Water Quality Monitoring Report

Stream and Flow Monitoring

Introduction

In 2021, the Lake Ripley Management District received a Surface Water grant from the Wisconsin Department of Natural Resources for ‘“Expanding the Scope of Lake Ripley Watershed Monitoring”. This grant worked towards gaining a better understanding of how much sediment and nutrients are being filtered through wetlands, and how much is making its way into Lake Ripley. One of our main goals of this project was to monitor continuous flow at the inlet and the outlet to compare with phosphorus samples, and be able to determine the amount of phosphorus entering and leaving the lake system.

The District has been collecting water quality data along the inlet creek dating back to the early 90s, but since 2013 we have been collecting consistent water quality data. We were gathering data that would tell us how much sediment and nutrients were entering the system, but it was unclear how much of that sediment and nutrient load was coming out of the lake, and how quickly.

To improve our understanding of how water, total phosphorus (TP), total suspended solids (TSS), nitrogen, and nitrates are moving through Lake Ripley and its surrounding watershed, an updated monitoring program was developed in 2021 and implemented in 2022 and 2023. The goals of the monitoring program are to quantitatively model the volume of water entering and leaving Lake Ripley, the total mass or load of phosphorus entering and leaving Lake Ripley and the total mass of suspended solids entering and leaving Lake Ripley.

Materials and Methods

Data was collected from June 2022 through November 2023 for flow, water depth (later converted via modeling to flow or discharge), total phosphorus and total suspended solids. There were four

Picture 1: Monitoring Locations and Instream Monitoring Wells

monitoring locations. Listed in order of upstream to downstream: Preserve Central, Highway A (Hwy A), Ripley Road, and Park Road (outlet).

We originally intended to install the HOBO water logger to monitor the flow at the inlet site, just upstream of the confluence of the inlet and the lake. Unfortunately, the site was not suitable due to the wide and shallow nature of the inlet creek, and the lack of flow moving through that site. As a result, the installation of the HOBO logger was moved to the Ripley Road site.

Picture 2: HOBO Water Logger Locations

Monitoring Sites

Preserve Central
The Preserve Central site is *the furthest upstream site*, located within the District's 207-acre Preserve It is located on the southern boundary of the Preserve. This section of the inlet is channelized, and noticeable excavation spoils are located along the banks resulting in an entrenched state including eroding banks and a silty substrate.

Highway A
The Highway A site is downstream from Preserve Central and located just west of the Lake Ripley Preserve parking area. It is surrounded by wetlands that receive flood water during high flow conditions. The stream meanders in this section of the inlet creek and alternates between sandy substrate and silty substrate that supports aquatic plants such as spatterdock and sago pondweed.

Ripley Road
The Ripley Road site is located downstream of both the Preserve Central site and the County Road A (Hwy A) site, just downstream of the intersection of the creek and Ripley Road. This site is

surrounded by wetlands and just downstream of a box culvert at the intersection of the creek and Ripley Road.

Park Road

The Park Road site is located just downstream of the lake outlet at the intersection of the outlet creek and Park Road.

Water Quality Sampling

Water quality sampling for total phosphorus and total suspended solids was collected monthly in 2022 and 2023 in March, April, May, September, and October at our four established sampling sites (Highway 18, Preserve Central, County Road A, and Ripley Road). Samples were collected biweekly in June, July, and August.

We used a Hach HQ 2100 portable multimeter with a dissolved oxygen electrode to monitor dissolved oxygen, pH, temperature, and conductivity. All nutrient samples were hand-collected using the "surface-grab" method. All samples were mailed to the Wisconsin State Lab of Hygiene for laboratory analysis.

Flow Monitoring

Flow monitoring data was collected monthly in 2022 and 2023 in March, April May, September and October. Flow data was collected biweekly in June, July and August. A Swoffer Model 2100 Velocity Meter was used to collect all flow data. The 0.6 depth velocity-area method at 1-foot intervals was used to calculate overall discharge. Additional flow monitoring data was collected during periods of low or high flow conditions to capture the widest range of values possible during the project.

Barometric Pressure / Stream Depth Monitoring

A series of HOBO data loggers were deployed at Preserve Central, Highway A (Hwy A), Ripley Road, and Park Road (outlet) to collect barometric pressure. Each HOBO data logger was installed in a vented instream monitoring well. The barometric pressure was measured at 15-minute intervals for each site. An atmospheric barometric pressure monitor was used to provide baseline barometric pressure data that was later used to convert instream barometric pressure to stream depth using the HOBOware software package.

Water Volume / Discharge Modeling

Water volume, or discharge, was modeled at each monitoring site using the relationship between water depth and flow measurements. Flow data collected in the field was matched to the nearest 15-minute interval of water depth data collected by the HOBO data loggers. The relationship between flow and water depth was used to create a flow rating curve for each monitoring site (Figure 1). The resulting equation was used to predict the overall discharge in cubic feet per second (cfs) for each 15-minute interval. All flow rating curves, TP versus flow and TSS versus flow relationships are included in Appendix A.

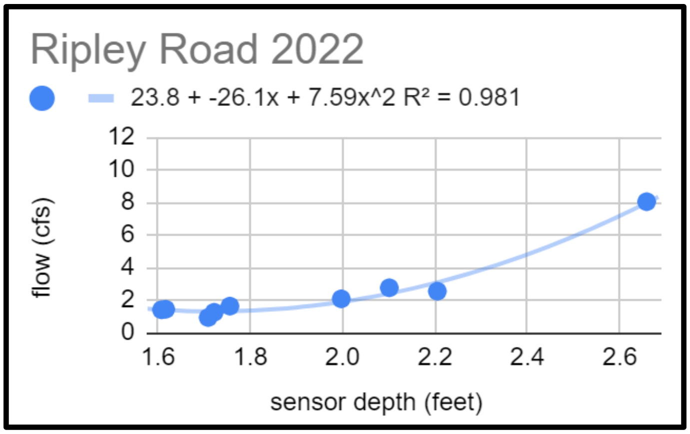


Figure 1: Example Flow Rating Curve

Total Suspended Solids Modeling

Total suspended solids were modeled at Preserve Central, Highway A (Hwy A), Ripley Road, and Park Road (outlet) using the relationship between flow measurements collected in the field and total suspended solids sampling. Total suspended solids data and flow measurements were collected concurrently. The relationship between flow and total suspended solids was used to create an equation to estimate the total suspended solids loading at each monitoring site (Figure 2). The resulting equation was used to predict the total suspended solids loading for each 15-minute interval.

