percent of the samples that are monitored for TP are chosen each year to participate in collection of additional quality assurance/quality control (QA/QC) samples. The samples are randomly selected from the list of stations 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. The result of the additional sampling is an additional sample for each parameter mailed to the lab. Duplicate samples were collected at seven sampling locations in 2022. One duplicate sample in 2022 was not taken on the same day as the original sample, the volunteer coordinator took the Mud Creek duplicate sample three weeks after the original July sample was taken. Since this duplicate was taken on a different day the results can be disregarded as the samples were taken during different conditions.

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. 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. There was one sample result with high variance in 2022, the September TSS result for Montello River at 11th St. had a 98.51% difference. This variance could be due to sampling error by the volunteer or error during the analysis at the lab. Duplicate sample results are in Appendix G.

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.

Volunteers measure streamflow using a velocity-area approach. A 20 ft. length of stream is assessed followed by measuring the width 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. Streamflow data can be found in Appendix H.

Water transparency is collected each month with a transparency tube. Water clarity is closely tied to suspended sediment in the water. Water clarity is also affected by dissolved material and algae. Transparency data can be found in Appendix H.

Key Takeaways for 2020-2022

- The number of TP samples below the State Water Quality Standard of 0.075 mg/L increased in 2022, with 51% of the samples below 0.075 mg/L in 2022 compared to 42% in 2021
- Eight of the 20 streams sampled in the UFW basin "Clearly Meet" TP state water quality standards according to their confidence limits calculated with data from 2020-2022
- TP median values for 11 of the 20 monitoring streams exceeded the state water quality standard. Four of these streams had at least one missed sample across the season meaning these values may not be a proper representation of the true yearly median TP values
- DRP concentrations were lower in 2022 compared to previous years, 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, in 2022 the percent sample completeness was 4% lower than 2021
    - Less precipitation in 2022 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
- Transparency is closely tied to suspended sediment, dissolved material, and algae in the water, if there is more sediment the transparency will decrease

Conclusions

Data Conclusions

The data collected in the UFW basin shows there is water quality improvements that still need to be made, which means establishing best management practices in these basins is important. There were eight streams that met the TP state water quality standard of 0.075 mg/L, but this is only based on three years of data.

This program has been going on for three 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 start to grab ahold and improve the water quality in 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. These are additional reasons definitive conclusions cannot be made at this time.

Dissolved phosphorus percentages have decreased over the three sampling seasons, yet there is still a large portion of total phosphorus concentrations that are made up of DRP. Appendix E provides a table of the percentage of DRP making up each TP sample and table 4 categorizes the values into percentage categories. In 2022 the DRP percentage range with the most samples was 20-40%, which is also the range with the most samples over the three sampling seasons at 27% of the total samples collected from 2020-2022. 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.

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 UFW Basin currently have or are developing 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.

Program Conclusions

The primary goal of the UFW Volunteer Monitoring Program is to engage the public and increase their awareness of water quality issues. In 2022, 14 volunteers collected samples across 20 streams. 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 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 basin.

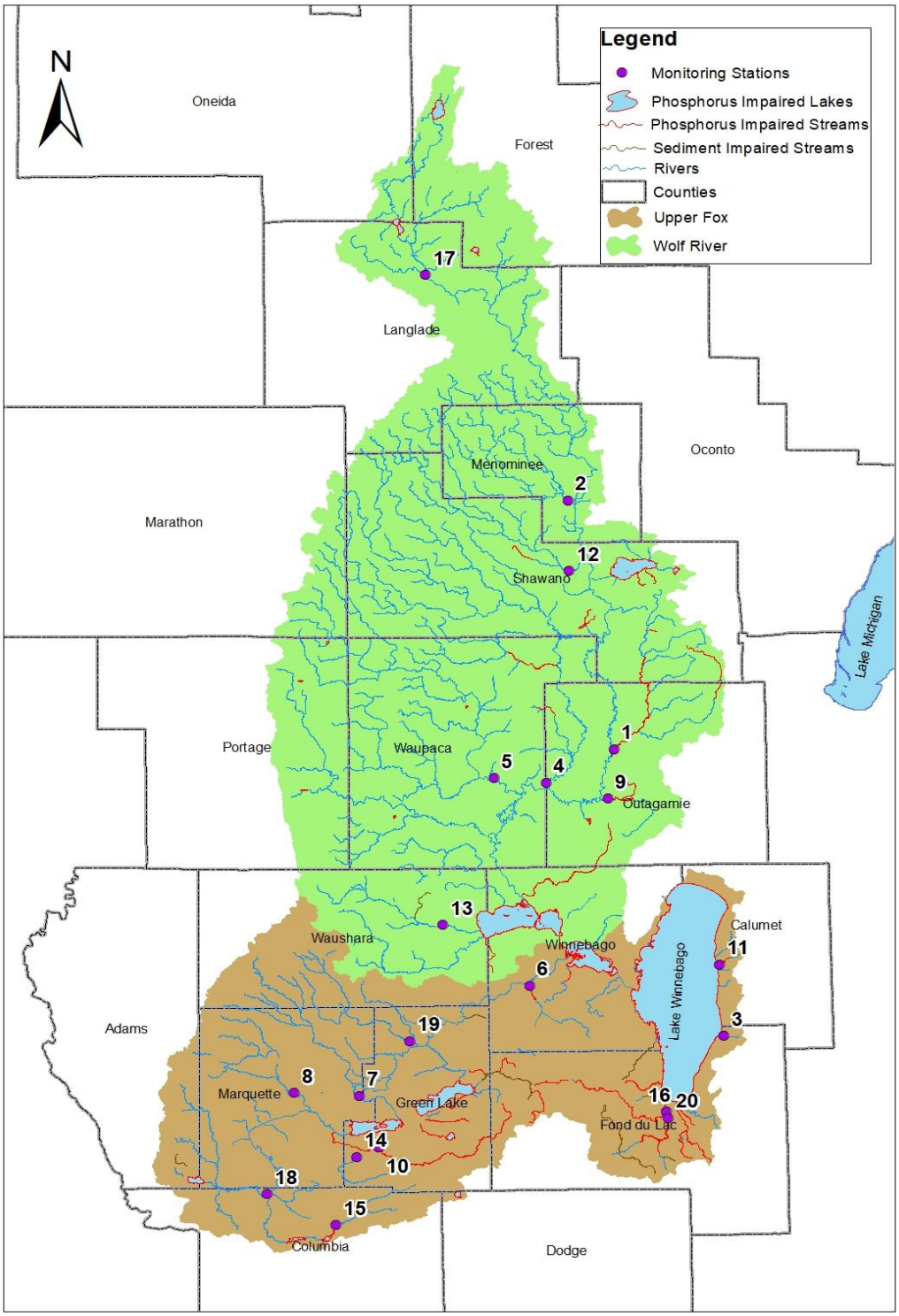
Volunteer recruitment was carried out in different ways in 2022. Two main contributions to volunteer recruitment were expanding outreach through FWWA and outreach to County Land and Water Conservation Departments. These partnerships allowed the DNR to recruit volunteers on a bigger platform.

