SAUK COUNTY STREAM MONITORING EFFORT – 2016 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 it's 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

Two sites were monitored with the HOBO U26 Dissolved Oxygen Sonde during the 2016 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 two sites were located within the Baraboo River watershed. Two locations on Twin Creek were monitored (see map).

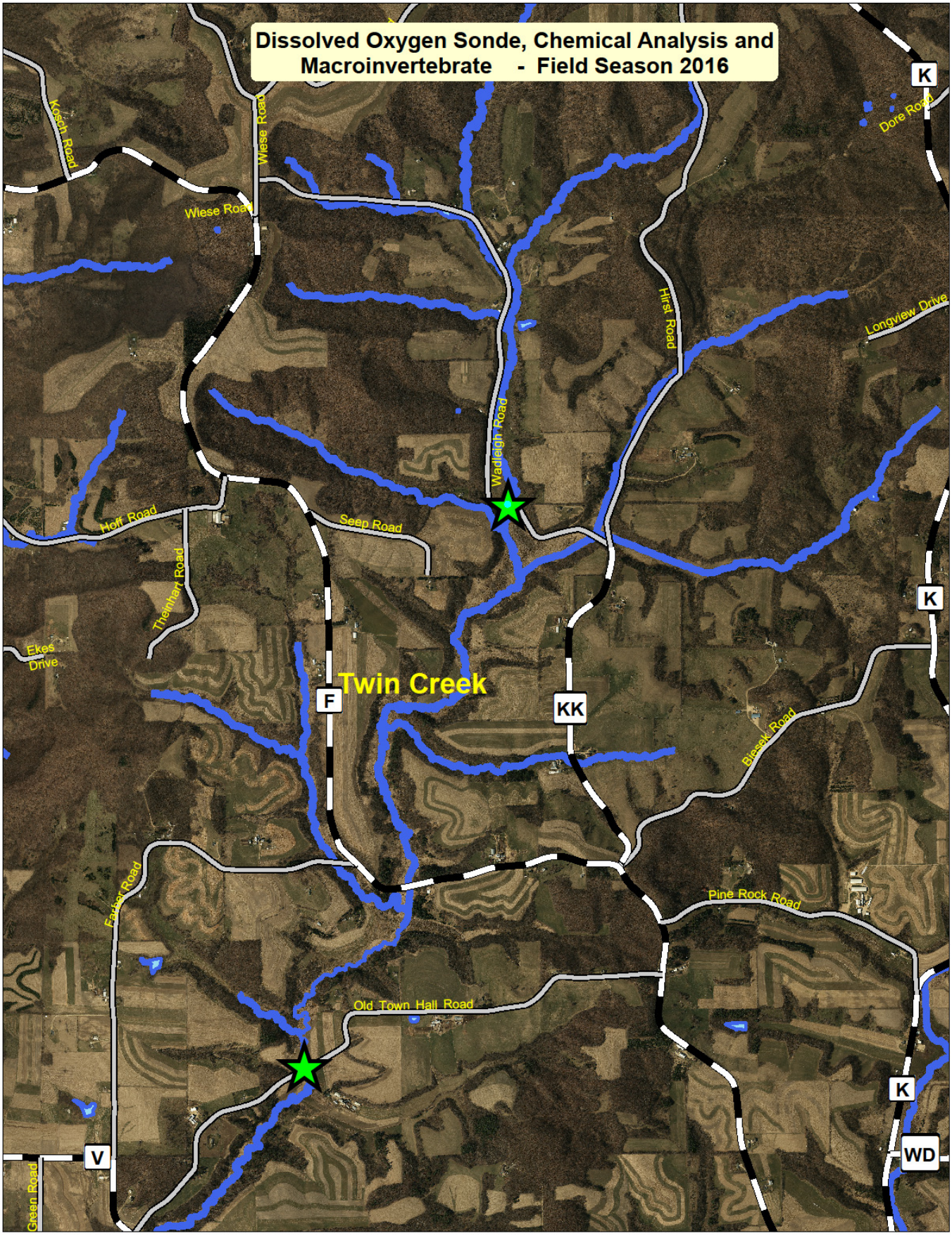
Thirteen sites were monitored with the Tidbit Temperature Loggers from the Onset Corporation. Seven sites were from the upper reaches of the Baraboo River watershed Trout Unlimited, under the direction of Tom Gawle, monitored six sites on Bear Creek.

