4

Years of Ongoing Research & Analysis

Watershed Size

1,900

Square Miles

$600K

Total Project Cost

Major Project Partners

8

Project Partners:

UW-Stout

» Social Survey/Communication Network Analysis

» Community Capacity

» Economic Impact Analysis

» Limnological Analysis

US Army Corps of Engineers - St. Paul District

» Technical Assistance & Project Support

» ACPF Tool Run (two HUC 12s)

» CE-QUAL-W2 Modeling

» Two-Year Water Quality Monitoring

» Assistance with Community Capacity/ Economic Analysis

Wisconsin Department of Natural Resources

» Grant Funding & Technical Support

Division of Extension, UW-Madison

» Local Assistance & Planning

Tainter Menomin Lake Improvement Association

» Red Cedar Watershed Conference Lead

Dunn County Land & Water Conservation

» LiDAR Data, Local Assistance & Planning

Barron County Land Conservation

» LiDAR Data, Local Assistance & Planning

West Central Wisconsin Regional Planning Commission

» Project Coordination, Administration & Summary Report - December 2020

PROJECT GOAL

The goal of the Red Cedar Basin Assessment for Water Quality Improvement Project is to better understand the barriers that prevent or discourage landowner participation in practices and management that benefit water quality and to identify ways to overcome those barriers in a way that increases public participation and leads to improved water quality.

Additionally, this project will inform the tri-annual update of the Red Cedar River Watershed 9 Key Element Plan, A River Runs Through Us: A Water Quality Strategy for the Land and Waters of the Red Cedar River Basin (2015).

This report is a summary of the project inclusive of its objectives, goals, tasks, and deliverables.

Photo: Aaron Carlson

Table of Contents

Table of Contents

ADDENDUM #1

LAKES REU Community Capacity Report. 2019. UW-Stout.

ADDENDUM #2

Limnological Conditions in Tainter and Menomin
Reservoirs: Final Report 2014-2018. William F. James. UW-Stout, Discovery
Center for Limnological Research & Rehabilitation.

ADDENDUM #3

Red Cedar River, Menomonie, WI: CE-QUAL-W2
Water Quality Model. 2019. US Army Corps of Engineers-St. Paul District.

ADDENDUM #4

Dorrity Creek-Hay River & Lower Pine Creek
ACPF Map Books. 2018. US Army Corps of Engineers-St. Paul District.

Photo: Aaron Carlson

PROJECT SUMMARY

Red Cedar Basin Assessment

This project, which took place from April of 2016 through December of 2020, was funded in large part with a grant provided by the Wisconsin Department of Natural Resources (WDNR) and through technical assistance and project support provided by the United States Army Corps of Engineers (USACE) - St. Paul District.

Funding also came from additional project partners, with West Central Wisconsin Regional Planning Commission acting as the project administrator for a USACE Section 22 Funding Agreement and a WDNR Lake Protection Grant. For additional information on partners and funding, please see the complete budget summary provided in the Task 9 highlight of this report (pages 30-31).

This project is addressing key goals and strategies identified in previous studies and plans for the Red Cedar Basin. In 2012, the U.S. EPA approved a Total Maximum Daily Load (TMDL) for Lakes Tainter and Menomin, calling for a 65% reduction in total phosphorus load in order to meet minimum surface water quality standards. To achieve this TMDL reduction, the Red Cedar River Water Quality Partnership was created and embarked on the creation of a 9-Key Element (9KE) Watershed Plan, which was approved by the EPA in 2016.

This ten-year 9KE Plan provides a detailed implementation strategy to achieve the TMDL goals, including encouraging good soil health while nurturing civic governance and the social capacity for change. And the Red Cedar Basin Assessment (the project summarized in this document) grew directly from the recommendations within the 9KE Plan. The appendix of this report summarizes some of the key findings and goals from the TMDL and 9KE Plan.

Report Purpose

The purpose of this report is to describe the objectives, goals, tasks, and deliverables of this 4-year effort. This includes a two-page summary for each project task which highlights some of the key points and findings provided by project partners throughout the course of the project. While these task summaries are useful for providing condensed project findings and recommendations, readers are strongly encouraged to explore the complete partner task reports located in Addendums 1-4.

This report demonstrates that partnerships are critical to achieving water quality goals and improving soil health. This project was only possible through several organizations working cooperatively to creatively leverage resources and technical skills. This project is also unique for combining sociological research with water quality modeling and analysis. As will be demonstrated in this report, project partners and researchers worked to:

- » Measure the socio-economic conditions in the watershed by assessing attitudes, knowledge, and social networks.
- » Increase and track participation by stakeholders through the building of community capacity and civic engagement.
- » Implement and track land management changes on the ground that reduce sediment and phosphorus loads to rivers and lakes.
- » Monitor surface water quality to establish baselines and evaluate progress.

Objective 1: Conduct Socio-Economic Research & Analysis

Goals

- » Provide important decision-making information on how to engage farmers, modify existing programs, and prioritize existing resources to achieve water quality goals.
- » Provide sociological data and professional direction on how best to approach nonfarming farmland owners regarding conservation management and farmland lease agreements.
- » Understand the water quality impact in the housing and property market in the Menomonie and Dunn County area.
- » Understand the big-picture economic impact when considering secondary and tertiary multiplier effects across sectors.

- » Identify the potential impacts on the northern lakes in the watershed if their water quality degrades similarly.
- » Evaluate what levels of water quality improvement will induce which additional recreation activities and whether these levels of quality are feasible with a 40% reduction of phosphorus.
- » Assess the community's capacity to collaborate on initiatives to make sustainable, cost-effective changes in water quality.

Tasks
(Detailed on pages 14-19)

1	**Social Analysis of the Red Cedar River Basin**
2	**Economic Impact of Water Quality in Red Cedar Watershed**
3	**Community Capacity - Measuring Basic Civil Engagement**

Deliverables

- » Data to help facilitate identification of "high value" HUC 12s for agency workers to begin developing more extensive BMP adoption by farmers.
- » Estimates of economic sensitivity to water quality for housing, real estate, and businesses.

- » Estimates of the use value of water resources for recreation, aesthetics, and tourism, as well as how sensitive potential visitors and residents are to improvements or degradations in water quality.
- » LAKES REU Community Capacity Report (UW-Stout, 2019)

Objective 2: Conduct Water Quality Analysis & Monitoring

Goals

» Monitor and model nutrient and chlorophyll dynamics on Tainter and Menomin lakes over a three-year period (2016-2018) in order to address knowledge gaps and gain a better understanding of factors regulating cyanobacterial growth and cyanotoxicity.

» Assist the WDNR with refining phosphorus loading reduction scenarios originally derived from the 2012 Tainter Lake and Lake Menomin phosphorus TMDL.

» Examine interrelationships between hydrology, advection (horizontal water movement), residence time and riverine nutrient (primarily phosphorus) delivery on cyanobacteria dynamics and potential cyanotoxicity in wet versus dry years.

» Identify locations where conservation best management practices could be installed to improve management of agricultural water quality.

Tasks
(Detailed on pages 20-25)

4 **Water Quality Analysis - Monitoring & Modeling**

5 **2-D Modeling (CE-QUAL-W2) of the Tainter-Menomin Reservoir System**

6 **Agricultural Conservation Planning Framework (ACPF) Analysis**

Deliverables

» A report and dataset that describes seasonal nutrient and phytoplankton dynamics in the Tainter-Menomin system in relation to tributary nutrient loading and transport.

» Limnological Conditions in Tainter and Menomin Reservoirs: Final Report 2014-18 (W.F. James, December 2019)

» A report describing the CE-QUAL W2 model output and scenario application.

» Red Cedar River, Menomonie, WI CE-QUAL-W2 – Water Quality Model (USACE, July 2019)

» Agricultural Conservation Planning Framework datasets and maps for two HUC-12 watersheds in the Red Cedar basin.

» Dorrity Creek ACPF Map Book (USACE, 2018)

» Lower Pine Creek ACPF Map Book (USACE, 2018)

» Semi-annual reports and/or presentations at project steering committee meetings throughout project.

Objective 3: Conduct Project Outreach & Coordination

Goals

» Provide broad education, outreach, and engagement activities, including project outreach, presentation of project results, and encouraging local action based on the project results.

» Facilitate project steering committee and provide overall coordination and administration support for both USACE Section 22 assistance and a DNR Lake Protection Grant.

» Increase participation in water quality improvement by local landowners, provide technical data needed to assist outreach and assessment activities, and coordinate efforts of the Red Cedar Water Quality Partnership to carry out the project.

Tasks
(Detailed on pages 26-31)

7 **Outreach at the Annual Red Cedar Land, Water, and People Conference**

8 **Outreach and Assistance from Local Partners**

9 **Project Coordination & Administration**

Deliverables

» Measured conference outreach through attendance numbers, participant surveys, media coverage, and other qualitative feedback.

» Tracked activities and reports from county partners.

» GIS data provided by county partners.

» Completion of 10-year Dunn County Land and Water Resource Management Plan.

» Execution of program/grant agreements with USACE and WDNR.

» Execution of sub-agreements and administrative guidance to USACE, TMLIA, and UW- Stout regarding programmatic responsibilities, match commitments, and reporting requirements.

» Project administration including coordination of funding and quarterly grant reporting.

» Facilitation of quarterly project steering committee meetings throughout project term.

» Red Cedar Basin Assessment Project Summary Report (this paper), WCWRPC, December 2020.

SOCIAL ANALYSIS
OF THE RED CEDAR RIVER BASIN

Social Networks & Improving Water Quality

Encouraging farmers to transition from conventional to conservation agriculture is not just a matter of making such changes financially feasible or increasing equipment access. Instead, it begins with farmers and farmland owners receiving accurate information from people they trust. Task #1 evaluated the social capacity of the Red Cedar Basin to adopt soil health and water quality best management practices (BMPs) by researching farmer social networks and attitudes as well as the willingness to act by non-farming landowners. This knowledge is key to understanding barriers to BMP adoption and to identify related opportunities and outreach strategies.

