Blue Lake Monitoring Report 2018

Lake Data for Upper (Little) Blue Lake	
Township	Spencer Brook
MN Lake ID	30010701
# of Public Boat Access	0
Aquatic Invasive Species	Curly Leaf Pondweed
Surface Area	43 acres
Maximum Depth	10ft
Lake Meets Clean Water Goals	Total Phosphorus: **YES**
(When compared to shallow lake goals)	Chlorophyll-a: **YES**
	Secchi Transparency: **YES**

Lake Data for Lower (Big) Blue Lake	
Township	Spencer Brook/Stanford
MN Lake ID	30010702
# of Public Boat Access	2
Aquatic Invasive Species	Curly Leaf Pondweed
Surface Area	241 acres
Maximum Depth	30ft
Lake Meets Clean Water Goals	Total Phosphorus: **YES**
(When compared to deep lake goals)	Chlorophyll-a: **YES**
	Secchi Transparency: **YES**

Blue Lake Monitoring Report 2018

What: LID volunteers collected Total Phosphorus (TP), Chlorophyll-a, and transparency information every two weeks from May through October in both Upper and Lower Blue Lake. SWCD Staff collected dissolved oxygen, pH, conductivity and temperature information throughout the water column, once a month, from May to October in both lakes. SWCD staff provided training, equipment and coordinated lab testing.

Why: The lake was not monitored with any regularity before 2013. In 2015 the Blue Lake Improvement District began partnering with the Isanti SWCD in an effort to collect monitoring data on a regular basis. The data being gathered provides us with an understanding of the lake's health and water quality trends; furthermore, the data helps us diagnose areas of concern and provides evidence for the need to implement lake improvement projects (great for grant applications). In fact, monitoring data from 2015 and 2016 was used to obtain over $250,000 of State grant funding to implement water quality projects around the lake.

Upper and Lower Blue Lake samples are summarized in this report individually.

General Definitions

Total Phosphorus (TP): An essential plant nutrient in which an excess can cause severe algal blooms.
Chlorophyll-a (Chl-a): A pigment found in green plants, used to estimate quantity of algae in a lake.
Secchi Transparency: A measure of light penetration in water, an indication to the amount of algae in the water.

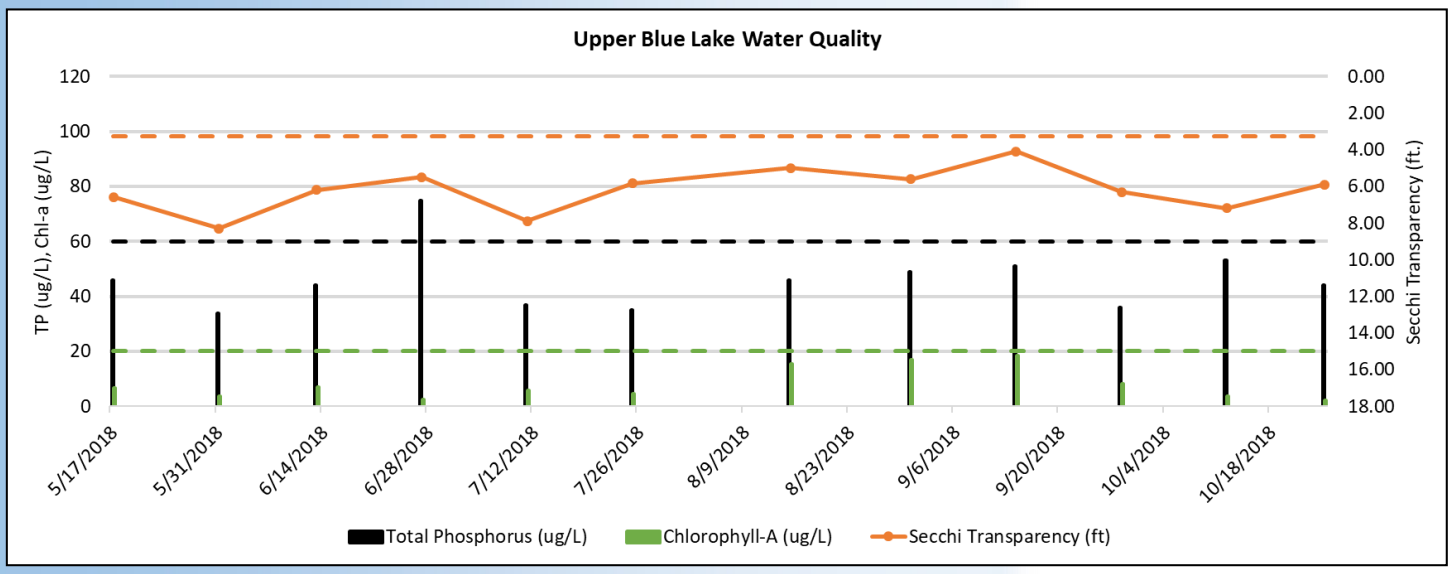
Upper (Little) Blue Lake Monitoring Results 2018

Total Phosphorus (TP), Chlorophyll-a (Chl-a) and Secchi Transparency

MN Clean Water Goals for Shallow Lakes

Total Phosphorus (TP): ≤ 60 ug/L Chlorophyll-a: ≤ 20 mg/L Secchi Depth: ≥ 3.28 feet

Growing season average	46.63 ug/L (TP)	9.88 mg/L (Chl-a)	5.80 ft. (Secchi)



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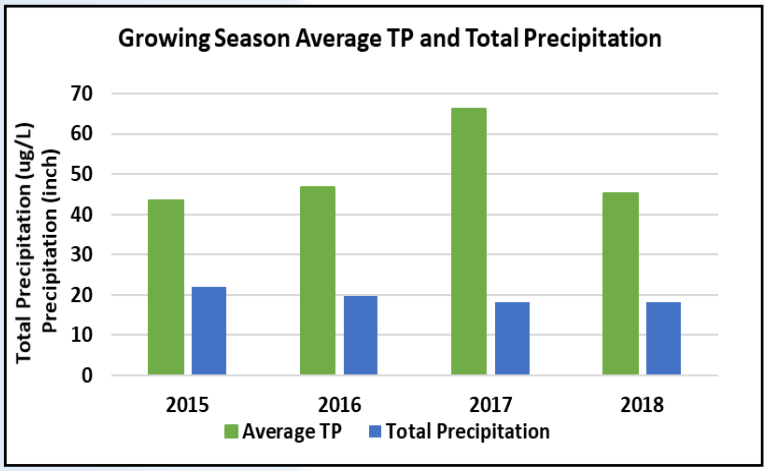


- Max lake depth of 10 ft., categorized as a shallow lake.
- Monitoring results are compared to state water quality goals for shallow lakes.
- Overall lake water quality was very good in 2018.
- TP exceeded the quality goal only in late June. This occurrence was likely due to die-off of curly leaf pond-weed, increased boat traffic, and low precipitation. In previous years TP exceeded the quality goal more often.
- While the overall precipitation was similar to 2017, timing and amounts of rain events were different. This occurrence helps to explain why TP was higher in 2017.
- Water clarity (Secchi Depth) was better than the state goal during all sample events. Weather condition plus reduced curly leaf pondweed played a role.
- Chlorophyll-a (algae) was also very low in 2018 which is expected based on the low TP and increased water clarity.
- Nutrient concentrations stay consistent for most of the year, suggesting continuous lake mixing. This is typical for shallow lakes.
- 2018 was largely devoid of heavy rainfalls that would have contributed to pollutants in rainwater runoff. This undoubtedly influenced lake conditions for the year.

