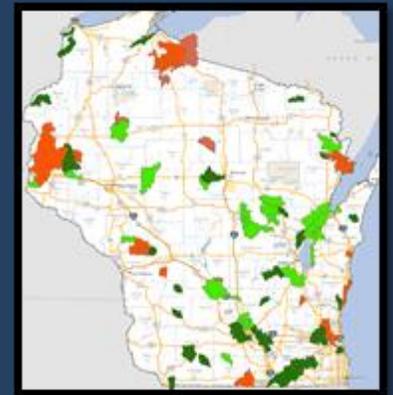


Pigeon River Targeted Watershed Assessment: A Plan to Restore Wisconsin Watersheds, 2020

*Pigeon River Watershed (WR10)
HUC: 040302021103, Monitored 2015*



South Branch Pigeon River at Brewer Road, September 9th, 2015.
Photo by Dave Bolha, East District Water Quality Biologist
Wisconsin Department of Natural Resources

To learn more about this area, see [this Wisconsin TWA Project Online!](#)

Find more about waters, watersheds and projects on [Explore Wisconsin's Waters Online!](#)

EGAD # 3200-2017-09
Water Quality Bureau,
Wisconsin DNR

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Targeted Watershed Assessment Summary

The purpose of the Pigeon River Watershed evaluation in 2015 and 2016 was to provide chemical, physical, and biological data to assess water quality impacts in the watershed from the installation of BMPs to reduce nutrient and sediment loads into the Pigeon River. This watershed evaluation supported the watershed improvement efforts by the Natural Resource Conservation Service (NRCS) and the Waupaca County Land and Water Conservation Department (Waupaca LWCD) through the National Water Quality Initiative (NWQI) program.

Evaluation surveys included fish, aquatic macroinvertebrate, diatoms, continuous temperature, water chemistry and quantitative habitat surveys to calculate and compare instream nutrient concentrations and Index of biological integrity (IBI) scores between survey years.

About the Watershed

The Pigeon River Watershed drains a 116.3 square-mile watershed in Waupaca and Shawano Counties before discharging into the Embarrass River near Clintonville, Wisconsin. The North and South Branches of the Pigeon River flow generally easterly between 15 and 25 miles until they meet and form the Pigeon River Mainstem (Figure 1). A 116-acre impoundment of the North Branch of the Pigeon River forms Marion Millpond. The Pigeon River Mainstem flows roughly 11 miles east until its confluence with the Embarrass River. A 173-acre impoundment of the Pigeon River forms Pigeon Lake (locally known as Pigeon Pond) in the City of Clintonville. There are 146 named and unnamed stream miles in the watershed. The watershed is dominated by mixture of forested and agricultural land uses. Less than 10% is considered developed.

Water Quality

The total phosphorus, aquatic macroinvertebrate, and fish monitoring in this project demonstrated that the water quality in the Pigeon River Watershed ranges from poor to excellent condition. As indicated above, the watershed is dominated by mixture of forested and agricultural land uses. Typically, as increases in agricultural land use occur, there is a correlating increase in TP and TN concentrations in creeks in the watersheds in Wisconsin. Water clarity decreases and chlorophyll a concentration (which is an indication of algae populations) increases as TP increases. Water clarity and chlorophyll a concentration are indicators of water quality in Wisconsin lakes (WisCALM 2014).

Management Priorities

While the good portions of the watershed remain forested, land use characteristics observed during the 2015 and 2016 monitoring project that can have a negative impact on the water quality of the Upper and Lower Pigeon River and its tributaries included:

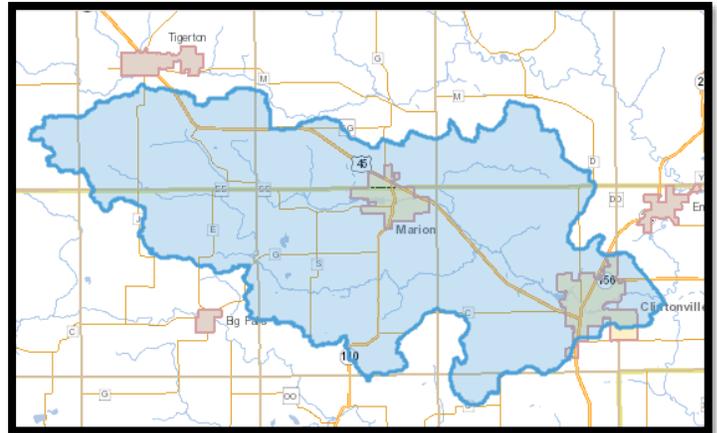
- ✚ limited buffer protection along the stream corridors,
- ✚ eroding streambanks,
- ✚ barnyard runoff,
- ✚ cropland erosion,
- ✚ channelization,
- ✚ sedimentation of fish and aquatic life habitat,
- ✚ thermal impacts from impoundments, and
- ✚ the presence of aquatic invasive species.

The documented degraded stream health (Nordin-Pedersen 1997, NRCS 1999, and WDNR 2015-2016) and the potential for improved water quality indicate that the need for watershed improvements remains throughout the Pigeon River Watershed.

Recommendations

- ✚ Reduce the transportation of phosphorus and sediment by implementing Best Management Practices such as streamside buffer strips, nutrient management, conservation tillage, cover crops, manure storage and barnyard runoff practices, and streambank and wetland restorations
- ✚ Reduce the thermal impacts from impoundments to the North Branch of the Pigeon River and the Pigeon River
- ✚ Preserve the Good to Excellent water quality and biotic communities of Geskey, Mehlberg, and Hydes Creeks, and the Unnamed Tributaries WBIC 297400 and 295700
- ✚ Continue to conduct water quality monitoring of the Pigeon Lake and River and Honey Creek to understand the role each have in the water quality of the River

Figure 1: Pigeon River TWA project location



Wisconsin Water Quality Monitoring and Planning

This Water Quality Management Plan was created under the state’s Water Quality Planning and Water Monitoring programs. This document reflects the priorities for condition data collection articulated in the Water Resources Monitoring Strategy, as well as the program’s overall goals and priorities. This document is a formal update to the state’s Areawide Water Quality Management Plan under the Clean Water Act. Condition information and resource management recommendations support and guide program priorities for the watershed.

This plan is approved by the Wisconsin DNR and is a formal update to the **Wolf River Areawide Water Quality Management Plan** and Wisconsin’s Statewide Areawide Water Quality Management Plan. This plan will be forwarded to USEPA for certification as a formal plan update.

Dave Bolha, East District Water Quality Biologist

Date

Marsha Burzynski, East District Water Quality Field Supervisor

Date

Greg Searle, Water Quality Field Operations Director

Date

Timothy Asplund, Water Quality Monitoring Section Chief

Date

Basin/Watershed Partners

- Waupaca County Land and Water Department
- US Geological Service
- USDA Natural Resources Conservation Service

Report Acknowledgements

- Dave Bolha, Primary Author and Investigator, Eastern District, Wisconsin DNR
- Amanda Perdsock, Program Support, Water Quality Bureau, Wisconsin DNR
- Lisa Helmuth, Program Coordinator, Water Quality Bureau, Wisconsin DNR

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Wisconsin Department of Natural Resources
101 S. Webster Street • PO Box 7921 •
Madison, Wisconsin 53707-7921 608-266-2621



EGAD #3200-2017-09

Abbreviations

BMP: Best Management Practice. A practice that is determined effective and practicable (including technological, economic, and institutional considerations) in preventing or reducing pollution generated from nonpoint sources to a level compatible with water quality goals.

Brown County LCD. Brown County Land and Water Conservation Department -- a branch of the county government charged with Developing and implementing programs and plans for conservation of soil and water by County In Wisconsin.

CAFO. Concentrated animal feeding operation. In animal husbandry, a concentrated animal feeding operation (CAFO), as defined by the United States Department of Agriculture (USDA), is an intensive animal feeding operation (AFO) in which over 1000 animal units are confined for over 45 days a year.

DATCP: Wisconsin Department of Agriculture, Trade and Consumer Protection – the state agency in partnership with DNR responsible for a variety of land and water related programs.

DNR. Wisconsin Department of Natural Resources is an agency of the State of Wisconsin created to preserve, protect, manage, and maintain natural resources.

END: Endangered Species - Wisconsin species designated as rare or unique due to proximity to the farthest extent of their natural range or due to anthropogenic deleterious impacts on the landscape or both.

ERW: Exceptional Resource Water- Wisconsin's designation under state water quality standards to waters with exceptional quality and which may be provided a higher level of protection through various programs and processes.

FHMD: Fisheries and Habitat Management Database – or Fish Database – the state's repository for fish taxonomy and auto-calculated metrics involving fish assemblage condition and related.

FVTC. Fox Valley Technical College. This is a local area college serving the greater Green Bay Fox Valley region.

FIBI: Fish Index of biological integrity (Fish IBI). An Index of Biological Integrity (IBI) is a scientific tool used to identify and classify water pollution problems. An IBI associates anthropogenic influences on a water body with biological activity in the water and is formulated using data developed from biosurveys. In Wisconsin, Fish IBIs are created for each type of natural community in the state's stream system.

HUC: Hydrologic Unit Code. A code or sequence of numbers that identify one of a number of nested and interlocked hydrologic catchments delineated by a consortium of agencies including USGS, USFS, and Wisconsin DNR.

MIBI: Macroinvertebrate Index of biological integrity. In Wisconsin, the MIBI, or macroinvertebrate Index of biological integrity, was developed specifically to assess Wisconsin's macroinvertebrate community (see also Fish IBI).

Monitoring Seq. No.: Monitoring Sequence Number refers to a unique identification code generated by the Surface Water Integrated Monitoring System (SWIMS), which holds much of the state's water quality monitoring data.

MDM: Maximum Daily Averages – maximum daily average is a calculated metric that may be used for temperature, dissolved oxygen and related chemistry parameters to characterize water condition.

NC: Natural Community. A system of categorizing water based on inherent physical, hydrologic, and biological components. Streams and Lakes have uniquely derived systems that result in specific natural community designations for each lake and river segment in the state. These designations dictate the appropriate assessment tools which improves the condition result, reflecting detailed nuances reflecting the modeling and analysis work foundational to the assessment systems.

mg/L: milligrams per liter - a volumetric measure typically used in chemistry analysis characterizations.

NEW Water: Northeast Wisconsin Water. an advocacy group operating in the northeast portion of the state for the restoration of the Wolf upper Fox in lower Fox basins.

NOAA: National Oceanic and Atmospheric Administration – a federal agency responsible for water / aquatic related activities involve the open waters, seas and Great Lakes.

ND: No detection – a term used typically in analytical settings to identify when a parameter or chemical constituent was not present at levels higher than the limit of detection.

NRCS: USDA Natural Resources Conservation Service -- formerly known as the Soil Conservation Service, the federal agency providing local support and land management outreach work with landowners and partners such as state agencies.

ORW: Outstanding Resource Water- Wisconsin's designation under state water quality standards to waters with outstanding quality and which may be provided a higher level of protection through various programs and processes.

Overwhelming Exceedance (OE), When total phosphorus concentrations in rivers exceed assessment thresholds more than two times the standard deviation of the surface water criteria in NR 102 (WQC for Total Phosphorus), the water is considered impaired and no biological response to confirm impairment is needed. Thus, if a river's lower 90% confidence interval exceeds the WQC 2 times the water is listed as impaired. One year of overwhelming exceedance is needed as long as the data was from a year not considered an extreme weather year and biological confirmation is not required.

SC: Species of Special Concern- species designated as special concern due to proximity to the farthest extent of their natural range or due to anthropogenic deleterious impacts on the landscape, or both.

SWIMS ID.: Surface Water Integrated Monitoring System (SWIMS) identification number is the unique monitoring station identification number for the location of monitoring data.

TDP: Total Dissolved Phosphorus – an analyzed chemistry parameter collected in aquatic systems positively correlated with excess productivity and eutrophication in Wisconsin waters.

TMDL: Total Maximum Daily Load – a technical report required for impaired waters Clean Water Act. TMDLs identify sources, sinks and impairments associated with the pollutant causing documented impairments.

TP: Total Phosphorus - an analyzed chemical parameter collected in aquatic systems frequently positively correlated with excess productivity and eutrophication in many of Wisconsin's waters.

TWA: Targeted Watershed Assessment. A monitoring study design centered on catchments or watersheds that uses a blend of geometric study design and targeted site selection to gather baseline data and additional collection work for unique and site-specific concerns for complex environmental questions including effectiveness monitoring of management actions, evaluation surveys for site specific criteria or permits, protection projects, and generalized watershed planning studies.

TSS: Total suspended solids – an analyzed physical parameter collected in aquatic systems that is frequently positively correlated with excess productivity, reduced water clarity, reduced dissolved oxygen and degraded biological communities.

TWA: Targeted Watershed Assessment. A statewide study design involving a rotating watershed approach to gathering of baseline monitoring data with specialized targeted assessments for unique and site-specific concerns, such as effectiveness monitoring of management actions.

UWGB. University of Wisconsin Green Bay. One of the University of Wisconsin system campuses comma and active research and analysis partner with the Wisconsin Department of natural resources that actively pursues the causes of, tools for, and restoration of Total phosphorus and suspended solids which are pollutants of concern in the upper Fox Wolf and Lower Fox basins.

USGS. United States Geological Survey. This federal agency is charged with researching and documenting critical resources throughout the United States period the USGS actively monitors and develops condition reports for ambient and trend water, sediment, soil, and geological resources in the Fox River Basins.

WATERS ID.: The Waterbody Assessment, Tracking, and Electronic Reporting System Identification Code. The WATERS ID is a unique numerical sequence number assigned by the WATERS system, also known as "Assessment Unit ID code." This code is used to identify unique stream segments or lakes assessed and stored in the WATERS system.

WBIC: Water Body Identification Code. WDNR's unique identification codes assigned to water features in the state. The lines and information allow the user to execute spatial and tabular queries about the data, make maps, and perform flow analysis and network traces.

WSLH: Wisconsin State Laboratory of Hygiene– the state's certified laboratory that provides a wide range of analytical services including toxicology, chemistry, and data sharing.

WQC: Water quality criteria – a component of Wisconsin's water quality standards that provide numerical endpoints for specific chemical, physical, and biological constituents.

Water Quality Plan Goals

The overall goal of this plan is to improve and protect water quality in the Pigeon River Watershed of the Wolf River Basin. This Targeted Assessment provided data to analyze current conditions and to make recommendations for future management actions in the area. The Pigeon River Watershed evaluation in 2015 and 2016 provided chemical, physical, and biological data to assess water quality impacts in the watershed from the installation of agricultural Best Management Practices (BMPs) to reduce nutrient and sediment loads.

This watershed evaluation supported the watershed improvement efforts by the Natural Resource Conservation Service (NRCS) and the Waupaca County Land and Water Conservation Department (Waupaca LWCD) through the National Water Quality Initiative (NWQI) program. An additional goal of the project was to conduct fish and aquatic life use impairment assessments based on phosphorus water quality standards of the Pigeon River and its tributaries.

Resources

Watershed Overview

The Pigeon River Watershed drains a 116.3 square-mile watershed in north-central Waupaca and south-central Shawano Counties before discharging into the Embarrass River near Clintonville, Wisconsin. The North and South Branches of the Pigeon River flow generally easterly between 15 and 25 miles until they meet and form the Pigeon River Mainstem. A 116-acre impoundment of the North Branch of the Pigeon River forms Marion Millpond. The Pigeon River Mainstem flows roughly 11 miles east until its confluence with the Embarrass River. A 173-acre impoundment of the Pigeon River, Pigeon Lake (locally known as Pigeon Pond), is in the City of Clintonville. There are 146 named and unnamed stream miles in the watershed.

Land Use and Population

Land use in Pigeon River watershed which is 116.32 mi². Land use in the watershed is primarily agricultural (46.63%), forest (27.16%) and a mix of wetland (17.24%) and other uses (8.96%). This watershed has 146.47 stream miles, 197.04 lake acres and 15,030.25 wetland acres. This watershed has 146.47 stream miles, 197.04 lake acres and 15,030.25 wetland acres (Figures 2 & 3). Two villages are located in the watershed, Marion, Clintonville and three additional communities are located nearby – Tigerton, Embarrass, and Big Pass. Marion is a city in Shawano and Waupaca counties in the U.S. state of Wisconsin. The population was 1,260 at the 2010 census.

Figure 2: Percent of Land Use Categories in Pigeon River Watershed

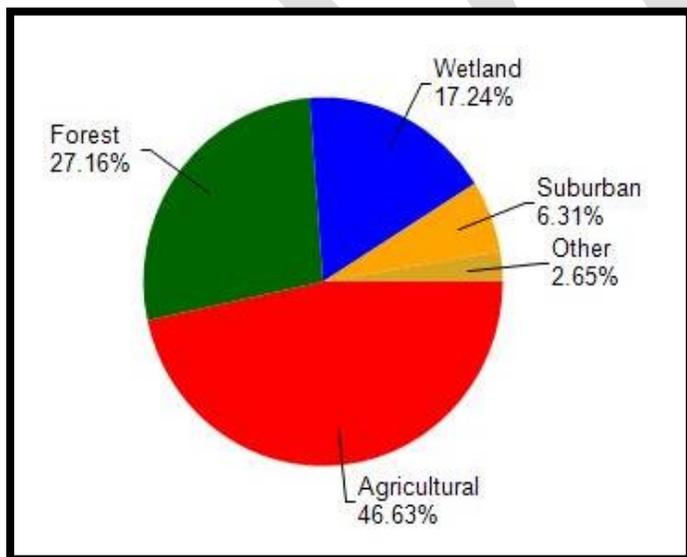
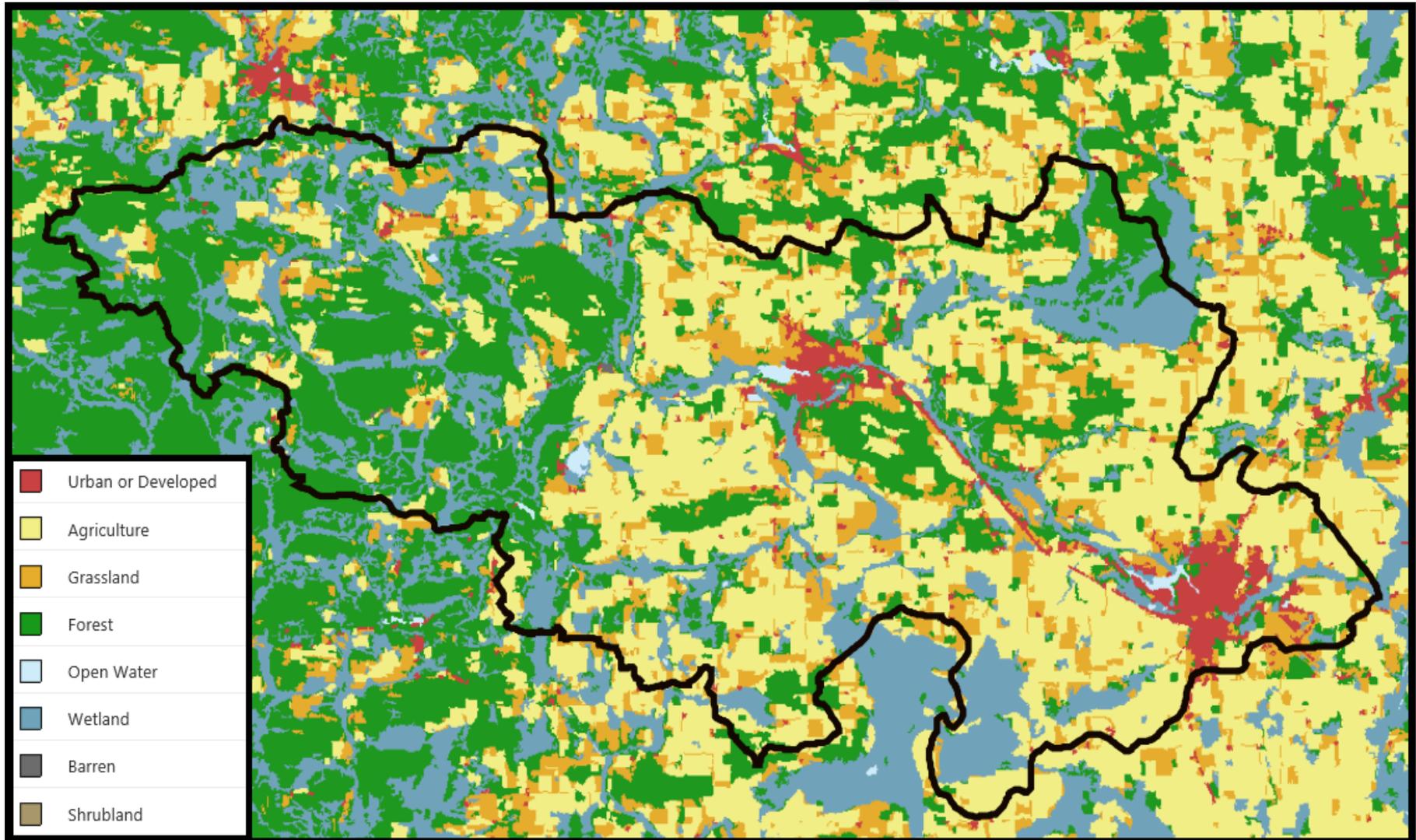


Figure 3: Land Use in the Pigeon River Watershed (2016) (WisLand2)



Ecological Landscapes

The Pigeon River Watershed is primarily covered by two ecological landscapes: Northern Lake Michigan Coastal Ecological Landscape and Forest Transition Ecological Landscape (Figure 4). The **Northern Lake Michigan Coastal Ecological Landscape** (see pink in statewide map, light green in watershed map (Figure 4) landforms consist of the *Niagara escarpment*, a prominent dolomite outcropping along the east side of Green Bay, a lacustrine plain along the west side of Green Bay, and ground moraine elsewhere. Low sand dunes and beach ridges that support Great Lakes endemics and many other rare species are found along the Great Lakes shoreline. The influence of Lake Michigan moderates extreme temperatures.

