# EPA Region 7 TMDL Review

**TMDL ID:** IA01-MAQ-00680-L-0 **State:** IA

**Document Name:** SILVER LAKE DELAWARE

**Basin(s):** NORTHEAST IOWA RIVER BASIN

**HUC(s):** 07060006

**Water body(ies):** SILVER LAKE

**Tributary(ies):**

**Pollutant(s):** ALGAL GROWTH, AMMONIA, DISSOLVED OXYGEN, PH, TOTAL PHOSPHORUS, TURBIDITY

**Submittal Date:** 11/3/2008 **Approved:** Yes

**Submittal Letter**

*State submittal letter indicates final Total Maximum Daily Load(s) (TMDL) for specific pollutant(s)/water(s) were adopted by the state, and submitted to EPA for approval under section 303(d) of the Clean Water Act [40 CFR § 130.7(c)(1)]. Include date submitted letter was received by EPA, date of receipt of any revisions, and the date of original approval if submittal is a phase II TMDL.*

This TMDL was modified and submitted as a revised TMDL. A 2006 assessment indicated water quality was not improving and found the water was also impaired for the pollutants nuisance algal growth, pH, turbidity, and ammonia. This TMDL was submitted to the United States Environmental Protection Agency (EPA) from the Iowa Department of Natural Resources (IDNR) on November 3, 2008. A revision to this TMDL was sent via email January 22, 2009.

The initial TMDL (approved December 13, 2001) was written for the pollutants nutrients and organic enrichment.

**Water Quality Standards Attainment**

*The water body's loading capacity (LC) for the applicable pollutant is identified and the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources is described. TMDL and associated allocations are set at levels adequate to result in attainment of applicable water quality standards (WQS) [40 CFR § 130.7(c)(1)]. A statement that WQS will be attained is made.*

The designated uses listed for Silver Lake are Primary Contact Recreation (A), Class B (LW), and Fish Consumption (HH). The state of Iowa (IA) has no numeric water quality criteria for algae or turbidity, therefore the desired endpoints for WQS were based on acquiring Carlson's Trophic State Index (TSI) values of 65 for chlorophyll-a and Secchi depth, and 70 for total phosphorous. These targets were also based on meeting the IA WQS for pH and ammonia as described in Chapter 61 of the WQS. For pH, the submittal states that pH shall not be less than 6.5 nor greater than 9.0.

EPA agrees that attainment of the LCs should result in the attainment of WQS.

**Numeric Target(s)**

*Submittal describes applicable WQS, including beneficial uses, applicable numeric and/or narrative criteria. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, site specific if possible, was developed from a narrative criterion and a description of the process used to derive the target is included in the submittal.*

The designated uses listed for Silver Lake are Primary Contact Recreation (A), Class B (LW), and Fish

Consumption (HH). The specific water quality criteria for these designated uses listed below are published in the Environmental Protection Rule 567, Chapter 61 WQS:

Subrule 61.3(5) for Class A waters and pH states, "The pH shall not be less than 6.5 nor greater than 9.0. The maximum change permitted as a result of a waste discharge shall not exceed 0.5 pH units."

Subrule 61.3(5) 6(1) for Class B (LW) waters is referenced in Table 2 of the IA WQS (Ch.1, p.21). The minimum value at any time during every 24-hour period should be 5.0 mg/L (milligrams per liter). The value of 5.0 mg/L applies only to the upper layer of stratification in lakes.

Subrule 61.3(3) states, "The waters shall contain no substances in concentrations which will make fish or shell-fish inedible due to undesirable tastes or cause a hazard to humans after consumption." Specific toxic chemical criteria were also available.

Table 6 on page 23 of the TMDL lists the Acute Ammonia Water Quality Criterion for listed classes.

