Implementation Progress Report

2017 – 2019

Wisconsin's Nutrient Reduction Strategy

April 2020
Environmental Management
Wisconsin DNR

EGAD # 3200-2020-15

The original Nutrient Reduction Strategy (2013) was developed by the Department of Natural Resources with contractual assistance from the University of Wisconsin – Extension. This Implementation Progress Report provides information on progress achieved since the publication of the original work. Substantial input from WDNR staff and individuals in federal, state and local agencies was provided both for the original and this Implementation Progress Report. To keep the document to a reasonable size, programs and activities are not described in detail. For more information, the reader is encouraged to go to websites identified in the text.

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Introduction

In November 2013, the Wisconsin Department of Natural Resources issued "Wisconsin's Nutrient Reduction Strategy" on behalf of state, federal and local agencies in Wisconsin that are involved in managing phosphorus and nitrogen losses to water. Wisconsin, like all states in the Mississippi River basin, had agreed to develop and implement a nutrient reduction strategy to address its contribution to Gulf of Mexico hypoxia (consistent with the *Gulf of Mexico Hypoxia Action Plan 2008*). However, Wisconsin's main objective in minimizing nutrient losses to water is to improve lakes, rivers, streams and groundwater within the state. Like other states in the Mississippi River basin, implementation of the Nutrient Reduction Strategy is occurring mainly through existing programs which have catalyzed municipalities, farmers, landowners, technical assistance providers and concerned citizens to collaborate in addressing water quality problems in their own watersheds. The actions implemented to address local nutrient-related water quality impairments are also effective in reducing nutrient losses to the Mississippi River.

A previous progress report was published to document actions taken in 2015-2016 to reduce nutrient losses to Wisconsin rivers, lakes, streams and groundwater. Actions to reduce phosphorus, primarily, are widespread. This report is a compendium of nutrient reduction activities in 2017-2019 that represent further progress in implementing Wisconsin's Nutrient Reduction Strategy.

2013 Nutrient Reduction Strategy

2015 – 2016 Implementation Progress Report

Executive Summary

Water Quality Status and Trends

- *Lakes*--Overall, nutrient concentrations have not changed in most lakes over time. A small number saw increases or decreases. Some lakes with phosphorus concentrations that are below the phosphorus standard are trending upwards and some others that are above the criterion are trending downwards.

- *Rivers/Streams*—In flowing waters, we see a reduction in **total phosphorus** for all years since 2013—the reductions are small but significant, and most of the reduction occurs in sites that drain to the Mississippi River basin. The opposite is true for statewide trends in **nitrate**—loads have increased statewide since 2013, and most increases have occurred in streams that drain to the Mississippi River.

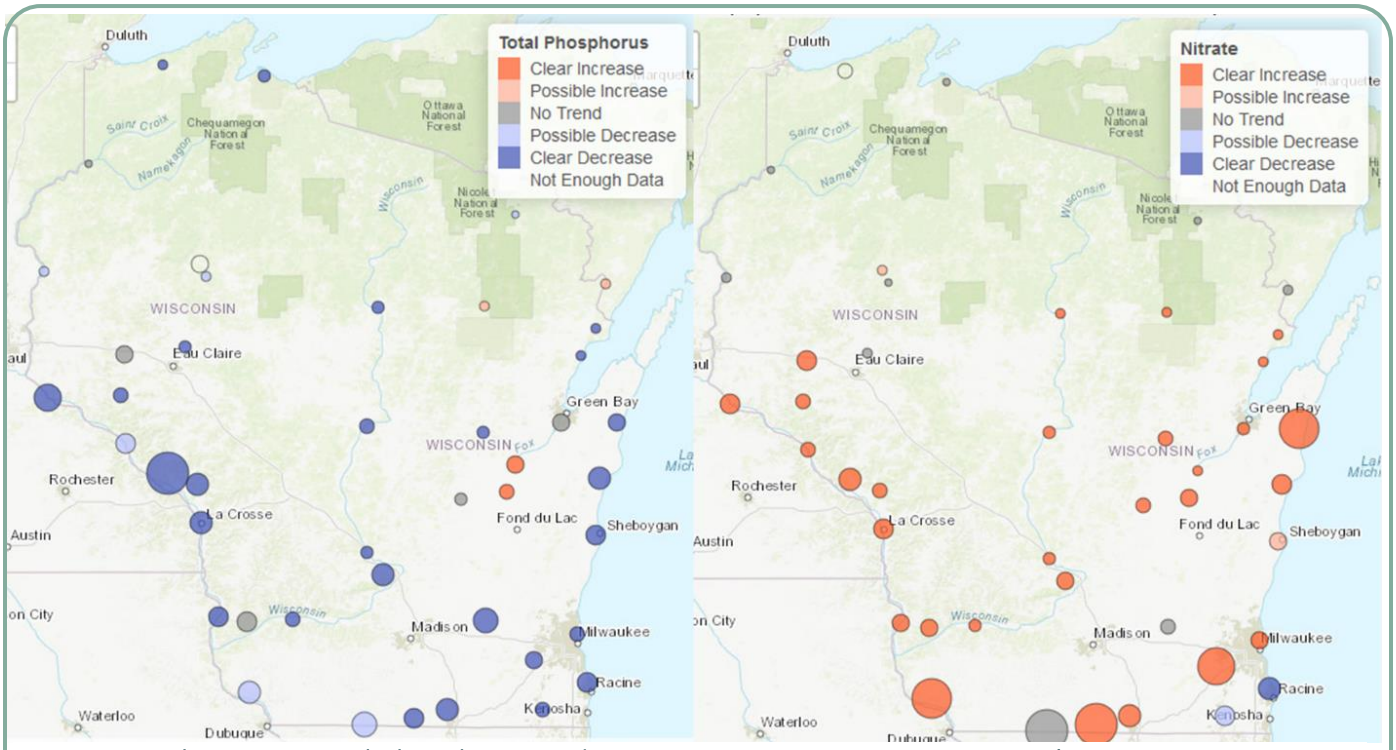


Figure 1. Changes in total phosphorus and nitrate concentrations in Wisconsin's 44 River Long-Term Trend Monitoring Network sites. The size of the circle corresponds to the 2018 mean annual concentration (high values correspond with larger circles). Current concentration and flow-normalized trend estimates are derived from the WRTDS model for each site. Background maps courtesy of Leaflet Tiles© by ESRI.

- *Phosphorus Impairments*—Phosphorus continues to be a main cause of impairments in rivers, lakes and streams, accounting for 47% of impairments listed on Wisconsin's 2018 303(d) list.

- *Progress Toward Gulf Hypoxia Goals*-- The Wisconsin Nutrient Reduction Strategy (WDNR, 2013) estimated Wisconsin's baseline total phosphorus load in 1995, and the progress made toward meeting the 45% reduction for the year 2009, for both the point and nonpoint source contributions within the

Mississippi River Basin side of Wisconsin. The report estimated a total reduction of 23% between the years of 1995 and 2009; however the methods for determining this reduction at the time were limited. Using a method that more accurately estimates the Wisconsin contribution to the Mississippi River Basin, we estimated the flow normalized load for 2018 to be 3,803 tons per year, or a 20% reduction from the baseline 4,778 tons in 1995. This load reduction is less than what was originally estimated for 2009, however the disparity may simply be associated with better data and tools for estimating loads, rather than a backsliding from reaching the reduction goal.

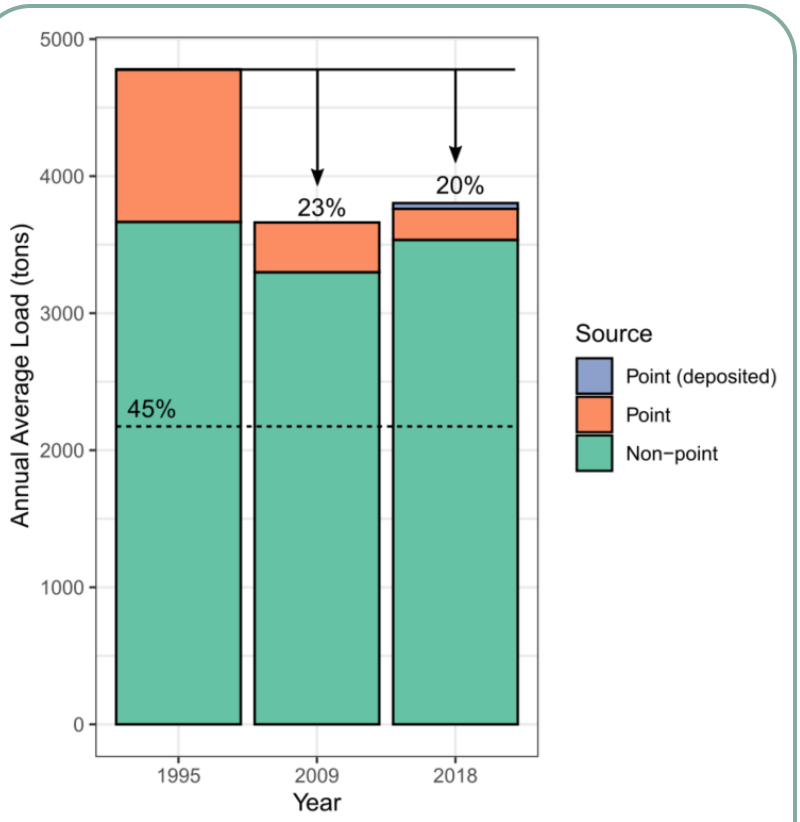


Figure 2. Progress toward meeting the 45% total phosphorus reduction goals established in the Gulf Hypoxia Task Force Action Plans (MRGMWNTF, 2001, 2008). The original Nutrient Reduction Strategy Report (WDNR, 2013) estimated a 23% reduction between the years of 1995 and 2009 using coarse-level estimates for loading. We have more recently estimated loading reductions from 1995 to 2018 to be 20%, less than what was estimated for 2009; however the methods used for 2018 are more accurate than those that were used for 2009. "Deposited" refers to the estimated fraction of point source load that is not delivered to the Mississippi River.

Nutrient Reduction through WPDES Permits

Through the use of Wisconsin Pollutant Discharge Elimination System (WPDES) permits, point source phosphorus discharges are limited under the permit according to the applicable water quality criterion for phosphorus and/or by the Waste Load Allocation established by a Total Maximum Daily Load (TMDL) for the receiving waterbody. Point sources continue to make steady progress in reducing phosphorus loads: a 70% reduction has been realized between 1995 and 2018. Although Wisconsin does not currently have a water quality criterion for nitrogen, WPDES permits for municipal majors in the Mississippi River Basin issued since November 2012 contain a requirement for quarterly effluent monitoring for total nitrogen. In the fall of 2019, this requirement was expanded to include Great Lakes Basin dischargers as well. WPDES permittees can address stringent phosphorus permit limits through optimization and/or treatment upgrades, or through watershed-based options, noted below.

Adaptive Management

Adaptive management is a phosphorus compliance option that allows point and nonpoint sources (e.g. agricultural producers, non-regulated storm water utilities, developers) to work together to improve water quality in those waters not meeting phosphorus water quality standards. The clear environmental and economic benefits of the adaptive management approach have been recognized by communities across Wisconsin. As of 2019, 21 municipal wastewater facilities have undertaken an adaptive management effort. These permittees will work to curtail roughly 30,000 lbs/year of phosphorus loading within their watersheds over the next five-year permit term. The 20-year goal for these projects (to restore their receiving water to the water quality criterion) requires a reduction of over 200,000 lbs/year.

The Adaptive Management Technical Handbook is available to help describe adaptive management and how to develop a successful adaptive management strategy: http://dnr.wi.gov/topic/surfacewater/documents/adaptivemanagmenthandbooksigned.pdf

Water Quality Trading

Water Quality Trading (WQT) may be used by WPDES permit holders to acquire pollutant reductions from other sources in the watershed to offset their point source load so that they will comply with their own permit requirements. As of 2019, over 40 permittees have formally indicated that WQT will be used to comply with phosphorus limits. Of these, 23 permittees have submitted an approvable water quality trading plan to WDNR. The average phosphorus reduction for each trade is roughly 800 lbs/year, and with the average trade ratio of 2:1, the average point source credit user applies approximately 400 lbs/year of credit to offset its point source discharge. The most frequently used nonpoint source best management practices include conversion of row crops to perennial prairie vegetation and streambank stabilization. Stormwater practices, buffer strips, and cropping practices have also been used to generate credits.

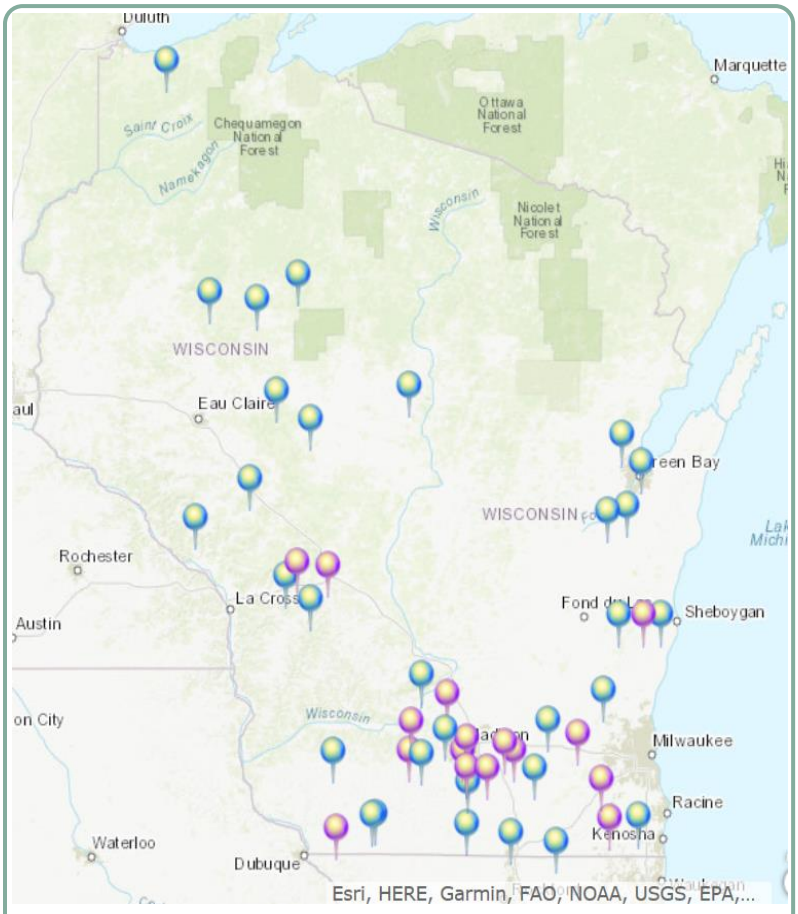


Figure 3. Adaptive Management and Water Quality Trading project locations.

Guidance for implementing WQT is available to help describe water quality trading and how to develop a successful trading strategy (https://dnr.wi.gov/topic/SurfaceWater/documents/WQT_guidance_Aug_21_2013signed.pdf).

Multi-Discharger Variance (MDV)

The MDV allows eligible point sources a longer timeframe (up to 20 years) to comply with low phosphorus limits while making strides in water quality improvement within the watershed. A discharger may choose to pay $50 per pound (adjusted for inflation) of phosphorus discharged above a target value (generally 0.2 mg/L). The payment is made available to the county land and water conservation departments (LCDs) within the HUC 8 watershed to provide cost sharing for meeting NR 151 agricultural performance standards. In 2019, 74 WDPES permittees were covered under the MDV, with approximately $935,000 paid to 34 participating counties.

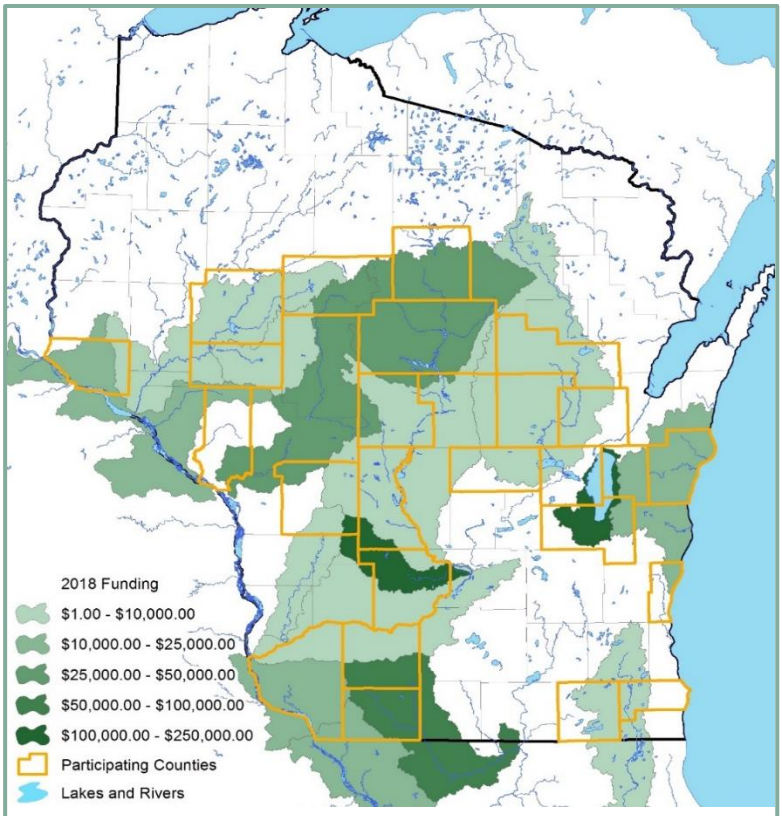


Figure 4. Multi-discharger variance funding 2018; final

Nutrient Reduction through Agricultural Nonpoint Source Programs

Nutrient Management Plan (NMP) Development

In 2018, Wisconsin farmers reported 8,220 NMPs on 3.3 million acres covering 36.6% of Wisconsin's nine million cropland acres. Some counties reported NMPs in place for between 50% and 100% of cropland acres (Figure 5). More information is available in Wisconsin's Nutrient Management Update, produced by DATCP in November 2018.

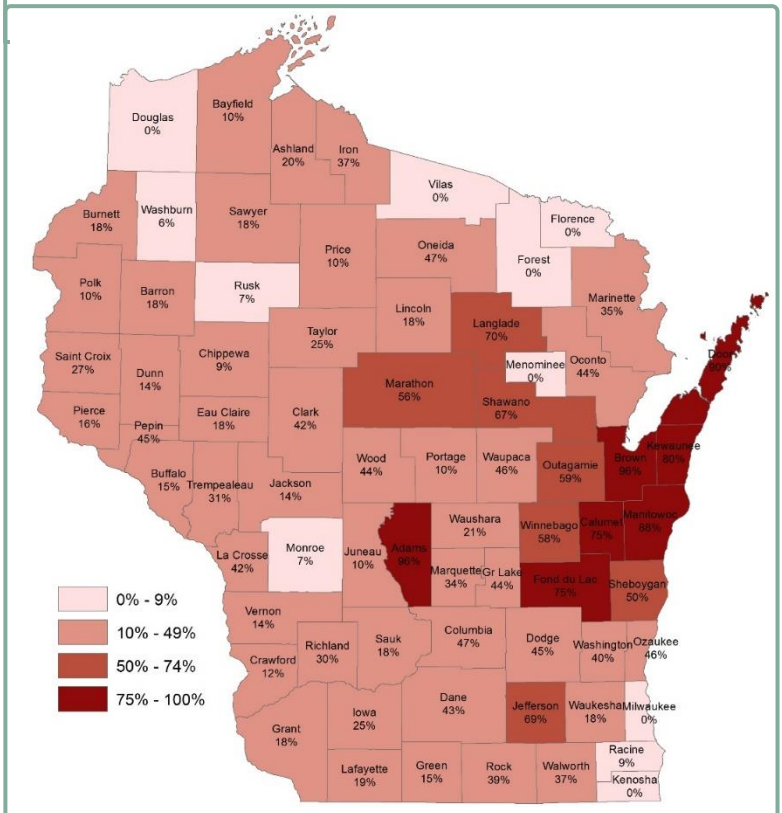


Figure 5. Percentage of cropland acres with Nutrient Management Plans. Cropland acres derived from National Agriculture Statistics Service, Census of Agriculture, 2012. Pasture land not included.

Nine Key Element Watershed Plans

Watershed-based plans consistent with EPA's nine key elements provide an important framework for improving water quality in a holistic manner within a geographic watershed. These plans are a typical precursor in Wisconsin to implementation activities to reduce agricultural losses of nutrients to water, particularly in TMDL watersheds.

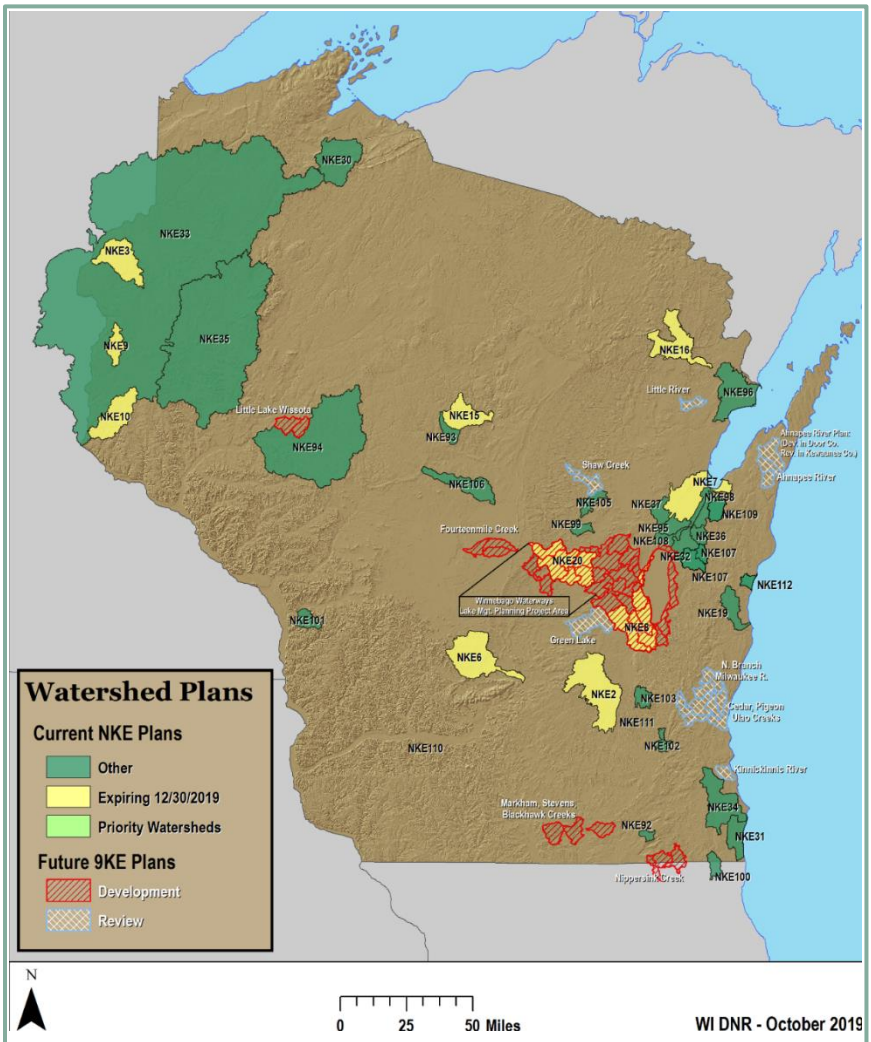


Figure 6. Nine Key Element Watershed Plans, current and future.

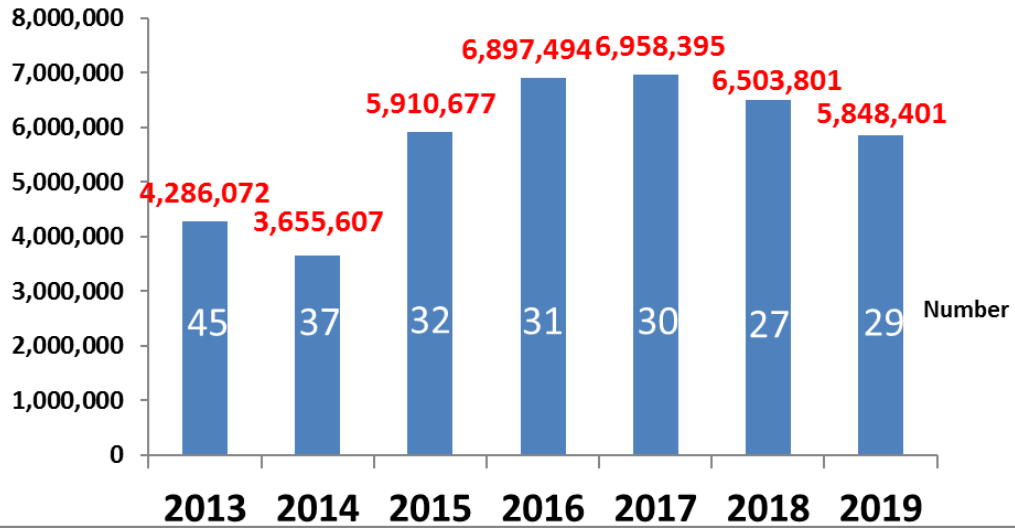


Figure 7. Wisconsin total acres and count of Nine Key Element Watershed Plans.

Wisconsin Producer-Led Watershed Groups

Wisconsin's Producer-Led Watershed Protection Grant program continues to grow as does the popularity of this important approach to nutrient loss reduction at the watershed scale. In 2019, $750,000 in grants was awarded to projects that focus on ways to prevent and reduce water quality impacts from farming operations and that work to increase farm participation in these voluntary efforts (see DATCP Producer Led Project Summaries) (Figure 8). Program objectives include supporting groups as they work to improve water quality through reduced phosphorus and sediment loading, increase farmer knowledge of and engagement with water quality issues (including adoption of conservation practices) and develop water quality leadership among farmers in the watershed.

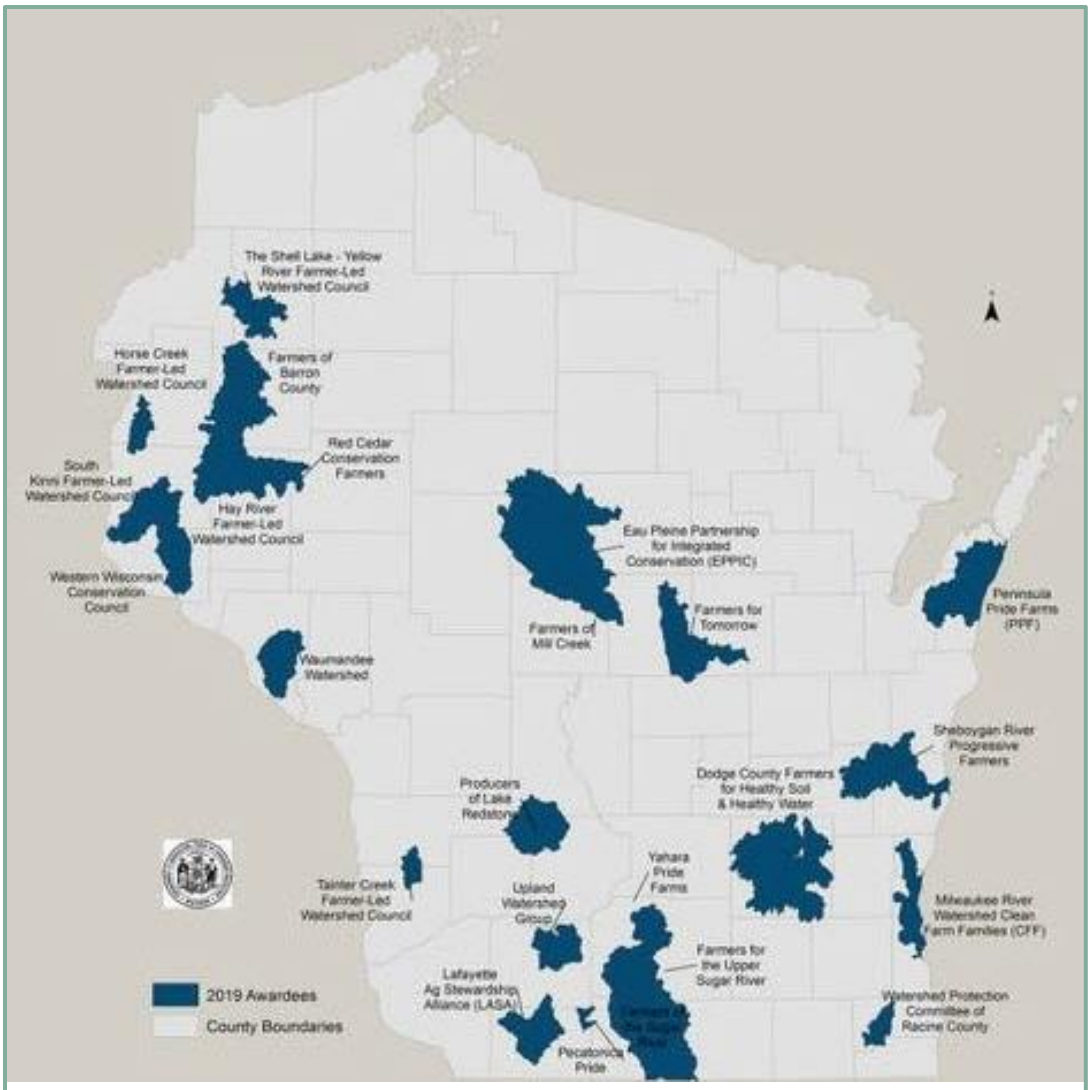


Figure 8. 2019 Producer-Led Watershed Protection Grant recipients.

State Financial Assistance

The Wisconsin DNR and DATCP partner to provide financial support that is critical to achieving nutrient reductions through agricultural nonpoint source conservation practices. In 2017 and in 2018, DATCP provided nearly $9.0 million, and nearly $9.4 million in 2019 statewide for technical staff at county Land and Water Conservation Departments. DATCP also provided between $600,000 and $650,000 in financial support each year for awards to cooperators to carry out training, nutrient management support and related activities of statewide significance. County staff, with the help of cooperators, provide outreach, education and technical and financial assistance to farmers to plan, design and install conservation practices that reduce sources of nutrients and

protect water quality. In 2017, 2018 and 2019 WDNR and DATCP jointly allocated $11.65 million, $11.33 million and $10.7 million in grant funding to cost-share conservation practices, respectively. Highlights of land and water conservation programs and project success stories can be found in the 2017 and 2018 Land and Water Conservation Annual Report.

University of Wisconsin Extension – Discovery Farms Networks

Discovery Farms is a program of the University of Wisconsin-Madison Division of Extension. Discovery Farms is working with farmers across Wisconsin on phosphorus and nitrogen management. Research from edge-of-field sites, evaluations like nitrogen use efficiency, and information sharing strategies like webinars, presentations and materials are tools that Discovery Farms uses in its educational programming. Discovery Farms finished watershed projects within the Jersey Valley watershed (Monroe and Vernon Counties) and the Dry Run watershed (St. Croix County), and began projects in Rock, Langlade, Juneau, and Kewaunee Counties. Additionally, a monitoring project funded by the Conservation Innovation Grants program to understand the connection between agricultural tile drainage, farming systems and soil health began in 2017 in Kewaunee, Shawano, Manitowoc and Brown Counties. The project includes 24 monitoring sites and 14 farms.

USDA Natural Resources Conservation Service (NRCS) Programs

Wisconsin NRCS programs and staff play a key role in providing technical and financial assistance for implementing practices to reduce nutrient losses to water. The Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP) and Agricultural Conservation Easement Program (ACEP) provided $62 million (M) in 2018 funding for conservation practices statewide. In Fiscal Year (FY) 18, the Environmental Quality Incentives Program (EQIP) obligated $10.88 M for 1,316 cover crop contracts compared to $2.34 M for 513 cover crop contracts in FY15. This demonstrates the growing interest in soil health practices to reduce nutrient losses, reduce erosion and improve soil quality. **Through all NRCS programs in FY18, 414,216 acres had conservation practices applied to improve water quality.**

In 2019, the WDNR proposed the de-listing of 303(d) impaired sections of the Legler School/Pioneer Valley streams in Green County. These segments were targeted as part of one of the original NRCS National Water Quality Initiative (NWQI) watersheds in Wisconsin in 2012. Through the partnership efforts of the Green County Land and Water Conservation Department, WDNR, NRCS and cooperating producers, this is the first NWQI watershed in Wisconsin to reach this point in the de-listing process.

Demonstration Farms Networks

The USDA Natural Resources Conservation Service (NRCS) and the Great Lakes Commission (GLC) partnered to establish a Great Lakes Demonstration Farm Network, the first of its kind in Wisconsin. Brown County Land & Water Conservation Department has since assumed the project agreement with NRCS, and the Outagamie

County Land Conservation Department and University of Wisconsin Extension are also partners in the project. The Network is working to provide better information on the effectiveness of conservation systems used to improve water quality. The participating farms demonstrate effectiveness and adaptability of conservation practice systems to reduce erosion and sedimentation, control phosphorus runoff, and address other nonpoint source pollution issues.

The initial four farms participating in the Network have now increased to eight and a new project element has been added to provide dedicated, one-on-one technical assistance to other farms that are interested in adapting the demonstrated practices on their operations. Due to the success and interest generated by the Lower Fox model, NRCS has partnered with county land conservation departments, DATCP, producer-led groups, and a lake association to form four new Demonstration Farm Networks to pursue similar goals in Door-Kewaunee Counties, Ozaukee County (primarily Milwaukee River watershed), Upper Fox-Wolf, and Between the Lakes (Manitowoc-Sheboygan River Watershed).

Tracking/Measuring Progress

County land and water conservation departments reported to DATCP the amount of conservation practice adoption in 2018, and estimated what amount of phosphorus, nitrogen and sediment reduction was associated with groups of practices (Figure 9). Not all reductions of phosphorus, nitrogen and sediment achieved through conservation practices implemented in 2018 are tracked and reported. The numbers shown here capture only the known estimated reductions in 2018 as reported by counties in March 2019, or provided in the Conservation Reserve Enhancement Program's annual report. As a result, the numbers shown here are only a fraction of the likely total reductions in phosphorus, nitrogen and sediment from conservation efforts in 2018.

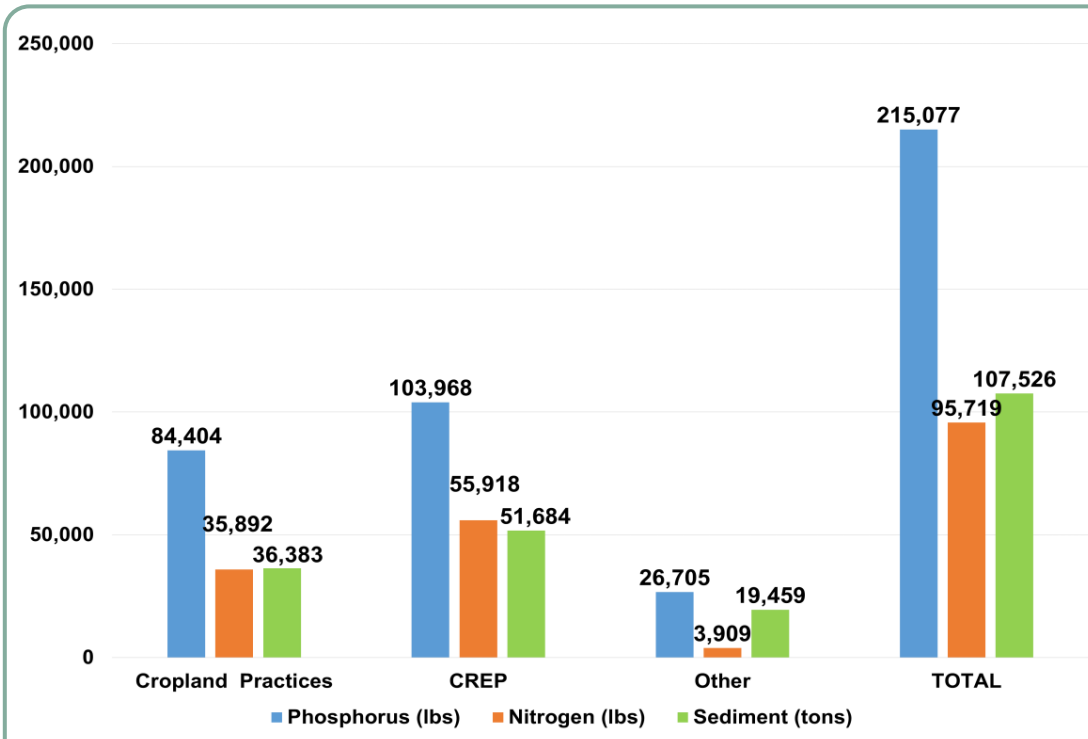


Figure 9. Estimated reductions from conservation practices in 2018. "Other" conservation practices include streambank stabilization, riparian buffers, and critical area stabilization.

When it comes to phosphorus loss from cropland, widespread adoption of two key practices, no till and cover crops, are important to improving water quality. Using data from the 2012 and 2017 census of agriculture, an assessment was made of changes in adoption of these practices (Figure 10). Counties were ranked from 1 to higher than 30 based on degree of implementation.

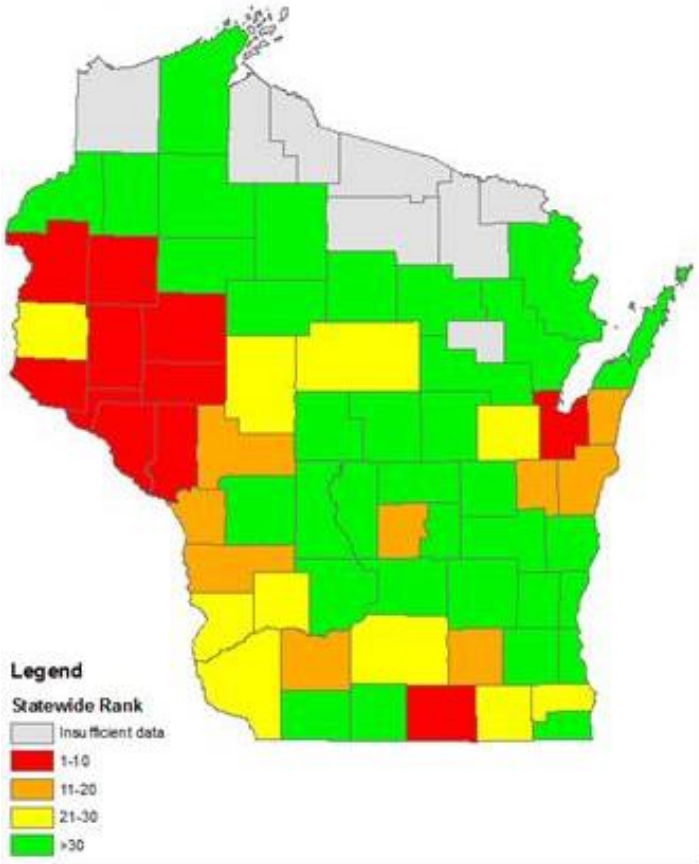


Figure 10. Ranking of counties based on no-till and cover crop practice implementation.

Nutrient Reduction in High Priority Watersheds

Whether in watersheds identified within the top group in the 2013 Strategy or within TMDL watersheds, and in the Mississippi River Basin or the Great Lakes Basin, nutrient reduction is widespread. The focus is mainly phosphorus reduction, but reducing nitrate loss to groundwater has become a more common "high priority issue" in several counties. Implementation at the watershed scale is detailed in two of the chapters in this report. Portraying watershed-scale implementation status for nonpoint sources is challenging. However, a few different approaches to portraying degree of implementation are highlighted below.

Upper Rock River TMDL Implementation

Progress continues with both point and nonpoint sources towards TMDL Implementation goals. A strong foundation for promoting nutrient reductions in the Rock River Basin has been provided by a combination of the Rock River TMDL, WPDES permit programs, efforts of three farmer-led watershed groups, implementation of statewide phosphorus criteria, and watershed-based permit compliance alternatives (Adaptive Management and Water Quality Trading).

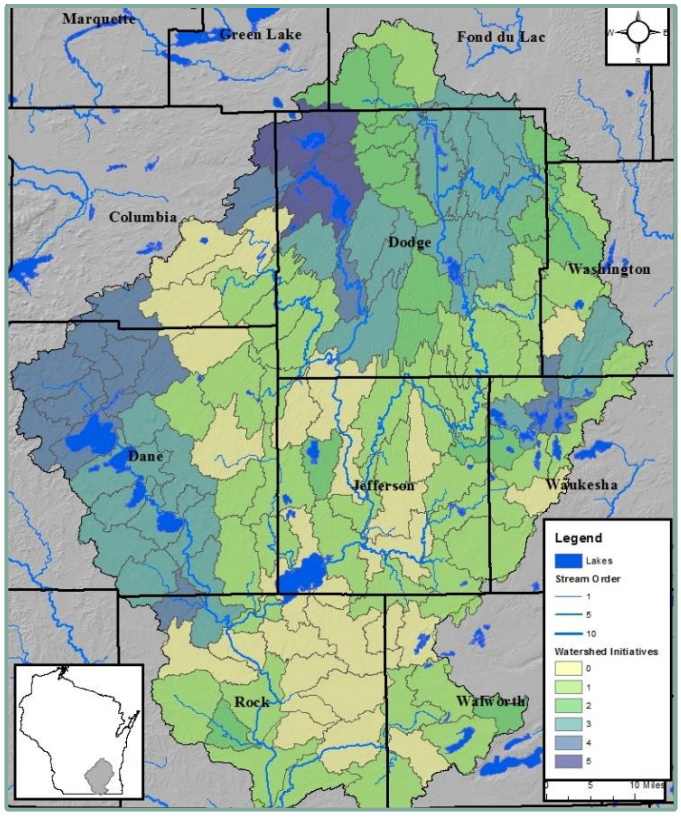


Figure 11. Rock River Recovery: TMDL implementation initiatives by watershed. Note: This figure only includes watershed-scale activities and does not reflect local activities – e.g., a watershed ranked 0 in this figure will still have local projects being implemented.

From a basin perspective, TMDL implementation progress can be viewed as the sum of implementation related activities within a HUC 12 watershed. Figure 11 summarizes targeted implementation-related activities by ranking each HUC 12 watershed by how many of the following implementation activities are taking place:

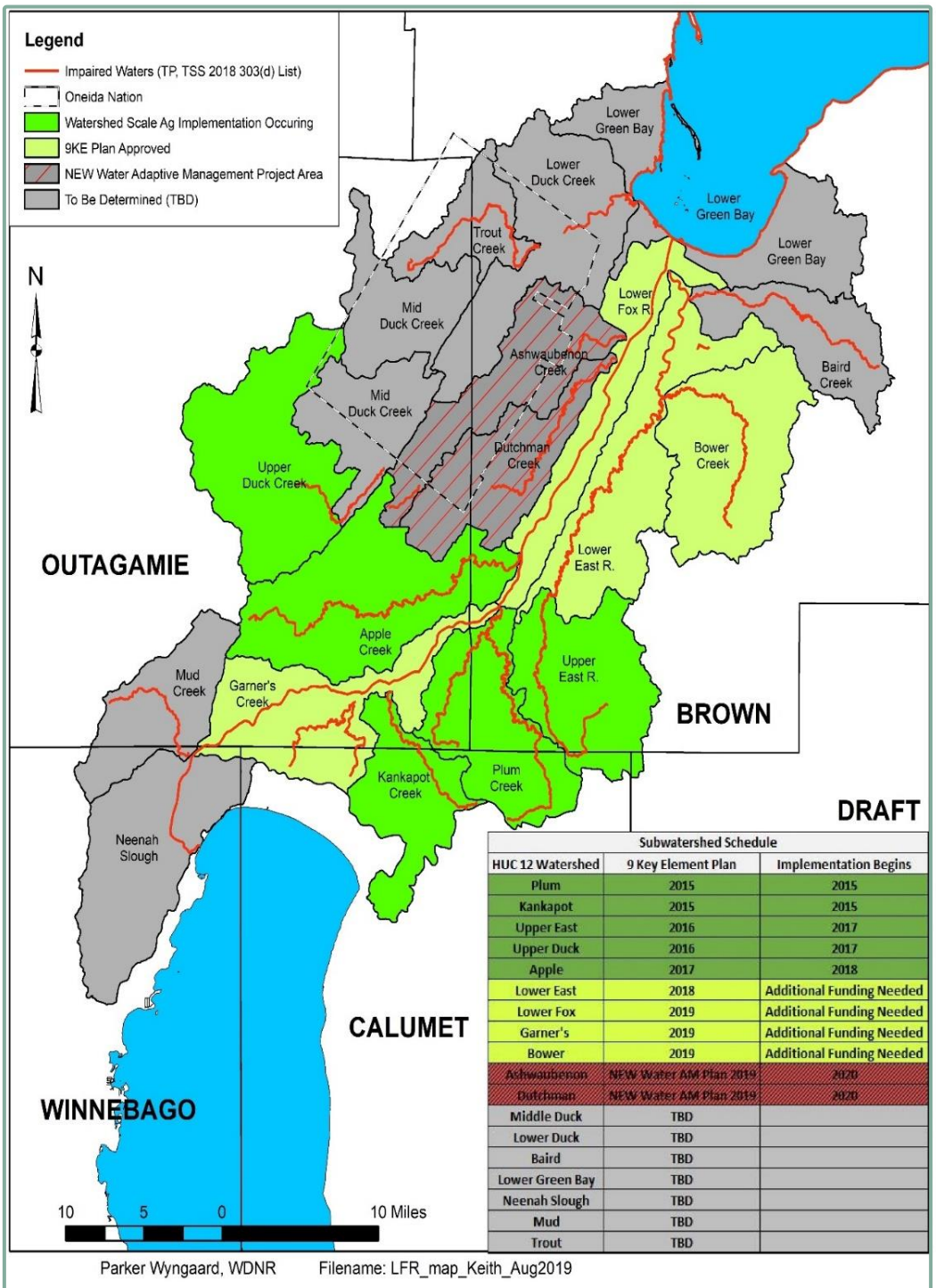
- Priority Watershed Restoration Project
- Nine Key Element Watershed Restoration Plan
- Active Farmer-led Watershed Group implementing recognized practices
- Point source discharge facility with TMDL limits
- Watershed-based permit compliance projects – (Adaptive Management or Water Quality Trading)

Lower Fox River TMDL Implementation

Nonpoint Source Implementation – Nine Key Element Watershed Plans

WDNR completed review and issued approval of Nine Key Element Watershed Plans for the Apple River in 2017, the Lower East River in 2018 and the Lower Fox River, Garner's Creek and Bower Creek in 2019 (Figure 12). Nine Key Element Plans for the Upper East and Upper Duck began implementation in 2017. The Apple River plan began implementation in 2018.

