Total Maximum Daily Load
For Siltation and Nutrients
Lake Miami
Monroe County, Iowa

December 13, 2001

Iowa Department of Natural Resources
Water Resources Section

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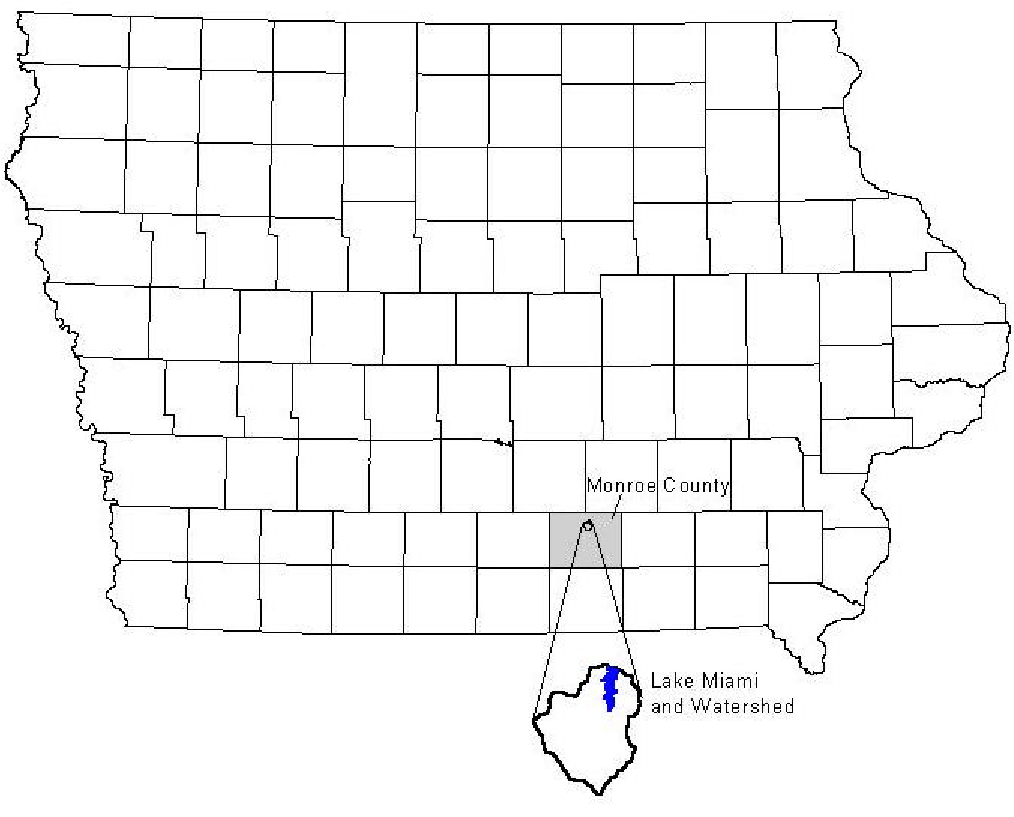
TMDL for Siltation and Nutrients
Lake Miami
Monroe County, Iowa

Waterbody Name:	Lake Miami
IDNR Waterbody ID:	IA 04-LDM-00270-L
Hydrologic Unit Code:	HUC11 07100009040
Location:	Sec. 20, T73N, R17W
Latitude:	41 Deg. 7 Min. N
Longitude:	92 Deg. 52 Min W
Use Designation Class:	A (primary contact recreation) B(LW) (aquatic life)
Watershed:	3,595 acres
Lake Area:	140 acres
Major River Basin:	Lower Des Moines
Tributaries:	Bluff Creek
Receiving Water Body:	Bluff Creek
Pollutant:	Siltation and Nutrients
Pollutant Sources:	Agricultural NPS
Impaired Use	Aquatic Life
1998 303d Priority:	Medium



1. Introduction

The Federal Clean Water Act requires the Iowa Department of Natural Resources (DNR) to develop a total maximum daily load (TMDL) for waters that have been identified on the state's 303(d) list as impaired by a pollutant. The purpose of these sediment and nutrient TMDLs for Lake Miami is to calculate the maximum amount of sediment and nutrients that the lake can receive and still meet water quality standards, and then develop an allocation of that amount of sediment and nutrients to the sources in the watershed.