Relationship building and social connections are critical to increasing the adoption of the best management practices (BMPs) needed to meet the Watershed's phosphorus-reduction goals. We need to identify and support those public conservation agencies and technicians that are most trusted by the agricultural community and provide the sociological tools and messaging to enhance these relationships. There is a great opportunity to show that such BMPs can not only improve soil health and water quality, but can also increase farm profitability.

It is also crucial to enhance existing (and foster new) social networks within the farming community and use civic governance concepts to empower these networks to share resources and make changes that benefit everyone. Bringing farmers together through agricultural conferences, nutrient management planning workshops, and other outreach activities are all important was to build trust and encourage the creation of farmer-led organizations.

Recommendations

» **Prioritize funding for staff to focus on building connections, especially within a peer-to-peer framework.**

» **Continue to direct resources to increasing cooperation and voluntary compliance with regulations and BMPs.**

» **Continue to concentrate on high impact areas for conservation work, utilizing traditional and modern technologies to identify and correct land use problems.**

» **Focus on fostering diverse relationships.**

» **Explore alternatives to traditional soil amendments, including reclaimed soil. Support strengthened legislation regarding fertilizer regulation.**

» **Develop plans that are tailored to the unique geographic and social landscape, and regularly reassess. Include social science data more thoroughly in the planning process.**

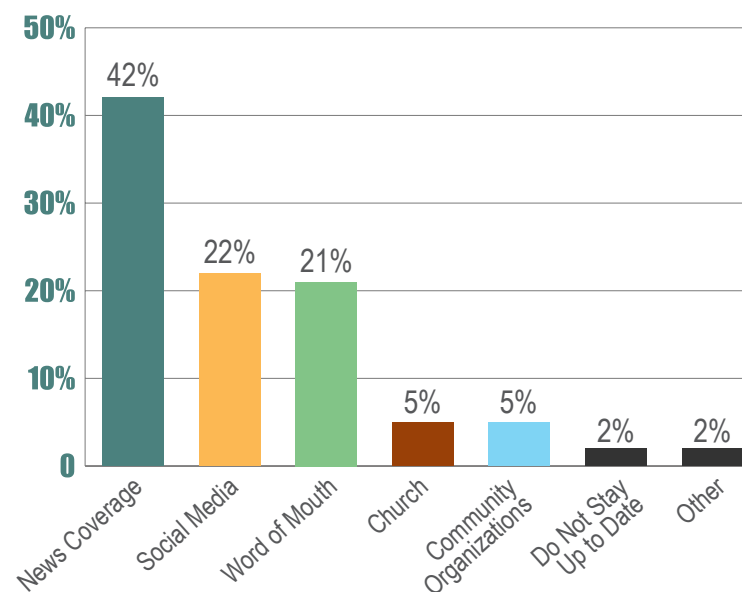## Where are the strongest existing social networks?

The green region on this heat map shows that this particular area of the Red Cedar Watershed has farmers with a high number of connections to others in our network.

No Significant Clustering → High Value Clustering

Data source:
Higgins, Paulsen and Quilling, 2017

Are farmers trusting their closest neighbors?

More needs to be done to build trust between farmers and their neighbors in the Watershed. This heat map shows that there is only one general area where there is a high level of trust between farmers and their closest neighbors.

Primary Ways Citizens Stay Up to Date on Community Matters

Category	Percentage
News Coverage	42%
Social Media	22%
Word of Mouth	21%
Church	5%
Community Organizations	5%
Do Not Stay Up to Date	2%
Other	2%

Data source:
Regnier, Gehrke and Zagorski, 2019

Sources of Information Relied Upon to Determine Lake Usage By Those Who Consume Wisconsin Media

Category	Percentage
Presence of Others	28%
Scientific Data	12%
Posted Warning Signs	45%
News Coverage	22%

Responsible Partners
UW-Stout ● US Army Corps of Engineers

Full Report: Addendum #1

Estimates of direct spending by students and visitors in the watershed were utilized to develop several alternative economic scenarios related to summer water-related tourism spending.

Measuring the Economic Impact of Water Quality

Water quality extends far beyond the enjoyment and health of the water itself. It can have an impact on the local economy by driving tourism, home values, business, and industry. The economic impact of water quality can be measured in dollars public perception, and actions of people. For Task #2, UW-Stout LAKES-REU students and supervising professors completed a number of projects to evaluate the economic impact of water quality in Menomonie, Chetek, and surrounding areas.
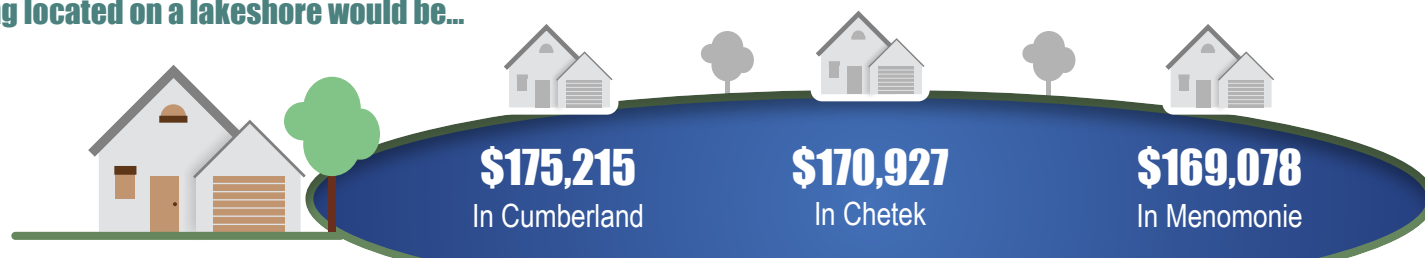
Data was collected via surveys of farmers, non-operating landowners (NOLs), Chetek and Menomonie households and businesses, and UW-Stout students. Informational interviews with area policy makers and community members complemented the survey data. Results were analyzed using Hedonic estimation, contingent valuation, statistical regression models, and IMPLAN modeling.

Key Findings of the Hedonic Price Modeling

» The "lake premium" is the higher price paid for a house on or near lakefront versus that same home located elsewhere in the community. This study found that the lake premium was positively correlated to water quality, meaning that the better the water quality, the higher the lake premium.

» Water clarity is positively correlated to home values. Each additional foot of clarity (as measured with a Secchi disk) adds $3,650 in value, resulting in a higher lake premium.

» The value of homes near lakes (without waterfront) are also expected to have higher lake premiums with improved water quality, but their values are not affected by water quality as much as waterfront homes.

» For more information on how the lake premium and economic impact were calculated, see the LAKES REU Community Capacity report in Addendum #1.

A typical House, controlling for all else, would cost...

$107,100 In Cumberland
$121,869 In Chetek
$133,055 In Menomonie

Data source: Pedrotti, Melly, Delaney and Ferguson, 2016

The increased value of that same house being located on a lakeshore would be...

$175,215 In Cumberland
$170,927 In Chetek
$169,078 In Menomonie

Scenario 1: Shows estimates of the current impacts of summer water-related tourism in Dunn & Barron Counties.

886 Jobs (full-time)
$18.1 Labor Income (in millions)
$26.3 Total Added Value (in millions)

Resulting in an estimated

$53 million

in total economic effect, and approximately $4.3 million in State and Local tax revenue annually.

Scenario 2: Shows the potential gains added from just a 10% increase in summer Menomonie, Chetek tourism.

+220 Jobs (full-time)
+$4.5 Labor Income (in millions)
+$6.5 Total Added Value (in millions)

Resulting in an additional

$13 million

of added economic effect, and an additional $1.1 million in State and Local tax revenue annually.

Average Secchi depth of **Cumberland Lakes**	Average Secchi depth of **Chetek Area Lakes**	Average Secchi depth of **Tainter & Menomin**
8 - 13 feet	2 - 10 feet	3 feet

Data source: Pedrotti, Melly, Delaney and Ferguson, 2016

Waterfront housing value is predicted to increase by...

$3,650

with each additional foot of Secchi depth.

RECREATION IMPACTS OF POOR WATER QUALITY

Do people from Menomonie travel to other lakes?

- No — 15%
- **Yes** — 85%
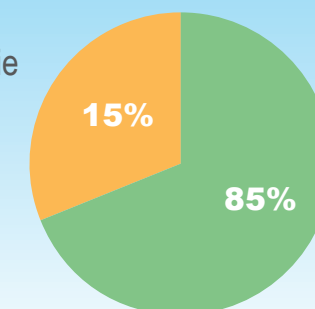
...and why?

