

SAUK COUNTY STREAM MONITORING EFFORT – 2017 Field Season

By Serge Koenig

Introduction

Water quality monitoring is performed by staff of the Sauk County Conservation, Planning and Zoning Department annually to ascertain the effectiveness of conservation efforts undertaken within the county. The effort is also used to target certain areas within the county that may need extra attention and to procure grants from various sources in an effort to address water quality problems. Various water quality parameters are measured including dissolved oxygen, temperature, physical characteristics, water clarity, phosphorus, nitrogen, suspended solids, pH depending on funding and staff time availability.

Background

Dissolved Oxygen & Temperature

All fish and other animals that live in water, such as snails, aquatic insects, and crayfish, require oxygen to survive. Most animals require concentrations of at least 5 parts per million. Some animals, such as trout, require water relatively high in oxygen. Others, such as carp and many native fish can survive in water quite low in oxygen. Therefore, a change in oxygen concentration in water may affect the composition of aquatic communities.

Dissolved oxygen concentration also affects the chemicals in the water. For example, in the presence of oxygen, some metals such as cadmium solidify and sink out of the water. Without oxygen, these metals dissolve into the water in a form which is far more dangerous to animals.

Nutrients in water also change form depending on oxygen concentrations. Without oxygen, phosphorus in lake sediments may dissolve back into the water and contribute to over-fertilizing the lake.

The critical times for measuring dissolved oxygen is primarily July and August due to low water levels and warm temperatures, which tends to stress the aquatic system. Higher water temperatures hold less dissolved oxygen which is critical to macroinvertebrates and fish populations. Macroinvertebrates and fish breathe oxygen that is dissolved in the water. In the immature stage, many species require high levels of dissolved oxygen in order to survive.

How do human activities affect the dissolved oxygen concentrations in water? Microorganisms such as bacteria decompose organic waste in water—a process which requires oxygen. Organic waste is anything that was once part of a plant or animal, such as leaves and manure. If there is a lot of organic waste in the stream, then the microorganisms multiply and use more oxygen than can be replaced in the stream.

Organic wastes may come from a variety of sources:

- Untreated sewage;
- Runoff from dairies, feedlots, and other agricultural operations;
- Lawn clippings, top soil, and other materials from around our homes;
- Land clearing activities such as logging or construction;

- Storm water runoff from agricultural fields and urban areas.

Removal of the trees and plants that grow along the edge of streams and rivers decreases shading, resulting in warmer water temperatures. This can indirectly cause lower dissolved oxygen concentrations because warm water holds less oxygen. Phosphorus or nitrogen added to water can also indirectly affect oxygen concentrations. These nutrients may over-fertilize the water, resulting in excess aquatic plant growth. When these plants die and decay they consume oxygen, leading to a drop in concentration.

Water temperature greatly affects macroinvertebrates and other aquatic organisms. Macroinvertebrates, fish and amphibians are cold-blooded. The metabolisms of these animals are affected by temperature. It speeds up and slows down based on the surrounding temperature. If the temperature changes too drastically, their metabolisms may not function as well, decreasing their ability to reproduce and survive. Optimal temperature ranges for organisms vary. Trout do best at temperatures below 22°C (71.6°F) while carp may do fine in temperatures as high as 28°C (82.4°F). Fish can be divided into two groups, coldwater fish (who require fairly cool temperatures) and warmwater fish (who can survive in warmer water temperatures).



Tidbit Temperature Logger



Dissolved Oxygen Sonde

Suspended Solids (Turbidity)

The amount of material suspended in the water (e.g., sediment, microorganisms, pollution) affects light penetration. The degree to which light penetration is blocked by these suspended solids is referred to as turbidity. In short, turbidity is a measurement of how much suspended material is in the water.