Specifically these sediment and nutrient TMDLs for Lake Miami will:

- Identify the adverse impact that sediment and nutrients are having on the designated use of the lake and how the excess load of sediment and nutrients are threatening the water quality standards,
- Identify a target by which the waterbody can be assured to maintain its designated uses,
- Calculate acceptable sediment and nutrient loads, including a margin of safety, and allocate to the sources, and
- Present a brief implementation plan to offer guidance to Department staff, DNR partners, and watershed stakeholders in an effort to achieve the goals of the TMDL and maintain the lake's intended uses.

Iowa DNR believes that sufficient evidence and information is available to protect Lake Miami from further degradation by sediment and nutrients. The Department acknowledges, however, that additional information will likely be necessary. Therefore, in order to accomplish the goals of this TMDL, a phased approach will be used. This will allow feedback from future assessments to be incorporated into the plan.

Phase I of the sediment and nutrient TMDLs for Lake Miami will be to maintain or reduce sediment and nutrient loads that are threatening the aquatic life uses. Phase II will evaluate the effect that the sediment and nutrient load targets have on the intended results. In Phase II monitoring of Lake Miami will continue and the allocations of sediment and nutrients will be reassessed. Ultimately, the intent of this TMDL is not to set in stone arbitrary targets, but maintain the aquatic life uses. The phased approach allows DNR to utilize a feedback loop to determine if the initial sediment and nutrient load targets have been effective.

2. Description of Waterbody and Watershed

2.1 General Information

Lake Miami is a 140 acre impoundment constructed on Bluff Creek in 1966. The lake is located in southern Iowa about 6 miles northwest of Albia. Lake Miami has a volume of 1,336 acre-feet, a mean depth of 10 feet, and a maximum depth of 24 feet. The lake is entirely within the 776 acre Miami Lake State Game Management Area.

Miami Lake State Game Management Area provides facilities for boating, swimming, fishing, camping, picnicking and hiking. The game management area is open for public hunting of waterfowl, deer, squirrel, quail, pheasant, and rabbit. Park use is approximately 12,000 visits per year.

The Lake Miami watershed has an area of approximately 3,595 acres and has a watershed to lake ratio of 26:1. The wildlife area at the state park comprises 550 acres of this watershed. Land use data was collected in 1991 by the Division of Soil Conservation (DSC-DNR, 1991). Row crop and CRP acres were updated in 2001 by the Monroe County SWCD for the Lake Miami watershed. The landuses and associated areas for the watershed are shown in Table 1.

Table 1. 2001 Landuse in Lake Miami watershed.

Landuse	Area in Acres	Percent of Total Area
Cropland	1,648	46
Wildlife	1144	31
Pasture	488	13
Conservation Reserve	274	8
Woodlot	31	1
Farmsteads, Roads, etc.	12	<1
Total	3,595	100

In 2001, cropland comprised 46 percent of the watershed. Pasture and Conservation Reserve account for 13 percent and 10 percent of the watershed, respectively. The lake and state wildlife management area cover 15 percent of the watershed. In addition, to the state wildlife area, sixteen percent of the watershed is classified as wildlife habitat. This area includes irregular tracts of land that are not used for agricultural uses. The remaining area includes woodlots, farmsteads, and roads.

Many structures and best management practices are in place in the Lake Miami watershed. These include roadside structures, terraces, ponds, and other sediment retaining structures. In addition, the IDNR completed construction of three large detention basins on the west side of the lake in 2000.

Topography of the watershed varies from level to moderately steep. Soils of the watershed were formed primarily from loess or pre-Wisconsin till under prairie or mixed forest-prairie vegetation and include the Pershing-Gosport-Lindley and Pershing-Gara-Armstrong associations. These soils vary from well drained to poorly drained and are moderately erodable.

Average rainfall in the area is 35 inches/year, with the greatest monthly amount (5.0 inches) occurring in June (DSC-DNR, 1991).