- Other reasons — 31%
- **Because other lakes are cleaner** — 69%

Task 3

COMMUNITY CAPACITY

MEASURING BASIC CIVIC ENGAGEMENT

Responsible Partners
UW-Stout ● US Army Corps of Engineers

Full Report: Addendum #1
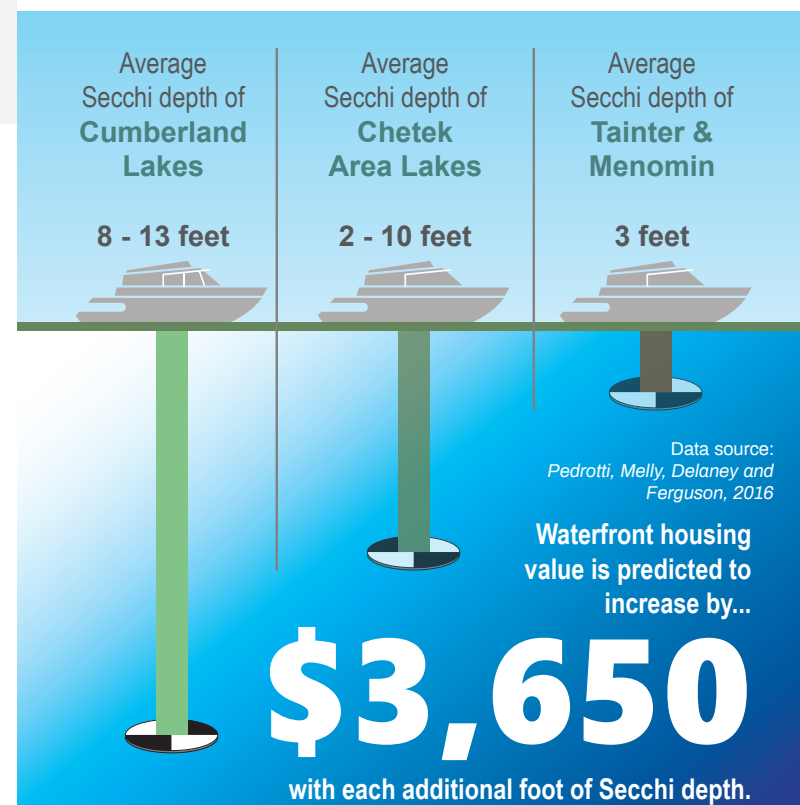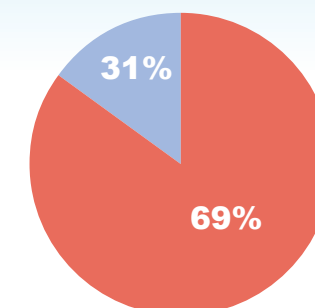
"The idea of community capacity is rooted in realizing what a community already has, what it is lacking, and how it can use its current strengths, skills, and resources to deal with complex problems."

Current Capacity

The rubric to evaluate the current state of the Red Cedar Watershed was based on a similar rubric designed by Davenport and Seekamp (2013). This rubric contains the four main capacity categories and their respective subcategories shown on the following page adjusted for the Red Cedar Watershed. A copy of the complete rubric is found in Addendum #1.

The ratings commonly consider the population as two groups—general population and epistemic communities. General population refers to the communities in general; individuals who live and work within the watershed. Epistemic communities refer to the groups of individuals actively engaged and knowledgeable about water quality issues who make decisions about and prioritize what we know about water quality and how we know what we know. Within the watershed, this group typically includes county agencies such as Land and Water Conservation, NRCS and DNR agents, NGOs, university faculty, and city/county officials.

Recommendations

» Develop and share a central narrative about water and water quality problems, focusing on the history of the watershed, ideas for direct action, and a shared vision of the future.

» Continue to promote open communication and networking between organizations. Introduce water quality issues and partnerships where appropriate to benefit the community and water quality goals.

» Engage youth organizations and public education in introducing age-appropriate water quality education and activities.

» Provide financial support to county agencies and staff so they can foster relationships with producers in the watershed and support the adoption and continuation of conservation agriculture practices.

» Evaluate tax policy and consider tax policy changes to fund water quality initiatives in the watershed.

» Use new and advancing technologies when possible and applicable, to coordinate and concentrate conservation practices in problem/high impact areas, without commitment to any single technology.

» Prioritize water quality in public, formal discussions about community development and economic growth and public policies (considering the impact economic improvement or decline can have on the local economy).

» Recognize support exists currently for voluntary compliance in the watershed rather than regulatory authority, planning accordingly for adequate staff time for such relationship building necessary for voluntary compliance.

Community Capacity Model Ratings		Somewhat Unfavorable	Somewhat Favorable	Favorable
Member	Awareness & Concern			→→→
	Knowledge		→→	
	Collective Memory & Vision	→		
	Responsibility		→→	
	Agency		→→	
Relational	Social Networks	→		
	Sense of Community		→	
	Sense of Collective Responsibility	→		
Organizational	Member Base	→		
	Leadership Base			→→→
	Leadership Activation		→→	
	Networks Among Groups		→→	
	Collective Memory & Vision		→→	
	Conflict Resolution	→		
	Decision-Making		→→	
Programmatic	Money & Staff		→	
	Education/Outreach Support		→	
	Monitoring & Expertise		→→	
	Accountability		→	
	Regulatory Authority		→	
	Cross-Organizational Cooperation			→→→

WATER QUALITY ANALYSIS
MONITORING & MODELING

Limnological Analysis of the Tainter-Menomin Reservoir System

The purpose of Task #4 is to help improve the understanding of soluble reactive phosphorus and total phosphorus loading to Lakes Tainter and Menomin. This includes an improved understanding of the interrelationships between nitrogen and phosphorus loading, reservoir flushing, and cyanobacteria blooms in order to develop models that may forecast changes in loading and cyanobacteria as a result of management efforts throughout the watershed.

Key Findings:

» Soluble reactive phosphorus, the form that is available to cyanobacteria for use, accounted for ~ 54% of summer phosphorus loading from Red Cedar and Hay rivers.

» Increased streamflow is positively associated with total phosphorus concentrations but is not strongly correlated with soluble reactive phosphorus.

» As inflows subsided and residence times increased, chlorophyll concentrations increased substantially in conjunction with declines in soluble reactive phosphorus, suggesting cyanobacterial nutrient assimilation for growth.

» Soluble reactive phosphorus appeared to be driving cyanobacterial growth versus dissolved inorganic nitrogen in 2014-18.

» Best Management Practices may include soil management to reduce phosphorus buildup at the surface, reducing overall soil phosphorus concentrations, increasing hydrological infiltration, sequestering soluble phosphorus in detention ponds, iron-enhanced sand benches, trapping soluble phosphorus using structures containing phosphorus binding materials, and nutrient reduction facilities.

Recommendations

In addition to soil loading control, phosphorus loading reduction strategies need to focus on lowering soluble phosphorus (SRP) in the watershed. However, more information is needed to identify the processes that regulate high SRP concentrations and loads in the Red Cedar Watershed.

Above average flow in summer years may have skewed results, study should be repeated in dryer year or over longer term period.

Potential soluble phosphorus inputs from the groundwater watershed also need to be quantified and factored into phosphorus management.

RATIO OF SUMMER PHOSPHORUS LOADING

🟠 SOLUBLE REACTIVE PHOSPHORUS (SRP)
🟤 PARTICULATE PHOSPHORUS (P)

Red Cedar
2014-2018
50% | 50%

Combined
2014-2018
54% | 46%
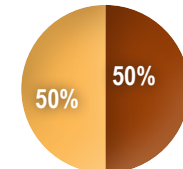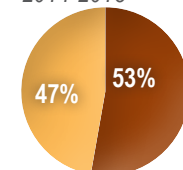
Hay River
2014-2018
47% | 53%
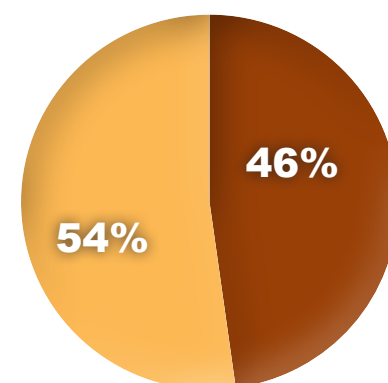
Data source:
W.F. James, 2019
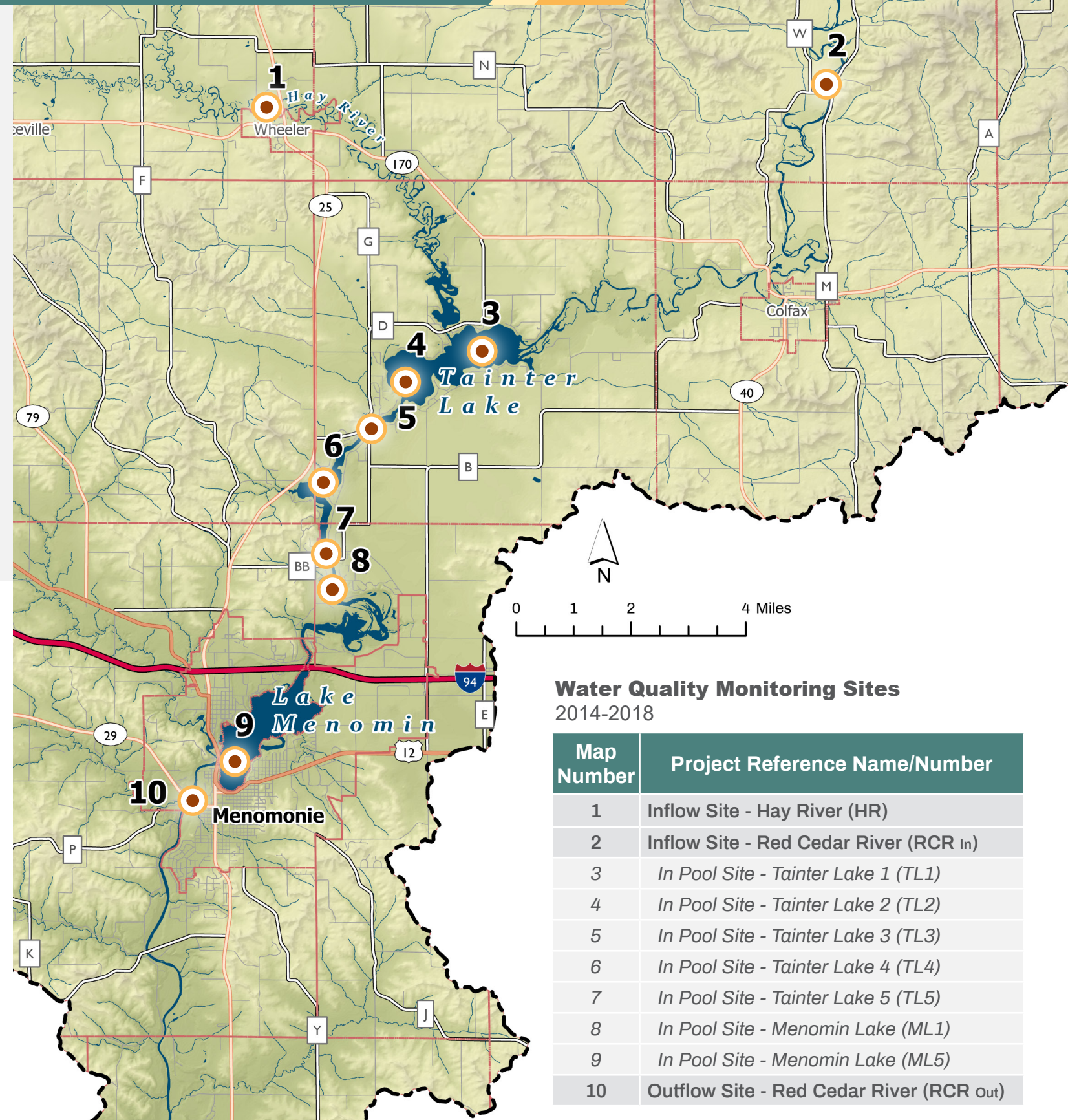
Water Quality Monitoring Sites
2014-2018

