DENR Watershed Protection Logo

Total Maximum Daily Loads (TMDLs)

Lake Madison / Brant Lake TMDL

Total Maximum Daily Load (TMDL)
Lake Madison / Brant Lake Watershed,
Lake County South Dakota

January, 1999
TMDL Summary

Waterbody Name	**Lake Madison**
Hydrologic Unit Code (HUC)	10170203
TMDL Pollutant	**Total phosphorus**
Water Quality Target	Trophic State Index (TSI) of 50 (mesotrophic)
TMDL Goal	50% reduction in total phosphorus
303(d) Status	1998 303(d) Waterbody List; Priority 1, Page 20, 29, 32
Impaired Beneficial Uses	Warmwater permanent fish life propagation; immersion recreation; limited contact recreation
Reference Document	Phase I Watershed Assessment Final Report - Madison Lake/Brant Lake, Lake County SD (SDDENR, 1998)
TMDL Development	Alan Wittmuss / Mark McIntire

TMDL Summary

Waterbody Name	**Brant Lake**
Hydrologic Unit Code (HUC)	10170203
TMDL Pollutant	**Total phosphorus**
Water Quality Target	Trophic State Index (TSI) of 50 (mesotrophic)
TMDL Goal	50% reduction in total phosphorus
303(d) Status	1998 303(d) Waterbody List; Priority 1, Page 20, 29, 32
Impaired Beneficial Uses	Warmwater permanent fish life propagation; immersion recreation; limited contact recreation
Reference Document	Phase I Watershed Assessment Final Report - Madison Lake/Brant Lake, Lake County SD (SDDENR, 1998)
TMDL Development	Alan Wittmuss / Mark McIntire

I. Executive Summary:

Waterbody Description and Impairments

Lake Madison and Brant Lake are located in Lake County, South Dakota. Lake Madison, Brant Lake and Lake Herman form a chain of lakes connected by a single tributary. The tributary joining the three lakes is Silver Creek (Figure 2).

Lake Madison is a hypereutrophic natural lake of glacial origin located approximately three miles southeast of the city of Madison, South Dakota. The lake has a surface area of 2,799 acres (1,132 ha) and mean depth of 9.7 ft. (3.0 m). The lake has a heavily developed shoreline with cabins and permanent homes. Public access to the lake is excellent and the lake experiences very high use. According to 1990 census figures, the population within a 65-mile radius is 270,159.

Lake Madison has been included in South Dakota's Statewide Lakes Assessment sampling since 1989. The mean Carlson Trophic State Index is 74.15, which is typical of hypereutrophic conditions. There is an established sanitary district encompassing the entire shoreline. Sanitary treatment consists of a central collection facility and infiltration-percolation basins.

Brant lake is a 1,000 acre (405 ha) lake of glacial origin located 1.5 miles northwest of the town of Chester, South Dakota and 2 miles southeast of Lake Madison. Brant Lake has a highly developed shoreline with cabins and permanent homes. The mean depth of the lake is 11 ft. (3.4 m). Data from 1989 indicates that Brant Lake has a mean trophic state index of 70.73 which is indicative of hypereutrophic conditions. Sanitary treatment around the lakeshore currently consists of privately owned septic tanks and drain fields.

During the 1993 flood event, Brant Lake and Lake Madison experienced damage to shorelines and homes due to high water. Brant Lake had a catastrophic failure of a shoreline stabilization project due to the high water and wind erosion.

Stakeholder Description

The Lake Conservation District was the local sponsor of the water quality assessment project. Both lakes were listed as a priority of the Section 319 Nonpoint Source Pollution Control Program for South Dakota. Funds for the project were obtained from Section 314 Clean Lakes funds ($100,000) administered by the Environmental Protection Agency (EPA) and granted to the State of South Dakota. The 30 % local match ($42,857) needed for the project was provided by the conservation district and the two lake associations. Figure 1 lists the participants and stakeholders during the assessment project.