2.2 Current Watershed Conditions

Gross sheet and rill erosion for the watershed was calculated using the Revised Universal Soil Loss Equation (RUSLE) and sediment delivery to Lake Miami was determined using the erosion and sediment delivery worksheet (USDA-NRCS, 1998). The average sediment delivery rate in the Lake Miami watershed is 1.26 tons/acre/yr based on calculations in the Structure Design Documentation Sheet for three structures in the Lake Miami watershed made in 1999. This rate would yield 4,530 tons/yr of sediment. When ponds and sediment basins in the watershed are accounted for, the sediment delivery rate drops to 1,120 tons/year.

Recent work in the watershed would indicate that the downward trend in water quality in Lake Miami may have been halted or reversed.

A long term commitment between the DNR, the Iowa Department of Agriculture and Land Stewardship (IDALS), Natural Resource Conservation Service (NRCS) and the Chariton Valley Resource Conservation and Development (RCD) office, has worked to significantly reduce watershed erosion and nutrient delivery to Lake Miami. This commitment began in the 1970's with a RCD roadside erosion project that shaped and seeded a county road right of way and constructed two small retention basins on the east side of the lake. In the early 1980's the project was expanded with the construction of three large sediment retaining basins in the lake's major drainage.

More recently, the Fisheries Bureau of the Iowa Department of Natural Resources constructed three large detention basins on the west side of the lake in 2000. These structures were completed with EPA Section 319 grant funds.

In addition, since 1990, landowners in the watershed have installed 6.13 miles (32,369 feet) of terraces, five ponds and four small sediment retaining structures.

3. Applicable Water Quality Standards

The *Iowa Water Quality Standards* (Iowa, 1996) list the designated uses for Lake Miami as Primary Contact Recreation (Class A) and Aquatic Life (Class B(LW)). Lake Miami also has general uses of secondary contact recreation, agricultural uses, domestic uses, and livestock watering.

The State of Iowa does not have numeric water quality criteria for siltation or nutrients that apply to Lake Miami. Lake Miami was included on the list of Iowa impaired waters based on the best professional judgment of DNR field staff regarding the water quality. Lake Miami has been assessed as "fully supported-threatened" since 1994. The DNR Fisheries Bureau indicates that sediment and nutrient loading were threatening the Class B(LW) designated use. The Class B(LW) designated use states that the physical and chemical characteristics are suitable to maintain a balanced community normally associated with lake-like conditions (IAC 567-61.3(1)b(7)). Excess sediment and nutrients are threatening to alter the physical and chemical characteristics of the lake so that a balanced community normally associated with lake-like conditions is not maintained. Beneficial uses of aquatic habitat, spawning and reproduction, and sport fishing may become impaired if the physical and chemical characteristics of the lake are altered.

A waterbody is fully supporting but threatened for a particular designated use when it fully supports that use now but may not in the future unless pollution prevention or control action is taken because of anticipated sources or adverse pollution trends. Monitoring and evaluative data indicated an apparent declining water quality trend in Lake Miami in the 1998 305(b) report. The water quality conditions had deteriorated compared to earlier assessments (1990), but the lake still supported its designated uses. Although historic sediment problems have in part been corrected since 1990, concerns remain about both the levels of total phosphorus found in the lake and turbidity, as monitored in 2000. As a result, the DNR fisheries bureau determination for the 1998 303(d) listing remains that sediment and nutrient loading are threatening the Class B(LW) designated use.

Activities in the watershed since 1990 have worked to reduce sediment and nutrient delivery to Lake Miami. The completion of these structures would suggest that the downward trend in water quality may have been halted and perhaps reversed.

4. Water Quality Conditions

4.1 Water Quality Studies

Water quality surveys have been conducted on Lake Miami by Iowa State University in 1979, 1990, 1991, and 2000 (Bachmann et. al, 1980, Bachmann, 1991, Bachmann et. al, 1994, Downing and Ramstack, 2001) and the University of Iowa Hygienic Laboratory in 1986 (Kennedy and Miller, 1987).

Samples were collected three times each summer for the lake studies conducted in 1979 and 1990 (Bachmann et. al, 1980, Bachmann et. al, 1994). This data is shown in Tables 2 and 4 in the Appendix.

