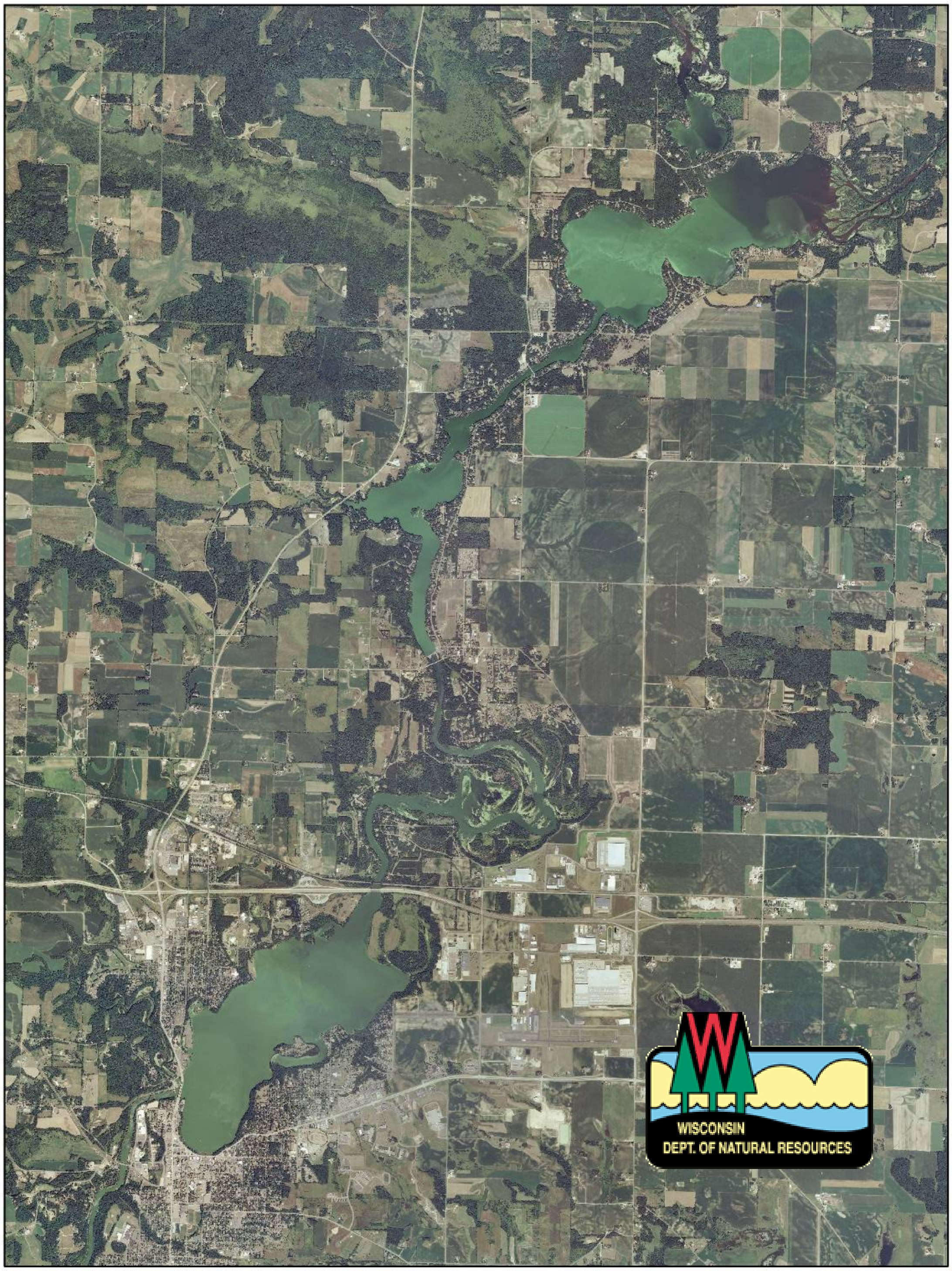
Phosphorus Total Maximum Daily Loads (TMDLs)
Tainter Lake and Lake Menomin
Dunn County, Wisconsin

Wisconsin Department of Natural Resources



Phosphorus Total Maximum Daily Loads (TMDLs)
Tainter Lake and Lake Menomin
Dunn County, Wisconsin – May 31, 2012

Wisconsin Department of Natural Resources
Western District
Eau Claire WI

Contributors

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Introduction

Tainter Lake is a 1,692-acre impoundment of the Red Cedar and Hay rivers located in Dunn County of west central Wisconsin (WBIC 2068000). The lake has a mean depth of about 13 feet, a mean annual residence time of 7 days and a drainage area of approximately 1,700 square miles. The Hay and Red Cedar rivers are the primary sources of inflow to Tainter Lake (Figure 1).

Lake Menomin (WBIC 2065900) is a 1,405 acre impoundment located directly downstream of Tainter Lake and receives over 95% of its flow from the Red Cedar River. Because of its short residence time of about 5 days, water quality and algal densities of Lake Menomin are greatly influenced by the discharge from Tainter Lake. Wilson Creek enters Lake Menomin directly above the outlet dam (Figures 2 and 3). Because the dam discharges at a rate that exceeds the flow of Wilson Creek it is expected to immediately pass all water received from Wilson Creek with the remaining flow through the dam coming from the lake. Wilson Creek therefore is expected to have no influence on Lake Menomin water quality. The lake is nearly surrounded by the City of Menomonie (population 14,993), has a mean depth of 7.5 feet and a drainage area of about 1,760 square miles.

Both dams are managed within a limited range of daily hydropower peaking and their Federal Energy Regulatory Commission licenses (FERC Projects 2181-014 and 2697-014) do not allow significant seasonal storage. The impoundments have a maximum pool operation range of 0.5 feet. As a result, daily average flows delivered by the watershed are not likely affected by dam operation and potential for impact on water quality would be identical to a non-hydropower dam were inflow equals outflow on a daily basis. Tainter Lake and Lake Menomin are on Wisconsin's Impaired Waters List due to recreational use impairments from severe blue green algae blooms resulting from excessive phosphorus loading. (Table 1).

Table 1. Tainter Lake and Lake Menomin Impaired Waters Listings

Waterbody Name	WBIC	TMDL ID	Pollutant	Impairment	Priority
Tainter Lake	2068000	483	Phosphorus	Recreational Restrictions – Blue Green Algae	High
Lake Menomin	2065900	281	Phosphorus	Recreational Restrictions – Blue Green Algae	High

Background

Tainter Lake and Lake Menomin are hypereutrophic and experience severe summer algae blooms and very poor water clarity. Recreational use of both lakes during the summer is greatly limited by poor water quality. Blue green algae were found in abundance in both lakes during surveys conducted in 2004 and 2005. The Red Cedar River basin is primarily located in the North Central Hardwood Forest Ecoregion (Omernik and Gallant, 1988). This EPA ecoregion is characterized by nearly level to rolling glacial till plains and significant agricultural land use. Land use in the Tainter Lake watershed consists of forest (51%), agricultural cropland (28%), grassland/pasture (19%) and urban (2%). Lakes in the ecoregion are typically eutrophic and have summer total phosphorus concentrations greater than 50 μg/L.

Figure 1. The Red Cedar River basin including Tainter Lake and Lake Menomin.

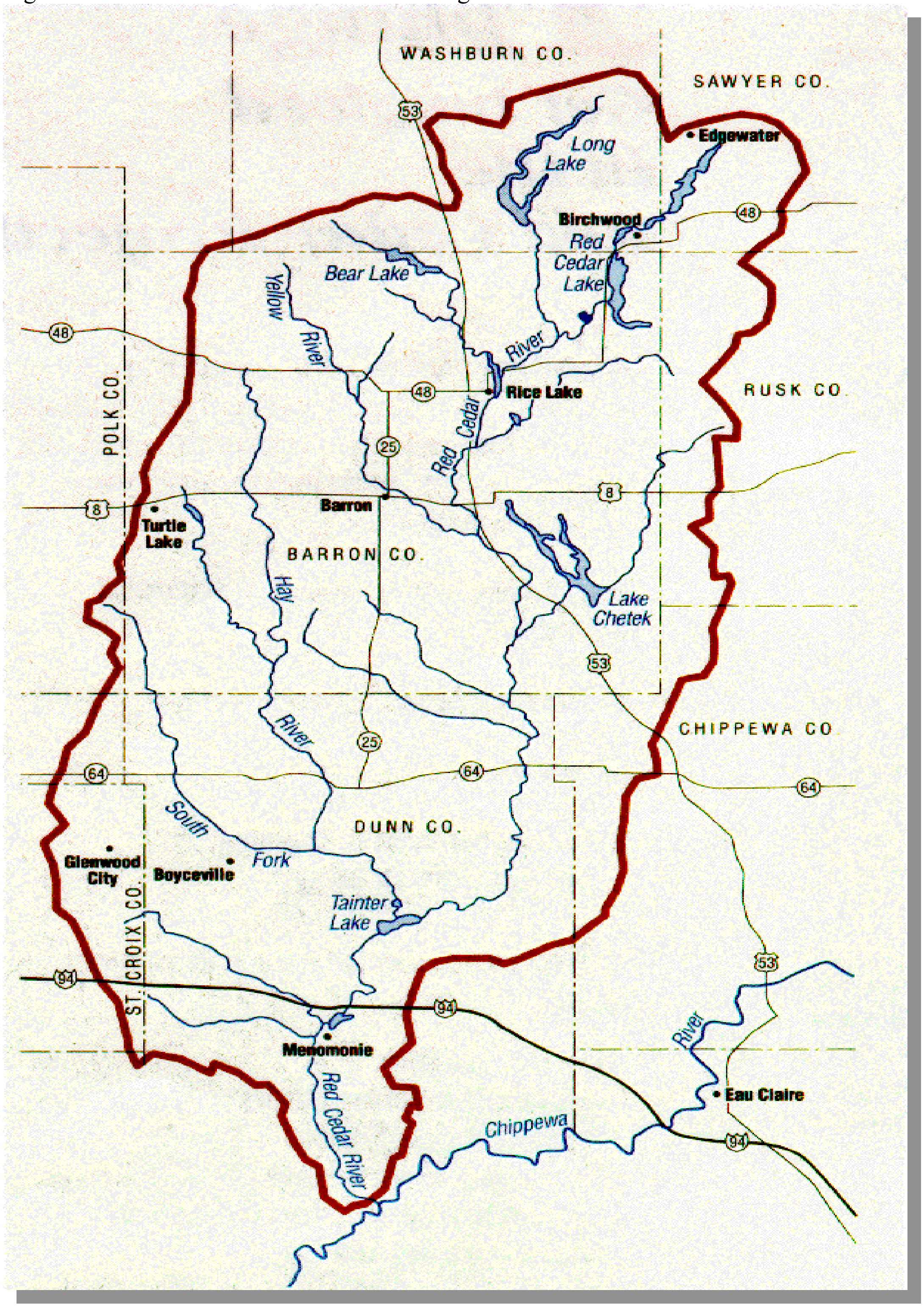


Figure 2. City of Menomonie and Lake Menomin subwatershed of the Red Cedar basin.

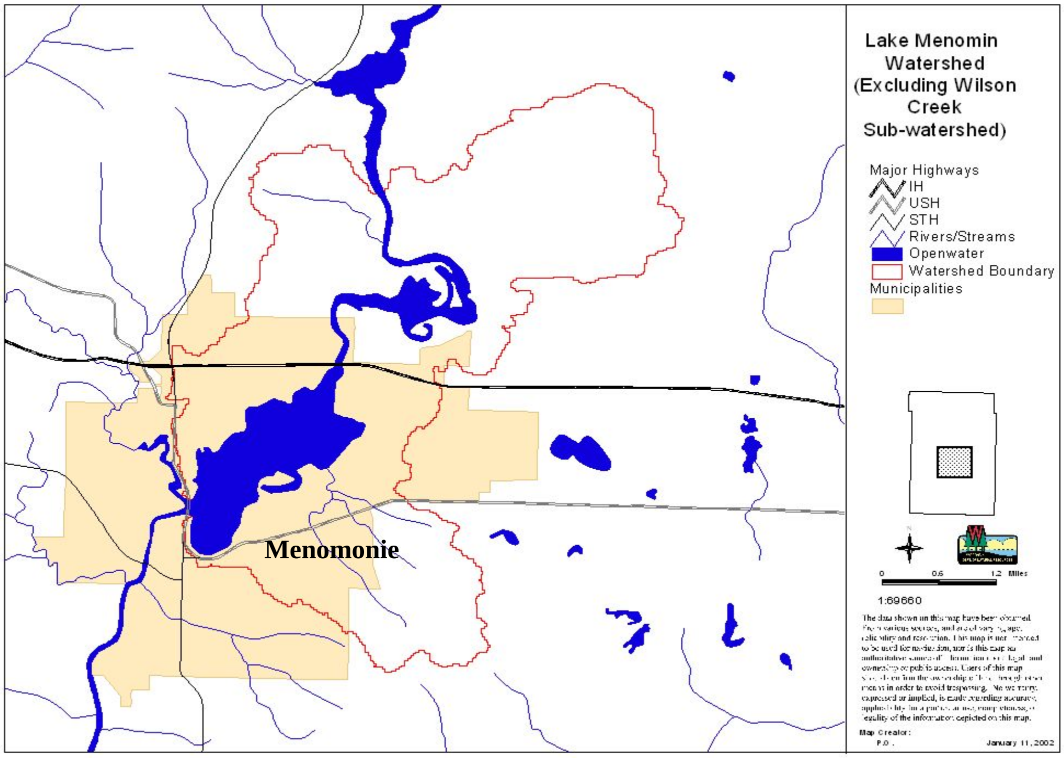


Figure 3. Photo showing proximity of Wilson Creek outlet to Lake Menomin dam.

Tainter Lake

The trophic condition of Tainter Lake was initially assessed in 1972 as part of the National Eutrophication Survey conducted by the U.S. Environmental Protection Agency. The study determined Tainter Lake to be highly eutrophic with phosphorus loading nine times that necessary to maintain eutrophic conditions (USEPA, 1974).

A study was subsequently conducted by the Wisconsin Department of Natural Resources (WDNR) in 1989-1990 to measure in-lake water quality and pollutant loads to Tainter Lake (Schreiber 1992). The study included sampling of the Red Cedar and Hay Rivers weekly for one year with additional samples taken during storm events. Tainter Lake was sampled at 3 stations on three days in the summer of 1990. Point source discharges throughout the watershed were sampled monthly for one year (Figure 4). The study found the lake hypereutrophic with an average phosphorus Trophic Status Index (TSI) of 77 (Figure 5). TSI values greater than 50 are considered eutrophic (Carlson and Simpson 1996).

The total annual phosphorus load to Tainter Lake during the October 1989 - September 1990 monitoring period was determined to be about 700,000 pounds. A single runoff event during March 1990 produced 39% and 56% of the annual phosphorus load from the Red Cedar and Hay rivers, respectively. Examination of streamflow records for the Red Cedar River below Menomonie shows that the quantity of water passed during this snowmelt event was equaled or exceeded only 5 times in the past 102 years. Modeling described later in this report estimates the 9 year average total phosphorus load to Tainter Lake using 1990 land use data at 506,000 pounds per year. The 1990 seasonal (May-September) phosphorus load was 224,000 pounds, which was about 32% of the annual load to Tainter Lake. WDNR maintains a long term water chemistry station downstream of Lake Menomin at USGS gage 05369000 (Red Cedar River at Menomonie, WI). Based on data collected at this station, the 15 year average seasonal phosphorus load is ~40% of the annual load, further indicated that the loading attributed to the 1990 spring snowmelt was unusual. The U.S. Army Corps of Engineers lake eutrophication model BATHTUB was used to predict how changes in phosphorus loading would affect trophic conditions in Tainter Lake (House 1991, Walker 1995, Schreiber 1992).

Lake Menomin

Lake Menomin was intensively monitored by WDNR in 1996. Sampling by a consultant for the City of Menomonie under a WDNR Lake Planning Grant in 2002 and 2003 collected bi-weekly from May through September at five different sampling locations on the lake for a total of 40 samples (Appendix A). Both studies found Lake Menomin to be hypereutrophic with an average phosphorus TSI of 65 (Figure 6). The methodology used in developing the water quality model for Lake Menomin is outlined in Appendix A.

Modeling

A process based computer model, Simulator for Water Resources in Rural Basins - Water Quality (SWRRB – a precursor to the SWAT model), was used to estimate average annual sediment and phosphorus contributions from various agricultural, forested and urban land uses in the Red Cedar River basin (Arnold et al., 1990). The model characterized the watershed above Tainter Lake by dividing the 7 major watersheds into 10 subwatersheds each to construct 70 individual hydrologic units. For each hydrologic unit the processes of surface runoff, return flow, percolation, evapotranspiration, transmission losses, pond and flowage storage, sedimentation and crop growth are simulated. Model inputs included land use and related parameters such as roughness coefficient and SCS curve number as well as soil type, cropping practices, topographic data, routing characteristics within a watershed and local weather records. This model information was augmented with documented loading from WPDES permitted point sources and load estimates from barnyards.

Figure 4. Water quality sampling stations on Tainter Lake and the Red Cedar and Hay rivers.

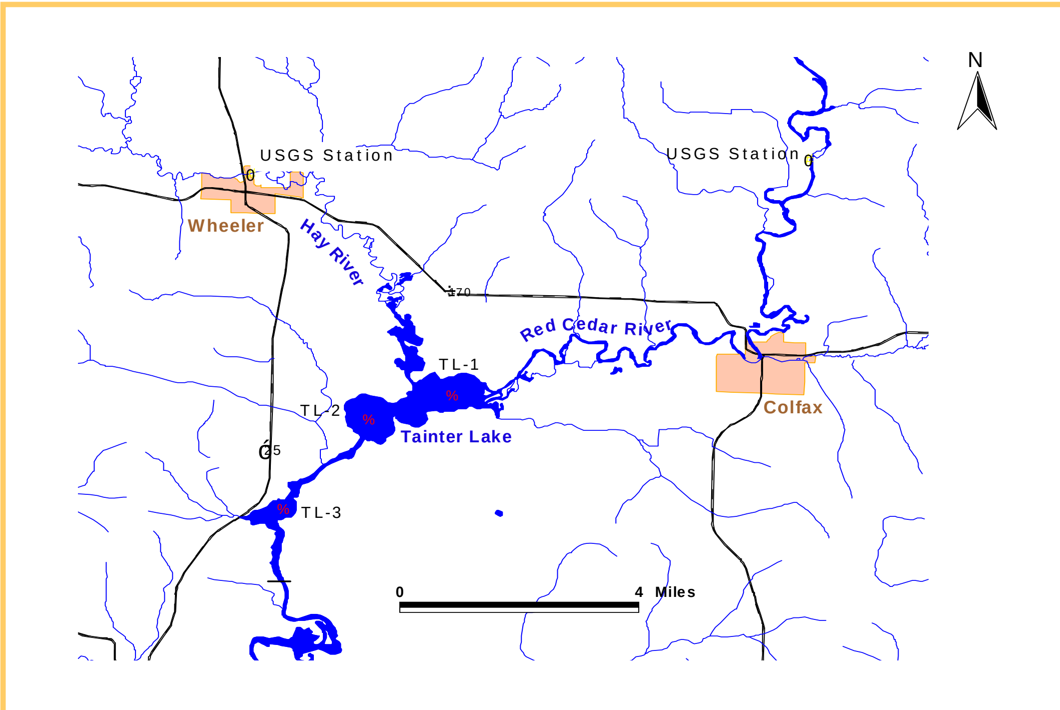


Figure 5. Trophic Status Index (TSI) of Tainter Lake during the summers of 1989 and 1990. TSI values above 50 are considered eutrophic; values above 70 are considered hypereutrophic.

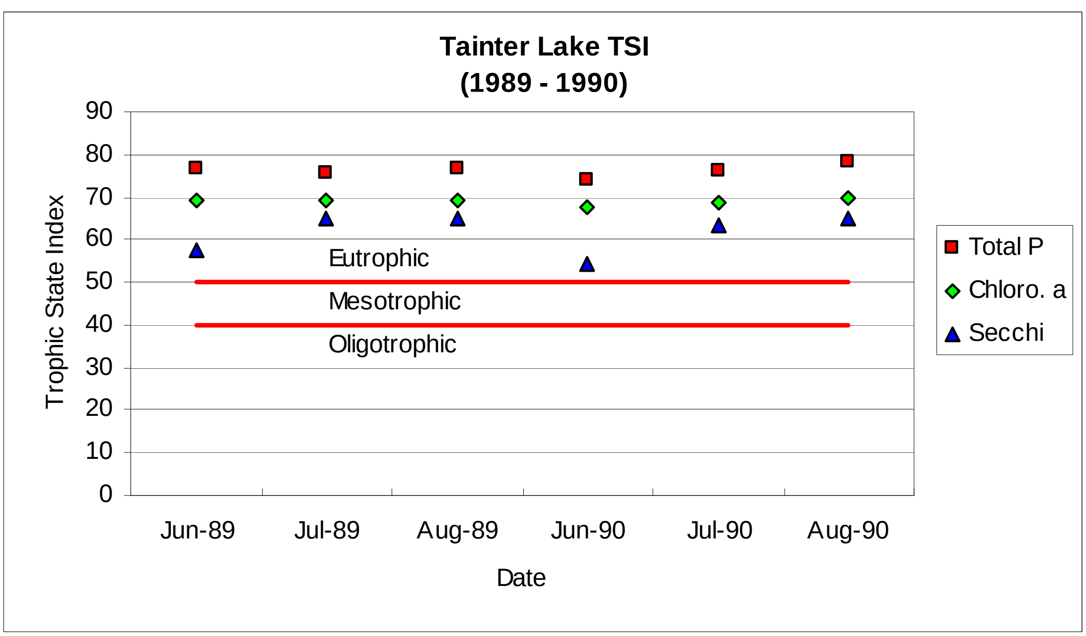
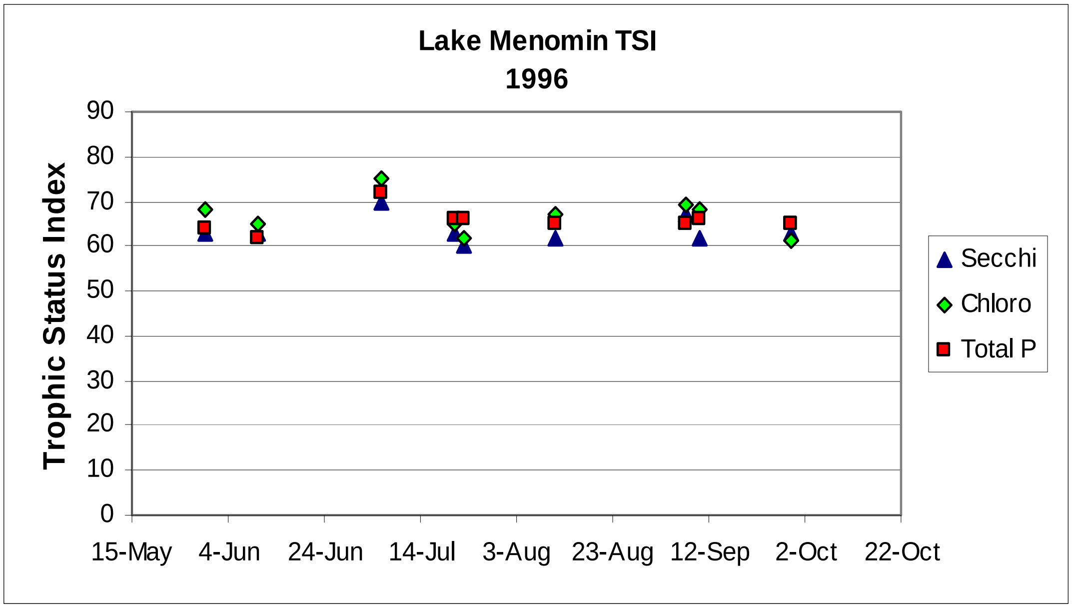


Figure 6. Trophic Status Index (TSI) of Lake Menomin during the summer of 1996. TSI values above 50 are considered eutrophic; values above 70 are considered hypereutrophic.



The nine year annual average sediment and phosphorus loads to Tainter Lake using the SWRRB model were calibrated using 1990 monitoring results from the two inlets to Tainter Lake (WDNR, 1999). The SWRRB model predicted that about 506,000 pounds of phosphorus is delivered to mouths of 7 watersheds that constitute the Tainter Lake drainage area on an average annual basis using 1990 land use and point source conditions. The estimated annual average nonpoint modeled load for the TMDL is much less than the 1990 monitored load. As mentioned previously, the 1990 monitored load included an unusually large spring runoff event which may have biased the annual load. The SWRRB model was constructed to provide an "average" annual load by utilizing a 9 year climate database to estimate an average hydrologic condition.

