UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

FEB 23 2012

REPLY TO THE ATTENTION OF:

WW-16J

Rebecca Flood, Assistant Commissioner
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

Dear Ms. Flood:

The U.S. Environmental Protection Agency has conducted a complete review of the final Total Maximum Daily Load (TMDL) for Cedar Lake (DNR ID#70-0091) and McMahon Lake (DNR ID #70-0050), including supporting documentation and follow up information. Cedar and McMahon Lakes are located in southeastern Minnesota, in Scott and Rice Counties. The TMDL addresses Aquatic Recreation Use impairment due to excess nutrients (total phosphorus).

The TMDL meets the requirements of Section 303(d) of the Clean Water Act and EPA's implementing regulations at 40 C.F.R. Part 130. Therefore, EPA hereby approves Minnesota's two (2) TMDLs for total phosphorus for Cedar Lake (DNR ID#70-0091) and McMahon Lake (DNR ID #70-0050). The statutory and regulatory requirements, and EPA's review of Minnesota's compliance with each requirement, are described in the enclosed decision document.

We wish to acknowledge Minnesota's effort in submitting this TMDL and look forward to future TMDL submissions by the State of Minnesota. If you have any questions, please contact Mr. Peter Swenson, Chief of the Watersheds and Wetlands Branch, at 312-886-0236.

Sincerely,

Tinka G. Hyde
Director, Water Division

Enclosure

cc: Chris Zadak, MPCA
David L. Johnson, MPCA

wq-iw7-31g

TMDL: Cedar (ID #70-0091) and McMahon Lakes (ID #70-0050), Scott and Rice County, MN
Date:

DECISION DOCUMENT
FOR CEDAR LAKE AND MCMAHON (CARL'S) LAKE TMDLs

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and EPA's TMDL regulations should be resolved in favor of the regulations themselves.

1. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the waterbody as it appears on the State's/Tribe's 303(d) list. The waterbody should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the waterbody and specify the link between the pollutant of concern and the water quality standard (see Section 2 below).

The TMDL submittal should include an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the NPDES permits within the waterbody. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

(1) the spatial extent of the watershed in which the impaired waterbody is located;
(2) the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;

(4) present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and
(5) an explanation and analytical basis for expressing the TMDL through *surrogate measures*, if applicable. *Surrogate measures* are parameters such as percent fines and turbidity for sediment impairments; chlorophyll-a (chl-a) and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

Comment:

Location Description/Spatial Extent: The Minnesota Pollution Control Agency (MPCA) has developed TMDLs for Cedar Lake (DNR ID#70-0091) and McMahon Lake (#70-0050), located in southeastern Minnesota in Scott and Rice County. Cedar and McMahon Lakes are approximately 15-20 miles south of the Minneapolis-St. Paul Metropolitan area in unincorporated areas outside the City of New Prague. Cedar Lake lies approximately 5 miles west of McMahon Lake and although the lakes are discussed together in this document and the TMDL, these watersheds do not share a direct hydrologic connection. However, both lakes are within the Minnesota River Basin and within the North Central Hardwood Forest (NCHF) ecoregion. The boundary between NCHF and the Western Cornbelt Plains (WCBP) ecoregion is approximately 10-15 miles from Cedar and McMahon Lakes (Figure 1-1, Section 2.1, Section 2.2., and 'Executive Summary' of the TMDL).

Both lakes are shallow, hypereutrophic, and polymictic (i.e., meaning they mix multiple times per year). MPCA stated that prior to construction of a new outfall in the 1950's Cedar Lake resembled a shallow wetland. After the new outfall was constructed Cedar Lake water levels increased by five feet (Section 6.0 of the TMDL). McMahon Lake is a smaller lake which drains only the surrounding direct watershed. Current aerial photos of McMahon Lake compared to USGS topographic maps indicate lake levels have increased and adjacent wetlands became inundated since the 1970's (Appendix D of the TMDL). Additional measurements and contributing watershed areas for both lakes are given in Table 1 below.

Table 1. Lake and watershed measurements for Cedar (#70-0091) and McMahon (#70-0050) Lakes.

Lake Characteristics	Cedar Lake	McMahon Lake
Mean depth (ft)	6.9	8.5
Maximum depth (ft)	13	14
Lake surface area (acres)	779	130
Direct watershed drainage (acres)	2472	393
Direct drainage to lake area ratio	2.1:1	3.1:1
Tributary drainage (acres)	7169	n/a
St. Patrick wetland drainage (acres)	610	n/a

Cedar Lake receives flow from the direct drainage area, the St. Patrick wetland east of the lake, and partial inflows from Sand Creek tributary to the south. Sand Creek is connected to Cedar Lake via County Ditch 2. A weir in County Ditch 2 prevents backflow from Cedar to Sand

Creek, and also controls the inflow volume from the ditch (i.e., Sand Creek tributary area) to Cedar Lake when conditions are wet enough that the weir is overtopped. During 2007, when the TMDL study was underway, no inflow from Sand Creek to Cedar Lake occurred due to a beaver dam blockage at the weir (Section 2.2 of the TMDL).

