Resolution 18-1 of the Amnicon Dowling Lake Management District, Douglas County
December 6, 2018

Lake Management Planning (LPL) Grant Resolution

WHEREAS, the Amnicon Dowling Lake Management District (ADLMD) is interested in obtaining a cost-share grant from the Wisconsin Department of Natural Resources for the purpose of supporting water quality management planning for Dowling Lake in Douglas County;

WHEREAS, the applicant attests to the validity and veracity of the statements and representations contained in the grant application;

WHEREAS, a grant agreement is requested to carry out the project; and

NOW, THEREFORE, BE IT RESOLVED, that the ADLMD has budgeted a sum sufficient to fully and satisfactorily complete the project and hereby authorized and empower the following officials or employees to submit the following documents to the Wisconsin Department of Natural Resources for financial assistance that may be available:

Task	Title of Authorized Representative
Sign and submit a grant application	Chair
Enter into a grant agreement with the DNR	Chair
Submit quarterly and/or final reports to the DNR to satisfy the grant agreement, as appropriate	Chair
Submit reimbursement requests(s) to the DNR no later than the date specified in the grant agreement	Chair
Sign and submit any other documents as necessary	Chair

BE IT FURTHER RESOLVED that applicant will comply with all local, state and federal rules, regulations and ordinances relating to this project and the cost-share agreement.

Adopted on the 6th day of December, 2018

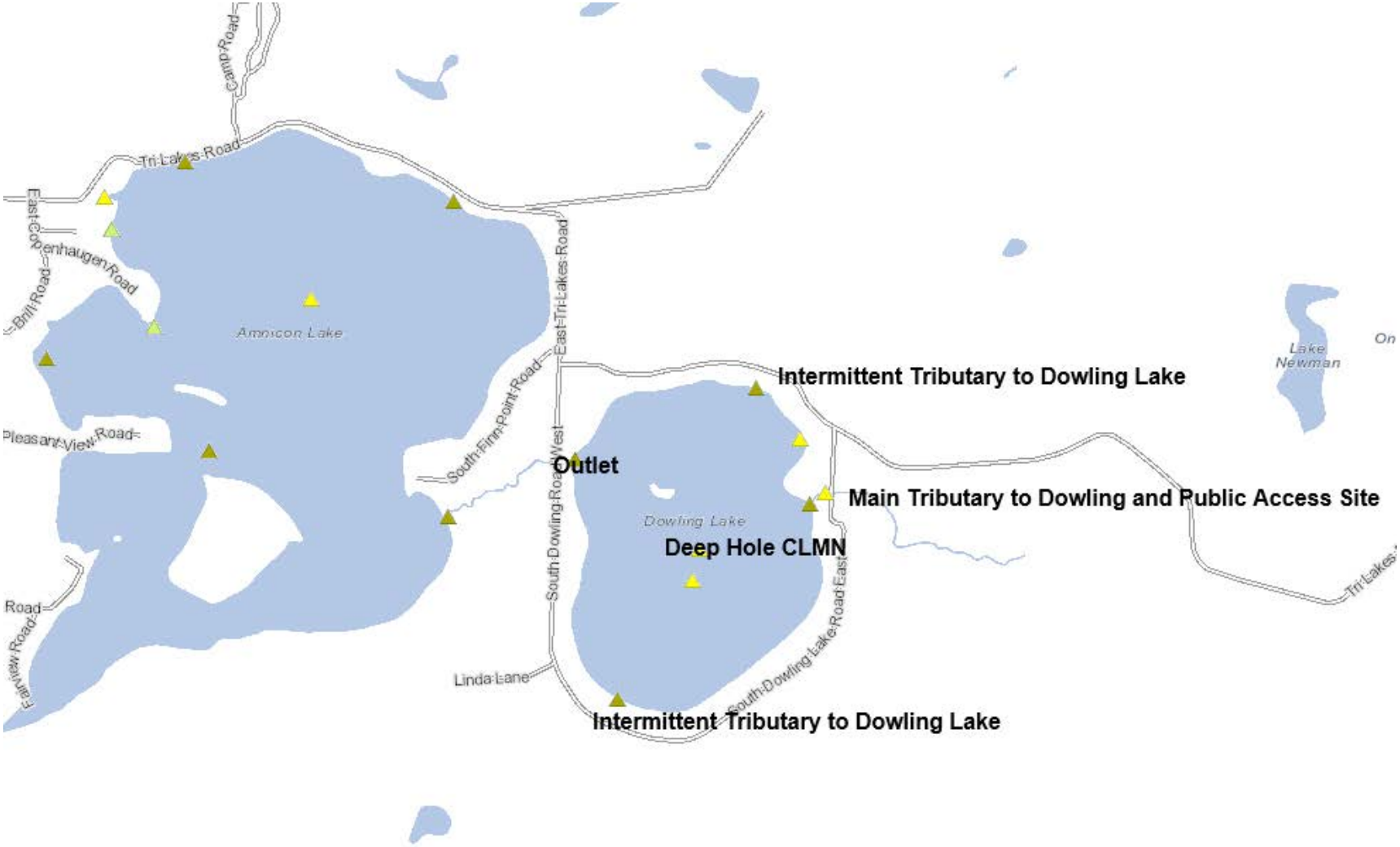
I hereby certify that the foregoing resolution was duly adopted by the ADLMD by a vote of: _5__ in favor, __0_ against, and _0__ abstain.