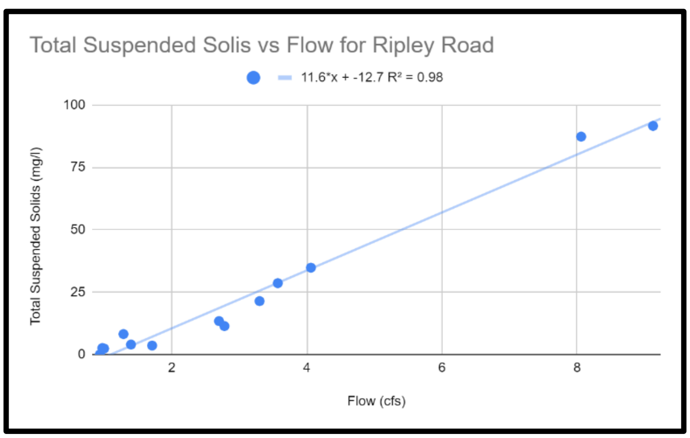


Figure 2: Example Total Suspended Solids versus Flow

Total Phosphorus Modeling

Total phosphorus was modeled at Preserve Central, Highway A (Hwy A), Ripley Road, and Park Road (outlet) using the relationship between flow measurements collected in the field and total phosphorus sampling. Total phosphorus data and flow measurements were collected concurrently. The relationship between flow and total phosphorus was used to create an equation to estimate the total phosphorus loading at each monitoring site (Figure 3). The resulting equation was used to predict the total suspended solids loading for each 15-minute interval.

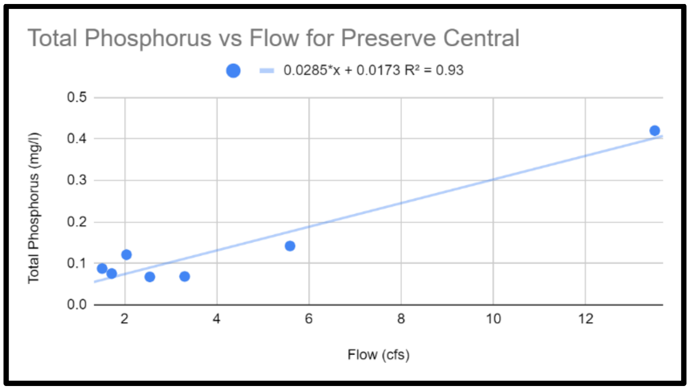


Figure 3: Example Total Phosphorus versus Flow

Results and Discussion

The following section summarizes the modeling results from early June through the end of October 2022. Due to technical issues related to monitor installation and performance in 2022, HOBO logger data from March–June 2022 was not usable in the final modeling effort. In 2023, the rating curve predictions for the Preserve Central site appeared to greatly overestimate the flow from March–May. This is likely due to differences in the seasonal relationship between flow and water depth. For 2023, the same range of data was used as in 2022 from June–October.

The conclusions from the impacts of watershed-based total suspended solids and total phosphorus are likely underestimates of the total contribution in 2022 and 2023. The modeling results for the 2022 and 2023 monitoring seasons (June–October) are shown in Table 1. Additionally, no relationship was found at the outlet at Park Road with respect to flow and suspended solids or total phosphorus so only water volume is reported.

In general, 2022 had much higher predicted water volume, higher predicted total suspended solids loading, and higher predicted total phosphorus loading than 2023. The majority of the differences between 2022 and 2023 can be attributed to a large rain event in 2022.

Table 1: Watershed Modeling Results for Lake Ripley 2022–2023

Site	Dates	Water Volume (cubic feet)	Suspended Solids (tons)	Phosphorus (pounds)
Preserve Central	June-October 2022	31,000,400	37.1	364.4
Hwy A		33,124,709	67.8	588.1
Ripley Road		29,665,344	69.3	572.1
Park Road		85,885,874		
% Change Preserve Central to Hwy A		6.9	82.9	61.4

% Change A to Ripley Road		-10.4	2.3	-2.7
% Change Preserve Central to Ripley Road		-4.3	87.0	57.0
Preserve Central	June - October 2023	17,540,313	8.6	108.5
Hwy A*		*8,640,866*	*3.2*	*60.6*
Ripley Road		16,089,975	8.8	122.3
Park Road		18,304,640		
% Change A to Ripley Road				
% Change Preserve Central to Ripley Road		-8.3	2.1	12.7
% Change 2023 versus 2022 at Ripley Road		-45.8	-87.4	-78.6
**Monitoring dates for Hwy A = August-October*				

Water Volume

In 2022, there was a relatively small net gain of water from Preserve Central to Hwy A and a loss of water volume from the upstream Preserve Central site to Ripley Road. Overall, the water volume decreased 4.3% from Preserve Central to Ripley Road and 10.4% from Hwy A to Ripley Road. There was an increase in water volume of 6.4% from Preserve Central to Hwy A. The volume of water leaving Lake Ripley was much greater than the inflow.

In 2023, the pattern for water volume was similar to 2022 where water volume was lower at Ripley Road compared to Preserve Central by 8.3%. The total volume of water in 2022 was 13,000,000 gallons larger than in 2023 at Ripley Road representing a percent change of -45.8%. The volume of water leaving the lake in 2023 was comparable to the input.