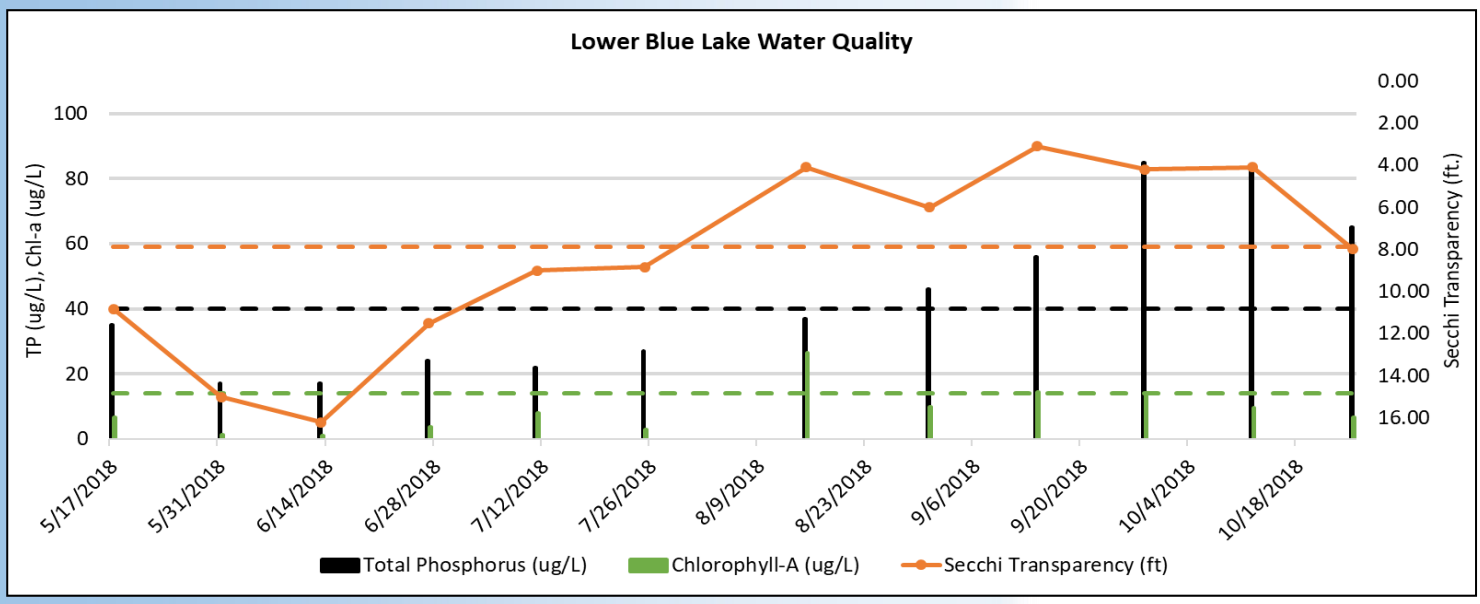
Lower (Big) Blue Lake Monitoring Results 2018

Total Phosphorus (TP), Chlorophyll-a (Chl-a) and Secchi Transparency

MN Clean Water Goals for Deep Lakes:

Total Phosphorus (TP): ≤ 40 ug/L Chlorophyll-a: ≤ 14mg/L Secchi Depth: ≥ 4.59 feet

Growing season average	39.25 ug/L (TP)	10.08 mg/L (Chl-a)	7.87 ft. (Secchi)



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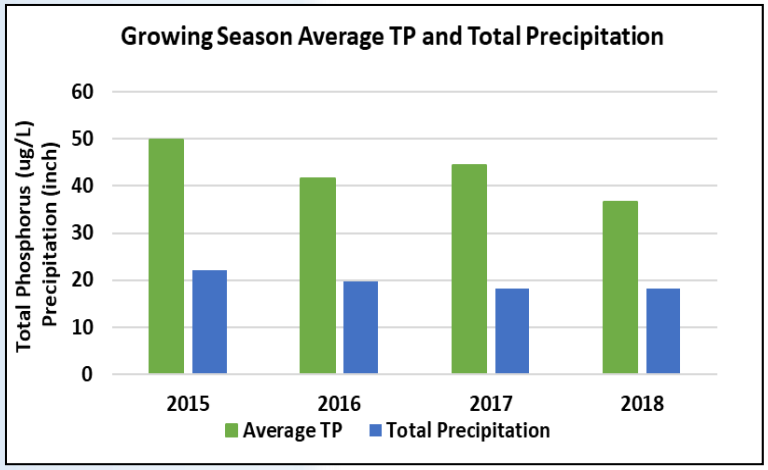
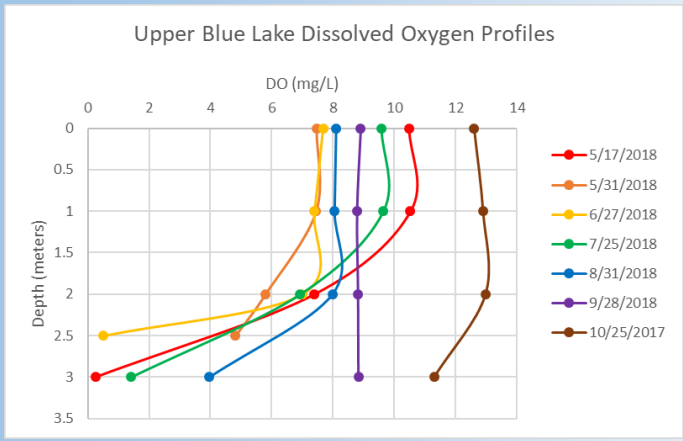