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.

Acknowledgements

Thank you to all the volunteers who have made the Upper Fox and Wolf Volunteer Monitoring Program possible. Thank you to the Wisconsin DNR and the Water Action Volunteer program for funding and support.

Appendix A: Upper Fox and Wolf Volunteer Monitoring Program Locations



Appendix A continued: Upper Fox and Wolf Monitoring Location Information

Sampling Location	SWIMS Station ID	Stream Name	SWIMS Station Name	County	X	Y	Reason For Sampling Location
1	453030	Shioc River	Shioc River At Sth 187	Outagamie	-88.5602	44.46438	Represents the outlet of TMDL subbasin 53, improvements can be demonstrated over time
2	403003	West Branch Wolf River	West Branch Wolf River- West Branch Rd	Menominee	-88.6643	44.94093	Represents the outlet of the West Branch Wolf River HUC 10 watershed
3	10016803	Pipe Creek	Pipe Creek- Pipe Creek- 30 Feet Above Hwy 151 bridge	Fond du Lac	-88.3103	43.91841	Location monitored in 2012 to support the development of the TMDL, repeating the sampling can demonstrate improvements over time.
4	10033493	Embarrass River	Embarrass River at New London Hwy 54	Outagamie	-88.7302	44.40595	Location monitored in 2012 to support the development of the TMDL, repeating the sampling can demonstrate improvements over time.
5	693217	Little Wolf River	Little Wolf River at Royalton STH 54	Waupaca	-88.8565	44.41828	Location monitored in 2012 to support the development of the TMDL, repeating the sampling can demonstrate improvements over time.
6	713285	Waukau Creek	Waukau Creek at Cth E USGS Site ID 04073970	Winnebago	-88.7854	44.01841	Location monitored in 2012 to support the development of the TMDL, repeating the sampling can demonstrate improvements over time.
7	393005	Mecan River	Mecan River- CTH C	Marquette	-89.2095	43.81679	Represents the outlet of TMDL subbasin 21.
8	10022879	Montello River	Montello River At 11th St. Bridge USGS Site ID 04072845	Marquette	-89.3575	43.82047	Location monitored in 2012 to support the development of the TMDL, repeating the sampling can demonstrate improvements over time.
9	453259	Bear Creek	Bear Creek at Sth 76	Outagamie	-88.5779	44.36569	Location monitored in 2012 to support the development of the TMDL, repeating the sampling can demonstrate improvements over time.
10	243015	Grand River	Grand River at Cth H Near Kingston WI	Green Lake	-89.1541	43.71198	Represents the inlet of the Grand River Marsh and the outlet of a subbasin 14.
11	83121	Mud Creek	Mud Creek at Mud Creek Rd	Calumet	-88.3171	44.05352	Location monitored in 2012 to support the development of the TMDL, repeating the sampling can demonstrate improvements over time.
12	10014632	Red River	Red River- Maple Ave	Shawano	-88.6598	44.80352	Represents the outlet of the Red River HUC 10 watershed.
13	10032735	Pine River	Pine River at Hwy 49	Waushara	-88.9962	44.13583	Represents the outlet of TMDL subbasin 47, improvements can be demonstrated over time
14	243028	Belle Fountain Creek	Belle Fountain Creek at Cth B	Green Lake	-89.2148	43.70417	Represents the outlet of Belle Fountain Creek HUC 12 watershed.
15	10014339	Fox River	Fox River- Highway 33	Columbia	-89.277	43.56994	Represents the outlet of TMDL subbasin 5 and the water quality of headwater section of the Fox River. Improvements can be demonstrated over time
16	10037662	West Branch Fond du Lac River	West Branch FDL at Forest Ave	Fond du Lac	-88.4553	43.77697	Represents the outlet of TMDL subbasin 44. The West Branch Fond du Lac River is listed as impaired. Repeated sampling can demonstrate improvements over time.
17	343057	Wolf River	WOLF River- CTH T	Langlade	-89.0129	45.36753	Represents the outlet of subbasin 80.
18	113070	Neenah Creek	Neenah Creek - Cth Cm	Columbia	-89.4352	43.63128	Represents the outlet of Neenah Creek and TMDL subbasins 1 and 4. Improvements can be demonstrated over time
19	10041320	White River	White River- White River Rd Landing	Green Lake	-89.079	43.91748	Represents the outlet of TMDL subbasin 21.
20	10014745	East Branch Fond du Lac River	East Branch FDL at 12th St.	Fond du Lac	-88.4511	43.76557	Location monitored in 2012 to support the development of the TMDL, repeating the sampling can demonstrate improvements over time.