Suspended solids prevent sunlight from reaching aquatic plants. Without light photosynthesis cannot take place, which may reduce the amount of dissolved oxygen in the water. Dissolved oxygen is vital for fish and other aquatic life. Sediment absorbs heat, so turbidity can raise the surface water temperature. Turbidity can also make it hard for fish to see their prey. Heavy loads of suspended solids can even clog fish gills and filter-feeding devices of aquatic macroinvertebrates (water bugs). As solid matter settles, it may cover and harm bottom-dwelling plants and animals and spawning beds. However, turbidity isn't always bad. All streams have a natural level of turbidity. While some forms of aquatic life need clear water to survive, other aquatic species are adapted to and thrive in high turbidity. The Colorado River is very turbid, yet its waters hold abundant life.

Natural influences that cause the turbidity of a stream to change:

- Geology - the types of material in the area where the stream flows affects turbidity (e.g., banks with loose soil will cause more erosion).
- Stream size - large rivers may have many microscopic plants that increase turbidity.
- Seasonal weather - spring snow melt and rain can increase runoff which generally also increases turbidity.
- Plant root systems - roots help hold soils in place and out of the river. Fires, floods, wind storms, and other natural events may take out this vegetation which would increase erosion and turbidity.

Human influences that cause the turbidity of a stream to change:

- Bank stabilization - maintaining riparian vegetation or installing rip rap can help decrease turbidity.
- Activities that will increase erosion:
 - ~ Road building
 - ~ Overgrazing
 - ~ Development
 - ~ Cropland practices

Phosphorus

Phosphorus has long been recognized as the controlling factor in plant and algae growth in Wisconsin lakes and streams. Small increases in phosphorus can fuel substantial increases in aquatic plant and algae growth, which in turn can reduce recreational use, property values, and public health.

Phosphorus entering our lakes and streams comes from “point sources” - piped wastes such as municipal and industrial wastewater treatment plants that release liquid effluent to lakes and rivers or spread sludge on fields; and from natural sources, including past phosphorus loads that build up in lake bottom sediments.

Phosphorus also comes from “nonpoint” or “runoff” pollution. Such pollution occurs when heavy rains and melting snow wash over farm fields and feedlots and carry fertilizer, manure and soil into lakes and streams, or carry phosphorus-containing contaminants from urban streets and parking lots.

In Wisconsin, according to the phosphorus water quality standard, the limit for phosphorus in streams is 0.075 mg/L and 0.100 mg/L in rivers.

Macroinvertebrates

What is an aquatic macroinvertebrate? "Aquatic" means water, "macro" means big (or big enough for us to see without using a microscope) and "invertebrate" means without a backbone. So an aquatic macroinvertebrate is a

water bug that we can see with our naked eye. Many of these macroinvertebrates make their homes in rocks, leaves and sediment in stream beds. Some of these insects and non-insects spend their entire lives in water, like scuds, clams, mussels and snails. However, usually just the larva and nymph stages (the immature stages of insects' lives) are spent in water. Then the larva or nymph will spend its adult life out of the water.

They are indicators of water quality. Different types of macroinvertebrates tolerate different stream conditions and levels of pollution. Depending on the types of macroinvertebrates found in a stream, predictions about water quality can be made. For example, caddisflies, mayflies, and stoneflies can not live in polluted water. If these bugs are found in a stream, the water quality there is probably good. However, that doesn't mean that if these bugs are not found in a stream the water quality is bad. Other factors like temperature and flow also come into play. These bugs prefer cold rushing water, so a stream that has good water quality, but is a slow-moving stream in a desert may not have these bugs.

Aquatic macroinvertebrates are also an important part of aquatic and terrestrial food chains. They graze on algae and break down leaves and sticks that fall into the water. They are also an important food source for fish.