All plans have ten-year schedules and contain milestones that reflect realistic landowner participation rates and implementation of various practices on 75% of cropland acres in each watershed. Because of this, the plans explain they will make substantial progress towards, but fall short of, meeting overall Lower Fox TMDL phosphorus reduction goals. To meet the nine elements, each plan explains additional practices or



Subwatershed Schedule

HUC 12 Watershed	9 Key Element Plan	Implementation Begins
Plum	2015	2015
Kankapot	2015	2015
Upper East	2016	2017
Upper Duck	2016	2017
Apple	2017	2018
Lower East	2018	Additional Funding Needed
Lower Fox	2019	Additional Funding Needed
Garner's	2019	Additional Funding Needed
Bower	2019	Additional Funding Needed
Ashwaubenon	NEW Water AM Plan 2019	2020
Dutchman	NEW Water AM Plan 2019	2020
Middle Duck	TBD	
Lower Duck	TBD	
Baird	TBD	
Lower Green Bay	TBD	
Neenah Slough	TBD	
Mud	TBD	
Trout	TBD	

Figure 12. Lower Fox River Basin TMDL Watershed Implementation Schedule.

new technologies to meet the remaining TMDL phosphorus and sediment reductions that are predicted, via SWAT modeling, to restore impaired waters in the basin. The plans represent current pieces of the overall Lower Fox TMDL implementation strategy. The status of TMDL implementation by watershed is shown in Figure 12.

Wisconsin River Basin TMDL Implementation

In April 2019, the USEPA approved a TMDL addressing phosphorus impairments for 120 river segments and nine lakes. The TMDL project area encompasses the Wisconsin River Basin upstream of the Prairie du Sac Dam which forms Lake Wisconsin, and includes Petenwell and Castle Rock Lakes, covering approximately 14% of the state.

Implementation is just beginning for this TMDL, but already nonpoint source implementation efforts have been focused on a variety of locally-led projects through the Wisconsin River Basin. These early, locally-led projects have been developed in areas where considerable nonpoint reductions are needed. Implementation comes through various programs, as noted in Figure 13.

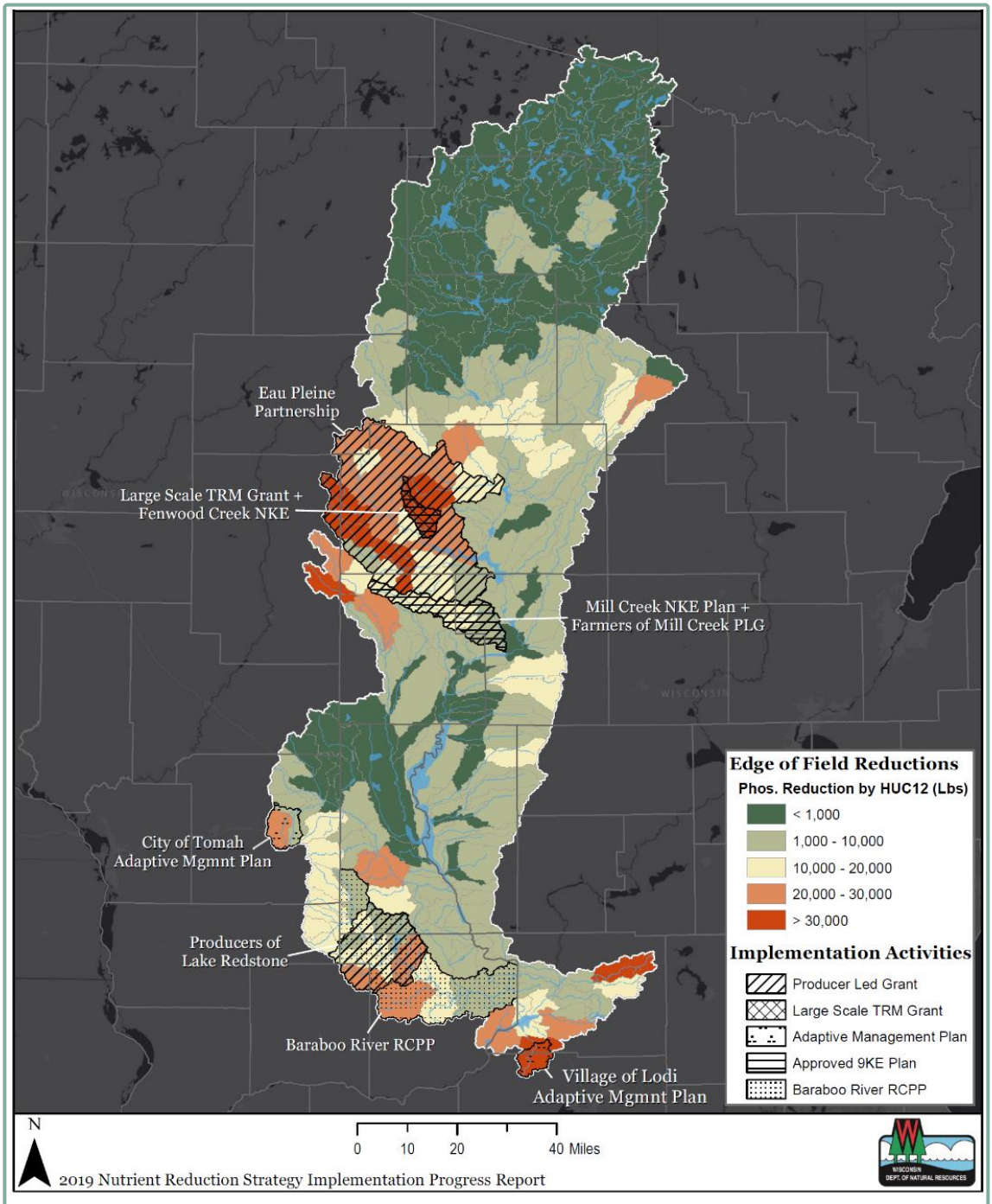


Figure 13. Cropland Phosphorus Targets & Implementation Activities in the Wisconsin River TMDL – 2019.

Contents

Chapter 1. Water Quality Status and Trends

1.1 Lake Long-Term Nutrient Trends

Anthropogenic nutrient loading is a major stressor of lakes worldwide. Although watershed management efforts have reduced nutrient loading, eutrophication may worsen as agriculture expands, land develops, and precipitation intensifies. The WDNR has been collecting total phosphorus (TP), Total Kjeldahl Nitrogen (TKN), and Nitrite +Nitrate (NO_2+NO_3) on 62 lakes for up to 45 years, providing an opportunity to test whether nutrient concentrations have changed over time. These lakes occur throughout the state in agricultural, urbanized, and forested watersheds and vary in size, trophic status, and hydrology. Additionally, volunteers have collected phosphorus data on lakes since the late 1980s through the Citizen Lake Monitoring Network. Thus, we were able to analyze phosphorus trends on an even greater number of lakes.

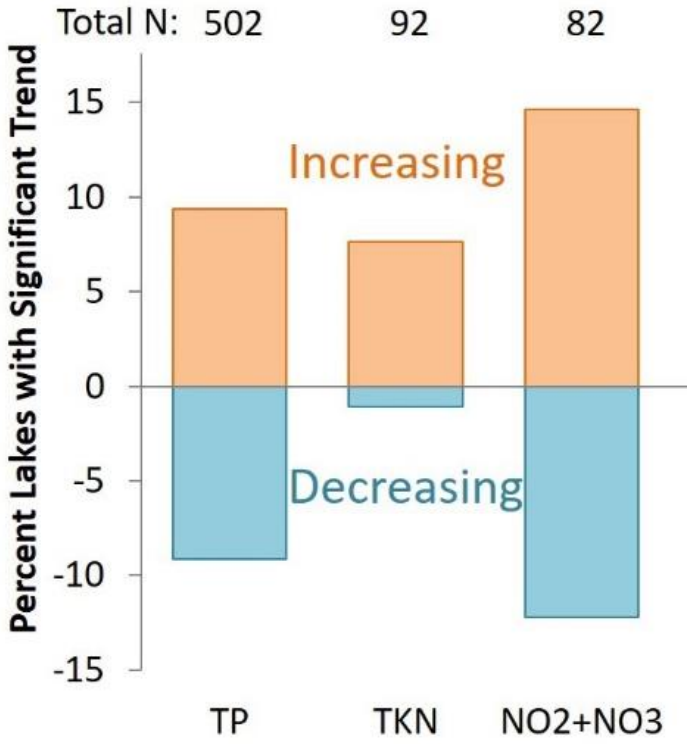


Figure 14. Percent of lakes with a significant increasing vs. decreasing trend in nutrient concentrations.

Linear regression models were used to test for change in annual mean TP, TKN, or NO_2+NO_3 over time. Annual averages were calculated using data from June 15 to September 15 from 1968 to 2015. We took the natural logarithm of the concentrations for all analyses. We excluded 153 hypereutrophic lakes (≥ 0.1 mg/L annual mean TP) from analysis because these values are unusually high for lakes and would have a strong influence on trend analysis. Thus, these results do not apply to hypereutrophic lakes in the state. Trends were calculated only if there were at least 5 years of TP and NO_2+NO_3 and 4 years of TKN data.

Nutrient concentrations did not change over time in most lakes. The median slope of concentrations over time across all lakes was 0.003 for TP, 0.25 for TKN, and 0.000 for NO_2+NO_3. A small percent of lakes (9 – 27%) had significant increasing or decreasing trends in nutrients over time (Figure 14). For total phosphorus, approximately the same percent of lakes showed a significant increase as decrease (9.4 vs 9.2, respectively). The same was true for NO_2+NO_3 (14.6% increased vs. 12.2% decreased), but TKN increased on more lakes (7.6% increased vs. 1.1% decreased). There was not a strong geographic pattern in trends for any of the three nutrients. Increasing, decreasing, or no trends occurred throughout all areas of Wisconsin (Figure 15). Note that only one lake had a significantly decreasing TKN trend, and that lake was in south-central Wisconsin.

Whether lake water quality is getting better or worse over time in terms of nutrient pollution is of primary interest. Nutrients may change over time but still be far above or below Wisconsin water quality criteria. We

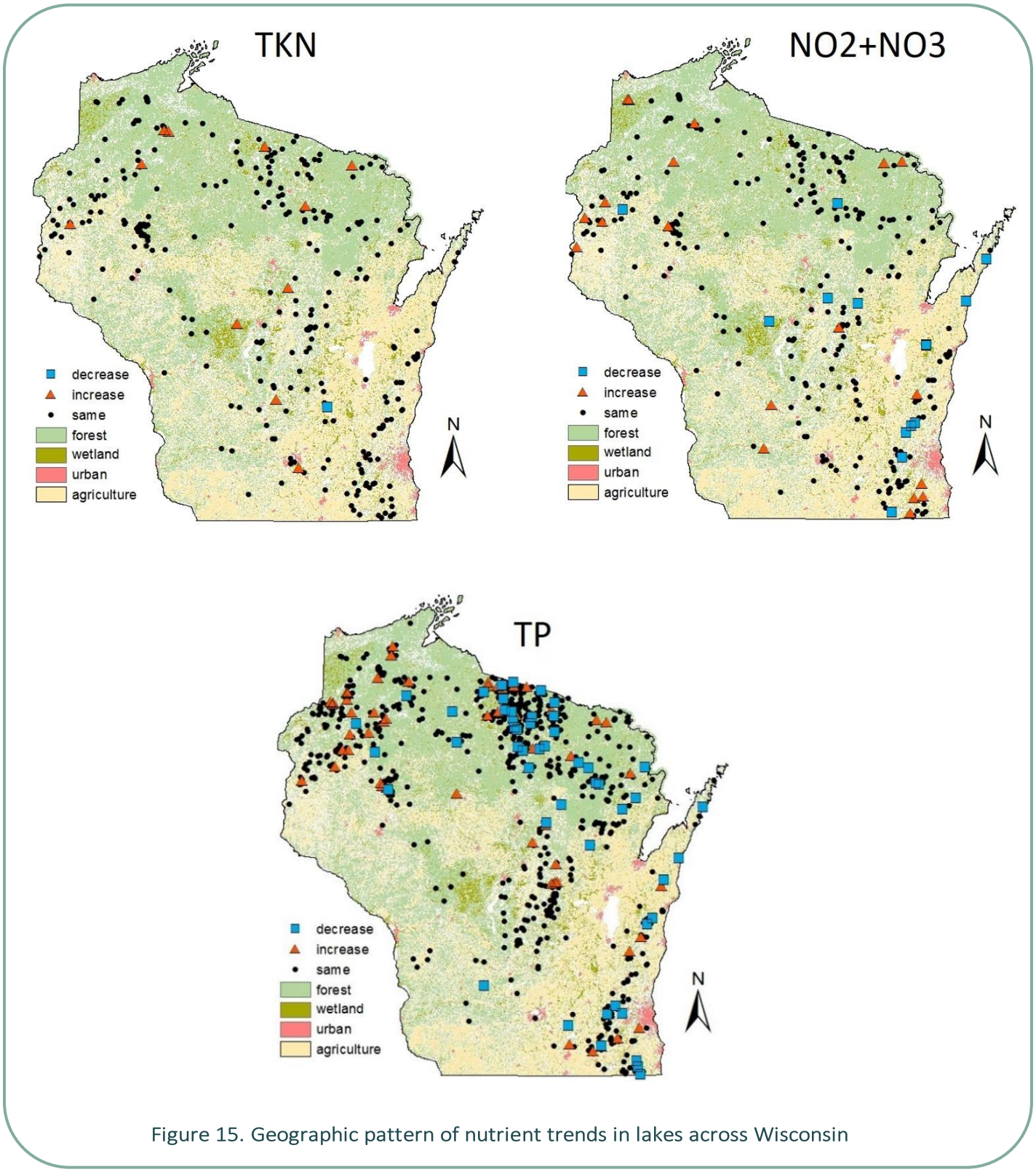


Figure 15. Geographic pattern of nutrient trends in lakes across Wisconsin

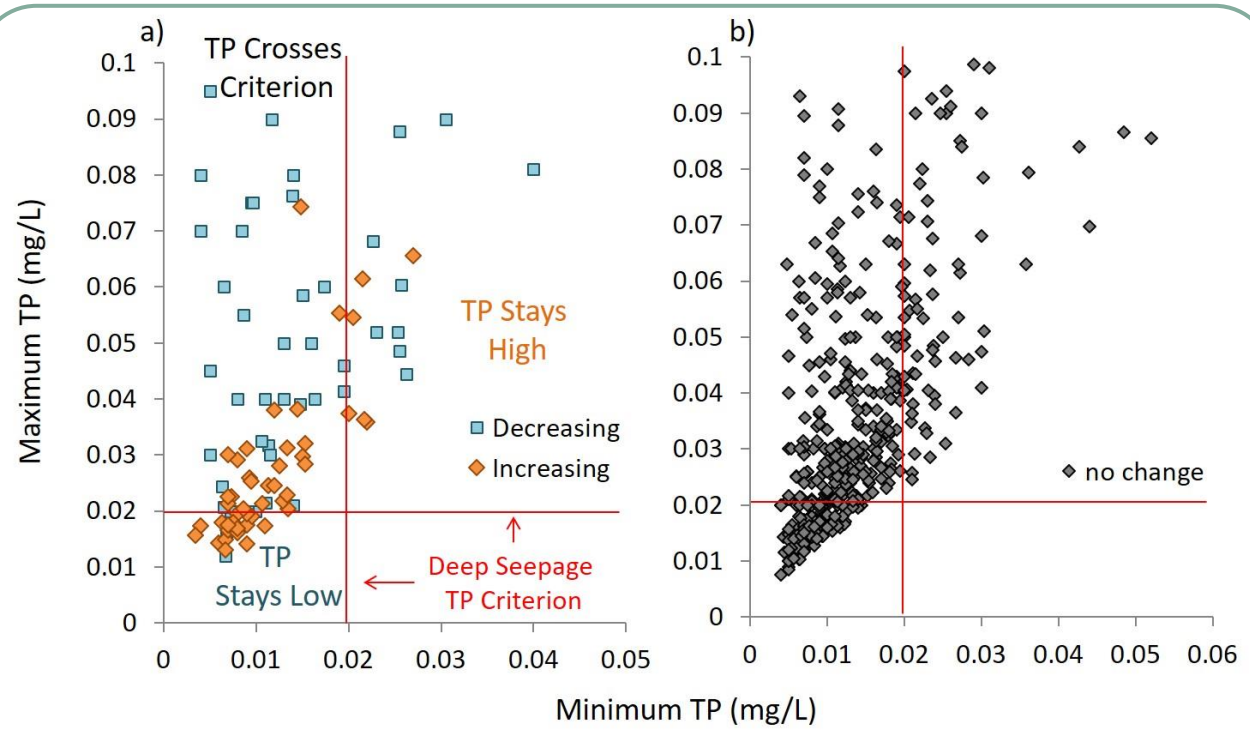


Figure 16. Minimum and maximum annual mean TP observed throughout the entire time series of each lake a) with a significant trend over time, or b) without a significant trend over time. Red vertical and horizontal lines depict the TP criterion of 20 ug/L for deep seepage lakes. TP criteria range from 15 to 40 ug/L depending on the lake type.

examined how phosphorus trends compare to Wisconsin's phosphorus criteria. Because Wisconsin does not have nitrogen criteria, we only conducted this analysis on phosphorus. By examining the minimum and maximum annual mean TP concentration in each lake's period of record, we can determine whether the trajectory crosses the TP criterion. We used 20 ug/L TP for visual purposes, which is one of the more stringent criteria that is applied to deep seepage lakes. Criteria range from 15 – 40 ug/L depending on the lake type.

There were a large number of lakes that have significantly improved or degraded in terms of TP (increasing or decreasing TP that crossed the criterion of 20 ug/L, see upper left quadrant of Figure 16a). Those shown as orange diamonds in the upper left quadrant represent lakes that moved from attaining to exceeding the criterion. Those shown as blue squares improved and shifted from exceeding to attaining the criterion. A small number of lakes show significant trends over time but remain above the criterion (upper right quadrant of Figure 16a). A few of those lakes with decreasing TP are approaching the criterion and may be removed from the impaired waters list in the future. There are quite a few lakes with an increasing TP trend that remain below the TP criterion of 20 ug/L (lower left quadrant of Figure 16a). These trends are of concern and should be examined before the lakes become impaired.

Many lakes' time series cross the criterion over time, but without a significant increasing or decreasing trend (upper left quadrant of Figure 16b). This indicates that some years have TP above and some below the criteria, but without a trending pattern. Some lakes vary over time, but always remain above 20 ug/L TP (upper right quadrant of Figure 16b), whereas others are consistently below 20 ug/L TP (lower left quadrant of Figure 16b).

Water Clarity and Nutrient Trends Based on Published Literature

Looking at large, regional patterns across the Upper Midwest and Northeast, water clarity varied year to year, but generally stayed the same on most lakes. These were the results that Noah Lottig and colleagues found when they examined 140,000 regional water clarity measurements made by citizens from 1938 to 2012. Though water clarity didn't change over time on 89% of lakes, it did become clearer on 7% and more turbid on 4% of lakes. The strongest water clarity improvements occurred before the 1970s. A separate study by Kevin Rose and others used satellite imagery to track water clarity trends in Wisconsin lakes since 1991. These researchers' results concurred: water clarity did not trend in one direction on most lakes. However, unlike Lottig's regional study, this Wisconsin-based study of a more recent time frame found water clarity worsened on 23% of lakes.

Similarly, a recent study found that nutrient and chlorophyll *a* concentrations have not changed since 1990 in most Midwestern and Northeastern lakes. Samantha Oliver and colleagues analyzed trends over time in 2,913 lakes, many of which were in Wisconsin. Total Nitrogen (TN) was the only variable that trended over time regionally, with an overall decrease of 1.1% per year from 1990 to 2011 in the entire population of lakes. The decline in TN is likely a response to reduced atmospheric deposition as a result of the Clean Air Act. Although this study does not give statistics for Wisconsin alone, the maps show that TN did not significantly change over time in Wisconsin lakes. Across the entire region, TP increased in 7% of lakes and decreased in 9% of lakes, and chlorophyll *a* increased in 10% and decreased in 5% of lakes. Total Phosphorus and chlorophyll *a* varied in their results in Wisconsin, with some lakes exhibiting no trend while others increased or decreased.

1.2 River Long-Term Nutrient Trends

WDNR has been monitoring water quality at 44 river stations for periods from 15 to 55 years. Long-term trends in these datasets were analyzed with the Weighted Regressions on Time, Discharge and Season model (WRTDS, Hirsch et al. 2010), which estimates water quality trends in concentration and loads while controlling for the effects of discharge and season. This type of analysis is ideal for comparing loading across years because the effect of wet or dry seasons can be corrected, and the change in loading can be more easily observed. The most useful output for this application is the flow-normalized flux output from the WRTDS loading model, which estimates total load plus or minus the fraction that is related to an abnormally wet or dry year. This metric provides a better estimate of the changes in loading that result from changes in management, such as industrial/municipal wastewater reductions, agricultural best-management practice installation, or streambank restoration. To test for changes in overall loading over the most recent five years, we summed changes in annual flow-normalized flux for all non-nested (farthest downstream) long-term trend sites for each year since 2013 for both total phosphorus and nitrate (Figures 17 and 18).

If all site loads are aggregated together, we have observed a reduction in total phosphorus for each year since 2013 (Table 1)—the reductions are small but significant, and most of the reduction occurs in sites that drain to the Mississippi River basin. It can be problematic to compare progress from a single-year baseline if the baseline year was an abnormal year—changes between year combinations can be found in Table 1. For most years,

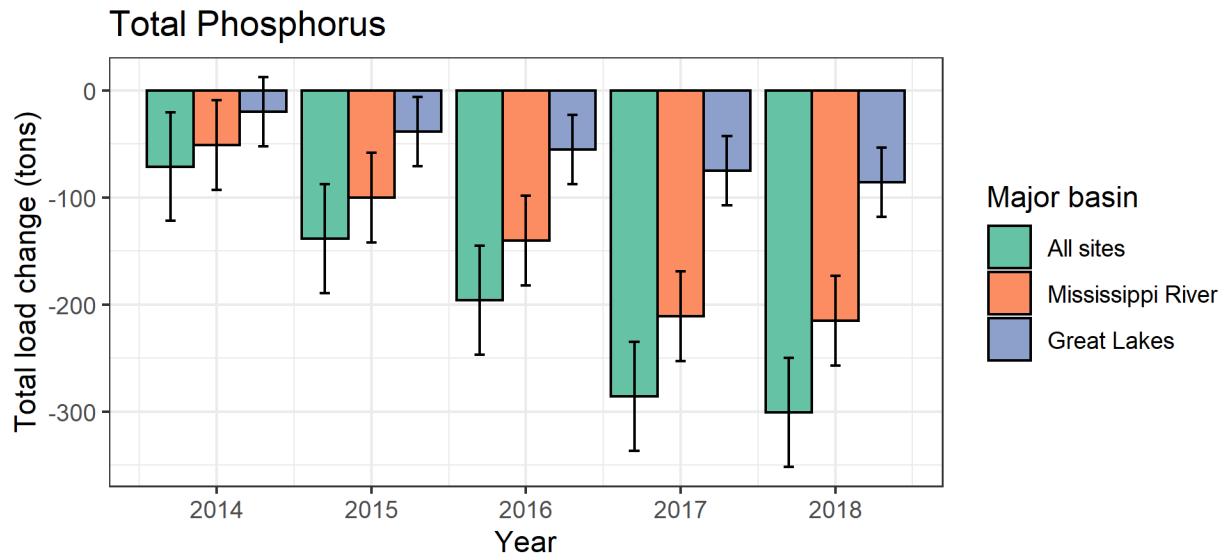


Figure 18 . Cumulative total phosphorus load change (negative values represent a load reduction) when compared to loading in 2013, summed across all long-term trend sites in Wisconsin. Green bars represent the sum of all loads, orange represent those that drain to the Mississippi River, and purple represent those that drain to the Great Lakes. The error bars represent the 95% confidence interval (a confidence interval that ranges from positive to negative represents a statistically insignificant change).

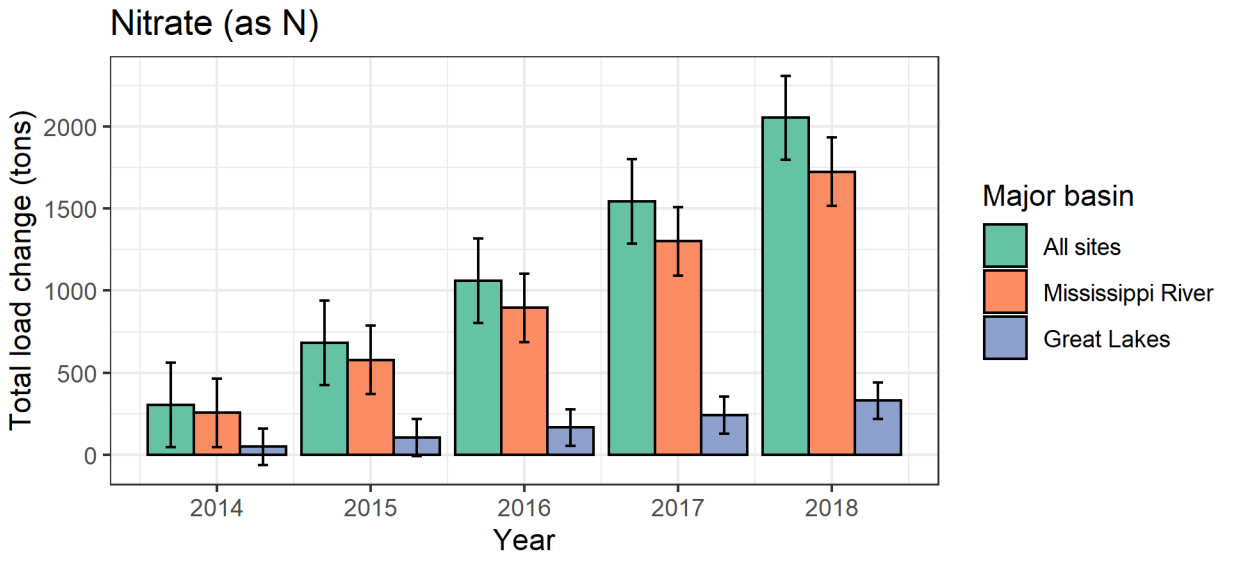


Figure 17. Cumulative nitrate load change (positive values represent a load increase) when compared to loading in 2013, summed across all long-term trend sites in Wisconsin. Green bars represent the sum of all loads, orange are those that drain to the Mississippi River, and purple are those that drain to the Great Lakes. The error bars represent the 95% confidence interval (a confidence interval that ranges from negative to positive represents a statistically insignificant change).

statistically significant reductions were observed for every combination of years, providing a second line of evidence to support the conclusion that phosphorus loads have progressively been decreasing.

The opposite is true for statewide trends in nitrate—loads have increased statewide since 2013, and most increases have occurred in streams that drain to the Mississippi River (Figure 19). For most year combinations between 2013 and 2018, there were statistically significant increases. (Table 2).

Table 1. Changes in the sum of all statewide phosphorus loads at long-term trend sites, represented as the number of tons less than the earlier year (i.e., a positive value indicates a reduction in phosphorus) for each year combination between 2013 and 2018. The range of values in parentheses represents the 95% confidence interval of load reduction. A negative value in the confidence interval would indicate a non-significant change (the only combination when this occurred was between 2017 and 2018, marked by an asterisk). Between the years 2015 and 2016, marked by an asterisk, the confidence in change was not greater than 99% (p = 0.017).

Year	*2013*	*2014*	*2015*	*2016*	*2017*
2014	71 (20–122)				
2015	138 (88–189)	67 (16–118)			
2016	196 (145–247)	125 (74–176)	57 (6–108)*		
2017	286 (235–337)	215 (164–266)	147 (96–198)	90 (39–141)	
2018	301 (250–352)	230 (179–281)	162 (112–214)	105 (54–156)	15 (-35–66)*

Table 2. Changes in the sum of all nitrate loads at long-term trend sites, represented as the number of tons more than the earlier year (i.e., a positive value indicates an increase in nitrate) for each year combination between 2013 and 2018. The range of values in parentheses represents the 95% confidence interval of load increase. A negative value in the confidence interval, of which there are none, would indicate a non-significant change. Between the years 2013 and 2014, marked by an asterisk, the confidence in change was not greater than 99% (p = 0.010).

Year	*2013*	*2014*	*2015*	*2016*	*2017*
2014	304 (46–560)*				
2015	683 (426–940)	379 (122–636)			
2016	1061 (804–1318)	757 (501–1014)	378 (121–635)		
2017	1543 (1286–1800)	1239 (982–1496)	860 (603–1117)	482 (225–738)	
2018	2053 (1796–2310)	1749 (1492–2006)	1370 (1113–1627)	992 (735–1249)	510 (253–767)

Additional results using these models have been organized into an interactive application, called Long-Term River Water Quality Trends in Wisconsin, that allows users to explore trends in water quality pollution from several different perspectives (e.g., trends across the state, how trends compare between pollutants, how loading compares across watersheds, etc.). The summaries discussed in this chapter can be explored in further detail using the application, which can be accessed by following this URL: https://wisconsindnr.shinyapps.io/riverwq/.

Using the application described above, we see that river water quality trends were highly variable among parameters and regions of the state. Concentrations of total phosphorus have decreased in most rivers over the last several decades (at 35 sites concentration decreased, at 4 sites it increased, and at 5 sites it showed no trend). In contrast, concentrations of nitrate (the major component of total nitrogen) have increased in most rivers over this period (at 33 sites concentration increased, at 2 sites it decreased, and at 9 sites it showed no trend, Figure 19). The largest reductions in total phosphorus occurred in the more densely populated southern Wisconsin. Earlier years (between 1960 and 2000) showed a reduction in total phosphorus without a commensurate reduction in total suspended solids, suggesting that most reductions resulted from reductions in point source loading. Conversely, a more recent trend (after 2000) shows reductions simultaneously in both phosphorus and suspended solids, suggesting a shift in focus toward reduction in nonpoint pollution related to runoff. Nitrate concentrations have increased in most rivers in agricultural basins in Wisconsin, even since 2000, suggesting that the types of nonpoint BMP installations that control runoff (and associated suspended solids and phosphorus) may not be effective at concurrently controlling nitrate pollution.

We estimated the total load leaving the State at 23 of the downstream-most, non-nested sites over different timeframes. Although the River Long-Term Trend Network monitoring extends back to the 1960s, sites have been added over time to increase total watershed coverage. In 1997 the monitoring network covered 60% of the state. Among those sites we have observed a 31% decrease in total phosphorus loads and a 59% increase in nitrate loads from 1977-2018. The reasons for these trends are likely a combination of changes in land management practices, including agricultural production systems, erosion control, nutrient management and improvements in wastewater treatment.

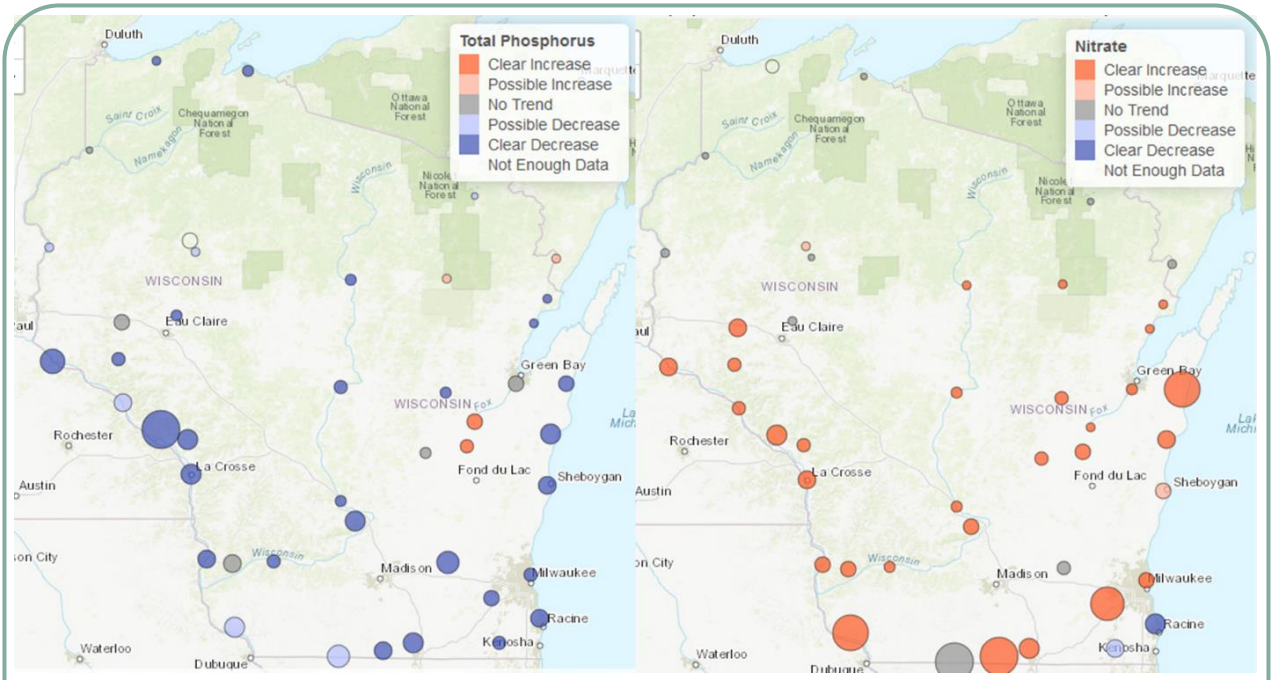


Figure 19. Changes in total phosphorus and nitrate concentrations in Wisconsin's 44 River Long-Term Trend Monitoring Network sites. The size of the circle corresponds to the 2018 mean annual concentration (high values correspond with larger circles). Current concentration and flow-normalized trend estimates are derived from the WRTDS model for each site. Background maps courtesy of Leaflet Tiles© by ESRI.

1.3 Wadable Stream Probabilistic Sampling

Wisconsin's employs a probabilistic monitoring program for wadable streams that mirrors the U.S. Environmental Protection Agency's (EPA's) National Aquatic Resource Surveys (NARS, https://www.epa.gov/national-aquatic-resource-surveys), but with more frequent sampling. The EPA NARS monitoring program and Wisconsin's Natural Community Stratified Random monitoring programs are probability-based monitoring designs intended to assess the condition of all the waters within a given resource. As all the wadeable streams in Wisconsin are far too numerous to sample each one individually (approximately 45,000 miles of perennial streams), a probability-based random sampling design allows statistically valid inferences about the condition of all streams to be made from sampling a much smaller number of streams. For this report, the results for total phosphorus and total nitrogen are presented in two ways. First, the proportion of streams in "Poor" condition, which is the estimated percentage of streams that exceed a previously established parameter-specific threshold (the applicable water quality criteria for total phosphorus and a threshold derived from reference site distributions for total nitrogen). Secondly, we estimated the annual median concentration, plus/minus a confidence interval, of total phosphorus and total nitrogen among all streams (see WDNR 2015 for more information on sampling and analyses).

Total phosphorus showed a slight decrease through time, while total nitrogen estimates were variable. The total phosphorus estimates between 2010-13 and 2014-15 surveys are nearly identical, however in 2016-17 there

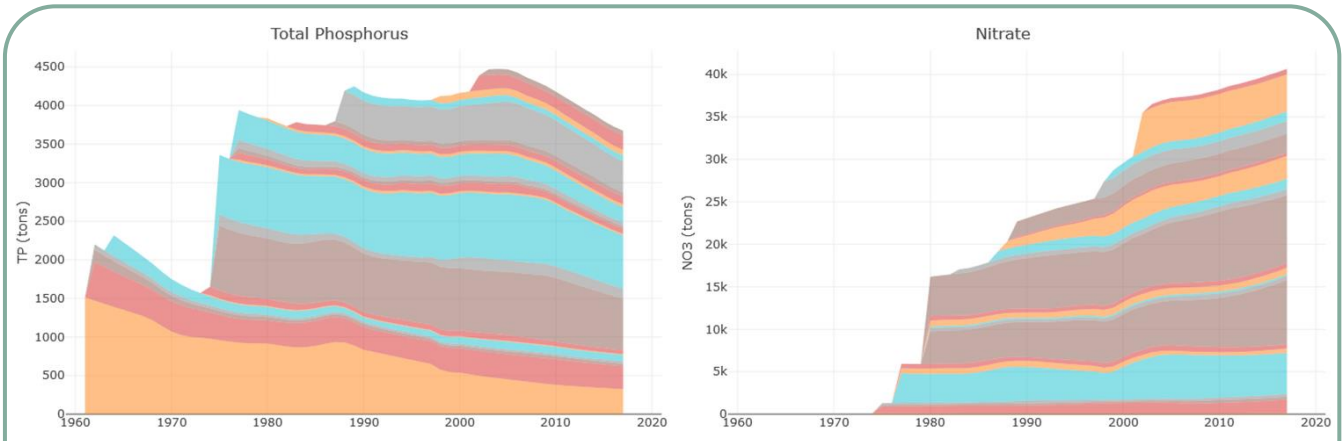


Figure 20. Total phosphorus and nitrate (as N) loads (flow-weighted, i.e., corrected for variation in discharge) from Wisconsin's 23 non-nested river sites in the Long-Term Trend Monitoring Network. Sites are added to the plot temporally as they were added into the network, colors indicate different monitoring sites. For any given site, the trend is indicated by the thickness of the bar, the trend among all sites is indicated by the slope of the uppermost line of all the bars. A compression of the thickness of a bar over time, like those seen in the phosphorus plot on the left, illustrates watershed-specific loading reductions, whereas an expansion of the thickness of a bar, like those in the nitrate plot on the right, illustrates watershed-specific loading increases. Loads were estimated using WRTDS models.

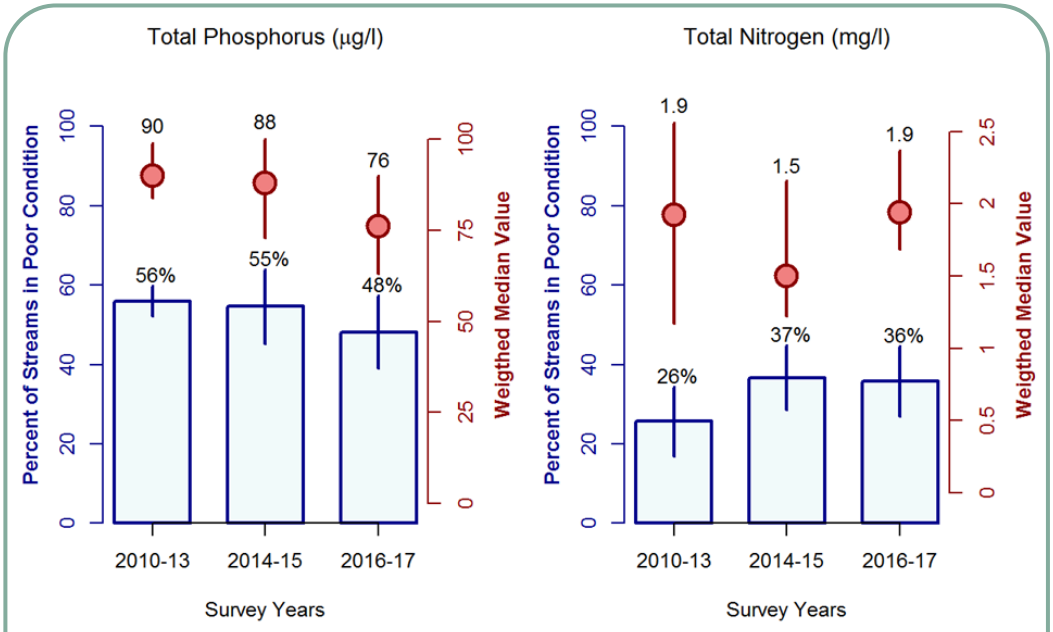


Figure 21. Results from probability-based surveys of Wisconsin's wadeable streams. Blue bars (left-hand y-axis) represent the percent of streams in "Poor" condition and the red circles (right-hand y-axis) are the weighted annual median concentration among all streams.

appeared to be lower total phosphorus concentrations where the percent of streams in poor condition and the annual median value decreased by approximately 8% and 13 µg/l, respectively (Figure 21). For total nitrogen, the percent of streams in poor condition increased from the first survey to the second two surveys (26-36%), but the median stream value showed no consistent pattern, including large confidence intervals within each survey. This shows that the number of streams with very high nitrogen concentration increased, even though the central tendency was variable. Nitrogen has a complex biogeochemical cycle; therefore, it is not surprising that nitrogen provides uncertain estimates within and among surveys. Although there is considerable variation among surveys, probability-based surveys are likely the best way to assess condition and track trends among a resource as large as wadeable streams in Wisconsin. Considering the uncertain estimates, a much longer time-frame will be needed before definitive trends can be detected for phosphorus and nitrogen in Wisconsin's wadeable streams.

1.4 Progress toward meeting the goals of the Gulf Hypoxia Task Force

The Gulf Hypoxia Task Force Action Plans (MRGMWNTF, 2001, 2008) called for a 45% reduction in both total nitrogen and total phosphorus for all contributing areas to the Mississippi River Delta. To track progress, the Wisconsin Nutrient Reduction Strategy (WDNR, 2013) estimated Wisconsin's baseline total phosphorus load in 1995 (to be consistent with the baseline year in the Gulf Hypoxia Action Plan), and the progress made toward meeting the 45% reduction for the year 2009, for both the point and nonpoint source contributions within the Mississippi River Basin side of Wisconsin. The report estimated a total reduction of 23% between the years of 1995 and 2009 (Figure 22), however the methods for determining this reduction at the time were limited (assumed 100% delivery of point source loads, and a coarse-level estimate of uniformly 10% reduction of nonpoint loads based on implementation of best-management practices). We now have greater coverage of the Mississippi River Basin with long-term water quality sampling, as well as improvements in load modeling, particularly the flow-normalization calculations that are implemented in the WRTDS model framework.