Figure 1. List of stakeholders

Ron Byrd, Local Coordinator Lake County Conservation District Natural Resource Conservation Service - Lake County Lake Madison Association Lake Madison Sanitary District Brant Lake Association	City of Madison Lake County SD Dept GF&P SD DENR - Water Rights SD DENR - Environmental Services SD DENR - Watershed Protection US EPA - Clean Lakes Program

Intent to Submit as a Clean Water Act Section 303(d) TMDL

In accordance with Section 303(d) of the Clean Water Act, the South Dakota Department of Environment and Natural Resources submits for EPA, Region VIII review and approval, the total maximum daily load (TMDL) for total phosphorus for Lake Madison and the TMDL for total phosphorus for Brant Lake as provided in this summary and attached document. These TMDLs have been established at a level necessary to meet the applicable water quality standards for nutrients with consideration of seasonal variation and a margin of safety. The following designated use classifications will be protected through implementation of these TMDLs: warmwater permanent fish life propagation, immersion recreation and limited contact recreation.

II. Problem Characterization:

Maps

Map Location of Madison/Brandt Watershed

Figure 2. Lake Herman, Lake Madison, and Brant Lake Watershed in Lake County, South Dakota.

Waters Covered by TMDL

Lake Madison
Brant Lake

Rationale for Geographic Coverage

The individual watersheds of Lake Madison and Brant Lake encompass 29,191 acres (11,813 ha) and 7,658 acres (3,099 ha), respectively. The size of the combined watershed is 36,849 acres (14,912 ha). For the purpose of this study the two-lake drainage were treated as a single system. The watershed of Lake Herman is not included in the study. The watershed area under investigation was from the Lake Herman outlet to the Skunk Creek outlet of Brant Lake.

Land use is primarily agricultural with a community of 6,257 people (Madison, SD) within the watershed. Agricultural land use is approximately 84% cropland and 15% grass or pasture. Animal feeding operations for beef, swine and poultry are scattered throughout the watershed. Major soil associations include Egan-Viborg, Egan-Wentworth, and Dempster.

The city of Madison has some light industrial business and storm sewers which drain directly to Silver Creek above Lake Madison. Agbusinesses pertaining to sales and storage of fertilizers and pesticides are located within the city.

Brant Lake has three public access areas that offer boat ramps, shore fishing, and toilet facilities. Lake Madison has four state-owned public access areas offering camping, picnic areas, shore fishing, boat ramps, swimming areas and toilet facilities. Both lakes are located within convenient driving distance of the city of Sioux Falls, SD (population +100,000). As a result, these lakes experience heavy recreational use during the spring, summer and fall.

Pollutant(s) of Concern

Total phosphorus

Use Impairments or Threats

Since blue-green algae are not only able to assimilate phosphorus but can assimilate several kinds of nitrogen, a total nitrogen to phosphorus ratio was used to determine the limiting nutrient. When the total nitrogen to phosphorus ratio increases to 7:1, blue-green algae appear to be phosphorus limited. The average total nitrogen to phosphorus ratio for Lake Madison was 29:1. Brant Lake exhibited the phosphorus limitation phenomenon. The average total nitrogen to phosphorus ratio for Brant Lake was 25:1. The mean total phosphorus trophic status was (TSI) 84 for Lake Madison and 77 for Brant Lake. The hypereutrophic range of TSI begins at 65. The TSI's from Lake Madison and Brant Lake indicate that both lakes are in the hypereutrophic range.

Lake Madison and Brant Lake have been assigned the following water quality beneficial uses:

(4) Warmwater Permanent Fish Life Propagation
(7) Immersion Recreation
(8) Limited Contact Recreation
(9) Wildlife Propagation and Stock Watering

Both lakes experience winter kills due to snow cover and decreased photosynthesis, resulting in anoxia. This phenomenon also occurs over the summer when there is not enough oxygen produced to maintain the high rate of biodegradation due to the tremendous amount of organic matter (algae blooms). The predominant forms of algae during the summer are blue-green. These blue -green blooms can create super-oxygenated conditions but can also undergo respiration, reducing oxygen levels even more during the evening and dark hours. The filamentous taxon *Aphanizomenon flos-aquae* was the dominant form identified during the study period. *Aphanizomenon* species are commonly identified as problem algae related to eutrophication, taste and odor problems, toxicity and aesthetic nuisance (Taylor, 1974).