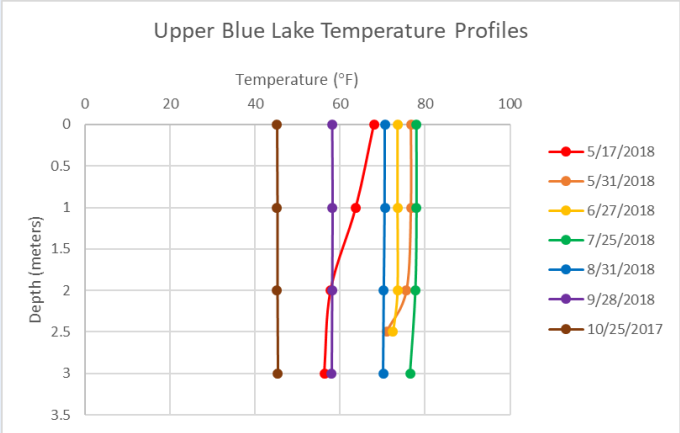
- Max Lake depth of 30ft., categorized as a deep water lake.
- Monitoring results are compared to state water quality goals for deep lakes.
- Overall lake water quality was very good in 2018.
- Low TP in in May-late August corresponds with lower than usual curly leaf pondweed, low monthly rain, and water column stratification.
- TP, similar to previous years, increased continually from July to October. This suggests nutrients from the bottom of the lake is being mixed into the water column as the lake turns over (internal loading).
- Water clarity (secchi Depth) and Chl-a (algae) also increased through out the summer, this is expected based on the TP results. This occurrence is similar to previous years.
- While the overall precipitation was similar to 2017, timing and amounts of rain events were different. This occurrence helps to explain why TP was higher in 2017.
- 2018 was largely devoid of heavy rainfalls that would have contributed to pollutants in rainwater runoff. This undoubtedly influenced lake conditions for the year.

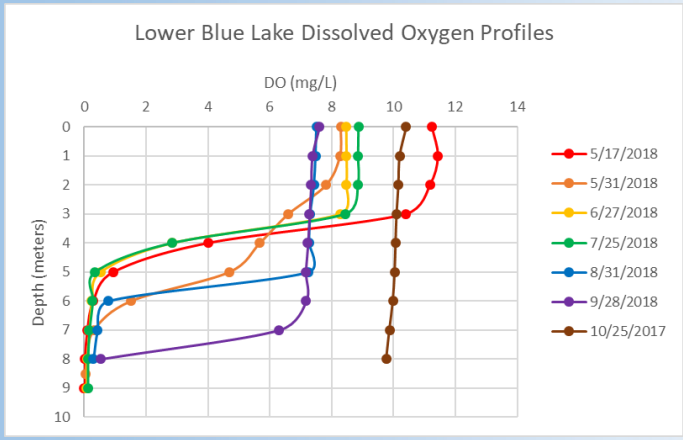
2018 Lake Stratification

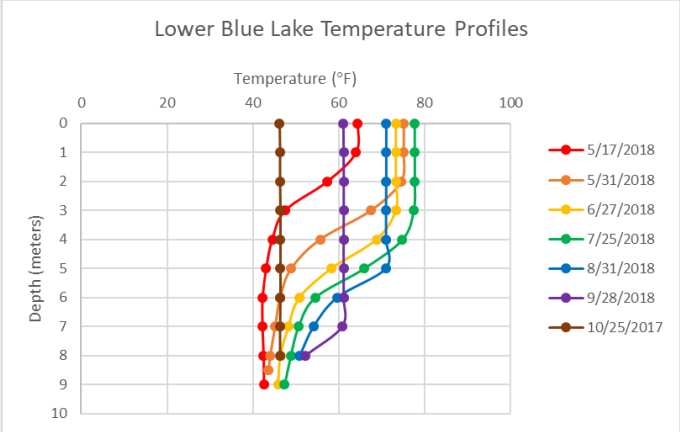
In 2018 we measured temperature and dissolved oxygen profiles starting at the surface of the water and then at one meter increments to the bottom of the lake. This information adds to the story when we analyze lake water quality data. The graphs below display the collected data.

Upper Blue Lake: Temperature remains consistent from top to bottom throughout the majority of the summer season. This indicates that the water column is continually mixing (as expected since it is a shallow lake). Therefore, nutrients that are sitting at the bottom are regularly mixed into the lake (internal loading). Dissolved oxygen periodically decreases to near zero at the bottom which increases phosphorus solubility and adds to the internal nutrient loading. The decreases in dissolved oxygen may be a result of the decay of excess organic matter such as curly leaf pondweed.





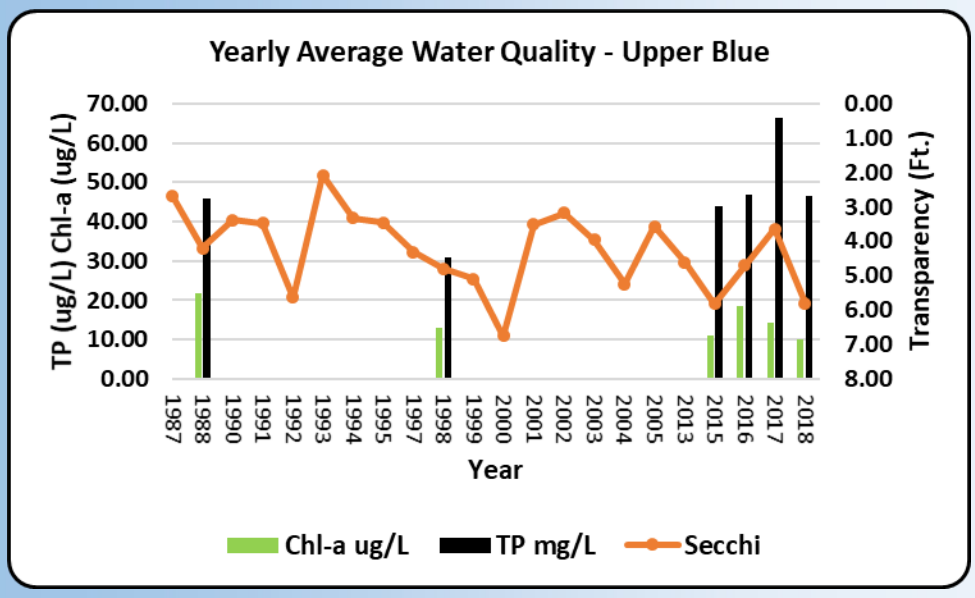




Lower Blue Lake: Temperature is consistent throughout the water column early and late in the year and forms layers of water with different temperatures from late May to late August. This process is called thermal stratification and is expected in a deep lake. The cool water acts as a barrier between the lake bottom and the warm waters above. Dissolved oxygen periodically decreases to near zero at the lake bottom. This phenomenon is typical in deep, nutrient rich lakes and occurs as the supply of oxygen is consumed by bacteria and decaying matter over the summer months. When the lake mixes (during fall turnover or because of other events such as heavy rains or winds) the nutrients are allowed to escape into the surface water and can stimulate an algal bloom.