Natural influences that cause macroinvertebrate populations to change:

- Seasons - life histories of invertebrates are tied to food availability. For example, macroinvertebrates that eat algae are most abundant in the summer when algae production is at its highest.
- Dissolved Oxygen - macroinvertebrates breathe oxygen that is dissolved in the water. In the immature stage, many species require high levels of dissolved oxygen in order to survive.
- Substrate - what the bottom of the stream is comprised of will affect the types of macroinvertebrates. For example, macroinvertebrates that eat tiny food particles prefer sandy or muddy substrate.

Human influences that cause macroinvertebrate populations to change:

- Nutrient enrichment - added nutrients from human sewage, fertilizer or manure can accelerate the growth of algae and other plants. When these plants die decomposition by microorganisms can use up dissolved oxygen in the water.
- pH - Dumping of industrial pollutants and runoff from mining activities can lower pH (making water more acidic). Low pH can weaken shells and exoskeletons and kill macroinvertebrates.
- Removal of riparian vegetation - this takes away macroinvertebrates' food source and important breeding grounds.



Dragonfly larva



Stonefly larva

Interpretation of Values for HBI

0.00-3.50	Excellent	No apparent organic pollution.
3.51-4.50	Very Good	Possible slight organic pollution.
4.51-5.50	Good	Some organic pollution.
5.51-6.50	Fair	Fairly significant organic pollution.
6.51-7.50	Fairly Poor	Significant organic pollution.
7.51-8.50	Poor	Very significant organic pollution.
8.51-10.00	Very Poor	Severe organic pollution

Monitored Sites

Four sites were monitored with the HOBO U26 Dissolved Oxygen Sonde during the 2017 field season. The sonde monitored dissolved oxygen and temperature within the stream continuously at 30 minute intervals. The data is stored digitally within the sonde's memory chip. Data is then downloaded onto a computer in the office and analyzed using the HOBOWare Pro software supplied by the Onset Corporation. The four sites were located within the Baraboo River watershed(see map).

Fourteen sites were monitored with the Tidbit Temperature Loggers from the Onset Corporation. Four sites were from stream reaches on land owned by the Riverland Conservancy. Trout Unlimited, under the direction of Tom Gawle, monitored seven sites on Bear Creek.

Water samples were collected for chemical analysis at nine locations using the Wisconsin DNR protocol. The protocol states that samples are to be collected once per month at the same time of the month from May until October. The four dissolved oxygen sonde sites are included in the nine locations. Members of the Dutch Hollow Lake Association sampled various tributaries within the Dutch Hollow Lake watershed. Five unnamed tributaries flowing into Dutch Hollow Lake were monitored. Phosphorus and suspended sediment were the primary pollutants analyzed. The water samples were taken to CT Laboratories in Baraboo for analysis.

Two sites on the Big Hollow drainage ditch were sampled once in June, July, September and October. Nitrogen and phosphorus content in the water was analyzed. The samples were collected by Sauk County staff.

As part of Sauk County's environmental education efforts with local schools, Sauk County staff organized a brief water quality monitoring effort with the Baraboo High School environmental studies/biology classes on May 16, 2017. Members of the Lake Buckhorn Property Owners' Association facilitated the educational activities. Water sampling took place on two lake inlets, the lake outlet as well as one in-lake location.

Macroinvertebrates were sampled at 4 stream locations on November 20, 2017. A D-frame dip net was used while wading in the stream to collect the aquatic insects. The samples were sent off to University of Wisconsin Superior for analysis.