Appendix B: Upper Fox and Wolf 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, 20 stream sites were chosen as part of the UFW volunteer monitoring program to collect water samples throughout the UFW basin beginning in 2020. 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 TP, TSS, and Total Nitrogen (TN).

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?

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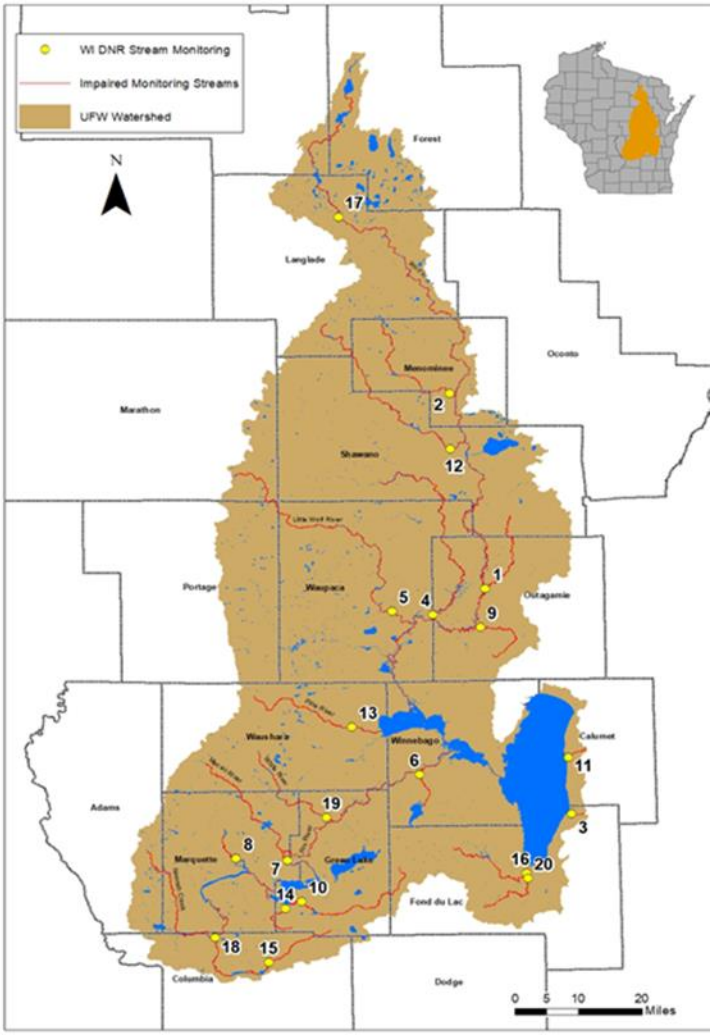

See Backside for exact sample locations

Upper Fox River and Wolf River Volunteer Monitoring Program

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Sampling Location	SWIMS Station ID	Stream Name	SWIMS Station Name	County	X	Y
1	453030	Shioc River	Shioc River At Sth 187	Outagamie	-88.56017	44.464379
2	403003	West Branch Wolf River	West Branch Wolf River- West Branch Rd	Menominee	-88.66435	44.94093
3	10016803	Pipe Creek	Pipe Creek- Pipe Creek- 30 Feet Above Hwy 151 bridge	Fond du Lac	-88.3103	43.91841
4	10033493	Embarrass River	Embarrass River at New London Hwy 54	Outagamie	-88.73024	44.405953
5	693217	Little Wolf River	Little Wolf River at Royalton STH 54	Waupaca	-88.85648	44.418276
6	713285	Waukau Creek	Waukau Creek at Cth E USGS Site ID 04073970	Winnebago	-88.7854	44.01841
7	393005	Mecan River	Mecan River- CTH C	Marquette	-89.20955	43.816794
8	10022879	Montello River	Montello River At 11th St. Bridge USGS Site ID 04072845	Marquette	-89.3575	43.82047
9	453259	Bear Creek	Bear Creek at Sth 76	Outagamie	-88.57791	44.365693
10	243015	Grand River	Grand River at Cth H Near Kingston WI	Green Lake	-89.1541	43.711983
11	83121	Mud Creek	Mud Creek at Mud Creek Rd	Calumet	-88.3171	44.05352
12	10014632	Red River	Red River- Maple Ave	Shawano	-88.65981	44.803515
13	10032735	Pine River	Pine River at Hwy 49	Waushara	-88.9962	44.13583
14	243028	Belle Fountain Creek	Belle Fountain Creek at Cth B	Green Lake	-89.21482	43.704172
15	10014339	Fox River	Fox River- Highway 33	Columbia	-89.27703	43.569939
16	10037662	West Branch Fond du Lac River	West Branch FDL at Forest Ave	Fond du Lac	-88.4553	43.77697
17	343057	Wolf River	WOLF River- CTH T	Langlade	-89.01287	45.367529
18	113070	Neenah Creek	Neenah Creek - Cth Cm	Columbia	-89.43518	43.631283
19	10041320	White River	White River- White River Rd Landing	Green Lake	-89.07898	43.917482
20	10014745	East Branch Fond du Lac River	East Branch FDL at 12th St.	Fond du Lac	-88.4511	43.76557