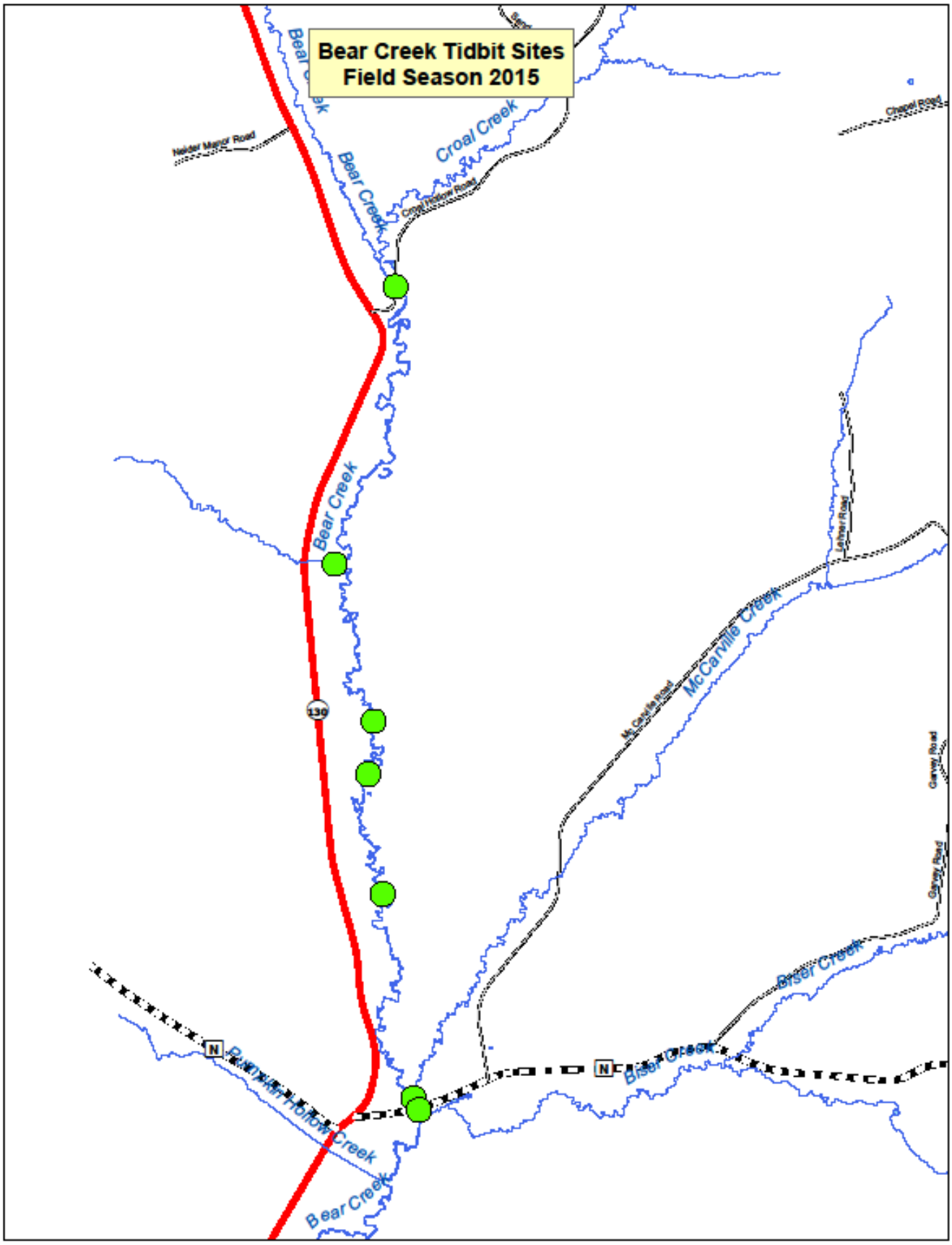
Water samples were collected for chemical analysis at 8 locations using the Wisconsin DNR protocol. The protocol states that samples are to be collected once per month at the same time of the month from May until October. The 2 dissolved oxygen sonde sites are included in the 8 locations. Members of the Lake Redstone Protection District sampled various tributaries within the Lake Redstone watershed. Five unnamed tributaries to the West Branch Big Creek were monitored. Phosphorus and suspended sediment were the primary pollutants analyzed. The water samples were taken to CT Laboratories in Baraboo for analysis.