To estimate progress toward the goal of 45% reduction in total phosphorus, we used an improved approach that more accurately estimates the Wisconsin contribution to the Mississippi River Basin. There are 12 Long-Term Trend Sites within the Mississippi River Basin in Wisconsin, over which 83% is covered by the watersheds above these sites. For the year 2018, we estimated a flow-normalized load at each of these sites, and assumed the same proportional yield (tons/acre/yr) for the remaining 17%, resulting in a total of 3,803 tons per year, or a 20% reduction from the baseline 4,778 tons in 1995 (Figure 22). This load reduction is less than what was originally

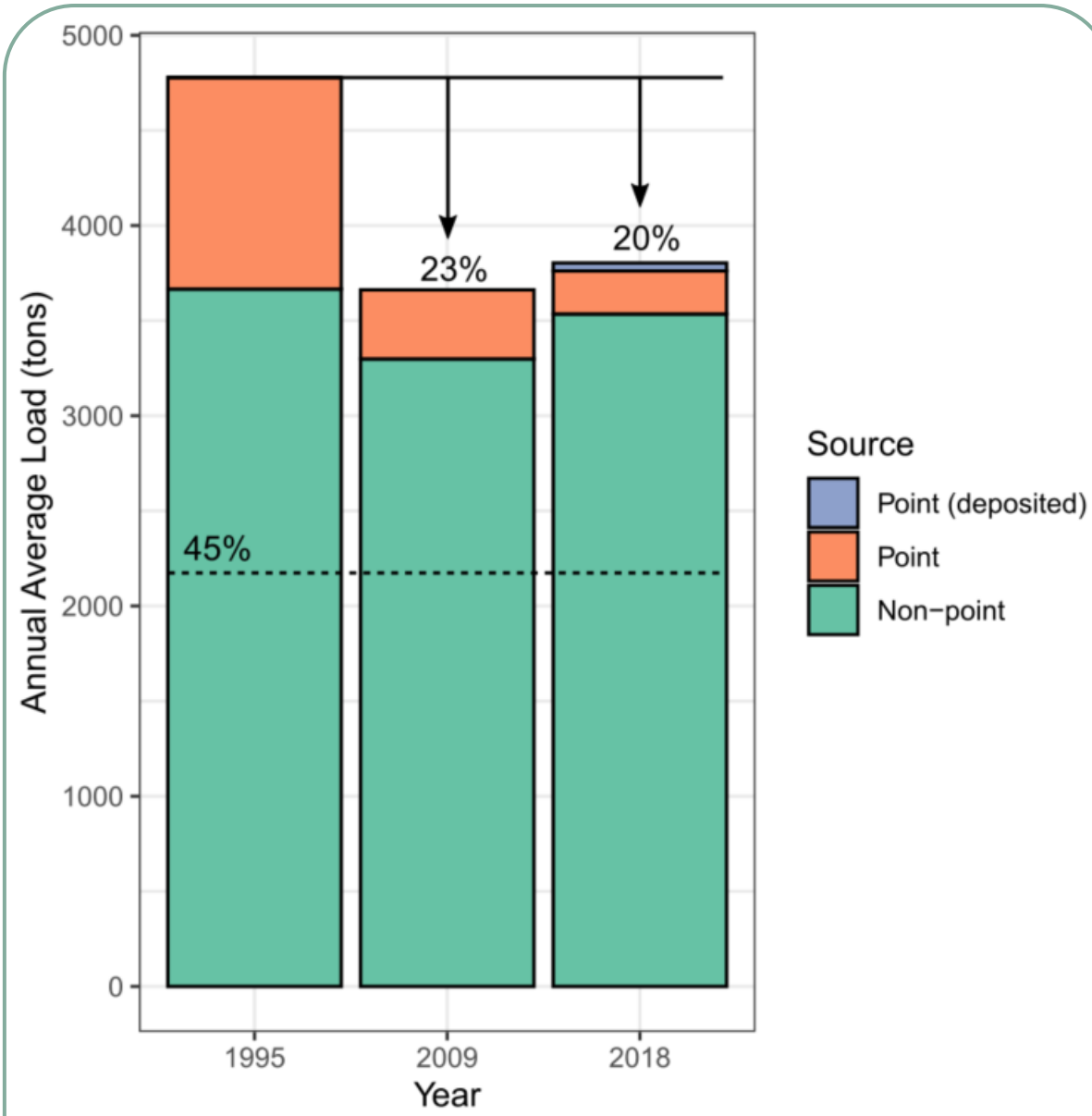


Figure 22. Progress toward meeting the 45% total phosphorus reduction goals established in the Gulf Hypoxia Task Force Action Plans (MRGMWNTF, 2001, 2008). The original Nutrient Reduction Strategy Report (WDNR, 2013) estimated a 23% reduction between the years of 1995 and 2009 using coarse-level estimates for loading. We have more recently estimated loading reductions from 1995 to 2018 to be 20%, less than what was estimated for 2009; however the methods used for 2018 are more accurate than those that were used for 2009. "Deposited" refers to the estimated fraction of point source load that is not delivered to the Mississippi River.

estimated for 2009, however the disparity may be associated with simply better data and tools for estimating loads, rather than a backsliding from reaching the reduction goal.

A relatively small fraction of the overall load discharging into the Mississippi River comes from point sources. If all point source loads were summed for the year 2018 using monitored flows and concentrations at point source outfall locations (an accurate measure of point source loading), the resulting total within the Mississippi River Basin is 268 tons/year (7% of the total 3,803 tons), assuming 100% delivery from the outfall location to the Mississippi River. Because some of the load will be deposited before reaching the Mississippi River, we can improve upon this estimate by reducing the load for each point source by an estimated delivery ratio, where the delivery is lessened by reservoirs, particularly those with greater residence times (Robertson and Saad, 2011). Using this approach, the delivered point source load to the Mississippi River was estimated as 226 tons/year (6% of the total)—the 1% that was not delivered is shown as deposited point source load in Figure 22.

1.5 Harmful Algal Blooms

1.5.1 Cyanotoxin-related illness

The Wisconsin Department of Health Services/Division of Public Health (WDPH) receives HAB-related illness complaints as part of the Wisconsin Harmful Algae Bloom (HAB) Surveillance Program. An illness complaint can involve multiple individuals, for example if several children in a family were sickened after swimming in water containing a harmful algal bloom. Cases are evaluated by WDPH epidemiologists and in instances when symptoms are consistent with cyanotoxin exposure and complaints are reported soon after exposure, WDNR staff collect Response Monitoring samples in the waterbody for case investigations.

2017: 16 complaints (10 human, 6 animal); 7 possibly related to cyanobacteria.

2018: 25 complaints (24 human, 9 animal); 15 possibly related to cyanobacteria.

2019: 17 illness complaints (19 human, 10 animal); 8 possibly related to cyanobacteria.

Because cases are often reported well after HAB exposure, the complaints that are "possibly related to cyanobacteria" encompass cases with a known possible exposure and which are evaluated and categorized as:

Suspect- symptoms reported are consistent with cyanotoxin exposure;

Probable - symptoms and environmental conditions reported are consistent with cyanotoxin exposure;

Confirmed - symptoms and environmental conditions reported are consistent with cyanotoxin exposure and environmental and/or clinical test results.

Human cases of cyanobacteria and cyanotoxin poisoning became required reporting Category II diseases for Wisconsin in July 2018. Animal cases are not required reporting conditions and are likely under-reported.

1.5.2 Harmful algal bloom occurrences reported to WDNR 2017-2019

There is no formal definition for what constitutes a cyanobacterial harmful algal bloom. Usually a HAB is understood to mean a large-scale increase in planktonic cyanobacterial cell density in response to favorable environmental conditions, particularly elevated phosphorus and nitrogen, resulting in visibly discolored water or the formation of surface scums. In mesotrophic and oligotrophic systems with low nutrients and usually low cyanobacterial densities, wind-driven accumulations can form very localized bloom conditions. Growths of cyanobacterial mats that are normally benthic can float to the surface following disturbance or prolific oxygen production in clear water. Finally, macroscopic globular colonies of *Aphanothece* and *Nostoc*, normally growing in benthic or metaphytic habitats, may form noticeable floating accumulations that may be interpreted as blooms.

Blooms and other nuisance accumulations of cyanobacteria are often reported to WDNR staff. Starting with the summer 2018 bloom season, the public could report blooms via a HAB-specific email address, DNRHABS@wisconsin.gov. While it is not practical to expect to capture comprehensive bloom occurrence statewide via public reporting, voluntary reporting does allow us to acquire information about smaller-scale events and blooms in small waterbodies, both of which are often beyond the resolution of satellite imaging which requires a minimum lake diameter of 900 meters for valid data.

Table 3. Planktonic blooms and other cyanobacterial accumulations reported to WDNR in 2017-2019.

Year	*Planktonic blooms*	*Wind-driven accumulations*	*Floating benthic mats & material*	*Macroscopic Aphanothece & Nostoc colonies*
2017	23	4	1	0
2018	36	5	13	1
2019	40	16	8	2

These data include direct reports from the public, municipal and county partners, and other state agencies. They are provisional and should not be considered a comprehensive representation of bloom occurrence in Wisconsin in the years from 2017 to 2019. While bloom reporting increased from 2017 to 2019, this may be due to greater awareness of blooms by the public and access to new reporting methods, rather than increases in actual bloom occurrence.

Planktonic blooms were reported most often from shallow, eutrophic lakes. Many of the water bodies from which blooms were reported in 2017-2019 are within watersheds which are already recognized as having high nutrient levels and are part of Wisconsin's Total Maximum Daily Load projects.

Blooms of *Dolichospermum lemmermannii* (formerly *Anabaena lemmermannii*) were reported in 2017 and 2018 from the nearshore zone of Lake Superior in Bayfield County. The 2017 bloom was restricted to the sea caves region but the 2018 bloom was much larger and garnered national media attention. Researchers are currently investigating links between the Lake Superior blooms and flooding events, nutrients, water temperature, and *Dolichospermum* propagules that may be transported from inland rivers and lakes to Lake Superior during flooding.

WDNR is in the early stages of developing methods for evaluating bloom occurrence using remotely sensed satellite data. When operational, WDNR's semi-automated methods for remote bloom sensing will provide a synoptic view of statewide bloom occurrence in Wisconsin's 150-180 largest lakes.

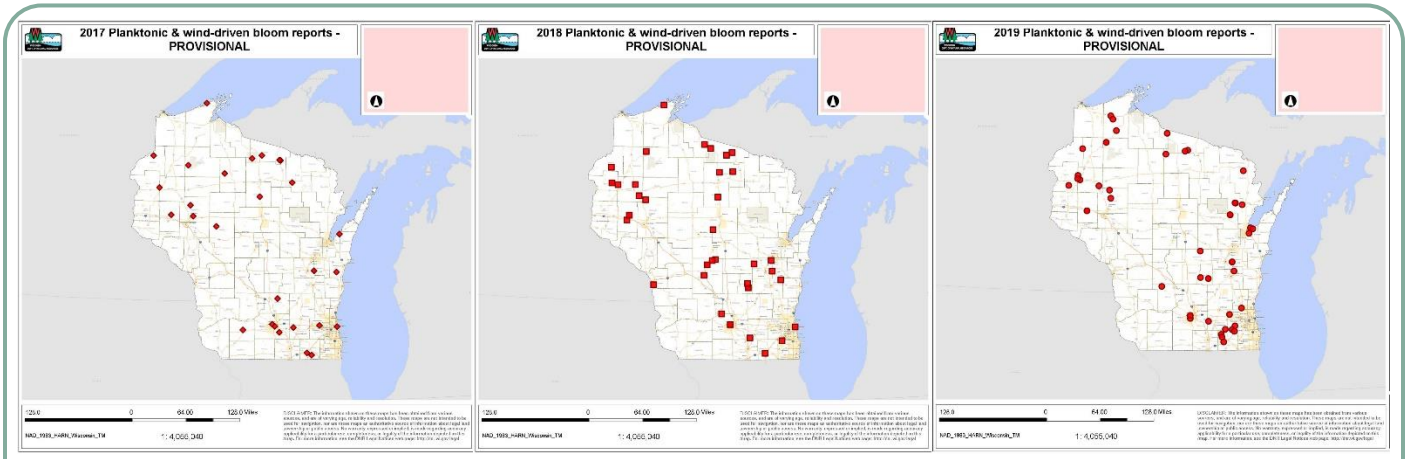


Figure 23. Distribution of planktonic bloom and wind-driven accumulation reports to WDNR in 2017-2019. These are provisional data and should not be considered a comprehensive depiction of statewide bloom occurrence.

1.6 Clean Water Act Section 303(d) List (Impaired Waters)

Assessing waterbodies against water quality standards and identifying impaired waters that do not meet standards is part of the overarching federal Clean Water Act framework for restoring impaired waters. Waters that do not meet their designated uses because of water quality standard violations are impaired. Waterbodies are removed from the list when new data indicates that water quality standards are attained.

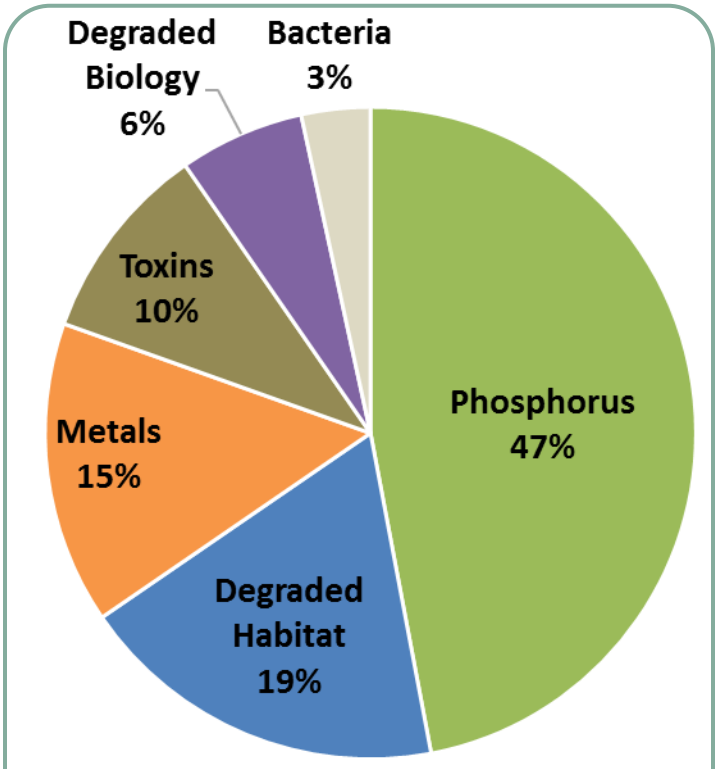


Figure 24. Pollutant groups on the 2018 impaired waters list.

The full 2018 list has 1,957 pollutant/impairment listings. Of those listings a large portion, 47%, are for total phosphorus (Figure 24). The majority of pollutant listings prior to 2012 were for mercury, but this does not mean that total phosphorus has become an issue in just the past 6 years. Phosphorus is recognized as the controlling factor in plant and algae growth in Wisconsin's lakes and streams; waters with excess algal growth have been an issue for decades. In an effort to protect human health surface water quality, criteria for total phosphorus were enacted in 2010. From the 2012 cycle on impairment assessments have compared water quality data against the phosphorus criteria in code, which has allowed for the objective identification of waters that are impaired

for total phosphorus. With these waters identified, the issues associated with high levels of phosphorus can be addressed with the help of grant money aimed at listed waters (USDA Environmental Quality Incentives Program, Targeted Runoff Management (TRM) grants, EPA Section 319 Grant, among others).

Chapter 2. Nutrient Reduction Through Point Source Programs

2.1 WPDES Program

Nutrients discharged to water from point sources are under state and federal regulation. Through the use of Wisconsin Pollutant Discharge Elimination System (WPDES) permits, phosphorus levels in the discharge from a point source are limited under the permit according to the applicable water quality criterion for phosphorus and/or by the Waste Load Allocation established by a Total Maximum Daily Load (TMDL) for the receiving waterbody. Before 2010, most wastewater dischargers had a technology-based phosphorus limit of 1 mg/L. New permit limits (whether a Water Quality Based Effluent Limit (WQBEL), or TMDL load limit) are incorporated as WPDES permits are renewed every five years. With promulgation of 2010 phosphorus rules, water quality criteria were adopted into ch. NR 102 Wis. Adm. Code. Almost 80% of all WPDES permittees face more restrictive phosphorus limits than previously applicable under technology-based limits. Of these, 60% of phosphorus WQBELs are set equal to the phosphorus criterion. Although Wisconsin does not currently have a water quality criterion for nitrogen, WPDES permits for municipal majors in the Mississippi River Basin issued since November 2012 contain a requirement for quarterly effluent monitoring for total nitrogen.

Wisconsin permittees have the option of complying with new phosphorus permit limits through improved controls or through adaptive management or water quality trading. Regardless of the compliance option chosen, most point sources have compliance schedules that extend beyond one permit cycle. If the above compliance options are not cost-effective, WPDES permittees may pursue an individual phosphorus variance or they may be eligible for the multi-discharger variance, described later.

A first step that most point sources are taking to reduce phosphorus is to optimize existing equipment for phosphorus removal. Many variance provisions or alternative strategies dictate some form of phosphorus removal occur at a facility.

Fond du Lac Optimization Success

Fond du lac Wastewater Treatment and Resource Recovery Facility (WTRRF) receives an average of 8MGD. It uses biological nutrient removal for ammonia control, and a combination of either biological phosphorus removal or chemical treatment to achieve its current 1.0 mg/l phosphorus limit. Fond du Lac was preparing to receive a stringent WQBEL of 0.04 mg/l and 3.3 lbs/day under the pending TMDL for the Upper Fox/Wolf River Basin. Fond du Lac spent several years evaluating various options: tertiary treatment technologies, chemical types, chemical optimization, and watershed options. One constant objective throughout this process was to do everything possible for phosphorus removal.

The plant went through a large reconstruction in 2008 that included installation of an MLE Activated Sludge process for nitrification/denitrification with chemical phosphorus removal. It was not set up to biologically remove phosphorus. There is also a large industrial load to the plant that fluctuates quite regularly creating inconsistent biological phosphorus removal (bio-p). Plant staff made the decision to promote biological phosphorus removal as much as possible and add chemical as necessary. Promoting bio-p started out by profiling the entire process for total and ortho-phosphorus and chemical oxygen demand (COD). Eventually the focus became breaking down phosphorus into its different fractions and identifying that there was a high level of soluble non-reactive phosphorus which is very difficult to remove. By performing more sampling of the process and the different wastes accepted, the source of phosphorus was identified and the different fractions following treatment were evaluated. Fond du Lac staff found through profiling that more "food" (COD) was needed to achieve the necessary ratio for bio-p to occur. Various changes were made to improve this, and optimization efforts were made to free up as much carbon for bio-p as possible. In 2020, the plant will be installing a struvite sequestration system to prevent struvite from forming in pipes and digesters, and to remove some of the sidestream phosphorus to the mainstream. Staff say "It has been a long road to get where we are, but **our efforts have paid off in that we have seen an average effluent phosphorus reduction of nearly 60%.**"

2.2 Adaptive Management

Adaptive management is a phosphorus compliance option that allows point and nonpoint sources (e.g. agricultural producers, non-regulated stormwater utilities, developers) to work together to improve water quality in those waters not meeting phosphorus water quality standards. This option recognizes that the excess phosphorus accumulating in our lakes and rivers comes from a variety of sources, and that reductions in both point and nonpoint sources are frequently needed to achieve water quality goals. By working in their watershed with landowners, municipalities, and counties to target sources of phosphorus runoff, point sources can minimize their overall investment while implementing actions to enable the receiving water to achieve its water quality criterion.

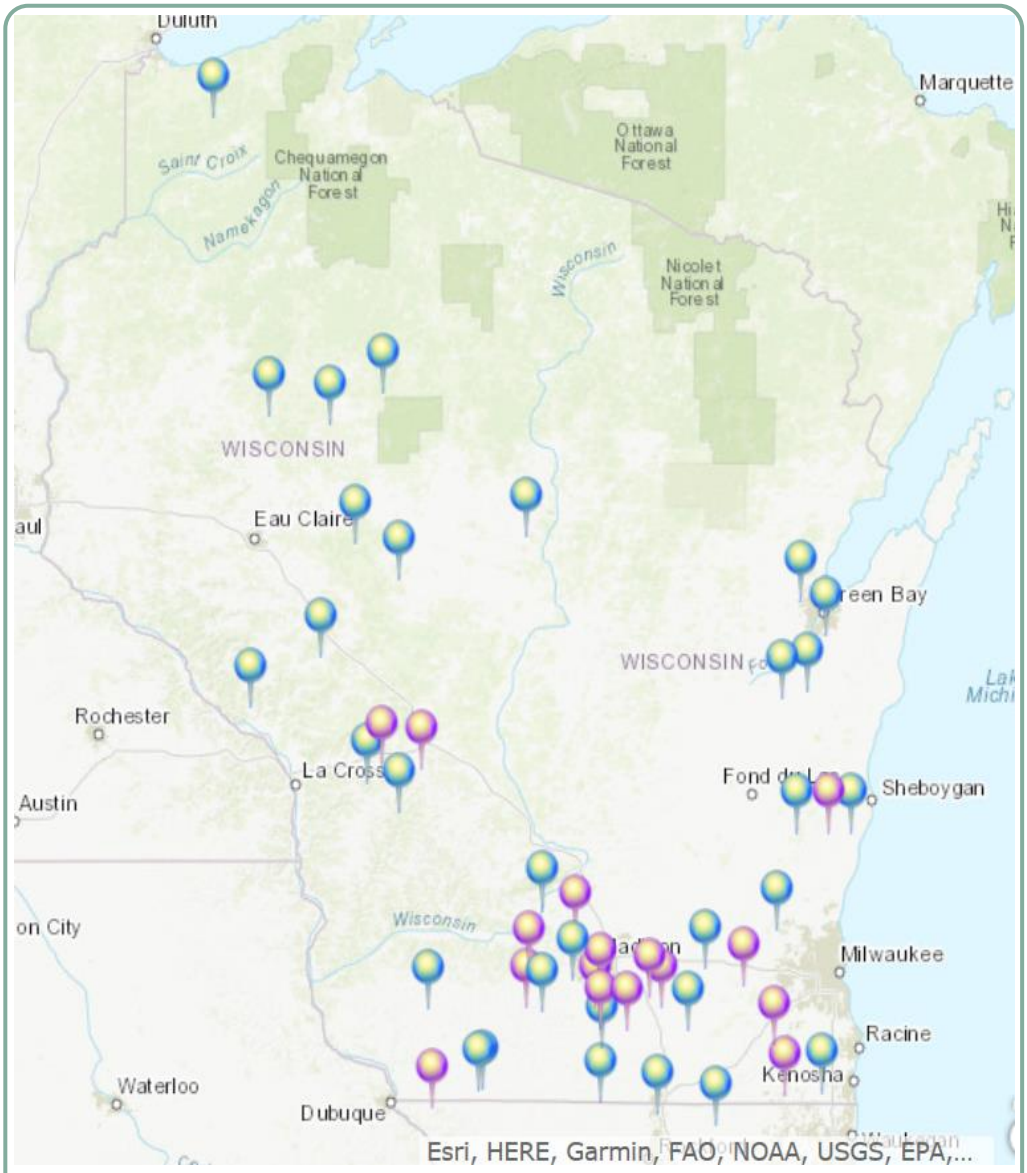


Figure 25. Adaptive Management and Water Quality Trading project locations.

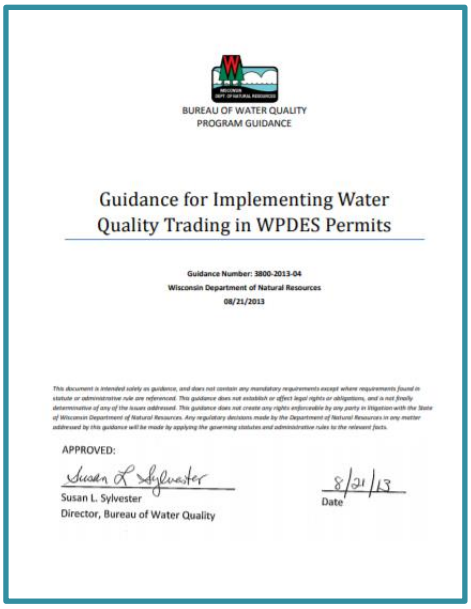
The clear environmental and economic benefits of the adaptive management approach have been recognized by communities across Wisconsin. As of 2019, 21 municipal wastewater facilities have undertaken an adaptive management effort. These permittees will work to curtail roughly 30,000 lbs/year of phosphorus loading within their watersheds over the next five-year permit term. The 20-year goal for these projects (to restore their receiving water to the WQ criterion) requires a reduction of over 200,000 lbs/year.

The Adaptive Management Technical Handbook is available to help describe adaptive management and how to develop a successful adaptive management strategy:
http://dnr.wi.gov/topic/surfacewater/documents/adaptivemanagmenthandbooksigned.pdf

2.3 Water Quality Trading

Water Quality Trading (WQT) may be used by WPDES permit holders to demonstrate compliance with WQBELs. Generally, water quality trading involves a point source that is facing relatively high pollutant reduction costs compensating another party to achieve less-costly pollutant reduction with the same or greater water quality benefit. In other words, water quality trading provides point sources with the flexibility to acquire pollutant reductions from other sources in the watershed to offset their point source load so that they will comply with their own permit requirements. In Wisconsin, stringent phosphorus and total suspended solids (TSS) limits drive interest in WQT. Given the options for controlling these pollutants on the landscape, the vast majority of all trades involve nonpoint source pollutant reductions.

Statewide, WPDES permittees and their consultants are gaining experience in establishing relationships with credit generators (nonpoint sources), quantifying nonpoint source pollution reductions, and executing projects in tandem with permit deadlines. As of 2019, over 40 permittees have formally indicated that WQT will be used to comply with phosphorus limits. Of these, 23 permittees have submitted an approvable water quality trading plan to WDNR. The average phosphorus reduction for each trade is roughly 800 lbs/year, and with the average trade ratio of 2:1, the average point source credit user applies approximately 400 lbs/year of credit to offset its point source discharge. The most frequently used nonpoint source best management practices include conversion of row crops to perennial prairie vegetation and streambank stabilization. Stormwater practices, buffer strips, and cropping practices have also been used to generate credits.



BUREAU OF WATER QUALITY
PROGRAM GUIDANCE

Guidance for Implementing Water Quality Trading in WPDES Permits

Guidance Number: 3800-2013-04
Wisconsin Department of Natural Resources
08/21/2013

This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

APPROVED:

Susan L. Sylvester
Director, Bureau of Water Quality

8/21/13
Date

The provisions of all water quality trades are incorporated into the discharger's WPDES permit, with a monthly accounting process for the use of pollutant credits. All nonpoint source best management practices are inspected regularly and conform to an NRCS or WDNR performance standard. Many practices may prevent multiple pollutants from entering waterways and have ancillary benefits such as atmospheric carbon reduction or improved habitat or aesthetics.

The guidance describes water quality trading and how to develop a successful trading strategy.

2.4 Wisconsin's Multiple Discharger Variance for Phosphorus

Point source compliance with restrictive WQBELs frequently requires substantial capital investments, yet only targets a small fraction of the total phosphorus loading entering many Wisconsin surface waters. To help dischargers work towards compliance in a more equitable manner, Wisconsin adopted a multiple discharger variance (MDV) for phosphorus. EPA approved the phosphorus MDV on February 6, 2017. The MDV allows eligible point sources a longer timeframe (up to 20 years) to comply with low phosphorus limits while making strides in water quality improvement within the watershed. The concept of a watershed phosphorus offset is employed as a source reduction measure and applies economy of scale to support reduction of agricultural nonpoint source pollution at the watershed scale. A discharger may choose to pay $50 per pound (adjusted for inflation) for

phosphorus discharged above a target value (generally 0.2 mg/L). The payment is made available to the county land and water conservation departments (LCDs) within the HUC 8 watershed to provide cost sharing for meeting NR 151 agricultural performance standards. The variance is deemed to have a greater environmental benefit than similar individual efforts to implement source reduction measures.

In 2018, 41 WPDES permittees were covered under the MDV. Collectively, they made $619,000 in payments to 25 LCDs across the State. In 2019, 74 WDPES permittees were covered under the MDV, with approximately $935,000 paid to 34 participating counties. These funds are being put to work statewide reducing nutrient runoff from agricultural lands. MDV coverage is expected to grow in the future, with payment projections exceeding $1 million annually.

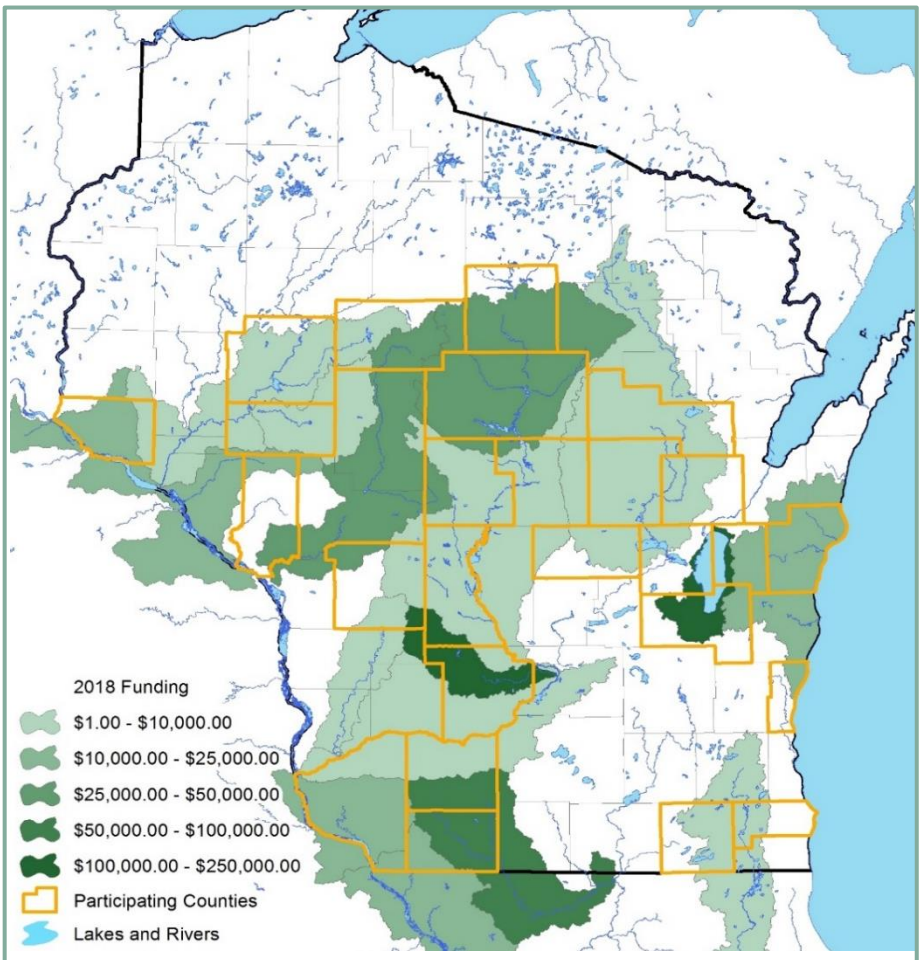


Figure 26. Multi-discharger variance funding 2018; final values by HUC 8 Watershed.

2.5 Changes in Point Source Phosphorus Loads to Wisconsin Waters, 2013-2018

The WDNR Water Quality Bureau has been tracking point source phosphorus loads over the years, as summarized below. The annual load estimates are based on the average daily discharge rate and average daily effluent phosphorus concentration reported over a calendar year by each WPDES permittee that is required to monitor phosphorus. The annual loading has been decreasing over the period of record (1995-2018). In summary, the total point source loadings to the Great Lakes and Mississippi Basins in 1995 were estimated at approximately 4 million pounds, while in 2016 they were 946,700 pounds, in 2017 they were 900,700 pounds, and in 2018 they were 958,700 pounds. Over the period of record, the annual point source loadings will have decreased by about 70% percent or about 2,788,100 pounds per year

Table 3 . Point Source Phosphorus Loading Summary 2018; total discharges, all values in units of thousand pounds per year.

BASIN	1ST Year Loading	POINT SOURCE ANNUAL LOADING BY YEAR										Change from 1st Year	% Change from 1st Yr
		2000	2004	2008	2012	2013	2014	2015	2016	2017	2018		
OUTSIDE GREAT LAKES													
ST. CROIX	47.1	30.1	18.6	19.3	15.1	13.7	14.1	12	8.8	10	10.7	-36.4	-77%
UPPER CHIPPEWA	50.2	43.4	40.6	30.6	18.9	20.6	25.4	17.1	18.1	19.2	18.1	-32.1	-64%
LOWER CHIPPEWA	112.9	75.5	66	59.9	52.2	54.4	59.7	46.3	33.2	35	34.3	-78.6	-70%
BLACK, BUFFALO, TREMPEALEAU	124.9	56.3	55.1	27.6	21	23.4	25.5	24.2	20.2	19.3	22.2	-102.7	-82%
LA CROSSE - BAD AXE	430	36.9	40.2	43.6	36.2	33.4	30.8	27.4	21.2	23.4	25.5	-404.5	-94%
UPPER WISCONSIN	702.9	506.6	377.8	278.9	191.9	186.1	185.8	160.8	127.8	125.1	136.6	-566.3	-81%
LOWER WISCONSIN	145.5	107.8	49.6	58	40.8	48.3	40.2	35.9	40.9	28.3	47.6	-97.9	-67%
SUGAR - PECATONICA	47.1	35	38.9	32.1	20.3	32	19.5	17.2	19.3	18.8	20.7	-26.4	-56%
GRANT- PLATTE	34.7	32.1	16.2	24.5	16.3	17.1	17.7	19.9	14.4	13.9	15.2	-19.5	-56%
UPPER ROCK	364.9	334.9	94.6	70.7	48.6	62.1	56	51.8	54.1	56.8	58.1	-306.8	-84%
LOWER ROCK	332.2	300.1	169.1	155.4	103.1	105.7	100	106.7	102.1	103.6	113.9	-218.3	-66%
FOX (ILLINOIS)	77.9	64.5	47.5	56.7	45.4	51.1	44.2	44.4	40.7	39	40.7	-37.2	-48%
GREAT LAKES													
LAKE SUPERIOR	22.4	14.3	18.5	18.7	14.2	18.8	20.2	17	14.2	16.2	12.8	-5.4	-24%
WOLF	60.9	38.5	35.8	31.4	25	26.3	26.7	25	15.2	14.8	16.7	-36	-59%
UPPER FOX (WI)	54.3	57.6	61.4	63.9	59	61.8	48.4	40.7	32.1	31	28.2	-13.6	-25%
LOWER FOX (WI)	294.6	173.7	191.8	193.7	132.5	130.5	152.4	120.4	118.9	91	95.1	-174.1	-59%
UPPER GREEN BAY	67.9	40.2	46.8	28.1	16.5	18.7	20.2	20.3	10.4	10.7	9.6	-47.7	-70%
SHEBOYGAN	46.5	37.4	40.1	43.4	26	32.9	32.8	31.2	35	34.6	34.7	-15.3	-33%

BASIN	1ST Year Loading	POINT SOURCE ANNUAL LOADING BY YEAR										Change from 1st Year	% Change from 1st Yr
		2000	2004	2008	2012	2013	2014	2015	2016	2017	2018		
DOOR - TWIN - MANITOWOC	63	52	48.8	45.9	31.5	31.4	29	27.6	24.3	25.4	28.2	-35.3	-75%
MILWAUKEE	707.7	405.4	339.1	339.9	233.1	243.9	264.8	254.7	250.5	247.2	260.4	-453	-64%
ROOT - PIKE	178.6	87.8	113.1	105.9	79.8	96.5	88.4	87.7	82.2	70.6	68.5	-91	-51%
TOTALS													
OUTSIDE THE GREAT LAKES BASINS	2470.5	1623.3	1014.2	859.3	606.8	646.9	618.9	573.7	500.8	492.4	543.6	-1926.9	-78%
GREAT LAKES BASINS	1495.9	907.6	895.4	870.9	617.6	660.8	682.9	604.6	582.8	541.5	554.2	-891.3	-60%
ALL FACILITIES	3966.4	2530.9	1909.6	1730.2	1224.4	1307.7	1301.8	1178.3	992.6	946.2	998.5	-2788.1	-70%

2.6 CAFO

Concentrated Animal Feeding Operations (CAFOs) are required to operate under a WPDES permit. Ch. NR 243, Wis. Adm. Code, outlines the requirements of WDNR's WPDES permit program for CAFOs. A large CAFO is a livestock operation that has 1,000 "animal units" or more—the equivalent of 700 milking cows, 1,000 beef steers or 55,000 turkeys. There are currently 303 permitted large CAFOs in Wisconsin. The WDNR issues approximately 14 new CAFO permits every year. There are currently another 26 first-time applications at some stage of the permitting process. The WDNR can also require operations with fewer than 1,000 animal units to obtain a WPDES permit based on discharges. There are currently 7 operations with fewer than 1,000 animal units covered under a WPDES permit. Ninety percent of the permitted CAFOs are dairy operations.

CAFO production areas (areas where animals are housed and feed, manure, or process wastewater are stored) are required to meet restrictive discharge limitations. WPDES permits require that CAFOs have zero discharge of pollutants to navigable waters from the production area except under limited circumstances related to precipitation.

CAFO buildings.

Existing or proposed CAFOs must submit plans and specifications for reviewable construction projects to the WDNR for approval. The WDNR also reviews evaluations of existing structures when required as part of a permit application or permit construction schedule. WDNR review of proposed structures and evaluations of existing structures ensures that constructed facilities meet applicable design standards and minimizes the potential for discharges to surface and ground waters. 2018 marked the second consecutive year that the CAFO program emphasized review of evaluations of existing structures. Evaluations play a critical role in WPDES permitting because they often determine if a storage structure or other reviewable system can continue to be used or if the facility needs to be upgraded, abandoned, or replaced due to water quality concerns. The number of evaluations the WDNR reviewed roughly tripled in 2017 and 2018 compared to previous years.

The increase in the number of permitted CAFOs on an annual basis means that every year additional acres in the state come under WPDES nutrient management plans (NMPs) and associated land spreading requirements for manure and process wastewater. CAFO NMP requirements include restrictions that are more stringent than nonpermitted livestock operations, particularly in limiting application on frozen or snow-covered ground and implementing additional practices when land spreading near streams, lakes and their conduits. As of 2018, approximately 1,136,190 acres of cropland were covered under CAFO NMPs. For reference, there were approximately 1,065,587 and 884,879 acres covered under CAFO NMPs in 2017 and 2014, respectively.

NR 243 was updated on July 1, 2018, to reference the state's Silurian Bedrock Performance standard. The rule was developed in response to groundwater studies that showed high percentages of wells contaminated by fecal bacteria in northeast Wisconsin. Prevention of manure pathogens entering groundwater was the main goal behind the changes. For CAFOs in the targeted area permitted before July 2018, the new regulations on fields in Silurian bedrock areas will be incorporated at permit reissuance.

The WDNR added two additional CAFO regional staff in 2017 and recently received approval to add 4 positions to the CAFO program. Additional CAFO staff improve the WDNR's ability to conduct review of submittals (e.g., NMPs and engineering plans), ensure permits are reissued in a timely manner, and conduct compliance inspections in order to prevent or respond to discharge issues.

2.7 Stormwater Management

Stormwater discharges from certain municipal separate storm sewer systems (MS4s), industrial facilities, and construction sites are regulated as point sources under the WPDES stormwater permit program, typically through general permits (several MS4s are covered under individual stormwater permits). Currently, an industrial facility covered under a stormwater general permit is not given a specific wasteload allocation in an approved TMDL unless the WDNR identifies the facility as a significant source of a pollutant of concern. However, these facilities are required to develop a site-specific stormwater pollution prevention plan that addresses pollutants associated with the facility. Accordingly, if a facility has outdoor exposure of equipment, industrial processes or activities, feedstock, final product, waste materials, etc., that are sources of nutrients identified as a pollutant of concern, its stormwater pollution prevention plan is required to address those sources through source area pollution prevention controls and stormwater best management practices to reduce, with the goal of eliminating, the stormwater discharge of that pollutant.

MS4s and construction sites permitted under their respective stormwater permits are required to meet certain WDNR-established performance standards for stormwater runoff that aid with reducing the discharge of nutrients. Like an industrial facility, a construction site covered under a stormwater general permit is not given a specific wasteload allocation under a TMDL unless WDNR identifies the site as a significant source of a pollutant of concern. However, the construction site and post-construction performance standards require the design and implementation of best management practices that reduce the discharge of sediment during construction and the discharge of total suspended solids after construction is complete. Meeting these performance standards through the implementation of best management practices reduces the discharge of nutrients that bind to sediment and total suspended solids by preventing mobilization and facilitating capture of these particles prior to discharge. To assist permittees with meeting the construction site and post-construction performance standards, the WDNR has created a series of peer-reviewed technical standards for effective best management practices to reduce the discharge of pollutants.

Along with the six minimum control measures established by the USEPA, the WDNR's "developed urban area performance standards" apply to all permitted MS4s and are implemented through the MS4 stormwater permit program. In addition to meeting these performance standards, permitted MS4s discharging to an impaired waterbody with an approved TMDL are assigned specific wasteload allocations for the pollutant(s) of concern.

The developed urban area performance standards require all permitted MS4s to achieve a reduction in total suspended solids in runoff that enter a water of the state as compared to no controls. A permitted MS4 demonstrates compliance with this performance standard through water quality modeling. By comparing the situation with stormwater controls to no controls, the MS4 can determine if it is meeting the performance standard or if it needs to implement additional best management practices.

Approved TMDLs with an urban component typically address sediment, total suspended solids, and/or phosphorus as the pollutants of concern. Permitted MS4s that are assigned wasteload allocations for these pollutants under an approved TMDL need to assess their level of compliance by determining if existing controls are adequate. If a permitted MS4 is not in compliance based on existing controls, it develops a written plan that describes how it will make progress toward achieving compliance. Elements of the plan include: recommendations and options for stormwater control measures that will be considered to reduce the discharge of each pollutant of concern; a proposed schedule for implementation of the recommendations and options; and a cost effectiveness analysis. The proposed schedule for implementation may extend beyond the five-year term of the permit.

With the reissuance of the MS4 general permit in May 2019, the WDNR has taken an innovative approach to TMDL compliance and implementation for the five-year permit cycle. To accommodate implementation of several TMDLs for different watersheds approved at different times, the WDNR has included three appendices to the general permit that provide options and flexibility to permitted MS4s for developing plans and demonstrating progress towards TMDL compliance. All three appendices include phosphorus reduction goals, expressed as percent reduction from baseline condition, consistent with the particular TMDL and are tailored to the affected MS4s based on the watershed, TMDL approval date, and current level of progress.

Chapter 3. Nutrient Reduction Through Agricultural Nonpoint Source Programs

3.1 Wisconsin Agricultural Performance Standards and Prohibitions

Wisconsin's agricultural performance standards and prohibitions were created to control runoff from agricultural fields, pastures and livestock facilities and are described in ch. NR 151 of Wisconsin Administrative Code. All farmers in Wisconsin must comply with the performance standards and prohibitions (Wisconsin Runoff Rules: What Farmers Need to Know). In some cases, an offer of state cost-sharing for best management practices must be made before a farm is required to comply with NR 151. Concentrated animal feeding operations (CAFO) must comply with additional requirements described in their WPDES permit and ch. NR 243 of Wisconsin Administrative Code. Other programs and tools that are used to implement agricultural performance standards and prohibitions include the Farmland Preservation Program, Livestock Facility Siting rules, and local county ordinances. Farmers must demonstrate compliance to participate in some state and local programs (such as Wisconsin's Farmland Preservation Tax Credit) or to obtain local and state permits (e.g., for livestock siting and manure storage facilities).

In 2018, NR 151 was revised to include a targeted performance standard related to mechanical application of manure over Silurian bedrock areas of the state with shallow soils. This rule identifies the targeted area of "Silurian bedrock" as locations where certain rock formations are overlain by soils of 20 feet or less, and establishes performance standards that will apply. The performance standards in the proposed rule are designed to minimize the risk for pathogen delivery to groundwater, however implementation of these requirements will also reduce the risk of runoff to surface waters. Within the Silurian bedrock area, the rule sets forth manure spreading rates and practices that vary according to the soil depth and texture. The most restrictive practices apply to those limited areas of the highest risk for pathogen delivery (areas with less than 5 feet of soil). Less restrictive requirements apply in areas with 5 to 20 feet to bedrock.

Although NR 151 implementation is a basic element of water quality protection related to agricultural runoff in Wisconsin, implementation success requires **outreach and education** to farmers on water quality best management practices, building **partnerships** to effectively address water quality issues and **financial assistance.**

3.2 Nutrient Management

Nutrient Management Plan (NMP) Development. Developing and implementing an NMP is one of the best practices farmers can use to protect their soil and water resources and farm profitability. The Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) annually tracks NMPs on farms through NM checklists that are submitted from farmers, agronomists, and public agency staff. In 2018, Wisconsin farmers reported 8,220 NMPs on 3.3 million acres covering 36.6% of Wisconsin's 9 million cropland acres (Figure 27).