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/

Appendix C: 303d Impaired Waters

Local Waterbody Name	Waters ID	WBIC	County	Start Mile	End Mile	Total Size	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	

							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)

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	
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	

Appendix D: Confidence Interval Tables

River	TP Calculation	2021	2022
Bear Creek	**U90% (mg/L)**	0.1678	0.2045
	Median (mg/L)	0.117	0.168
	L90% (mg/L)	0.09297	0.1315
		Clearly Exceeds	Clearly Exceeds
Belle Fountain Creek	**U90% (mg/L)**	0.11686	0.0859
	Median (mg/L)	0.0944	0.0602
	L90% (mg/L)	0.06939	0.0344
		May Exceed	Clearly Meets
East Branch FDL River	**U90% (mg/L)**	0.31633	0.3868
	Median (mg/L)	0.296	0.2890
	L90% (mg/L)	0.21489	0.1912
		Clearly Exceeds	Clearly Exceeds
Embarrass River	**U90% (mg/L)**	0.09931	0.1058
	Median (mg/L)	0.0825	0.0892
	L90% (mg/L)	0.06145	0.0726
		May Exceed	May Exceed
Fox River	**U90% (mg/L)**	0.14288	0.1242
	Median (mg/L)	0.09775	0.0891
	L90% (mg/L)	0.07302	0.0540
		May Exceed	May Exceed
Grand River	**U90% (mg/L)**	0.18069	0.2012
	Median (mg/L)	0.174	0.1610
	L90% (mg/L)	0.11518	0.1208
		Clearly Exceeds	Clearly Exceeds
Little Wolf River	**U90% (mg/L)**	0.05411	0.0599
	Median (mg/L)	0.0486	0.0511
	L90% (mg/L)	0.03603	0.0422
		Clearly Meets	Clearly Meets
Mecan River	**U90% (mg/L)**	0.06915	0.0667
	Median (mg/L)	0.0603	0.0468
	L90% (mg/L)	0.04103	0.0269
		Clearly Meets	Clearly Meets
Montello River	**U90% (mg/L)**	0.11042	0.1100
	Median (mg/L)	0.1002	0.0901
	L90% (mg/L)	0.06758	0.0702
		May Exceed	May Exceed
Mud Creek	**U90% (mg/L)**	0.6824	0.9411
	Median (mg/L)	0.6260	0.7815
	L90% (mg/L)	0.56960958	0.6219
		Clearly Meets	May Exceed
Neenah Creek	**U90% (mg/L)**	0.15073	0.1099
	Median (mg/L)	0.13	0.0892
	L90% (mg/L)	0.10178	0.0685
		Clearly Exceeds	May Exceed
Pine River	**U90% (mg/L)**	0.08707064	0.0492
	Median (mg/L)	0.0496	0.0424
	L90% (mg/L)	0.01212936	0.0355
		Clearly Meets	Clearly Meets

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Pipe Creek	**U90% (mg/L)**	0.32851652	0.2609
	Median (mg/L)	0.2220	0.2205
	L90% (mg/L)	0.1155	0.1801
		Clearly Exceeds	Clearly Exceeds
Red River	**U90% (mg/L)**	0.02607	0.0239
	Median (mg/L)	0.02295	0.0178
	L90% (mg/L)	0.01859	0.0116
		Clearly Meets	Clearly Meets
Shioc River	**U90% (mg/L)**	0.37548	0.3624
	Median (mg/L)	0.3065	0.3148
	L90% (mg/L)	0.2364	0.2671
		Clearly Exceeds	Clearly Exceeds
Waukau Creek	**U90% (mg/L)**	0.138	0.1790
	Median (mg/L)	0.10785	0.1305
	L90% (mg/L)	0.07286	0.0820
		May Exceed	Clearly Exceeds
West Branch FDL River	**U90% (mg/L)**	0.3607	0.4998
	Median (mg/L)	0.31	0.4095
	L90% (mg/L)	0.19822	0.3192
		Clearly Exceeds	Clearly Exceeds
West Branch Wolf River	**U90% (mg/L)**	0.03794	0.0225
	Median (mg/L)	0.0238	0.0189
	L90% (mg/L)	0.01858	0.0152
		Clearly Meets	Clearly Meets

White River	**U90% (mg/L)**	0.03775	0.0424
	Median (mg/L)	0.0289	0.0314
	L90% (mg/L)	0.02435	0.0204
		Clearly Meets	Clearly Meets
Wolf River	**U90% (mg/L)**	0.03661	0.0300
	Median (mg/L)	0.0343	0.0266
	L90% (mg/L)	0.02939	0.0232
		Clearly Meets	Clearly Meets