In 1986, the University Hygienic Laboratory sampled Lake Miami three times near the deepest part of the lake. On each sampling date, samples were collected from approximately the 0.5, 3.0, and 6.0m depths. These results are shown in Table 3 (Appendix).

During the 1991 study (Bachmann, 1991) Lake Miami was sampled in two locations. Site 1 was in the deepest part of the lake near the dam, and site 2 was on Bluff Creek as it enters Lake Miami. Site 1 was sampled 13 times between May 1990 – April 1991. Samples were collected at the 0.5, 3.0, and 6.0m depths. Site 2 was also sampled 13 times from May 1990 – April 1991. These results are shown in Tables 5 and 6 (Appendix).

Lake Miami was sampled again in 2000 as part of the Iowa Lakes Survey (Downing and Ramstack, 2001). This survey will sample the lake three times each summer for five years. The data collected in 2000 is shown in Table 7 (Appendix).

For the past 20 years, average Secchi disk readings in Lake Miami have remained relatively constant, ranging from 0.5 to 0.9 m.

Suspended solids values in 1979 ranged from 4 to 19 mg/L. In 1986 these values ranged from 10 to 34 mg/L. The 1986 samples showed higher suspended solid values from the bottom samples, which is attributed to the settling of material from the upper water layers. Total suspended solids values in 1990 and 2000 remained consistent with the 1986 values (see Appendix).

Nitrogen data for 1979 is very limited (one sample each for nitrate-nitrite and ammonia). During 1986, except for two elevated values found in the hypolimnion in July (1.6 and 1.4 mg/L), the ammonia nitrogen concentration remained at relatively low levels (0.03 to 0.24 mg/L) throughout the three sampling periods. The increase in ammonia with depth and the elevated hypolimnetic values observed in July may be attributed to the decay of organic matter near the bottom and the reduction of nitrate to ammonia in the deoxygenated water. Nitrate-nitrite nitrogen levels in the water were highest in June (1.4 to 1.6 mg/L) and declined to <0.1 mg/L in both July and September. The decline in the nitrate concentration in the epilimnion can be attributed to assimilation by the phytoplankton and other plant life. In 1990, total nitrogen results ranged from 1.5 to 2.4

mg/L. Based on the available monitoring data, nitrate levels in Lake Miami do not appear to be excessive.

During 1979 sampling, total phosphorous ranged from 130 to 720 µg/L. There does not appear to be any discernable pattern based on water depth. Total phosphorous concentrations in surface samples in 1986 ranged from 90 to 250 µg/L as compared to 140 to 260 µg/L in the bottom samples. Because phosphorous is an essential nutrient for phytoplankton, any available phosphorous is rapidly assimilated. The slightly lower value of total phosphorous in the upper water column may be attributed to phosphorous uptake by phytoplankton. In the oxygen deficient part of the hypolimnion, phosphorous levels were slightly higher for each sampling period than those of the epilimnion. It is not unusual for phosphorous to increase in the bottom waters from decomposition of sinking phytoplankton and liberation of phosphorous from the sediment by reduction. Composite samples collected from the entire water column in 1990 had phosphorous results ranging from 70 to 190 µg/L. The average of the samples (n=3) collected in 2000 was 210 µg/L (Downing and Ramstack, 2001).

Chlorophyll values are an indirect measurement of the phytoplankton populations. Corrected chlorophyll-a values in the 1979 study averaged 21 ug/L for July, 49 ug/L for August, and 42 ug/L for September. In 1986 the corrected chlorophyll-a values ranged from 2 to 46 ug/L. The corrected chlorophyll-a value was lowest in June and higher in both July (46 ug/L) and September (35 ug/L). Chlorophyll data for both 1979 and 1986 indicated average phytoplankton populations. Chlorophyll-a values collected in 1990 were not corrected for phaeophytin, and ranged from 9.9 to 76.8 ug/L. Average chlorophyll-a values in 2000 were 18 µg/L. Current chlorophyll-a levels are in the middle of the range for eutrophic lakes (EPA, 2000).