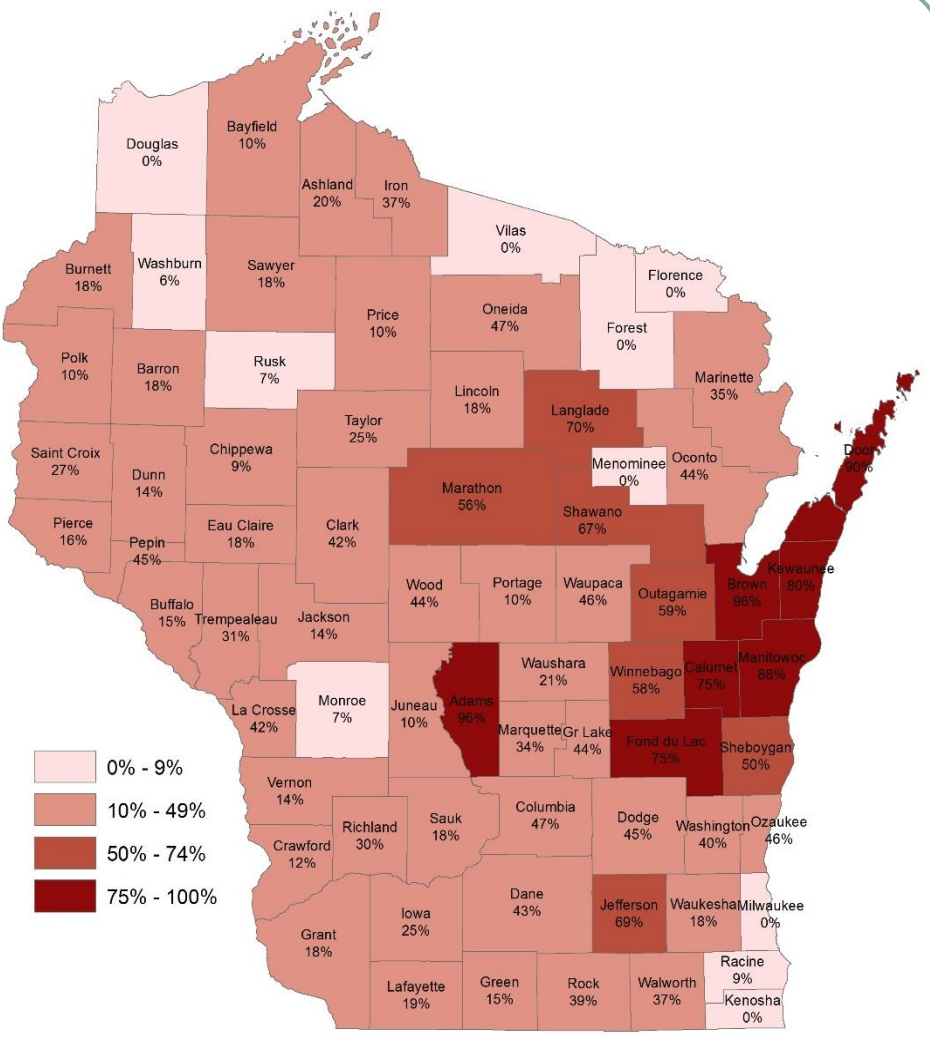


Figure 27. Percentage of cropland acres with Nutrient Management Plans

More information is available in Wisconsin's Nutrient Management Update, produced by DATCP in November 2018.

An NMP follows Natural Resource Conservation Service's (NRCS) WI 590 Nutrient Management

Standard (2015) and accounts for all N-P-K nutrients applied, and planned to be applied, to fields over the crop rotation. The NMP reflects actual crop management practices.

Farms can be required to implement nutrient management if they are: a) offered NMP or manure storage cost-share funds; b) participating in the Farmland Preservation Program; c) regulated by a local manure storage or livestock siting ordinance; d) regulated by a WDNR WPDES permit; or e) causing a significant discharge (Figure 28).

The majority of NMPs in Wisconsin are developed through the state's SnapPlus (Soil Nutrient Application Planner) nutrient management planning software. The software offers farmers a tool to manage on-farm nutrients, make informed commercial fertilizer purchases, and calculate potential soil and phosphorus runoff losses on a field-by-field basis.

Nutrient Management Farmer Education (NMFE) Grants. Each year DATCP awards funding to groups or entities to sponsor training courses in which farmers learn how to write their own NMPs that are compliant with the NRCS 590 NM Standard. The NMFE program allows applications in one of two funding tiers. Tier 1 projects enable farmers to become qualified to write and update their NMPs for four years, after which the farmer must come back through a training course to update their skills and knowledge of NM. Tier 2 projects allow applicants to

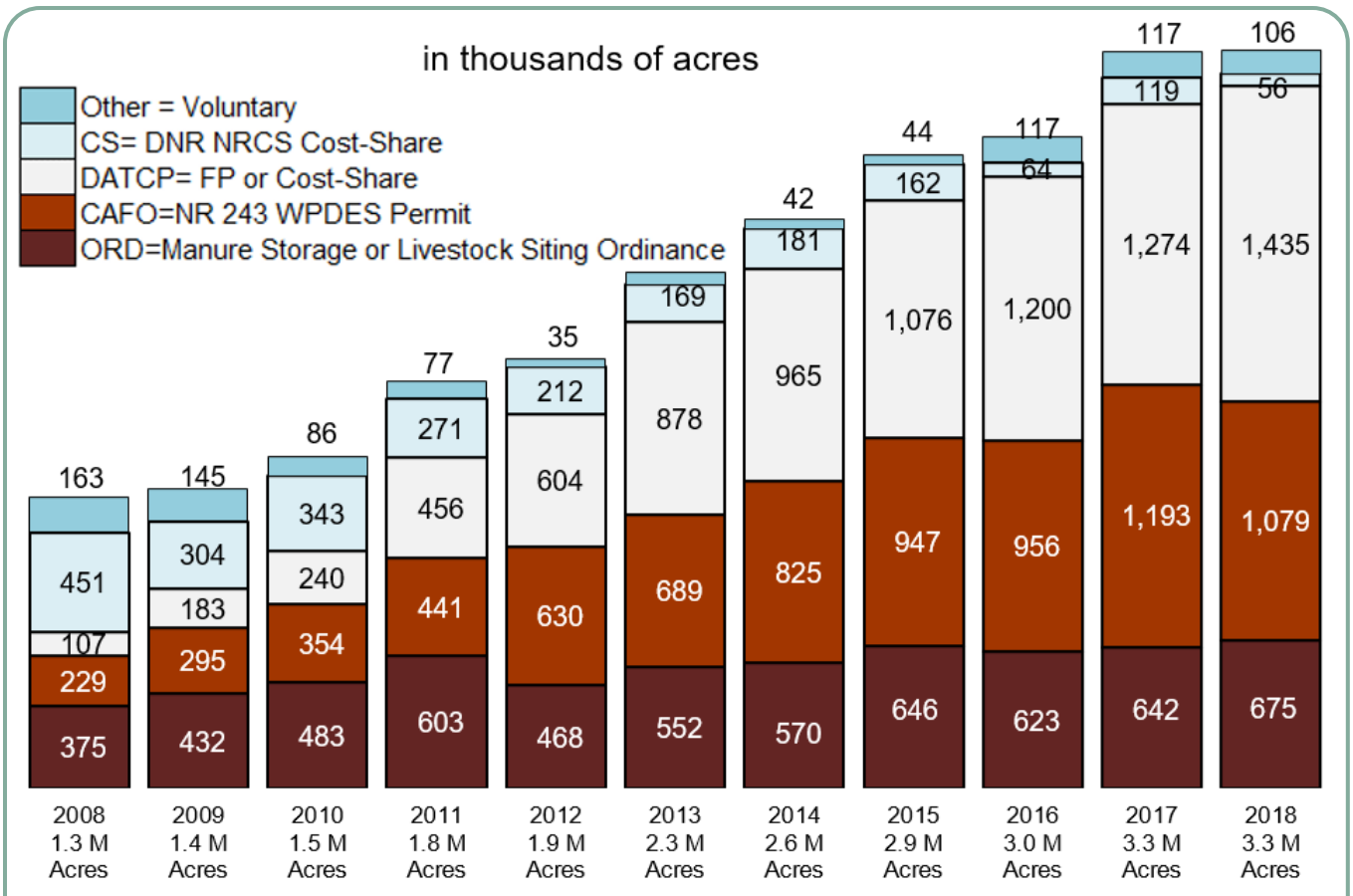


Figure 28. Nutrient management plan acres, derived from NMP checklists reported to WDATCP. USDA-NRCS NMPs on 11,000 acres may not all be included for 2018.

provide training on general nutrient management principles, water quality issues associated with improper nutrient management, and soil health.

For 2018, DATCP awarded fourteen Tier 1 grants and two Tier 2 grants for a total of $206,491. Grant cooperators spent $152,832 of their awards and extended the remainder of their funds into 2019. All grant recipients must sign a contract with DATCP that incorporates the requirements of s. ATCP 50.35 and commit to developing nutrient management plans meeting the NRCS WI 590 Standard.

Mitigating Runoff Risk. DATCP maintains tools to help farmers assess and mitigate risks associated with spreading manure and fertilizer. SnapMaps is maintained to provide an initial inventory of nutrient spreading risks and restriction areas to assist a farmer in planning nutrient applications on vulnerable fields (steep or close to water). The Runoff Risk Advisory Forecast map displays the runoff risk for 72 hours into the future based on precipitation model forecasts, snow accumulation and melt, soil moisture content and temperature. Both tools are available at: http://www.manureadvisorysystem.wi.gov/.

3.3 County Land and Water Conservation Departments

In every watershed where nutrient water quality issues are being addressed, the county conservation departments are providing leadership, outreach, education and technical and financial assistance to farmers in locating cost-share dollars for implementation. Annually, DATCP provides base funding for county technical staff (nearly $9.0 million in 2017 and in 2018, and nearly $9.4 million in 2019 statewide) and landowner cost-sharing as long as counties have DATCP-approved Land and Water Resource Management Plans. The Land and Water Resource Management Plans are 10-year plans that identify resource concerns and county strategies to address these concerns. Each year, counties develop annual work plans that include targets for annual sediment and nutrient reductions that help them achieve the larger goals established in their 10-year plan. These planning activities address many of the nine key elements that WDNR and USEPA look for in a high-quality watershed-based water quality management plan.

3.4 Development/Approval of Nine Key Element Watershed Plans

Watershed-based plans consistent with EPA's nine key elements provide an important framework for improving water quality in a holistic manner within a geographic watershed. These plans, called "Nine Key Element Plans", are a typical pre-cursor in Wisconsin to implementation activities to reduce agricultural losses of nutrients to water. The nine elements identify the contributing causes and sources of nonpoint source pollution (NPS), involve key stakeholders, and prioritize restoration and protection strategies to address water quality problems. The first three elements characterize pollution sources and set goals to address them. The remaining six elements determine specific resources and criteria to implement and evaluate the plan. For agriculture NPS contribution to nutrient impairments, a common strategy used by watershed-based plans is to use modeling tools such as SNAP+ or STEPL to estimate current and future agricultural pollutant loads and use WDNR's EVAAL tool with other watershed inventory data to identify critical areas within the watershed where nutrient losses to surface or ground water are projected to be the highest. These critical areas can then be targeted for agricultural BMP adoption. Having an approved Nine Key Element watershed plan is a prerequisite in Wisconsin to accessing federal 319 grant funds and some state funding for plan implementation.

The watersheds shown in Figure 29 have WDNR- and EPA-approved Nine Key Element watershed plans. Figure 30 shows the number of plans and the total acres covered by plans as of June 2019.

Many Nine Key Element Plans are being developed in Wisconsin within areas with approved TMDLs or TMDLs under development. As the number of plans within TMDL areas increases, the amount of funding available for plan implementation has remained fixed. Unless funding levels increase, widespread implementation of watershed-based plans in Wisconsin will remain limited.

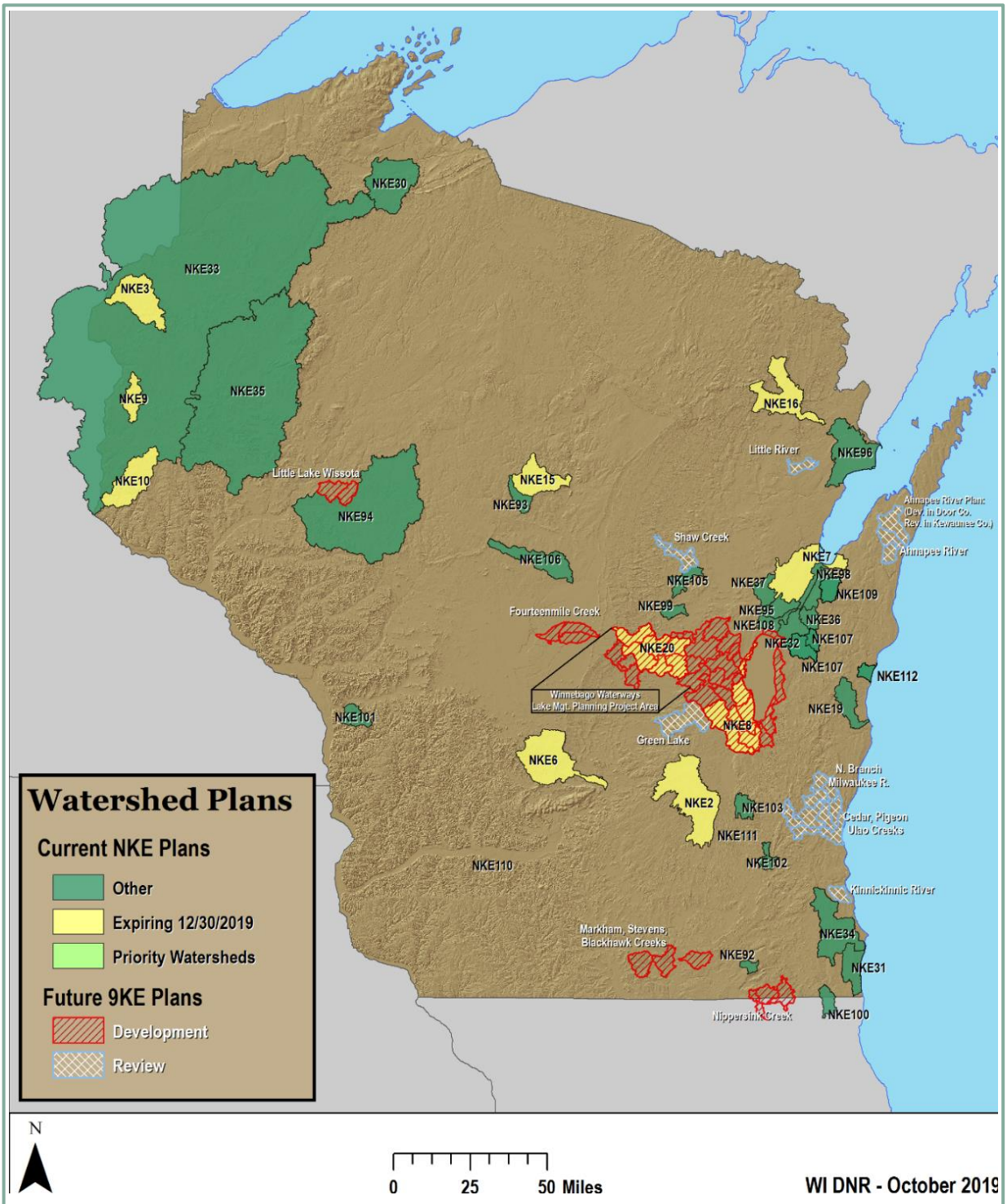


Figure 29. Nine Key Element Watershed Plans, current and future.

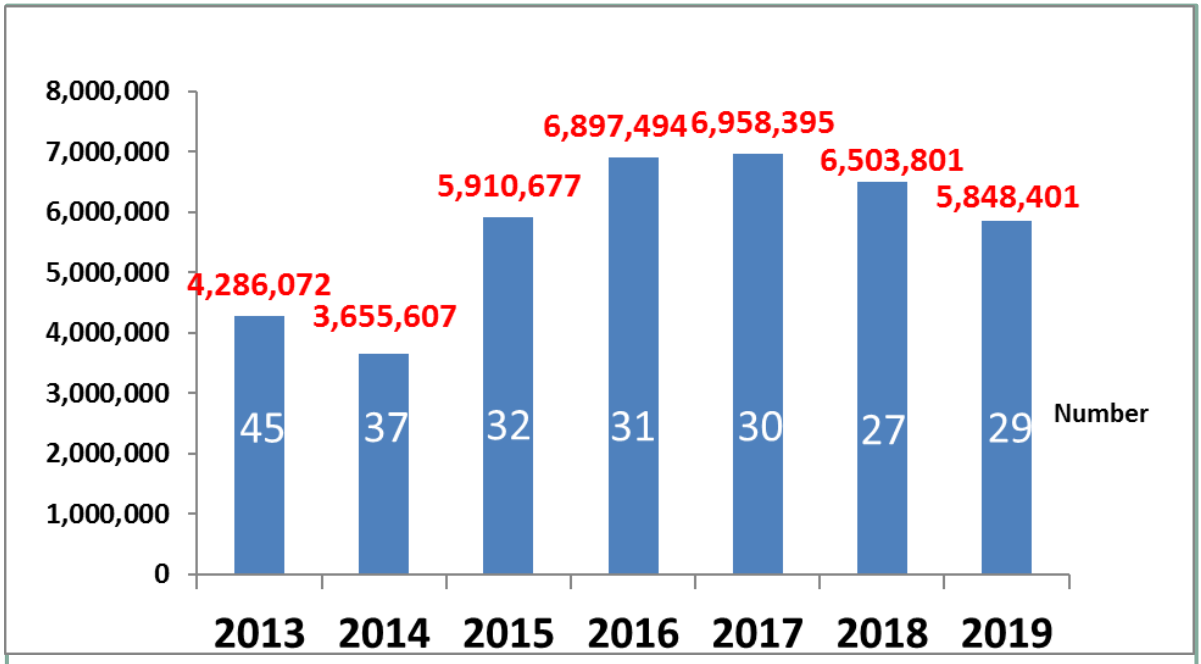


Figure 30. Wisconsin total acres and count of Nine Key Element Watershed Plans.

3.5 Wisconsin Producer-Led Watershed Groups

Wisconsin's Producer-Led Watershed Protection Grant program continues to grow, as does the popularity of this important approach to nutrient loss reduction at the watershed scale (Figure 31). The first producer-led watershed protection grants were awarded in 2016. The grants go to projects that focus on ways to prevent and reduce water quality impacts from farming operations and that work to increase farm participation in these voluntary efforts (see

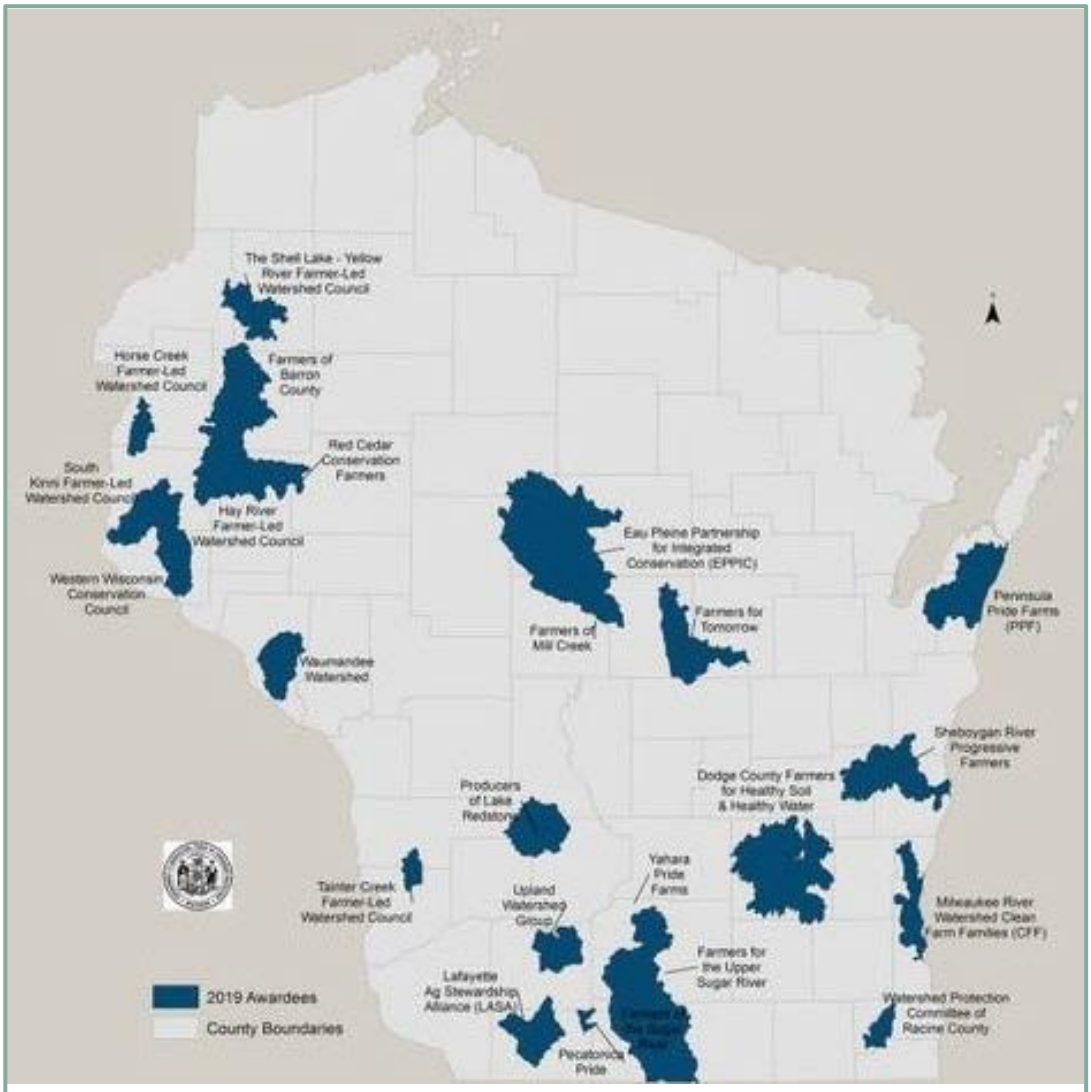


Figure 31. 2019 Producer-Led Watershed Protection Grant recipients.

https://datcp.wi.gov/Pages/Programs_Services/ProducerLedProjectSummaries.aspx). Program objectives include supporting groups as they work to improve water quality by reducing phosphorus and sediment loading, increase farmer knowledge of and engagement with water quality issues (including adoption of conservation practices), and develop water quality leadership among farmers in the watershed.

3.6 State Financial Assistance

The WDNR and DATCP partner to provide financial support that is critical to achieving nutrient reductions through agricultural nonpoint source conservation practices. In 2017 and 2018, DATCP provided nearly $9.0 million, and nearly $9.4 million in 2019 statewide for technical staff at county Land and Water Conservation Departments. DATCP also provided between $600,000 and $650,000 in financial support each year for awards to cooperators to carry out training, nutrient management support and related activities of statewide significance. County staff, with the help of cooperators, provide outreach, education and technical and financial assistance to farmers to plan, design and install conservation practices that reduce sources of nutrients and protect water quality. In 2017, 2018 and 2019 WDNR and DATCP jointly allocated $11.65 million, $11.33 million and $10.7 million (respectively) in grant funding to cost-share conservation practices.

The following state programs are particularly focused on reducing nutrient impacts on water quality:

- Targeted Runoff Management (TRM) (WDNR): TRM grants are provided by the WDNR to control nonpoint source pollution from both agricultural and urban sites. A combination of state segregated funds, state bond revenue, and federal Section 319 grant funds may be used to support TRM grants. The grants are available to local units of government (typically counties) and target high-priority resource problems. TRM grants can fund the design and construction of agricultural and urban BMPs. In 2017-2019, WDNR awarded $11,363,359 in TRM grants to counties.

- Notice of Discharge (NOD) (WDNR): NOD grants are provided by WDNR and DATCP to local units of government (typically counties). A combination of state segregated funds, state bond revenue, and federal Section 319 grant funds may be used to support NOD grants. The purpose of these grants is to provide cost sharing to farmers who are required to install agricultural best management practices to comply with a Notice of Discharge issued to the farmer. Notices of Discharge are issued by WDNR in accordance with ch. NR 243 Wis. Adm. Code, to small and medium animal feeding operations where noncompliance with the agricultural performance standards and prohibitions (NR 151) at a livestock operation causes a discharge of pollutants to waters of the state. Both state agencies work cooperatively to administer funds set aside to make NOD grant awards. From FY 2018-2019, WDNR and DATCP awarded a combined amount of $4.4 million in NOD grant funding statewide.

- Soil & Water Resources Management (SWRM) (DATCP): DATCP administers the SWRM Grant Program which primarily provides grants to counties to support conservation staff and for cost-sharing to landowners. These grants implement the counties' Land and Water Resource Management (LWRM) Plans, which are approved by DATCP. DATCP funding is supplemented by local budgets and other sources to support a statewide network of over 350 conservation department staff in 72 counties.

Table 4. SWRM Grant allocations to counties, 2017, 2018, 2019.

Year/Allocation	Staff and Support	Cost-share
2017	$8,739,100	$5,400,935
2018	$8,964,100	$6,082,520
2019	$8,964,100	$5,989,476

Table 5. Practices installed using Soil and Water Resource Management Funds in 2017, WI

Conservation Practices		Practices Installed		
		Acres	Feet	Number
Soil Erosion Control	CREP Equivalent	2.87		
	Animal Trails and walkways		6,215	
	Cover and green manure crop	999		
	Critical area stabilization			37
	Diversions		4,301	
	Field windbreaks		35,456	
	Grade stabilization structures			40
	Riparian buffers	818		
	Sinkhole treatment			1
	Streambank crossing		3,561	
	Streambank and shoreline protection		24,469	
	Subsurface drains			9
	Terrace systems		2,000	
	Underground outlet			33
	Water and sediment control basins			25
	Waterway systems	1343		
Manure	Manure storage closure			40
	Manure storage systems			20
	Access roads		4,634	
	Barnyard runoff control systems			16
	Livestock fencing		32,407	
	Livestock watering facilities			30
	Milking center waste control system			4
	Nutrient management	66,038		
	Residue management	266		
	Roof runoff systems			16
	Roofs			9
	Waste transfer systems			4
	Wastewater treatment strips		100	
Other Practices	Prescribed grazing; permanent fencing		109,761	
	Prescribed grazing; est permanent	82		
	Well decommissioning			153
	Wetland development or restoration	14		
	Feed storage runoff control systems			2

Table 6. Practices installed using Soil and Water Resource Management Funds in 2018, WI DATCP.

Conservation Practices		Practices Installed		
		Acres	Feet	Number
Soil Erosion Control	CREP Equivalent	6		
	Animal Trails and walkways		2,375	
	Cover and green manure crop	764		
	Critical area stabilization			27
	Diversions		3,291	
	Field windbreaks		8,005	
	Grade stabilization structures			39
	Riparian buffers	35		
	Sinkhole treatment			0
	Streambank crossing		2,907	
	Streambank and shoreline protection		23,087	
	Subsurface drains			8
	Terrace systems		0	
	Underground outlet			12
	Water and sediment control basins			25
	Waterway systems	1,735		
Manure	Manure storage closure			31
	Manure storage systems			14
	Access roads		4,989	
	Barnyard runoff control systems			6
	Livestock fencing		79,464	
	Livestock watering facilities			24
	Milking center waste control system			2
	Nutrient management	53,414		
	Residue management	633		
	Roof runoff systems			10
	Roofs			1
	Waste transfer systems			6
	Wastewater treatment strips		0	
Other Practices	Prescribed grazing; permanent fencing		78,378	
	Prescribed grazing; est permanent	190		
	Well decommissioning			171
	Wetland development or restoration	47		
	Feed storage runoff control systems			2

Highlights of land and water conservation programs and project success stories can be found in the 2017 and 2018 Land and Water Conservation Annual Report.

3.7 Farmland Preservation Program

Landowners can participate in the Farmland Preservation Program via farmland preservation zoning or with a 15-year farmland preservation agreement on land located in a designated agricultural enterprise area. Eligible landowners can claim an income tax credit if they meet state soil and water conservation standards and have a certificate of compliance with these standards issued by the county land conservation department. The most recent available data shows that 14,406 certificates of compliance were issued to landowners in 53 counties. This participation accounted for approximately 2.4 million acres of farmland being enrolled in the program. In 2018, an additional 400,000 acres in the state became eligible under the program through certification of a farmland preservation zoning ordinance or designation as an agricultural enterprise area.

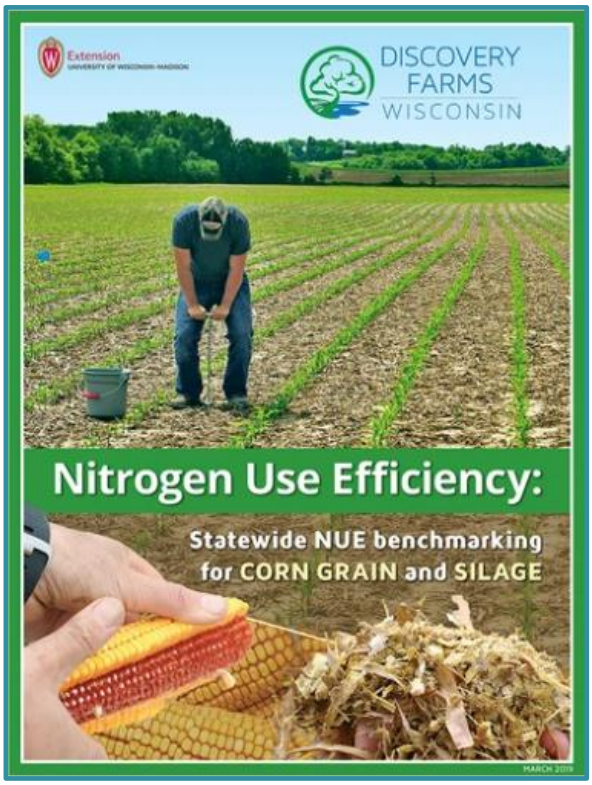
3.8 Conservation Reserve Enhancement Program (CREP)

CREP is a subprogram of the Conservation Reserve Program (CRP) and is administered by both the USDA and the state of Wisconsin DATCP through county land conservation departments. Participating landowners voluntarily establish conservation practices on environmentally sensitive agricultural land near bodies of water. The conservation practices are intended to decrease erosion, safeguard ground water and surface water, and restore wildlife habitat. Enrollment is through 15-year agreements or perpetual easements. As of the beginning of 2019, about 38,000 acres were enrolled under CREP agreements and easements, with approximately 6,700 acres under CREP easements and the remainder under CREP 15-year agreements. Of those enrollments 36,066 acres are currently under active agreements. The conservation benefits of the practices installed on the active agreements (e.g. riparian buffers and filter strips) are as follows: 1,009 miles of streams buffered with an estimated annual phosphorus removal of 103,968 pounds, annual nitrogen removal of 55,918 pounds and sediment removal of 51,684 tons.

3.9 University of Wisconsin Extension – Discovery Farms Networks

Discovery Farms is a program of the University of Wisconsin-Madison Division of Extension (UW-Extension). Discovery Farms is working with farmers across Wisconsin on phosphorus and nitrogen management. Discovery Farms uses a variety of tools in its educational programming, including research from edge-of-field sites, evaluations such as nitrogen use efficiency, and information sharing strategies like webinars, presentations and materials.

Specifically, the program's annual winter conference brings together more than 180 farmers, crop consultants and nitrogen and phosphorus experts. Conference presenters include farmers, nutrient management and water quality experts, and agricultural advisors. Attendees have the opportunity to learn more about nitrogen use efficiency, phosphorus challenges with manure in no-till systems, manure application strategies and ways to effectively minimize nutrient loss. The conference includes farmer panels to increase farmer-to-farmer information sharing. The conference web page houses presentations and handouts from the conference.



In addition, the UW Discovery Farms Nitrogen Use Efficiency Project has the potential to improve soil and water resources, while preserving farm productivity and profitability. Since 2015, the project has worked with 85 farmers on over 300 fields in 15 counties around Wisconsin. The project has four main objectives: (1) evaluate nitrogen use efficiency (NUE) on farms at the field level; (2) train farmers to conduct their own on-farm evaluations of NUE; (3) allow farmers to test their own management practices for improvements in NUE; and (4) enhance farmer understanding of the connection between NUE and water quality. This project was initially made possible by a USDA Conservation Innovation Grant, but has since been supported by Wisconsin agricultural groups. A report on the first three years of the NUE project was published in 2019.

Discovery Farms has completed watershed projects within the Jersey Valley watershed (Monroe and Vernon Counties) and the Dry Run watershed (St. Croix County), and began projects in Rock, Langlade, Juneau, and Kewaunee Counties. Additionally, a monitoring project funded by the Conservation Innovation Grants program to understand the connection between agricultural tile drainage, farming systems and soil health began in 2017 in Kewaunee, Shawano, Manitowoc and Brown Counties. The project includes 24 monitoring sites and 14 farms.

To facilitate information exchange, Discovery Farms staff present at numerous events, co-host more than eight events annually and conduct water quality research on farms to increase understanding of water quality challenges and develop farm-specific solutions that make both economic and environmental sense. Based on the evaluation of work in the watersheds, it is clear that farmers in the area value the local data provided by the program and use it as well as guidance from Discovery Farms staff when making nutrient management decisions. A journal article about the results was completed in the fall of 2016 in the Journal of Soil and Water Conservation (Radatz, Amber M., et al. 2018) and a report with results from the watershed projects was published in 2018.

3.10 USDA Natural Resources Conservation Service (NRCS) Programs

The Wisconsin NRCS programs and staff play a key role in providing technical and financial assistance for implementing practices to reduce nutrient losses to water. The Environmental Quality Incentives Program (EQIP),

Conservation Stewardship Program (CSP) and Agricultural Conservation Easement Program (ACEP) provided $62 million (M) in 2018 funding for conservation practices statewide. In Fiscal Year (FY) 18, EQIP obligated $10.88 M for 1,316 cover crop contracts compared to $2.34 M for 513 cover crop contracts in FY15. This demonstrates the growing interest in soil health practices to reduce nutrient losses, reduce erosion and improve soil quality. **Through all NRCS programs in FY18, 414,216 acres had conservation practices applied to improve water quality.** The following programs are particularly focused on reducing nutrient impacts on water quality:

- **MRBI** – To improve the health of the Mississippi River Basin, NRCS established the Mississippi River Basin Healthy Watersheds Initiative (MRBI). Through this initiative, NRCS and its partners help producers in selected watersheds in the Mississippi River Basin voluntarily implement conservation practices that prevent, control, and trap nutrient runoff; improve wildlife habitat; and maintain agricultural productivity. Project work in five subwatersheds of the Rush River watershed in Pierce County began in 2015, and in 2016 twelve subwatersheds of the Kickapoo River in Vernon, Crawford, and Richland County were added. Through MRBI, with the help of numerous partners, $6.3 M has been obligated through 188 producer contracts on nearly 17,038 acres through 2018. Cover crops, grassed waterways, grade stabilization structures, and animal feedlot/pasture management are the most utilized conservation practices. While funding for these watersheds has concluded, five new subwatersheds in the Rush River in Pierce County are currently in the planning stage with MRBI funding for practices anticipated in 2021.

- **NWQI** – Through the National Water Quality Initiative (NWQI), the NRCS and partners work with agricultural producers to implement voluntary conservation practices to improve water quality in high-priority watersheds while maintaining agricultural productivity. NWQI is designed to help individual agricultural producers take actions to reduce the runoff of sediment, nutrients, and pathogens into waterways where water quality is a critical concern. The goal is to implement conservation practices in focused watersheds in a concentrated area so that agriculture no longer contributes to the impairment of water bodies within these priority watersheds. Within NWQI, eligible producers may receive assistance through EQIP for installing on-farm conservation practices. With coordination through the WDNR and watershed planning partnerships with county land conservation departments, two watersheds are currently active within NWQI in Wisconsin: Bear Lake-Lower Little Wolf River in Waupaca County and North Branch Little River in Oconto County.

  In 2019, the Wisconsin Department of Natural Resources proposed the de-listing of 303(d) impaired sections of the Legler School/Pioneer Valley streams in Green County. These segments were targeted as part of one of the original NWQI watersheds in Wisconsin in 2012. Through the partnership efforts of the Green County Land and Water Conservation Department, WDNR, NRCS and cooperating producers, this is the first NWQI watershed in Wisconsin to reach this point in the de-listing process.

- **RCPP** – The Regional Conservation Partnership Program (RCPP) promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. Water quality is the top resource priority for RCPP in Wisconsin and several active projects directly address

that resource concern. Projects with partners in the Yahara River, Baraboo River, Oconomowoc River, Milwaukee River, Pecatonica River and Little Plover River watersheds, as well as stream restoration projects within the Driftless Area are implementing several strategies for reducing nutrient loading to surface waters.

- Baraboo River Watershed Regional Conservation Partnership Program (RCPP)/Sauk County Conservation, Planning and Zoning Dept. – The Baraboo River has been identified as the second greatest contributor of total phosphorus loading to the Wisconsin River (for more on TMDL implementation, see Chapter 4). The Sauk County Conservation, Planning and Zoning Department has partnered with five other County Land and Water Conservation Departments to improve water quality in the Baraboo River Watershed through promotion and installation of soil and water conservation practices in high-yield locations identified through EVAAL and SWAT modeling. The process of identifying priority fields has been completed in Sauk County. The other partnering counties have plans to complete their priority landowner list in the future. A total of 274 priority landowners have been identified in Sauk County, meaning that 137 priority landowners will be assisted to reach the project goal of 50%. To date, Sauk County has assisted nine priority landowners. Sauk County is working to increase contacts with priority landowners in the future. Outreach and education to promote practices has occurred through field day demonstrations focused on cover crops and rotational grazing, nutrient management education classes and direct mailings to priority landowners identifying available cost-share for conservation practices. The project also includes monitoring of chemistry and biology at ten sites in the Baraboo River watershed to evaluate water quality status and progress. Due to the success of the initial Baraboo River RCPP project from 2015, Sauk County sought and was awarded funding for a second, more targeted Baraboo River project in 2018 that is currently underway in Sauk and Juneau counties.

- Demonstration Farm Networks – The NRCS and the Great Lakes Commission (GLC) partnered to establish a Great Lakes Demonstration Farm Network, the first of its kind in Wisconsin. Brown County Land & Water Conservation Department has since assumed the project agreement with NRCS and the Outagamie County Land Conservation Department and UW-Extension are also partners in the project. The Network is working to provide better information on the effectiveness of conservation systems used to improve water quality. The participating farms demonstrate effectiveness and adaptability of conservation practice systems to reduce erosion and sedimentation, control phosphorus runoff, and address other nonpoint source pollution issues. The Network also provides educational technology transfer opportunities for the public, farmers, land managers, agribusiness, environmental, natural resource agencies, research entities and other partners.

  The Demonstration Farm Network objectives are to:
  - establish demonstration farms within the Lower Fox Watershed to test new and standard conservation systems in reducing phosphorus and sediment;
  - establish an efficient mechanism to share this technology and information with farmers, agribusiness, conservation agencies and the public;

- create opportunities for others to test their research, technical and program ideas at the demonstration farms; and
- share information and lessons learned from the Lower Fox Watershed throughout the Great Lakes Basin.

The initial four farms participating in the Network have now increased to eight and a new project element has been added to provide dedicated, one-on-one technical assistance to other farms that are interested in adapting the demonstrated practices on their operations. Each of these farms have played an intricate role in trying, demonstrating, and sharing information about leading-edge practices and technologies applied on their farms. Practices include cover crops, reduced tillage, reduced-disturbance manure application, pesticide management and water quality monitoring.

Due to the success and interest generated by the Lower Fox model, NRCS has partnered with county land conservation departments, DATCP, producer-led groups, and a lake association to form four new Demonstration Farm Networks to pursue similar goals:

- Door-Kewaunee*
- Ozaukee County (primarily Milwaukee River watershed)
- Upper Fox-Wolf*
- Between the Lakes (Manitowoc-Sheboygan River Watershed)

Through their addition as eligible Nearshore Health watersheds eligible for NRCS GLRI EQIP, all these project areas are also eligible for Great Lakes Restoration Initiative (GLRI) conservation practice funding. In the most recent GLRI funding cycle, NRCS-WI received $8.5 M for practice implementation in these Lake Michigan watersheds.

3.11 Progress on Adoption of Nutrient Reduction Practices

County land and water conservation departments reported to DATCP the amount of conservation practice adoption in 2018, and estimated what amount of phosphorus, nitrogen and sediment reduction was associated with groups of practices (Figure 32). Not all reductions of phosphorus, nitrogen and sediment achieved through conservation practices implemented in 2018 are tracked and reported. The numbers shown here capture only the known estimated reductions in 2018 as reported by counties in March 2019, or provided in the Conservation Reserve Enhancement Program's (CREP) annual report. As a result, the numbers shown here are only a fraction of the likely total reductions in phosphorus, nitrogen and sediment from conservation efforts in 2018.

When it comes to phosphorus loss from cropland, widespread adoption of two key practices, no-till and cover crops, are important to improving water quality. Using data from the 2012 and 2017 census of agriculture, an assessment was made of changes in adoption of these practices. The assessment was undertaken in the following steps:

1. Ranked each county based on change in no-till acres (Rock Co. #1, reported increase of 42,685 acres);
2. Ranked each county based on change in cover crop acres (Dunn Co #1, reported increase of 10,929 acres);
3. Combined ranks obtained under 1 & 2 above for composite rank (Dunn Co #1 – they were #5 under step 1 and #1 under step 2);
4. Ranked each county based on change in no-till acres as a percent of cultivated land (Milwaukee #1, reported increase of 751 acres, which is 23% of cultivated land);
5. Ranked each county based on change in cover crop acres as a percent of cultivated land (Marquette #1, reported increase of 5,819 acres, which is 9% of cultivated land);
6. Combined ranks obtained under 4 & 5 above for composite rank (Pepin Co #1 – they were #2 in step 4 and #8 in step 5);
7. Combined composite ranks from 3 and 6 above for final rank;

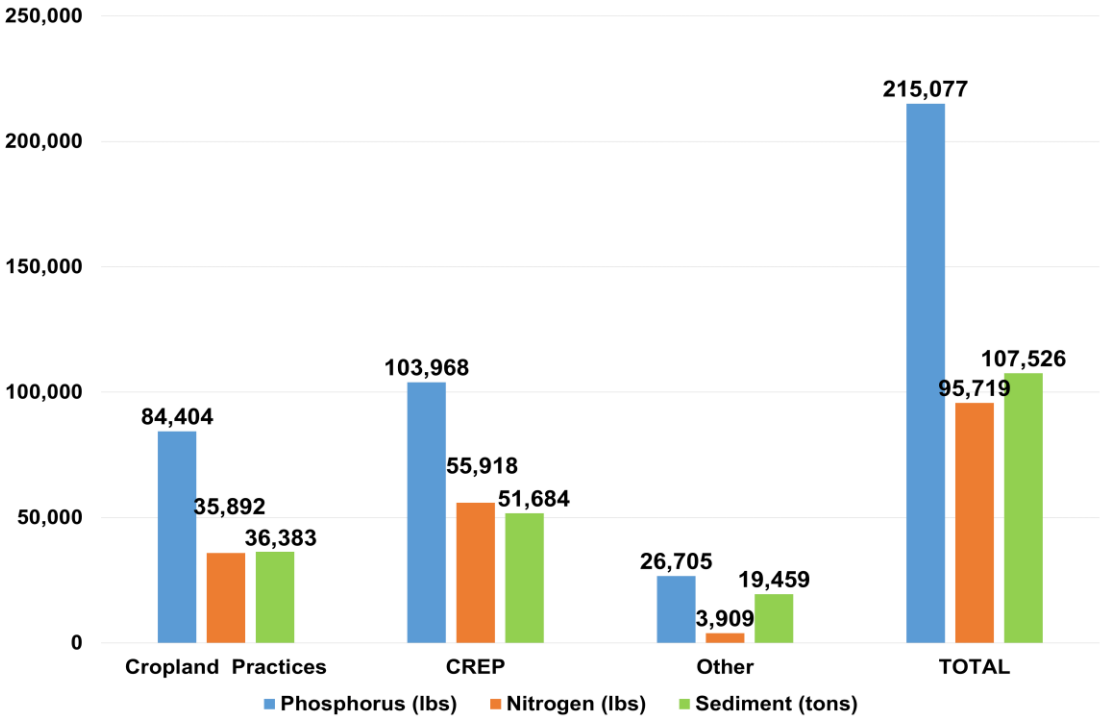


Figure 32. Estimated reductions from conservation practices in 2018. "Other" conservation practices include streambank stabilization, riparian buffers, and critical area stabilization.