Map Number	Project Reference Name/Number
1	Inflow Site - Hay River (HR)
2	Inflow Site - Red Cedar River (RCR In)
3	*In Pool Site - Tainter Lake 1 (TL1)*
4	*In Pool Site - Tainter Lake 2 (TL2)*
5	*In Pool Site - Tainter Lake 3 (TL3)*
6	*In Pool Site - Tainter Lake 4 (TL4)*
7	*In Pool Site - Tainter Lake 5 (TL5)*
8	*In Pool Site - Menomin Lake (ML1)*
9	*In Pool Site - Menomin Lake (ML5)*
10	Outflow Site - Red Cedar River (RCR Out)

2-D MODELING (CE-QUAL-W2)

OF THE TAINTER-MENOMIN RESERVOIR SYSTEM

Task Description

The central focus of the CE-QUAL-W2 Model is to assist the Wisconsin Department of Natural Resources with refining phosphorus loading reduction scenarios for the Tainter Lake and Lake Menomin Phosphorus TMDL. Originally, the TMDL predicted flowage responses to reduce phosphorus loading with a 1-D trophic response model (USACE BATHTUB Model).

However, due to the unique dynamic relationships between hydrology, constituent loading, and cyanobacterial bloom development in the Tainter-Menomin system, a CE-QUAL-W2 Model, which is developed specifically for reservoirs, was determined to be needed to more accurately predict current limnological conditions and project future responses to loading reduction. As a result, the modeling phase of this study was tasked to:

» **Develop a 2-D, laterally-averaged, CE-QUAL-W2 Model for the Red Cedar River system from Tainter Lake to the outflow of Lake Menomin.**

» **Calibrate the Model to current loading and limnological conditions found in the monitoring phase of the study (2014-2018), and**

» **Forecast river and reservoir responses to loading reducing scenarios that are needed to refine TMDL goals.**

Findings

» Additional observed data at a finer time interval would help validate the Model calibration. Discharge flows from the hydroelectric dams were not directly measured and discharge elevations were estimated between penstock and tainter gate sill elevations based on monthly maintenance records. Hourly inflow, temperature and water quality data plus better information on dam discharges for an additional summer would be ideal to verify the Model calibration.

» The Model was calibrated using water years that were all above average for the basin based on the gauged period of records. Not having low flow conditions available during Model calibration may make any conclusions drawn from loading scenarios during longer residence times less reliable.

» Due to the lack of a direct linkage between organic matter loading and sediment oxygen demand (SOD) and benthic nutrient flux, the Model in its present stage is not suitable for predicatively evaluating the long-term impact of load reductions on SOD. However, due to the relatively short residence times normally seen on these two reservoirs, internal loading of nutrients is not considered a major factor in algal growth.

» The water quality Model is built based on a laterally averaged 2-D framework, therefore, the Model is not capable of simulating the possible localized water quality change. However, it can be used to evaluate the overall consequence of watershed development or several "what if" scenarios.

Data source:
USACE, 2019
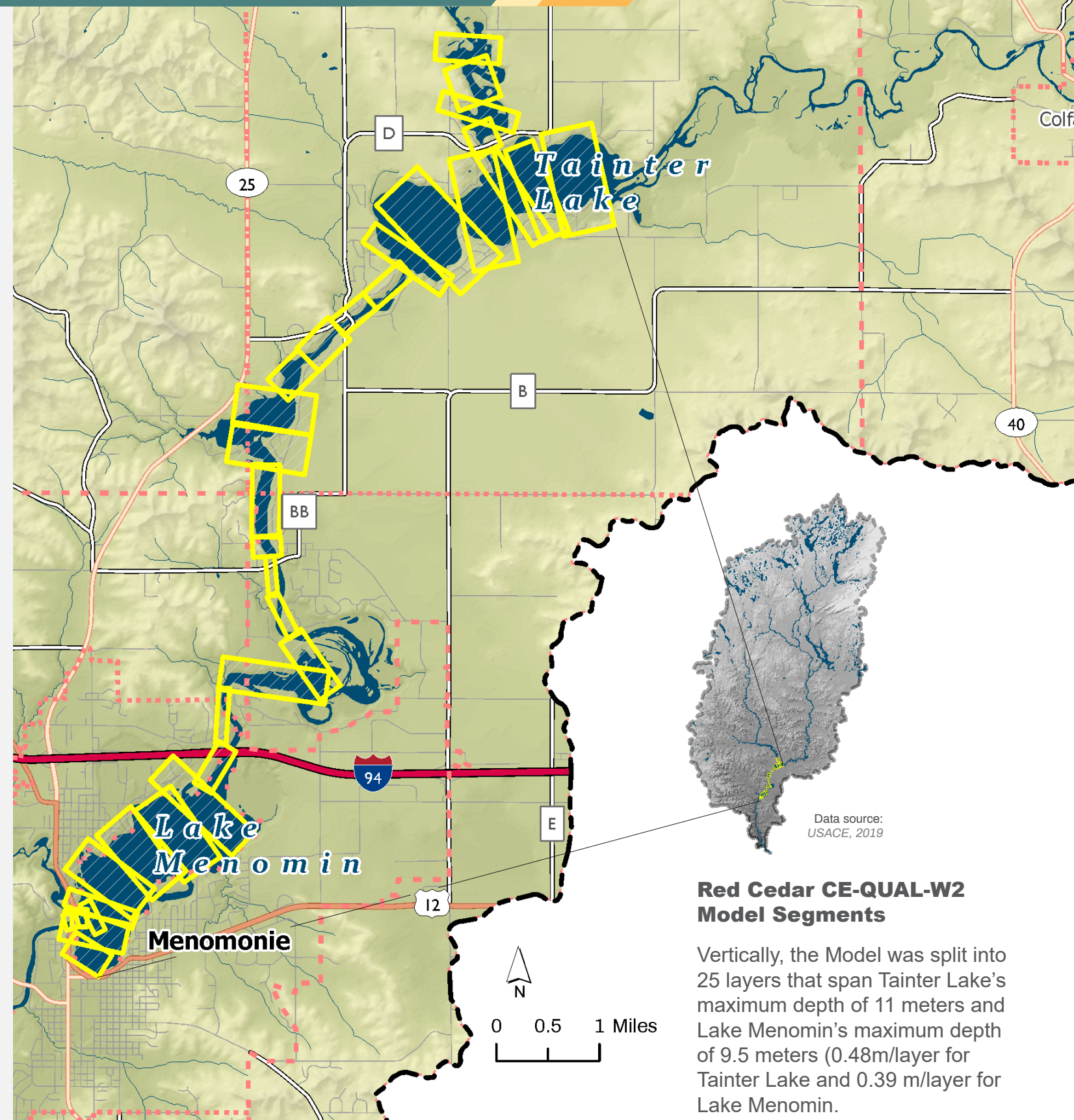
Red Cedar CE-QUAL-W2 Model Segments

Vertically, the Model was split into 25 layers that span Tainter Lake's maximum depth of 11 meters and Lake Menomin's maximum depth of 9.5 meters (0.48m/layer for Tainter Lake and 0.39 m/layer for Lake Menomin.

Task 6

Responsible Partner
US Army Corps of Engineers - St. Paul District

Full Report: Addendum #4

St. Paul District
GIS CENTER

US Army Corps of Engineers ®

ACPF ANALYSIS
AGRICULTURAL CONSERVATION PLANNING FRAMEWORK (ACPF)

Reducing Phosphorus Runoff

The Agricultural Conservation Planning Framework (ACPF) is a geospatial tool that combines terrain, soils, and land use to help conservationists prioritize solutions to soil and water conservation concerns. The ACPF is designed for identifying opportunities and appropriate sites for specific conservation practices. It has limited capability for prioritizing specific projects, in part because prioritization depends on social and economic factors as well as estimated downstream benefits that are not considered.

Although the ACPF doesn't prioritize practices, it does highlight high-priority sites. In this project, ACPF was run in two sub-watersheds that were selected for their potential to reduce phosphorus runoff based on prior watershed modeling as well as having strong community capacity based on the results of Task #1. The two sub-watersheds selected for ACPF analysis were the Dorrity Creek-Hay River Watershed and the Lower Pine Creek Watershed. The maps and data produced by the ACPF analysis are a useful tool for conservation planners to identify priority areas for targeted conservation efforts, thereby maximizing impact per dollar invested in the watershed.