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Appendix E: DRP % of TP

DRP % of TP																			
	Bear Creek	Belle Fountain Creek	East Branch FDL River	Embarrass River	Fox River	Grand River	Little Wolf River	Mecan River	Montello River	Mud Creek	Neenah Creek	Pine River	Pipe Creek	Red River	Shioc River	Waukau Creek	West Branch FDL River	West Branch Wolf River	White River	Wolf River
May 2020																				
June 2020																				
July 2020																				
August 2020			88%			98%								85%		46%	80%		63%	51%
September 2020	57%		82%	42%		73%	50%							89%	53%	74%	101%	134%	122%	71%
October 2020	82%		90%	87%		42%	132%							180%	70%	68%	96%	98%	71%	74%
May 2021	-	29%	71%	45%	27%	61%	50%	22%	31%	87%	20%	-	-	-	-	47%	80%	-	30%	14%
June 2021	82%	20%	61%	13%	50%	77%	59%	18%	38%	-	19%	16%	84%	33%	78%	78%	85%	23%	33%	26%
July 2021	71%	20%	80%	11%	48%	83%	52%	75%	12%	92%	25%	29%	83%	82%	59%	-	64%	39%	38%	26%
August 2021	77%	56%	82%	62%	62%	93%	77%	39%	62%	84%	18%	28%	88%	65%	79%	67%	83%	5%	35%	12%
September 2021	67%	50%	78%	34%	70%	76%	43%	59%	52%	97%	7%	40%	81%	27%	82%	29%	78%	35%	33%	25%
October 2021	74%	63%	84%	51%	58%	82%	61%	27%	29%	81%	7%	8%	76%	26%	75%	53%	86%	19%	38%	40%
May 2022	50%	30%	74%	47%	-	49%	37%	16%	34%	81%	-	14%	20%	23%	58%	17%	77%	30%	27%	31%
June 2023	72%	-	58%	35%	34%	84%	39%	-	-	80%	16%	35%	83%	33%	81%	45%	79%	28%	20%	31%
July 2022	84%	49%	65%	10%	64%	76%	41%	12%	37%	88%	15%	37%	7%	22%	78%	74%	84%	26%	36%	27%
August 2022	84%	-	81%	14%	-	69%	47%	-	-	84%	-	45%	71%	41%	79%	69%	87%	43%	29%	19%
September 2022	78%	37%	75%	27%	-	85%	53%	32%	48%	94%	18%	39%	45%	30%	56%	38%	71%	36%	40%	29%
October 2022	62%	32%	63%	51%	54%	52%	55%	27%	29%	93%	15%	61%	84%	-	-	0%	71%	39%	37%	24%
Average	72%	39%	75%	38%	52%	73%	51%	33%	37%	87%	16%	32%	66%	46%	71%	50%	82%	35%	38%	33%
Median	74%	39%	82%	44%	54%	77%	52%	33%	35%	87%	18%	28%	83%	65%	75%	60%	82%	29%	36%	26%

Highlighted values indicate the DRP concentration exceeded the 0.075 mg/L TP standard

Appendix F: Sampling Data

		TP (mg/L)			DRP (mg/L)			TSS (mg/L)			TN (mg/L)		
Stream Name	Month	2020	2021	2022	2020	2021	2022	2020	2021	2022	2020	2021	2022
Bear Creek	May	-	-	0.0871	-	-	0.0438	-	-	5.4	-	-	1.49
	June	-	0.324	0.167	-	0.267	0.121	-	7.4	4.75	-	1.29	1.66
	July	-	0.163	0.217	-	0.116	0.183	-	6.2	2.6	-	2.1	1.21
	August	-	0.145	0.194	-	0.112	0.162	-	4.6	2.6	-	2.59	0.888
	September	0.0576	0.117	0.169	0.033	0.0785	0.132	2.6	6	4.6	0.99	2.34	1.48
	October	0.0867	0.106	0.0686	0.071	0.0783	0.0422	ND	5.4	2.6	0.763	1.76	1.74
Belle Fountain Creek	May	-	0.0969	0.056	-	0.0279	0.0169	-	32	8.2	-	4.05	3.7
	June	-	0.143	-	-	0.0292		-	42.6		-	3.81	
	July	-	0.132	0.036	-	0.0263	0.0176	-	44.6	6	-	4.35	4.13
	August	-	0.0919	-	-	0.0512		-	14.6		-	3.11	
	September	-	0.0726	0.0643	-	0.036	0.0238	-	24.4	13.2	-	4.09	3.67
	October	-	0.0437	0.0301	-	0.0277	0.00975	-	27	3.8	-	4.31	3.66
East Branch FDL River	May	-	0.298	0.318	-	0.211	0.235	-	29.6	13.8	-	2.91	2.53
	June	-	0.299	0.445	-	0.183	0.256	-	56.6	60.8	-	5.46	2.97
	July	-	0.501	0.507	-	0.399	0.329	-	30	69	-	2.71	5.71
	August	0.203	0.405	0.254	0.179	0.331	0.205	5.6	16	14.8	3.51	2.48	3.27
	September	0.208	0.296	0.26	0.17	0.231	0.195	21	13.8	15.6	2.26	2.64	2.81
	October	0.129	0.191	0.0572	0.116	0.161	0.036	4	8.8	3.8	3.12	3.14	3.78
Embarrass River	May	-	0.0761	0.0914	-	0.0345	0.0434	-	16	14	-	2.03	1.58
	June	-	0.122	0.0887	-	0.0159	0.031	-	44.8	23.2	-	1.85	1.78
	July	-	0.144	0.0897	-	0.0162	0.00853	-	44.8	47.2	-	1.83	1.97
	August	-	0.0918	0.101	-	0.0567	0.0145	-	17.4	28	-	1.34	2.02
	September	0.0633	0.0889	0.081	0.0264	0.0301	0.0219	44	23.2	28.4	2.88	2.47	1.76
	October	0.0298	0.0674	0.0263	0.0258	0.0344	0.0133	2.8	28.6	2	2.4	2.05	2.41
Fox River	May	-	0.173	-	-	0.0471		-	55.7		-	4.56	
	June	-	0.0895	0.169	-	0.0446	0.0567	-	19.2	44.5	-	5.51	4.25
	July	-	0.209	0.0722	-	0.101	0.0462	-	35.4	4.2	-	2.21	5.08