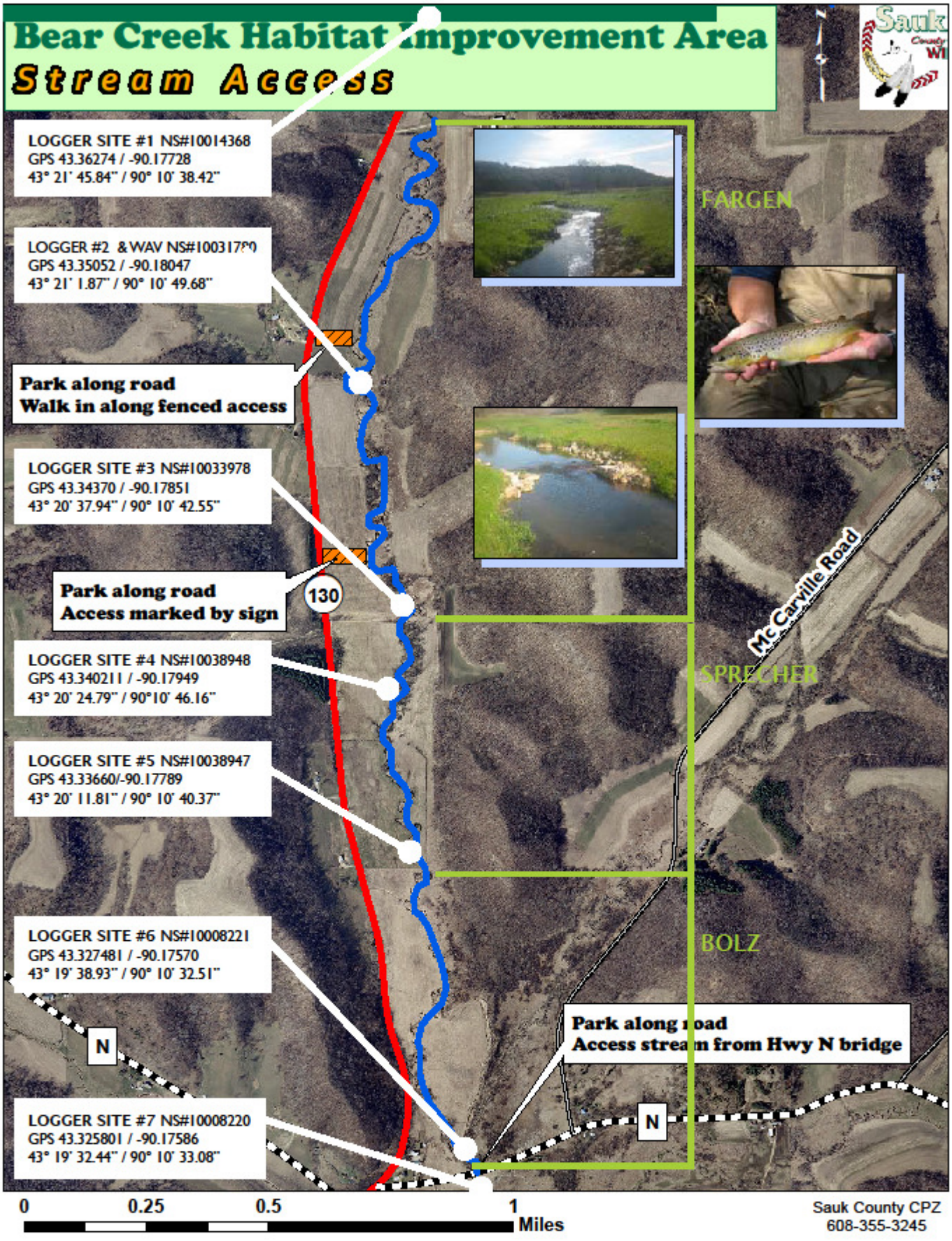
Macroinvertebrates were sampled at 2 stream locations on November 1, 2016. A D-frame dip net was used while wading in the stream to collect the aquatic insects. The samples were sent off to University of Wisconsin Superior for analysis.