MPCA states that at McMahon Lake the only surface water inflows include runoff from the 393 acre direct watershed and precipitation on the lake surface (Section 2.2 of the TMDL).

Minnesota Department of Natural Resources (MDNR) conducted fish surveys at Cedar Lake and estimated carp density of 400 lbs/acre (Section 3.2.3 of the TMDL). Aquatic plant surveys occurred at both lakes in 2007. The plant community was found to be dominated by curly-leaf pondweed and nuisance densities occurred in late spring/early summer. Between May and August, pondweed die-off occurred in both lakes and distribution of aquatic vegetation would drastically reduce by late summer (Appendix D of the TMDL).

Land Use: Land use in the Cedar and McMahon watersheds are similar and are comprised of agricultural land, woodlands, lakefront residential and rural development, pasture lands, open water, and wetlands. Lakefront developments exist at both lakes, although they are more prevalent at Cedar Lake. Land-use types and the percent coverage in each watershed are in Section 2.3 of the TMDL and summarized in Table 2 below.

Table 2. Percent coverage of land-use categories in Cedar (#70-0091) and McMahon (#70-0050) Lake watersheds.

	Percent of watershed area		
Land Use Category	Cedar Lake	Sand Creek (partial inflows to Cedar Lake)	McMahon Lake
Open Water (including lake surface)	33	n/a	29
Agricultural	21	52	21
Pasture/Range/Open/Non-ag.	14	22	6
Woodland	12	13	23
Rural Residential	12	10	13
Wetland	8	3	9

Problem Identification: MPCA assessment of in-lake water quality data from mid-May to September from 1999 to 2008 indicated that Cedar and McMahon Lakes were impaired by excess nutrients (total phosphorus) and not attaining designated uses. Annual averages from this 10-year period exceeded the total phosphorus and chl-a numeric standards. The 10-year average for Cedar Lake was 170 μg/L for total phosphorus, 71 μg/L for chl-a, and 1.28 m for Secchi disc depth; compared to the NCHF ecoregion water quality standards of 60 μg/L for total phosphorus, 20 μg/L for chl-a, and not less than 1.0 m for Secchi disc depth. For McMahon Lake, the 10-year averages were 85 μg/L for total phosphorus, 70 μg/L for chl-a, and 0.88 m for Secchi disc depth. MPCA determined that Cedar and McMahon Lakes were impaired by excess nutrients and placed both lakes on Minnesota's 2002 303(d) list (Section 1.0, Section 3.1, and Appendix A of the TMDL).

While total phosphorus is an essential nutrient for aquatic life, elevated phosphorus levels can lead to nuisance algal blooms that negatively impact aquatic life and recreation. Algal decomposition depletes oxygen levels which stresses benthic macroinvertebrates and fish. Also excess algae can limit establishment of a healthy assemblage of aquatic vegetation. A healthy vegetation assemblage stabilizes bottom sediments and provides habitat for macroinvertebrates and fish throughout the growing season.

Priority Ranking: The priority ranking of Minnesota waterbodies is implicit in MPCA's schedule to complete TMDLs. The Cedar Lake and McMahon Lake TMDLs were prioritized to begin in 2008 and be complete by 2012. Minnesota prioritizes project start and completion dates based on the likelihood that a TMDL can be completed expediently, the likelihood that the water can be restored, and that data are available ('EPA Summary Table' in the TMDL).

Pollutant of Concern: The pollutant of concern for Cedar and McMahon Lakes is total phosphorus (Section 1.0 of the TMDL).

Source Identification (point and nonpoint sources):
Point sources- There are no known point sources contributing the pollutant of concern to Cedar and McMahon Lakes. There are no Municipal Separate Storm Sewer System (MS4) discharges to Cedar Lake. The McMahon Lake watershed resides in part of an MS4 boundary, but discharge is not conveyed to the watershed.

No National Pollutant Discharge Elimination System (NPDES) permitted wastewater treatment plants (WWTPs) discharge to Cedar or McMahon Lakes.

MPCA also states there are currently no general NPDES permitted discharges, no Concentrated Animal Feeding Operations (CAFOs), and no known illicit septic discharges (i.e., 'straight pipe') to Cedar and McMahon Lakes (Section 3.4.1 of the TMDL).

Non-point sources- Nonpoint loads of total phosphorus to Cedar Lake include partial flows from Sand Creek, inflow from the St. Patrick wetland, direct watershed runoff, internal loading, and atmospheric deposition. Nonpoint sources of total phosphorus in McMahon Lake include direct watershed runoff, internal loading, and atmospheric deposition, and failing septics servicing lakefront homes (Section 3.3.2 and Section 3.3.4 of the TMDL).