Water quality models used in this TMDL include a tributary flow and loading model and a flowage trophic response model. The U.S. Army Corps of Engineers (USACE) FLUX model was used to estimate phosphorus loads and the USACE BATHTUB model was used to predict flowage response (Walker, 1999). Both models were developed by Dr. William Walker using USACE flowage data sets specifically for flowage eutrophication applications

FLUX is an interactive program designed for use in estimating loadings of nutrients passing a tributary sampling station over a period of time. Data requirements include (a) grab-sample nutrient concentrations, typically measured at a weekly to monthly frequency for a period of at least 1 year, (b) corresponding flow measurements (instantaneous or daily mean values) and (c) a complete flow record (mean daily flows) for the period of record. FLUX is offered as a companion to the BATHTUB model (Walker 1999).

BATHTUB facilitates application of empirical eutrophication models to morphometrically complex flowages. The program performs water and nutrient balance calculations in a steady-state, spatially segmented hydraulic network that accounts for advective transport, diffusive transport, and nutrient sedimentation. Eutrophication-related water quality conditions (expressed in terms of total phosphorus, total nitrogen, chlorophyll a, transparency, organic nitrogen, nonortho-phosphorus, and hypolimnetic oxygen depletion rate) are predicted using empirical relationships previously developed and tested for flowage applications. The residence time for Tainter and Menomin Lakes both fell within the range of the dataset used to develop the BATHTUB model. The model author participated in application of this model to Tainter Lake.

WinSLAMM (Source Loading and Management Model for Windows) was used to estimate loads from urban areas in the City of Menomonie. WinSLAMM was developed to evaluate nonpoint source pollutant loadings in urban areas using small storm hydrology. The model determines runoff from a series of normal rainfall events and calculates pollutant loading from each individual source area created by these rainfall events. The modeler can apply a series of stormwater control practices, such as infiltration/biofiltration, street sweeping, wet detention ponds, grass swales, porous pavement, catch basins, or various proprietary devices to determine how effectively these practices remove pollutants. WinSLAMM is based largely upon research conducted in the United States and Canada and studies conducted through the WDNR and USGS (http://winslamm.com/).

Point Sources

During 1990, 12 point sources discharged approximately 43,000 lbs. of phosphorus to surface waters in the Red Cedar River Basin above Lake Menomin (Table 2) accounting for 6% of the annual phosphorus load and 8% of the summer seasonal load (Schreiber 1992). The remainder of loading in the basin was from nonpoint sources. Since WPDES facilities in the basin do not have phosphorus load allocations specifically identified in their permits, their "implied allocation" was determined using their average design flow and their effluent phosphorus concentration limit, if present, or their expected current effluent phosphorus concentration if they did not have a concentration limit. The surface water point sources in the Tainter/Menomin watershed discharged an average 12,500 pounds per year of phosphorus (documented via sampling) in 2004-2006 (Table 2).

Nonpoint Sources

Monitoring and modeling of the Red Cedar River watershed indicated that nonpoint sources of pollution are the major contributor of phosphorus to Tainter Lake and Lake Menomin. Of the nonpoint sources, cropland runoff was determined to be a predominant factor. A portion of the phosphorus applied in the form of manure and commercial fertilizer is vulnerable to runoff if applied in excess of crop needs and/or if applied on erodible soils. Phosphorus is transported from cropland attached to soil or, in some cases, in the dissolved form as surface runoff. Once this phosphorus leaves the field and enters the waterway, most of it eventually reaches the downstream impoundments and contributes to algae blooms in Tainter Lake and Lake Menomin.

In addition to cropland, livestock grazing on grassland/pasture in the watershed can contribute phosphorus from manure being washed into the waterbodies. Phosphorus losses from barnyards too small to be covered under a WPDES permit are estimated at 6.7% of the annual load. Forest lands contribute phosphorus either from wildlife waste or from vegetation naturally deposited in the waterbody. As the vegetation decomposes, phosphorus is available for transport downstream. Urban lands contribute phosphorus from a variety of sources, such as pet waste, wildlife waste (i.e., geese), plant material washed into stormwater systems, or runoff from fertilizer, etc and are estimated at 2.5% of the annual load. Human activities in each of these areas affect phosphorus loss and reduced loads are possible through use of best management practices. For example, recent legislation on use of phosphorus fertilizer on lawns is expected to reduce urban phosphorus loads.

SWRRB land use modeling estimated the following distribution of phosphorus loads to the Tainter Lake watershed (WDNR, 1999):

Source	Percent of Total P Load
Cropland	67%
Grassland/pasture	6.3%
Forest	10.6%
Urban	2.5%
Barnyards	6.7%
Point sources	7.0%.

Table 2. Surface water point source dischargers in the Red Cedar River watershed above Lake Menomin (not including Village of Wilson).

Facility	Permit No.	Discharge Type	"Implied Allocation" (lbs./year)	Mean 2004-2006 P Load (lbs/year)
Almena	WI-0023183	Seasonal [5]	2612	814
Boyceville [1]	WI-0060330	Continuous	670	277
Chetek	WI-0021598	Continuous	1172	400
Colfax	WI-0023663	Seasonal[5]	3164	1,315
Crystal Lake SD	WI-0035114	Seasonal[5]	147	156
Cumberland [2]	WI-0020354	Continuous	1218	2,410
Dallas [1]	WI-0023698	Continuous	689	223
Glenwood City	WI-0060381	Continuous	1380	643
Jennie O Turkey Store	WI-0070408	Continuous	3349	1,026
Lakeland SD #1 [3]	WI-0061387	Continuous	0	0
Prairie Farm	WI-0025178	Continuous	435	274
Rice Lake	WI-0021865	Continuous	10046	3,038
Ridgeland	WI-0021296	Seasonal[5]	137	38
Saputo Cheese-Almena [4]	WI-0050725	Continuous	0	0
Turtle Lake	WI-0025631	Seasonal[5]	3324	1,725
Wheeler [1]	WI-0060852	Seasonal[5]	616	197
		Totals:	28958	12,536
CAFO production areas				
Norswiss Farms INC	WI-0059340	None	0	0
Scheps Dairy INC	WI-0063690	None	0	0
Sugar Bol Farms	WI-0062995	None	0	0
Four Mile Creek Dairy	WI-0063321	None	0	0
Jennie O Turkey Store	WI-0062049	None	0	0
Knut Sons INC	WI-0049492	None	0	0
John and Mary Jane Higbie	WI-0063487	None	0	0

[1] No surface water discharge in 1990
[2] Does not reflect non-point source trades
[3] First surface water discharge in 2007
[4] No longer routinely discharging to surface water
[5] Facilities designed to discharge spring & fall, with the exception of Colfax which discharges during summer

Applicable Water Quality Standards

Wisconsin's numeric phosphorus water quality standards are listed in NR 102 (Wis. Admin. Code). Based on the summer mean flow conditions derived from data collected from the Red Cedar River below Lake Menomin (USGS gage 05369000), Tainter Lake and Lake Menomin have short hydraulic residence times during the growing season (7.5 and 5.5 days, respectively) and do not fall within the categorization as either lakes or reservoirs for purposes of applying the numeric phosphorus standard. The two lakes are categorized as impounded waters and the applicable phosphorus standard associated with the primary tributary (Red Cedar River) is 100 μg/L.

In addition, Tainter Lake and Lake Menomin have excessive algal blooms that cause objectionable odors and limit recreational use. These lakes are not currently meeting applicable narrative water quality criterion as defined in NR 102.04 (1); Wis. Admin. Code:

"To preserve and enhance the quality of waters, standards are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all waters including the mixing zone and the effluent channel meet the following conditions at all times and under all flow conditions: (a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state, (b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the states, (c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state."

This narrative criterion describes unacceptable water quality conditions caused by excessive phosphorus loading and severe algae blooms and allows the WDNR to set numeric water quality targets for Tainter Lake and Lake Menomin to protect recreational uses from excessive algal blooms. Reductions in phosphorus loadings resulting from this TMDL will reduce algal densities and improve the recreational use of these lakes.

Setting Numeric Water Quality Targets

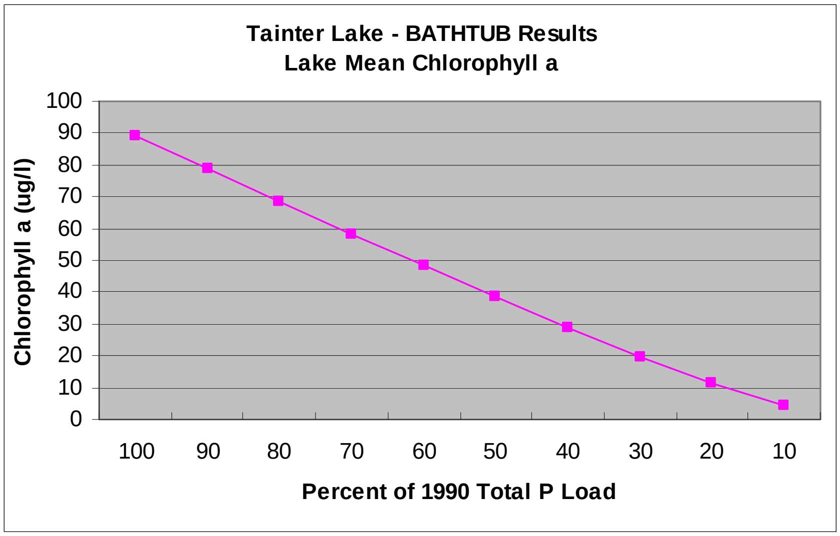
Despite the fact that their retention time does not meet the definition of a lake or reservoir found in NR 102, (Wis. Admin. Code), the response of lakes Tainter and Menomin to phosphorus can be predicted with the BATHTUB flowage model and these impoundments behave more like flowages than rivers. BATHTUB modeling of Tainter Lake projects a growing season mean chlorophyll A (ChlA) level of 55 μg/L at 100 μg/L total phosphorus (TP), the applicable numeric phosphorus standard. At these concentrations, the lake is considered hypereutrophic and experiences algae blooms about 75% of the growing season resulting in an impaired waterbody. Similar results would be found in Lake Menomin. Therefore, an alternative numeric water quality target was developed for this TMDL. To utilize the narrative standard to set a TMDL goal in this situation, it must be converted to a numeric value. The promulgation of phosphorus standards for Wisconsin lake classes in December 2010 can be used to infer acceptable algae levels. In other words, the algae levels present in Wisconsin lakes that attain the designated phosphorus standard were used to define an acceptable algae level, A statistical analysis of similar flowages in the state was completed to develop a numeric Chlorophyll A goal for Tainter Lake and Lake Menomin (Appendix B). Using Bathtub estimates the water quality target of 25 μg/L Chl –A is attained at a phosphorus level of is 59 μg/L in Tainter lake and 57 μg/L phosphorus in Lake Menomin..

This evaluation is essentially a initial TMDL for phosphorus impacts to these waterbodies. Both waterbodies are listed for pH impairments, which is related to algal density which is related to phosphorus. Attempts were made to establish a phosphorus/ pH relationship using 92 paired samples from both lakes. The percentage of samples below a pH of 9 su were too low to establish a statistical relationship. The pH/phosphorus relationship will continue to be monitored by the Self Help Lake Monitoring Program and WDNR. As watershed phosphorus reductions take place and lake algae levels respond, sufficient data below a pH of 9 will be gathered and development of a phosphorus goal to attain the pH standard of 9 su will be possible. Also, the lakes have documented algal toxin problems which are once again related to phosphorus levels. The relationship of phosphorus to the documented presence of algal toxins was examined using statewide lake data. This dataset was insufficient to establish the relationship so a lake goal specific to elimination of toxin production could not be set. In the future, another phosphorus TMDL will be needed to address these two additional aspects of phosphorus impact. Therefore this initial TMDL uses the state's narrative standard to set initial TMDL goals to encourage further phosphorus reduction efforts in the watershed.

Table 3. In-lake water quality goals for the Tainter Lake and Lake Menomin TMDL, expressed as summer in-lake area weighted mean epilimnetic concentrations. At a Chl-A level of 25 μg/L, the lakes will still be characterized by a trophic status index reflecting a eutrophic lake.

Tainter Lake	**1990**	**TMDL Goals**
Total phosphorus (μg/L)	150	59
Chlorophyll-a (μg/L)	87	25
Secchi depth (m)	0.8	1.6
Percent time >30μg/L Chl-a	92	28
Lake Menomin	**1990**	**TMDL Goals**
Total phosphorus (μg/L)	108	57
Chlorophyll-a (μg/L)	40	25
Secchi depth (m)	1.3	2.0
Percent time >30μg/L Chl-a	54	28

Figure 7. Relationship between lake area mean ChlA and TP load reductions (using the BATHTUB model and 1990 monitored May –September phosphorus load).



TMDL Loading Capacity and seasonal considerations

The TMDL loading capacity is the total permissible pollutant load that is allocated to point and nonpoint sources, and a reserve capacity for future sources of pollution. The loading capacity determines the amount of pollutant reduction needed to bring a waterbody into compliance with water quality standards. As the term implies, TMDLs need to reflect total maximum daily loads. This TMDL is expressed in both allowable annual and daily phosphorus loads.

The response of lake algae levels to watershed phosphorus loads was performed using bathtub analysis on May –September seasonal averages. This growing season average analysis needs to be converted to an annual average for four reasons.

1. Historically, nuisance algal blooms in both lakes have been limited to the summer and late summer season when optimal light and water temperatures exist to support bloom conditions. While most algal growth occurs during these times, there is the possibility that during a warm, dry spring or fall significant algal growth may occur earlier or later than the May-September period.

2. Although critical conditions occur during summer when algal growth is more likely to interfere with water uses, Tainter Lake and Lake Menomin are generally not sensitive to daily or short term loading.

3. The growing season load entering the lakes is a function of the annual loads leaving the source areas in the watershed interacting with areas of temporary storage such as streambeds, wetlands, floodplains and flowages. Sufficient reduction in the annual loads leaving watershed source areas will ultimately result in attaining the desired growing season load to Lakes Tainter and Menomin and associated water quality goal.

4. The technical basis for nonpoint source controls is annual phosphorus and sediment loss and is more readily accomplished on an annual rather than a daily or seasonal basis.

Conversion of the seasonal load goal for the lakes into an annual load goal is particularly important in this watershed since the majority of the phosphorus load comes from runoff from nonpoint sources.

Bathtub modeling of Tainter Lake using the 1990 summer growing season data identified that a load of 75,000 lbs/summer season (or a 65% reduction of the 1990 load) would be needed to attain the water quality goal of 25 µg/L Chl – A.. This was translated into an annual average TMDL load goal 177,000 lbs/yr by calculating a 65% reducing of the unrouted SWRRB model phosphorus load estimate, which utilizes an average of 9 years of climate data. This technique results in a margin of safety explained later in this document.

Tainter Lake

The total loading capacity for Tainter Lake is based on a summer mean in-lake epilimnetic ChlA water quality target of 25 µg/L. The annual phosphorus load that Tainter Lake can receive and still meet this summer mean concentration goal is approximately 177,000 pounds.

Lake Menomin

When developing a TMDL for Lake Menomin the USACE load estimation tool FLUX was used to estimate phosphorus loads leaving Tainter Lake, and the BATHTUB model was used to estimate a load associated with attaining the 25 µg/L Chl-A water quality target for Lake Menomin. Water quality, mean daily flow and continuous mean daily flow files were developed using 2002 and 2003 monitoring data from the upstream most site below Tainter Lake (LM5) as input into FLUX. To account for lag effects between event flow at the Menominee USGS gage site and Cedar Falls Dam (forming Tainter Lake), flow data from the gage was offset by one day when matched with chemistry data before inputting into FLUX (see Appendix A). The BATHTUB model was calibrated to observed conditions for both TP and ChlA for the 2002 and 2003 monitoring seasons. The model was then run using outputs from the Tainter Lake BATHTUB (i.e.1990 outflow TP concentration and flow data) from as inputs to the Lake Menomin BATHTUB model to estimate the 1990 condition in Lake Menomin. Finally the model was run using loading outputs from the Tainter Lake model under the draft TMDL load allocations (Appendix A).

The 1990 modeled annual average phosphorus load from Tainter Lake to Lake Menomin is estimated at approximately 319,000 pounds (Table 6). When the Tainter Lake TMDL is fully implemented, approximately 145,300 lbs/yr (about 84%) of the 177,000 lbs of phosphorus entering Tainter Lake will be transported downstream to Lake Menomin. Under the proposed WLA and LA another 4,410 lbs/yr will be contributed to Lake Menomin by the intervening watershed area. This is projected to maintain a ChlA of 22 µg/L in Lake Menomin, which is lower than the proposed goal of 25 µg/L. The difference between these values provides a margin of safety.

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Wasteload Allocations (Point Sources)

Tainter Lake

The phosphorus load from monitored WPDES permitted point sources was 42,900 pounds or 6% of the total load in 1990 (Schreiber 1990). The SWRRB model determined that on a long-term average annual basis, these point sources represent about 7% of the total phosphorus load reaching Tainter Lake (WDNR 1999). Since that time, watershed point sources have reduced their loads significantly. The implied allocation associated with the current permits for these facilities totals 28,958 lbs/yr (Table 2). The annual and daily phosphorus allocations for Tainter Lake is presented in Table 4. For individual WPDES permit holders with a phosphorus monitoring history, their allocation was set using their design annual average flow at 1 mg/L. The resultant WLA for these facilities (17067 lbs/yr) is 59% of their current implied allocation and a 60% reduction of what they were discharging in 1990. Under the wasteload and load allocations in this TMDL, point sources would constitute 11% of the total load to Tainter Lake.

Three individually permitted point sources that have permit provisions for back-up discharge of low strength wastewater had 2.5 pounds TP of this wasteload allocation assigned to each of them based on professional judgment. Birchwood Mfg. Co. seasonally discharges low strength wastewater and has received an annual allocation of 4.5 pounds based on recent monitoring data. The reserve capacity was developed in anticipation of future surface water discharge needed for domestic wastewater treatment in areas currently discharging to groundwater.

The estimated year 2025 acreage of urban land use area in the Rice Lake MS4 is 3800 acres. A detailed analysis of phosphorus delivery was done for the Menomonie urban area (described below and in Appendix D) and yielded a WLA total phosphorus goal of 0.445 lbs/ac/yr. This value was applied to the Rice Lake 2025 urban land use area estimate to develop a WLA of 1700 lbs/yr.

Wasteload allocations for individual surface water point source dischargers above Tainter Lake are summarized in Table 5. Data used to develop these wasteload allocations appear in Appendix E.

Table 4. Summary of annual and daily phosphorus TMDL allocations for Tainter Lake.

Category	1990 Modeled Phosphorus Load (pounds)	Annual Phosphorus Load Allocation (pounds)	Daily Phosphorus Load Allocation (pounds)
Nonpoint Sources	463,400	157,400	436
WPDES Permits	42,900	20,100	55
Totals:	506,300	177,000	486

Table 5. Wasteload allocations for point sources in the watershed above Tainter Lake.

Facility, WPDES Permit #	Wasteload Allocation (lbs/yr P)	Wasteload Allocation (lbs/day P)
Individual allocations using proportionate design flow:		
Almena WI-0023183	435	1.19
Boyceville WI-0060330	670	1.84
Chetek WI-0021598	1,172	3.21
Colfax WI-0023663	320	0.88
Crystal Lake SD WI-0035114	37	0.10
Cumberland WI-0020354	1,218	3.34
Dallas WI-0023698	231	0.63
Glenwood City WI-0060381	798	2.19
Jennie O Turkey Store WI-0070408	3,349	9.17
Lakeland SD #1 WI-0061387	46	0.13
Prairie Farm WI-0025178	183	0.50
Rice Lake WI-0021865	6,697	18.35
Ridgeland WI-0021296	97	0.27
Turtle Lake WI-0025631	1,662	4.55
Wheeler WI-0060852	152	0.42
Rice Lake MS4	1,700	4.66
Individual permit reserve capacity	831	2.28
Individual allocations using best professional judgment:		
AB Mauri Food Inc. WI-0044521	2.5	0.007
Saputo Cheese-Almena WI- 0050725	2.5	0.007
Birchwood Mfg. Co.	4.5	0.012
Seneca Foods-Cumberland WI-0052701	2.5	0.007
Group allocations using proportionate watershed area:		
All general industrial and non-MS4 stormwater permits	490	1.34
CAFO permits	0	0
Total Wasteload Allocation:	20,100	55.04

Lake Menomin

The major permitted point source discharges in the Lake Menomin watershed are MS4 outfalls from the City of Menomonie. Land use data from the 1993 City of Menomonie Comprehensive Plan was used to establish a basis for wasteload allocation (Appendix D). The future (and TMDL) condition was based on the 2007 City of Menomonie Comprehensive Plan. Two land use models were used to complete the analysis of stormwater phosphorus loading. The Windows version of the Source Loading and Management Model (WinSLAMM) was used to model storm water runoff from urbanized areas in 1993 and 2025. The WinSLAMM model accepts land use data and provides estimated runoff volumes and pollutant loadings. Pollutant loadings from other sources were based on the recommended values for various land uses in Wisconsin (Panuska and Lilly 1995).

Based on this analysis, it was determined that the 1993 modeled phosphorus load from storm sewers and the intervening direct drainage area was approximately 7,000 pounds (3,500 pounds from the stormwater planning area) (Table 6). Much of the 2007 stormwater planning area was in agricultural land use in 1993, but since has been developed and sewered. The WLA for the Menomonie MS4 stormwater discharges is 2,200 lbs/yr and represents a 37% reduction in phosphorus from 1993 levels. This analysis includes estimates of phosphorus load reductions associated with stormwater control practices installed since 1993 and projected additional reductions associated with application of stormwater regulations as the urban area expands to its boundary in 2025.

Table 6. Summary of annual and daily phosphorus TMDL allocations for Lake Menomin.

Category	1990/93 Annual Phosphorus Load (pounds)	Annual Phosphorus Load Allocation (pounds)	Daily Phosphorus Load Allocation (pounds)
Discharge from Tainter Lake at TMDL goal	319,000	145,300	398
Nonpoint Sources (unsewered watershed) LA	3,500	2,200	6.2
Point Sources (Menomonie MS4) WLA	3,500*	2,200	6.1
General WPDES Permits WLA		10	0.028
CAFO permits		0	
Totals:	326,000	149,710	411

** Includes 1993 nonpoint source load (i.e. cropland in addition to urbanized land) from 2007 MS4 planning area.*

Other Industrial Wasteload Allocations

Other permitted industrial facilities and construction sites in the watershed are covered under WPDES general permits. Due to the transitory nature and uncertainty of facility locations and whether they are discharging the pollutant of concern, a group wasteload allocation was identified for these facilities. It is estimated that there are about 300 active general permits in the Red Cedar River basin in any given year. The general permit wasteload allocation is based on the concept that the quantity of phosphorus discharged from individually permitted municipal and industrial point sources represent a measure of commercial and residential human activity in a watershed. Furthermore, this level of development is similarly reflected in the general permit activity in the watershed and its associated wasteload level. This anticipated proportionate relationship between phosphorus discharges from individually permitted and monitored point source loads and unmonitored general permit discharges forms the basis of the wasteload allocation.

The phosphorus wasteload allocation for general permits was estimated as approximately 4% of the load documented from individually permitted point sources in the Red Cedar Basin upstream from Lake Menomin, which had an average of 12,536 lbs/yr in 2004-2006. This results in an estimated annual phosphorus wasteload allocation for general permits of 490 pounds (Table 5&6). A list of the general permits can be found in Appendix C. Based on watershed area ratios, 95% of this load is associated with the Tainter Lake watershed and 5% of the phosphorus load drains to Lake Menomin.

If it becomes necessary to convert a WPDES facility currently discharging phosphorus under general permit coverage to an individual permit, an appropriate amount of wasteload allocation will be transferred from the aggregate wasteload allocation for general permits to the new individual permit. This would be an alternative way to regulate an existing waste stream and outfall via conversion from general permit to individual permit and therefore does not constitute a new discharge.

Confined Animal Feeding Operations (CAFOs) Wasteload Allocations

Pollutant losses from CAFO production areas are covered by WPDES permits and therefore must receive a TMDL wasteload allocation. Since these facilities are designed to retain all stormwater up to a 25 year, 24 hour runoff event, existing and future CAFOs are given a wasteload allocation of zero. Existing CAFO permits in the watershed are listed above in Table 2 and the group allocation appears in Tables 5&6.

Load Allocations (Nonpoint Sources)

Tainter Lake

As explained above, the Bathtub and SWRRB models were used to determine a long-term average phosphorus TMDL load goal.. The nonpoint source load allocation was determined by subtracting the point source wasteload allocations from this value. The nonpoint source annual phosphorus load allocation includes the natural background load

Table 4 provides the estimated annual phosphorus load from point and nonpoint sources and the TMDL allocations for Tainter Lake. Of 157,400 pounds per year of phosphorus associated with nonpoint sources, about 6% is attributed to urban sources not subject to a WLA.