Authorized Signature Dennis Corbin

Title: Secretary/Treasurer

Date 12/10/2018

Dowling Lake Public Access and Monitoring Sites



2019-20 Lake Management Planning Project (LEAPS 12-03-2018)

Dowling Lake, Douglas County

DRAFT Budget and Task List Start Date: Feb 1, 2019 End Date: June 30, 2021

Goal	Objective	Action	Time Line
2019 & 2020 Inlet Monitoring	Determine the level of loading coming from the area of the watershed drained by the three inlets to the lake	Sample one inlet stream two intermittent inlet streams for TP, TSS, Flow, and volume. Main Trib will be samples once monthly from April to October (7) and during snowmelt (1), and during two runoff events (2). Intermittent tribs will be monitored three times a year - snowmelt and two rain events. All trib monitoring will take place to two years.	2019-2020
		Preparation of sampling materials, shipping of water samples	
Surface and Bottom Water Quality: Determine current water quality parameters and how they affect Dowling Lake	Collect sufficient water quality data from Dowling Lake over two years (2019& 2020) to establish the current condition of the lake, and to compare the current condition of the lake to past conditions in the lake	2019 Surface Water: once a month May-Oct for Secchi, Temp/DO profiles, conductivity/alkalinity/pH/TDS, TP, orthophosphates, nitrites/nitrates, ammonia, and Total Kjeldahl nitrogen; chlorophyll A once a month June-Oct; chloride once a month in May and October. 2019 Bottom Water: once a month July - Sept for TP, orthophosphates, nitrites/nitrates, ammonia, Total Kjeldahl nitrogen, iron, and sulfates.	2019
		Rental of a Van Dorn Sampler	
		Preparation of sampling materials, shipping of water samples	
		2020 Surface Water: once a month May-Oct for Secchi, Temp/DO profiles, conductivity/alkalinity/pH/TDS, TP, orthophosphates, nitrites/nitrates, ammonia, and Total Kjeldahl nitrogen; chlorophyll A once a month June-Oct; chloride once a month in May and October. 2019 Bottom Water: once a month July - Sept for TP, orthophosphates, nitrites/nitrates, ammonia, Total Kjeldahl nitrogen, iron, and sulfates.	2020
		Rental of a Van Dorn Sampler	
		Preparation of sampling materials, shipping of water samples	
Nearshore Area Contributions: Evaluate the shoreland and nearshore area for habitat, nutrient loading, and improvement projects	Identify shoreland habitat health by individual parcel on Dowling Lake	Complete a Shoreland Habitat and Woody Debris Assessment on Dowling Lake following WDNR protocol	2019
	300-ft Land Use Determination around Dowling Lake	Land use identification in a 300-ft area around the lakes using aerial photos in order to calculate nutrient loading from specific land uses in the near shore area	2020
	Gather "time at lake" and septic system data	Create and distribute a one-page property owner survey to all property owners on the lakes to collect "time at lake" data to be used for estimating septic system load.	2019
Precipitation Monitoring: Collect rainfall data to aide in the development of loading models	Record daily, monthly, and annual rainfall within the Dowling Lake Watershed	Set-up at least one volunteer on the lake to collect rainfall data between April and November via the CoCoRaHS program	2019-20
Develop a Water Quality Improvement Plan for Dowling Lake	Make recommendations based on lake data and modeling that will make improvements to Dowling Lake	Revew all old and new data, assemble a water quality improvement plan	2019-20
General Project Support	Lead Consultant	Meetings, Misc, Mileage, and Materials	2019-20
	ADLMD Support	ADLMD Administration of Project	

	Target
Total Project Cost	**$31,430.00**
State Share Requested (67%)	**$21,058.10**
Sponsor Share	**$10,371.90**
Match Included in this Application (Volunteer (time) and Donated Services)	**$7,439.00**
Extra Match	**-$2,932.90**

LEAPS		Volunteer (time)		Donated Services		Equipment/Paid Services		Sub-Total	NOTES
		100	$1,200.00	Mileage	$275.00	SLOH	$1,880.00	$3,355.00	
24	$1,020.00					Shipping	$520.00	$1,540.00	$4,895.00
8	$640.00	48	$576.00	24 (boat use)	$240.00	SLOH	$1,878.00	$3,334.00	
				Van Dorn Water Sampler	$204.00			$204.00	
12	$480.00					Shipping	$180.00	$660.00	$4,198.00
8	$640.00	48	$576.00	24 (boat use)	$240.00	SLOH	$1,878.00	$3,334.00	
				Van Dorn Water Sampler	$204.00			$204.00	
12	$540.00					Shipping	$180.00	$720.00	$4,258.00
64	$2,560.00	40	$480.00	40 (boat use)	$400.00	Mileage and Materials	$545.00	$3,985.00	
32	$1,440.00							$1,440.00	
16	$640.00	32	$384.00	Printing, postage and envelopes	$500.00			$1,524.00	$6,949.00
		20	$240.00					$240.00	$240.00
80	$6,400.00	64	$768.00			Printing	$150.00	$7,318.00	$7,318.00
24	$1,920.00					Mileage and Materials	$500.00	$2,420.00	
		96	$1,152.00					$1,152.00	$3,572.00
280	**$16,280.00**	**448**	**$5,376.00**	**0**	**$2,063.00**	**0**	**$7,711.00**	**$31,430.00**	
								$31,430.00	

TP - Total Phosphorus
SLOH - State Lab of Hygiene
Temp/DO - Temperature and Dissolved Oxygen
Ortho - orthophosphates