The major source of total phosphorus is from internal loading. MPCA estimated that in 2008 internal loading accounted for 93% and 85% of the total load to Cedar and McMahon Lakes respectively (Table 3-6, Table 3-8, Section 3.3.2, and Section 3.3.4 of the TMDL). MPCA identified four in-lake processes that produce internal loads of phosphorus. These included mixing events and carp activity that resuspend sediments, release of phosphorus from bottom sediments during anoxic conditions, and curly-leaf pondweed die-off (Section 3.3.3 and Section 3.3.4 of the TMDL).

Future Growth: Cedar and McMahon Lake watersheds are located in unincorporated areas near the City of New Prague. MPCA assumed urbanized land uses will not increase from now to 2030, based the 2030 Scott County Comprehensive Land Use Plan ('Executive Summary' of the TMDL).

In approximately 2001, lakefront homes around Cedar Lake were connected to a sewer system that does not discharge in the Cedar or McMahon Lake watersheds. Therefore, expansions of the City of New Prague WWTP are not expected to be future sources of total phosphorus to Cedar and McMahon Lakes (Section 1.0 of the TMDL).

To account for any future loads from construction or industrial activity, MPCA gave a wasteload allocation (WLA) for general NPDES permitted construction and industrial stormwater discharges of 0.017 lbs total phosphorus/day for Cedar Lake and 0.0037 lbs total phosphorus/day for McMahon Lake. The WLAs can currently function as reserve capacity for future construction or industrial stormwater permitted discharges in the watershed ('Executive Summary' of the TMDL, Section 3.4.1 of the TMDL, Table 3-11 and 3-12 of the TMDL).

The EPA finds that the TMDL document submitted by the MPCA satisfies the requirements of the first criterion.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy (40 C.F.R. §130.7(c)(1)). EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) – a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target,

Comment:
Designated Uses: Minnesota Rule Chapter 7050 designates uses for waters of the state. Cedar and McMahon Lakes are designated as Class 2B waters for aquatic recreation use (Section 2.1 of the TMDL). The Class 2 aquatic recreation designated use is described in Minnesota Rule 7050.0140 (3):

"Aquatic life and recreation includes all waters of the state that support or may support fish, other aquatic life, bathing, boating, or other recreational purposes and for which quality control is or may be necessary to protect aquatic or terrestrial life or their habitats or the public health, safety, or welfare."

Standards:
Narrative Criteria- Minnesota Rule 7050.0150 (3) contains the narrative criteria for Class 2 waters of the State:

"For all Class 2 waters, the aquatic habitat, which includes the waters of the state and stream bed, shall not be degraded in any material manner, there shall be no material increase in undesirable slime growths or aquatic plants, including algae, nor shall there be any significant increase in harmful pesticide or other residues in the waters, sediments, and aquatic flora and fauna; the normal fishery and lower aquatic biota upon which it is dependent and the use thereof shall not be seriously impaired or endangered, the species composition shall not be altered materially, and the propagation or migration of the fish and other biota normally present shall not be prevented or hindered by the discharge of any sewage, industrial waste, or other wastes to the waters."

Numeric criteria- Numeric criteria for total phosphorus, chl-a, and Secchi disc depth are set forth in Minnesota Rules 7050.0222. These three parameters are the eutrophication standards that must be achieved to attain aquatic recreation designated use. Cedar and McMahon lakes are designated as Class 2B shallow lakes in the NCHF ecoregion (Section 2.1 in the TMDL). The applicable numeric eutrophication criteria for these lakes are in Table 3 below.

The TMDL document provides allocations based on both WCBP and NCHF ecoregions given the watersheds are near the ecoregion boundary. This approval document does not indicate EPA approval of WCBP targets or allocations based on WCBP standards. The NCHF ecoregion standards are the current applicable standards to Cedar and McMahon Lakes (Table 3 in this decision document).

Table 3. Numeric Water Quality Standards applicable to Cedar (#70-0091) and McMahon (#70-0050) Lakes.

Class 2B eutrophication standards for shallow lakes in the North Central Hardwood Forest (NCHF) ecoregion	
Total Phosphorus	60 μg/L
Chlorophyll-a	20 μg/L
Secchi disc depth	not less than 1.0 m

Target: MPCA selected a target of 60 μg/L of total phosphorus to develop the TMDL (Section 3.5.2 of the TMDL).

MPCA selected total phosphorus as the appropriate parameter to address eutrophication problems at Cedar and McMahon Lakes because of the interrelationships between total phosphorus and chl-a, as well as Secchi disc depth. Algal abundance is measured by chl-a, which is a pigment found in algal cells. As more phosphorus becomes available, algae growth can increase. Increased algae in the water column will decrease water clarity that is measured by Secchi disc depth (Section 3.1 of the TMDL).