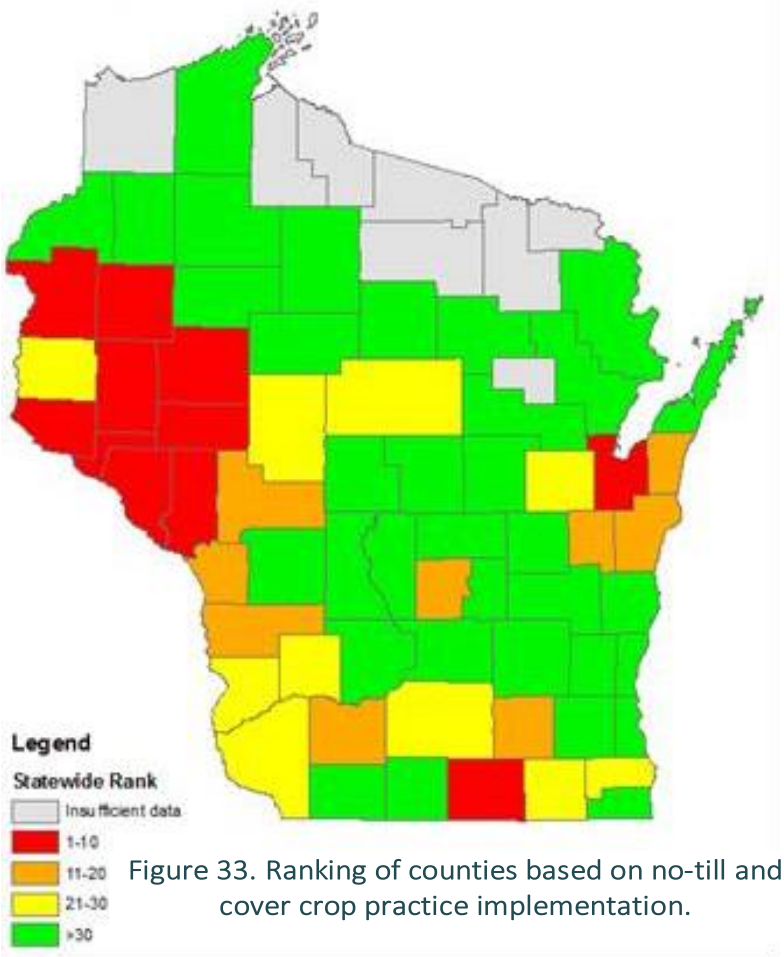


Figure 33. Ranking of counties based on no-till and cover crop practice implementation.

8. Mapped the final ranks. The red areas on the map (Figure 33) are where this approach indicates practices have been adopted on a broad scale in the county.

Looking at the changes in no-till, the counties with the highest percentage of no-till also tended to have the greatest increase of practice adoption (Figure 34).

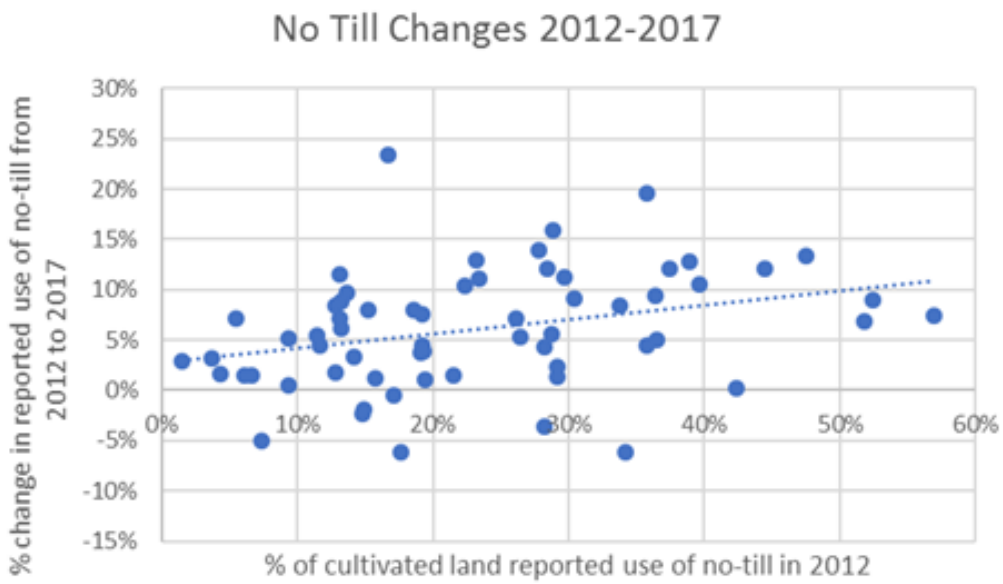


Figure 34. Change in no-till and cover crops from 2012 to 2017 per USDA Census of Agriculture.

3.12 Tracking and Measuring Progress

Tracking the implementation of NPS pollution reduction practices on the landscape is an important but often challenging component of TMDL implementation tracking and assessment. These challenges become even greater in the context of point source permit compliance/variance programs that require NPS partnerships, such as adaptive management, water quality trading and the multi-discharger variance (MDV). WDNR continues to develop the BMP (Best Management Practice) Implementation Tracking System (BITS) that will be used by external partners to report their BMP activities that have been funded through WDNR programs. The web/GIS-based system will store the precise spatial location of each BMP, along with specific details regarding type, characteristics, cost, pollutant load reductions, and more.

WDNR staff, with support from a contractor, have finalized the BITS MDV project module, and it is being used by external partners in the MDV program. WDNR staff and the contractor are currently building project modules for WDNR's Targeted Runoff Management (TRM), Notice of Discharge (NOD), and Urban Nonpoint Source (UNPS) Grant Programs and NR 151 performance standards implementation tracking. Continued development of BITS will be partially supported by funding provided through the Hypoxia Task Force. Funds will be used to hire a WDNR staff member dedicated to managing the continued development of BITS and to coordinating with external partners as the modules are released.

Chapter 4. Nutrient Reduction at the Watershed Scale: "Top Group" Watersheds

Six clusters of watersheds were identified in the 2013 Strategy as the top group of watersheds in the state for phosphorus control based on stream phosphorus concentrations and modeled phosphorus loads (pounds lost per acre per year). A top group of watersheds was also identified for nitrogen management and a top group for groundwater nitrate concerns. This chapter describes nutrient reduction in these targeted watersheds.

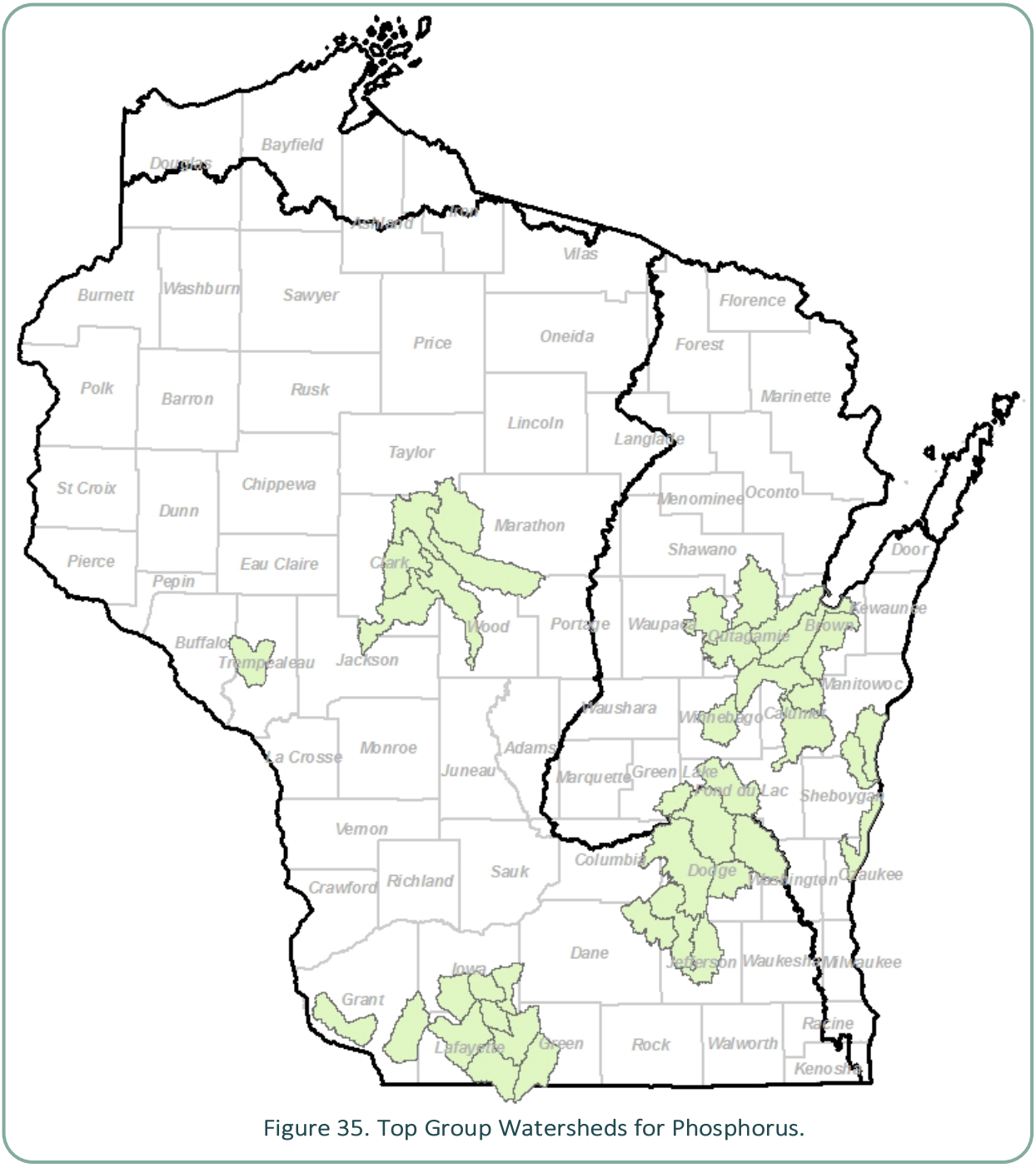


Figure 35. Top Group Watersheds for Phosphorus.

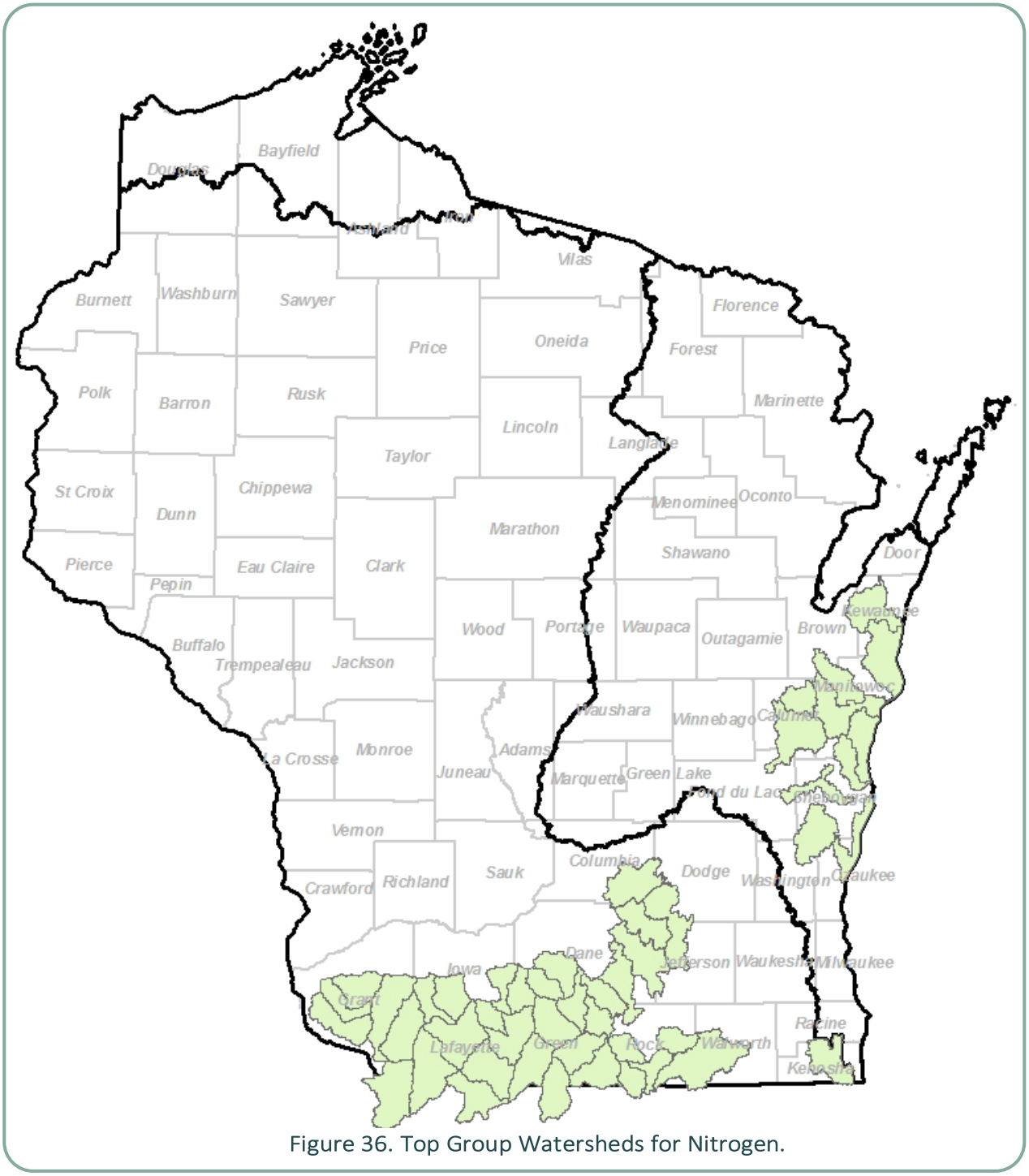


Figure 36. Top Group Watersheds for Nitrogen.

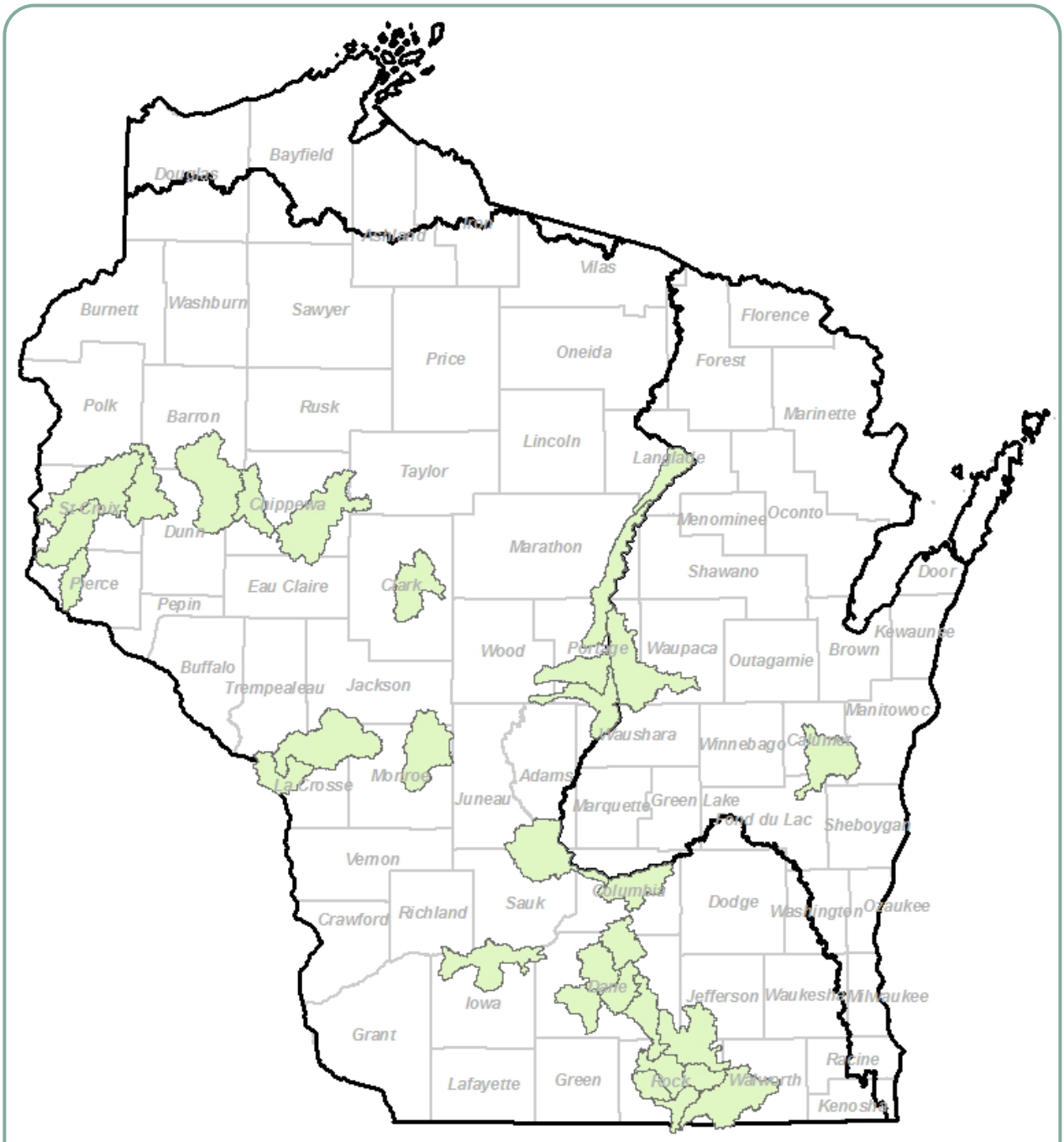


Figure 37. Top Group Watersheds for Drinking/Groundwater.

I. Reducing Phosphorus Loss in the Mississippi River Basin

4.1 Sugar - Pecatonica River Watersheds

The Sugar–Pecatonica River watersheds (>90% agricultural lands) in southern Wisconsin include parts of Dane, Iowa, and Rock counties, and most of Lafayette and Green counties. The Sugar-Pecatonica River Basin TMDL (2005) included 23 streams listed as specifically impaired for sediment (Figure 38). While additional stream segments have been added to the impaired waters list as more data have been collected (for both TSS and phosphorus), this does not tell the whole story. A great deal of implementation activity is happening throughout the region with coordinated partnerships including local farmer-led groups, county staff, DATCP, The Nature Conservancy, Professional Dairy Producers of Wisconsin, Wisconsin Farmers Union, and the Dairy Business Association. More detail on these coordinated efforts are presented below for each watershed.

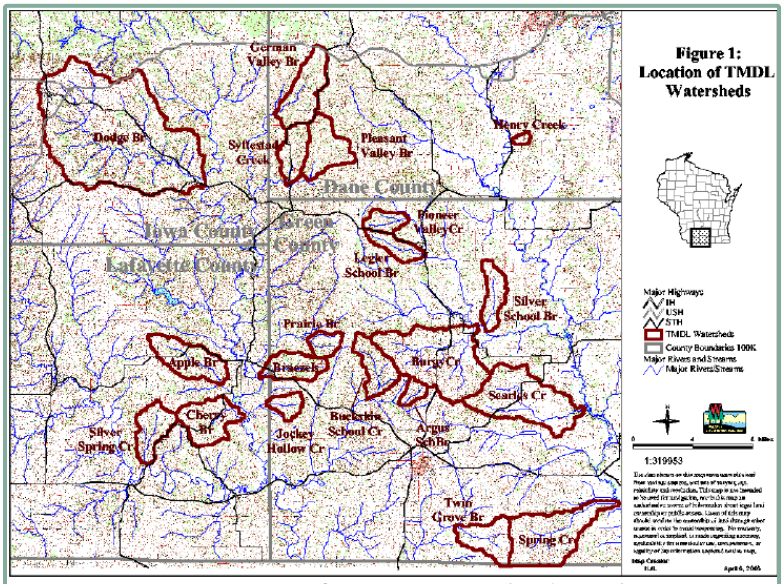


Figure 38. Location of TMDL watersheds in the Sugar-Pecatonica TMDL.

4.1.1 Sugar River

The Sugar River watershed (>90% agricultural lands) in southern Wisconsin includes parts of Dane and Rock counties, and most of Green county. While twenty-four streams in the watershed are currently listed as impaired for TSS and/or phosphorus, there is much work underway to address these impairments.

Nonpoint Sources: This has also been an area of focused conservation and land stewardship activities dating back as far as the early 1990's. Data from the Operational Tillage Information System (OpTIS) indicate there was broad adoption of conservation tillage and no-tillage early in the 1990s (Figure 39).

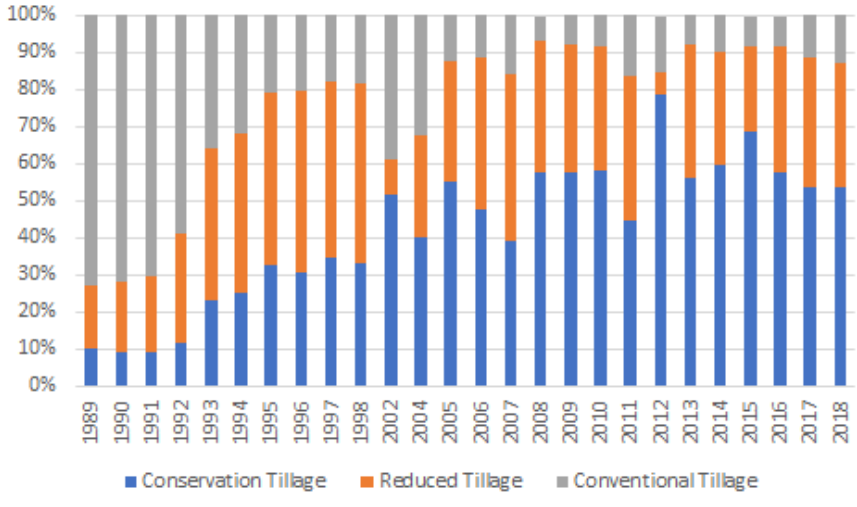


Figure 39. Operational Tillage Information System (OpTIS) data showing change in tillage methods over time.

Long-term hydrology and water quality trends in the Sugar River Basin reflect these widespread improvements in agricultural practices and tell a compelling story of successful conservation, dating back to the early 1990s. The USGS, in the analyses of over 100 years of flow data, attributed a 40% reduction in the 100-year flood and near doubling of the dry-weather

flows to improved agricultural practices throughout the watershed (USGS, 2015) and greater infiltration and storage of precipitation, despite increasing rainfall intensity and depths over the period of record. Long-term monitoring of water quality data for total phosphorus (Figure 40) are consistent with these results, showing a decline since the '90s, consistent with a long-term decline in agricultural nonpoint runoff. However, with the increase in infiltration, long-term nitrate discharge was increasing through the early 2000s. Over the past decade, the nitrate numbers have stabilized.

Point Sources: All of the ten WPDES point source discharge permit holders in the Sugar River Basin either have, or are being issued, permits with phosphorus WQBELs. The compliance plan of each facility is listed below:

- **Water quality trading:** Albany, Belleville (TBD), Brodhead, Brooklyn, and Monticello
- **Multi-discharger variance:** Grande Cheese
- **Individual variance:** Orfordville
- Mt. Horeb and Madison Metropolitan Sewerage District (currently doing adaptive management in the Rock River TMDL) are in the process of determining their final permit compliance option.
- New Glarus has selected a facility upgrade.

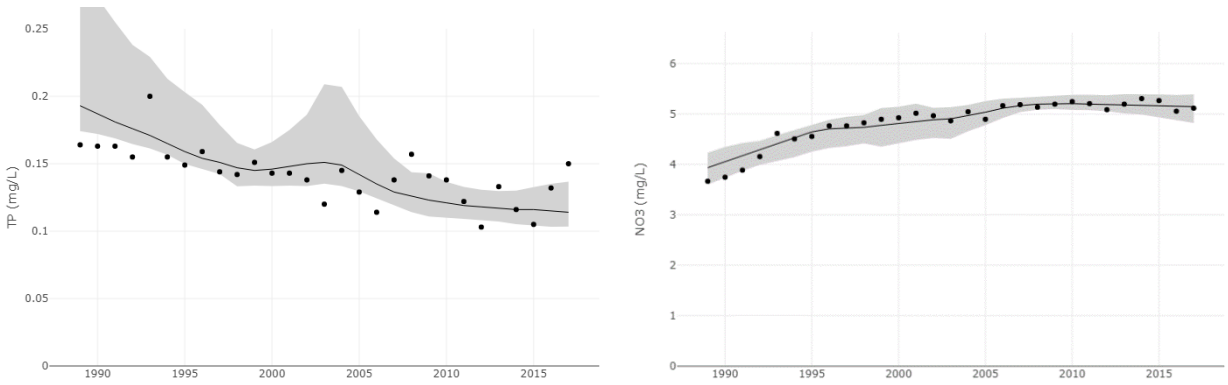


Figure 40. Long-term record of phosphorus and nitrate discharge at Sugar River at Brodhead – 1989 – 2017 (523 sq. miles).

As noted above, 5 of 10 total Sugar River dischargers are currently pursuing water quality trading as their compliance option, and most have identified trading partners. This 50-60% participation rate in water quality trading is much higher than the statewide average. WDNR wastewater staff were very proactive in encouraging watershed-based compliance options and organizing a series of phosphorus workshops throughout the region a few years ago. That prompted a lot of discussion between communities. Additionally, farmer-led groups (see links below) have been active in communicating with the communities and helping to focus attention on water quality partnerships in the Sugar River.

Nonpoint sources: There has been a widespread education/outreach effort by Dane and Green County Conservation staff and the NRCS to encourage adoption of cover crops by farmers – with one of the primary benefits being to sequester soil nitrogen and convert it to organic forms that are less vulnerable to leaching. Two farmer-led watershed groups, covering 8 HUC12 tributary watersheds, are active in the Sugar River watershed:

- Farmers for the Upper Sugar River (2 HUC12s in Dane County): Purpose: Targeting reduction in phosphorus loading by bringing together like-minded farmers to strengthen water quality improvement efforts using education and financial resources.
- Farmers of the Sugar River Watershed (5 HUC12s in Green County): Purpose: Learn from other farmers to be profitable, protect and increase soil functions, and improve water quality in the watershed. They have been busy teaching other farmers and the public about no-till, cover crops and other ways to minimize soil erosion.

4.1.2 Pecatonica River

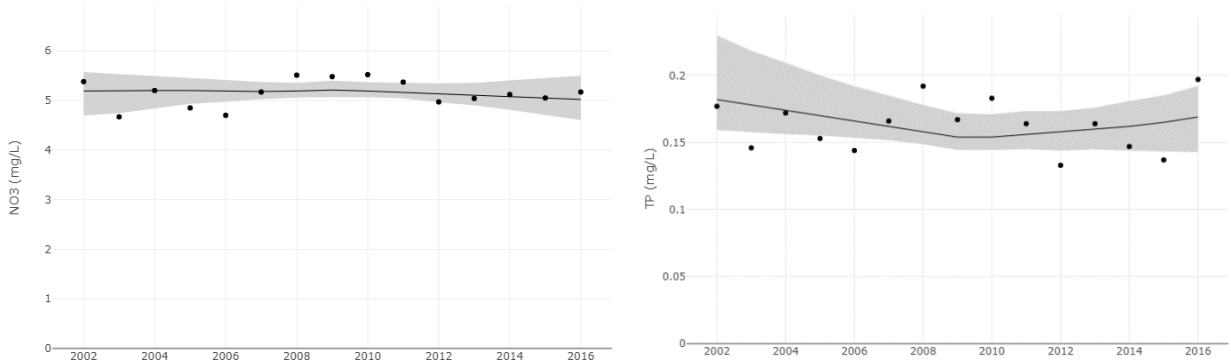


Figure 41. Long-term record of phosphorus and nitrate discharge at Pecatonica River at Martintown – 2002 – 2017 (1,034 sq. miles).

Lafayette County Agricultural Enterprise Area Water Quality Project

DATCP is the lead partner in this five-year project, which is a part of the USDA-Natural Resources Resource Conservation Partnership Program (RCPP). The partnership has secured $600,000 over five years from the USDA-NRCS for a unique regional project in Lafayette County. The project provides cost-sharing and technical assistance to help farmers implement conservation practices on their land, primarily within the Pecatonica River watershed.

The intent is to coordinate the expertise and resources of 13 partner agencies and organizations, both public and private, to help farmers reduce soil loss and nutrient runoff in this area of hills and valleys, with longstanding water quality and soil loss issues. The group of partners is working with two large farmer networks that already exist in the watershed, formed through DATCP's Agricultural Enterprise Area (AEA) program.

- Lafayette Ag. Stewardship Alliance (LASA)
- Pecatonica Pride

The lands eligible for participation are those within two agricultural enterprise areas in the southwest corner of Wisconsin: the Pecatonica AEA and the Southwest Lead Mine Region AEA. About 200 landowners petitioned to be included in these AEAs; their goals include keeping agriculture vital and preserving their resources. Participants will receive technical assistance and some funding to

Figure 42. DATCP's Agricultural Enterprise Areas.

install conservation practices or adopt new farming practices to prevent nutrient runoff and the water quality problems that follow. Because they are in AEAs, these landowners will also be able to claim Farmland Preservation Tax Credits when they bring their land into conservation compliance.

The partners will also present workshops and field days several times a year, and there will be a citizen water monitoring component as well. Farmer-to-farmer education will be an important component of the project. There will be opportunities for non-farm citizens to participate in water quality monitoring, and local municipalities may be able to work with the project on water quality trading. While all farms in the defined area will be eligible, beginning farmers and farmers who are military veterans are particularly encouraged to participate.

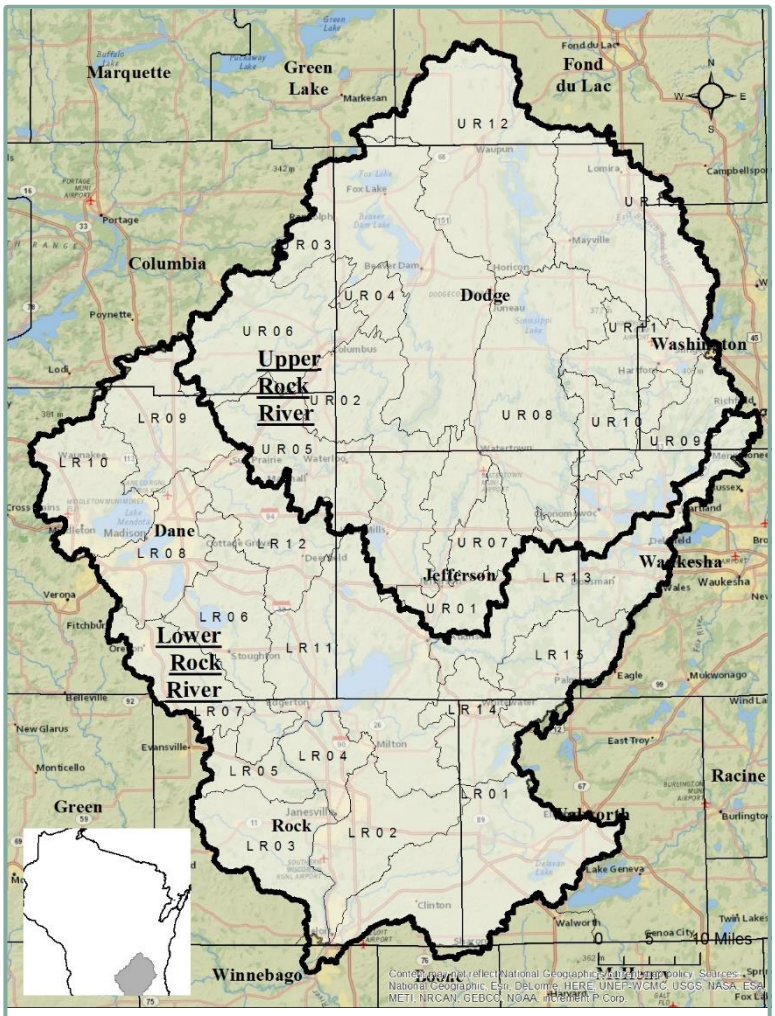


Figure 43. Map of the Upper and Lower Rock River Basins.

4.2 Upper Rock River Basin

The Rock River TMDL, the first large-scale TMDL developed by the WDNR (covering >3,700 sq. miles), was published in September 2011 and created a great deal of uncertainty and questions throughout the basin stakeholder community. Now, with nearly eight years of TMDL implementation, the stakeholder community is familiar with the TMDL and understands that basin partners must work together to achieve the reductions in the TMDL – whether urban, industry, stormwater runoff, agricultural runoff, or other sources. The common phrase used to talk about the need for all stakeholder partners to work together to find solutions, rather than pointing the finger is, "We all have mud on our hands". Further, with long-term data clearly showing dramatic reductions in total phosphorus at both the Watertown and Afton monitoring sites (Figure 44 and Figure 45), the community is energized realizing that shared efforts are making a difference. Nitrates, however, have not shown a similar reduction – the general trend at Watertown has been relatively flat, while at Afton, early increases in nitrates (1960s and 1970s) seem to have stabilized in the last 15 years, and may now appear to be showing a declining trend.

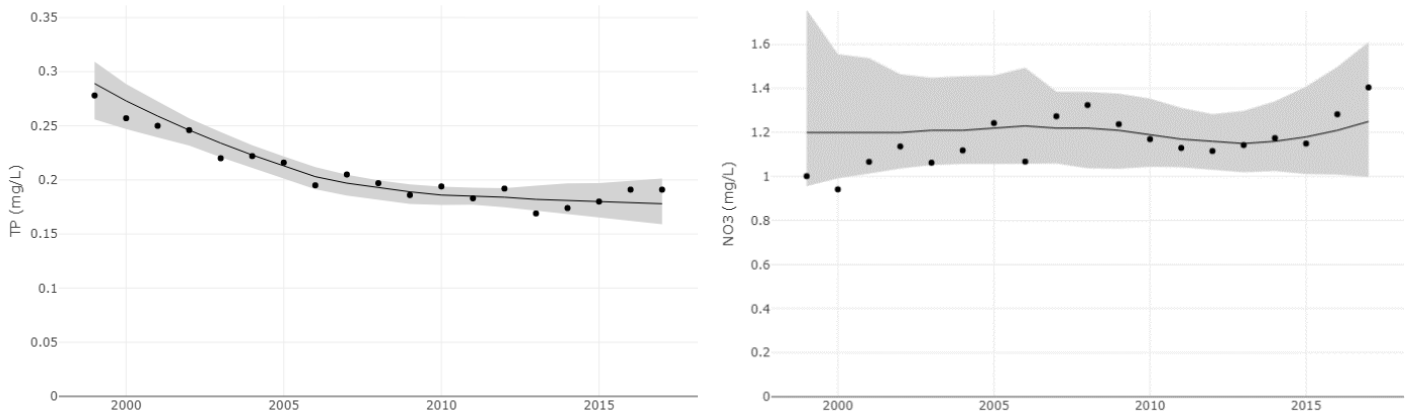


Figure 44. Long-term record of phosphorus and nitrate discharge at Rock River at Watertown – 1999 – 2017 (969 sq. miles – Upper Rock River Basin).

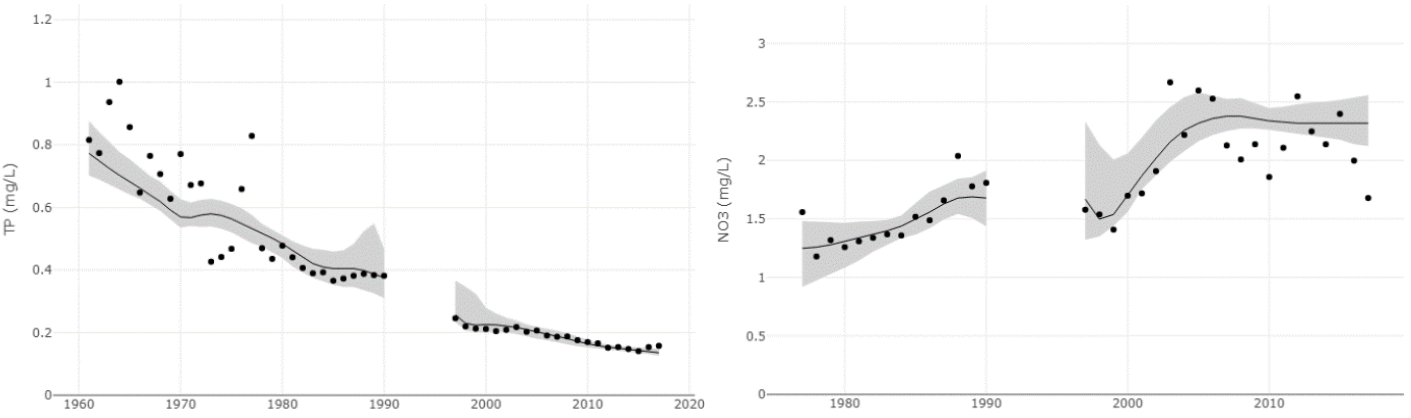


Figure 45. Long-term record of phosphorus and nitrate discharge at Rock River at Afton - 1960 – 2017 (3,340 sq. miles – Upper and Lower Rock River Basins).

TMDL Implementation Update

Progress continues with both point and nonpoint source progress towards TMDL implementation goals. The combination of the Rock River TMDL, WPDES permit programs, efforts of three farmer-led watershed groups, implementation of statewide phosphorus criteria, and watershed-based permit compliance alternatives (Adaptive Management and Water Quality Trading) have provided a strong foundation for building and promoting nutrient reductions in the Rock River Basin.

From a basin perspective, TMDL implementation progress can be viewed as the sum of implementation-related activities within a HUC 12 watershed. The basin map in Figure __ summarizes targeted implementation-related activities by ranking each HUC 12 watershed by how many implementation activities are taking place:

- Priority Watershed Restoration Project
- Nine Key Element Watershed Restoration Plan
- Active Farmer-led Watershed Group implementing recognized practices
- Point source discharge facility with TMDL limits
- Watershed-based permit compliance projects – (Adaptive Management or Water Quality Trading)

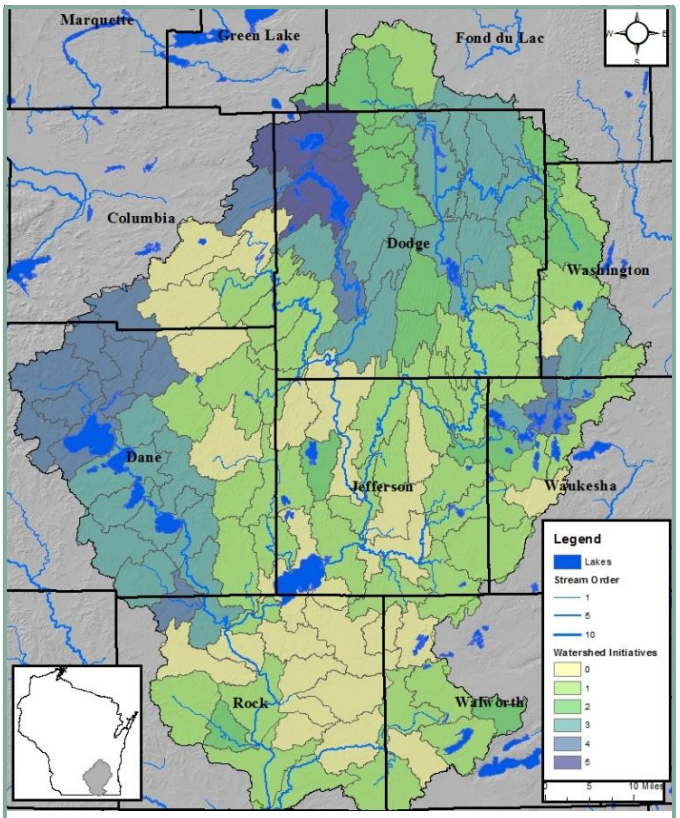


Figure 46. Rock River Recovery: TMDL implementation initiatives by watershed. Note: This figure only includes watershed-scale activities and does not reflect local activities – e.g., a watershed ranked 0 in this figure will still have local projects being implemented.

While we use our online "Rock River TMDL Landing Page" to share general information about the Rock River TMDL and "Rock River TMDL Dynamic Pages" to provide details, the monthly Rock River Recovery – TMDL Implementation Newsletter continues to serve as our primary means of communication to the basin community. This newsletter has among the highest readership rates for agency newsletters (second to the Milwaukee River TMDL Implementation Newsletter). Each edition of the newsletter (now up to 63 editions of uninterrupted publication) features monthly updates relevant to different topic areas (aka Sectors) including Agricultural/NPS, Education/Outreach, Monitoring, Stormwater/Urban Runoff, and Wastewater topics.

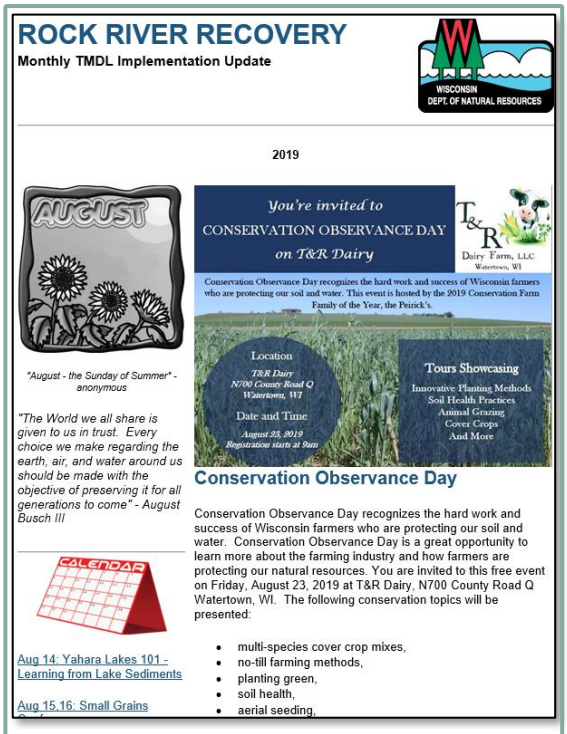

ROCK RIVER RECOVERY
Monthly TMDL Implementation Update
WISCONSIN DEPT. OF NATURAL RESOURCES
2019
AUGUST
"August - the Sunday of Summer" - anonymous
"The World we all share is given to us in trust. Every choice we make regarding the earth, air, and water around us should be made with the objective of preserving it for all generations to come" - August Busch III
CALENDAR
Aug 14: Yahara Lakes 101 - Learning from Lake Sediments
Aug 15,16: Small Grains
You're invited to
CONSERVATION OBSERVANCE DAY
on T&R Dairy
T&R Dairy Farm, LLC Watertown, WI
Conservation Observance Day recognizes the hard work and success of Wisconsin farmers who are protecting our soil and water. This event is hosted by the 2019 Conservation Farm Family of the Year, the Peirick's.
Location
T&R Dairy
N700 County Road Q
Watertown, WI
Date and Time
August 23, 2019
Registration starts at 9am
Tours Showcasing
Innovative Planting Methods
Soil Health Practices
Animal Grazing
Cover Crops
And More
Conservation Observance Day
Conservation Observance Day recognizes the hard work and success of Wisconsin farmers who are protecting our soil and water. Conservation Observance Day is a great opportunity to learn more about the farming industry and how farmers are protecting our natural resources. You are invited to this free event on Friday, August 23, 2019 at T&R Dairy, N700 County Road Q Watertown, WI. The following conservation topics will be presented:
- multi-species cover crop mixes,
- no-till farming methods,
- planting green,
- soil health,
- aerial seeding,

Figure 47. Example of a monthly Rock River Recovery – TMDL Implementation Newsletter.

Point Sources:

- 98% of WPDES point source discharge permit holders in the Rock River Basin have permits with TMDL limits (Figure 48).
- The few remaining permits are being issued as they expire.
- One third of all facilities are now in their second term (5 years) with TMDL limits.
- 41% of facilities are in the last 2 years of their first permit term with TMDL limits and will be moving into the second term by next year.
- Watershed-based options have become popular options for permit compliance (Figure 49).