Lake Menomin

The phosphorus load allocations for Lake Menomin are heavily influenced by the load allocation associated with the TMDL for Tainter Lake. The Red Cedar River outlet from Tainter Lake directly enters the upstream portion of Lake Menomin and over 95% of the total phosphorus load to Lake Menomin is from phosphorus leaving Tainter Lake. As a result, the prevailing load entering Tainter Lake transfers downstream to Lake Menomin, minus losses to sedimentation.

For the direct drainage area to Lake Menomin, the non-point load allocation was derived based on estimated loadings for each land cover classification and a proportional reduction strategy. This strategy results in identical percentage reduction for both non-point sources and point sources (Menominee MS4) in the direct drainage area.

Margin of Safety

A margin of safety (MOS) is a required component of a TMDL to account for uncertainty of the relationship between pollutant loads and quality of the receiving waterbody. The statutory requirement that TMDLs incorporate a MOS is intended to account for uncertainty in the available data or in the actual effect controls will have on loading reductions and receiving water quality. The MOS may be either implicitly accounted for by choosing conservative assumptions about loading estimates or water quality response, or is explicitly accounted for during the allocation of loads.

The process used in this TMDL was to use the BATHTUB model to establish the TP load needed to attain a ChlA goal of 25 μg/L during the growing season (May – September) and then transfer the percent reduction from seasonal conditions to annual average conditions. This conversion to annual average conditions is necessary to set the stage for TMDL implementation among nonpoint sources. Using this approach, any decision which has the effect of underestimating the annual average load will result in a proportionately lower TMDL goal. An implicit margin of safety is incorporated into this TMDL by using conservative procedures at two points in the process of translating the Tainter Lake growing season goal into an annual average phosphorus reduction goal:

As noted earlier, The BATHTUB model for Tainter Lake determined that a growing season TP load of about 75,000 lbs would be sufficient to achieve 25 µg/L ChlA and is based on a 65% reduction of the 1990 monitored seasonal load. The seasonal load was translated into the annual average TMDL load goal 177,000 lbs/yr by calculating a corresponding 65% reducing of the unrouted SWRRB model phosphorus load estimate.

Review of gage data from the Red Cedar River immediately downstream from Lake Menomin (10/1994 to 9/2009) indicates that ~40% of the phosphorus loading in the system occurs during the growing season. The TMDL allocates approximately 177,000 lbs of TP on an annual average basis to Tainter Lake. Assuming the watershed exhibits a similar seasonal loading pattern after TMDL implementation, an estimated average 40% of 177,000 lbs (or ~70,800 lbs) should be delivered during the growing season to Tainter Lake. As this is less than the 75,000 lbs of phosphorus needed to achieve the chlorophyll-a goal, it represents a margin of safety.

An additional margin of safety exists for Lake Menomin. The BATHTUB model predicts that the TMDL the load and wasteload allocations should result in a mean ChlA of 22 µg/L. The proposed ChlA goal for Lake Menomin is 25 µg/L; therefore the load and wasteload allocations are conservative and represent a margin of safety.

Reasonable Assurance

Required by the Clean Water Act, reasonable assurances provide a level of confidence that the wasteload allocations and load allocations in TMDLs will be implemented. This TMDL will be implemented through enforcement of existing regulations, financial incentives, and various local, state, and federal water pollution control programs. The following are some of the activities, programs, requirements, and institutional arrangements that will provide reasonable assurance that this TMDL will be implemented and that the water quality goals will be achieved. Additional information about organizations and initiatives related to water quality in the Red Cedar River Basin is presented in Appendix G.

Implementation Plan Development

The next step following approval of the TMDL is to develop an implementation plan that specifically describes how the TMDL goals will be achieved. Wisconsin DNR has initiated an implementation planning process which builds on past planning and implementation of practices to control or reduce phosphorus in the Red Cedar River Basin. An implementation planning process has already begun for the Red Cedar Basin that will include strategies to most effectively utilize existing federal, state, and county-based programs to achieve wasteload and load allocations outlined in the TMDL. Details of the implementation plan will include project goals, actions, costs, timelines, reporting requirements, and evaluation criteria.

History of Watershed and Water Quality Planning in the Red Cedar River Basin

Over the last three decades, there has been a significant amount of collaboration and partnering throughout the Red Cedar River Basin to try to restore use impairments and reduce loadings of phosphorus in the basin. WDNR's history of step-by-step progress toward water quality improvement and the current actions WDNR has taken to implement the TMDL demonstrate the Department's commitment to addressing water quality problems in the Red Cedar River Basin.

Wisconsin has conducted Water Quality Planning since the mid-1970s, when newly promulgated Clean Water Act authorities were delegated to the State Department of Natural Resources. The specific type of planning work has changed over time, but the end goal -- restoring, protecting and maintaining clean water and healthy aquatic ecosystems -- has been a constant through the past nearly 40 years.

Water quality planning helps direct resources toward high priority work items. Initially water quality management plans, or "basin plans," were designed to assess the need for and extent of wastewater treatment plant upgrades to secondary treatment. The majority of work involved conducting wasteload allocations for biological oxygen demand (BOD) on major river systems to determine the allowable pollutant loads from point source discharges.

The 1980s brought significant changes to the water quality planning program in Wisconsin. The state implemented its innovative Priority Watershed Program to control nonpoint source discharges and enacted state legislation to systematize the connection between the state's delegated Clean Water Act responsibility and its evaluation of point source discharges including urbanizing areas throughout the state. State Administrative Code chapters NR 121, NR 110, and NR 120 provided a structure and framework to tie together the state's planning program with its implementation vehicles for permitting point source discharges and to strengthen outreach and education for voluntary efforts for nonpoint sources of pollutants.

The development of Sewer Service Area Plans began in the 1980s for areas designated in NR121 and for communities with populations exceeding 10,000 people. This work required that specific actions such as permits or specialized plans be reviewed and formally amended to the state's basin plans, which were the umbrella vehicle for related water quality work in the state. Water Quality Planners conducted conformance reviews for proposed permit limits, stormwater plans, sewer service area plans, and priority watershed nonpoint source control plans to ensure that the proposed work protected, or if needed, helped to restore, the water quality in the respective basin.

In the 1990s, the state began enacting a series of water resources rules which up until that point had been covered under the state Sewer Service Area Program's Environmentally Sensitive Area (ESA) designations. [ESAs are resource areas identified in Sewer Service Area Plans that must not be developed with public sewer (as per NR 121).]

Basin planning, or Water Quality Management Planning, continued to evolve in response to the modified legal framework and supplementary management tools. In the late 1990s, recommendations in basin plans began to focus on partnerships and on ecosystem-scale objectives.

In 1999, the water quality program worked with WDNR's Land Division and Bureau of Fisheries Management to develop integrated basin plans statewide. These plans were designed to capture the essence of holistic, systems-based planning approaches. These Integrated Basin Plans, or *State of the Basin Reports*, reflected the department's reorganized structure into geographic management units (GMUs) and utilized basin team partnerships at the local level. The *State of the Lower Chippewa River Basin* (WDNR, 2001) describes in detail the current status of the land and water resources in the basin, and identifies issues and recommendations to address each of the water quality concerns.

Following approval by WDNR and EPA, this TMDL will be amended to the Areawide Water Quality Management Plan for the Lower Chippewa River Basin pursuant to chapter NR 121, Wisconsin Administrative Code. A detailed discussion of management activities aimed at meeting the goals of the TMDL will be included in a separate TMDL implementation plan and also amended to the Areawide Water Quality Management Plan.

The Land and Water Resources Management Planning Program, created by state statute in 1999, requires each county to develop a resource management plan for their county. Each county Land and Water Conservation Department in the basin has developed an approved plan for addressing soil and water conservation concerns in its respective county. These plans are required to be updated every five years. Wisconsin DNR staff work collaboratively with each of the counties to develop recommendations and plans for addressing the water quality concerns identified in the county plans. WDNR staff work collaboratively with the counties to assist with implementation of the county plans, and particularly to assist the counties with enforcement activities necessary to address animal waste runoff concerns in basin waters.

Ch. NR 217, Wis. Adm. Code, adopted in 1992, required point source discharges of phosphorus greater than 150 lbs/month to reduce phosphorus in their effluent to 1 ppm. In response to this requirement, the feasibility of pollutant trading between point and nonpoint sources of phosphorus was explored at 2 places in the basin. A trading program was launched for the Cumberland WWTP that continues to this day. The broker for trading is the Barron County Land and Water Conservation Department. The program has evolved over the years both in the technical crediting practices employed and the individual management practices funded. The current system is limited to temporarily providing monetary incentives for conversion to no-till cultivation methods. Crediting is done using principles of Wisconsin's Phosphorus Index for cropland. Temporary crediting means that after a few years the monetary incentives are diverted to new fields so that the progress toward phosphorus reduction goals continues to advance. It is anticipate that additional point sources will participate in this program to meet their WLA, especially very small facilities where addition of phosphorus treatment would be very expensive. It is also possible that other counties will elect to serve as trade brokers.

The Red Cedar River Basin TMDL provides WDNR and County Land and Water Conservation Departments with the data necessary to more effectively identify and target pollutant sources so that strategies can be developed and applied to reduce pollutant loads in basin waters.

TMDL Implementation Planning

In anticipation of the completion of the TMDL, WDNR has funded a position to create a nonpoint source implementation plan that addresses the 319 nine key elements. A draft plan should be available shortly after the TMDL is approved. A Planning Team began meeting in December, 2010 to develop a strategy for a series of watershed scale nonpoint source phosphorus reduction pilot projects in multiple counties. It is proceeding as a cooperative effort to implement nonpoint source reductions in both the Red Cedar River Basin and the adjacent St. Croix River Basin, which also recently concluded public comment on a TMDL that will be submitting to EPA.
The project emphasis will be:

- Performance based incentives (as opposed to participation based incentives)
- Targeting of efforts to address the areas contributing the highest phosphorus levels
- A strong component of rural leadership in developing all program components, including monetary incentives.

The program is being patterned after a very successful similar effort in Iowa. Most of the funds necessary to begin this project have been identified. An additional grant application, submitted by the Wisconsin Farmers Union is pending before the McKnight foundation.

Partners in development of implementation pilots include:

Land and Water Conservation Departments: Barron, Dunn, St Croix, Polk and Pierce counties.
WDNR
UW Extension
Wisconsin Farmers Union
Sand County Foundation
River Country RC&D
River Alliance of WI
Clean Lakes Alliance of WI
UW River Falls College of Agriculture
St Croix River Association
Kinnickinnic River Land Trust
WI Department of Agriculture
Iowa State University Extension
Nature Conservancy

A website hosted by UW Extension had been operation for several years and is being updated as an online communication tool for public outreach for the Red Cedar River Basin: http://naturalresources.uwex.edu/redcedar/

Management Strategies for Point Sources

Point source discharges in the Red Cedar River Basin include municipal and industrial wastewater treatment facilities, stormwater, and CAFOs. WDNR regulates point sources discharging wastewater to surface water or groundwater through the WPDES Permit Program. WPDES permits are divided into two categories - specific and general permits. Specific permits are issued to more complex facilities and activities such as municipal and industrial wastewater discharges. General permits are issued to classes of industries or activities that are similar in nature, such as nonmetallic mining, non-contact cooling water, and stormwater discharges.

Individual WPDES permits issued to municipal and industrial wastewater discharges to surface water will include limits that are consistent with the approved TMDL wasteload allocations, providing the necessary reasonable assurance that the WLAs in the TMDL will be achieved. Once a TMDL has been state and federally approved, the permit for a point source that has been allocated a WLA by the TMDL may not be reissued without a limit that is consistent with the WLA. WDNR may modify an existing permit to include WLA-derived limits or wait until the permit is reissued to include WLA-derived limits.

Facilities operating under general permits will be screened to determine whether additional requirements may be needed to ensure that the permitted activity is consistent with TMDL goals; this may include issuing individual permits or other measures. Facilities under general permits that are found to be meeting the terms of their permit will be considered in compliance with their WLA.

WDNR is developing guidance for Wastewater, Stormwater and CAFO staff to facilitate the implementation of the permitting process for WPDES permits when the TMDL is approved. The documents will provide detailed guidance to answer the many questions that will arise as the WDNR initiates these new requirements for WPDES permittees. Guidance is also being developed on the water quality trading concept and watershed permitting.

In June, 2010 the Wisconsin Natural Resources Board approved revisions to NR 102 and NR 217 to create and implement numeric phosphorus water quality standards criteria for lakes, reservoirs, streams and rivers. The rule revisions are part of a comprehensive strategy to address excess phosphorus in Wisconsin waters. The regulations are being revised in response to federal CWA regulations and identified phosphorus-related pollution problems to ensure protection of designated uses of Wisconsin's waters.

Approved revisions to NR 102.06 create numeric criteria of 100 $\mu g/L$ phosphorus for certain listed rivers and 75 $\mu g/L$ for all other streams, unless exempted, to protect fish and aquatic life uses. For lakes and reservoirs a series of phosphorus concentrations ranging from 15 $\mu g/L$ for cold-water fishery lakes to 40 $\mu g/L$ for shallow lakes and reservoirs was established. For small impoundments, the criterion is the same as that of the inflowing stream or river. The Natural Resources Board also approved amendments to NR 217 and created new subchapters to implement the new phosphorus criteria in municipal and industrial point source WPDES permits.

WDNR has regulated storm water discharges from certain MS4s, industries, and construction sites under permits issued pursuant to ch. NR 216, Wis. Adm. Code since 1994. NR 216 contains regulations derived from federal law to implement the WPDES storm water program in Wisconsin. Within the Red Cedar River Basin, there currently are 2 MS4s, plus constriction sites that start up each year that are subject to regulation under NR 216. WDNR has also established its own developed urban area, construction site, and post-construction performance standards under subchs. III and IV of ch. NR 151, Wis. Adm. Code, which are implemented through storm water MS4 and construction site permits. The developed urban area performance standard requires that areas developed prior to October 2004 control 40% of TSS relative to what performance would be with no stormwater controls; however, the 2011 State Budget removed enforceable compliance dates from these requirements. Areas developed after October 2004 are expected to control 80% of TSS relative to what performance would be with no stormwater controls. The Natural Resources Board has recently approved revisions to ch. NR 151, and has given approval for WDNR to work on proposed revisions to ch. NR 216, in order to incorporate new federal effluent limitations guidelines and new source performance standards for construction sites.

Management Strategies for Nonpoint Sources

To ensure the reduction goals of this TMDL are attained, management measures must be implemented and maintained to control phosphorus loadings from nonpoint sources of pollution. Wisconsin's Nonpoint Source Pollution Abatement Program (NPS Program), described in the state's Section 319 Program Management Plan, outlines a variety of financial, technical, and educational programs, which support implementation of management measures to address nonpoint source pollution. WDNR and the Department of Agriculture, Trade, and Consumer Protection (DATCP) coordinate statewide implementation of the NPS Program.

With cropland runoff being a significant portion of the phosphorus load, substantial reductions from this source will be necessary to improve water quality in the lakes. Fortunately, there are many proven, highly effective best management practices that can be utilized to reduce phosphorus loss from cropland. Table 7 summarizes the opportunities to reduce phosphorus loads from non-point sources in the watershed (Simonson & LaLiberte 2010).

Table 7. Best management practices that would substantially reduce phosphorus loading in the Tainter/Menomin watershed.

Recommended Best Management Practices In Decreasing Order of potential significance within the Red Cedar Basin:
Conservation Tillage
Eliminate Winter Manure Spreading by use of Storage
Phosphorus based Nutrient Management
Remove Winter Manure Application from Critical Acres
Milk house Waste Treatment
Traditional Conservation Practices
Barnyard Runoff Controls
Install Stream Buffers
Control of Urban Stormwater Phosphorus Delivery
Wetland Restoration
Replace Failing, Critically Located Septic Systems
Control of Stormwater on Rural, Riparian, Residential Properties

WDNR is a leader in the development of regulatory authority to prevent and control nonpoint source pollution. Chapter NR 151, Wisconsin Administrative Code, establishes polluted runoff performance standards and prohibitions for agricultural and non-agricultural facilities and practices. These standards are intended to be minimum standards of performance necessary to achieve water quality standards. Implementing the performance standards and prohibitions on a statewide basis is a high priority for the NPS Program. In particular, the implementation and enforcement of agricultural performance standards and manure management prohibitions, listed below, will be critical to achieving the necessary nonpoint source load reductions throughout the basin:

- Sheet, rill and wind erosion: All cropped fields shall meet the tolerable (T) soil erosion rate established for that soil.
- Manure storage facilities: All new, substantially altered, or abandoned manure storage facilities shall be constructed, maintained or abandoned in accordance with accepted standards. Failing and leaking existing facilities posing an imminent threat to public health or fish and aquatic life or violating groundwater standards shall be upgraded or replaced.
- Clean water diversions: Runoff from agricultural buildings and fields shall be diverted away from contacting feedlots, manure storage areas, and barnyards located within water quality management areas (300 feet from a stream or 1,000 feet from a lake or areas susceptible to groundwater contamination).
- Nutrient management: Agricultural operations applying nutrients to agricultural fields shall do so according to a nutrient management plan.

Manure management prohibitions:

- No overflow of manure storage facilities;

- No unconfined manure piles in a water quality management area;
- No direct runoff from feedlots or stored manure into state waters; and
- No unlimited livestock access to waters of the state in locations where high concentrations of animals prevent the maintenance of adequate or self-sustaining sod cover.

In June 2010 the Wisconsin Natural Resources Board approved revisions to NR151. The most significant changes to the code affecting agriculture include:

- NR151.02 was modified to apply the sheet, rill and wind erosion performance standard to pastures in addition to cropland.
- NR151.03 creates new tillage setback requirements that state that no crop tillage operation may negatively impact stream bank integrity or deposit soil from the tillage operation directly in surface waters.
- In lieu of the buffer standard created in the original NR151 a new phosphorus index is created. NR151.04 creates a phosphorus index performance standard for croplands, pastures and winter grazing areas, a tool for assessing the potential to contribute phosphorus to nearby water bodies. The standard also prohibits mechanical application of nutrients or manure directly into surface waters.
- NR151.055 will allow the department to regulate significant discharges of process wastewater from non-permitted livestock operations including feed storage leachate and milk house waste to state waters.
- NR151.005 requires that crop or livestock producers reduce discharges of pollutants if necessary to meet a load allocation in an approved TMDL. This requirement would be implemented through existing targeted performance standards provisions of the rule and best management practices, conservation practices and technical standards established in ch. ATCP 50.

In addition to the NR151 performance standards and prohibitions, the NPS Program supports NPS pollution abatement by administering and providing cost-sharing grants to fund best management practices (BMPs) through various WDNR grant programs, including, but not limited to:

- The Targeted Runoff Management (TRM) Grant Program
- The Notice of Discharge (NOD) Grant Program
- The Urban Nonpoint Source & Storm Water Management Grant Program
- The River Planning & Protection Grant Program.
- The Lake Protection Grant Program

DATCP oversees and supports county conservation programs that implement the state performance standards and prohibitions and conservation practices. DATCP's Soil and Water Resource Management Program requires counties to develop Land and Water Resource Management (LWRM) Plans to identify conservation needs. Counties must receive DATCP's approval of their plans to receive state cost-sharing grants for BMP installation. DATCP is also responsible for providing local assistance grant (LAG) funding for county conservation staff implementing NPS control programs included in the LWRM plans. This includes local staff support for DATCP and WDNR programs. County LWRM plans advance land and water conservation and prevent NPS pollution by:

- Inventorying water quality and soil erosion conditions in the county.

- Identifying relevant state and local regulations, and any inconsistencies between them.
- Setting water quality goals in consultation with the WDNR.
- Identifying key water quality and soil erosion problems, and practices to address those problems.
- Identifying priority farm areas using a range of criteria (e.g., impaired waters, manure management, high nutrient applications).
- Identifying strategies to promote voluntary compliance with statewide performance standards and prohibitions, including information, cost-sharing, and technical assistance.
- Identifying enforcement procedures, including notice and appeal procedures.
- Including a multi-year work plan to achieve soil and water conservation objectives.

WDNR, DATCP, and the county Land Conservation Departments (LCD) will work with landowners to implement agricultural and non-agricultural performance standards and manure management prohibitions to address phosphorus loadings in the Red Cedar River Basin.

Many landowners voluntarily install BMPs to help improve water quality and comply with the performance standards. Cost sharing may be available for many of these BMPs. Present Wisconsin statutes require that farmers must be offered at least 70% cost sharing funds for BMP installation before they can be required to comply with the agricultural performance standards and prohibitions. If cost-share money is offered, those in violation of the standards are obligated to comply with the rule. Recent changes to the DATCP Farmland Preservation Program now require that any agricultural land enrolled in the program must be in compliance with NR151 performance standards.

The counties and other local units of government in the basin may apply for TRM grants through WDNR. TRM grants are competitive financial awards to support small watershed-scale, short-term projects (24 months) completed locally to reduce runoff pollution. Both urban and agricultural projects can be funded through TRM grants, which require a local contribution to the project. Projects that correct violations of the performance standards and prohibitions and reduce runoff pollution to impaired waters are a high priority for this grant program.

Numerous federal programs are also being implemented in the basin and are expected to be an important source of funds for future projects designed to control phosphorus loadings in the Red Cedar River Basin. A few of the federal programs include:

- Environmental Quality Incentive Program (EQIP). EQIP is a federal cost-share program administered by the Natural Resources Conservation Service (NRCS) that provides farmers with technical and financial assistance. Farmers receive flat rate payments for installing and implementing runoff management practices. Projects include terraces, waterways, diversions, and contour strips to manage agricultural waste, promote stream buffers, and control erosion on agricultural lands.
- Conservation Reserve Program (CRP). CRP is a voluntary program available to agricultural producers to help them safeguard environmentally sensitive land. Producers enrolled in CRP plant long-term, resource conserving covers to improve the quality of water, control soil erosion, and enhance wildlife habitat. In return, the Farm Service Agency (FSA) provides participants with rental payments and cost-share assistance.
- Conservation Reserve Enhancement Program (CREP). CREP provides annual rental payments up to 15 years for taking cropland adjacent to surface water and sinkholes out of production. A strip of land adjacent to the stream must be planted and maintained in vegetative cover consisting of certain mixtures of tree, shrub, forbs, and/or grass species. Cost

sharing incentives and technical assistance are provided for planting and maintenance of the vegetative strips. Landowners also receive an upfront, lump sum payment for enrolling in the program, with the amount of payment dependent on whether they enroll in the program for 15 years or permanently.

• Mississippi River Healthy Watersheds Initiative. To improve the health of the Mississippi River Basin, including water quality and wildlife habitat, the USDA Natural Resources Conservation Service announced the Mississippi River Basin Healthy Watersheds Initiative (MRBI). Through this new Initiative, NRCS and its partners will help producers in selected watersheds in the Mississippi River Basin voluntarily implement conservation practices and systems that avoid, control, and trap nutrient runoff; improve wildlife habitat; and maintain agricultural productivity. The Initiative will build on the past efforts of producers, NRCS, partners, and other State and Federal agencies in the 12-State Initiative area to address nutrient loading in the Mississippi River Basin. Nutrient loading contributes to both local water quality problems and the hypoxic zone in the Gulf of Mexico. The 12 participating States are Arkansas, Kentucky, Illinois, Indiana, Iowa, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin. MRBI will be implemented by NRCS through the Cooperative Conservation Partnership Initiative (CCPI), the Wetlands Reserve Enhancement Program (WREP), Conservation Innovation Grants (CIG), and other programs. NRCS will offer this Initiative in fiscal years 2010 through 2013, dedicating at least $80 million in financial assistance in each fiscal year. This is in addition to funding by other Federal agencies, States, and partners and the contributions of producers. The $80 million will be in addition to regular NRCS program funding in the 12 Initiative States and will be supported with needed technical assistance.

Public Participation

A TMDL stakeholder group was formed in 2001 to advise WDNR in development of the Tainter/Menomin TMDL. This group consisted of state agency staff (WDNR and University of Wisconsin-Extension), county Land Conservation Department staff, private businesses, lake associations and private individuals. The group met 12 times between November 2001 and March 2003. In addition, two public informational meetings were held in the Red Cedar River basin during November 2002. Several news articles about the TMDL were sent out and printed by local newspapers during development and a web site was created to highlight the TMDL at: http://basineducation.uwex.edu/lowerchip/redcedar/index.html

Four stakeholder meetings were held in 2007 with WPDES permitted point source discharge representatives in the Red Cedar River Basin to discuss the Tainter/Menomin TMDL and wasteload allocations for individual facilities. Discussion items included wasteload allocation options, compliance schedules, policies related to pollutant trading and use of reserve capacity.