Regression relationships were established between the causal factor total phosphorus and the response variables chl-a and Secchi disc depth at Cedar and McMahon Lakes (Figures 3-4, 3-5, 3-9, and 3-10 in the TMDL). Based on these relationships a TMDL based on the total phosphorus target of 60 μg/L was predicted to also result in attainment of chl-a, and Secchi disc depth standards ('EPA TMDL Summary Table', Section 3.4, and Section 3.5.2 of the TMDL).

The EPA finds that the TMDL document submitted by the MPCA satisfies the requirements of the second criterion.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a waterbody for the applicable pollutant. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). If the TMDL is expressed in terms other than a daily load, e.g., an annual load, the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

TMDLs must take into account *critical conditions* for steam flow, loading, and water quality parameters as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable *critical conditions* and describe their approach to estimating both point and nonpoint source loadings under such *critical conditions*. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

Comment: In equation form, the TMDLs for Cedar Lake and McMahon Lake may be expressed as follows:

	TMDL	=	WLA	+	LA	+	MOS
Cedar L.:	**6.679 lbs/day**	**=**	**0.017 lbs/day**	**+**	**6.662 lbs/day**	**+**	**Implicit**
McMahon L.:	**0.8131 lbs/day**	**=**	**0.0037 lbs/day**	**+**	**0.8094 lbs/day**	**+**	**Implicit**

where the WLA is the allowable discharge given to point sources in the TMDLs, Load Allocation (LA) represents allowable loads from nonpoint sources, and Margin of Safety (MOS) represents implicit assumptions that account for uncertainty inherent in the TMDL.

The loading capacity, or total maximum daily load, for **Cedar Lake is 6.6790 lbs of total phosphorus per day** (Table 3-11 in the TMDL). The loading capacity for **McMahon Lake is 0.8131 lbs of total phosphorus per day** (Table 3-12 in the TMDL). This is the estimated amount of total phosphorus load each lake can receive per day, during the growing season, and still meet eutrophication water quality standards. It is the sum of WLA, LA, and MOS.

Modeling Summary:
The TMDLs were determined in a multi-step process. First current loads of total phosphorus going to the lake were estimated using either modeled estimates [empirical equations and the P8 model (Program for Predicting Polluting Particle Passage thru Pits, Puddles, & Ponds)], monitoring data, or some combination of both. Second, in-lake water quality responses were modeled using the Vollenweider equation. Variables in the Vollendweider equation were iteratively adjusted to determine the numerical loading capacity, i.e., the TMDL. Finally, the TMDL was allocated to the sources of total phosphorus at Cedar and McMahon Lakes.

Current Loading to the Lakes- Current phosphorus loads in runoff from the direct watersheds (Cedar and McMahon) were modeled using land-use based runoff coefficients, land use coverage data, and annual rainfall inputs (Section 3.2.2 of the TMDL). MPCA selected the runoff coefficients developed for the Minnesota River region in a previous study (Section 3.2.2 of the TMDL). Climate data from the Minneapolis-St. Paul airport were adjusted to represent local conditions. Adjustments were based on a precipitation gage local to the watershed (Section 3.2.2 of the TMDL). Annual rainfall during the study period was two to three inches below average precipitation for the Minnesota Basin (Section 3.4.3 of the TMDL).

The P8 model was used to estimate daily loads of phosphorus in watershed runoff (rather than bulk year estimates). The P8 model estimates loads based on rainfall and the phosphorus export coefficients, which were based on precipitation amounts during an average year. This model was selected so loadings and inflow could be calculated on a daily timescale to better account for variability observed during the study. P8 can also estimate treatment effects of Best Management Practices (BMPs) and thus be an implementation tool. MPCA compared the loading estimates from P8 with results from previous studies of total phosphorus export in the Minnesota River basin to assess accuracy of modeled phosphorus loads (Section 3.2.2 of the TMDL).

Other calculations of external load included phosphorus in Sand Creek and St. Patrick's Wetland inflows to Cedar Lake. Loading was estimated from flow monitoring and water quality grab samples taken at the weir in County Ditch 2 (i.e., Sand Creek inflows) and in the wetland at approximately weekly intervals in the 2007 and 2008 growing seasons (Section 3.2.1 of the TMDL). Atmospheric loads to both lakes were determined using rainfall data, lake surface area, and a deposition rate of 0.2615 kg total phosphorus/ha/yr which was selected given it was considered representative of the Minnesota River Basin (Section 3.4.2 of the TMDL).