Serge Koenig collecting macroinvertebrates with D-Net

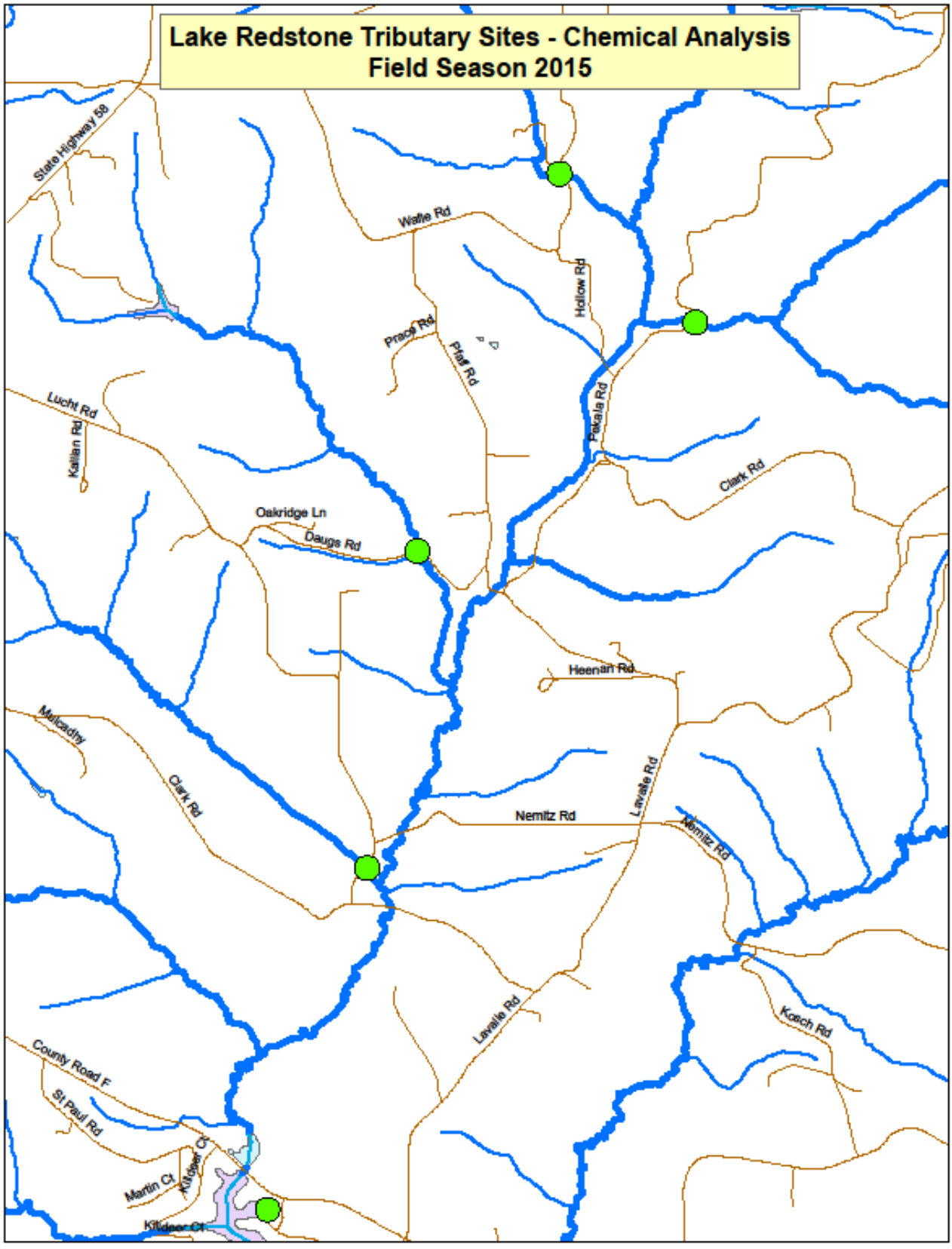
D-Frame Net

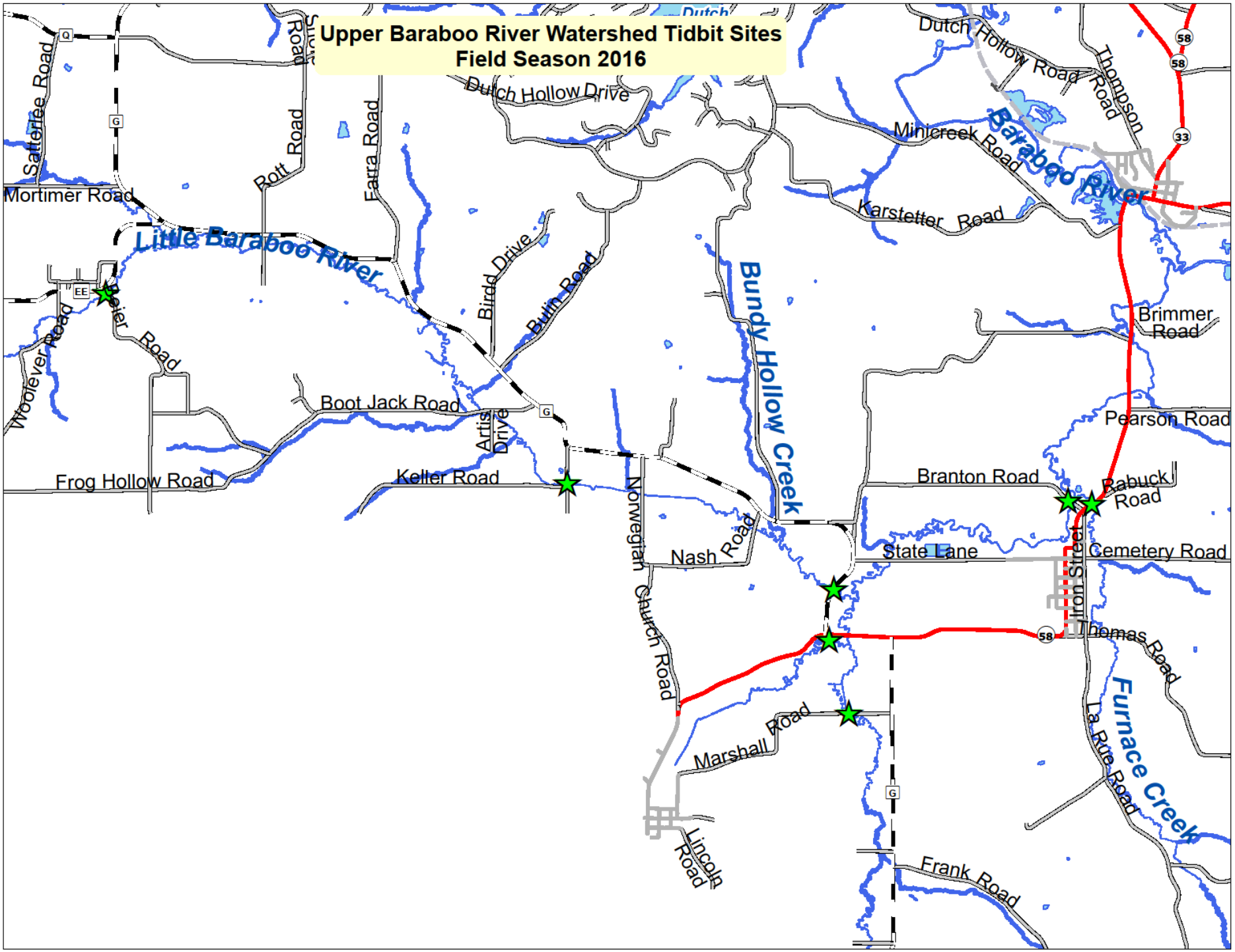

Dissolved Oxygen Sonde, Chemical Analysis and Macroinvertebrate - Field Season 2016
Twin Creek
Koech Road
Wiese Road
Wiese Road
Dore Road
Hirst Road
Longview Drive
Waldleigh Road
Hoff Road
Seep Road
Theinhart Road
Ekes Drive
Bieseik Road
Farber Road
Pine Rock Road
Old Town Hall Road
Green Road
K
K
K
K
F
KK
V
WD