TSS - Total Suspended Solids
LEAPS - Lake Education and Planning Services

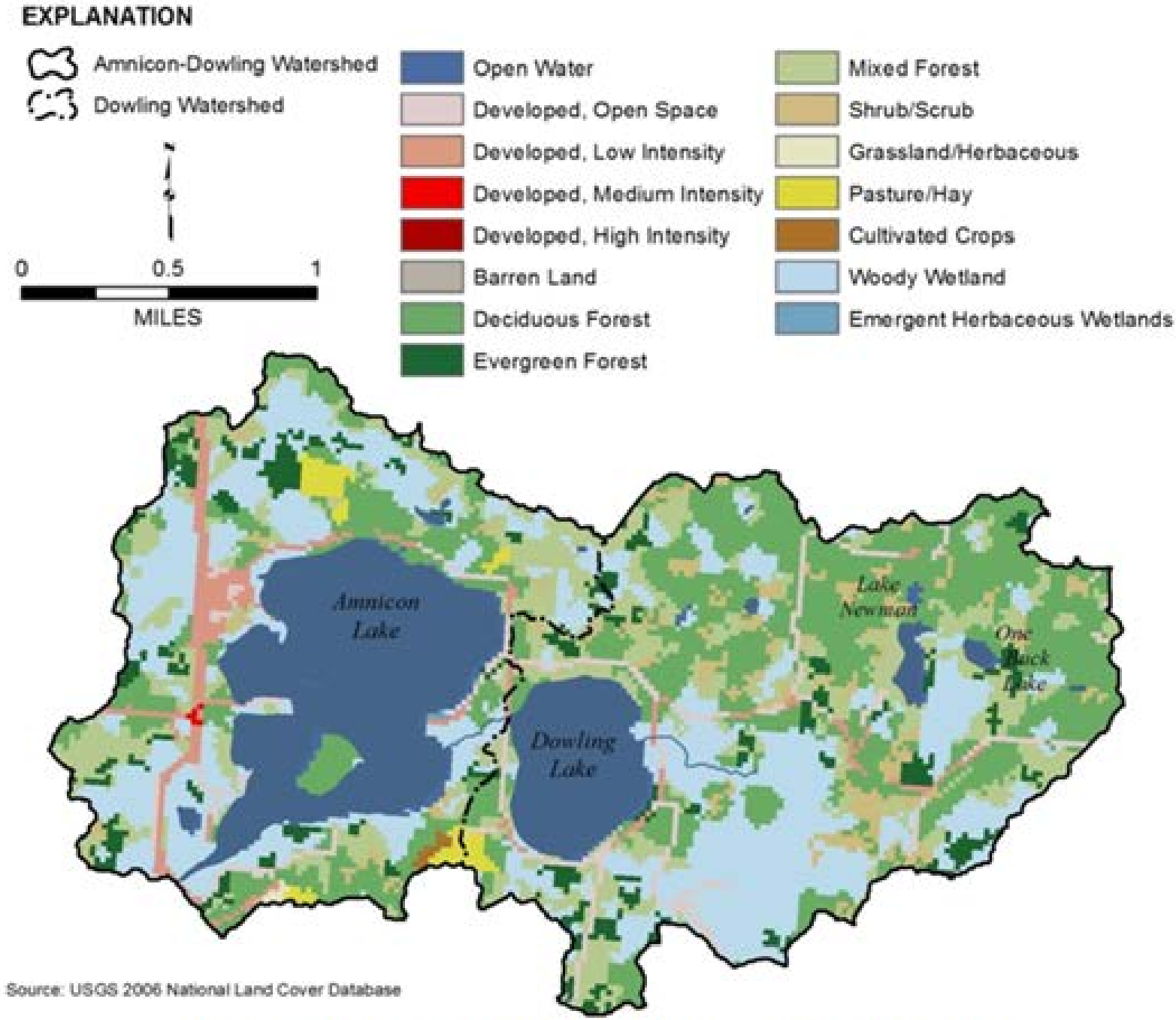
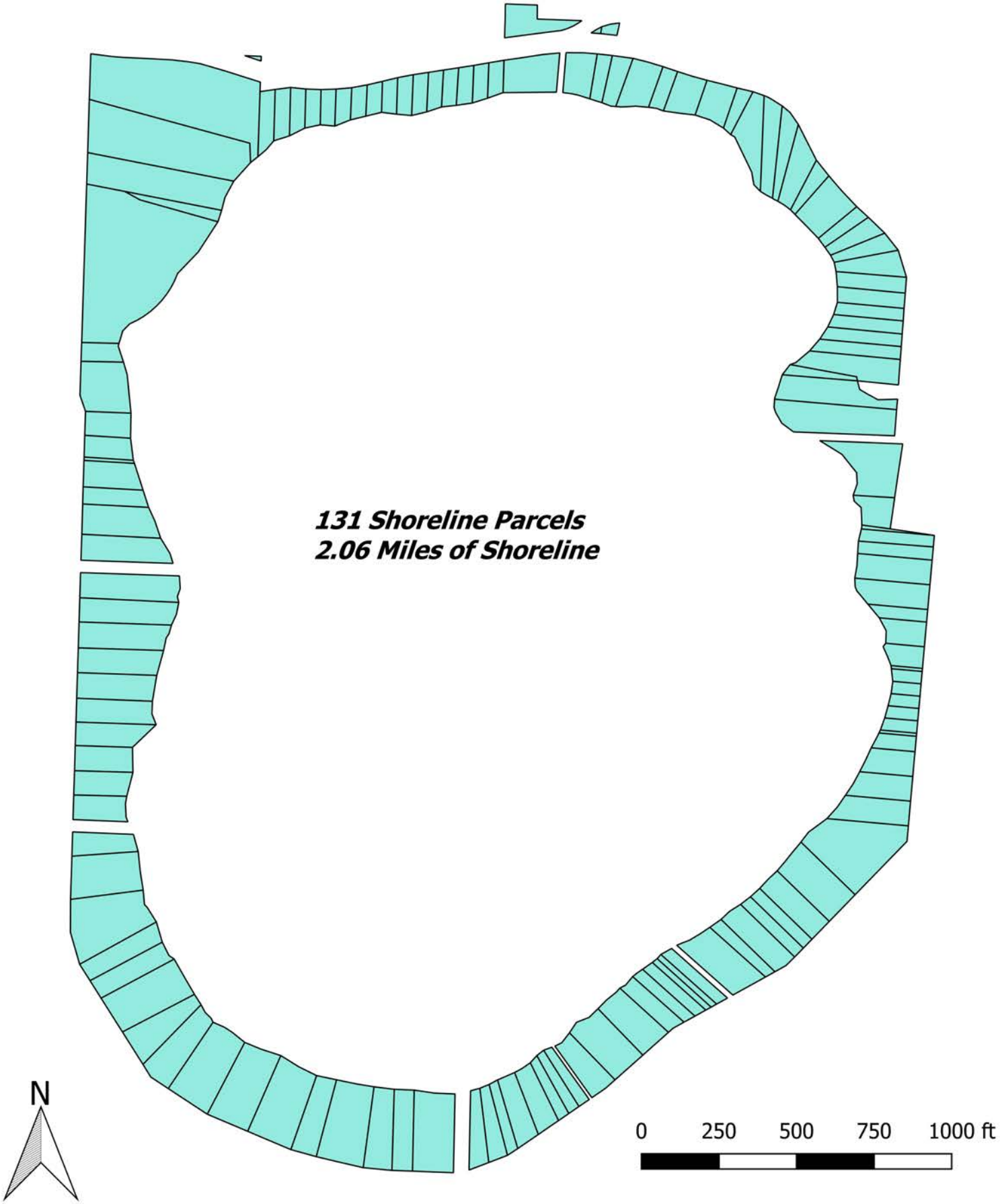