Probable Sources

Possible sources of high nutrient and sediment loads were identified as high slopes and bank erosion due to lack of riparian vegetation as well as crop and lawn fertilization. Confined and pastured livestock feeding areas were also identified as significant sources.

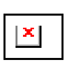
III. TMDL Endpoint:

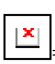
Description

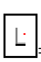
A model **(**Vollenweider and Kerekes (1980) was used to estimate the effects of reducing phosphorus in the watershed for both Lake Madison and Brant Lake. The model predicts that a 50% reduction of tributary loadings to Lake Madison and Brant Lake results in a reduction in chlorophyll *a* concentration by 88% and 90%, respectively. If this reduction is be reached, the TSI ranking for chlorophyll *a* will be reduced to mesotrophic for both lakes**.** However, a more realistic goal, based on best professional judgement, is a reduction of 40% for the tributary loadings. This would substantially reduce the chlorophyll *a* concentrations for each lake by 79% and 72%, respectively. The TSI ranking for chlorophyll *a* would fall within the lower end of the eutrophic range which begins at 50.

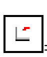
Reduction/Response Model

Inlake total phosphorus concentrations are a function of the total phosphorus load delivered to the lake by the watershed. Vollenweider and Kerekes (1980) developed a mathematical relationship for inflow of total phosphorus and the inlake total phosphorus concentration. They assumed that if you change the inflow of total phosphorus you change inlake phosphorus concentration a relative but steady amount over time. The variables used in the relationship are:

 = Average inlake total phosphorus concentration

 = Average concentration of total phosphorus which flow into the lake

 = Average residence time of inlake total phosphorus

 = Average residence time of lake water

Reduction/Response Model (Lake Madison)

Data collected during the project (1994 and 1995) provided enough information to estimate , , and . In order to estimate the residence time of total phosphorus () it was necessary to back calculate Equation 5 below, and solve for by forming Equation 6 (Wittmuss, 1996).

{Equation 5} = [Calc]

{Equation 6} [Caculation]

Values for , , were determined in the following manner:

was determined by averaging all of the surface total phosphorus samples from 1994-95 collection period.

was determined by adding all of the input loadings for total phosphorus in milligrams and dividing that number by the total number of liters that entered the lake. The values for both of these numbers came from tributaries, groundwater, and the atmosphere.

was determined by averaging the total volume of Lake Madison (27,153 acre-feet) by the total inputs of water into the lake (40,101 acre-feet/days of discharge measurements).

= [Calculation] = 158.4 days = 0.434 year

The final values for and are:

= 0.254 mg/L = 0.231 mg/L

By placing the numbers in the proper places as discussed in Equation 3, would be:

[Calculation] = 0.478 years = 175 days

Referring back to Equation 5, reducing the inputs of total phosphorus, the equation estimates the reduction of inlake total phosphorus. This is assuming constant inputs of water. Theoretically the retention time for total phosphorus should also be reduced. With only one year of sampling, there is no way to estimate the reduction in the retention time of total phosphorus. The constant (0.478) derived from the data was used in Equation 5. After estimating the amount of reduction of inlake phosphorus after a reduction of input phosphorus, Equation 3 (page 87) can be used to see the reduction of chlorophyll *a*. As can be seen in Table 1, a 50% reduction in phosphorus inputs to Lake Madison will reduce the inlake chlorophyll *a* concentration by an estimated 88%. The 50% reduction would also lower the chlorophyll TSI value to the mesotrophic line (Figure 3). As stated above, this is considering no reduction in the retention time of total phosphorus. If the retention time is lowered, the lake should experience even lower inlake concentrations and lower chlorophyll *a* concentrations. As the input concentrations of phosphorus are lowered, the lake will see algal blooms that are less intense and of a shorter duration. These tables and graphs are predictive on the data collected during the study. Actual changes can be expected to be different depending on runoff values and the extent of change that occurs in the volume of water passing through Lake Madison.