4.2 Angling

A survey of the fishery was conducted on Lake Miami on September 22 and 23, 1986. Six pound nets were used overnight and an electrofishing unit was utilized for 83 minutes. Species composition and relative abundance are shown below.

Species	Nets	Shocker	Total Number	Total Percent
Bluegill	81	107	188	35
White Crappie	40	16	56	11
Black Crappie	11	1	12	2
Largemouth Bass	1	59	60	11
Redear	47	24	71	13
Black Bullhead	6	1	7	1
Channel Catfish	121	3	124	23
Walleye	1	0	1	<1
Carp	1	0	1	<1
Northern Pike	1	0	1	<1
Green Sunfish	0	9	9	2
Golden Shiner	0	3	3	<1
Total	310	223	533	

A creel survey in 1987 showed a harvest rate of 1.36 fish per angler hour and angling pressure at 119 hours/acre during the spring and summer season. Size of panfish harvested tended to be marginal. The harvest consisted of crappie (62%), bluegill (28%), channel catfish (5%), other (5%).

5. Desired Target

The listing of Lake Miami is based on narrative criteria. Lake Miami was included on the list of Iowa impaired waters based on the best professional judgment of DNR field staff regarding the water quality. Lake Miami has been assessed as "fully supported-threatened" since 1994. The DNR Fisheries Bureau indicates that sediment and nutrient loading were threatening the Class B(LW) designated use. There are no numeric criteria for siltation or nutrients applicable to Lake Miami or its sources in Chapter 61 of the Iowa Water Quality Standards (Iowa, 1996). The Environmental Protection Agency is requiring all states to adopt or show significant progress towards adopting nutrient criteria by 2004. This will include water quality standards for nitrogen, phosphorous, and chlorophyll-a. Since numeric criteria for these parameters do not currently exist, appropriate targets need to be determined. The targets for Lake Miami need to include a sediment and a nutrient load as well as a measurement of the aquatic life. This is a phased TMDL and each phase will incorporate a separate target. Phase I will include targets for sediment and nutrient delivery to the lake. Monitoring the water quality and the fishery of the lake will be included in both Phase I and Phase II.

5.1 Siltation

The Phase I sediment delivery target will address the amount of sediment delivered to the lake from the watershed. A direct measure of the sediment load is difficult to make given seasonal variability and actual measurement tools. Acceptable estimates using established soil loss equations can be made to predict the erosion rates in the watershed, and subsequent delivery to the lake.

Gross sheet and rill erosion for the watershed was calculated using the Revised Universal Soil Loss Equation (RUSLE) and sediment delivery to Lake Miami was determined using the erosion and sediment delivery worksheet (USDA-NRCS, 1998). The average sediment delivery rate in the Lake Miami watershed is 1.26 tons/acre/yr based on calculations in the Structure Design Documentation Sheet for three structures in the Lake Miami watershed made in 1999. This rate would yield 4,530 tons/yr of sediment. When ponds and sediment basins in the watershed are accounted for, the sediment delivery rate drops to 1,120 tons/year.

Because the Class B(LW) designated use for Lake Miami is fully-supported threatened, the siltation target is to maintain or reduce current sediment delivery rates to the lake. The sediment delivery target and current sediment delivery rate to Lake Miami is 1,120 tons/year.

5.2 Nutrients

The Phase I nutrient delivery target will address the amount of phosphorous delivered to the lake from the watershed. A direct measure of the phosphorous load is difficult to make given seasonal variability and actual measurement tools. An estimated phosphorous delivery rate of 0.8 lbs/acre yields a total delivery of 1.4 tons/ year to Lake Miami.

The class B(LW) is fully supporting but threatened, therefore the nutrient target should ensure that water quality is not reduced beyond the current level. Sediment structures have been installed in the watershed, and a wetland is currently under design that will be installed at the south end of the lake, which will continue to improve the water quality of the lake. Therefore, the nutrient target is to maintain or reduce the current nutrient delivery rate of 1.4 tons/year to the lake. The additional wetland will provide for increasing water quality and assurance of a fully supporting attainment of designated uses.