Figure 5 – Amnicon and Dowling Lake Watersheds and Land Use

Shoreline Parcels for 2019 Habitat Assessment

Dowling Lake, Douglas County
WDNR WBIC: 2858300

LEAPS
Lake Education and Planning Services




LEAPS
Lake Education and Planning Services
300 Foot Near Shore Area
Dowling Lake, Douglas County
WDNR WBIC: 2858300
Legend
Dowling Lake
Near Shore Area
N
0
250
500
750
1000 ft


Photo: Steve Camp

Data on the web

Volunteers submit their observations using the CoCoRaHS website or apps. Observations are immediately available to the public via maps and data analysis tools, and to data users via the CoCoRaHS Web API. Data users such as scientists, resource manages, decision makers and others have come to rely on the high density, high quality measurements provided by CoCoRaHS observers.

CoCoRaHS is Educational

CoCoRaHS offers learning opportunities too. In addition to training materials, newsletters and the 'Message of the Day', members also enjoy opportunities to attend Webinars featuring experts in weather, climatology and other pertinent disciplines. CoCoRaHS offers classroom resources for K-12 teachers. Students get to collect and submit real scientific data – all while meeting State and National Standards in science, math, geography and more!


Photo: Carol Orand

Join CoCoRaHS Today!

CoCoRaHS is a practical, enjoyable and useful activity. If you have an interest in weather and would like to help your local community, as well as scientists and others interested in precipitation, then CoCoRaHS is for you. It only takes a few minutes a day and gives you the chance to participate in real hands-on science. You'll be amazed at what you learn as you become more aware of the variable weather that impacts you, your neighbors, your state and our entire country.

Thanks

CoCoRaHS is supported by many sponsors and collaborators. To view a full list please visit the CoCoRaHS Web page.

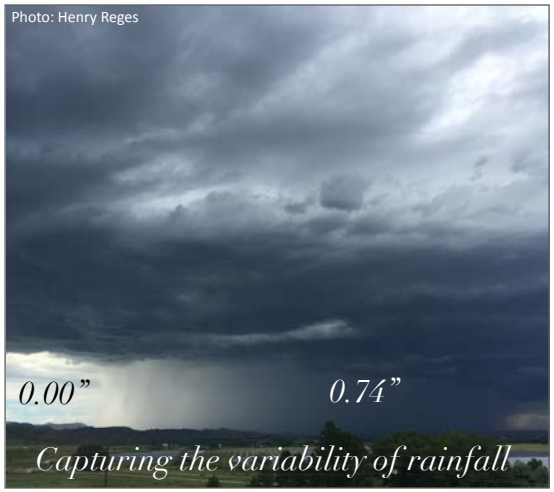
FOR MORE INFORMATION CONTACT:

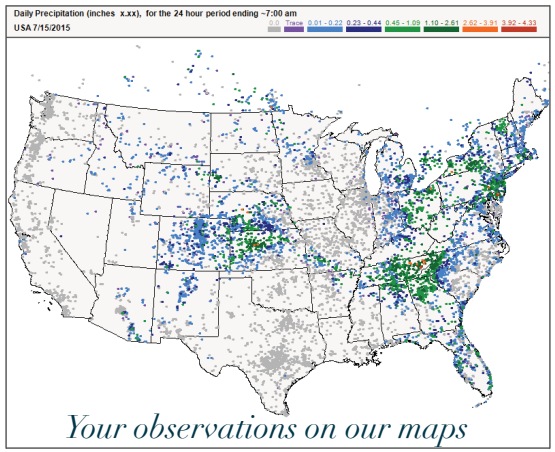
www.cocorahs.org

CoCoRaHS

The Community Collaborative Rain, Hail and Snow Network

Help measure rain!





Because every drop counts!

What is CoCoRaHS?

The Community Collaborative Rain, Hail and Snow Network, is a non-profit, community based, network of volunteers who measure and report rain, hail and snow in their backyards.

A brief History

CoCoRaHS came about as a result of a devastating flash flood that hit Fort Collins, Colorado in July 1997. A very localized storm dumped over a foot of rain in several hours while other portions of the city had only modest rainfall. The ensuing flood caught many by surprise, caused $200 million in damages, and resulted in five deaths. CoCoRaHS was born in 1998 with the intent of doing a better job of mapping and reporting intense storms. CoCoRaHS became a nationwide volunteer network in 2010 and is now international with observers helping provide critical precipitation observations, benefiting their country's needs.

Volunteers of all ages welcome!