Table 1. Effects of Reducing Phosphorus to Lake Madison

Reduction of Phosphorus Inputs	Input Phos Concentration	InLake Phos Concentration[1]	Chlorophyll *a*	Percent Reduction Chlorophyll *a*	Phosphorus TSI	Chlorophyll TSI

0%	0.231	0.254	52.08	0%	84.05	69.35
10%	0.208	0.229	37.57	28%	82.53	66.14
20%	0.185	0.203	26.08	50%	80.83	62.56
30%	0.162	0.178	17.24	67%	78.91	58.50
40%	0.139	0.153	10.69	79%	76.68	53.81
50%	0.115	0.127	6.08	88%	74.05	48.27
60%	0.092	0.102	3.04	94%	70.83	41.49
70%	0.069	0.076	1.25	98%	66.68	32.74
80%	0.046	0.051	0.36	99%	60.83	20.41
90%	0.023	0.025	0.04	100%	50.83	N/A

[1] Inlake phosphorus concentrations must be converted from mg/L to mg/m^3 before using Equation 1 to predict chlorophyll *a*.

Figure 3 Predicted Reduction of Chlorophyll *a* and Phosphorus for Lake Madison

Chart on Pollutants

Reduction Response Model (Brant Lake)

The variables used in this process were the same variables as those used for Lake Madison.

The residence time of total phosphorus ( ) was calculated using the same manner described previously through the use of Equation 5 and 6.

{Equation 5} = Calc

{Equation 6} Calculations

Values for , , were:

was determined by averaging all of the surface total phosphorus samples from the 1994-95 collection period.

was determined by adding all of the input loadings for total phosphorus in milligrams and dividing that number by the total number of liters of water that entered the lake. The values for both of these numbers came from tributaries, groundwater, and the atmosphere.

was determined by averaging the total volume of Brant Lake (11,000 acre-feet) by the total inputs of water into the lake (46,969 acre-feet/days of discharge measurements).

= Calculation = 55 days = 0.15 year

The final values for and are:

= 0.170 mg/L = 0.196 mg/L

By placing the numbers in the proper places as discussed in Equation 3, would be:

Calculation = 0.13 year = 47 days

Referring back to Equation 5, reducing the inputs of total phosphorus, the equation would estimate the reduction of inlake total phosphorus. This is assuming constant inputs of water. Theoretically, the retention time for total phosphorus should also be reduced. With only one year of sampling, there is no way to estimate the reduction in the retention time of total phosphorus. The constant (0.13) derived from the data will be used in Equation 5. After estimating the amount of reduction of inlake phosphorus after a reduction of input phosphorus, Equation 4 (page 99) can be used to determine the reduction of chlorophyll *a*. As can be seen in Table 2, a 50% reduction in phosphorus inputs to Brant Lake will reduce the inlake chlorophyll *a* concentration by an estimated 90%. The corresponding inlake total phosphorus concentration would be 0.085 mg/L. The 50% reduction would also lower the chlorophyll TSI value to the mesotrophic line (Figure 3). As stated previously, this reduction response model does not consider a reduction in the phosphorus retention time. Brant Lake should experience even lower inlake phosphorus and chlorophyll *a* concentrations if inflow phosphorus concentrations are reduced. As reductions in the phosphorus loadings to the lake are lowered, the lake will see algal blooms that are less intense and of shorter duration. The tables and graphs are predictive of the data collected during the study. As the parameters in this model change with the addition of more data, changes in the output will occur as well.