- Vegetation consists of more than 60% non-forested land, most of which is in agricultural crops, with smaller amounts of grassland, wetland, scrubland, and urbanized areas. Forested lands are dominated by maple-basswood, with smaller amounts of lowland hardwoods, aspen-birch, and lowland conifers.
- High quality areas of exposed alkaline bedrock beach occur on the northern Door Peninsula, providing habitat for many rare plants. Several islands lie off the Door Peninsula and these also provide critical habitat for rare species and colonially nesting birds.

The **Forest Transition Ecological Landscape** (Dark green in both maps, Figure 4) lies along the northern border of Wisconsin's Tension Zone, through the central and western part of the state, and supports both northern forests and agricultural areas. The central portion of the Forest Transition lies primarily on a glacial till plain deposited by glaciation between 25,000 and 790,000 years ago. The eastern and western portions are on moraines of the Wisconsin glaciation.

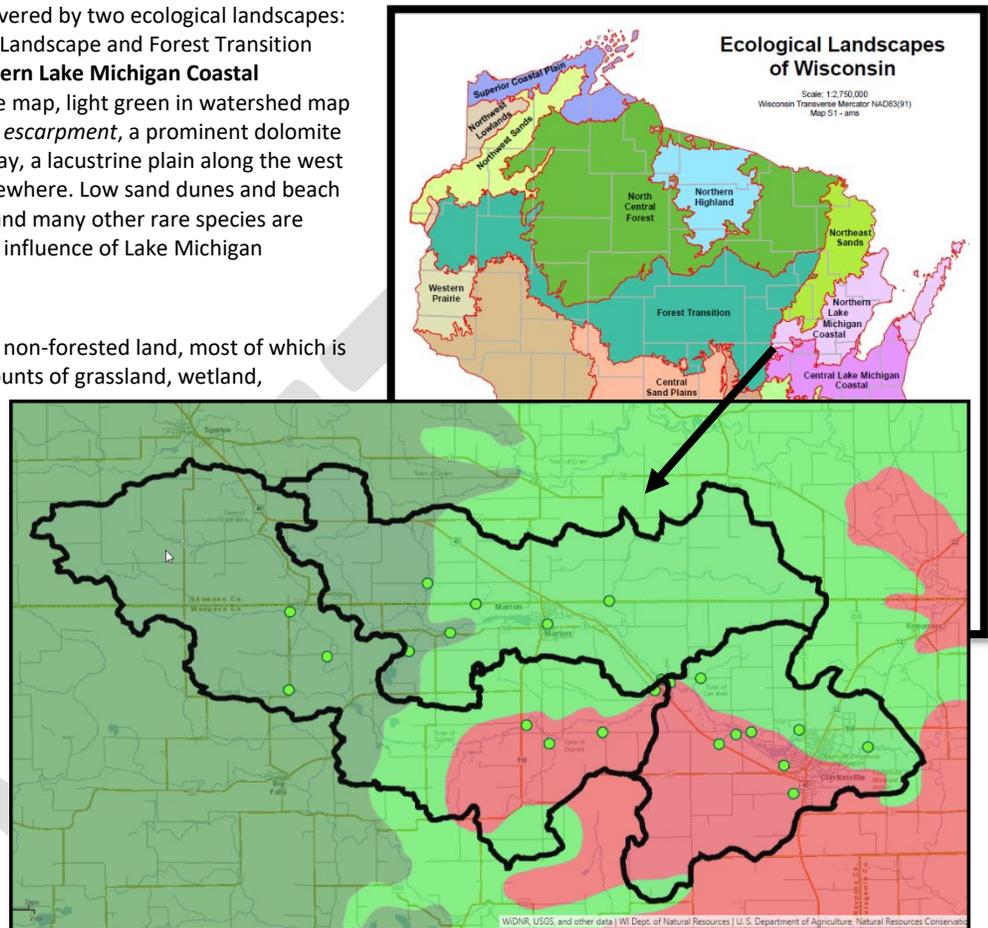
Soils are diverse, ranging from sandy loam to loam or shallow silt loam, and from poorly drained to well drained. The historic vegetation of the Forest Transition was primarily northern hardwood forest that were dominated by sugar maple and hemlock, with yellow birch, red pine and white pine.

- Currently, over 60% of this Ecological Landscape is non-forested. Forested areas consist primarily of northern hardwoods and aspen, with smaller amounts of oak and lowland hardwoods.
- The eastern portion of the Ecological Landscape differs from the rest of the area in that it remains primarily forested and includes some ecologically significant areas. Small areas of conifer swamp are found near the headwaters of streams and associated with lakes in kettle depressions on moraines. Ground flora show characteristics of both northern and southern Wisconsin, as this Ecological Landscape lies along the Tension Zone.

Hydrology

Soils are very diverse; in some areas, lacustrine sands are found overlying clays or bedrock within only a few feet of the surface. In the Door Peninsula, soils are typically stony loamy sands to loams. Poorly drained sands are common in the lake plain or in depressions between dunes and beach ridges. On the western side of Green Bay, the ground moraine is composed mostly of moderately well drained, rocky sandy loams, interspersed with lacustrine sands and clays, and peat and muck also common. Historic vegetation included maple-basswood-beech forest, hemlock-hardwood forest, northern white cedar swamp, hardwood-conifer swamp, wet meadows, and coastal marshes. Conifer dominated upland forests that resemble the boreal forest were present along Lake Michigan; they contain a

Figure 4. Ecological Landscapes, Pigeon River Watershed



significant component of white spruce and balsam fir. Cliffs, sinkholes, and dolomite ledges are associated with the Niagara Escarpment (WDNR, 2015).

Study Summary

Against this ecological, social and landscape within the Pigeon River Watershed, this 2015 and 2016 water quality monitoring study was implemented to provide chemical, physical, and biological data. This study was also intended to assess water quality improvements from agricultural Best Management Practices (BMPs) installed to reduce nutrient and sediment loads. This evaluation supported the watershed improvement efforts by the Natural Resource Conservation Service (NRCS) and the Waupaca County Land and Water Conservation Department (Waupaca LWCD) through the National Water Quality Initiative (NWQI) program. An additional goal of the project was to conduct fish and aquatic life use impairment assessments based on phosphorus water quality standards of the Pigeon River and its tributaries.

Purpose

This Targeted Watershed Assessment monitoring project provided an evaluation of water condition in 2015 and 2016, utilizing chemical, physical, and biological data to assess water quality impacts in the watershed from the agricultural Best Management Practices (BMPs) installed to reduce nutrient and sediment loads.

This evaluation of condition and documentation of change over time supports the improvement efforts by the [USDA Natural Resources Conservation Service \(NRCS\)](#) and the [Waupaca Land and Water Conservation Department \(LWCD\)](#) through the [National Water Quality Initiative \(NWQI\) program](#).

The Winnebago Comprehensive Management Plan ranked the Pigeon River a high priority due to animal waste and soil erosion problems with a critical average soil loss rate of 3.7 tons per acre per year. The data search for the Wolf River Basin Plan indicated problems with excess vegetation, turbidity, and habitat degradation (Gansberg, 1993). The soils, geology and other physical resources in the watershed's northwest portion indicate it is highly susceptible to groundwater contamination by poor land use practices. Approximately 70 percent of the remaining land area is of medium susceptibility. A data search revealed no runoff-related groundwater contamination problems in this area. An additional goal of the project was to conduct fish and aquatic life use assessments based on waters with potential phosphorous water quality standards issues in the Pigeon River and its tributaries.

The following outcomes of this study include:

- ✦ Watershed monitored with a baseline survey;
- ✦ Watershed; monitored to understand its status and any presence of and sources of impairments;
- ✦ Streams monitored to assess condition;
- ✦ Water condition updated and recommendations for management actions are created for Water Quality Management Planning.

Management Recommendations

- ✦ Reduce the transportation of phosphorus and sediment by implementing Best Management Practices such as streamside buffer strips, nutrient management, conservation tillage, cover crops, manure storage and barnyard runoff practices, and streambank and wetland restorations
- ✦ Reduce the thermal impacts from impoundments to the North Branch of the Pigeon River and the Pigeon River
- ✦ Preserve the Good to Excellent water quality and biotic communities of Geskey, Mehlberg, and Hydes Creeks, and the Unnamed Tributaries WBIC 297400 and 295700
- ✦ Continue to conduct water quality monitoring of the Pigeon Lake and River and Honey Creek to understand the role each have in the water quality of the River



Photo 1. Blandings Turtle found on Geskey Creek;
Photo by Dave Bolha, 09/29/2015.

Site Selection, Study Design

The Pigeon River Watershed evaluation in 2015 and 2016 provided chemical, physical, and biological data to assess water quality impacts in the watershed from the installation of agricultural Best Management Practices (BMPs) to reduce nutrient and sediment loads. This watershed evaluation supported the watershed improvement efforts by the Natural Resource Conservation Service (NRCS) and the Waupaca County Land and Water Conservation Department (Waupaca LWCD) through the National Water Quality Initiative (NWQI) program. An additional goal of the project was to conduct fish and aquatic life use impairment assessments based on phosphorus water quality standards of the Pigeon River and its tributaries. Sites were selected to provide a broad representation for baseline purposes and to confirm impaired waters from specific assessment determinations (Table 1, Figures 5-9 below).

Table 1. Pigeon River TWA Monitoring Stations

Map #	Station ID	Waterbody	WBIC	Location	HUC12
1	10043172	North Branch Pigeon River	293900	Fishery area	North Branch Pigeon River HUC12: 040302021101
2	10043173	UN Tributary No Br Pigeon Rd	284900	Gruenstern Rd.	
3	10017231	Hydes Creek	280100	Swamp Rd.	
4	10043176	Mehlberg Creek	283100	Upstream Burma Rd.	
5	10038319	North Branch Pigeon River	293900	DS Parkview Ave.	
6	693125	North Branch Pigeon River	293900	Knitt Rd.	
7	10043171	UN Tributary No Br Pigeon Rd	284900	Kopitzke Rd.	
8	693135	Pigeon River	272400	Klemp Rd.	Pigeon Lake-Pigeon River HUC12: 040302021103
9	10016706	UN Tributary to Pigeon River	293800	Knitt Road	
10	10042359	Honey Creek	5016138	1st Ave.	
11	10043229	Brandy Creek	293700	Lakeshore Rd	
12	10043230	UN Tributary to Pigeon Lake	5015321	River Rd.	
13	10043237	Brandy Creek	293700	Lakeshore Rd	
14	10043365	UN Tributary to Pigeon Lake	5015231	Green Tree Rd.	
15	10043366	Pfeiffer (Grady) Lake Outlet to Pigeon Lake	293500	Lakeshore Rd	
16	10044929	Pigeon River	272400	DS No. & So. Br Confluence	South Branch Pigeon River HUC12: 040302021102
17	10014791	Geskey Creek	297200	County E	
18	10043174	UN Tributary to So. Br Pigeon River	295800	Hauschultz Rd.	
19	10042814	UN Tributary to So. Br Pigeon River	297400	County E	
20	10014784	South Branch Pigeon River	295600	HWY 110	
21	10043175	UN Tributary to So. Br Pigeon River	295700	Nietzke Rd.	
22	10030525	South Branch Pigeon River	295600	Buckbee Rd.	
23	10014783	South Branch Pigeon River	295600	Brewer Rd.	

Figure 5: North Branch Pigeon River Subwatershed TWA Monitoring Stations



Map #	Station ID	Waterbody	WBIC	Location	HUC12 Subwatershed
1	10043172	North Branch Pigeon River	293900	Fishery area	North Branch Pigeon River HUC12: 040302021101
2	10043173	UN Tributary No Br Pigeon Rd	284900	Gruenstern Rd.	
3	10017231	Hydes Creek	280100	Swamp Rd.	
4	10043176	Mehlberg Creek	283100	Upstream Burma Rd.	
5	10038319	North Branch Pigeon River	293900	DS Parkview Ave.	
6	693125	North Branch Pigeon River	293900	Knitt Rd.	
7	10043171	UN Tributary No Br Pigeon Rd	284900	Kopitzke Rd.	

Figure 6: Pigeon Lake Subwatershed TWA Monitoring Stations

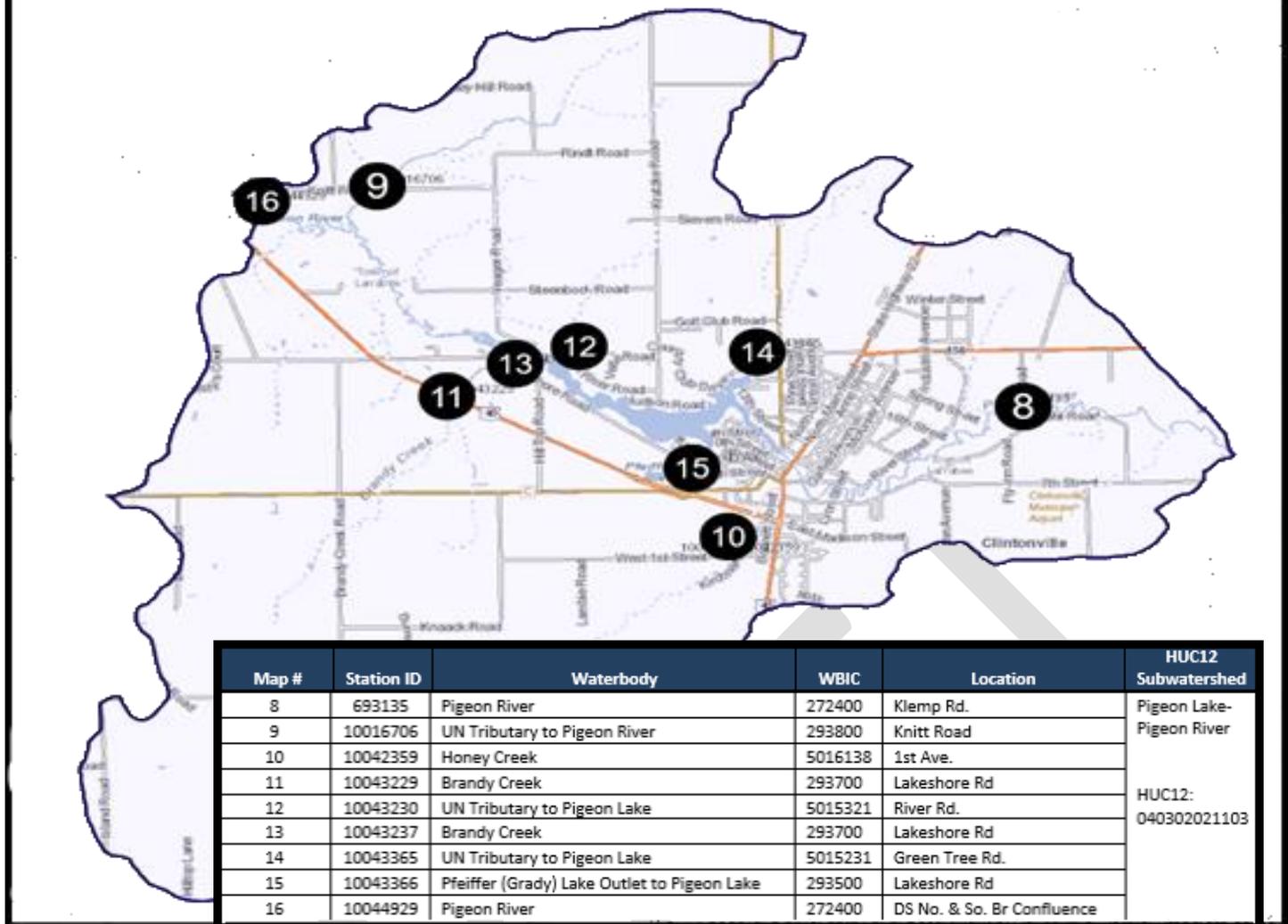


Figure 7: South Branch Pigeon River Subwatershed TWA Monitoring Stations

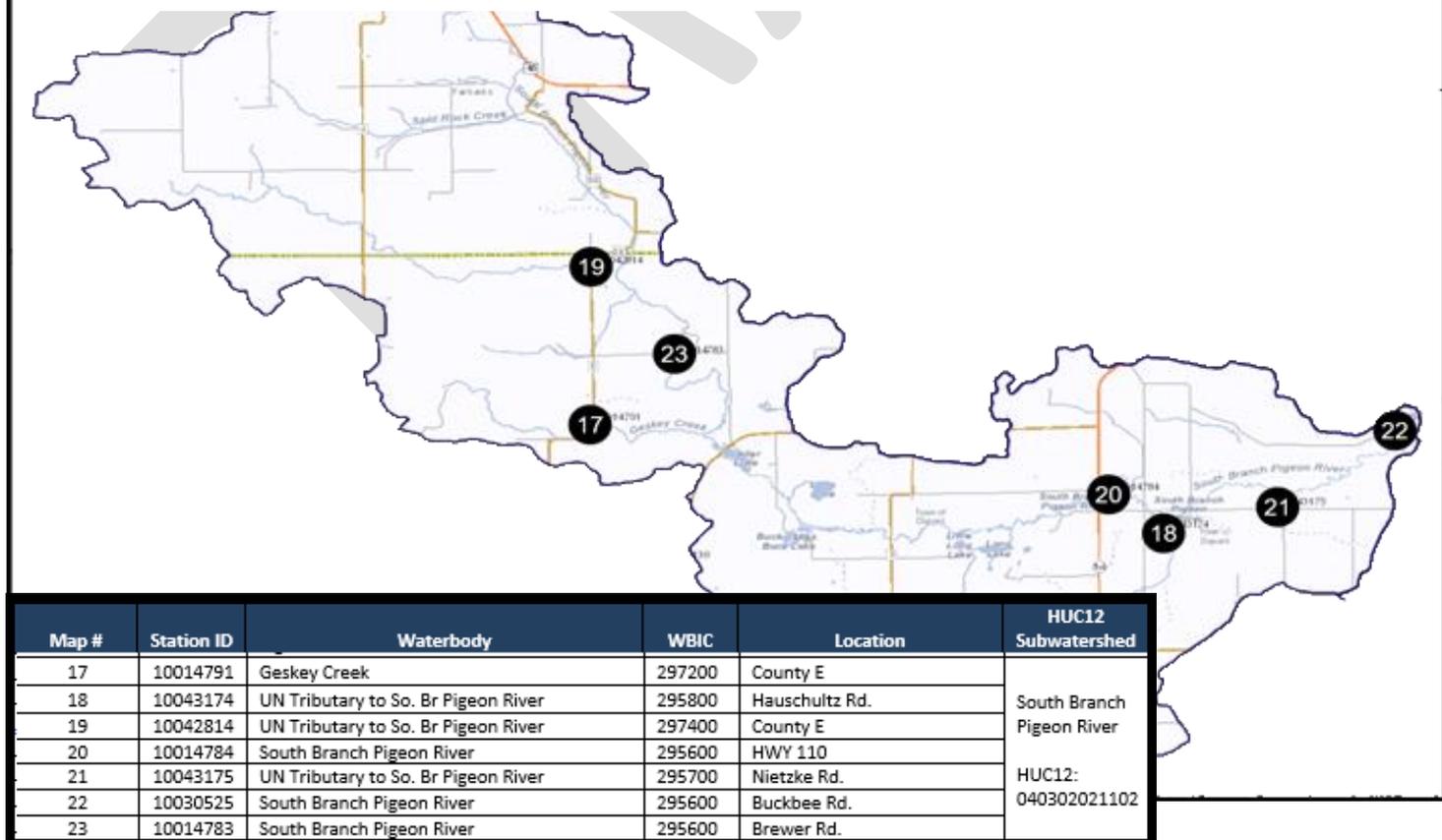


Figure 8: Pigeon River Watershed TWA Monitoring Stations (Whole Watershed)