- 13% of facilities have chosen Adaptive Management or Water Quality Trading as their permit compliance option.
- 15% of facilities have chosen the Multi-Discharger Variance to meet interim limit requirements via payments for NPS implementation.
- 12% of facilities are now meeting their limits.
- Remaining facilities will be choosing their compliance options over the next couple of years.
- Yahara WINS Adaptive Management Pilot project continues to grow as agricultural, municipal, and wastewater partners work together collectively to implement TMDL practices. **Phosphorus reductions for 2018 were 47,223 lbs across the 540 sq. mile watershed (16% of Rock River Basin) and represent 48% of the 2036 goal of 96,000 lb/yr.**
- Oconomowoc Watershed Protection Program (Oconomowoc Watershed Protection Program): This Adaptive Management project continues to make progress towards the goal of 4,500 lbs/yr of P reduction across the 140 sq. mile watershed. Nested within this project is the Mason Creek Watershed Nine Key Element Plan with focused practices being implemented on agricultural lands.
    - **Wastewater: annual P discharge reduced 356 lbs/yr**
    - Municipal: 157 acres of stormwater runoff treated
    - Agriculture: Farmers for Lake Country Farmer-Led Group
        - 567 acres of long-term agricultural projects
        - 2,029 acres of cover crops implemented

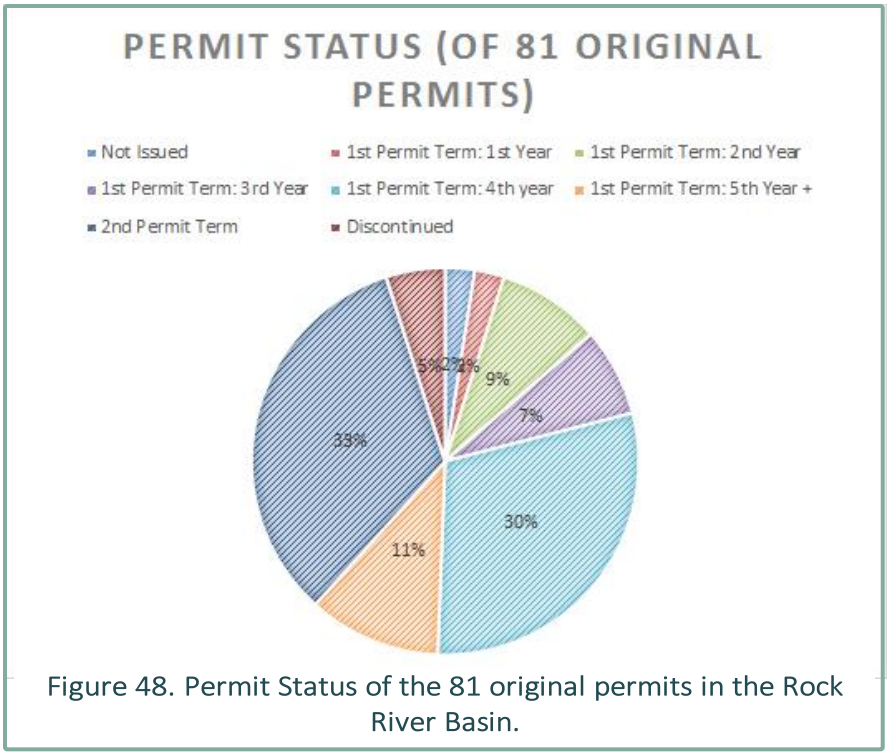


Figure 48. Permit Status of the 81 original permits in the Rock River Basin.

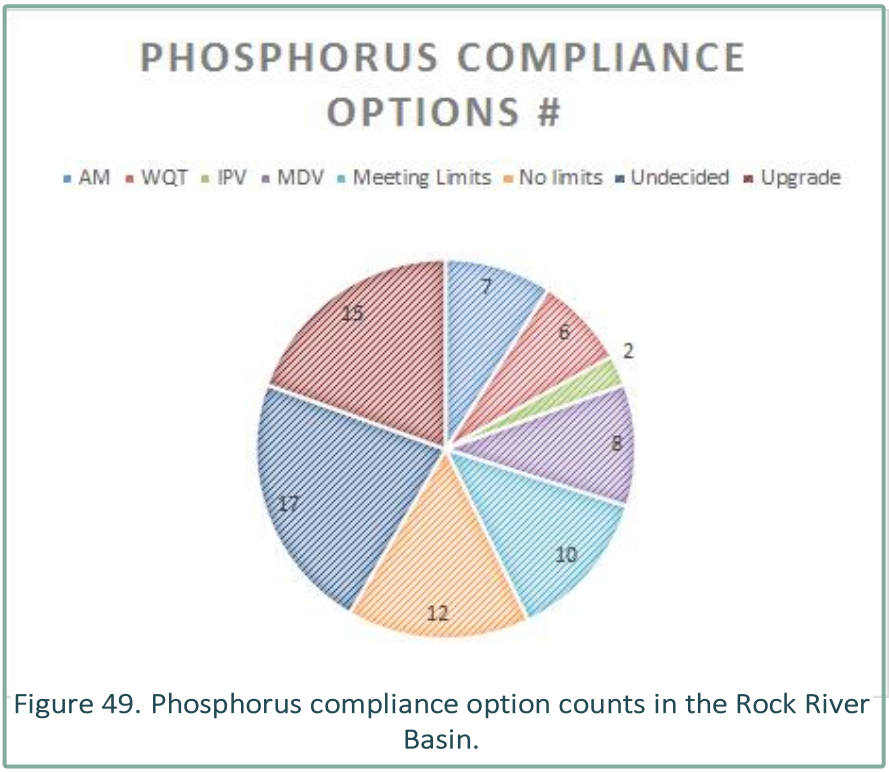


Figure 49. Phosphorus compliance option counts in the Rock River Basin.

- City of Beaver Dam Lake Adaptive Management: The City of Beaver Dam Lake is initiating Watershed Adaptive Management as their WPDES permit compliance option. WDNR staff worked with the City of

Beaver Dam to review permit compliance options, and in 2018 published the Beaver Dam Lake TMDL to reflect updated monitoring data and limits. The Adaptive Management project will incorporate this nested TMDL and the final Adaptive Management Plan is due in December of 2019, with the draft plan and compliance alternatives available here:

- City of Beaver Dam: Final Compliance Alternatives Plan
- Beaver Dam Lake Total Maximum Daily Load for Total Phosphorus, June 20, 2018
- EPA Approval letter, August 17 2018

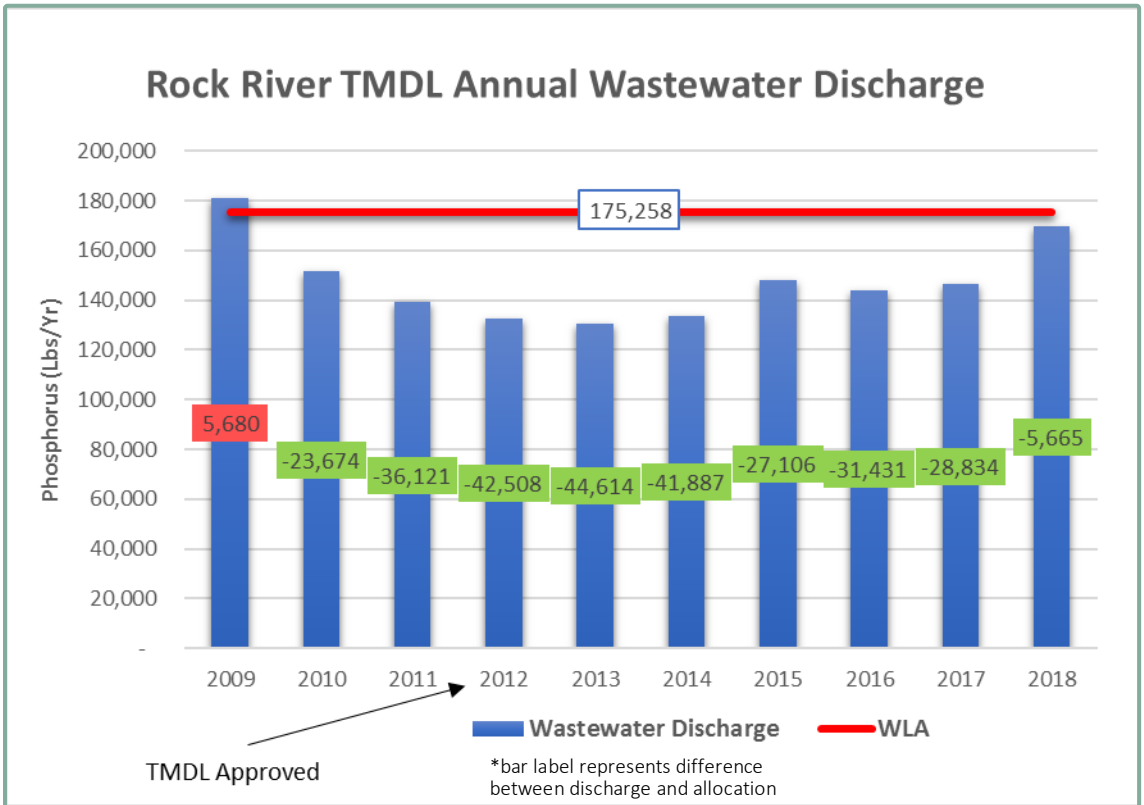


Figure 50. Wasteload allocations and annual discharge values for the Rock River TMDL. Discharge values populated from NR101 billing query.

Point Sources – MS4 Stormwater:

- Permitted MS4 communities in the Madison Area Metropolitan Stormwater Partnership (MAMSWAP) are participating in the Yahara WINs Adaptive Management Project for stormwater compliance with TMDL reductions and for meeting in-stream criteria.
- The WDNR has reissued WPDES MS4 General Permit No. WI–S050075–3, effective May 1, 2019, which replaces previous coverage under expired WPDES MS4 General Permits No. WI–S050075–2 and WI–S050181–1. The new GP requires municipalities to reduce polluted stormwater runoff by implementing stormwater management programs with best management practices to specifically address TMDL reductions. Goals for communities that are members of Adaptive Management projects are focused on meeting in-stream criteria, while other communities must specifically address percent reductions.

- Included in the new permit is the finalized TMDL permitting strategy for regulated stormwater systems. s. Existing MS4 communities had already received the first (general and individual) permit in this cycle for the Rock River Basin.
- No new MS4 communities have been added to the TMDL since the last report in 2016.

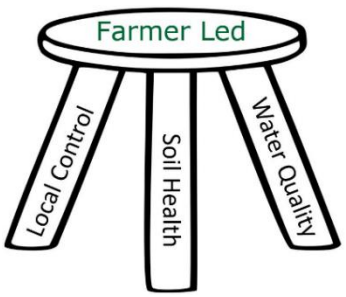
Nonpoint Sources:

- Both the **Upper Mendota** and Beaver Dam River Priority Watershed Plans have expired, or soon will. The Upper Mendota area is now included within the Yahara WINs Adaptive Management Project, and the Beaver Dam watershed is being incorporated into the Beaver Dam Lake Adaptive Management Plan.

- The Wildcat Creek HUC 12 Nine Key Element Plan in Dodge County was approved earlier this year. Combined with the **Lake Sinnissippi** HUC 12 Nine Key Element Plan (to be completed this year), these targeted plans will cover ~50% of the agricultural land in Dodge County. This represents a critical portion of the upper half of the Rock River Basin that will help to establish the baseline water quality trends through the entire system.

- Jackson Creek Watershed Protection Plan (Nine Key Element Plan): The Jackson Creek watershed has been identified as a significant contributor of sediment and phosphorus to the Rock River. The Jackson Creek Watershed Protection Plan provides a framework for communities to work together on a common mission to protect and improve land and water resources and meet the assigned TMDL nonpoint source and wasteload allocations. The protection plan is designed to be a practical guide for the improvement of water quality within the Jackson Creek watershed. It addresses the management of land surfaces that drain directly and indirectly to streams—and consequently to downstream reaches including Delavan Lake, the Turtle Creek, the Rock River, and ultimately, the Mississippi River. The Jackson Creek Plan sets reduction goals of 49% or 26,231 pounds of total phosphorus and 25% or 8,842 tons of total suspended solids. While Jackson Creek is not currently identified as impaired, it is a tributary to Turtle Creek, which has been listed as an impaired waterway by the EPA and WDNR. Excessive sediment and nutrient loading to Delavan Lake have led to increased algal blooms, oxygen depletion, and water clarity issues that have been periodically documented since the WDNR's Turtle Creek Priority Watershed Plan in 1984. Excessive sediment and nutrient loading to the Rock River has also led to more algal blooms, oxygen depletion, water clarity issues, and degraded habitat in the Rock River Basin, prompting the need for action to be taken in that watershed. (TMDL requirements for phosphorus and sediment were approved for the Rock River Basin and its tributaries in 2011.)

- **"Common Ground" Initiative:** The baseline condition for NPS pollutants in the Rock River TMDL is a basin-wide Phosphorus Index of 6 lbs/ac/year and tolerable soil loss of 2 T/ac/yr, consistent with the statewide Agricultural Runoff Performance Standards in NR 151. Working with the existing farmer-led watershed groups in the Rock River Basin (Yahara Pride Farms, Dodge County Farmers for Soil Health and Water Quality, and Farmers for Lake Country), as well as through direct contact with the farmers, helping at various farms with field days, and unofficial surveys of farmers



at their events, meetings, etc., it appears that these farmers are employing best farming practices across tens of thousands of acres. It is likely (although undocumented) that these practices not only exceed the NR 151 requirements, they also meet or exceed the NPS reductions required in the TMDL. The "Common Ground" initiative builds on these successes and the three related goals of Farmer-Led Watershed Groups – local control, soil health, and water quality. This initiative, being coordinated with the Producer-Led Watershed Grant Program of the Dept. of Ag., Trade and Consumer Protection (DATCP) further builds on the success of the WDNR "Green Tier" initiative for private industry that looks to facilitate superior performance through collaborative industry/agency partnerships.

- Yahara Pride Farms: Farmers in this organization reduced phosphorus runoff by over 20,000 lbs in 2018 using "prevention-based" best practices on agricultural lands to minimize or eliminate runoff from fields (Yahara WINs 2018 report).
- Dodge County Farmers: Farmers in this large farmer-led group (covering all of Dodge county) have been implementing "prevention-based" best practices on nearly 100,000 acres of agricultural fields across Dodge County.
- Farmers for Lake Country: Farmers for Lake Country have been instrumental in adopting "prevention-based" best practices, riparian buffers, easements, and field retirement to minimize or eliminate runoff from fields (Oconomowoc Watershed Restoration Project Report, 2018).

Upper Rock River—Dane County LCD Fall Grazing Cover Crops Project

Livestock producers, both large and small, need to find innovative ways to reduce input costs and improve profitability. Grazing of fall-planted cover crops can significantly reduce feed costs when properly managed. In addition to providing an additional source of forage, cover crops reduce soil erosion, improve soil microbiology, increase infiltration and sequester carbon. This project will promote the use of cover crops by making an economical and environmental sustainability case on livestock farms in Southern Wisconsin.

Year One successfully engaged five farms in 2019 to utilize cover crops for forage. Farms that grazed cover crops used highly diverse mixes and rotations depending on their current row crop rotations. One example rotation was Cereal Rye aerially seeded in fall of 2018 into corn; the rye was then grazed after corn harvest. Forage oats and red clover were then planted and grazed in late June. Various mixes of Sorghum and Sorghum-Sudan grass were planted in early July. Farms were able to graze or harvest three times. Fields were then planted back to forage oats for a late fall grazing. All fields were also aerial seeded back to cereal rye to ensure fall cover and a spring cover crop before the field is planted back to corn. The Red Clover that was planted in spring will also offer up to 80 lb/ac of nitrogen credits. It is a complicated rotation, but allowed the farmer to experiment with different forages.

The goal of the project is phosphorus reduction in the Yahara Watershed. This project also includes converting some cropland to permanent pasture. This specific project will reduce phosphorus by 332.1 pounds per year with a project lifespan of 15 years on the permanently pastured crop ground. This is at a cost of $30/lb of P reduced. In addition, 165.5 pounds of phosphorus will be reduced per year on the cover-cropped portion of the farm at a cost of $26/lb of P.

If these practices can be expanded throughout the watershed, significant savings in phosphorus reaching surface waters can be achieved. By converting cropland to permanent managed pasture, 5.3 lbs of P/ac/year can be reduced. By utilizing cover crops, 1.9 lbs of P/ac/year can be reduced. The combination of grazing cover crops and permanent pasture has the potential to not just reduce nutrient loading, but reduce all chemical applications of fertilizers and pesticides in the watershed. In addition, managed grazing has been shown to improve wildlife habitat, soil health and profitability on livestock operations.

II. Reducing Phosphorus Loss in the Lake Michigan Basin

4.3 Lower Fox River Basin

The Lower Fox River Basin, located between Lake Winnebago and Green Bay, is one of the highest priority watersheds in the Great Lakes Basin as well as having one of the first basin-wide TMDLs for phosphorus, approved on May 18, 2012. Implementation activities have received federal funding from the USDA NRCS and from the EPA's Great Lakes Restoration Initiative (GLRI), as well as state funding.

Point Sources—Wastewater: Under the TMDL, reductions of 107,595 pounds TP per year will occur when all WPDES permits are reissued and all reduction actions are fully implemented. Currently, all 28 WPDES permits have been reissued with limits reflecting the WLA. It is expected that most reductions will be realized over the next 10 years. A major discharger, NEW Water (the Green Bay municipal wastewater agency) has proposed an Adaptive Management plan with a 20-year compliance timeline. Two dischargers in the Lower Fox, one existing and one new, have approved water quality trades for TSS and TP/TSS, respectively. One discharger (P&G) has selected the MDV option.

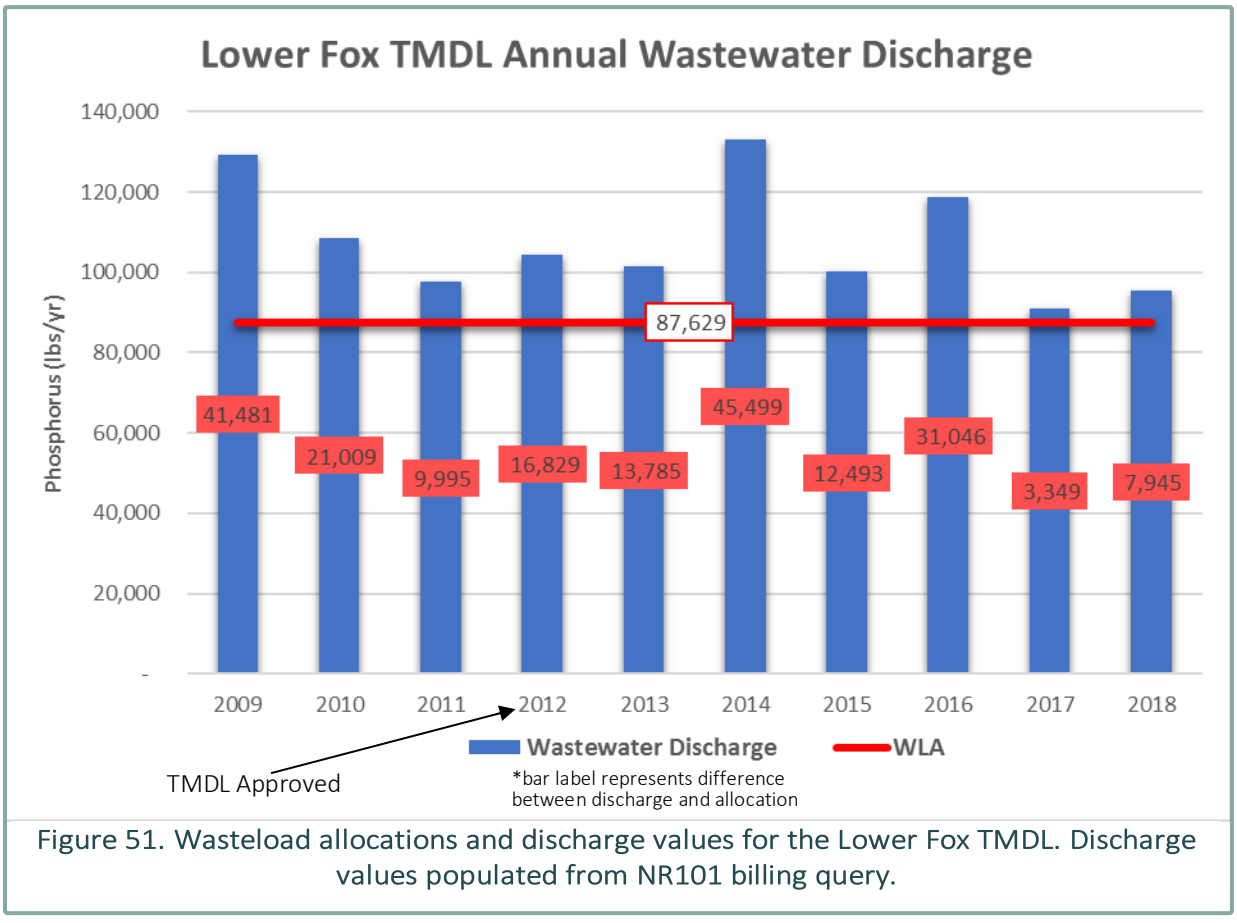


Figure 51. Wasteload allocations and discharge values for the Lower Fox TMDL. Discharge values populated from NR101 billing query.

Point Sources—Municipal separate storm sewer systems (MS4s): In May 2014, 29 municipalities received coverage under the WPDES general permit. Full implementation will reduce 21,058 pounds TP per year.

- Both TSS and TP loading reductions in the Lower Fox TMDL area continue to be pursued by the 30 permitted MS4s in 2017 and 2018. All 30 affected MS4s have completed pollutant modeling, more than three quarters of them with cost-share from Urban Nonpoint Source planning grants over the last 9 years. Two MS4s are currently meeting their MS4 WLA implemented as an annual percent reduction in TSS and TP. The remaining 28 MS4s have submitted implementation plans and the WDNR has concurred with 24 of those plans. The MS4 general permit reissued in May 2019 gave MS4s several options to meet or make progress toward meeting their TMDL WLAs. These options include following concurred-with implementation plans and demonstration of incremental progress. The WDNR has supported those efforts in 2017 and 2019 with the Urban Nonpoint Source construction grants on construction of six new regional ponds, one streambank stabilization project, and two biofilters.

Nonpoint Sources – The Agriculture sector has been heavily engaged in implementation:

- Demonstration Farm Networks – The USDA NRCS and the Great Lakes Commission (GLC) partnered to establish a Great Lakes Demonstration Farm Network, the first of its kind in Wisconsin. Brown County Land & Water Conservation Department has since assumed the project agreement with NRCS, and the Outagamie County Land Conservation Department and UW-Extension are also partners in the project. The Network is working to provide better information on the effectiveness of conservation systems used to improve water quality. The participating farms demonstrate effectiveness and adaptability of conservation practice systems to reduce erosion and sedimentation, control phosphorus runoff, and address other nonpoint source pollution issues. The Network also provides educational technology transfer opportunities for the public, farmers, land managers, agribusiness, environmental groups, natural resource agencies, research entities and other partners.

  The Demonstration Farm Network objectives are to:
  - establish demonstration farms within the Lower Fox Watershed to test new and standard conservation systems in reducing phosphorus and sediment;
  - establish an efficient mechanism to share this technology and information with farmers, agribusiness, conservation agencies and the public;
  - create opportunities for others to test their research, technical and program ideas at the demonstration farms; and
  - share information and lessons learned from the Lower Fox Watershed throughout the Great Lakes Basin.

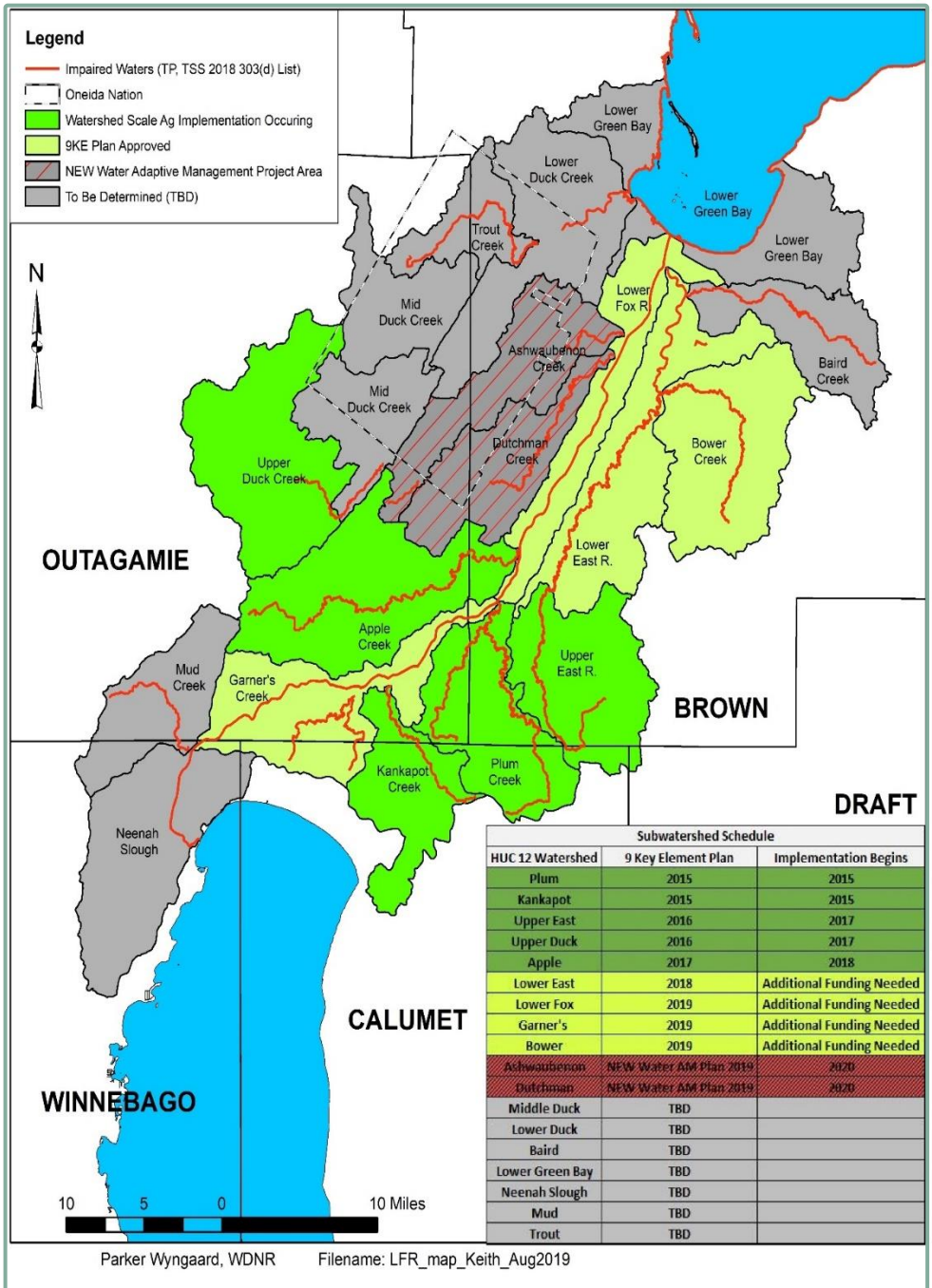
  The initial four farms participating in the Network have now increased to eight and a new project element has been added to provide dedicated, one-on-one technical assistance to other farms that are interested adapting the demonstrated practices on their operations. Each of these farms have played an intricate role in trying, demonstrating, and sharing information on leading-edge practices and technologies applied

on their farms. Practices include cover crops, reduced tillage, reduced-disturbance manure application, pesticide management and water quality monitoring.

- Nine Key Element Watershed Plans-- WDNR completed review and issued approval of Nine Key Element watershed plans for the Apple River in 2017, the Lower East River in 2018 and the Lower Fox River, Garner's Creek and Bower Creek in 2019 (Figure 52). Nine Key Element plans for the Upper East and Upper Duck began implementation in 2017. The Apple River plan began implementation in 2018.

All these plans follow the same approach of using WDNR and EPA modeling tools – EVAAL and STEPL – to identify priority areas and model pollutant reductions from a combination of various practices in order to address the nine elements and Lower Fox TMDL reduction goals. The plans also rely upon existing or new water quality monitoring stations at the mouth of each of these watersheds to confirm if practices implemented (and modeled reductions) do or do not result in improved water quality.

All plans have ten-year schedules and contain milestones that reflect realistic landowner participation rates and implementation of various practices on 75% of cropland acres in each watershed. Because of this, the plans explain they will make substantial progress towards, but fall short of, meeting overall Lower Fox TMDL TP



Subwatershed Schedule		
HUC 12 Watershed	9 Key Element Plan	Implementation Begins
Plum	2015	2015
Kankapot	2015	2015
Upper East	2016	2017
Upper Duck	2016	2017
Apple	2017	2018
Lower East	2018	Additional Funding Needed
Lower Fox	2019	Additional Funding Needed
Garner's	2019	Additional Funding Needed
Bower	2019	Additional Funding Needed
Ashwaubenon	NEW Water AM Plan 2019	2020
Dutchman	NEW Water AM Plan 2019	2020
Middle Duck	TBD	
Lower Duck	TBD	
Baird	TBD	
Lower Green Bay	TBD	
Neenah Slough	TBD	
Mud	TBD	
Trout	TBD	

Figure 52. Lower Fox River Basin TMDL Watershed Implementation Schedule.

reduction goals. To meet the nine elements, each plan explains additional practices or new technologies to meet the remaining TMDL TP and sediment reductions that are predicted, via SWAT modeling, to restore impaired waters in the basin. The plans represent current pieces of the overall Lower Fox TMDL implementation strategy. The status of TMDL implementation by watershed is shown in Figure 52.

- Plum -Kankapot Creek GLRI Project (from the Fox Wolf Watershed Alliance website) – The Plum Creek and Kankapot Creek watersheds, located near the villages of Kaukauna and Wrightstown in northeast Wisconsin, were identified in the Lower Fox River TMDL plan (2012) as one of the highest contributing watersheds to the Lower Fox River for sediment and phosphorus pollution.

  In order to address water quality issues, a "Nonpoint Source Implementation Plan" was prepared for these watersheds in 2014. Since this plan was created, funding has been used to implement a number of agricultural conservation practices within the watershed, with the Fox-Wolf Watershed Alliance (FWWA) playing a major role. Other partners are Outagamie County, Calumet County, Brown County, UW-Green Bay, USGS and The Nature Conservancy. Funding through the GLRI has been utilized to begin the process of reducing the amount of sediment and phosphorus delivery to these creeks and ultimately, the Lower Fox River and Bay of Green Bay. The FWWA GLRI Projects Team has been busy promoting cover crop planting, no-till or reduced tillage farming, treatment wetlands, conservation buffer strips, grassed waterways and streambank protections.

  With the implementation plan in place for the past five years, project staff felt it was time to review the plan in order to gauge the progress towards reducing sediment and phosphorus inputs to the Plum and Kankapot Creeks.

  The original goals listed in the plan indicated the need to reduce yearly inputs by the following amounts:

  - Plum Creek: 23,799 lbs/yr of phosphorus and 8,336,265 lbs/yr of total suspended solids
  - Kankapot Creek: 14,060 lbs/yr of phosphorus and 4,142,164 lbs/yr of total suspended solids

  Initial analysis of the practices that have been installed from 2015 to 2018 indicate the following average input reductions (note that these reductions are for both the Plum and Kankapot Creek watersheds combined, and also encompass various entities and funding sources):

  - For Cover Crops: 1,263 lbs/yr of phosphorus and 292,000 lbs/yr of total suspended solids
  - For Buffer Strips: 211 lbs/yr of phosphorus and 38,000 lbs/yr of total suspended solids
  - For Streambank Protection Projects: 82 lbs/yr of phosphorus and 118,000 lbs/yr of total suspended solids

  In addition to the above reductions:

  - Nutrient management planning has provided an additional total of 364 lbs of phosphorus reductions.
  - Barnyard runoff and waste storage projects have provided a total of 467 lbs of phosphorus reductions.
  - Conservation practices such as grassed waterways or concentrated flow area treatments have provided 759 lbs of phosphorus reductions and 948,000 lbs of total suspended solids.

- Other projects (such as treatment wetlands) and practices (such as conversion to grazing) have provided reductions of 3,767 lbs of phosphorus and 1,486,000 lbs of total suspended solids.

The Lower Green Bay & Fox River Area of Concern (AOC) - Great Lakes rivers and harbors that have been most severely affected by historical pollution and habitat loss are considered "Areas of Concern," or AOCs. Designated in 1987 under an international agreement between the U.S. and Canada known as the *Great Lakes Water Quality Agreement*, these sites need special attention for restoration and cleanup. The Lower Green Bay/Fox River is one of Wisconsin's five designated AOCs. It is impaired for "Eutrophication or Undesirable Algae," one of 14 possible impairments listed in the *Great Lakes Water Quality Agreement*. Wisconsin has been exploring ways that the AOC program can address this impairment for several years, while acknowledging the scope of the program, which focuses on defined geographic areas and legacy pollutants. Given the scope and complexity of the eutrophication issue, the AOC program is evaluating the potential to sponsor the implementation of best management practices that complement and support efforts that are underway through other programs and initiatives. These practices would be focused primarily on reducing flow in tributaries in the Lower Fox River Basin through increased capacity to store water on the landscape, and include agricultural runoff treatment systems, wetland restoration, streambank stabilization, two-stage ditches, and saturated buffers. WDNR continues to work with partners and stakeholders to refine the outcomes (e.g. level of implementation of storage practices) that will define success for the AOC program for the "Eutrophication or Undesirable Algae". Together, these will set the stage for the AOC to contribute a defined amount of conservation practice implementation to reduce nutrient loading to the Lower Fox River and Lower Green Bay.

Lower Fox River Basin--Outagamie County LCD Plum Wetland Project

Outagamie County LCD partnered with UW-Green Bay and USGS to explore effectiveness of the first installed treatment wetland (now called Ag Runoff Treatment System or ARTS) in removing phosphorus. A study in June 2017 showed that for a 10 acre crop field, over 6 tons of sediment and 9 lbs of phosphorus were in the runoff from end of June 2017 rainfall events. The monitoring data collected allowed for a mass balance analysis which showed the amount of sediment (90%) and phosphorus (79% TP) trapped by the ARTS. The system was not effective in trapping dissolved P. Sediment core data confirmed the trapping effectiveness seen in the mass balance study. The practice looks promising for trapping sediment and nutrients and potentially for reducing downstream flooding and streambank erosion.

4.4 Upper Fox/Wolf River Basin TMDL

The Upper Fox and Wolf River Basins (UFW) are two separate basins that converge within a series of pool lakes in Winnebago County (Lake Poygan, Lake Winneconne and Lake Butte des Morts) before finally flowing collectively into Lake Winnebago. All the surface water drainage to Lake Winnebago is contained within these two basins. Lake Winnebago outlets into the Lower Fox River Basin, where it eventually flows into Green Bay. All four lakes are currently impaired due to excess phosphorus, and are experiencing severe algae problems that interfere with recreation. In addition, Lake Winnebago is the source of drinking water for 250,000 people. The presence of reoccurring harmful algal blooms puts this drinking water source at risk of cyanotoxins breaking through the water treatment process.

The WDNR, together with many partners throughout the basins, is working to improve water quality within the Upper Fox and Wolf River systems, which include many lakes and tributaries. The TMDL study and implementation plan will provide a strategic framework and prioritize resources for water quality improvement in the UFW. This TMDL was approved by EPA on February 28, 2020.

The UFW TMDL study area spans Wisconsin's east central corridor from the headwaters in Forest County and the City of Portage to Lake Winnebago, covering 5,900 square miles, approximately 10 percent of the state (Figure 53).

Point Sources—Wastewater: There are 69 municipal and industrial wastewater treatment facilities in the UFW that hold individual WPDES permits. These will be reissued with phosphorus limits consistent with the TMDL WLA over the next 4 years.

The TMDL provides additional information to support water quality

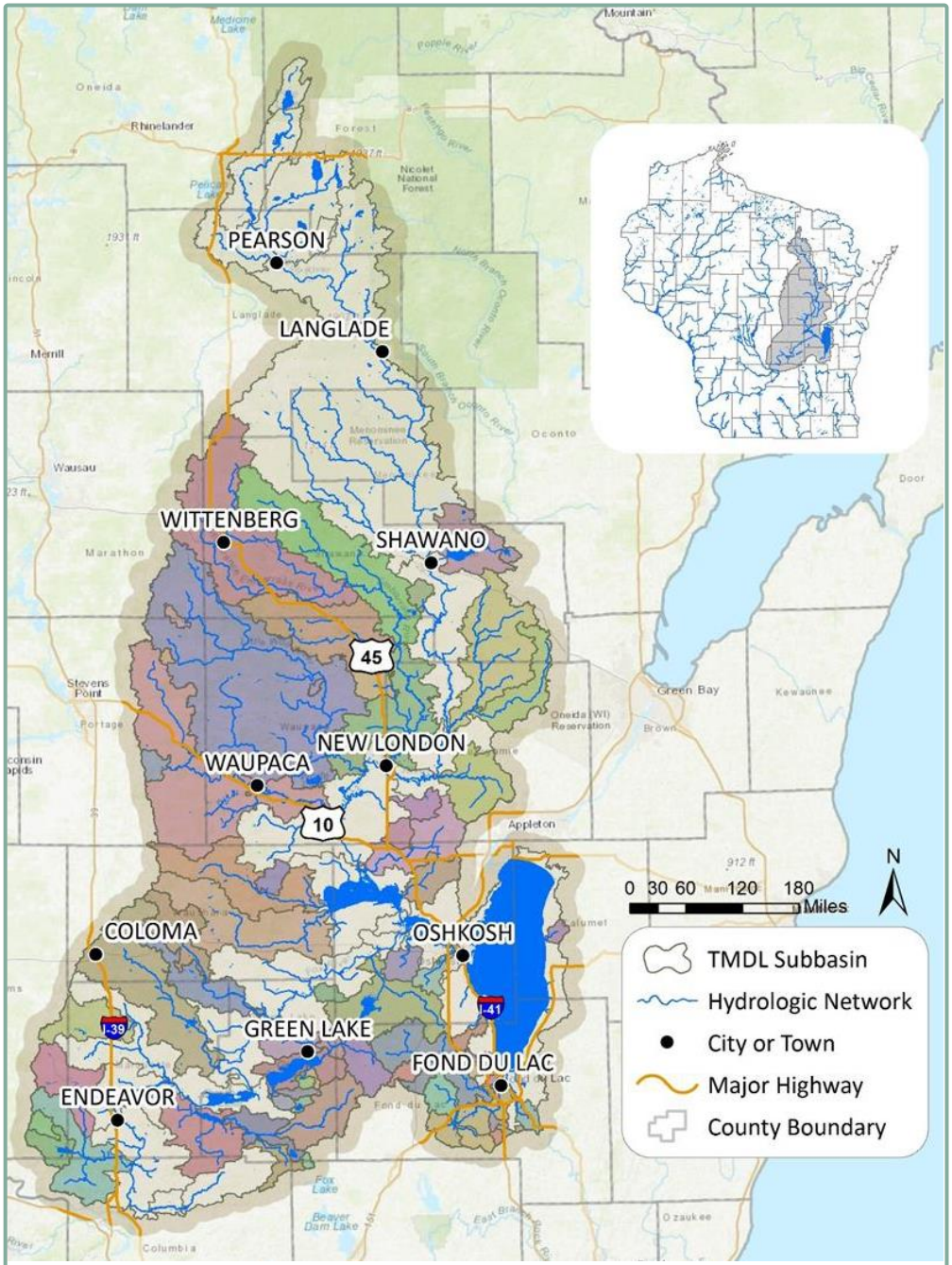


Figure 53. Map of Upper Fox/Wolf River Basin TMDLs.

trading (WQT) and adaptive management (AM), if a WPDES permittee wishes to select and implement these options to comply with more stringent phosphorus limits. In many cases, the Upper Fox and Wolf Basins (UFWB) TMDL expands the geographic extent available for generating WQT credits from just the facility's subbasin to the entire drainage area of one of the lakes or reservoirs in the UFWB. In addition, flexibility is provided for cases where an AM plan might not be viable if the downstream lakes and reservoirs were used as the point of standards compliance. In such cases, facilities can evaluate AM at a subbasin scale since subbasin allocations are set to meet the water quality standards of the downstream lakes/reservoirs.

Point Sources--MS4: Both TSS and TP loading reductions in the Upper Fox/Wolf TMDL area were pursued by the 27 permitted MS4s in the 2017-2019 time period. The Department has supported those efforts by providing Urban Non-Point Source construction grants for the construction of one new regional pond and one underground detention project. Once the TMDL is approved, the focus of TMDL-related MS4 permittee efforts during the current 5-year permit term will be on assessment and planning. While the TMDL is not yet approved by EPA, many of the communities have either recently completed or are in the process of completing community-wide pollutant modeling to estimate pollutant reductions achieved within the TMDL watersheds and identify locations for new structural best management practices to be installed in the future. The Department is providing cost-share dollars through the Urban Non-point source planning grant program for seven permitted MS4s in the Upper Fox/Wolf TMDL.

Nonpoint Sources: Although the TMDL for the Upper Fox/Wolf has not yet been approved, implementation of phosphorus-reducing activities has already started. Watershed-based planning is a key first step. Nine Key Element plans have been approved for the Weyauwega Lake – Waupaca River and Bear Lake – Little Wolf River watersheds. A

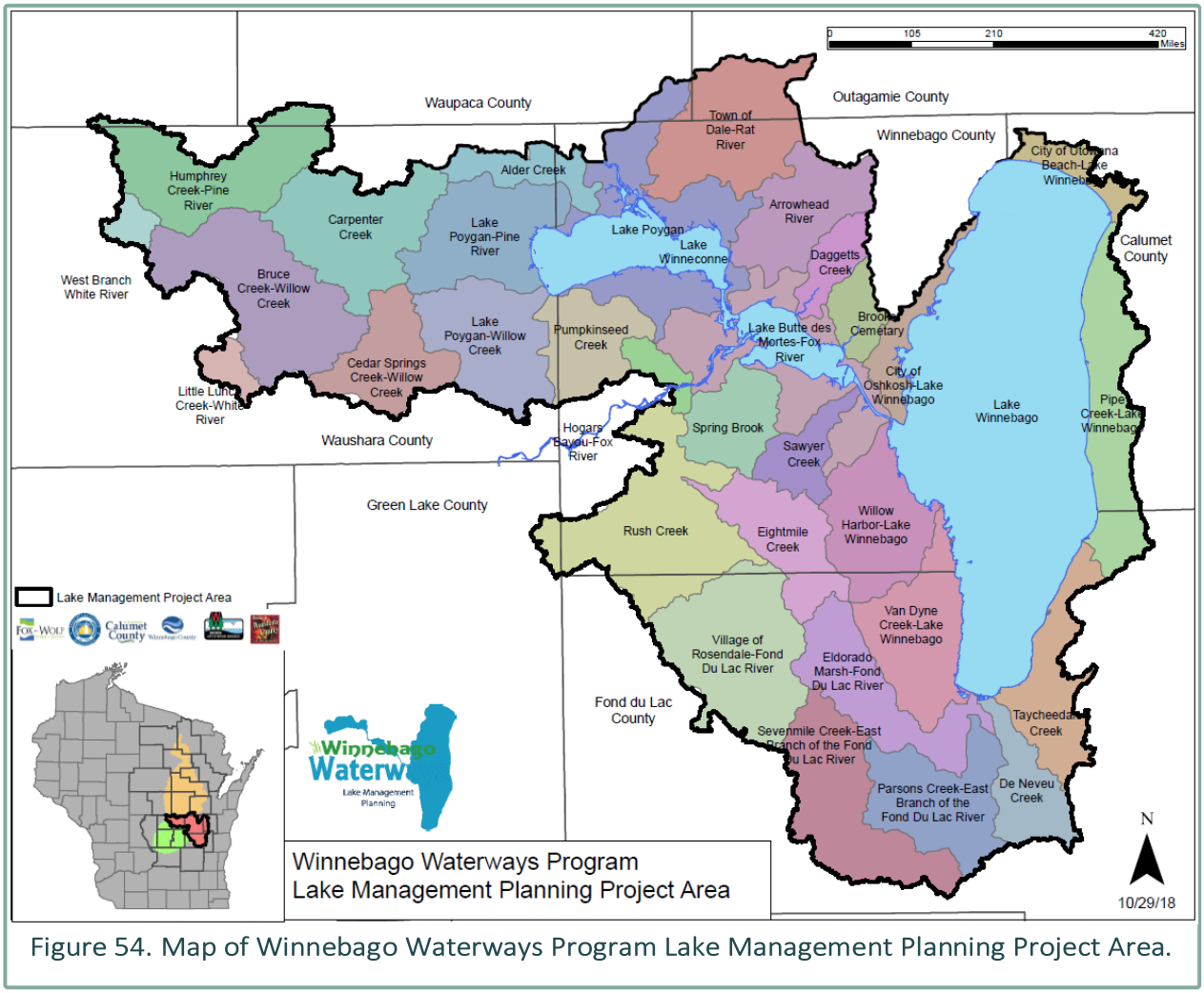


Figure 54. Map of Winnebago Waterways Program Lake Management Planning Project Area.

large lake management planning effort called Winnebago Waterways is underway, the water quality piece of which includes developing a Nine Key Element plan for 32 HUC 12 watersheds (Figure 54).

