Green Lake Priority Watershed Project

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Wisconsin Department of Natural Resources
Bureau of Watershed Management
Runoff Management Practices Section

Author

Gail Puzach, Runoff Management Practices Section

Contributors

James Hebbe, County Conservationist, Green Lake County Land Conservation Department
Lynn Mathias, County Conservationist, Fond Du Lac County Land Conservation Department

Publication Coordinator

Gail Puzach, Bureau of Watershed Management

Wisconsin Department of Natural Resources
Runoff Management Practices Section
P.O. Box 7921
Madison, Wisconsin 53707

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Introduction

In 1980, the Big Green Lake Watershed was selected for participation in the Wisconsin Nonpoint Source (NPS) Pollution Abatement program. The primary role of this program is to provide cost-sharing and technical assistance to local agencies for the control of nonpoint source pollution. The planning period was completed in December 1984, and installation of BMPs began immediately after. The installation of all BMPs was completed in December, 1992.

Big Green Lake is located in mid-eastern Wisconsin, with 60 percent of the watershed in eastern Green Lake County, and the remaining 40 percent in western Fond du Lac County (Map 1). The watershed spans approximately 100 square miles and is primarily used for agricultural purposes. The value of the lake as a recreational resource was a major reason for the project. Some residential development surrounds Big Green Lake. The cities of Ripon and Green Lake are the only two incorporated cities located within the watershed boundaries.

Traditionally, Big Green Lake was considered to have good water quality. However, long term trend monitoring indicated the lake was moving toward a more nutrient rich tropic state. The eutrophic trend of Big Green Lake was traced to high annual sediment loading from direct runoff and surrounding tributaries. The primary objective of this project was to reduce sediment and nutrient loading to Big Green Lake by installing and implementing best management practices.

The goals of the Big Green Lake Priority Watershed Project were designed to protect existing high water quality areas, to rehabilitate areas degraded by nonpoint source pollution, and to halt or reverse the declining water quality trend in Big Green Lake.

This report is required under the Evaluation Plan of the Soil and Water Resource Management and Nonpoint Source Program. The objective of this report is to evaluate water quality and habitat improvements resulting from the implementation of BMPs and to determine to what extent the objectives of the project were met. It also serves as a mechanism for targeting areas for improvements in the NPS Program.

Land Management Assessment & Results

The watershed plan established a pollutant reduction goal to reduce the nutrient input to the lake from the various nonpoint sources by 40%. Upland erosion is a concern for water quality because it can be the main contributor of sediment in the streams and lakes of the watershed. The suspended sediment can destroy fish habitat, increase turbidity, and add to expansion of the littoral zone. Soil from cropland entering the water can also contain nutrients and pesticides. These pollutants can increase the algae and weed growth in lakes.

Phosphorus is an essential element contributing to fertility and growth of plants in the lake. When phosphorus is found in excess, the productivity of the lake is accelerated to a rate higher than normally observed. Phosphorus occurs naturally in parent soil and bedrock, but anthropogenic activites are largely responsible for increased phosphorus loading to Big Green Lake. These include: agricultural runoff, lawn fertilization, soap and detergent and sewage effluent.

The littoral zone expansion rate is defined by the increase in the distance between the shoreline and the 20 foot bottom contour over a given time period. This expansion can be evaluated by examining tributary sediment loading and direct loading associated with shoreline erosion. Littoral currents flow from east to west along the north and south shores of Big Green Lake. These currents are formed by surface water movement caused by the prevailing winds. Since much of the sedimentation that is occurring is of silty composition, it is easily transported by these currents and deposited on the west shore where the two currents merge. It can be assumed that any reduction of sediment loading to tributaries on the east end of the lake will slow littoral zone expansion on the west end of Big Green Lake.

The reduction in pollutant loading was calculated for upland soil erosion, animal waste runoff from barnyards, and gully erosion. The upland soil loss control reached 41% of the watershed plan's goal. In the entire watershed, out of the 16,884 acres needing erosion control measures, 8,479 acres were managed (50%). On a watershed basis, the reduction in phosphorus loading from barnyard runoff was calculated as 75%. This exceeds the 40% reduction goal established in the watershed plan. This reduction was accomplished through control of 36 out of 111 (32%) barnyards in the project area. It is important to note that not all of the phosphorus sources are controllable. In fact, 18% of the phosphorus loading cannot be altered by installing rural and urban conservation practices. Streambank and gully erosion accounts for only a small fraction of the nutrient and sediment load to the lake. 17% of the sediment coming from gully or streambank erosion was controlled through the project.