Loads from internal lake sources were further described where data were available. A fish survey taken at Cedar Lake, and aquatic macrophyte surveys and sediment core sampling taken at Cedar and McMahon Lakes were used in conjunction with literature values to estimate internal loading from fish, curly-leaf pondweed decay, and release of phosphorus from bottom sediment. These estimated loads agreed with the loading estimates developed by the P8 modeling efforts (Section 3.2.3 and Appendix C of the TMDL)

Estimated phosphorus loads (lbs per growing season) from each identified source are shown in Table 3-6 and Table 3-8 in the TMDL for Cedar and McMahon Lakes, respectively (Section 3.3.2 and Section 3.3.4 of the TMDL). Internal loads were found to contribute up to 96% of the total load to Cedar Lake and up to 85% in McMahon Lake (during 2007 and 2008). Daily internal loading rates used in the model are given in Table 3-4 in the TMDL (Section 3.2.3, Appendix C, and Appendix D of the TMDL). At Cedar Lake, sediment release and carp activity were the two largest sources of phosphorus to the lake. At McMahon Lake the largest sources of phosphorus were releases of sediment, and drainage from the direct watershed.

External loads to Cedar Lake (i.e., direct watershed, wetland, flow diverted from Sand Creek at the weir, and rainfall) accounted for up to 5.1% of the total load to the lake during the study. At McMahon Lake, external loads accounted for up to 20% of the total load (Section 3.3.2 and Section 3.3.4 of the TMDL).

In-Lake Water Quality Modeling- The water quality response to incoming loads was estimated using the Vollenweider equation. The equation was also used to determine the numerical loading capacity by adjusting the watershed and internal load variables until the Vollenweider equation predicted total phosphorus of 60 μg/L (i.e., the TMDL target) (Section 3.2, Appendix C, and Appendix D of the TMDL). The Vollenweider equation was selected because it could be modified to account for daily variation in loads, sedimentation, and flushing rates. MPCA believed this would more accurately represent daily water quality at Cedar and McMahon Lakes than other models considered (Section 3.2.3 of the TMDL). The Vollenweider equation, predicts total phosphorus as:

$$TP = (L + Lint) / (z^* (\rho + \sigma))$$

Where;

z = average lake depth in meters;

ρ = flushing rate per year;

σ = sedimentation rate per year;

L = areal (i.e., watershed and atmosphere) loading rate in mg/(m2*yr); and

Lint = internal loading rate in mg/(m_2*yr).

To populate the equation, average lake depth (z) for both Cedar and McMahon Lakes were estimated using lake morphometry and inflow data. Flushing rates (ρ) were determined from water balance calculations based on daily precipitation data, average lake depth, estimated watershed runoff (from P8), lake volume, and evaporation measured using the Meyer Model. A sedimentation rate (σ) was back-calculated using the Vollenweider equation. MPCA assumed that under well-mixed periods, generally after spring turnover, internal loads were minimal and thus total phosphorus concentrations in the lake are determined by sedimentation, and watershed and atmospheric loads. Based on these assumptions, the internal load term in the Vollenweider equation was set to zero then sedimentation rates were back calculated. Areal loading (*L*) rates are understood to be the modeled P8 outputs of phosphorus in direct watersheds (plus loading from the wetland and Salt Creek for Cedar Lake and atmosphere).

Given that internal loads were found to be the dominant source of phosphorus in both lakes, it was a key term in the Vollenweider equation. MPCA calibrated the internal load term, by varying sedimentation rates and by estimating net internal loads (Section 3.2.3 of the TMDL). Internal loading rates (*Lint*) were determined from estimated loads for fish, sediment, and curlyleaf pondweed decay. MPCA stated that the internal loading rates (*Lint*) used in the Vollenweider equation compared well to the estimates derived from the sediment coring studies at both lakes (Appendix C of the TMDL).

Model fit- MPCA examined the accuracy of the Vollenweider model estimates of in-lake water quality by comparing monitoring data from the growing season in 2007 and 2008. The average total phosphorus for the growing season estimated from the model varied less than 1% from the measured growing season average. The r^2 values for monitored versus modeled data points were 0.79 and 0.95 for McMahon and Cedar Lake, respectively. MPCA believed the model fit for both lakes was good (Figure 3-11, Figure 3-12, and Section 3.3.1 of the TMDL).

Critical Conditions: MPCA determined that critical conditions occurred during the growing season (mid-May to September) in an average precipitation year. MPCA identifies the growing season as the critical condition due to reduced inflow and flushing rates that cause nutrients to accumulate. Accumulated nutrients coupled with warmer temperatures enhance algal growth which can cause anoxic conditions and subsequent release of phosphorus from bottom sediments (Section 3.4 of the TMDL). Among the two years observed for the TMDL study, 2008 best reflected these conditions. The annual average precipitation was 25" in 2008, whereas average annual rainfall for the Minnesota River Basin is cited as 28". In addition, higher in-lake total phosphorus concentrations were observed in 2008 (Section 3.4.2 of the TMDL).