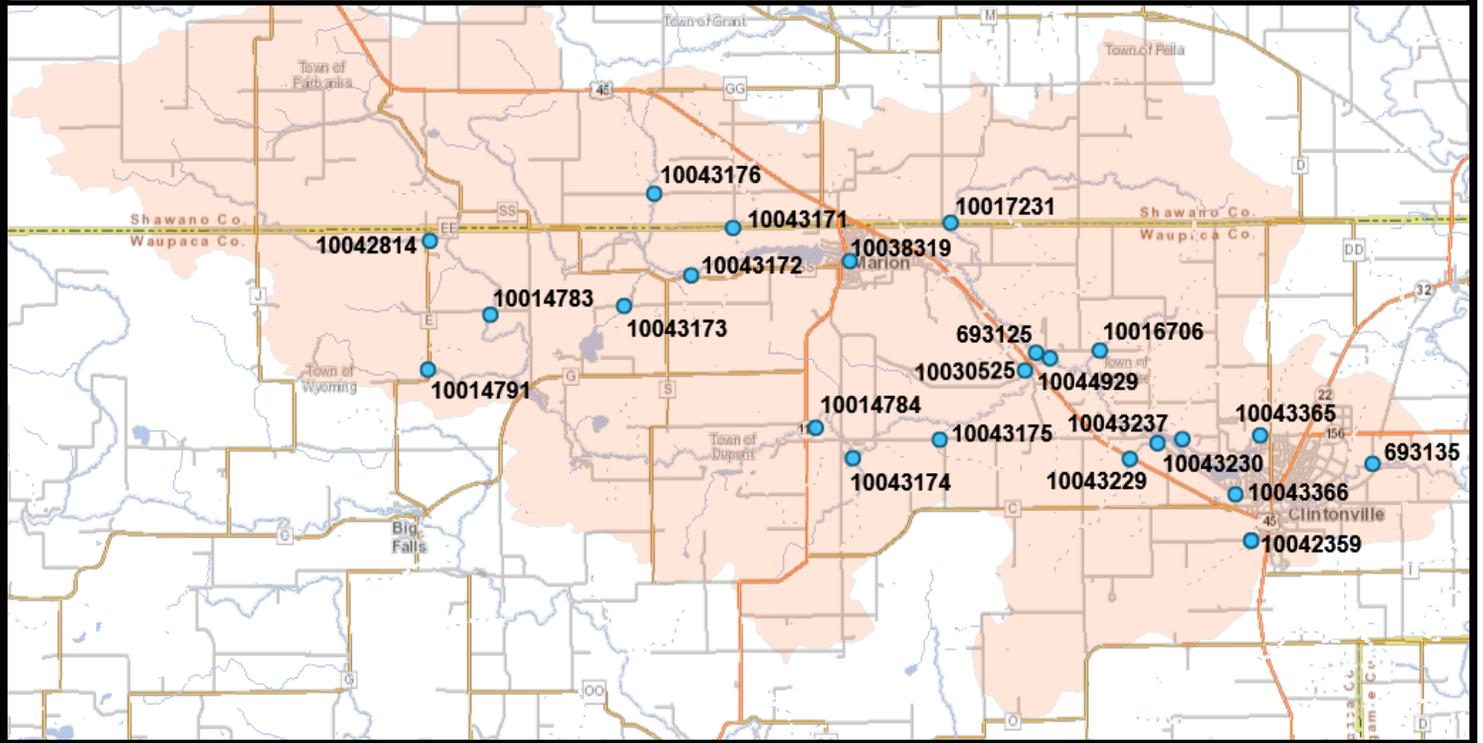
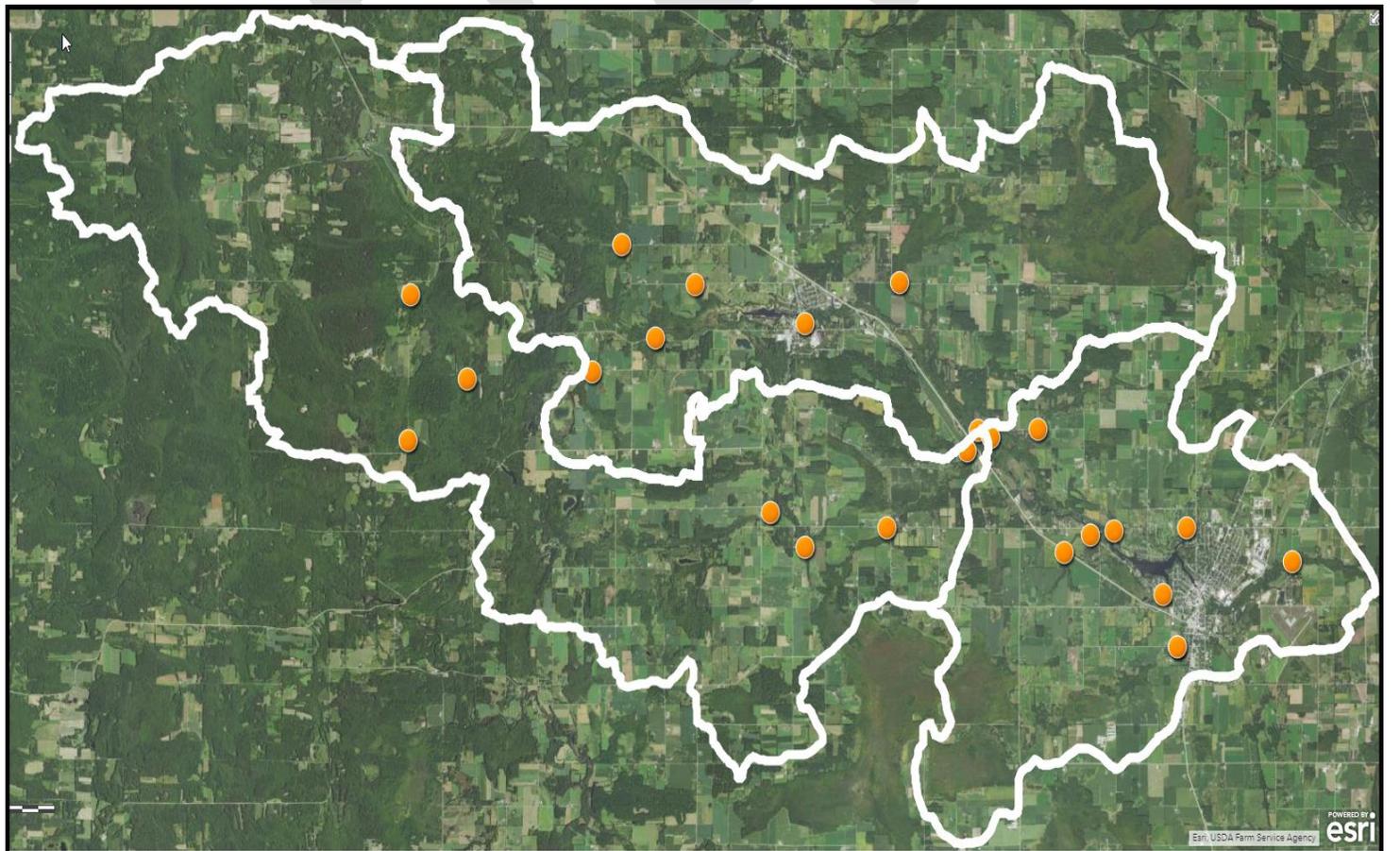


Figure 9: Aerial Photography of the Pigeon River TWA Project (NAIP 2017)



Methods, Equipment and Quality Assurance

The department collected fish, habitat, macroinvertebrate and water chemistry data for streams in this watershed with a special focus on evaluating the potential improvements from best management practices that have been installed over the years (Appendix B, for the location of the practices). This data gathering effort not only helps determine whether streams are achieving attainable use and overall health but the data, in conjunction with the locations of the actions and observations, can be used to guide additional planning for improvements. This subwatershed, and the adjoining subwatersheds that make up the HUC 10 were identified as one of the top group watersheds for nutrient input by the WI Nutrient Reduction Strategy.

Total Phosphorus

Total Phosphorus (TP) samples were collected at 15 locations once per month from May through October 2015 (Tables 5, 10). TP samples were collected at 6 additional locations once per month from May through October 2016.

- All samples were collected using the standard WDNR grab sampling method for a total of 126 samples (WDNR 2014).
 - [Guidelines and Procedures for Surface Water Grab Sampling \(Dec. 2005 Version 3\)](#)

Neither baseflow nor storm or snowmelt event sampling were targeted during this project, following the protocol of Wisconsin Consolidated Assessment and Listing Methodology (WisCALM 2014). All samples were shipped to Wisconsin State Laboratory of Hygiene (WISLOH) for analysis. The WISLOH entered all sample analysis data into the WDNR Surface Water Integrated Monitoring System (SWIMS) database.

Macroinvertebrate Evaluation

Thirteen creek and river locations were sampled for in October 2015 (Tables 5,). An additional 7 locations were sampled in 2016 for aquatic macroinvertebrates.

- All sites were sampled using the WDNR *Guidelines for Collecting Macroinvertebrate Samples from Wadable Streams* (2000).
 - [Guidelines for Collecting Macroinvertebrate Samples in Wadeable Streams](#)
 - [Wadeable Macroinvertebrate Field Data Report Form 3200-081 \(R 08/14\)](#)

A D-shaped kicknet with 600-micron mesh was used at all sites by standing upstream from the net and placing it firmly on the stream bed while digging into the substrate with the heel or toe to free the macroinvertebrates from the substrate. Riffles were targeted at each of the sites, but if none were present then overhanging vegetation, woody debris, or other vegetation would be sampled. This was done by jabbing the net into the vegetation to free the invertebrates. For a representative sample of the aquatic macroinvertebrate community, a minimum of 100 aquatic macroinvertebrates collected in each sample was targeted. The aquatic macroinvertebrates were preserved in a 70-80% ethanol solution inside quart "Mason" jars. If necessary, multiple "Mason" jars were used per sample depending upon how much sediment and organic material was collected with the aquatic macroinvertebrates. Within the next 24 hours, the samples were preserved with another 70-80% ethanol solution. Samples were taken to the UWSP Aquatic Entomology Laboratory (AEL) for lowest possible taxonomic identification. Staff at the AEL entered the data into the SWIMS database in 2016 and 2017.

Fish Assemblage

Wadable fish surveys were conducted at 16 locations (Table 4) between June and September 2015 and 2016. All 16 locations were surveyed in June through September during the guidance-recommended summertime survey period.

- The fish surveys were conducted following the WDNR *Guidelines for Assessing Fish Communities of Wadable Streams in Wisconsin* (2001).
 - [Wadeable Stream Fish Community Evaluation Form 3600-230 \(R 7/00\)](#)
 - [Guidelines for Assessing Fish Communities of Wadeable Streams in Wisconsin](#)

Stream flow and water chemistry data was recorded at each wadable site prior to conducting the fish survey. The wadable fish survey stations were a minimum of 35 times the mean stream width (overall minimum of 100 meters, overall maximum of 400 meters). An otter sled stream shocker with a 4000 Peak Watt generator was used for 6 of the 16 wadable sites with appropriate stream width and/or depth. A 12 Volt, 18 Amp Hour battery-powered backpack shocker was used for 10 of the 16 sites based upon the streams' smaller width and depth. Catch per effort sampling procedures were used for this project (no particular species was targeted, all captured). A single upstream pass was made using 0.125-inch mesh nets to collect the fish. At the end of the station, captured fish were identified and counted and all game fish were measured for length. Once all data was collected, the fish were returned to the creek. Fish survey data was entered into the WDNR Fisheries Management Database (FMDB) by WDNR Water Resources staff.

Habitat Evaluation

Quantitative habitat surveys were conducted at 18 locations in the Pigeon River Watershed between October 2015 and 2016 (Table 4).

- All sites were surveyed following the WDNR *Guidelines for Evaluating Habitat of Wadable Streams* (2002).
 - [Guidelines for Qualitative Physical Habitat Evaluation of Wadeable Streams](#)

- [Qualitative Habitat Rating less than 10m Form \(3600-532A\) \(R 6/07\)](#)
- [Guidelines for Evaluating Habitat of Wadeable Streams Rev 2002 \(Quantitative Habitat\)](#)
- [Wadeable Stream Quantitative Habitat Evaluation Form 3600-228 \(R 6/07\)](#)

Each quantitative habitat survey station length was 35 times the mean stream width of the survey station. Following the determination of station length, the station was divided into 12 transects. At each transect, substrate, sedimentation, erosion, water depth, and riparian land use data were collected. WDNR Water Resources staff entered the quantitative habitat data into the FMDB.

Continuous Temperature

Onset Hobo Pendant thermistors were deployed to collect temperature data from May through October between 2015 and 2016 at 19 locations in the Pigeon River Watershed (Table 4). Temperature measurements were taken once per hour at each location from May through October.

- [Guidelines and Standard Procedures for Continuous Temperature Monitoring Wisconsin DNR May 2004 \(Version 1\)](#)

Temperature measurements were taken with a thermistor attached to a fence post driven into the stream bed of the creek or river. The thermistor was attached to the fence post in such a manner as to suspend the thermistor in the water column low enough to stay under water in low flow conditions and high enough to not get buried in bottom substrate (~ 6 inches above the bottom). The thermistor was placed in a shaded location when possible. Temperature data were uploaded into the SWIMS database by WDNR Water Resources staff.



Photo 2: Field Crew Performs Quantitative Habitat Monitoring in an Unnamed Tributary to Pigeon Lake at River Road; Photo taken by Dave Bolha, on September 25th, 2015

Project Results

Monitoring Stations and Data Tables

This study's primary stations and associated data collection work are displayed in Figures 5 through Figure 9 (above) and in Table 2 below.

Table 2: Monitoring Locations and parameters measured during study of the Pigeon River Watershed.

Map Site No.	Waterbody	Station ID	WBIC	Location	Parameter				
					Fish	Habitat	Total Phosphorus	Invertebrates	Temperature
1	North Branch Pigeon River	10043172	293900	Fishery area	X	X	X	X	X
2	UN Trib to No Br Pigeon Road	10043173	284900	Gruenstern Rd.	X	X	X	X	X
3	Hydes Creek	10017231	280100	Swamp Rd.	X	X	X	X	X
4	Mehlberg Creek	10043176	283100	Upstream Burma Rd.	X	X	X	X	X
5	North Branch Pigeon River	10038319	293900	Downstream Parkview Ave.	X	X	X	X	X
6	North Branch Pigeon River	693125	293900	Knitt Rd.	X	X	X	X	X
7	Unnamed Tributary to Branch Pigeon Road	10043171	284900	Kopitzke Rd.	X	X	X	X	X
8	Pigeon River	693135	272400	Klemp Rd.	X	X	X	X	
9	Unnamed Tributary to Pigeon River	10016706	293800	Knitt Road		X	X		
10	Honey Creek	10042359	5016138	1st Ave.			X	X	X
11	Brandy Creek	10043229	293700	Lakeshore Rd			X		
12	Tributary to Pigeon Lake	10043230	5015321	River Rd.	X	X	X	X	X
13	Brandy Creek	10043237	293700	Lakeshore Rd	X	X		X	X
14	Tributary to Pigeon Lake	10043365	5015231	Green Tree Rd.	X	X	X	X	X
15	Pfeiffer (Grady) Lake Outlet to Pigeon Lake	10043366	293500	Lakeshore Rd			X		
16	Pigeon River	10044929	272400	DS No and So Br Confluence				X	
17	Geskey Creek	10014791	297200	County E	X	X	X	X	X
18	Tributary to South Branch Pigeon River	10043174	295800	Hauschultz Rd.	X	X	X	X	X
19	Tributary to South Branch Pigeon River	10042814	297400	County E			X	X	X
20	South Branch Pigeon River	10014784	295600	HWY 110	X	X	X	X	X
21	Tributary to South Branch Pigeon River	10043175	295700	Nietzke Rd.	X	X	X	X	X
22	South Branch Pigeon River	10030525	295600	Buckbee Rd.		X	X	X	X
23	South Branch Pigeon River	10014783	295600	Brewer Rd.	X	X	X	X	X

Water Chemistry

The TP sample analysis results in the Pigeon River Watershed ranged from 0.0176 mg/L at Unnamed Tributary to Pigeon Lake at River Rd in October to 0.832 mg/L at the Unnamed Tributary to the North Branch of the Pigeon River at Kopitzke Rd. in August (Table 6-7, Chart 1-2). The TP sample analysis results in the South and North Branches and Pigeon River Mainstems ranged from 0.0221 mg/L at the South Branch of the Pigeon River at Brewer Rd in May to 0.222 mg/L at North Branch of the Pigeon River at the Doty Creek Fishery Area in June (Table 6, Chart 1). Nine of the 21 locations in this project had an average TP concentration (mg/L) exceeding the Wisconsin Administrative Code ch. NR 102.06(3)(b) water quality criteria (WQC) for creeks and rivers at 0.075 mg/L (Table 6-7, Chart 1-2). Twelve of the 21 locations had average TP concentrations less than the WQC (Table 6-7, Chart 1-2). The average TP concentrations for the 21 sites in this project ranged from 0.032 mg/L in the Unnamed Tributary to Pigeon Lake at River Rd to 0.3553 mg/L in Honey Creek at 1st Ave (Table 6-7, Chart 1-2).

Table 3: Total Phosphorus Concentrations (mg/L) and Averages of Samples in the North and South Branches and Pigeon River

Waterbody	WBIC	Station ID	Location	Month of Sampling Event						
				May	June	July	August	September	October	Average
North Branch Pigeon River	293900	10043172	Fishery area	0.0636	0.222	0.0438	0.0595	0.0384	0.0574	0.08078
North Branch Pigeon River	293900	10038319	DS Parkview Ave.	0.0428	0.0393	0.0345	0.0273	0.0389	0.0232	0.03433
North Branch Pigeon River	293900	693125	Knitt Rd.	0.0605	0.0836	0.0727	0.056	0.0602	0.0439	0.06282
South Branch Pigeon River	295600	10014783	Brewer Rd.	0.0221	0.0636	0.0504	0.0365	0.0406	0.0343	0.04125
South Branch Pigeon River	295600	10014784	HWY 110	0.0313	0.0655	0.0456	0.0364	0.0481	0.0347	0.0436
South Branch Pigeon River	295600	10030525	Buckbee Rd.	0.0364	0.0955	0.0575	0.0386	0.0538	0.0485	0.05505
Pigeon River	272400	693135	Klemp Rd.	0.0697	0.152	0.0785	0.152	0.081	0.0575	0.09845

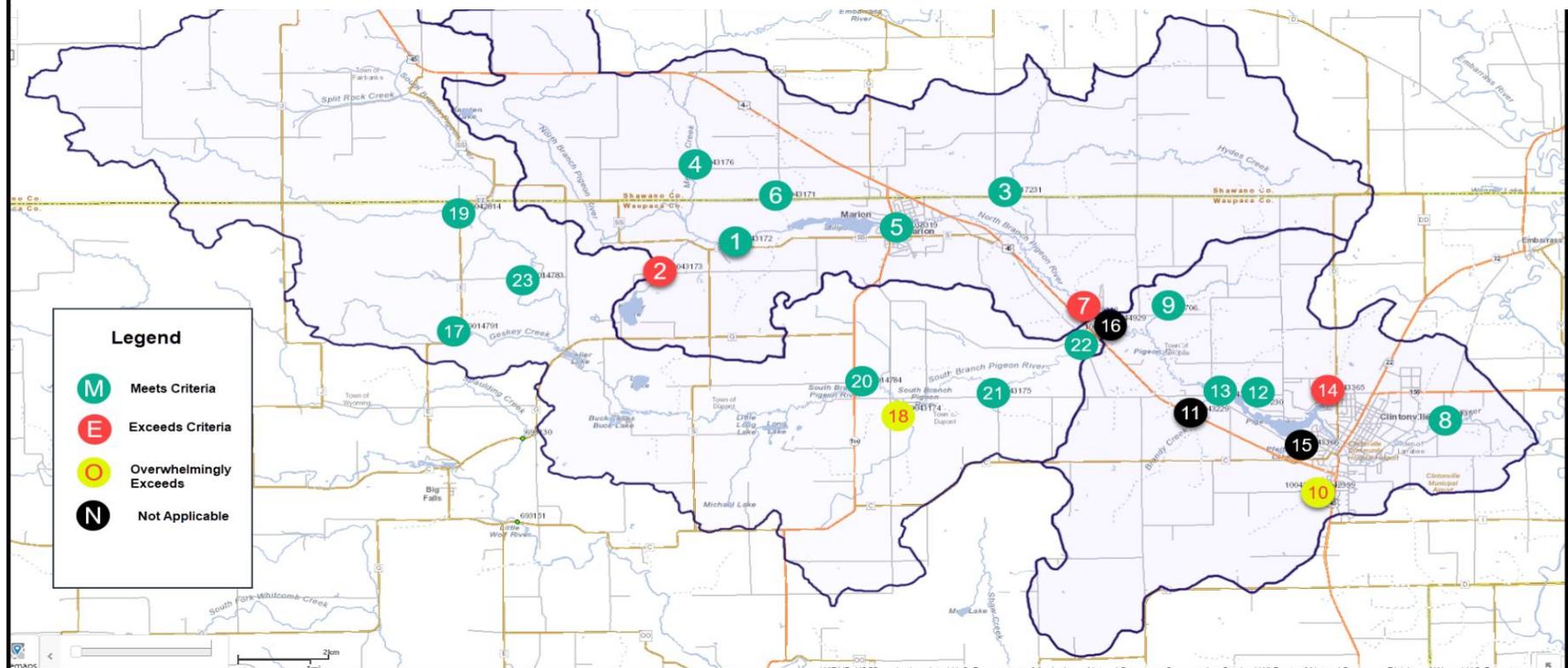
Table 4: Total Phosphorus Concentrations (mg/L) and Averages of Samples in the Tributaries of the Pigeon River Watershed.