Within the cities of Green Lake and Ripon, leaf disposal procedures were found to have an impact on water quality. The common practice was to rake the leaves into the roadside ditches and leave them there. This allowed the nutrients to enter the lakes and streams during runoff events. A leaf collection and street cleaning regime was initiated in both cities as a 50% cost sharable BMP.

Water Resources Evaluation & Results

There is a large amount of background data characterizing the ecological condition of Big Green Lake prior to implementation of the priority watershed project. Lake monitoring efforts have been primarily performed by the Green Lake Sanitary District and the DNR. Since 1975, the water quality of Big Green Lake appears to have stabilized. Prior to this time, the ecological trends showed a gradual decline.

Because of the lake's large volume and its long hydraulic residence time (21 years), water quality improvements in Big Green Lake are not expected to be observed for several more years. In fact, it may take decades before positive results are visible. Changes in the tributary streams to the lake would be measurable before quantifiable changes in the lake take place. Water quality has been shown to deteriorate as land is changed from its original state toward intensive uses. The activities associated with modern agriculture often increase runoff which can include sediment, nutrients, and pesticides.

Phosphorus is the limiting nutrient in aquatic ecosystems. When found in levels above .025 milligrams per liter (mg/l), algal blooms occur. After implementation of BMPs began in 1984, there was greater than .01 mg/l decrease in the yearly total phosphorus levels.

Chlorophyll-a pigment is widely used as an estimation of the amount of phytoplankton present in lakes. Phytoplankton have a short life cycle and quickly respond to environmental changes which is why they are an used as an indicator for lake water quality. Aesthetically pleasing lakes have chlorophyll-a concentrations below 10.0 micrograms per liter (ug/l). In the last three to four years, the chlorophyll-a concentrations have ranged anywhere from 5.0 to 6.5 ug/l.

Bacteriological samples which have exceeded the recommended water quality standard decreased during the mid-1980's and have shown variable increases to date. Fecal coliform levels have been variable over the past 15 years. Enterococcus bacteria concentrations have been sampled since 1987 and levels have been variable. The variability in water quality standards and bacteria concentration levels can be attributed in part to climatic conditions, frequency and length of flow events, as well as seasonal uses of the lake and streams.

Financial Evaluation

The Big Green Lake Watershed Project was well supported by the Counties, DNR and other cooperating agencies. Adequate funding was available to support needed staff, equipment and supplies. Conservation practices that landowners installed were cost-shared at the 50 to 70 percent rate by the State, depending on the practice. Total State expenditures were: $987,374.86. Of this total, 68% ($674,461.36) was Nonpoint Source cost-share dollars, which funded actual installation of BMPs. The other 32% ($312,913.50) was for Local Assistance Grants, which funded the project planning and implementation costs incurred by the Counties. There was an additional $1,125,496. from local sources that was made available for implementing BMPs. For every dollar spent by the State, approximately $1.67 was provided by other sources.

The Soil and Water Conservation Districts of Green Lake and Fond du Lac Counties served as the designated management agencies for the unincorporated areas. The cities of Green Lake and Ripon were responsible for implementing any nonpoint source controls within their respective incorporated limits. These units of government are able to provide program funding to landowners, to install practices on public lands, and develop regulatory processes to protect water resources if voluntary programs prove unsuccessful. Green Lake County SWCD was the lead management agency and was responsible for coordinating activities among all the agencies as well as the overall management of the watershed project. In addition to the designated management agencies, the Green Lake Sanitary District provided writing, planning and cost-share assistance for the watershed project. The Sanitary District was also responsible for water quality monitoring in the watershed to measure the effects of installation of BMPs. The Green Lake Association is a private association interested in protecting and enhancing the water quality in Big Green Lake. The Association provided additional funds to aid landowners in cost-sharing projects that were especially beneficial to the lake and were not fully funded otherwise.