	August	-	0.106	-	-	0.0654		-	9.14		-	4.87	
	September	-	0.0706	-	-	0.0494		-	4.8		-	4.43	
	October	-	0.0469	0.0321	-	0.0271	0.0174	-	3.2	2.8	-	4.91	4.91
Grand River	May	-	0.24	0.149	-	0.147	0.0723	-	25.4	18.4	-	3.61	2.77
	June	-	0.208	0.184	-	0.16	0.154	-	23	3.6	-	1.64	2.72
	July	-	0.174	0.237	-	0.144	0.179	-	2.4	15.4	-	1.86	2.12
	August	0.178	0.148	0.16	0.174	0.138	0.11	ND	5.8	43.2	2.07	2.57	1.97
	September	0.11	0.0666	0.162	0.0808	0.0503	0.137	2	ND	5	3.32	2.73	3.04
	October	0.229	0.0705	0.0382	0.0965	0.0579	0.0198	17.8	4.4	ND	3.94	3.94	3.24
Little Wolf River	May	-	0.0515	0.0555	-	0.0259	0.0204	-	10.3	9.8	-	2.11	1.62
	June	-	0.0566	0.0545	-	0.0332	0.021	-	7.4	10.8	-	2.01	2.08
	July	-	0.0658	0.0476	-	0.034	0.0193	-	8.2	9	-	1.98	1.86
	August	-	0.0457	0.0581	-	0.035	0.0273	-	5.8	9.8	-	1.84	2.05
	September	0.0664	0.0323	0.038	0.0335	0.0319	0.02	24	5.2	6.4	2.31	2.34	1.86
	October	0.02	0.0384	0.0201	0.0263	0.0236	0.0111	2	5.4	2.8	2.55	2.14	2.56
Mecan River	May	-	0.0708	0.0482	-	0.0158	0.00751	-	46.5	25	-	2.34	2.22
	June	-	0.0855	-	-	0.0155		-	33.4		-	1.9	
	July	-	0.0498	0.0454	-	0.0373	0.00547	-	23.3	23.4	-	2.25	2.25
	August	-	0.074	-	-	0.0291		-	7.4		-	1.28	
	September	-	0.0314	0.0323	-	0.0186	0.0102	-	15.8	9.6	-	2.56	2.31
	October	-	0.0326	0.0312	-	0.00875	0.00854	-	9.2	9.6	-	2.42	2.38
Montello River	May	-	0.122	0.0838	-	0.038	0.0285	-	43.8	8.8	-	1.8	1.4
	June	-	0.104	-	-	0.04		-	33.6		-	1.73	
	July	-	0.123	0.107	-	0.0149	0.0394	-	16.6	5.2	-	1.16	1.17
	August	-	0.0964	-	-	0.0593		-	12		-	1.23	
	September	-	0.0452	0.0492	-	0.0236	0.0235	-	24.2	20	-	1.08	1.01
	October	-	0.0611	0.0278	-	0.0176	0.008	-	22.2	11.8	-	1.43	1.87
Mud Creek	May	-	0.694	0.291	-	0.606	0.236	-	9.6	13	-	3.27	2.56
	June	-	-	0.348	-	-	0.278	-	-	13.4	-	-	16.2
	July	-	0.626	0.88	-	0.573	0.774	-	18.4	38	-	3.62	5.56