Waterbody	WBIC	Station ID	Location	May	June	July	August	September	October	Average
Mehlberg Creek	283100	10043176	US Burma Rd.	0.0357	0.0434	0.0496	0.0406	0.0396	0.0534	0.0437
Trib. to No. Br. Pigeon R	284900	10043173	Gruenstern Rd.	0.0779	0.0775	0.092	0.0888	0.0683	0.0842	0.0815
Trib. to No. Br. Pigeon R	284900	10043171	Kopitzke Rd.	0.36	0.104	0.337	0.832	0.119	0.09	0.307
Hydes Creek	280100	10017231	Swamp Rd.	0.0401	0.0448	0.04	0.0363	0.0369	0.0388	0.0395
Geskey Creek	297200	10014791	County E	0.0262	0.0806	0.0556	0.0422	0.0373	0.0311	0.0455
Trib. to So. Br. Pigeon R	297400	10042814	County E	0.0266	0.0587	0.043	0.0364	0.0321	0.0356	0.0387
Trib. to So. Br. Pigeon R	295800	10043174	Hauschultz Rd.	0.214	0.449	0.308	0.151	0.14	0.178	0.24
Trib. to So. Br. Pigeon R	295700	10043175	Nietzke Rd.	0.0414	0.0528	0.0431	0.0433	0.035	0.0205	0.0394
Tributary to Pigeon Lake	5015321	10043230	River Rd.	0.0248	0.0193	0.0908	0.0199	0.0196	0.0176	0.032
Unnamed Trib to Pigeon Lake	5015231	10043365	Green Tree Rd.	0.0742	0.185	0.16	0.249	0.112	0.102	0.147
Brandy Creek	283700	10043229	Lakeshore Rd.	0.0673	0.1	0.0598	0.0441	0.0714	0.0859	0.0714
Pfeiffer (Grady) Lake Outlet to Pigeon Lake	293500	10043366	Lakeshore Rd.	0.0554	0.101	0.163	0.085	0.0853	0.0615	0.0919
Unnamed Trib to Pigeon R	293800	10016706	Knitt Rd.	0.0602	0.279	0.0213	0.0579	0.0715	0.0532	0.0905
Honey Creek	5016138	10042359	1st Ave.	0.178	0.18	0.474	0.631	0.519	0.15	0.355

Table 5: Total Phosphorus Lower 90% Confidence Limits in the Pigeon River Watershed.

Waterbody	Map No.	WBIC	Station ID	Location	TP Lower 90% Confidence Limit	Exceedance Level
North Branch Pigeon River	1	293900	10043172	Fishery Area	0.039	Meets
Tributary to North Branch Pigeon River	2	284900	10043173	Gruenstern Rd.	0.076	Exceeds
Hydes Creek	3	280100	10017231	Swamp Rd.	0.038	Meets
Mehlberg Creek	4	283100	10043176	Upstream Burma Rd.	0.040	Meets
North Branch Pigeon River	5	293900	10038319	Downstream Parkview	0.030	Meets
North Branch Pigeon River	6	293900	693125	Knitt Rd.	0.055	Meets
Tributary to North Branch Pigeon River	7	284900	10043171	Kopitzke Rd.	0.136	Exceeds
Pigeon River	8	272400	693135	Klemp Rd.	0.073	Meets
Unnamed Tributary to Pigeon River	9	293800	10016706	Knitt Rd.	0.034	Meets
Honey Creek	10	5016138	10042359	1st Ave.	0.229	Overwhelmingly Exceeds
Unnamed Tributary to Pigeon Lake	12	5015321	10043230	River Rd.	0.015	Meets
Brandy Creek	13	293700	10043229	Lakeshore Rd.	0.058	Meets
Unnamed Tributary to Pigeon Lake	14	5015231	10043365	Green Tree Rd.	0.108	Exceeds
Pfeiffer Lake	15	293500	10043366	Outlet to Pigeon Lake at Lakeshore Rd.	0.069	Not Applicable
Geskey Creek	17	297200	10014791	County E	0.034	Meets
Tributary South Branch Pigeon River	18	295800	10043174	Hauschultz Rd.	0.168	Overwhelmingly Exceeds
Tributary South Branch Pigeon River	19	297400	10042814	County E	0.032	Meets
South Branch Pigeon River	20	295600	10014784	HWY 110	0.036	Meets
Tributary South Branch Pigeon River	21	295700	10043175	Nietzke Rd.	0.033	Meets
South Branch Pigeon River	22	295600	10030525	Buckbee Rd.	0.042	Meets
South Branch Pigeon River	23	295600	10014783	Brewer Rd.	0.033	Meets

Figure 10: Total Phosphorus Concentration Exceedance Level Lower 90% Confidence Limits Map



Macroinvertebrate

Aquatic macroinvertebrate communities were sampled at 19 locations between October 2015 and 2016 (Table 2). Some aquatic macroinvertebrate species are tolerant of environmental degradation, while some species are moderately tolerant, and some others are intolerant. Based upon the representative macroinvertebrate sample collected and their associated tolerance to environmental degradation, an Index of Biotic Integrity (mIBI) was calculated to indicate the water quality condition of the stream or river (Table 8, Chart 3-4). In general, the higher the mIBI score, the better the water quality rating for a waterbody. The mIBI scores ranged from 1.59 in Honey Creek at 1st Ave to 7.85 in Hydes Creek at Swamp Rd (Table 8, Chart 3-4). The Condition Categories for the 19 sites ranged from Poor to Excellent. The North and South Branches and Pigeon River Mainstem samples demonstrated a macroinvertebrate community that ranged from some slight to significant apparent impact from environmental degradation. The 12 tributary macroinvertebrate communities indicated no apparent to significant impact from environmental degradation. Ten of the 19 locations indicate a Condition Category of Good, while 7 indicate a Condition Category of Fair (Table 8, Chart 3-4). Honey Creek and the North Branch of the Pigeon River in Marion indicate a water quality Condition Category of Poor based upon the macroinvertebrates collected.

Table 6: Macroinvertebrate Index of Biotic Integrity and Water Quality Condition in the Pigeon River Watershed.

Waterbody	WBIC	SWIMS ID	Location	mIBI Score	Condition
North Branch Pigeon River	293900	10043172	Fishery area	2.55	Fair
North Branch Pigeon River	293900	10038319	Downstream Parkview Ave.	2.13	Poor
North Branch Pigeon River	293900	693125	Knitt Rd.	6.33	Good
South Branch Pigeon River	295600	10014783	Brewer Rd.	5.08	Good
South Branch Pigeon River	295600	10014784	HWY 110	6.56	Good
South Branch Pigeon River	295600	10030525	Buckbee Rd.	5.88	Good
Pigeon River	272400	10044929	DS No. and So. Br Confluence	3.99	Fair
Pigeon River	272400	693135	Klemp Rd.	2.98	Fair
Mehlberg Creek	283100	10043176	Mehlberg Cr. US Burma Rd.	7.27	Good
Tributary to North Br. Pigeon Road	284900	10043173	Gruenstern Rd.	7.07	Good
Tributary to North Br. Pigeon Road	279600	10043171	Kopitzke Rd.	6.48	Good
Hydes Creek	280100	10017231	Swamp Rd.	7.85	Excellent
Geskey Creek	297200	10014791	County E	6.08	Good
Tributary to So. Br. Pigeon River	297400	10042814	County E	7.23	Good
Tributary to So. Br. Pigeon River	295800	10043174	Hauschultz Rd.	4.68	Fair
Tributary to So. Br. Pigeon River	295700	10043175	Nietzke Rd.	5.3	Good
Tributary to Pigeon Lake	5015321	10043230	River Rd.	3.19	Fair
Tributary to Pigeon Lake	5015231	10043365	Green Tree Rd.	3.13	Fair
Brandy Creek	293700	10043237	Lakeshore Rd.	4.28	Fair
Honey Creek	5016138	10042359	1st Ave.	1.59	Poor

Fish Natural Community and Condition

Between June and September 2015 and 2016, 16 locations in the Pigeon River Watershed were surveyed for representative fish communities. Some fish species are tolerant of environmental degradation, while some species are moderately tolerant, and some others are intolerant. Based upon the representative fish collected during the survey and their associated tolerance to environmental degradation, an Index of Biotic Integrity (FIBI) was calculated to indicate the water quality of each creek or river (Table 9, Chart 5). The FIBI scores ranged from 40 in Brandy Creek to 100 in the North and South Branches of the Pigeon River and Geskey Creek (Table 9, Chart 5). The Condition Category for the 16 sites ranged from Fair to Excellent. All 6 fish surveys in the North and South Branches and the Pigeon River Mainstems indicate a Condition Category of Excellent, with the FIBI scores ranging from 75 to 100. Three of the 10 tributary sites demonstrated a Condition Category of Excellent (Table 9, Chart 5). Four of the Unnamed Tributaries had a Condition Category of Good while the remaining 3 sites had a Condition Category of Fair based upon the fish surveys (Table 9, Chart 5).

Each fish community surveyed was used to verify or update the modeled Natural Community for that stream segment. Each of the 10 tributary streams' Natural Community was verified or changed based upon the fish caught in the survey (and any historical known surveys in that stream segment). Verifying or changing the modeled Natural Community was important since the Natural Community determines which FIBI was used to determine the water quality of that stream segment. The results of the calculated FIBI calculations displayed in Table 9 and Chart 5 are based upon the verified or changed Natural Community.

Table 7: Fish Index of Biotic Integrity Scores and Condition Categories in the Pigeon River Watershed.

Waterbody	WBIC	Station ID	Location	Modeled Community	Selected Community	IBI Used	Fish IBI	Package Results	Condition Category
Tributary to Pigeon R.	293800	693125	Knitt Rd.	Cool-Warm Mainstem	Cool-Warm Mainstem	Cool-Warm IBI	80	80	Excellent
Pigeon River	272400	693135	Klemp Rd.	Warm Mainstem	Warm Mainstem	Warmwater IBI CS Near	75	80*	Excellent
South Branch Pigeon R.	295600	10014783	Brewer Rd.	Cool-Cold Mainstem	Cool-Cold Mainstem	Cool-Cold IBI	90	90	Excellent
	295600	10014784	HWY 110	Cool-Warm Mainstem	Cool-Warm Mainstem	Cool-Warm IBI	100	95*	Excellent
Geskey Creek	297200	10014791	County E	Cool-Warm Headwater	Cool-Warm Headwater	Intermittent IBI	100	100	Excellent
Hydes Creek	280100	10017231	Swamp Rd.	Cool-Cold Mainstem	Cool-Warm Headwater	Intermittent IBI	80	60*	Excellent
North Branch Pigeon R.	293900	10038319	DS Parkview Ave.	Cool-Warm Mainstem	Cool-Warm Mainstem	Cool-Warm IBI	80	70*	Excellent
Tributary to North Branch Pigeon Road	284900	10043171	Kopitzke Rd.	Cool-Cold Headwater			50	**	Fair
	284900	10043173	Gruenstern Rd.	Cool-Warm Headwater	Warm Headwater		70	**	Good
North Branch Pigeon R.	293900	10043172	Fishery area	Cool-Cold Mainstem			100	**	Excellent
South Branch Pigeon R.	295600	10014783	Brewer Rd.	Cool-Cold Mainstem	Cool-Cold Mainstem	Cool-Cold IBI	90	90	Excellent
	295600	10014784	HWY 110	Cool-Warm Mainstem	Cool-Warm Mainstem	Cool-Warm IBI	100	95*	Excellent
Tributary to South Branch Pigeon R.	295800	10043174	Hauschultz Rd.	Cool-Warm Headwater	Cool-Warm Headwater	Intermittent IBI	70	70	Good
	295700	10043175	Nietzke Rd.	Cool-Cold Headwater	Cool-Cold Headwater	Intermittent IBI	70	70	Good
Mehlberg Creek	283100	10043176	US Burma Rd.	Cool-Warm Headwater	Coldwater**	Cool-Cold IBI	90	**	Excellent
Brandy Creek	293700	10043237	Lakeshore Rd.	Cool-Warm Mainstem	Cool-Warm Mainstem	Cool-Warm IBI	40	40	Fair
Tributary to Pigeon Lake	5015231	10043365	Green Tree Rd.	Cool-Cold Headwater	Cool-Cold Headwater	Intermittent IBI	50	50	Fair

**Study was not all species – This survey did not target all species

Habitat Condition

Habitat condition is listed below, as well as other parameters collected at the station (Fish and mIBI).

Table 8: Quantitative Habitat Survey, Fish IBI and mIBI Conditions for the Pigeon River Watershed

Waterbody	WBIC	Station ID	Location	Quantitative	Condition	Fish IBI	Mibi
No Br Pigeon River	293900	10043172	Fishery area	58	Good	Excellent	Fair
No Br Pigeon River	293900	10038319	DS Parkview.	65	Good	Excellent	Poor
No Br Pigeon River	293900	693125	Knitt Rd.	55	Good	Excellent	Good
So Br Pigeon River	295600	10014783	Brewer Rd.	73	Good	Excellent	Good
So Br Pigeon River	295600	10014784	HWY 110	55	Good	Excellent	Good
So Br Pigeon River	295600	10030525	Buckbee Rd.	57	Fair		Good
Pigeon River	272400	693135	Klemp Rd.	48	Fair	Excellent	Fair
Mehlberg Creek	283100	10043176	US Burma Rd.	63	Good	Excellent	Good
Trib to No Br Pigeon Rd	284900	10043173	Gruenstern Rd.	63	Good	Good	Good
Trib to No Br Pigeon Rd	284900	10043171	Kopitzke Rd.	63	Good	Fair	Good
Hydes Creek	280100	10017231	Swamp Rd.	55	Good		Excellent
Geskey Creek	297200	10014791	County E	57	Good	Excellent	Good
Trib to So Br Pigeon River	295800	10043174	Hauschultz Rd.	28	Fair	Good	Fair
Trib to So Br Pigeon River	295700	10043175	Nietzke Rd.	25	Fair	Good	Good
Tributary to Pigeon River	293800	10016706	Knitt Rd.	55	Good		
Tributary to Pigeon Lake	5015321	10043230	River Rd.	48	Fair		Fair
Tributary to Pigeon Lake	5015231	10043365	Green Tree Rd.	40	Fair	Fair	Fair
Brandy Creek	293700	10043237	Lakeshore Rd.	45	Fair	Fair	Fair

Water Temperature

Water temperature data in Fahrenheit (F) was collected at 19 locations in the Pigeon River Watershed between 2015 and 2016 (Table 10, Map 1-2). Monthly average temperatures were reported for months with complete data only. The average monthly temperatures ranged from 52.5F in the Unnamed Tributary to the North Branch of the Pigeon River at Kopitzke Rd in July to 77.4F in the North Branch of the Pigeon River downstream of Parkview Ave in August (Table 10, Chart 6-7). The Maximum Daily Averages (MDM) of the North and South Branches of the Pigeon River ranged from 66.2F in the North Branch of the Pigeon River at the Doty Creek Fishery Area to 81.2F in the North Branch of the Pigeon River downstream of Parkview Ave (Table 10, Chart 6). The MDM of the Tributaries of the Pigeon Watershed ranged from 61.6F in the Unnamed Tributary to the North Branch of the Pigeon River at Kopitzke Rd to 72.3F Unnamed Tributary to the North Branch of the Pigeon River at Gruenstern Rd (Table 10, Chart 7).

Table 9: Monthly Average and Maximum Daily Average Temperatures (°F) in the Pigeon River Watershed.

Waterbody	WBIC	Station ID	Location	June Average Temp	July Average Temp	August Average Temp	September Average Temp	Maximum Daily Mean
North Branch Pigeon	293900	10043172	Fishery Area	61.0	61.8	61.5	58.7	66.2
North Branch Pigeon	293900	10038319	Downstream Parkview	72.9	77.3	77.4	69.5	81.2
North Branch Pigeon	293900	693125	Knitt Rd.	63.5	67.4	65.8	64.2	71.6
South Branch Pigeon	295600	10014783	Brewer Rd.	60.8	64.1	62.7	61.3	69.0
South Branch Pigeon	295600	10014784	HWY 110	65.8	70.8	68.1	65.4	75.8
South Branch Pigeon	295600	10030525	Buckbee Rd.	64.5	68.8	66.4	64.5	73.3
Mehlberg Creek	283100	10043176	Upstream Burma Rd.	60.3	61.9	62.0	58.9	66.7
Trib to North Branch Pigeon River	284900	10043173	Gruenstern Rd.	66.7	67.7	65.9	61.3	72.3
Trib to North Branch Pigeon Road	284900	10043171	Kopitzke Rd.	54.4	52.5	52.5	53.0	61.6
Hydes Creek	280100	10017231	Swamp Rd.	61.7	64.0	64.7	59.9	67.9
Geskey Creek	297200	10014791	County E	59.0	63.5	62.9	60.6	70.4

Waterbody	WBIC	Station ID	Location	June Average Temp	July Average Temp	August Average Temp	September Average Temp	Maximum Daily Mean
Geskey Creek	297200	10014791	County E	57.9	61.0	60.0	59.1	66.5
Trib to South Branch Pigeon River	295800	10043174	Hauschultz Rd.	61.1	60.3	59.8	59.5	67.5
Trib to South Branch Pigeon River	295700	10043175	Nietzke Rd.	54.3	57.4	57.5	57.7	63.2
Trib to Pigeon	293800	10016706	Knitt Rd.	56.2	59.1	58.5	58.0	66.3
Trib to Pigeon Lake	5015321	10043230	River Rd.	60.5	64.9	64.3	61.4	69.3
Trib to Pigeon Lake	5015231	10043365	Green Tree Rd.	60.6	63.0	62.0	60.9	69.6
Brandy Creek	293700	10043237	Lakeshore Rd.	62.5	62.4	61.3	61.6	67.9
Honey Creek	5016138	10042359	1st Ave.	64.1	66.4	63.3	63.5	70.9

Discussion

The total phosphorus, aquatic macroinvertebrate, and fish monitoring in this project demonstrated that *the water quality in the Pigeon River Watershed is between poor and excellent condition*. However, the 2005-2006 monitoring results exceeded the WQC with at LCL of 0.082 mg/L; thus, the Pigeon River was added to the 2014 list.

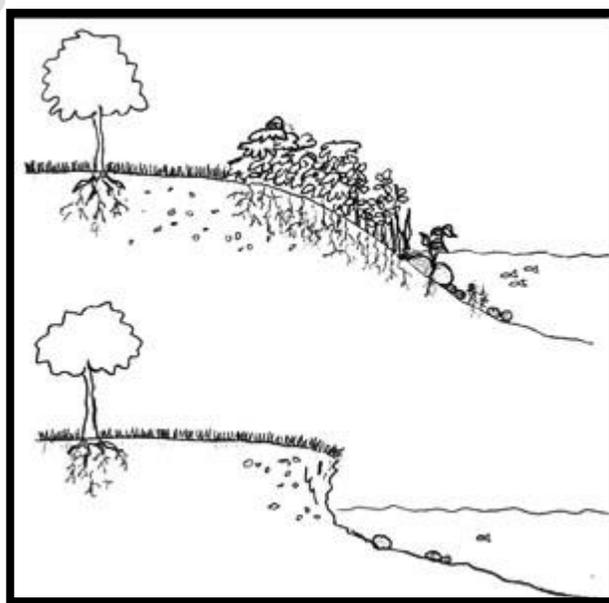
The median of the 2005-2006 TP samples used for the 2014 assessment was 0.107 mg/L; whereas, the 2015 median was 0.079 mg/L. Based on the difference in median TP concentrations from 2005-2006 to 2015, *there may have been a reduction of phosphorus in the Pigeon River from BMPs installed as part of the NWQI program and various DNR runoff management grants over the years*.