To account for critical conditions, in-lake water quality and climate data recorded in 2008 were used to determine the TMDL. In-lake water quality observations were made during mid-May to September, while modeled loads incorporated weather data from this time period. Thus MPCA calculated TMDL allocations that reflect critical conditions (Section 3.1 and Section 3.4.3 of the TMDL).

The EPA finds that the TMDL document submitted by the MPCA satisfies the requirements of the third criterion.

4. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R.

§130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources.

Comment:

Load Allocations (LA): To attain water quality standards, current loading of total phosphorus needs to be reduced by 85% for Cedar Lake and by 81% at McMahon Lake (Section 3.4.2 of the TMDL). There are no point source discharges to Cedar and McMahon Lake, thus reductions must be achieved from nonpoint sources. Load allocations to atmospheric inputs remained equal to current estimated loads based on an average precipitation year. Greater load reductions will be required from internal loads on the basis that they are responsible for a large majority of the load (Table 3-11, Table 3-12, and Section 3.5 of the TMDL). Table 4 in this decision document summarizes the load allocations for each lake.

Table 4 Load Allocations for Cedar (#70-0091) and McMahon (#70-0050) Lakes.

Load Allocations	Cedar Lake (TP lbs/day)	McMahon Lake (TP lbs/day)
Watershed Sources	1.701	0.3630
Atmospheric Inputs	0.702	0.1290
Internal Loading (carp, sediment release, and curlyleaf pondweed)	4.259	0.3174
Total Load Allocation	**6.662**	**0.8094**

The EPA finds that the TMDL document submitted by the MPCA satisfies the requirements of the fourth criterion.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permittees should be notified of any deviations from the initial individual WLAs contained in the TMDL. EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

Comment: A WLA was given to general NPDES construction and industrial permits. MPCA stated that no current construction or industrial activities were identified; however MPCA set the following WLAs assuming that 1% of the watershed area could be subject to future construction or industrial activity:

- Cedar Lake general NPDES construction and industrial stormwater permits
  WLA = 0.017 lbs total phosphorus/day.

- McMahon Lake general NPDES construction and industrial stormwater permits
  WLA = 0.0037 lbs total phosphorus/day.

MPCA found no additional individual or general NPDES permitted discharges in the Cedar and McMahon Lake watersheds. No WWTPs, MS4s, individual NPDES permits, or general NPDES permits for industrial stormwater were found to discharge in the watershed (Table 3-11, Table 3-12, and Section 3.4.1 of the TMDL).

The EPA finds that the TMDL document submitted by the MPCA satisfies the requirements of the fifth criterion.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

Comment: Implicit margin of safety is provided through conservative assumptions. Export coefficients used to estimate watershed loads were based on average precipitation years, rather than the drier years observed in 2007 and 2008. Thus incoming loads were modeled to be higher than what would be expected during the study period. The Scott Watershed Management Organization (WMO) indicated that this resulted in an overestimate of load reductions required by approximately 4% and 7% for Cedar and McMahon Lake watersheds respectively (Section 3.4.3 of the TMDL and Administrative Record No. 8-6-c).

The EPA finds that the TMDL document submitted by the MPCA satisfies the requirements of the sixth criterion.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Comment: Phosphorus loads can vary by season, and the source loads varies with precipitation. For example in a dry year with little precipitation, less flushing of lake volume concentrates nutrients, and increases stratification, which are conditions that support internal loading from anoxic bottom sediments. By contrast, in a wet precipitation year, water and nutrients in shallow lakes can be flushed through at a greater rate, which limits nutrient accumulation and algal growth.

Seasonal variation was accounted for in the Cedar and McMahon Lake TMDL calculations by modifying the Vollenweider equation to account for daily fluctuations in inflow and outflow in the lakes. This allowed for daily estimation of in-lake total phosphorus and more accurately defines when total phosphorus concentrations vary within the growing season (Section 3.2.3 of the TMDL).

Total phosphorus loads at Cedar and McMahon Lakes will also vary from year to year based on the amount of rainfall-driven runoff that occurs. Total annual precipitation from 2007 and 2008 was 26″ and 25″, respectively. These years are slightly drier than the average of 28″ per year for the Minnesota River basin (Section 3.2.2 of the TMDL). These observations support that data used to develop the TMDL best reflect dry and average conditions, which are the more critical conditions at these lakes for meeting water quality standards.

The EPA finds that the TMDL document submitted by the MPCA satisfies the requirements of the seventh criterion.