The draft TMDL was public noticed from July 12, 2011 to August 19, 2011 and a news release was sent to local newspapers. The news release, public notice and draft TMDL were placed on the WDNR website at:

http://dnr.wi.gov/org/water/wm/wqs/303d/Draft_TMDLs.html.

Public informational hearings were held in Rice Lake on July 27, 2011 and in Menomonie on July 28, 2011. Over 95 persons attended the hearings and 16 provided verbal testimony.

Monitoring and Evaluation

Tainter Lake has been monitored annually by WDNR as part of the state lake Trend Monitoring Program since 2000. Trend lakes are monitored four times per year during spring turnover and monthly from July through September for nutrients, water clarity and chlorophyll (Figure 8). Stream flow and monthly water chemistry are collected at a USGS gauge site in Menomonie to evaluate concentration and load trends over time.

An ongoing monitoring effort supported by the Wisconsin Citizen Lake Monitoring program provides water quality data collection by local volunteers dating back to 1989 (http://dnr.wi.gov/lakes/CLMN/). Volunteers collect weekly Secchi depth during the growing season at 4 sites, and monthly phosphorus and ChlA data from 3 sites in Tainter Lake. In 2008, monthly volunteer monitoring began on 3 sites on Lake Menomin as well.

Future monitoring efforts will be conducted by the WDNR on Tainter Lake and Lake Menomin and upstream in the watersheds after initiation of the TMDL implementation plan as resources allow. Monitoring will provide an interim evaluation of project effectiveness and goals. This effort will generally replicate monitoring conducted in 1989-1990, with some modifications based on TMDL monitoring technical guidance (WDNR, 2001). As resources allow, pollutant loads may be measured for at least two years at stations located on the Hay River at Wheeler and the Red Cedar River near Colfax. Ideally, continuous stream flow and water chemistry samples would be collected bi-weekly at the two sites. Lake water quality will continued to be monitored at 3 sites in Tainter Lake and Lake Menomin, following the protocols outlined in Schreiber (1992). Water quality and stream flow will continue to be monitored monthly at a WDNR and USGS long term monitoring site located downstream of the Lake Menomin dam. In the future, the monitoring data would be paired with updated land use and management data to develop a loading model for Lake Menomin and Tainter Lake and an updated lake response model to evaluate the effectiveness of implementation in the basin and re-evaluate project goals of the TMDL if necessary.

Figure 8. Data from volunteer lake monitoring.

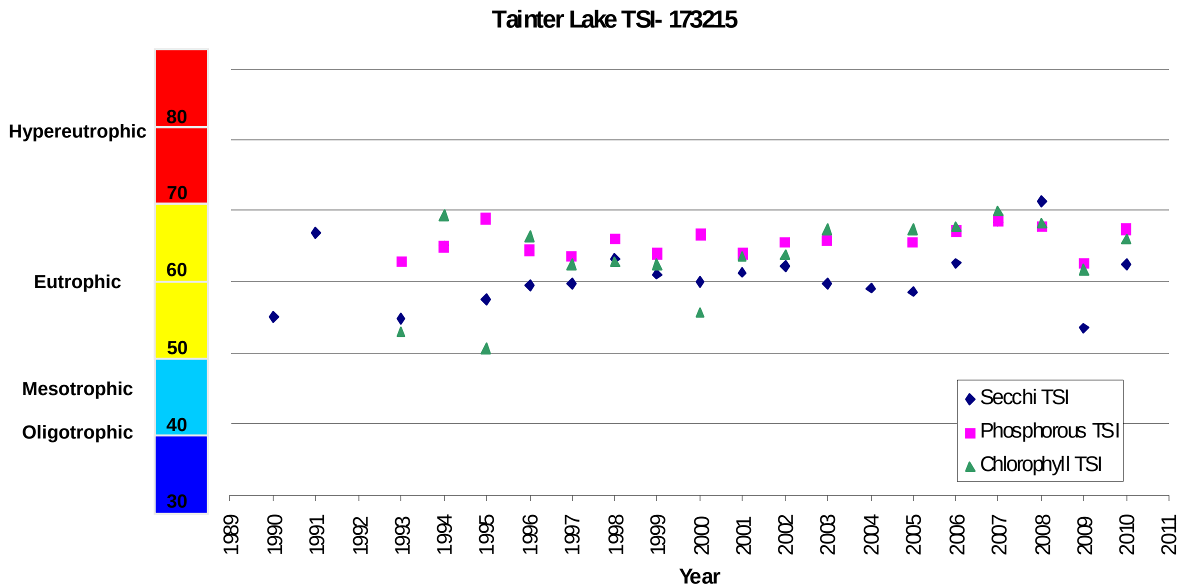
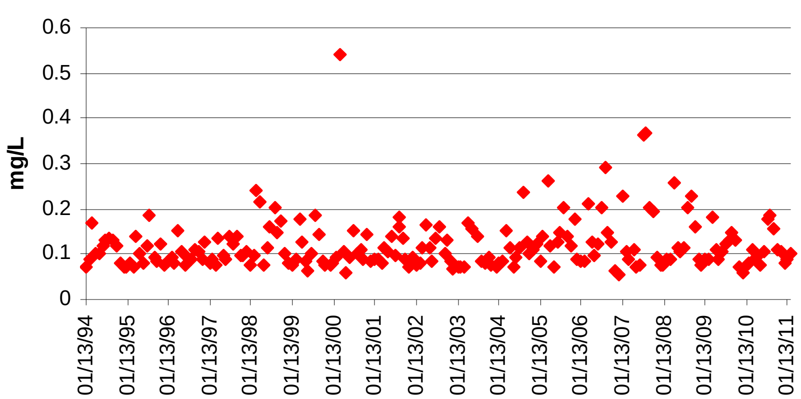


Figure 9. Total phosphorus in Red Cedar River at USGS gauge site in Menomonie.



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Appendix A. BATHTUB Modeling of Lake Menomin, Dunn County, WI (P. Oldenburg, updated May 2011, WDNR).

Introduction

Lake Menomin is an impoundment of the Red Cedar River in central Dunn County in west central Wisconsin. The impoundment has a surface area of 536 ha; a maximum depth of 10.3 m and a mean depth of 2.3 m. Lake Menomin has poor water quality and is on Wisconsin's 303(d) impaired waters list due to excessive nutrient loading, primarily phosphorus. It is located directly downstream of Tainter Lake, which is also on Wisconsin's 303(d) list for impairments due to excessive nutrient loading. Currently, a Total Maximum Daily Load (TMDL) is being developed for Tainter Lake, and a draft mean annual load goal of 80,300 kg (177,000 lbs) has been identified. The goal of this study was to determine what impact achieving the draft TMDL load goal for Tainter Lake will have on water quality in Lake Menomin. This report summarizes the monitoring and modeling methods and results.

Method of Analysis

Monitoring

Monitoring was conducted in 2002 and 2003 by staff of Cedar Corp. for the City of Menomonie under a Wisconsin DNR Lake Planning Grant. Samples were scheduled to be taken bi-weekly from May through September at five different sampling locations on the lake (Figure 1). Surface grab samples were collected as a 2 meter integrated sample. All samples were iced then shipped to the Wisconsin State Laboratory of Hygiene and analyzed for total suspended solids, total kjeldahl nitrogen, NO_3+NO_2 nitrogen, total phosphorus, dissolved ortho-phosphate and chlorophyll-a. Field data was also collected including pH, Secchi depth and dissolved oxygen and temperature profiles.

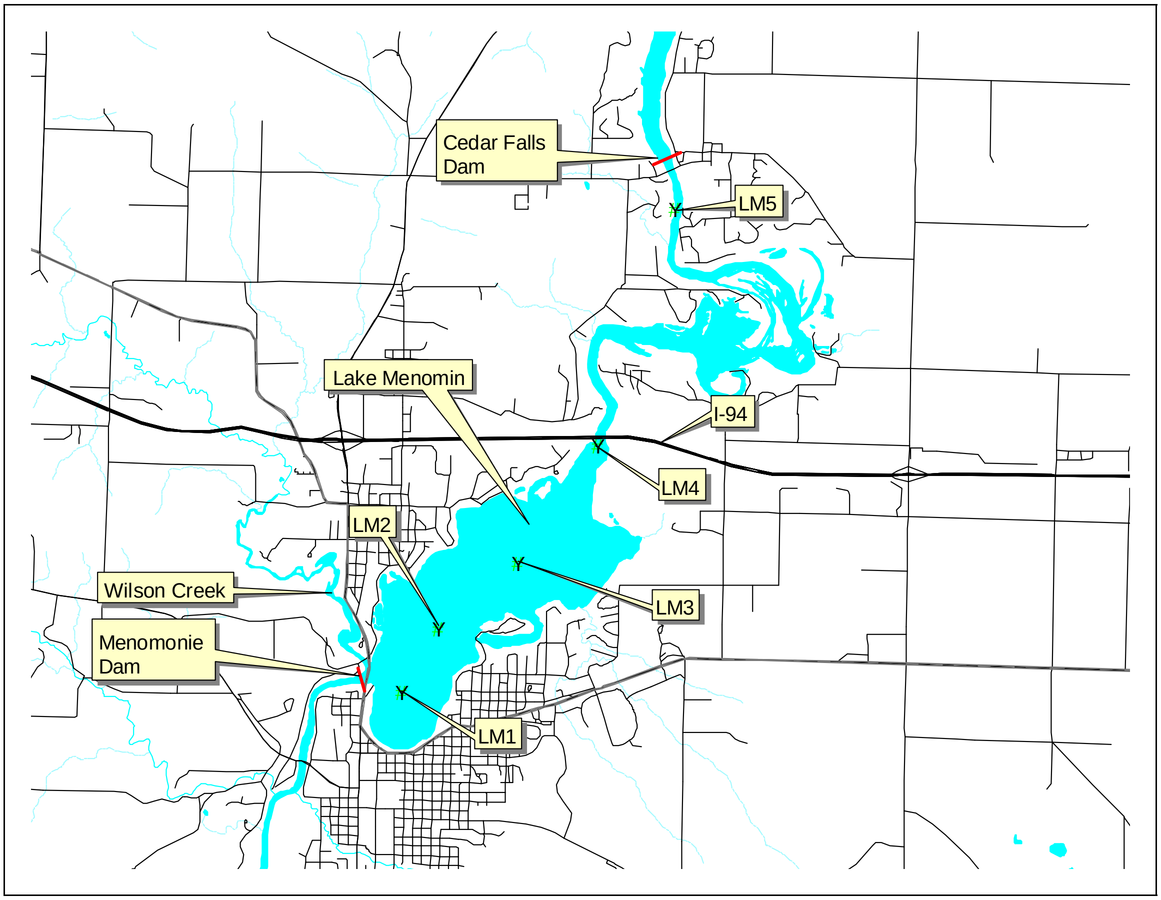
Daily flow was recorded at USGS gage #05369000 (Red Cedar River at Menomonie). The published drainage area at this site is 4,584 km^2, while the published drainage area at the outlet of Tainter Lake (Cedar Falls Dam) is 4,299 km^2. There is approximately a 6% drainage area difference between the two sites, and the bulk of this difference is associated with the Wilson Creek watershed. Wilson Creek enters Lake Menomin immediately upstream of the Menomonie Dam. Because the dam discharges continuously at a rate that exceeds the flow of Wilson Creek it is expected to immediately pass all water received from Wilson Creek with the remaining flow coming from the lake. Wilson creek therefore is expected to have no detectable influence on the monitoring locations in this study or on the general water quality of Lake Menomin.

Flows from the Menomonie gage site were adjusted downwards based on drainage area to simulate flows at the Cedar Falls Dam. While there is loading to Lake Menomin from the intervening watershed apart from the Wilson Creek watershed, the effects of this loading was not taken into account in the modeling, as this loading is so small compared to the Red Cedar River that it is well within model error.

Modeling

The models used in this analysis included a tributary flow and loading model and an impoundment trophic response model. The tributary loading model used was the Corps of Engineers (COE) FLUX model, while the lake was modeled using the COE BATHTUB model (Walker, 1996). Both models were developed by Dr. William Walker using COE impoundment data sets specifically for impoundment eutrophication applications. A grab sample and mean daily flow file as

Figure 1. Water quality monitoring sites in Lake Menomin.



well as a continuous mean daily flow file were developed using the 2002 and 2003 monitoring data from the upstream most site (LM5) and input into FLUX. In an attempt to account for lag effects between event flow at the Menominee USGS gage site and Cedar Falls Dam, flow data from the gage was offset by one day when matched with the chemistry data before inputting into FLUX.

The total flow volume and flow weighted mean concentration of ortho and total phosphorus and total nitrogen output from FLUX were subsequently input into the BATHTUB model. Inputs to the BATHTUB model included: the model averaging period (0.42 years, 1 May – 30 September) basin morphometry, the observed in-lake ortho and total phosphorus concentration in µg/L, total nitrogen in µg/L, chlorophyll-a concentration in µg/L and Secchi Depth in meters. To account for differences in impoundment morphometry, the impoundment was segmented into two segments. The first segment extended from the upper end of the impoundment to the Interstate Highway 94 bridge crossing, the other segment contained the main body of the impoundment..

The surface mean total phosphorus, chlorophyll-a, and Secchi depth along with the coefficient of variation were calculated for the observed data and input into BATHTUB. Data from LM5 and

LM4 were combined to estimate the average water quality in the upper segment, and the data from the other three sites were pooled to estimate the average water quality in main body of the impoundment. The BATHTUB model was then calibrated to the observed conditions for both total phosphorus and chlorophyll-a for the 2002 and 2003 monitoring seasons. Once the model was calibrated, it was run using the 1990 flow and total phosphorus concentration data from the 1995 Tainter Lake Bathtub model calibrated by Dr. William Walker. Finally the model was run using outputs from the Tainter Lake model under the draft Tainter Lake TMDL load condition.

Results

FLUX Loading Estimates

The seasonal average flow rates at the Menomonie gage were 63.57 m^3/s and 49.16 m^3/s for 2002 and 2003 respectively. The mean seasonal flow rate based on 1977 through 2006 was 40.75 m^3/s. The median value for this data set is 41.29 m^3/s. The seasonal loadings and flow weighted mean concentrations of ortho and total phosphorus are summarized in Table 1.

Table 1. Summary of FLUX model outputs for Red Cedar River at Cedar Falls Dam (May – September).

Year	Total Phosphorus (µg/L)	Ortho Phosphorus (µg/L)	Total Kjeldahl Nitrogen (µg/L)	NO_2+NO_3 Nitrogen (µg/L)
2002	125.8	58.7	822.3	596.2
2003	105.9	33.9	749.8	725.8
Year	**Total Phosphorus (kg)**	**Ortho Phosphorus (kg)**	**Total Kjeldahl Nitrogen (kg)**	**NO_2+NO_3 Nitrogen (kg)**
2002	105,629	49,238	690,270	500,495
2003	69,005	22,075	488,618	472,995

BATHTUB Modeling

The BATHTUB model was first run using the 2002 and 2003 monitoring and loading data. For total phosphorus modeling the Vollenweider regression was used. This model predicted total phosphorus values quite well (within 10%). The calibration coefficient for the phosphorus sedimentation model was set to a low number, 0.14 for the upper segment. No adjustments to the calibration coefficient were needed for the main lake segment (Figure 2). Most of the available chlorophyll-a models in Bathtub are insensitive to flushing rates and over predicted chlorophyll-a concentrations. Given the high flushing rate of Lake Menomin these models are not appropriate. The selected uncalibrated chlorophyll-a model (TP, Light, and Flushing Rate) over-predicted the observed chlorophyll-a concentrations for both years prior to calibration. Calibration coefficients for the selected chlorophyll model were 0.42 for the upper segment above Interstate 94 and 0.93 for the main impoundment (Figures 3 & 4).

Discussion

Mean summer flow in the Red Cedar River was higher in 2002 than in 2003, and likewise total and ortho-phosphorus concentrations were higher during 2002 than in 2003. This pattern of this loading information is consistent with the observations that nutrient loading to Lake Menomin is dominated by non-point source pollution from the Red Cedar River Basin. For both 2002 and 2003 the model slightly underestimated phosphorus settling, this is to be expected due to the presence of Tainter Lake upstream. In reviewing the model calibration parameters, the chlorophyll-a calibration value needed to be decreased to match observed values. In an attempt to characterize the importance of flushing rates on Lake Menomin, the chlorophyll-a model was run with flushing rates ignored (i.e. use Canfield-Bachman model). The result was a model that consistently over predicted chlorophyll-concentrations even more so than the chosen model and also had and overall poorer fit to the observed data even after calibration.

Based on the calibrated BATHTUB models for Tainter Lake and Lake Menomin, it appears that reductions in phosphorus loading to Tainter Lake will be transferred to Lake Menomin, since internal loading in both systems is normally fairly limited. However, due to trapping of phosphorus in Tainter Lake, the percentage decrease to Lake Menomin will be lower. That is a 65% reduction in load entering Tainter Lake will not result in a 65% reduction in phosphorus leaving Lake Tainter. The current draft TMDL for Tainter Lake calls for a mean annual loading of 80,300 kg versus the 1990 modeled condition of 230,000 kg. Under the 1990 flow conditions (42.28 m^3/s) this translates into 144,600 kg total phosphorus leaving Tainter Lake under the 1990 modeled condition and 65,900 kg (145,300 lbs) leaving Tainter Lake and entering Lake Menomin under the TMDL conditions. The predicted effects of this condition are depicted in Table 2 below.

Figure 2. Observed and predicted total phosphorus concentrations in Lake Menomin.

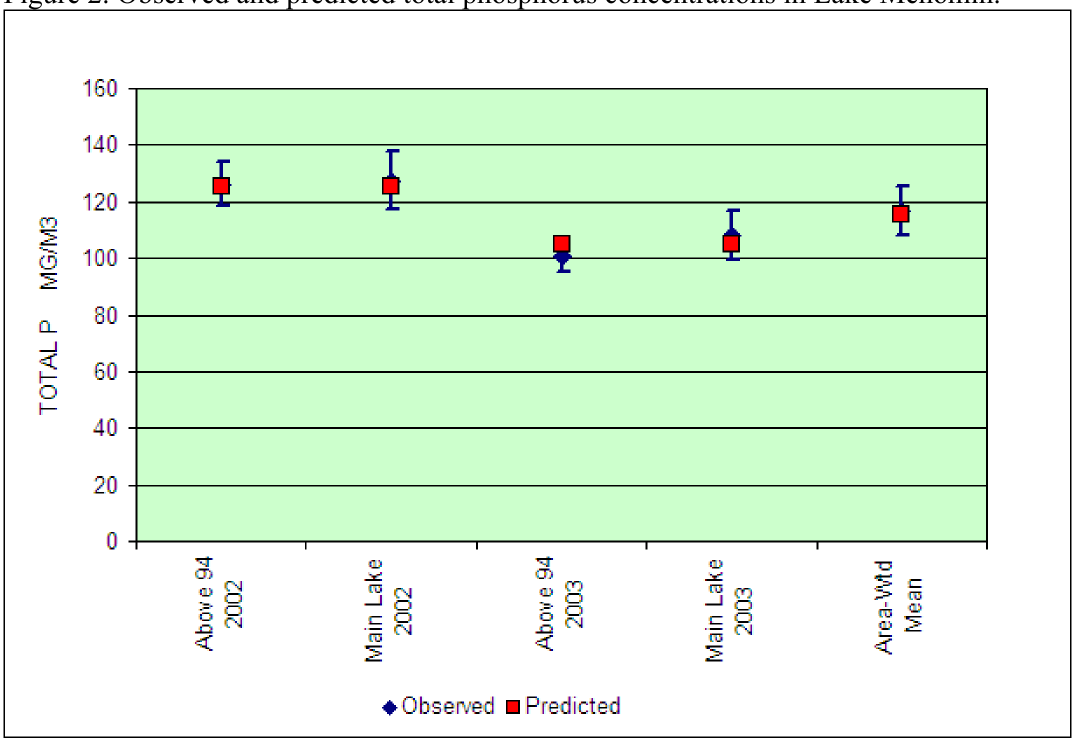


Figure 3. Observed and predicted chlorophyll-a concentrations (for uncalibrated model) in Lake Menomin.

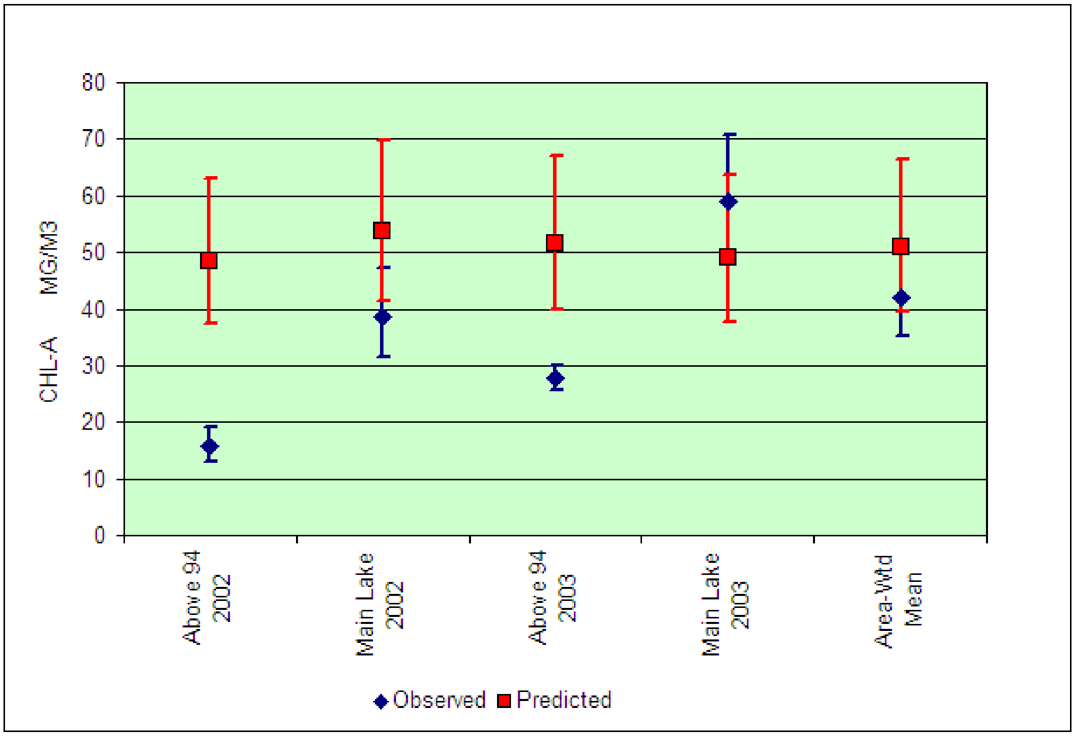


Figure 4. Observed and predicted chlorophyll-a concentrations (for calibrated model) in Lake Menomin.

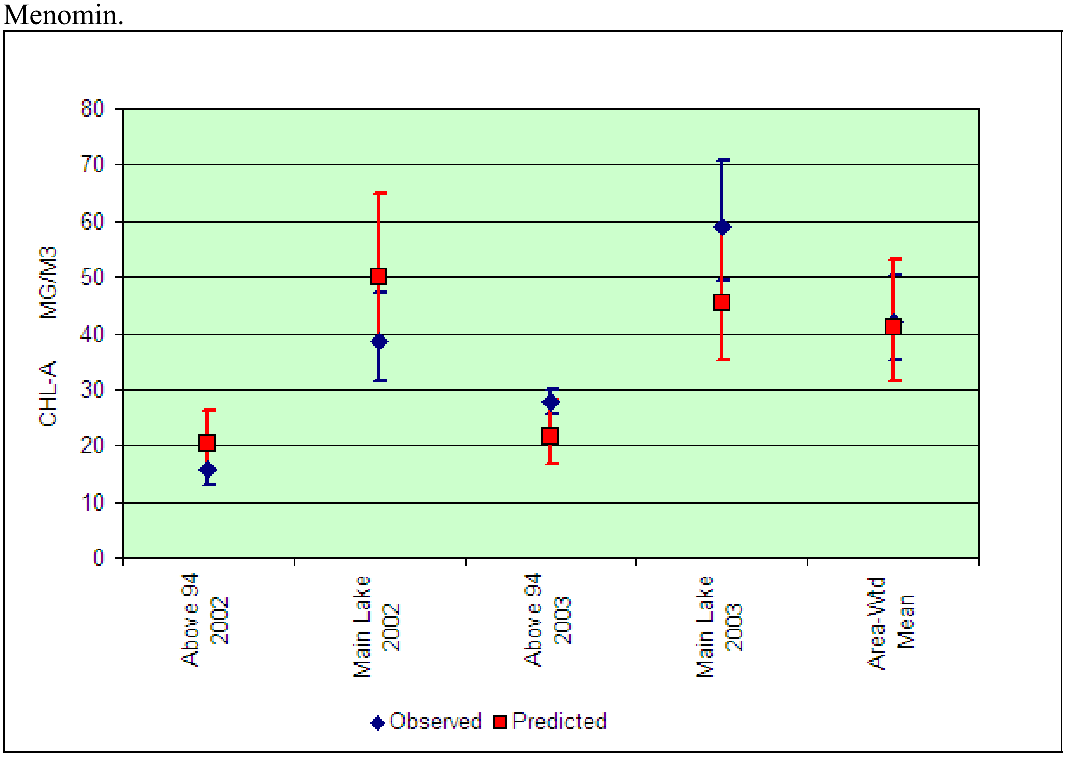


Table 2. Predicted water quality parameters in Lake Menomin based on the proposed Tainter Lake TMDL phosphorus loads.