ACPF Analysis Produced Maps of the Following

1. Fields likely to have tile drainage based on hydric soils and slope.

2. Runoff risk based on slope steepness and proximity to streams.

3. Suitable locations for:

» Edge of field bioreactors

» Field drainage water management

» Grassed waterways

» Contour buffer strips

» Water and Sediment Control Basins (WASCOBs)

» Nutrient removal wetlands

4. Riparian corridor management:

» Saturated buffer suitability

» Riparian function

» Recommended riparian buffer width
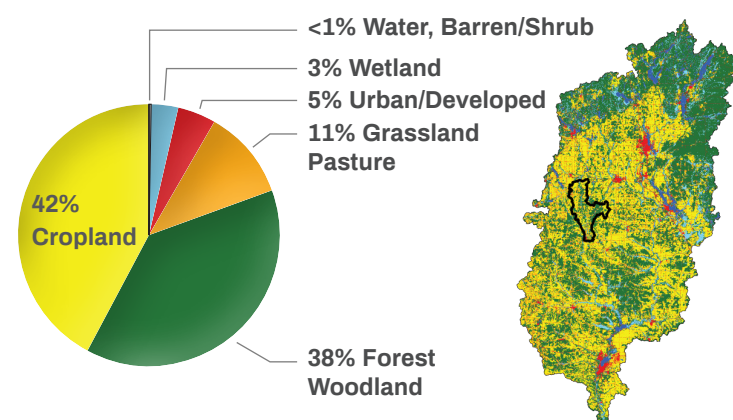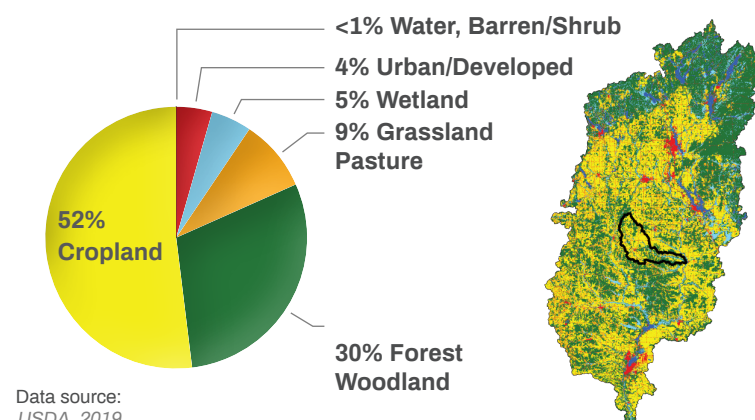
Dorrity Creek-Hay River & Lower Pine Creek
Runoff Risk

This map shows the runoff risk potential in the sub-watersheds. Stream proximity rank and slope steepness rank are used in a cross classification to determine runoff risk on a field-by-field basis.

	Runoff Risk	Area (ac)	% Ag Fields
🔴	Critical	1,600	5
🟣	Very High	4,850	14
🟠	High	13,100	38
🟡	Present	14,950	43
	Total	**34,500**	

Data source: USACE, 2018

Dorrity Creek-Hay River & Lower Pine Creek
Total Number of Conservation Measures by Field

This map shows the total number of different conservation measures recommended for each agricultural field. Possible conservation measures include edge-of-field bioreactors, drainage water management with controlled drainage, grass waterways, contour buffer strips, and water and sediment control basins (WASCOBs).

Conservation Measures		Area (ac)	% Ag Fields
⚪	0	7,550	22
🟢	1	10,100	29
🟡	2	11,950	34
🟠	3	5,200	15
🔴	4	200	1
	Total	**35,000**	

Data source: USACE, 2018

Dorrity Creek-Hay River (HUC12)

<1% Water, Barren/Shrub
3% Wetland
5% Urban/Developed
11% Grassland Pasture
42% Cropland
38% Forest Woodland

Lower Pine Creek (HUC12)

<1% Water, Barren/Shrub
4% Urban/Developed
5% Wetland
9% Grassland Pasture
52% Cropland
30% Forest Woodland

Data source: USDA, 2019

EDUCATION & OUTREACH
RED CEDAR LAND, WATER & PEOPLE CONFERENCE

Responsible Partner
Tainter Menomin Lake Improvement Association

> "The conference is what keeps water quality issues of the Red Cedar Watershed in front of people!"
>
> - Conference Attendee

Project Outreach

The *Red Cedar Watershed Conference: Land, Water and People Coming Together* is held annually in March at UW-Stout in Menomonie. The first conference was held in 2012 with 210 attendees and it has continued to evolve and grow each year. Attendees of the conference include farmers from the watershed, lake residents, officials from federal, state, county and local government agencies, non-governmental organizations, concerned citizens, and others from outside the watershed who demonstrate an interest and concern for water quality throughout the Red Cedar Basin and waters of the State.

The conference is widely publicized throughout the region and beyond building a community conversation around water quality, the Red Cedar Conference environment has led to new partnerships and cooperative projects focused on improved water quality. The conference was a crucial venue to share information learned throughout this study, and network with citizens and professionals regarding challenges and opportunities to address water quality concerns.

Red Cedar Watershed Conference

2017 - March 9
Total Attendance: 444
Surveys Returned: 205

> Land: Jimmy Bramblett, U.S. Dept. of Agriculture Natural Resource Conservation Service
>
> Water: Kathleen Dean Moore, Oregon State University Emerita
>
> People: Nels Paulson, Tina Lee, and Chris Ferguson, University of Wisconsin – Stout

2018 - March 8
Total Attendance: 332
Surveys Returned: 171

> Land: Rebecca Smith, The Nature Conservancy
>
> Water: Kevin Masarik, University of Wisconsin – Stevens Point Center for Watershed Science and Education
>
> People: Mary Kolar, Dane County Board and Steve Rasmussen, Dunn County Board

2019 - March 12
Total Attendance: 294
Surveys Returned: 133

> Land: David Montgomery, University of Washington
>
> Water: Gina LaLiberte, Wisconsin Dept. of Natural Resources and Amanda Koch, Wisconsin Div. of Public Health
>
> People: Whitney Prestby, Barry Bubolz, Dan Brick, and Dan Diederich, Fox Demo Farms

2020 - March 11
Total Attendance: 309
Surveys Returned: 102

> Land: Kris Nichols, KRIS Systems Education & Consultation
>
> Water: Raj Shukla, River Alliance of Wisconsin
>
> People: Paul Robbins, University of Wisconsin - Madison

Data source: UW-Stout Discovery Center, 2017-2020

Conference Attendee Map
Residence by Zip Code 2018-2020

69%
from within the watershed

31%
from outside the watershed

Data source: UW-Stout, 2020

Attendee Place of Residence

2017 2018 2019 2020
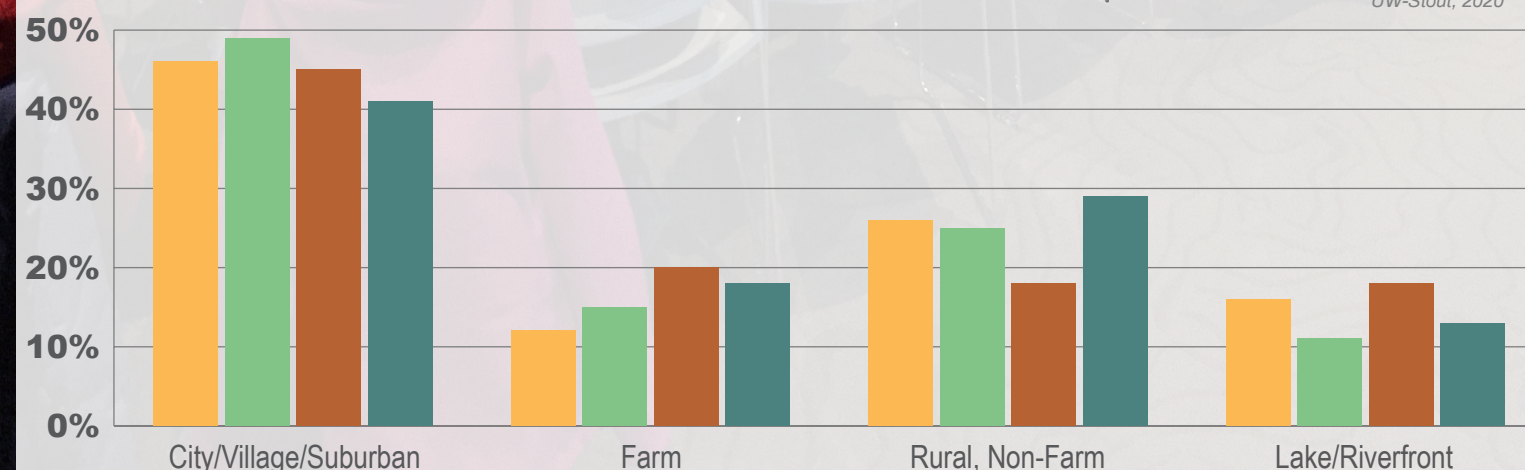
OUTREACH & ASSISTANCE

FROM LOCAL PARTNERS

Responsible Partners

Dunn & Barron Counties ● Division of Extension, UW-Madison

Digital Elevation Models

LiDAR data was provided by both Barron and Dunn Counties to assist with modeling and analysis efforts as part of this Assessment project.

Dunn County Land Conservation

Dunn County Land Conservation staff provided assistance in several ways throughout the project. Some of their most notable efforts include:

» Partnering with the Hay River Watershed Farmer-Led Council to apply knowledge and information toward working with other farmers and increasing participation in the watershed.

» Updating the Dunn County Land and Water Resource Management Plan to include details on outreach and education activities focused on water quality in the Red Cedar Watershed.

» Management of the Red Cedar Demonstration Farm, a 150-acre test site used to explore the long term effects of conservation farming practices and as an educational site.

Barron County Land Conservation

Barron County Land Conservation provided staff support and costly GIS data needed to assist in targeting areas for water quality analysis and modeling completed by the US Army Corps of Engineers.

Division of Extension, UW-Madison

Extension staff continue to provide critical planning and outreach support throughout the Red Cedar Basin. For this project, the Extension regional natural resource educator helped to coordinate activities of the Red Cedar River Water Quality Partnership, helped plan the Red Cedar River Conferences, and assisted in various education and outreach activities.

All project partners provided outreach, education, coordination and technical assistance throughout the course of this project. Partner activities helped increase participation by local landowners, provided technical data needed to assist in outreach and assessment activities, and also helped to coordinate efforts of the Red Cedar River Water Quality Partnership to carry out the activities of this comprehensive and large-scale project.

Photo: UW-Stout

Dunn County Land & Water Conservation conducting field based regenerative agriculture education with UW-Stout Lakes REU students.