8. Reasonable Assurances

When a TMDL is developed for waters impaired by point sources only, the issuance of a NPDES permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

Comment:

Clean Water Legacy Act (CWLA): The CWLA is a statute passed in Minnesota in 2006 for the purposes of protecting, restoring, and preserving Minnesota water. The CWLA provides the process to be used in Minnesota to develop TMDL implementation plans, which detail the restoration activities needed to achieve the allocations in the TMDL. The TMDL implementation plans are required by the State to obtain funding from the Clean Water Fund. The Act discusses how MPCA and the involved public agencies and private entities will coordinate efforts regarding land use, land management, water management, etc. Cooperation is also expected between agencies and other entities regarding planning efforts, and various local authorities and responsibilities. This would also include informal and formal agreements to jointly use technical, educational, and financial resources. MPCA expects the implementation plans to be developed within a year of TMDL approval.

The CWLA also provides details on public and stakeholder participation, and how the funding will be used. The implementation plans are required to contain ranges of cost estimates for point and nonpoint source load reductions, as well as monitoring efforts to determine effectiveness. MPCA has developed guidance on what is required in the implementation plans (Implementation Plan Review Combined Checklist and Comment, MPCA), which includes cost estimates, general timelines for implementation, and interim milestones and measures. The Minnesota Board of Soil and Water Resources administers the Clean Water Fund as well, and has developed a detailed grants policy explaining what is required to be eligible to receive Clean Water Fund money (FY '11 Clean Water Fund Competitive Grants Policy; Minnesota Board of Soil and Water Resources, 2011).

Point Sources: Reasonable assurance that the WLAs will be implemented is provided by regulatory actions. According to 40 CFR 122.44(d)(1)(vii)(B), NPDES permit effluent limits must be consistent with assumptions and requirements of all WLAs in an approved TMDL. MPCA implements its storm water and NPDES permit programs, and is responsible for making the effluent limits consistent with the WLAs in this TMDL. Furthermore, MPCA states that the Scott WMO has comprehensive management efforts in place to mitigate phosphorus loads from development activity (Section 6.2 of the TMDL).

Nonpoint Sources: MPCA acknowledged challenges to implementation and activities that they believe should not be pursued based on lack of stakeholder support, uncertainty in management methods, and the likelihood of ineffective treatment. MPCA considered these challenges and then selected implementation activities that have demonstrated ability to reduce pollutant loads (Section 5.0 and Section 6.2 of the TMDL). Given that an implementation plan is expected to be complete within a year of the TMDL approval, there is reasonable assurance that the BMPs to be implemented would reduce phosphorus loads.

Scott WMO will play a leading role in Cedar and McMahon Lake TMDL implementation. Scott WMO is a local unit of government formed in 2000 that is responsible for planning and implementing surface water management plans. Scott WMO was involved in TMDL development and has demonstrated a commitment to improving water quality (Section 1.0 of the TMDL).

Scott County and Scott WMO have adopted a "Natural Areas Corridor concept" that promotes implementation of green infrastructure which will reduce phosphorus loads (Section 6.2 of the TMDL). Also, a recent acquisition of parklands was made adjacent to Cedar Lake. If current restoration plans of the parklands are completed, buffering capacity and infiltration would increase and reduce phosphorus loading. Implementation will be supported by NRCS and Scott Soil and Watershed Conservation District (SWCD) Technical Assistance and Cost Share (TACS) program, which began in 2006 and implemented low impact development projects, filter strips, and wetland restoration, and other watershed improvements. The Cedar Lake area has been identified as a priority area for the TACS program (Administrative Record No. 8-6-c).

Implementation of practices that will control internal loading was discussed at stakeholder meetings during TMDL development. Carp and macrophyte management was discussed and MN DNR requested that Scott WMO further coordinate with them if these practices are implemented (Section 5.2.2.2 and Section 5.3 of the TMDL).

MPCA identified sources of funding for implementation activities to include: the Scott WMO cost share program, the Wetland Reserve Enhancement Program grant received by Scott SWCD, and Clean Water Legacy Act Funding (Section 5.0 and Section 6.0 of the TMDL).

The EPA finds that this criterion has been adequately addressed.

9. Monitoring Plan to Track TMDL Effectiveness

EPA's 1991 document, *Guidance for Water Quality-Based Decisions: The TMDL Process* (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

Comment: Annual water quality and some flow data will continue to be collected through the Citizen Assisted Monitoring Program (CAMP). The CAMP is coordinated by the Metropolitan Council and Scott WMO. The group monitors in-lake total phosphorus, chl-a, Secchi disk depth, temperature, and dissolved oxygen, approximately 8-10 times between April and September. These monitoring data can be used to estimate current loading for a post-TMDL period and compared to the current loading estimates provided in this study. This comparison would assess if water quality improvements have occurred post-TMDL implementation (Section 4.0 of the TMDL).

The EPA finds that this criterion has been adequately addressed.