Total Suspended Solids

In 2022, total suspended solids contributed an estimated 69.3 tons of sediments to Lake Ripley. An increase of 87% of total suspended solids occurred from Preserve Central to Ripley Road; however, there was only a 2% increase in total suspended solids between Hwy A and Ripley Road. The relative inputs from the watershed upstream of Preserve Central are large, but the inputs between Preserve Central and Hwy A are even larger. The likely cause of this pattern in 2022 will be discussed further in the "*Event Analysis*" section.

In 2023, total suspended solids contributed a total of 8.8 tons of sediment to Lake Ripley at Ripley Road. Just under 98% of the sediments entering Lake Ripley were present in the water column at the Preserve Central site. The 8.8 tons is an overall percent change of -87.4% relative to 2022.

Total Phosphorus

In 2022, the total phosphorus inputs to the lake were 572.2 pounds at Ripley Road. A total of 364.4 pounds of total phosphorus were present at Preserve Central and 588.1 pounds at Hwy A. While the majority of phosphorus originates upstream of Preserve Central, a significant amount of phosphorus enters the stream between Preserve Central and Hwy A.

In 2023, total phosphorus loads were relatively small compared to 2022. 108.5 pounds of phosphorus entered the watershed upstream of Preserve Central while 122.3 pounds were present at Ripley Road for a 12.7% change. The overall percent change in total phosphorus was -78.6% from 2022 to 2023.

Event Analysis

The predicted flow for 2022 and 2023 are shown in Figure 4 and Figure 5, respectively. For the 2022 and 2023 monitoring seasons, flow was generally less than 3 cfs at all sites. In general, relatively small rain events cause rapid increases in flow over the course of a few days to over a week depending on the magnitude of the storm events. In 2023, flows did not exceed 10 cfs at any of the monitoring sites. In 2022, a large rain event resulted in flows exceeding 20 cfs. The following analysis will focus on the large flow event that occurred from 9/11/2022 through 9/22/2022 as 9.1 inches of rain fell in two storms.