Summary & Conclusions

Installation and implementation of BMPs throughout the watershed began in the spring of 1985. The completion date for installation of BMPs was readjusted to December, 1992, to accommodate added cost-share projects acquired through an extended sign-up period offered in 1988. With the additional projects gained through the supplementary sign-up period, participation levels in the Big Green Lake Priority Watershed project were in the 75% success rate range. Big Green Lake Priority Watershed project experienced a high level of participation which has resulted in control of cropland soil erosion and a high reduction of nutrient runoff from barnyards. There was great success in the control of barnyard runoff. This practice was perceived by the farmers to have a more direct benefit to farm operations and production than some of the other practices. The success of this practice is the likely reason for the significant reduction of bacteria levels at certain beaches on Big Green Lake.

One of the original goals of the watershed was to improve the lake's water quality. Because Big Green lake is a high quality water resource, this goal was revised to protect or maintain the current level of water quality at that time. Although the project did not attain all of the goals set forth in the plan, there was significant improvement in the level of nonpoint source control. It will take time for the installed practices to become stabilized and for the sediment already in transport toward Big Green Lake to be "flushed out" of the system. Both the number of water quality standards violations and the average bacteria count at the beaches on Big Green Lake had dropped during the latter years of the project. Climatic and anthropogenic variability can have dramatic effects on water quality and must be considered when evaluating the overall success of a project.

Before implementing the Big Green Lake Watershed project, it was determined that the public benefit to be derived from the project was worth the public cost, and the the project had sufficient scope and detail to be able to accomplish its objectives. The most critical areas contributing pollutants to the surface waters of Big Green Lake and its tributaries were identified. Through implementation of the Big Green Lake Watershed Plan these problems could be controlled with proper practices. Reduction of pollutant loads from the sources will not be immediately evident in the lake, but the alternative of allowing the pollutants to continue to enter the lake would mean a continued trend of decreasing the water quality in the lake.

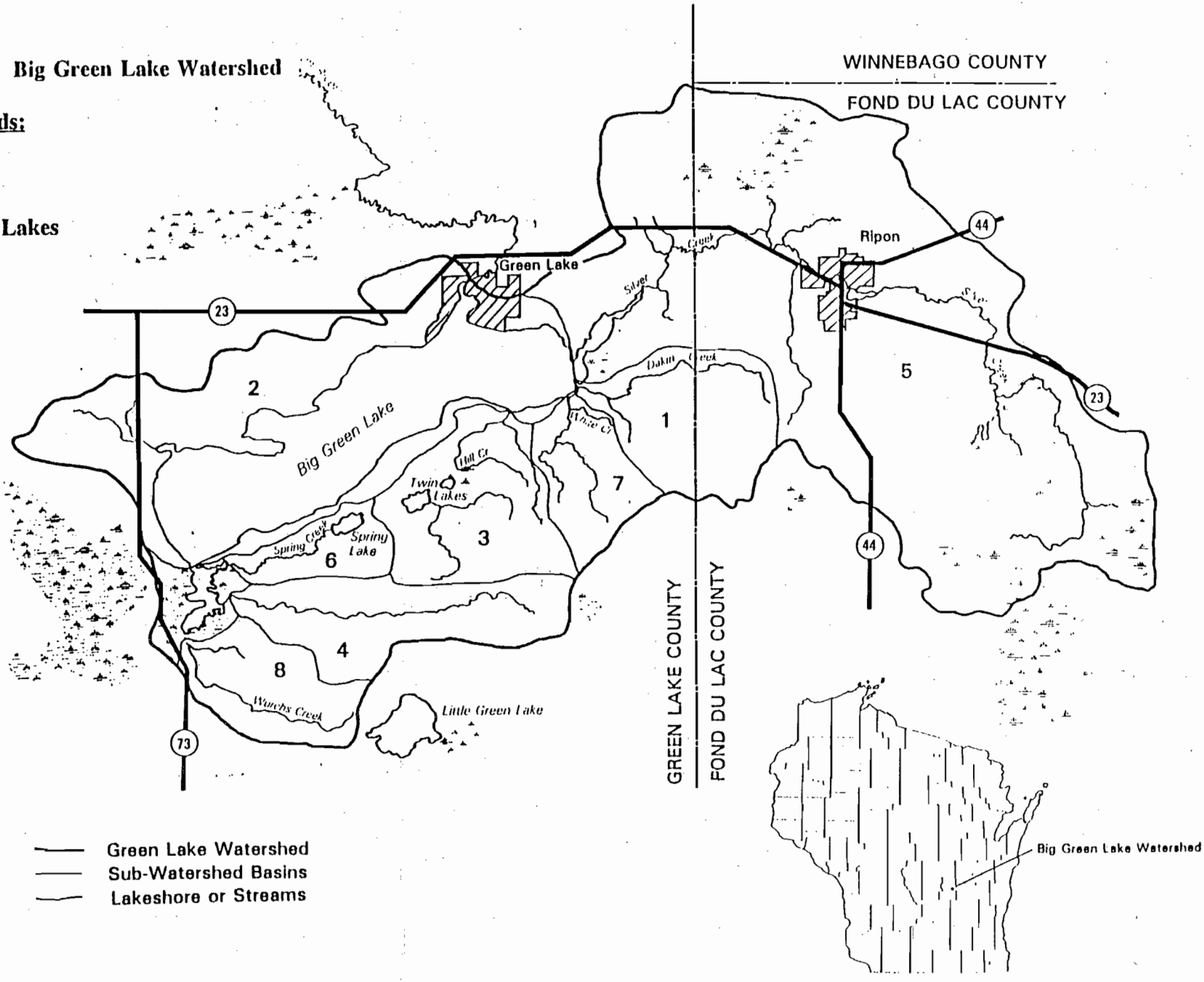
The agricultural impacts to Big Green Lake have been minimized through BMP implementation. Some soil loss through wind, sheet and rill erosion is inevitable, but soil loss resulting from agricultural practices have been controlled to tolerable levels. Nonpoint sources of pollution associated with dense forests and roadside gullies continue to significantly impact Big Green Lake and should be the focus of future nonpoint source reduction efforts. The Green Lake County Department of Land Conservation developed a pilot project to address this problem. The objective was to reduce the forest canopy and expose the understory to more sunlight. Steep streambanks were graded back and more desirable grass species were introduced. This effort has resulted in excellent stabilized streambanks and reduced sheet and rill erosion.