Historic Monitoring Data Comparison

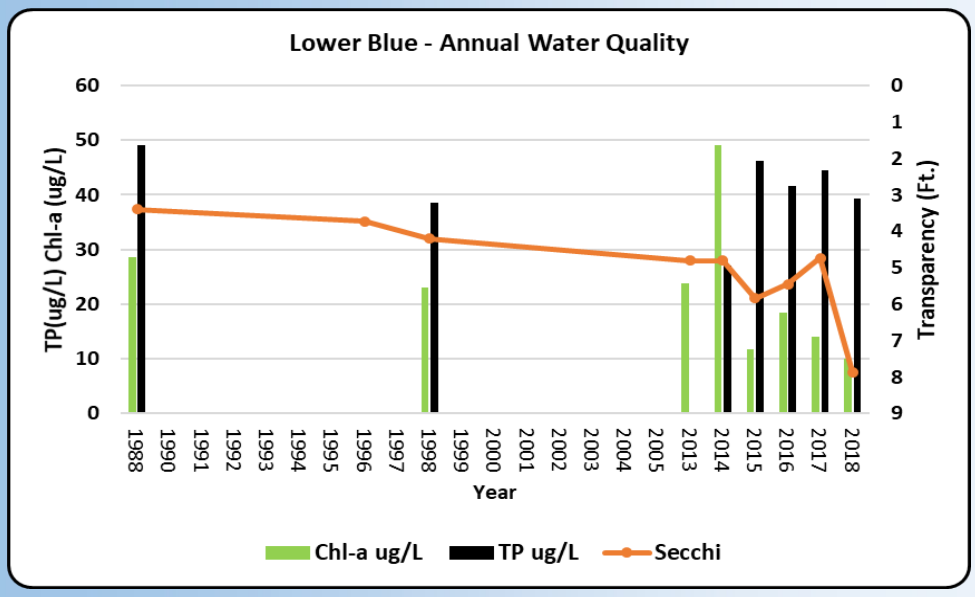
Total Phosphorus (TP), Chlorophyll-a (Chl-a) and Secchi Transparency



Source: MPCA and Isanti SWCD

Little (Upper) Blue Lake has a significant amount of historical water clarity (transparency) monitoring data. Based on this data alone there does appear to be a slight increasing trend in water clarity (clarity is getting better).

TP, Chl-a and water clarity varies year to year. In 2018 TP was much lower than in 2017. Similarly, water clarity was improved as compared to 2016 and 2017. Weather conditions and timing and amounts of rain defiantly impact the health of the lake.



Source: MPCA and Isanti SWCD

Lower (Big) Blue Lake has nine years of water clarity (transparency) data. While 10 years is preferred for calculating trends, it does look like there is also an increasing trend in water clarity (clarity is getting better).

While TP, Chl-a and water clarity varies year to year TP and Chl-a levels have hovered close to or just over the state water quality goals since the onset of monitoring in 2015.

Similar to Upper Blue, water health as a whole appeared better in 2018 than previous years. Weather conditions and timing and amounts of rain defiantly impact the health of the lake.

2019 Monitoring Recommendations

The data collected from 2015– 2018 gives us valuable insight into water health and how the lake responds to variables over time. The 2014-2023 monitoring plan does not include monitoring of the lake from 2019-2021. However, recent recommendations from Wenck Associations and conversations with the Blue Lake Improvement District indicate that there is interest in continuing to regularly monitor the health of the lake; as such, a modified 2019 lake monitoring plan is presented below.

Below are key points and recommendations for lake monitoring in 2019:

- Bi-weekly OR monthly lake sampling by the BLID. 2019 will not include temperature and dissolved oxygen profiles.

Future Recommendations:

- Consider collecting lake sediment cores in 2020 or 2021 to determine internal recycling of phosphorus (per Wenck Inc. Recommendations) and potential solutions to the issue.

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Thanks to the BLID members who have assisted with lake and stream monitoring, especially Dan Dixon!

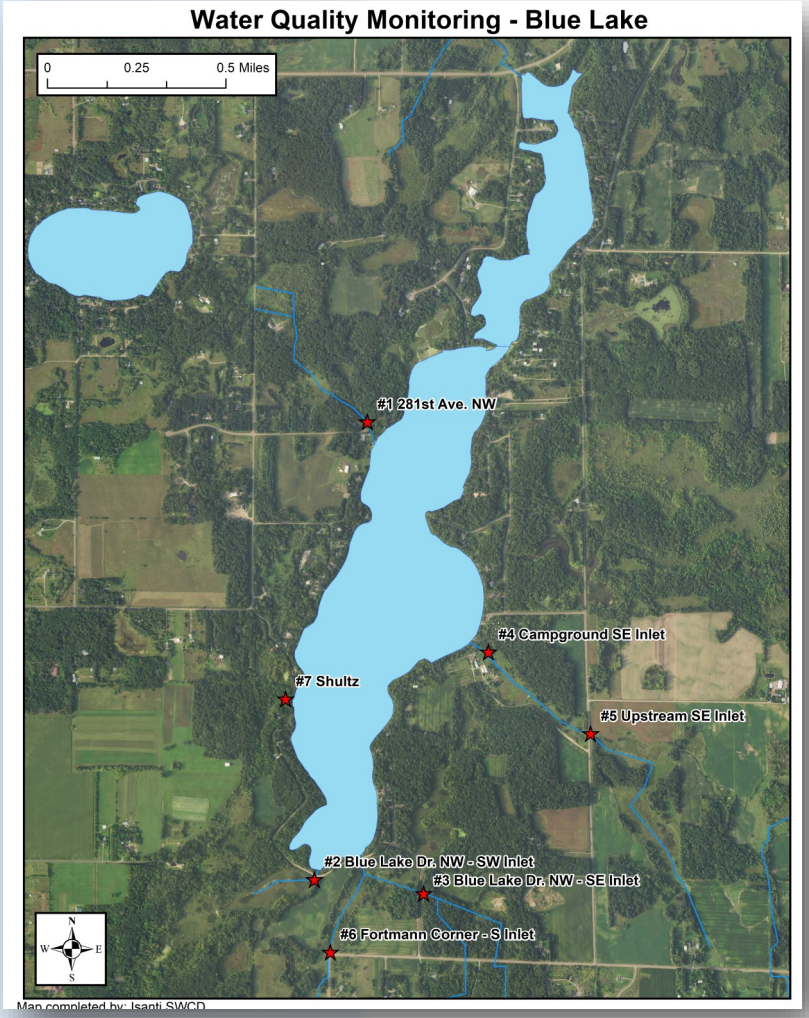
Blue Lake
Tributary Monitoring 2018

Introduction

2018 was the fourth year that the Blue Lake Improvement District (BLID) partnered with the Isanti Soil and Water Conservation District (SWCD) to monitor the health of five tributaries that drain into Blue Lake:

- #1 — 281st Ave. NW
- #3 — Blue Lake Dr. — SE inlet
- #4 — Tiger Street SE Inlet
- #6 — Fortmann Curve
- #7 — Shultz Inlet

Site #3



Tributary ID's were developed by the Isanti SWCD

Total Phosphorus: An essential plant nutrient in which an excess can cause severe algal blooms.

Orthophosphate: The amount of phosphorus that is immediately available for algae and plant growth.

Total Suspended Solids: Tiny particles of soil and other matter that remain suspended in water making it cloudy. Particles include sediment and organic matter.