Figure 4: Predicted Flow (cfs) for Lake Ripley Monitoring Sites 2022

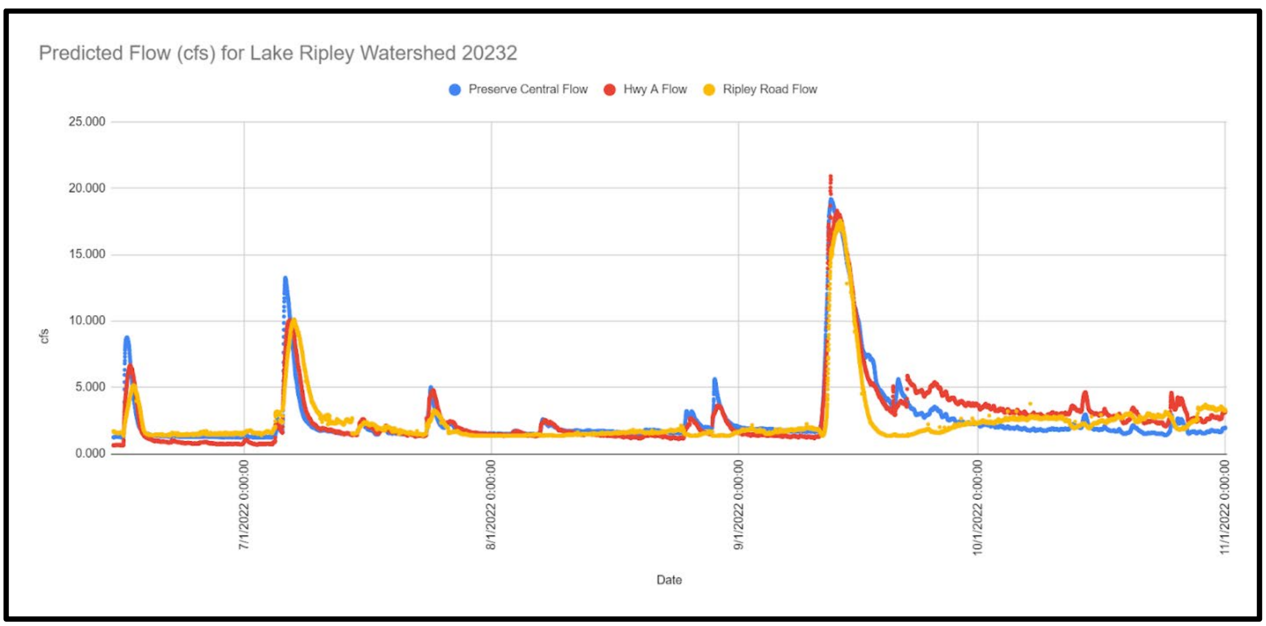


Figure 5: Predicted Flow (cfs) for Lake Ripley Monitoring Sites 2023

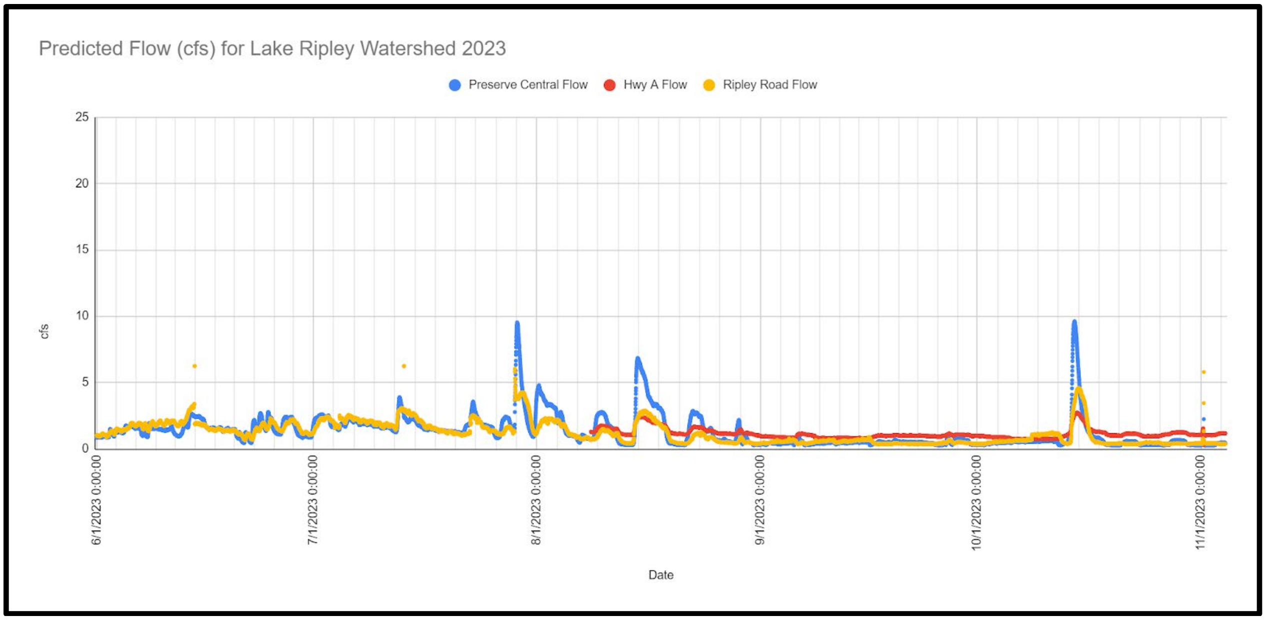


Table 2 summarizes the water budget and watershed modeling for total suspended solids and total phosphorus for 2022 comparing the entire monitoring season to the large precipitation event.

Table 2: 2022 Water Budget and Watershed Modeling for Lake Ripley

2022	Full Monitoring Season (June through October)			Event Only (9.1 inches of rain from 9/11/2022 to 9/22/2022 where >4cfs)					
Site	Water Volume (millions of cubic feet)	TSS (tons)	TP (pounds)	Water Volume (millions of cubic feet / % total)		TSS (tons / % total)		TP (pounds / % total)	
Preserve Central	31.0	37.1	364.4	8.5	**27.3**	25.5	**68.5**	218.6	**60.0**
Hwy A	33.1	67.8 (30.7)	588.1 (223.7)	7.9	**23.8**	41.1 (15.6)	**60.7**	339.8 (121.2)	**57.8**
Ripley Road	29.7	69.3 (1.5)	572.1 (16.0)	6.0	**20.2**	54.3 (13.2)	**78.4**	384.9 (45.1)	**67.3**

Event Water Volume

The water volume increases from upstream to downstream from Preserve Central to Hwy A by approximately 2 million cubic feet over the monitoring season while the water volume decreases from upstream todownstream from Hwy A to Ripley Road by 4 million cubic feet. When a large storm event is considered in isolation, the pattern changes. There is a decrease in water volume of 2.4 million cubic feet from upstream to downstream at each site. The largest reduction occurs between Hwy A and Ripley Road of 1.9 million cubic feet. Overall, the event water volume comprised 20.2% of the overall flow reaching Lake Ripley in 2022. In context, the monitoring season reported was for a total of ~5 months and the storm event occurred over ~11 days.

Features of the watershed might explain these patterns. Upstream of the Preserve Central site, the watershed is largely agricultural. A large storm event would likely result in large amounts of surface runoff. Downstream of the Preserve Central site, there are abundant wetlands surrounding the Hwy A site which persist continuously to the Ripley Road site. In addition, there is a culvert at Ripley Road that backs up during periods of high flow. It is likely that these two watershed features result in the reduced water volume at Hwy A, during storms only, and Ripley Road.

Event Total Suspended Solids

Table 2 shows the total suspended loading model predictions for 2022. Overall, there is an increase in total suspended solids from Preserve Central to Hwy A and a decrease from Hwy A to Ripley Road. Since total suspended solids increase as flow increases, there is a disproportionate amount of total suspended solids in the stream during storm events. The large storm event accounted for 78.4% of the total suspended solids loading in 2022 at Ripley Road. Again, characteristics of the watershed can explain this pattern as well as characteristics of the stream bed. The wetlands and culvert at Ripley Road mentioned in the previous section, likely play a large role in absorbing flood waters and reducing TSS moving downstream as they are deposited in the wetlands.

The stream bed at the Preserve Central site is very soft and composed of loose sediments. These sediments are easily disturbed and moved downstream. There are areas of deposition in the stream bed at both the Hwy A and Ripley Road sites alternating with firm substrates. The generally high amounts of total suspended solids found at Hwy A might be caused by eroding streambed and stream bank material moving downstream. This material is likely being deposited in slower moving parts of the stream as it moves through the wetlands.

Event TotalPhosphorus

The patterns for total phosphorus are similar to the patterns for total suspended solids. In 2022, 67.3% of the total phosphorus entering Lake Ripley was due to the large precipitation event. Just under 57% of the event total phosphorus entering Lake Ripley was present at Preserve Central with most of the remaining total phosphorus entering the inlet creek between Preserve Central and Hwy A with a smaller amount entering the inlet creek between Hwy A and Ripley Road. The same factors influencing flow and total suspended solids are likely impacting patterns in total phosphorus.