5.3 Aquatic Life

The Phase II aquatic life target for this TMDL will be achieved when the fishery of Lake Miami is determined to be fully supporting the Class B aquatic life uses. This determination will be accomplished through an assessment conducted by the DNR Fisheries Bureau by 2002. This assessment will be in accordance with the Statewide Biological Sampling Plan protocol (Larscheid, 2001). This protocol is currently being used to develop benchmarks for the fishery of Iowa's lakes. The results from the Lake Miami assessment will be compared with the benchmarks being developed. These assessments will include age, growth, size structure, body condition, relative abundance, and species.

6. Loading Capacity

The State of Iowa does not have numeric water quality criteria for siltation that apply to Lake Miami. Lake Miami was included on the list of Iowa impaired waters based on the best professional judgment of DNR field staff regarding the water quality. Excess sediment and nutrients are threatening the Class B(LW) designated use.

The Class B(LW) designated use for Lake Miami is fully-supported threatened, therefore the current sediment and nutrient delivery rates to the lake should be maintained or reduced. The current sediment delivery rate to Lake Miami is 1,120 tons/year, and the current phosphorous delivery rate is 1.4 tons/year. Therefore the loading capacity for Lake Miami is 1,120 tons/year of sediment and 1.4 tons/year of phosphorous.

The Class B(LW) designated use is fully supporting but threatened, therefore the sediment and nutrient targets should ensure that water quality is not reduced beyond the current level. Sediment structures have been installed in the watershed, and a wetland is currently under design that will be installed at the south end of the lake, which will further improve the water quality of the lake by trapping sediment and nutrients before they reach the lake. By maintaining or reducing the current sediment delivery rate, phosphorous delivery to the lake will also be reduced. The proposed new wetland south of the lake will provide for increasing water quality and assurance of a fully supporting attainment of designated uses.

7. Pollutant Sources

Water quality in Lake Miami is influenced only by nonpoint sources. There are no point source discharges in the watershed.

The watershed of Lake Miami is composed of 54% cropland and pasture. The majority of this land is in good management practices. This is due, in part to the conservation efforts of the previous twenty years. Very few areas exist in the watershed where good conservation practices are not in place.

There is little to no active gully erosion in the watershed. The principle source of sediment and nutrients to the lake is from sheet and rill erosion. Other possible sources of sediment and nutrients are streambed and shoreline erosion.

Modeling of sediment and nutrient delivery to Lake Miami has been completed using Agricultural Nonpoint Source Pollution Model (AGNPS) (Mitzner, 2000) and a GIS based RUSLE model. While these models cannot estimate exact quantities of sediment and nutrients transported through erosion, they can identify areas within the watershed that have higher rates of erosion and subsequent delivery potential. These models identify the subwatershed directly south of the lake as contributing the most sediment and nutrients of any subwatershed.

Field investigations to determine landuses, cropping patterns, fertilizer use, conservation practices, livestock operations, and gully erosion were originally made in January 1990 and were repeated in April 2000.

8. Pollutant Allocation

8.1 Point Sources

There are no point source discharges in the Lake Miami watershed. Therefore, the Wasteload Allocations for sediment and nutrients established under this TMDL are zero.

8.2 Non-Point Sources

The non-point source discharges are originating from sheet and rill erosion. The majority of the watershed is used for agriculture production, either row crop, hay, or pasture. The desired target is maintain or reduce the current levels of sediment and nutrient delivery to the lake. The Load Allocation established under this TMDL is 1,120 tons of sediment and 1.4 tons of phosphorous delivered to the lake from the watershed each year.

8.3 Margin of Safety

The margin of safety for this TMDL is implicit. The dual targets for this TMDL assures that the aquatic life uses will be restored regardless of the accuracy of the sediment and nutrient delivery targets. Failure to achieve water quality standards will result in review of the TMDL, allocations, and/or sediment and nutrient management approaches and probable revision. In addition, calculations were made using conservative estimates. RUSLE uses conservative calculations to calculate the gross erosion.

The Monroe County SWCD and NRCS wetland project will provide a further reduction in sediment and nutrient delivery rates, and therefore an additional margin of safety. By continuing to reduce sediment and nutrient delivery to Lake Miami, the water quality will improve and the Class B(LW) designated use should be assessed as fully supporting again.