10. Implementation

EPA policy encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

Comment: In accordance with MPCA policy, an implementation plan will be completed within one year of TMDL approval. Estimated reductions to meet the TMDL were 81 pounds of total phosphorus from watershed sources and 5,196 pounds from internal loading sources at Cedar Lake. Reductions needed at McMahon Lake were estimated to be 17 pounds from external and 455 pounds from internal sources (Section 5.1 and 5.2 of the TMDL).

A sequence of reduction strategies was based on model outputs, knowledge of the watershed, and discussion with stakeholders and other agencies. The sequence included: development of an aquatic plant management plan, reduction of external watershed sources, aquatic plant treatment, carp treatment, and lastly lake sediment inactivation. By managing plants, watershed sources, and fish before inactivating the sediment, any improvements in water quality from managing sources directly could be assessed (Section 5.2 of the TMDL).

MPCA considers watershed reductions a priority given that it both directly prevents loading to the lake, and reduces internal loading from sediments over the longer term. Examples of actions to reduce watershed sources included: shoreline stabilization, BMPs in parks, and restoration of native plant communities (Section 5.2.1 of the TMDL).

The EPA finds that this criterion has been adequately addressed.

11. Public Participation

EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2)).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

Comment: The first public information meeting was held on December 6, 2007. On October 15, 2009 stakeholders and Scott WMO staff met to discuss the TMDL study to date. The Technical Advisory Committee of the Scott WMO was briefed on the TMDL study at semi-annual meetings over the course of the project. In addition, the Watershed Planning Commission (a committee of citizens appointed to advise the Scott WMO Board) was periodically briefed throughout the study (Section 7.0 of the TMDL).

The TMDL was posted for public comment from June 20, 2011 to July 20, 2011. The comment period was extended to August 15, 2011 due to the State of Minnesota shutdown during July 2011. The public comment period was published in the Minnesota State Register on Monday June 20, 2011, and announced in a MPCA news release. Electronic copies of the draft TMDL were published on the MPCA website along with a notification of the public comment period (Administrative Record No. 8-3, 8-4, and 8-5).

The Minnesota Corn Growers Association (MCGA) and the Midwest Center for Environmental Advocacy (MCEA) submitted written comments to MPCA during the public comment period. The MCGA commented that they believe the current standards may not be reasonable or attainable, they requested clarification on land use information, and stated concern on the emphasis of using cost-share or land acquisition programs. MPCA provided the appropriate clarifications and responses to these comments (Administrative Record No. 8-6-a).

MCEA commented that further source assessment of watershed sources was needed, there was an overreliance on internal load reductions, no reserve capacity was provided, and the margin of safety was insufficient. The Scott WMO provided a written response to support MPCA, which MPCA agreed with and provided to the commenter. The Scott WMO clarified that future growth was not expected in Cedar and McMahon Lakes through 2030. The response also indicated that further characterization of watershed pollutant sources would provide diminishing returns given that most phosphorus is sourced from internal loads, and therefore Scott WMO indicated that large reductions from internal loads were necessary. Scott WMO stated that even 90% reduction of watershed loads would still require substantial reductions from internal loads to achieve the TMDL. Further enumeration of the margin of safety was also provided. MPCA adequately addressed each comment that was received (US EPA Administrative Record No. 8-6).

The EPA finds that the TMDL document submitted by the MPCA satisfies the requirements of this eleventh element.

12. Submittal Letter

A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a *technical review* or *final review and approval*. Each final TMDL submitted to EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the waterbody, and the pollutant(s) of concern.

Comment: On February 6, 2012, EPA received a submittal letter dated January 23, 2012 signed by Rebecca J. Flood, MPCA Assistant Commissioner, addressed to Tinka Hyde, EPA Region 5, Water Division Director. The submittal letter identified the names of the waterbodies for which the TMDLs were developed. The location of the waterbodies was provided in the supporting documentation. The letter explicitly states that the Cedar and McMahon TMDLs are being submitted for final approval by EPA under Section 303(d) of the Clean Water Act.

The EPA finds that the TMDL document submitted by the MPCA satisfies the requirements of this twelfth element.

13. Conclusion

After a full and complete review, the US EPA finds that the TMDLs for excess nutrients (total phosphorus) for Cedar Lake (DNR ID#70-0091) and McMahon Lake (DNR ID#70-0050) meet all of the required elements of approvable TMDLs. This decision document addresses a total of two **(2) TMDLs**, one for Cedar Lake (DNR ID#70-0091) and one for McMahon Lake (DNR ID#70-0050) as identified on Minnesota's 2002 303(d) list.

EPA's approval of this TMDL does not extend to those waters that are within Indian Country, as defined in 18 U.S.C. Section 1151. EPA is taking no action to approve or disapprove TMDLs for those waters at this time. EPA, or eligible Indian Tribes, as appropriate, will retain responsibilities under the CWA Section 303(d) for those waters.