The Big Green Lake Priority Watershed Project is an example of how state, local, and federal agencies along with partners from the private sector, can work together cooperatively to achieve goals of improving conditions that have been degraded as well as maintain areas with high water quality

Map 1. **Big Green Lake Watershed**

Subwatersheds:

1. Dakin
2. Direct
3. Hill-Twin Lakes
4. Roy
5. Silver
6. Spring
7. White
8. Wurches



Appendix A
Glossary

COST SHARE AGREEMENT (CSA):

The contract between the local governmental unit (county, city, village, lake district) and the program participant (landowner or operator). The CSA lists the Best Management Practices, cost estimates, installation schedule, operation & maintenance requirements, and the obligations of both parties signing the agreement.

BEST MANAGEMENT PRACTICE (BMP):

As defined in s.144.25, Stats., means a practice, technique or measure identified in areawide water quality management plans which is determined to be the most effective, practicable means of preventing or reducing pollutants generated from nonpoint sources to a level compatible with water quality objectives, which does not have an adverse impact on fish and wildlife habitat. BMPs are described in s. NR 120, Wis. Admin. Code.

LOCAL ASSISTANCE GRANT:

NPS Program funds to support local costs of project planning and implementation including: Local staff salaries, supplies, travel and training, information and education efforts, professional services contracts.

NONPOINT SOURCE GRANT:

NPS Program funds used for cost sharing of Best Management Practices. The state shares the cost of installing best management practices from 70 to 100%, with the landowner/operator and sometimes the local government unit.

NONPOINT SOURCE:

A land management activity (land use) which contributes to sediment runoff, seepage or percolation which adversely affects or threatens the quality of waters of this state and which is not a point source under s. 147.015 (12), Stats.

PRIORITY WATERSHED:

A large-scale or small-scale watershed which the department has identified through the continuing planning process under s.147.25, Stats., as one of those watersheds where the need for nonpoint source water pollution abatement is most critical.

PRIORITY WATERSHED PLAN:

A detailed portion of the areawide water quality management plan prepared for priority watersheds as described in s. NR 120, Wis. Admin. Code

Appendix B
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