	August	-	0.597	0.751	-	0.501	0.634	-	17.6	28.8	-	2.35	3.82
	September	-	0.728	0.815	-	0.704	0.766	-	7.4	22	-	5.01	4.72
	October	-	0.51	0.812	-	0.414	0.752	-	4.4	14	-	4.02	7.18
Neenah Creek	May	-	0.131	-	-	0.0264		-	35.8		-	1.78	
	June	-	0.143	0.0914	-	0.0266	0.0145	-	60	24.8	-	1.64	2.07
	July	-	0.177	-	-	0.0435		-	43.6		-	1.95	
	August	-	0.126	-	-	0.023		-	20.4		-	1.25	
	September	-	0.129	0.0852	-	0.00846	0.015	-	39.6	20.4	-	1.54	1.27
	October	-	0.067	0.038	-	0.00451	0.00578	-	23.6	10.8	-	1.73	1.32
Pine River	May	-	-	0.0614	-	-	0.00838	-	-	5	-	-	2.22
	June	-	0.0908	0.0373	-	0.0146	0.013	-	17	6.75	-	2.09	2.18
	July	-	0.0438	0.0435	-	0.0129	0.0163	-	10.2	12	-	2.28	2.2
	August	-	0.0496	0.0466	-	0.014	0.0209	-	12.4	8.2	-	1.97	1.89
	September	-	0.0364	0.0412	-	0.0145	0.0162	-	2.6	9.8	-	2.3	2.09
	October	-	0.173	0.028	-	0.0146	0.017	-	3.6	2.4	-	2.39	2.28
Pipe Creek	May	-	-	0.183	-	-	0.0369	-	-	8.6	-	-	1.84
	June	-	0.205	0.299	-	0.173	0.249	-	7	3.6	-	1.22	12
	July	-	0.154	0.137	-	0.128	0.01	-	3.2	23.4	-	8.14	7.03
	August	-	0.31	0.226	-	0.272	0.161	-	5.4	7.2	-	4.74	2.1
	September	-	0.222	0.215	-	0.18	0.0976	-	17.6	19.3	-	2.28	1.59
	October	-	0.561	0.306	-	0.425	0.258	-	10.6	17	-	4.92	1.87
Red River - Maple Ave	May	-	-	0.0361	-	-	0.00832	-	-	6.2	-	-	1.26
	June	-	0.0408	0.0309	-	0.0134	0.0103	-	11.2	4.4	-	1.22	1.31
	July	-	0.0218	0.0192	-	0.0178	0.00418	-	ND	ND	-	1.23	1.06
	August	0.0243	0.0241	0.0153	0.0207	0.0157	0.0062	ND	2.2	ND	1.38	2.28	1.15
	September	0.0255	0.0144	0.0163	0.0228	0.00386	0.00496	4.4	ND	ND	1.5	1.23	1.34
	October	0.0142	0.0203	0.01	0.0256	0.00531	ND	ND	ND	ND	2.2	1.62	1.57
Shioc River	May	-	-	0.209	-	-	0.121	-	-	3.4	-	-	1.79
	June	-	0.243	0.404	-	0.189	0.327	-	2.8	12	-	1.62	1.71
	July	-	0.194	0.393	-	0.114	0.306	-	7.6	8.2	-	2.75	1.13

	August	-	0.658	0.348	-	0.523	0.274	-	4.6	3.4	-	1.8	1.86
	September	0.275	0.338	0.264	0.147	0.278	0.148	14.8	2	6.4	1.74	1.41	2.74
	October	0.365	0.198	-	0.257	0.149		5	2.6		1.34	1.59	
Waukau Creek	May	-	0.0917	0.129	-	0.0433	0.0223	-	8.6	75.8	-	1.31	1.37
	June	-	0.18	0.0984	-	0.14	0.0445	-	5.8	46.8	-	0.916	2.48
	July	-	-	0.132	-	-	0.0971	-	-	5.4	-	-	1.26
	August	0.143	0.124	0.168	0.0659	0.0832	0.116	7.4	8	6.6	0.964	1.41	1.54
	September	0.0432	0.0772	0.285	0.032	0.0226	0.108	7.6	38.2	133	1.03	1.24	4.6
	October	0.247	0.0424	0.0537	0.167	0.0223	ND	117	7.2	10.8	1.84	1.36	1.21
West Branch FDL River	May	-	0.338	0.462	-	0.269	0.357	-	7	2.4	-	1.18	1.21
	June	-	0.452	0.479	-	0.383	0.379	-	6.2	10.8	-	2.01	1.32
	July	-	0.856	0.462	-	0.552	0.39	-	19.8	7.43	-	1.46	1.2
	August	0.31	0.335	0.357	0.249	0.277	0.312	12	5.8	3.2	1.23	1.14	1.09
	September	0.177	0.204	0.252	0.179	0.159	0.18	7	6.6	15.4	0.938	1.03	1.16
	October	0.114	0.125	0.112	0.11	0.107	0.0797	5	2.4	2.2	0.911	0.799	0.777
West Branch Wolf River	May	-	-	0.0252	-	-	0.00761	-	-	5.6	-	-	0.718
	June	-	0.0435	0.0222	-	0.0101	0.00616	-	5	4.6	-	0.777	0.772
	July	-	0.0238	0.0248	-	0.00931	0.00653	-	9.2	6.4	-	0.652	0.681
	August	-	0.0691	0.0151	-	0.00338	0.00654	-	17.2	2.6	-	0.926	0.546
	September	0.0188	0.00988	0.0155	0.0251	0.00344	0.0056	ND	ND	2.2	0.623	0.588	0.561
	October	0.0178	0.0393	0.0111	0.0174	0.00754	0.00438	8	26	ND	0.892	0.997	0.847
White River	May	-	0.044	0.0535	-	0.013	0.0145	-	22	21.6	-	1.88	1.57
	June	-	0.0729	0.0556	-	0.0244	0.0109	-	6	35.4	-	1.4	1.87
	July	-	0.0289	0.0376	-	0.011	0.0135	-	7.6	17.4	-	1.6	1.46
	August	0.0238	0.0433	0.0177	0.015	0.0151	0.00519	6.8	7.2	3.2	1.38	1.43	1.55
	September	0.0211	0.0168	0.0252	0.0258	0.00552	0.00996	4	3	5	1.95	1.97	1.73
	October	0.0326	0.0196	0.0144	0.0232	0.00739	0.00531	ND	4.8	ND	1.5	2.43	2.09
Wolf River	May	-	0.041	0.0354	-	0.00579	0.0109	-	7.2	6.2	-	0.657	0.656
	June	-	0.0454	0.0258	-	0.0118	0.00794	-	26.2	3.8	-	0.658	0.577
	July	-	0.0343	0.0267	-	0.00879	0.00732	-	4.4	ND	-	0.601	0.602