The 2006 305(b) Report states that the Class A (Primary Contact Recreation) uses were assessed (monitored) as "not supported" due to 1) extremely poor water transparency that violates IA's WQS protecting objectionable conditions and 2) frequent violations of IA's water quality criterion for pH. In addition, the presence of very large populations of nuisance aquatic life (blue-green algae) likely represents an additional impairment to the Class A uses. The Class B (LW) aquatic uses were assessed as "not supported" due to violations of state water quality criteria for dissolved oxygen (DO) and pH. The Class B (LW) uses were also assessed as "not supported" due to excessive nutrient loading to the water column, nuisance blooms of algae, and re-suspension of sediment.

As previously stated, the state of IA has no numeric water quality criteria for algae or turbidity. The assessment protocol from the IA 305(b) Report states that if a lake is determined impaired by algae or turbidity, the targets for this TMDL are a mean TSI value of less than 65 for both chlorophyll-a and Secchi depth. These values are noted to be equivalent to a chlorophyll-a concentration of 33 µg/L (micrograms per liter) and a Secchi depth of 0.7 meters. This is how and why the indicated targets are set to assist in the achievement of increased water quality within Silver Lake. Chapter 61 of the IA WQS was also used to determine criteria for the water quality and is available at http://www.iowadnr.com/water/standards/files/chapter61.pdf for reference purposes.

This revised TMDL uses data from the initial TMDL and subsequent sampling results to more accurately define present conditions within the lake. The re-evaluation has resulted in a better characterization of the lake's condition and response of the algal community to nutrient conditions.

EPA agrees that the phase II TMDL results in an improved analysis and more appropriate LCs.

**Pollutant(s) of concern**

*An explanation and analytical basis for expressing the TMDL through surrogate measures (e.g., parameters such as percent fines and turbidity for sediment impairments, or chlorophyll-a and phosphorus loadings for excess algae) is provided, if applicable. For each identified pollutant, the submittal describes analytical basis for conclusions, allocations and margin of safety (MOS) that do not exceed the LC. If submittal is a phase II TMDL there are refined relationships linking the load to WQS attainment. If there is an increase in the TMDL there is a refined relationship specified to validate the increase in TMDL (either load allocation (LA) or waste load allocation (WLA)). This section will compare and validate the change in targeted load between the versions.*

TSI values of less than 65 for chlorophyll-a and Secchi depth, and a TSI value of less than 70 for total phosphorous were the established criteria used as surrogate measures for excess algae within the lake. To achieve attainment of water quality standards, the submittal states that pH shall not be less than 6.5 nor greater than 9.0. TSI values for chlorophyll-a, Secchi depth, and phosphorous were considered due to the fact that IA has no numeric water quality criteria for algae or turbidity. All impairments in this lake can be linked to excess phosphorous that often supports high amounts of algal biomass. Biomass, which is mainly comprised of blue-green algae, is noted to lead to the additional impairments of Silver Lake that include nuisance algal growth, pH, turbidity, and ammonia. When phosphorous is recycled within the lake due to the number of minimal outlets within the watershed, algal blooms are produced which then increases turbidity. The decomposition of algal blooms causes a decrease in DO and a release of ammonia into the water.

To further assist with the designated criteria, the Volenwider 1983 Combined Organization for Economic Cooperation and Development model was completed by Herring in 2006. This model was used and expanded for this TMDL in order to target phosphorous as a translator for the impairment of algal growth, pH, turbidity, and

ammonia.

Although designated targets for chlorophyll-a, Secchi depth, and pH have not changed from the initial TMDL, the annual total maximum load of phosphorous has increased. A reduction of 67% from the current load of 457 lbs/year is required to fully attain the WQS of Silver Lake.

The initial TMDL was based on a volumetric equation with a desired concentration of 100 µg/L for the pollutants nutrients and organic enrichment. The revised TMDL uses improved modeling techniques with current monitoring data, as well as better sourcing data. The additional impairments still target phosphorous as a translator.

The revised LC, reduction of total phosphorous, and increased LA will meet the WQS, and attain designated uses.