Conclusions

There are some important conclusions that can be drawn from this study:

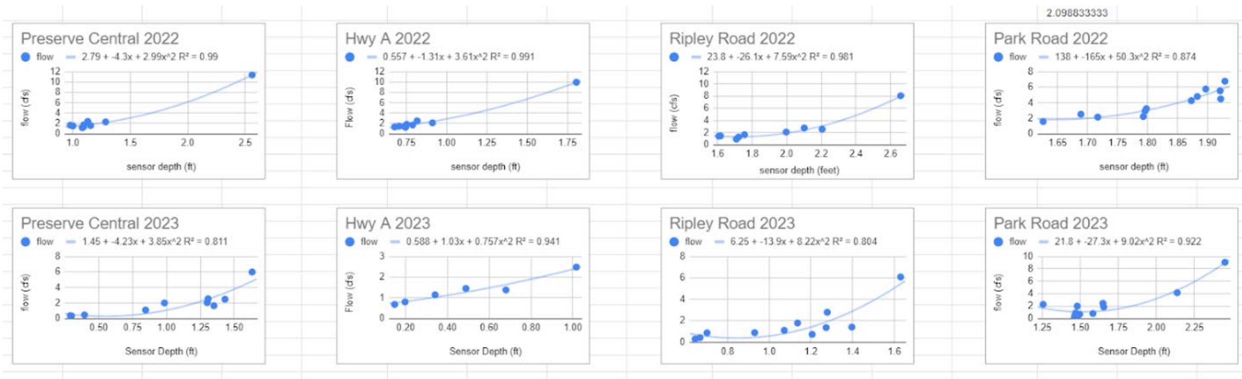
- In dry years, the majority of the total suspended solid and total phosphorus inputs to the inlet creek occur upstream of Preserve Central in the largely agricultural portion of the watershed.
- During large precipitation events, the upstream portion of the watershed contributes large amounts of total suspended solids and total phosphorus in excess of what is measured during dry years, but there are additional contributions to the inlet creek downstream of Preserve Central for total suspended solids and total phosphorus.
- It is important to address watershed contributions upstream of Preserve Central to the inlet creek to protect the water quality of Lake Ripley.
- It is critical to address watershed contributions to the inlet creek during large precipitation events to protect the water quality of Lake Ripley.

Management Recommendations

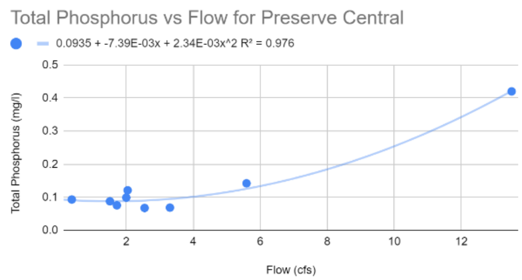
Future actions are required to reduce the impacts of total suspended solids and total phosphorus to Lake Ripley.

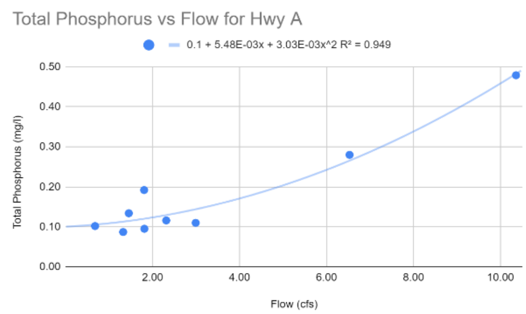
- Work with local landowners to reduce nonpoint source pollution in the upstream agricultural portions of the watershed.
- Implement projects to stabilize the streambed of the inlet creek upstream of Hwy A.
- Implement projects to minimize the impacts of large precipitation events on the inlet creek in all parts of the watershed.
- Continue to monitor water quality.
- Continue to measure water depths and model water volume, total phosphorus loading and total suspended solids loading.