Table 2 . Effects of Reducing Phosphorus to Brant Lake

Reduction of Phosphorus Inputs	Input Phos Concentration	InLake Phos Concentration	Chlorophyll *a*	Percent Reduction Chlorophyll *a*	Phosphorus TSI	Chlorophyll TSI
0%	0.196	0.170	71.19	0%	78.20	72.41
10%	0.176	0.153	58.34	18%	76.68	70.46
20%	0.157	0.136	45.49	36%	74.98	68.02
30%	0.137	0.119	32.64	54%	73.06	64.76
40%	0.118	0.102	19.79	72%	70.83	59.85
50%	0.098	0.085	6.94	90%	68.20	49.57
60%	0.078	0.068	N/A	N/A	64.98	N/A
70%	0.059	0.051	N/A	N/A	60.83	N/A
80%	0.039	0.034	N/A	N/A	54.98	N/A
90%	0.020	0.017	N/A	N/A	44.98	N/A

[1] Inlake phosphorus concentrations must be converted from mg/L to mg/m^3 before using Equation 1 to predict chlorophyll *a*.

Figure 4 Predicted Reduction of Chlorophyll *a* and Phosphorus for Brant Lake

Chart on Pollutants

Endpoint Link to Surface Water Quality Standards

The water quality goal for each lake is a 50% reduction in phosphorus. The water quality standards target is a Trophic State Index (TSI) of 50.

The goal will greatly diminish productivity in the lake which in turn will lead to greater support of assigned beneficial uses. This improvement in water quality will assure the following:

a. visible pollutants are controlled;
b. more pollutants will not form in the lake;
c. growth of nuisance aquatic life will eventually diminish; and
d. improve recreation on the lake by:
   1. increasing aesthetics for swimming and fishing; and
   2. reduce possible bacterial contamination originating from animal feeding areas.

IV. TMDL Analysis and Development:

Data Sources

Data was collected by the department and the Lake Conservation District beginning in 1994 and ending in 1996 sampling seasons.

Analysis Techniques or Models

Eleven tributary locations were chosen for collecting hydrologic and nutrient information from the Lake Madison and Brant Lake Watershed. These monitoring locations were placed at specific areas within the watershed that would best show DENR which sub-watersheds were contributing the largest nutrient and sediment loads. Gauging stations were installed where water quality samples would be collected to record the daily stage of the tributary. The recorders were checked weekly and data was downloaded monthly. A Marsh-McBirney flow meter was used to take periodic flow measurements at different stage heights. The stage and flow measurements were used to develop a stage/discharge table for each site. The stage/discharge table was used to calculate an average daily loading for each site. The loadings for each day were totaled for annual loading rate.

In addition to the measurements above, Silver Creek water quality and quantity was monitored above and below the city of Madison. Sampling sites LMT1 through LMT4 were placed at certain locations above the city of Madison to determine the water quality and quantity prior to the city of Madison's storm sewer network. Each one of these sites was monitored through 1995 and partially through 1996. A full year of data including loadings, water quality concentrations (mg/L) and export coefficients (kg/year) were calculated.

All sites, (tributary and outlet) were sampled twice weekly during the first week of snowmelt runoff and once a week thereafter until the runoff stopped in April. Base flow monitoring also took place after the snowmelt runoff ceased. All nutrient and solids parameters were sampled using approved methods documented in the South Dakota's EPA approved *Standard Operating Procedures for Field Samplers*. The South Dakota State Health Laboratory in Pierre, SD analyzed all samples. The purpose of these samples was to develop nutrient and sediment loadings to determine critical areas in the watershed.

In addition to water quality monitoring, information was collected to complete a comprehensive watershed landuse model. The AGNPS model was developed by the United States Department of Agriculture (Young et al, 1986) to give comparative values for every forty acre cell in a given watershed. Twenty-one parameters were collected for every 40 acre cell in the watershed.

Seasonality

Different seasons in the year can yield different water quality in a tributary due to the changes in precipitation and agricultural practices. To determine seasonal differences, tributary samples were separated into spring (March 15, to May 31, 1995), summer (June 1, to August 31, 1995), and fall (September 1, to October 30, 1995). According to the water quality samples collected in 1995, the largest nutrient and sediment concentrations and loadings typically occurred during the spring.