**Source Analysis**

*Important assumptions made in developing the TMDL, such as assumed distribution of land use in the watershed, population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources, are described. Point, nonpoint and background sources of pollutants of concern are described, including magnitude and location of the sources. Submittal demonstrates all significant sources have been considered. If this is a phase II TMDL any new sources or removed sources will be specified and explained.*

The Silver Lake watershed is approximately 238.9 acres and has a watershed to lake ratio of 6.7:1. The land use is made up of farmstead (2.2%), grass/timber (8.46%), pasture (0.63%), road (6.86%), row crop (63.33%), and urban residential (5.4%). Water accounts for 13.02% of this watershed. Soils within the Silver Lake watershed are primarily forest-derived including Chelsea, Olin Variant, Lamont, and Schley soils. The permeability of these soils is moderately rapid, with runoff slow to medium. In normal circumstances, these soil types have low to very low amounts of available phosphorous.

Based on the information before us, the states decision to apply the discharges associated with unpermitted sources to the LA, as opposed to the WLA for purposes of this TMDL is acceptable. The decision to allocate these sources to the LA does not reflect any determination by EPA as to whether these discharges are, in fact, unpermitted point source discharges within this watershed. In addition, by approving these TMDLs with some sources treated as LAs, EPA is not determining that these discharges are exempt from NPDES permitting requirements. If sources of the allocated pollutant in this TMDL are found to be, or become, NPDES-regulated discharges, their loads must be considered as part of the calculated sum of the WLA in this TMDL. WLA in addition to that allocated here is not available.

Any CAFO that does not obtain an NPDES permit must operate as a no discharge operation. Any discharge from an unpermitted CAFO is a violation of Section 301. It is EPA's position that all CAFOs should obtain an NPDES permit because it provides clarity of compliance requirements, authorization to discharge when the discharges are the result of large precipitation events (e.g., in excess of 25-year and 24-hour frequency/duration) or are from a man-made conveyance. However, many large CAFOs (mostly the poultry and swine sectors) contend that they do not discharge nor propose to discharge therefore are not required to obtain an NPDES permit. It is EPA's opinion that many of the "no discharge" CAFOs do not have adequate land application area to ensure the agronomic uptake of land applied waste. Furthermore, there are many AFOs that meet the definition of a medium CAFO (i.e., discharge via a man-made conveyance) but are unpermitted and have not limited their impact on waters by applying Best Professional Judgment to effluent reductions.

Permitted CAFOs identified in this TMDL are part of the assigned WLA. AFOs and unpermitted CAFOs are considered under the LA because we do not currently have enough detailed information to know whether these facilities are required to obtain NPDES permits. This TMDL does not reflect a determination by EPA that such facility does not meet the definition of a CAFO nor that the facility does not need to obtain a permit. To the contrary, a CAFO that discharges or proposes to discharge has a duty to obtain a permit. If it is determined that any such operation is an AFO or CAFO that discharges, any future WLA assigned to the facility must not result in an exceedance of the sum of the WLAs in this TMDL as approved.

When phosphorous is applied to fields as either fertilizer or manure, it often attaches to soil until used by crops. Regionally one ton of sediment contains 1.3 pounds of phosphorous, as a result approximately 114 tons of sediment per year washes into Silver Lake during a year of average rainfall. Critical conditions for phosphorous loading and algal growth are taken into consideration prior to and during the growing season which is March

through September. During March and April soil moves readily with snowmelt and increased precipitation; this in turn transports increased amounts of phosphorous attached to sediment into the lake. Manure and fertilizer are applied during the early part of the spring season, adding additional phosphorous to the soil. During April through late July/early August algal blooms grow and peak. As blooms decompose additional phosphorous is released into the lake. Dependant upon the temperature and pH of the system, ammonia may build up to toxic levels. Consequently, once sediment is transported into the water body it serves as a nutrient source for algal blooms. The production of algal blooms then increases turbidity, decreases water clarity, and increases pH via photosynthesis. Assumptions discussed within the submittal suggests that water may escape the lake by a seepage at the dam and from the lake to the groundwater. As a result of the small amount of water leaving the lake, sediment and phosphorous is trapped within the lake resulting in algal blooms, periods of low DO, high pH, increased turbidity, as well as increased levels of ammonia.