TMDL load allocations for agricultural sources can be challenging to incorporate into TMDL implementation planning efforts due to: 1) the dependence of nonpoint source pollutant loading on weather, soil, and land management practices that vary widely in space and time; and 2) conceptual differences between watershed models used for TMDL development and field-scale models used by agricultural producers to estimate nutrient and sediment losses under alternative management practices.

WDNR has developed a framework for communicating agricultural load allocations which translates results of the watershed model used for TMDL development to field-scale model outputs that are better understood by the agricultural community. The framework serves as a tool for producers to evaluate BMPs to implement on their own fields in order to meet TMDL load allocations.

The TMDL report target phosphorus and sediment yields for agricultural sources in the Upper Fox and Wolf Basins that are comparable to outputs from SnapPlus (Soil Nutrient Application Planner), the standard nutrient management planning software used by Wisconsin agricultural producers. Producers can use SnapPlus software to verify whether their management plans are meeting TMDL targets for phosphorus and sediment yields. Producers can look up the appropriate target phosphorus and sediment yields defined by the TMDL for their location.

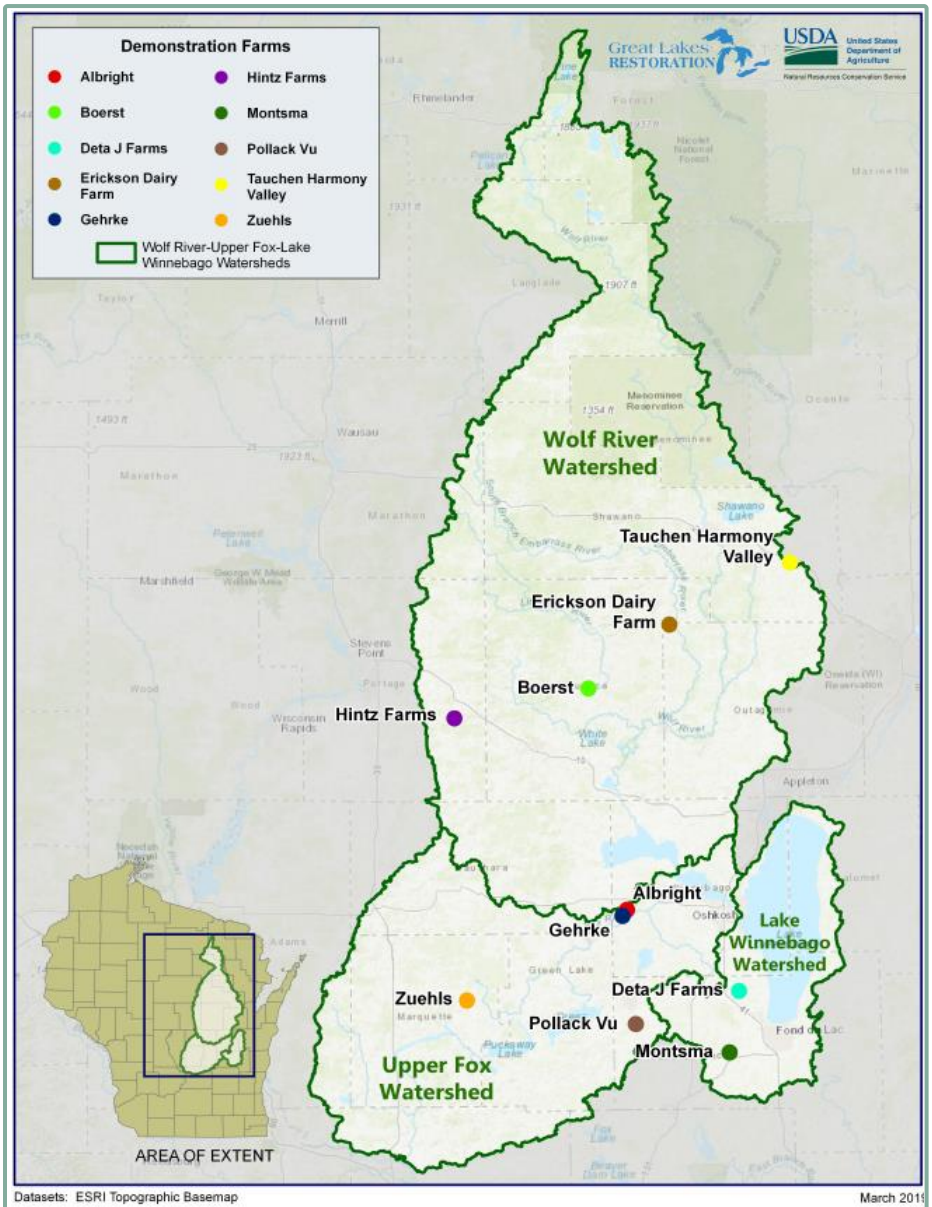


Figure 55. Map of Upper Fox – Wolf Demonstration Farms Network.

Upper Fox/Wolf Demonstration Farms Network

The Upper Fox-Wolf Demonstration Farms were initiated in 2019 and consist of 10 farms/producers across 8 counties. It is a collaborative agreement with the counties of Shawano, Winnebago, Portage, Waupaca, Fond du Lac, Green Lake,

Marquette, Outagamie, and the Green Lake Association, all located within the 6,000 sq mile Upper Fox River and Wolf River Basin. This network of growers across the Upper Fox and Wolf River watersheds has the goal of demonstrating conservation practices, technologies and techniques that reduce sediment loss and improve water quality. In 2019, practices included inter-seeded cover crops, late summer/fall seeded cover crop applications, no-till planting, planting into green cover, rotational grazing, low-disturbance manure application, and alternative forages. As part of the agreement, each farm is to do conservation practices on 100 acres. Ten farms would equate to a minimum of 1,000 acres. Almost all the farms are well beyond the 100 acre requirement through conservation practices applied at their own initiative. In 2020, conservation practices will expand upon last year's practices and incorporate lessons learned. Additional practices that are being considered are native/pollinator friendly buffers, buffers along watercourses, trafficability, relay cropping, in-season applications of manure, grazing cover crops, alternative crops and forages, and experimenting more in-depth with the use of cover crops.

Upper Fox/Wolf River Basin--Fond du Lac County LWCD Pipe Creek Watershed Project

Fond du Lac County LWCD combined local, state and federal funding sources to cost share practices in this small watershed to reduce soil erosion/sediment and phosphorus delivery to Pipe Creek and ultimately Lake Winnebago. The project started by working with landowner/farmers to verify nutrient management plan information as step one. Fond du Lac LWCD felt strongly that this step critical to moving forward with conversations because if the NMP data was inaccurate, it would be then difficult to determine how effective additional BMPs would be on the landscape. After the NMP info was verified, County LWCD staff worked with farmers to identify areas on the farm that are susceptible erosion and then made recommendations to address them.

Fond du Lac LWCD felt that they had cost share sources to build the needed structural BMPs to reduce runoff but were lacking funding for cropping/soft practices that were also needed. Even so, two producers in the watershed who own the most land in the watershed, are committed to utilizing cover crops and less tillage as often as possible on as much acreage as possible, thanks to the insights and conversations had through the outreach activities, farm walkovers, and individual meetings. So while only 111 acres of cover crops were cost shared through the grant dollars, the grant funding has had a very positive impact on the adoption of cover crops throughout the watershed on many more acres than were paid on. Fond du Lac staff have established long term working relationships with many of the farmers in this watershed and will continue to work with them on maintaining an accurate record of nutrient management through SNAP+. This project became the first step in leading the department to develop a 9 Key Element plan for the watershed to further continue implementation efforts.

4.5 Northeast Lakeshore TMDL

(Includes Sheboygan River and Manitowoc River Targeted Phosphorus Watersheds)

The Northeast Lakeshore TMDL is currently in the development phase. Initial stream monitoring for the Northeast Lakeshore TMDL began in 2016 and expanded to 43 locations in 2017 when the Wisconsin legislature appropriated funding for developing the Northeast Lakeshore TMDL. The resulting TMDL will address 42 streams and 12 inland lakes impaired from phosphorus or sediment in the basins that make up the northeast lakeshore of Lake Michigan along the Door Peninsula. Completion and EPA approval of the Northeast Lakeshore TMDL are expected in 2022.

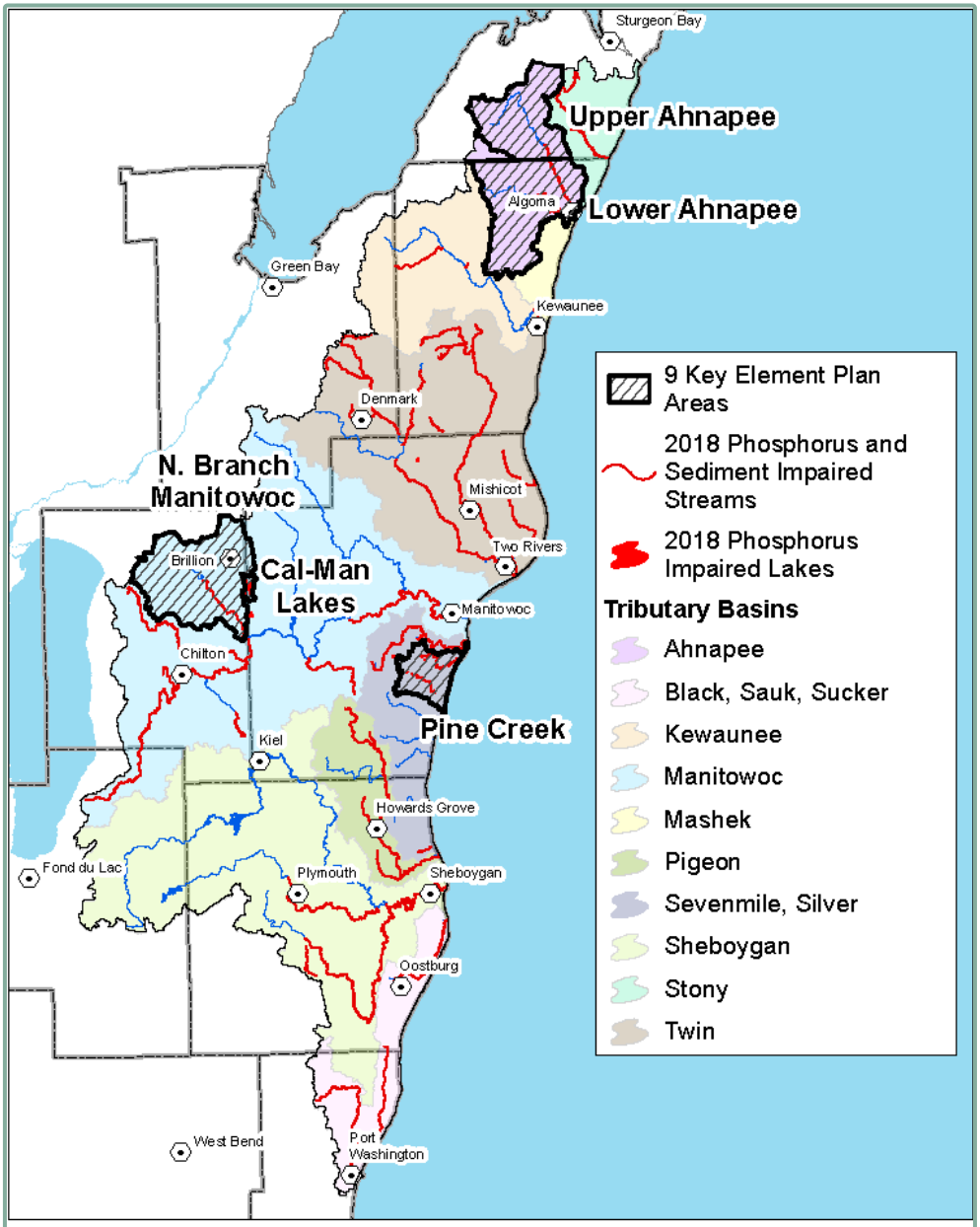


Figure 56. Nine Key Element Plans approved and in progress within the Northeast Lakeshore TMDL.

The WDNR has been engaging with all stakeholder groups during the TMDL development phase. Additional informational meetings are planned to take place throughout the remainder of the development phase to describe TMDL development methods and help stakeholders prepare for TMDL implementation. Following the approval of the TMDL, a detailed implementation plan will be developed to describe how TMDL goals can be achieved for each pollutant source.

Initial contact has been made with all stakeholder groups to facilitate data collection and verify watershed model inputs. These data-gathering efforts have prepared stakeholders for TMDL implementation by increasing awareness of the Northeast Lakeshore TMDL and prompting further discussion regarding the effects of a TMDL on pollutant sources.

Point sources: WDNR has been in contact with the 32 municipal wastewater, 14 industrial wastewater, and 10 urban stormwater stakeholders that hold WPDES permits to verify discharge locations and monitoring data for TMDL development. This process is helping prepare permit holders for TMDL implementation by increasing awareness and planning for potential changes to their effluent limits.

Nonpoint sources: WDNR has been engaging with county partners to gather agricultural land use and land management data for incorporation into the TMDL watershed model. This data gathering effort has helped prepare counties for the TMDL implementation phase by facilitating the identification of high priority areas for TMDL implementation and Nine Key Element Plan development.

There are currently five Nine Key Element plans that are either approved or in development within the Northeast Lakeshore TMDL area. In all plan areas, except the Cal-Man Lakes, agriculture makes up a majority (greater than 50%) of the land use. The plans that are approved or in development focus on reducing sediment and phosphorus runoff, which will directly contribute to achieving the phosphorus and sediment reduction goals developed in the Northeast Lakeshore TMDL. Together, these plans cover 8 of the 12 TP impaired lakes listed in 2018 and 5 of the 44 phosphorus or sediment impaired streams listed in 2018.

Table 7. Nine Key Element Plans within the Northeast Lakeshore TMDL.

9KE Plan Name	County	Status	Pollutant Focus	Acres covered by plan	HUC12 watersheds in plan	2018 impaired waters covered in plan
Upper Ahnapee	Door	Review and revision stage	Phosphorus and Sediment	34,000	Approx. 2/3 of the Ahnapee River HUC12	Ahnapee River
Lower Ahnapee	Kewaunee	Review and revision stage	Phosphorus, sediment, with ties to groundwater water quality	42,191	Approx. 1/3 of the Ahnapee River HUC12; Spring Creek; Rio Creek	Ahnapee River, Silver Creek
Cal-Man Lakes	Calumet & Manitowoc	DNR approved March 2019	Phosphorus and Sediment	1,234	Lake focused plan within the Spring Creek HUC12	Round Lake, Boot Lake, Long Lake, Becker Lake
North Branch Manitowoc	Calumet	Review and revision stage	Phosphorus and Sediment	47,647	Headwaters of North Branch Manitowoc; North Branch Manitowoc; Spring Creek	North Branch Manitowoc River
Pine Creek	Manitowoc	DNR approved September 2019	Phosphorus and Sediment	13,409	Pine Creek	Pine Creek, Calvin Creek, Carstens Lake, Gass Lake, Hartlaub Lake, Weyers Lake

Education and Outreach: In 2018 and 2019, the WDNR presented project updates to watershed groups, farmer-led groups, and technical teams in the Ahnapee and Manitowoc River Basins. These updates increase the interest in and awareness of TMDL implementation activities.

Lakeshore Natural Resource Partnership (LNRP)

The Lakeshore Natural Resource Partnership and its watershed partners are playing a key role in outreach, education, and non-point implementation aspects of the Northeast Lakeshore TMDL. Since 2012, LNRP has expanded their role in watershed stewardship by partnering with eight watershed groups in the Northeast Lakeshore TMDL area. LNRP acts as a central point of communication for the groups and works to create a unified vision amongst the groups through strategic planning. The watershed groups largely focus on the protection and enjoyment of their resources through advocacy, education, and improvement projects. The watershed partner groups include:

- Sheboygan River Basin Partnership
- Friends of North Point
- Friends of Hika Bay
- Friends of the Manitowoc River Watershed
- Friends of the Twin Rivers
- Friends of the Branch River
- Friends of Crescent Beach
- Forest Recovery Project of Door County

LNRP has also contributed to watershed-based planning in the Northeast Lakeshore TMDL area. In 2017 LNRP secured funding to convene a technical group known as the Manitowoc River Technical Team. This group included members from municipalities, county land and water departments, WDNR, and UW-Extension. The Manitowoc River Technical Team has facilitated collaboration amongst its members and helped positioned them for implementation of the TMDL. Additionally, LNRP provided technical and financial assistance for the Nine Key Element plans developed, or in development, by the Calumet and Manitowoc Land and Water Conservation departments.

Finally, LNRP and its watershed groups have coordinated a collaboration between the University of Wisconsin, Green Bay – Manitowoc Campus to create the Lakeshore Water Institute. LNRP contributed funding to the Lakeshore Water Institute to monitor five streams within the Manitowoc River Basin. The data collected from this monitoring will be used in the development of the Northeast Lakeshore TMDL.

Door-Kewaunee Demonstration Farms Network

The Door-Kewaunee Watershed Demonstration Farm Network, a collaboration between USDA-NRCS, DATCP, and Peninsula Pride Farms, was formed in 2017 to show how different conservation practices and technologies can be used to protect surface and groundwater in Northeastern Wisconsin. The four demonstration farms implement a variety of conservation practices and technologies to demonstrate the effectiveness of those practices in reducing soil erosion and nutrient runoff. Practices being tested include application of manure on growing crops, interseeding cover crops into corn, low disturbance manure applications, no-till, and a denitrifying

bioreactor to reduce nitrogen loss through drain tile with USGS monitoring. Events such as field days, farm tours, and workshops are being done throughout the growing season to demonstrate the lessons learned to other farmers, natural resources managers, and researchers throughout Wisconsin. In 2018, the Door-Kewaunee Watershed Farm Network received an increase in funding of $300,000 from the Great Lakes Restoration Initiative and an additional two years to the agreement.

Otter Creek Watershed Project—The Nature Conservancy

From 2011 thru 2018, conservation partners worked with farmers in the Otter Creek Watershed of the Sheboygan River Basin to improve water quality. In-stream monitoring stations were installed at the end of the treatment watershed, called Otter Creek, and the control watershed on Fisher Creek. The goal of the project was to focus phosphorus reduction efforts on the highest phosphorus loss fields by engaging the farmers that operated these fields to implement phosphorus-reducing conservation practices.

There were three phases to the project: inventory, implementation and monitoring. The inventory involved meeting with each farmer to learn how they farm each field in the watershed. Farmers were very willing to participate in the study; 96% of the crop fields in the watershed were included in the inventory. Based on this inventory data, it was determined that *85% of the inventoried phosphorus load* was coming from land operated by 12 farmers.

Conservation practices through the end date of the project, 2018, have produced the following results:

- A 1,201 pound (15%) reduction in modeled phosphorus based on the change in practices made by eleven farmers implemented in the Otter Creek watershed. These reductions were determined using SNAP runs done on their fields prior to implementation of practices and then after practices were installed.
- 15 out of 18 fields (83%) with an inventoried PI > 6 had conservation practices implemented.
- Of the 12 farmers with the highest total inventoried phosphorus load, 9 farmers (75%) implemented new conservation practices.
- Nutrient management plans were the most widely adapted practice. At the time of the inventory, only 390 acres of cropland existed in the Otter Creek watershed that were operated under a nutrient management plan. After the implementation phase, there were 1,840 acres of cropland operated under a nutrient management plan, an increase of 1,450 acres or 370%.
- The second most implemented practice in the project was grassed buffers along at least 20 feet of the banks of Otter Creek. A total of seven grassed buffers were established on four farms.

Farmer-Led Watershed Groups

Producer-led watershed groups are an important catalyst for implementation of conservation practices that reduce nutrients. Two active groups in the Northeast Lakeshore TMDL area are the Sheboygan River Progressive Farmers https://srpfarmers.com/ and Peninsula Pride https://peninsulapridefarmsinc.org/.

III. Reducing Nitrates in Groundwater

4.6 Source Water Protection Through the 2018 Farm Bill

The Agricultural Improvement Act of 2018 (the 2018 Farm Bill) included provisions requiring the Secretary of Agriculture to encourage the protection of drinking water sources through the following methods:

- Identifying local priority areas for drinking water protection in each State. This is done in collaboration with State Technical Committees and community water systems and may address concerns about either the quality, quantity of source water, or both.
- Providing increased incentives for practices that relate to water quality and quantity and protect drinking water sources while also benefitting producers.
- Dedicating at least ten percent of the total funds available for conservation programs (with the exception of CRP), each year beginning in FY 2019 through FY 2023, to be used for source water protection.

NRCS has initiated efforts to meet the above requirements, forming a Source Water Protection Subcommittee of the NRCS-Wisconsin State Technical Committee, and is in the process of prioritizing areas and conservation practices for drinking water protection in the coming years.

4.7 Wisconsin Nitrate Initiative

Reducing nitrogen losses to the waters of the state is critical to Wisconsin. In addition to the objective of reducing exports to the Mississippi River, Wisconsin relies on groundwater as the source of drinking water for 95% of public water supply systems and for approximately 70% of the state's population. Nitrogen losses and discharges originate from many sources, but agricultural sources are the most significant contributor based on sitewide aggregate loading (approximately 90%; Shaw B. 1994). The primary nitrogen loss pathway is nitrate leaching through subsurface drainage to groundwater, where it is transported to sensitive receptors such as potable wells. Statewide, about 10% of private well samples exceed the maximum contaminant level (MCL) for nitrate-N of 10 mg/L, although one third of private well owners have never had their water tested for nitrate (Knobeloch et al., 2013; Schultz and Malecki, 2015). In agricultural areas, such as the highly cultivated regions in south-central Wisconsin, around 20%-30% of private well samples exceed the MCL (Mechenich, 2015). In addition, groundwater transport of nitrate is the most significant source of loading to baseflow dominant streams. Wisconsin has some large basins where the baseflow contribution at the monitoring station is estimated as high as 90% (USGS - Gerbert et al., 2011).

The Wisconsin Safe Drinking Water Nitrate Initiative is designed to address nitrate impacts to groundwater sources of drinking water. This long-term project is a collaborative effort among a broad stakeholder cohort, including cooperating agricultural producers, and aims to reduce nitrate levels in sensitive groundwater recharge areas. The initiative focuses on making more efficient use of nitrogen in agricultural production and directing conservation practice cost-share dollars to critical recharge areas. Activities in project areas include measuring current nitrogen inputs and baseline groundwater nitrate loading, determining and implementing best nitrogen management practices, and measuring whether predicted results are achieved. Pilot projects areas are focused

in locations where drinking water systems are approaching unsafe levels of nitrate contamination. Costs associated with groundwater protective nutrient management alternatives will be compared to baseline nutrient management as a means to devise more effective conservation practices while maintaining farm profitability.

The overarching goal of Wisconsin's Nitrate Initiative is to build technical, institutional, industry and community capacity that will enable meaningful reductions in nitrogen losses to sources of drinking water. The initiative started by building partnerships within the WDNR, and across a cohort of stakeholder state agencies, institutions and organizations such as the UW-Extension, the Wisconsin Geologic and Natural History Survey, the University of Wisconsin system, DATCP, the Wisconsin Rural Water Association (WRWA), and the Wisconsin Land and Water Conservation Association (WLWCA). In addition, the WDNR collaborates with federal partners such as the EPA, USGS, and the NRCS. Early activities included analysis of available data on the occurrence of nitrate in groundwater and surface water throughout the state. A series of technical meetings with partners and a review of available literature resulted in the development of an initial monitoring plan template designed for application in priority groundwater protection areas that contribute recharge to public water supplies. With the assistance of UW-Extension, WRWA and WLWCA, WDNR engaged in outreach to specific communities with rising nitrate trends in public water supplies.

These efforts resulted in the establishment of pilot projects (Nitrate Demonstration Projects) in three separate communities: the Village of Spring Green; Village of Fall Creek; and the City of Waupaca. These projects serve as "problem focus areas," as each of them have community water systems with nitrate trends above 5 mg/L and approaching the maximum contaminant level of 10 mg/L. The objective is to evaluate and demonstrate methods of source water protection and use knowledge gained to develop a set of decision support tools for transfer to other communities. Activities in project areas started with an assessment of individual wellhead vulnerability to nitrate impacts, consideration of refinements to existing delineations of source water protection areas and assessment of existing nitrogen management practices with a view toward opportunities to increase nutrient utilization efficiency and reduce losses to groundwater. Additionally, data have been collected to assess water quality changes based on land management practices, and methods are being tested for evaluating the potential water quality benefits of specific management practices. These methods include field edge monitoring, nitrogen budgeting (mass balance) and the use of agro-ecosystem modeling for the purpose of nitrogen management scenario testing. Agreements with producers to modify nitrogen management in order to achieve water quality benefits are developed using voluntary, incentive-based mechanisms. The Nitrate Demonstration Pilot projects have yielded the following results to date:

- Statewide assessment of all subwatersheds (groundwater nitrate condition, sensitive drinking water receptors, wastewater discharge collaboration opportunities, hydrogeologic data and flow model availability).
- Development of a monitoring and modeling scope of work and identification of partner capacity ("Nitrate Transport Monitoring Scope").
- Identification of geographic priority areas through application of Selection Criteria.
- Landowner recruitment (cooperating farmers) in pilot demonstration areas.
- Agreements with landowners and municipalities concerning regulatory assurance and confidentiality of sensitive producer records (example institutional and regulatory assurance agreements).

- Evaluation and improvement of wellhead protection area delineations for priority areas.
- Installation of local hydrogeologic characterization and a field-edge groundwater nitrate flux monitoring system in Spring Green.
- Advanced wellhead vulnerability assessments.
- Contract for evaluation and adaptation of an agro-ecosystem model for use in developing dynamic decision support tools to support source water protection efforts throughout the state.
- Development of a simple economic analysis template to compare cost of providing drinking water that meets nitrate standards by water supply infrastructure changes (new well or treatment system) versus incentivized implementation of nitrogen management practices within wellhead protection areas (see example below).
- Establishment of the Wisconsin Land and Water Conservation Association as an effective means to coordinate and transfer knowledge of advancing source water protection methods to all 72 counties in the state.
- Continued progress to better integrate groundwater-focused source water protection across programs that play a role in reducing nutrient pollution. This includes priority rankings for state conservation practice cost sharing awards where drinking water receptors, such as public supply wells, are the focus of protection. Groundwater and drinking water protection is now being incorporated into watershed based plans such as Nine Key Element Plans, and groundwater protection priorities feature more comprehensively in the state's Nonpoint Source Management Plan.
- Collaboration with NRCS to implement new Farm Bill requirements to direct 10% of federal conservation practice funding to source water protection.

Based on lessons learned through experience with the pilot projects and from feedback from stakeholders, the WDNR has developed a scope for, and is beginning work with partners on, a series of groundwater and nitrogen decision support tools. These tools will help resource managers and stakeholders plan and implement reductions in nitrate impacts to groundwater sources of drinking water on a broader statewide basis. Groundwater Decision Support Tools (GW-DSTs) will improve stakeholder access to information on local groundwater flow systems, including critical groundwater recharge areas, that provide estimates of the magnitude of groundwater pollutant load reduction required to achieve water quality targets at a sensitive receptor well or water body. In addition, GW-DSTs will help approximate the expected lag time between changes at the land surface and changes in water quality at these receptors. Nitrogen Decision Support Tools (NDSTs) will facilitate the incorporation of groundwater protection objectives into agricultural nutrient management planning and will enable design of community source water protection plans that reduce aggregate nitrate loading to sources of drinking water. Specifically, the NDST project will assess the impacts of varied agricultural land management (e.g. crop type and rotation, N fertilizer and manure management, and irrigation) and weather variability across Wisconsin on nitrogen losses to the environment, with a focus on nitrate leaching past the root zone to the groundwater system. In addition to empirical data, the project will use biophysical modeling to increase the realism and utility of proposed guidance documents and interactive decision support tools. The models should help users test scenarios and estimate how effective various options are for reducing nitrate losses while maintaining agricultural production. Initial products will be designed to provide reasonable estimates of potential nitrate losses to groundwater based on the details of a nutrient management plan and applicable conservation practices. We

anticipate that the NDSTs will provide a framework for ongoing collaborative improvement to advance the state of knowledge and science around this subject.

Chapter 5. Nutrient Reduction at the Watershed Scale: High Priority TMDLs

The watersheds in this chapter were generally not targeted by the 2013 Nutrient Reduction Strategy as among the top tier for nutrient loss. However, they were identified as high priority for phosphorus reduction through development and implementation of TMDLs.

5.1 Milwaukee River TMDL

The Milwaukee River Basin TMDL features four individual TMDLs covering:

I. The Milwaukee River Watershed,
II. The Kinnickinnic River Watershed,
III. The Menomonee River Watershed, and
IV. The Milwaukee Harbor/Estuary (which includes the Milwaukee Harbor Area of Concern).

The TMDL was published in March 2018 and developed as a third party TMDL by Milwaukee Metropolitan Sewerage District, along with numerous partners, including WDNR. A significant proportion of pollutant loading (TSS, TP, and fecal coliform/E. coli) in the Milwaukee comes from point sources – both municipal and industrial waste water discharges and urban stormwater. Nearly 100% of reductions in the Kinnickinnic River watershed (fully developed) and Menomonee River watershed (~80% developed) will be required to come from point sources, while approximately 50% - >75% in the Milwaukee River will be required of point sources.

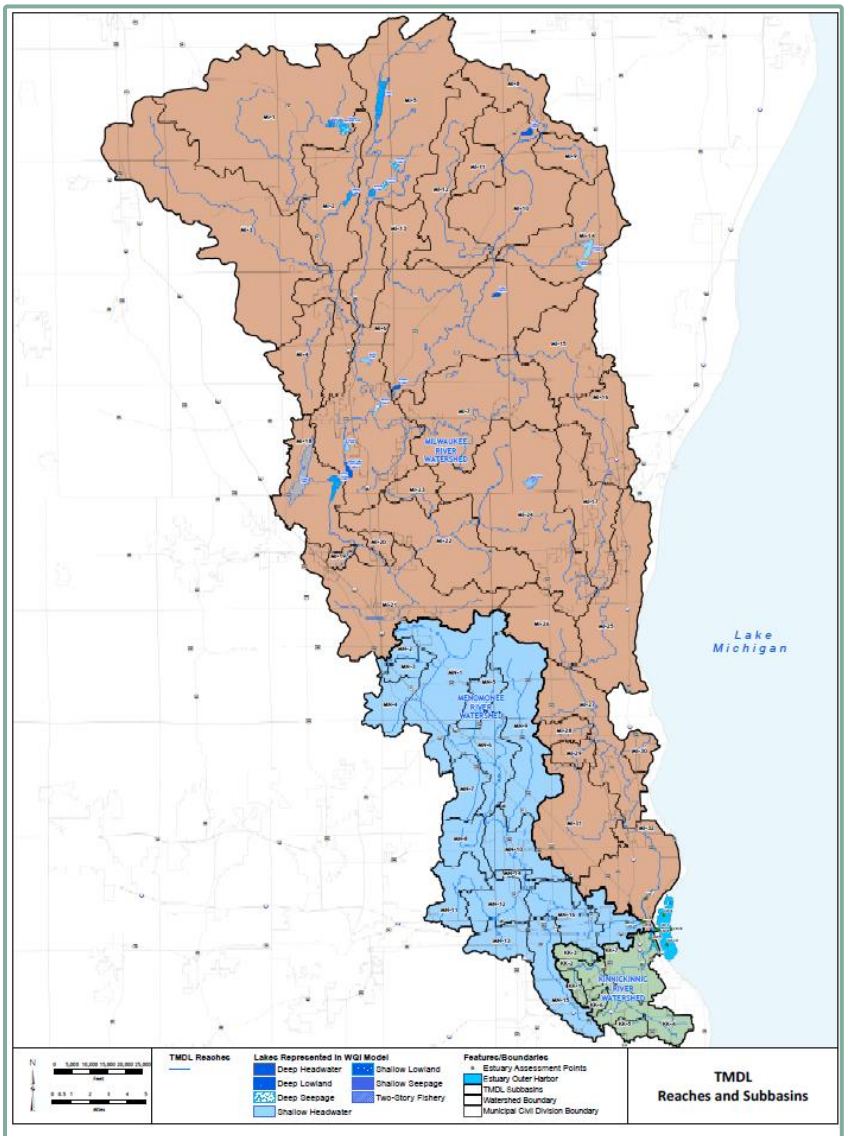


Figure 57. Milwaukee River TMDL reaches and subbasins.

The Milwaukee River Basin is an excellent example of the dramatic watershed recovery success that can take place when all basin stakeholders work together to focus on improving water quality and the river corridor. The Milwaukee River has shifted from a river that caught fire and burned for 3 days in 1958, to today, where it:

- is nearly meeting TP criteria (Fig. X),
- salmon and sturgeon have returned and are successfully spawning up the river,
- U.S. Masters Swimming Races are being held in the river, and
- Otters have been repopulating the Milwaukee River in downtown Milwaukee.

However, despite these remarkable successes, waters of the greater Milwaukee Basin still struggle in places from excessive nutrient, sediment, and bacterial loading and low dissolved oxygen – especially in the heavily urbanized Menomonee and Kinnickinnic River watersheds. Long-term monitoring data from the harbor-estuary and Milwaukee River (Figure 58) show dramatic reductions in TP (currently being reviewed for delisting as impaired due to TP on

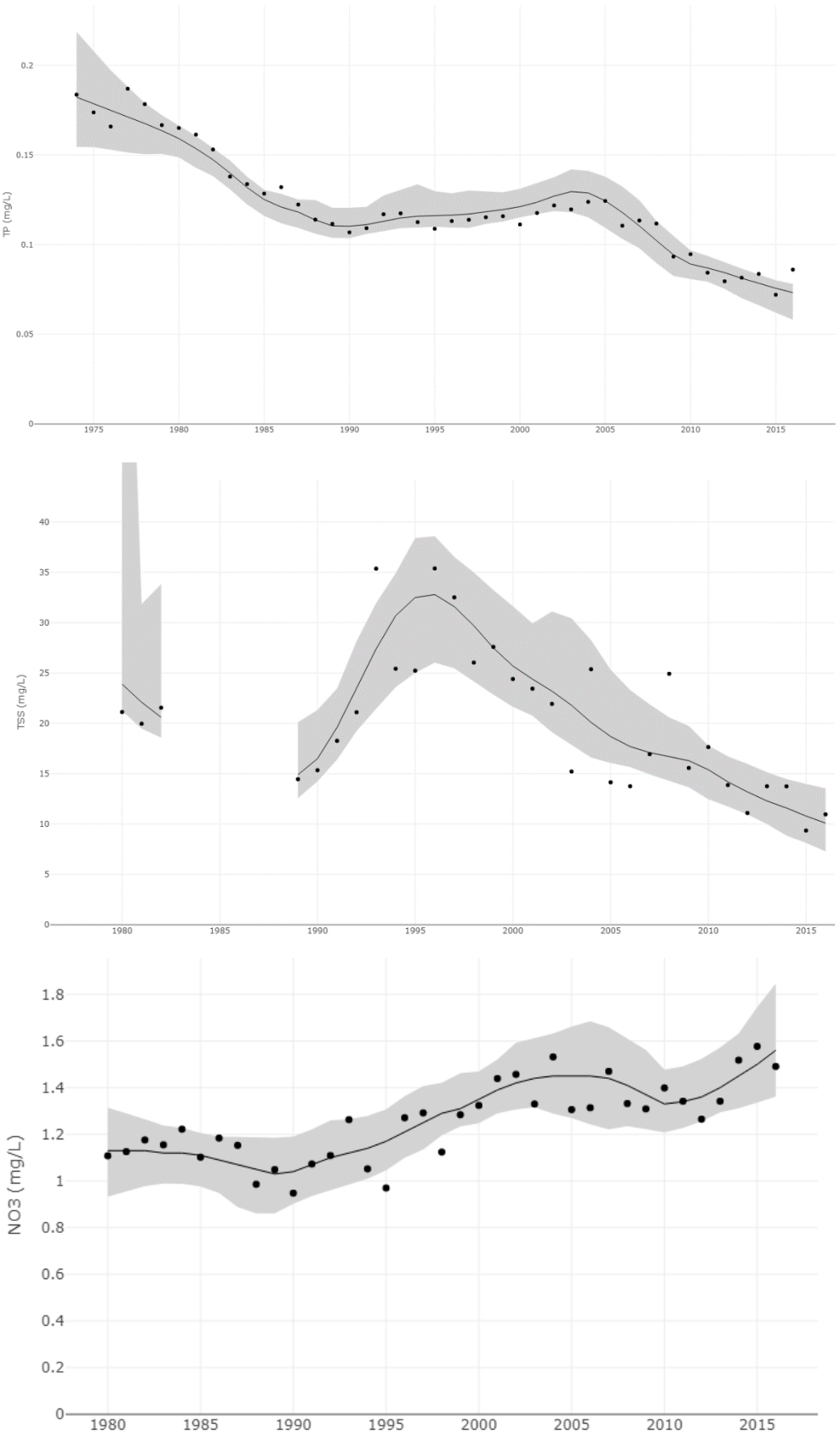


Figure 58. Long-term record of phosphorus, TSS, and nitrate discharge at Milwaukee River at Milwaukee: 1961 – 2017 (696 sq. miles).

the Impaired Waters List) and TSS. Nitrates, however, have been showing a consistent increasing trend through the period of record.

Given these remaining challenges, the TMDL team continues working together and are jointly developing the Milwaukee Basin Water Quality Improvement Plan (WQIP). This plan (to be completed by second quarter of 2020 and included in Milwaukee Metropolitan Sewerage District's (MMSD) WPDES permit) builds on the technical strength of the TMDL Report, several Nine Key Element (9KE) Plans, MMSD's Regional Green Infrastructure and 2050 Facilities Plans, and a number of Southeastern Wisconsin Regional Planning Commission's (SEWRPC) plans.

However, the WQIP is different from these plans in that it focuses on how to make sure the goals and the recommendations in these other plans (including TMDL targets) are put into action in an efficient way while also achieving important co-benefits. This relates directly to how work is funded and implemented, how work is prioritized, how collaboration can work to leverage the strengths of each sector, and how the impacts of watershed restoration efforts can be monitored and measured over time. It will achieve these goals through the use of integrated watershed management, which recognizes the need for collaboration among a range of stakeholders in an impaired watershed. The WQIP also serves as a framework, bringing together the watershed restoration plans (WRPs – presented below, all as 9KE plans) of the Milwaukee, Kinnickinnic, and Menomonee Rivers and the Remedial Action Plan for the Milwaukee Harbor Area of Concern, which now incorporates the TMDLs by reference, as measures necessary to remove the sources of Beneficial Use Impairments (BUIs) in the harbor/estuary. The BUIs are consistent with the designated use impairments addressed by the TMDLs.

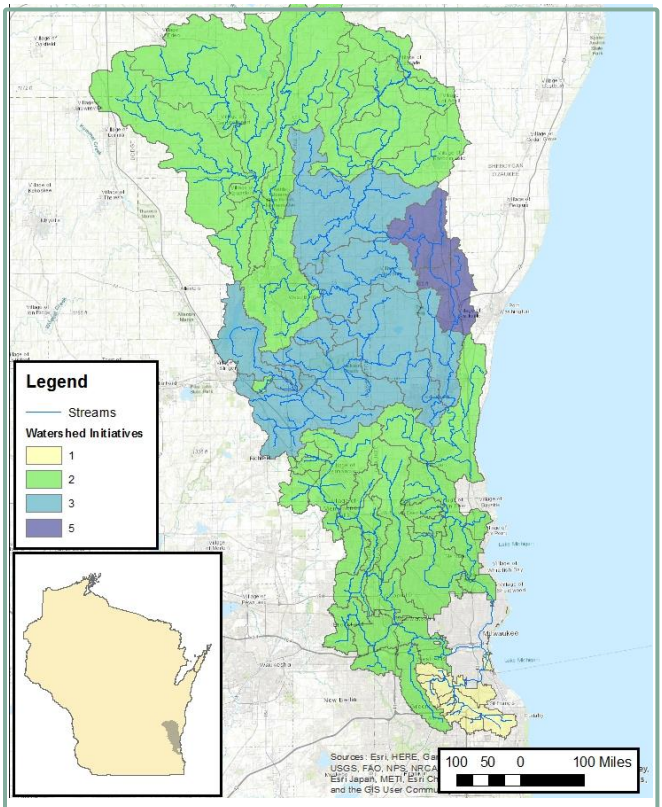


Figure 59. Milwaukee River Basin TMDL Watershed Implementation Initiatives. (Note: This figure only includes watershed-scale activities and does not reflect local activities – e.g., a watershed ranked 0 in this figure will still have local projects being implemented)

TMDL Implementation Update

The TMDL team has transitioned from focusing on development and finalization of the TMDL to planning and implementation. Indeed, even as the TMDL was in development, community partners were working aggressively to secure funding and implement watershed restoration activities.

From a basin perspective, TMDL implementation progress can be viewed as the sum of implementation-related activities, by HUC 12 watershed. The basin map in Figure X summarizes targeted implementation-related activities by ranking each HUC 12 watershed by how many implementation activities are taking place:

- Priority Watershed Restoration Project
- Nine Key Element Watershed Restoration Plan
- Active Farmer-led Watershed Group implementing recognized practices
- Point Source Discharge Facility with TMDL limits
- Watershed-based permit compliance projects – (Adaptive Management or Water Quality Trading)

While we use our online "Milwaukee Basin TMDL Landing Page" to share information about the TMDL, the monthly Milwaukee River Basin TMDL Implementation Newsletter continues to serve as our primary means of communication to the basin community. This newsletter has one of the highest readership rates for agency newsletters. Each edition of the newsletter (now up to 39 editions of uninterrupted publication) features monthly updates relevant to different topic areas (aka Sectors) including Agricultural/NPS, Education/Outreach, Monitoring, Stormwater/Urban Runoff, and Wastewater topics.

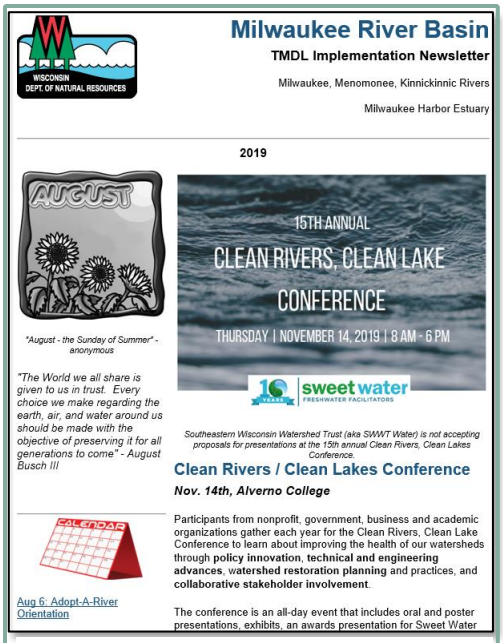

Milwaukee River Basin
TMDL Implementation Newsletter
Milwaukee, Menomonee, Kinnickinnic Rivers
Milwaukee Harbor Estuary
2019
AUGUST
"August - the Sunday of Summer" - anonymous
"The World we all share is given to us in trust. Every choice we make regarding the earth, air, and water around us should be made with the objective of preserving it for all generations to come" - August Busch III
15TH ANNUAL
CLEAN RIVERS, CLEAN LAKE CONFERENCE
THURSDAY | NOVEMBER 14, 2019 | 8 AM - 6 PM
sweet water
Southeastern Wisconsin Watershed Trust (aka SWWT Water) is not accepting proposals for presentations at the 15th annual Clean Rivers, Clean Lakes Conference.
Clean Rivers / Clean Lakes Conference
Nov. 14th, Alverno College
Participants from nonprofit, government, business and academic organizations gather each year for the Clean Rivers, Clean Lake Conference to learn about improving the health of our watersheds through policy innovation, technical and engineering advances, watershed restoration planning and practices, and collaborative stakeholder involvement.
The conference is an all-day event that includes oral and poster presentations, exhibits, an awards presentation for Sweet Water
CALENDAR
Aug 6: Adopt-A-River Orientation

Figure 60. Example of Milwaukee River Basin TMDL Implementation Newsletter.