Water quality of the North Branch of the Pigeon River has been negatively influenced over the years by land use and has been influenced by the export of sediment and nutrients from Marion Millpond. In 2018, the river is proposed for an additional listing for temperature exceedances on top of the existing total phosphorus water quality standard exceedances. Temperature data collected in 2015 indicated exceedances of NR 102 thermal standards with a corresponding biological impairment (poor MIBI at Parkview Ave). Honey Creek and three unnamed tributaries demonstrated phosphorus water quality criteria exceedances, as well.

Watershed survey work also documented land uses in 2015 and 2016 that are associated with reduced water quality and negative impacts on resources, and in this case, the water quality of the Upper and Lower Pigeon River and its tributaries.

These waters had:

- ✚ Limited buffer protection along the stream corridors,
- ✚ eroding streambanks,
- ✚ barnyard runoff,
- ✚ cropland erosion,
- ✚ channelization,
- ✚ sedimentation of fish and aquatic life habitat,
- ✚ thermal impacts from impoundments, and the
- ✚ presence of aquatic invasive species.



Documentation of degraded stream health over the years (Nordin-Pedersen 1997, NRCS 1999, and WDNR 2015-2016) and the potential for improved water quality indicate that the need for watershed improvements remains throughout the Pigeon River Watershed. A good effort was made to decrease the pollutant loads during the NWQI implementation as demonstrated by the manure storage and concrete barnyard installed in 2016 (Photo 3-4); however, there are more opportunities to install practices to lower the nutrients and sediment reaching the Pigeon River.



Photo 3: Aerial Image of farm in Pigeon River watershed before BMP Installation



Photo 4: Post-Construction Image of Concrete Barnyard Taken by Waupaca LWCD in 2016.

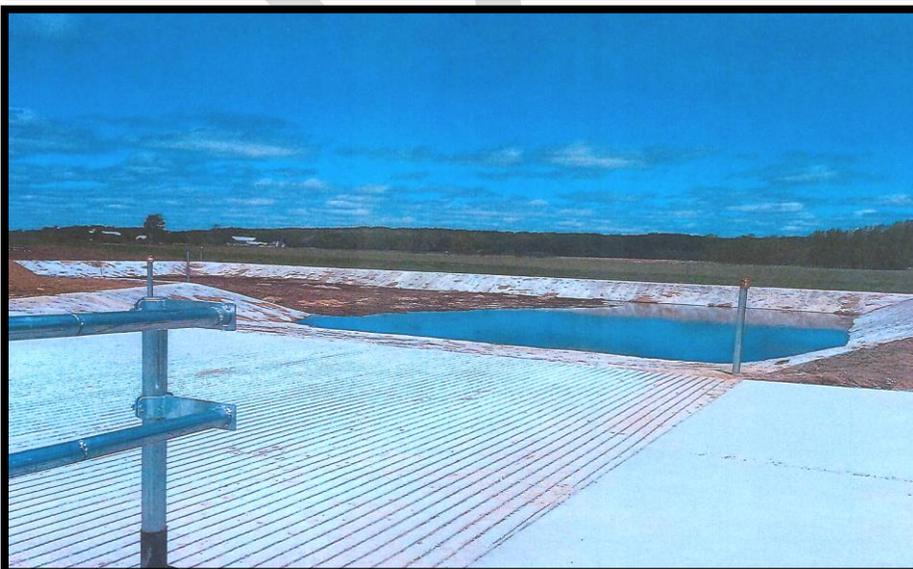


Photo 5: Manure Storage Pit on Farm. Photo taken by Waupaca LWCD in 2016.

Chemistry Results

For phosphorus, the department's listing methodology for impaired waters (WDNR, 2018) lists waters where the median concentration exceeds 0.075 mg/l on wadable streams and 0.1 mg/l on rivers. The impairment listing protocol uses a 90% confidence interval about the median for listing streams and rivers.

The total phosphorus (TP) sample analysis results in the Pigeon River Watershed ranged from 0.0176 mg/L at Tributary to Pigeon Lake at River Rd in October to 0.832 mg/L at the Tributary to the North Branch of the Pigeon River at Kopitzke Rd. in August (Table 9 and 10, Figure 10 through Figure 14). The TP sample analysis results in the South and North Branches and Pigeon River Mainstems ranged from 0.0221 mg/L at the South Branch of the Pigeon River at Brewer Rd in May to 0.222 mg/L at North Branch of the Pigeon River at the Doty Creek Fishery Area in June.

Nine of the 21 locations in this project had an average TP concentration (mg/L) exceeding the Wisconsin Administrative Code ch. NR 102.06(3)(b) water quality criteria (WQC) for creeks and rivers at 0.075 mg/L. Twelve of the 21 locations had average TP concentrations less than the WQC. The average TP concentrations for the 21 sites in this project ranged from 0.032 mg/L in the Unnamed Tributary to Pigeon Lake at River Rd to 0.3553 mg/L in Honey Creek at 1st Ave.

Typically, as increases in agricultural land use occur, there is a correlating increase in TP and TN concentrations in creeks in the watersheds in Wisconsin. Water clarity decreases and chlorophyll a concentration (which is an indication of algae populations) increases as TP increases. Water clarity and chlorophyll a concentration are indicators of water quality in Wisconsin lakes (WisCALM 2018).

Nine of the 21 locations in the Pigeon River Watershed monitored for TP demonstrated average concentrations above reference conditions for USEPA North Central Hardwood Forest Ecoregion (Omernik et al 2000) and the United States Geological Survey Environmental Phosphorus Zone 1 (EPZ 1) (Robertson et al 2006), and the Wisconsin Administrative Code ch. NR 102 Water Quality Criteria (WQC) of 0.075 mg/L for rivers and streams in Wisconsin. Therefore, an impairment assessment was conducted to verify whether the Pigeon River Watershed TP concentrations meet the WQC or if the waterbodies should be placed on the United States Environmental Protection Agency Clean Water Act Section 303d Impaired Waters List (CWA 303d IWL). The sampling requirements to demonstrate if WQC for TP were being met, clearly exceeded, or overwhelmingly exceeded were accomplished through this project.

The impairment assessment protocol requires a parametric statistical approach to assess stream and river TP data against the applicable water quality criterion found in NR 102 (WisCALM 2018). This approach involves the calculation of a 90% confidence limit around the median of a TP sample dataset. If the lower 90% confidence limit (LCL) exceeds the criterion for TP, then that stream or river segment (assessment unit) is considered to be exceeding the criterion. The LCLs were calculated for each complete set of TP samples (Table 9, Figure 13 and 14). A stream is considered to be overwhelmingly exceeding the criteria when the LCL is > 0.15 mg/L TP. No indication of biological impairment, such as a poor FBI or mIBI, is needed to list a stream that overwhelmingly exceeds the TP WQC.

All 7 South and North Branches and Pigeon River Mainstem sample sets met the WQC of 0.075mg/L. Eight of the 14 tributary LCL met the WQC. A LCL was calculated for the Grady Lake outlet location for comparison; however, the streams water quality criterion does not apply. Three tributary LCL exceeded 0.075mg/L TP. Two of the 14 tributary LCL overwhelmingly exceeded (LCL of ≥ 0.15 mg/L) the water quality criterion for TP. Honey Creek (WBIC 5016138), the Unnamed Tributary to the South Branch of the Pigeon River (WBIC 295800), and the Unnamed Tributary to Pigeon Lake (WBIC 5015231) have been proposed for the 2018 CWA 303d IWL due to the pollutant phosphorus. The Unnamed Tributary to the North Branch of the Pigeon River (WBIC 3000102) will be recommended for the 2020 CWA 303d IWL. The Pigeon River from the confluence of the North and South Branches down to its discharge into the Embarrass River is on the 2016 303d IWL for the pollutant phosphorus. The LCL calculated based upon the 2015 samples from the Pigeon River at Klemm Rd met the 0.075mg/L WQC. To delist the Pigeon River, both the median (0.080 mg/L in 2015) and the Upper Confidence Limit (0.117 mg/L in 2015) would need to be below 0.075 mg/L. The Pigeon River will remain on the 2018 CWA 303d IWL.



Photo 6. Unnamed Trib to N Br Pigeon River at Gruenstern Rd Photo taken by D. Bolha on 5/5/2016

Figure 11: Total Phosphorus Concentrations and Averages of Samples Collected in the North and South Branches and the Pigeon River Mainstem (with 0.075 mg/L WQC red line).

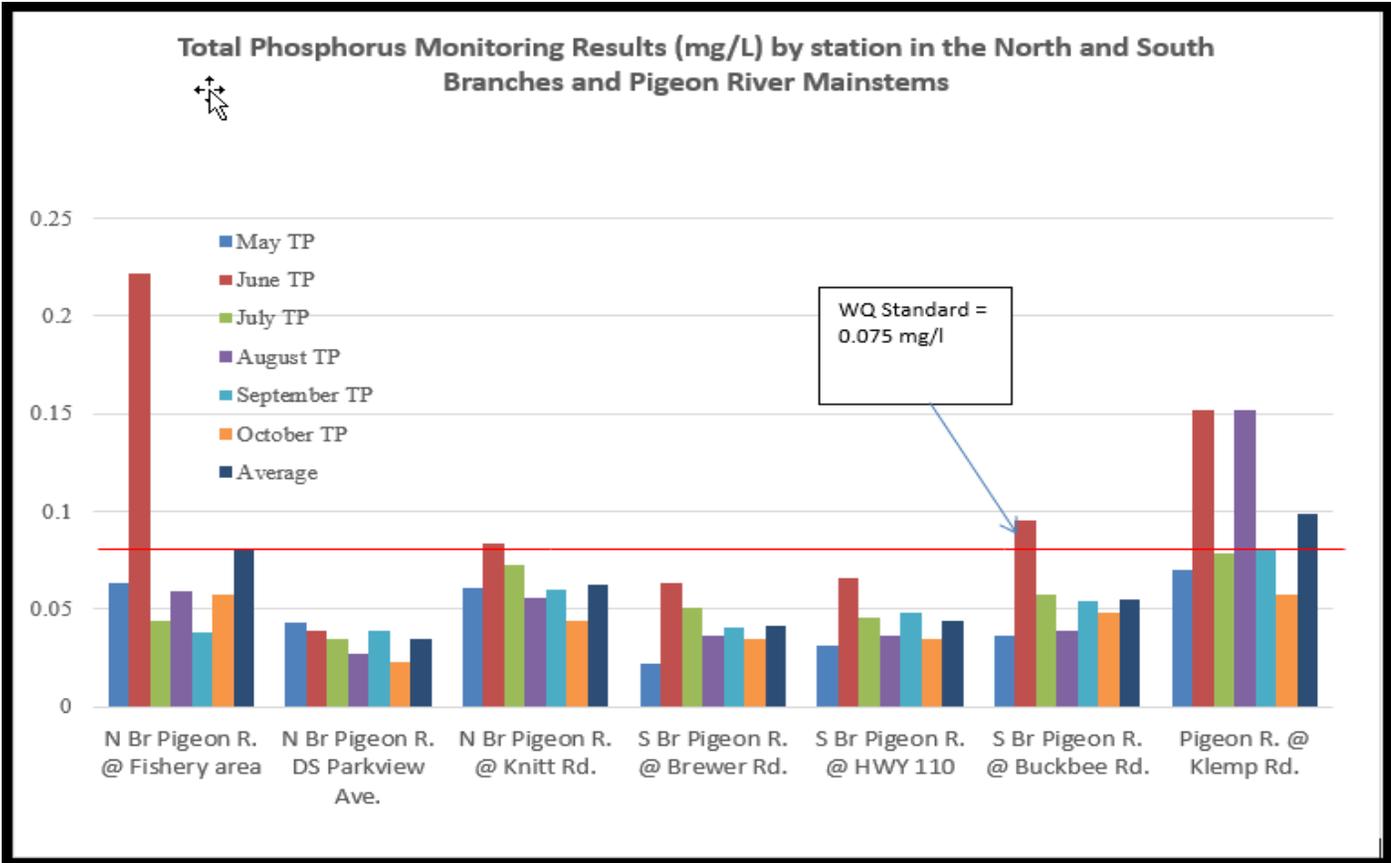


Photo 7. South Branch Pigeon River at Brewer Road.
 Photo by David Bolha, East District Water Quality Biologist, WDNR.
 Photo taken on September 9, 2015.

Figure 12: Total Phosphorus and Averages of Samples Collected in Tributaries of Pigeon River Watershed (with 0.075 mg/L WQC red line).

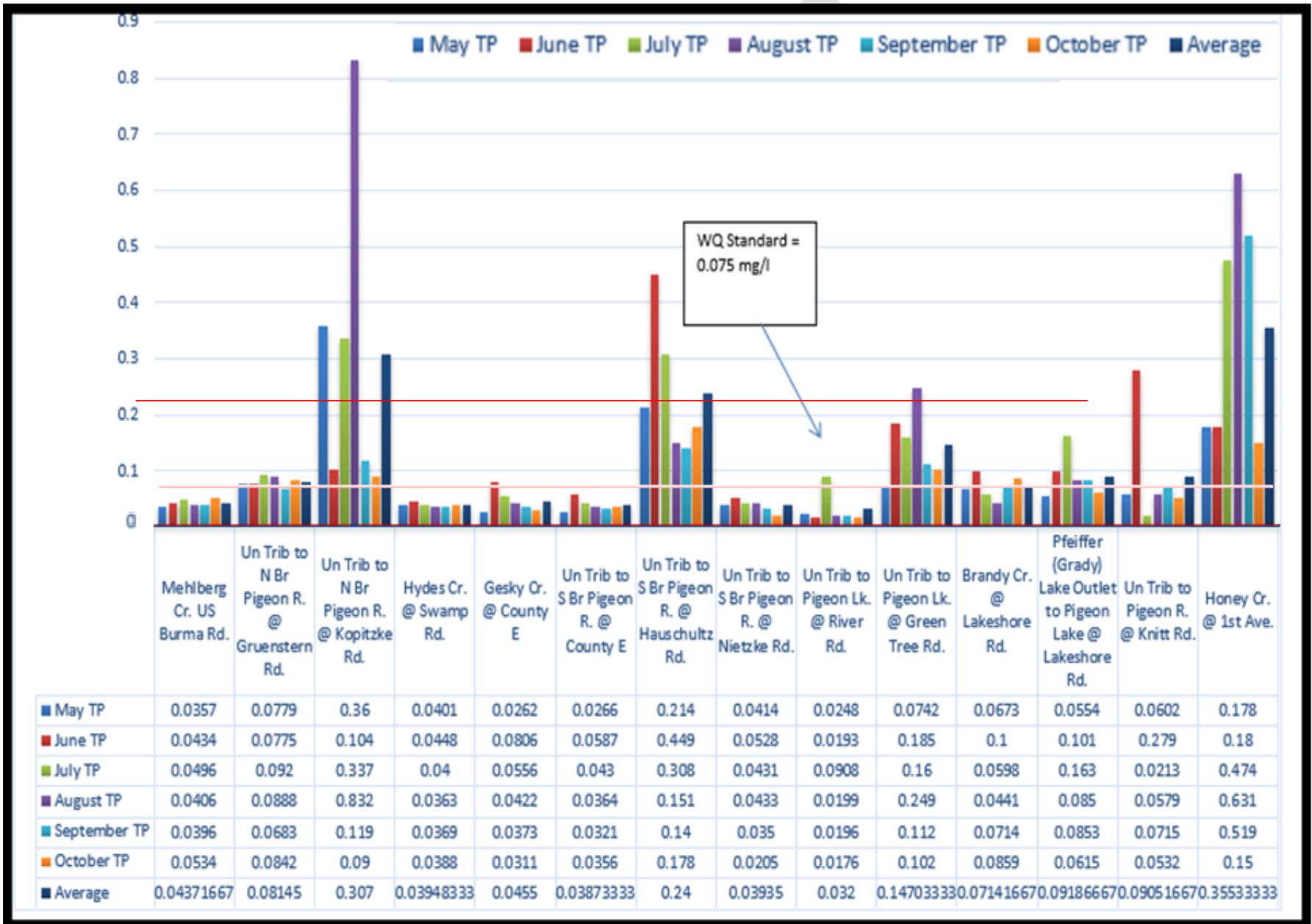


Figure 13: Waterbodies with Total Phosphorus Lower 90% Confidence Limits in the North and South Branches and Pigeon River Mainstem. Red line indicates the NR 102 WQC for Total Phosphorus.

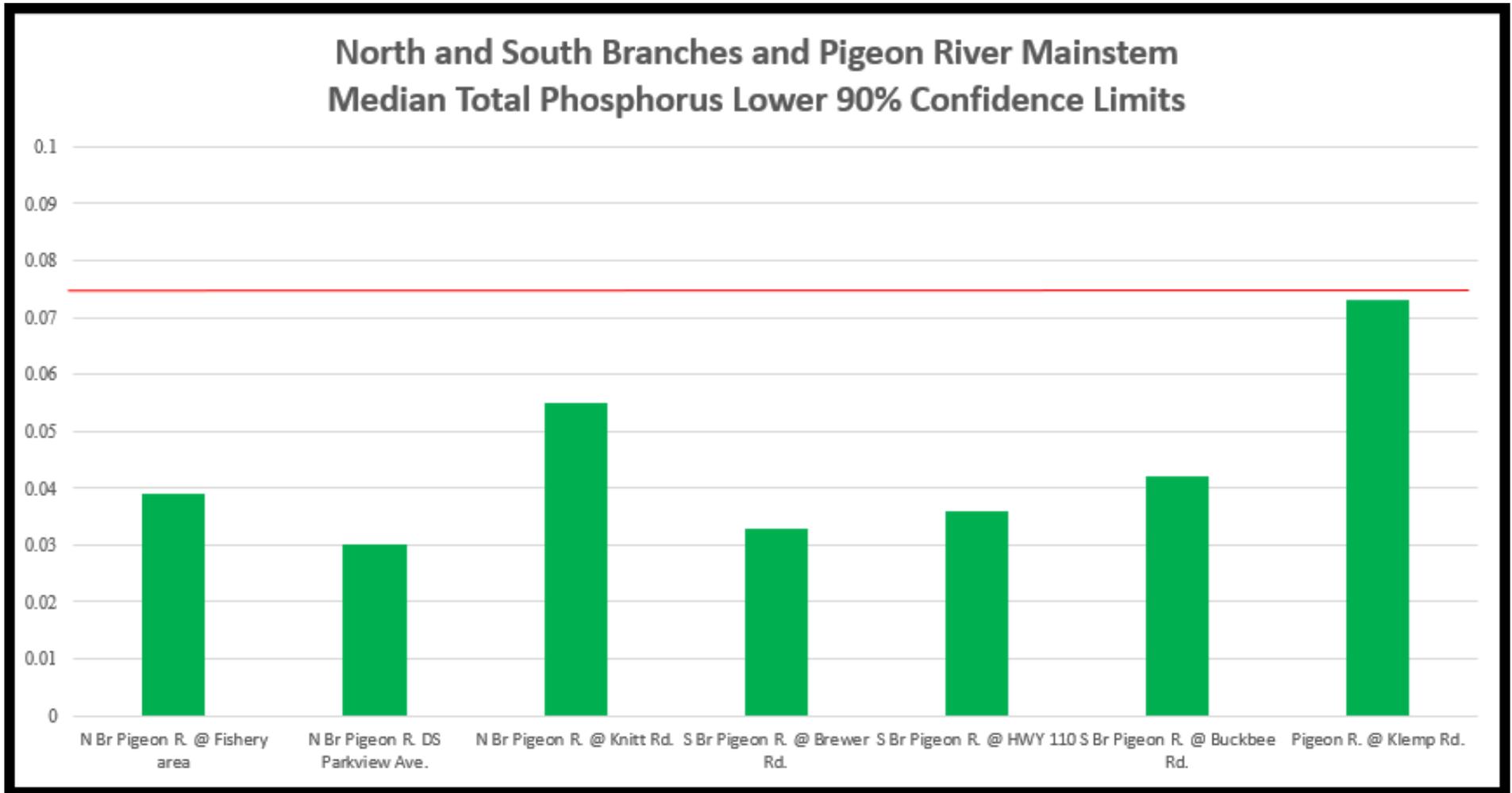
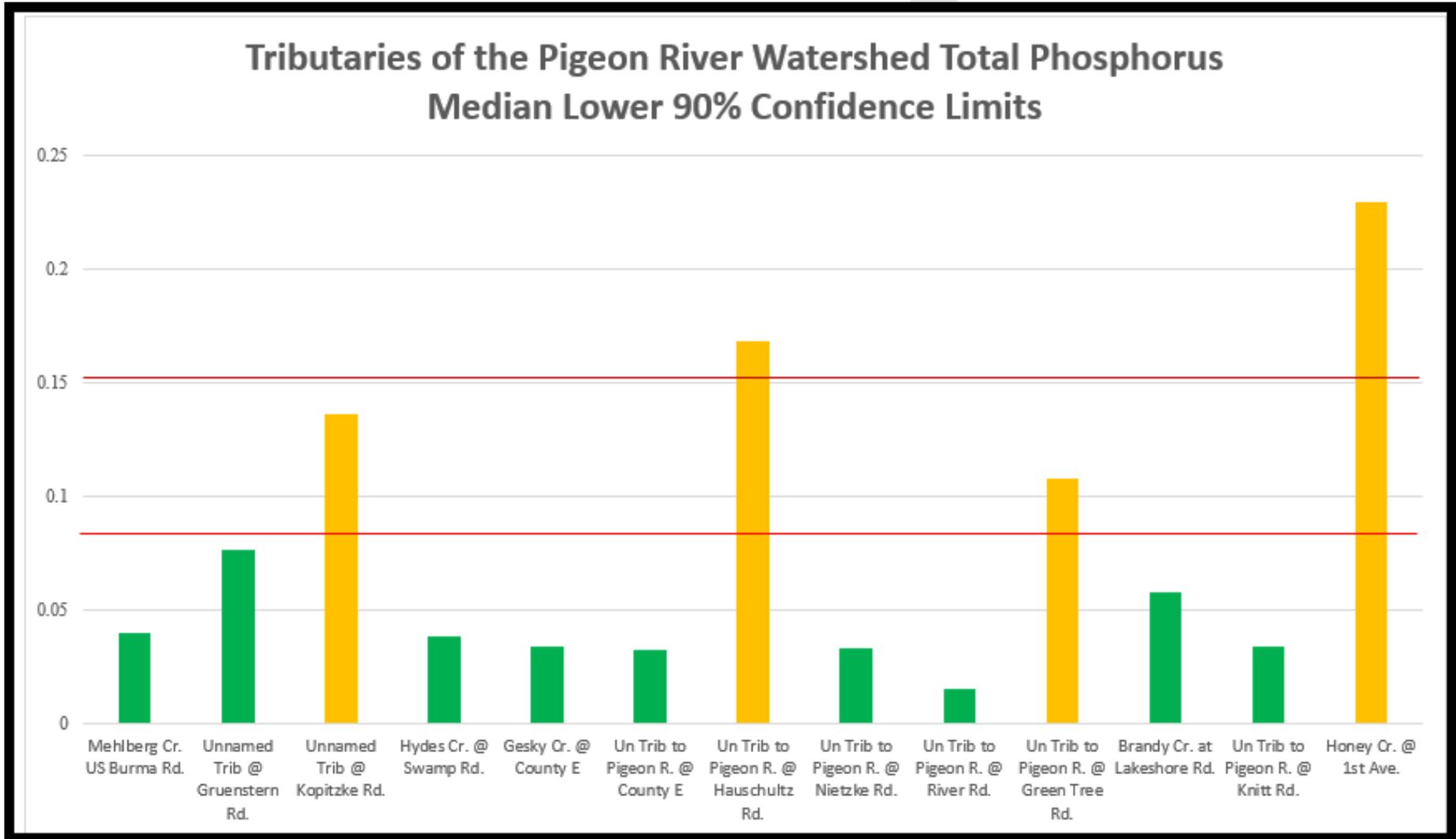