Transparency: An indirect measure of suspended and dissolved materials (soil particles and tea color caused by organic materials) in the water.

2018 Area Conditions

Blue Lake Inlet #1

2018 Rainfall

The area was largely missed by heavy rains throughout the year. The majority of rain events occurred during the growing season (vegetation was growing and available to take up water) and nearly all events were under two inches. As a result, less sediment and phosphorus made its way into surface waters and water levels and flow were lower than usual across the county. Consistent (though still small) rain events and cooler than average temperatures in the Fall led to a sight rebound in stream levels late in the season.

Water Health Comparisons:

- TP measurements for this ecoregion typically range between 60 and 150 µg/L.
- TSS measurements for this area typically range between 4.8 and 16 mg/L.
- The State goal or standard for TP in streams is 100 µg/L (i.e. we would like to see TP stay well below this number).

Tributary Monitoring

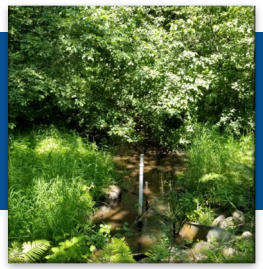
What: In 2018 eight sample events were targeted at four tributaries. We targeted four samples during rain events and four during base/low flow. Site #6 was sampled six times; four samples during high flow and two during base flow. No samples were collected at site #7 due to lack of flow. Samples were tested for total phosphorus (TP), total suspended solids (TSS) and transparency. Dissolved oxygen, temperature, conductivity, pH and water flow were measured in the field.

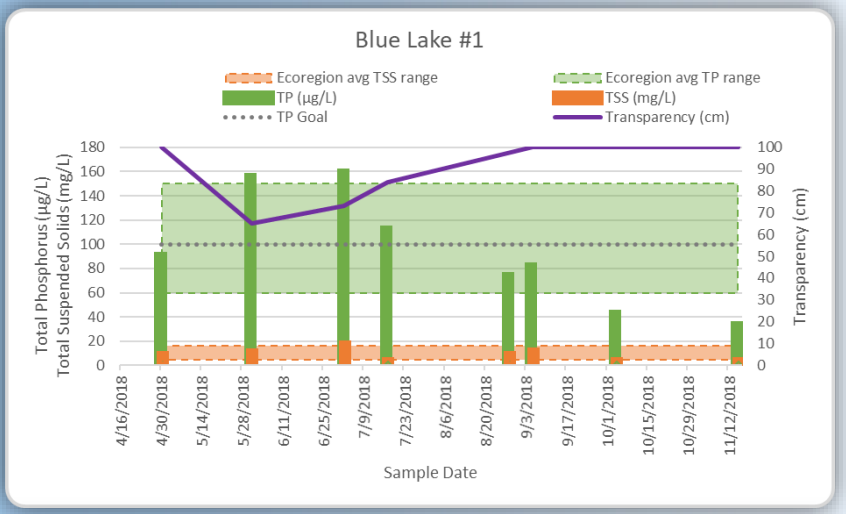
In addition to water quality, water levels were continually tracked using in-stream data loggers at three sample locations (#1, #3, and #4). The water levels were recorded every four hours from early May through early November. Water level readings were paired with flow to estimate the quantity of water and nutrients are being carried into the lake.

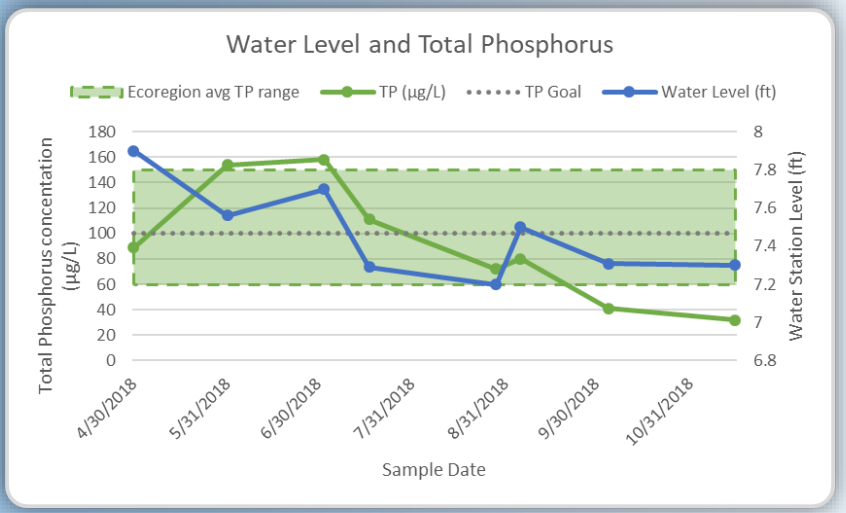
Why: The information collected helps us focus future lake water quality improvement projects at the best places on the landscape. In other words, near the streams that deliver the most nutrients to the lake. Additionally, this information will be used to track trends and to determine how well water quality improvement projects are working.

2018 Tributary Monitoring Results

Total Suspended Solids, Total Phosphorus and Transparency Tube



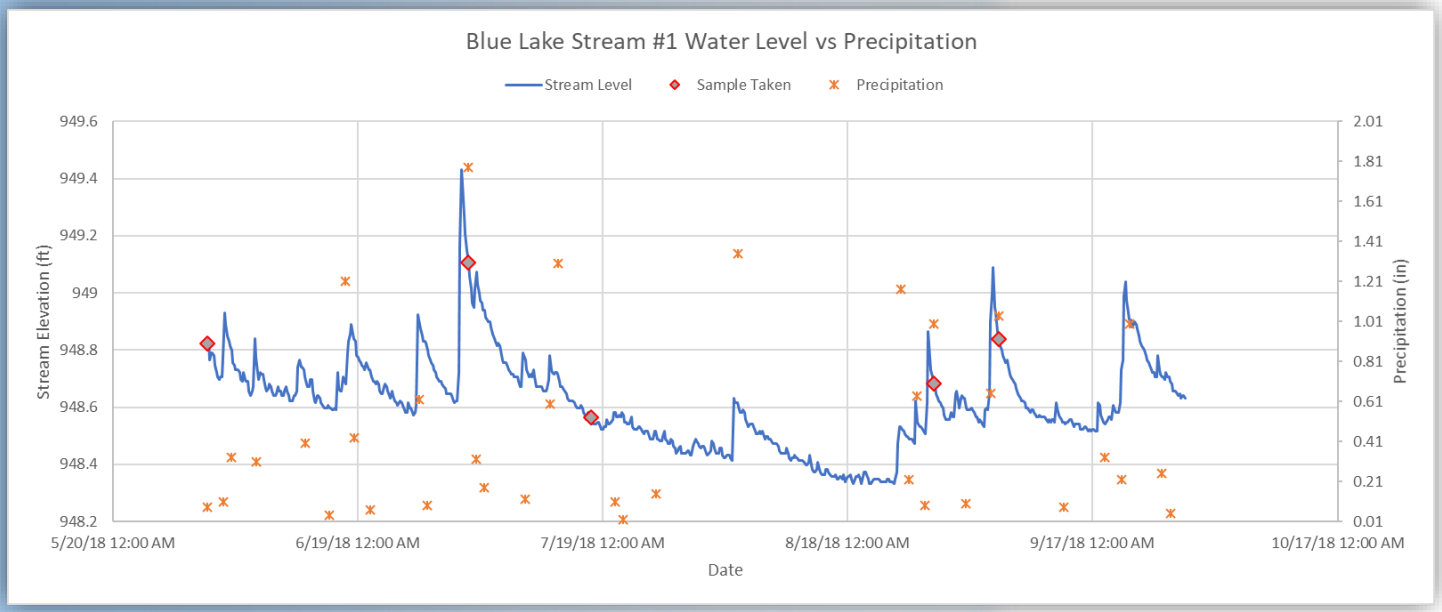




Site:

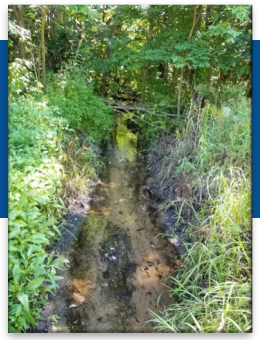
#1 281st Ave NW

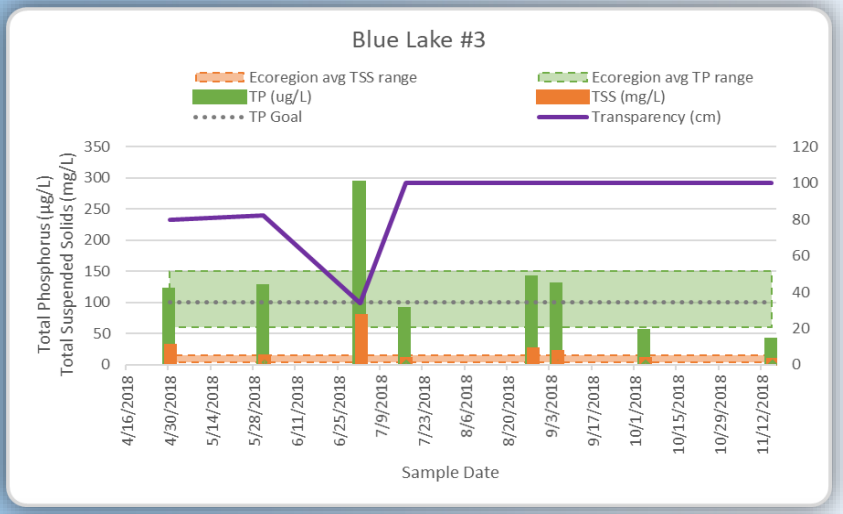
- 2018 average TP was 92 µg/L. The average TP range from 2015-2017 was 74-88 µg/L.
- TP concentrations at this site have been the lowest of all tributaries for four consecutive years.
- In 2018 the highest TP concentrations at this location were observed under higher water level conditions/ after rain events.
- 2018 average TSS was 6.9 mg/L. The average TSS range from 2015-2017 was 7-11.5 mg/L.
- The average TSS concentration was the lowest in 2018.
- 2018 average transparency was 89 cm. The average transparency range from 2015-2017 was 73-84 cm.
- Transparency readings only measure to 100 cm, this means the water is typically quite clear.
- Flow was and has consistently been the highest of all monitored tributaries at this location.
- Because flow is the highest at this location, the total phosphorus contribution to the lake is the highest at this location.