LiDAR

Light Detection and Ranging (LIDAR) is a technology similar to RADAR that can be used to create high-resolution digital elevation models (DEMs) with vertical accuracy as good as 10 cm.

LIDAR equipment, which includes a laser scanner, a Global Positioning System (GPS), and an Inertial Navigation System (INS), is generally mounted on a small aircraft. The laser scanner transmits brief laser pulses to the ground surface, from which they are reflected or scattered back to the laser scanner.

High Resolution Elevation map generated from County LiDAR Digital Elevation Models (DEM)

PROJECT COORDINATION
ADMINISTRATIVE SUPPORT & TASK MANAGEMENT
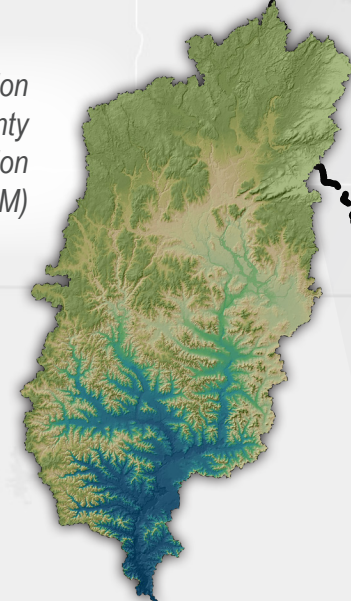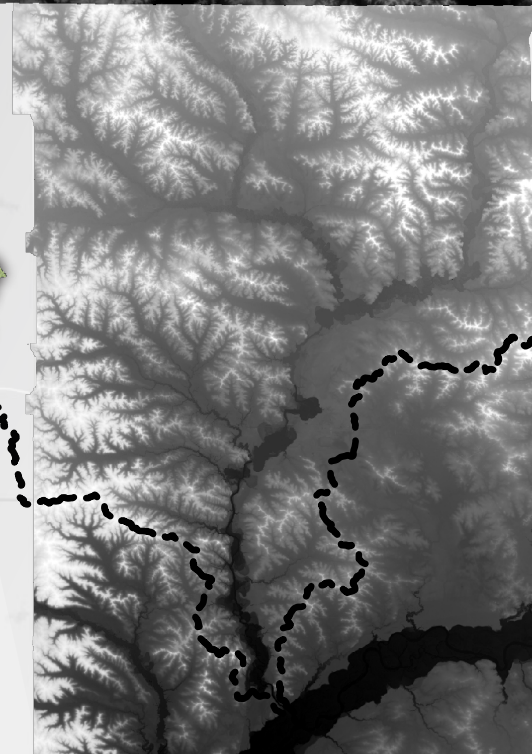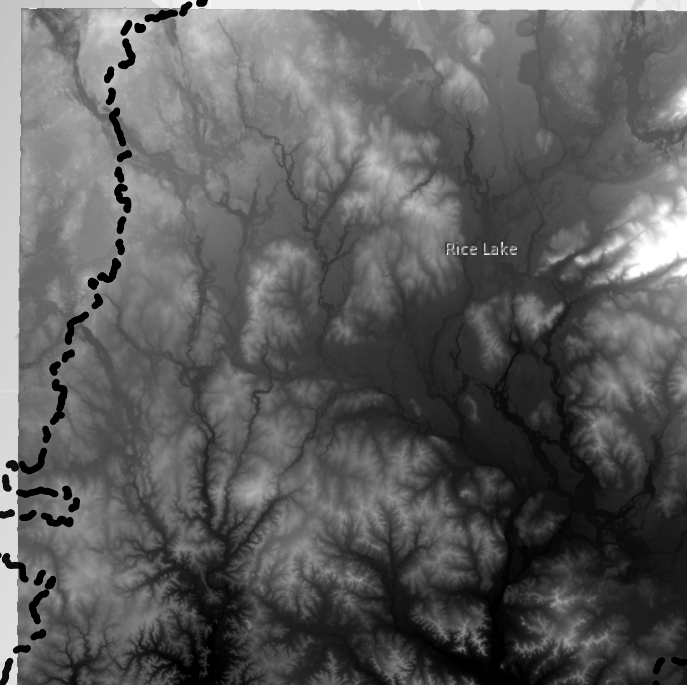
Partner Coordination & Funding

This innovative project leverages resources from numbers of partners, resulting in a complex and creative use of funding sources. West Central Wisconsin Regional Planning Commission provided project administration and the Wisconsin Department of Natural Resources provided $200,000 in grant funding with an additional $100,000 coming from local partners and in-kind contributions.

These sources were then combined to match US Army Corps of Engineers technical assistance valued at $300,000. The result is a $600,000 total project cost that was used to enhance, improve, and guide continuous water quality planning efforts throughout the entire Red Cedar Basin.

2016-2020 BUDGET SUMMARY

GENERALIZED PROJECT BUDGET

TASK	DESCRIPTION	TOTAL COST
1	Social Survey/Communication Network Analysis of the Watershed	$35,000
2	Economic Analysis of the Watershed	$65,000
3	Community Capacity	$125,000
4	Two-Year Water Quality Monitoring	$104,000
5	CE-QUAL-W2 Modeling	$138,000
6	ACPF Tool Run (Two HUC 12s)	$12,000
7	Education & Outreach - Red Cedar Land, Water & People Conference	$54,000
8	Local Assistance & Planning	$46,000
9	Project Coordination	$21,000

TOTAL $600,000

CONCLUSION

Looking Ahead

Land management changes are needed in the Red Cedar River Basin if water quality is to be improved. The human modifications of what was once mostly forested land have combined to increase levels of pollutants, promote the growth of toxic cyanobacteria, and decrease the quality of water in rivers and lakes. In order to affect such needed changes, existing programs and newly created programs focused on infiltration and soil health/conservation will require higher degrees of participation and adoption than has been present. Each aspect of this project contributes elements needed for such increased participation.

Sociological data collection and analysis allows better understanding of knowledge and attitudes among watershed residents, and also provides information on the best locations for probable success in changing behavior. This increased understanding of community capacity in the Red Cedar River Basin will help increase engagement and participation in activities focused on improving water quality.

Economic studies completed throughout this project help to understand the possible benefits of cleaner water, which in turn will provide the fuel for more interest and participation by those who will benefit from a healthier local economy. Limnological analysis and water quality monitoring data provides baseline measurements needed to update watershed models whose data and output is now more than 20 years old. This updated data provides a clearer picture of the dynamics of how and when algae blooms occur, their duration, and severity.

The new models and data collected throughout this project provide better tools to the Red Cedar River Water Quality Partnership to help determine geographic areas or subwatersheds that may be desirable targets for significant water quality improvements, while providing important baselines to evaluate progress on the TMDL and 9KE Plan goals. The project's modeling data, when combined with the sociological analysis, also allows the Partnership to evaluate how the physical and sociological capacity for the adoption of conservation practices varies throughout the Basin. This knowledge allows the Partnership to more efficiently and effectively tailor strategies and direct resources based on the specific opportunities within each subwatershed.

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THANK YOU!

To all the partners who contributed to the research, coordination, and outreach of this project to improve soil health and water quality in the Red Cedar River Basin.

Photo: UW-Stout

APPENDIX: BACKGROUND INFORMATION

About the Basin

The Red Cedar River Basin is a 1,900 square mile watershed dominated by agricultural and forest land located in northwestern Wisconsin. The area is the subject of several water quality improvement efforts over the past three decades with Tainter Lake and Lake Menomin, both impoundments of the Red Cedar River near the lower end of the watershed, being the primary focus of many of these efforts. In 1998 these lakes were 303d-listed as not meeting the minimum Federal clean water quality standards by the Environmental Protection Agency (EPA) due to excessive phosphorus with documented impairments of these lakes including eutrophication, excess algal growth, and elevated pH.

Location of study area

WISCONSIN

- Urban/Developed
- Cropland
- Grassland/Pasture
- Forest/Woodland
- Shrubland
- Barren
- Wetlands
- Water

Burnett Co.
Polk Co.

Washburn Co.

Sawyer Co.
Ruck Co.

Barron Co.

Cumberland

Rice Lake

Barron

Chetek

Rusk Co.
Chippewa Co.

Polk Co.
St. Croix, Co.

Glenwood City

Menomonie

St. Croix Co.
Pierce Co.

Dunn Co.

Chippewa Co.
Eau Claire Co.

Dunn Co.

Map Sources:
USDA,2019
Department of Administration

0   3.25   6.5   13 Miles

Total Maximum Daily Load (TMDL)

In 2012, a TMDL for Lakes Tainter and Menomin was approved by the US Environmental Protection Agency (EPA). The TMDL for Lakes Tainter and Menomin identifies baseline phosphorus loads and levels in those lakes utilizing research done mostly in the 1990s. This research includes sources of phosphorus and the goals for reducing phosphorus required to restore water quality to desired levels. Meeting these goals equates to 61% less phosphorus concentration in Tainter Lake and 54% less phosphorus concentration in Lake Menomin (*RCRWQP, 2015*).

Burnett Co.
Polk Co.
Washburn Co.
Barron Co.
Sawyer Co.
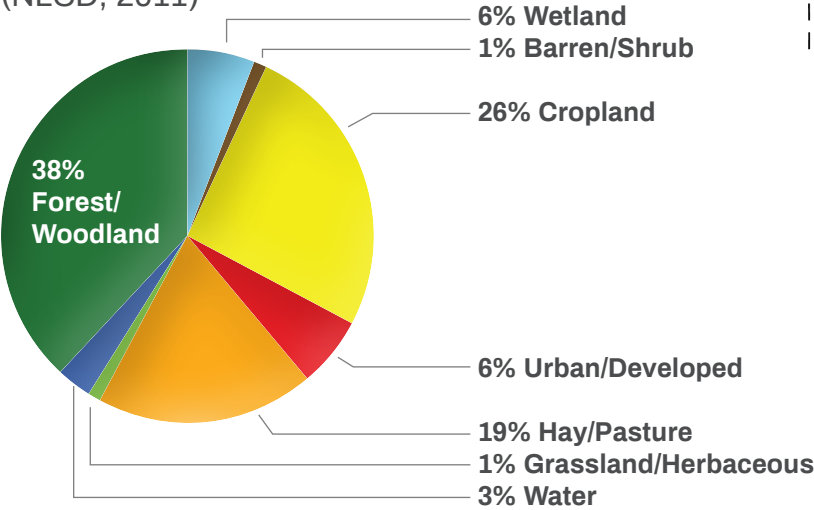Ruck Co.