Figure 14: Total Phosphorus Lower 90% Confidence Limits in the Pigeon River Tributaries. Red line indicates the NR 102 WQC for Total Phosphorus. Maroon line indicates level of overwhelming exceedance of NR 102 WQC for Total Phosphorus.¹



¹ For rivers and streams, an “overwhelming exceedance” is defined as 2 times the total phosphorus water quality criteria.

Macroinvertebrate Data

The macroinvertebrate IBI has shown the combination of watershed land cover and local riparian and instream conditions strongly influence one another (Weigel, 2003). Aquatic macroinvertebrate communities were sampled at 19 locations between October 2015 and 2016 (Table 4). Some aquatic macroinvertebrate species are tolerant of environmental degradation, while some species are moderately tolerant, and some others are intolerant.

Based upon the representative macroinvertebrate sample collected and their associated tolerance to environmental degradation, a Macroinvertebrate Index of Biotic Integrity (MIBI) was calculated to indicate the water quality condition of the stream or river (Table 6, Figure 15 and 16). In general, the higher the MIBI score, the better the water quality rating for a waterbody.

The MIBI scores ranged from 1.59 in Honey Creek at 1st Ave to 7.85 in Hydes Creek at Swamp Rd. The Condition Categories for the 19 sites ranged from Poor to Excellent. The North and South Branches and Pigeon River Mainstem samples demonstrated a macroinvertebrate community that ranged from some slight to significant apparent impact from environmental degradation. The 12 tributary macroinvertebrate communities indicated no apparent to significant impact from environmental degradation. Ten of the 19 locations indicate a Condition Category of Good, while 7 indicate a Condition Category of Fair. Honey Creek and the North Branch of the Pigeon River in Marion indicate a water quality Condition Category of Poor based upon the macroinvertebrates collected.

Figure 15: Aquatic Macroinvertebrate Index of Biotic Integrity Scores and Condition Mainstem and Branches

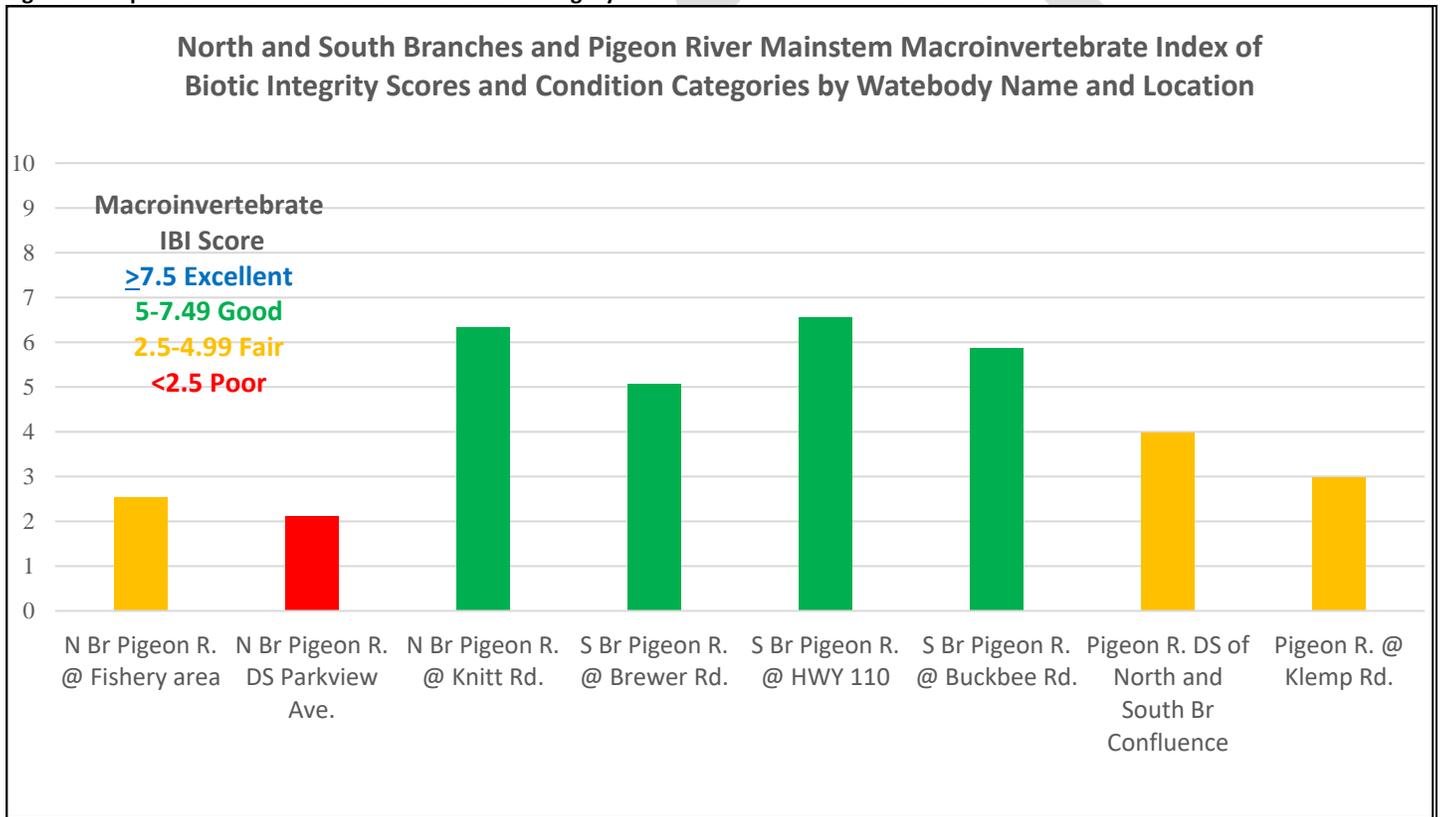
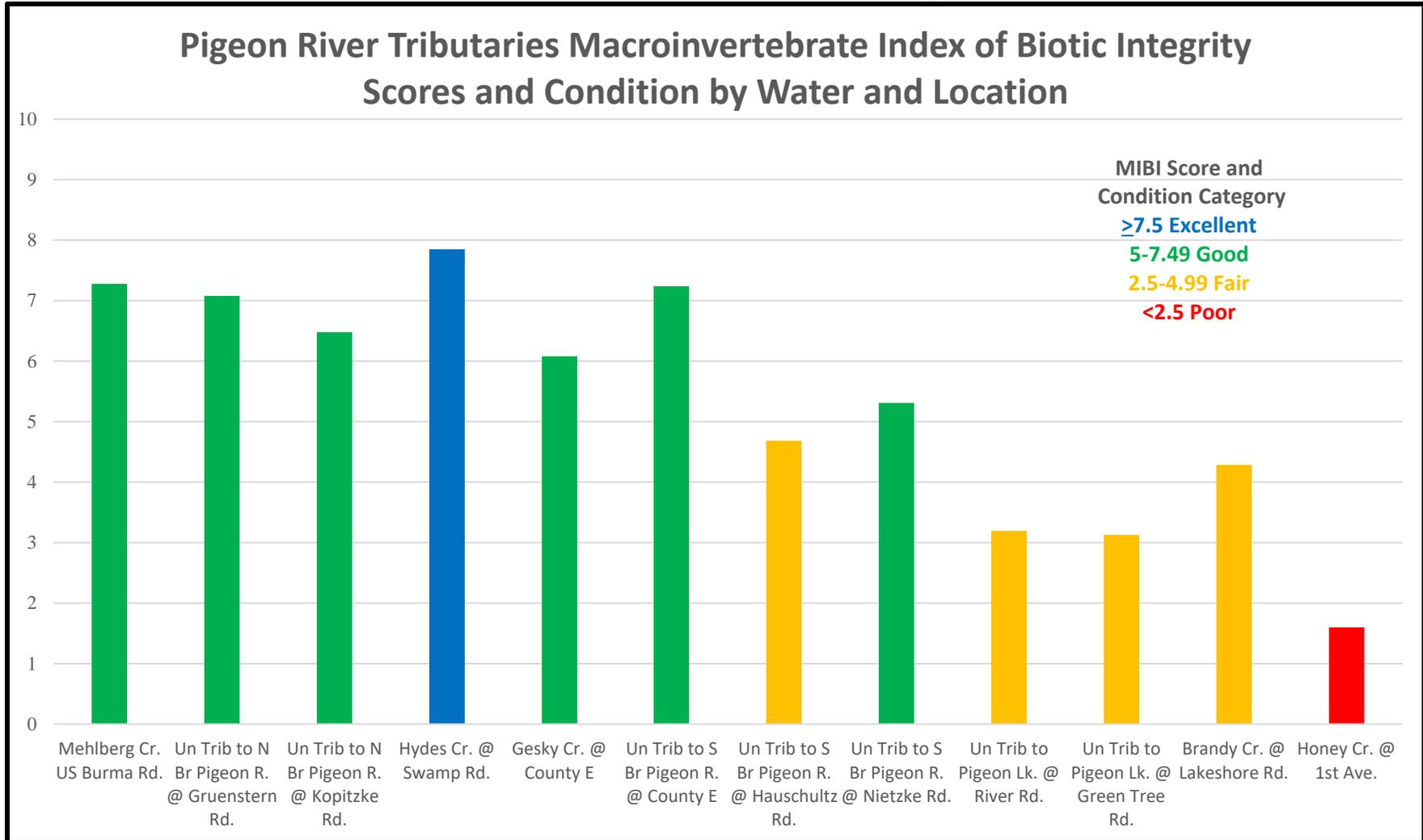


Figure 16: Aquatic Macroinvertebrate Index of Biotic Integrity Scores and Water Quality Condition Category



Natural Community Analysis

DNR uses a flow and temperature model to predict attainable uses for streams in the state. This model is reviewed through a process of evaluating fish assemblage against the expected fish species associated with the natural community modeled for that site.

This modeled decision verification process involves results in a determination of which fish index of biological integrity to use to obtain a condition status decision for the water. The details for this process are outlined in the state’s Wisconsin Consolidated Assessment and Listing Methodology (WisCALM 2018), which was developed using protocols explained in Lyons, 2013 and Natural Community Validation tools created by Lyons and Minahan (2017).

Each fish community survey was used to verify the modeled Natural Community for that stream segment. If the modeled natural community was found incorrect, natural community decision tools were used to identify the appropriate community and associated fish IBI condition information.

Each of the 10 tributary streams’ Natural Community was verified or changed based upon the fish caught in the survey (and any historical known surveys in that stream segment). The results of the FIBI condition decisions are displayed in Table 7 and Figure 17. The model resulted in fair accurate results for natural communities in this watershed.

Fish Index of Biological Integrity

Between June and September 2015 and 2016, 16 locations in the watershed were surveyed for representative fish communities. Some fish species are tolerant of environmental degradation, while some species are moderately tolerant, and some others are intolerant. Based upon the representative fish collected during the survey and their associated tolerance to environmental degradation, an Index of Biotic Integrity (FIBI) was calculated to indicate the water quality of each creek or river (Table 7, Figure 17). The FIBI scores ranged from 40 (Fair) in Brandy Creek to 100 (Excellent) in the North and South Branches of the Pigeon River and Geskey Creek. The Condition for the 16 sites ranged from Fair to Excellent.

All 6 fish surveys in the North and South Branches and the Pigeon River Mainstems indicate excellent, condition with the FIBI scores ranging from 75 to 100. Three of the 10 tributary sites demonstrated a condition of excellent. Four of the tributaries had a condition of good while the remaining 3 sites had a condition fair based upon the fish surveys.

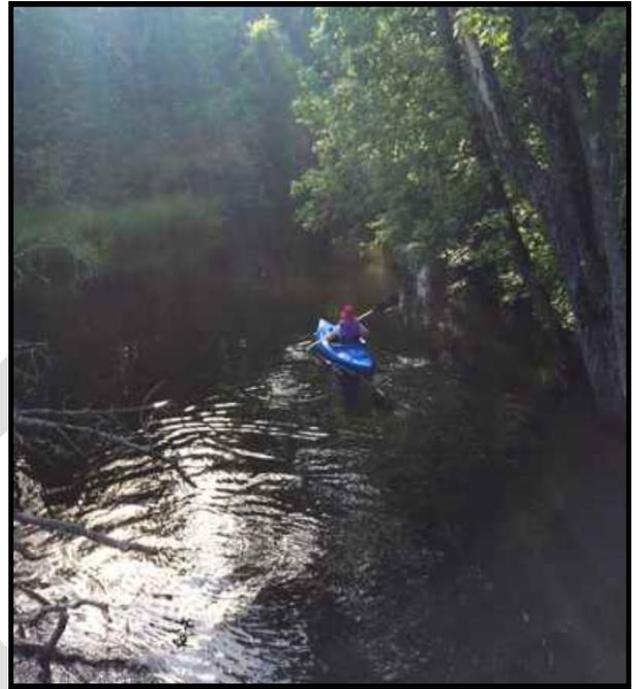


Photo 8.: Pigeon River. Photo by the Wisconsin Department of Tourism.



Photo 9. North Branch Pigeon River Downstream Park Avenue, 2016.

Photo by Dave Bolha, East District Water Quality Biologist, Wisconsin Department of Natural Resources

Figure 17: Fish Index of Biotic Integrity Scores and Condition Categories in the Pigeon River Watershed.

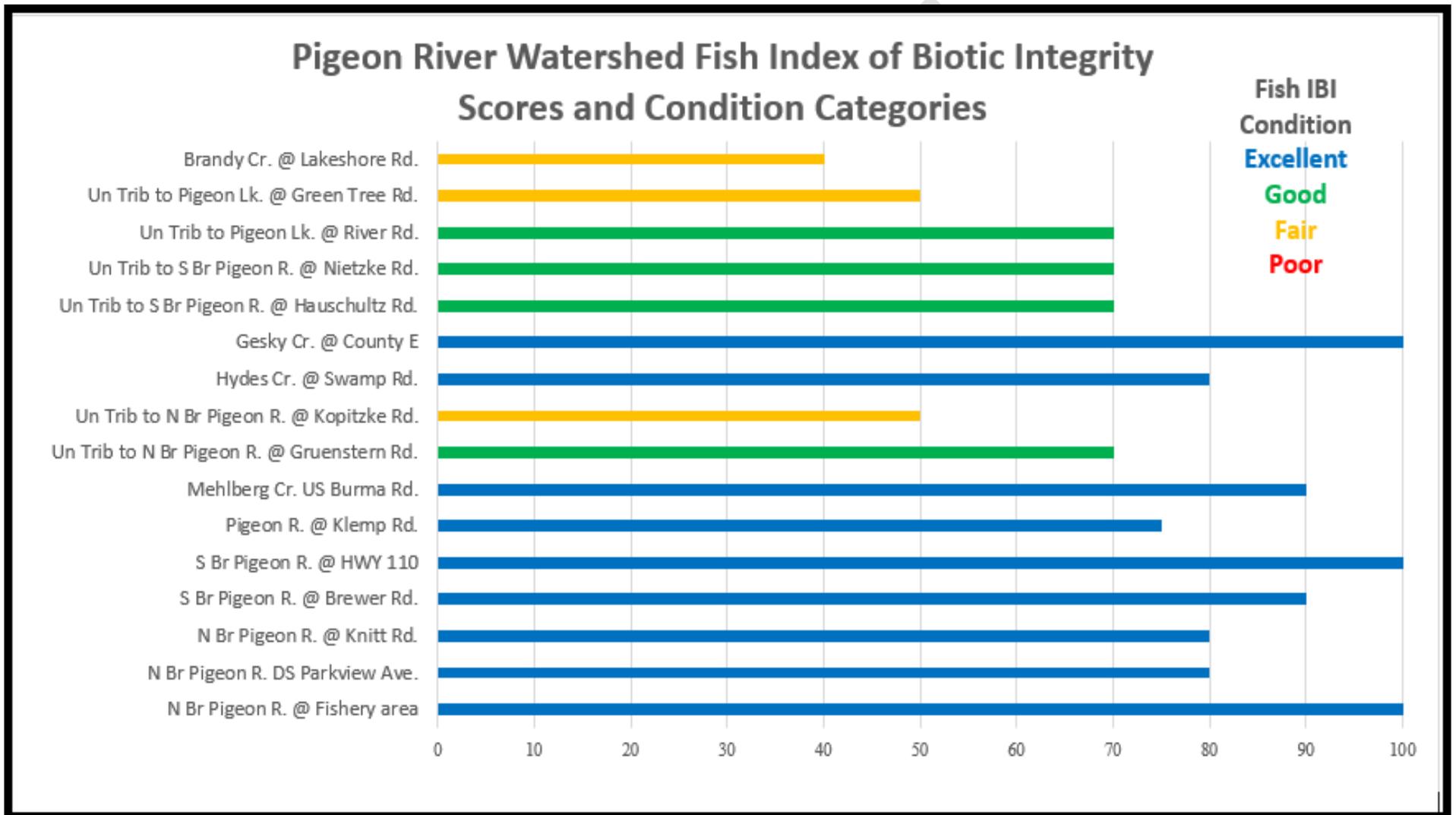
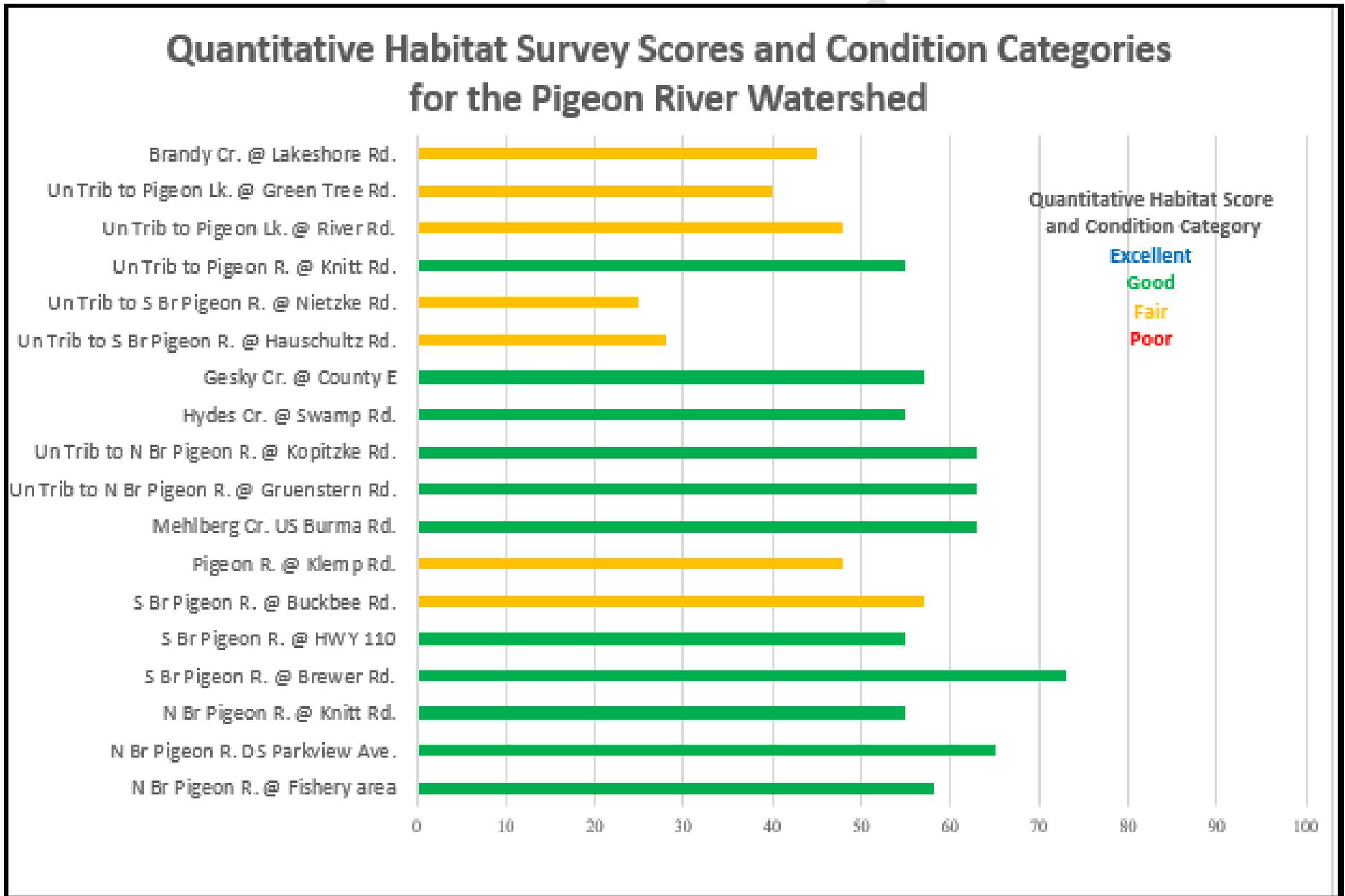