Individuals and family volunteers of all ages and all walks of life are the foundation of the CoCoRaHS network, Anyone can help. It only takes a few minutes to check the rain gauge and report your observations.

Training: “the Key to our success”

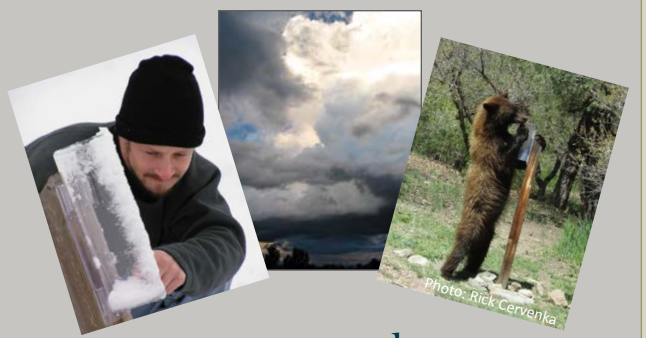
It is important that all CoCoRaHS precipitation reports be accurate and consistant. Training is provided on how to install gauges, properly measure precipitation and transmit reports. CoCoRaHS precipitation reports are accurate and very useful.

Simple Measuring Tools

Volunteers use high quality rain gauges. In some states, “hail pads” are used to study hail storms.

Why is there so much interest in rain, hail and snow?

Precipitation is essential for life. It varies greatly with topography, storm type and season. It really is true that it may pour on one side of the street and be dry on the other. A portion of a field may be pounded by hail while others nearby receive no damage. Snowfall may pile up in one neighborhood and only dust another. Rain, hail and snow are fairly easy to measure, and the data collected are very important. Meteorologists, hydrologists, engineers, builders, farmers . . . you name it, everyone seems to care about rain, hail and snow. That's why we ask, “How much fell in your backyard?”



www.cocorahs.org

RESULTS OF SEDIMENT CORES TAKEN FROM AMNICON AND DOWLING LAKES, DOUGLAS COUNTY, WISCONSIN

Paul Garrison Wisconsin Department of Natural Resources
April 2013

Aquatic organisms are good indicators of a lake's water quality because they are in direct contact with the water and are strongly affected by the chemical composition of their surroundings. Most indicator groups grow rapidly and are short lived so the community composition responds rapidly to changing environmental conditions. One of the most useful organisms for paleolimnological analysis are diatoms. These are a type of algae which possess siliceous cell walls, which enables them to be highly resistant to degradation and are usually abundant, diverse, and well-preserved in sediments. They are especially useful, as they are ecologically diverse. Diatom species have unique features as shown in Figure 1, which enable

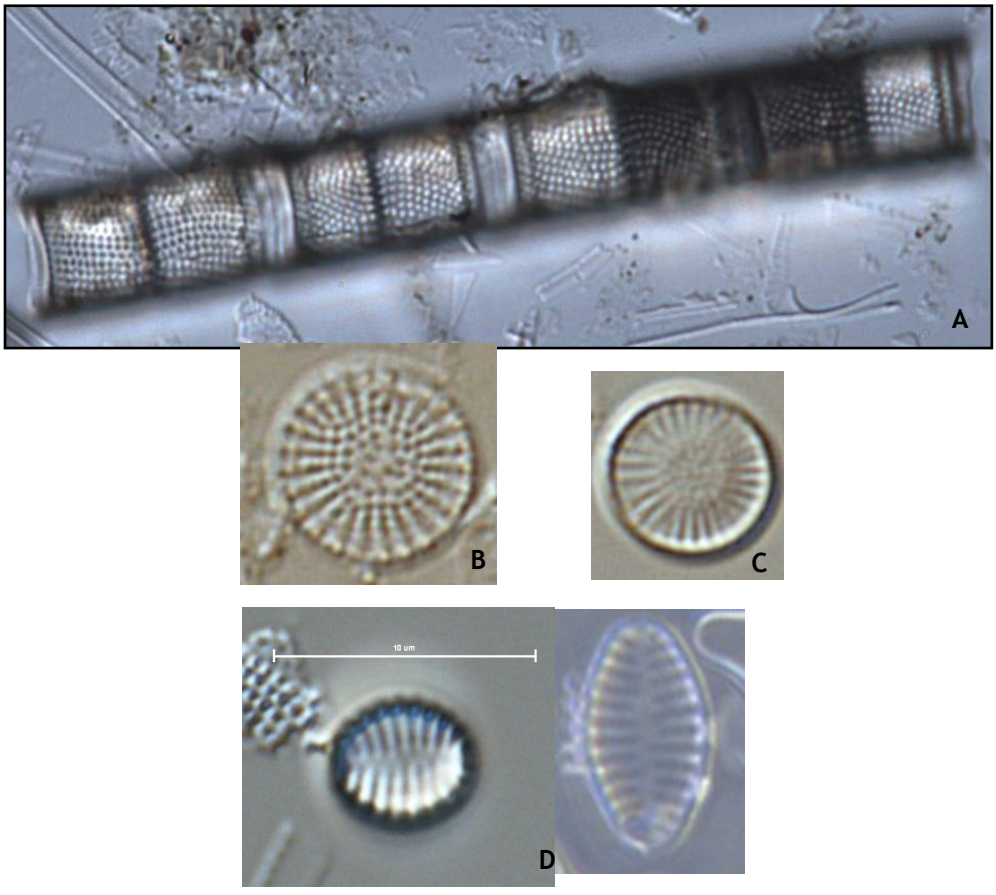


Figure 1. Photomicrographs of the diatoms commonly found in the study lakes. The top three diatoms, *Aulacoseira am*bigua (A), *Cyclostephanos tholiformis* (B), and *Stephanodiscus hantzschii* (C) are found in the open water environments while the bottom two diatoms are part of the benthic *Fragilaria* (D). The latter two diatoms are commonly found attached to substrates such as macrophytes. Diatoms B and C are found in waters with elevated phosphorus concentrations.

them to be readily identified. Certain taxa are usually found under nutrient poor conditions while others are more common under elevated nutrient levels. Some species float in the open water areas while others grow attached to objects such as aquatic plants or the lake bottom.