Serge Koenig collecting macroinvertebrates with D-Net

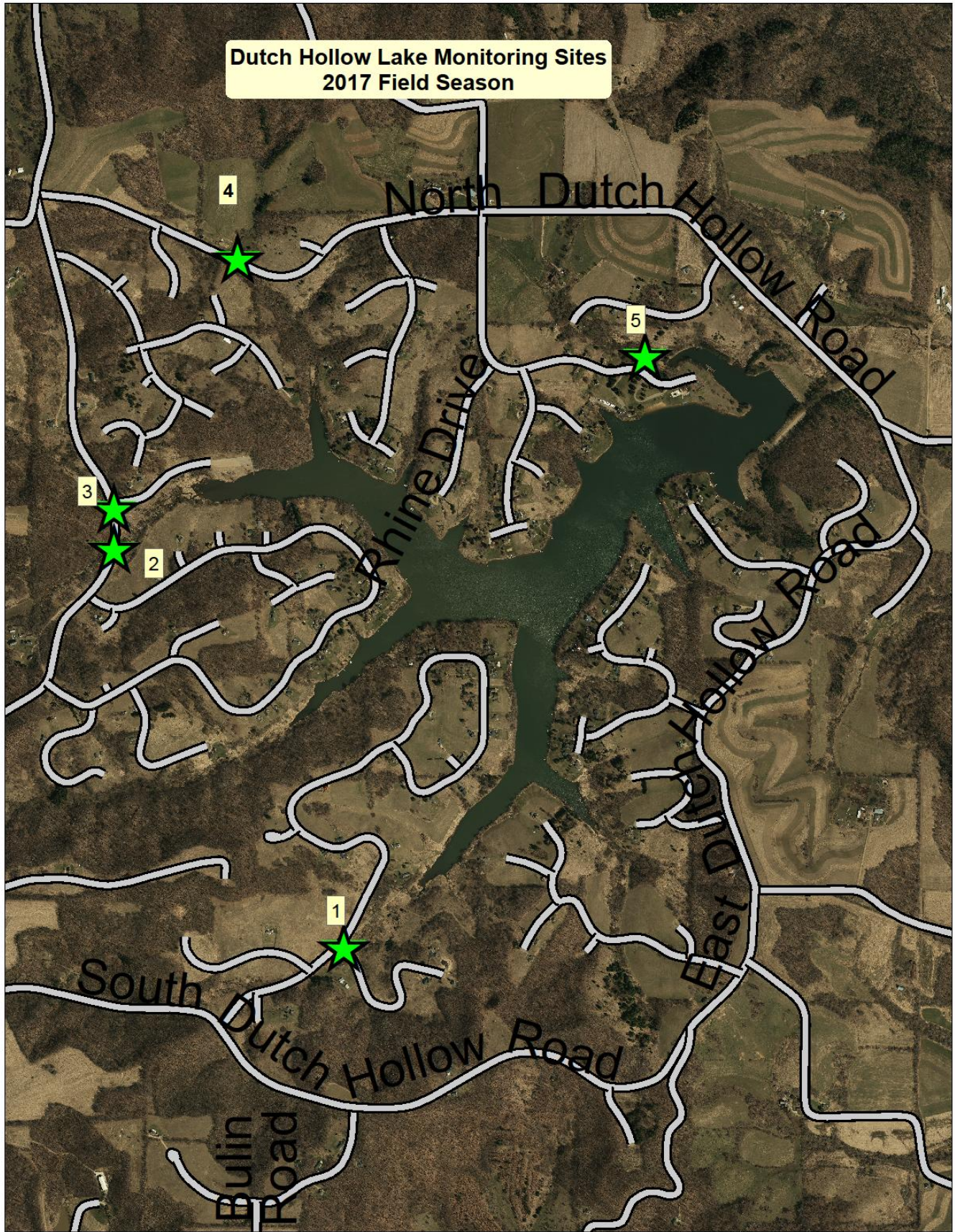


D-Frame Net

**Dissolved Oxygen, Chemical Analysis and
Macroinvertebrate Monitoring Sites
2017 Field Season**



Dutch Hollow Lake Monitoring Sites