Cumberland
Rice Lake
Barron
Chetek

Rusk Co.
Chippewa Co.

Polk Co.
St. Croix Co.

Glenwood City

Menomonie

St. Croix Co.
Pierce Co.

Dunn Co.

Chippewa Co.
Eau Claire Co.

Legend:
- Urban/Developed
- Cropland
- Hay/Pasture
- Forest/Woodland
- Grassland/Herbaceous
- Shrubland
- Wetlands
- Barren
- Water

Map Sources:
2011 National Land Cover Dataset (NLCD),
Department of Administration

LAND COVER CLASSES
(NLCD, 2011)

- 6% Wetland
- 1% Barren/Shrub
- 26% Cropland
- 38% Forest/Woodland
- 6% Urban/Developed
- 19% Hay/Pasture
- 1% Grassland/Herbaceous
- 3% Water

Although forest/woodland is the dominant land use, cropland provides a greater phosphorus load contribution to the lakes and rivers of the watershed.

66% of estimated phosphorus comes from cropland

Additionally, climate change research indicates that although average annual rainfall amounts in northwest Wisconsin have risen slightly in the last several decades, what's more apparent is that much of the precipitation that falls is coming in fewer, more intense events, which have the potential to produce more runoff (*Wisconsin Initiative on Climate Change Impacts, 2011*).

Dominant Land Uses

- 38% Forest/Woodland
- 26% Cropland

SOURCES OF PHOSPHORUS
(WDNR, 1999)

- 3% Urban/Developed
- 6% Grassland/Hay/Pasture
- 7% Barnyards
- 8% Point Sources
- 10% Forest/Woodland
- 66% Cropland
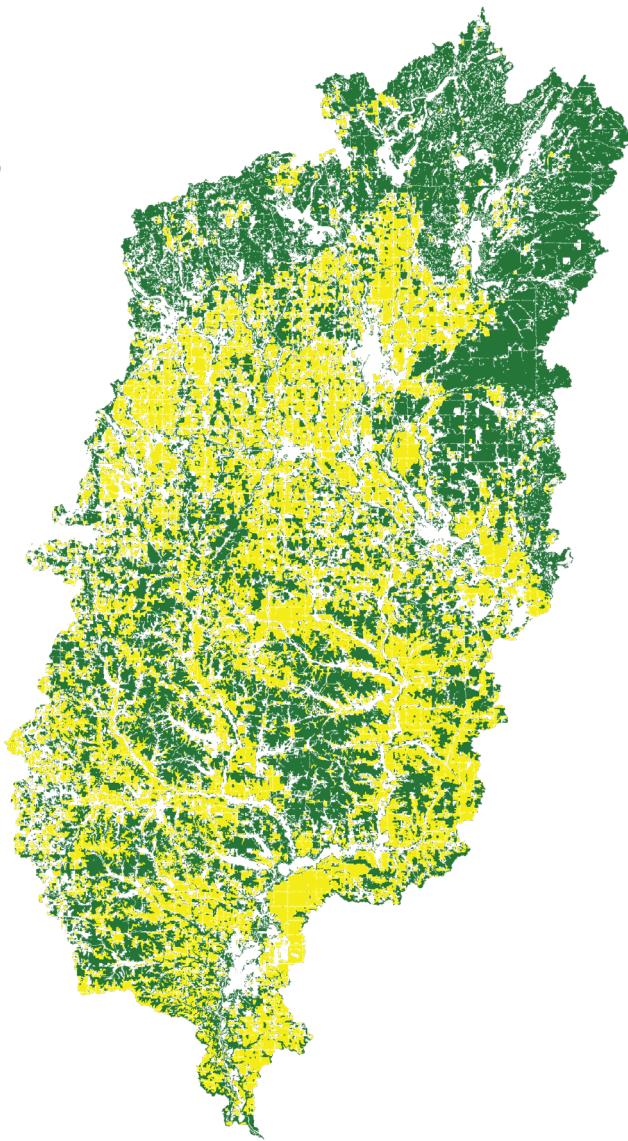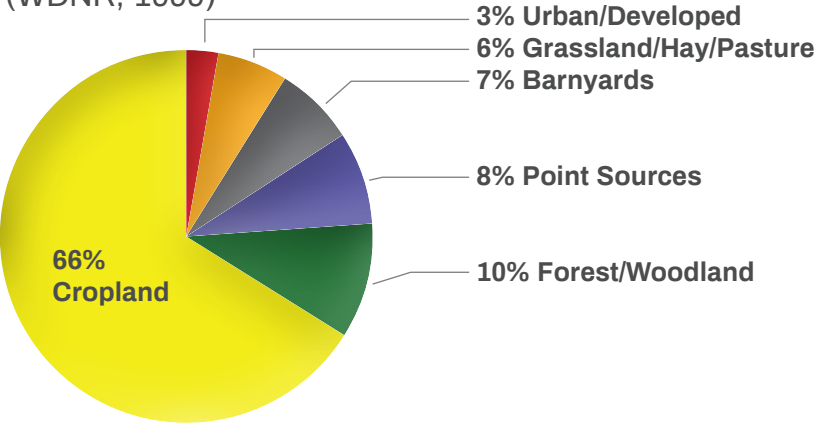
Tainter Lake TMDL Phosphorus & Water Quality Goals

Lake Menomin TMDL Phosphorus & Water Quality Goals

TAINTER LAKE ALLOWABLE PHOSPHORUS LOADS

- ■ **Annual Phosphorus Load Allocation (pounds)**
- ■ 1990/93 Baseline Annual Phosphorus Load (pounds)

	Allocation	Baseline
TOTAL	177,000	506,300
Nonpoint Sources	157,400	463,400
WPDES Permits	20,100	42,900

61%
Overall Phosphorus Reduction
(e.g., needed to meet minimum water quality standards)

Data sources:
TMDL, 2012
RCRWQP, 2015

LAKE MENOMIN ALLOWABLE PHOSPHORUS LOADS

- ■ **Annual Phosphorus Load Allocation (pounds)**
- ■ 1990/93 Baseline Annual Phosphorus Load (pounds)

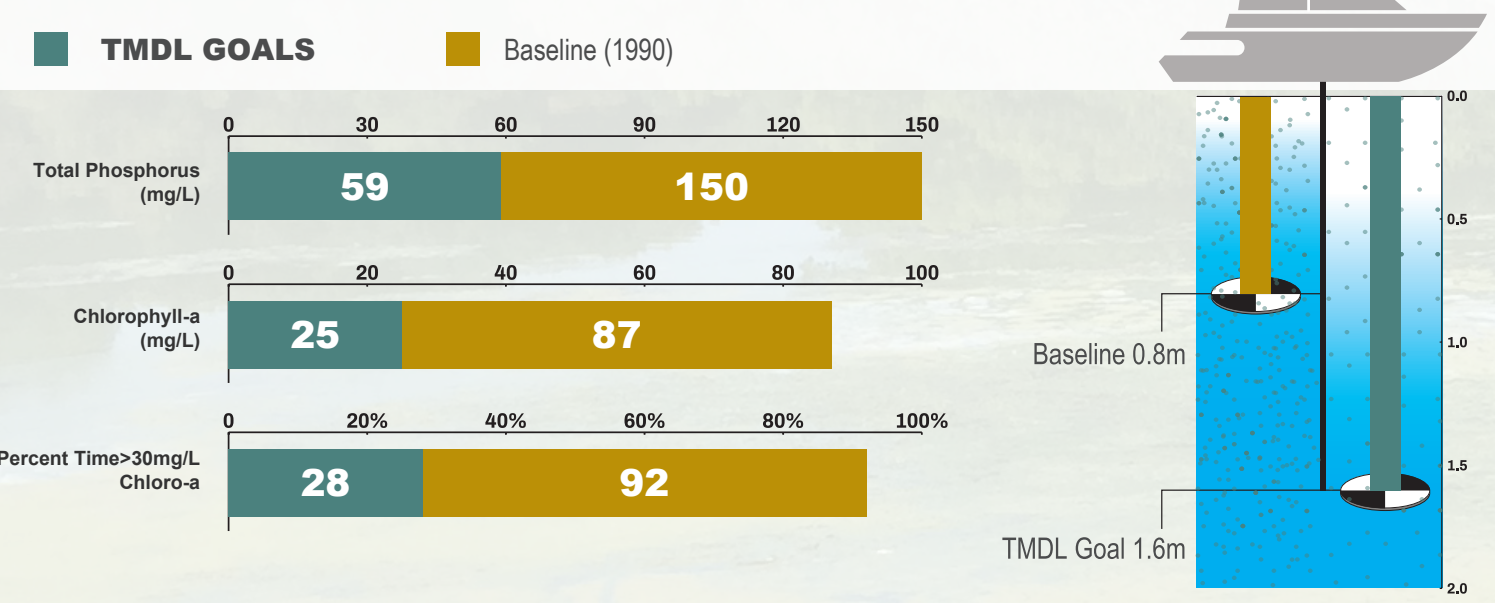|	Allocation	Baseline
TOTAL	149,710	326,000
Discharge from Tainter Lake at TMDL Goal	145,300	319,000
Nonpoint Sources (unswewered watershed)	2,200	3,500
Point Sources (Menomonie MS4)	2,200	3,500
General WPDES Permits	10	

54%
Overall Phosphorus Reduction
(e.g., needed to meet minimum water quality standards)