By determining changes in the diatom community it is possible to determine water quality changes that have occurred in the lake. The diatom community provides information about changes in nutrient concentrations, water clarity, and pH conditions as well as alterations in the aquatic plant (macrophyte) community.

On 28 August 2012 sediment cores were collected near the deep areas of Amnicon (N46.47780° W92.05885°) and Dowling (N46.47434° W92.04238°) lakes using a gravity corer. The water depth in Amnicon Lake was 22 feet and 12 feet in Dowling Lake. The length of the Amnicon core was 36.5 cm and the length of the Dowling core was 32.5 cm. In the Amnicon and Dowling cores the sediment was brown in color throughout the core. It is assumed that the upper sample represents present conditions while the deeper sample is indicative of water quality conditions at least 100 years ago. A radiochemical analysis of the bottom samples will be conducted to determine if the sample was deposited at least 100 years ago. This analysis will not be completed until the fall of 2013.

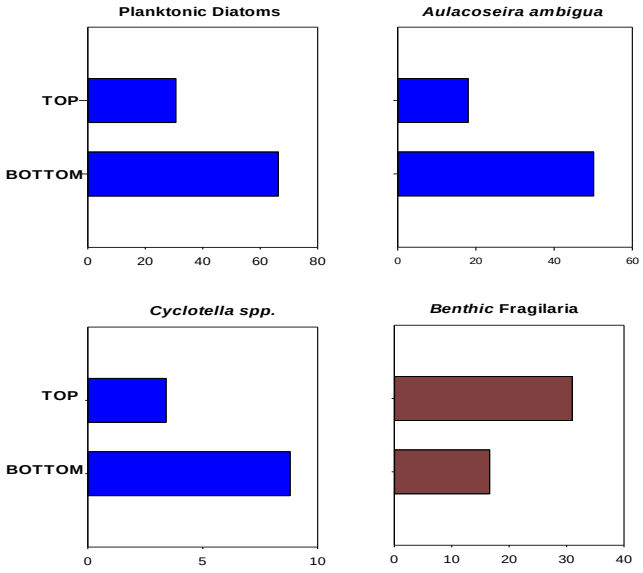
Results

The diatom communities in the bottom samples of both lakes are somewhat similar. The communities are dominated by planktonic diatoms, those that float in the open water. The diatom *Aulacoseira ambigua* is a dominant component of this community (Figure 2). The bottom samples contain some benthic *Fragilaria* which indicate the presence of submerged aquatic vegetation (SAV) in the lakes at that time. The top samples are very different in the lakes indicating that their water quality is presently much different. In Amnicon Lake, there is a higher percentage of benthic *Fragilaria* which indicates an increase in SAV. In Dowling Lake there appear to be fewer SAV at the present time. In fact when the core was taken we also extensively examined the nearshore area around the lake. We observed very few submerged plants. In Dowling Lake the biggest change in the diatom community between the bottom and top samples was the dominance of *Cyclostephanos tholiformis* and *Stephanodiscus hantzschii* and *S. minutulus* in the top samples. These diatoms are usually found when phosphorus levels are elevated. This indicates that phosphorus concentrations in Dowling Lake at the present time are much higher than they were historically.

In many lakes in northern and north central WI that have significant shoreland development, there has been an increase in submerged aquatic vegetation and only a small increase in phosphorus in recent years. This appears to be the case with Amnicon Lake but not Dowling Lake. In fact Dowling seems to have fewer SAV and there has been a large increase in phosphorus levels.

In order to better understand how much the lakes have changed from historical times, a multivariate statistical analysis, detrended correspondence analysis, was performed on the diatom communities in the top and bottom samples of a number of lakes where cores were collected in 2012. The greater the separation between the bottom and top samples, the more the lake is different at the present time from its historical ecosystem. The bottom samples from Amnicon and Dowling are fairly close together (Figure 4) indicating these lakes

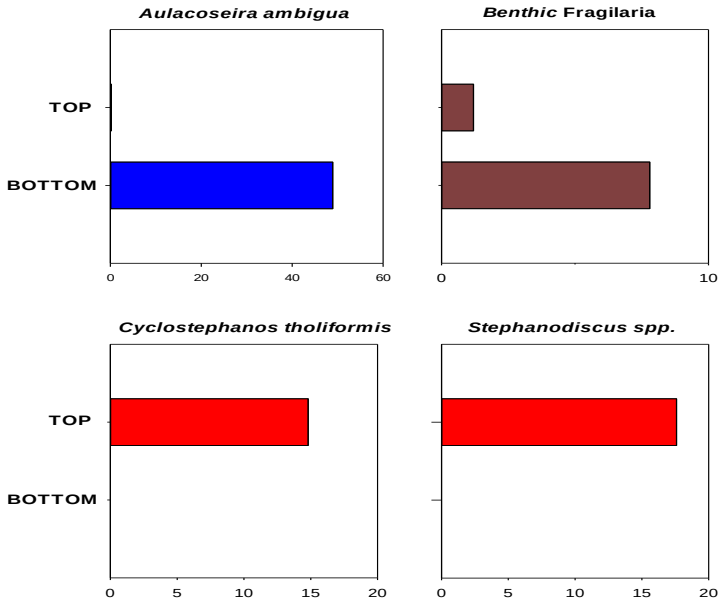
AMNICON LAKE



Percentage of Total Diatoms

Figure 2. Changes in the abundance of some important diatoms found in the Amnicon Lake sediment core. The decrease in planktonic diatoms in the top sample compared with the bottom sample, indicates more submerged aquatic vegetation at the present time.