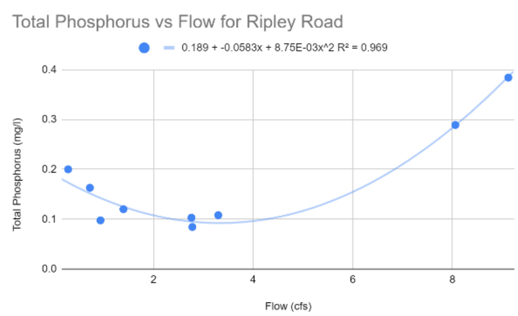
Appendix A: Flow Rating Curves

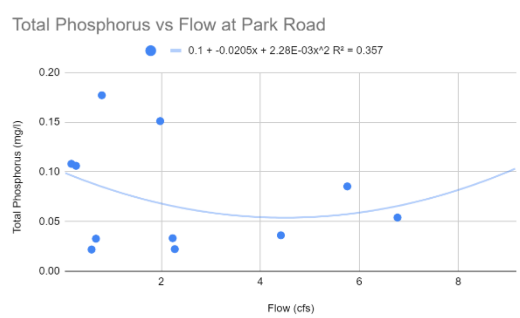


Appendix B: Total Phosphorus Modeling

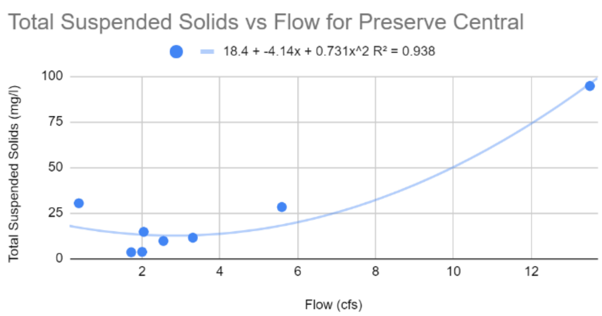


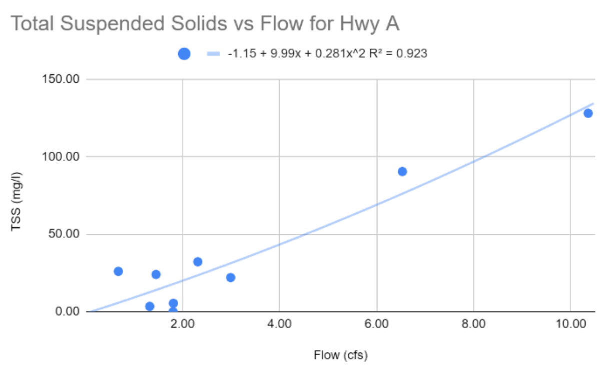


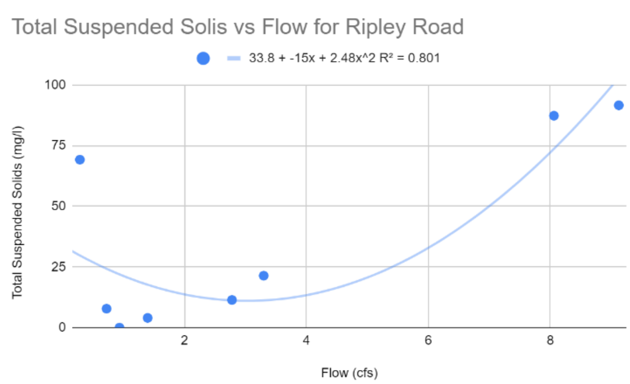


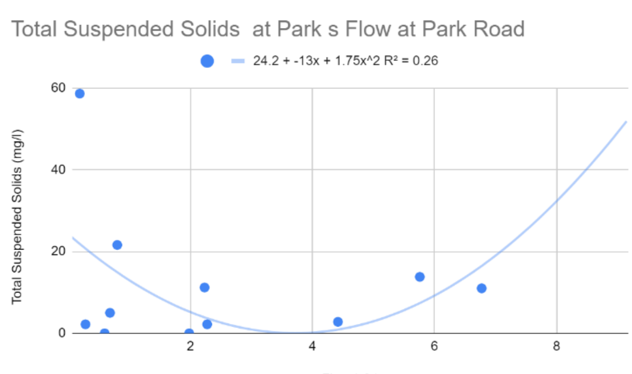


Appendix C: Total Suspended Solids Modeling









Water Quality Monitoring Report

Inlet and Outlet Monitoring

Introduction

Lake Ripley receives a significant amount of its water, nutrient loading and sediment loading, from its watershed via the inlet stream. In 2021, the Lake Ripley Management District received a Surface Water grant from the Wisconsin Department of Natural Resources for ‘“Expanding the Scope of Lake Ripley Watershed Monitoring”. This grant worked towards gaining a better understanding of how much sediment and nutrients are being filtered through wetlands, and how much is making its way into Lake Ripley. One of our main goals of this project was to monitor continuous flow at the inlet and the outlet to compare with phosphorus samples, and be able to determine the amount of phosphorus entering and leaving the lake system.

Methods and Data Collection

Water quality was measured according to DNR protocols at 6 monitoring stations in our watershed (Highway 18, Preserve Central, County Road A, Ripley Road, downstream of Ripley Road) during 2020, 2021, 2022 and 2023. Samples were collected as a surface grab sample, at a depth of 0.5’. The frequency of sampling was monthly, March through May and October, and then biweekly June through September. All samples were analyzed for total phosphorus (TP), total suspended solids (TSS), dissolved oxygen (DO), turbidity, temperature, temperature, pH and conductivity.

In July 2021, the LRMD’s pH/conductivity probe failed so pH and conductivity were not collected after July 13, 2021. A new pH/conductivity probe was purchased, and data collection resumed for those parameters in 2022. Flow was measured at the two most downstream sites in 2020 and 2021 (CTH A and Ripley Road) and at the Preserve Central site in 2022 and 2023, in addition to water quality monitoring.

Two additional sites were added in 2022 and 2023 at the most downstream section of the inlet creek near the confluence with Lake Ripley called “Unnamed Lake Inlet” and the outlet at “Park Road”. The frequency of sampling was monthly, March through May and October, and then bi weekly June through September. All samples were analyzed for total phosphorus (TP), total suspended solids (TSS), nitrate + nitrite, and total nitrogen.

Here is a list of field equipment used for this project: Swoffer Model 2100 flow meter, Hannah Model HI 98125 pH/Conductivity Multi-parameter Probe, HACH LDO Dissolved Oxygen Probe and LaMotte 2020we Turbidity Meter. All field equipment was calibrated the day of sampling according to manufacturer instructions.

Results and Discussion

The following subsections summarize the data collected in 2020, 2021, 2022 and 2023. The data from 2020 was collected prior to the grant activities, but it has been included to provide greater context of any patterns in the data.

Total Phosphorus

Phosphorus drives biological productivity in aquatic ecosystems. The annual mean total phosphorus (mg/l) for all sites is listed in Table 1 and Figure 1. All years exceeded the nutrient criteria goal for surface waters of 0.075 mg/l at all sites, with the exception of the lake outlet at Park Road.

Total Phosphorus (mg/l) *Threshold: 0.075 mg/l*				
Site	**Year**			
--	**2020**	**2021**	**2022**	**2023**
Hwy 18	0.106	0.090	0.116	0.096
Preserve Central	0.108	0.083	0.143	0.090
Hwy A	0.129	0.103	0.204	0.140
Ripley Road	0.149	0.126	0.171	0.135
Inlet	-	-	0.129	0.128
Park Road (outlet)	-	-	0.031	0.044

Table 1: Total Phosphorus Summary Data

In 2020 and 2021, there is a general increase in total phosphorus concentrations as water moves closer to the lake, with the highest values closest to Lake Ripley at Ripley Road. In 2022, the pattern changes as there is a decrease in overall phosphorus concentration from Hwy A to Ripley Road.

The 2022 sampling season captured two large storm events. Visual observations noted that the culvert on Ripley Road was backing up much of the storm water into the surrounding wetlands. This is a likely mechanism to explain the lower phosphorus concentration at Ripley Road.

In all years there is a relatively large increase of total phosphorus between the Preserve Central and Hwy A site. This suggests that there are significant sources of nutrient loading in the watershed between the Preserve Central and Hwy A sites. Possible explanations for this observation include bank erosion along the channel or nutrient addition from the watershed.