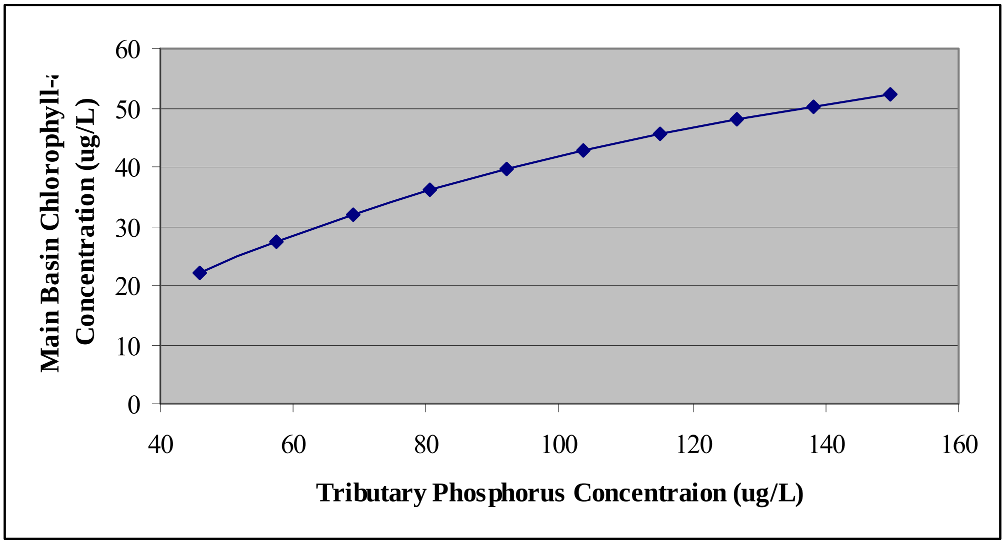
Parameter	Upper Segment	Main Lake	Area Weighted Mean
Total Phosphorus (μg/L)	52.2	48.1	49.1
Chlorophyll- a (μg/L)	12.6	25.2	22.0
Secchi Depth (m)	3.3	1.8	2.2
FREQ(CHL-a>10) %	52.5	88.1	79.1
FREQ(CHL-a>20) %	14.5	52.4	42.8
FREQ(CHL-a>30) %	4.4	27.6	21.7
FREQ(CHL-a>40) %	1.5	14.5	11.2
FREQ(CHL-a>50) %	0.6	7.8	6.0
FREQ(CHL-a>60) %	0.2	4.3	3.3

Therefore, meeting the Tainter Lake TMDL goals should result in a 54% reduction of loading from the Red Cedar River to Lake Menomin based on the baseline (i.e. 1990) loading to Tainter Lake. Note that these estimates do not include direct loading from the Lake Menomin watershed. Based on modeling exercises developed by the City of Menomonie as part of their stormwater planning, it is estimated that this load is between 1,000 and 2,000 kg/yr. While this load does need to be accounted for as part of the TMDL process, from a modeling perspective it results in insignificant changes to the estimated in-lake water chemistry.

In order to obtain good model fit, the phosphorus sedimentation model for the upper segment of the lake had to be lowered considerably. This change reflects that the upper portion of Lake Menomin has a lower than expected phosphorus sedimentation rate, this was not an unanticipated outcome due to the presence of Tainter Lake immediately upstream. If the two impoundments were modeled as a system rather than separately, it is likely that the calibration coefficient would not have needed to be modified to such an extent. This is further evidenced by the lack of adjustments needed to the calibration coefficients for the Tainter Lake model (1.1) and for the main basin portion of this model (1.0). It would have been preferable to model the system as a whole rather than piecemeal, however lack of a consistent monitoring effort precluded that possibility. Even so based on the model fit it is felt that the model can consistently predict in-lake phosphorus concentrations for a given load.

The resultant changes in chlorophyll-a concentrations are less predictable. This is normally the case as relationship between measured chlorophyll levels and phosphorus levels among lakes is variable. Overall chlorophyll levels are inherently more variable than phosphorus levels for any given lake due to a variety of biological interactions. Current model predictions indicate that Lake Menomin is somewhat sensitive to changes in tributary phosphorus concentrations (Figure 5). The Tainter Lake model indicated that Tainter Lake is more sensitive to phosphorus concentration and less sensitive to flushing rates than Lake Menomin. This is likely due to the particular chlorophyll-a model selected in each case. The Canfield-Bachman model was used to predict mean chlorophyll levels in Tainter Lake while the Walker model was used for Lake Menomin. The Walker model typically has a flatter response to changes in chlorophyll than the Canfield-Bachman model. For shallow, high turnover rate impoundments like Lake Menomin, use of the Walker model should give conservative results, and chlorophyll reductions for a given phosphorus reduction would likely be greater than those depicted by the model (Bill James pers.com.).

Figure 5. Lake Menomin Chl-a response for fixed tributary stream flow at various phosphorus concentrations.



Conclusions

The BATHTUB model accurately predicted the in-lake concentration of phosphorus based on estimated phosphorus loads for 2002 and 2003. It appears that the model should be fairly robust given the overall model fit and lack of adjustments to the phosphorus calibration coefficient.
It was initially anticipated that flushing of live algal biomass from Tainter Lake would play a dominant role in algal densities in the upper portion of Lake Menomin. This appears not to be the case. This is likely because most of the water passing through the Cedar Falls dam does not originate at the surface (normal pool elevation – 872.4', normal draw – 855.83'). Since most of the algae in Tainter Lake consist of floating blue-green algae, it appears that mass transfer of live algae from Tainter Lake is not a dominant mechanism, and algal levels in Lake Menomin are driven by growth in the lake itself.

While the model was able to reasonably predict chlorophyll levels for the two years of monitoring, there is considerably more uncertainty in how the lake will respond to decreases in phosphorus levels. The selected chlorophyll model predicts only modest decreases in chlorophyll levels under the draft Tainter Lake conditions, it is felt that the response will be greater than predicted, so the model estimates presented in this can be considered a conservative estimate of algal response to decreased phosphorus loading

Appendix B. Method for Deriving Water Quality Targets for Tainter Lake and Lake Menomin

Since lakes Tainter and Menomin respond to phosphorus like flowages[1], and would be expected to attain a phosphorus standard if 40 µg/L if their retention times were longer, an approach was used to determine a TMDL goal that would produce an algae level in these two impoundments within the range of that associated with comparable Wisconsin flowages with a growing season average phosphorus (TP) concentration of 40 µg/L. The chlorophyll-a (ChlA) level associated with comparable Western Wisconsin flowages at a TP level of 40 µg/L was determined as follows.

The following waterbody classification terms are part of a system of monitoring and evaluating statewide waterbodies of various types that can be found in WisCALM[2]. Only the waterbodies classified as “deep lowland” or “shallow lowland” by that system were deemed similar enough to Tainter and Menomin Lakes to be included. The list of waterbodies was further reduced using these criteria:

- Lakes (flowages) that had a dam height responsible for at least 33% of the lake's maximum depth were included. Lake St Croix was also included due to its physical similarity even though it does not have a man made dam.
- Flowages from West Central, South Central and Northern Regions were included but not the most northern counties (Forrest, Florence, Iron, Ashland, Bayfield & Vilas), as the watersheds were too dissimilar to Western Wisconsin.
- Lakes with a natural community classification of "deep seepage, shallow seepage, small" or with no classification were eliminated to limit the dataset to flowages of similar size and hydrology.
- Flowages under 30 surface acres or with maximum depth under 15’ were eliminated.
- Flowages with a watershed/lake surface area ratio of < 35 (too lake-like to behave like an impoundment) were eliminated.
- Flowages with a watershed/lake surface area ratio of >2000 (too riverine to behave like an impoundment) were eliminated.

This process identified 145 flowages. Flowages were included in the data set if they had at least 3 paired TP and ChlA sample days, in a May-September growing season, collected from the surface, near the middle of the lake. Mean TP and ChlA were calculated separately for each mid flowage sample station and for each year where the 3 sample minimum was met. This resulted in a sample set of 158 samples from 54 sites on 31 flowages.

ChlA generally increases as TP increases, but is affected by many other factors, resulting in considerable variability in the observed concentrations of ChlA at any given level of TP (Figure B1). In addition, the variability among ChlA observations increase as TP increases. This is a common pattern in environmental applications where the concentration or abundance of one factor is affected by multiple limiting factors such as nutrients (Cade and Noon 2003).

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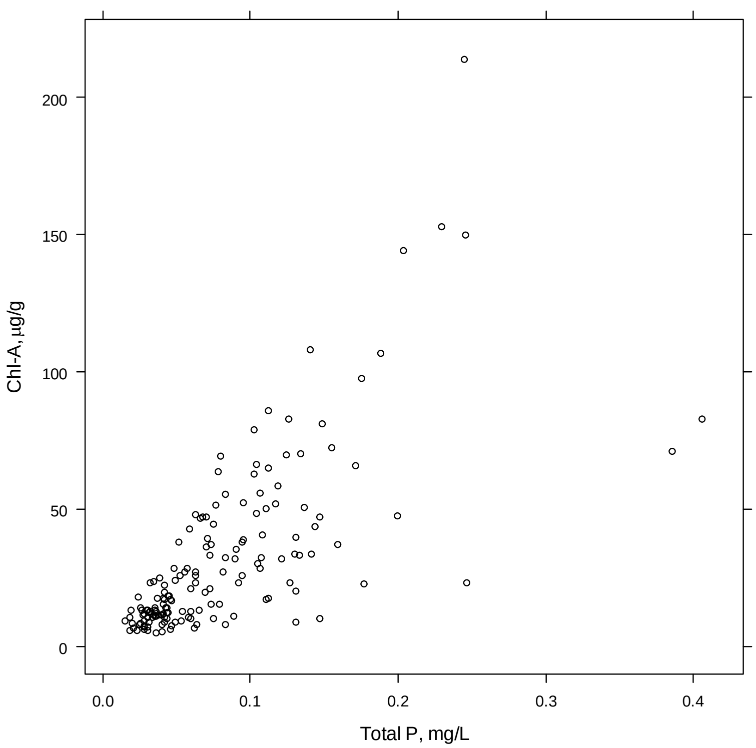
[1] The term flowage is used to reflect a broader class of waterbodies that are functioning as reservoirs from a social and limnological perspective, but may not necessarily meet the residence time criteria set forth in ch. NR 106.06 Wis. Admin. Code.

[2] Wisconsin 2010 Consolidated Assessment and Listing Methodology (WisCALM), Clean Water Act Section 305(b), 314, and 303(d) Integrated Reporting WIDNR

Quantile regression provides a method of describing relationships in such situations. A quantile is the value below which a specified proportion of the population lies. Thus, the 0.9 quantile of ChlA is the value of ChlA below which 0.9 of the ChlA values lie. It may be easier to think of these in terms of percentiles (multiply the quantile by 100), so that the 90th percentile is the value below which 90% of the population lies. Quantile regression estimates the relationship between a specified quantile and a predictor variable. For the ChlA – TP relationship, the relationship between the 0.9 quantile of the ChlA distribution and TP can be estimated, and repeated for a series of other quantiles. The quantile regression relationship is much easier to interpret than prediction intervals. The upper limit of the 95% prediction interval does not have an easily specified relationship with actual percentiles or quantiles of the ChlA distribution. Quantile regression does not assume homogeneous variance, nor does it assume a particular distribution for error.

Figure B-1. Distribution of data from Western Wisconsin Flowages.

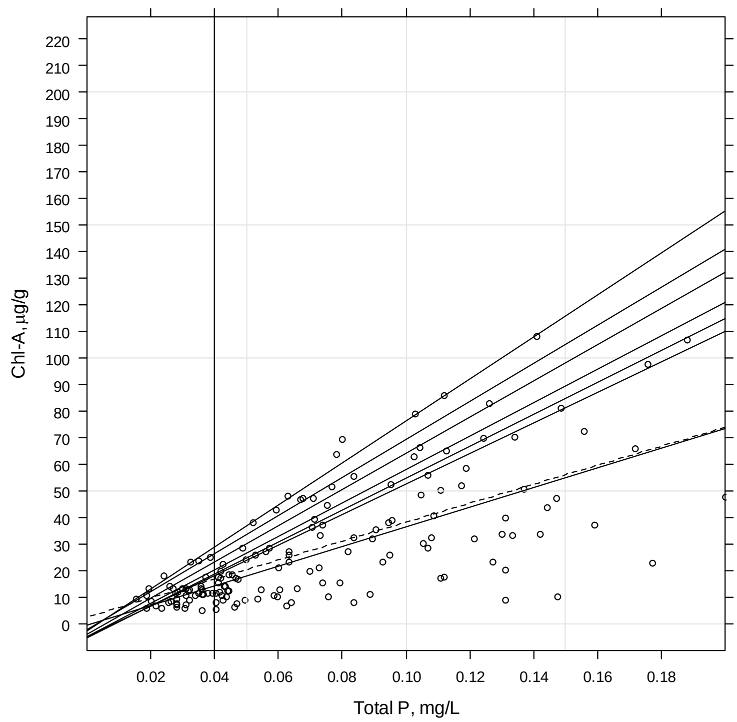


The estimated quantile regression relationships are shown in Figure B-2 for the proportions 0.95, 0.90, 0.85, 0.80, 0.75, and 0.70 (note that the range of TP values shown in the figure extends to 0.2, but all observations were included in analyses). The dashed line shows the standard linear regression relationship (it estimates the mean ChlA for each value of TP); the lowest line in the figure is the quantile regression relationship for the median (quantile = 0.50). The vertical line in the figure is the TP standard for lakes of of 0.04 mg/L (40 µg/L). The estimated ChlA quantiles and their 95% confidence intervals when TP is equal to the standard of 0.04 mg/L are given in the Table B-1. Thus, for lakes in which total P equals the standard, we can expect 95% of Chl-A values to be below 28.6 µg/L, 90% of ChlA values to be below 26.4 µg/L, and so on. For comparison, the estimated mean value of ChlA at this concentration of total P is 14.8 (by linear regression).

Table B-1. Regression relationships for Western Wisconsin Flowages

Proportion	Estimated ChlA(μg/L)	95% CI
0.95	28.6	26.4 – 30.8
0.90	26.4	23.2 – 29.7
0.85	23.2	19.2 – 27.2
0.80	20.3	16.9 – 23.7
0.75	18.6	15.2 – 21.9
0.70	18.0	16.3 – 19.6
0.50	14.1	12.7 – 15.6

Figure B-2. Assignment of quantiles and intercept with 40 μg/L phosphorus.



The data in Figure B-2 shows that a TP level of .04 mg/L (40 μg/L) in these flowages will yield ChlA levels of 5-25 μg/L. In essence, the establishment of 40 μg/L phosphorus as the standard for these kinds of flowages in Wisconsin established a range of 5-25 μg/L ChlA as the level of algae acceptable for recreational uses in these waters. **A TMDL goal of 25** μg/L **ChlA in Tainter Lake and Lake Menomin will meet recreational uses; as this ChlA level of 25** μg/L **is consistent with algae levels found in WI lowland drainage lakes that meet the total phosphorus standard of 40** μg/L**.**

County	WBIC	Official Name	Natural Community	Acres	Watershed (mi^2)	Area Ratio	Max Depth (ft)	Dam Height (ft)
Polk	2624200	Apple River Flowage	Shallow Lowland	604	134	142	18	8
Jackson	1727700	Arbutus Lake	Deep Lowland	774	1290	1067	50	
Adams	1377700	Arrowhead Lake (Manchester)	Shallow Lowland	295	99	215	30	
Marathon	1427400	Big Eau Pleine Reservoir	Deep Lowland	6348	363	37	46	
Adams	1374800	Big Roche A Cri Lake	Shallow Lowland	217	71	210	20	
Adams	1378100	Camelot Lake	Shallow Headwater	393	91	148	24	
Eau Claire	2135600	Coon Fork Flowage	Deep Lowland	62	47	484	20	
Wood	1369900	Dexter Lake	Shallow Lowland	287	210	469	17	
Adams	1352000	Friendship Lake (Millpond)	Shallow Lowland	125	59	302	16	
Rusk	2184900	Holcombe Flowage	Deep Lowland	2881	4995	1110	61	42
Barron	2094000	Lake Chetek	Shallow Lowland	923	196	136	22	12
Dunn	2065900	Lake Menomin	Deep Lowland	1009	1761	1117	34	
Lincoln	1515400	Lake Mohawksin	Shallow Lowland	1515	1967	831	25	15
Saint Croix	2607400	Little Falls Lake	Shallow Lowland	170	171	645	18	
Saint Croix	2607100	Mallalieu Lake	Shallow Lowland	289	175	387	17	
Sawyer	2420600	Moose Lake	Shallow Lowland	1559	190	78	21	13
Price	2245100	Musser Flowage	Shallow Lowland	503	80	102	15	12
Columbia	180300	Park Lake	Shallow Lowland	330	56	109	27	13
Juneau	1377100	Petenwell Lake	Shallow Lowland	23173	5879	162	44	
Oneida	1595300	Rainbow Flowage	Shallow Lowland	3153	750	152	28	21
Lincoln	1516400	Rice River Flowage*(Nokomis)	Shallow Lowland	764	57	48	26	13
Adams	1377900	Sherwood Lake (Deer Lodge)	Shallow Lowland	216	91	270	27	
Lincoln	1506800	Spirit River Flowage	Shallow Lowland	1220	174	91	22	14
Dunn	2068000	Tainter Lake	Deep Lowland	1605	1677	669	37	
Monroe	1342100	Tomah Lake	Shallow Lowland	245	26	68	19	
Washburn	2712000	Trego Lake	Deep Lowland	383	290	484	36	31
Sauk	1258100	White Mound Lake	Shallow Lowland	93	7	48	16	32
Oneida	1528300	Willow Flowage	Shallow Lowland	4217	327	50	30	12
Chippewa	2152800	Wissota Lake	Deep Lowland	6037	5475	580	72	
Marathon	1437500	Lake Wausau	Shallow Lowland	1422	4016	1807	30	20-25
Pierce	2601500	Lake Saint Croix	Deep Lowland	7696	9998	831	60	

Appendix C. General WDPES permits that could be part of the group wasteload allocation for the Tainter/Menomin Phosphorus TMDL

General Permits

General permits are assigned a group wasteload allocation of 490 lbs P/year. These are the General Permits that apply to the Red Cedar River Basin:

Carriage and Interstitial Water from Dredging Operations…………(WI-0046558-4)
Concrete Products Operations………………………………………(WI-0046507-5)
Contaminated Groundwater from Remedial Action Operations……(WI-0046566-5)
Hydrostatic Test Water and Water Supply System Water………….(WI-0057681-4)
Non-Contact Cooling Water, or Condensate and Boiler Blowdown (WI-0044938-5)
Nonmetallic Mining Operations …………………………………... (WI-0046515-5)
Petroleum Contaminated Water …………………………………… (WI-0046531-4)
Pit/Trench Dewatering …………………………………………….. (WI-0049344-3)
Potable Water Treatment and Conditioning ………………………. (WI-0046540-5)
Sanitary Sewer Overflows (SSO) from Sewage Collection Systems (WI-0047341-4)
Short Duration Discharge …………………………………………. (WI-0059137-3)
Swimming Pool Facilities …………………………………………. (WI-0046523-5)
Wastewater from the Outside Washing of Vehicles, Equipment
and Other Objects …………………………………………………. (WI-0059153-3)

Wisconsin also has stormwater general permits for municipal MS4s, and construction and industrial activities, including:
Stormwater Construction Sites……………………………………. (WI-S067831)
Stormwater Industrial Tier 1 ……………………………………… (WI-S067849)
Stormwater Industrial Tier 2 ……………………………………… (WI-S067857)
Municipal Separate Storm Sewer System………………………… (WI-S050075)

Appendix D. Summary of City of Menomonie stormwater modeling results and recommendations (P. Oldenburg, Nov. 2008, WDNR)

Stormwater Modeling Evaluation:

Modeling provided by the City of Menomonie's consultant Cedar Corporation provided two main circumstances. The base condition used land use from the 1993 City of Menomonie Comprehensive Plan and the future (2025) land use from the 2007 City of Menomonie Comprehensive Plan. Two models were used to complete the calculations for this project. The first model, WinSLAMM, was used to model storm water runoff from urbanized areas in 1993 and 2025. The WinSLAMM model accepts land use data and provides estimated runoff volumes and pollutant loadings. The second model, Snap-Plus, was used to model storm water runoff from agricultural areas in 1993. Snap-Plus is the software that calculated the Wisconsin Phosphorus Index (P Index).

The report predicted a 52% phosphorus reduction to Lake Menomin based on their modeling. In looking at the results this percentage reduction figure may be an overestimate. Primarily, it is likely that the phosphorus losses from cropland are overestimated in the analysis. The mean estimate of phosphorus losses from cropland was estimated as 1.15 lbs/acre/yr for the Lake Menomin watershed. Based on statewide average losses from cropland, results of the Tainter Lake SWRRB model, and firsthand knowledge of the landscape in the modeled area it is likely that this value is an overestimate. The recommended average loss from mixed agricultural (row and forage crops) lands in Wisconsin is 0.71 lbs/acre/yr and 0.89 lbs/acre/yr for row crops. In looking at the Tainter Lake SWRRB the average cropland loss was 0.95 lbs/acre/yr from the Pine Creek and Red Cedar River Watershed. Given the flat topography and relatively light soils in the study area actual losses from the Lake Menomin watershed may be even slightly lower than this. This is not an unexpected result as the P Index is a semi-quantitative planning tool and expected to give a conservative value, so the actual phosphorus losses in lbs/are/yr are less than the P Index value. Also, the analysis included an internally drained portion of the watershed that does not drain into Lake Menomin. This area is relatively small, likely less than 10% of the total modeled area, so it likely does not significantly impact the overall outcome.

As a more conservative estimate of the pre-development loading conditions, the statewide average value for mixed agricultural lands was used to estimate cropland losses. Using the statewide average for mixed agricultural lands provides a conservative estimate of phosphorus losses for these lands within the planning boundary as they were primarily managed as row crop, which would be expected to have a higher phosphorus export rate. With the 2,533 acres of cropland in 1993 this translates into 1,798 lbs/yr compared to the Cedar Corporation estimate of 2,903 lbs/yr. The pre-existing stormwater load was estimated as 1,686 lbs/yr. Therefore the total loading estimate from the planning area using the statewide mixed agricultural lands loss rate was 3,484 lbs/yr. The estimated post development load is 2,212 lbs/yr or a 37% reduction of the 1993 condition using this alternative. Relating this to a year 2025 estimate of 4974 urban land use acres contributing to the water quality of Lake Menomin yields an export rate of 0.445 lbs/ac/yr under WLA conditions. Use of the SWWRB export rate in this same exercise yields an estimate of a 45% reduction.

It is clear that the overall mass of phosphorous leaving the portion of the Lake Menomin watershed within the planning area of the City of Menomonie will be less than it was previously due to land use conversion and the installation of various stormwater BMPs. The precise amount of reduction is open to interpretation, but is likely in the range of 35-50% from the 1990 modeled condition. Since the 1990/93 modeled estimates have about 3500 lbs/yr of watershed phosphorus affecting Lake Menomin from both the Menomonie urban area and the remaining area, the TMDL proposes the same percentage load reduction and proposes both the wasteload allocation for the Menomonie MS4 and the load allocations for the remaining watershed be set at 2200 lbs/yr each.

Overall Lake Menomin Phosphorus Loading Estimates (updated May 2011):

Phosphorus loading to Lake Menomin is dominated by the Red Cedar River which exits Tainter Lake at the Cedar Falls Dam and almost immediately enters Lake Menomin. Applying the BATHTUB model under 1990 conditions, the load entering Lake Menomin from Tainter Lake is estimated as 319,000 lbs/yr. The current draft TMDL for Tainter Lake has set the loading goal to Tainter Lake as 177,000 lbs/yr entering the impoundment.