DOWLING LAKE



Percentage of Total Diatoms

Figure 3. Changes in the abundance of some important diatoms found in the Dowling Lake sediment core. The large increase of *C. tholiformis* and *Stephanodiscus* indicates higher phosphorus levels at the present time.

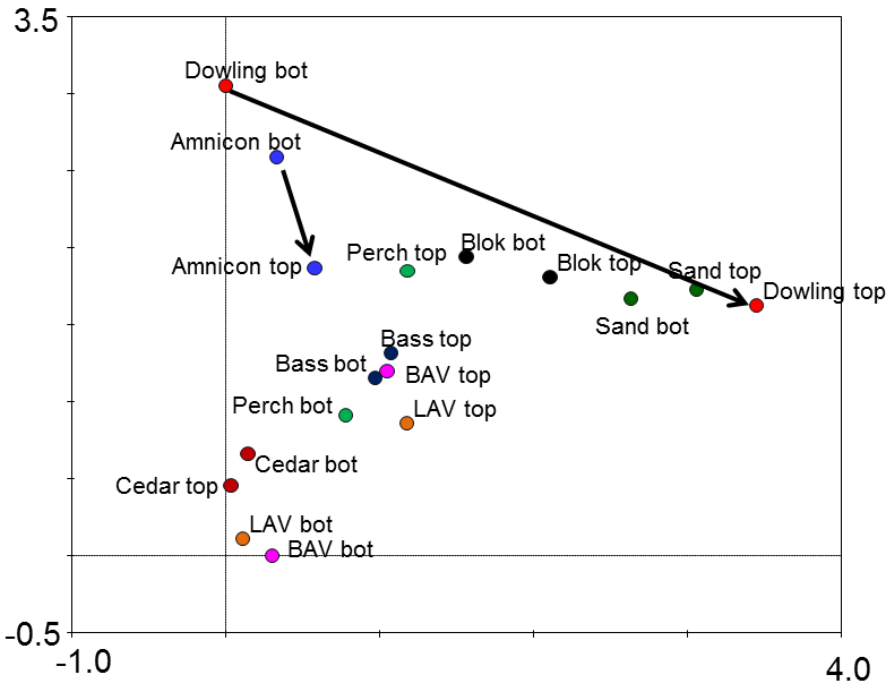


Figure 4. A detrended correspondence analysis plot of top and bottom samples from selected lakes. The further apart the bottom and top samples for the same lake the greater the change in the diatom community and thus the lake ecosystem.

were similar prior to development. The top sample from Amnicon is separated somewhat from the bottom sample but not by a lot. In contrast, the top sample of Dowling Lake is very far away from the bottom sample. This is further indication that this lake has changed in the last 100 years. In fact the difference between the bottom and top samples is greater for Dowling than any of the other 8 lakes.

Diatom assemblages historically have been used as indicators of nutrient changes in a qualitative way. In recent years, ecologically relevant statistical methods have been developed to infer environmental conditions from diatom assemblages. These methods are based on multivariate ordination and weighted averaging regression and calibration. Ecological preferences of diatom species are determined by relating modern limnological variables to surface sediment diatom assemblages. The species-environment relationships are then used to infer environmental conditions from fossil diatom assemblages found in the sediment core.

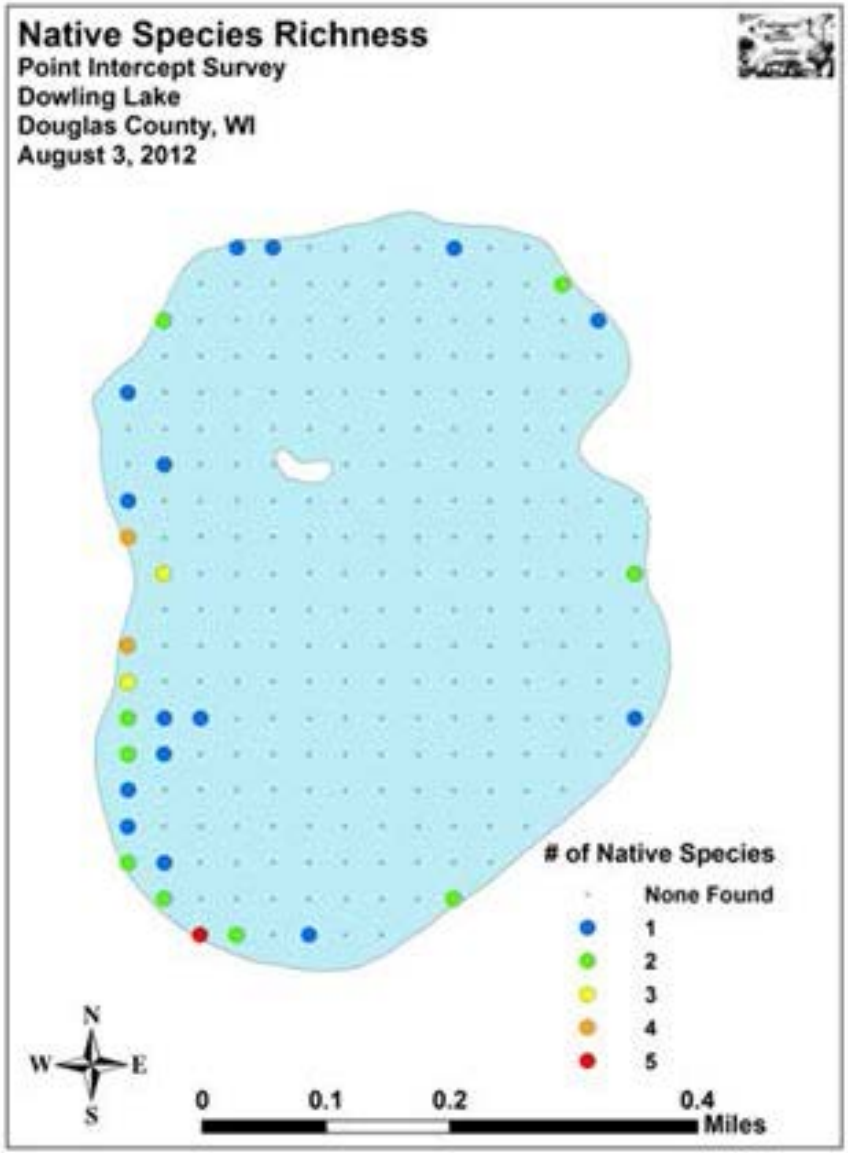
Such a model was applied to the diatom communities in the Amnicon and Dowling lakes. The estimated historical phosphorus concentration in both lakes was about 25 µg L^{-1} (Table 1). In Amnicon Lake the phosphorus concentration in the top sample is very similar to the bottom sample. In contrast, the top sample of Dowling Lake is over 3 times higher at 86 µg L^{-1} compared with the phosphorus concentration in the bottom sample. This amount of increase in phosphorus is unusual in northern Wisconsin lakes that have shoreland development. I have only seen this in 2 other lakes, Big and Little Arbor Vitae lakes in Vilas County. Similar to Dowling Lake, these lakes are relatively shallow. The large increase in phosphorus may be partially the result of increased internal phosphorus loading from the bottom sediments. Historically the internal loading rate may have been low but increased external loading from