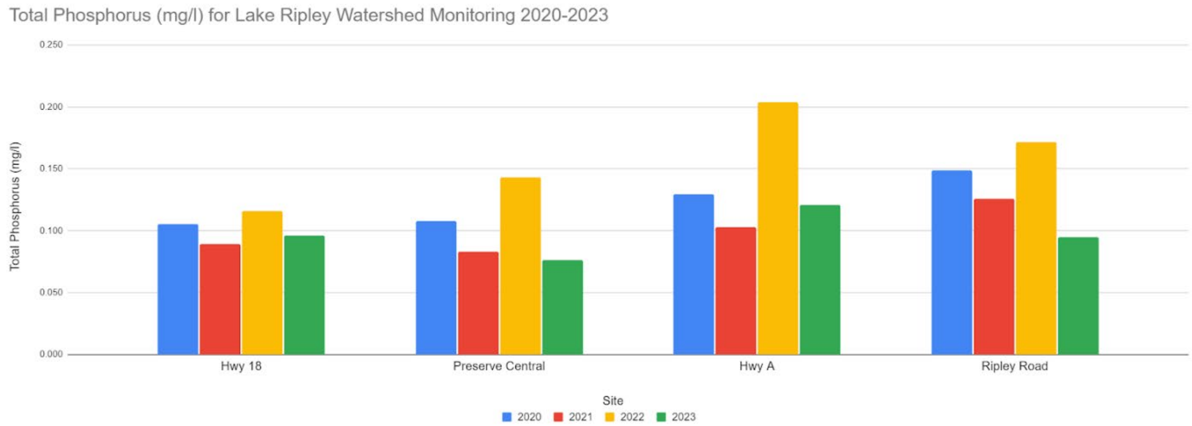


Figure 1: Site Comparison for Total Phosphorus 2020-2023

Total Suspended Solids

Table 2 and Figure 3 shows total suspended solids by site for 2020, 2021, 2022 and 2023. Total suspended solids is a measurement to quantify the amount of solids in the water column including organic (living organisms and detritus) and inorganic particles (minerals and sediments). Ideally, the total suspended solids should not exceed ~12 mg/l. Total suspended solids were overall about 30% lower in 2021 versus 2020. This is likely due to a relatively dry summer in 2021. Most values were higher in 2022 due to two large rainfall events that were sampled in March and June 2022.

Total Suspended Solids (mg/l)				
Site	Year			
--	**2020**	**2021**	**2022**	**2023**
Hwy 18	10.2	17.2	7.1	20.1
Preserve Central	26.8	17.0	24.0	13.9
Hwy A	24.0	14.7	47.3	19.6
Ripley Road	25.9	13.9	31.5	22.8
Inlet	-	-	8.39	12.0
Park Road (outlet)	-	-	5.84	5.41

Table 2: Total Suspended Solids Summary Data for 2020-2023

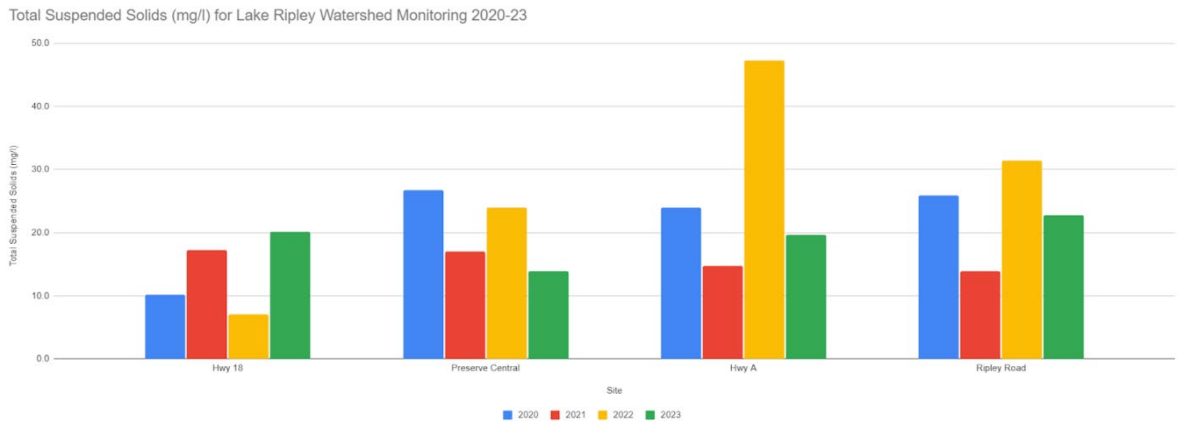


Figure 2: Site Comparison for Suspended Solids 2020-2023

Dissolved Oxygen

Table 3 shows the summary for dissolved oxygen levels at all sites for 2020 through 2023. Dissolved oxygen is the oxygen in the water column available for living organisms. A "healthy" stream will maintain dissolved oxygen between 5 and 12 mg/l. Dissolved oxygen levels are not a concern and within expected ranges for all sites. The greatest fluctuations occurred at the Hwy 18 site. This site is full of silt and adjacent to a small pool full of duckweed (*Lemna minor*) and algae. In summer, the values alternate between a supersaturated state (200%) and relatively low levels (50%), which is typical for small streams impacted by agricultural runoff. This impact was not observed at the remaining sites further downstream.

Dissolved Oxygen (mg/l)				
Site	**Year**			
	2020	**2021**	**2022**	**2023**
Hwy 18	11.0	6.9	4.8	7.3
Preserve Central	7.7	7.8	7.1	7.8
Hwy A	7.7	8.6	7.4	8.1
Ripley Road	7.6	8.7	7.8	8.4
Inlet	-	-	7.7	10.7
Park Road (outlet)	-	-	8.6	10.1

Table 3: Dissolved Oxygen Summary Data for 2020-2023

Water Temperature

The average water temperature data from 2020-2023 is summarized in Table 4. Water temperature changed seasonally with warmer temperatures occurring in the summer months.