The outlet of Lake Madison and Brant Lake discharged the majority of nutrient loadings (phosphorus) during the summer. As the loadings from the tributaries enter the lake, a lag period (retention time) occurs until the nutrients that do not settle to the bottom of the lake, are discharged. For Lake Madison and Brant Lake, the greatest level of phosphorus loss was during the summer when the lake discharged; however, this accounted for only 50% or less of the total phosphorus loads. The smaller tributaries discharged most of their nutrient and sediment loads during the spring.

The concentrations of phosphorus, nitrogen, and suspended solids are higher in the spring than any other time of year. The most likely sources of these elevated concentrations include applied fertilizer, decaying organic matter and a buildup of animal waste are carried by spring run-off and rain events . Nitrate is water-soluble; meaning it can easily dissolve in water. In the spring, the soil may be either frozen or saturated and most of the flow occurs overland into lakes and streams.

Margin of Safety

The margin of safety is addressed through the final TMDL recommendation for each lake as a 50% reduction in phosphorus target to achieve meostrophy rather than a 40% reduction in phosphorus that resulted by the reduction response modeling efforts.

Another means to insure that this TMDL will be attained is the SD DENR requirement of the city of Madison to collect water quality samples above and below the discharge point to assess water quality impact on Silver Creek if an emergency discharge from the total retention wastewater facility occurs. This scenario is most likely to occur during a large spring precipitation event. It is recommended that total phosphorus be added to the parameter monitoring list so total nutrient loadings to Silver Creek and Lake Madison can be determined during any discharge.

The Lake Madison Sanitary District and the city of Madison have been requested to add total phosphorus to their groundwater monitoring program for the wells surrounding the two wastewater treatment facilities. Although the nutrient mass balance calculations indicated that these facilities were contributing insignificant levels of phosphorus to Lake Madison, the potential for major contributions of nutrients from the groundwater due to septage contamination is possible. In addition, it is recommended that 2-3 piezometers (shallow wells) be installed near the shoreline of Bourne Slough near the wastewater ponds of the Lake Madison Sanitary District. This should be completed during the Phase II Implementation project. The seepage from the wastewater ponds along the shoreline of Bourne Slough should be monitored to determine if total phosphorus concentrations are increasing.

Another recommendation that will provide for a margin of safety is the installation of a centralized sewer system or continued upgrades to modern individual septic and holding tanks for homes and businesses located at Brant Lake. Some type of modernized nutrient abatement procedure needs to be implemented for the failing onsite wastewater disposal systems. The contribution of nutrients from these individual facilities will only become worse if modernization does not take place.

Finally, Lake Herman is a major phosphorus contributor to Silver Creek, Lake Madison, and Brant Lake. The reductions in phosphorus loadings described in these TMDLs do not consider the impact of water quality improvements within the Lake Herman watershed. If the water quality can be improved within the Lake Herman watershed, a further reduction in total phosphorus loadings will be realized for the lakes downstream. Please see the Phase III Post-Implementation Investigation of Lake Herman final report for restoration alternatives for the Lake Herman watershed.

V. Allocation of TMDL Loads or Responsibilities:

Wasteload Allocation

There are no point sources of pollutants that are of concern in this watershed with the exception of potential emergency discharges from the city of Madison's total retention wastewater facility. Therefore, the "wasteload allocation" component of these TMDLs is considered a zero value. The TMDLs are considered wholly included in the "load allocation" component.

Load Allocation

The load allocation is the 50% reduction in phosphorus loads. In order to achieve this reduction a variety of best management practices (BMPs) need to be implemented in the watershed. According to the AGNPS program, with BMP installation on those 40-acre cells with a rate of erosion greater than 7.0 tons per acre, and with proper management of feeding areas contributing nutrients to the lakes, a reduction in total phosphorus loadings of 32.5% for Lake Madison and 40.0% for Brant Lake can be realized.