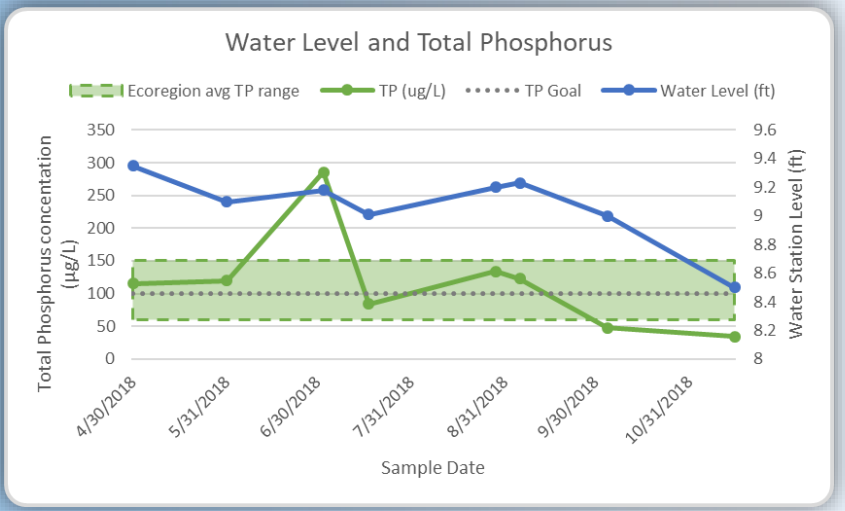


2018 Tributary Monitoring Results

Total Suspended Solids, Total Phosphorus and Transparency Tube



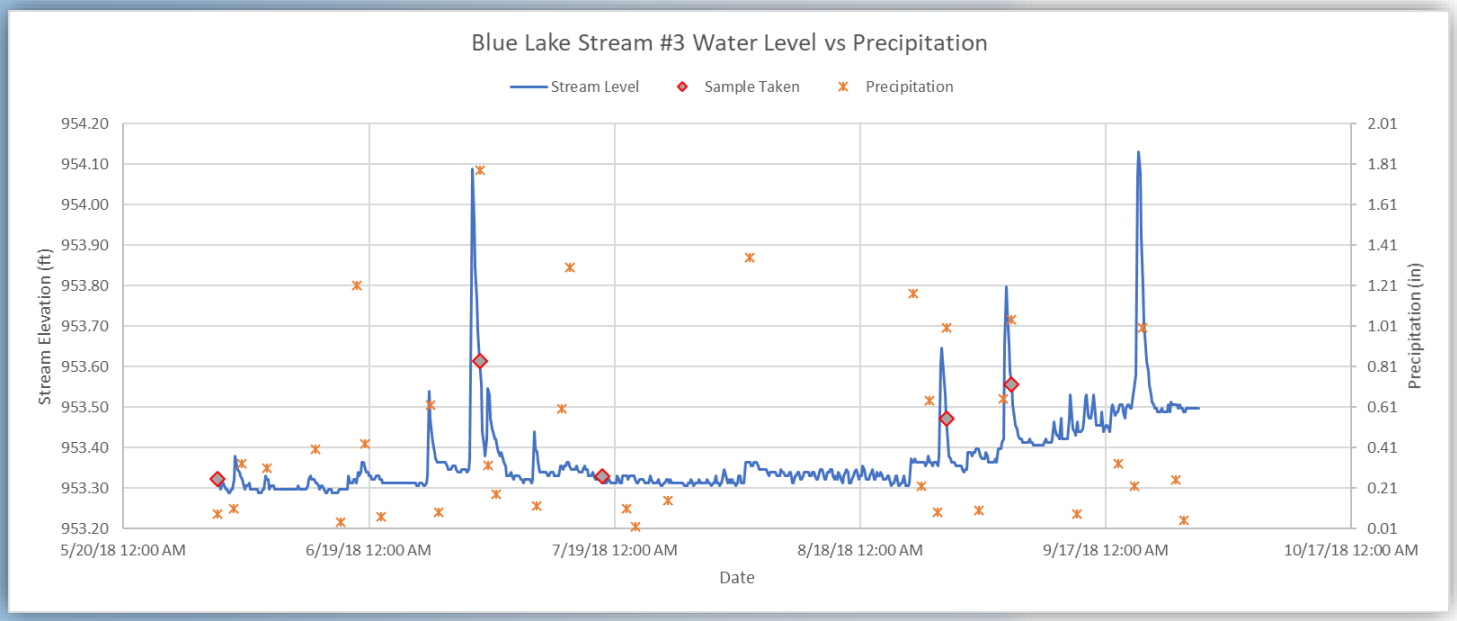




Site:

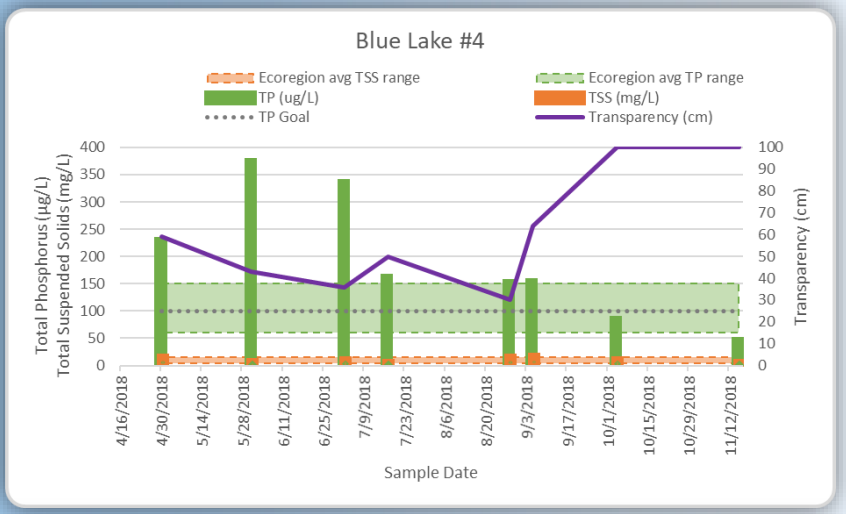
#3 Blue Lake Dr. — SE inlet

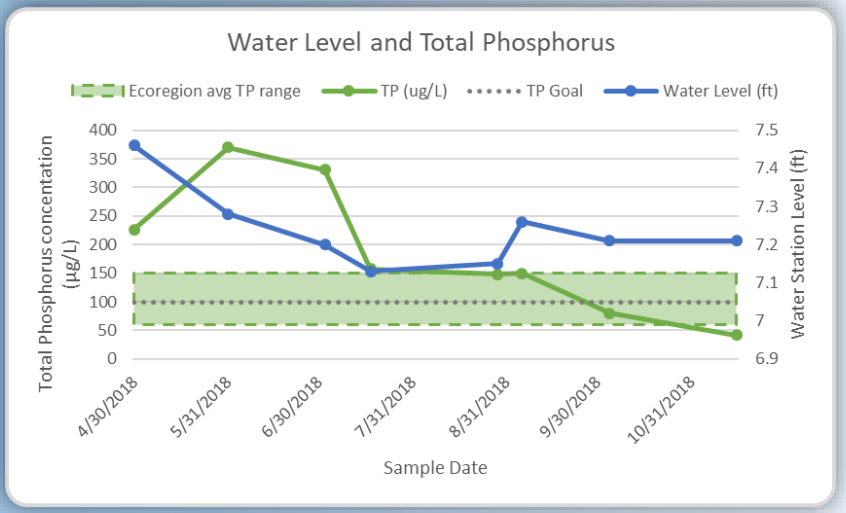
- 2018 average TP was 118 µg/L. The average TP range from 2015-2017 was 106-122 µg/L.
- This tributary has the second highest TP of the four sites.
- In 2018 the highest TP concentration was observed after a rain event.
- 2018 average TSS was 18 mg/L. The average TSS range from 2015-2017 16-21 was mg/L.
- In 2018 TSS was the highest at this location.
- 2018 average transparency was 87 cm. The average transparency range from 2015-2017 was 75-79 cm.
- While the clarity is typically over 80 cm, a storm event in early July reduced transparency by more than 50cm from the average. This corresponds with high TP and TSS.
- Flow was and has consistently been the second highest at this location.