2017 Field Season





Annual Restoration Information

2011 Lower Fargen = 4,900 stream feet @ a cost of approx. \$135,000

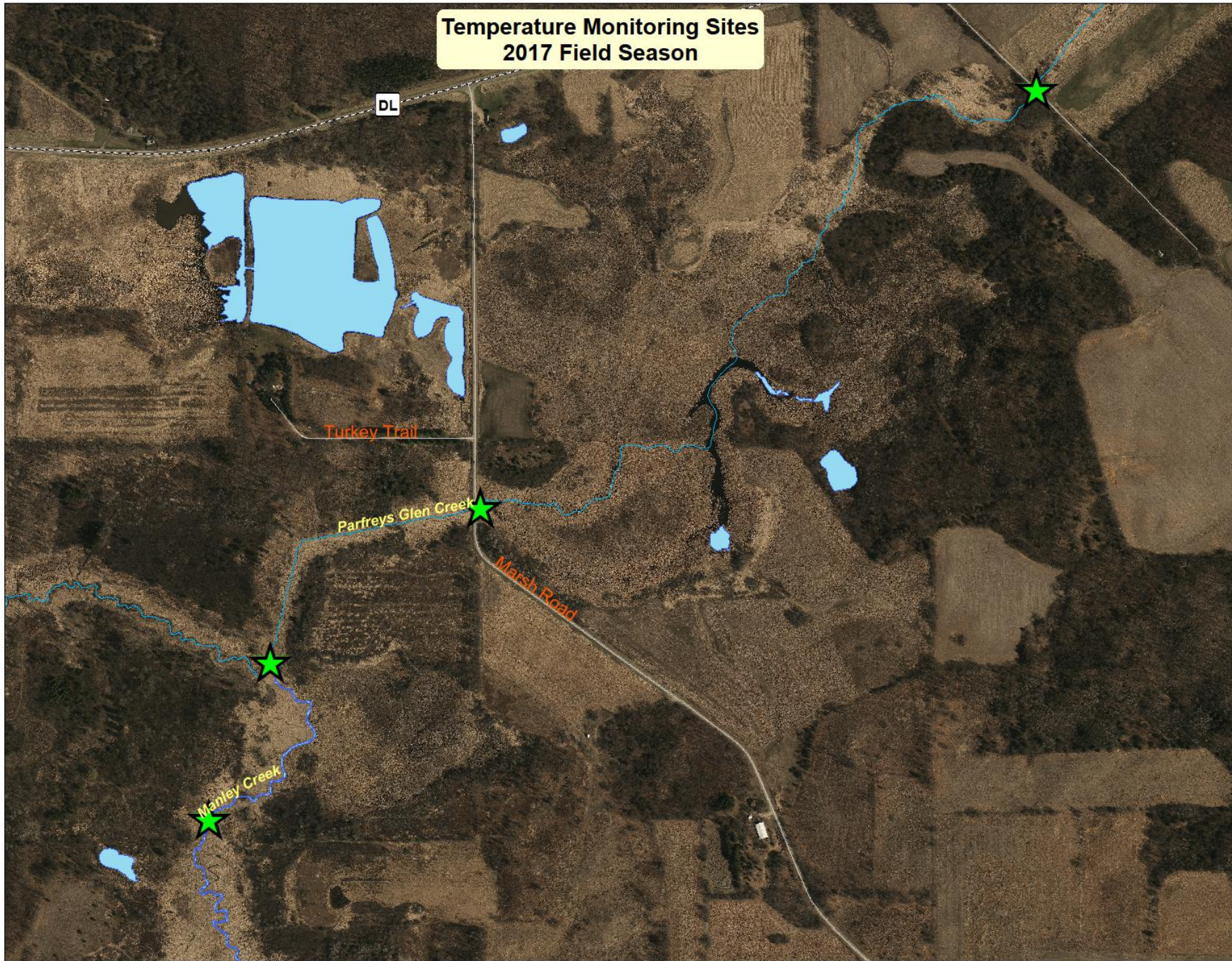
2012 Upper Fargen = 5,300 stream feet @ a cost of approx. \$155,000