Another 10-13% reduction in phosphorus loadings can be realized if the storm sewers contributing nutrients to the Silver Creek are rerouted, reduced or eliminated. Lake Madison can achieve and Brant Lake can exceed a 40% reduction in the phosphorus load. The storm sewers present a direct discharge from an urban area. Any hazardous spill in the drainage area of the storm sewers would result in damage to Lake Madison and Brant Lake. There are a variety of BMPs specifically tailored to urban areas that can help achieve a significant reduction of nutrient and sediment loadings when implemented.

As mentioned as part of the margin of safety section, Lake Herman is a major phosphorus contributor to Silver Creek, Lake Madison, and Brant Lake. The reductions in phosphorus loadings described in these TMDLs do not consider the impact of water quality improvements within the Lake Herman watershed. If the water quality can be improved within the Lake Herman watershed, a further reduction in total phosphorus loadings will be realized for the lakes downstream. Please see the Phase III Post-Implementation Investigation of Lake Herman final report for restoration alternatives for the Lake Herman watershed.

Nuisance algal blooms are a significant problem on Lake Madison and Brant Lake reducing their recreational value during the summer. All nutrient sources need to be reduced in order to achieve a 50% reduction and allow full beneficial use of these two lakes.

A final option to improve the water quality of Lake Madison and Brant Lake is dredging. The contribution of internal phosphorus loading to the nutrient budget of Lake Madison and Brant Lake was not calculated. Bourne Slough continually receives phosphorus from Silver Creek. Phosphorus is then transported into the main inlake area of Lake Madison. The shallow nature of Bourne Slough has reduced its capacity to withhold phosphorus from the rest of Lake Madison. A small sediment removal project to increase the depth around the mouth of Bourne Slough may increase its ability to retain a greater amount of phosphorus. A sediment survey should be conducted to determine the volume and distribution of sediment within Bourne Slough and the feasibility of a sediment removal project.

It was also identified that Round Lake was releasing more sediment and phosphorus to Brant Lake than it received from Lake Madison. A sediment survey should also be completed on this 152-acre lake to determine the volume and distribution of sediment. From this data a cost/benefit analysis of sediment removal can be completed.

VI. Schedule of Implementation:

The department is working with potential sponsors to initiate an implementation project on Lake Madison that would begin in the spring of 2000. It is expected that the sponsors will request project assistance during the fall 1999 funding round.

VII. Post-Implementation Monitoring:

The department is working with potential sponsors to initiate an implementation project on the watershed that would begin in the spring of 2000. It is expected that the sponsors will request project assistance during the 1999 fall funding round.

The department will also conduct monitoring on these lakes every two to four years as part of the Lakes Assessment Program.

VIII. Public Participation:

Summary of Public Review

Public Meetings/ Personal Contact	***Articles/ Fact Sheets***	***Document Distribution***
Pre-project meetings May 11, 1993 **Funding meeting** **Mid-project meeting** August 4, 1996 **Near-end project meeting** **Final Report meeting** December 8, 1998 **Pre-Implementation meeting**	**Madison Daily Leader** November 30, 1998	**October 1998** Lake Conservation District NRCS - Lake County Lake Madison Association Lake Madison Sanitary District Brant Lake Association City of Madison Lake County SD GF&P SD DENR - Water Rights SD DENR - Environmental Services SD DENR - Watershed Protection US EPA - Clean Lakes Program **January 1999**

January 25, 1999		US EPA TMDL Program
Electronic media	***Mailings***	***Public Comments Received***
December, 1998 Project Summary added to department website **January, 1999** TMDL Summary advertised on department website		Comments received during project meetings and review of the draft report and findings were considered

IX. Supporting Development Document(s) (attached):

Wittmuss, A. and McIntire, M., October 1998. PHASE I WATERSHED ASSSESSMENT FINAL REPORT - LAKE MADISON/BRANT LAKE - LAKE COUNTY SOUTH DAKOTA. South Dakota Watershed Protection Program, Division of Financial and Technical Assistance, South Dakota Department of Environment and Natural Resources, Pierre, South Dakota.