9. Seasonal Variation

This TMDL accounts for seasonal variation by recognizing that (1) sediment and nutrient loading varies substantially by season and between years, and (2) sediment and nutrient impacts are felt over multi-year timeframes. Sediment and nutrient loading and transport are predictable only over long timeframes. Moreover, in contrast to pollutants that cause short-term beneficial use impacts and are thus sensitive to seasonal variation and critical conditions, the sediment and nutrient impacts in this watershed occur over much longer time scales. For these reasons, the longer timeframe (tons per year) used in this TMDL is appropriate.

10. Monitoring

Monitoring will be completed at Lake Miami as part of the Iowa Lakes Survey 2000. In-lake water monitoring will be completed three times per year for each of the field seasons 2000 – 2004. In addition, the DNR Fisheries Bureau will conduct an assessment of the fishery of Lake Miami in accordance with the Statewide Biological Sampling Plan protocol (Larscheid, 2001). At the completion of this assessment, the data will be evaluated to determine the listing status of Lake Miami.

11. Implementation

The Iowa Department of Natural Resources recognizes that an implementation plan is not a required component of a Total Maximum Daily Load. However, the IDNR offers the following implementation strategy to DNR staff, partners, and watershed stakeholders as a guide to improving water quality at Lake Miami.

Phase I of this TMDL is to maintain or reduce the amount of sediment and nutrients delivered to Lake Miami. Although a sediment reduction is not called for at this time, future work will be done in the watershed to continue to reduce sediment and nutrient delivery to the lake. Modeling of sediment and nutrient delivery to Lake Miami has been completed using Agricultural Nonpoint Source Pollution Model (AGNPS) (Mitzner, 2000) and a GIS based RUSLE model. While these models cannot estimate exact quantities of sediment and nutrients transported through erosion, they can identify areas within the watershed that have higher rates of erosion. These models identify the subwatershed directly south of the lake as contributing the most sediment and nutrients.

The Monroe County SWCD and NRCS are currently designing a wetland structure to be placed at the south end of Lake Miami. This structure will remove sediments and nutrients from the entire area south of the watershed, just before it enters the lake. This area has the highest delivery rates of sediment and nutrients from the Lake Miami watershed. With this structure in place, it is expected the sediment delivery to Lake Miami will be reduced by another 636 tons/year, to a total of 484 tons/year. It is also expected that this wetland will remove a large portion of the phosphorous and nitrogen that would have otherwise been transported to the lake.

In addition to the construction of a new wetland structure, there are other activities that could help the fishery and overall water quality at Lake Miami. Existing sediment structures in the watershed should be evaluated to determine their current trap efficiencies. Any sediment structures that are no longer efficient at retaining sediment should be improved so that they continue to effectively protect the lake. Aquatic macrophytes in the lake would provide needed habitat and food for the aquatic life, and utilize nutrients in the lake. Sediment removal from the lake may also be beneficial by restoring habitat in areas that have silted in.

12. Public Participation

Public meetings were held in Des Moines and Albia regarding the proposed TMDL for siltation and nutrients for Lake Miami on January 17 and January 22, 2001. Another public meeting was held on October 31, 2001 in Albia to present the final draft TMDL. Comments received were reviewed and given consideration and, where appropriate, incorporated into the TMDL.

13. References

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14. Appendix

Table 2. Data collected in 1979 by Iowa State University (Bachmann, et al, 1980).

Date Collected	7/19/79				8/22/79			9/26/79		
Depth (meters)	0	1	2	5	0	2	4	0	2	4
Secchi (meters)	1.2				0.8			0.7		
Suspended Solids (mg/L)	7	7	7	5	19	5	4	12	12	12
Dissolved Oxygen (mg/L)	7.3	7.2	7.1	0	13.2	1.3	.2	10.8	10.3	8.8
Ammonia Nitrogen (mg/L)								0.08		
Nitrate-Nitrite Nitrogen (mg/L)								0.06		
Total Phosphorus (mg/L) po4	.14	.13	.15	.72	.26	.28	.18	.15	.18	.14
Chlorophyll a (ug/L) Corrected	26.9	26.6	23.6	4.5	113.8	24.7	7.1	41.9	40.4	42.3

Table 3. Data collected in 1986 by the University of Iowa Hygienic Laboratory (Kennedy and Miller, 1987).