Water Temperature (C°)				
Site	**Year**			
--	**2020**	**2021**	**2022**	**2023**
Hwy 18	18.2	17.3	16.0	15.5
Preserve Central	15.6	16.4	15.7	14.2
Hwy A	17.8	16.8	16.8	15.8
RipleyRoad	18.3	17.8	18.4	17.2
Inlet	-	-	25.5	22.4
Outlet	-	-	27.0	20.8

Table 4: Average Water Temperatures 2020-2023

Turbidity

Table 5 shows the turbidity data for 2020-2023. Turbidity measures water clarity using an optical sensor and should be <10 NTU. The turbidity was generally low at all sites. Higher values were detected during and following storm events. The higher values detected at the Preserve Central site are likely due to large amounts of silt on the streambed and/or bank erosion.

Turbidity (NTU)				
Site	**Year**			
--	**2020**	**2021**	**2022**	**2023**
Hwy 18	3.2	3.6	4.5	3.1
Preserve Central	8.7	7.4	12.2	4.8
Hwy A	7.8	4.9	11.7	6.3
Ripley Road	7.2	5.1	7.8	6.0
Inlet	-	-	4.8	3.8
Park Road (outlet)	-	-	6.0	2.9

Table 5: Turbidity Data for 2020-2023

Conductivity

Table 6 summarizes the conductivity data for 2020-2023. Conductivity is the amount of dissolved minerals and salts in the water column. Values between 400-900 are common for streams in Wisconsin that have significant groundwater inputs. The values are similar at all sites and typical for the area.

Conductivity (uS/cm)				
Site	**Year**			
--	**2020**	**2021**	**2022**	**2023**
Hwy 18	547	625	576	548
Preserve Central	537	627	590	535
Hwy A	548	607	600	607
Ripley Road	520	613	560	592
Inlet	-	-	590	608
Park Road (outlet)	-	-	417	430

Table 6: Conductivity Data for 2020-2023

pH

The pH values for 2020-2023 are shown in Table 7. The pH is stable year round ranging from 7.4-7.9 and similar at all sites. The outlet site has a higher mean pH value.

pH				
Site	**Year**			
--	**2020**	**2021**	**2022**	**2023**
Hwy 18	7.7	7.5	7.5	7.7
Preserve Central	7.4	7.5	7.7	7.7
Hwy A	7.5	7.7	7.8	7.7
Ripley Road	7.6	7.6	7.8	7.9
Inlet	-	-	7.3	8.0
Park Road (outlet)	-	-	8.7	8.7

Table 7: pH Data for 2020-2023

Stream Flow

Table 8 shows the stream flow measurements for 2020-2023. The Hwy 18 site is not monitored for flow because it is a very small, shallow agricultural ditch with standing water and intermittent flow. In 2021, flow monitoring at the Preserve Central site was added to the regular monitoring schedule. Flow generally increases from upstream to downstream. The main purpose of stream flow data collection is to support the watershed modeling project. Creating a comprehensive flow model is a key element to model loading for total phosphorus and total suspended solids.

Stream Flow (cfs)				
Site	**Year**			
--	**2020**	**2021**	**2022**	**2023**
Hwy 18	NA	NA	NA	NA
Preserve Central	NA	1.7	5.4	1.98
Hwy A	5.1	2.1	4.8	2.12
Ripley Road	5.9	2.2	4.7	1.75
Inlet	-	-	-	-
Park Road (outlet)	-	-	4.4	2.88

Table 8: Stream Flow Data for 2020-2023

Nitrogen (Total Nitrogen and Nitrate+Nitrite)

Tables 9 and 10 show the monitoring data for 2022 and 2023 for total nitrogen and nitrates + nitrites. Total nitrogen includes all types of nitrogen present in the sample. Nitrate + nitrite is an indicator of nitrogen pollution typically found in surface waters due to agricultural activities in the watershed. The nitrate + nitrite values are relatively high and compose a large amount of the total nitrogen present. The expected values for nitrate + nitrite is <1 mg/l in surface waters. Values in excess of 2 mg/l generally indicate local land use issues related to agriculture. The results of the 2022 and 2023 monitoring indicate impacts from local land uses are impacting the inlet creek.

Total Nitrogen (mg/l)		
Site	**Year**	
--	**2022**	**2023**
Inlet	3.294	2.336
Park Road (outlet)	0.953	1.274

Table 9: Total Nitrogen Data for 2022-2023

Nitrate + Nitrite (mg/l)		
Site	Year	
--	2022	2023
Inlet	2.578	1.805
Park Road (outlet)	0.113	0.418

Table 10: Total Nitrate + Nitrite Data for 2022-2023

Conclusion

Based on the 2020-2023 monitoring data, the primary concerns for the Lake Ripley tributary are total phosphorus and total suspended solids.

Phosphorus reaching Lake Ripley from the tributary creek contributes to undesirable conditions such as increased algae density in the water column and lakebed, and increased aquatic plant growth. The current annual averages generally exceed the desired 0.075 mg/l surface water standard. Management actions to reduce total phosphorus in the creek would benefit Lake Ripley.

Total suspended solids are an issue during rain events. The baseline values are relatively low, but during storms the total suspended solids increase rapidly delivering sediments to Lake Ripley. The location where the inlet reaches the lake is extremely silted in from years of sediments reaching the lake. Watershed management practices to reduce the influx of sediments to the creek would benefit Lake Ripley.

Stream flow is highly dependent on rainfall in the Lake Ripley watershed. While it is not possible to increase base flow during dry periods, it is possible to manage high flows by increasing the watershed storage capacity.

To reduce total phosphorus, total suspended solids, and mitigate high flows, a plan to encourage water from large rain events to overflow into the existing wetlands upstream from the Hwy A monitoring site should be developed. Observations after large rain events have confirmed the inlet creek overflows into the wetlands near the Ripley Road and CTH A sites. This would allow for settling to occur and reduce the amount of phosphorus and sediments reaching the lake. Ongoing efforts to control erosion in the watershed should be continued to limit the amount of total suspended solids and total phosphorus.

Nitrogen monitoring suggests that local land use practices are contributing to the relatively high nitrate levels in the inlet creek.