2018 Tributary Monitoring Results

Total Suspended Solids, Total Phosphorus and Transparency Tube

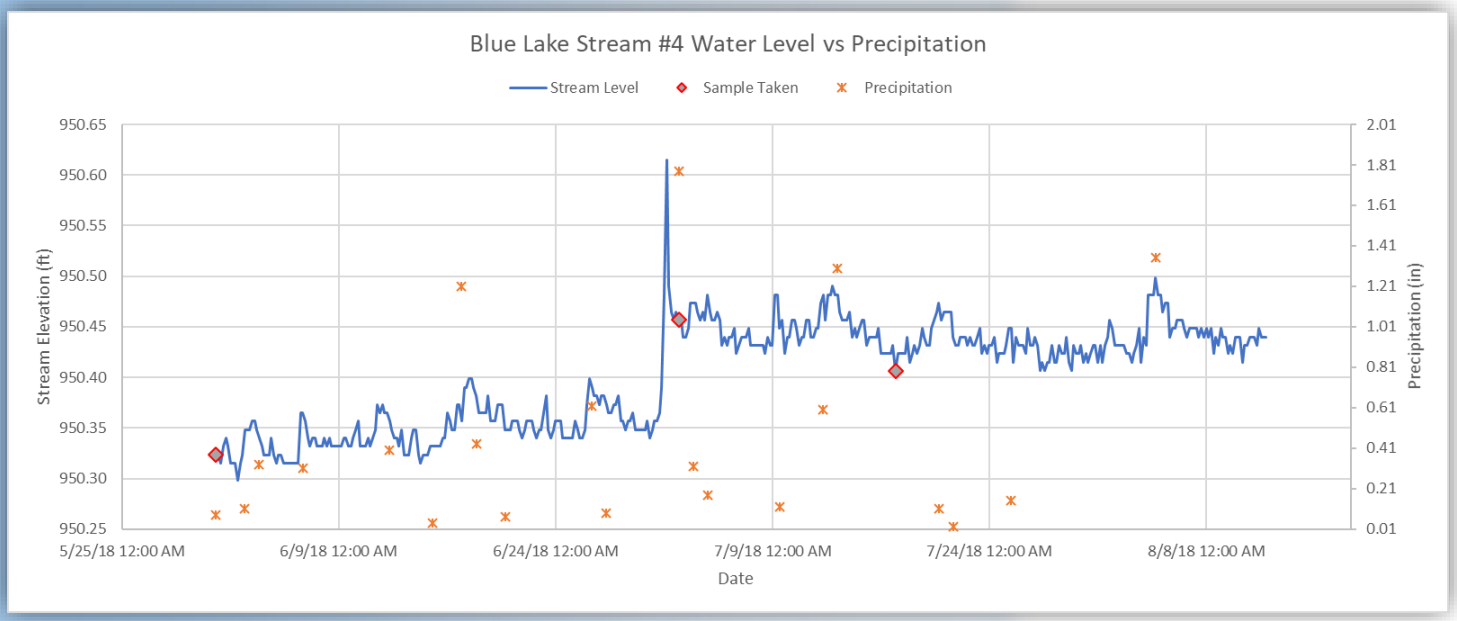




Site:

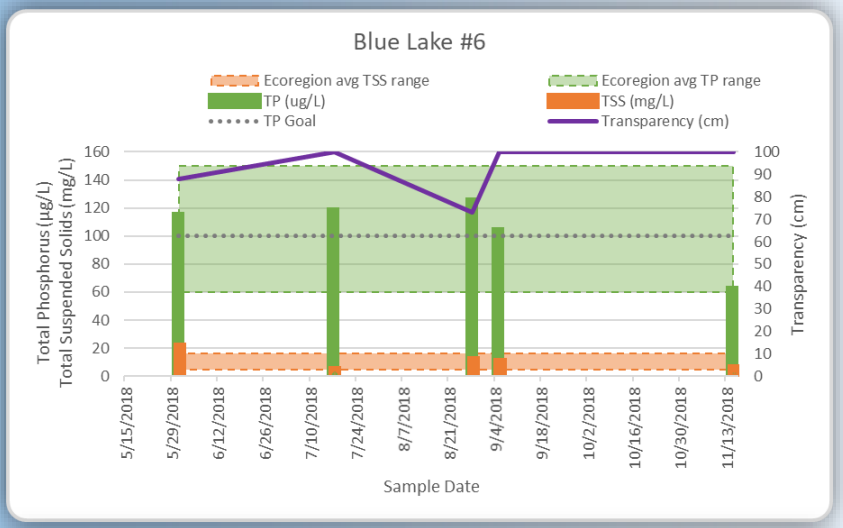
#4 East Tiger St. NW

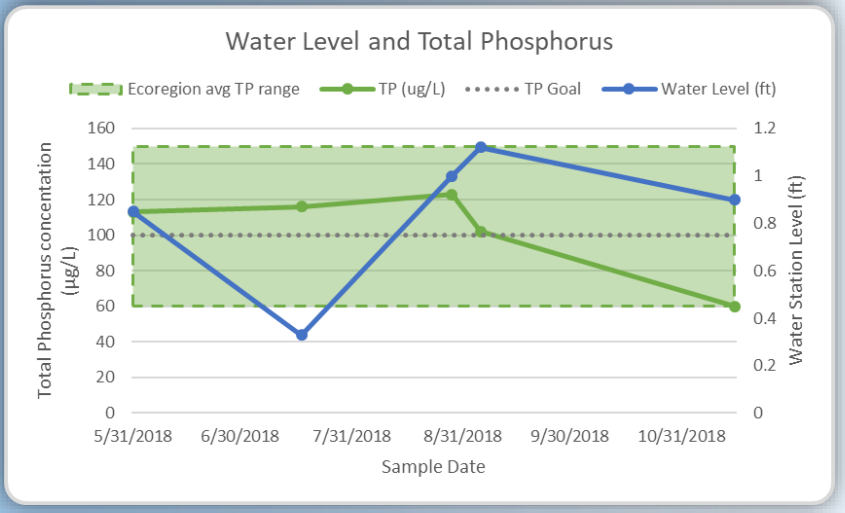
- 2018 average TP was 188 µg/L. The average TP range from 2015-2017 was 149-225 µg/L.
- TP concentrations at this site have been the highest of all tributaries for four consecutive years.
- 2018 average TSS was 7 mg/L. The average TSS range from 2015-2017 was 7-27mg/L.
- In 2018 TSS was the lower than usual and was tie second lowest.
- 2018 average transparency was 60 cm. The average transparency range from 2015-2017 was 45-56 cm.
- Transparency is the lowest of all four sites.
- In 2018 this site had the lowest flow of the monitored tributaries. In 2015 the flow was much higher, data indicates that water flow here (as with other tributaries draining to blue Lake) is linked to groundwater levels.
- TP and TSS levels increase in response to rain events. This occurrence is similar to the other tributaries.



2018 Tributary Monitoring Results

Total Suspended Solids, Total Phosphorus and Transparency Tube





Site:

#6 Fortmann Corner

- New collection site for 2018. Due to seasonal stream fluctuations, the specific location shifted a few times before settling on the final location.
- The average concentration of TP at this location was 103 µg/L, the second lowest concentration measured among the four tributaries.
- The average concentration of TSS detected at this locations was 9.2 mg/L. TSS seems to increase in response to high water levels.
- Transparency readings averaged 92 cm (Transparency tubes only measure to 100 cm) this means the water is quite clear.
- Road was repaved at the location September—October 2018. Erosion control practices were used but the process may have impacted the late August/early September samples.

2018 Results and Recommendations

2018 Summary:

TP concentrations at site #4 remained the highest of all locations sampled. This was the proposed location for a sand filter to treat TP and TSS before it enters the lake— the project was cancelled due to unforeseen circumstances. The SWCD is currently working with the BLID to locate an alternate and comparable project location.

Nutrient concentrations at sites #1, #3 and #6 were, with few exceptions, within the typical range for the region—however, TP concentrations at all locations were higher than the State standard/goal for TP. A recent report completed by Wenck Associates indicates that the lake would benefit from a small reduction in TP from all tributaries. Projects to reduce TP (improve lake health) at these locations include wetland restorations and agricultural best management practices.

TP and TSS at all tributaries increases after rain events. This occurrence indicates that material is being washed into the water from upland land use and/or decaying debris is being flushed from the tributaries that are dominated by wetlands and ditch systems.

No samples were collected at site #7 due to a lack of flow.

Monitoring:

While the 2014-2023 monitoring plan does not include monitoring of tributaries in 2019 Wenck Associates has suggested limited monitoring to track effectiveness of a wetland restoration. The recommendations are presented below.

<u>Recommendations for monitoring in 2019:</u>

- Consider sampling sites #1, 2, 3 and/or 6: collect 8 grab samples for TP, Ortho-phosphorus, dissolved phosphorus, and TSS.
- No flow will be collected, water level loggers may be installed at 2-3 of the locations.

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