The total phosphorous load within Silver Lake is comprised of an external and internal load. The external load consists of phosphorous attached to sediment and dissolved phosphorous entering the lake by means of tributaries or runoff. Internal loads consist of phosphorous that is trapped in the lake and recycled between sediment and the water column via in-lake processes. Distinguishing how much of the total load is external verses internal is very difficult for a system like Silver Lake for several reasons. The lake has no direct tributaries coming in or out of the lake. The only incoming water source is from overland flow and direct precipitation. It is very difficult to quantify the amount of water escaping the lake through seepage at the dam and percolation to groundwater. In 2001, a geophysical study of the lake was performed. Results indicated possible water loss to groundwater under the deepest part of the lake. A review of the data revealed discrepancies in data collection. Until evidence proves this to be true, the conservative approach is to assume no loss of lake water or phosphorous via the bottom of the lake. The internal load of phosphorous being recycled within Silver Lake was estimated at 21-25% of the average annual phosphorous load.

Plant respiration, a by-product of algal blooms, plays a significant role in the loss of DO within a water body. Low DO causes stress to fish populations often leading to the death of fish. Predatory fish are more susceptible to stress as a result of low DO in the water body. If a reduction in predatory fish occurs, the reproduction of smaller fish will go unchecked. Smaller fish are known to feed on zooplankton which feed on algae. A vast reduction in zooplankton population results in the increase of algal blooms in biomass. When this occurs, algal blooms die and the initial phosphorous that was used and stored is then re-released into the lake.
The decomposition of algal blooms then leads to the release of ammonia into the water. If ammonia is released during periods of warm water temperatures and high pH, a strong possibility of toxic levels of ammonia could occur within the lake. When photosynthesis is performed by algal blooms the pH of the water increases because carbon dioxide is removed from the water. This results in the reduction of the amount of carbonic acid within the water and raises the pH. The ability of sediment to retain phosphorous is extremely dependant upon pH.

The initial TMDL submitted in December of 2001 listed impairments for excessive nutrients (phosphorous) and organic enrichment (blue-green algae blooms). This revised TMDL includes nuisance algal growth, pH, turbidity, ammonia, and DO as pollutant sources, since the water body is now listed on the 2006 Iowa 303(d) list as impaired for algae and pH.

EPA agrees that all known sources are considered in this submittal.

**Allocation - Loading Capacity**

*Submittal identifies appropriate WLA for point, and load allocations for nonpoint sources. If no point sources are present the WLA is stated as zero. If no nonpoint sources are present, the LA is stated as zero [40 CFR § 130.2 (i)]. If this is a phase II TMDL the change in LC will be documented in this section.*

The LC for Silver Lake is now 154 lbs/yr, or 1.2 lbs/day for phosphorous. This LC is a 67% reduction from the current load of 457 lbs/yr.

The targeted LC in this revised TMDL is an increase from the LC of 60 lbs/yr for phosphorous assigned in the initial TMDL. Phosphorous is stated to serve as a nutrient source to algal blooms, thus increasing turbidity, decreasing water clarity, and increasing pH via photosynthesis.

EPA agrees this is an appropriate LC.

**WLA Comment**

*Submittal lists individual WLAs for each identified point source [40 CFR § 130.2(h)]. If a WLA is not assigned it*

*must be shown that the discharge does not cause or contribute to WQS excursions, the source is contained in a general permit addressed by the TMDL, or extenuating circumstances exist which prevent assignment of individual WLAs. Any such exceptions must be explained to a satisfactory degree. If a WLA of zero is assigned to any facility it must be stated as such [40 CFR § 130.2(i)]. If this is a phase II TMDL any differences in phase I and phase II WLAs will be documented in this section.*

The WLA for Silver Lake is zero because there are no point sources that currently discharge into this water body.

The initial TMDL target was also zero and there were no other changes indicated.

EPA agrees this is an appropriate WLA.