Based on the Tainter Lake BATHTUB model, this translates into approximately 145,300 lbs/yr leaving Tainter Lake and entering Lake Menomin or a 54% reduction in loading to Lake Menomin from Tainter Lake when compared to the 1990 condition. . This loading then results in a predicted mean summer epilimnetic phosphorus concentration for Lake Menomin of 49 μg/L and an area weighted mean chlorophyll a concentration of 22 μg/L. As a comparison, for growing seasons 2002 and 2003 the observed mean summer epilimnetic phosphorus for Lake Menomin was 117 μg/L and the area weighted mean chlorophyll a concentration was 42 μg/L.

In addition to the load leaving Tainter Lake, loading for direct drainage to Lake Menomin would need to be accounted for in any future TMDL. Based on the modeling exercise described above, the projected load from the City of Menomonie based on their stormwater plan is 2,212 lbs/yr. Finally, there are additional non-point sources to Lake Menomin.

The table below represents an estimate of the land use in the direct Lake Menomin watershed not included in the City of Menomonie planning area. The estimate is based on a review of the 1992 WiscLand Land Use Layer and 2005 aerial photography. Also included are the recommended most likely phosphorus export rates for Wisconsin and the resultant annual load estimate.

Land Use	Estimated Area (acres)	Phosphorus Export Coefficient (lbs/acre/yr)	Phosphorus Export (lbs/yr)
Low Density Urban	350	0.089	31
Mixed Ag	4,270	0.71	3,050
Grass	1150	0.27	308
Woodlands	1600	0.080	129
Wetlands	200	0.089	18
		Σ	3,536

Based on the relative proportion of the estimated load from the intervening watershed and that coming from Tainter Lake, accounting for the load from the intervening watershed (5,748 lbs/yr total) would have an insignificant impact on the Lake Menomin response modeling results. That however does not mean that these loads do not need to be accounted for in the TMDL or in subsequent implementation plans.

Appendix E. Wasteload Allocation Worksheet

Facility	Design Year	Design Flow (MGD)	effluent limit or current conc (mg/L)	WLA @ Design flow & 1PPM (lbs/da)	daily allocation (lbs/da)	implied allocation (lbs/yr)
Boyceville	2010	0.22	1	670	1.83	670
Colfax	2002	0.105	9.9	320	0.88	3164
Glenwood City	2002	0.262	1.73	798	2.19	1380
Ridgeland Village	1998	0.032	1.41	97	0.27	137
Wheeler	2014	0.05	4.05	152	0.42	616
Almena	2016	0.143	6	435	1.19	2612
Chetek	2005	0.385	1	1172	3.21	1172
Crystal Lake SD	2022	0.012	4.02	37	0.10	147
Cumberland	2019	0.4	5.89	1218	3.34	1218
Dallas	1999	0.076	2.98	231	0.63	689
Lakeland SD #1	2016	0.015	0	46	0.13	0
Prairie Farm	2016	0.06	2.38	183	0.50	435
Rice Lake	2003	2.2	1.5	6697	18.35	10046
Turtle Lake	2017	0.546	2	1662	4.55	3324
Jennie O Turkey Store	NA	1.1	1	3349	9.17	3349
total		5.606		17065	46.75	28,958

Appendix F. Public Comments and Responses

A minimum 30-day comment period was held on the Tainter and Menomin Lake TMDLs from July 12 to August 19, 2011. A public hearing was held in Rice Lake on July 27th, 2011 and in Menomonie on July 28th, 2011. 59 verbal and written statements explicitly supported the TMDL. The most critical comments received focused on implementation or questioned the Reasonable Assurance section. One written statement opposed the TMDL on a technical basis. 42 additional individuals attended the public informational hearings without making a comment or indicating support/opposition. To construct the following list, related comments were summarized and combined.

General Attitudes about the Watershed

The following comments were received regarding the unacceptable condition of Tainter & Menomin Lakes*(McAloon, Rueckl, Morin, Corbin, Nelson, Flis, Sabatke)*:

- It is a significant health issue
- People hide in their houses to avoid the vicinity of the lake altogether
- People have left the area permanently.
- Some people have been told their lives will be cut short if they remain near the lake.
- Friends of a family refuse to visit during the summer.
- Neither people nor dogs can swim in the lake.
- A decline in property values has been well documented.

Setting Lake Goals

1. Comment: Tainter Lake and Lake Menomin are shallow, unstratified reservoirs. The applicable TP standard applied to them should be 40 µg TP/L, not 100 µg TP/L. The DNR should have used 30 years of mean flow data to calculate a 153 day(May-Sept) retention time instead of 10 years of calculating a 120 day summer low flow figure. *MEA*

Response: The method for calculation of lake retention time was changed to match that found in NR102 Wisconsin Administrative Code.

2. Comment: The goal of the draft TMDL, identified by WDNR is clearly inadequate to protect human health from serious illness and even death from extremely toxic cyanobacteria blooms that have become a hallmark for both reservoirs. This TMDL should be rewritten based upon a TP standard of 40 µg/L in order to address what should be the overall goal: To minimize the risk of serious human health impacts from cyanotoxins. *MEA*

Related Comment: The BATHTUB model predicts (Appendix A, p.A-7) "only modest decreases" in algal biomass when, clearly, major decreases are needed to protect public health and aquatic life from the now-common, "severe" (p.1) toxic cyanobacteria blooms. Thus, the model indicates that the suggested TP target is still much too high to protect the designated uses of these waters. *MEA*

Response: The subject of establishment of a goal to prevent algal toxin production was added to the document. The comment suggests 40 µg/L TP as that level but provides no supporting information. Lacking data to determine this level, DNR used an alternate technique intended to have Tainter and Menomin Lakes attain algae levels similar to WI reservoirs meeting the statewide phosphorus standard. That technique identified a ChlA level of 25 µg/L. This was deemed adequate until a threshold for algal production is determined and another TMDL to address this issue is done.

3. Comment: The BATHTUB modelers (Appendix A) report a high degree of uncertainty in model predictions for algal biomass (chlorophyll a) response to TP concentrations. This uncertainty, critical to the success or failure of the TMDL, is not accounted for in the draft TMDL. Therefore, there is no scientific basis for the draft TMDL's "conclusion" that the target of < 25 μg chlorophyll a/L will be achieved. *MEA*

Response: As noted in Appendix A, the selected chlorophyll sub-model used on Lake Menomin provides a conservative estimate of algal response as it is less sensitive to changes in phosphorus concentrations than would be expected. Algal densities in flowages with high chlorophyll concentrations, shallow depth, and blue - green algae types found in Tainter and Menomin Lakes, typically are not controlled by light or flushing rates. Based on regional experiences, Dr. Walker normally recommends the use of the Jones & Bachman chlorophyll sub-model which is much more responsive to reductions in phosphorus loadings. Therefore it is likely that chlorophyll levels will be less than 25 μg/L under the TMDL.

4. Comment: The Draft TMDL alternatively calls these waterbodies "reservoirs," "impoundments" and "flowages" making it difficult to know what the applicable phosphorus standard is supposed to be under NR 102.06 of the Wisconsin Administrative Code. *MEA*

Response: The TMDL report was changed to utilize terms consistent with the December 2010 revision to NR102 Wisconsin Administrative code. All three terms are still used in the report in the following way: "Flowage" includes all waterbodies behind a dam on a stream with "reservoir" and "impoundment" as subcategories defined in NR102 based on retention time and absence of unidirectional flow.

5. Comment: WDNR stated (p.9), "A statistical analysis of similar flowages in the state was completed to develop more stringent applicable [TP] criteria for Tainter Lake and Lake Menomin (Appendix B)." Appendix B (p.B-1) states that flowages less than 30 acres in surface area, or less than 15 feet deep, were eliminated. Parameter values (surface area, maximum depth, and mean depth, which are important for total volume considerations) for Tainter Lake and Lake Menomin were compared to the other flowages that were used in WDNR's modeling effort as "similar" to the two reservoirs. Parameters that were within + two-fold of the parameter values for the two reservoirs were evaluated as "similar." As shown in the table below, of the 28 flowages that WDNR included, only 6 had surface areas, mean depths, and maximum depths that were similar to those of Tainter Lake and Lake Menomin. Some were, in fact, *extremely dissimilar* to the two reservoirs. One flowage with surface area less than 30 acres was included, and another with maximum depth less than 15 feet was included. *MEA*

Response: Four of the lakes in the table provided with MEA's comments were located by MEA in the wrong county and not part of the DNR dataset. Their inclusion of Park Lake in Polk (instead of Columbia) County and Sherwood Lake in Clark (instead of Adams) County resulted in depths and areas outside the stated range. All lakes utilized by DNR were deeper than 15 feet and larger than 30 acres. A list of the lakes utilized in the analysis was added to the document in Appendix B for clarification.

6. Comment: WDNR should redo this analysis using flowages that actually are similar to these two reservoirs. The fact that 22 of the 28 flowages were ***not*** similar to Tainter Lake and Lake Menomin does not inspire confidence that the TP and chlorophyll *a* data from these flowages can be used to reliably approximate the TP / chlorophyll *a* relationships in Tainter Lake and Lake Menomin. It also makes the TP targets derived from these flowages and applied to Tainter/Menomin highly questionable…., the draft TMDL states that flowages [reservoirs] with a watershed-to- [lake] reservoir surface area ratio (W/R SA) of less than 35 ("too lake-like") or greater than 2000 ("too riverine") were eliminated. This is a very broad

range, especially considering that Tainter Lake and Lake Menomin have W/R SAs of 644 and 800, respectively. Use of such a range would have included reservoirs with W/R SAs that were very different than the 7 characteristics of Tainter Lake and Lake Menomin. WDNR should narrow this range so that it does include reservoirs with a similar W/R SA. *MEA*

Response: DNR reduced the dataset to include only the 6 waterbodies considered similar enough to Lakes Tainter and Menomin by MEA. This reduced the dataset size from 33 waterbodies to six and reduced the number of observations from 158 to 21. Quantile analysis was attempted on the reduced dataset and was found to be too small to estimate confidence intervals at the high end of the range. DNR will use the original dataset.

7. Comment: WDNR writes (p.B-1) that "lakes with a natural community classification of "deep seepage, shallow seepage, small" or with no classification were eliminated…" – What does that mean? *MEA*

Response: Additional explanation was added to Appendix B.

8. Comment: The draft TMDL should address pH. *MEA*

Response: A section addressing pH was added to the document.

Data Quality

9. Comment: Additional data on citizen monitoring sites was provided. *Ludwig*

Response: The additional data was referenced in the TMDL.

10. Comment: Without a statistical trend analysis there is no scientific basis to support WDNR's assertion, key to this TMDL, that eutrophication conditions in Tainter Lake and Lake Menomin have not changed from 1989-1990 to the present or that land use, loading and water quality data from the 1990s still reflect current conditions. *MEA*

Response: The objectives of these TMDLs are to establish ChlA goals and meet phosphorus limits essential to meeting recreational uses in Tainter Lake and Lake Menomin. Since eutrophication and algal blooms have plagued these two waterbodies for decades, the age of the load/response analysis (data/modeling from 1990) is irrelevant in determination of the goals. The term "baseline" has been eliminated from the TMDL report to avoid confusion. Appendix H has been added to provide information relevant to the age of the data used.

11. Comment: The draft TMDL inaccurately described the 1990 in-lake monitoring of Tainter Lake as "intensive." In reality, the 21- to 22-year-old data that WDNR used as the "baseline" for this draft TMDL consist of *four sampling dates, three of which were taken during the May-September growing season*; that is, 6 data points were available for Lake Tainter (from 2 stations), unreplicated, during the critical growing season, and 4 data points, unreplicated, were available for Lake Menomin. These data are completely inadequate to capture the previous TP conditions in Tainter Lake. Assessment of average concentration in surface waters within a season should encompass baseflow, stormflow, and wetflow conditions (Bukaveckas and Crain 2002, Hollabaugh and Harris 2004). Quarterly data are widely regarded as insufficient to assess mean nutrient concentrations in a particular surface water because they miss many storm events and associated higher nutrient concentrations that would be detected with more frequent sampling. For determining compliance and the possibility of deviations (modified criteria), at least monthly sampling is recommended (e.g. Robertson and Roerish 1999, Stansfield 2001).The 1989-

1990 data (2 samples on each of 3 dates) used as the "baseline" for TP conditions in Tainter Lake during the growing season are inadequate to capture present-day TP conditions, and should not be used as the "baseline" condition for this TMDL…..6 data points were available for Lake Tainter (from 2 stations), unreplicated, during the critical growing season, and 4 data points, unreplicated, were available for Lake Menomin. *MEA*

Response: The monitoring data used for the Tainter Lake Bathtub model was actually from 3 stations, so the total number of samples was 9. While, the Tainter Lake monitoring data would be considered the minimum required data needed to apply BATHTUB, the calibration done by Dr. William Walker (the model originator) indicates the documented response to phosphorus loading is very similar to what would be expected based on the large, high quality data set used to develop the BATHTUB model. As explained in Appendix A, the Lake Menomin bathtub model utilized biweekly sampling during May – September over 2 years at 4 stations for a total of 40 samples. Two watershed load stations were sampled for flow daily and chemistry weekly with additional sampling during storm events for one year

12. Comment: One year of load data is insufficient to calibrate the SWRRB model. *MEA*

Response: Text was added to the document indicating the initial nature of this TMDL. It is recognized that multiple years of calibration data is better than one. However, since the TMDL will need to be done again in the future to address algal toxin and pH exceedances, the single year of calibration data was deemed sufficient.

13. Comment: The Draft TMDL switches between using 1990 loading data, a nine year average, and fifteen year average seasonal data, in order to determine loading in Tainter Lake without explaining the reasoning. *MEA*

Response: A nine year climate averaging routine was a standard feature of the land use model used (SWRRB). The fifteen year average data is presumably a reference by MEA to the period of record for the monthly water quality monitoring station at the Red Cedar River in Menomonie (1994-2009). Further explanation is in the TMDL document and the cited references.

14. Comment: The Draft TMDL states that the models used to determine wasteload allocations were calibrated, but does not describe how this calibration was done. *MEA*

Response: Modeling was not used to set the wasteload allocations. They were set for each point source at 1mg/L total phosphorus and the design facility flow.

15. Comment: The "baseline" for the TP contributed by MS4 areas in the Lake Menomin watershed is antiquated 1993 land use data (Appendix D, p.D-1, mislabeled as p.C-1), based on the assumption that these 18-year-old data accurately depict present conditions. Such antiquated data cannot be expected to simulate present conditions. Data for present-day conditions should be used to capture stormwater TP contributions as a more realistic, more scientifically accurate baseline condition for MS4s. *MEA*

Response: The issue of the age of the data used in this analysis is addressed in appendix H.

16. Comment: The data available for three of the four modeling efforts (SWRRB, WinSLAMM, Snap-Plus, BATHTUB) used to develop the draft TMDL are not clearly described, inaccurately described, or not mentioned. *MEA*

Response: A narrative describing the data utilized by the Bathtub and SWRRB can be found on the following website:

http://basineducation.uwex.edu/lowerchip/redcedar/pdf/Tainter%20BATHTUB%20Model%20Final%20Report.pdf

The raw water quality data used are available from the DNR Surface Water Integrated Monitoring System using the map interface: http://dnr.wi.gov/org/water/data_viewer.htm

Note: Use the "identify" and "view data" features to see data.

Flow data is available on the USGS website:
http://waterdata.usgs.gov/wi/nwis/current?type=flow&group_key=basin_cd&search_site_no_station_nm

The data used to develop the Menomonie MS4 report wasteload allocation is available on the Lower Chippewa Basin website: http://basineducation.uwex.edu/lowerchip/redcedar/publications.html

17. Comment: The FLUX model which was "companion" to the BATHTUB model, the U.S. Geological survey (USGS) data for the FLUX model, which was used by WDNR (2011) to estimate TP loads to the lakes, were described in Schreiber (1992, p.9) as having been collected in Colfax, more than six river miles upstream from the inflow to Tainter Lake. There is no mention of corrective measures that should have been used to adjust the data upward in an attempt to capture TP loads from the watershed over the "missing" area. *MEA*

Response: Graphs in Figure 5 in the cited DNR report includes an estimate for ungaged tributary loads, which provides the information MEA is requesting.

18. Comment: Schreiber (1992, Appendix 3) shows that point source TP loads to Tainter Lake were calculated from the mean effluent TP concentration (measured 2 to 22 times) and the average daily flow during May-September, in several cases described as "seasonal" flow values suggesting that only one flow measurement was available. *MEA*

Response: "Seasonal" is applied to fill and draw wastewater treatment operations and a report of zero flow for a month is not an absence of data from a discharging facility but rather a report that the facility did not discharge that month.

Margin of Safety

19. Comment: The Draft TMDL describes a margin of safety from the SWRRB estimate of the total baseline load to Tainter Lake and downstream Lake Menomin as potentially 16% lower without explaining the reasoning. *MEA*

Response: The explanation of margin of safety was changed.

20. Comment: The draft TMDL lacks a protective MOS. Two of the three components invoked as conservative measures for an implicit MOS do not account for the uncertainties that WDNR (2011) has shown elsewhere in the draft TMDL. The third component, that particulate P in the "baseline" TP load estimated by SWRRB is conservatively low, cannot be evaluated based upon the information provided. On the other hand, WDNR's use of many non-conservative steps in developing the TMDL support the need for a meaningful, protective MOS to help restore and protect water quality in these two extremely impaired reservoirs. The DNR should set aside a greater load percentage to the MOS. *MEA*

Response: The explanation of margin of safety was changed

21. Comment: A segment by segment analysis of MOS should be included. *MEA*

Response: The TMDL includes two segments, Tainter and Menomin Lakes. A single seasonal mean goal utilizing multiple stations was set for each lake. The factors contributing to the MOS for Tainter Lake are explained in the report. Since the majority of the phosphorus load from Lake Menomin comes from Tainter Lake, the factors contributing to the MOS for Tainter Lake load reductions also proportionately apply to Menomin Lake. An additional factor unique to the MOS analysis for Lake Menomin was identified in the report. Therefore both segments were individually analyzed for a MOS.

Wasteload Allocation

22. Comment: The Draft TMDL does not describe the reasoning behind the allocated 35% reduction in the wasteload from the Menominee Municipal Separate Storm Sewer System (MS4) stormwater permit and inappropriately assumes complete success of various stormwater BMPs to reduce TP. *MEA*

Related Comment: The "baseline" condition for MS4s likely underestimates the TP contributed by stormwater. The "baseline" for the TP contributed by MS4 outfalls in the Lake Menomin watershed is based upon 1993 land use data (Appendix D, p.D-1, mislabeled as p.C-1), which are nearly 20 years old and should not be expected to simulate present-day conditions. *MEA*

Response: The WLA for the Menomonie MS4 was determined using models to project the likely phosphorus load associated with expanding the Menomonie MS4 out to its anticipated year 2025 extent in compliance with it's MS4 stormwater plan and all promulgated performance standards. This yielded a number that was 35% less than that thought to exist in 1993. As explained in the response to item 10, the TMDL does not attempt to present conditions as they exist today. Rather, the analysis was performed to support an informed decision on the load allocation for the City of Menomonie MS4.

23. Comment: Appendix E: What is "implied allocation"? Is that the current (actual) load? The WLAs in Table 5 are the ones that will be considered in the decision document. *Werbach*

Response: The definition of "implied allocation" appears in the point source section on page 7.

24. Comment: The TMDL should reduce, rather than allow an increase of WLAs for individual point sources. *MEA*

Response: DNR believes the proposed WLAs are consistent with the Clean Water Act.

25. Comment: With no explanation, the draft TMDL (p.14) estimates the total P wasteload allocation for general permits as only ~4% of the load documented from individually permitted point sources in the Red Cedar basin upstream from Lake Menomin. Without clearer explanation, it is not possible to assess whether the WLA for general permits is too low, or whether the WLA can realistically be achieved. *MEA*

Response: Professional judgment was used to estimate that phosphorus loads from general permits, many of which do not even have a discharge to surface water, was 4% of the phosphorus load from individual permits. In the future, adjustments to the allocations can be made as new information becomes available.

26. Comment: The draft TMDL (p.14) states that if it becomes necessary to convert a WPDES facility covered under the general permit to an individual permit, "an appropriate amount of WLA will be

transferred…to the new individual permit." What if the individual permit needs to be much higher? That possibility should be accounted for in the TMDL. *MEA*

Response: The details on wasteload allocation transfers and utilization of the reserve capacity among point sources is not a necessary element of a TMDL but rather an implementation issue addressed in a point source implementation plan or individual WPDES permits.

27. Comments: TP loads from dairy CAFO production areas with WPDES permits are underestimated as "zero." *MEA*

Response: The existing federal and state requirements for CAFOs set a zero discharge from the production area, therefore guidance from EPA suggests that CAFOs have a wasteload allocation of zero. The TMDL can not assign an allocation to the CAFO facilities nor can the TMDL assume a violation of the CAFO permit will occur resulting in a discharge of manure. Per EPA regulations, the spreading of manure is a nonpoint source of pollution and is addressed in the load allocation of the TMDL.

28. Comment: Page 12; Table 4: There appears to be a typo in the table. The WPDES daily load is 50 lbs/d in this table, but is 55 lbs/d in Table 5. *Werbach*

Response: Table 5 value was correct – Table 4 was corrected

29. Comment: Page 18; Industrial Wastewater and Stormwater permits: Note that compliance with the conditions of the general permit does not determine compliance with the WLA. That is an issue addressed in the permit process, not the TMDL process. *Werbach*

Response: This language was changed in the TMDL.

30. Comment: Is it possible to reduce costs to point sources by using "bioavailable" limits rather than total phosphorus limits? *McAloon*

Response: Initial sampling by DNR to investigate the concept of applying bioavailability concepts to wastewater effluents did not show promise. Bioavailability will be a consideration in regulation of phosphorus in landspreading solids generated by municipal and industrial wastewater treatment.

31. Comment: We appreciate the fact that this TMDL acknowledges the relatively small contribution of point sources to the total phosphorus load in the watershed and that "watershed point sources have reduced their loads significantly." In general, both the methodology and the resulting allocations seem to strike a reasonable balance between point and nonpoint source reductions in phosphorous. *Kent*

Response: Comment noted.

Load Allocations

32. Comment: Page 7; Nonpoint sources: A bit more expansion on the sources is needed. Cropland is discussed, but a bit more discussion of other sources in the watershed is needed. Attached is some language that may be useful (feel free to expand). *Werbach*

Response: A modified version of the suggested text was added to the TMDL.

33. Comment: The TMDL should quantify the amount of phosphorus coming from the groundwater. The municipal well at Colfax has tested at high levels. *Olson*

Related Comment: Groundwater entering Long Lake in Washburn County is higher than the water in the lake yet the lake still has exceptional clarity. *Sabatke*

Response: It is acknowledged that groundwater phosphorus levels are not uniform across the watershed and in some places is likely high. The land use model used to estimate the sources of phosphorus in the watershed was calibrated to actual stream monitoring station data. The groundwater component is therefore integrated into the model's settings. The model was not capable of separately estimating groundwater loads or describing their geographic distribution across the watershed. The model essentially spreads the existing groundwater load uniformly over all watershed land uses. It will be important to recognize this phenomenon when targeting implementation actions around the watershed. However, for estimating the net effect of land use over the entire Tainter Lake watershed, the selected model is considered adequate. Additional growing season stream data is being collected by DNR statewide and will provide insight into this phenomenon in future years.

34. Comment: The draft TMDL underestimates dairy cattle CAFO contributions to nonpoint TP pollution because the land use categories (cropland, barnyards) from the late 1980s reflect traditional farming practices and fail to capture the high TP pollution from the extremely large amounts of wastes that CAFOs produce. In addition, the potential expansion of presently permitted dairy CAFOs in the watershed, and the projected increase in dairy CAFOs in the watershed, have not been accounted for in setting wasteload allocations. *MEA*

Response: This comment presumes that CAFO-based agriculture delivers more phosphorus via manure from a watershed than non-CAFO agriculture on a per square mile basis. There is actually a trend toward declining numbers of cattle and calves in the watershed. The load allocation for nonpoint sources includes TP loading from CAFO and non-CAFO land spreading and will be addressed during the implementation portion of this TMDL.

Reasonable Assurance

35. Comment: The draft TMDL fails to provide reasonable assurance that the TP target will be achieved through WQBELs for point sources…. Under "Implementation of WLAs through the WPDES Permit Program" (p.15), the draft TMDL states, "Note that WPDES permit effluent limits do not have to be identical to the WLAs in this TMDL. Rather, effluent limits must be consistent with the assumptions and requirements of the TMDL and its WLAs. Accordingly, the WDNR…*may* [emphasis added] derive water quality-based effluent limits from WLAs." In this writing, the draft TMDL provides no reasonable assurance that WQBELs *will*, in fact, be set. *MEA*

Response: Once the TMDL is approved by US EPA, the wasteload allocations for point sources will be implemented as WPDES permits are reissued. WDNR may express limits in the permits as daily maximums, weekly averages or monthly averages consistent with 40 CFR Part 122.44(d)(1)(vii) which does not require permit limits to be expressed in the same form as wasteload allocations. Federal requirements state only that WLA-based permit limits need only be "consistent with the assumptions and requirements" with the approved TMDL wasteload allocations.