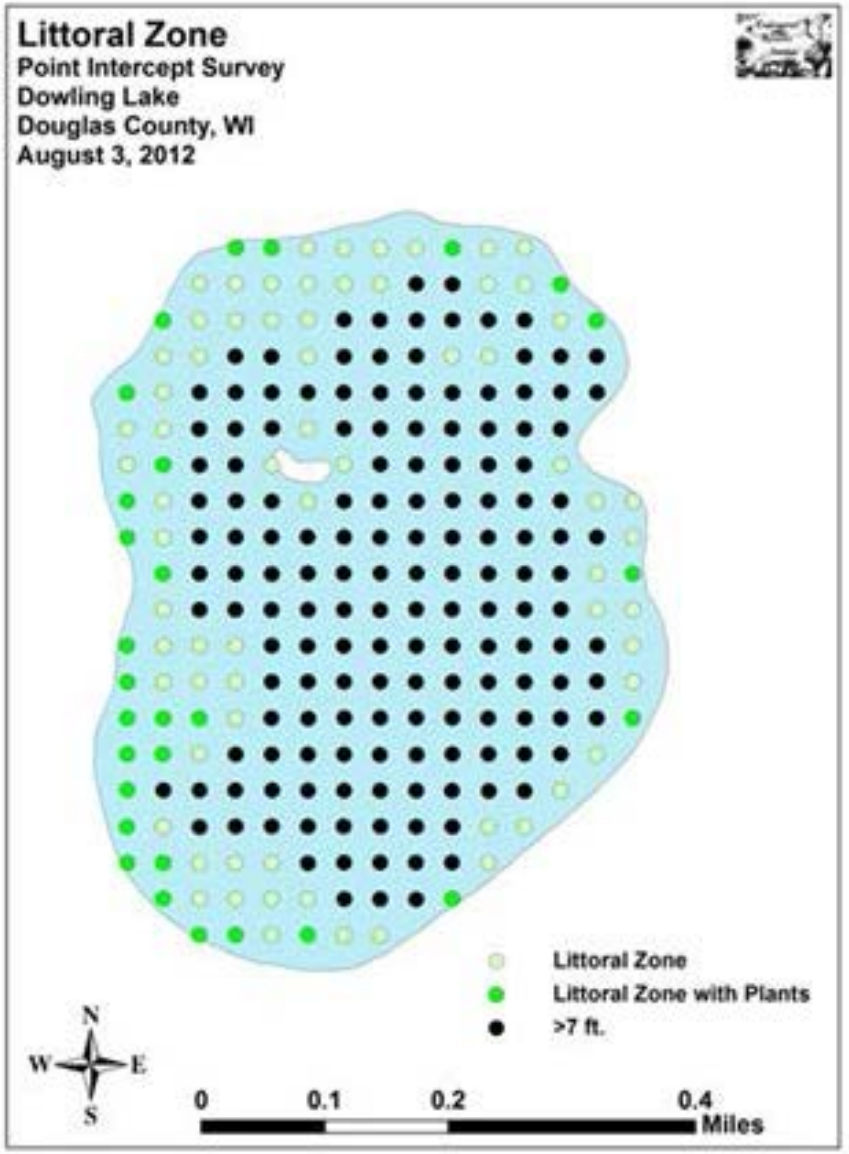
Table. 1. Mean summer phosphorus concentrations Amnicon and Dowling lakes (µg L^{-1}). The concentration for the top and bottom samples were estimated from the diatom community.

	Top	Bottom
Amnicon	26	25
Dowling	80	26

shoreland development may have been enough to push these lakes past the threshold where internal loading is now a significant part of the phosphorus budget in these relatively shallow lakes.

In summary, like many northern Wisconsin lakes with shoreland development, Amnicon has experienced little change in phosphorus concentrations in the last 100 years but there has been an increase in the growth of submerged aquatic plants. In contrast, Dowling Lake has experienced a very large increase in phosphorus concentrations and a loss of aquatic plants.


Native Species Richness
Point Intercept Survey
Dowling Lake
Douglas County, WI
August 3, 2012
# of Native Species
None Found
1
2
3
4
5
N
W
E
S
0
0.1
0.2
0.4
Miles


Littoral Zone
Point Intercept Survey
Dowling Lake
Douglas County, WI
August 3, 2012
Littoral Zone
Littoral Zone with Plants
>7 ft.
N
W
E
S
0
0.1
0.2
0.4
Miles