Date Collected	6/16/86			7/23/86			9/8/86	
Depth (meters)	0	3	5	0	4	5	0	6
Secchi (meters)	0.6			0.9			0.7	
Suspended Solids (mg/L)	12	20	34	10	10	18	12	12
Dissolved Oxygen (mg/L)	8.6	1.0	0.0	9.8	0.2	0.2	7.4	4.2
Ammonia Nitrogen (mg/L)	0.07	0.14	0.24	0.08	1.6	1.4	0.03	0.07
Nitrate-Nitrite Nitrogen (mg/L)	1.4	1.6	1.5	<0.1	<0.1	<0.1	<0.1	<0.1
Total Phosphorus (mg/L)	0.09	0.11	0.14	0.14	0.26	0.24	0.25	0.25
Chlorophyll a (ug/L) Corrected	17	10	2	46	22	8	35	29

Table 4. Data collected in 1990 by Iowa State University (Bachmann, et al, 1994).

Date Collected	5/28/90			6/26/90			7/24/90		
Sample Number	1	2	3	1	2	3	1	2	3
Secchi (inches)	36			8			24		
Suspended Solids (mg/L)	16	16	16	37	34	31	20	19	18
Total Nitrogen (mg/L)	2	1.9	2.4	2	2	2.1	1.5	1.7	1.5
Total Phosphorus (mg/L)	0.19	0.13	0.14	0.14	0.15	0.15	0.08	0.08	0.07
Chlorophyll a (ug/L) Corrected	9	12.5	8.2	25.7	24	27.2	83.5	72.9	74.1

Each sample was a composite water sample from all depths of the lake.

Table 5. Data collected at site 2 (Bluff Creek before entering Lake Miami) in 1990-1991 (Bachmann, 1991)

Date	TSS mg/L	NH4 mg/L	Org N mg/L	NO3 + NO2 mg/L	TP mg/L	SRP mg/L
5/29/90	72.9	0.08	1.41	1.81	0.280	0.051
6/13/90	29.8	0.14	0.9	0.9	0.172	0.029
6/27/90	170.6	0.04	1.45	2.53	0.390	0.054
7/9/90	87.9	0.04	1.48	0.65	0.263	0.054
7/25/90	94.6	0.02	1.04	2.4	0.257	0.046
8/9/90	42.9	0.08	1.46	0.47	0.180	0.011
8/23/90	5.4	0.04	0.8	0.02	0.133	0.019
9/18/90	17.2	0.04	34.96	<.01		0.013
10/23/90	2.4	0.05	13.55	0.09		
11/29/90	3.8	0.05	0.51	0.13		
1/26/91						
3/23/91	25.3	0.24	0.9	2.12	0.101	0.006
4/26/91	39.3	0.07	0.99	1.67	0.196	

Table 6. Data collected in 2000 by Iowa State University (Downing and Ramstack, 2001)

Parameter	**6/29/2000**	**7/26/2000**	**8/24/2000**	**Mean of 3 samples**
Secchi Depth m	0.4	0.5	0.7	0.5
Chlorophyll (ug/L)	7	42	6	18
NH_3+NH_4^+ -N (ug/L)	1925	823	1083	1277
NH_3 –N (un-ionized) (ug/L)	6	55	18	26
NO_3+NO_2-N (mg/L)	0.25	0.11	0.23	0.19
Total Nitrogen (mg/L as N)	3.66	1.61	1.59	2.28
Total Phosphorus (ug/l as P)	275	191	163	210
Silica (mg/L as SiO_2)	38	28	28	31
pH	6.8	8.1	7.5	7.5
Alkalinity (mg/L)	286	83	96	155
Total Suspended Solids (mg/L)	31.5	18.8	2.8	17.7
Inorganic Suspended Solids (mg/L)	24.1	12.2	1.6	12.6
Volatile Suspended Solids (mg/L)	7.4	6.6	1.2	5.1

Lake Miami and Watershed