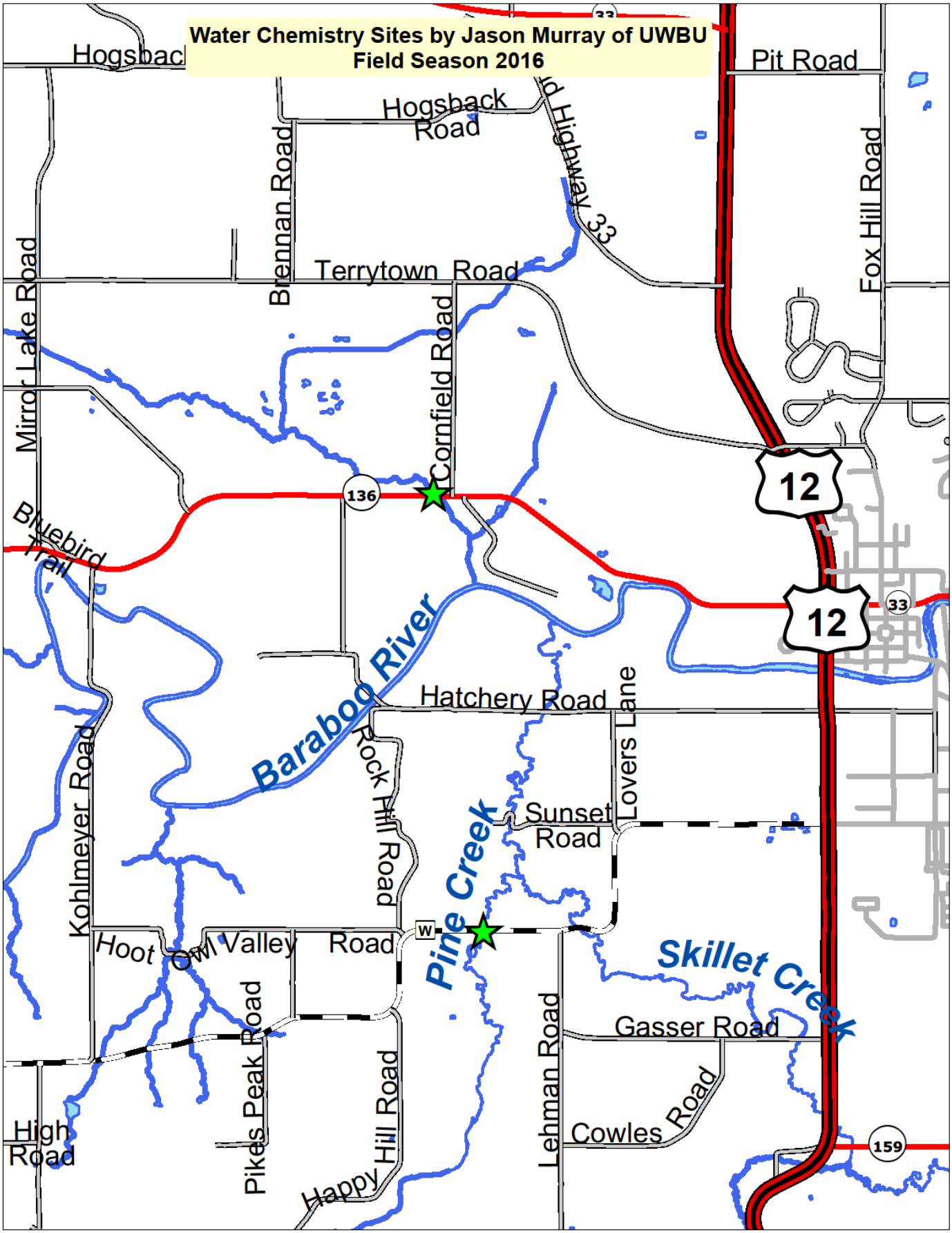

Bear Creek Tidbit Sites
Field Season 2015
Croal Creek
Bear Creek
Bear Creek
Bear Creek
Bear Creek
Holder Manor Road
Croal Hollow Road
Chapel Road
Lehner Road
McCarville Creek
McCarville Road
Garvey Road
Garvey Road
Briser Creek
Briser Creek
Bear Creek
139
N
N



Annual Restoration Information


Lake Redstone Tributary Sites - Chemical Analysis
Field Season 2015
State Highway 58
Walle Rd
Hollow Rd
Pracel Rd
Pfaff Rd
Pekala Rd
Lucht Rd
Kallian Rd
Clark Rd
Oakridge Ln
Daugs Rd
Heenan Rd
Mullcadry
Clark Rd
Nemitz Rd
Lavalle Rd
Nemitz Rd
Lavalle Rd
Kasch Rd
County Road F
St Paul Rd
Martin Ct
Killdeer Ct
Killdeer Ct


Upper Baraboo River Watershed Tidbit Sites
Field Season 2016
Dutch Hollow Drive
Dutch Hollow Road
Thompson Road
Minicreek Road
Baraboo River
Karstetter Road
Satterlee Road
Rott Road
Faira Road
Mortimer Road
Little Baraboo River
Bird Drive
Bulin Road
Bundy Hollow Creek
Brimmer Road
Woolever Road
Meier Road
Boot Jack Road
Artis Drive
Pearson Road
Frog Hollow Road
Keller Road
Norwegian Church Road
Branton Road
Rabuck Road
Nash Road
State Lane
Cemetery Road
Iron Street
Thomas Road
Marshall Road
La Rue Road
Furnace Creek
Lincoln Road
Frank Road
Q
G
EE
58
33


Water Chemistry Sites by Jason Murray of UWBU
Field Season 2016
Hogsback
Hogsback Road
Pit Road
Brennan Road
Highway 33
Fox Hill Road
Terrytown Road
Mirror Lake Road
Cornfield Road
136
12
Bluebird Trail
Barabog River
Hatchery Road
Lovers Lane
Rock Hill Road
Kohlmeyer Road
Sunset Road
Pine Creek
Skillet Creek
Hoot Owl Valley Road
W
Gasser Road
Pikes Peak Road
Happy Hill Road
Lehman Road
Cowles Road
High Road
159

Findings

Twin Creek at Wadleigh Rd - Due to a malfunction in the dissolved oxygen meter, the data was faulty and therefore not used. This site will be monitored again in 2017. Median total phosphorus was 0.068 mg/L which meets the water quality standard. Some of this may be from groundwater phosphorus levels derived from the underlying geology of the area. The average Total Suspended Solids for the season was 47.5 mg/L. Macroinvertebrates were collected with an average HBI of 5.04, which indicates " Good" water quality meaning there is some organic pollution in the stream.