2013 Sprecher = 5,700 stream feet @ a cost of approx. \$163,000

2014 Lower Bolz = 3,000 stream feet @ a cost of approx. \$103,000

2015 Upper Bolz = 3,100 stream feet @ an estimated cost of approx. \$100,000

**Temperature Monitoring Sites
2017 Field Season**



Findings

Plum Creek at Town Shed Rd - The average dissolved oxygen concentration was 8.54 mg/L with an average temperature of 64.75° F for the months of July through August. Based on these two parameters, the water quality is excellent. Median total phosphorus was 0.115 mg/L which exceeds the state water quality standard concentration of 0.075 mg/l. The average Total Suspended Solids for the season was 30.5 mg/L. Macroinvertebrates were collected with an average HBI of 5.01, which indicates “ Good” water quality, meaning there is some organic pollution in the stream.

Little Baraboo River at Beier Rd - The average dissolved oxygen concentration was 8.86 mg/L with an average temperature of 63.19° F for the months of July through August. Based on these two parameters, the water quality is excellent. The average Total Suspended Solids for the season was 9 mg/L. Median total phosphorus was 0.072 mg/l which meets the state water quality standard. Macroinvertebrates were collected with an average HBI of 4.47, which indicates “Very Good” water quality meaning there is slight organic pollution in the stream.

Little Baraboo River at Quacker Valley Rd - The average dissolved oxygen concentration was 8.59 mg/L with an average temperature of 65.62° F for the months of July through August. Based on these two parameters, the water quality is excellent. The average Total Suspended Solids for the season was 38 mg/L. Median total phosphorus was 0.101 mg/l which exceeds the state water quality standard. Macroinvertebrates were collected with an average HBI of 5.04, which indicates “Good” water quality meaning there is some organic pollution in the stream.

Little Baraboo River at County Highway G - Due to excessive siltation of the dissolved oxygen meter, the oxygen data was deemed unusable. Temperature at the site averaged 65.56° for the months of July and August. The average Total Suspended Solids for the season was 40.5 mg/L. Median total phosphorus was 0.11 mg/l which exceeds the state water quality standard. Macroinvertebrates were collected with an average HBI of 4.48, which indicates “Very Good” water quality meaning there is slight organic pollution in the stream.

Unnamed Tributary to Plum Creek at Peshorn Rd - Instrumentation malfunction for this particular site.

Plum Creek at County Hwy Y - Average temperature at the site for June 16, 2017 to August 31, 2017 was 63.96° F which is below the 68° F needed for trout. Maximum temperature was 75.25° F and the minimum being 53.78° F.

Mortimer Valley Creek at County Hwy EE - Average temperature at the site for June 16, 2017 to August 31, 2017 was 64.08° F which is below the 68° F needed for trout. Maximum temperature was 76.64° F and the minimum being 52.82° F.

Parfreys Glen Creek at Millionaires Alley - Average temperature at the site for June 16, 2017 to August 31, 2017 was 68.17° F which is below the 68° F temperature parameter needed for trout. Maximum temperature was 79.43° F and the minimum being 56.29° F.

Parfreys Glen Creek at Marsh Rd - Average temperature at the site for June 16, 2017 to August 31, 2017 was 67.53° F which is below the 68° F temperature parameter needed for trout. Maximum temperature was 80.18° F and the minimum being 56.12° F.

Parfreys Glen Creek 60 feet above intersection with Manley Creek - Average temperature at the site for June 16, 2017 to August 31, 2017 was 70.08°F which is above the 68° F temperature parameter needed for trout. Maximum temperature was 81.55° F and the minimum being 59.62°F.

Parfreys Glen Creek 1500 feet below intersection with Manley Creek - Average temperature at the site for June 16, 2017 to August 31, 2017 was 63.62°F which is below the 68° F temperature parameter needed for trout. Maximum temperature was 74.81° F and the minimum being 54.47°F.

Bear Creek Tidbit sites - The water temperatures from all 6 sites were well within the range for trout for the 2017 seasons.