Data sources:
TMDL, 2012
RCRWQP, 2015

TAINTER LAKE WATER QUALITY GOALS

- ■ **TMDL GOALS**
- ■ Baseline (1990)

	TMDL Goals	Baseline
Total Phosphorus (mg/L)	59	150
Chlorophyll-a (mg/L)	25	87
Percent Time>30mg/L Chloro-a	28	92

Secchi Depth (m)

Baseline 0.8m

TMDL Goal 1.6m

LAKE MENOMIN WATER QUALITY GOALS

- ■ **TMDL GOALS**
- ■ Baseline (1990)

	TMDL Goals	Baseline
Total Phosphorus (mg/L)	57	108
Chlorophyll-a (mg/L)	25	40
Percent Time>30mg/L Chloro-a	28	54

Secchi Depth (m)

Baseline 1.8m

TMDL Goal 2.0m
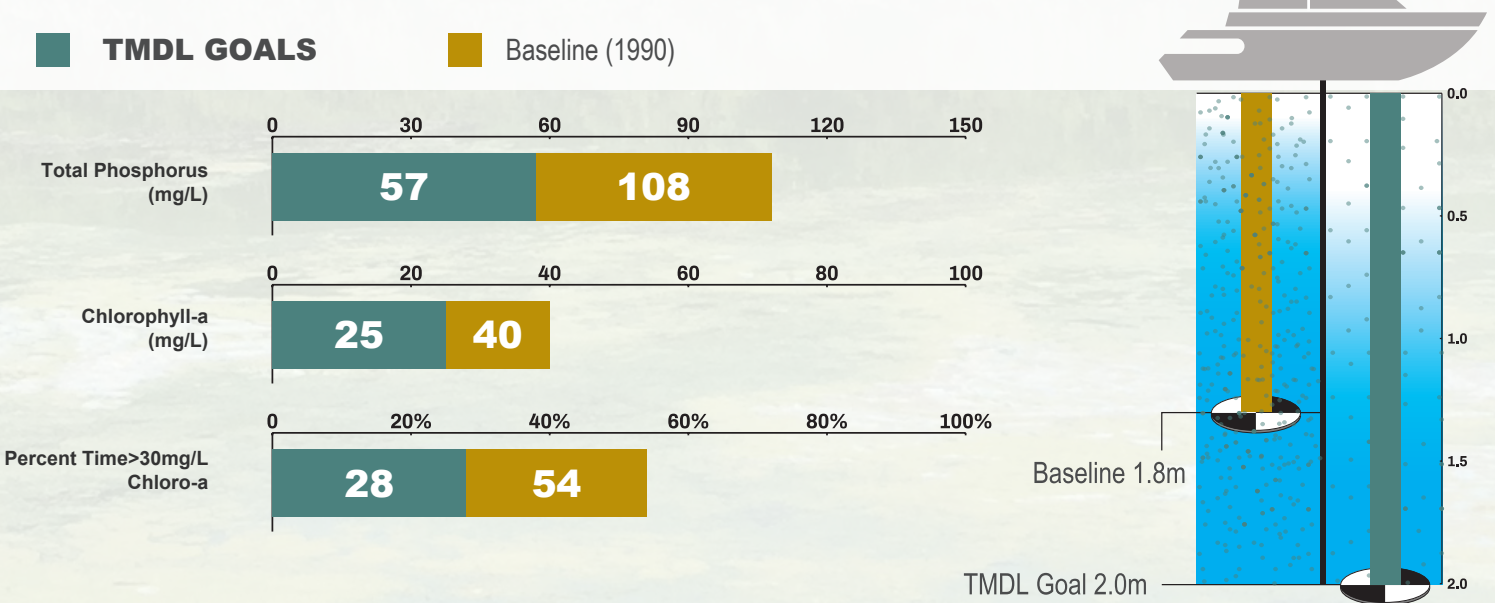
9 Key Element Watershed Planning

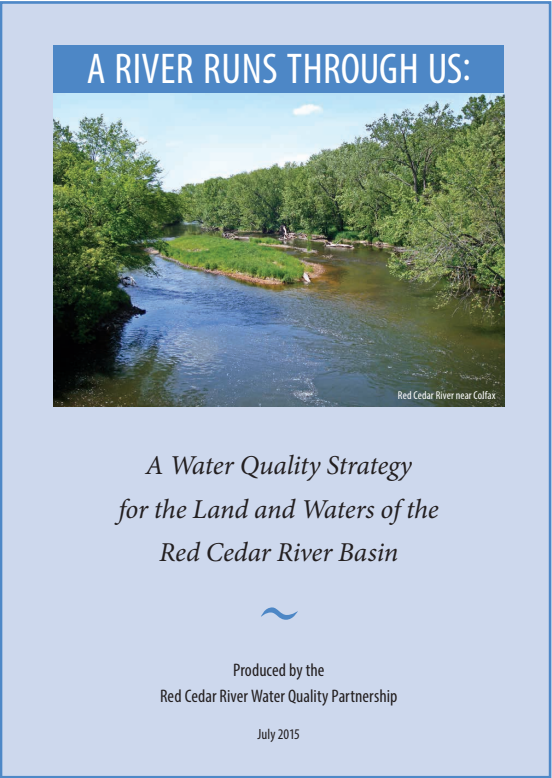In order to meet the reduction goals identified in the TMDL, in 2013 a large group of stakeholders formed to develop a 9-Key Element (9KE) Watershed Plan for the Red Cedar Basin. The Environmental Protection Agency (EPA) has identified nine key planning elements deemed critical for protecting and improving water quality.

Plans that reflect the nine key elements help assess the contributing causes and sources of nonpoint source pollution within a defined watershed area and then prioritize pollutant reduction strategies to restore or protect water quality. The final 9KE Watershed Plan, *A River Runs Through Us: A Water Quality Strategy for the Land and Waters of the Red Cedar River Basin*, was approved by the EPA in July 2015 and meets eligibility requirements for certain Federal Clean Water Act (Section 319) funding for nonpoint source pollution management.

A RIVER RUNS THROUGH US:

Red Cedar River near Colfax

*A Water Quality Strategy
for the Land and Waters of the
Red Cedar River Basin*

~

Produced by the
Red Cedar River Water Quality Partnership

July 2015
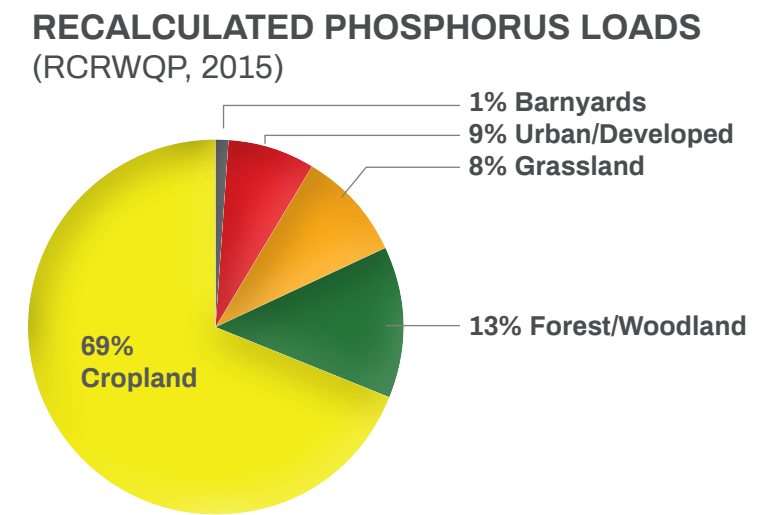
A major highlight of the 2015 9KE Watershed Plan includes discussion of the significant changes in land cover and research methods occurring in the watershed since the 1990s. This led to new baseline phosphorus loads for Lakes Tainter and Menomin along with the realization that it would be unlikely to achieve the full nonpoint TMDL goal in only ten years. As a result, the Partnership selected an interim goal for nonpoint source phosphorus reductions of 40% or 186,000 lbs/yr above Tainter Lake over the next ten years (by 2025).

In order to achieve the TMDL and 9KE water quality goals for Lakes Tainter and Menomin, the 2015 9KE Watershed Plan identifies several strategies to be implemented throughout the watershed. Some of the key strategies and recommendations are summarized here and ultimately led to the development of the Red Cedar Basin Assessment project that is the focus of this report.

RECALCULATED PHOSPHORUS LOADS
(RCRWQP, 2015)

- 1% Barnyards
- 9% Urban/Developed
- 8% Grassland
- 13% Forest/Woodland
- 69% Cropland

Best Management Practice Examples
(example evaluation from area draining to Tainter Lake only)

Lbs/yr
Phosphorus Reduced

Practice	Lbs/yr
No-till method on 86,000 cropland acres without targeting or 60,000 acres if high delivery areas are targeted	63,000
Eliminate winter manure spreading on 6,000 acres by adding 50 manure storage structures	34,000
Draw phosphorus levels down to 25 PPM on 1/3 of cropland with the highest delivery rates (86,000 acres)	31,500
Plant cover crops on 107,000 acres (40%) of cropland	18,000
Traditional conservation practices on 10% of cropland acres	11,000
Add treatment of milk house waste at 50 farms	6,600
Control of urban stormwater Phosphorus delivery outside MS4 areas	5,700
Install stream buffers on 15% of stream miles	4,600
Add runoff control to 62 barnyards	4,200
Replace all failing, critically located septic systems (440)	420
Control stormwater on all rural, residential properties near waterbodies (2200 lots ¼ acre in size)	220
200 acres of wetland restoration	210
Past barnyard load reductions	27,000
Total of example reductions	**206,450**
Interim, ten-year goal of 40% reduction in nonpoint source load	186,000
TMDL FINAL REDUCTION GOAL FOR NONPOINT SOURCE LOAD	**306,000**

Data source:
RCRWQP, 2015

No-till + Cover Crop

3-yr Alfalfa, 2017 Corn

No-till only

2016 Corn, 2017 Soybean

Conventional Tillage

No Cover Crop

Unproductive Pasture

Healthy Pasture