36. Comment: The draft TMDL fails to provide reasonable assurance that the TP target will be achieved through plans to assess compliance of MS4s, *MEA*

Response: Through the MS4s WPDES stormwater permit, the MS4 permittee will need to assess whether the TMDL wasteload allocation is being met and adjust stormwater controls as needed to achieve and maintain compliance with the TMDL WLA.

37. Comment: The draft TMDL fails to provide reasonable assurance that the TP target will be achieved through implementation plans for achieving nonpoint source reductions. *MEA*

Response: Current Federal regulations do not require that a TMDL include a schedule or identifiable milestones for achieving nonpoint load allocations (40 CFR 130). However, DNR acknowledges the importance of meeting nonpoint load allocations and intends that implementation plans will have schedules, and measureable milestones for nonpoint implementation. The reasonable assurance section of the TMDL was substantially revised and more detail added.

38. Comment: The draft TMDL fails to provide reasonable assurance that the TP target will be achieved through monitoring plans to assess water quality in Tainter Lake and Lake Menomin. *MEA*

Response: Consistent with the Department's Statewide Monitoring Strategy, follow-up monitoring is a regular feature of Wisconsin's efforts to determine if applied management has been successful. In addition, U.S. EPA requires states receiving federal Clean Water Act funds to periodically document the level of success of pollution remediation efforts supported by those funds. Accordingly, the Department will monitor to document any water quality changes associated with eventual implementation of the TMDL as staff and fiscal resources allow.

39. Comment: No reasonable assurance for estimating or controlling pollutant loads from sources covered under general permits – *MEA*

Response: Recognition of TMDL wasteload allocations are being added to all general WPDES permits as they expire and arere-issued.

TMDL Implementation

Point sources

40. Comment: Develop detailed point source implementation plan before putting limits in permits. Municipal treatment plants must be given adequate time to gather data, analyze site-specific conditions, and evaluate alternative compliance options, such as compliance schedules, variances, trading and adaptive management, in addition to traditional facilities planning. Implementation options with compliance schedules spanning more than one permit term will be absolutely essential. The TMDL implementation plan must provide both the time and the incentive for all sources to work together to find cost-effective ways to improve water quality in the basin. *Thom, Kent*

Related Comment: Point source implementation plan should integrate TMDL phosphorus limits with incorporation of 2010 revisions to NR217 into WPDES permits including adaptive management . *Thom, Kent, Caneff*

Response: The TMDL will be implemented in accordance with current state rules (NR 217, NR 216, NR 151, Wis. Adm. Code) and corresponding compliance periods if applicable. A point source implementation plan covering some aspects of implementation will be pursued as an Update to the Area-wide Water Quality Management Plan for the Lower Chippewa River Basin. Statewide policy and guidance on pollutant trading and adaptive management is currently under development to allow for more flexibility during implementation of TMDLs.

41. Comment: Inclusion of pollutant trading needs to utilize methods for crediting based on good science. The Cumberland trades were specifically mentioned. *Zillmer, Caneff*

Related Comment: Nutrient trading between point and nonpoint sources could further weaken water quality protection… If point sources elect not to reduce their P loads by purchasing credits from nonpoint sources that already are underestimated by the TMDL, this will further weaken protection of Tainter Lake and Lake Menomin. *MEA*

Response: Any trading program will have to ensure that both the point source wasteload allocations and the nonpoint source load allocations are attained and that crediting mechanisms are based on current science. The original phosphorus crediting method used for the Cumberland trade was replaced in the last WPDES permit with one based on the recently promulgated (NR151) phosphorus index for cropland. Nonpoint source implementation in Wisconsin is frequently a function of availability of cost share incentives. A pollutant trading program utilizing temporary credits can provide these funds. The current trading system in the basin is temporary in nature, requiring the point source to continually find new fields with which to trade. Under this system of temporary credit, the point source will eventually need to add treatment resulting in both point and nonpoint controls in place. The crediting method and other procedures for trading are expected to change over time as the science advances and a statewide policy on trading is established:
http://fyi.uwex.edu/wqtrading/

42. Comment: Support continuation of pollutant trading in Red Cedar Basin and develop details on how it will work in the TMDL context. *Thom, Kent*

Response: The DNR is sharing its draft Water Quality Trading Framework with EPA and discussing issues regarding credit threshold for both TMDL and Non-TMDL trading scenarios.

43. Comment: Imposition of a 0.1 phosphorus limit will cost the Chetek wastewater facility $30,000 more per year in chemical cost plus capital costs. This cost puts a huge burden on sewer and water utility customers (about 1000) and presents difficulties enticing any new industries and residential customers to the small community. *Knapp*

Response: The TMDL does not specify a number this low for the Chetek WWTP but it is likely that implementation of the statewide phosphorus standard for the Chetek River will. An assortment of implementation options are included in the statewide phosphorus rule package, including extended compliance schedules, adaptive management, pollutant trading and economic variance processes. These will be explored through the WPDES permit process.

Nonpoint Sources

44. Comment: The TMDL should acknowledge the 70% cost share requirement associated with NR151 , and address how best management practices will be deployed and paid for. Make a dollars per acre estimate of the proposed costs associated with meeting the proposed nonpoint source load allocation. *Caneff*

Response: Because of the variability of costs, depending on which best management practices are chosen and how many acres need to be addressed, it is difficult to determine at the outset a dollars/acre estimate of the proposed costs associated with meeting nonpoint source load allocations. The key to cost effective phosphorus runoff reductions from farmland is locating and addressing the highest delivery areas. Studies in southern Wisconsin have shown that a majority of the phosphorus load comes from a monitory of farmed acres. To determine which acres and regions have the highest loads requires a determination of the Phosphorus Index on a large portion of the 313,000 cropland acres in the Lake Tainter/Menomin watershed. This requires considerable resources and research. The implementation plan will endeavor to garner the necessary resources to plan and conduct a targeted approach to phosphorus reduction from farmland. Until then it is difficult to estimate the cost of targeted nonpoint source implementation.

45. Comment: The priority farms element of the Barron & Dunn County Land and Water Management Plans should be part of the strategy to target nonpoint phosphorus load reductions in the Red Cedar Basin. *Caneff*

Related Comment: The TMDL should propose that Dunn & Barron counties or other municipalities work with DNR to direct TRM grants priority farms doing the most damage. A strategy should be developed to target these efforts. *Caneff*

Related Comment: County Land Conservation Departments expressing interest in working toward attaining TMDL goals. *Prestebak, Heise*

Response: The Department agrees that state and local regulations, in conjunction with cost sharing to address agricultural sources of TP and TSS are a critical component of TMDL implementation. A TMDL implementation plan is currently under development. Additional detail on how this may happen in this basin was added to the document.

46. Comment: Nonpoint source rules need to be adequately enforced. *Menefee, Plaza, Caneff*

Response: All crop and livestock producers in the watershed will be required to comply with state agricultural performance standards and prohibitions in ch. NR 151, Wis. Adm. Code. Further reductions beyond this for CAFOs and non-CAFOs would be identified through the TMDL implementation planning process. It is expected that most compliance checks on non-permitted operations will occur through local agencies (counties, towns) with the DNR monitoring compliance for WPDES-permitted CAFOs.

47. Comment: The current system that depends on traditional voluntary farm runoff reduction programs that have been ineffective, or are underfunded and unpopular with landowners is not working: Need more regulation of farmer's land management. Need farm support payments to be tied to good management. Manure spreading on frozen ground is a particular problem. *Flis, Menefee, Corbin, Schutz, Caneff*

Response: NR 151 Wisconsin Administrative codes requires that additional restrictions on agriculture must go through the rule making process and cannot be established through the TMDL process. Most farm support payments conditions come from the federal government. Manure spreading on frozen ground will be addressed in the implementation plan. The draft nonpoint source implementation plan currently under development will propose an alternative mechanism for approaching voluntary phosphorus reduction incentive programs found to be effective elsewhere.

48. Comment: CRP is not a tool that can be depended on to reduce the soil erosion that causes the phosphorus in the Red Cedar Basin. CRP enrolled acres in Dunn County dropped from 22,000 to 13,000 between 2000 and 2010 and from 4,000 to 3,600 acres in Barron County. CRP funding continues to be cut by congress. *Caneff*

Related Comment: Funding for conservation programs is not keeping up with commodity prices. This causes a reduction in conservation practices. *McAloon, Kruger, Mickelson*

Response: It is recognized that CRP is declining in popularity and the success of other agricultural conservation programs are linked to market forces but they are included nonetheless to recognize their potential under the right circumstances.

49. Comment: TMDL should investigate the need to establish a watershed-specific Phosphorus Index value (lower than the statewide maximum of 6) as allowed in NR151. *Caneff*

Related Comment: Emerging satellite-based technology should facilitate targeting of phosphorus control activities better than before. *Lamers*

Response: WDNR is working, in cooperation with other partners, on the technical ability to develop watershed specific PI values and better ways to identify high delivery fields. Currently it is not possible at the scale the size of the watersheds for Tainter Lake and Lake Menomin. Once this technology is developed and applied, it will still be necessary to promulgate watershed specific PI values in NR151 before they can replace the statewide minimum of 6.

50. Comment: The TMDL does not explicitly propose a strategy for attaining load reductions. *Caneff, MEA*

Response: Current Federal regulations do not require a timeline or identifiable milestones for achieving nonpoint load allocations in a TMDL (40 CFR 130). However, DNR acknowledges the importance of meeting nonpoint load allocations and is funding the development of a TMDL implementation plan.

51. Comment: Is converting some areas to wetlands or eliminating dams a solution? *Hagaman*

Response: Elimination of small portions of either Lakes Tainter or Menomin by conversion to wetlands will remove aquatic habitat and recreational uses but may not remove the impairments associated with algae. The impairment might just move down the shoreline. Elimination of the dams and associated flowages would result in much less algae growth and water clarity similar to that entering Tainter Lake. This conversion would be associated with large loss of recreational use and aquatic habitat as well as economic impacts to real estate and businesses. Extensive removal of bays and backwaters to change the impoundments into "wide rivers" would have an effect intermediate to the previous two.

52. Comment: Is the phosphorus release from curly leaf pondweed in the Chetek Chain of lakes a significant phosphorus source in the basin and would its control be eligible for pollutant trading? *Knapp*

Response: Since a phosphorus budget for the Chetek Chain is still under development, the relative significance of the phosphorus load associated with seasonal release from curly leaf pondweed is not known. Phosphorus reduction techniques that can be quantified and verified can be considered for pollutant trading. If deemed feasible, this particular technique, like all others, would get assigned a trading ratio and have to make economic sense when compared to other trading options in the watershed. Aquatic plant management in any lake needs to be carefully planned and executed to maintain important lake functions and uses.

53. Comment: Concern was expressed that private golf courses are not subject to turf management regulations. *Mollerus , Zillmer*

Response: NR151 required professional nutrient management for both public and privately owned turf areas of over 5 acres starting in 2008.

54. Comment: Lakefront property owners should be subject to turf management regulations. *Zillmer*

Response: Lakefront property, like all other residential property, is subject to regulations restricting the sale and use of phosphorus containing fertilizers starting in 2010.

55. Comment: Farmers are currently subject to a variety of controls tied to government programs. Required to file and follow a farm plan or risk losing government payments. Farmers in the watershed are already trading carbon credits with industry. We need to support our farmers so they can implement technologies that will protect their ability to continue to produce high-yield harvests or affordable food while protecting our critical water resources. *Kruger*

Response: Comment noted.

56. Comment: Local lake organizations need to lead by example and create a network to be more effective. *Schutz, Mollerus* Response - A process to create a regional lake resident network had already started. *Lamers, Sabatke*

Related Comment: Lake groups listed their roles in monitoring and fostering appropriate land management and indicated their willingness to partner for implementation. *Ludwig, Lamers, Sabatke, Plaza*

Response: As we move toward implementation of this TMDL, it will be important for the WDNR to involve engaged lake organizations in implementation planning, including determining appropriate land management strategies and monitoring effectiveness of installation of practices.

57. Comment: It is important to communicate the need to implement nonpoint source controls to legislators *Lamers*

Response: Comment noted.

58. Comment: More funds are needed to support county staff to work with farmers to control phosphorus sources. *McAloon, Zerr*

Response: Comment noted.

59. Comment: As sources of phosphorus (mines) are exhausted phosphorus will be become too valuable to waste. Eventually it will be cost effective to recover "used" phosphorus from places where it has accumulated in the environment. *Olson, Baillergeon*

Related Comment: The cost of phosphorus for fertilizer has increased 5 fold in recent years, providing an effective incentive not to waste it. Agricultural phosphorus use has started to decline. Conservation tillage practices are becoming more common. *Kruger*

Response: Thank you for your comments.

60. Comment: People in the upper watershed are unaware of problems downstream. Education to raise awareness is important. *Ester, Mollerus, Sabatke McAloon*

Response: WDNR will continue to work closely with partners, including county staff and Basin Educators to educate all stakeholders in the watershed about downstream impacts to water quality.

61. Comment: Innovative shoreline protection measures are available and should be used. *Baillargeon*

Response: Comment noted.

62. Comment: Wisconsin should follow the example how the Swiss handled a similar problem in Lake Sempach. *Homa*

Response: Comment noted.

63. Comment: More funds are needed for more DNR assessment of waterbodies using biological measures is needed, along with corrective actions on the landscape to address identified problems. *McAloon, Mickelson*

Response: Comment noted.

64. Comment: While pursuing watershed-wide phosphorus reductions efforts, continue to allow small scale, in-lake efforts to reduce local accumulations of harmful algae blooms. *Thibado, Baillargeon*

Response: Comment Noted.

65. Comment: We need to limit close-proximity high-use water industries (such as sand plants) that can deplete or contaminate the groundwater which is so essential in recharging our surface waters. *McAloon*

Response: DNR regulates the operation of mines through a WPDES permit for nonmetallic mining and approval authority for high capacity wells.

66. Comment: A commenter submitted documentation to show that historic water levels have increased in Bear Lake, Washburn County and suggested that reducing water levels in this lake will reduce shoreline erosion which will benefit Bear Lake and downstream waters. *Weber*

Response: The prevailing concentration of phosphorus in Bear Lake is 23 μg/L. The estimated base flow of the creek below the dam is 5.6 cfs (7Q10 flow from USGS). Using these values the estimated phosphorus loss from the lake is 250 lbs/yr. The 2006 study of Bear Lake performed by Blue Waters Sciences did not identify shoreline erosion as a significant problem on Bear Lake. Given these conditions, it is unlikley that water level management decisions on Bear Lake will have an effect on phosphorus export to the lower watershed.

67. Comment: The design flows for Dallas WWTP is actually 0.076 MGD and the Prairie Farm WWTP is actually 0.06 MGD.

Response: These changes were made to the document and wasteloads adjusted accordingly. The difference was subtracted from the WLA reserve capacity to keep the total wasteload allocation the same.

APPENDIX G. ORGANIZATIONS AND INITIATIVES THAT MAY CONTRIBUTE TO IMPLEMENTATION OF THE TMDL

Wisconsin Working Lands Initiative

The Wisconsin Working Lands Initiative was passed as a part of the state's 2009-2011 biennial budget process. The Wisconsin Working Lands Initiative can be found primarily in Chapter 91 of Wisconsin State Statutes. Main components include:

- Expand and modernize the state's existing farmland preservation program
- Establish agricultural enterprise areas (AEAs)
- Develop a purchase of agricultural conservation easement matching grant program (PACE)

The goal of the Working Lands Initiative is to achieve preservation of areas significant for current and future agricultural uses through successful implementation of these components:

- Expand and modernize the state's existing farmland preservation program
- Modernize county farmland preservation plans to meet current challenges
- Provide planning grants to reimburse counties for farmland preservation planning
- Establish new minimum zoning standards to increase local flexibility and reduce land use conflicts; local governments may apply more stringent standards
- Increase income tax credits for program participants
- Improve consistency between local plans and ordinances
- Simplify the certification process and streamline state oversight
- Ensure compliance with state soil and water conservation standards
- Collect a flat per acre conversion fee when land under farmland preservation zoning is re-zoned for other uses
- Establish agricultural enterprise areas
- Maintain large areas of contiguous land primarily in agricultural use and reduce land use conflicts
- Encourage farmers and local governments to invest in agriculture
- Provide an opportunity to enter into farmland preservation agreements to claim income tax credits
- Encourage compliance with state soil and water conservation standards
- Develop a purchase of conservation easement (PACE) grant program
- Protect farmland through voluntary programs to purchase agricultural conservation easements
- Provide up to $12 million in state grant funds in the form of matching grants to local governments and non-profit conservation organizations to purchase agricultural conservation easements from willing sellers
- Stretch state dollars by requiring grants to be matched by other funds such as federal grants, local contributions and/or private donations
- Establish a council to advise the state on pending grants and proposed easement purchases
- Consider the value of the proposed easement for preservation of agricultural productivity, conservation of agricultural resources, ability to protect or enhance waters of the state, and proximity to other protected land
- Ensure consistency of state-funded easement purchases with local plans and ordinances

River Country Resource Conservation and Development District

The River Country Resource Conservation and Development District's mission is to initiate, facilitate and build connections for the wise use of natural, human, and economic resources. The River Country RC&D Council Inc. is a non-profit 501(c)3 organization that brings people and resources together to address issues and opportunities, in order to conserve our natural resources, provide sustainability and improve the quality of life for the people who live and work in the River Country Area.

A current River Country RC&D project in the Red Cedar River Basin is encouraging farmers to try no-till planting techniques by providing access to a no-till drill in the Town of Grant in Dunn County. River Country RC&D is sponsoring an position funded by WDNR to develop a detailed nonpoint source implementation plan for this TMDL. River Country has also teamed up with the Tainter Menomin Lake Improvement Association to sponsor one of the first in an annual series of conferences on improving water quality in the Red Cedar River Basin.

River Alliance of Wisconsin

River Alliance of Wisconsin was formed in 1993 by trout anglers, paddlers, conservationists, and educators who saw the need for a strong, effective voice for the flowing waters of the state. River Alliance has since grown into one of the largest and strongest statewide river conservation organizations in the nation and is recognized as one of Wisconsin's leading conservation groups. Membership is comprised of over 3,200 individual, organizational and business members. River Alliance of Wisconsin members' common interest is their passion for rivers and the inspiration they bring to the organization.

River Alliance priorities change from time to time, mimicking the ever-changing rivers they work to protect. But like a river's steady current, the River Alliance adheres to some core principles that do not change with the times including:

- Advocating respectfully but assertively for rivers.
- Bringing people to rivers so they experience their beauty and understand their threats.
- Partnering with, when appropriate, and challenging, when necessary, the government agencies entrusted with protecting rivers.
- Developing the ability of ordinary citizens and grassroots groups to organize their passion for rivers.

Wisconsin Association of Lakes and its members

The Wisconsin Association of Lakes (WAL) is the only statewide organization working exclusively to protect and enhance the quality of Wisconsin's 15,000 inland lakes. The Wisconsin Association of Lakes is a nonprofit group of citizens, organizations, and businesses working for clean, safe, healthy lakes for everyone.

To accomplish this mission, WAL:

- Assists lake groups and lake users in their efforts to carry out our mission
- Helps local leaders manage and restore lakes and their watersheds
- Provides a unified voice for public policy that will protect and preserve lakes
- Advances public knowledge of lakes, their watersheds, and ecosystems

WAL members work so Wisconsinites will continue to have the right to boat, fish, swim, and enjoy the natural scenic beauty of our special lakes. WAL goals include:

• Developing a network of informed lake citizens with the know-how and motivation to become highly active in statewide lake issues
• Developing a strong base of lake organizations active in local and county government decision making
• Helping communities build a set of common goals, and create local partnerships to implement lake protection programs

Multiple Lake Associations and Districts exist in the Red Cedar River Basin. Each has their own projects in progress, many to address nutrient impacts. They have begun to network among each other to more effectively address issues.

Wisconsin Farmers Union

The Wisconsin Farmers Union, a member-driven organization, is committed to enhancing the quality of life for family farmers, rural communities, and all people through educational opportunities, cooperative endeavors, and civic engagement. The strength of Wisconsin Farmers Union comes from our grassroots membership, comprised of farmers and consumers alike. Issues that concern the Wisconsin Farmers Union include:

- Food Safety
- Renewable Energy
- Environmental Conservation
- Health Care
- Nutrition Programs
- International Trade Standards
- Local Food Systems
- Sustainable Rural Lifestyles
- Agricultural Policies and Economics
- Food Biotechnology (GMOs)
- Organic Agriculture
- Agribusiness Research and Education

Sand County Foundation

\Sand County Foundation's mission is to advance the use of ethical and scientifically sound land management practices and partnerships for the benefit of people and the ecological landscape. Their vision includes a future where there is widespread adoption of a land ethic based on private responsibility, meaningful incentives, and competent science resulting in improved land health and betterment for the people who live and work there. Sand County achieves their mission by:

- Providing financial, technical, and organizational support to private individuals and communities as primary agents of long-term landscape-scale conservation and management

- Rewarding responsible stewards and providing public recognition for outstanding private lands leadership to inspire others by their examples

- Serving as a conduit and catalyst for the exchange of monitoring and management practice information between and among private individuals, scientists, funders, and policy makers
- Removing regulatory barriers and creating meaningful incentives for landowners who enhance the environment for benefit to themselves and their community
- Creating on the land examples of environmental improvement suitable for replication

Nature Conservancy – Wisconsin

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. The Nature Conservancy has a diverse staff including more than 550 scientists, located in all 50 U.S. States and 33 countries. The Nature Conservancy partners with individuals, government agencies, corporations and local non-profit to achieve their mission. They take a non-confrontational, collaborative approach to stay true to their 5 unique core values. The Nature Conservancy's vision is a sustainable world for future generations. Today's society faces unprecedented challenges. Dwindling natural resources, declining economies, a rapidly changing climate and other threats require that all of us begin working together to reach common solutions. More than ever before, the Nature Conservancy believes we must find innovative ways to ensure that nature can continue to provide the food, clean water, energy and other services our growing population depends upon for survival. Now is a time of opportunity. A time to move conservation from the sidelines of global priorities to the center of the world stage—because human well-being depends on a healthy, diverse environment.

Appendix H Response to concerns over the age of data used.

The elapsed time between when data collection for this TMDL was begun in 1989 and completion of this analysis has raised the question about the current relevance of the data presented. This section was added to the TMDL document to address that issue.

Lake Response Modeling:

The lake response model documents the way the lake responds to phosphorus loads. The lake is expected to have different responses in different years as the watershed phosphorus load varies. This is precisely why a predictive model is used. The main driving forces for the lake model, other than the watershed phosphorus load are:

The volume of the lake, coupled with the watershed hydrology determines the hydraulic residence time in the lake. Like all flowages, the lakes will experience some volume loss over time due to sedimentation. If this happened to a significant extent it would change the way the lake responds to phosphorus loads. Fortunately, compared to many other flowages, Tainter and Menomin Lakes are filling in at a low rate and therefore lake total volume is changing only gradually.

Sediment release of phosphorus has been studied in Tainter Lake and found to be a small source of phosphorus to the water column in relation to the watershed load. Monitoring indicates the lakes continue to stay mixed and therefore the significance of sediment phosphorus is not likely changing.

Since the seasonal average water residence time in the lake will likely change only gradually over time and no evidence of the development of conditions that will increase the release of phosphorus have been documented it is concluded that the lakes likely still respond to phosphorus as they did in the 1990s.

Land Use Categories:

A comparison of land use categories for the watershed shows that the only category that changed significantly is urban use (Table 1). This has been attributed in this, and other watersheds with small urban components, as a result of increased ability of modern GIS software and satellite imagery to separate roads from surrounding landscapes (i.e higher resolution data). Comparison of the land use maps from 1990 and 2006 (Figures 1-3) for a portion of the Red Cedar basin illustrates that new GIS technology identifies roadways and small developed areas unnoticed by the older methods.

Table 1 Comparison of land use category totals.

Land Cover	1992 WiscLand	2006 WiscLand	SWRRB Report
Devloped	0.4%	5.6%	2.0%
Grasslands/hay/pasture	20.5%	20.0%	19.0%
Row Crops	24.0%	25.7%	28.0%
Forest	41.9%	39.1%	52.0%*
Open Water	3.3%	3.4%	
Wetland/shrubland	8.1%	6.2%	
Barren	1.7%	0.0%	

* total included wetlands and open water.