**LA Comment**

*Includes all nonpoint sources loads, natural background, and potential for future growth. If no nonpoint sources are identified the LA must be given as zero [40 CFR § 130.2(g)]. If this is a phase II TMDL any differences in phase I and phase II LAs will be documented in this section.*

The LA for Silver Lake was set at 138.6 lbs/yr, or 1.2 lbs/day for phosphorous. This is an increase from the initial TMDL LA of 60 lbs/yr for phosphorous.

The initial TMDL was based on a volumetric equation with a desired concentration of 100 µg/L for the pollutants nutrients and organic enrichment. This revised TMDL uses improved modeling techniques with current monitoring data, as well as better sourcing information. The additional impairments still target phosphorous as a translator.

EPA agrees this is an appropriate LA.

**Margin of Safety**

*Submittal describes explicit and/or implicit MOS for each pollutant [40 CFR § 130.7(c)(1)]. If the MOS is implicit, the conservative assumptions in the analysis for the MOS are described. If the MOS is explicit, the loadings set aside for the MOS are identified and a rationale for selecting the value for the MOS is provided. If this is a phase II TMDL any differences in MOS will be documented in this section.*

The MOS has an explicit 10% yield resulting in a MOS of 15.4 lbs/yr, or 0.1 lbs/day.

The MOS for the initial TMDL was implicit and based on the target where the aquatic life use was to be restored to the lake in addition to total phosphorous load reductions that were identified within the TMDL.

A refined MOS has been demonstrated in this revised TMDL due to the fact that moving from an implicit to explicit MOS exemplifies an enhanced MOS.

**Seasonal Variation and Critical Conditions**

*Submittal describes the method for accounting for seasonal variation and critical conditions in the TMDL(s) [40 CFR § 130.7(c)(1)]. Critical conditions are factors such as flow or temperature which may lead to the excursion of WQS. If this is a phase II TMDL any differences in conditions will be documented in this section.*

The months of March through September were accounted for as seasonal variation in this submittal. Prior to and during the indicated months are considered critical conditions for phosphorous loading and algal growth.

There were no changes indicated in seasonal variation or critical conditions from the initial TMDL.

Seasonality and any critical conditions have been addressed in the submittal.

**Public Participation**

*Submittal describes required public notice and public comment opportunity, and explains how the public comments were considered in the final TMDL(s) [40 CFR § 130.7(c)(1)(ii)].*

On March 25, 2008, a meeting was held in Delhi, IA, in which the initial notice of the TMDL development was given to the public. Attendees of this meeting included 24 landowners, stakeholders, city officials, school district officials and IDNR staff. A final public meeting was held in Delhi, IA, on October 8, 2008. Attendees included

IDNR staff, a Soil Conservation District member, and three private land owners from within the watershed.

This TMDL was posted on the internet to allow the public an opportunity to review and comment. The public comment period closed on October 27, 2008, no written comments were received.

EPA agrees the TMDL received the opportunity for meaningful public input.

**Monitoring Plan for TMDL(s) Under Phased Approach**

*The TMDL identifies a monitoring plan that describes the additional data to be collected to determine if the load reductions required by the TMDL lead to attainment of WQS, and a schedule for considering revisions to the TMDL(s) (where phased approach is used) [40 CFR § 130.7].*

Currently, Silver Lake is monitored three times a year during the months of May to September to track the annual water quality trends and condition of Silver Lake. Future monitoring plans listed in the submittal were water chemistry sampling taken bi-weekly from March to November, plant and fish inventory performed annually, and continuous DO performed on six-minute intervals during the months of June to October.

In the initial TMDL, monitoring was conducted from 2000 to 2004 by Iowa State University as part of the statewide Iowa Lakes Survey. Surveys indicated that the Class A uses were "not supported" as a result of the extremely poor water transparency caused by algal blooms and high levels of non-algal turbidity.

**Reasonable Assurance**

*Reasonable assurance only applies when less stringent WLAs are assigned based on the assumption of nonpoint source reductions in the LA will be met [40 CFR § 130.2(i)]. This section can also contain statements made by the state concerning the state's authority to control pollutant loads.*

No reasonable assurances are required because the TMDL has no point sources and a WLA of zero.