Figure 18. Quantitative Habitat Survey Scores and Condition Categories for the Pigeon River Watershed.



Temperature Results

Water temperature data in Fahrenheit (F) was collected at 19 locations in the Pigeon River Watershed between 2015 and 2016 (Table 9, Figure 19 and 20). Monthly average temperatures were reported for months with complete data only. The average monthly temperatures ranged from 52.5F in the Unnamed Tributary to the North Branch of the Pigeon River at Kopitzke Rd in July to 77.4F in the North Branch of the Pigeon River downstream of Parkview Ave in August. The Maximum Daily Averages (MDM) of the North and South Branches of the Pigeon River ranged from 66.2F in the North Branch of the Pigeon River at the Doty Creek Fishery Area to 81.2F in the North Branch of the Pigeon River downstream of Parkview Ave. The MDM of the Tributaries of the Pigeon Watershed ranged from 61.6F in the Unnamed Tributary to the North Branch of the Pigeon River at Kopitzke Rd to 72.3F Unnamed Tributary to the North Branch of the Pigeon River at Gruenstern Rd.

Figure 19: Graph of Monthly Average and Maximum Daily Average Temperatures in the North and South Branches of the Pigeon River.

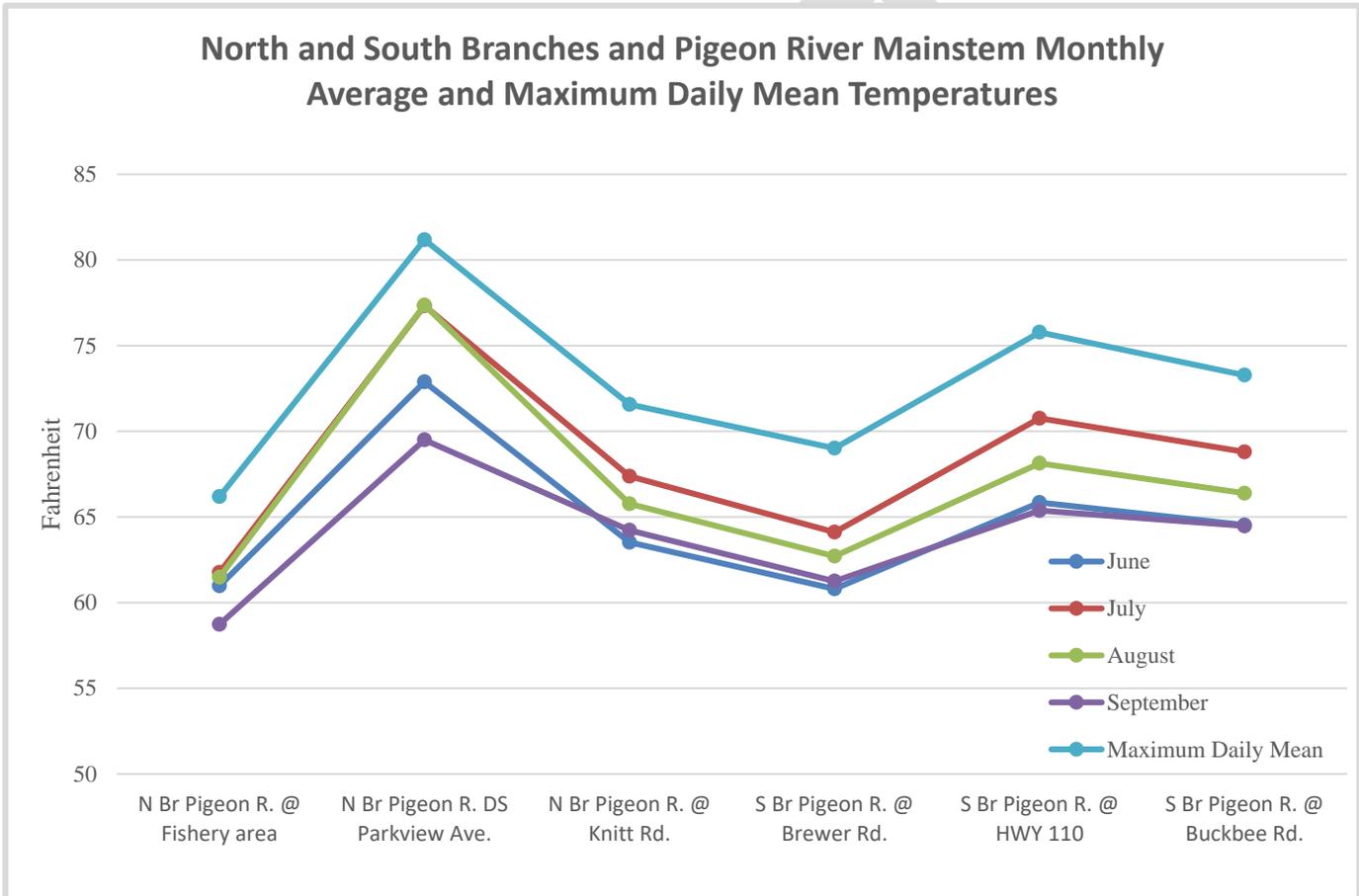
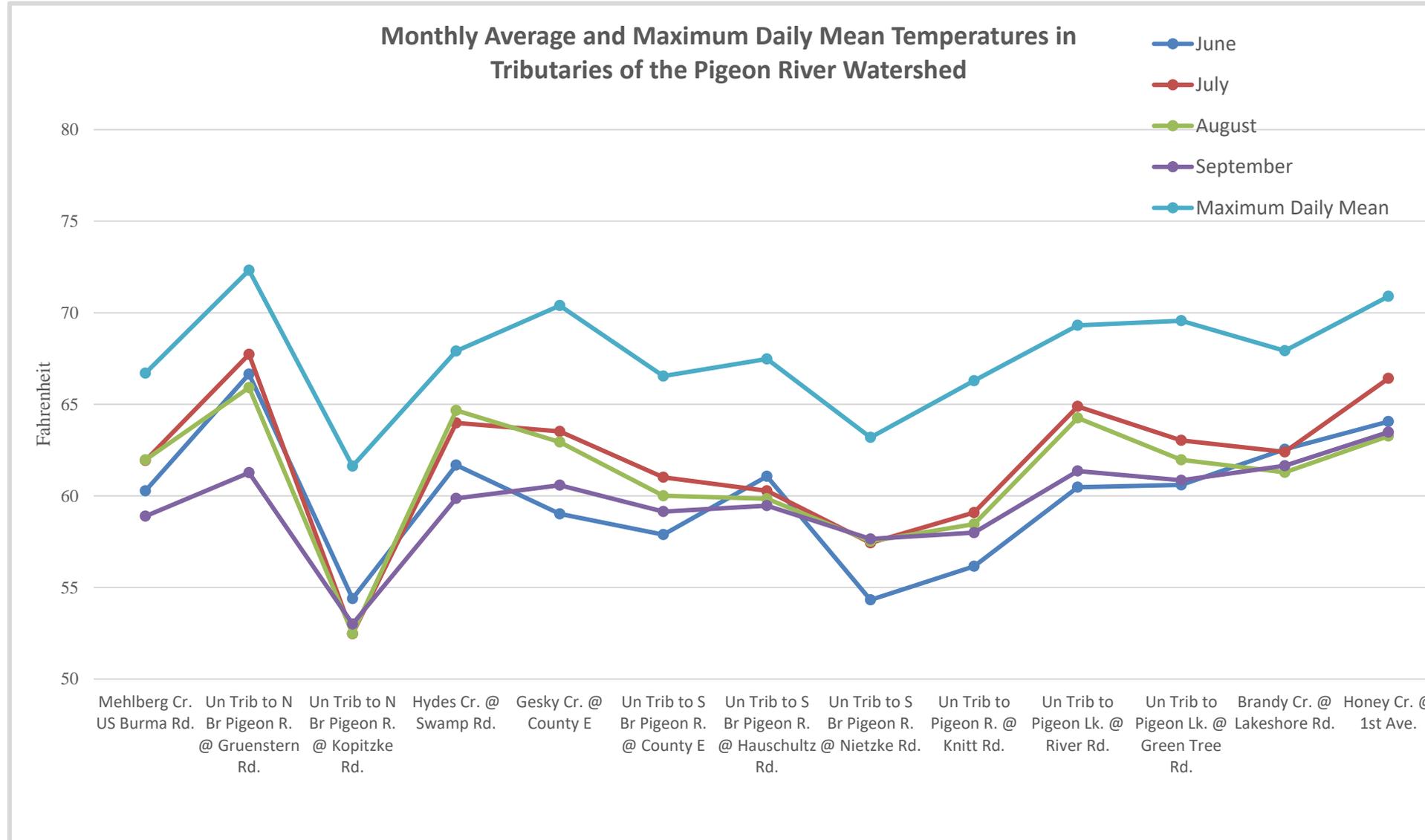


Figure 20: Graph of Monthly Average and Maximum Daily Average Temperatures in the Tributaries of the Pigeon River Watershed.



Management Actions

Management Priorities

- Reduce the transportation of phosphorus and sediment by implementing Best Management Practices such as streamside buffer strips, nutrient management, conservation tillage, cover crops, manure storage and barnyard runoff practices, and streambank and wetland restorations.
- Reduce the thermal impacts from impoundments to the North Branch of the Pigeon River and the Pigeon River.
- Preserve the Good to Excellent water quality and biotic communities of Geskey, Mehlberg, and Hydes Creeks, and the Unnamed Tributaries WBIC 297400 and 295700.
- Continue to conduct water quality monitoring of the Pigeon Lake and River and Honey Creek to understand the role each have in the water quality of the River.

Management Goals

- Delist the Pigeon River and three Unnamed Tributaries within the watershed as Impaired due to the pollutant Phosphorus.
- Delist the North Branch of the Pigeon River as Impaired due to the pollutant Temperature.
- Complete the Drafting and Implementation of EPA-Approved 9 Key Element Plans for the three HUC 12 Watersheds within the Pigeon River Watershed.

Monitoring and Assessment Recommendations

- Conduct temperature, nutrient, aquatic plant, habitat, and aquatic biota monitoring in Pigeon Lake and River and Honey Creek.
- Conduct nutrient, habitat, and aquatic biota monitoring in three Unnamed Tributaries (WBIC 5016138, 5015231, 295800).
- Conduct targeted watershed assessments of three HUC 12 watersheds at 5-year and 10-year post-9KE implementation.

Management Recommendations for DNR

- Coordinate with External Partners, such as Waupaca County LWCD and NRCS, target areas of the Pigeon River Watershed to implement BMP.
- Provide funding to External Partners for drafting and implementing 9KE Plans.
- Provide the monitoring and resources to assess the water quality influences of 9KE Plan implementation.

Management Recommendations for External Partners

- Coordinate the implementation of BMP with land owners and users within the watershed.
- Write Nine Key Element Plans for the three HUC 12 watersheds of the Pigeon River Watershed.

Appendix A: References

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Appendix B: Best management practice (BMP) locations and fish IBI conditions.

Figure 21. Map of Runoff Management Practices and Fish IBI Condition Assessment Results.

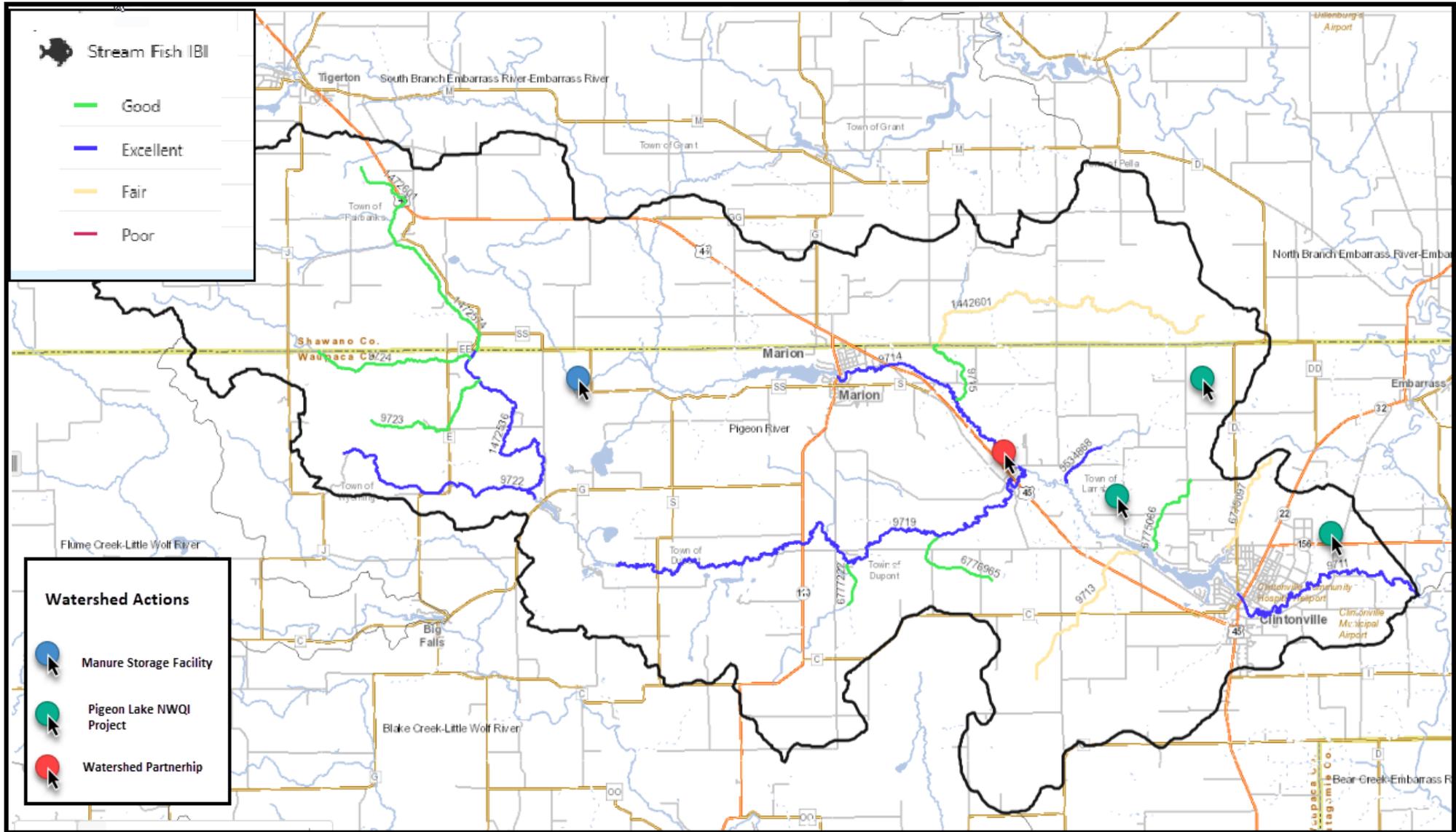


Figure 22. Locations of Best Management Practice Implementation



Appendix C: Water Narratives

Monitored in Study

Brandy Creek

Brandy Creek, in the Pigeon River Watershed, is a 3.26-mile river that falls in Waupaca County. This river is managed for fishing and swimming and is currently not considered impaired. Brandy Creek was assessed during the 2018 listing cycle; total phosphorus sample data were below the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. Available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). Temperature data did not exceed thresholds. Based on the most recent data, this water was proposed to be a Category 2 water. This water was meeting this designated use and not considered impaired.

Geskey Creek

Geskey Creek, in the Pigeon River Watershed, is a 4.03-mile river that falls in Waupaca County. This river is a Class II Trout Water under the Fisheries Program. This river is managed for fishing and swimming and is currently not considered impaired. Geskey Creek (WBIC 297200) was assessed during the 2018 listing cycle; new total phosphorus, biological (macroinvertebrate and fish Index of Biotic Integrity (IBI) scores), and temperature sample data were below the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. This water was meeting this designated use and was not considered impaired.

Unnamed Tributary to Pigeon River (Honey Creek)

The 2018 assessments of this Unnamed Tributary to the Pigeon River (WBIC 5016138) showed impairment by phosphorus; new total phosphorus sample data overwhelmingly exceeded the 2018 WisCALM listing criteria for the Fish and Aquatic Life use and biological impairment was observed (i.e. at least one macroinvertebrate Index of Biotic Integrity (IBI) scored in the "poor" condition category). Based on the most updated information, this water was proposed for the impaired waters list.

Hydes Creek

Hydes Creek is a Class II trout stream which is managed for brook trout. The habitat has been affected by silt deposits. The land use around this stream is rural agricultural and unpopulated wild lands. Hydes Creek (WBIC 294000) from the headwaters to Shawano/Waupaca county line was assessed during the 2018 listing cycle; new biological (fish Index of Biotic Integrity (IBI) scores) and temperature sample data were clearly below the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. This water meets fish and aquatic life and is not impaired.

Mehlberg Creek

Mehlberg Creek, in the Pigeon River Watershed, is a 3.05-mile river that falls in Shawano and Waupaca Counties. This river is managed for fishing and swimming and is currently not considered impaired. Mehlberg Creek (295000) was assessed during the 2018 listing cycle; new temperature sample data were clearly below the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. This water was meeting this designated use and was not considered impaired. This water has trout however a fish survey conducted to assess condition did not result in the minimum number needed to provide an updated condition score or natural community confirmation decision.

Pigeon River

The main stem of the Pigeon River is an 11-mile-long tributary to the Embarrass River. It is formed by the junction of the north and south branches of the Pigeon River in north central Waupaca County. The fishery consists of warm water sport fish and forage species. Nonpoint sources identified include sediment and nutrient problems from cropland and feedlot runoff, as well as bank erosion. An impoundment of the river near Clintonville forms Pigeon Lake.

Pigeon River (293100) was placed on the impaired waters list for total phosphorus in 2014. The 2016 assessments showed continued impairment by phosphorus; total phosphorus sample data exceeded 2016 WisCALM listing criteria for the Fish and Aquatic Life use, however, available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). Based on the most updated information, no change in existing impaired waters listing is needed.