	August	0.036	0.0299	0.0351	0.0182	0.00368	0.00668	4.4	3.2	6.4	0.755	0.566	0.652
	September	0.036	0.0213	0.0265	0.0254	0.00528	0.00759	4.6	3	4	0.711	0.556	0.552
	October	0.0249	0.0335	0.0216	0.0184	0.0135	0.00519	2.6	3.6	47.6	0.642	0.858	0.51

ND indicates sample concentration was not detected

Appendix G: Duplicate Sample Results

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
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

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

Upper Fox River and Wolf River Volunteer Monitoring Program

Project Summary

August 2023

Appendix H: Stream Flow and Transparency Data

		Stream Flow			Transparency		
Stream Name	Month	2022	2021	2020	2022	2021	2020
Bear Creek	May		-	-	120	-	-
	June		4.67	-		82.9	-
	July		40.7	-		93.7	-
	August			-	120	91	-
	September		64.2	-	100	72	-
	October		-	6.5		99	106
Belle Fountain Creek	May		-	-	120	55	-
	June		-	-		56	-
	July		-	-		62	-
	August		-	-		77	-
	September		-	-		74	-
	October		-	-		120	-
East Branch FDL River	May	38.12	10.76	-	39.7	-	-
	June	93.1		-	10.7	12.2	-
	July		11.28	-	12.8	17.9	-
	August	15.9		0.6	27.4	28.2	60
	September		10.8	420	27.3	25.66	34
	October	11.2	0.65	19.06	79	50.3	80.6
Embarrass River	May		-	-	40.5	43	-
	June		-	-	31.2	18	-
	July		-	-	43.2	34.2	-
	August		-	-	42.5	45.5	-
	September		-	-	125	48	62.5
	October		-	-	66.2	81	-
Fox River	May		-	-		56	-
	June		-	-		72.5	-

	July		-	-	49.5	53.5	-
	August		-	-		90	-
	September		-	-		120	-
	October		-	-	120	100	-
Grand River	May		-	-		76.5	-
	June		-	-	120	120	-
	July		-	-		120	-
	August		-	-		102	120
	September		-	-	120	120	120
	October		-	-	120	120	120
Little Wolf River	May		-	-	95.6	94.2	-
	June		-	-	65	111.5	-
	July		-	-	100.1	96.4	-
	August		-	-	98.5		-
	September		-	-	107	120	74
	October		-	-	125	120	-
Mecan River	May		-	-	81	52	-
	June		-	-		74	-
	July		-	-	72	66	-
	August		-	-		93	-
	September		-	-		94	-
	October		-	-		118	-
Montello River	May		-	-	120	84	-
	June		-	-		77	-
	July		-	-	52		-
	August		-	-		98	-
	September		-	-		90	-
	October		-	-		97	-
Mud Creek	May	1.3	1.18	-	23.6	-	-
	June	15.1	-	-	30.5	-	-

	July	1.4	0	-	13.46	31	-
	August	0.6	-	-	9.96	29.65	-
	September	0.053	-	-	19.16	32.5	-
	October		-	-	22.5	111.45	-
Neenah Creek	May		-	-		56	-
	June		-	-		35	-
	July		-	-		27.5	-
	August		-	-		51	-
	September		-	-	120	28	-
	October		-	-	60	55	-
Pine River	May		-	-	88		-
	June		-	-	76.8		-
	July		-	-	50	66	-
	August		-	-	58	75	-
	September		-	-	90	120	-
	October		-	-	120	120	-
Pipe Creek	May		-	-		0	-
	June		-	-		8.58	-
	July		-	-			-
	August		-	-			-
	September		-	-			-
	October		-	-			-
Red River	May		-	-	99		-
	June		-	-	120		-
	July		-	-	120		-
	August		-	209.76	120	120	120
	September		-	-	120	120	120
	October		-	93	120	120	120
Shioc River	May		-	-		-	-
	June		-	-		-	-

	July		-	-		95	-
	August		-	-		54	-
	September		-	-		120	-
	October		-	-		120	51
Waukau Creek	May		44.3	-	20	115	-
	June		21.1	-		89.4	-
	July		-	-			-
	August		-	-	27	95.4	60.8
	September		-	-		53.4	75.4
	October		-	-	57.2	60.8	39.2
West Branch FDL River	May		-	-	120	54.2	-
	June		-	-	52.1	52.45	-
	July		-	-	46.3	51.88	-
	August		-	-	72.4	79.26	76
	September		-	-	43	83.93	95
	October		-	-	90.4	120	105.3
West Branch Wolf River	May		-	-	120	-	-
	June		-	-	120	115	-
	July		-	-	120	110	-
	August		-	-	120	92.5	-
	September		-	-	120	120	120
	October		-	-	120	120	67.4
White River	May		-	-	70	56	-
	June		-	-		108	-
	July		-	-		120	-
	August		-	-		72	120
	September		-	-	102.5	120	120
	October		-	-	120	120	120
Wolf River	May		-	-		-	-
	June		-	-		-	-

	July		-	-		-	-
	August		-	-		-	109
	September		-	-		-	-
	October		-	-		-	95