Point Sources – Wastewater:

- WDNR began preparing draft WPDES permits with TMDL limits before publication of the TMDL.
- The approved TMDL included 34 specific permit holders in the basin. Due to the ability to switch to a general permit or discharge to sanitary sewer, there are 27 permit holders

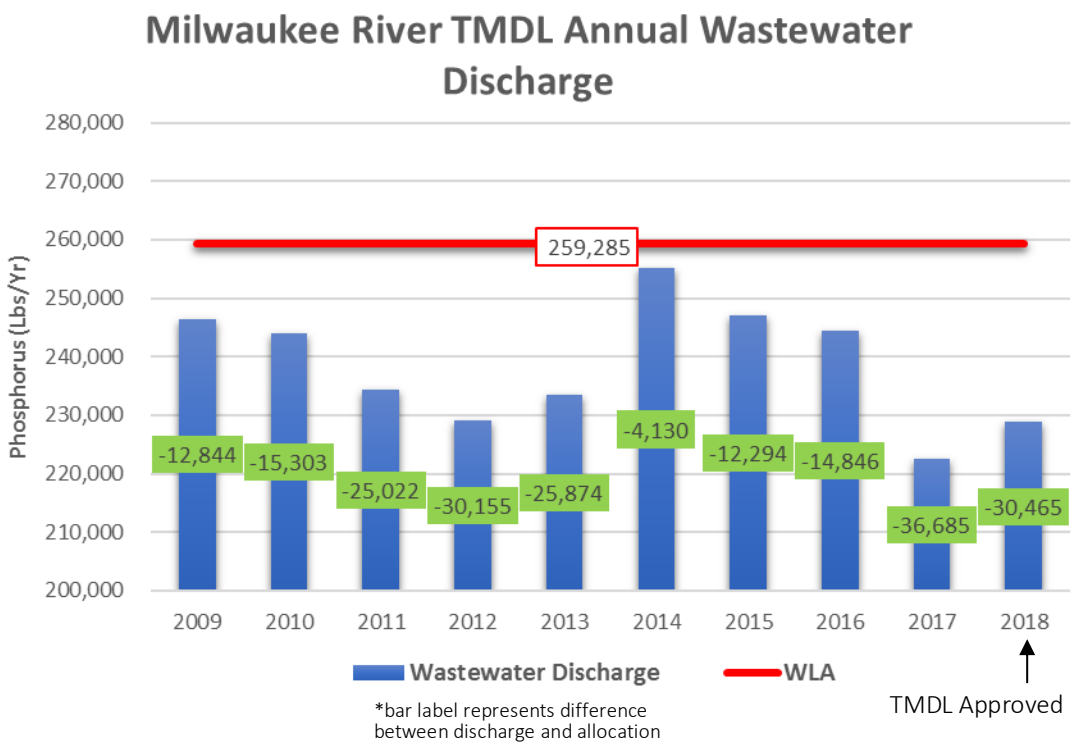


Figure 61. Wasteload allocations and discharge values for the Milwaukee River TMDL. Values come from NR101 Billing Query and from manual aggregations from Nick Lent. *The total WLA and wastewater discharge values include all returned outfall data except for the Greater Mitchell International Airport as it is mostly a stormwater type discharge.

remaining. Twenty-six of these have allocations (WE Valley Power Plant was given 0 for WLA). Six of these (23%) have TMDL limits in their active permits. All permits are expected to be reissued with TMDL limits by 2024.

- WDNR is working with community partners throughout the basin to facilitate watershed-based permitting, water quality trading and adaptive management for facilities that may choose to explore these alternative permit compliance options.
- The City of Grafton has chosen Adaptive Management for permit compliance, with the MS4 permit being included.
- The City of Saukville is pursuing an internal Water Quality Trade for permit compliance using a combination of stormwater, optimization, and treatment practices.
- Several additional communities have indicated to WDNR that they will choose either Adaptive Management or Water Quality Trading as their permit compliance option.

Point Sources – MS4 Stormwater:

- The City of Grafton has chosen Adaptive Management for permit compliance, with the MS4 permit being included.
- The City of Saukville is pursuing an internal Water Quality Trade for permit compliance using a combination of stormwater, optimization, and treatment practices.
- There are 43 MS4s with WLAs in the Milwaukee River Basin TMDL . Of those 43, 12 are covered by the newly reissued general permit for MS4s, and the remaining are covered under individual permits. The new GP requires municipalities to reduce polluted stormwater runoff by implementing stormwater management programs with best management practices to specifically address TMDL reductions. Goals for communities that are members of Adaptive Management projects are focused on meeting in-stream criteria, while other communities must specifically address percent reductions. WDNR has drafted one permit, assigning WLAs to 11 individual MS4s, that is under review by the MS4s. Permits for the remaining 20 individual MS4s with TMDL WLAs are currently being drafted. There are 9 municipalities with updated stormwater management plans (SWMPs) focused on the TMDL. There are 1 or 2 SWMPs in progress ahead of their individual permits being issued. WDNR expects more of the plans to come in within the next 2-3 years, but it is good progress that 20% of MS4s are already at that stage.

Nonpoint Sources:

Milwaukee River Watershed Restoration – WDNR is working with MMSD to help facilitate their implementation of two large NPS reduction efforts – Green Seams (buffer and easement program) and Working Lands Initiative (soil health and agricultural wetland restoration). MMSD has dedicated staff and allocated approximately $1.5 million to these programs over 3 years.

Milwaukee River Watershed Conservation Partnership – Initiated in Fall of 2016, the Milwaukee River Watershed Conservation Partnership (MRWCP) began a five-year effort to build the capacity of watershed stakeholders within the Milwaukee River watershed to increase the support of healthy soils, clean water, and smart business.

Led by a steering committee, partners are utilizing $1.5 million of the U.S. Department of Agriculture's Regional Conservation Partnership Program (RCPP) funding made available through NRCS programs to offset the costs of conservation implementation in the watershed. Twenty-four organizations have pledged support to the partnership and contribute time and resources toward the achievement of program goals.

Ozaukee County Demo Farm – Through this collaboration and funding, farmer-led groups are working with Ozaukee County to highlight the most effective conservation systems that have the greatest environmental and economic benefit. Demonstrations will be conducted to showcase the effectiveness and adaptability of conservation practice systems that reduce erosion, sedimentation and nonpoint source pollution and that also provide education and technology transfer opportunities for the public, farmers, land managers, agribusiness, environmental organizations, natural resources agencies and research entities. The specific objectives of the project are to:

1. Establish up to four Demonstration Farms within Ozaukee County to test the effectiveness of current and innovative conservation systems as they pertain to nonpoint pollution control in those unique landscapes.
2. Establish an efficient and effective mechanism to provide the transfer of technology and information on the effectiveness of conservation systems to the end-users, land management agencies, agribusiness and the public.
3. Create opportunities for others including resource, environmental and research agencies and agribusiness to test research, technical assistance and program implementation on the demonstration farm sites.
4. Create and implement an information/outreach strategy to share information and lessons learned to other natural resource managers, researchers, and stakeholders throughout the Great Lakes Basin.

Community River Program – This initiative, led by RiverEdge Nature Center, focuses on a three-pronged approach to transforming a community's relationship with the Milwaukee River. Ultimately, the program hopes to develop a model that is replicable across the region, creating long-term sustainability in the health of the Milwaukee River watershed. In each participating community (Fredonia, Newburg, and Saukville), the initiative is facilitating regional community engagement and partner building between rural and urban partners to support enhanced monitoring of water quality through volunteer citizen monitoring programs, prioritization and development of targeted watershed and river restoration activities, and encouraging greater community access and recreation along the Milwaukee River.

Milwaukee River Watershed – Targeted Watershed Planning and Implementation – Two large-scale watershed restoration planning initiatives are underway in the Milwaukee River Watershed. These efforts, funded through a combination of WDNR, EPA, and MMSD dollars, are being led by the Southeastern Wisconsin Watershed Trust (SWWT) and MMSD, respectively. The goal of these planning initiatives is to develop collaborative and targeted watershed restoration plans, consistent with the USEPA Nine Key Element Planning Process, and ultimately facilitating the implementation of projects and practices that will improve water quality and restore impaired uses in the Milwaukee River and its tributaries.

- **Cedar, Pigeon, Mole, Ulao:** This series of watersheds encompasses the confluence of numerous tributaries in the central portion of the Milwaukee Watershed and was strategically targeted in an area with active Farmer-Led groups, a number of watershed partners, and communities actively engaged in watershed planning. Watersheds included in this effort include:
    - 040400030603 - Village of Grafton-Milwaukee River
    - 040400030604 - Milwaukee River-Frontal Lake Michigan
    - 040400030301 - Town of Richfield – Cedar Creek
    - 040400030302 - Cedar Lake - Cedar Creek
    - 040400030303 - Jackson Marsh State Wildlife Area - Cedar Creek
    - 040400030304 – Cedar Creek

- Fredonia-Newburg Nonpoint Source Watershed Restoration: This planning initiative focuses on watersheds around the confluence of the Milwaukee River and North Branch Milwaukee River (Figure 59). The planning process is complete and the final plans are available.
    - 040400030107 - North Branch Milwaukee River
    - 040400030209 - Village of Newburg-Milwaukee River
    - 040400030602 - Town of Freedonia-Milwaukee River

Kinnickinnic River Watershed Restoration – The Kinnickinnic River Watershed is the smallest and the most densely populated within the Milwaukee River Basin. It drains 25 square miles of urban landscape in the heart of Metropolitan Milwaukee and falls within the borders of six local municipalities (Milwaukee, West Milwaukee, West Allis, Greenfield, Cudahy and St. Francis). The current planning effort is a partnership between Sixteenth Street Community Clinic, SWWT, MMSD, and other key community, environmental and municipal agencies.

- Kinnickinnic River Watershed Plan Update - 2011 [pdf]
- Kinnickinnic River Watershed Restoration Plan (WRP)

Menomonee River Watershed Restoration – The Menomonee River Watershed has undergone extensive disturbances since settlement and development of the greater Milwaukee Region. Numerous restoration efforts have also been undertaken. The Menomonee River Watershed covers 136 square miles in portions of Washington, Ozaukee, Waukesha and Milwaukee counties. The river originates in the Village of Germantown and the City of Mequon and flows in a southeasterly direction for about 32 miles before it meets the Milwaukee and Kinnickinnic Rivers in the Milwaukee Harbor-Estuary. The watershed contains 96 total stream miles and 4,537 wetland acres. Current planning efforts are focused on updating the recently expired Menomonee River Watershed Restoration 9KE Plan and the Menomonee River Watershed Group Permit.

- Menomonee River Water Quality Plan Update – 2010[pdf]
- Menomonee River Watershed Restoration Plan (WRP)

Pay for Performance—West Branch Milwaukee River – From 2104 to 2017, Winrock International, Delta Institute and Sand County Foundation completed a Pay for Performance Conservation pilot project funded by the Great Lakes Protection Fund in the West Branch of the Milwaukee River. Using SNAP-Plus as an agricultural phosphorus loss calculation tool, the project was designed to create a system that was based on paying for a defined

environmental outcome instead of the standard "pay for practice" system used in most conservation delivery programs. The primary goal was to test a system that uses a quantification watershed approach that can be used in meeting agricultural watershed goals and offsets needed by other TP loss sources in the watershed. In 2016, working with 11 farms in the West Branch of the Milwaukee River, encompassing 3,802 acres of agricultural land, the project worked with farmers to create whole farm conservation systems that reduced the annual watershed TP loading by 983 pounds. The farmers were paid $25 per pound of TP reduced; for 2016 the total payments to farmers for TP loss reductions was $24,570. Individual farm reductions varied by size and type of operation, but all farms showed reductions, with one farm achieving a 40% reduction in TP loss from baseline across the entire farm. In 2016, the project average reduction in TP loss was 0.26 lbs per acre. Sand County Foundation is using the lessons learned from this project in a new effort, supported through the Fund for Lake Michigan. This project will be working with the Village of Grafton WI, Ozaukee County Land and Water Conservation Department and the Clean Farm Families farmer-led watershed group to meet the village wastewater treatment plant's water quality permit needs through agricultural offsets.

5.2 Lake St. Croix TMDL

In 2012, the EPA approved a TMDL for Lake St. Croix calling for a 38% reduction in the human-caused phosphorus carried to the rivers and streams of the basin. In 2015, a TMDL implementation plan was finalized and approved. The 2017 progress report details phosphorus reduction activities in the St. Croix River Basin by partners in Wisconsin and Minnesota. It reports accomplishments primarily from survey responses from counties and local partners on best management practices (BMPs) and educational efforts. The report acknowledges that many more projects were completed by a variety of partners and individuals beyond what is captured in the report. The information below is excerpted from the 2017 progress report and summarizes phosphorus reduction activities in the Wisconsin portion of this shared watershed.

A wide range of practices were implemented to reduce phosphorus within the St. Croix River Basin and improve the health of these waters. Practices included:

- Forestry: Prescribed burning management and maintenance of riparian management zones.
- Agriculture: Soil health and tillage practice improvements, grassed waterways, nutrient management and manure storage.
- Shoreline: Lake management planning, shoreline buffer and habitat restoration.
- Urban: Installation of rain gardens and infiltration strips.
- Land Protection: Land protection, native plantings, and prairie restoration.
- Education: Educational efforts in all categories.

USGS staff are developing a water quality model for Lake St. Croix to calculate nutrient loads and the effectiveness of implemented practices to reduce nutrient loading into Lake St. Croix.

Point Sources—Wastewater: The wastewater treatment facilities in the St. Croix River basin with individual WPDES permits collectively discharged well below the Lake St. Croix TMDL Waste Load Allocation (WLA) in 2017. The total WLA for wastewater treatment discharges is 74,957 lbs/yr, divided between Minnesota and Wisconsin facilities. A portion of each state's allocation is also combined as an "aggregate" allocation for smaller facilities. The facilities included in this category can demonstrate compliance either by meeting their individual allocation, or by showing that the combined discharge levels of all facilities in this group is less than the aggregate allocation.

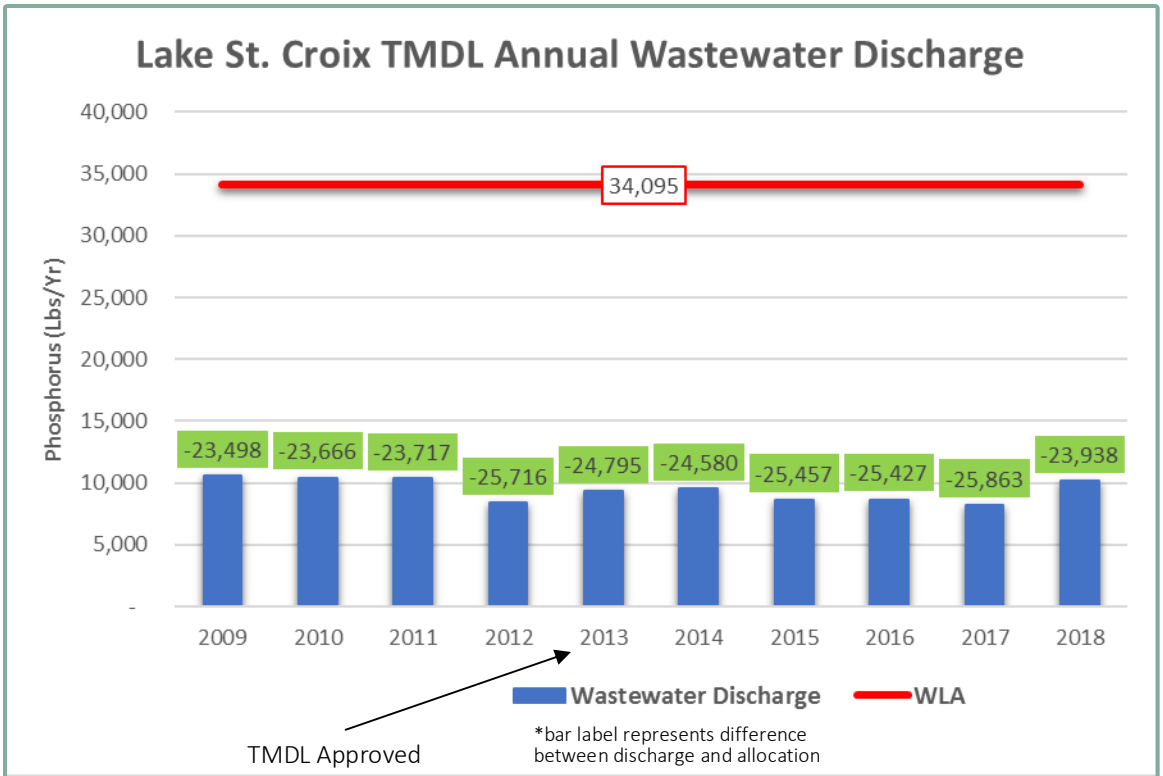


Figure 62. Wasteload allocations and discharge values for the Lake St. Croix TMDL. Values come from NR101 Billing Query. Wasteload allocation and discharge are only reflective of dischargers within the Wisconsin area of the Lake St. Croix TMDL.

Point Sources—MS4: There are five MS4s within the TMDL area: City of Hudson, Town of St. Joseph, City of River Falls, UW-River Falls and St. Croix County. Two of these are already meeting their WLA, two are finalizing implementation plans, and one does not need to have MS4 permit coverage.

Point Sources—CAFO: In 2017, there were nine permitted CAFOs in the Wisconsin portion of the St. Croix River Basin. The number of CAFOs will fluctuate as farms expand, change operation or stop production. Since there is no phosphorus allocation allowed for the production areas at CAFOs, and the permits require the cropland be operated under a Nutrient Management Plan, it is not possible to quantify reductions for this sector. However, there is potential for soil conservation measures and non-point source phosphorus reduction through proper manure handling and improved cropping practices (e.g., improved soil health, year-round cover crops, no-till planting, etc.) on the large farms as well as on the smaller ones that don't require CAFO permits.

Nonpoint Sources—Farmer-Led Councils: The Farmer-Led Watershed Council program was originally developed by the UW-Extension and the WDNR to improve water quality in the Red Cedar and St. Croix River Basins through reduced phosphorus and sediment loading while increasing farmer knowledge and leadership on water quality issues. There are currently three Farmer-Led Watershed Councils located in the St. Croix River Basin: Horse Creek

Watershed (Polk County); Dry Run Creek Watershed (St. Croix County); South Kinnickinnic Watershed (Pierce County). Implementation activities in 2017 include:

- Horse Creek Watershed—1,562 acres of cover crops planted, 1,425 acres of soil sampled, 1,388 acres of phosphorus indexing, one 24-acre demonstration plot.
- Dry Run Creek Watershed—960 acres of cover crops planted, 5,800 ft of grassed waterways, 390 acres of soil sampled, 14 farm walkthroughs for BMP installation.
- South Kinnickinnic Watershed—379 acres of cover crops planted, 10,515 ft of grassed waterways, 25 acres of buffer strips, 285 acres of soil sampled.

Nonpoint Sources—Recommendations: With steady effort from federal, state, local and county partners, progress in the implementation of BMPs continues to be made within the St. Croix Basin. Over 290 new practices were identified by partners in 2017 (see county by county details in 2017 Progress Report https://dnr.wi.gov/water/wsSWIMSDocument.ashx?documentSeqNo=201479888), with a high likelihood that many more projects were completed but not reported. While these estimates are encouraging, the problem of accurate reporting continues. Reporting on total phosphorus reduction numbers is difficult without a consistent tracking, reporting and modeling database. Minnesota has the eLINK database where partners can report BMPs and model phosphorus reductions annually. Wisconsin is working towards a similar capability, but it does not currently exist.

5.3 Tainter Lake/Lake Menomin TMDL (Red Cedar River Basin)

In 2012, the EPA approved WDNR's TMDL for Lakes Tainter and Menomin, two impounded lakes formed by dams located on the lower Red Cedar River. The TMDL describes the extent of the phosphorus issue in the watershed and prescribes the amount of phosphorus reduction needed to significantly improve water quality in Lakes Tainter and Menomin.

In 2013, the Red Cedar River Water Quality Partnership, a stakeholder group, was formed to oversee all education, outreach, engagement and implementation activities regarding water quality improvement in the basin. Those involved in the Partnership include UW–Extension, WDNR, NRCS, county and city officials and departments, citizens, nongovernmental organizations, lake associations, and corporate representatives. The group developed a 10-year plan for implementing the TMDL and related water quality improvement goals called "A River Runs Through Us: A Water Quality Strategy for the Land and Waters of the Red Cedar River Basin."

The WDNR and EPA approved the plan in 2016 as both a TMDL implementation plan and Nine Key Element Watershed Plan. The following description of phosphorus reduction activities is taken from the Year Three Update to the Strategy (April 2019) https://fyi.extension.wisc.edu/redcedar/files/2019/05/Year-Three-Update.pdf

Point Sources—Wastewater: Phosphorus entering the Red Cedar River system from point sources (mainly wastewater treatment plants) has been well-controlled and regulated under state and federal rules. Point sources were estimated to be contributing over 42,000 lbs of phosphorus per year when baseline data were

collected in the 1990s. Through WPDES permits, that had been reduced to an average of 12,900 lbs per year over the period of 2010-2014. The most recent data available shows that in 2018, the amount of phosphorus that entered the Red Cedar River system from point sources was approximately 8,570 lbs, which is less than half of the TMDL Waste Load Allocation of 20,100 lbs per year.

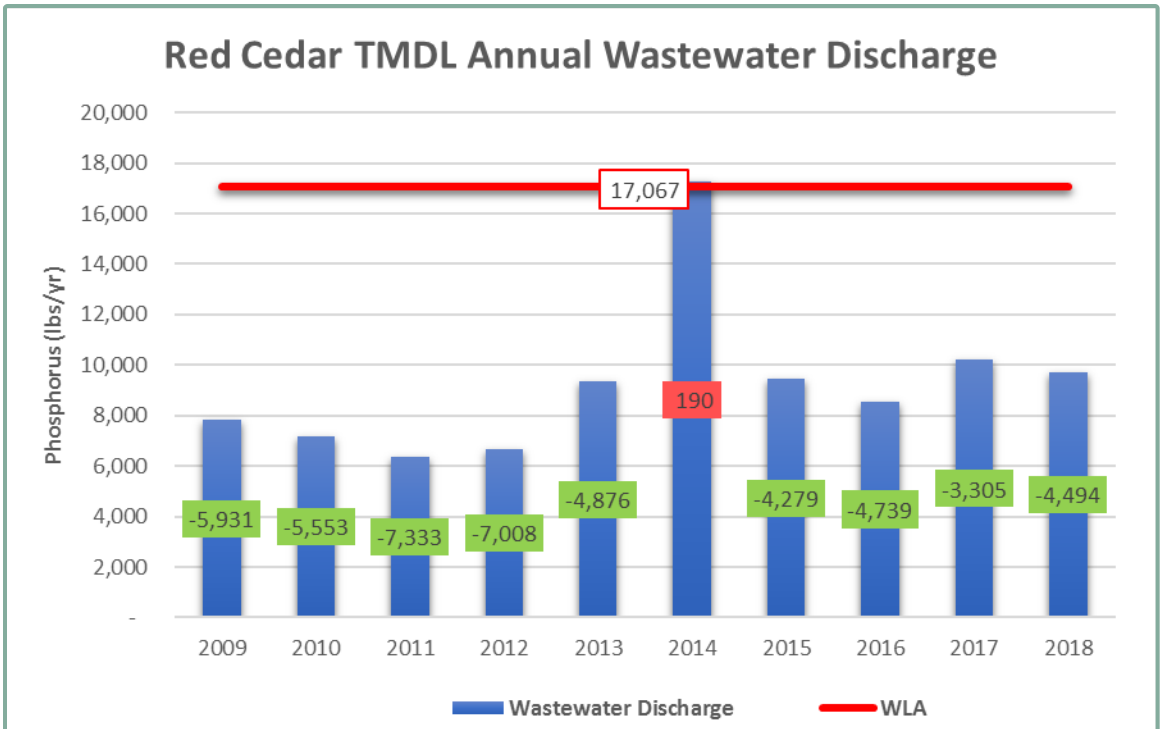


Figure 63. Wasteload allocations and annual discharge values for the Red Cedar Basin TMDL. The Wasteload Allocation provided reflects the site-specific criteria allocation of the Wisconsin River TMDL.

Point Sources—MS4: There are two permitted MS4s in the basin: Menomonie and Rice Lake. The City of Menomonie has reduced the phosphorus load to the Red Cedar TMDL area by 323 lbs by creating public and private BMPs in the watershed. Continued efforts with creating new regional stormwater ponds will only increase the amount of phosphorus removed. For the City of Rice Lake, current modeling (though not verified) shows that the city contributes 1,932 lbs/yr of phosphorus through urban runoff, compared to the TMDL goal of 1,700 lbs/yr. The city estimates it can further reduce phosphorus loads to meet and perhaps surpass the TMDL goal through construction of four new detention ponds, and the improvement of two other existing ponds.

Nonpoint Sources: The ten-year plan estimated that a 40% reduction in phosphorus could be achieved in ten years, equaling a little over 200,000 lbs reduced over that time period. The original modeling work estimated how much load reduction could be achieved with BMPs. These estimates were done using average conditions in the watershed, reducing phosphorus loads to meet a P index of 6 (the statewide standard), and other factors. For each recommended BMP, a goal was set for phosphorus reductions using that BMP. These are summarized in Table 3.2 of the ten-year plan:
https://fyi.extension.wisc.edu/redcedar/files/2017/08/RedCedarPlanFinalMedResolution.pdf

Tracking of practices has been difficult, and the Partnership has not yet come up with a comprehensive approach. Some changes on the land take place with no cost-share program participation or record of any sort, be it positive change to prevent runoff or changes that cause more runoff pollution, such as converting land from forest to cropland. However, tracking through NRCS and Farm Service Agency cost-share contracts (and the acres and practices in those contracts) shows a substantial increase in cover crop acreage in Dunn County, beginning in 2016. The Partnership attributes this to the combined efforts of many members, including NRCS. More workshops were held in the watershed to introduce and educate about cover crops, peer-to-peer learning was taking place and cost share programs were marketed more aggressively. Phosphorus reductions were calculated using the formula on p. 23 of the original TMDL implementation plan and substantial progress has been made toward reaching the goal of 18,000 lbs of phosphorus reduction per year from cover crops.

Many other educational events, activities and BMP installations take place through government programs and outside of government. Members of the Partnership are often involved in such activities and do keep track of the work. A Year Three Update of "A River Runs Through Us: A Water Quality Strategy for the Land and Waters of the Red Cedar Basin" was release in April 2019.

are appendices showing activities related to the TMDL implementation plan including all reported BMP installations in the watershed for 2018 done through government programs. Also included are several reports from various partners on activities that may lead, directly or indirectly, to reductions in the amount of phosphorus entering the waters of the Red Cedar River watershed.

5.4 Wisconsin River Basin TMDL

Wisconsin's namesake river, the Wisconsin River, is an important recreational, industrial, and natural resource to the State of Wisconsin. In April 2019, the USEPA approved a TMDL addressing phosphorus impairments for 120 river segments and nine lakes. The TMDL project area encompasses the Wisconsin River Basin upstream of the Prairie du Sac Dam which forms Lake Wisconsin, and includes Petenwell and Castle Rock Lakes, Wisconsin's second and fifth largest inland lakes. The Wisconsin River Basin TMDL covers all or parts of 22 counties in central Wisconsin. The TMDL project area encompasses 9,156 square miles, covering approximately 14% of the state. Twenty-four major tributaries, and additional smaller ones, drain into the mainstem of the river. The river system includes 25 hydroelectric dams on the mainstem of the river and 21 tributary storage reservoirs that regulate flow on the river's mainstem. The Wisconsin River Basin TMDL is truly a "blended" TMDL where reductions will be needed for both point and nonpoint sources to achieve water quality goals. The TMDL also covers three of the Top Group HUC 10 Watersheds for Phosphorus identified in Wisconsin's Nutrient Reduction Strategy: Dill Creek-Big Eau Pleine River (HUC 10: 0707000215), Little Eau Pleine River (HUC 10: 0707000217) and Rocky Creek-Yellow River (HUC 10: 0707000311).

It is important to note that the TMDL analysis found that the applicable statewide phosphorus criterion of 40 µg/L for Petenwell and Castle Rock Lakes was more stringent than necessary to achieve the designated uses (recreational and aquatic life uses). Based on the analysis conducted during the TMDL for the Wisconsin River Basin, the Department has proposed a phosphorus site-specific criteria (SSC) of 55 µg/L for Castle Rock Lake and

an SSC of 53 µg/L for Petenwell Lake. Lake Wisconsin is classified as an impounded flowing water because its summer water residence time is less than 14 days, so the statewide TP criterion that would normally apply to the lake is equal to the criterion of the inflowing river (100 µg/L). The TMDL analysis found that this criterion allows frequent nuisance algal blooms and is not protective of recreational uses. The Department is recommending a phosphorus SSC for Lake Wisconsin of 47 µg/L. The Department is currently pursuing adoption of these SSC into rule. Because the TMDL was developed prior to adoption of these SSC, the TMDL contains two sets of allocations, one set based on the current criteria, the other based on the proposed SSC.

Point Sources—Wastewater: There are over 100 active municipal and industrial point sources with specific permits in the TMDL project area. Since the TMDL was approved, 16 permits have been reissued with TMDL-based limits, and it is anticipated that as many as a third of these facilities will receive new permits with TMDL-based phosphorus limits within the coming year. As a group, watershed point sources are close to their final TMDL phosphorus wasteload allocation goal (Figure x), but the circumstances vary amongst the individual facilities.

- Adaptive Management Plans: Adaptive Management is a phosphorus compliance option that allows point and nonpoint sources (e.g. agricultural producers, non-regulated stormwater utilities, developers) to work together to improve water quality. Adaptive management recognizes that excess phosphorus is the result of a variety of activities and sources; both point and nonpoint source reductions are needed to achieve water quality standards. In lieu of more restrictive phosphorus limits, the point source commits to work with nonpoint sources to reduce phosphorus losses in order to reduce in-stream phosphorus levels. The Village of Lodi (Columbia Co.) and City of Tomah (Monroe Co) are currently implementing Adaptive Management Plans in their respective watersheds, however these plans were developed prior to the TMDL.

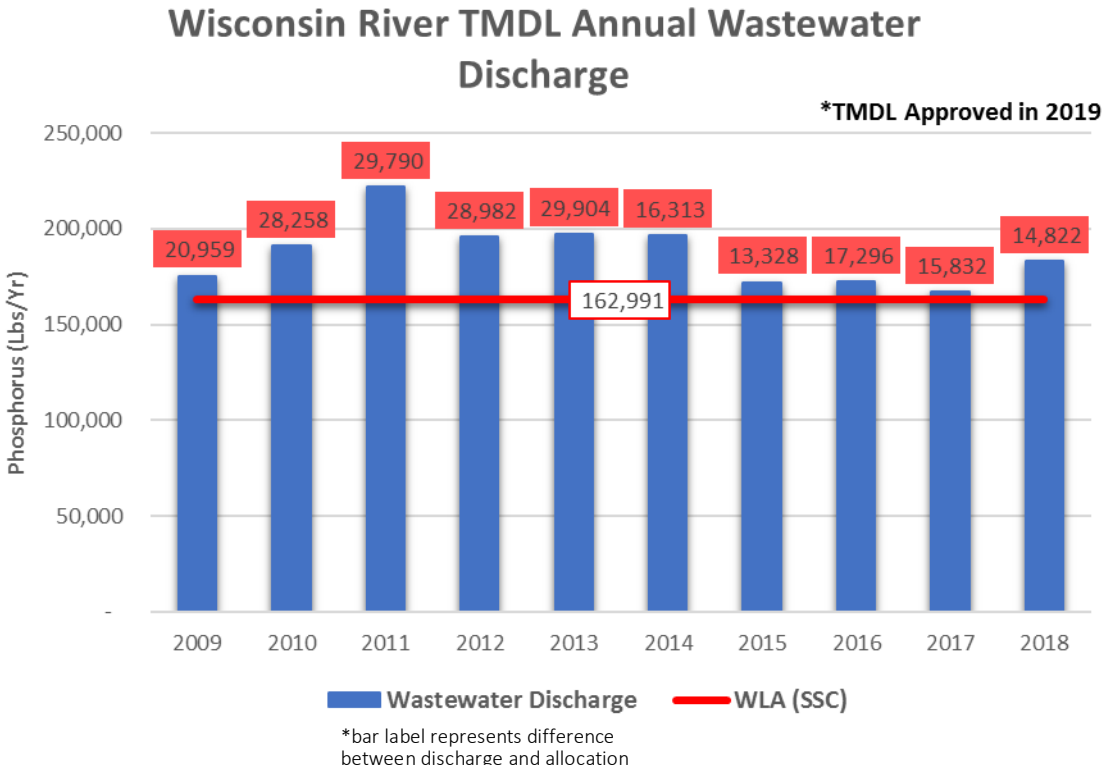


Figure 64. Wasteload allocations and annual discharge values for the Wisconsin River Basin TMDL. The Wasteload Allocation provided reflects the site-specific criteria allocation of the Wisconsin River TMDL.

Point Sources—MS4: There are 15 permitted municipal separate storm sewer systems (MS4s) within the TMDL project area. The recently reissued MS4 general permit (WI-S050075-3) contains specific requirements relating to the Wisconsin River Basin TMDL. As a first step, permittees are required to provide updated information on their storm sewer systems including a determination of whether their communities are meeting their TMDL load goals. If their goals are not being reached, the permittees are required to submit a plan and implementation schedule that describes how the permittee will make progress toward achieving their TMDL goals.

Nonpoint Sources: Agriculture is the predominant land use in many parts of the basin. The dominant type of agriculture varies from mixed dairy and cash in the lower and upper basins, to potatoes, vegetables and cranberries in the central sands, and limited agriculture in the northern part of the basin.

Agricultural load allocations have always been challenging to effectively communicate due to the inherent variability across the landscape and because the traditional approach lumps multiple nonpoint sources together into one number, expressed in total pounds, for a subbasin. This lumped number—even if broken down between its main components of non-permitted urban, background, and agricultural loads—may not effectively target or translate reduction requirements into needed implementation practices and actions. To address this issue, the WDNR has developed a framework for communicating agricultural loads, into edge of field total phosphorus targets (TP Targets) by using the watershed model SWAT (Soil and Water Assessment Tool). These TP Targets can then be implemented by a field-scale model called SnapPlus (Soil Nutrient Application Planner).

SnapPlus is Wisconsin's widely used software program to prepare nutrient management plans. Two critical features of this program related to water quality are its ability to generate, by field, a phosphorus loss value and to calculate soil erosion. By calculating potential soil and phosphorus runoff losses on a field-by-field basis while assisting in the economic planning of manure and fertilizer applications, Snap-Plus provides Wisconsin farmers with a tool for protecting soil and water quality.

The goal of identifying edge-of-field targets, as described above, is to provide agricultural practitioners such as county conservationists, nutrient management specialists, crop consultants, and farmers a more meaningful expression of the TMDL goals: one that is expressed in the same manner as their nutrient management planning and implementation tools. These edge of field goals are currently being incorporated into Nine Key Element watershed plans and in county land and water plans as they are developed/revised.

Nonpoint source implementation efforts have been focused on a variety of locally-led projects through the basin (Figure 65). These early, locally-led projects have developed in areas where considerable nonpoint reductions are needed. These locally-led implementation projects fall into several categories, described below.

- Baraboo River Watershed Regional Conservation Partnership Program (RCPP): RCPP promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. Phase 1 of the project was highly popular, with funds being exhausted two years earlier than anticipated, and Phase 2 of the project is currently underway. Partners

include Sauk County, NRCS, Juneau County Land Conservation Department, and the City of Reedsburg wastewater treatment facility. Common conservation practices include streambank stabilization, no-till, cover crops, rotational grazing, nutrient management, and grassed waterways.

- Nine Key Element Watershed Plans: Watershed plans consistent with EPA's nine key elements provide a framework for improving water quality in a holistic manner within a geographic watershed. The nine elements help assess the contributing causes and sources of nonpoint source pollution, involve key stakeholders and prioritize restoration and protection strategies to address water quality problems. Additionally, these plans open the door to additional implementation funding opportunities. Nine Key Element Watershed Plans have been approved for the Fenwood Creek HUC12 (Marathon Co.) and the Mill Creek HUC10 in Portage and Wood Counties.

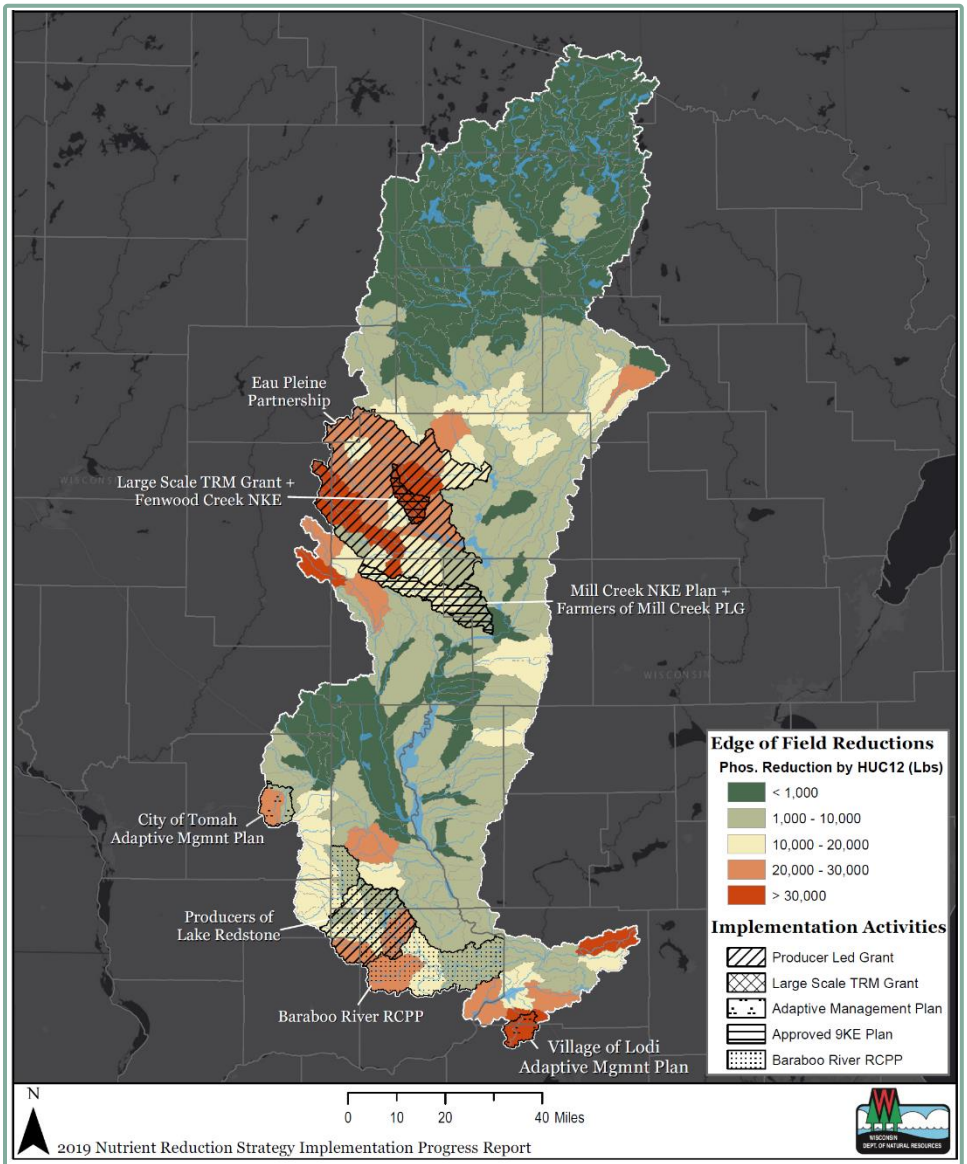


Figure 65. Cropland Phosphorus Targets & Implementation Activities in the Wisconsin River TMDL – 2019.

  - The Fenwood Creek HUC12 drains roughly 39 square miles of predominantly agricultural land in Marathon County. Fenwood Creek is a tributary to the Big Eau Pleine Reservoir which has a long history of excessive algae blooms and periodic winter fish kills. Marathon County is working to improve soil health and to protect water quality within the watershed by promoting the adoption of several best management practices, such as managed grazing, no-tillage planting, and cover crops. The County organizes educational events and provides landowners with technical assistance and cost-sharing opportunities.
  - The Mill Creek HUC 10 in Portage and Wood Counties drains roughly 129 square miles of predominantly agricultural land. Mill Creek is a tributary to the Wisconsin River and is one of the highest phosphorus loading HUC 10s in the Wisconsin River TMDL project area. Portage and Wood

Counties along with UW-Extension and the Farmers of Mill Creek Watershed Council are also working to improve soil health and to protect water quality within the watershed by promoting the adoption of best management practices.

- **Large Scale Targeted Runoff Management Grants**: The Targeted Runoff Management (TRM) Grant Program offers competitive grants for local governments for the control of nonpoint source pollution. Grants from the TRM Program reimburse costs for agricultural or urban runoff management practices in targeted, critical geographic areas with surface water or groundwater quality concerns. Eligible costs include construction of structural best management practices, implementation of non-structural cropping practices and some staffing costs to plan and install management practices. Marathon County has received a large-scale TRM grant to implement the Fenwood Creek watershed plan. Similarly, Wood County has received a large-scale TRM grant to implement the Mill Creek watershed plan.

- **Producer-Led Watershed Groups**: Active producer led watershed groups include the Eau Pleine Partnership for Integrated Conservation (Marathon Co), Producers of Lake Redstone (Sauk and Juneau Co.) and Farmers of Mill Creek Watershed Council (Wood and Portage Co). These groups are focused on improving soil health and reducing nutrient losses from their operations by implementing such practices and no-till, cover crops and rotational grazing.

Wisconsin River Basin--Collaborative Farmer Nutrient Management Training: A Recipe for Success

Call it what you want – a collaboration, team approach, regional effort or all of the above – but no matter how you put it, the Marathon, Clark, Taylor, Lincoln, and Wood Counties' Farmer Nutrient Management Training Program has been a recipe for success.

The program is effectively streamlining the resources of the five county conservation departments, UW-Extension, Northcentral Area Technical College, and the regional Nutrient and Pest Management Program to provide training for farmers in the region and beyond. The trainings are providing invaluable information on farm nutrient management planning, plan development, and implementation for the community.

Farm nutrient management planning is widely recognized as an agronomic and conservation best practice to help achieve water and soil quality protection and improvement, while maintaining or increasing farm profitability. As such, it is a Wisconsin agricultural performance standard requirement that is intended to be adopted and implemented on all farms that apply nutrients (fertilizer and/or manure) to cropland or pasture land, and on farms with high stocking rates of livestock on pasture land. To meet this requirement on the large number of farms and acres in the central and north-central counties that make up the "Heart of America's Dairyland" requires a multi-faceted approach.

In 2009, training partners in Marathon, Clark, and Taylor Counties recognized that each county was providing similar but separate farmer nutrient management training. The counties decided to join forces with the goals of standardizing the training and expectations of farmers in the Heart of America's Dairyland region, further enhancing the training, and gaining further efficiencies of a broader partnership, and the MCTLW Program was born. the MCTLW Program further evolved and developed by securing Nutrient Management Farmer Education (NMFE) grant funds of $15,000-$20,000 per year to augment the collaborative program and help offset the costs of training for the partners and the farmer participants. The MCTLW Program also brought the Lincoln County conservation department, the Wood County conservation department, and the farmers in those respective counties into the partnership. In 2018 the MCTLW Program was further enhanced with the addition of the Nutrient and Pest Management Program Regional Nutrient Management Specialist to the partnership. And most recently in 2019, in response to the size, scope, and successes of the MCTLW Program, DATCP increased the NMFE grant fund authorization limit, which has allowed the MCTLW Program to secure a grant for $53,350 for the 2020 training program, up from a maximum of $20,000 previously.

The past several years, farmer participation in the MCTLW Program has been steady and has averaged about 60 farms, covering approximately 21,000 acres annually. The significant increase in NMFE grant funding for the program in 2020, will allow, for the first time, incentivization of program participation by funding farm soil testing costs at a rate of $8 per sample, maximum $750 per farm. With this funding increase, the MCTLW Program anticipates that farmer participation in 2020 may also increase, making the collaborative MCTLW Program an even more effective recipe for success.

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