The Pigeon River was assessed during the 2018 listing cycle; total phosphorus data nearly exceeded the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. Available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). No listing change was needed for this already impaired water.

North Branch Pigeon

The North Branch Pigeon River is a slightly stained, Class I trout stream and an Exceptional Resource Water. The river is dammed near Marion, forming the Marion Millpond. The 2018 assessments of the North Branch Pigeon River (miles 0-5.34) showed impairment by temperature; new temperature sample data exceeded the 2018 WisCALM listing criteria for the Fish and Aquatic Life use and biological impairment was observed (i.e.

at least one macroinvertebrate Index of Biotic Integrity (mIBI) scored in the poor condition category). Based on the most updated information, this water was proposed for the impaired waters list. The North Branch of the Pigeon River (reach of the N Br Pigeon River from Marion Pond inlet to the county line, also known as Doty Creek) was assessed during the 2018 listing cycle; temperature data did not exceed the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. This water is considered meeting fish and aquatic life uses. Based on the most recent temperature data, this water was proposed to be a Category 2, meeting one or more of the state's water quality standards.

South Branch Pigeon

The South Branch Pigeon River has its origin in south central Shawano County. The river is dammed in Waupaca County, forming 20-acre **Keller Lake**. The watershed is principally wetland and forested above Keller Dam and agricultural below. The stream has habitat deterioration from streambank pasturing and cropland runoff, although the severity varies from year to year as crops are rotated. The river was assessed during the 2018 listing cycle; new total phosphorus, biological (macroinvertebrate and fish Index of Biotic Integrity (IBI) scores), and temperature sample data were clearly below the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use indicating that the water meets this designated use and is not impaired.

Doty Creek - North Branch Pigeon River

The 2018 assessments of the North Branch Pigeon River (miles 0-5.34) showed impairment by temperature; new temperature sample data exceeded the 2018 WisCALM listing criteria for the Fish and Aquatic Life use and biological impairment was observed (i.e. at least one macroinvertebrate Index of Biotic Integrity (mIBI) scored in the poor condition category). Based on the most updated information, this water was proposed for the impaired waters list.

Trib to South Branch Pigeon River

(WBIC 295800) The 2018 assessments of this Unnamed Tributary to the South Branch Pigeon River (miles 0-0.72) showed impairment by phosphorus; new total phosphorus sample data overwhelmingly exceeded the 2018 WisCALM listing criteria for the Fish and Aquatic Life use. Available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). Based on the most updated information, this water was proposed for the impaired waters list.

Trib to South Branch Pigeon River

Unnamed Trib to S Br Pigeon River (WBIC **295700**) was assessed during the 2018 listing cycle; new total phosphorus, biological (macroinvertebrate and fish Index of Biotic Integrity (IBI) scores), and temperature sample data were clearly below the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. This water was meeting this designated use and was not considered impaired.

Trib to Pigeon

This Unnamed Tributary to the Pigeon River (WBIC 293800) was assessed during the 2018 listing cycle; new temperature sample data were clearly below the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. This water was meeting this designated use and was not considered impaired.

Trib to Pigeon Lake

The 2018 assessments of this Unnamed Tributary to the Pigeon River (WBIC 5015231) showed impairment by phosphorus; new total phosphorus sample data exceeded the 2018 WisCALM listing criteria for the Fish and Aquatic Life use. However, available biological data did not indicate impairment (i.e. no macroinvertebrate or fish Index of Biotic Integrity (IBI) scored in the "poor" condition category). Based on the most updated information, this water was proposed for the impaired waters list.

Marion Millpond

Marion Millpond is an impoundment of the North Branch Pigeon River. Water levels are maintained by a 16-foot dam. Natural water color is light brown. Littoral bottom materials consist of sand and silt. The pond is managed for northern pike, largemouth bass, and panfish. Northern pike, perch, largemouth bass, bluegill, black crappie, green sunfish, bullhead, and brook trout are present. Stocking is occasionally necessary to replenish fish population after a partial winterkill. The upper one-third of the pond is surrounded by marsh land supporting a large population of muskrats. Bluewing Teal are known to nest on this pond. Large numbers of migrant puddle ducks use the lake as a nesting area. Hunting is allowed outside the corporate limits. Marion Millpond, in the Pigeon River Watershed, is a 115.71-acre lake that falls in Waupaca County. This lake is managed for fishing and swimming and is currently not considered impaired.

Unnamed Tributary to Pigeon River

The 2018 assessments of this Unnamed Tributary to the Pigeon River (WBIC 5016138) showed impairment by phosphorus; new total phosphorus sample data overwhelmingly exceeded the 2018 WisCALM listing criteria for the Fish and Aquatic Life use and biological impairment was observed (i.e. at least one macroinvertebrate Index of Biotic Integrity (IBI) scored in the "poor" condition category). Based on the most updated information, this water was proposed for the impaired waters list.

Waters Outside the Project Area

Keller Lake is a hard water impoundment of the South Branch Pigeon River. Water levels are maintained by a 19-foot dam. The water is low in transparency and displays light brown color. Gravel, rock, and muck are the predominant littoral bottom types present. Fish present are largemouth bass, smallmouth bass, rock bass, sunfish, brown bullhead, brown trout, rainbow trout, and white sucker. A Waupaca County Park occupies the entire shoreline east of County Highway "G", which provides camping and picnic facilities and a boat landing. Other access is available from a boat landing. Other access is available from CTH "G" and from navigable water via the inlet and outlet. Other developments include one cottage. Filling of the basin with silt is a management problem for this lake. Source: 1971, Surface Water Resources of Waupaca County Keller Lake, T25N, R13E, Section 18, Surface Acres = 20.5, S.D.F. = 2.13, Maximum Depth = 13 feet

Kersten Lake, A medium-hard water seepage lake having slightly alkaline, clear water of moderate transparency. The entire littoral zone consists of muck. The shoreline is predominantly coniferous wetland (65 percent) with the balance being in upland of which some is pasture. The only fish reported to be present are black bullhead. Due to its shallow depth this lake is probably subject to winterkill. The lake may be of some value to nesting waterfowl. Puddle ducks and diving ducks make use of this lake on their spring and fall migrations. There is no public access. There are no developments located on the immediate shoreline. Source: 1968, Surface Water Resources of Shawano County Kersten Lake, T26N, R12E, Section 26 Surface Acres = 16.0, S.D.F. = 1.25, Maximum Depth = 4 feet

Kinney Lake, in the Pigeon River Watershed, is a 65.89-acre lake that falls in Waupaca County. This lake is managed for fishing and swimming and is currently not considered impaired. Source: 1971, Surface Water Resources of Waupaca County Kinney Lake, T25N, R13E, Sections 7, 8 Surface Acres = 83.2, S.D.F. = 1.12, Maximum Depth = 10 feet Kinney Lake is a spring and seepage fed clear, hard water basin having an intermittent outlet but no inlet. While a natural lake basin, water levels are partially maintained by a low head dam constructed in the late 1950's. Littoral bottom materials consist of marl and sand. Northern pike, perch, largemouth bass, bluegill, pumpkinseed, black bullhead, and brown bullhead, are present. Periodic severe winterkill is a major problem encountered in the management of this lake. A significant population of muskrats is found in the marsh that surrounds the lake. Mallards, bluewing teal and wood ducks nest on the lake shore. Fairly large numbers of puddle ducks and diving ducks use the lake as a rest area during spring and fall migrations. Hunting is allowed. A county owned access with parking is located on the southwest corner of the lake; There are no other developments present.

Little Lake, in the Pigeon River Watershed, is a 23.62-acre lake that falls in Waupaca County. This lake is managed for fishing and swimming and is currently not considered impaired. This is a clear, hard water, landlocked lake with occasional severe winterkills. Fish present are northern pike, perch, largemouth bass, bluegill, and black bullhead. Fingerling largemouth bass are stocked following severe winterkills. Bluewing teal are known to nest here. Migrating puddle ducks and diving ducks use the lake as a resting area. Seepage is the principle water source while marl, muck, sand, and gravel are the major littoral bottom types. There is no public access and there are no developments around the lake.

Unnamed Stream (WBIC 297400) was assessed during the 2018 listing cycle; new total phosphorus, biological (macroinvertebrate and fish Index of Biotic Integrity (IBI) scores), and temperature sample data were clearly below the 2018 WisCALM listing thresholds for the Fish and Aquatic Life use. This water was meeting this designated use and was not considered impaired.

Michael Lake, in the Pigeon River Watershed, is a 2.88-acre lake that falls in Waupaca County. This lake is managed for fishing and swimming and is currently not considered impaired.

Lembke Lake is a small, clear, hard water drained basin with a navigable outlet to Long Lake. The main water source is seepage. There is no inlet stream present. Muck is the predominate material present. This lake is managed primarily for trout. Nesting bluewing teal and a limited number of migrating diving ducks and puddle ducks use the lake. Hunting is allowed. Access is available from a town park with a landing designed to handle small boats. Developments consist of one cottage.

Outstanding and Exceptional Resource Waters

Wisconsin has designated many of the state’s highest quality waters as Outstanding Resource Waters (ORWs) or Exceptional Resource Waters (ERWs). Waters designated as ORW or ERW are surface waters which provide outstanding recreational opportunities, support valuable fisheries and wildlife habitat, have good water quality, and are not significantly impacted by human activities. ORW and ERW status identifies waters that the State of Wisconsin has determined warrant additional protection from the effects of pollution.

Table 10: Pigeon River Watershed Outstanding/Exceptional Resource Waters.

Name	Local Name	WBIC	ORW/ERW	Start Mile	End Mile	Code Reference	Counties	Watersheds
Hydes Creek	Hydes Creek	294000	ERW	0	1.49	102.11(1)(a)	Waupaca	WR10
North Branch Pigeon River	Doty Creek	293900	ERW	6.88	11.4	102.11(1)(a)	Waupaca	WR10
South Branch Pigeon River	South Branch Pigeon River	295600	ERW	14.6	22	102.11(1)(a)	Waupaca	WR10
South Branch Pigeon River	South Branch Pigeon River	295600	ERW	22	24	102.11(1)(a)	Shawano	WR10
Split Rock Creek	Split Rock Creek	297700	ERW	0	1.64	102.11(1)(a)	Shawano	WR10
Unnamed	Un Creek 15-2 (T26n-R12e-S15)	306400	ERW	0	2.05	102.11(1)(a)	Shawano	WR10,WR11
Unnamed	Creek 28-14 (T26n, R12e)	297750	ERW	0	0.57	102.11(1)(a)	Shawano	WR10
Unnamed	Creek 2-1 (T25n R12e)	297500	ERW	0	0.64	102.11(1)(a)	Shawano	WR10
Unnamed	Creek 28-9 (T26n R12e)	3000283	ERW	0	1.75	102.11(1)(a)	Shawano	WR10
Unnamed	Creek 2-1 (T25n R12e)	297400	ERW	3.08	5.4	102.11(1)(a)	Shawano, Waupaca	WR10

Trout Waters

DNR classifies and lists all trout streams online. New waters are monitored and identified or evaluated every year. Trout waters in this watershed are listed in Table 2. High quality trout waters (Class I) have sufficient natural reproduction to sustain populations of wild trout, at or near carry capacity. Class II streams may have some natural reproduction, but not enough to utilize available food and space. Stocking is required to maintain a desirable sport fishery but these streams have good survival and carryover of adult trout, often producing some fish larger than average size. Class III are marginal trout habitat with no natural reproduction occurring. There is no carryover of trout from one year to the next.

Table 11: Watershed Trout Streams in Pigeon River Watershed (WR10).

Waterbody Name	WBIC	Start Mile	End Mile	Trout Class
Hydes Creek	294000	0	1.49	CLASS I
Hydes Creek	294000	1.5	8.73	CLASS II
Creek 28-14 (T26n, R12e)	297750	0	0.52	CLASS I
Creek 28-9 (T26n R12e)	3000283	0	1.77	CLASS I
Doty Creek	293900	6.88	11.41	CLASS I
Geskey Creek	297200	0	4.03	CLASS II
North Branch Pigeon River	293900	0	5.34	CLASS II
North Branch Pigeon River	293900	11.78	16.64	CLASS II
South Branch Pigeon River	295600	12.31	14.08	CLASS II
South Branch Pigeon River	295600	14.59	24	CLASS I
Split Rock Creek	297700	0	1.64	CLASS I
Un Creek 27-2 (T26n-R12e-S27)	297800	0	1.14	CLASS I

Impaired Waters

Section 303(d) of the Clean Water Act requires states to publish a list of waters that do not meet water quality standards. This list reflects waters that are newly added or removed based on new information. Pigeon River is listed for excess Total Phosphorus (exceeding water quality standards) (Table 3).

Table 12: Impaired Waters in Pigeon River watershed.

Local Name	WBIC	Start	End	Pollutant	Impairment	Sources	Status
Pigeon River	293100	0	11	Total Phosphorus	Unknown	Non-Point Source (Rural or Urban)	TMDL Development
Honey Creek	5016138	0	1.85	Total Phosphorus	Degraded Biological Community	Non-Point Source (Rural or Urban)	TMDL Development
Unnamed Tributary to S. Br. Pigeon River	295800	0	0.72	Total Phosphorus	High Phosphorus Levels	Non-Point Source (Rural or Urban)	TMDL Development
N. Branch Pigeon River	293900	0	5.34	Unknown Pollutant	Degraded Biological Community, Elevated Water Temperature	Non-Point Source (Rural or Urban)	TMDL Development
Unnamed Tributary to Pigeon River	5015231	0	1.80	Total Phosphorus	Impairment Unknown	Non-Point Source (Rural or Urban)	TMDL Development



Fisheries Biologists conduct stream survey on Hydes Creek, Waupaca, 2013. Photo Courtesy of Al Neibur, Wisconsin DNR.

Appendix D: Water Quality Standards Assessment Table

Table 13: Water Quality Standards Use Attainment Table, Fish and Aquatic Life – Pigeon River Watershed

WBIC	Local Waterbody Name	Start Mile	End Mile	Current Use	Attainable Use	Supporting Attainable Use	Designated Use	Assessment	Qual	DNR Category
293100	Pigeon River	0	5.23	WWSF	WWSF	Not Supporting	WWFF	Monitored	P4, B1, B3, H2	Category 4A
293100	Pigeon River	7.71	10.7	WWSF	WWSF	Not Supporting	WWFF	Monitored	P4, B1, B3, H2	Category 4A
293300	Pigeon Lake	0	173.01	Reservoir	FAL	Supporting	Default FAL	Monitored	P1, B2	Category 2
293700	Brandy Creek	0	3.26	FAL	FAL	Fully Supporting	Default FAL	Monitored	B1, P3	Category 2
293800	Unnamed Trib to Pigeon R	0	0.88	FAL	FAL	Fully Supporting	Default FAL	Monitored	B3	Category 2
293900	North Branch Pigeon River	0	5.34	Cold (Class II Trout)	Cold (Class II Trout)	Not Supporting	Cold	Monitored	P4, B1, P3, B3, B2, H2	Category 5A
293900	Doty Creek	6.88	11.41	Cold (Class II Trout)	Cold (Class II Trout)	Fully Supporting	Cold	Monitored	P3	Category 2
293900	North Branch Pigeon River	11.78	16.64	Cold (Class II Trout)	Cold (Class II Trout)	Supporting	Cold	Monitored	B2	Category 2
294000	Hydes Creek	0	1.49	Cold (Class I Trout)	Cold (Class I Trout)	Supporting	Cold	Monitored	B1, H1	Category 2
294000	Hydes Creek	1.5	8.73	Cold (Class II Trout)	Cold (Class II Trout)	Fully Supporting	Cold	Monitored	B1, P3, B3	Category 2
294500	Marion Millpond	0	115.71	Reservoir	FAL	Supporting	Default FAL	Monitored	P1, B2	Category 2
294700	Un Trib to N Br Pigeon R	0	1.47	FAL	FAL	Fully Supporting	Default FAL	Monitored	P3	Category 2
295000	Mehlberg Creek	0	3.05	Cold (Class I Trout)	Cold (Class I Trout)	Fully Supporting	Cold	Monitored	B1, H1, P3	Category 2
295600	South Branch Pigeon River	0	12.31	WWSF	WWSF	Fully Supporting	Default FAL	Monitored	P4, B1, B3, H2	Category 2
295600	South Branch Pigeon River	12.31	14.08	Cold (Class II Trout)	Cold (Class II Trout)	Not Assessed	Cold	Evaluated: Watershed Tables	P4, B1, B3, H2	Category 3
295600	South Branch Pigeon River	14.59	19.49	Cold (Class I Trout)	Cold (Class I Trout)	Fully Supporting	Cold	Monitored	P4, B1, B3, H2	Category 2
295600	South Branch Pigeon River	19.49	22.03	Cold (Class I Trout)	Cold (Class I Trout)	Fully Supporting	Cold	Monitored	B1, B3	Category 2
295600	South Branch Pigeon River	22.03	24	Cold (Class I Trout)	Cold (Class I Trout)	Supporting	Cold	Monitored	B1, B3	Category 2
295700	Unnamed Trib to S Br Pigeon River	0	1.56	FAL	FAL	Fully Supporting	Default FAL	Monitored	P3, B3	Category 2
295800	Unnamed Trib to S Br Pigeon River	0	0.72	FAL	FAL	Not Supporting	Default FAL	Monitored	P3, B3	Category 4A
297200	Geskey Creek	0	4.03	Cold (Class II Trout)	Cold (Class II Trout)	Fully Supporting	Cold	Monitored	B1, H1, P3	Category 2

WBIC	Local Waterbody Name	Start Mile	End Mile	Current Use	Attainable Use	Supporting Attainable Use	Designated Use	Assessment	Qual	DNR Category
297300	Pigeon River-S. Fork, S. Branch	0	3	Cold	Cold	Fully Supporting	FAL Coldwater	Monitored	B1, H1, B3	Category 2
297400	Un Creek (T25n-R12e-S02)	0	3.08	FAL	FAL	Fully Supporting	Default FAL	Monitored	B1, P3, B3	Category 2
297400	Creek 2-1 (T25n R12e)	3.08	5.4	FAL	FAL	Supporting	Cold	Monitored	B1	Category 2
297700	Split Rock Creek	0	1.64	Cold (Class I Trout)	Cold (Class I Trout)	Not Assessed	Cold	Evaluated: Watershed Tables	B1, H1	Category 3
297750	Creek 28-14 (T26n, R12e)	0	0.57	FAL	FAL	Not Assessed	Cold	No Assessment on File	B1	Category 3
297800	Un Creek 27-2 (T26n-R12e-S27)	0	1.15	Cold (Class I Trout)	Cold (Class I Trout)	Not Assessed	Cold	No Assessment on File	B1	Category 3
306400	Un Creek 15-2 (T26n-R12e-S15)	0	2.05	Cold (Class I Trout)	Cold (Class I Trout)	Not Assessed	Cold	No Assessment on File	B1	Category 3
3000102	Unnamed Trib to N Br Pigeon River	0	3.38	FAL	FAL	Not Supporting	Default FAL	Monitored	P3	Category 5P
5015231	Unnamed Trib to Pigeon River	0	1.8	FAL	FAL	Not Supporting	Default FAL	Monitored	P3, B3	Category 4A
5015321	Unnamed Trib to Pigeon Lake	0	1.51	FAL	FAL	Fully Supporting	Default FAL	Monitored	P3, B3	Category 2
5016138	Unnamed Trib to Pigeon River	0	1.85	FAL	FAL	Not Supporting	Default FAL	Monitored	P3, B3	Category 4A

This table reflects the condition of waters in the study area watershed. This table data is stored in the Water Assessment Tracking and Electronic Reporting System (WATERS) and is updated on an ongoing basis via monitoring data and assessment calculations.

Current Use – current condition of water based on monitoring data.

Attainable Use – “ecological potential” of water based on water type, natural community, lack of human-induced disturbances.

Supporting Use – decision on whether the water’s current condition is supporting its designated use under “water quality standards”.

Designated Use – the water’s classified use under NR102, Wisconsin Water Quality Standards, for Fish and Aquatic Life.

Assessment – field indicates what type of data or information supports the decisions in the table (current, attainable, and supporting attainable).

Data Quality – Specific data areas used for the decision (see below)

- P –Physical
- B – Biological
- C – Chemistry
- H – Habitat
- PA – Pathogen

Range 1-4 (1 – lowest level, 4 most sophisticated data collection)

DNR Category Is water meeting or not meeting standards

Category 2: Water meets at least 1 WQ standard,

Category 3: Insufficient data,

Category 4A: Water is impaired, TMDL in progress,

Category 5A: Water is impaired, TMDL required.

Category 5P: Water that has total phosphorus levels that exceed the State water quality standard but which currently do not exhibit biological impairment