Figure 1. 1990 land use category map

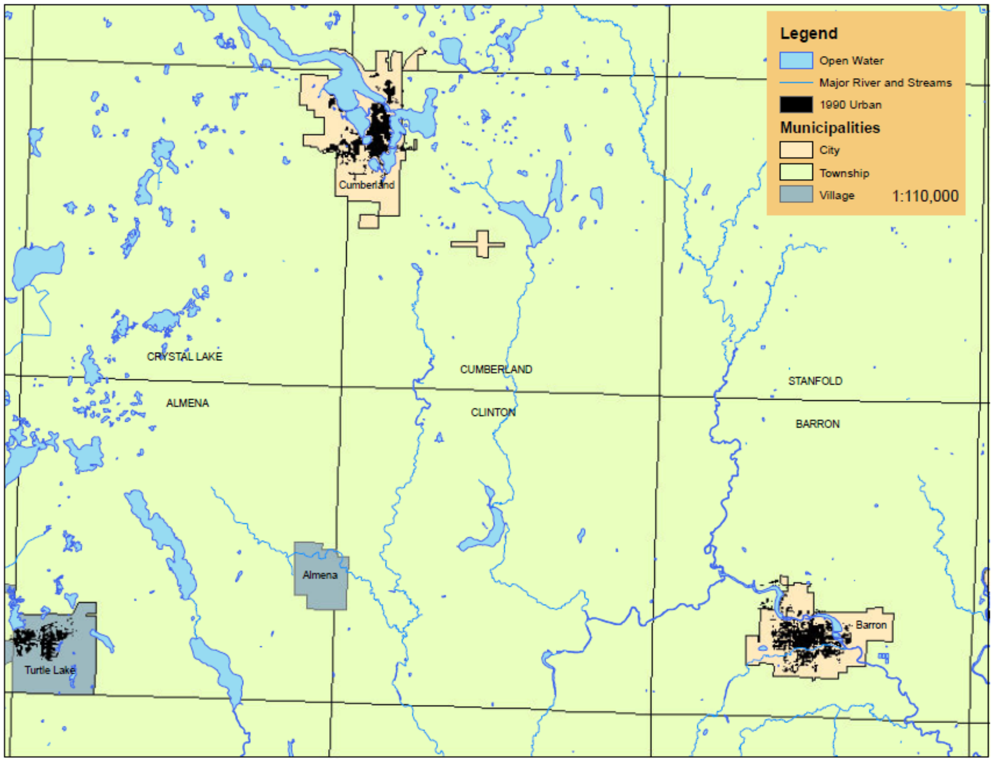


Figure 2. 2006 land use category map

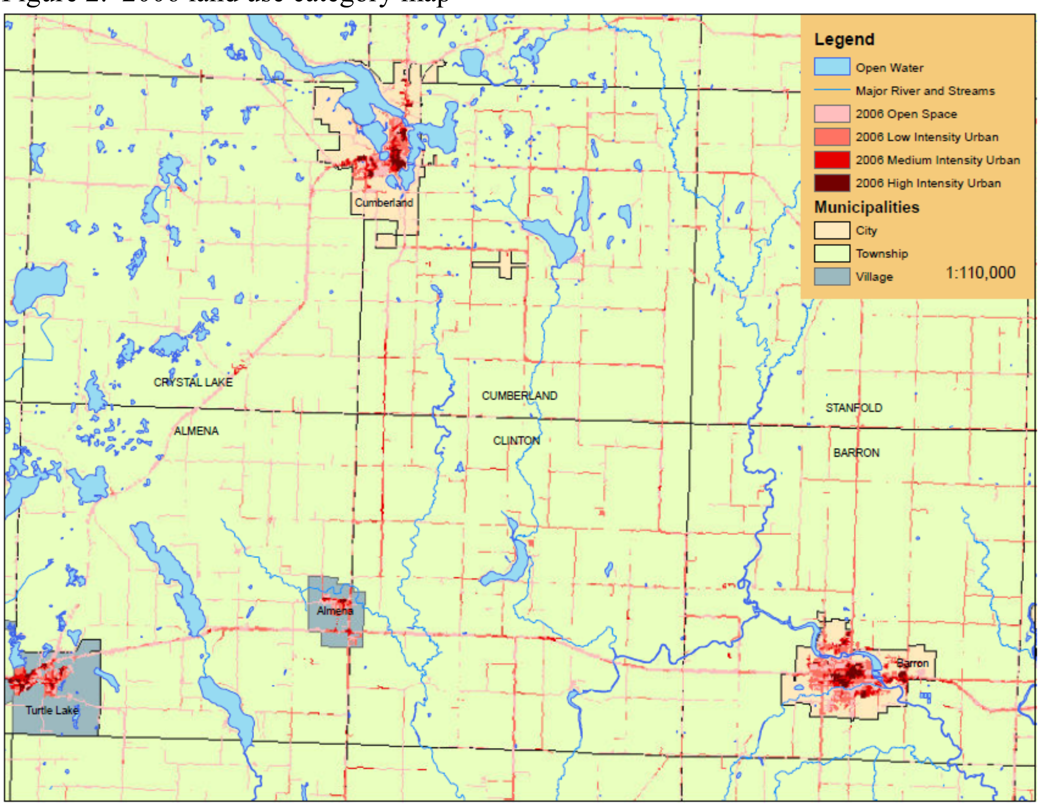
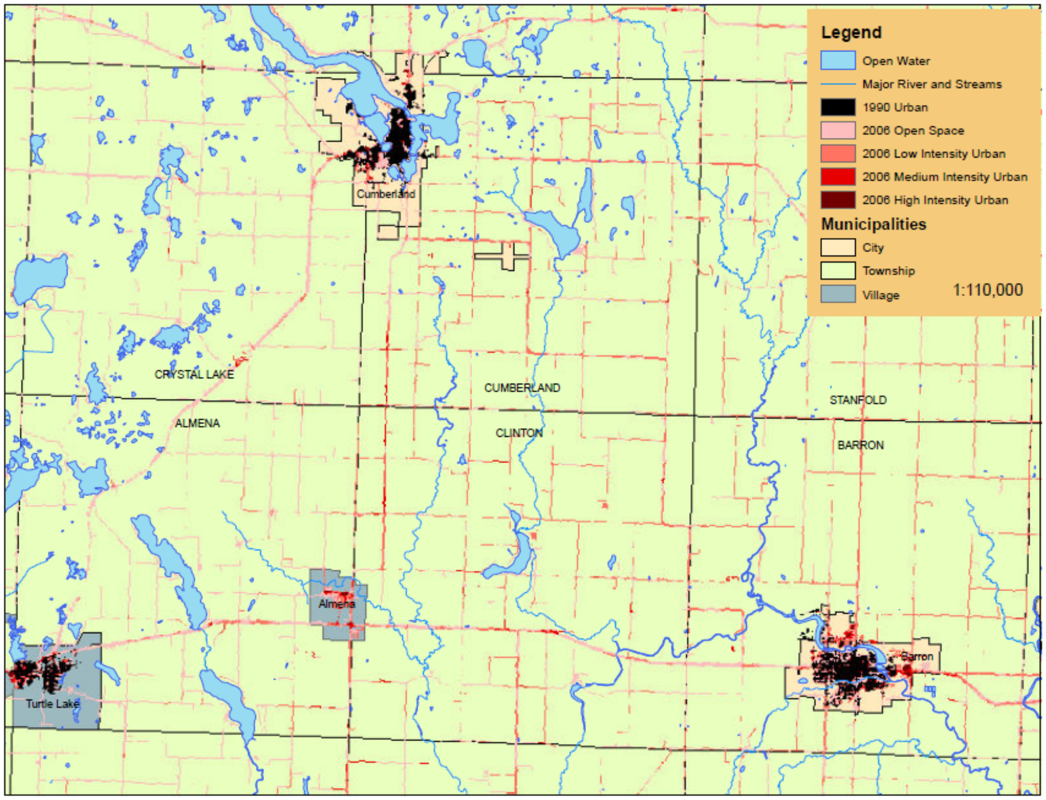


Figure 3. Overlay of 1990 and 2006 land use category maps



In addition to including roadways, the map of the village of Almena shows developed areas in the 2006 layer but not in the 1990 layer. However, census data for the communities in the example maps shows very little population growth (Table 2). The difference between urban land use acreage in 1990 versus 2006 therefore does not represent an actual increase in watershed urban land use. This effect is particularly noticeable in watersheds with a very small urban component, such as the Red Cedar Basin. It is therefore concluded that land use category data has not significantly changed since 1990

Table 2. Census data comparison.

Municipality Type	Name	1990 Census	2010 Census
Village	ALMENA	625	677
Township	ALMENA	773	858
City	BARRON	2,986	3,423
Township	BARRON	1,015	873
Township	CLINTON	849	879
Township	CRYSTAL LAKE	700	757
City	CUMBERLAND	2,163	2,170
Township	CUMBERLAND	884	876
Township	STANFOLD	644	719
	Totals	10,014	10,555

Point Source Loads:

A reduction in point source phosphorus contribution is documented in this report. While not documented through on-site monitoring, the enforcement of stormwater control legislation and turf and lawn fertilization regulation in the watershed has certainly reduced the phosphorus loads to some extent as well.

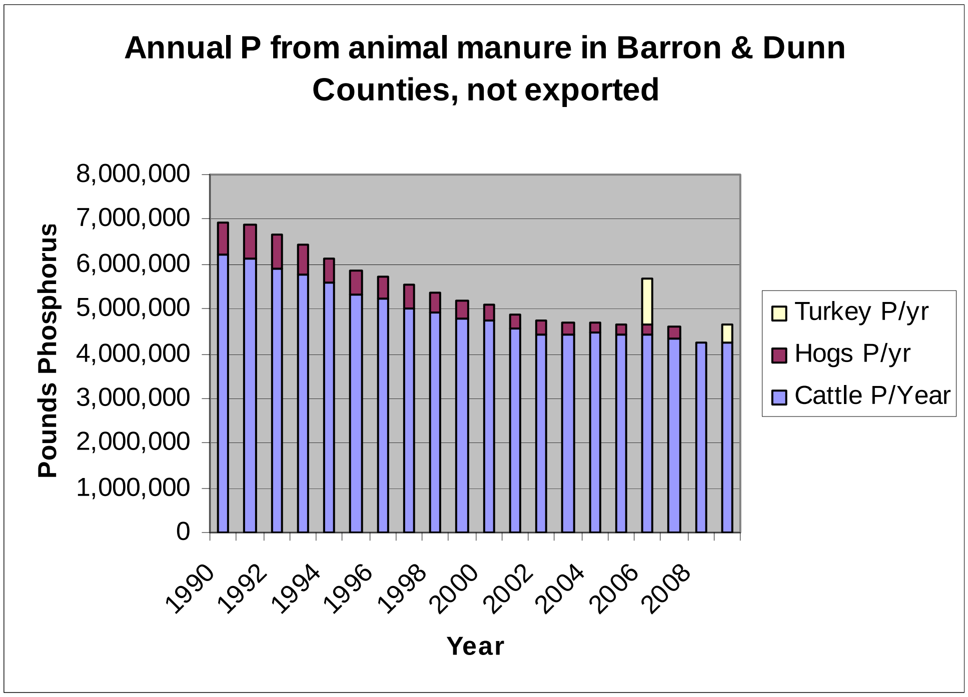
Nonpoint Source Loads:

The SWRRB model was calibrated with monitoring data and used to estimate nonpoint source loads. SWRRB model input variables that should not change significantly over the course of 20 years include soil type, slope, channel routing characteristics of the watershed (location of dams, etc), planting & harvest dates and 9 year average precipitation.

The SWRRB land use practice input variables most likely to change are tillage methods, cropping practice and fertilizer and manure application rates. These variables could not be empirically quantified at the time of model development due to the lack of inventory information (and still cannot today), so the professional judgment of land conservation professionals in Dunn and Barron Counties was used to identify representative practices. The following information summarizes what can be determined about trends in land use practice.

Estimated cattle manure phosphorus in Dunn and Barron counties peaked at 7.5 million lbs annually in 1981, and has decreased in subsequent years to about 4.2 million lbs annually in 2009 (Figure 1). Hog manure phosphorus peaked at 0.8 million lbs annually in 1979, and has trended downward to 0.26 million lbs in 2007. Turkey manure contributed 1 million lbs phosphorus in 2006, before export out of the watershed began, and was reduced to 0.4 million lbs phosphorus in 2009, after export contracts were in place. Turkey production is significant in the watershed but privacy protections in agricultural programs restrict access to that data. Since the 1990s a higher percentage of the livestock in the basin have come under regulatory control as CAFOs under the WPDES system.

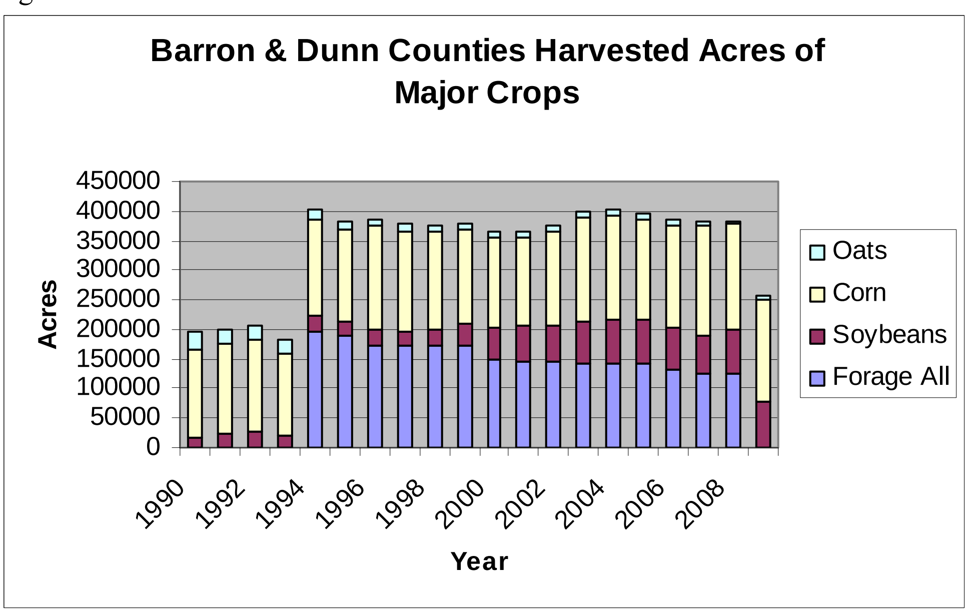
Figure 1.



http://www.nass.usda.gov/Data_and_Statistics/index.asp).

A trend away from dairy in the basin has resulted in more row crops and less forage crops (Figure 2), a conversion commonly associated with greater phosphorus losses. The Conservation Reserve Program has declining enrollment and the associated increase in row crops will tend to mobilize more phosphorus

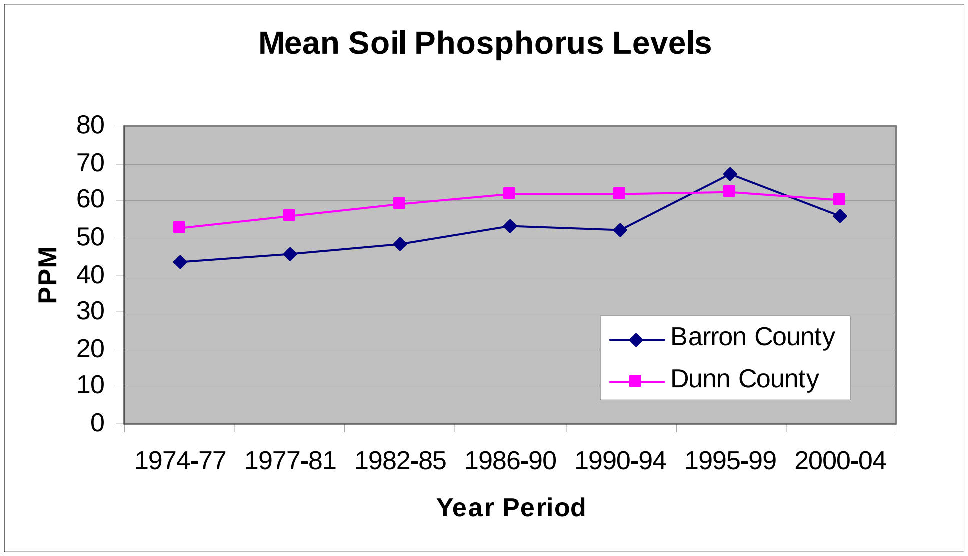
Figure 2.



http://www.nass.usda.gov/QuickStats/Create_County_Indv.jsp

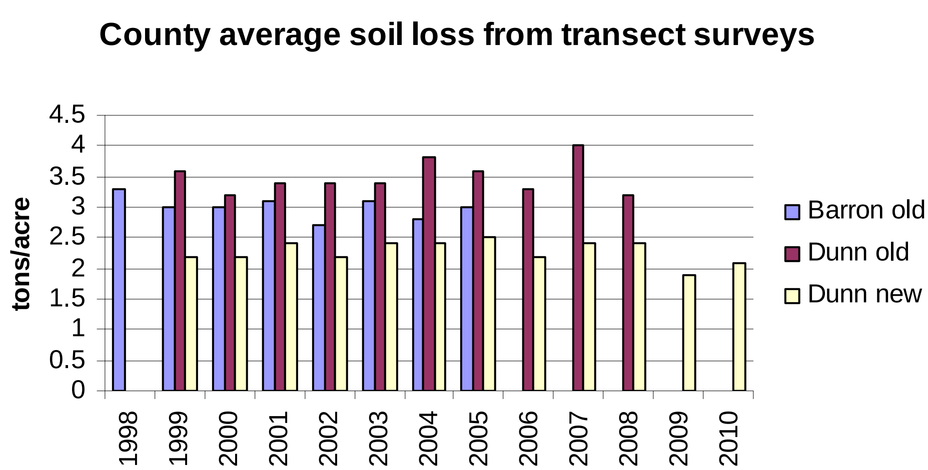
Trends in agricultural land use practices listed above go in opposite directions with some expected to decrease phosphorus loads and some expected to increase phosphorus loads. Local, comprehensive inventory information is not available on trends in tillage practice, fertilizer rates and many other conservation practices. The following objective measures of land use practice were utilized to estimate the extent to which these land use practices may have changed the ability of cropland to deliver phosphorus over time.

Figure 3,



http://uwlab.soils.wisc.edu/madison/

Figure 4.



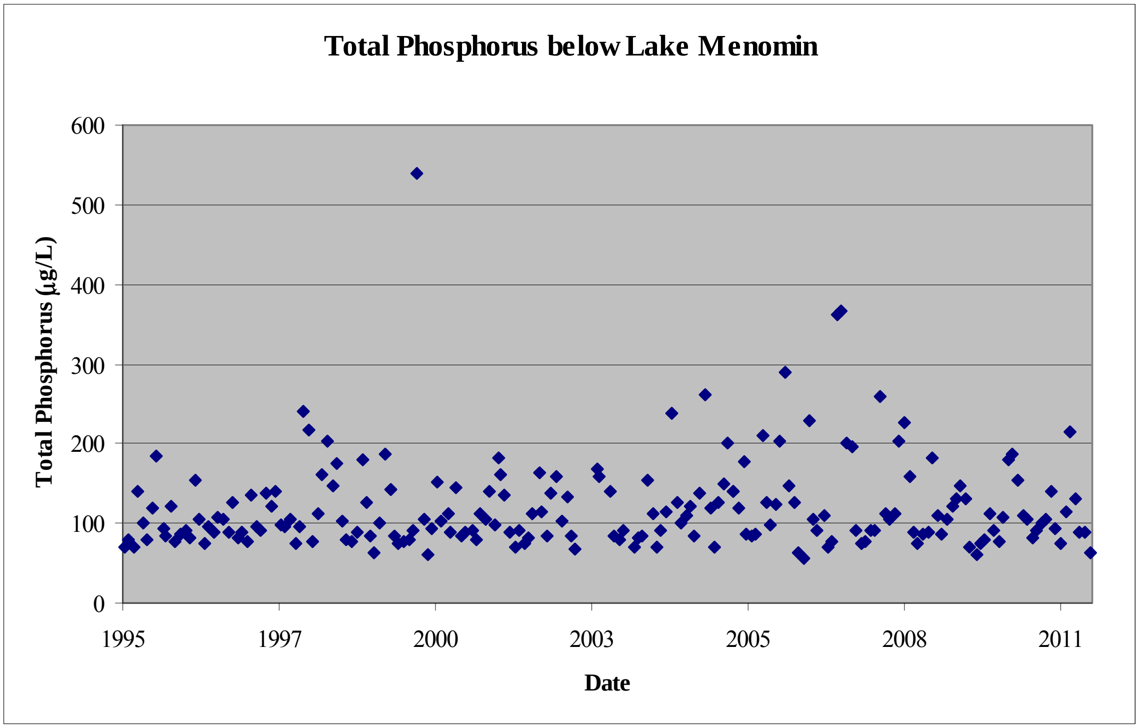
Source – Barron & Dunn County land Conservation Departments

Neither the estimated soil loss rate from county transect survey data (Figure 3) nor county average soil phosphorus level (Figure 4) show an evident trend. The soil loss transect data is complicated by a change in methods but dual method analysis by Dunn County indicates a relatively stable situation. These metrics would be expected to respond to widespread changes in tillage practice and fertilizer and manure application rates.

Water Quality Monitoring:

An indirect measure of trends in land use practice are measures of phosphorus movement in the river system itself. Analysis using Fluxmaster[2], which adjusts for effects of flow and seasonal trends, indicate that total phosphorus concentrations in the Red Cedar below Lake Menomin increased between 1994 and 2010 (Figure 5). The flow-adjusted concentration was 102 µg/L in 1994 and 126 µg/L in 2010, which indicates an annual increase of 1.53 µg/L. The trend is statistically significant, with a p-value of 0.008.

Figure 5.

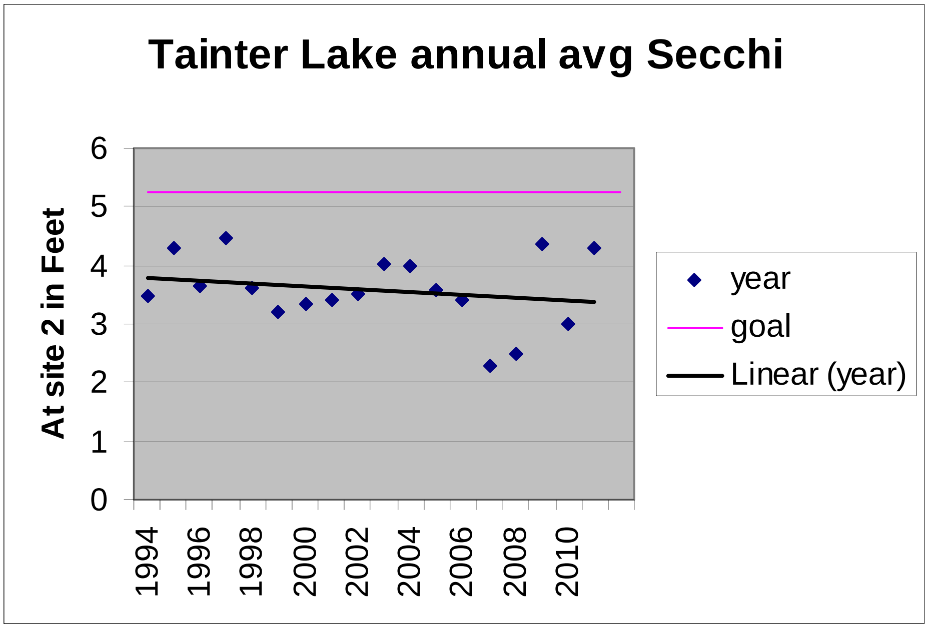


WIDNR data

[2] Schwarz G.E., Hoos A.B., Alexander R.B., and Smith R.A. (2006). "The SPARROW surface water-quality model—theory, applications and user documentation." U.S. Geological Survey, techniques and methods, chapter 6–B3, <http://pubs.usgs.gov/tm/2006/tm6b3/> (Oct. 2009).

This trend toward increasing phosphorus levels is echoed in a trend in decreasing water clarity in Tainter as measured by Secchi (Figure 6.). No statistical analyses was made of this data.

Figure 6.



Conclusion

The land use category data used to develop this TMDL still accurately describes the watershed condition. Measures of land use practice are a mix of trends expected to increase phosphorus export, decrease phosphorus export or are neutral to phosphorus export. Trends in monitoring of the water body itself suggest that the balance of these land use factors is an increasing trend in phosphorus levels, and associated impacts, in the system. More recent information and evaluation techniques will be used went a final TMDL for phosphorus is developed, which addresses the issue of pH standard attainment and hopefully the phosphorus level at which algal toxins will no longer be present. This data emphasizes the need to make progress on watershed phosphorus reductions as quickly as possible**.**