Twin Creek at Old Town Hall Rd - Due to a malfunction in the dissolved oxygen meter, the data was faulty and therefore not used. The site will be monitored again in 2017. The average Total Suspended Solids for the season was 10.5 mg/L. Median total phosphorus was 0.09 mg/L which exceeds the water quality standard. Macroinvertebrates were collected with an average HBI of 5.0, which indicates "Good" water quality meaning there is some organic pollution in the stream.

Unnamed Tributary to West Branch Big Creek at Lucht Rd – The median Total Suspended Solids(TSS) for the season was 9.1 mg/L and the total phosphorus for the season was 0.078 mg/L. The P concentration slightly exceeds the state standard.

Unnamed Tributary to West Branch Big Creek at Daugs Rd – The median Total Suspended Solids for the season was 28.5 mg/L and the total phosphorus for the season was 0.081 mg/L. The P load exceeds the state standard.

Unnamed Tributary to West Branch Big Creek at Wafle Rd – The median Total Suspended Solids for the season was 14.2 mg/L and the total phosphorus for the season was 0.12 mg/L. The P concentration exceeds the state standard.

Unnamed Tributary to West Branch Big Creek at Pekala Rd – The median Total Suspended Solids for the season was 5.2 mg/L and the total phosphorus for the season was 0.076 mg/L. The P concentration slightly exceeds the state standard.

Unnamed Tributary to Lake Redstone at Warbler Court - The median Total Suspended Solids for the season was 2.2 mg/L and the total phosphorus for the season was 0.069 mg/L. The P concentration is within the state standard.

Pine Creek at County Hwy W - The median Total Suspended Solids for the season was 6.2 mg/L and the total phosphorus for the season was 0.069 mg/L. The P concentration is within the state standard.

Unnamed Tributary to the Baraboo River at Hwy 136 - The median Total Suspended Solids for the season was 8.2 mg/L and the total phosphorus for the season was 0.14 mg/L. The P concentration is exceeds the state standard.

Cazenovia Branch Creek at Hwy 58 & G - Average temperature at the site for June 1, 2016 to August 31, 2016 was 73.3° F which is above the 68° F needed for trout. Maximum temperature was 83.9° F and the minimum being 61.6°F.

Furnace Creek at Hwy 58 - Average temperature at the site for June 1, 2016 to August 31, 2016 was 65.2° F which is below the 68° F needed for trout. Maximum temperature was 72.7° F and the minimum being 53.8°F.

Little Baraboo River at Quacker Valley Rd - Average temperature at the site for June 1, 2016 to August 31, 2016 was 68.9° F which is above the 68° F needed for trout. Maximum temperature was 79.3° F and the minimum being 55.9°F.

Little Baraboo River at County Hwy G - Average temperature at the site for June 1, 2016 to August 31, 2016 was 68.4° F which is slightly above the 68° F needed for trout. Maximum temperature was 76.1° F and the minimum being 57.2°F.

Little Baraboo River at Beier Rd - Average temperature at the site for June 1, 2016 to August 31, 2016 was 65.9°F which is within the 68° F temperature parameter needed for trout. Maximum temperature was 74.8° F and the minimum being 54.2°F.

Carr Valley Branch at Marshall Rd - Average temperature at the site for June 1, 2016 to August 31, 2016 was 64.1°F which is within the 68° F temperature parameter needed for trout. Maximum temperature was 74.0° F and the minimum being 52.9°F.

Little Baraboo River at Branton Rd - Could not locate the Tidbit in fall of 2016….flood damage??? Will look once more in spring of 2017.

Bear Creek Tidbit sites - The water temperatures from all 6 sites were well within the range for trout for the 2016 seasons.